GROUP TAB LOCATOR

INTRODUCTION

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VEHICLE SAFETY CERTIFICATION LABEL

DESCRIPTION

A vehicle safety certification label (Fig. 1) is attached to every DaimlerChrysler Corporation vehicle. The label certifies that the vehicle conforms to all applicable Federal Motor Vehicle Safety Standards. The label also lists:

- Month and year of vehicle manufacture.
- Gross Vehicle Weight Rating (GVWR). The gross front and rear axle weight ratings (GAWR's) are based on a minimum rim size and maximum cold tire inflation pressure.
- Vehicle Identification Number (VIN).
- Type of vehicle.
- Type of rear wheels.
- Bar code.
- Month, Day and Hour (MDH) of final assembly.
- Paint and Trim codes.
- Country of origin.

The label is located on the driver-side door shutface.

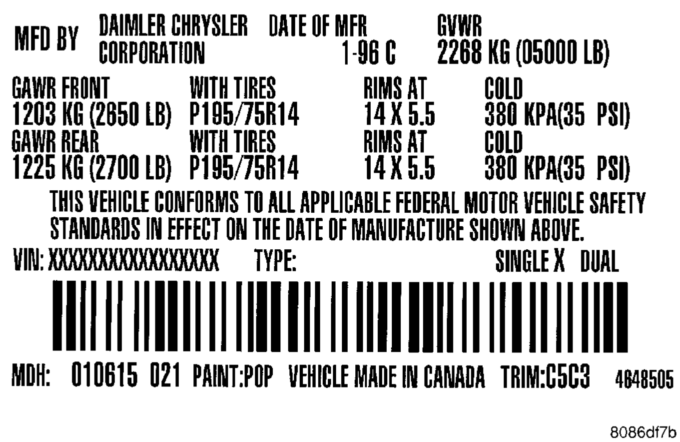


Fig. 1 VEHICLE SAFETY CERTIFICATION LABEL - TYPICAL

VEHICLE IDENTIFICATION NUMBER

DESCRIPTION

VIN CODING/LOCATIONS

The Vehicle Identification Number (VIN) plate is located on the lower windshield fence near the left a-pillar (Fig. 2). The VIN contains 17 characters that provide data concerning the vehicle. Refer to the VIN decoding chart to determine the identification of a vehicle.

The VIN is also imprinted on the:

- Body Code Plate.
- Equipment Identification Plate.
- Vehicle Safety Certification Label.
- Frame rail.

To protect the consumer from theft and possible fraud the manufacturer is required to include a Check Digit at the ninth position of the VIN. The check digit is used by the manufacturer and government agencies to verify the authenticity of the vehicle and official documentation. The formula to use the check digit is not released to the general public.

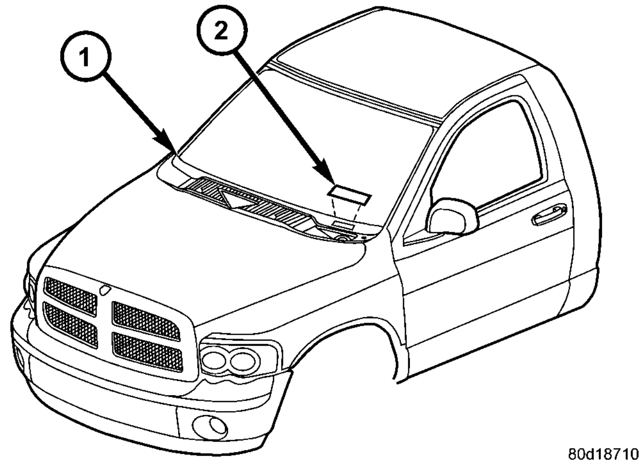


Fig. 2 VIN LOCATION

1 - DASH PANEL
2 - VIN CODE PLATE

POSITION	INTERPRETATION	CODE = DESCRIPTION
1	Country of Origin	1 = Manufactured By DaimlerChrysler Corporation 3 = Manufactured By DaimlerChrysler De Mexico
2	Make	D = Dodge
3	Vehicle Type	2 = Incomplete with Side Airbag 3 = Truck with Side Airbag 6 = Incomplete Less Side Airbag 7 = Truck Less Side Airbag
4	Gross Vehicle Weight Rating	G = 5,001-6000 lbs. H = 6,001-7,000 lbs. J = 7,001-8,000 lbs. K = 8,001-9,000 lbs. L = 9,001-10,000 lbs. M = 10,001-14,000 lbs. W = Buses/Incomplete Vehicles with Hydraulic Brakes
5	Vehicle Line	A = Ram Pickup 4X2 U = Ram Pickup 4X4
6	Series	1 = 1500 2 = 2500 3 = 3500 Less Dual Rear Wheels 4 = 3500 With Dual Rear Wheels
7	Body Style	6 = Conventional Cab 8 = Quad Cab Full Rear Doors

VEHICLE IDENTIFICATION NUMBER (Continued)

POSITION	INTERPRETATION	CODE = DESCRIPTION
8	Engine	K = 3.7L 6 cyl. MPI Gasoline N = 4.7L 8 cyl. MPI Gasoline D = 5.7L 8 cyl. SMPI Gasoline 6 = 5.9L 6 cyl. Turbo Diesel C = 5.9L 6 cyl. Turbo Diesel High Output W = 8.0L 10 cyl. MPI Gasoline Z = 5.9L 8 cyl. SMPI Gasoline Light Duty
9	Check Digit	0 through 9 or X
10	Model Year	3 = 2003
11	Plant Location	S = Dodge City G = Saltillo J = St. Louis (North)
12 thru 17	Vehicle Build Sequence	

VEHICLE EMISSION CONTROL INFORMATION (VECI)

DESCRIPTION

All models have a Vehicle Emission Control Information (VECI) Label. DaimlerChrysler permanently attaches the label in the engine compartment (Fig. 3). The label cannot be removed without defacing label information and destroying label.

The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

The label also contains an engine vacuum schematic. There are unique labels for vehicles built for sale in the state of California and the country of Canada. Canadian labels are written in both the English and French languages.

The VECI label contains the following:

- Engine family and displacement
- Evaporative family
- Emission control system schematic
- Certification application
- Engine timing specifications (if adjustable)
- Idle speeds (if adjustable)
- Spark plug and gap

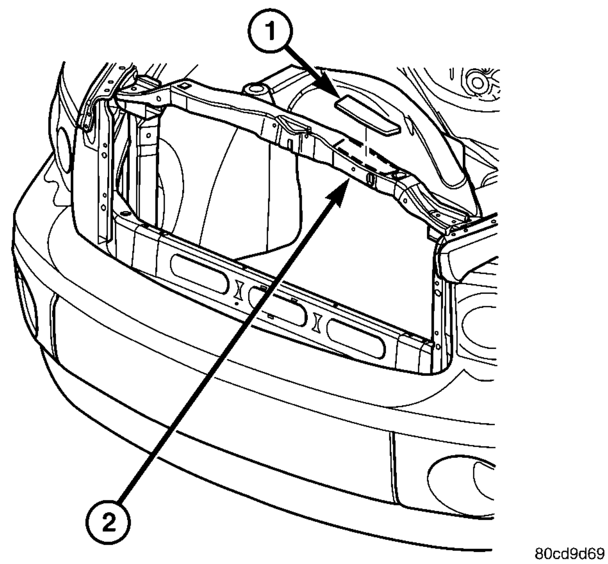


Fig. 3 VEHICLE EMISSIONS CERTIFICATION INFORMATION LABEL

1 - VECI LABEL LOCATION
2 - RADIATOR SUPPORT

BODY CODE PLATE

DESCRIPTION

The Body Code Plate (Fig. 5) is located on the right front hydroform fender rail just behind the headlight assembly (Fig. 4). There are seven lines of information on the body code plate. Lines 5, 6, and 7 are not used to define service information. Information reads from left to right, starting with line 4 in the center of the plate to line 1 at the bottom of the plate.

The last code imprinted on a vehicle code plate will be followed by the imprinted word END. When two vehicle code plates are required, the last available spaces on the first plate will be imprinted with the letters CTD (for continued).

When a second vehicle code plate is necessary, the first four spaces on each row will not be used because of the plate overlap.

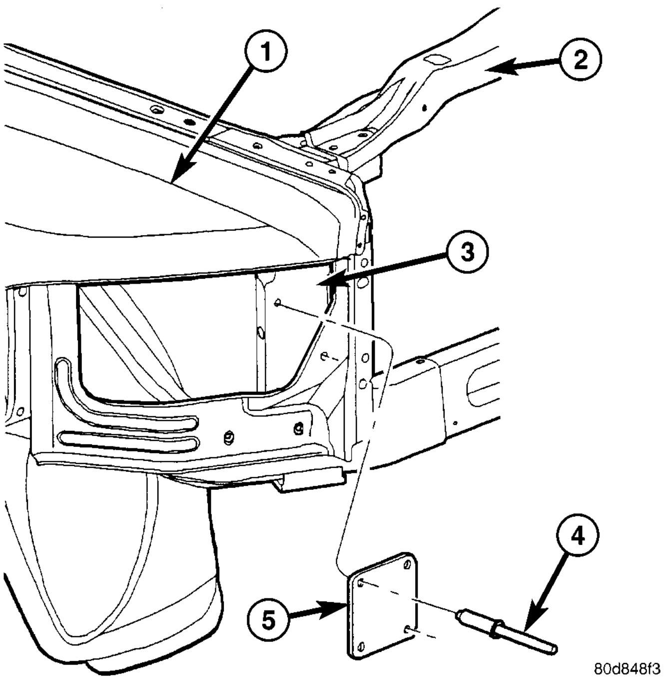


Fig. 4 BODY CODE PLATE LOCATION

1 - FENDER
2 - RADIATOR CROSSMEMBER
3 - HYDROFORM FENDER RAIL
4 - RIVOT (2)
5 - BODY CODE PLATE

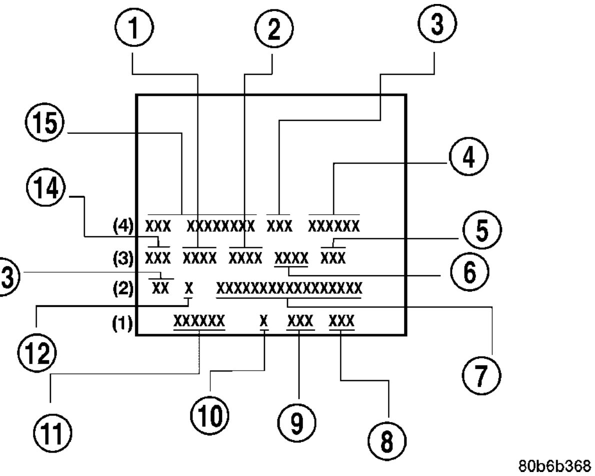


Fig. 5 BODY CODE PLATE

1 - PRIMARY PAINT
2 - SECONDARY PAINT
3 - TRANSMISSION CODE
4 - VEHICLE MODEL NUMBER
5 - ENGINE CODE
6 - INTERIOR TRIM CODE
7 - VEHICLE IDENTIFICATION NUMBER
8 - TAILGATE CODE
9 - CARGO BOX CODE
10 - TAILGATE TRIM CODE
11 - BODY-IN-WHITE SEQUENCE
12 - MARKET CODE
13 - SPECIES CODE
14 - PAINT PROCEDURE
15 - VEHICLE ORDER NUMBER

BODY CODE PLATE—LINE 4

DIGITS 1 THROUGH 12

Vehicle Order Number

DIGITS 13, 14, AND 15

Transmission Codes

- DGT = 4–speed Automatic (46RE)
- DG4 = 4–speed Automatic (45RFE)
- DGP = 4–speed Automatic (47RE)
- DG8 = 4–speed Automatic (48RE)
- DDC = 5–speed Manual (NV3500)
- DDP = 5–speed Manual (NV4500)
- DEE = 6–speed Manual (NV5600)

DIGITS 16, 17, AND 18

Car Line Shell

- DR1 = 1500 4 X 2
- DR6 = 1500 4 X 4
- DR2 = 2500 4 X 2
- DR7 = 2500 4 X 4
- DR3 = 3500 4 X 2
- DR8 = 3500 4 X 4

BODY CODE PLATE (Continued)

DIGIT 19

Price Class
- L = Low
- H = Highline

DIGITS 20 AND 21

Body Type
- 41 = Ram Truck Quad Cab, Short Box
- 42 = Ram Truck Quad Cab, Long Box
- 61 = Ram Truck Standard Cab, Short Box
- 62 = Ram Truck Standard Cab, Long Box

BODY CODE PLATE—LINE 3

DIGITS 1,2, AND 3

Paint Procedure
- APA = Monotone
- AP9 = Special
- APD = Two-tone (Lower break)

DIGIT 4

Open Space

DIGITS 5 THROUGH 8

Primary Paint

(Refer to 23 - BODY/PAINT - SPECIFICATIONS) for color codes.

DIGIT 9

Open Space

DIGITS 10 THROUGH 13

Secondary Paint

DIGIT 14

Open Space

DIGITS 15 THROUGH 18

Interior Trim Code

DIGIT 19

Open Space

DIGITS 20, 21, AND 22

Engine Code
- EKG = 3.7 L 6 cyl. MPI Gasoline
- EVA = 4.7 L 8 cyl. MPI Gasoline
- EZA = 5.7 L 8 cyl. SMPI Gasoline
- EML = 5.9 L 8 cyl. SMPI Gasoline
- ETC = 5.9 L 6 cyl. Cummins Turbo Diesel
- ETH = 5.9 L 6 cyl. Cummins Turbo Diesel High Output
- EWA = 8.0 L 10 cyl. MPI Gasoline

BODY CODE PLATE—LINE 2

DIGIT 1 Open Space

DIGITS 2 AND 3 Species Code. (Used for Manufacturing)

DIGIT 4

Open Space

DIGIT 5

Market Code
- B = International
- C = Canada
- M = Mexico
- U = United States

DIGIT 6

Open Space

DIGITS 7 THROUGH 23

Vehicle Identification Number (VIN)

(Refer to VEHICLE DATA/VEHICLE INFORMATION/VEHICLE IDENTIFICATION NUMBER - DESCRIPTION) for proper breakdown of VIN code.

BODY CODE PLATE—LINE 1

DIGITS 1 THROUGH 6 Body-in-white assembly sequence.

DIGIT 7

Open Space

DIGIT 8 Tailgate trim code.

DIGIT 9

Open Space

DIGITS 10 THROUGH 12 Cargo box code

DIGIT 13

Open Space

DIGITS 14 THROUGH 16 Tailgate code

INTERNATIONAL VEHICLE CONTROL & DISPLAY SYMBOLS

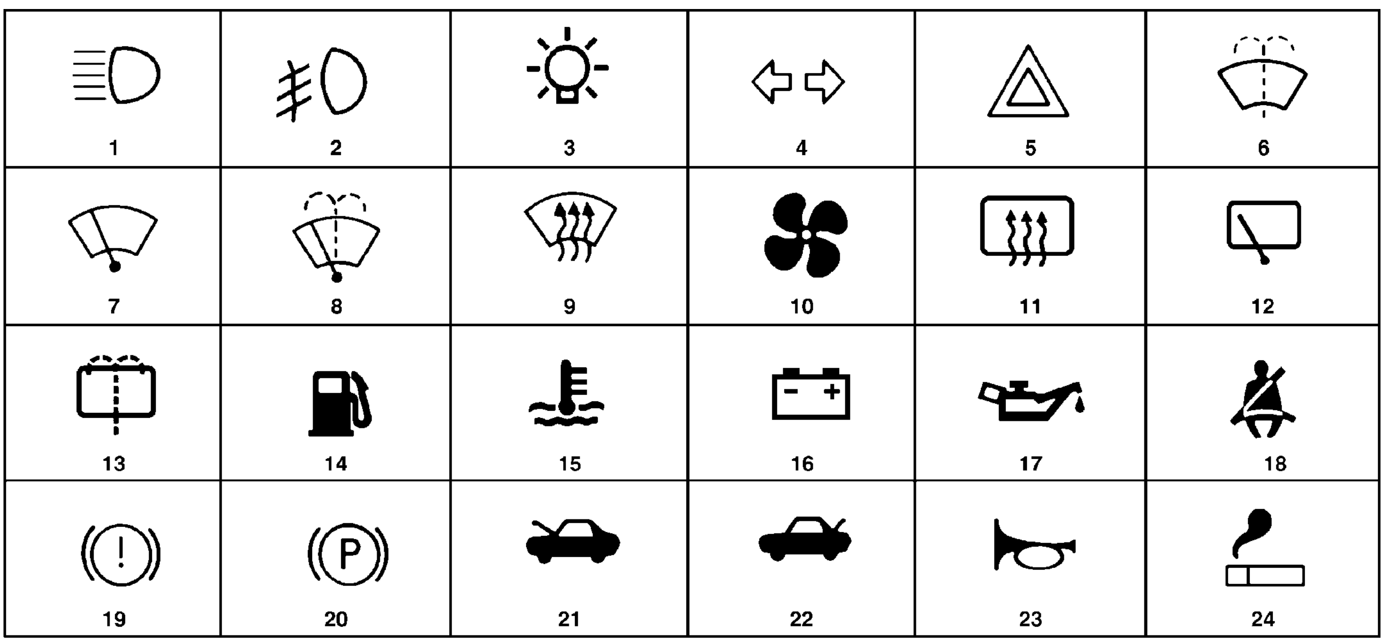
DESCRIPTION - INTERNATIONAL SYMBOLS

The graphic symbols illustrated in the following International Control and Display Symbols Chart are used to identify various instrument controls. The symbols correspond to the controls and displays that are located on the instrument panel.

FASTENER IDENTIFICATION

DESCRIPTION

The SAE bolt strength grades range from grade 2 to grade 8. The higher the grade number, the greater the bolt strength. Identification is determined by the line marks on the top of each bolt head. The actual bolt strength grade corresponds to the number of line marks plus 2. The most commonly used metric bolt strength classes are 9.8 and 10.9. The metric strength class identification number is imprinted on the head of the bolt. The higher the class number, the greater the bolt strength. Some metric nuts are imprinted with a single-digit strength class on the nut face. Refer to the Fastener Identification and Fastener Strength Charts (Fig. 6) and (Fig. 7).



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INTERNATIONAL SYMBOLS

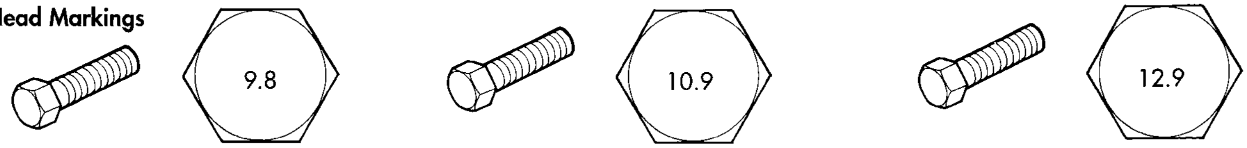
1	High Beam	13	Rear Window Washer
2	Fog Lamps	14	Fuel
3	Headlamp, Parking Lamps, Panel Lamps	15	Engine Coolant Temperature
4	Turn Warning	16	Battery Charging Condition
5	Hazard Warning	17	Engine Oil
6	Windshield Washer	18	Seat Belt
7	Windshield Wiper	19	Brake Failure
8	Windshield Wiper and Washer	20	Parking Brake
9	Windscreen Demisting and Defrosting	21	Front Hood
10	Ventilating Fan	22	Rear hood (Decklid)
11	Rear Window Defogger	23	Horn
12	Rear Window Wiper	24	Lighter

FASTENER IDENTIFICATION (Continued)

Bolt Markings and Torque - Metric

Commercial Steel Class: 9.8, 10.9, 12.9

Bolt Head Markings

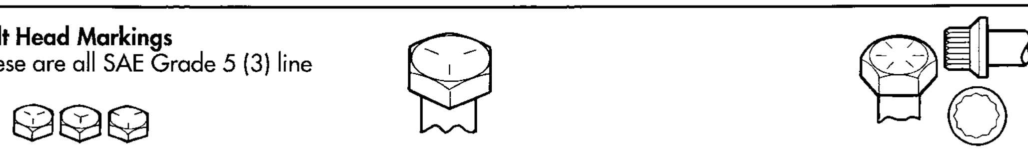


Body Size Diam. mm	9.8 Cast Iron N•m	9.8 Cast Iron ft-lb	9.8 Aluminum N•m	9.8 Aluminum ft-lb	10.9 Cast Iron N•m	10.9 Cast Iron ft-lb	10.9 Aluminum N•m	10.9 Aluminum ft-lb	12.9 Cast Iron N•m	12.9 Cast Iron ft-lb	12.9 Aluminum N•m	12.9 Aluminum ft-lb
6	9	5	7	4	14	9	11	7	14	9	11	7
7	14	9	11	7	18	14	14	11	23	18	18	14
8	25	18	18	14	32	23	25	18	36	27	28	21
10	40	30	30	25	60	45	45	35	70	50	55	40
12	70	55	55	40	105	75	80	60	125	95	100	75
14	115	85	90	65	160	120	125	95	195	145	150	110
16	180	130	140	100	240	175	190	135	290	210	220	165
18	230	170	180	135	320	240	250	185	400	290	310	230

Bolt Markings and Torque Values - U.S. Customary

SAE Grade Number: 5, 8

Bolt Head Markings
These are all SAE Grade 5 (3) line



Body Size	Grade 5 Cast Iron N•m	Grade 5 Cast Iron ft-lb	Grade 5 Aluminum N•m	Grade 5 Aluminum ft-lb	Grade 8 Cast Iron N•m	Grade 8 Cast Iron ft-lb	Grade 8 Aluminum N•m	Grade 8 Aluminum ft-lb
1/4 - 20	9	7	8	6	15	11	12	9
- 28	12	9	9	7	18	13	14	10
5/16 - 18	20	15	16	12	30	22	24	18
- 24	23	17	19	14	33	24	25	19
3/8 - 16	40	30	25	20	55	40	40	30
- 24	40	30	35	25	60	45	45	35
7/16 - 14	60	45	45	35	90	65	65	50
- 20	65	50	55	40	95	70	75	55
1/2 - 13	95	70	75	55	130	95	100	75
- 20	100	75	80	60	150	110	120	90
9/16 - 12	135	100	110	80	190	140	150	110
- 18	150	110	115	85	210	155	170	125
5/8 - 11	180	135	150	110	255	190	205	150
- 18	210	155	160	120	290	215	230	170
3/4 - 10	325	240	255	190	460	340	365	270
- 16	365	270	285	210	515	380	410	300
7/8 - 9	490	360	380	280	745	550	600	440
- 14	530	390	420	310	825	610	660	490
1 - 8	720	530	570	420	1100	820	890	660
- 14	800	590	650	480	1200	890	960	710

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Fig. 6 FASTENER IDENTIFICATION

FASTENER IDENTIFICATION (Continued)

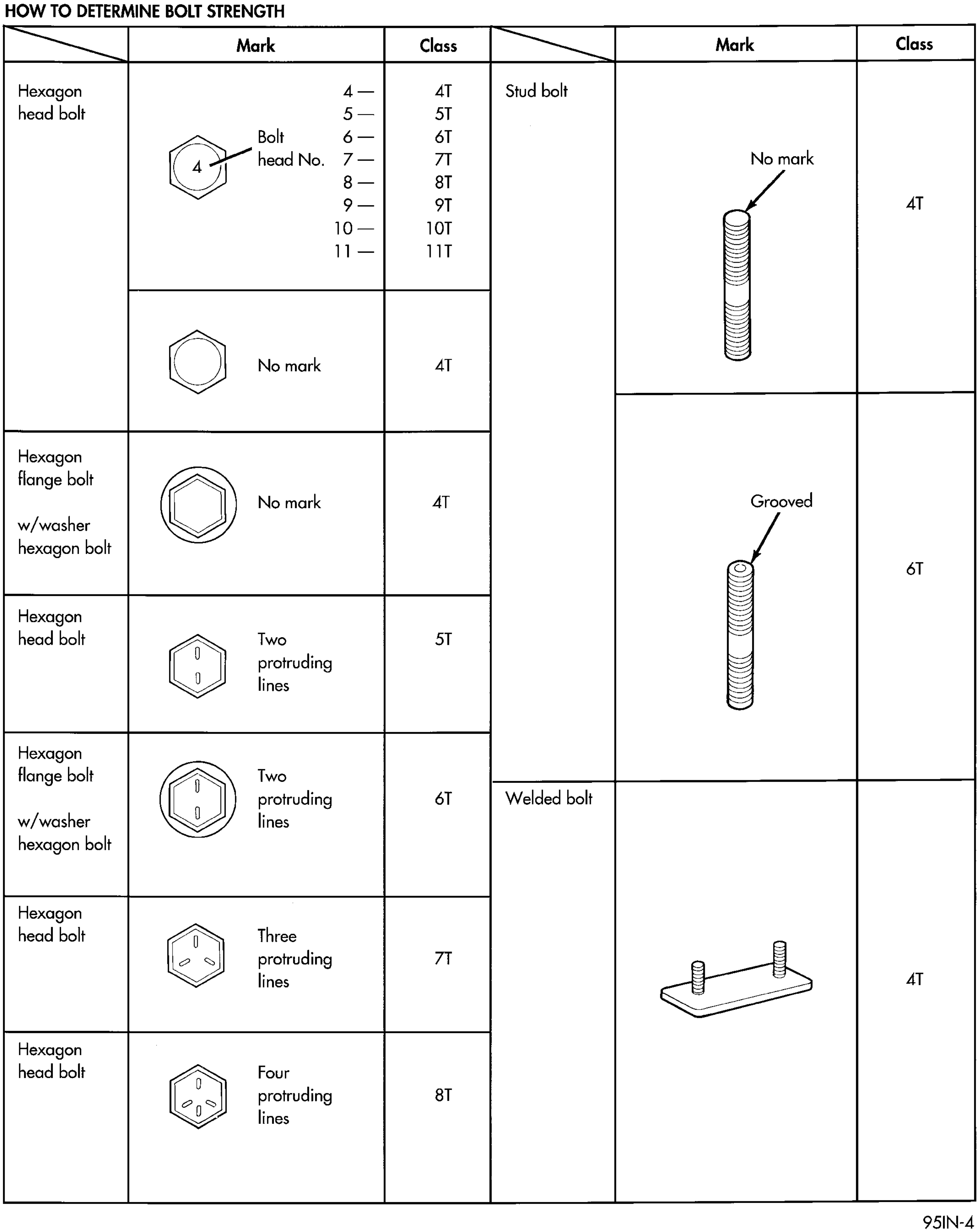

Fig. 7 FASTENER STRENGTH

FASTENER USAGE

DESCRIPTION - FASTENER USAGE

WARNING: USE OF AN INCORRECT FASTENER MAY RESULT IN COMPONENT DAMAGE OR PERSONAL INJURY.

Fasteners and torque specifications references in this Service Manual are identified in metric and SAE format.

During any maintenance or repair procedures, it is important to salvage all fasteners (nuts, bolts, etc.) for reassembly. If the fastener is not salvageable, a fastener of equivalent specification must be used.

THREADED HOLE REPAIR

DESCRIPTION - THREADED HOLE REPAIR

Most stripped threaded holes can be repaired using a Helicoil®. Follow the vehicle or Helicoil® recommendations for application and repair procedures.

METRIC SYSTEM

DESCRIPTION

The metric system is based on quantities of one, ten, one hundred, one thousand and one million.

The following chart will assist in converting metric units to equivalent English and SAE units, or vise versa.

CONVERSION FORMULAS AND EQUIVALENT VALUES

MULTIPLY	BY	TO GET	MULTIPLY	BY	TO GET
in-lbs	x 0.11298	= Newton Meters (N·m)	N·m	x 8.851	= in-lbs
ft-lbs	x 1.3558	= Newton Meters (N·m)	N·m	x 0.7376	= ft-lbs
Inches Hg (60° F)	x 3.377	= Kilopascals (kPa)	kPa	x 0.2961	= Inches Hg
psi	x 6.895	= Kilopascals (kPa)	kPa	x 0.145	= psi
Inches	x 25.4	= Millimeters (mm)	mm	x 0.03937	= Inches
Feet	x 0.3048	= Meters (M)	M	x 3.281	= Feet
Yards	x 0.9144	= Meters	M	x 1.0936	= Yards
mph	x 1.6093	= Kilometers/Hr. (Km/h)	Km/h	x 0.6214	= mph
Feet/Sec	x 0.3048	= Meters/Sec (M/S)	M/S	x 3.281	= Feet/Sec
mph	x 0.4470	= Meters/Sec (M/S)	M/S	x 2.237	= mph
Kilometers/Hr. (Km/h)	x 0.27778	= Meters/Sec (M/S)	M/S	x 3.600	Kilometers/Hr. (Km/h)

COMMON METRIC EQUIVALENTS

1 inch = 25 Millimeters	1 Cubic Inch = 16 Cubic Centimeters
1 Foot = 0.3 Meter	1 Cubic Foot = 0.03 Cubic Meter
1 Yard = 0.9 Meter	1 Cubic Yard = 0.8 Cubic Meter
1 Mile = 1.6 Kilometers	

Refer to the Metric Conversion Chart to convert torque values listed in metric Newton- meters (N·m). Also, use the chart to convert between millimeters (mm) and inches (in.) (Fig. 8).

METRIC SYSTEM (Continued)

in-lbs to N•m

in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m
2	.2260	42	4.7453	82	9.2646	122	13.7839	162	18.3032
4	.4519	44	4.9713	84	9.4906	124	14.0099	164	18.5292
6	.6779	46	5.1972	86	9.7165	126	14.2359	166	18.7552
8	.9039	48	5.4232	88	9.9425	128	14.4618	168	18.9811
10	1.1298	50	5.6492	90	10.1685	130	14.6878	170	19.2071
12	1.3558	52	5.8751	92	10.3944	132	14.9138	172	19.4331
14	1.5818	54	6.1011	94	10.6204	134	15.1397	174	19.6590
16	1.8077	56	6.3270	96	10.8464	136	15.3657	176	19.8850
18	2.0337	58	6.5530	98	11.0723	138	15.5917	178	20.1110
20	2.2597	60	6.7790	100	11.2983	140	15.8176	180	20.3369
22	2.4856	62	7.0049	102	11.5243	142	16.0436	182	20.5629
24	2.7116	64	7.2309	104	11.7502	144	16.2696	184	20.7889
26	2.9376	66	7.4569	106	11.9762	146	16.4955	186	21.0148
28	3.1635	68	7.6828	108	12.2022	148	16.7215	188	21.2408
30	3.3895	70	7.9088	110	12.4281	150	16.9475	190	21.4668
32	3.6155	72	8.1348	112	12.6541	152	17.1734	192	21.6927
34	3.8414	74	8.3607	114	12.8801	154	17.3994	194	21.9187
36	4.0674	76	8.5867	116	13.1060	156	17.6253	196	22.1447
38	4.2934	78	8.8127	118	13.3320	158	17.8513	198	22.3706
40	4.5193	80	9.0386	120	13.5580	160	18.0773	200	22.5966

N•m to in-lbs

N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb	N•m	in-lb
.2	1.7702	4.2	37.1747	8.2	72.5792	12.2	107.9837	16.2	143.3882
.4	3.5404	4.4	38.9449	8.4	74.3494	12.4	109.7539	16.4	145.1584
.6	5.3107	4.6	40.7152	8.6	76.1197	12.6	111.5242	16.6	146.9287
.8	7.0809	4.8	42.4854	8.8	77.8899	12.8	113.2944	16.8	148.6989
1	8.8511	5	44.2556	9	79.6601	13	115.0646	17	150.4691
1.2	10.6213	5.2	46.0258	9.2	81.4303	13.2	116.8348	17.2	152.2393
1.4	12.3916	5.4	47.7961	9.4	83.2006	13.4	118.6051	17.4	154.0096
1.6	14.1618	5.6	49.5663	9.6	84.9708	13.6	120.3753	17.6	155.7798
1.8	15.9320	5.8	51.3365	9.8	86.7410	13.8	122.1455	17.8	157.5500
2	17.7022	6	53.1067	10	88.5112	14	123.9157	18	159.3202
2.2	19.4725	6.2	54.8770	10.2	90.2815	14.2	125.6860	18.5	163.7458
2.4	21.2427	6.4	56.6472	10.4	92.0517	14.4	127.4562	19	168.1714
2.6	23.0129	6.6	58.4174	10.6	93.8219	14.6	129.2264	19.5	172.5970
2.8	24.7831	6.8	60.1876	10.8	95.5921	14.8	130.9966	20	177.0225
3	26.5534	7	61.9579	11	97.3624	15	132.7669	20.5	181.4480
3.2	28.3236	7.2	63.7281	11.2	99.1326	15.2	134.5371	21	185.8736
3.4	30.0938	7.4	65.4983	11.4	100.9028	15.4	136.3073	22	194.7247
3.6	31.8640	7.6	67.2685	11.6	102.6730	15.6	138.0775	23	203.5759
3.8	33.6342	7.8	69.0388	11.8	104.4433	15.8	139.8478	24	212.4270
4	35.4045	8	70.8090	12	106.2135	16	141.6180	25	221.2781

ft-lbs to N•m

ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m
1	1.3558	21	28.4722	41	55.5885	61	82.7049	81	109.8212
2	2.7116	22	29.8280	42	56.9444	62	84.0607	82	111.1770
3	4.0675	23	31.1838	43	58.3002	63	85.4165	83	112.5328
4	5.4233	24	32.5396	44	59.6560	64	86.7723	84	113.8888
5	6.7791	25	33.8954	45	61.0118	65	88.1281	85	115.2446
6	8.1349	26	35.2513	46	62.3676	66	89.4840	86	116.6004
7	9.4907	27	36.6071	47	63.7234	67	90.8398	87	117.9562
8	10.8465	28	37.9629	48	65.0793	68	92.1956	88	119.3120
9	12.2024	29	39.3187	49	66.4351	69	93.5514	89	120.6678
10	13.5582	30	40.6745	50	67.7909	70	94.9073	90	122.0236
11	14.9140	31	42.0304	51	69.1467	71	96.2631	91	123.3794
12	16.2698	32	43.3862	52	70.5025	72	97.6189	92	124.7352
13	17.6256	33	44.7420	53	71.8583	73	98.9747	93	126.0910
14	18.9815	34	46.0978	54	73.2142	74	100.3316	94	127.4468
15	20.3373	35	47.4536	55	74.5700	75	101.6862	95	128.8026
16	21.6931	36	48.8094	56	75.9258	76	103.0422	96	130.1586
17	23.0489	37	50.1653	57	77.2816	77	104.3980	97	131.5144
18	24.4047	38	51.5211	58	78.6374	78	105.7538	98	132.8702
19	25.7605	39	52.8769	59	79.9933	79	107.1196	99	134.2260
20	27.1164	40	54.2327	60	81.3491	80	108.4654	100	135.5820

N•m to ft-lbs

N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1	.7376	21	15.9888	41	30.2400	61	44.9913	81	59.7425
2	1.4751	22	16.2264	42	30.9776	62	45.7289	82	60.4801
3	2.2127	23	16.9639	43	31.7152	63	46.4664	83	61.2177
4	2.9502	24	17.7015	44	32.4527	64	47.2040	84	61.9552
5	3.6878	25	18.4391	45	33.1903	65	47.9415	85	62.6928
6	4.4254	26	19.1766	46	33.9279	66	48.6791	86	63.4303
7	5.1629	27	19.9142	47	34.6654	67	49.4167	87	64.1679
8	5.9005	28	20.6517	48	35.4030	68	50.1542	88	64.9545
9	6.6381	29	21.3893	49	36.1405	69	50.8918	89	65.6430
10	7.3756	30	22.1269	50	36.8781	70	51.6293	90	66.3806
11	8.1132	31	22.8644	51	37.6157	71	52.3669	91	67.1181
12	8.8507	32	23.6020	52	38.3532	72	53.1045	92	67.8557
.13	9.5883	33	24.3395	53	39.0908	73	53.8420	93	68.5933
14	10.3259	34	25.0771	54	39.8284	74	54.5720	94	69.3308
15	11.0634	35	25.8147	55	40.5659	75	55.3172	95	70.0684
16	11.8010	36	26.5522	56	41.3035	76	56.0547	96	70.8060
17	12.5386	37	27.2898	57	42.0410	77	56.7923	97	71.5435
18	13.2761	38	28.0274	58	42.7786	78	57.5298	98	72.2811
19	14.0137	39	28.7649	59	43.5162	79	58.2674	99	73.0187
20	14.7512	40	29.5025	60	44.2537	80	59.0050	100	73.7562

in. to mm

in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
.01	.254	.21	5.334	.41	10.414	.61	15.494	.81	20.574
.02	.508	.22	5.588	.42	10.668	.62	15.748	.82	20.828
.03	.762	.23	5.842	.43	10.922	.63	16.002	.83	21.082
.04	1.016	.24	6.096	.44	11.176	.64	16.256	.84	21.336
.05	1.270	.25	6.350	.45	11.430	.65	16.510	.85	21.590
.06	1.524	.26	6.604	.46	11.684	.66	16.764	.86	21.844
.07	1.778	.27	6.858	.47	11.938	.67	17.018	.87	22.098
.08	2.032	.28	7.112	.48	12.192	.68	17.272	.88	22.352
.09	2.286	.29	7.366	.49	12.446	.69	17.526	.89	22.606
.10	2.540	.30	7.620	.50	12.700	.70	17.780	.90	22.860
.11	2.794	.31	7.874	.51	12.954	.71	18.034	.91	23.114
.12	3.048	.32	8.128	.52	13.208	.72	18.288	.92	23.368
.13	3.302	.33	8.382	.53	13.462	.73	18.542	.93	23.622
.14	3.556	.34	8.636	.54	13.716	.74	18.796	.94	23.876
.15	3.810	.35	8.890	.55	13.970	.75	19.050	.95	24.130
.16	4.064	.36	9.144	.56	14.224	.76	19.304	.96	24.384
.17	3.318	.37	9.398	.57	14.478	.77	19.558	.97	24.638
.18	4.572	.38	9.652	.58	14.732	.78	19.812	.98	24.892
.19	4.826	.39	9.906	.59	14.986	.79	20.066	.99	25.146
.20	5.080	.40	10.160	.60	15.240	.80	20.320	1.00	25.400

mm to in.

mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
.01	.00039	.21	.00827	.41	.01614	.61	.02402	.81	.03189
.02	.00079	.22	.00866	.42	.01654	.62	.02441	.82	.03228
.03	.00118	.23	.00906	.43	.01693	.63	.02480	.83	.03268
.04	.00157	.24	.00945	.44	.01732	.64	.02520	.84	.03307
.05	.00197	.25	.00984	.45	.01772	.65	.02559	.85	.03346
.06	.00236	.26	.01024	.46	.01811	.66	.02598	.86	.03386
.07	.00276	.27	.01063	.47	.01850	.67	.02638	.87	.03425
.08	.00315	.28	.01102	.48	.01890	.68	.02677	.88	.03465
.09	.00354	.29	.01142	.49	.01929	.69	.02717	.89	.03504
.10	.00394	.30	.01181	.50	.01969	.70	.02756	.90	.03543
.11	.00433	.31	.01220	.51	.02008	.71	.02795	.91	.03583
.12	.00472	.32	.01260	.52	.02047	.72	.02835	.92	.03622
.13	.00512	.33	.01299	.53	.02087	.73	.02874	.93	.03661
.14	.00551	.34	.01339	.54	.02126	.74	.02913	.94	.03701
.15	.00591	.35	.01378	.55	.02165	.75	.02953	.95	.03740
.16	.00630	.36	.01417	.56	.02205	.76	.02992	.96	.03780
.17	.00669	.37	.01457	.57	.02244	.77	.03032	.97	.03819
.18	.00709	.38	.01496	.58	.02283	.78	.03071	.98	.03858
.19	.00748	.39	.01535	.59	.02323	.79	.03110	.99	.03898
.20	.00787	.40	.01575	.60	.02362	.80	.03150	1.00	.03937

J901N-10

Fig. 8 METRIC CONVERSION CHART

TORQUE REFERENCES

DESCRIPTION

Individual Torque Charts appear within many or the Groups. Refer to the Standard Torque Specifications Chart for torque references not listed in the individual torque charts (Fig. 9).

SPECIFIED TORQUE FOR STANDARD BOLTS

Class	Diameter mm	Pitch mm	Specified torque					
			Hexagon head bolt			Hexagon flange bolt		
			N•m	kgf-cm	ft-lbf	N•m	kgf-cm	ft-lbf
4T	6	1	5	55	48 in.-lbf	6	60	52 in.-lbf
	8	1.25	12.5	130	9	14	145	10
	10	1.25	26	260	19	29	290	21
	12	1.25	47	480	35	53	540	39
	14	1.5	74	760	55	84	850	61
	16	1.5	115	1,150	83	—	—	—
5T	6	1	6.5	65	56 in.-lbf	7.5	75	65 in.-lbf
	8	1.25	15.5	160	12	17.5	175	13
	10	1.25	32	330	24	36	360	26
	12	1.25	59	600	43	65	670	48
	14	1.5	91	930	67	100	1,050	76
	16	1.5	140	1,400	101	—	—	—
6T	6	1	8	80	69 in.-lbf	9	90	78 in.-lbf
	8	1.25	19	195	14	21	210	15
	10	1.25	39	400	29	44	440	32
	12	1.25	71	730	53	80	810	59
	14	1.5	110	1,100	80	125	1,250	90
	16	1.5	170	1,750	127	—	—	—
7T	6	1	10.5	110	8	12	120	9
	8	1.25	25	260	19	28	290	21
	10	1.25	52	530	38	58	590	43
	12	1.25	95	970	70	105	1,050	76
	14	1.5	145	1,500	108	165	1,700	123
	16	1.5	230	2,300	166	—	—	—
8T	8	1.25	29	300	22	33	330	24
	10	1.25	61	620	45	68	690	50
	12	1.25	110	1,100	80	120	1,250	90
9T	8	1.25	34	340	25	37	380	27
	10	1.25	70	710	51	78	790	57
	12	1.25	125	1,300	94	140	1,450	105
10T	8	1.25	38	390	28	42	430	31
	10	1.25	78	800	58	88	890	64
	12	1.25	140	1,450	105	155	1,600	116
11T	8	1.25	42	430	31	47	480	35
	10	1.25	87	890	64	97	990	72
	12	1.25	155	1,600	116	175	1,800	130

Fig. 9 TORQUE SPECIFICATIONS

LUBRICATION & MAINTENANCE

TABLE OF CONTENTS

INTERNATIONAL SYMBOLS

DESCRIPTION

DaimlerChrysler Corporation uses international symbols to identify engine compartment lubricant and fluid inspection and fill locations (Fig. 1).

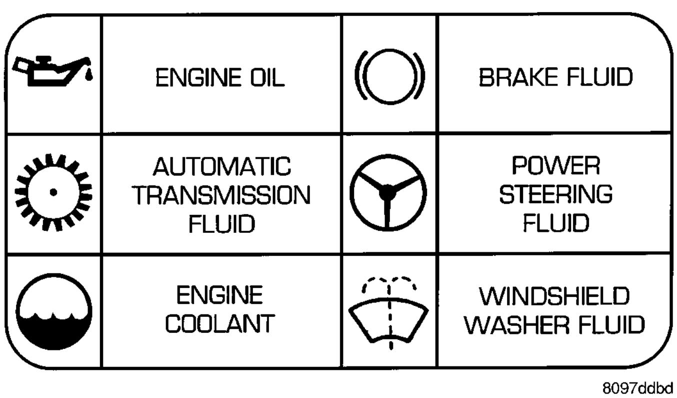

Fig. 1 INTERNATIONAL SYMBOLS

FLUID TYPES

DESCRIPTION

DESCRIPTION - FUEL REQUIREMENTS - DIESEL ENGINE

DESCRIPTION

WARNING: Do not use alcohol or gasoline as a fuel blending agent. They can be unstable under certain conditions and hazardous or explosive when mixed with diesel fuel.

Use good quality diesel fuel from a reputable supplier in your Dodge truck. For most year-round service, number 2 diesel fuel meeting ASTM specification D-975 will provide good performance. If the vehicle is exposed to extreme cold (below 0°F/-18°C), or is required to operate at colder-than-normal conditions for prolonged periods, use climatized No. 2 diesel fuel or dilute the No. 2 diesel fuel with 50% No. 1 diesel fuel. This will provide better protection from fuel gelling or wax-plugging of the fuel filters.

FLUID TYPES (Continued)

Diesel fuel is seldom completely free of water. To prevent fuel system trouble, including fuel line freezing in winter, drain the accumulated water from the fuel/water separator using the fuel/water separator drain provided. If you buy good-quality fuel and follow the cold-weather advice above, fuel conditioners should not be required in your vehicle. If available in your area, a high cetane “premium” diesel fuel may offer improved cold starting and warm-up performance.

DESCRIPTION - ENGINE OIL AND LUBRICANTS

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

When service is required, DaimlerChrysler Corporation recommends that only Mopar® brand parts, lubricants and chemicals be used. Mopar® provides the best engineered products for servicing DaimlerChrysler Corporation vehicles.

Only lubricants bearing designations defined by the following organization should be used.

- Society of Automotive Engineers (SAE)
- American Petroleum Institute (API)
- National Lubricating Grease Institute (NLGI)

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Certified. MOPAR® provides engine oils, that meet or exceed this requirement.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 2).

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

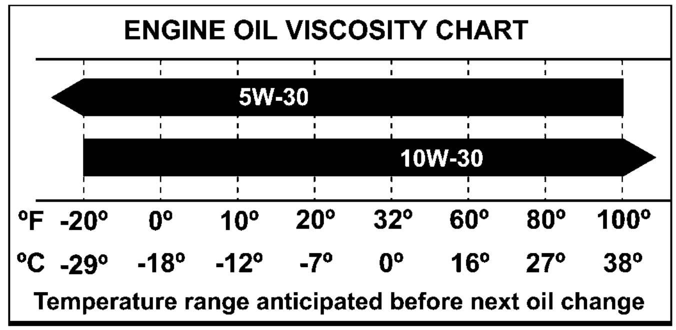

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Fig. 2 TEMPERATURE/ENGINE OIL VISCOSITY

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the front label of engine oil plastic bottles and the top of engine oil cans (Fig. 3).

This symbol means that the oil has been certified by the American Petroleum Institute (API). Diamler-Chrysler only recommend API Certified engine oils. Use Mopar® engine oil or equivalent.

9400-9

Fig. 3 API SYMBOL

GEAR LUBRICANTS

SAE ratings also apply to multigrade gear lubricants. In addition, API classification defines the lubricants usage. Such as API GL-5 and SAE 75W-90.

LUBRICANTS AND GREASES

Lubricating grease is rated for quality and usage by the NLGI. All approved products have the NLGI symbol (Fig. 4) on the label. At the bottom of the NLGI symbol is the usage and quality identification letters. Wheel bearing lubricant is identified by the letter “G”. Chassis lubricant is identified by the letter “L”. The letter following the usage letter indicates the quality of the lubricant. The following symbols indicate the highest quality.

FLUID TYPES (Continued)

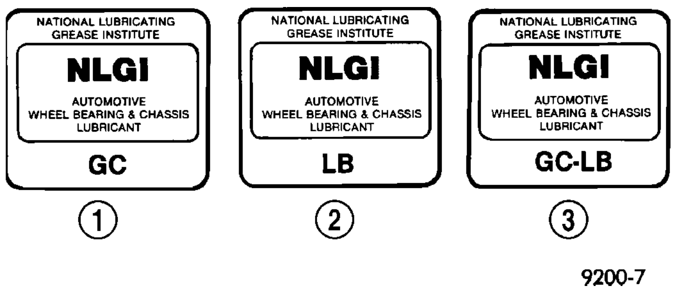


Fig. 4 NLGI SYMBOL

1 - WHEEL BEARINGS
2 - CHASSIS LUBRICATION
3 - CHASSIS AND WHEEL BEARINGS

SPECIALIZED LUBRICANTS AND OILS

Some maintenance or repair procedures may require the use of specialized lubricants or oils. Consult the appropriate sections in this manual for the correct application of these lubricants.

DESCRIPTION - POWER STEERING FLUID

Mopar® ATF +4, Automatic Transmission Fluid is required in the power steering system. Substitute fluids can induce power steering system failure.

Mopar® ATF +4, Automatic Transmission Fluid when new is red in color. The ATF is dyed red so it can be identified from other fluids used in the vehicle such as engine oil or antifreeze. The red color is not permanent and is not an indicator of fluid condition. As the vehicle is driven, the ATF will begin to look darker in color and may eventually become brown. **This is normal.** ATF+4 also has a unique odor that may change with age. Consequently, odor and color cannot be used to indicate the fluid condition or the need for a fluid change.

DESCRIPTION - ENGINE COOLANT

WARNING: ANTIFREEZE IS AN ETHYLENE GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.

CAUTION: Use of Propylene Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769), or the equivalent ethylene glycol base coolant with organic corrosion inhibitors (called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% Ethylene Glycol and 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769) may not be mixed with any other type of antifreeze. Mixing of coolants other than specified (non-HOAT or other HOAT), may result in engine damage that may not be covered under the new vehicle warranty, and decreased corrosion protection.

COOLANT PERFORMANCE

The required ethylene-glycol (antifreeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows:

Pure Water-Water can absorb more heat than a mixture of water and ethylene-glycol. This is for purpose of heat transfer only. Water also freezes at a higher temperature and allows corrosion.

100 percent Ethylene-Glycol-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at -22°C (-8°F).

50/50 Ethylene-Glycol and Water-Is the recommended mixture, it provides protection against freezing to -37°C (-34°F). The antifreeze concentration

FLUID TYPES (Continued)

must always be a minimum of 44 percent, year-round in all climates. If percentage is lower, engine parts may be eroded by cavitation. Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7°C (-90°F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because specific heat of antifreeze is lower than that of water.

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

COOLANT SELECTION AND ADDITIVES

NOTE: Refer to the vehicle's coolant bottle to identify HOAT or Non-HOAT coolant. Non-HOAT coolant is green in color.

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

DESCRIPTION - TRANSFER CASE - NV241 GENII

Recommended lubricant for the NV241 GENII transfer case is Mopar® ATF +4, Automatic Transmission Fluid.

DESCRIPTION - TRANSFER CASE - NV271

Recommended lubricant for the NV271 transfer case is Mopar® ATF +4, Automatic Transmission Fluid.

DESCRIPTION - TRANSFER CASE - NV243

Recommended lubricant for the NV243 transfer case is Mopar® ATF +4, Automatic Transmission Fluid.

DESCRIPTION - TRANSFER CASE - NV273

Recommended lubricant for the NV273 transfer case is Mopar® ATF +4, Automatic Transmission Fluid.

DESCRIPTION - AXLE

NOTE: DaimlerChrysler recommends using Mopar® lubricants or lubricants of equal quality.

FRONT AXLE

- C205F - Mopar® Gear Lubricant 75W-90
- 9 1/4 AA - Mopar® Synthetic Gear Lubricant 75W-90

REAR AXLE

- 9 1/4 - Mopar® Synthetic Gear Lubricant 75W-140
- 10 1/2 AA - Mopar® Synthetic Gear Lubricant 75W-90
- 11 1/2 AA - Mopar® Synthetic Gear Lubricant 75W-90

NOTE: Trac-Lok® differentials require Limited Slip Additive in the lubricant. Trac-Rite™ differentials DO NOT require Limited Slip Additive.

DESCRIPTION - MANUAL TRANSMISSION

NOTE: DaimlerChrysler recommends using Mopar® lubricants or lubricants of equal quality.

- NV3500 - Mopar® Manual Transmission Lubricant
- NV4500 - Mopar® Synthetic 75W85 Manual Transmission Lubricant
- NV5600 - Mopar® Manual Transmission Lubricant

DESCRIPTION - AUTOMATIC TRANSMISSION FLUID

NOTE: Refer to Service Procedures in this group for fluid level checking procedures.

Mopar® ATF +4, Automatic Transmission Fluid is the recommended fluid for DaimlerChrysler automatic transmissions.

Dexron II fluid IS NOT recommended. Clutch chatter can result from the use of improper fluid.

Mopar® ATF +4, Automatic Transmission Fluid when new is red in color. The ATF is dyed red so it can be identified from other fluids used in the vehicle such as engine oil or antifreeze. The red color is not permanent and is not an indicator of fluid condition. As the vehicle is driven, the ATF will begin to look darker in color and may eventually become brown. **This is normal.** ATF+4 also has a unique odor that may change with age. Consequently, odor and color cannot be used to indicate the fluid condition or the need for a fluid change.

FLUID TYPES (Continued)

FLUID ADDITIVES

DaimlerChrysler strongly recommends against the addition of any fluids to the transmission, other than those automatic transmission fluids listed above. Exceptions to this policy are the use of special dyes to aid in detecting fluid leaks.

Various "special" additives and supplements exist that claim to improve shift feel and/or quality. These additives and others also claim to improve converter clutch operation and inhibit overheating, oxidation, varnish, and sludge. These claims have not been supported to the satisfaction of DaimlerChrysler and these additives **must not be used.** The use of transmission "sealers" should also be avoided, since they may adversely affect the integrity of transmission seals.

OPERATION - AUTOMATIC TRANSMISSION FLUID

The automatic transmission fluid is selected based upon several qualities. The fluid must provide a high level of protection for the internal components by providing a lubricating film between adjacent metal components. The fluid must also be thermally stable so that it can maintain a consistent viscosity through a large temperature range. If the viscosity stays constant through the temperature range of operation, transmission operation and shift feel will remain consistent. Transmission fluid must also be a good conductor of heat. The fluid must absorb heat from the internal transmission components and transfer that heat to the transmission case.

FLUID CAPACITIES

SPECIFICATIONS

FLUID CAPACITIES

2DESCRIPTION	SPECIFICATION
FUEL TANK	
Short Box (Lt. Duty)	98 L (26 gal.)*
Long Box (Lt. Duty)	132 L (35 gal.)*
ENGINE OIL WITH FILTER	
3.7L	4.7 L (5.0 qts.)
4.7L	5.6 L (6.0 qts.)
5.7L	6.6 L (7.0 qts.)
5.9L	4.7 L (5.0 qts.)
8.0L	6.6 L (7.0 qts.)
5.9L DIESEL	10.4 L (11.0 qts.)

2DESCRIPTION	SPECIFICATION
COOLING SYSTEM	
3.7L	15.4 L (16.2 qts.)**
4.7L	15.4 L (16.2 qts.)**
5.7L	15.4L (16.2 qts.)**
5.9L	15.5 L (16.3 qts.)**
8.0L	24L (24.3 qts.)**
5.9L Diesel Engine	28L (29.5 qts.)**
POWER STEERING	
Power steering fluid capacities are dependent on engine/chassis options as well as steering gear/cooler options. Depending on type and size of internal cooler, length and inside diameter of cooler lines, or use of an auxiliary cooler, these capacities may vary. Refer to 19, Steering for proper fill and bleed procedures.	
AUTOMATIC TRANSMISSION	
Service Fill - 46RE	3.8 L (4.0 qts.)
O-haul - 46RE	9-9.5L (19-20 pts.) ◊
Service Fill - 45RFE/545RFE	4X2 - 5.2 L (11.0 pts.) 4X4 - 6.2 L (13.0 pts.)
O-haul - 45RFE/545RFE	14-16 L (29-33 pts.) ◊
◊ Dry fill capacity Depending on type and size of internal cooler, length and inside diameter of cooler lines, or use of an auxiliary cooler, these figures may vary. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/FLUID - STANDARD PROCEDURE)	
MANUAL TRANSMISSION	
NV3500 4X2	2.3 L (4.8 pts.)
NV3500 4X4	2.0 L (4.2 pts.)
NV4500	3.8 L (8.0 pts.)
NV5600	4.5 L (9.5 pts.)
TRANSFER CASE	
NV241 GENII	1.6 L (3.4 pts.)
NV243	1.6 L (3.4 pts.)
NV271	1.89 L (4.0 pts.)
NV273	1.89 L (4.0 pts.)
FRONT AXLE ± .03 L (1 oz)	
C205F	1.66 L (3.5 pts.)
9 1/4 AA	2.25 L (4.75 pts.)
REAR AXLE ± .03 L (1 oz)	
9 1/4	2.32 L (4.9 pts.)***
10 1/2 AA	2.25 L (4.75 pts.)
11 1/2 AA	3.62 L (7.65 pts)
*** With Trac-Lok add 118 ml (4 oz.) of Limited Slip Additive.	
** Includes 0.9L (1.0 qts.) for coolant reservoir.	
*Nominal refill capacities are shown. A variation may be observed from vehicle to vehicle due to manufacturing tolerance and refill procedure.	

MAINTENANCE SCHEDULES

DESCRIPTION

Maintenance Schedule Information not included in this section, is located in the appropriate Owner's Manual.

There are two maintenance schedules that show the **required** service for your vehicle.

First is Schedule **"B"**. It is for vehicles that are operated under the conditions that are listed below and at the beginning of the schedule.

- Day or night temperatures are below 0° C (32° F).
- Stop and go driving.
- Extensive engine idling.
- Driving in dusty conditions.
- Short trips of less than 16 km (10 miles).
- More than 50% of your driving is at sustained high speeds during hot weather, above 32° C (90° F).
- Trailer towing.
- Taxi, police, or delivery service (commercial service).
- Off-road or desert operation.
- **If equipped for and operating with E-85 (ethanol) fuel.**

NOTE: Most vehicles are operated under the conditions listed for Schedule ″B″.

Second is Schedule **"A"**. It is for vehicles that are not operated under any of the conditions listed under Schedule ″B″.

Use the schedule that best describes your driving conditions. Where time and mileage are listed, follow the interval that occurs first.

CAUTION: Failure to perform the required maintenance items may result in damage to the vehicle.

At Each Stop for Fuel

- Check the engine oil level about 5 minutes after a fully warmed engine is shut off. Checking the oil level while the vehicle is on level ground will improve the accuracy of the oil level reading. Add oil only when the level is at or below the ADD or MIN mark.
- Check the windshield washer solvent and add if required.

Once a Month

- Check tire pressure and look for unusual wear or damage.
- Inspect the battery and clean and tighten the terminals as required.
- Check the fluid levels of coolant reservoir, brake master cylinder, power steering and transmission and add as needed.
- Check all lights and all other electrical items for correct operation.

At Each Oil Change

- Change the engine oil filter.
- Inspect the exhaust system.
- Inspect the brake hoses.
- Inspect the CV joints (if equipped) and front suspension components.
- Check the automatic transmission fluid level.
- Check the manual transmission fluid level.
- Check the coolant level, hoses, and clamps.
- Rotate the tires at each oil change interval shown on Schedule "A" 10 000 km (6,000 miles) or every other interval shown on Schedule "B" 10 000 km (6,000 miles).

Schedule "B"

Follow schedule "B" if you usually operate your vehicle under one or more of the following conditions.

- Day or night temperatures are below 0° C (32° F).
- Stop and go driving.
- Extensive engine idling.
- Driving in dusty conditions.
- Short trips of less than 16 km (10 miles).
- More than 50% of your driving is at sustained high speeds during hot weather, above 32° C (90° F).
- Trailer towing.
- Taxi, police, or delivery service (commercial service).
- Off-road or desert operation.
- **If equipped for and operating with E-85 (ethanol) fuel.**

MAINTENANCE SCHEDULES (Continued)

Miles (Kilometers)	**3,000 (5 000)**	**6,000 (10 000)**	**9,000 (14 000)**	**12,000 (19 000)**	**15,000 (24 000)**
Change engine oil and engine oil filter.	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.		X		X	
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.				X	
Inspect engine air cleaner filter, replace if necessary.					X

Miles (Kilometers)	**18,000 (29 000)**	**21,000 (34 000)**	**24,000 (38 000)**	**27,000 (43 000)**	**30,000 (48 000)**
Change engine oil and engine oil filter.	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X		X		X
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.			X		
Inspect engine air cleaner filter, replace if necessary.					X
Replace spark plugs.					X
Inspect PCV valve, replace as necessary.					X*
Drain and refill automatic tranmission fluid, change filter and adjust bands (46RE/47RE/48RE).‡					X
Drain and refill automatic tranmission fluid and change main sump filter (45RFE/545RFE only).‡					X

Miles (Kilometers)	**33,000 (53 000)**	**36,000 (58 000)**	**39, 000 (62 000)**	**42,000 (67 000)**	**45,000 (72 000)**
Change engine oil and engine oil filter.	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.		X		X	
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.		X			
Inspect engine air cleaner filter, replace if necessary.					X

MAINTENANCE SCHEDULES (Continued)

Miles (Kilometers)	**48,000 (77 000)**	**51,000 (82 000)**	**54,000 (86 000)**	**57,000 (91 000)**	**60,000 (96 000)**
Change engine oil and engine oil filter.	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X		X		X
Drain and refill transfer case fluid.					X
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.	X				X
Inspect engine air cleaner filter, replace if necessary.					X
Replace spark plugs.					X
Replace ignition cables (5.7L/5.9L/8.0L).					X
Inspect PCV valve, replace as necessary.					X*
Drain and refill automatic tranmission fluid, change filter and adjust bands (46RE/47RE/48RE).					X
Drain and refill automatic tranmission fluid and change main sump filter (45RFE/545RFE only).					X

Miles (Kilometers)	**63,000 (101 000)**	**66,000 (106 000)**	**69,000 (110 000)**	**72,000 (115 000)**	**75,000 (120 000)**
Change engine oil and engine oil filter.	X	X	X	X	
Lubricate outer tie rod ends 2500/3500 (4X4) models only.		X		X	
Inspect engine air cleaner filter.					X
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.				X	
Inspect auto tension drive belt and replace if required (3.7L/4.7L/5.7L/5.9L/8.0L).					X

MAINTENANCE SCHEDULES (Continued)

Miles (Kilometers)	**78,000 (125 000)**	**81,000 (130 000)**	**84,000 (134 000)**	**87,000 (139 000)**	**90,000 (144 000)**
Change engine oil and engine oil filter.	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X		X		X
Change rear axle fluid.					X
Change front axle fluid (4X4).					X
Inspect brake linings.			X		
Inspect engine air cleaner filter, replace if necessary.					X
Replace spark plugs.					X
Inspect PCV valve, replace as necessary.					X*
Inspect auto tension drive belt and replace if required (3.7L/4.7L/5.7L/5.9L/8.0L).					X‡
Drain and refill automatic tranmission fluid, change filter and adjust bands (46RE/47RE/48RE).					X
Drain and refill automatic tranmission fluid and change main sump and spin-on cooler return filter (if equipped) [45RFE/545RFE only].					X

Miles (Kilometers)	**93,000 (149 000)**	**96,000 (154 000)**	**99,000 (158 000)**	**100,000 (160 000)**	**102,000 (163 000)**
Change engine oil and engine oil filter.	X	X	X		X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.		X			X
Flush and replace engine coolant.				X	
Flush and replace Power Steering Fluid.				X	
Inspect brake linings.		X			

MAINTENANCE SCHEDULES (Continued)

Miles (Kilometers)	**105,000 (168 000)**	**108,000 (173 000)**	**111,000 (178 000)**	**114,000 (182 000)**	**117,000 (187 000)**	**120,000 (192 000)**
Change engine oil and engine oil filter.	X	X	X	X	X	X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.		X		X		X
Drain and refill transfer case fluid.						X
Change rear axle fluid.	X					X
Change front axle fluid (4X4).	X					X
Inspect brake linings.		X				X
Inspect engine air cleaner filter, replace if necessary.	X					X
Replace spark plugs.						X
Replace ignition cables (5.7L/5.9L/8.0L).						X
Inspect PCV valve, replace as necessary.						X*
Inspect auto tension drive belt and replace if required (3.7L/4.7L/5.7L/5.9L/8.0L).	X‡					X‡
Drain and refill automatic tranmission fluid, change filter and adjust bands (46RE/ 47RE/48RE).						X
Drain and refill automatic tranmission fluid and change main sump filter (45RFE/ 545RFE only).						X

* This maintenance is recommended by the manufacture to the owner but is not required to maintain the emissions warranty.

‡ This maintenance is not required if previously replaced.

Inspection and service should also be performed anytime a malfunction is observed or suspected. Retain all receipts.

MAINTENANCE SCHEDULES (Continued)

Schedule "A"

Miles (Kilometers) [Months]	**6,000 (10 000) [6]**	**12,000 (19 000) [12]**	**18,000 (29 000) [18]**	**24,000 (38 000) [24]**	**30,000 (48 000) [30]**
Change engine oil and engine oil filter.	X	X	X	X	X
Check transfer case fluid level.					X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X	X	X	X	X
Inspect brake linings.			X		
Replace engine air cleaner filter.					X
Replace spark plugs.					X

Miles (Kilometers) [Months]	**36,000 (58 000) [36]**	**42,000 (67 000) [42]**	**48,000 (77 000) [48]**	**54,000 (84 000) [54]**	**60,000 (96 000) [60]**	**66,000 (106 000) [66]**
Change engine oil and engine oil filter.	X	X	X	X	X	X
Check transfer case fluid level.					X	
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X	X	X	X	X	X
Flush and replace engine coolant at 60 months, regardless of mileage.					X	
Inspect brake linings.	X			X		
Replace engine air cleaner filter.					X	
Replace spark plugs.					X	
Inspect PCV valve, replace as necessary.					X*	
Replace ignition cables (5.7L/5.9L/8.0L).					X	

MAINTENANCE SCHEDULES (Continued)

Miles (Kilometers)	**72,000 (115 000)**	**78,000 (125 000)**	**84,000 (134 000)**	**90,000 (144 000)**	**96,000 (154 000)**	**100,000 (160 000)**
[Months]	**[72]**	**[78]**	**[84]**	**[90]**	**[96]**	
Change engine oil and engine oil filter.	X	X	X	X	X	
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X	X	X	X	X	
Drain and refill transfer case fluid.				X		
Flush and replace engine coolant, if not done at 60 mos.						X
Flush and replace Power Steering Fluid.						X
Inspect brake linings.	X			X		
Replace engine air cleaner filter.				X		
Replace spark plugs.				X		
Replace ignition cables (5.7L/5.9L/ 8.0L).				X		
Inspect PCV valve, replace as necessary.				X*		
Inspect auto tension drive belt and replace if required (3.7L/4.7L/5.7L/5.9L/ 8.0L).				X		
Drain and refill automatic tranmission fluid, change filter and adjust bands (46RE/47RE/48RE).						X
Drain and refill automatic tranmission fluid and change main sump filter and spin-on cooler return filter (if equipped) [45RFE/545RFE only].						X

Miles (Kilometers)	**102,000 (163 000)**	**108,000 (173 000)**	**114,000 (182 000)**	**120,000 (192 000)**
[Months]	**[102]**	**[108]**	**[114]**	**[120]**
Change engine oil and engine oil filter.	X	X	X	X
Check transfer case fluid level.				X
Lubricate outer tie rod ends 2500/3500 (4X4) models only.	X	X	X	X
Inspect brake linings.		X		
Inspect auto tension drive belt and replace if required (3.7L/4.7L/5.7L/5.9L/8.0L).	X‡			X‡
Replace engine air cleaner filter.				X
Replace spark plugs.				X

* This maintenance is recommended by the manufacture to the owner but is not required to maintain the emissions warranty.

‡ This maintenance is not required if previously replaced.

Inspection and service should also be performed anytime a malfunction is observed or suspected. Retain all receipts.

WARNING: You can be badly injured working on or around a motor vehicle. Do only that service work for which you have the knowledge and the right equipment. If you have any doubt about your ability to perform a service job, take your vehicle to a competent mechanic.

JUMP STARTING

STANDARD PROCEDURE - JUMP STARTING

WARNING: REVIEW ALL SAFETY PRECAUTIONS AND WARNINGS IN THE BATTERY SYSTEM SECTION OF THE SERVICE MANUAL. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE)

- **DO NOT JUMP START A FROZEN BATTERY, PERSONAL INJURY CAN RESULT.**
- **IF EQUIPPED, DO NOT JUMP START WHEN MAINTENANCE FREE BATTERY INDICATOR DOT IS YELLOW OR BRIGHT COLOR.**
- **DO NOT JUMP START A VEHICLE WHEN THE BATTERY FLUID IS BELOW THE TOP OF LEAD PLATES.**
- **DO NOT ALLOW JUMPER CABLE CLAMPS TO TOUCH EACH OTHER WHEN CONNECTED TO A BOOSTER SOURCE.**
- **DO NOT USE OPEN FLAME NEAR BATTERY.**
- **REMOVE METALLIC JEWELRY WORN ON HANDS OR WRISTS TO AVOID INJURY BY ACCIDENTAL ARCING OF BATTERY CURRENT.**
- **WHEN USING A HIGH OUTPUT BOOSTING DEVICE, DO NOT ALLOW BATTERY VOLTAGE TO EXCEED 16 VOLTS. REFER TO INSTRUCTIONS PROVIDED WITH DEVICE BEING USED.**

FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

CAUTION: When using another vehicle as a booster, do not allow vehicles to touch. Electrical systems can be damaged on either vehicle.

TO JUMP START A DISABLED VEHICLE:

(1) Raise hood on disabled vehicle and visually inspect engine compartment for:

- Battery cable clamp condition, clean if necessary.
- Frozen battery.
- Yellow or bright color test indicator, if equipped.
- Low battery fluid level.
- Generator drive belt condition and tension.
- Fuel fumes or leakage, correct if necessary.

CAUTION: If the cause of starting problem on disabled vehicle is severe, damage to booster vehicle charging system can result.

(2) When using another vehicle as a booster source, park the booster vehicle within cable reach. Turn off all accessories, set the parking brake, place the automatic transmission in PARK or the manual transmission in NEUTRAL and turn the ignition OFF.

(3) On disabled vehicle, place gear selector in park or neutral and set park brake. Turn off all accessories.

(4) Connect jumper cables to booster battery. RED clamp to positive terminal (+). BLACK clamp to negative terminal (-). DO NOT allow clamps at opposite end of cables to touch, electrical arc will result. Review all warnings in this procedure.

(5) On disabled vehicle, connect RED jumper cable clamp to positive (+) terminal. Connect BLACK jumper cable clamp to engine ground as close to the ground cable attaching point as possible.

(6) Start the engine in the vehicle which has the booster battery, let the engine idle a few minutes, then start the engine in the vehicle with the discharged battery.

CAUTION: Do not crank starter motor on disabled vehicle for more than 15 seconds, starter will overheat and could fail.

(7) Allow battery in disabled vehicle to charge to at least 12.4 volts (75% charge) before attempting to start engine. If engine does not start within 15 seconds, stop cranking engine and allow starter to cool (15 min.), before cranking again.

DISCONNECT CABLE CLAMPS AS FOLLOWS:

- Disconnect BLACK cable clamp from engine ground on disabled vehicle.
- When using a Booster vehicle, disconnect BLACK cable clamp from battery negative terminal. Disconnect RED cable clamp from battery positive terminal.
- Disconnect RED cable clamp from battery positive terminal on disabled vehicle.

HOISTING

STANDARD PROCEDURE - HOISTING

Refer to the Owner's Manual for emergency vehicle lifting procedures.

WARNING: THE HOISTING AND JACK LIFTING POINTS PROVIDED ARE FOR A COMPLETE VEHICLE. WHEN A CHASSIS OR DRIVETRAIN COMPONENT IS REMOVED FROM A VEHICLE, THE CENTER OF GRAVITY IS ALTERED MAKING SOME HOISTING CONDITIONS UNSTABLE. PROPERLY SUPPORT (Fig. 5) OR SECURE VEHICLE TO HOISTING DEVICE WHEN THESE CONDITIONS EXIST.

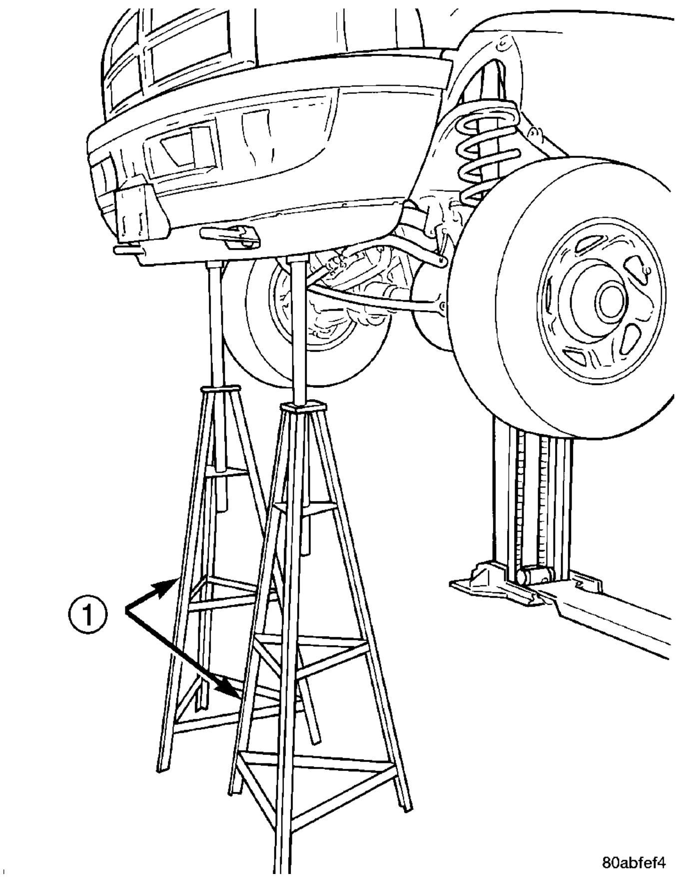


Fig. 5 Safety Stands

1 - SAFETY STANDS

FLOOR JACK

When properly positioned, a floor jack can be used to lift a vehicle (Fig. 6). Support the vehicle in the raised position with jack stands at the front and rear ends of the frame rails (Fig. 5).

CAUTION: Do not lift vehicle with a floor jack positioned under:
- **An axle tube.**
- **A body side sill.**
- **A steering linkage component.**
- **A drive shaft.**
- **The engine or transmission oil pan.**
- **The fuel tank.**
- **A front suspension arm.**

NOTE: Use the correct frame rail lifting locations only (Fig. 7) and (Fig. 8).

HOIST

A vehicle can be lifted with:
- A single-post, frame-contact hoist.
- A twin-post, chassis hoist.
- A ramp-type, drive-on hoist.

NOTE: When a frame-contact type hoist is used, verify that the lifting pads are positioned properly (Fig. 6). The forward lifting pads should be positioned against the forward flange of the transmission crossmember brackets at the bottom of the frame rail (Fig. 7). The real lifting pads should be wedged between the forward flange of the leaf spring bracket and the frame rail (Fig. 8). Safety stands should be placed under the frame rails at the front and rear ends (Fig. 5).

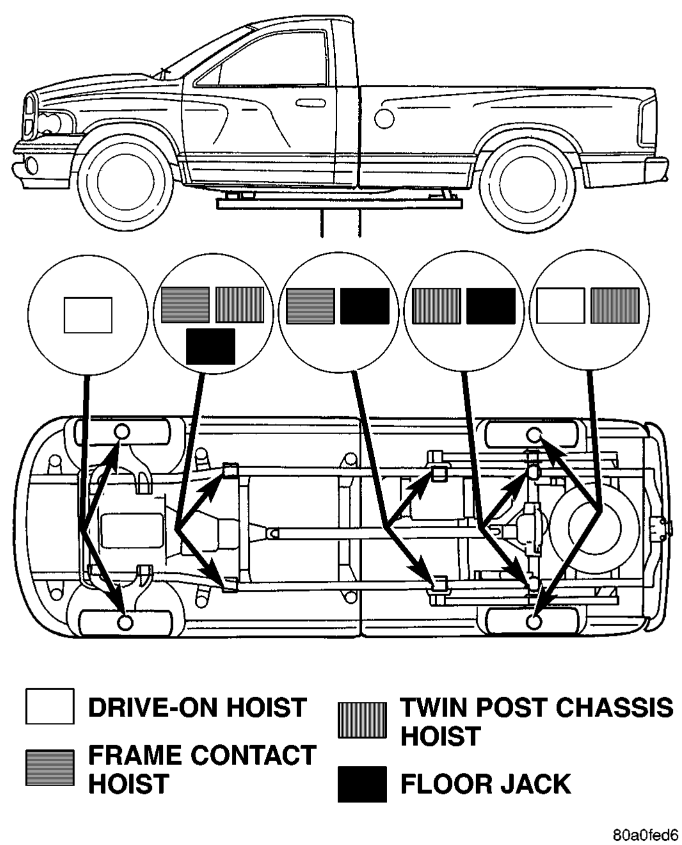


Fig. 6 Vehicle Lifting Locations

HOISTING (Continued)

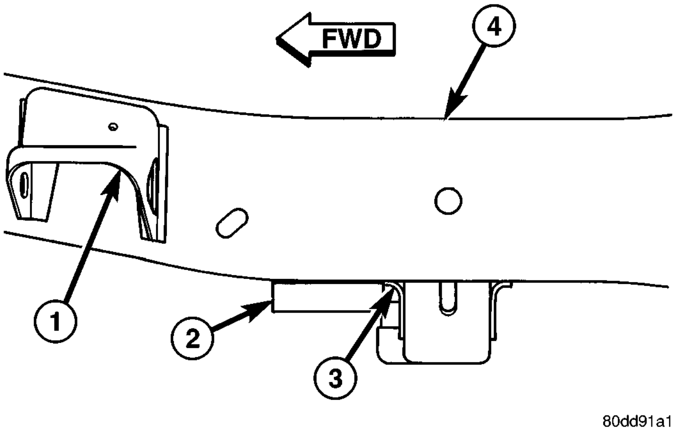


Fig. 7 FRONT LIFT PAD LOCATION

1 - BODY MOUNT BRACKET
2 - FRONT LIFT PAD
3 - TRANSMISSION CROSSMEMBER BRACKET
4 - FRAME RAIL

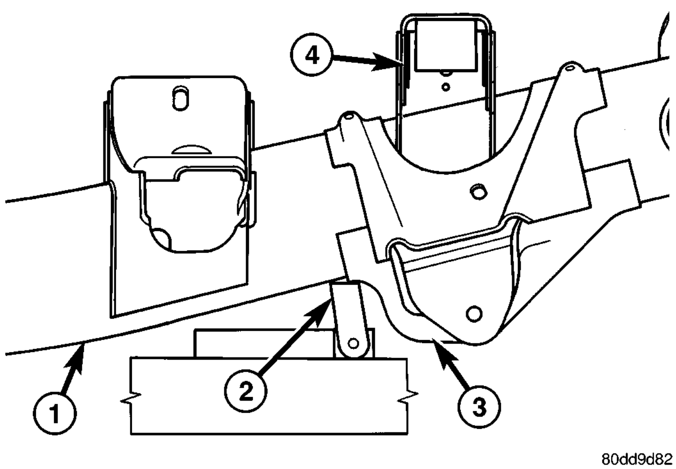


Fig. 8 REAR LIFT PAD LOCATION

1 - FRAME RAIL
2 - REAR LIFT PAD
3 - LEAF SPRING MOUNTING BRACKET
4 - BOX MOUNTING BRACKET

TOWING

STANDARD PROCEDURE - TOWING

A vehicle equipped with SAE approved sling-type towing equipment can be used to tow all vehicles. When towing a 4WD vehicle using a wheel-lift towing device, use tow dollies under the opposite end of the vehicle. A vehicle with flat-bed device can also be used to transport a disabled vehicle (Fig. 9).

A wooden crossbeam may be required for proper connection when using the sling-type, front-end towing method.

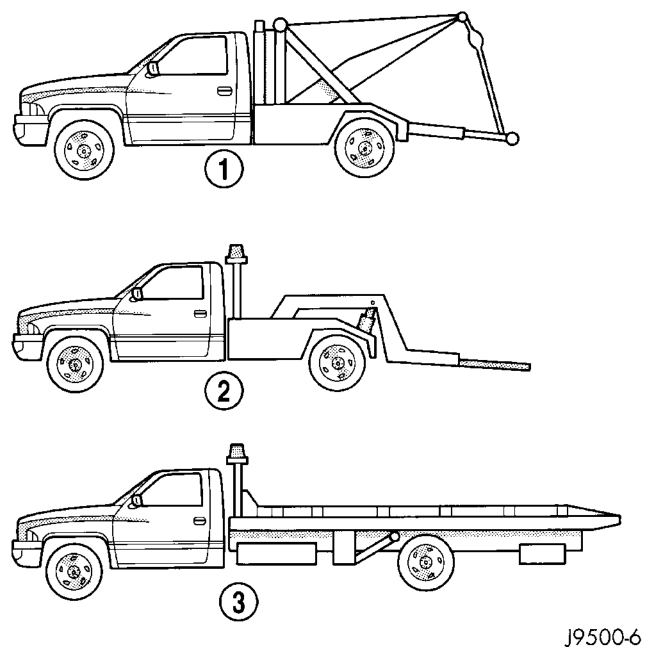


Fig. 9 Tow Vehicles With Approved Equipment

1 - SLING TYPE
2 - WHEEL LIFT
3 - FLAT BED

SAFETY PRECAUTIONS

CAUTION: The following safety precautions must be observed when towing a vehicle:

- Secure loose and protruding parts.
- Always use a safety chain system that is independent of the lifting and towing equipment.
- Do not allow towing equipment to contact the disabled vehicle's fuel tank.
- Do not allow anyone under the disabled vehicle while it is lifted by the towing device.
- Do not allow passengers to ride in a vehicle being towed.
- Always observe state and local laws regarding towing regulations.
- Do not tow a vehicle in a manner that could jeopardize the safety of the operator, pedestrians or other motorists.
- Do not attach tow chains, T-hooks, J-hooks, or a tow sling to a bumper, steering linkage, drive shafts or a non-reinforced frame hole.
- Do not tow a heavily loaded vehicle. Damage to the cab, cargo box or frame may result. Use a flatbed device to transport a loaded vehicle.

GROUND CLEARANCE

CAUTION: If vehicle is towed with wheels removed, install lug nuts to retain brake drums or rotors.

TOWING (Continued)

A towed vehicle should be raised until lifted wheels are a minimum 100 mm (4 in) from the ground. Be sure there is adequate ground clearance at the opposite end of the vehicle, especially when towing over rough terrain or steep rises in the road. If necessary, remove the wheels from the lifted end of the vehicle and lower the vehicle closer to the ground, to increase the ground clearance at the opposite end of the vehicle. Install lug nuts on wheel attaching studs to retain brake drums or rotors.

RAMP ANGLE

If a vehicle with flat-bed towing equipment is used, the approach ramp angle should not exceed 15 degrees.

TOWING WHEN KEYS ARE NOT AVAILABLE

When the vehicle is locked and keys are not available, use a flat bed hauler. A Wheel-lift or Sling-type device can be used on 4WD vehicles provided **all the wheels are lifted off the ground using tow dollies.**

FOUR-WHEEL-DRIVE VEHICLE TOWING

Chrysler Corporation recommends that a vehicle be transported on a flat-bed device. A Wheel-lift or Sling-type device can be used provided **all the wheels are lifted off the ground using tow dollies.**

WARNING: WHEN TOWING A DISABLED VEHICLE AND THE DRIVE WHEELS ARE SECURED IN A WHEEL LIFT OR TOW DOLLIES, ENSURE THE TRANSMISSION IS IN THE PARK POSITION (AUTOMATIC TRANSMISSION) OR A FORWARD DRIVE GEAR (MANUAL TRANSMISSION).

CAUTION: Many vehicles are equipped with air dams, spoilers, and/or ground effect panels. To avoid component damage, a wheel-lift towing vehicle or a flat-bed hauling vehicle is recommended.

SUSPENSION

TABLE OF CONTENTS

WHEEL ALIGNMENT

TABLE OF CONTENTS

WHEEL ALIGNMENT

DESCRIPTION

NOTE: Suspension components with rubber/urethane bushings should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

Wheel alignment involves the correct positioning of the wheels in relation to the vehicle. The positioning is accomplished through suspension and steering linkage adjustments. An alignment is considered essential for efficient steering, good directional stability and to minimize tire wear. The most important measurements of an alignment are caster, camber and toe (Fig. 1).

CAUTION: Never attempt to modify suspension or steering components by heating or bending.

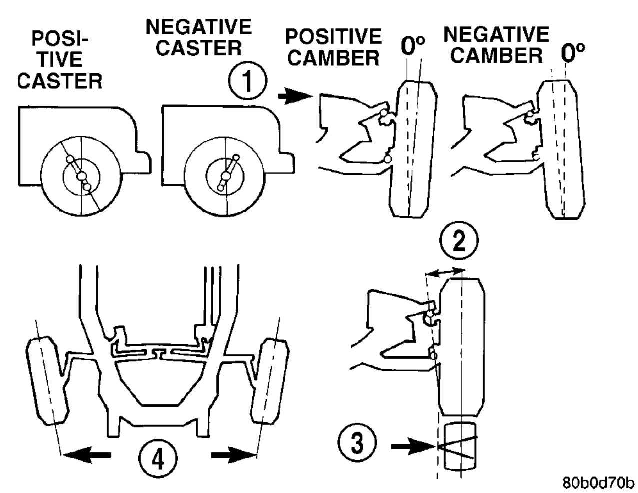


Fig. 1 Wheel Alignment Measurements

1 - FRONT OF VEHICLE
2 - STEERING AXIS INCLINATION
3 - PIVOT POINT
4 - TOE-IN

WHEEL ALIGNMENT (Continued)

OPERATION

- **CASTER** is the forward or rearward tilt of the steering knuckle from vertical. Tilting the top of the knuckle forward provides less positive caster. Tilting the top of the knuckle rearward provides more positive caster. Positive caster promotes directional stability. This angle enables the front wheels to return to a straight ahead position after turns (Fig. 1)
- **CAMBER** is the inward or outward tilt of the wheel relative to the center of the vehicle. Tilting the top of the wheel inward provides negative camber. Tilting the top of the wheel outward provides positive camber. Incorrect camber will cause wear on the inside or outside edge of the tire (Fig. 1)
- **TOE** is the difference between the leading inside edges and trailing inside edges of the front tires. Wheel toe position out of specification cause's unstable steering, uneven tire wear and steering wheel off-center. The wheel toe position is the **final** front wheel alignment adjustment (Fig. 1)
- **THRUST ANGLE** is the angle of the rear axle relative to the centerline of the vehicle. Incorrect thrust angle can cause off-center steering and excessive tire wear. This angle is not adjustable, damaged component(s) must be replaced to correct the thrust angle (Fig. 1)

DIAGNOSIS AND TESTING - PRE-ALIGNMENT INSPECTION

Before starting wheel alignment, the following inspection and necessary corrections must be completed. Refer to Suspension and Steering System Diagnosis Chart below for additional information.

(1) Inspect tires for size, air pressure and tread wear.

(2) Inspect front wheel bearings for wear.

(3) Inspect front wheels for excessive radial or lateral runout and balance.

(4) Inspect ball studs, linkage pivot points and steering gear for looseness, roughness or binding.

(5) Inspect suspension components for wear and noise.

(6) On 4x4 vehicles check suspension height (LD only).

(7) Road test the vehicle.

SUSPENSION AND STEERING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FRONT END NOISE	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Loose or worn steering or suspension components.	3. Tighten or replace components as necessary.
EXCESSIVE PLAY IN STEERING	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Loose or worn steering gear.	3. Replace steering gear.
FRONT WHEELS SHIMMY	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Tires worn or out of balance.	3. Replace or balance tires.
	4. Alignment.	4. Align vehicle to specifications.
VEHICLE INSTABILITY	1. Loose or worn wheel bearing.	1. Replace wheel bearing.
	2. Loose or worn steering or suspension components.	2. Tighten or replace components as necessary.
	3. Tire pressure.	3. Adjust tire pressure.
	4. Alignment.	4. Align vehicle to specifications.

WHEEL ALIGNMENT (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
EXCESSIVE STEERING EFFORT	1. Loose or worn steering gear.	1. Replace steering gear.
	2. Column coupler binding.	2. Replace coupler.
	3. Tire pressure.	3. Adjust tire pressure.
	4. Alignment.	4. Align vehicle to specifications.
VEHICLE PULLS TO ONE SIDE	1. Tire pressure.	1. Adjust tire pressure.
	2. Tire.	2. Criss-Cross Front Tires.
	3. Alignment.	3. Align vehicle to specifications.
	4. Loose or worn steering or suspension components.	4. Tighten or replace components as necessary.
	5. Radial tire lead.	5. Rotate or replace tire as necessary.
	6. Brake pull.	6. Repair brake as necessary.
	7. Weak or broken spring.	7. Replace spring.
	8. Ride height (LD) 4WD only.	8. Measure and adjust ride height. (LD only)

STANDARD PROCEDURE

STANDARD PROCEDURE - HEIGHT MEASUREMENT - 4WD (LD)

The vehicle suspension height MUST be measured and adjusted before performing wheel alignment procedure. Also when front suspension components have been replaced. This measure must be performed with the vehicle supporting it's own weight and taken on both sides of the vehicle.

(1) Inspect tires and set to correct pressure.

(2) Jounce the front of the vehicle.

(3) Measure and record the height from the ground at the centerline of the rear lower control arm bolt front tip (Fig. 2).

(4) Measure and record the height from the ground at the front spindle centerline (Static Load Radius) (Fig. 2).

(5) Subtract the first measurement from the second measurement. The difference between the two measurement should be 58 mm (2.3 inches) ± 3 mm (0.12 inches).

(6) If value is greater than 61 mm (2.4 inches), tighten the torsion bar bolt until the specification is achieved (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(7) If value is less than 55 mm (2.1 inches), loosen the torsion bar bolt until the specification is achieved,(Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(8) Repeat the previous steps until the ride height is within specifications.

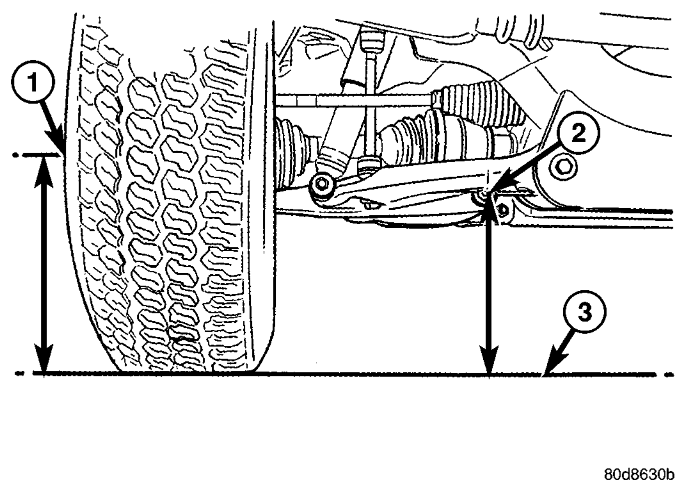


Fig. 2 HEIGHT MESUREMENT

1 - HEIGHT FROM THE GROUND AT THE FRONT SPINDLE CENTERLINE (STATIC LOAD RADIUS)
2 - CENTERLINE OF THE REAR LOWER CONTROL ARM BOLT FRONT TIP
3 - GROUND LINE

STANDARD PROCEDURE - HEIGHT ADJUSTMENT - 4WD (LD)

The vehicle suspension height MUST be measured and adjusted before performing wheel alignment procedure (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE). Also when front suspension components have been replaced. This measurement must be performed with the vehicle supporting it's own weight and taken on both sides of the vehicle.

WHEEL ALIGNMENT (Continued)

To adjust the vehicle height turn the torsion bar adjustment bolt CLOCKWISE to raise the vehicle and COUNTER CLOCKWISE to lower the vehicle.

CAUTION: ALWAYS raise the vehicle to the correct suspension height, NEVER lower the vehicle to obtain the correct suspension height. If the vehicle suspension height is too high, lower the vehicle below the height specification. Then raise the vehicle to the correct suspension height specification. This will insure the vehicle maintains the proper suspension height.

NOTE: If a height adjustment has been made, perform height measurement again on both sides of the vehicle.

STANDARD PROCEDURE - CAMBER AND CASTER ADJUSTMENT

NOTE: 4X4 (LD) SUSPENSION HEIGHT MEASUREMENT MUST BE PERFORMED BEFORE AN ALIGNMENT.

NOTE: When the upper control arm pivot bolts are loosened the upper control arm will normally go inwards toward the frame automatically with the weight of the vehicle.

Camber and caster angle adjustments involve changing the position of the upper control arm inconjunction with the slotted holes in the frame brackets, Install special tool 8876 between the top of the upper control arm bracket and the upper control arm (on 1500 series 4X2 & 4X4). Install special tool 8876 between the bottom of the upper control arm bracket pressing the tool against the frame and the upper control arm (on 2500/3500 series 4X2) in order to move the upper control arm outwards for proper adjustment with the vehicle at normal ride height (Fig. 3).

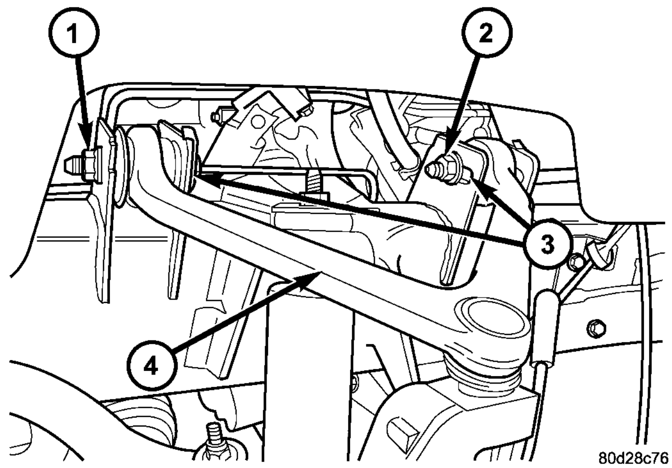


Fig. 3 CASTER & CAMBER ADJUSTMENT

1 - FRONT PIVOT BOLT
2 - REAR PIVOT BOLT
3 - SLOTTED HOLES FOR ADJUSTMENT OF CASTER & CAMBER
4 - UPPER CONTROL ARM

STANDARD PROCEDURE - TOE ADJUSTMENT

4X4 SUSPENSION HEIGHT MESUREMENT MUST BE PERFORMED BEFORE AN ALIGNMENT.

The wheel toe position adjustment is the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Secure the steering wheel with the front wheels in the straight-ahead position.

(2) Loosen the tie rod jam nuts.

NOTE: Each front wheel should be adjusted for one-half of the total toe position specification. This will ensure the steering wheel will be centered when the wheels are positioned straight-ahead.

(3) Adjust the wheel toe position by turning the inner tie rod as necessary (Fig. 4).

(4) Tighten the tie rod jam nut to 75 N·m (55 ft. lbs.).

(5) Verify the specifications

(6) Turn off engine.

STANDARD PROCEDURE - CAMBER, CASTER AND TOE ADJUSTMENT

NOTE: 4X4 (LD) SUSPENSION HEIGHT MEASUREMENT MUST BE PERFORMED BEFORE AN ALIGNMENT.

Camber and caster angle adjustments involve changing the position of the upper control arm with the slots in the frame brackets using special tool 8876 to move the upper control arm outwards for proper adjustment. (Fig. 3)

NOTE: When the upper control arm pivot bolts are loosened the upper control arm will normally go inwards toward the frame automatically with the weight of the vehicle.

CASTER

Moving the front or rear position of the upper control arm in or out, will change the caster angle and camber angle significantly. To maintain the camber

WHEEL ALIGNMENT (Continued)

angle while adjusting caster, move one pivot bolt of the upper control arm in or out. Then move the other pivot bolt of the upper control arm in the opposite direction. Install special tool 8876 between the top of the upper control arm bracket and the upper control arm (on 1500 series 4X2 & 4X4). Install special tool 8876 between the bottom of the upper control arm bracket pressing the tool against the frame and the upper control arm (on 2500/3500 series 4X2) in order to move the upper control arm outwards for proper adjustment with the vehicle at normal ride height (Fig. 3).

To increase positive caster angle, move the rear position of the upper control arm inward (toward the engine). Move the front of the upper control arm outward (away from the engine) slightly until the original camber angle is obtained using special tool 8876 to move the upper control arm for proper adjustment. (Fig. 3)

CAMBER

Move both pivot bolts of the upper control arm together in or out. This will change the camber angle significantly and little effect on the caster angle using special tool 8876 to move the upper control arm for proper adjustment. (Fig. 3)

After adjustment is made tighten the upper control arm nuts to proper torque specification.

TOE ADJUSTMENT

The wheel toe position adjustment is the final adjustment.

(1) Start the engine and turn wheels both ways before straightening the wheels. Secure the steering wheel with the front wheels in the straight-ahead position.

(2) Loosen the tie rod jam nuts.

NOTE: Each front wheel should be adjusted for one-half of the total toe position specification. This will ensure the steering wheel will be centered when the wheels are positioned straight-ahead.

(3) Adjust the wheel toe position by turning the inner tie rod as necessary (Fig. 4).

(4) Tighten the tie rod jam nut to 75 N·m (55 ft. lbs.).

(5) Verify the specifications

(6) Turn off engine.

STANDARD PROCEDURE - ALIGNMENT LINK/COIL SUSPENSION

Before each alignment reading the vehicle should be jounced (rear first, then front). Grasp each bumper at the center and jounce the vehicle up and down several times. Always release the bumper in the down position. **Set the front end alignment to specifications while the vehicle is in its NORMALLY LOADED CONDITION.**

CAMBER: The wheel camber angle is preset and is not adjustable.

CASTER: Check the caster of the front axle for correct angle. Be sure the axle is not bent or twisted. Road test the vehicle and make left and right turn. Observe the steering wheel return-to-center position. Low caster will cause poor steering wheel returnability.

Caster can be adjusted by rotating the cams on the lower suspension arm (Fig. 5).

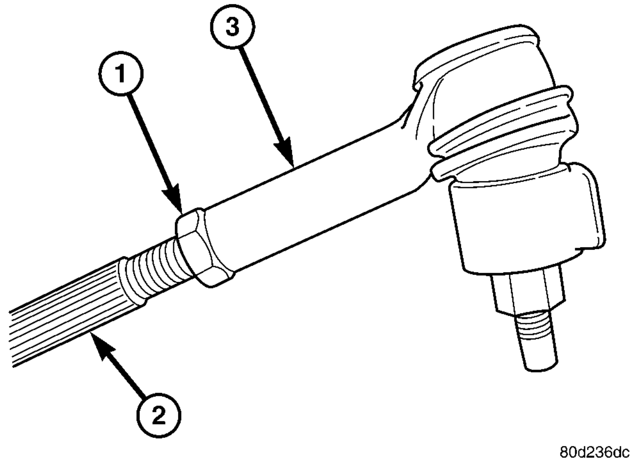


Fig. 4 TIE ROD END

1 - JAM NUT
2 - TIE ROD - INNER
3 - TIE ROD END - OUTER

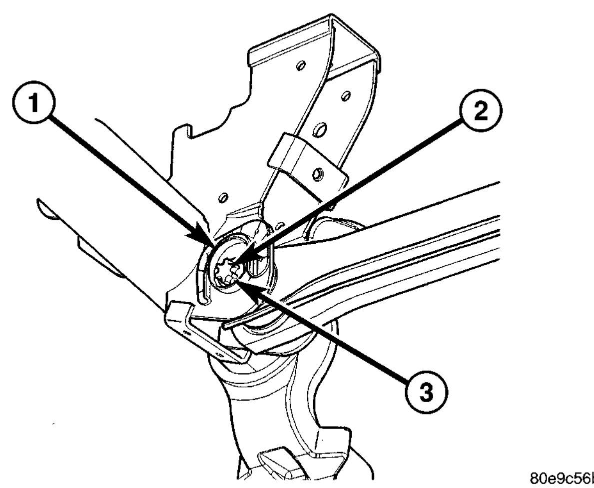


Fig. 5 ALIGNMENT ADJUSTMENT CAM

1 - BRACKET REINFORCEMENT
2 - ADJUSTING BOLT
3 - ADJUSTMENT CAM

TOE POSITION: The wheel toe position adjustment should be the final adjustment.

WHEEL ALIGNMENT (Continued)

(1) Start the engine and turn wheels both ways before straightening the wheels. Center and Secure the steering wheel and turn off engine.

(2) Loosen the adjustment sleeve clamp bolts.

(3) Adjust the right wheel toe position with the drag link. Turn the sleeve until the right wheel is at the correct TOE-IN position. Position clamp bolts to their original position and tighten to specifications. **Make sure the toe setting does not change during clamp tightening.**

(4) Adjust left wheel toe position with tie rod at left knuckle. Turn the sleeve until the left wheel is at the correct TOE-IN position. Position clamp bolts to their original position and tighten to specifications. **Make sure the toe setting does not change during clamp tightening.**

(5) Verify the right toe setting and a straight steering wheel.

(6) Road test the vehicle.

SPECIFICATIONS

ALIGNMENT

NOTE: All alignment specifications are in degrees.

SPECIFICATIONS

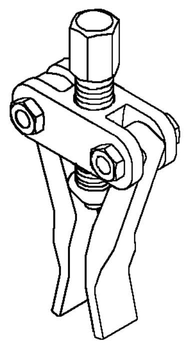
DESCRIPTION	SPECIFICATION			
VEHICLE 1500	WHEEL BASE	CASTER (3.0° Max, +.75° Target)	CAMBER (± .50°)	TOTAL TOE-IN (± .10°)
4X2	120.5 in	4.0°	.0°	.10°
4X2	140.5 in	4.2°	.0°	.10°
4X2	160.5 in	4.4°	.0°	.10°
VEHICLE 1500	WHEEL BASE	CASTER (3.0° Max, +.75° Target)	CAMBER (±.50°)	TOTAL TOE-IN (±.10°)
4X4	120.5 in	4.2°	.0°	.10°
4X4	140.5 in	4.4°	.0°	.10°
4X4	160.5 in	4.6°	.0°	.10°
MAX RT/LT DIFFERENCE 4X2 1500	—	.40°	.50°	0.06°
MAX RT/LT DIFFERENCE 4X4 1500	—	.40°	.60°	0.06°
VEHICLE 4X2 2500 & 3500	WHEEL BASE	CASTER (3.25° Max, +.75° Target)	CAMBER (±.50°)	TOTAL TOE-IN (0.20° ±.10°)
4X2 2500&3500	140	4.0°	0.0°	.10° ± .05°
4X2 2500&3500	160	4.3°	0.0°	.10° ± .05°
MAX RT/LT DIFFERENCE 4X2 2500&3500	—	±0.4°	±0.6°	0.1°
VEHICLE 4X4 2500&3500	WHEEL BASE	CASTER (4.0° Min, +.75° Target)	CAMBER (.25° ±.5°)	TOTAL TOE-IN (0.20° ±.10°)
4X4 2500&3500	140	4.5°	.25°	.10° ± .05°
4X4 2500&3500	160	4.7°	.25°	.10° ± .05°
MAX RT/LT DIFFERENCE 4X4 2500&3500	—	±.5°	±.5°	0.1°

DESCRIPTION	REAR SPECIFICATION
CAMBER (-.10° ± 0.35°)	TOTAL TOE-IN (0.30° ± 0.35°)
THRUST ANGLE 0° ± 0.4° 4X2 4X4 1500	
THRUST ANGLE -0.2° ± 0.2° 4X2 4X4 2500&3500	

WHEEL ALIGNMENT (Continued)

SPECIAL TOOLS

WHEEL ALIGNMENT



8876 - CAMBER/CASTER ADJUSTMENT TOOL

FRONT - INDEPENDENT FRONT SUSPENSION

TABLE OF CONTENTS

FRONT - INDEPENDENT FRONT SUSPENSION

DESCRIPTION

DESCRIPTION

The front suspension is designed to allow each wheel to adapt to different road surfaces independently. The wheels are mounted to hub/bearings units bolted to the steering knuckle. The double-row hub bearings are sealed and lubricated for life. The steering knuckles turn (pivot) on ball joints.

The front suspension is comprised of (Fig. 1) (Fig. 2):

- Shock absorbers
- Torsion bar - 4X4 (LD only)
- Coil Spring - 4X2
- Control arms
- Steering knuckles
- Stabilizer bar
- Stabilizer link
- Tie Rod Ends
- Hub/Bearing
- Rack & Pinion
- Ball Joints

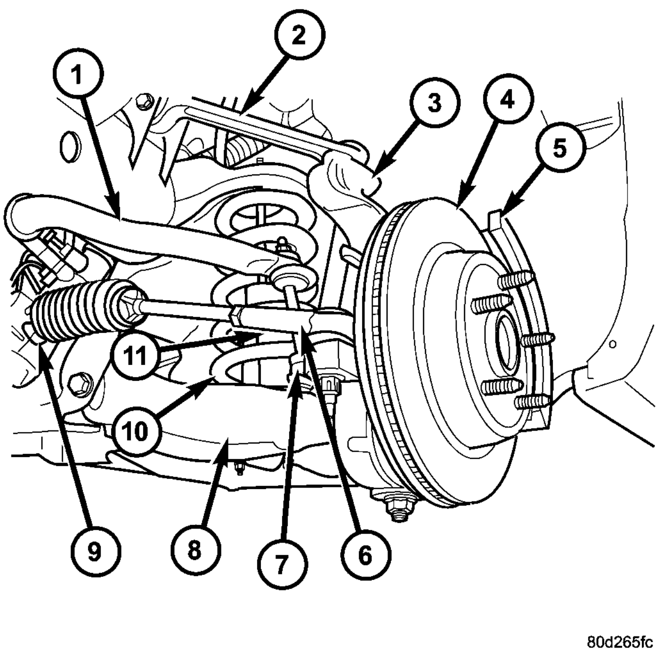


Fig. 1 FRONT SUSPENSION - 4X2

1 - STABILIZER BAR
2 - UPPER CONTROL ARM
3 - STEERING KNUCKLE
4 - ROTOR
5 - CALIPER ADAPTER
6 - OUTER TIE ROD END
7 - STABILIZER LINK
8 - LOWER CONTROL ARM
9 - RACK & PINION
10 - COIL SPRING
11 - SHOCK ABSORBER

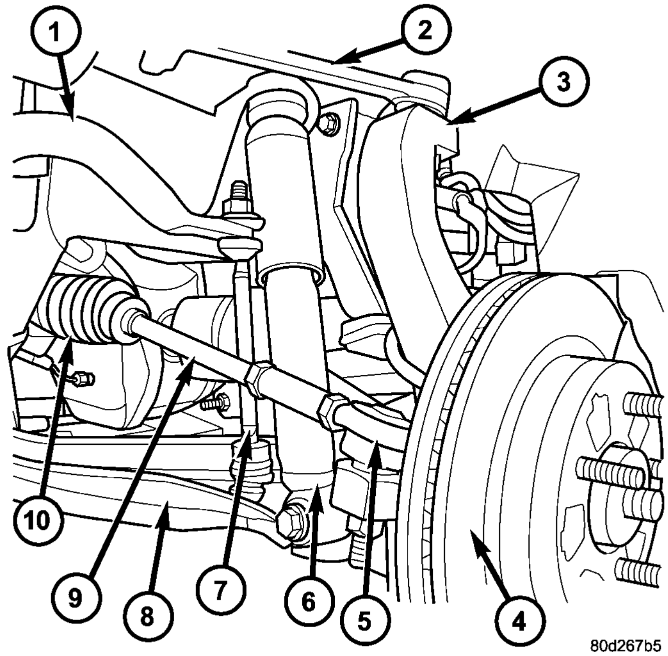


Fig. 2 FRONT SUSPENSION - 4X4 (LD ONLY)

1 - STABILIZER BAR
2 - UPPER CONTROL ARM
3 - STEERING KNUCKLE
4 - ROTOR
5 - OUTER TIE ROD END
6 - SHOCK ABSORBER
7 - STABILIZER LINK
8 - LOWER CONTROL ARM
9 - INNER TIE ROD
10 - RACK & PINION

NOTE: Components attached with a nut must be torqued to specification.

NOTE: Suspension components with rubber/urethane bushings should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

DESCRIPTION

The upper control arm bolts on frame brackets. The frame brackets have slotted holes which allow the arms to be adjusted for caster and camber.

The lower control arms bolt to the lower frame brackets and pivots through bushings.

The control arms have lube for life ball studs. The control arm travel (jounce) is limited through the use of rubber/urethane bumpers. Rebound travel is limited by the shock absorber.

FRONT - INDEPENDENT FRONT SUSPENSION (Continued)

SPECIFICATIONS

TORQUE CHART

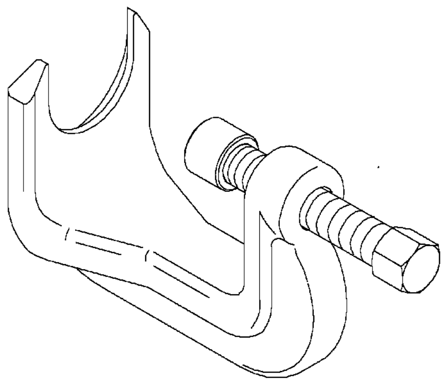
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Nut 4X4	54	40	—
Shock Absorber Lower Bolt 4X4	135	100	—
Shock Absorber Upper Nut 4X2	54	40	—
Shock Absorber Lower Bolt 4X2	34	25	—
Lower Suspension Arm Frame Nuts	204	150	—
Lower Suspension Arm Frame Nuts	285	210	—
Lower Suspension Arm Ball Joint Nut 1500 series only	52 Then an additional 90°	38 Then an additional 90°	—
Lower Suspension Arm Ball Joint Nut (HD 4X2 only	135	100	—
Upper Suspension Arm Frame Nuts (LD)	132	97	—
Upper Suspension Arm Frame Nuts (HD 4X2 only)	170	125	—
Upper Suspension Arm Ball Joint Nut 1500 series only	54 Then an additional 90°	40 Then an additional 90°	—
Stabilizer Bar Frame Bolt	61	45	—
Stabilizer Link Lower Control Arm Nut	102	75	—
Stabilizer Link Stabilizer Bar Nut	38	27	—
Hub/Bearing Bolts (LD)	163	120	—
Hub/Bearing Bolts (HD 4X2)	176	130	—
Tie Rod End Nut	61 Then an additional 90°	45 Then an additional 90°	—

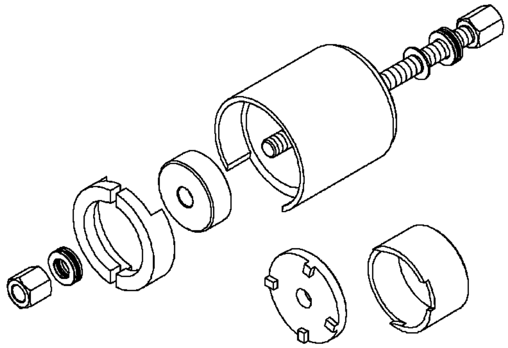
FRONT - INDEPENDENT FRONT SUSPENSION (Continued)

SPECIAL TOOLS

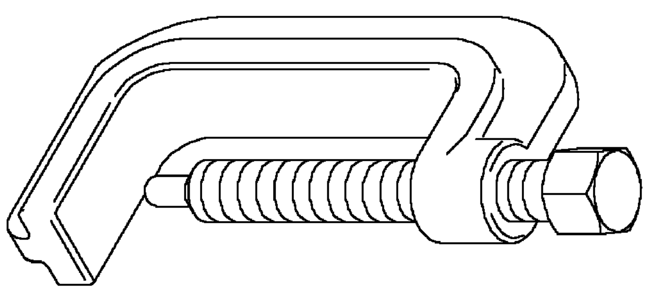
FRONT SUSPENSION



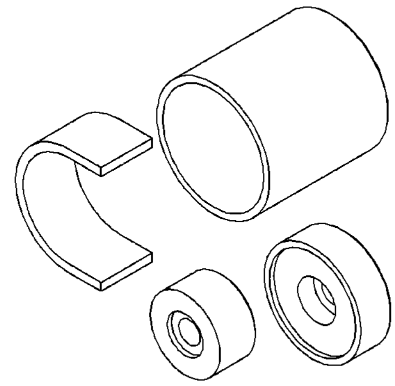
PULLER - 8677



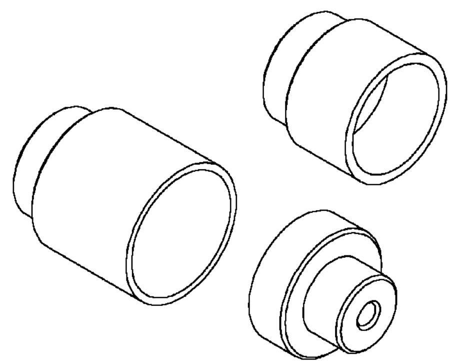
4WD BUSHING REMOVAL/INSTALL KIT - 8682



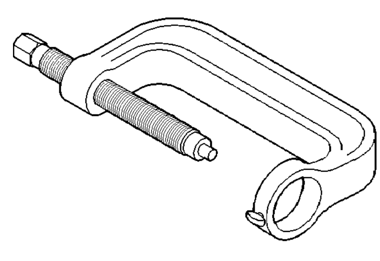
TORSION BAR LOADER/UNLOADER - 8686



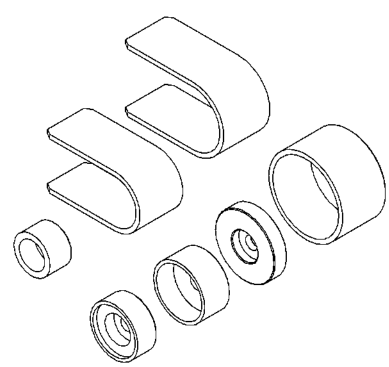
TORSION BAR BUSHING REMOVAL/INSTALL - 8835



RECEIVER/ DRIVER BALLJOINT - 8698



BALL JOINT PRESS - C-4212F



2WD - LOWER CONTROL ARM BUSHING REMOVAL/INSTALL - 8836

BUSHINGS

REMOVAL

REMOVAL - LOWER CONTROL ARM BUSHINGS - 4WD (LD)

(1) Remove the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).

(2) Secure the control arm in a vise.

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

FRAME MOUNTED BUSHING

(1) Install the bushing tool 8682-3 (receiver) and 8682-4 (driver) with the threaded rod and the two bearings as shown for the replacement of the frame bushing (Fig. 3)

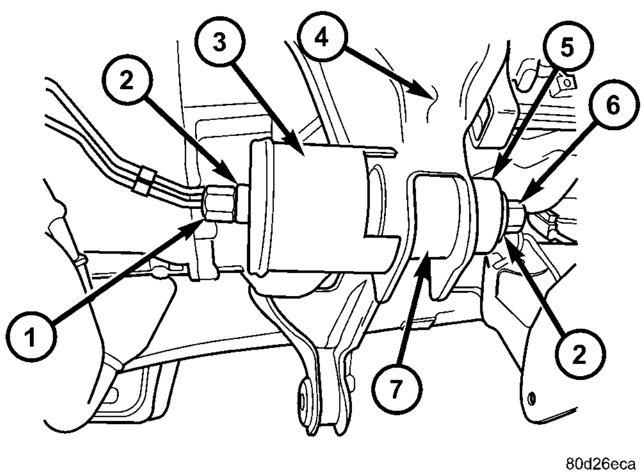


Fig. 3 FRAME BUSHING REMOVAL

1 - THREADED ROD
2 - BEARINGS
3 - 8682-3 (RECEIVER)
4 - FRAME
5 - 8682-4 (DRIVER)
6 - NUT
7 - BUSHING

CONTROL ARM BUSHING

(1) Install bushing remover tools 8682-2 (adapter), 8682-3 (receiver) and 8682-4 (driver) with the threaded rod and the two bearings as shown (Fig. 4)

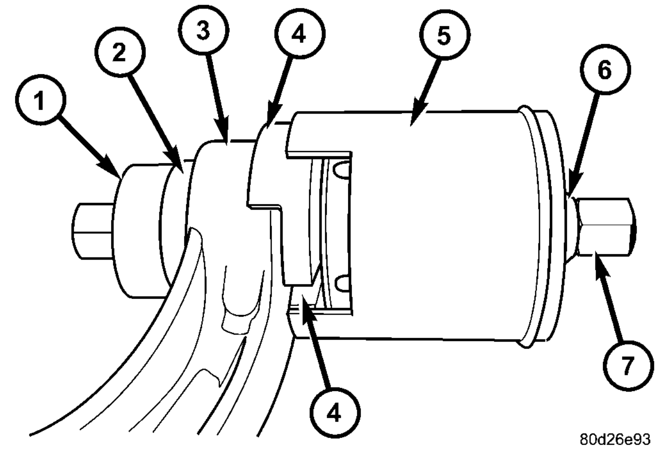


Fig. 4 CONTROL ARM BUSHING REMOVAL

1 - 8682-4 (DRIVER)
2 - BUSHING
3 - LOWER CONTROL ARM
4 - 8682-2 (ADAPTER)
5 - 8682-3 (RECEIVER)
6 - BEARING
7 - THREADED ROD

REMOVAL - TORSION BAR CROSSMEMBER BUSHING

(1) Remove the torsion bar cross member (Refer to 13 - FRAME & BUMPERS/FRAME/REAR CROSSMEMBER - REMOVAL).

(2) Secure the cross member in a vise.

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(3) Install special tools 8838 threaded rod, 8835-1, 8835-4 and 8835-3 as shown in the graphic below (Fig. 5).

(4) Press out the bushing.

REMOVAL - LOWER CONTROL ARM BUSHINGS - 2WD (LD)

NOTE: HD 4X2 bushings are not servicable.

(1) Remove the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - REMOVAL).

(2) Secure the control arm in a vise.

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

BUSHINGS (Continued)

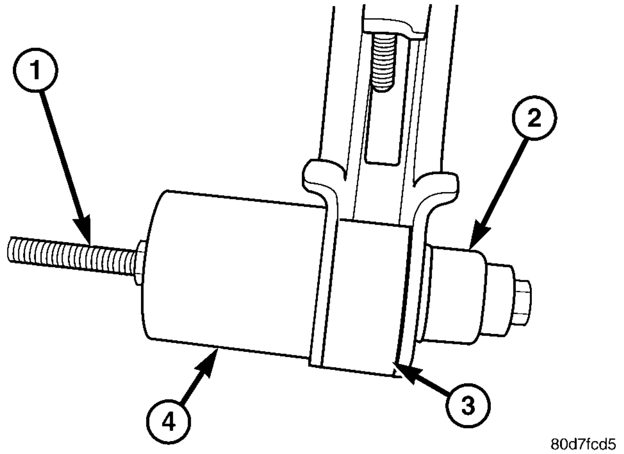


Fig. 5 TORSION BAR CROSS MEMBER BUSHING - REMOVAL

1 - 8838
2 - 8835-1
3 - 8835-4
4 - 8835-3

LARGE BUSHING

(1) Install bushing remover tools 8836-2 (receiver), 8836-4 (spacer) and 8836-5 (driver) with the threaded rod 8839 and the bearing as shown (Fig. 6) for replacement of the large bushing.

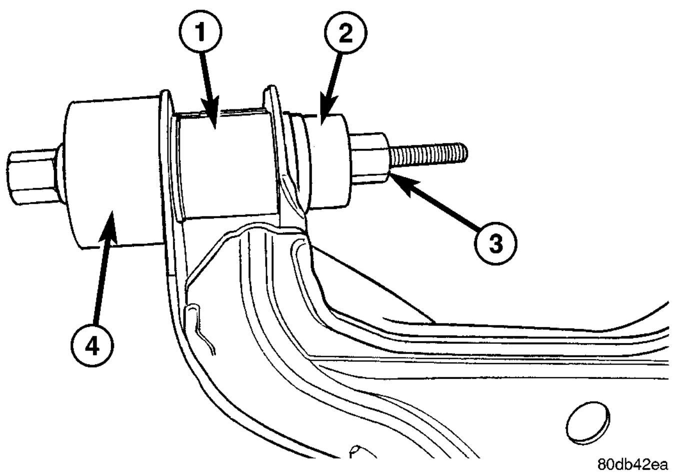


Fig. 6 LARGE LOWER CONTROL ARM BUSHING - REMOVAL

1 - 8836-4 (SPACER)
2 - 8836-5 (DRIVER)
3 - 8839 (THREADED ROD)
4 - 8836-2 (RECEIVER)

SMALL BUSHING

(1) Install the bushing tool 8836-6 (driver), 8836-3 (spacer) and 8836-2 (receiver) with the threaded rod 8839 and the bearing as shown for the replacement of the small bushing (Fig. 7)

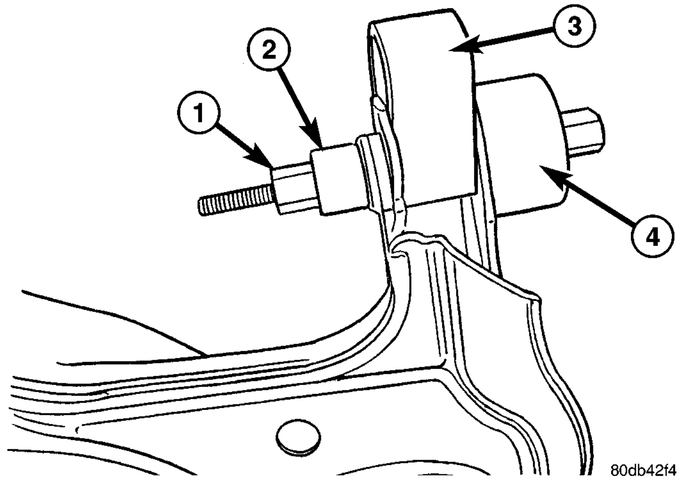


Fig. 7 SMALL LOWER CONTROL ARM BUSHING - REMOVAL

1 - 8839 (THREADED ROD)
2 - 8836-6 (DRIVER)
3 - 8836-3 (SPACER)
4 - 8836-2 (RECEIVER)

INSTALLATION

INSTALLATION - LOWER CONTROL ARM BUSHINGS - 4WD (LD)

NOTE: Be careful to properly orient the bushing voids in the correct position to within ± 10°. The correct position places the long narrow void outboard of the bushing and the short wide void inboard of the bushing (Fig. 8).

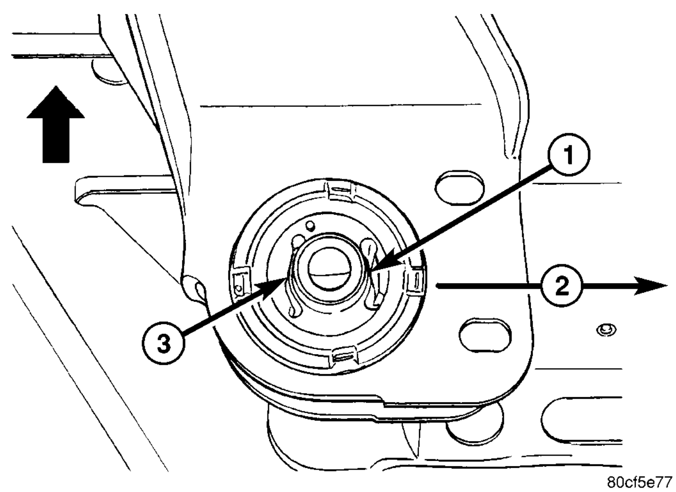


Fig. 8 REAR LOWER CONTROL ARM BUSHING

1 - SHORT - WIDE VOID
2 - INWARD TOWARD VEHICLE
3 - LONG - THIN VOID

BUSHINGS (Continued)

FRAME MOUNTED BUSHING

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new bushing into the frame using special tools 8682-3 (receiver), 8682-1 (driver) with the two bearings and the threaded rod (Fig. 9)making sure to properly orient the bushing as shown (Fig. 8).

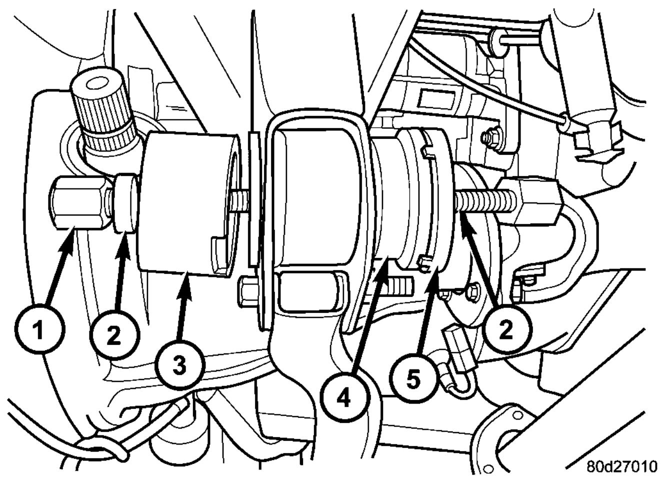


Fig. 9 FRAME BUSHING INSTALL

1 - THREADED ROD
2 - BEARINGS
3 - 8682-3 (RECEIVER)
4 - BUSHING
5 - 8682-1 (DRIVER)

CONTROL ARM BUSHING

(1) Install the new lower control arm bushings into the lower control arm using tools 8682-1 (driver), 8682-5 (receiver) and the two bearings with the threaded rod (Fig. 10) making sure to properly orient the bushing in the control (Fig. 8).

(1) Remove the control arm from the vise.

(2) Install the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).

(3) Reset the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(4) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

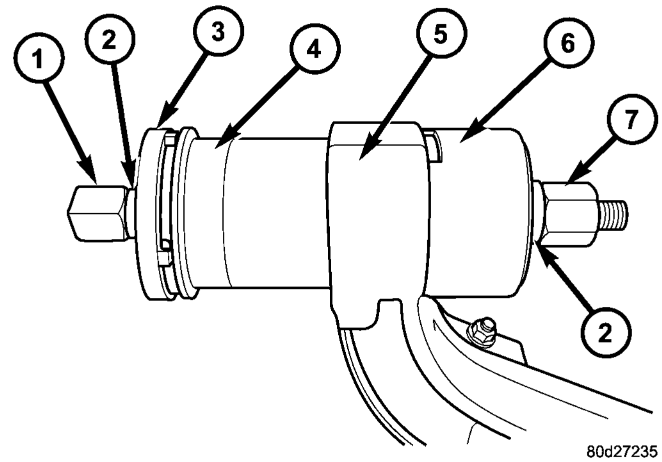


Fig. 10 CONTROL ARM BUSHING INSTALL

1 - THREADED ROD
2 - BEARINGS
3 - 8682-1 (DRIVER)
4 - BUSHING
5 - CONTROL ARM
6 - 8682-5 (RECEIVER)
7 - NUT

INSTALLATION - TORSION BAR CROSS MEMBER BUSHING

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new bushing into the cross member using special tools 8835-2, 8835-4 and 8835-3 with the bearing and the threaded rod 8838 (Fig. 11) making sure to properly orient the bushing.

(2) Remove the cross member from the vise.

(3) Install the torsion bar cross member (Refer to 13 - FRAME & BUMPERS/FRAME/REAR CROSSMEMBER - INSTALLATION).

(4) Reset the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

INSTALLATION - LOWER CONTROL ARM BUSHINGS - 2WD (LD)

NOTE: HD 4X2 bushings are not servicable.

BUSHINGS (Continued)

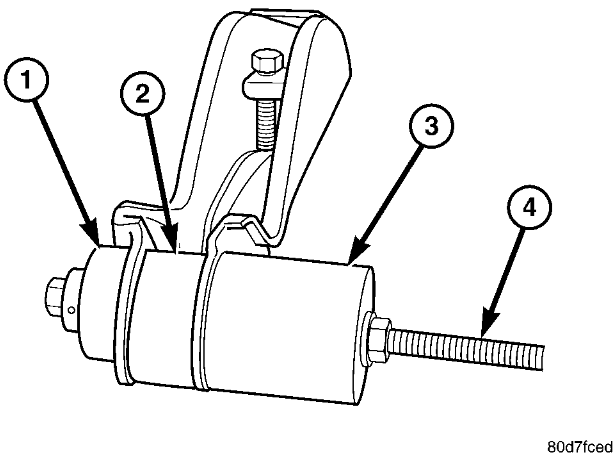


Fig. 11 TORSION BAR CROSS MEMBER BUSHING - INSTALLATION

1 - 8835-2
2 - 8835-4
3 - 8835-3
4 - 8838

LARGE BUSHING

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the new bushing into the lower control arm using special tools 8836-2 (receiver), 8836-1 (driver), 8836-4 (spacer) with the bearing and the threaded rod (8839) (Fig. 12).

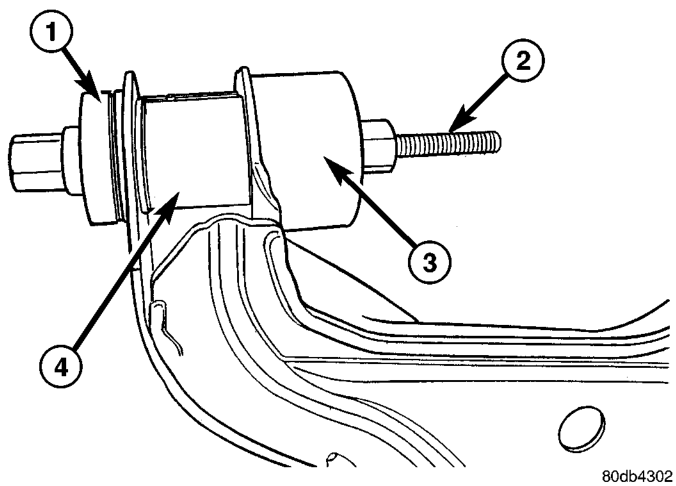


Fig. 12 LARGE LOWER CONTROL ARM BUSHING - INSTALL

1 - 8836-1 (DRIVER)
2 - 8839 (THREADED ROD)
3 - 8836-2 (RECEIVER)
4 - 8836-4 (SPACER)

SMALL BUSHING

(1) Install the small bushings into the lower control arm using tools 8836-7 (driver), 8836-2 (receiver), 8836–3 (spacer) and the bearing with the threaded rod (8839) (Fig. 13).

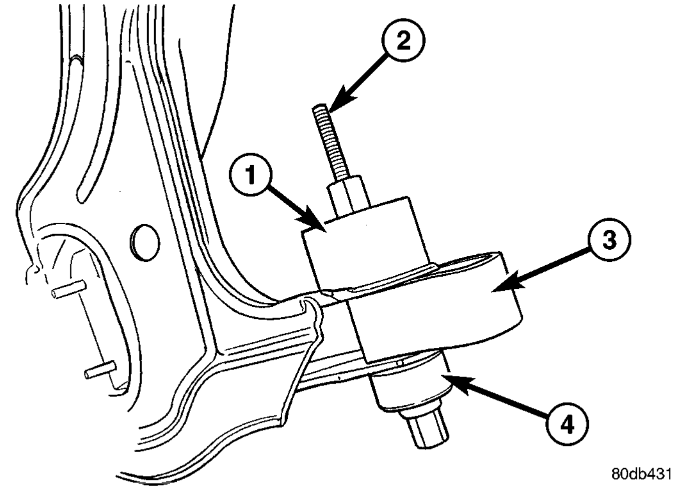


Fig. 13 SMALL LOWER CONTROL ARM BUSHING - INSTALL

1 - 8836-2 (RECEIVER)
2 - 8839 (THREADED ROD)
3 - 8836-3 (SPACER)
4 - 8836-7 (DRIVER)

(1) Remove the control arm from the vise.
(2) Install the lower control arm (Refer to 2 - SUSPENSION/FRONT/LOWER CONTROL ARM - INSTALLATION).
(3) Reset the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).
(4) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

HUB / BEARING

REMOVAL

REMOVAL - 4X4

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Remove the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).
(4) Remove the ABS wheel speed sensor if equipped, (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - REMOVAL).
(5) Remove the halfshaft nut.

HUB / BEARING (Continued)

NOTE: Do not strike the knuckle with a hammer to remove the tie rod end or the ball joint. Damage to the steering knuckle will occur.

(6) Remove the tie rod end nut and separate the tie rod from the knuckle using special tool 8677.

(7) Remove the upper ball joint nut and separate the upper ball joint from the knuckle using special tool 8677.

(8) Pull down on the steering knuckle to separate the halfshaft from the hub/bearing.

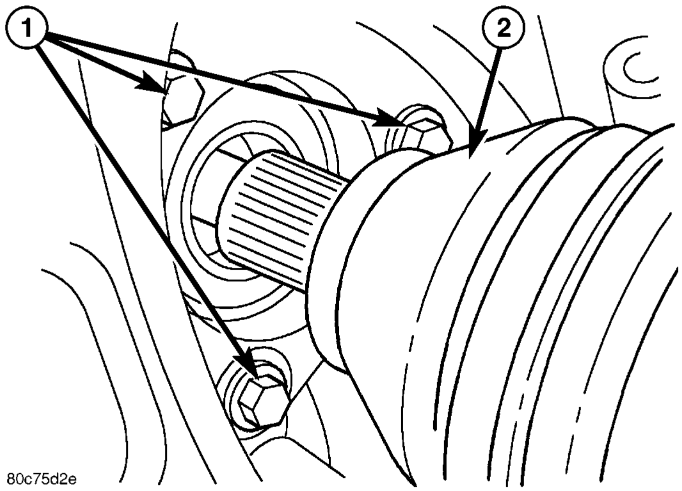


Fig. 14 HALFSHAFT / HUB/BEARING

1 - HUB/BEARING MOUNTING NUTS
2 - HALF SHAFT

(9) Remove the three hub/bearing mounting bolts from the steering knuckle (Fig. 14).

(10) Slide the hub/bearing out of the steering knuckle (Fig. 14).

(11) Remove the brake dust shield.

REMOVAL - 4X2

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove the ABS wheel speed sensor if equipped, (Refer to 5 - BRAKES/ELECTRICAL/ FRONT WHEEL SPEED SENSOR - REMOVAL) (Fig. 15)

(5) Remove the three hub/bearing mounting bolts from the steering knuckle (Fig. 15).

(6) Slide the hub/bearing out of the steering knuckle (Fig. 15).

(7) Remove the brake dust shield (Fig. 15).

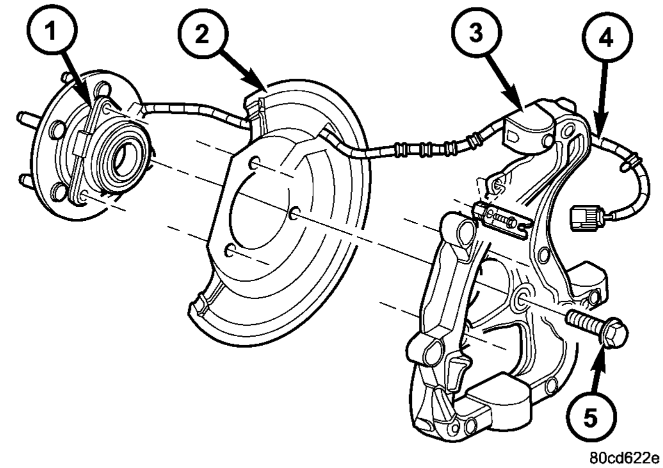


Fig. 15 HUB/BEARING 4X2

1 - HUB/BEARING
2 - DUST SHIELD
3 - STEERING KNUCKLE
4 - WHEEL SPEED SENSOR WIRE
5 - HUB/BEARING MOUNTING NUT

INSTALLATION

INSTALLATION - 4X4

(1) Install the brake dust shield (Fig. 16).

(2) Install the hub/bearing into the steering knuckle and tighten the bolts to 163 N·m (120 ft. lbs.) (Fig. 16).

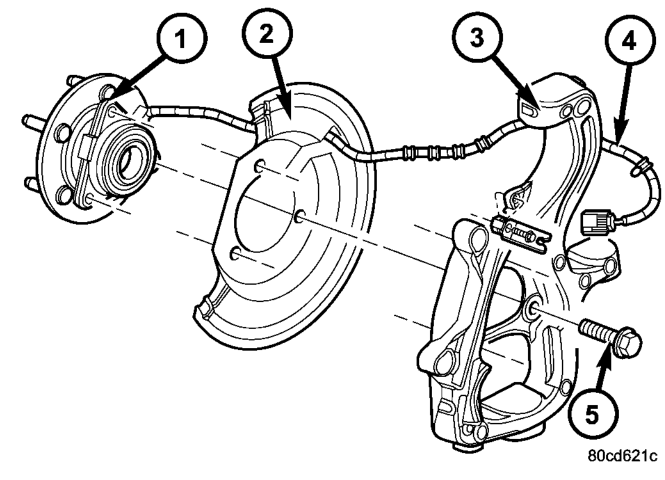


Fig. 16 HUB/BEARING 4X4

1 - HUB/BEARING
2 - DUST SHIELD
3 - STEERING KNUCKLE
4- WHEEL SPEED SENSOR WIRE
5 - HUB/BEARING MOUNTING NUT

(3) Install the brake rotor and caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

HUB / BEARING (Continued)

(4) Install the ABS wheel speed sensor if equipped (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION).

(5) Install the upper ball joint nut to the steering knuckle and tighten to 54 N·m (40 ft. lbs.) (on 1500 series only an additional 90° turn).

(6) Install the tie rod end nut to the steering knuckle and tighten to 61 N·m (45 ft. lbs.) then an additional 90°.

(7) Install the halfshaft nut and tighten to 251 N·m (185 ft. lbs.).

(8) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Remove the support and lower vehicle.

INSTALLATION - 4X2

(1) Install the brake dust shield (Fig. 15).

(2) Install the hub/bearing into the steering knuckle and tighten the bolts to 163 N·m (120 ft. lbs.) (Fig. 15).

(3) Install the brake rotor and caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(4) Install the ABS wheel speed sensor if equipped (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION) (Fig. 15).

(5) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(6) Remove the support and lower vehicle.

KNUCKLE

DESCRIPTION

The knuckle is a single casting with legs machined for the upper and lower ball joints. The knuckle also has machined mounting locations for the front brake calipers and hub bearing.

OPERATION

The steering knuckle pivot between the upper and lower ball joint. Steering linkage attached to the knuckle allows the vehicle to be steered.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake caliper, rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL), shield and ABS wheel speed sensor if equipped (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - REMOVAL).

(4) Remove the front halfshaft nut (if equipped).

(5) Remove the tie rod end nut. Separate the tie rod from the knuckle with Remover 8677.

CAUTION: When installing Remover 8677 to separate the ball joint, be careful not to damage the ball joint seal.

(6) Remove the upper ball joint nut. Separate the ball joint from the knuckle with Remover 8677 (Fig. 17)

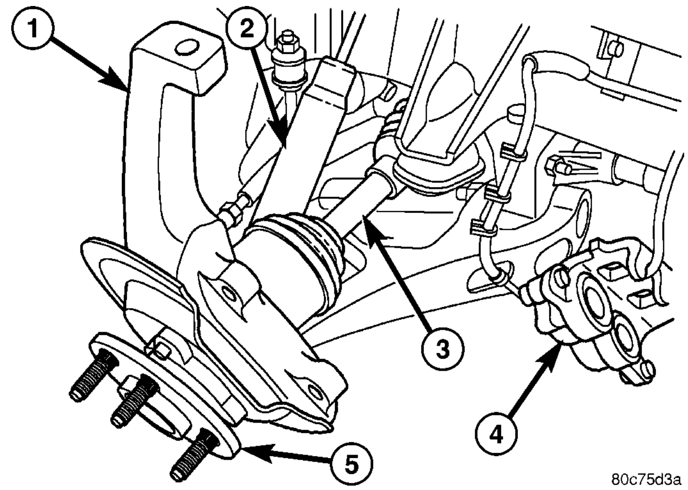


Fig. 17 STEERING KNUCKLE

1 - STEERING KNUCKLE
2 - SHOCK
3 - HALFSHAFT
4 - DISC BRAKE CALIPER
5 - HUB/BEARING

(7) Remove the lower ball joint nut. Separate the ball joint from the knuckle with Remover 8677 (Fig. 18) and remove the knuckle.

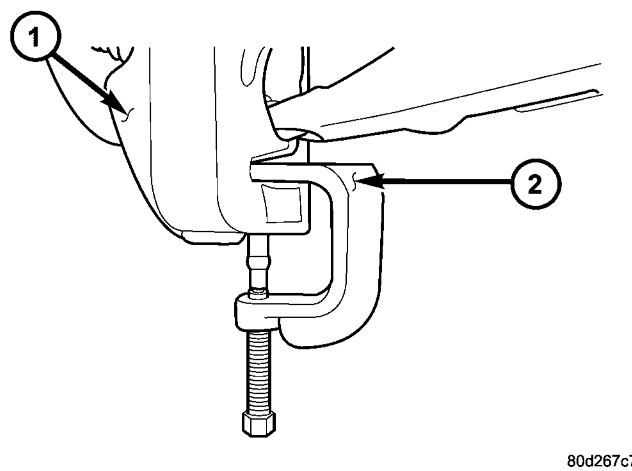


Fig. 18 LOWER BALL JOINT SEPARATION

1 - STEERING KNUCKLE
2 - SPECIAL TOOL 8677

KNUCKLE (Continued)

(8) Remove the hub/bearing from the steering knuckle (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).

INSTALLATION

CAUTION: The ball joint stud tapers must be CLEAN and DRY before installing the knuckle. Clean the stud tapers with mineral spirits to remove dirt and grease.

NOTE: When installing hub/bearing with ABS brakes, position the speed sensor opening towards the front of the vehicle.

(1) Install the hub/bearing to the steering knuckle and tighten the bolts to 163 N·m (120 ft. lbs.)(LD) or 176 N·m (130 ft. lbs.)(HD 4X2) (Fig. 19).

(2) Install the knuckle onto the upper and lower ball joints (Fig. 19).

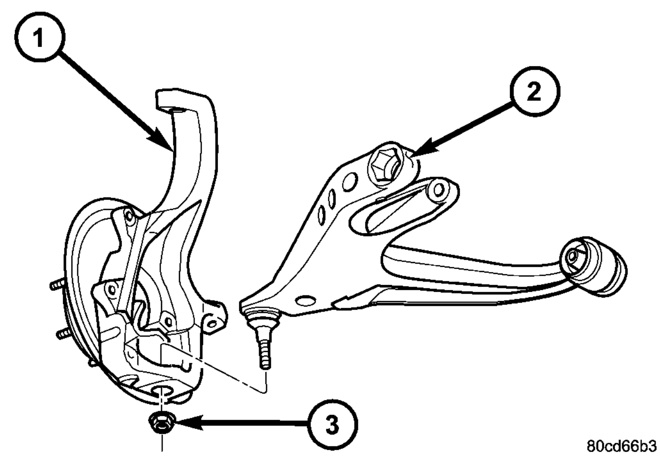


Fig. 19 STEERING KNUCKLE

1 - STEERING KNUCKLE
2 - LOWER CONTROL ARM
3 - LOWER BALL JOINT NUT

(3) Install the upper and lower ball joint nuts. Tighten the upper ball joint nut to 54 N·m (40 ft. lbs.) (on 1500 series only an additional 90° turn is required) and the lower ball joint nut to 52 N·m (38 ft. lbs.)(on 1500 series only an additional 90° turn is required)(LD) or 135 N·m (100 ft. lbs.)(HD 4X2).

(4) Remove the hydraulic jack from the lower suspension arm.

(5) Install the tie rod end and tighten the nut to 61 N·m (45 ft. lbs.).

(6) Install the front halfshaft into the hub/bearing (if equipped).

(7) Install the the halfshaft nut and tighten to 251 N·m (185 ft. lbs.) (if equipped).

(8) Install the ABS wheel speed sensor if equipped (Refer to 5 - BRAKES/ELECTRICAL/FRONT WHEEL SPEED SENSOR - INSTALLATION) and brake shield, rotor and caliper (Refer to 5 - BRAKES/HYDRAULIC/ MECHANICAL/ROTORS - INSTALLATION).

(9) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(10) Remove the support and lower the vehicle.

(11) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

LOWER BALL JOINT

DIAGNOSIS AND TESTING - LOWER BALL JOINT

NOTE: If the ball joint is equipped with a lubrication fitting, grease the joint then road test the vehicle before performing test.

(1) Raise the front of the vehicle. Place safety floor stands under both lower control arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.

(2) Mount a dial indicator solidly to the topside of the lower control arm and then zero the dial indicator.

(3) Position the indicator plunger against the bottom surface of the steering knuckle.

NOTE: The dial indicator plunger must be perpendicular to the machined surface of the steering knuckle.

(4) Position a pry bar under the tire assembly. Pry upwards on the tire assembly.

(5) If the travel exceeds 0.5 mm (0.020 in.), replace the lower ball joint (Refer to 2 - SUSPENSION/ FRONT/LOWER BALL JOINT - REMOVAL).

REMOVAL

(1) Remove the tire and wheel assembly.

(2) Remove the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(3) Disconnect the tie rod from the steering knuckle (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).

(4) Remove the steering knuckle (Fig. 20)(Refer to 2 - SUSPENSION/FRONT/KNUCKLE - REMOVAL).

(5) Move the halfshaft to the side and support the halfshaft out of the way (If Equipped).

(6) Remove the snap ring, from the lower control arm (HD 4X2 only)

LOWER BALL JOINT (Continued)

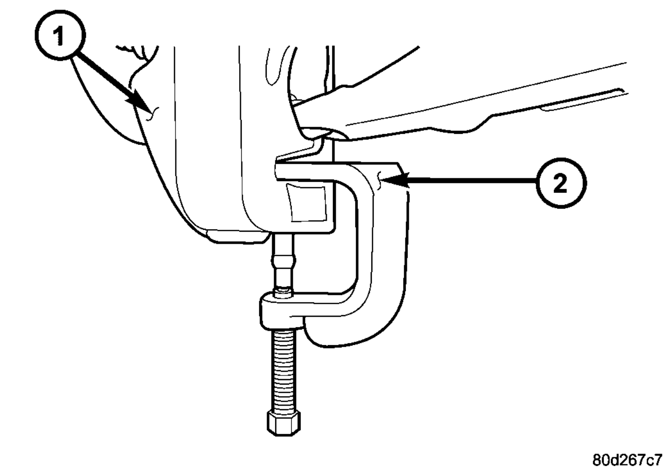


Fig. 20 LOWER BALL JOINT SEPARATION

1 - STEERING KNUCKLE
2 - SPECIAL TOOL 8677

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(7) Press the ball joint from the lower control arm using special tools C-4212–F (PRESS), 8698-2 (RECEIVER) and 8698-3 (DRIVER) (Fig. 21).

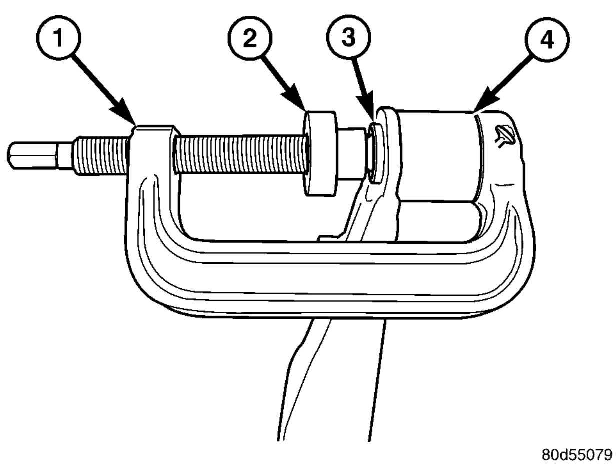


Fig. 21 REMOVAL LOWER BALL JOINT

1 - PRESS - C-4212-F
2 - DRIVER - 8698-3
3 - BALL JOINT
4 - RECEIVER - 8698-2

INSTALLATION

NOTE: Extreme pressure lubrication must be used on the threaded portions of the tool. This will increase the longevity of the tool and insure proper operation during the removal and installation process.

(1) Install the ball joint into the control arm and press in using special tools C-4212–F (press), 8698-1 (driver) and 8698-3 (receiver) (Fig. 22).

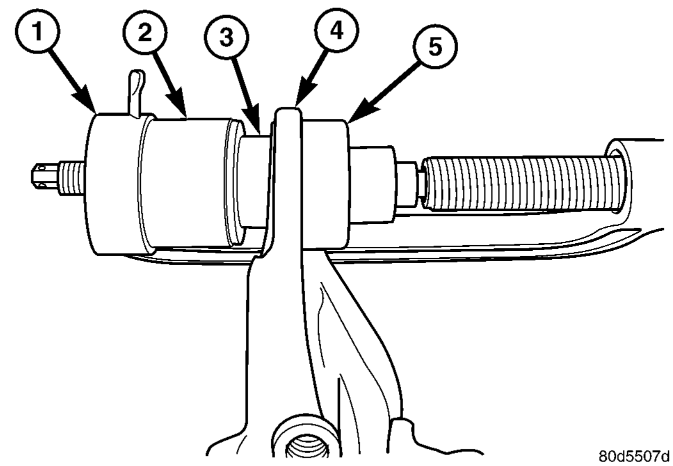


Fig. 22 INSTALL LOWER BALL JOINT

1 - PRESS - C-4212-F
2 - DRIVER - 8698-1
3 - BALL JOINT
4 - LOWER CONTROL ARM
5 - RECEIVER - 8698-3

(2) Install the ball joint boot.

(3) Stake the ball joint flange in four evenly spaced places around the ball joint flange, using a chisel and hammer (LD only).

(4) Replace the snap ring (HD 4X2 only)

(5) Remove the support for the halfshaft and install into position (If Equipped).

(6) Install the steering knuckle (Refer to 2 - SUSPENSION/FRONT/KNUCKLE - INSTALLATION).

(7) Install the tie rod end into the steering knuckle (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

(8) Install and tighten the halfshaft nut to 251 N·m (185 ft. lbs.). (If Equipped).

(9) Install the brake caliper and rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(10) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(11) Check the vehicle ride height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(12) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

LOWER CONTROL ARM

REMOVAL

REMOVAL - 4X4 (LD)

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the upper ball joint nut. Separate ball joint from the steering knuckle with Remover 8677.

(4) Remove the front halfshaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - REMOVAL).

(5) Remove the torsion bar, (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - REMOVAL).

(6) Remove the shock absorber lower bolt.

(7) Remove the stabilizer bar link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - REMOVAL).

(8) Remove the lower ball joint nut. Separate ball joint from the steering knuckle with Remover 8677.

(9) Remove the control arm pivot bolts and suspension arm from frame rail brackets (Fig. 23).

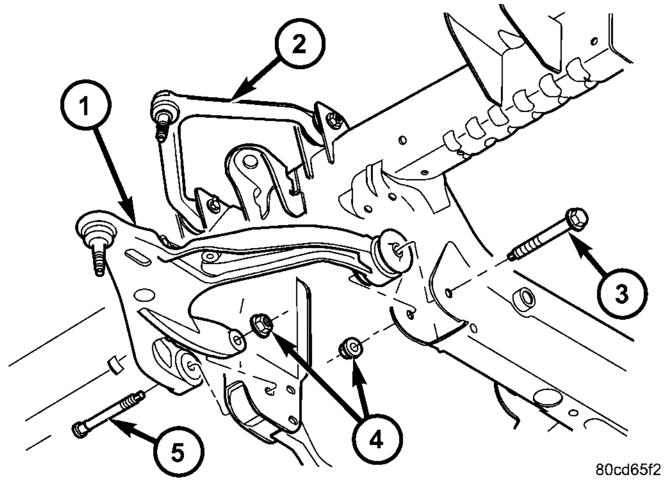


Fig. 23 LOWER CONTROL ARM

1 - LOWER CONTROL ARM
2 - UPPER CONTROL ARM
3 - FRONT BOLT
4 - NUTS
5 - REAR BOLT

REMOVAL - 4X2

(1) Raise and support the vehicle.

(2) Remove the tire and wheel assembly.

(3) Support the lower control arm at the outboard side of the lower control arm to support vehicle weight.

(4) Remove the shock (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(5) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring and shock hole in the frame. The bell-shaped adapter goes against the lower suspension arm. Install the nut on top of the tool at the shock hole.

(6) Tighten the spring compressor nut against bell-shaped adapter finger tight then loosen 1/2 turn.

NOTE: This will hold the spring in place until the lower suspension arm is separated from the steering knuckle.

(7) Remove the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - REMOVAL).

(8) Remove the lower ball joint nut at the steering knuckle.

(9) Install Ball Joint Remover tool 8677 on the lower ball joint and separate the ball joint from the knuckle.

NOTE: Do not allow the upper control arm and steering knuckle to rebound downwards they must be supported.

(10) Support the upper control arm and steering knuckle out of the way.

(11) Remove the lower control arm support.

(12) Tighten the spring compressor tool to allow clearance for the lower ball joint to be removed out of the knuckle.

(13) Loosen the tension on the spring compressor tool slowly allowing the lower suspension arm to pivot downward.

(14) Remove the spring compressor tool.

(15) Remove coil spring and isolator pad from the vehicle (Fig. 26).

(16) Remove the front and rear pivot bolts (Fig. 24).

(17) Remove the lower control arm.

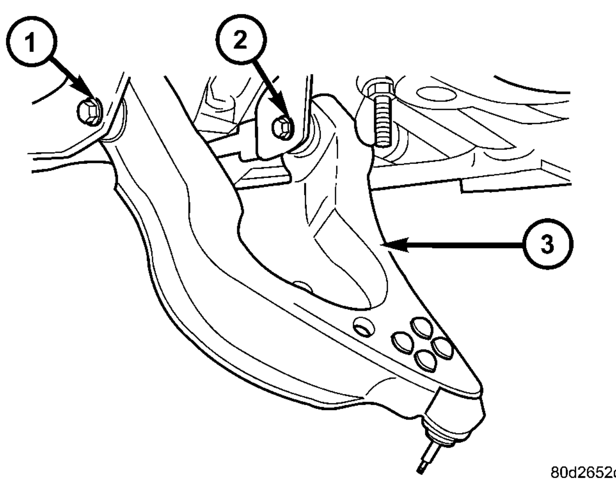


Fig. 24 LOWER CONTROL ARM - 4X2

1 - FRONT PIVOT BOLT
2 - REAR PIVOT BOLT
3 - LOWER CONTROL ARM

LOWER CONTROL ARM (Continued)

INSTALLATION

INSTALLATION - 4X4 (LD)

(1) Position the lower control arm at the frame rail brackets. Install the pivot bolts and nuts. Tighten the nuts finger-tight.

CAUTION: The ball joint stud taper must be CLEAN and DRY before installing the knuckle. Clean the stud taper with mineral spirits to remove dirt and grease.

(2) Insert the lower ball joint into the steering knuckle. Install and tighten the retaining nut to 52 N·m (38 ft. lbs.)(on 1500 series only an additional 90° turn is required).

(3) Install the torsion bar, (Refer to 2 - SUSPENSION/FRONT/TRACK BAR - INSTALLATION).

(4) Install shock absorber lower bolt and tighten to 135 N·m (100 ft. lbs.).

(5) Install the front halfshaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - INSTALLATION).

(6) Insert the upper ball joint into the steering knuckle. Install and tighten the retaining nut to 54 N·m (40 ft. lbs.)(on 1500 series only an additional 90° turn is required).

(7) Install the stabilizer bar link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - INSTALLATION).

(8) Tighten the lower control arm front pivot nut to 204 N·m (150 ft. lbs.). Tighten rear pivot bolt to 204 N·m (150 ft. lbs.).

(9) Install the wheel and tire assembly,(Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(10) Remove the support and lower the vehicle.

(11) Adjust the front suspension height and perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

INSTALLATION - 4X2

(1) Install the lower control arm into place on the vehicle.

(2) Install the front and rear control arm pivot bolts finger tight.

(3) Install the coil spring into the frame pocket(Refer to 2 - SUSPENSION/FRONT/SPRING - INSTALLATION).

(4) Install the Spring Compressor DD-1278 up through the lower suspension arm, coil spring and shock hole in the frame.

(5) Tighten the tool nut to compress the coil spring.

(6) Remove the support from the upper control arm and steering knuckle.

(7) Position the lower ball joint into the steering knuckle.

(8) Install the retaining nut on the lower ball joint and tighten to 52 N·m (38 ft. lbs.)(on 1500 series only an additional 90° turn is required) or 135 N·m (100 ft. lbs.)(HD 4X2 only).

(9) Support the lower control arm at the outboard side of the lower control arm to support vehicle weight.

(10) Remove the spring compressor tool.

(11) Install the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

(12) Install the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - INSTALLATION).

(13) Remove the lower control arm support.

(14) Install the wheel and tire assembly and lower the vehicle. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(15) Lower the vehicle to the floor with vehicle weight and Tighten the front and rear control arm pivot bolts to 204 N·m (150 ft. lbs.)(LD) or 285 N·m (210 ft. lbs.)(HD 4X2 only).

(16) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SPRING

REMOVAL

(1) Raise and support vehicle.

(2) Remove the front wheel and tire assembly.

(3) Support the lower control arm at the outboard side of the lower control arm to support vehicle weight.

(4) Remove the shock absorber (Refer to 2 - SUSPENSION/FRONT/SHOCK - REMOVAL).

(5) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring and shock hole in the frame. The bell-shaped adapter goes against the lower suspension arm. Install the nut on top of the tool at the shock hole (Fig. 25).

(6) Tighten the spring compressor nut against bell-shaped adapter finger tight then loosen 1/2 turn.

NOTE: This will hold the spring in place until the lower suspension arm is separated from the steering knuckle.

(7) Remove the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - REMOVAL).

(8) Remove the lower ball joint nut at the steering knuckle.

(9) Install Ball Joint Remover tool 8677 on the lower ball joint and separate the ball joint from the knuckle.

(10)

SPRING (Continued)

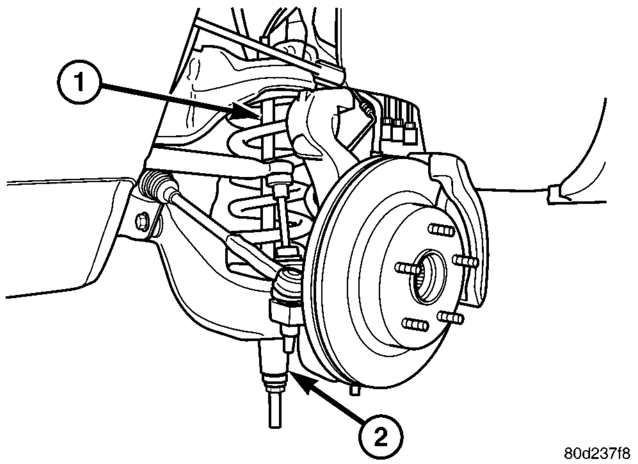


Fig. 25 SPRING COMPRESSOR TOOL

1 - SPECIAL TOOL DD-1278
2 - BELL-SHAPED ADAPTER

NOTE: Do not allow the upper control arm and steering knuckle to rebound downwards they must be supported.Support the upper control arm and steering knuckle out of the way.

(11) Remove the lower control arm support.

(12) Tighten the spring compressor tool to allow clearance for the lower ball joint to be removed out of the knuckle.

NOTE: It may necessary to loosen the control arm pivot bolt to allow downward swing.

(13) Loosen the tension on the spring compressor tool slowly allowing the lower suspension arm to pivot downward.

(14) Remove the spring compressor tool.

(15) Remove coil spring and isolator pad from the vehicle (Fig. 26).

INSTALLATION

(1) Tape the isolator pad to the top of the coil spring. Position the spring in the lower suspension arm well. Be sure that the coil spring is seated in the well.

(2) Install Spring Compressor DD-1278 up through the lower suspension arm, coil spring and shock hole in the frame.

(3) Tighten the tool nut to compress the coil spring.

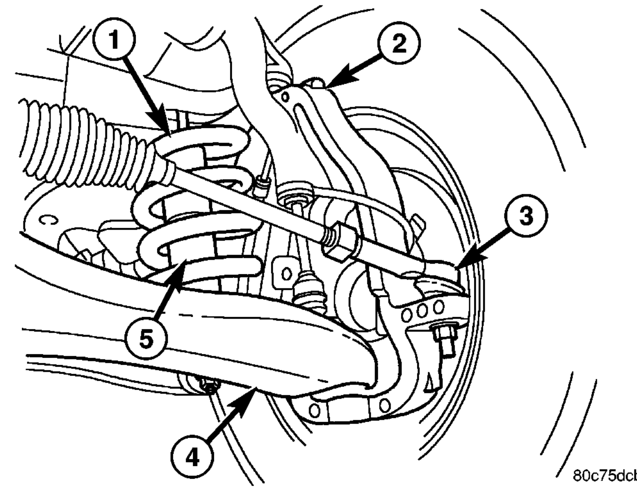


Fig. 26 COIL SPRING

1 - COIL SPRING
2 - STEERING KNUCKLE
3 - OUTER TIE ROD END
4 - LOWER CONTROL ARM
5 - SHOCK

(4) Remove the support from the upper control arm and steering knuckle.

(5) Position the lower ball joint into the steering knuckle.

(6) Install the retaining nut on the lower ball joint and tighten to 52 N·m (38 ft. lbs.)(on 1500 series only an additional 90° turn is required) or 135 N·m (100 ft. lbs.)(HD 4X2 only).

(7) Remove the spring compressor tool.

(8) Support the lower control arm at the outboard side of the lower control arm to support vehicle weight.

(9) Install the shock absorber. (Refer to 2 - SUSPENSION/FRONT/SHOCK - INSTALLATION).

(10) Install the stabilizer link (Refer to 2 - SUSPENSION/FRONT/STABILIZER LINK - INSTALLATION).

(11) Remove the lower control arm support.

(12) Install the wheel and tire assembly and lower the vehicle. (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(13) Lower the vehicle to the floor with vehicle weight and Tighten the front and rear control arm pivot bolts if loosened to 204 N·m (150 ft. lbs.)(LD) or 285 N·m (210 ft. lbs.)(HD 4X2 only).

(14) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

SHOCK

DIAGNOSIS AND TESTING - SHOCK

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

The shock absorber bushings do not require any type of lubrication. Do not attempt to stop bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing.

REMOVAL

REMOVAL - 4X2

(1) Raise and support vehicle.

(2) Support the lower control arm outboard end.

(3) Remove the upper shock absorber nut, retainer and grommet.

(4) Remove the lower nuts and remove the shock absorber.

REMOVAL - 4X4

(1) Raise and support the vehicle.

(2) Remove the tire and wheel assembly.

(3) Support the lower control arm outboard end.

(4) Remove the upper shock nut and with the insulator and retainer (Fig. 27).

(5) Remove the lower shock bolt (Fig. 27).

(6) Remove the shock

INSTALLATION

INSTALLATION - 4X2

NOTE: Upper shock nut must be replaced or use Mopar Lock 'N Seal or Loctite® 242 on existing nut.

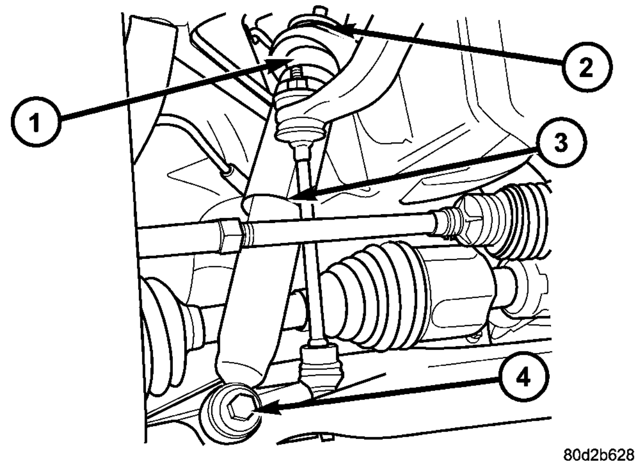


Fig. 27 SHOCK 4X4

1 - INSULATOR & RETAINER
2 - NUT
3 - SHOCK ABSORBER
4 - BOLT

(1) Install the lower retainer and grommet on the shock absorber stud. Insert the shock absorber through the frame bracket hole.

(2) Install the lower nuts and tighten the nuts to 34 N·m (25 ft. lbs.).

(3) Install the upper grommet, retainer and new nut or use Mopar Lock 'N Seal or Loctite® 242 on existing nut, on the shock absorber stud. Tighten nut to 54 N·m (40 ft. lbs.).

(4) Remove the support from the lower control arm outboard end.

(5) Lower the vehicle.

INSTALLATION - 4X4

(1) Install the upper part of the shock into the frame bracket with the insulators and retainers (Fig. 27).

(2) Install the nut and Tighten to 54 N·m (40 ft. lbs.).

(3) Install the lower part of the shock into the lower control arm and Tighten the bolt to 135 N·m (100 ft. lbs.) (Fig. 27).

(4) Remove the support from the lower control arm outboard end.

(5) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(6) Remove the support and lower the vehicle.

STABILIZER BAR

DESCRIPTION

The bar extends across the front underside of the chassis and connects to the frame crossmember. The ends of the bar mount to the lower suspension arm. All mounting points of the stabilizer bar are isolated by bushings (Fig. 28).

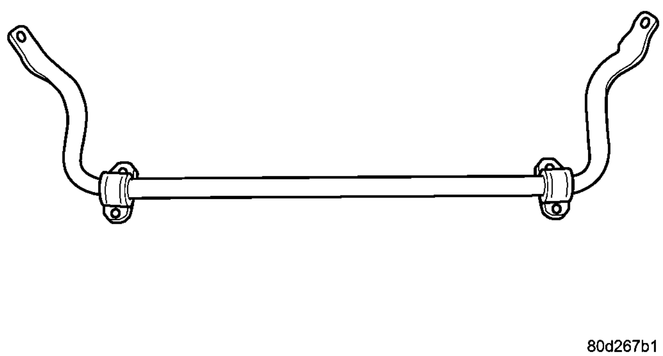


Fig. 28 STABILIZER BAR

OPERATION

The stabilizer bar is used to minimize vehicle front sway during turns. The bar helps to maintain a flat attitude to the road surface.

REMOVAL

NOTE: To service the stabilizer bar the vehicle should be on a drive on hoist. The vehicle suspension must be at curb height for stabilizer bar installation.

(1) Remove the stabilizer bar link upper nuts and remove the retainers and grommets (Fig. 29).
(2) Remove the stabilizer bar retainer, bolts and retainers from the frame crossmember (Fig. 29) and remove the bar.
(3) If necessary, remove the bushings from the stabilizer bar.

INSTALLATION

NOTE: To service the stabilizer bar the vehicle must be on a drive on hoist. The vehicle suspension must be at curb height for stabilizer bar installation.

(1) If removed, install the bushings on the stabilizer bar.
(2) Position the stabilizer bar on the frame crossmember brackets and install the bracket and bolts finger-tight (Fig. 29).

NOTE: Check the alignment of the bar to ensure there is no interference with the either frame rail or chassis component. Spacing should be equal on both sides.

(3) Install the stabilizer bar to the stabilizer link and install the grommets and retainers.
(4) Install the nuts to the stabilizer link and tighten to 38 N·m (27 ft. lbs.).
(5) Tighten the brackets to the frame to 61 N·m (45 ft. lbs.).

STABILIZER LINK

REMOVAL

REMOVAL - 4X4

(1) Raise and support the vehicle.
(2) Remove the lower nut (Fig. 29).
(3) Remove the upper nut, retainers and grommets (Fig. 29).
(4) Remove the stabilizer link from the vehicle (Fig. 29).

REMOVAL - 4X2

(1) Raise and support the vehicle.
(2) Remove the lower nut (Fig. 29).
(3) Remove the upper nut, retainer and grommets (Fig. 29).
(4) Remove the stabilizer link from the vehicle (Fig. 29).

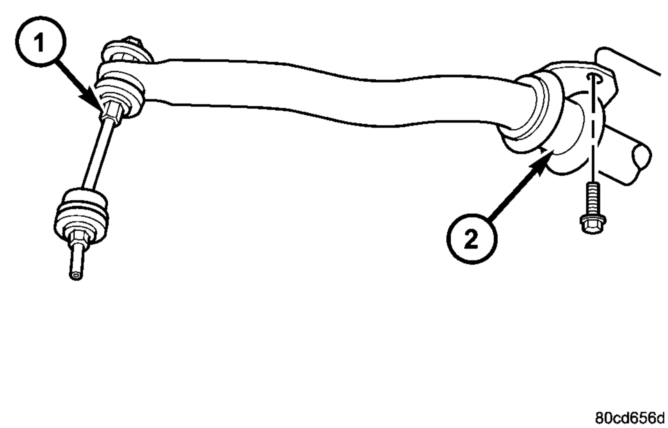


Fig. 29 STABILIZER LINK

1 - STABILIZER LINK
2 - SWAY BAR BRACKET

STABILIZER LINK (Continued)

INSTALLATION

INSTALLATION - 4X4

(1) Install the stabilizer link to the vehicle.
(2) Install the lower nut and Tighten to 102 N·m (75 ft. lbs.).
(3) Install the retainers, grommets and upper nut and Tighten to 38 N·m (27 ft. lbs.).
(4) Remove the support and lower the vehicle.

INSTALLATION - 4X2

(1) Install the stabilizer link to the vehicle (Fig. 29).
(2) Install the lower nut and Tighten to 102 N·m (75 ft. lbs.).
(3) Install the retainers, grommets and upper nut and Tighten to 38 N·m (27 ft. lbs.).
(4) Remove the support and lower the vehicle.

TORSION BAR

DESCRIPTION

The front of the bar connects to the back side of the lower suspension arm. The rear end of the bar is mounted in a anchor that rests in the frame cross-member.

OPERATION

The torsion bars are used to control ride height and ride quality. The vehicle height is adjusted through an anchor adjustment bolt that increases or decreases the wind up of the torsion bar. Increasing or decreasing the bar angle changes the wind up of the suspension arms.

REMOVAL

CAUTION: The left and right side torsion bars are NOT interchangeable. The bars are identified and stamped R or L, for right or left. The bars do not have a front or rear end and can be installed with either end facing forward.

(1) Raise and support the vehicle with the front suspension hanging.
(2) Remove the transfer case skid plate (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL).

NOTE: Count and record the number of turns for installation reference.

(3) Mark the adjustment bolt setting.
(4) Install Special Tool - 8686 to the anchor arm and the cross member (Fig. 30).
(5) Increase the tension on the anchor arm tool until the load is removed from the adjustment bolt and the adjuster nut (Fig. 30).
(6) Turn the adjustment bolt counterclockwise to remove the bolt and the adjuster nut..
(7) Remove the Special Tool - 8686, allowing the torsion bar to unload (Fig. 30).

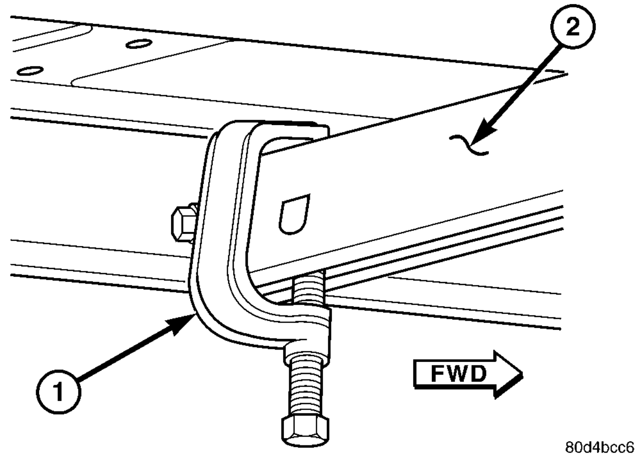


Fig. 30 LOADING/UNLOADING TORSION BAR

1 - SPECIAL TOOL – 8686
2 - CROSSMEMBER

(8) Remove torsion bar and anchor. Remove anchor from torsion bar (Fig. 31).
(9) Remove all foreign material from torsion bar mounting in anchor and suspension arm.
(10) Inspect adjustment bolt, bearing and swivel for damage.

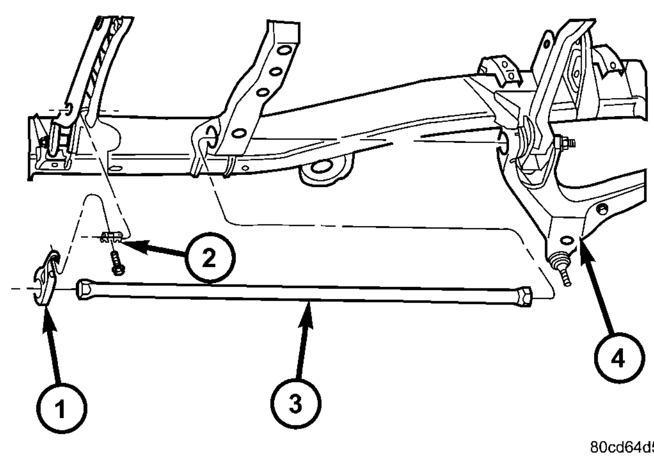


Fig. 31 TORSION BAR

1 - ANCHOR
2 - SWIVEL
3 - TORSION BAR
4 - LOWER CONTROL ARM

TORSION BAR (Continued)

INSTALLATION

CAUTION: The left and right side torsion bars are NOT interchangeable. The bars are identified and stamped R or L, for right or left. The bars do not have a front or rear end and can be installed with either end facing forward.

(1) Insert torsion bar ends into anchor and suspension arm.

(2) Position the anchor in the frame crossmember.

(3) Install Special Tool - 8686 to the anchor and the crossmember (Fig. 30).

(4) Increase the tension on the anchor in order to load the torsion bar.

(5) Install the adjustment bolt and the adjuster nut.

(6) Turn adjustment bolt clockwise the recorded amount of turns.

(7) Remove tool - 8686 from the torsion bar crossmember (Fig. 30).

(8) Install the transfer case skid plate (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION).

(9) Lower vehicle and adjust the front suspension height (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(10) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

UPPER BALL JOINT

DIAGNOSIS AND TESTING - UPPER BALL JOINT

NOTE: If the ball joint is equipped with a lubrication fitting, grease the joint then road test the vehicle before performing test.

(1) Raise the front of the vehicle. Place safety floor stands under both lower control arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.

(2) Remove the front tires.

(3) Mount a dial indicator solidly to the frame and then zero the dial indicator.

(4) Position dial indicator plunger on the topside of the upper ball joint (Fig. 32).

NOTE: The dial indicator plunger must be perpendicular to the machined surface of the ball joint (Fig. 32).

NOTE: Use care not to pry or tear the ball joint boot, when checking the free play.

(5) Position a pry bar between the steering knuckle and the upper control arm. Pry upwards on the upper control arm (Fig. 32).

(6) If the travel exceeds 0.5 mm (0.020 in.), replace the upper control arm since the upper ball joint is integral to the arm (Refer to 2 - SUSPENSION/FRONT/UPPER CONTROL ARM - REMOVAL).

(7) If the upper ball joint is within specs reinstall the front tires (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

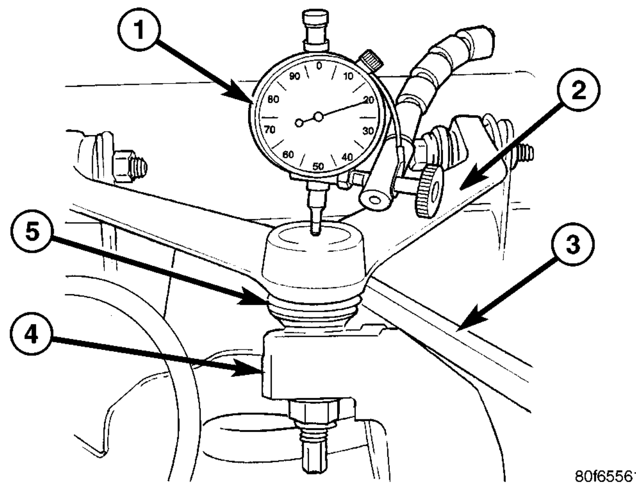


Fig. 32 UPPER BALL JOINT PLAY

1 - DIAL INDICATOR
2 - UPPER CONTROL ARM
3 - PRY BAR
4 - KNUCKLE
5 - BALL JOINT BOOT

UPPER CONTROL ARM

REMOVAL

(1) Raise and support vehicle.
(2) Remove wheel and tire assembly.
(3) Remove the nut from upper ball joint.
(4) Separate upper ball joint from the steering knuckle with Remover 8677 (Fig. 33)

CAUTION: When installing Remover 8677 to separate the ball joint, be careful not to damage the ball joint seal.

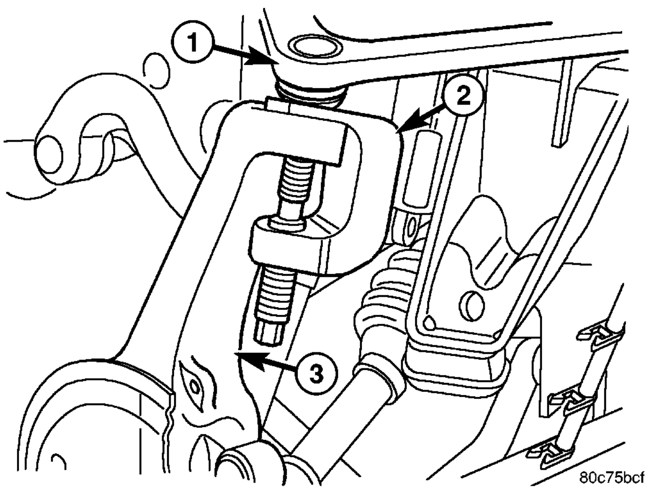


Fig. 33 UPPER BALL JOINT SEPARATION

1 - UPPER CONTROL ARM
2 - REMOVER
3 - STEERING KNUCKLE

(5) Remove the control arm pivot bolts and remove control arm (Fig. 34).

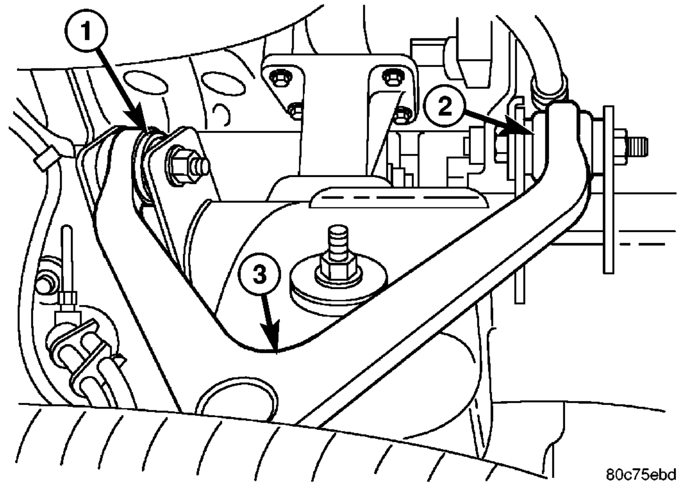


Fig. 34 UPPER CONTROL ARM

1 - REAR PIVOT BOLT
2 - FRONT PIVOT BOLT
3 - UPPER CONTROL ARM

INSTALLATION

(1) Position the control arm into the frame brackets. Install bolts and tighten to 132 N·m (97 ft. lbs.)(LD) or 170 N·m (125 ft. lbs.)(HD 4X2 only).
(2) Insert the ball joint in steering knuckle and tighten the upper ball joint nut to 54 N·m (40 ft. lbs.)(on 1500 series only an additional 90° turn is required).
(3) Install the wheel and tire assembly,(Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(4) Remove the support and lower vehicle.
(5) Perform a wheel alignment, (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

FRONT - LINK/COIL

TABLE OF CONTENTS

FRONT - LINK/COIL

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Upper Nut	54	40	—
Shock Absorber Lower Bolt	121	89	—
Lower Suspension Arm Frame Nuts	217	160	—
Lower Suspension Arm Axle Nut	217	160	—
Upper Suspension Arm Frame Nuts	149	110	—
Upper Suspension Arm Axle Nut	149	110	—
Stabilizer Bar Frame Bolt	61	45	—
Stabilizer Link Lower Control Arm Nut	102	75	—

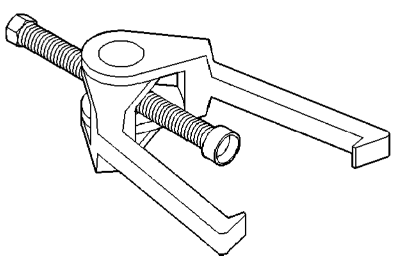
FRONT - LINK/COIL (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Stabilizer Link Stabilizer Bar Nut	38	27	—
Hub/Bearing Bolts	202	149	—
Axle Nut	179 Beginning Torque, Then Rotate 5 to 10 Times With a Final Torque of 356	132 Beginning Torque, Then Rotate 5 to 10 Times With a Final Torque of 263	—
Tie Rod End Nut	75	55	—

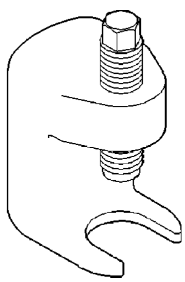
NOTE: Suspension components with rubber/urethane bushings should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

SPECIAL TOOLS

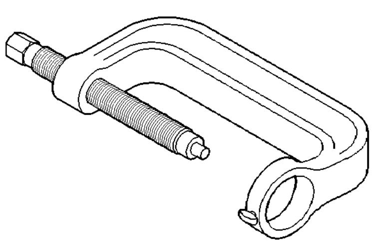
9 1/4 AA



Puller C-3894–A

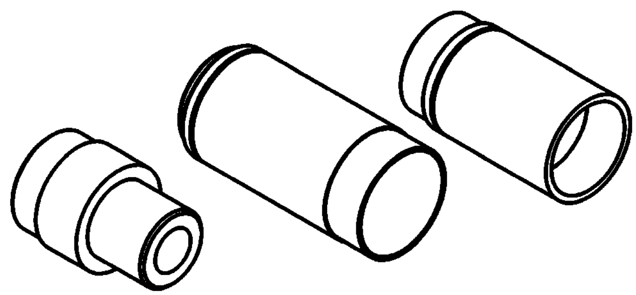


Remover, Wheel Stud C-4150A

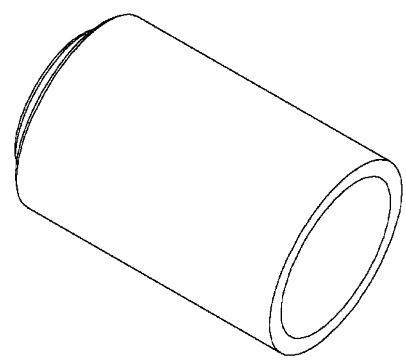


c-4212f-8C11d4af

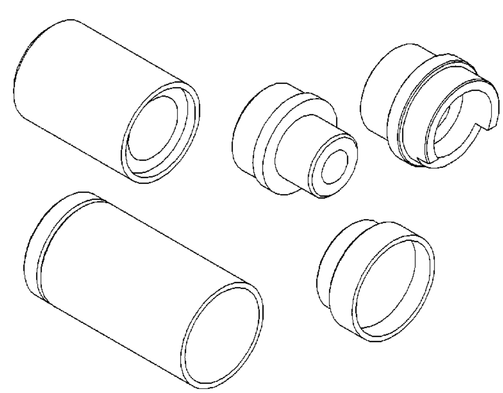
BALL JOINT PRESS - C-4212F



REMOVER / INSTALLER BALLJOINT - 8445



RECEIVER CUP - 6761



BALLJOINT RECIEVER/INSTALLER KIT- 8975

HUB / BEARING

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the hub extension mounting nuts and remove the extension from the rotor if equipped (Fig. 1).

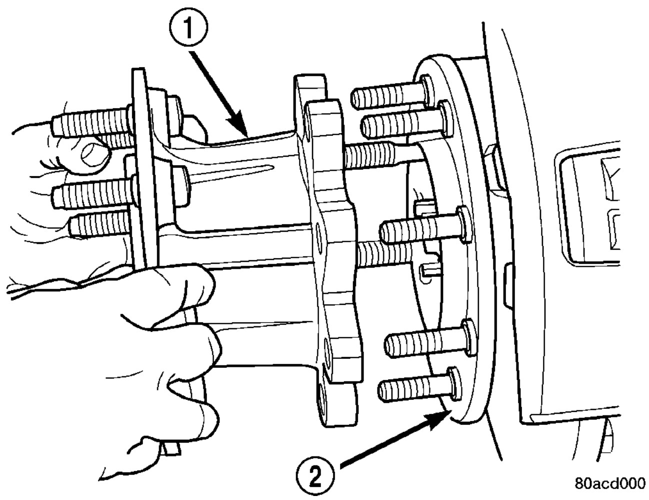


Fig. 1 Hub Extension

1 - HUB EXTENSION
2 - HUB

(4) Remove the brake caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(5) Remove the cotter pin and the hub nut from the axle shaft (Fig. 2).

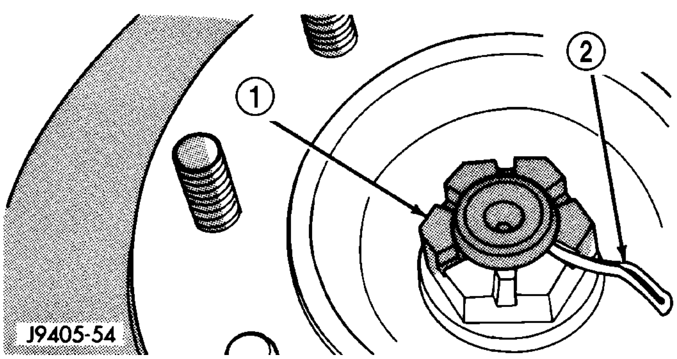


Fig. 2 Hub Nut Cotter Pin

1 - HUB NUT
2 - COTTER PIN

(6) Disconnect the ABS wheel speed sensor wire from under the hood. Remove the sensor wire from the frame and steering knuckle if equipped.

(7) Back off the hub/bearing mounting bolts 1/4 inch each (Fig. 3). Then tap the bolts with a hammer to loosen the hub/bearing from the steering knuckle.

(8) Remove the hub/bearing mounting bolts and remove the hub/bearing.

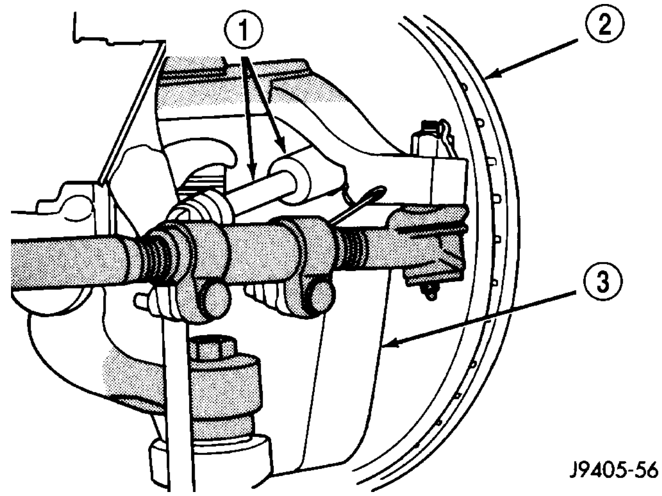


Fig. 3 Hub/Bearing Mounting Bolts

1 - SOCKET AND EXTENSION
2 - ROTOR AND HUB
3 - STEERING KNUCKLE

(9) Remove the rotor assembly (Fig. 4), brake shield and spacer from the steering knuckle.

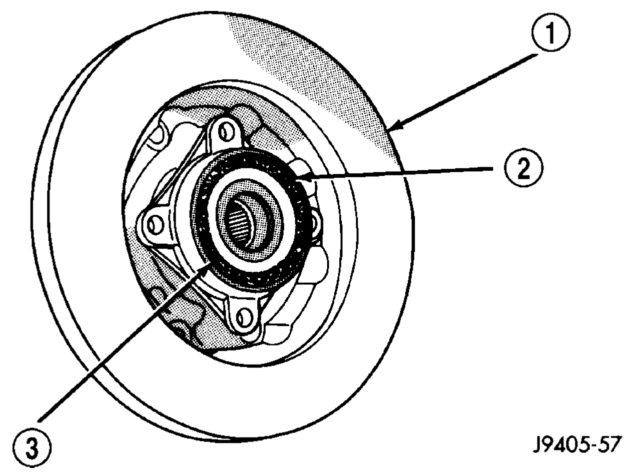


Fig. 4 Rotor Hub/Bearing Assembly

1 - ROTOR AND HUB
2 - UNIT BEARING ASSEMBLY
3 - SEAL

(10) Press out the wheel studs/hub extension studs and separate the rotor from the hub (Fig. 5).

(11) Remove the wheel speed sensor (Fig. 6) from the hub bearing if equipped.

HUB / BEARING (Continued)

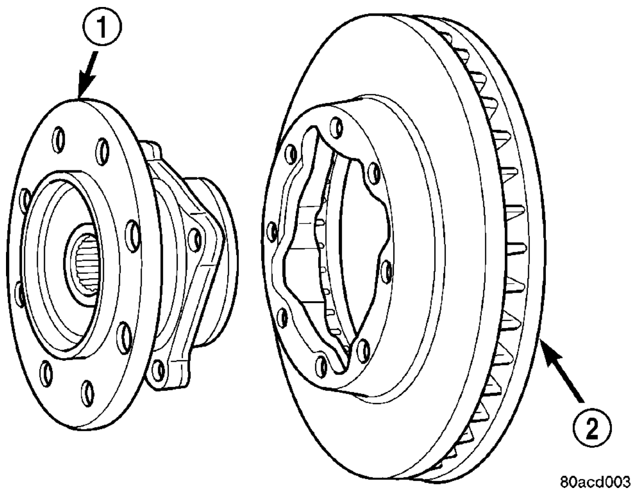


Fig. 5 ROTOR AND HUB/BEARING

1 - HUB BEARING
2 - ROTOR

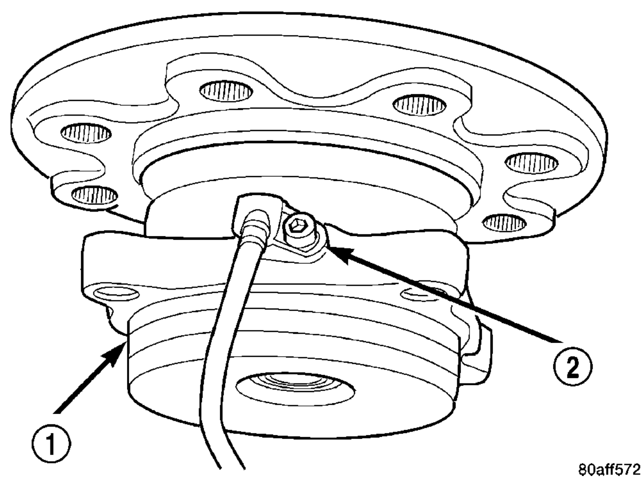


Fig. 6 Wheel Speed Sensor

1 - HUB BEARING
2 - WHEEL SPEED SENSOR

INSTALLATION

(1) Install the wheel speed sensor in the hub bearing if equipped.

(2) Position the rotor on the hub/bearing.

(3) Press the wheel studs/hub extension studs through the back side of the rotor and through the hub bearing flange (Fig. 7).

(4) Apply a liberal quantity of anti-seize compound to the splines of the front drive shaft.

(5) Insert the two rearmost, top and bottom rotor hub bolts in the steering knuckle. Insert the bolts through the back side of the knuckle so they extend out the front face as shown.

(6) Position the hub spacer (Fig. 8) and brake shield (Fig. 9) on bolts just installed in knuckle.

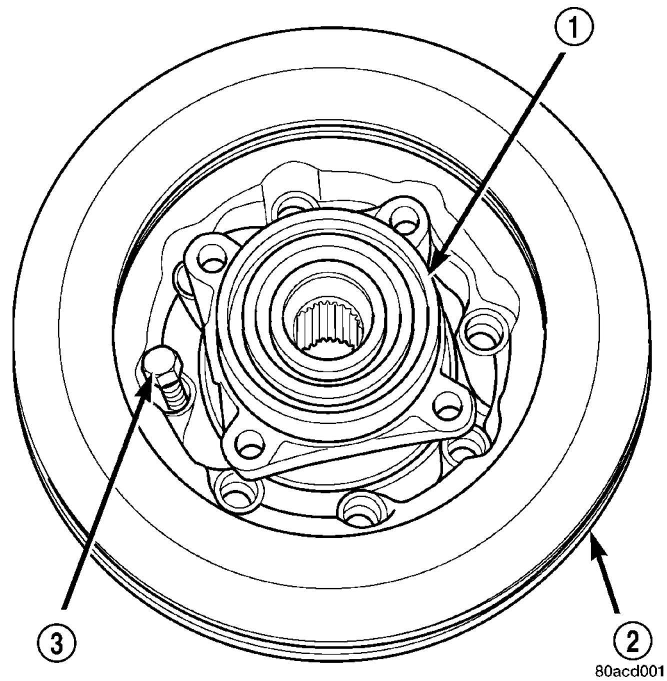


Fig. 7 Rotor, Hub/Bearing And Stud

1 - HUB BEARING
2 - ROTOR
3 - STUD

NOTE: If the vehicle is equipped with a wheel speed sensor the brake shield must be positioned on the hub bearing (Fig. 10).

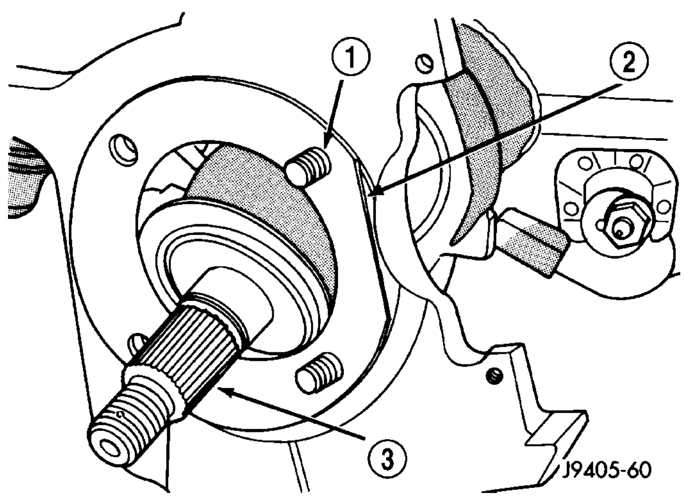


Fig. 8 Hub Spacer

1 - ROTOR HUB BOLTS
2 - HUB SPACER (POSITION FLAT TO REAR)
3 - APPLY ANTI-SEIZE COMPOUND TO SPLINES

(7) Align the rotor hub with the drive shaft and start the shaft into the rotor hub splines.

NOTE: Position wheel speed sensor wire at the top of the knuckle if equipped.

HUB / BEARING (Continued)

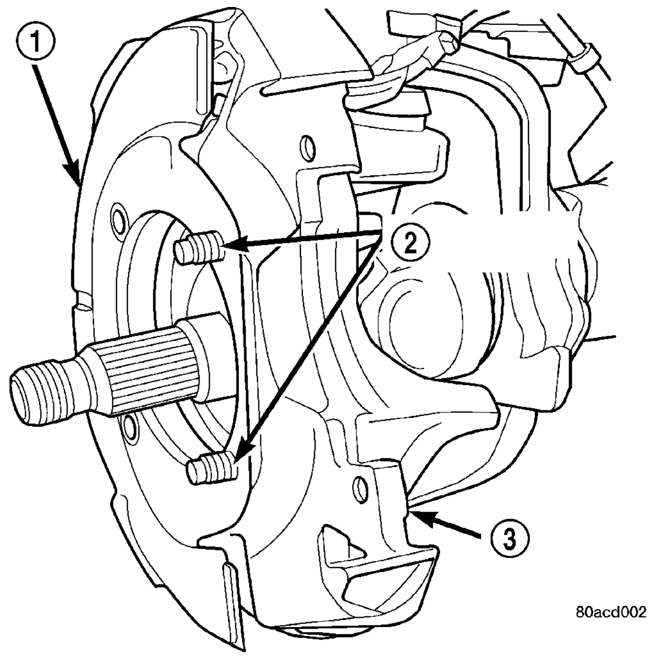


Fig. 9 Brake Shield

1 - BRAKE SHIELD
2 - HUB BEARING BOLTS
3 - STEERING KNUCKLE

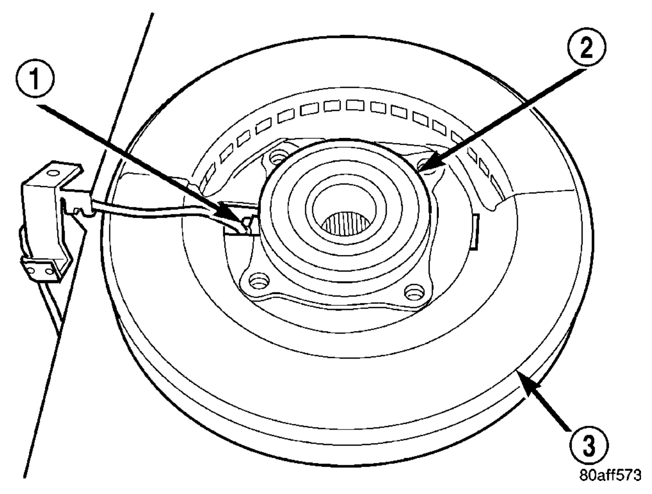


Fig. 10 Brake Shield With Wheel Speed Sensor

1 - WHEEL SPEED SENSOR
2 - HUB BEARING
3 - SHIELD

(8) Align the bolt holes in the hub bearing flange with the bolts installed in the knuckle. Then thread the bolts into the bearing flange far enough to hold the assembly in place.

(9) Install the remaining bolts. Tighten the hub/bearing bolts to 202 N·m (149 ft. lbs.

(10) Install the washer and axle nut and tighten a beginning torque of 179 N·m (132 ft. lbs.).

(11) Rotate the axle 5 to 10 times to seat the hub bearing.

(12) Tighten to a final torque of 356 N·m (263 ft. lbs.).

(13) Align the axle nut to the next forward cotter pin hole and install a new cotter pin in the axle nut.

(14) Install the brake caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(15) Install the sensor wire to the steering knuckle and frame and if equipped. Connect the wheel speed sensor wire under the hood.

(16) Install the wheel and tire assemblies, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(17) Remove the support and lower the vehicle.

(18) Apply the brakes several times to seat the brake shoes and caliper piston. Do not move the vehicle until a firm brake pedal is obtained.

LOWER BALL JOINT

REMOVAL

(1) Remove lower snap ring from the lower ball joint (Fig. 11).

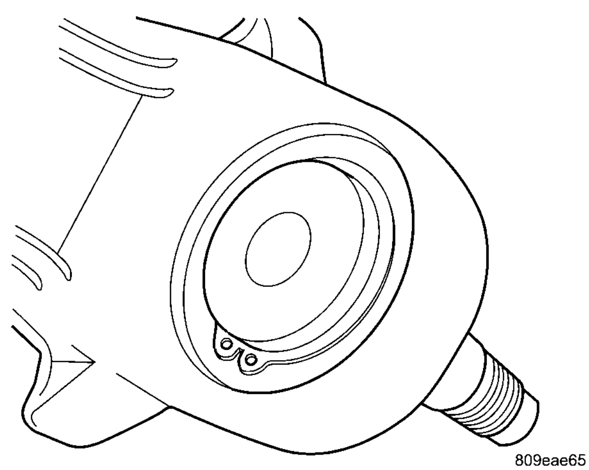


Fig. 11 LOWER SNAP RING

(2) Position special tool 8975–2 (RECEIVER) and 8975–4 (DRIVER) with tool C4212–F as shown to remove lower ball stud (Fig. 12).

LOWER BALL JOINT (Continued)

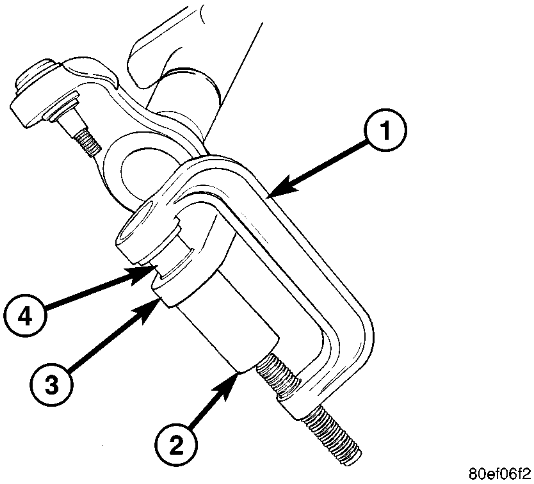


Fig. 12 LOWER BALL JOINT REMOVAL

1 - SPECIAL TOOL C4212-F
2 - SPECIAL TOOL 8975-2
3 - KNUCKLE
4 - SPECIAL TOOL 8975-4

INSTALLATION

(1) Position special tool 8975–1 (DRIVER) and 8975–3 (RECEIVER) with C4212–F as shown to install lower ball stud (Fig. 13).

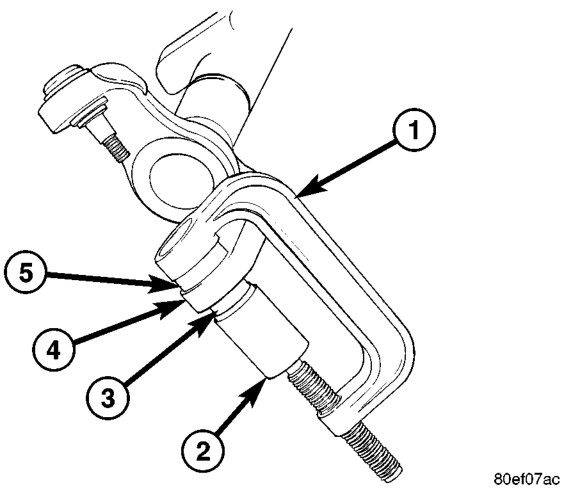


Fig. 13 LOWER BALL JOINT INSTALLATION

1 - SPECIAL TOOL C4212-F
2 - SPECIAL TOOL 8975-1
3 - BALL JOINT
4 - KNUCKLE
5 - SPECIAL TOOL 8975-3

UPPER BALL JOINT

REMOVAL

(1) Position special tool 6761 (RECEIVER) and 8445–3 (DRIVER) with C-4212–F as shown to remove upper ball stud (Fig. 14).

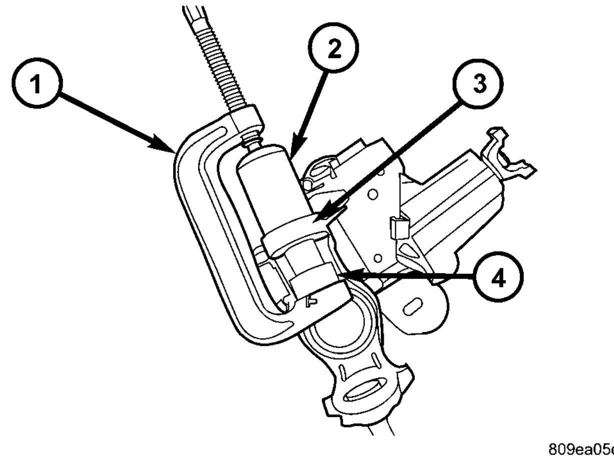


Fig. 14 UPPER BALL JOINT REMOVAL

1 - SPECIAL TOOL C4212-F
2 - SPECIAL TOOL 6761
3 - KNUCKLE
4 - SPECIAL TOOL 8445-3

INSTALLATION

(1) Position special tool 8445–2 (DRIVER) and 8975–5 (RECEIVER) with C-42121–F as shown to install upper ball stud (Fig. 15).

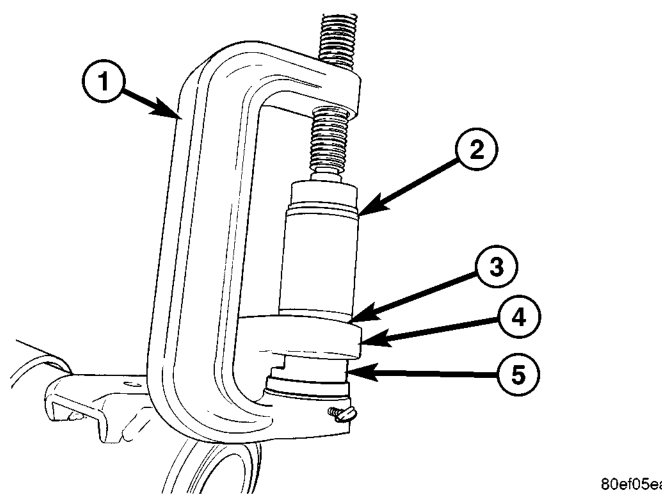


Fig. 15 UPPER BALL JOINT INSTALLATION

1 - SPECIAL TOOL C4212-F
2 - SPECIAL TOOL 8445-2
3 - BALL JOINT
4 - KNUCKLE
5 - SPECIAL TOOL 8975-5

KNUCKLE

REMOVAL

(1) Remove the hub bearing (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - REMOVAL).
(2) Remove tie-rod or drag link end from the steering knuckle arm.
(3) Remove the ABS sensor wire and bracket from knuckle. Refer to Brakes, for proper procedures.
(4) Remove the cotter pin from the upper ball stud nut. Remove the upper and lower ball stud nuts.
(5) Strike the steering knuckle with a brass hammer to loosen.
(6) Remove knuckle from axle tube yokes.

INSTALLATION

(1) Position the steering knuckle on the ball studs.
(2) Install and tighten lower ball stud nut to 47 N·m (35 ft. lbs.) torque. Do not install cotter pin at this time.
(3) Install and tighten upper ball stud nut to 94 N·m (70 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.
(4) Retorque lower ball stud nut to 190–217 N·m (140–160 ft. lbs.) torque. Advance nut to next slot to line up hole and install new cotter pin.
(5) Install the hub bearing (Refer to 2 - SUSPENSION/FRONT/HUB / BEARING - INSTALLATION).
(6) Install tie-rod or drag link end onto the steering knuckle arm.
(7) Install the ABS sensor wire and bracket to the knuckle. Refer to Brakes, for proper procedure.

UPPER SUSPENSION ARM

REMOVAL

REMOVAL - LEFT

(1) Raise and support the vehicle.
(2) Remove the upper suspension arm nut and bolt at the axle bracket (Fig. 16).
(3) Remove the nut and bolt at the frame rail and remove the upper suspension arm.

REMOVAL - RIGHT

(1) Raise and support the vehicle.
(2) Disconnect the exhaust system at the manifolds.
(3) Disconnect the rubber exhaust mounts at the muffler.
(4) Support the transmission.
(5) Remove the transmission cross member.
(6) Lower the exhaust system down in order to gain access to the removal of the upper bolt.

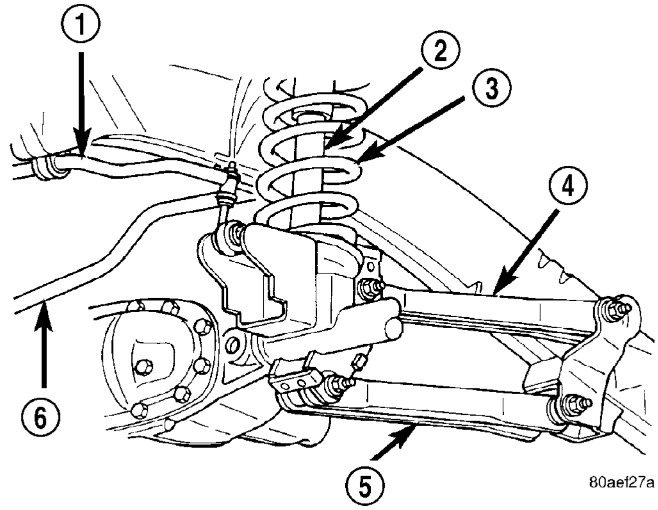


Fig. 16 Link/Coil Suspension

1 - STABILIZER BAR
2 - SHOCK ABSORBER
3 - COIL SPRING
4 - UPPER SUSPENSION ARM
5 - LOWER SUSPENSION ARM
6 - TRACK BAR

(7) Remove the nut and bolt at the frame rail and remove the upper suspension arm.
(8) Remove the upper suspension arm nut and bolt at the axle bracket.
(9) Remove the suspension arm from the vehicle.

INSTALLATION

INSTALLATION - LEFT

(1) Position the upper suspension arm at the axle and frame rail.
(2) Install the bolts and finger tighten the nuts.
(3) Remove the supports and lower the vehicle.
(4) Tighten nut at the axle bracket to 163 N·m (120 ft. lbs.). Tighten nut at frame bracket to 163 N·m (120 ft. lbs.).

INSTALLATION - RIGHT

(1) Position the upper suspension arm at the axle and frame rail.
(2) Install the bolts, then finger tighten the nuts.
(3) Reconnect the rubber exhaust mounts at the muffler.
(4) Reconnect the exhaust at the manifolds.
(5) Install the transmission crossmember.
(6) Remove the supports and lower the vehicle.
(7) Tighten nut at the axle bracket to 163 N·m (120 ft. lbs.). Tighten nut at frame bracket to 163 N·m (120 ft. lbs.).

LOWER SUSPENSION ARM

REMOVAL

(1) Raise and support the vehicle.

(2) Paint or scribe alignment marks on the cam adjusters and suspension arm for installation reference (Fig. 17).

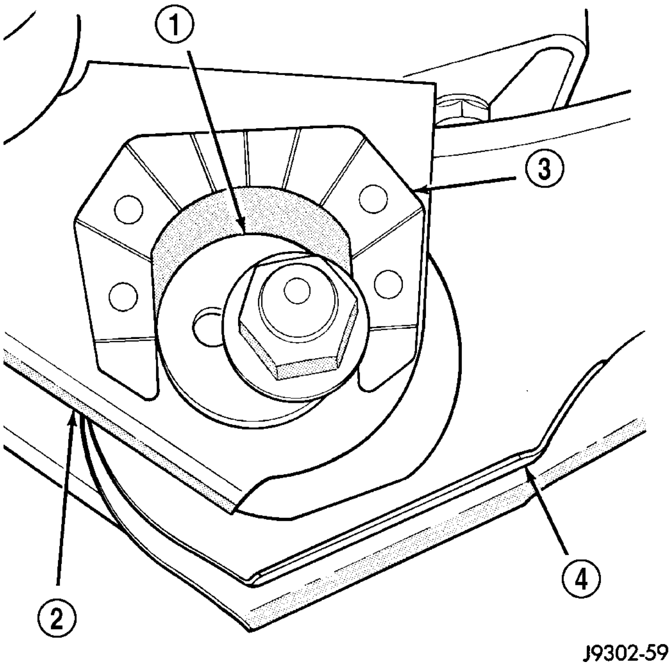


Fig. 17 Adjustment Cam

1 - ADJUSTMENT CAM
2 - AXLE BRACKET
3 - BRACKET REINFORCEMENT
4 - LOWER SUSPENSION ARM

(3) Remove the lower suspension arm nut, cam and cam bolt from the axle.

(4) Remove the nut and bolt from the frame rail bracket and remove the lower suspension arm (Fig. 17).

INSTALLATION

(1) Position the lower suspension arm at the axle bracket and frame rail bracket.

(2) Install the rear bolt and finger tighten the nut.

(3) Install the cam bolt, cam and nut in the axle and align the reference marks.

(4) Remove support and lower the vehicle.

(5) Tighten cam nut at the axle bracket to 217 N·m (160 ft. lbs.). Tighten rear nut at the frame bracket to 217 N·m (160 ft. lbs.).

SHOCK

DIAGNOSIS AND TESTING - SHOCK

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

The shock absorber bushings do not require any type of lubrication. Do not attempt to stop bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing.

REMOVAL

(1) Remove the nut, retainer and grommet from the upper stud in the engine compartment.

(2) Remove three nuts from the upper shock bracket (Fig. 18).

(3) Remove the lower bolt from the axle bracket (Fig. 19). Remove the shock absorber from engine compartment.

INSTALLATION

(1) Position the lower retainer and grommet on the upper stud. Insert the shock absorber through the spring from engine compartment.

(2) Install the lower bolt and tighten to 135 N·m (100 ft. lbs.).

(3) Install the upper shock bracket and three nuts. Tighten nuts to 75 N·m (55 ft. lbs.).

(4) Install upper grommet and retainer. Install upper shock nut and tighten to 47 N·m (35 ft. lbs).

SHOCK (Continued)

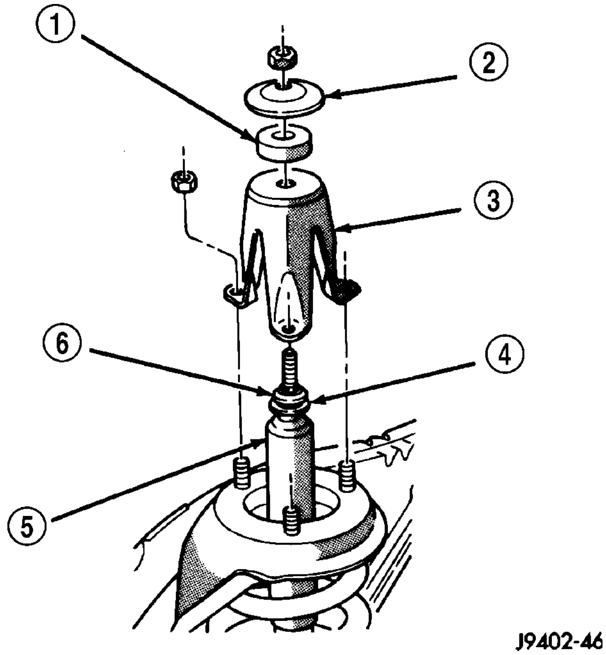


Fig. 18 Shock Absorber and Bracket

1 - GROMMET
2 - RETAINER
3 - BRACKET
4 - RETAINER
5 - SHOCK
6 - GROMMET

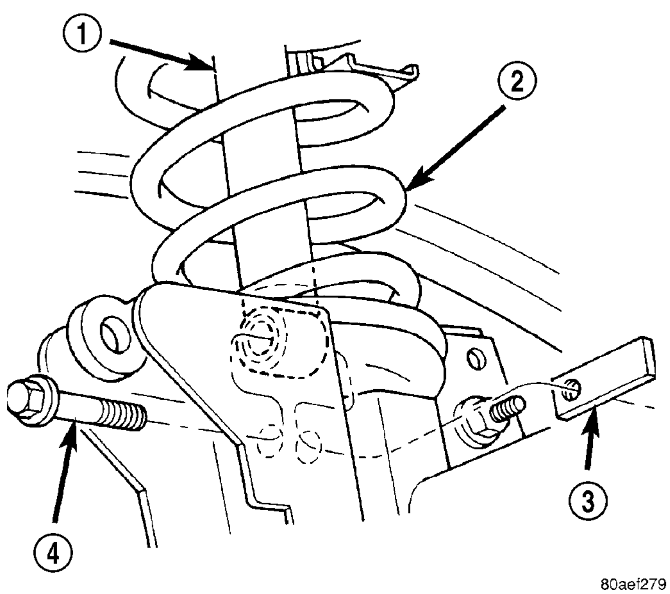


Fig. 19 Shock Absorber Axle Mount

1 - SHOCK
2 - SPRING
3 - FLAG NUT
4 - SHOCK BOLT

SPRING

REMOVAL

(1) Raise and support the vehicle. Position a hydraulic jack under the axle to support it.

(2) Paint or scribe alignment marks on lower suspension arm cam adjusters and axle bracket for installation reference.

(3) Remove the upper suspension arm and loosen lower suspension arm bolts.

(4) Mark and disconnect the front propeller shaft from the axle 4x4 models.

(5) Disconnect the track bar from the frame rail bracket.

(6) Disconnect the drag link from pitman arm.

(7) Disconnect the stabilizer bar link and shock absorber from the axle.

(8) Lower the axle until the spring is free from the upper mount. Remove the coil spring.

INSTALLATION

(1) Position the coil spring on the axle pad.

(2) Raise the axle into position until the spring seats in the upper mount.

(3) Connect the stabilizer bar links and shock absorbers to the axle bracket. Connect the track bar to the frame rail bracket.

(4) Install the upper suspension arm.

(5) Install the front propeller shaft to the axle 4x4 model.

(6) Install drag link to pitman arm and tighten nut to specifications. Install new cotter pin.

(7) Remove the supports and lower the vehicle.

(8) Tighten the following suspension components to specifications:

- Link to stabilizer bar nut.
- Lower shock bolt.
- Track bar bolt at axle shaft tube bracket.
- Upper suspension arm nut at axle bracket.
- Upper suspension nut at frame bracket.
- Align lower suspension arm reference marks and tighten cam nut.
- Lower suspension nut at frame bracket.

STABILIZER BAR

REMOVAL

(1) Raise and support the vehicle.

(2) Hold the stabilizer link shafts with a wrench and remove the link nuts at the stabilizer bar.

(3) Remove the retainers and grommets from the stabilizer bar links.

(4) Remove the stabilizer bar link nuts from the axle brackets.

(5) Remove the links from the axle brackets with Puller C-3894-A (Fig. 20).

(6) Remove the stabilizer bar clamps from the frame rails and remove the stabilizer bar.

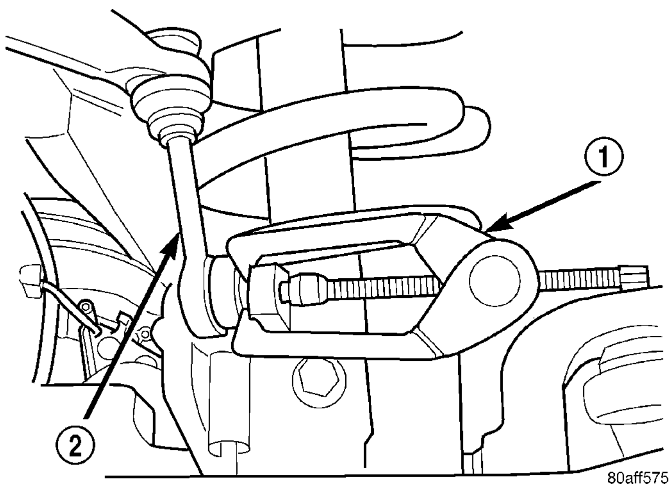


Fig. 20 Stabilizer Link

1 - PULLER
2 - LINK

INSTALLATION

(1) Position the stabilizer bar on the frame rail and install the clamps and bolts. Ensure the bar is centered with equal spacing on both sides.

(2) Tighten the clamp bolts to 61 N·m (45 ft. lbs.).

(3) Install links to the axle bracket and tighten nut to 47 N·m (35 ft. lbs.).

(4) Install links, retainers, grommets and nuts to the stabilizer bar. Hold the link shaft with a wrench and tighten the nuts to 37 N·m (27 ft. lbs.).

(5) Remove the supports and lower the vehicle.

REAR

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REAR

DESCRIPTION

The rear suspension is comprised of:

- Shock Absorbers
- Jounce Bumpers
- Stabilizer Bar (optional)
- Leaf Springs
- Auxiliary Leaf Spring (3500 series)
- Auxiliary Spring Bumpers (3500 series)
- Drive Axle

CAUTION: A vehicle should always be loaded so the vehicle weight center-line is located immediately forward of the rear axle. Correct vehicle loading provides proper front tire-to-road contact. This results in maximum vehicle handling stability and safety. Incorrect vehicle weight distribution can cause excessive tire tread wear, spring fatigue or failure, and erratic steering.

CAUTION: Suspension components with rubber/urethane bushings (except stabilizer bar) should be tightened with the vehicle at normal ride height. It is important to have the springs supporting the weight of the vehicle when the fasteners are torqued. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur.

DIAGNOSIS AND TESTING - SPRING AND SHOCK

A knocking or rattling noise from a shock absorber may be caused by movement between mounting bushings and metal brackets or attaching components. These noises can usually be stopped by tightening the attaching nuts. If the noise persists, inspect for damaged and worn bushings, and attaching components. Repair as necessary if any of these conditions exist.

A squeaking noise from the shock absorber may be caused by the hydraulic valving and may be intermittent. This condition is not repairable and the shock absorber must be replaced.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced. To test a shock absorber, hold it in an upright position and force the piston in and out of the cylinder four or five times. The action throughout each stroke should be smooth and even.

The spring eye and shock absorber bushings do not require any type of lubrication. Do not attempt to stop spring bushing noise by lubricating them. Grease and mineral oil-base lubricants will deteriorate the bushing rubber.

If the vehicle is used for severe, off-road operation, the springs should be examined periodically. Check for broken and shifted leafs, loose and missing clips, and broken center bolts. Refer to Spring and Shock Absorber Diagnosis chart for additional information.

REAR (Continued)

SPRING AND SHOCK ABSORBER

CONDITION	POSSIBLE CAUSES	CORRECTION
SPRING SAGS	1. Broken leaf. 2. Spring fatigue.	1. Replace spring. 2. Replace spring.
SPRING NOISE	1. Loose spring clamp bolts. 2. Worn bushings. 3. Worn or missing spring tip inserts.	1. Tighten to specification. 2. Replace bushings. 3. Replace spring tip inserts.
SHOCK NOISE	1. Loose mounting fastener. 2. Worn bushings. 3. Leaking shock.	1. Tighten to specification. 2. Replace shock. 3. Replace shock.

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Shock Absorber Lower Nut	135	100	—
Shock Absorber Upper Nut	135	100	—
Spring Clamp U-Bolts Nuts	149	110	—
Spring Front & Rear Bolt & Nut	163	120	—
Spring Spring Rear Shackle Nuts	163	120	—
Jounce Bumper Bolts	40	30	—
Auxialiary Spring Bumpers	41	30	—

BUSHINGS

REMOVAL

(1) Remove the spring from the vehicle.

(2) Make small relief cuts in the flared up end of the bushing metal being careful not to cut the spring. Use a punch to bend the flared bushing metal down for push out.

(3) Position the spring eye in a press.

(4) Press the bushing out with an appropriate size driver.

INSTALLATION

(1) Press new bushing into the spring eye with an appropriate size driver. The bushing should be centered in the spring eye.

(2) Stake the outermetal of the bushing in a minimum of six points to retain the bushing.

(3) Install the spring on the vehicle.

JOUNCE BUMPER

REMOVAL

(1) Remove the two bolts securing the jounce bumper to the bracket (Fig. 1).

(2) Remove the jounce bumper.

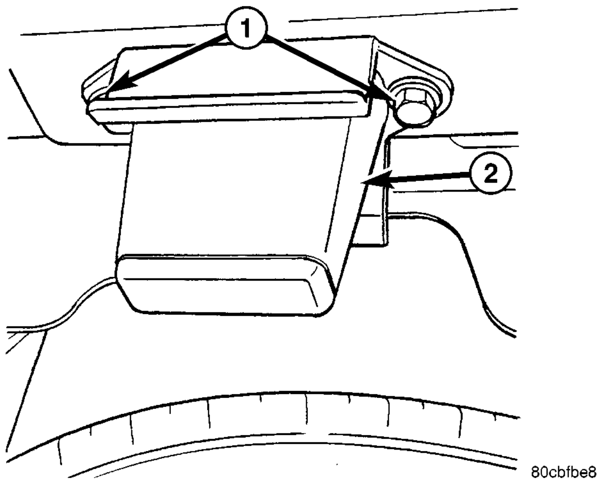

Fig. 1 JOUNCE BUMPER

1 - MOUNTING BOLTS
2 - JOUNCE BUMPER

INSTALLATION

(1) Install the jounce bumper.

(2) Install the two bolts securing the jounce bumper to the bracket. Tighten the bolts to 40 N·m (30 ft. lbs.).

AUXILIARY SPRING BUMPERS (3500)

REMOVAL

(1) Remove the nut securing the auxiliary spring bumper to the bracket (Fig. 2).

(2) Remove the auxiliary spring bumper.

INSTALLATION

(1) Install the auxiliary spring bumper.

(2) Install the nut securing the auxiliary spring bumper to the bracket (Fig. 2). Tighten the nut to 61 N·m (45 ft. lbs.).

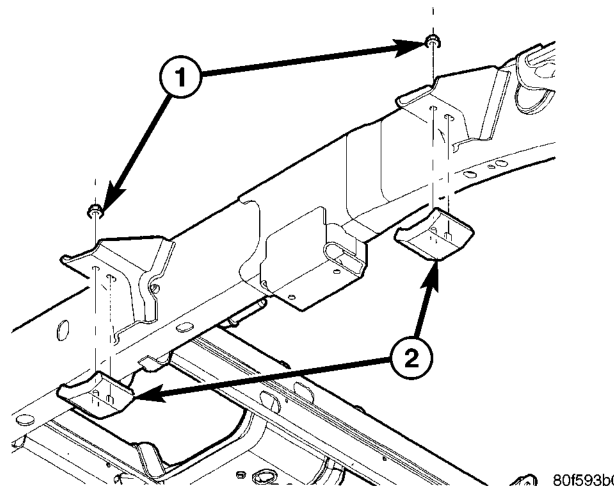

Fig. 2 AUXILIARY SPRING BUMPER (3500)

1 - NUTS
2 - AUXILIARY SPRING BUMPERS

SHOCK

REMOVAL

(1) Raise vehicle and support the axle.

(2) Remove the upper shock bolt and nut (Fig. 3).

(3) Remove the lower shock bolt and nut.

(4) Remove the rear shock absorber from the vehicle.

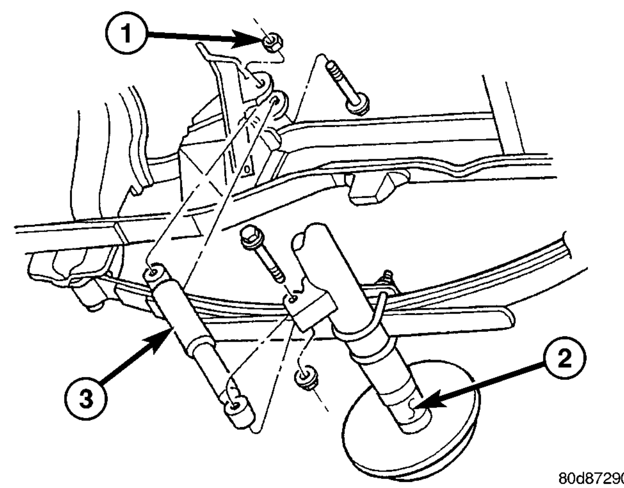

Fig. 3 SHOCK ABSORBER

1 - NUT
2 - AXLE
3 - SHOCK ABSORBER

INSTALLATION

(1) Position the shock absorber in the brackets.

(2) Install the bolts through the brackets and the shock. Install the flag nut on the top bolt and nut on lower bolt.

(3) Tighten the upper and lower bolt/nuts Tighten to 135 N.m (100 ft. lbs.)

(4) Remove the support and lower the vehicle.

SPRING

DESCRIPTION

The rear suspension system uses a multi-leaf springs and a solid drive axle. The forward end of the springs are mounted to the body rail hangers through rubber bushings. The rearward end of the springs are attached to the body by the use of shackles. The spring and shackles use rubber bushings.

OPERATION

The springs control ride quality and maintain vehicle ride height. The shackles allow the springs to change their length as the vehicle moves over various road conditions.

REMOVAL

(1) Raise and support the vehicle.
(2) Support the axle with a suitable holding fixture.
(3) Remove the nuts, spring clamp bolts and the plate that attach the spring to the axle (Fig. 4).
(4) Remove the nuts and bolts from the spring front and rear shackle (Fig. 4).
(5) Remove the spring from the vehicle.

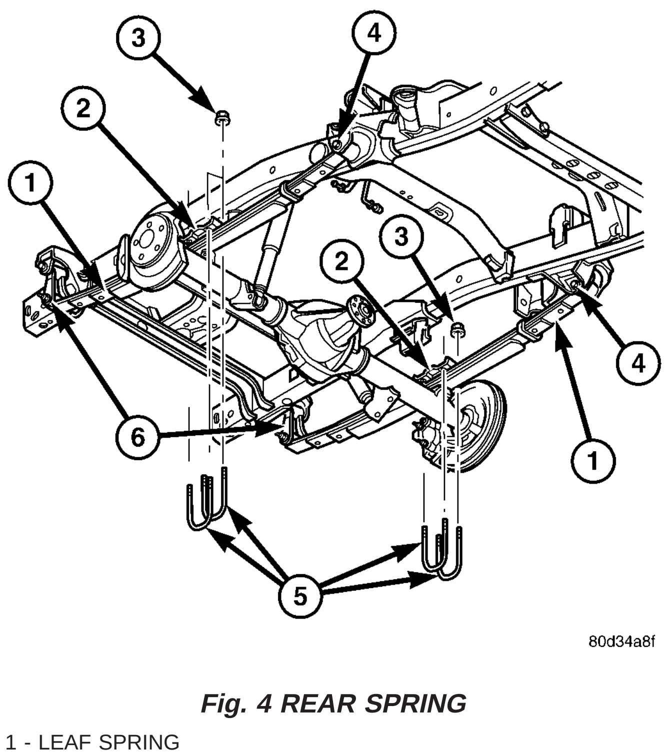

Fig. 4 REAR SPRING

1 - LEAF SPRING
2 - PLATE
3 - NUTS
4 - FRONT NUT & BOLT
5 - SPRING CLAMP BOLTS
6 - SHACKLES

INSTALLATION

(1) Position spring on axle shaft tube so spring center bolt is inserted into the locating hole in the axle tube.
(2) Align the front of the spring with the bolt hole in the front bracket. Install the eye pivot bolt and nut.
(3) Align the rear of the spring into the shackle and install the bolt and nut.
(4) Tighten the spring front and rear eye pivot bolt snug do not torque.
(5) Install the spring clamp bolts, plate and the retaining nuts.
(6) Remove the holding fixture for the rear axle.
(7) Remove the supports and lower the vehicle so that the weight is being supported by the tires.
(8) Tighten the spring clamp retaining nuts to 149 N·m (110 ft. lbs.).
(9) Tighten the spring front and rear pivot bolt nuts to 163 N·m (120 ft. lbs.).

SPRING TIP INSERTS

REMOVAL

(1) Raise and support the vehicle.
(2) Remove both rear tireand wheel assemblies
(3) Position a large C-Clamp adjacent to the spring clinch clip and clamp the leaves of the spring together

CAUTION: When working on the front leaf spring clinch clamps finish the front before starting on the rear to prevent personal injury.

(4) Use an appropriate pry bar to bend open the spring clinch clip (Fig. 5). If necessary, remove the existing spring clinch clip isolators.

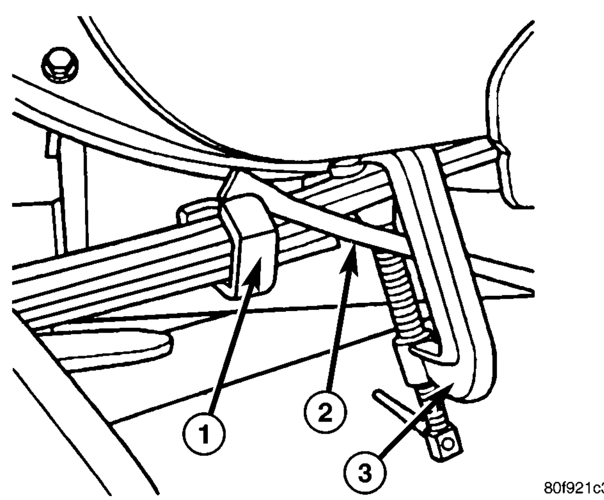

Fig. 5 C-CLAMP AND PRY BAR

1 - REAR LEAF SPRING CLINCH CLAMP
2 - PRY BAR
3 - C-CLAMP

SPRING TIP INSERTS (Continued)

(5) Use the pry bar to spread apart the leaf (Fig. 6). The clearance between the leaves should be enough to remove the old liner (if necessary) and install the replacement liner.

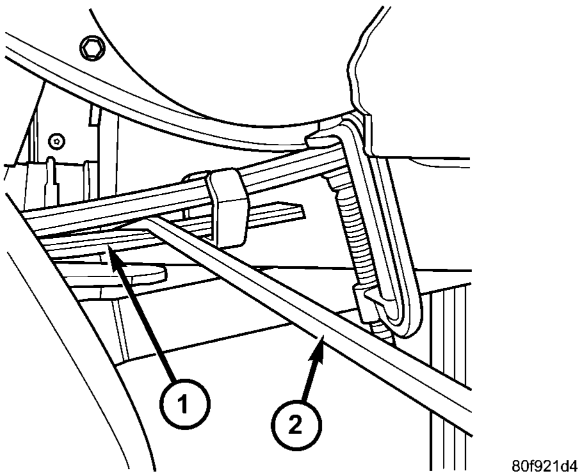

Fig. 6 SPRING SEPARATION

1 - REAR LEAF SPRING
2 - PRY BAR

(6) If necessary, remove the old spring tip liner (Fig. 7).

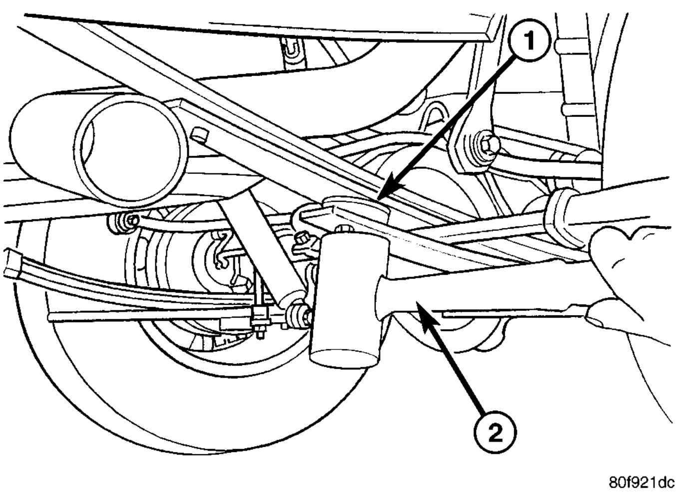

Fig. 7 SPRING TIP LINER REMOVAL

1 - SPRING TIP LINER
2 - RUBBER MALLET

INSTALLATION

(1) With the prybar still inserted between the leaves, install a new spring tip liner onto the leaf.

(2) Firmly seat the spring tip liner onto the leaf. A C-Clamp can be used to compress the adjacent leaves together (Fig. 8) which will seat the liner retaining pin into the hole.

NOTE: THE SPRING TIP LINER IS PROPERLY INSTALLED WHEN THE RETAINING PIN IS POINTING TOWARD THE PAVEMENT AND THE WEAR PAD IS CONTACTING THE LEAF SPRING.

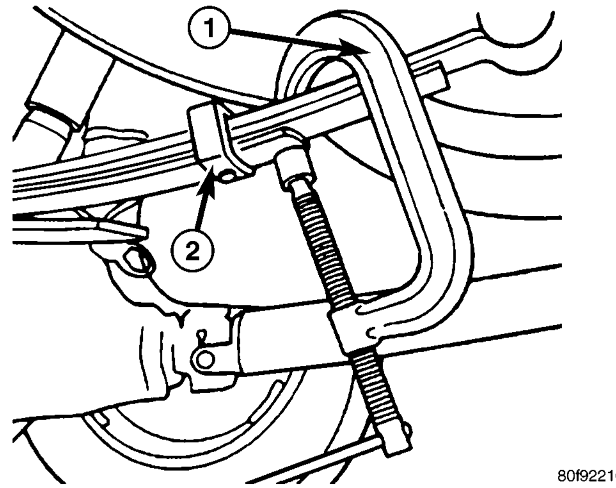

Fig. 8 CLINCH CLIP

1 - C-CLAMP
2 - SPRING CLINCH CLAMP

(3) Apply a small amount of lubricant oil onto the tip liner wear pad.

(4) Install all the spring tip liners.

(5) Place one spring clinch clip isolator onto the outboard side of the spring clinch clip (Fig. 9) and one isolator on the inboard side of the spring clinch clip.

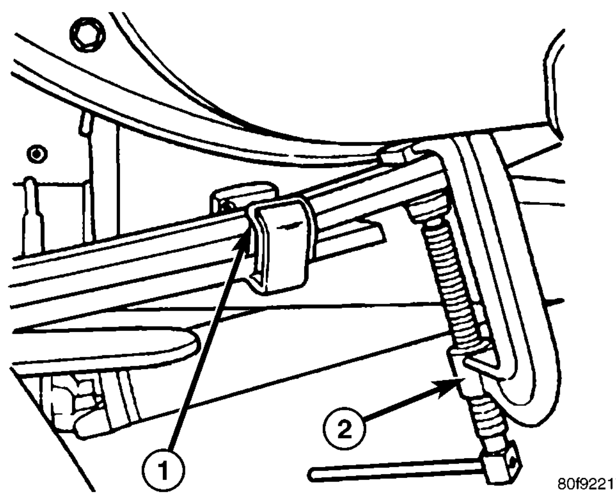

Fig. 9 CLINCH CLIP ISOLATOR

1 - SPRING CLINCH CLIP ISOLATOR
2 - C-CLAMP

SPRING TIP INSERTS (Continued)

(6) Using large adjustable pliers, close the spring clinch clip until the isolator contacts the leaf spring (Fig. 10).

CAUTION: DO NOT USE A HAMMER TO CLOSE THE SPRING CLINCH CLIP. DAMAGE TO THE ISOLATOR MAY RESULT.

(7) Use an appropriate pry bar to bend open the spring clinch clip. If necessary, remove the existing spring clinch clip isolators.

(8) Repeat procedure for the other side of the vehicle.

(9) Iinstall the tire wheel assemblies.

(10) Lower the vehicle.

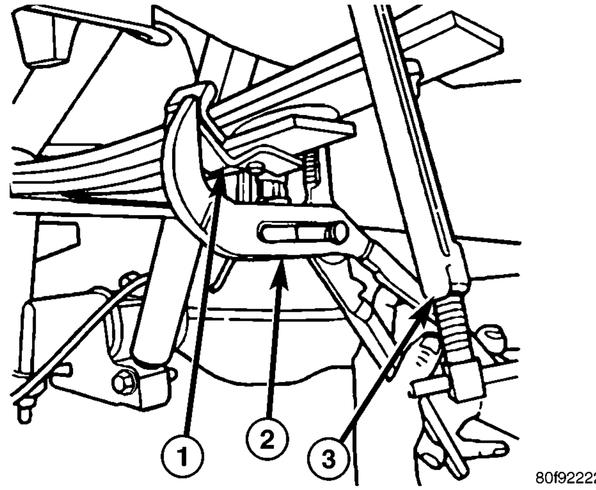

Fig. 10 CLINCH CLIP REASSEMBLY

1 - SPRING CLINCH CLIP
2 - ADJUSTABLE PLIERS
3 - C-CLAMP

DIFFERENTIAL & DRIVELINE

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PROPELLER SHAFT

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PROPELLER SHAFT

DIAGNOSIS AND TESTING

PROPELLER SHAFT VIBRATION

Tires that are out-of-round or wheels that are unbalanced, will cause a low frequency vibration.

Brake drums that are unbalanced will cause a harsh, low frequency vibration.

Driveline vibration can also result from loose or damaged engine mounts.

Propeller shaft vibration increases as the vehicle speed is increased. A vibration that occurs within a specific speed range is not usually caused by a propeller shaft being unbalanced. Defective universal joints or an incorrect propeller shaft angle are usually the cause of such a vibration.

PROPELLER SHAFT (Continued)

DRIVELINE VIBRATION

Drive Condition	Possible Cause	Correction
Propeller Shaft Noise	1) Undercoating or other foreign material on shaft.	1) Clean exterior of shaft and wash with solvent.
	2) Loose U-joint clamp screws.	2) Install new clamps and screws and tighten to proper torque.
	3) Loose or bent U-joint yoke or excessive runout.	3) Install new yoke.
	4) Incorrect driveline angularity.	4) Measure and correct driveline angles.
	5) Rear spring center bolt not in seat.	5) Loosen spring u-bolts and seat center bolt.
	6) Worn U-joint bearings.	6) Install new U-joint.
	7) Propeller shaft damaged or out of balance.	7) Installl new propeller shaft.
	8) Broken rear spring.	8) Install new rear spring.
	9) Excessive runout or unbalanced condition.	9) Re-index propeller shaft, test, and evaluate.
	10) Excessive drive pinion gear shaft runout.	10) Re-index propeller shaft and evaluate.
	11) Excessive axle yoke deflection.	11) Inspect and replace yoke if necessary.
	12) Excessive transfer case runout.	12) Inspect and repair as necessary.
Universal Joint Noise	1) Loose U-joint clamp screws.	1) Install new clamps and screws and tighten to proper torque.
	2) Lack of lubrication.	2) Replace as U-joints as necessary.

PROPELLER SHAFT BALANCE

NOTE: Removing and re-indexing the propeller shaft 180° relative to the yoke may eliminate some vibrations.

If propeller shaft is suspected of being unbalanced, it can be verified with the following procedure:

(1) Raise the vehicle.

(2) Clean all the foreign material from the propeller shaft and the universal joints.

(3) Inspect the propeller shaft for missing balance weights, broken welds, and bent areas. **If the propeller shaft is bent, it must be replaced.**

(4) Inspect the universal joints to ensure that they are not worn, are properly installed, and are correctly aligned with the shaft.

(5) Check the universal joint clamp screws torque.

(6) Remove the wheels and tires. Install the wheel lug nuts to retain the brake drums or rotors.

(7) Mark and number the shaft six inches from the yoke end at four positions 90° apart.

(8) Run and accelerate the vehicle until vibration occurs. Note the intensity and speed the vibration occurred. Stop the engine.

(9) Install a screw clamp at position 1 (Fig. 1).

(10) Start the engine and re-check for vibration. If there is little or no change in vibration, move the clamp to one of the other three positions. Repeat the vibration test.

(11) If there is no difference in vibration at the other positions, the source of the vibration may not be propeller shaft.

(12) If the vibration decreased, install a second clamp (Fig. 2) and repeat the test.

(13) If the additional clamp causes an additional vibration, separate the clamps (1/2 inch above and below the mark). Repeat the vibration test (Fig. 3).

(14) Increase distance between the clamp screws and repeat the test until the amount of vibration is at the lowest level. Bend the slack end of the clamps so the screws will not loosen.

PROPELLER SHAFT (Continued)

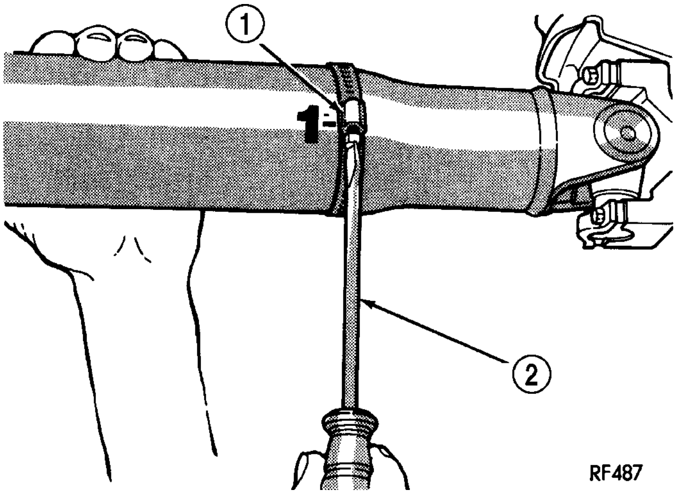


Fig. 1 CLAMP SCREW AT POSITION 1

1 - CLAMP
2 - SCREWDRIVER

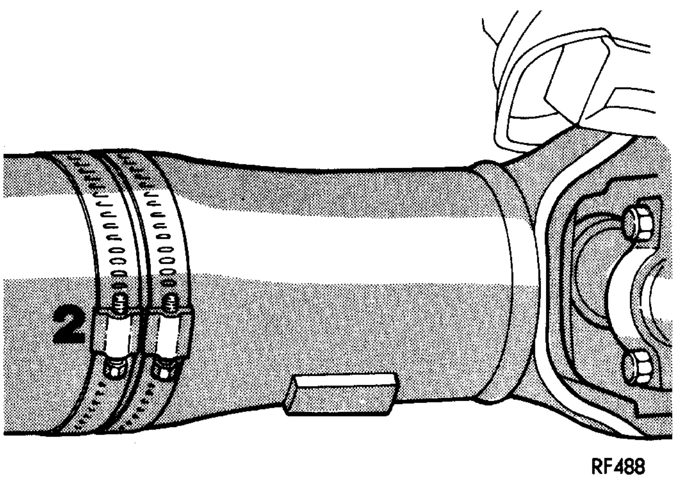


Fig. 2 TWO CLAMP SCREWS

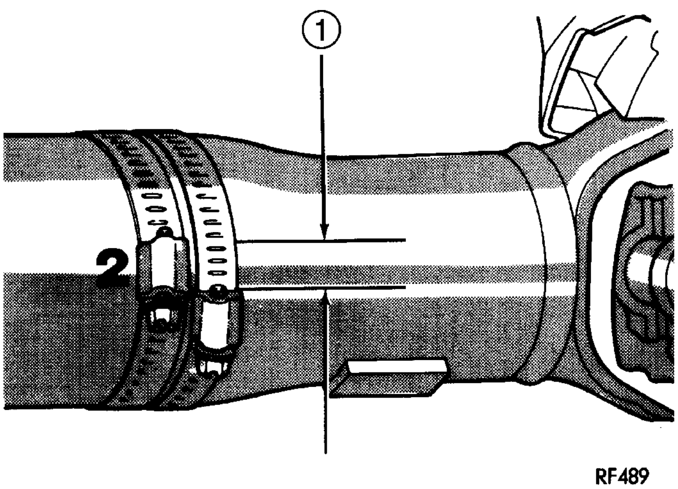


Fig. 3 CLAMP SCREWS SEPARATED

1 - ½ INCH

(15) If the vibration remains unacceptable, apply the same steps to the front end of the propeller shaft.

(16) Install the wheel and tires. Lower the vehicle.

PROPELLER SHAFT RUNOUT

(1) Remove dirt, rust, paint and undercoating from the propeller shaft surface where the dial indicator will contact the shaft.

(2) The dial indicator must be installed perpendicular to the shaft surface.

(3) Measure runout at the center and ends of the shaft sufficiently far away from weld areas to ensure that the effects of the weld process will not enter into the measurements.

(4) Refer to Runout Specifications chart.

(5) If the propeller shaft runout is out of specification, remove the propeller shaft, index the shaft 180°, and re-install the propeller shaft. Measure shaft runout again.

(6) If the propeller shaft runout is now within specifications, mark the shaft and yokes for proper orientation.

(7) If the propeller shaft runout is not within specifications, verify that the runout of the transmission/transfer case and axle are within specifications. Correct as necessary and re-measure propeller shaft runout.

(8) Replace the propeller shaft if the runout still exceeds the limits.

RUNOUT SPECIFICATIONS

Front of Shaft	0.020 in. (0.50 mm)
Center of Shaft	0.025 in. (0.63 mm)
Rear of Shaft	0.020 in. (0.50 mm)
note: Measure front/rear runout approximately 3 inches (76 mm) from the weld seam at each end of the shaft tube for tube lengths over 30 inches. For tube lengths under 30 inches, the maximum allowed runout is 0.020 in. (0.50 mm) for the full length of the tube.	

STANDARD PROCEDURE

PROPELLER SHAFT ANGLE

This procedure applies to both the front/rear propeller shafts. To obtain the front output angle (A) on the front propeller shaft, place the inclinometer the machined surface of the C/V joint.

(1) To check driveline alignment, raise and support the vehicle at the axles as level as possible. Allow the wheels and propeller shaft to turn.

(2) Remove any external bearing snap rings, if equipped from universal joint so protractor base sits flat.

PROPELLER SHAFT (Continued)

(3) Rotate the shaft until transmission/transfer case output yoke bearing is facing downward.

NOTE: Always make measurements from front to rear and from the same side of the vehicle.

(4) Place Inclinometer 7663 on yoke bearing (A) parallel to the shaft (Fig. 4). Center bubble in sight glass and record measurement.

This measurement will give you the transmission yoke Output Angle (A).

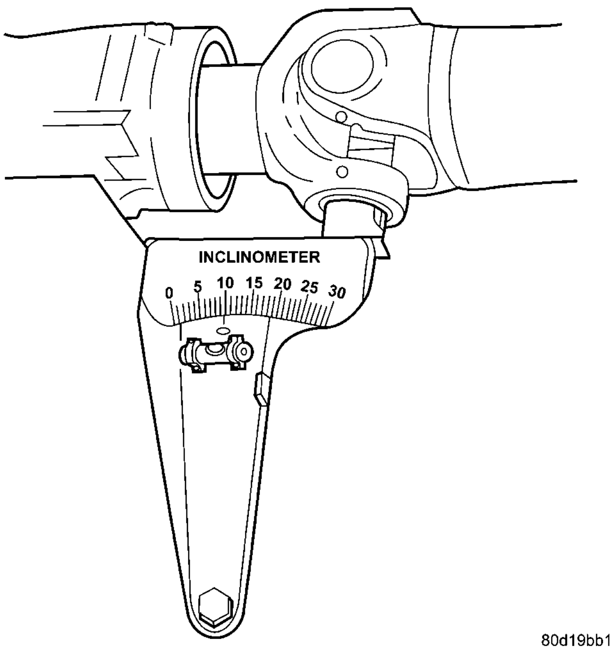


Fig. 4 OUTPUT ANGLE (A)

(5) Rotate propeller shaft 90 degrees and place Inclinometer on yoke bearing parallel to the shaft (Fig. 5). Center bubble in sight glass and record measurement. This measurement can also be taken at the rear end of the shaft.

This measurement will give you the Propeller Shaft Angle (C).

(6) Rotate propeller shaft 90 degrees and place Inclinometer on companion flange yoke bearing parallel to the shaft (Fig. 6). Center bubble in sight glass and record measurement.

This measurement will give you the pinion Companion Flange Input Angle (B).

(7) Subtract smaller figure from larger (C minus A) to obtain Transmission/Transfer Case **Output Operating Angle**.

(8) Subtract smaller figure from larger (C minus B) to obtain axle **Input Operating Angle**.

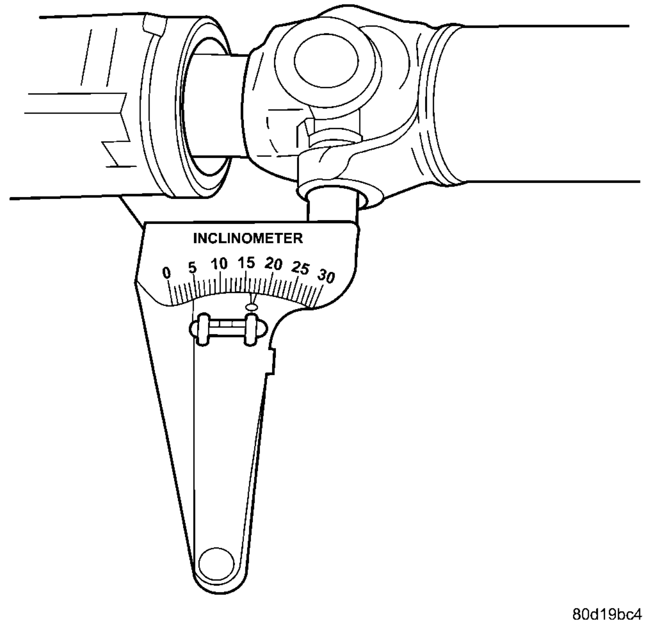


Fig. 5 PROPELLER SHAFT ANGLE (C)

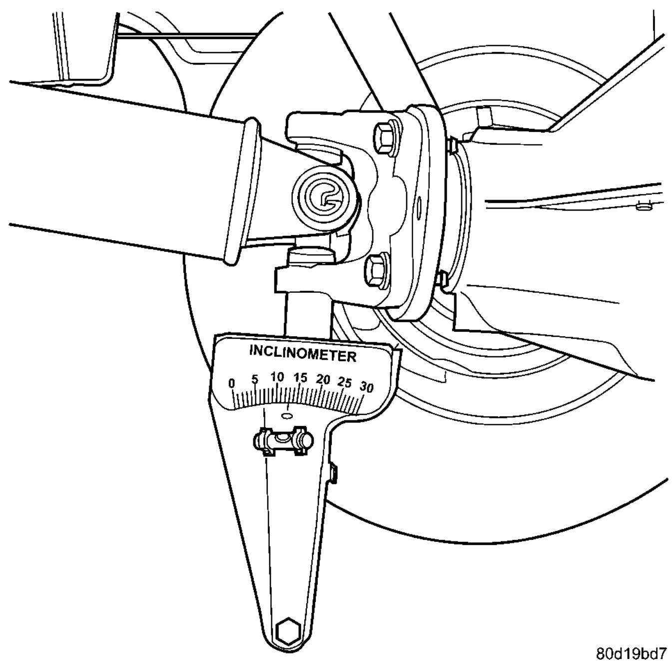


Fig. 6 INPUT ANGLE (B)

Refer to rules given below and the example in (Fig. 7) for additional information.

• Good cancellation of U-joint operating angles should be within 1°.

• Operating angles should be less than 3°.

• At least 1/2 of one degree continuous operating (propeller shaft) angle.

PROPELLER SHAFT (Continued)

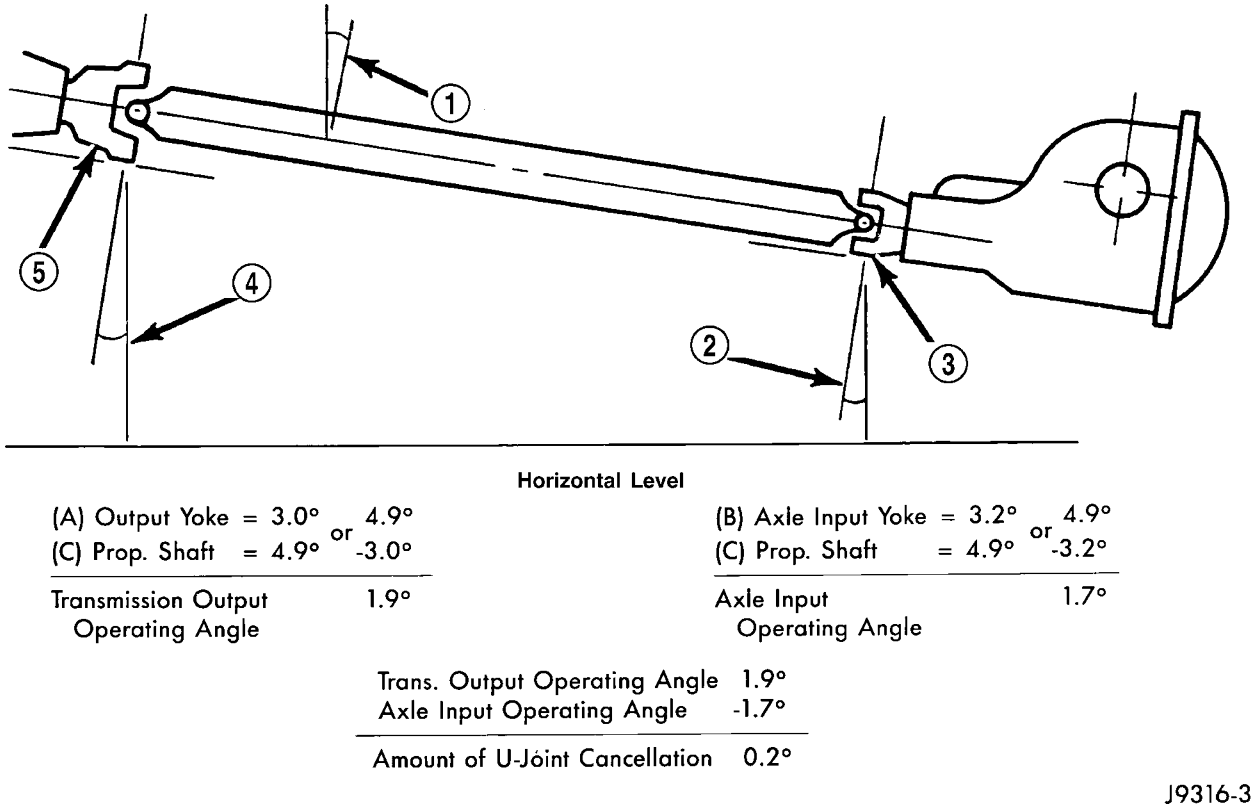


Fig. 7 UNIVERSAL JOINT ANGLE EXAMPLE

1 - 4.9° Angle (C)
2 - 3.2° Angle (B)
3 - Input Yoke
4 - 3.0° Angle (A)
5 - Output Yoke

TWO-PIECE PROPELLER SHAFT

The procedure to measure the propeller shaft angles involved with a two-piece (Fig. 8) propeller shaft is the same as those for a one-piece propeller shaft.

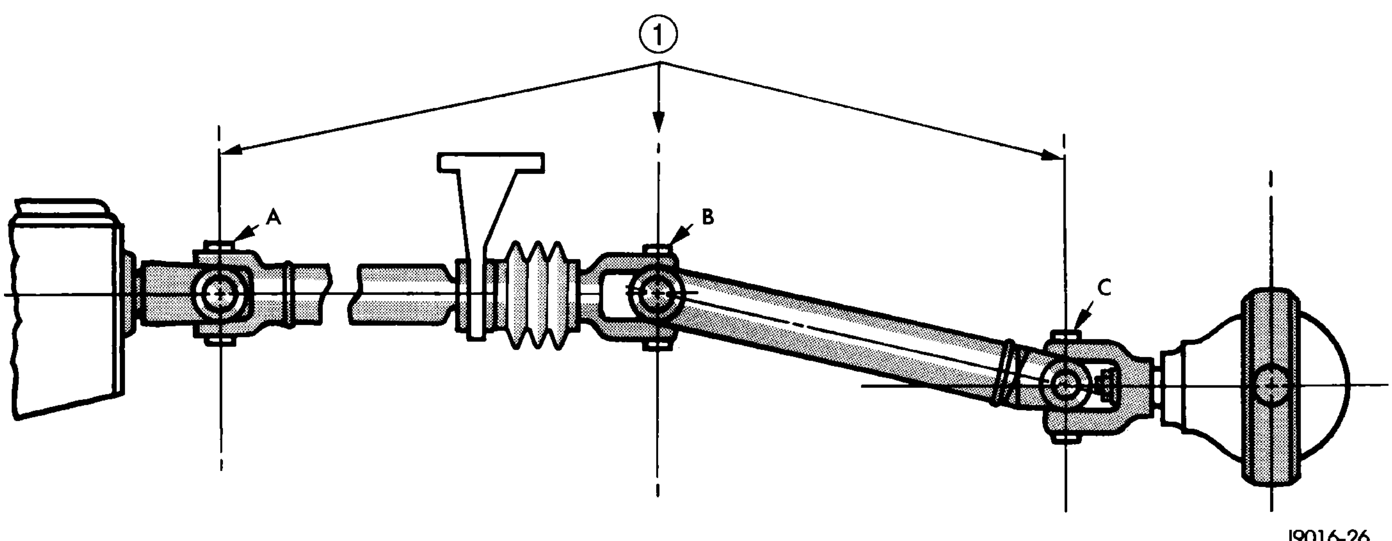


Fig. 8 UNIVERSAL JOINT ANGLE

1 - YOKES MUST BE IN SAME PLANE

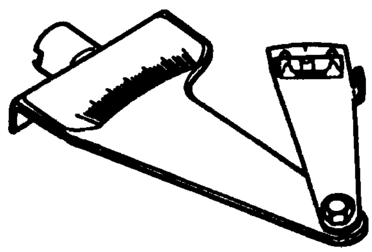
PROPELLER SHAFT (Continued)

SPECIFICATIONS

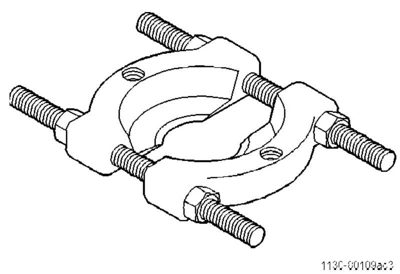
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Center Bearing Bolts	54	40	-
Front Pinion Flange Bolts	115	85	-
Rear Pinion Flange Bolts	115	85	-

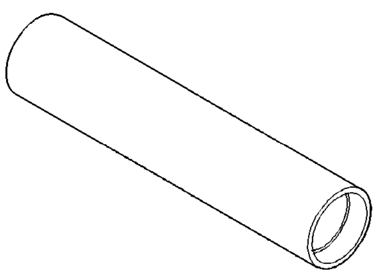
SPECIAL TOOLS



INCLINOMETER 7663



Bearing Splitter 1130



INSTALLER 6052

FRONT PROPELLER SHAFT

REMOVAL

(1) Position transmission and transfer case into neutral.

(2) Raise and support vehicle.

(3) Remove exhaust crossover pipe.

(4) Mark a line across the axle companion flange and propeller shaft flange yoke (Fig. 9) for installation reference.

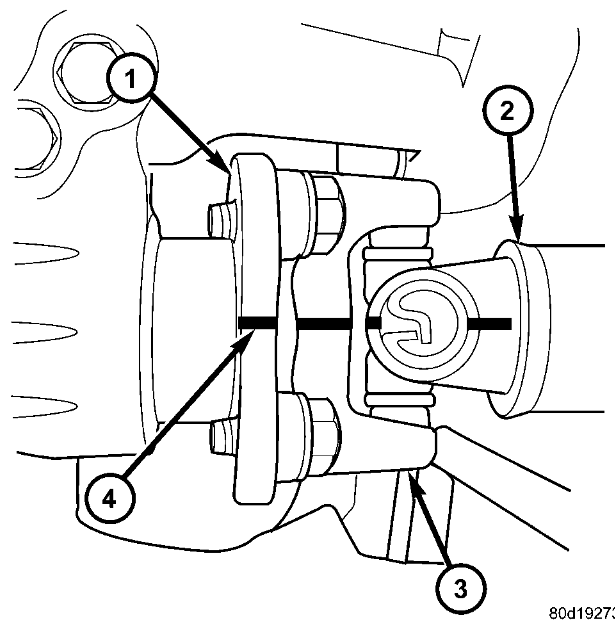


Fig. 9 COMPANION FLANGE

1 - COMPANION FLANGE
2 - PROPELLER SHAFT
3 - FLANGE YOKE
4 - REFERENCE MARK

(5) Remove companion flange bolts.

(6) Remove dust boot clamp (Fig. 10) from the C/V jonit end of the shaft.

(7) Remove propeller shaft.

FRONT PROPELLER SHAFT (Continued)

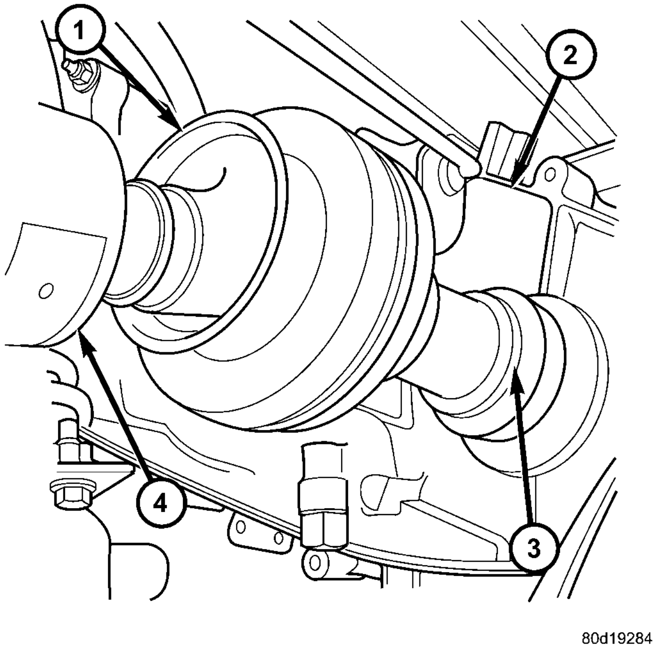


Fig. 10 DUST BOOT

1 - C/V JOINT
2 - TRANSFER CASE
3 - BOOT CLAMP
4 - PROPELLER SHAFT

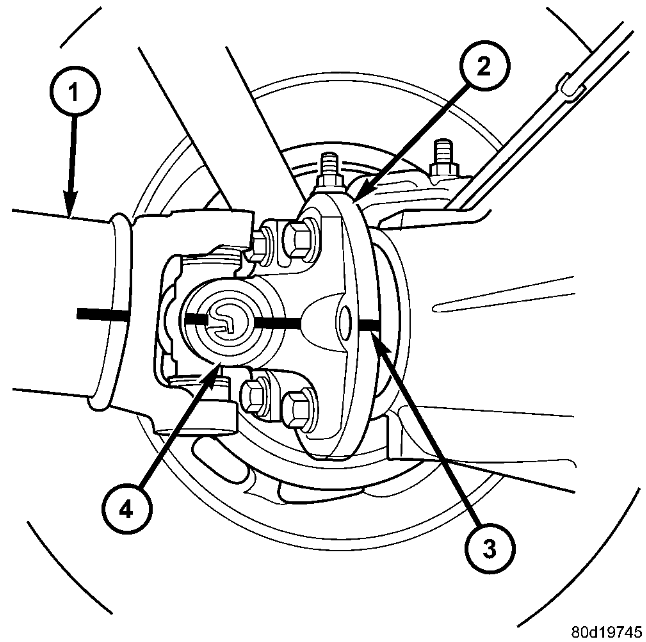


Fig. 11 COMPANION FLANGE

1 - PROPELLER SHAFT
2 - COMPANION FLANGE
3 - REFERENCE MARK
4 - SHAFT FLANGE YOKE

INSTALLATION

(1) Install propeller shaft with with all reference marks aligned.
(2) Install transfer case companion flange bolts and tighten to 30.5 N·m (22.5 ft. lbs.).
(3) Install axle companion flange bolts and tighten to 108 N·m (80 ft. lbs.).
(4) Install skid plate, if equipped.
(5) Lower vehicle and road test to verify repair.

REAR PROPELLER SHAFT

REMOVAL

(1) Shift transmission into Neutral.
(2) Raise and support vehicle.
(3) Mark a line across the pinion companion flange and propeller shaft flange yoke (Fig. 11) for installation reference.
(4) Mark the outline of the center bearing (Fig. 12) on the crossmember for installation reference, if equipped.
(5) Remove center bearing mounting nuts, if equipped.
(6) Remove pinion yoke companion flange bolts.
(7) Slide slip yoke off of the transmission or transfer case output shaft and remove propeller shaft.

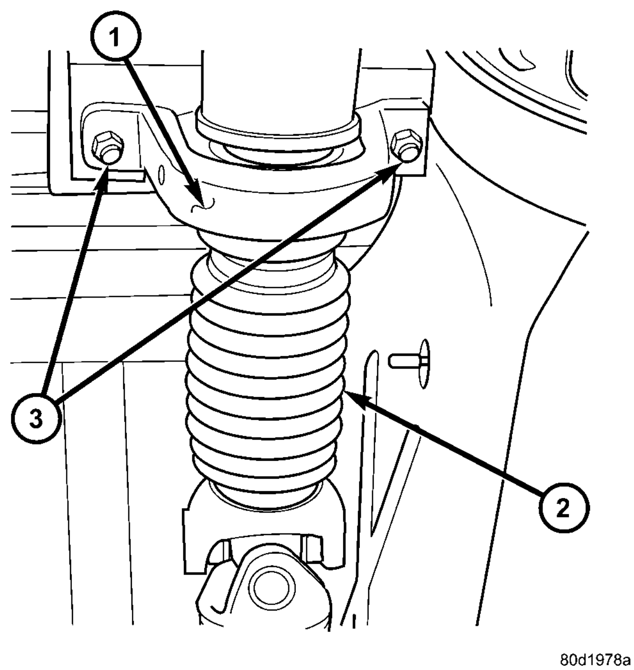


Fig. 12 CENTER BEARING

1 - CENTER BEARING
2 - DUST BOOT
3 - MOUNTING NUTS

REAR PROPELLER SHAFT (Continued)

INSTALLATION

(1) Slide the slip yoke onto the transmission/transfer case output shaft.

(2) Align and install center bearing on crossmember, if necessary and tighten nutts to 54 N·m (40 ft. lbs.).

(3) Align reference marks on the propeller shaft yoke and pinion companion flange (Fig. 13).

(4) Tighten pinion companion flange bolts to 115 N·m (85 ft. lbs.).

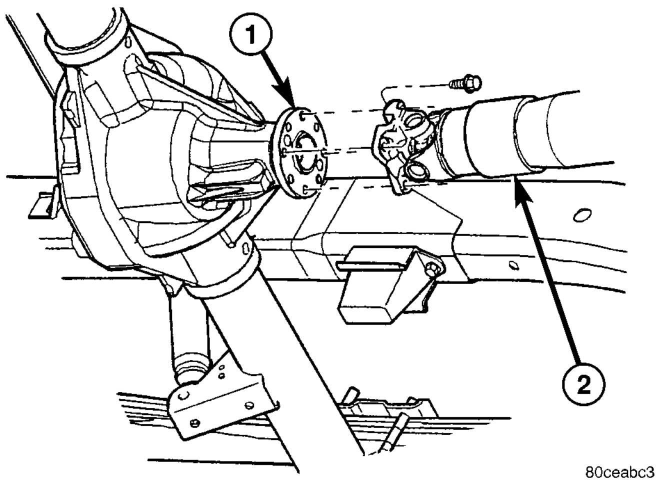


Fig. 13 REAR PROPELLER SHAFT

1 - COMPANION FLANGE
2 - PROPELLER SHAFT

(5) Lower the vehicle.

CENTER BEARING

REMOVAL

(1) Remove rear propeller shaft.

(2) Mark the two shafts (Fig. 14) for installation reference.

(3) Remove slip joint boot clamp and separate the two shafts.

(4) Use hammer and punch to tap slinger away from shaft to provide room for bearing splitter.

(5) Position Bearing Splitter Tool 1130 between slinger and shaft.

CAUTION: Do not damage shaft spline during removal of center bearing.

(6) Set shaft in press and press bearing off the shaft.

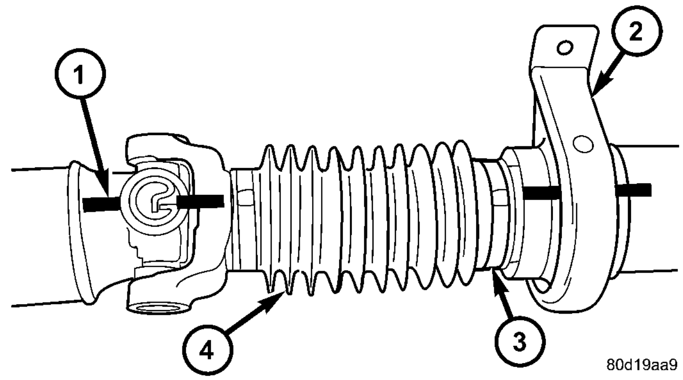


Fig. 14 REFERENCE MARKS

1 - REFERENCE MARK
2 - CENTER BEARING
3 - BOOT CLAMP
4 - DUST BOOT

INSTALLATION

NOTE: Two types of center bearings are used and are not interchangeable. Install the same type as the vehicle was built with.

(1) Install new slinger on shaft and drive into position with appropriate installer tool.

(2) Install new center bearing on shaft with Bearing Installer Tool 6052. Drive on shaft with hammer until bearing is seated.

(3) Clean shaft splines and apply a coat of multipurpose grease.

(4) Align master splines and slide front and rear half-shafts together. Reposition slip yoke boot and install new clamp.

(5) Install propeller shaft in vehicle.

ADJUSTMENTS

CENTER BEARING

Launch shudder is a vibration that occurs at first acceleration from a stop. Shudder vibration usually peaks at the engines highest torque output. Shudder is a symptom associated with vehicles using a two-piece propeller shaft. To decrease shudder, lower the center bearing in 1/8 inch increments. Use shim stock or fabricated plates. Plate stock must be used to maintain compression of the rubber insulator around the bearing. Do not use washers. Replace the original bolts with the appropriate increased length bolts.

SINGLE CARDAN UNIVERSAL JOINTS

DISASSEMBLY

NOTE: The following procedure is described for a propeller shaft equipped with only a cardan joint in the tube yoke. If the propeller shaft is equipped with a companion yoke, simply repeat the following steps to remove the cardan joint from the companion yoke after removing the cardan joint from the tube yoke.

Individual components of cardan universal joints are not serviceable. If worn or leaking, they must be replaced as an assembly.

(1) Remove the propeller shaft.

(2) Using a soft drift, tap the outside of the bearing cap assembly to loosen snap ring.

(3) Remove snap rings from both sides of yoke (Fig. 15).

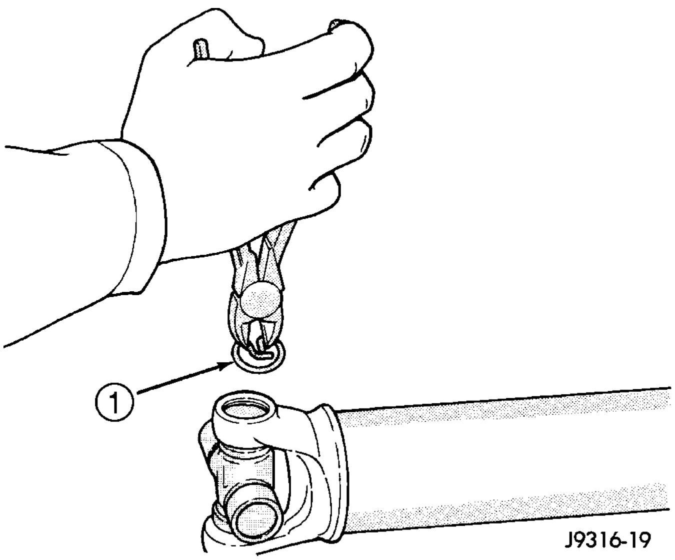


Fig. 15 Snap Ring

1 - SNAP RING

(4) Set the yoke in an arbor press or vise with a socket whose inside diameter is large enough to receive the bearing cap positioned beneath the yoke.

(5) Position the yoke with the grease fitting, if equipped, pointing up.

(6) Place a socket with an outside diameter smaller than the upper bearing cap on the upper bearing cap and press the cap through the yoke to release the lower bearing cap (Fig. 16).

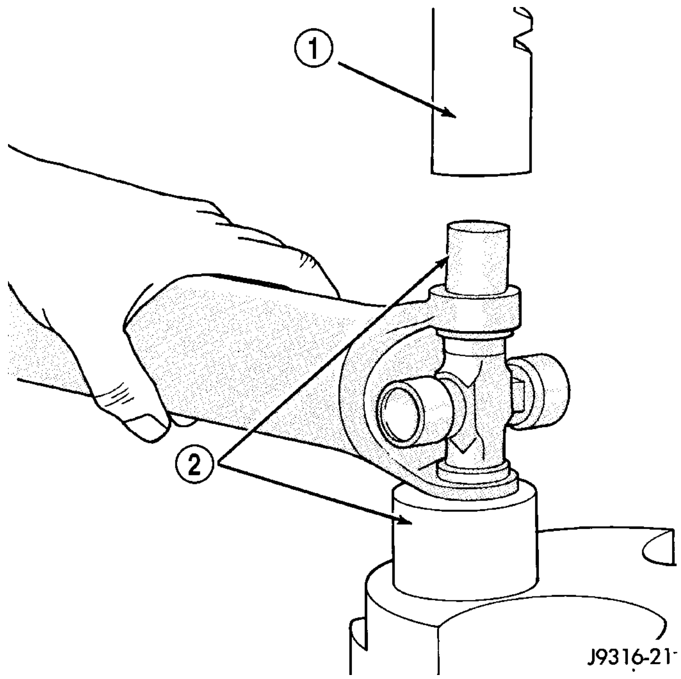


Fig. 16 Press Out Bearing

1 - PRESS
2 - SOCKET

(7) If the bearing cap will not pull out of the yoke by hand after pressing, tap the yoke ear near the bearing cap to dislodge the cap.

(8) To remove the opposite bearing cap, turn the yoke over and straighten the cross in the open hole. Then, carefully press the end of the cross until the remaining bearing cap can be removed (Fig. 17).

CAUTION: If the cross or bearing cap are not straight during installation, the bearing cap will score the walls of the yoke bore and damage can occur.

ASSEMBLY

NOTE: The following procedure is described for a propeller shaft equipped with only a cardan joint in the tube yoke. If the propeller shaft is equipped with a companion yoke, simply repeat the following steps to remove the cardan joint from the companion yoke after removing the cardan joint from the tube yoke.

(1) Apply extreme pressure (EP) N.L.G.I. Grade 1 or 2 grease to inside of yoke bores to aid in installation.

SINGLE CARDAN UNIVERSAL JOINTS (Continued)

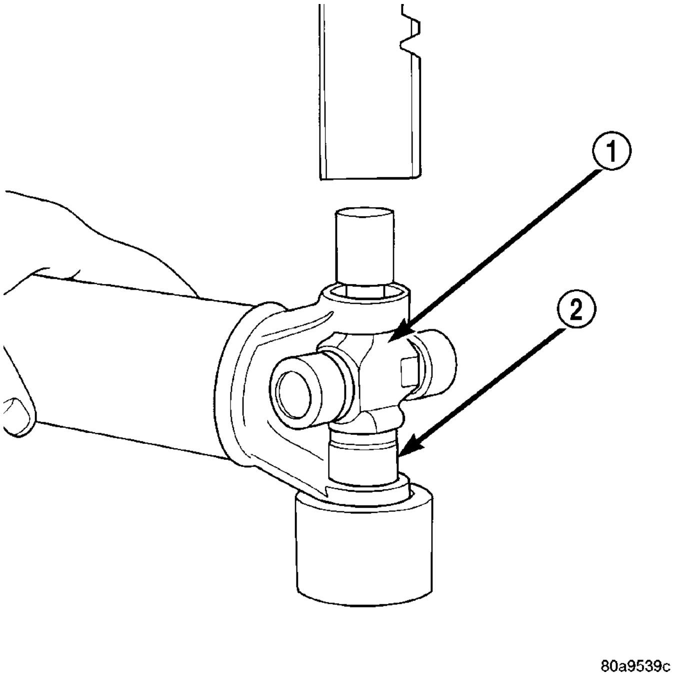


Fig. 17 Press Out Remaining Bearing

1 - CROSS
2 - BEARING CAP

(2) Position the cross in the yoke with its lube fitting, if equipped, pointing up (Fig. 18).

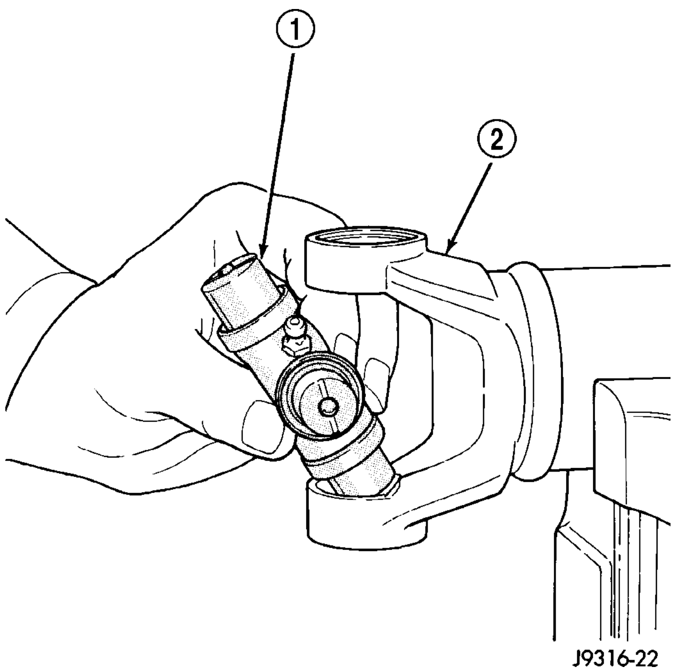


Fig. 18 Cross In Yoke

1 - CROSS
2 - YOKE

(3) Place a bearing cap over the trunnion and align the cap with the yoke bore (Fig. 19). Keep the needle bearings upright in the bearing assembly. A needle bearing lying at the bottom of the cap will prevent proper assembly.

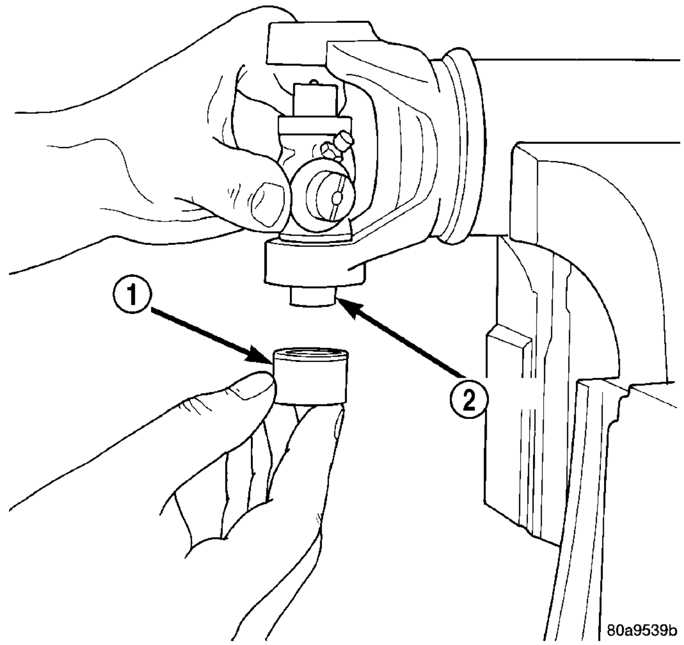


Fig. 19 Install Bearing On Trunnion

1 - BEARING CAP
2 - TRUNNION

(4) Press the bearing cap into the yoke bore enough to install a snap ring.

(5) Install a snap ring.

(6) Repeat Step 3 and Step 4to install the opposite bearing cap. If the joint is stiff or binding, strike the yoke with a soft hammer to seat the needle bearings.

(7) Add grease to lube fitting, if equipped.

(8) Install the propeller shaft.

HALF SHAFT

TABLE OF CONTENTS

HALF SHAFT

CAUTION

CAUTION:: Never grasp half shaft assembly by the boots. This may cause the boot to pucker or crease and reduce the service life of the boot.
Avoid over angulating or stroking the C/V joints when handling the half shaft.
Half shafts exposed to battery acid, transmission fluid, brake fluid, differential fluid or gasoline may cause the boots to deteriorate.

DIAGNOSIS AND TESTING

Check for grease at the inboard and outboard C/V joint. This is a sign of boot or boot clamp damage.

NOISE/VIBRATION IN TURNS

A clicking noise or a vibration in turns could be caused by a damaged outer C/V or inner tripod joint seal boot or seal boot clamps. This will result in the loss/contamination of the joint grease, resulting in inadequate lubrication of the joint. Noise could also be caused by another component of the vehicle coming in contact with the half shafts.

CLUNKING NOISE DURING ACCELERATION

This noise may be a result of a damaged or worn C/V joint. A torn boot or loose/missing clamp on the inner/outer joint which has allowed the grease to be lost will damage the C/V joint.

SHUDDER/VIBRATION DURING ACCELERATION

This problem could be a result of a worn/damaged inner tripod joint or a sticking tripod joint. Improper wheel alignment may also cause a shudder or vibration.

VIBRATION AT HIGHWAY SPEEDS

This problem could be a result of out of balance front tires or tire/wheel runout. Foreign material (mud, etc.) packed on the backside of the wheel(s) will also cause a vibration.

REMOVAL

(1) Loosen lug nuts and hub nut while the with the vehicle brakes applied.
(2) Raise and support the vehicle.
(3) Remove wheel and tire assembly
(4) Remove half shaft hub nut.
(5) Remove brake caliper and rotor.
(6) Position hydraulic jack under lower suspension arm and raise jack to unload rebound bumper.
(7) Remove lower shock absorber bolt.
(8) Remove upper ball joint nut and seperate ball with Remover 8677 (Fig. 1).

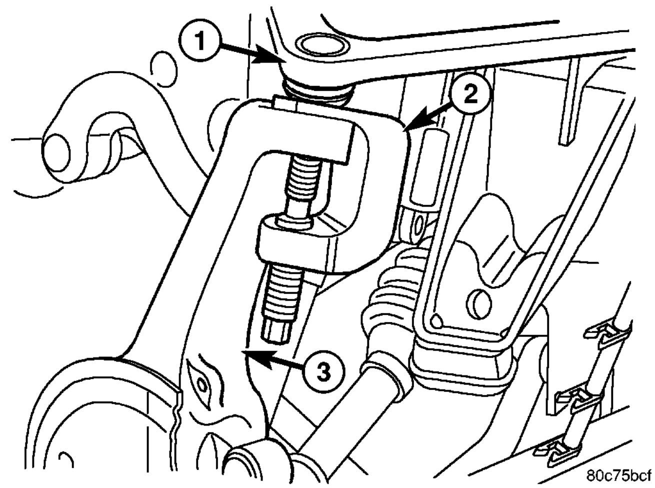


Fig. 1 UPPER BALL JOINT SEPARATION

1 - UPPER CONTROL ARM
2 - REMOVER
3 - STEERING KNUCKLE

HALF SHAFT (Continued)

(9) Disengage inner C/V joint from the axle shaft snap-ring by apply pressure with two pry bars between the C/V housing and axle housing.

(10) Tilt the knuckle out and push the half shaft out of the knuckle (Fig. 2).

CAUTION: Do not damage outer C/V threads while removing half shaft.

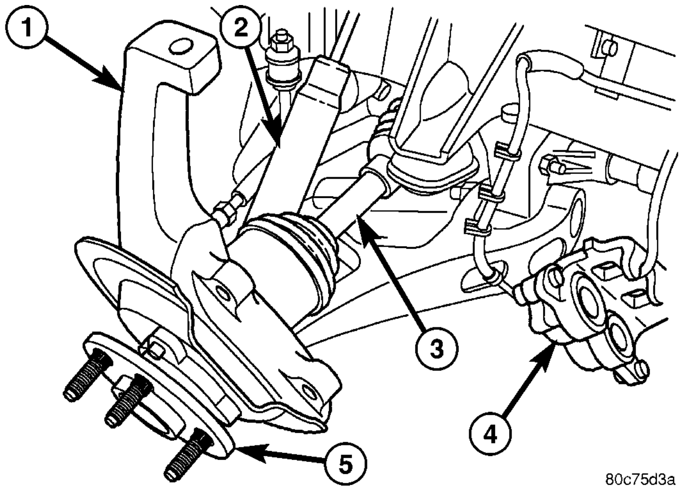


Fig. 2 STEERING KNUCKLE

1 - STEERING KNUCKLE
2 - SHOCK
3 - HALFSHAFT
4 - DISC BRAKE CALIPER
5 - HUB/BEARING

(11) Remove the half shaft from the vehicle.

INSTALLATION

(1) Clean hub bearing bore, hub bearing mating surface and half shaft splines.

(2) Apply a light coating of grease to the front axle shaft output splines.

(3) Install half shaft into the knuckle (Fig. 3).

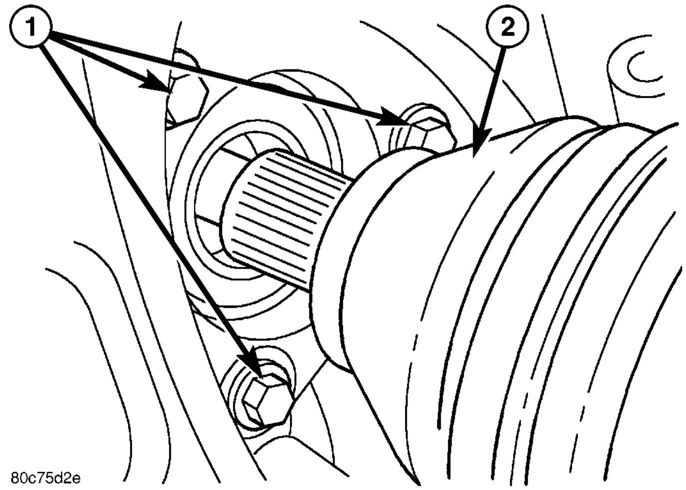


Fig. 3 HALF SHAFT AND HUB/BEARING

1 - HUB/BEARING MOUNTING NUTS
2 - HALF SHAFT

(4) Install half shaft on the axle output shaft. Push firmly to engage the axle output shaft snap ring into the inner C/V housing.

(5) Install upper ball joint into the knuckle.

(6) Install upper ball joint nut and tighten to specification.

(7) Install lower shock absorber bolt and tighten to specification.

(8) Install brake rotor and caliper.

(9) Install half shaft hub nut and tighten to 251 N·m (185 ft. lbs.).

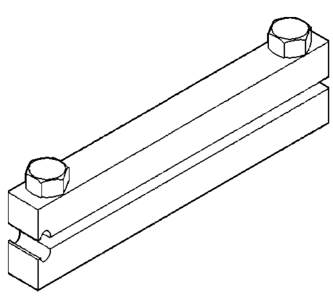
(10) Install the wheel and tire assembly.

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Half Shaft Nut	251	185	-

SPECIAL TOOLS



CLAMP INSTALLER C-4975A

CV JOINT-OUTER

REMOVAL

(1) Clamp shaft in a vise (with soft jaws) and support C/V joint.

(2) Remove clamps with a cut-off wheel or grinder (Fig. 4).

CAUTION: Do not damage C/V housing or half shaft.

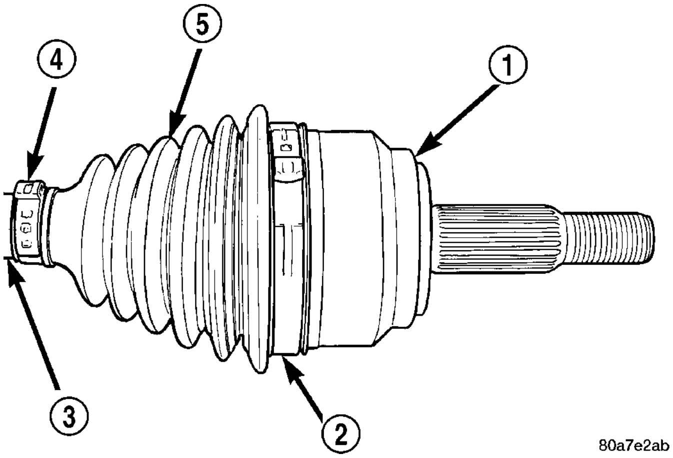


Fig. 4 BOOT CLAMP LOCATIONS

1 - C/V HOUSING
2 - CLAMP
3 - HALF SHAFT
4 - CLAMP
5 - C/V BOOT

(3) Slide the boot down the shaft.

(4) Remove lubricant to expose the C/V joint snap ring.

(5) Spread snap ring and slide the joint off the shaft (Fig. 5).

(6) Slide boot off the shaft and discard old boot.

(7) Mark alignment marks on the inner race/hub, bearing cage and housing with dabs of paint (Fig. 6).

(8) Clamp C/V joint in a vertical position in a soft jawed vise.

(9) Press down one side of the bearing cage to gain access to the ball at the opposite side.

NOTE: If joint is tight, use a hammer and brass drift to loosen the bearing hub. Do not contact the bearing cage with the drift.

(10) Remove ball from the bearing cage (Fig. 7).

(11) Repeat step above until all six balls are removed from the bearing cage.

(12) Lift cage and inner race upward and out from the housing (Fig. 8).

(13) Turn inner race 90° in the cage and rotate the inner race/hub out of the cage (Fig. 9).

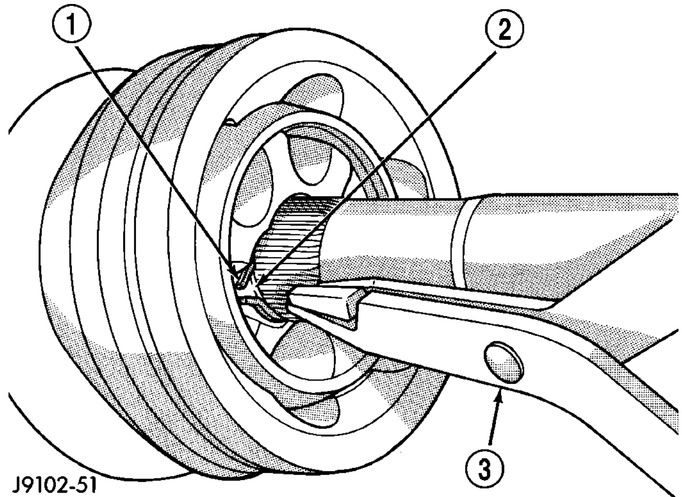


Fig. 5 OUTER C/V JOINT

1 - SNAP RING
2 - SNAP RING GROVE
3 - SNAP RING PLIERS

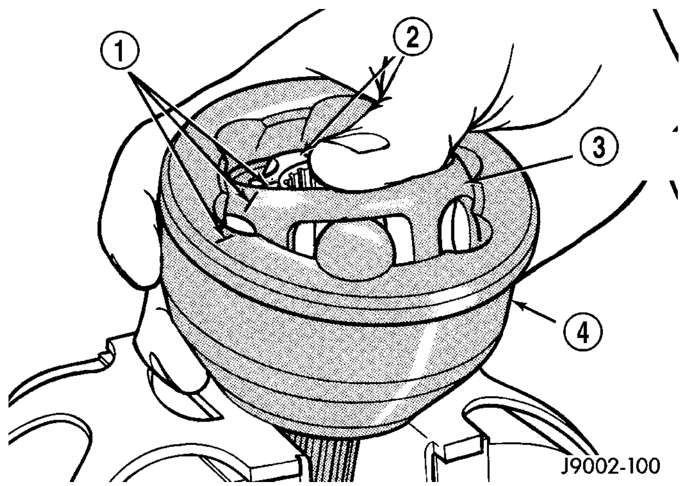


Fig. 6 BEARING ACCESS

1 - ALIGNMENT MARKS
2 - BEARING HUB
3 - BEARING CAGE
4 - HOUSING

INSTALLATION

NOTE: If C/V joint is worn, replace entire C/V joint and boot.

(1) Clean all C/V joint components and shaft.

(2) Apply a light coat of grease supplied with the joint/boot to the C/V joint components before assembling them.

(3) Align the inner race, cage and housing according to the alignment reference marks.

(4) Insert the inner race into the cage (Fig. 10) and rotate race into the cage.

(5) Rotate the inner race/hub in the cage (Fig. 11).

CV JOINT-OUTER (Continued)

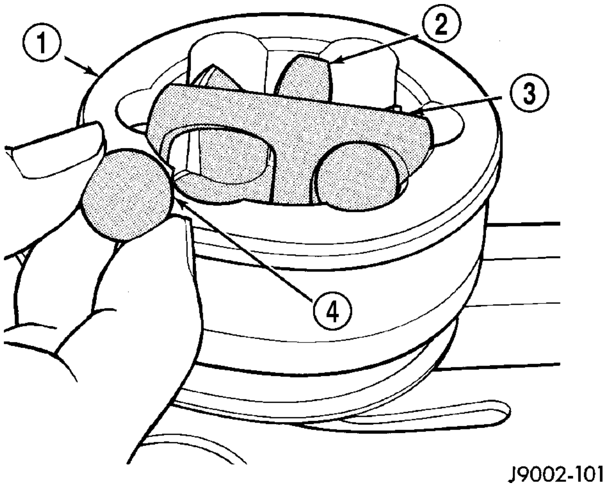


Fig. 7 BEARING

1 - HOUSING
2 - INNER RACE/HUB
3 - BEARING CAGE
4 - BALL

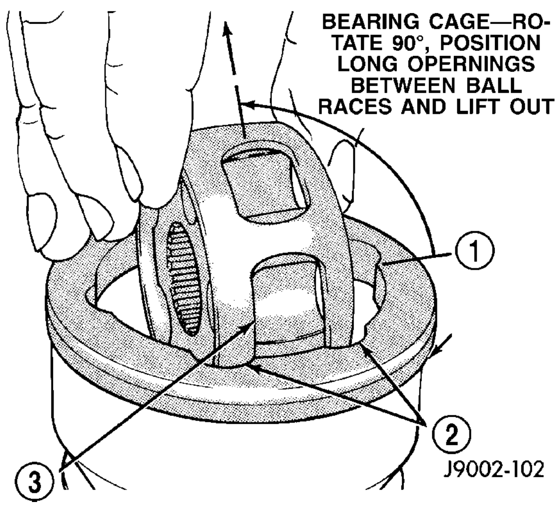


Fig. 8 CAGE AND INNER RACE/HUB

1 - HOUSING
2 - INNER RACE
3 - CAGE WINDOW

(6) Insert cage into the housing (Fig. 12). Rotate the cage 90° into the housing so the large bearing hub counterbore is facing outwards.

(7) Apply the grease supplied with the joint/boot to the ball races. Spread the grease equally between all the races.

(8) Tilt inner race/hub and cage and install the balls (Fig. 13).

(9) Place new clamps onto new boot and slide boot onto the shaft to it’s original position.

(10) Apply the rest of grease to the C/V joint and boot.

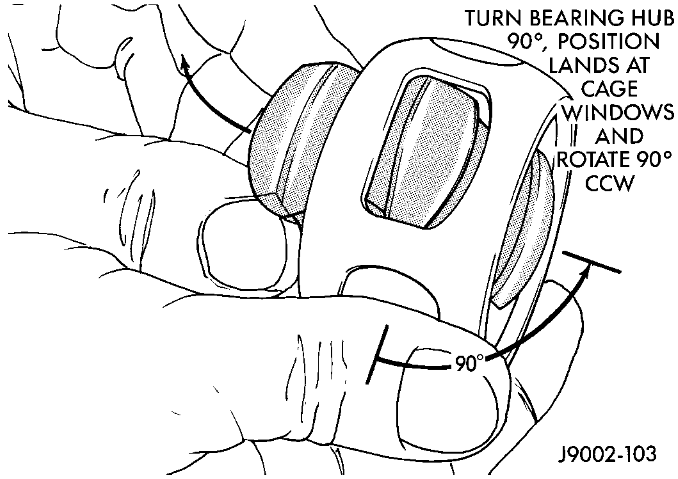


Fig. 9 INNER RACE/HUB

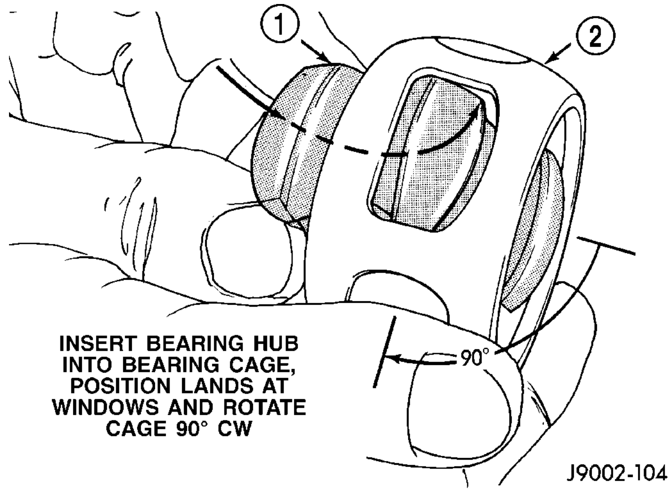


Fig. 10 INNER RACE/HUB

1 - INNER RACE/HUB
2 - BEARING CAGE

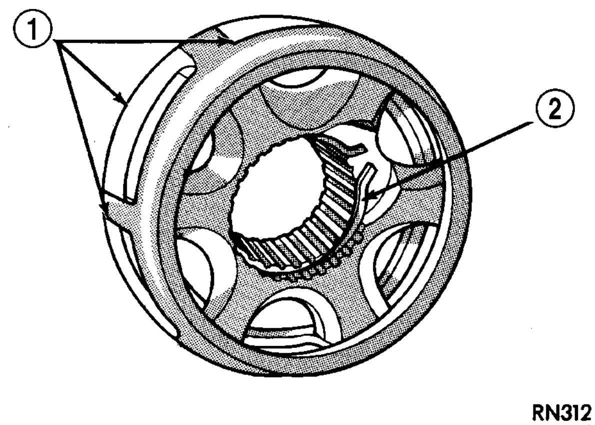


Fig. 11 CAGE AND INNER RACE/HUB

1 - CAGE WINDOWS
2 - SNAP RING

CV JOINT-OUTER (Continued)

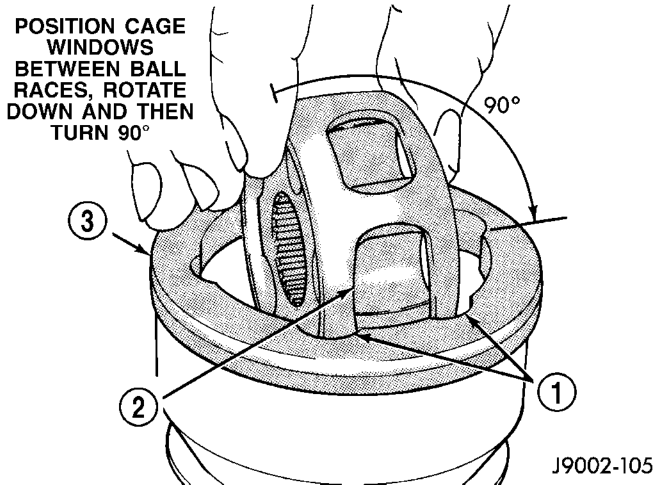


Fig. 12 BEARING CAGE AND HOUSING

1 - OUTER RACE
2 - BEARING CAGE WINDOW
3 - CV JOINT HOUSING

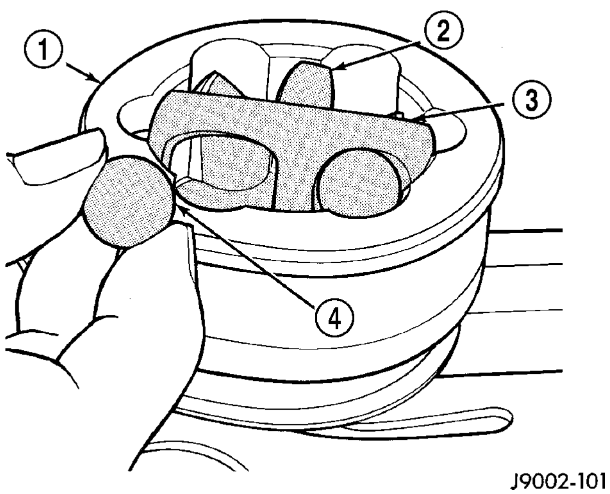


Fig. 13 BALL BEARING

1 - C/V HOUSING
2 - INNER RACE/HUB
3 - BEARING CAGE
4 - BEARING

(11) Install the joint onto the shaft. Push the joint onto the shaft until the snap ring seats in the groove (Fig. 14).

NOTE: Pull on the joint to verify the span ring has engaged.

(12) Position the boot on the joint in it's original position.

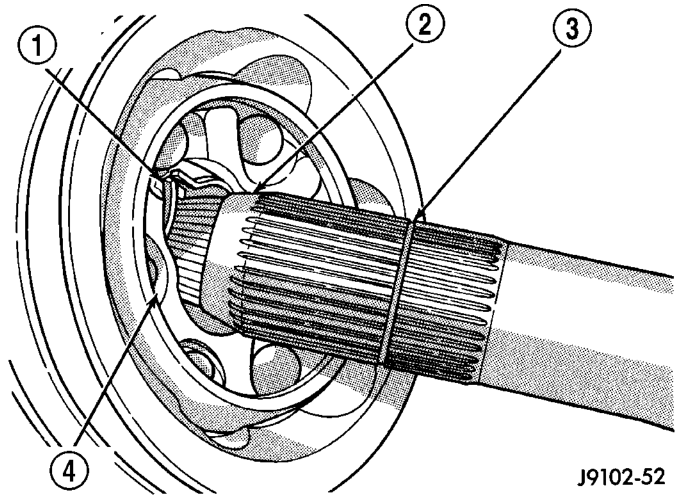


Fig. 14 OUTER C/V JOINT

1 - SNAP RING
2 - SHAFT TAPER
3 - SNAP RING GROVE
4 - BEARING HUB

NOTE: Verify boot is not twisted and remove any excess air.

(13) Secure both boot clamps (Fig. 15) with Clamp Installer C-4975A. Place tool on clamp bridge and tighten tool until jaws of the tool are closed.

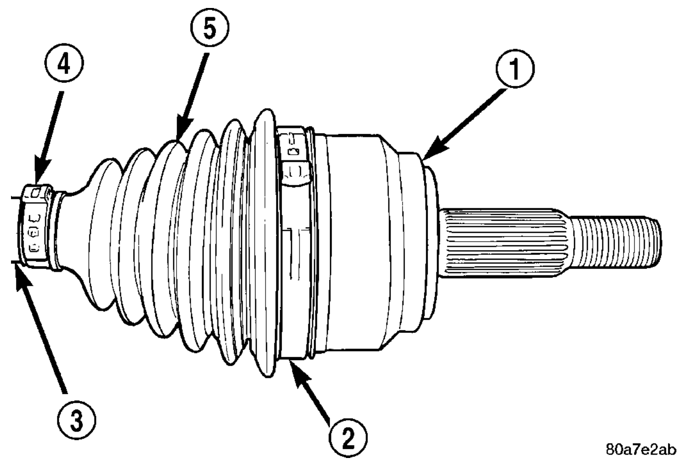


Fig. 15 BOOT CLAMP LOCATIONS

1 - C/V HOUSING
2 - CLAMP
3 - HALF SHAFT
4 - CLAMP
5 - C/V BOOT

CV JOINT-INNER

REMOVAL

(1) Clamp shaft in a vise (with soft jaws) and support C/V joint.

(2) Remove clamps with a cut-off wheel or grinder (Fig. 16).

CAUTION: Do not damage C/V housing or half shaft with cut-off wheel or grinder.

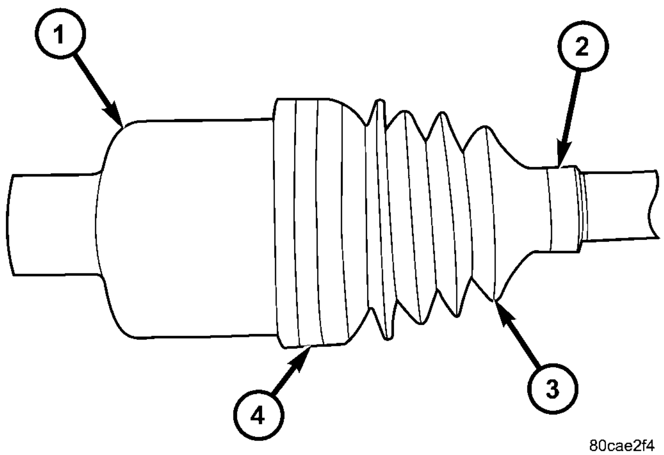


Fig. 16 BOOT CLAMP LOCATION

1 - C/V HOUSING
2 - CLAMP
3 - BOOT
4 - CLAMP

(3) Remove housing from the half shaft (Fig. 17) and slide boot down shaft.

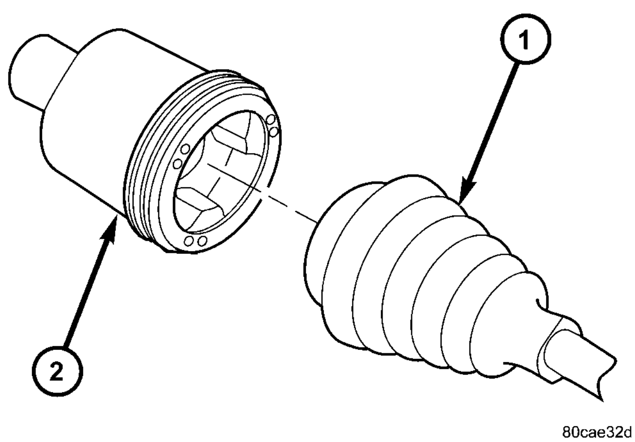


Fig. 17 C/V HOUSING

1 - BOOT
2 - HOUSING

(4) Remove housing bushing from the housing.

(5) Remove tripod snap ring (Fig. 18).

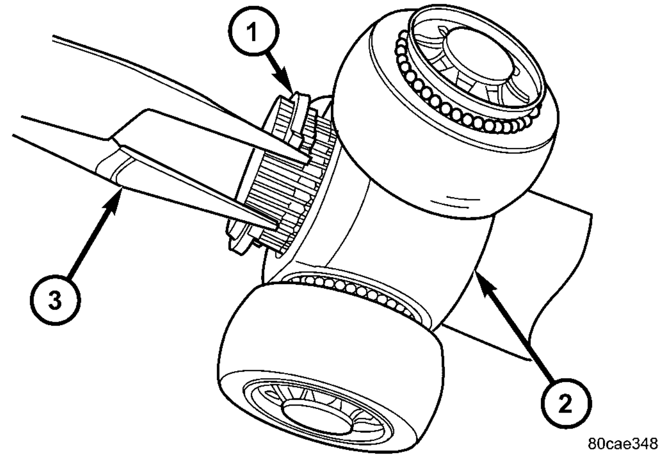


Fig. 18 TRIPOD SNAP RING

1 - SNAP RING
2 - TRIPOD
3 - PLIERS

(6) Remove tripod and boot from the half shaft.

(7) Clean and inspect C/V components for excessive wear and damage. Replace the tripod as a unit only if necessary.

INSTALLATION

(1) Clean all C/V joint components and shaft.

(2) Slide **new** boot down the half shaft.

(3) Install tripod and tripod snap ring on the half shaft (Fig. 19).

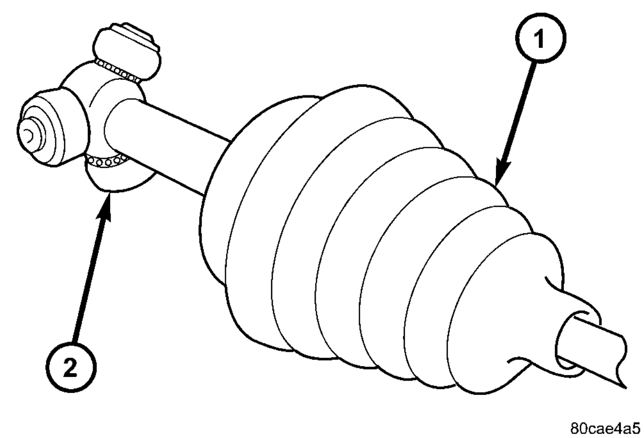


Fig. 19 C/V TRIPOD

1 - BOOT
2 - TRIPOD

(4) Pack grease supplied with the joint/boot into the housing and boot.

(5) Coat tripod with supplied grease.

(6) Install **new** bushing (Fig. 20) onto the housing.

(7) Insert the tripod and shaft in the housing.

CV JOINT-INNER (Continued)

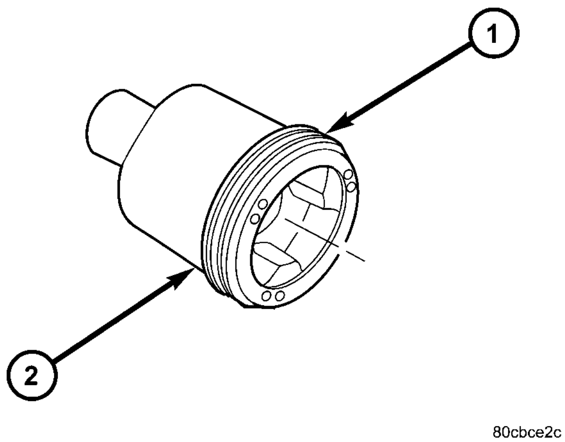


Fig. 20 HOUSING BUSHING

1 - BUSHING
2 - HOUSING

(8) Position the boot on the joint and shaft in it's original position (Fig. 21).

NOTE: Verify boot is not twisted and remove any excess air.

(9) Measure the distance from the end of the housing to the end of the boot on the shaft. This measurement should be 260 mm (10.25 in.).

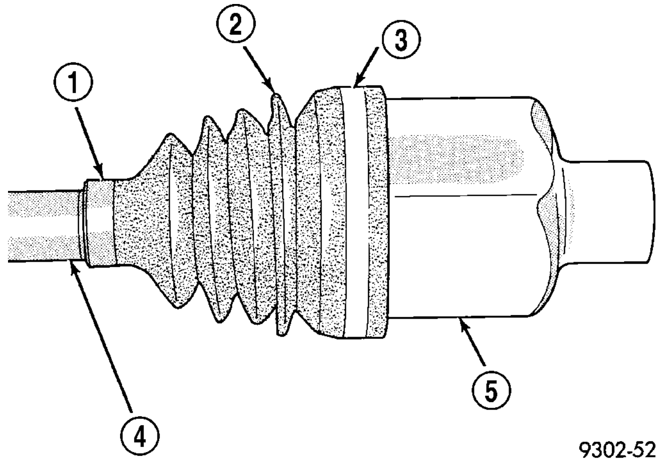


Fig. 21 INNER C/V BOOT

1 - CLAMP
2 - BOOT
3 - CLAMP
4 - SHAFT
5 - HOUSING

NOTE: If measurement is not correct, allow more or less air into the boot.

(10) Secure both boot clamps with Clamp Installer C-4975A. Place tool on clamp bridge and tighten tool until the jaws of the tool are closed.

FRONT AXLE - C205F

TABLE OF CONTENTS

FRONT AXLE - C205F

DESCRIPTION

The axle consists of an alumunum center section with an axle tube extending from one side. The tube is pressed into the differential housing. The power is transferred from the axle through two constant velocity (C/V) drive shafts to the wheel hubs. The drive shafts are identical and interchangeable.

OPERATION

The axle receives power from the propeller shaft. The propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, worn/damaged gears or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side gears and pinions can be checked by turning the vehicle. They usually do not cause noise during straight-ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differen-

FRONT AXLE - C205F (Continued)

tial bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side-gear thrust washers. A worn pinion shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out of balance wheels.
- Loose wheel lug nuts.
- Worn U-joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front end components or engine/transmission mounts. These components can contribute to what appears to be a rear end vibration. Do not overlook engine accessories, brackets and drive belts.

All driveline components should be examined before starting any repair.

(Refer to 22 - TIRES/WHEELS - DIAGNOSIS AND TESTING)

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged) can be caused by:

- High engine idle speed.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U-joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube. 2. Bent or sprung axle shaft. 3. End-play in pinion bearings. 4. Excessive gear backlash between the ring gear and pinion. 5. Improper adjustment of pinion gear bearings. 6. Loose pinion yoke nut. 7. Scuffed gear tooth contact surfaces.	1. Inspect axle tube alignment. Correct as necessary. 2. Inspect and correct as necessary. 3. Refer to pinion pre-load information and correct as necessary. 4. Check adjustment of the ring gear and pinion backlash. Correct as necessary. 5. Adjust the pinion bearings pre-load. 6. Tighten the pinion yoke nut. 7. Inspect and replace as necessary.

FRONT AXLE - C205F (Continued)

Condition	Possible Causes	Correction
Axle Shaft Broke	1. Misaligned axle tube.	1. Replace the broken shaft after correcting tube mis-alignment.
	2 Vehicle overloaded.	2. Replace broken shaft and avoid excessive weight on vehicle.
	3. Erratic clutch operation.	3. Replace broken shaft and avoid or correct erratic clutch operation.
	4. Grabbing clutch.	4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.
Loss Of Lubricant	1. Lubricant level too high.	1. Drain lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.

FRONT AXLE - C205F (Continued)

Condition	Possible Causes	Correction
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

REMOVAL

(1) Place transmission in netural.
(2) Raise and support the vehicle.
(3) Remove tire and wheel assemblies.
(4) Remove axle half shafts.
(5) Remove exhaust crossover.
(6) Mark front propeller shaft and remove shaft.
(7) Remove suspension crossmember mounting bolts (Fig. 1) and remove crossmember.
(8) Support axle with hydraulic jack.
(9) Remove axle housing pinion mounting bolts (Fig. 2).
(10) Remove axle shaft tube mounting bolts (Fig. 3).
(11) Remove differential housing mounting bolts (Fig. 4).
(12) Lower axle from the vehicle.

INSTALLATION

(1) Raise axle into position.
(2) Install axle mounting bolts and tighten nuts to 95 N·m (70 ft. lbs.).
(3) Install suspension crossmember and bolts. Tighten crossmember nuts to 102 N·m (75 ft. lbs.).
(4) Install front propeller shaft with reference marks aligned (Fig. 5) and tighten bolts to 115 N·m (85 ft. lbs.).
(5) Install exhaust crossover.
(6) Install axle half shafts.
(7) Check the differential fluid level and add fluid if necessary.
(8) Install tire and wheel assemblies.
(9) Remove support lower the vehicle.

ADJUSTMENTS

Ring gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and

FRONT AXLE - C205F (Continued)

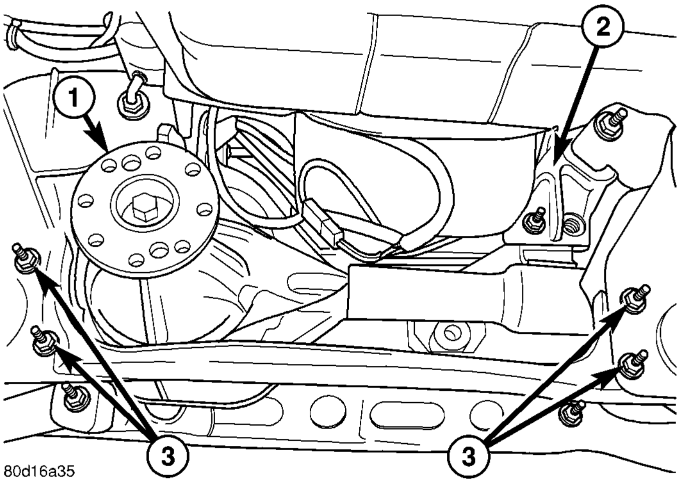


Fig. 1 SUSPENSION CROSSMEMBER

1 - PINION FLANGE
2 - AXLE TUBE MOUNTING BRACKET
3 - CROSSMEMBER BOLTS

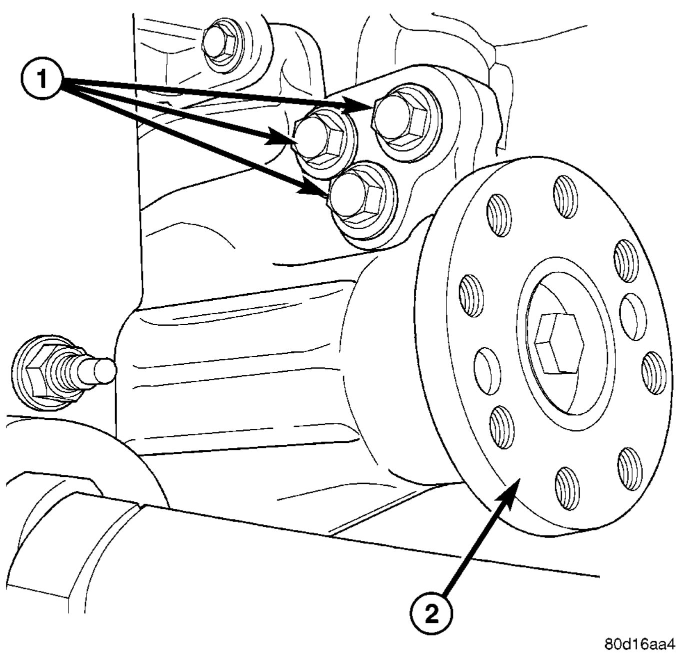


Fig. 2 HOUSING PINION MOUNTING BOLTS

1 - MOUNTING BOLTS
2 - PINION FLANGE

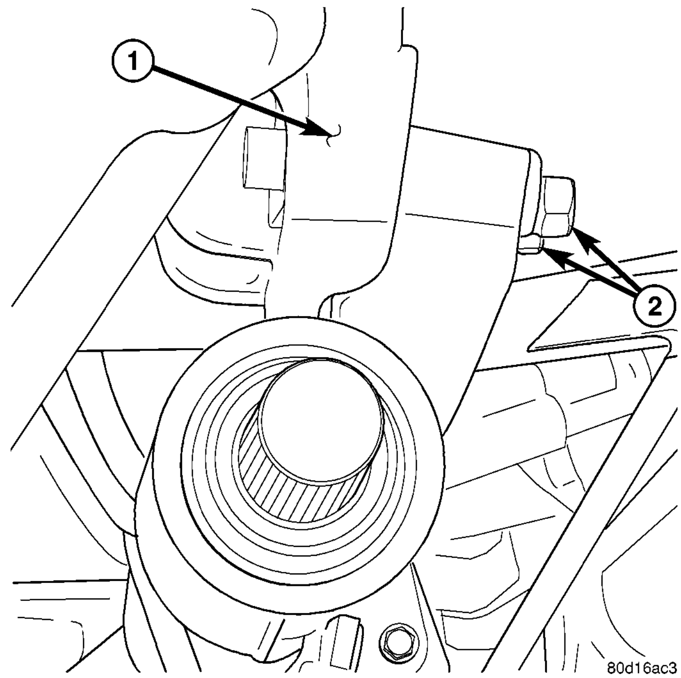


Fig. 3 AXLE TUBE MOUNT

1 - MOUNTING BOLTS
2 - BOLTS

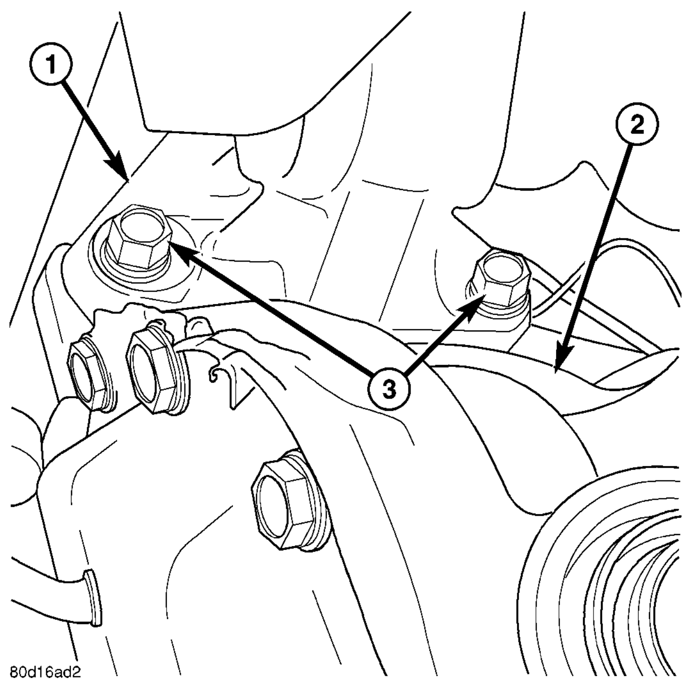


Fig. 4 DIFFERENTIAL MOUNT

1 - DIFFERENTIAL MOUNT
2 - DIFFERENTIAL HOUSING
3 - MOUNTING BOLTS

pinion are painted onto the pinion gear shaft and the side of the ring gear. A plus (+) number, minus (–) number or zero (0) along with the gear set sequence number (01 to 99) is on each gear. This first number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The next two numbers are the sequence number of the gear set. The standard setting from the center line of the ring gear to the back face of the pinion is 99.690 mm (3.925 in.). The standard depth provides the best teeth contact pattern.

Compensation for pinion depth variance is achieved with select shims. The shims are placed

FRONT AXLE - C205F (Continued)

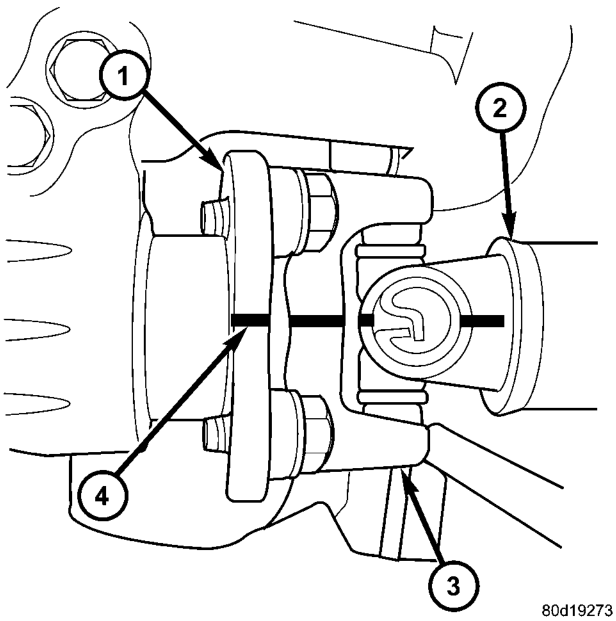


Fig. 5 COMPANION FLANGE

1 - COMPANION FLANGE
2 - PROPELLER SHAFT
3 - FLANGE YOKE
4 - REFERENCE MARK

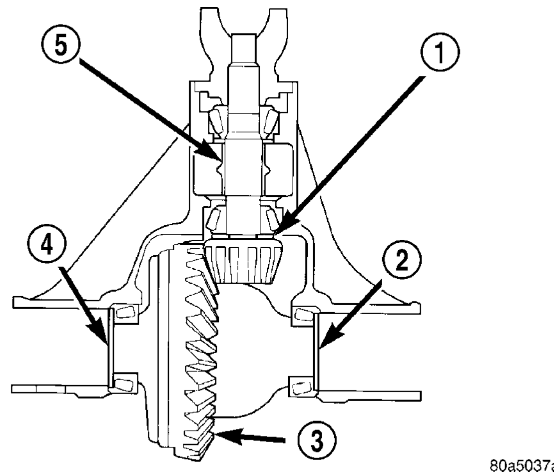


Fig. 6 ADJUSTMENT SHIM

1 - PINION GEAR DEPTH SHIM
2 - DIFFERENTIAL BEARING PRELOAD SHIM
3 - RING GEAR
4 - DIFFERENTIAL BEARING PRELOAD SHIM
5 - COLLAPSIBLE SPACER

between the rear pinion bearing cone and the pinion gear head. (Fig. 6).

If a new gear set is being installed, note the depth variance marked on both the original and replacement pinion. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Pinion Gear Depth Variance charts. Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus amount needed.

Note the painted number on the shaft of the drive pinion (–1, –2, 0, +1, +2, etc.). The numbers represent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shim(s). If the number is positive, subtract that value from the thickness of the depth shim(s). If the number is 0 no change is necessary.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	New Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

FRONT AXLE - C205F (Continued)

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion cups and pinion bearings installed in housing. Take measurements with a Pinion Gauge Set, Pinion Block 8177, Arbor Discs 8541 and Dial Indicator C-3339 (Fig. 7).

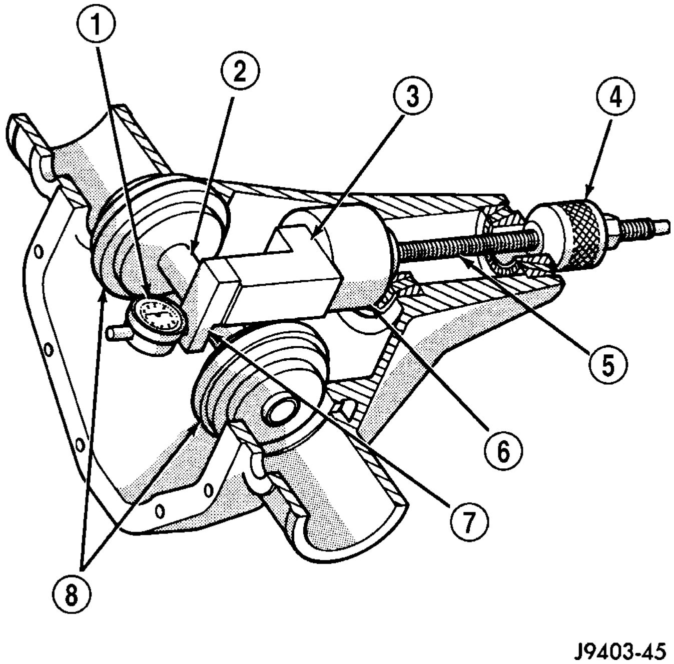


Fig. 7 PINION GEAR DEPTH GAUGE

1 - DIAL INDICATOR
2 - ARBOR
3 - PINION HEIGHT BLOCK
4 - CONE
5 - SCREW
6 - PINION BLOCK
7 - SCOOTER BLOCK
8 - ARBOR DISC

(1) Assemble Pinion Height Block 6739, Pinion Block 8177 and rear pinion bearing onto Screw 6741 (Fig. 7).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through the pinion bearing cups (Fig. 8).

(3) Install front pinion bearing and Cone 6740 onto the screw hand tight (Fig. 7).

(4) Place Arbor Discs 8541 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 9). Install differential bearing caps on arbor discs and tighten cap bolts to specification.

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Place Scooter Block/Dial Indicator in position in the housing so dial probe and scooter block are flush against the surface of the pinion height block. Hold scooter block in place and zero the dial indicator. Tighten dial indicator face lock screw.

(7) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 10). Slide the dial probe to the crest of the arbor bar and record the highest reading.

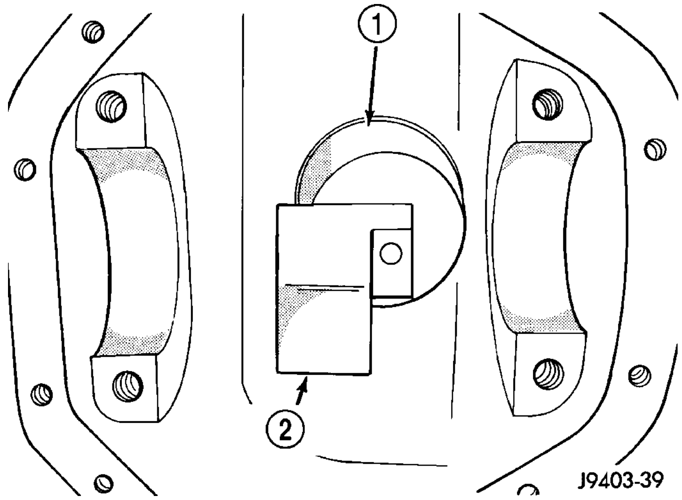


Fig. 8 PINION HEIGHT BLOCK

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

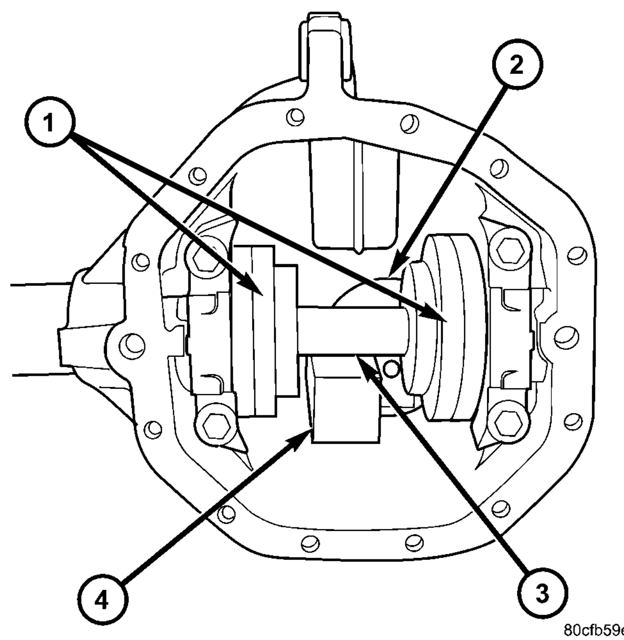


Fig. 9 PINION GAUGE TOOLS

1 - ARBOR DISC
2 - PINION BLOCK
3 - ARBOR
4 - PINION HEIGHT BLOCK

(8) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number marked on the shaft of the pinion gear using the opposite sign on the variance number. For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

FRONT AXLE - C205F (Continued)

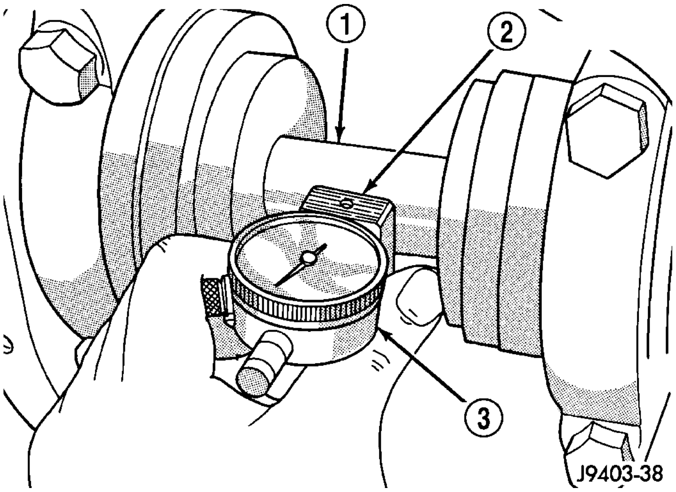


Fig. 10 PINION GEAR DEPTH MEASUREMENT

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

(9) Remove the pinion depth gauge components from the housing

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

Differential side bearing preload and gear backlash is achieved by selective shims inserted between the bearing cup and the housing. The proper shim thickness can be determined using slip-fit Dummy Bearings 8398 in place of the differential side bearings and a Dial Indicator C-3339. Before proceeding with the differential bearing preload and gear backlash measurements, measure the pinion gear depth and prepare the pinion for installation. Establishing proper pinion gear depth is essential to establishing gear backlash and tooth contact patterns. After the overall shim thickness to take up differential side play is measured, the pinion is installed, and the gear backlash shim thickness is measured. The overall shim thickness is the total of the dial indicator reading, starting point shim thicknesses, and the preload specification added together. The gear backlash measurement determines the thickness of the shim used on the ring gear side of the differential case. Subtract the gear backlash shim thickness from the total overall shim thickness and select that amount for the pinion side of the differential (Fig. 11).

SHIM SELECTION

NOTE: It is difficult to salvage the differential side bearings during the removal procedure. Install replacement bearings if necessary.

(1) Remove side bearings from differential case.

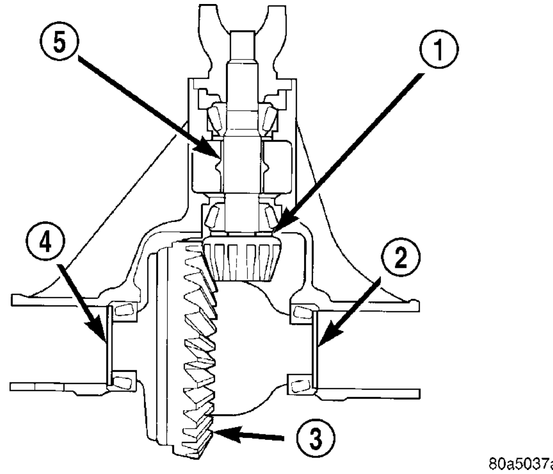


Fig. 11 ADJUSTMENT SHIM

1 - PINION GEAR DEPTH SHIM
2 - DIFFERENTIAL BEARING PRELOAD SHIM
3 - RING GEAR
4 - DIFFERENTIAL BEARING PRELOAD SHIM
5 - COLLAPSIBLE SPACER

(2) Install ring gear if necessary, on differential case and tighten bolts to specification.

(3) Install Dummy Bearings 8398 on differential case.

(4) Install differential case in the housing.

(5) Insert Dummy Shims 8107 3.0 mm (0.118 in.) starting point shims between both dummy bearings and the housing (Fig. 12).

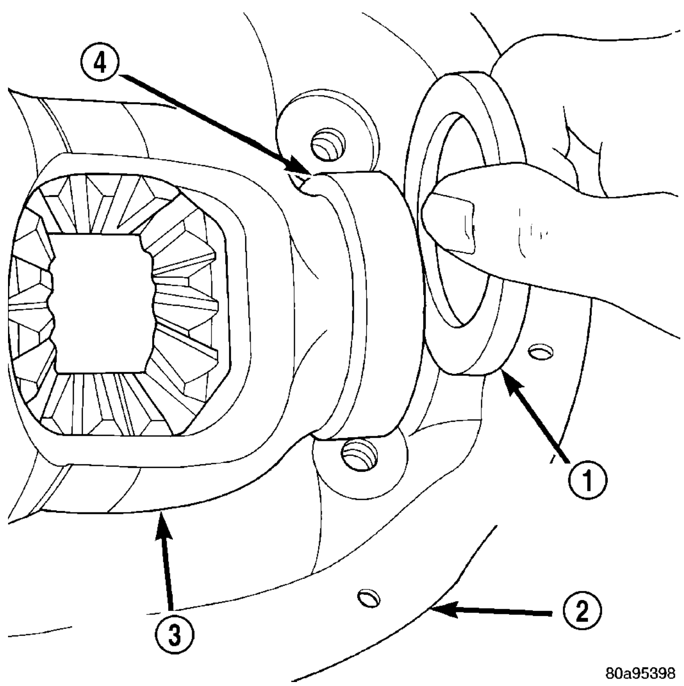


Fig. 12 DUMMY SHIM

1 - DUMMY SHIM
2 - DIFFERENTIAL HOUSING
3 - DIFFERENTIAL CASE
4 - DUMMY BEARINGS

FRONT AXLE - C205F (Continued)

(6) Install the marked bearing caps in their correct positions. Install and snug the bolts.

(7) Using a dead-blow hammer to seat the differential dummy bearings to each side of the differential housing (Fig. 13) and (Fig. 14).

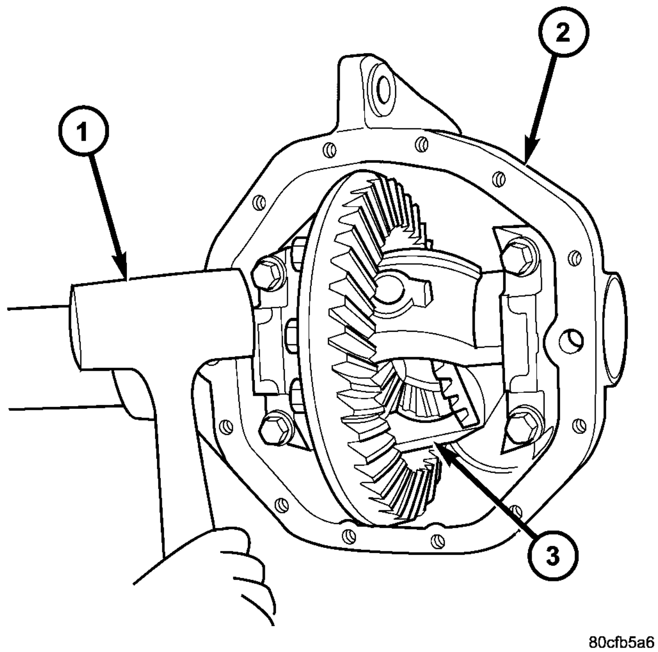


Fig. 13 SEAT PINION GEAR SIDE

1 - DEAD-BLOW HAMMER
2 - HOUSING
3 - PINION GEAR SIDE

(8) Install Pilot Stud C-3288-B in cover bolt hole below ring gear.

(9) Attach Dial Indicator C-3339 to post and position dial indicator plunger on a flat surface on a ring gear bolt head (Fig. 15).

(10) Push and hold differential to the pinion gear side of the housing (Fig. 16) and zero dial indicator.

(11) Push and hold differential case to the ring gear side and record dial indicator reading (Fig. 17).

(12) Add the dial indicator reading to the starting point shim thicknesses to determine the total shim thickness necessary to achieve zero differential end play.

(13) Add 0.2 mm (0.008 in) to the zero end play total. This new total represents the shims needed to preload the new differential case bearings.

(14) Rotate dial indicator out of the way on pilot stud.

(15) Remove differential case, dummy bearings and dummy shims from the housing.

(16) Install the pinion gear in the housing. Install the companion flange and establish the correct pinion rotating torque.

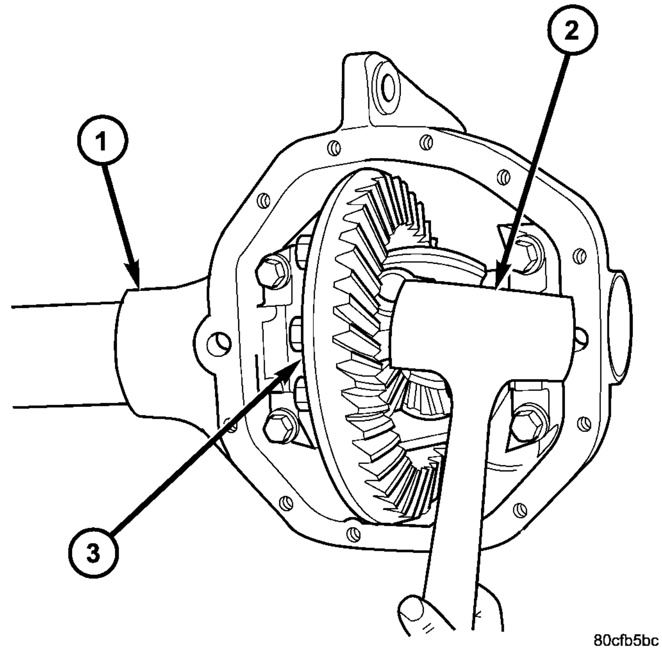


Fig. 14 SEAT RING GEAR SIDE

1 - HOUSING
2 - DEAD-BLOW HAMMER
3 - RING GEAR SIDE

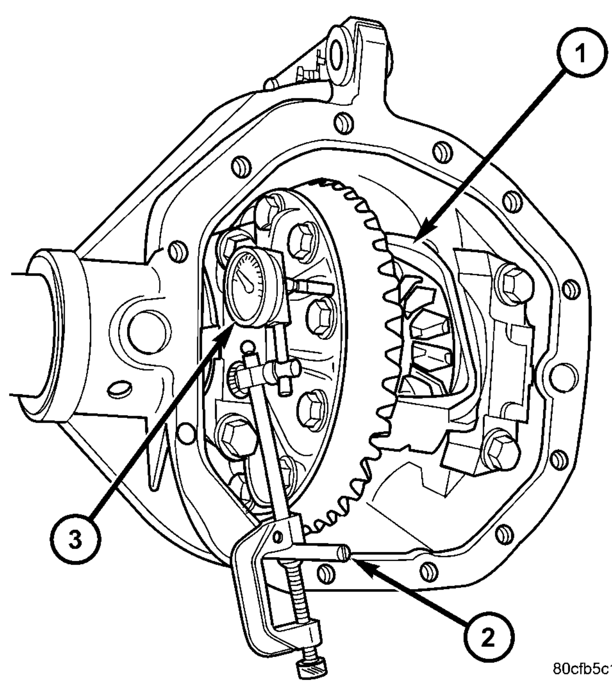


Fig. 15 DIFFERENTIAL SIDE PLAY

1 - DIFFERENTIAL
2 - PILOT STUD
3 - DIAL INDICATOR
4 - HOUSING

(17) Install differential case and Dummy Bearings in the housing with a single dummy shim on the ring gear side of the axle and tighten retaining cap bolts.

FRONT AXLE - C205F (Continued)

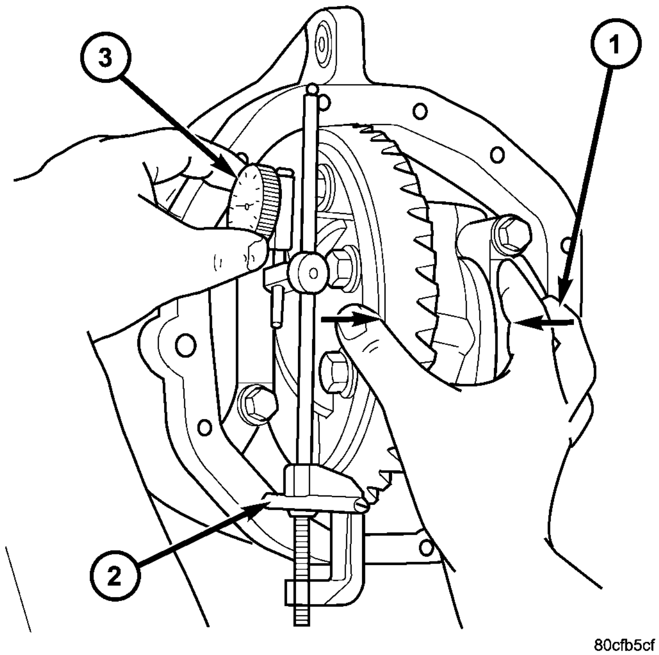


Fig. 16 ZERO DIAL INDICATOR

1 - PINION GEAR SIDE
2 - PILOT STUD
3 - DIAL INDICATOR

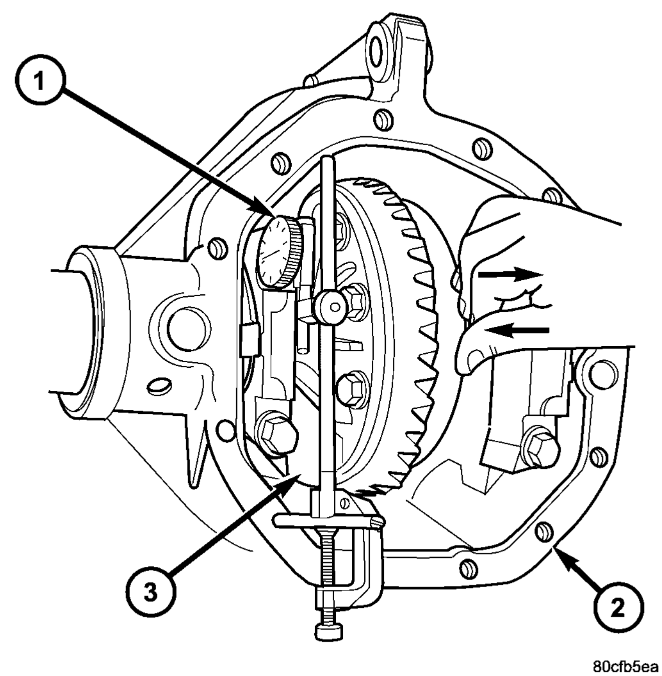


Fig. 17 RECORD DIAL INDICATOR

1 - DIAL INDICATOR
2 - HOUSING
3 - RING GEAR SIDE

(18) Position the dial indicator plunger on a flat surface between the ring gear bolt heads (Fig. 15).

(19) Push and hold differential case toward pinion.

(20) Zero dial indicator face to pointer.

(21) Push and hold differential case to ring gear side of the housing.

(22) Record dial indicator reading.

(23) Subtract 0.05 mm (0.002 in.) from the dial indicator reading to compensate for backlash between ring and pinion gears. Add the resulting measurement to the thickness of the single dummy shim. This is the thickness of shim required to achieve proper backlash.

(24) Subtract the backlash shim thickness from the total preload shim thickness. The remainder is the shim thickness required on the pinion side of the housing.

(25) Rotate dial indicator out of the way on pilot stud.

(26) Remove differential case, dummy bearings and dummy shim from the housing.

(27) Install new side bearing cones and cups on differential case.

(28) Install Spreader W-129-B and Adapter Plates 8142-A on the housing and spread open enough to receive differential case.

CAUTION: Never spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(29) Place the side bearing shims in the differential housing against the housing shoulder.

(30) Install the differential case in the housing.

(31) Rotate the differential case several times to seat the side bearings.

(32) Position the dial indicator plunger against a ring gear tooth (Fig. 18).

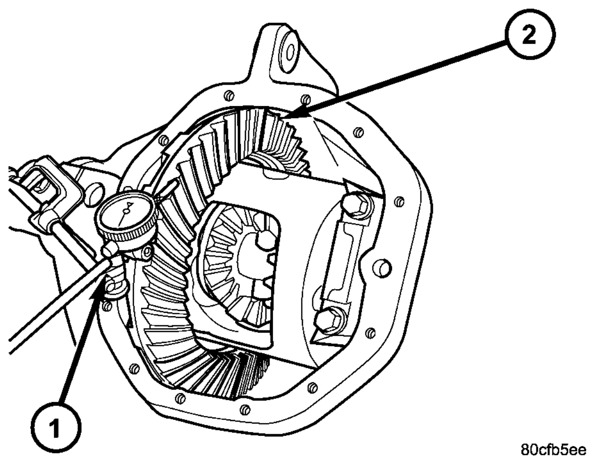


Fig. 18 RING GEAR BACKLASH

1 - RING GEAR
2 - DIAL INDICATOR

(33) Push and hold ring gear upward while not allowing the pinion gear to rotate.

FRONT AXLE - C205F (Continued)

(34) Zero dial indicator face to pointer.

(35) Push and hold ring gear downward while not allowing the pinion gear to rotate. Dial indicator reading should be between 0.12 mm (0.005 in.) and 0.20 mm (0.008 in.). If backlash is not within specifications transfer the necessary amount of shim thickness from one side of the differential housing to the other (Fig. 19).

(36) Verify differential case and ring gear runout by measuring ring to pinion gear backlash at eight locations around the ring gear. Readings should not vary more than 0.05 mm (0.002 in.). If readings vary more than specified, the ring gear or the differential case is defective.

After the proper backlash is achieved, perform the Gear Contact Pattern procedure.

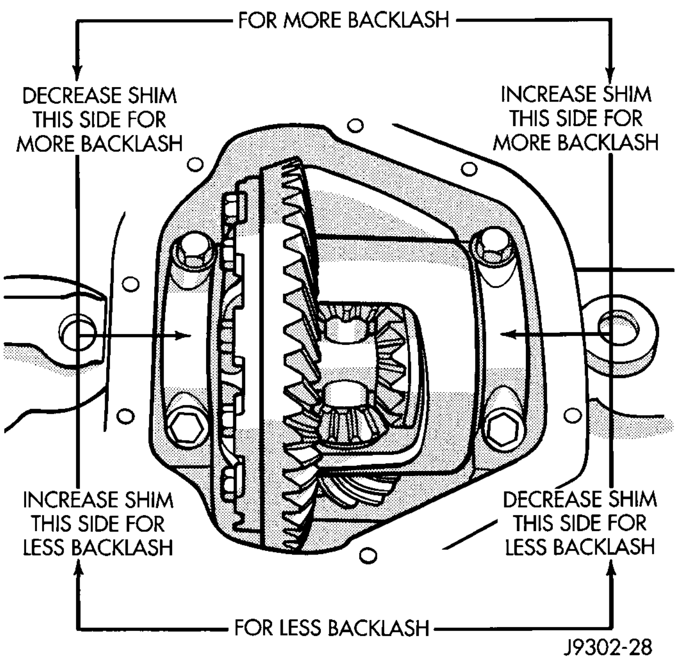


Fig. 19 BACKLASH SHIM ADJUSTMENT

GEAR CONTACT PATTERN

Gear tooth contact pattern is used to verify the correct running position of the ring and pinion gears. This will produce low noise and long gear life. Gears which are not positioned properly may be noisy and have shorten gear life.

(1) Wipe clean each tooth of the ring gear.

(2) Apply gear marking compound to all of the ring gear teeth.

(3) Verify bearing cap bolts are torque specification.

(4) Apply the brakes lightly to create at 14 N·m (10 ft. lbs.) pinion rotating torque.

(5) Rotate the pinion/pinion yoke 4 full revolutions in each directions.

(6) Read gear tooth contact pattern:

- Gear contact pattern correct (Fig. 20). Backlash and pinion depth is correct.

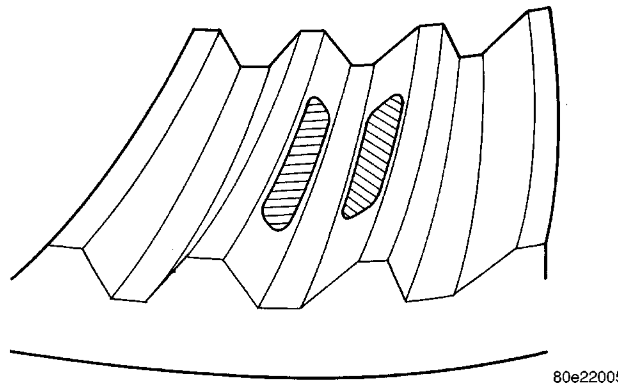


Fig. 20 CORRECT CONTACT PATTERN

- Ring gear too far away from pinion gear (Fig. 21). Decrease backlash by moving the ring closer to the pinion gear.

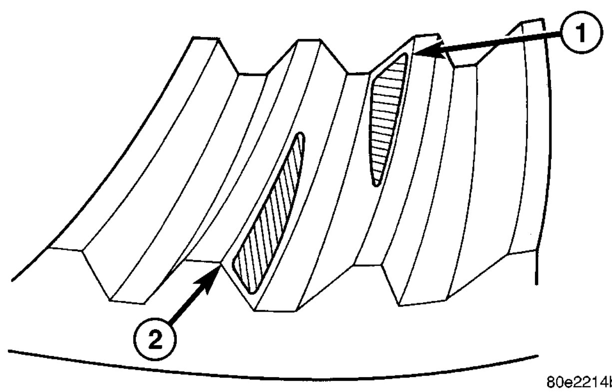


Fig. 21 INCORRECT BACKLASH

1 - COAST SIDE TOE
2 - DRIVE SIDE HEEL

- Ring gear too close to pinion gear (Fig. 22). Increase backlash, by moving the ring away from the pinion gear.

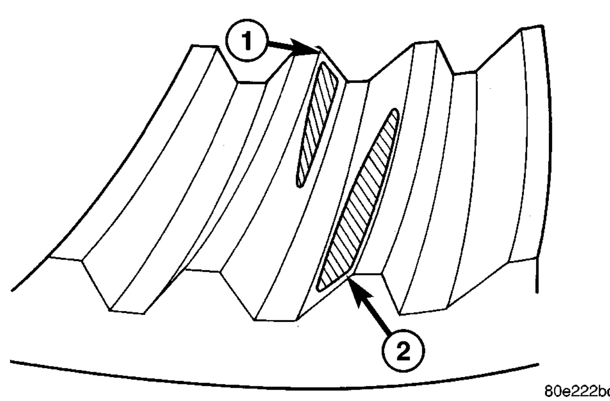


Fig. 22 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE HEEL

FRONT AXLE - C205F (Continued)

• Ring gear too far away from pinion gear (Fig. 23). Decrease backlash, by moving the ring closer to the pinion gear.

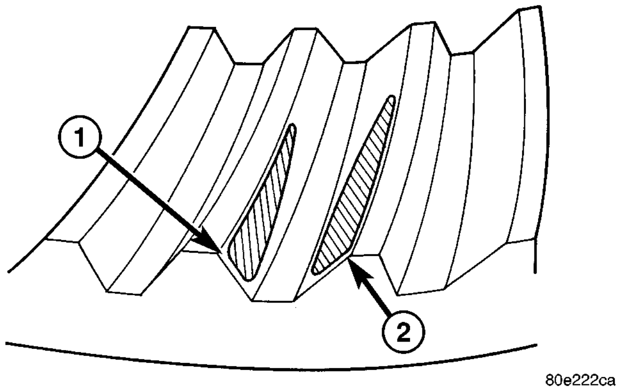


Fig. 23 INCORRECT BACKLASH

1 - DRIVE SIDE HEEL
2 - COAST SIDE HEEL

• Ring gear too close to pinion gear (Fig. 24). Increase backlash, by moving the ring away from the pinion gear.

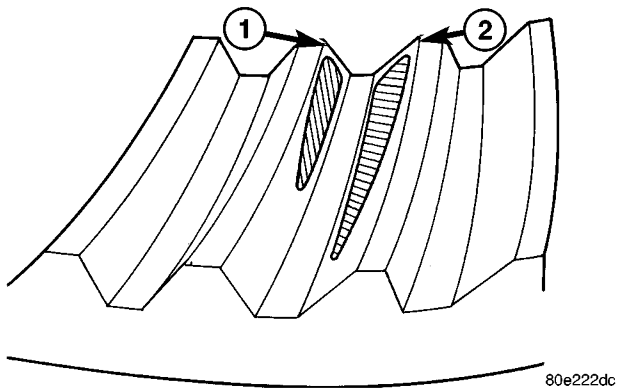


Fig. 24 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE TOE

• Pinion gear set too low (Fig. 25). Increase pinion gear height, by increasing the pinion depth shim thickness.

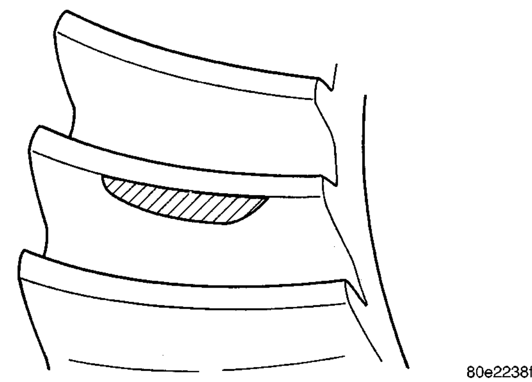


Fig. 25 LOW PINION HEIGHT

• Pinion gear set too high (Fig. 26). Decrease pinion depth, by decreasing the pinion depth shim thickness.

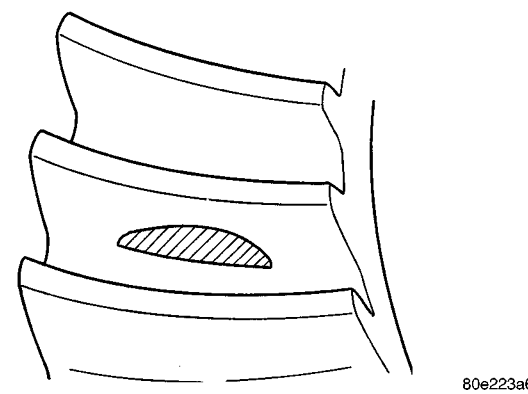


Fig. 26 HIGH PINION HEIGHT

SPECIFICATIONS

AXLE SPECIFICATIONS

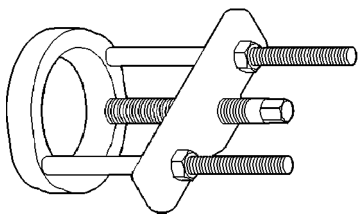
DESCRIPTION	SPECIFICATION
Axle Ratio	3.55, 3.92
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Side Gear Clearance	0-0.15 mm (0-0.006 in.)
Ring Gear Diameter	205 mm (8.0 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Bearing Preload - New Bearings	2.0-2.8 N·m (18-25 in. lbs.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)

FRONT AXLE - C205F (Continued)

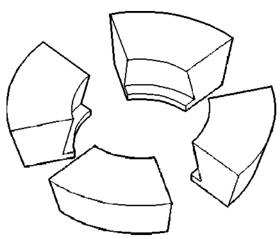
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Mounting Nuts	95	70	-
Differential Fill Hole Plug	34	25	-
Differential Cover Bolts	22	15	-
Bearing Cap Bolts	61	45	-
Ring Gear Bolts	108	80	-
Pinion Nut	271-475	200-350	-

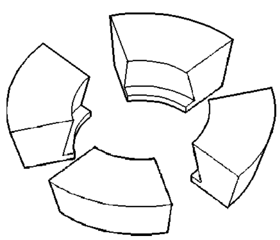
SPECIAL TOOLS



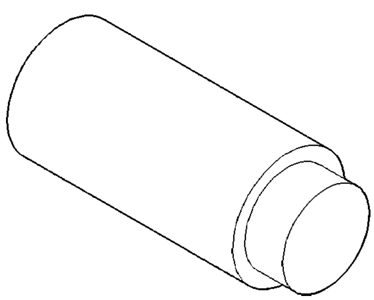
PULLER C-293-PA



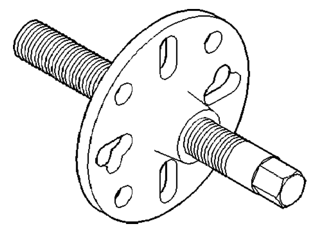
ADAPTER C-293-42



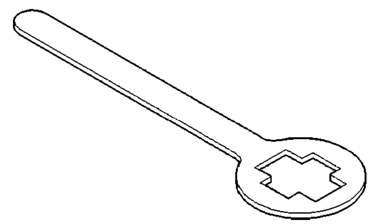
ADAPTER C-293-48



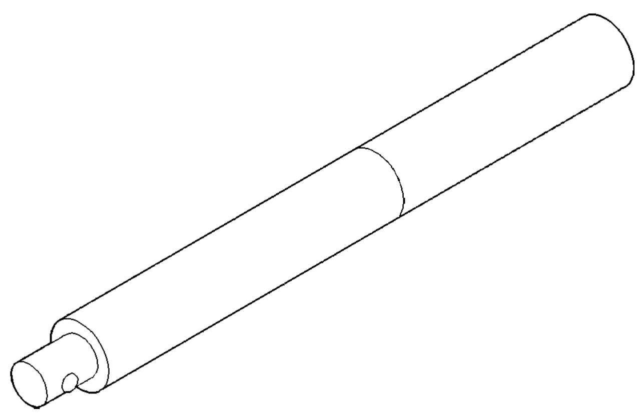
PLUG C-293-3



PULLER C-452

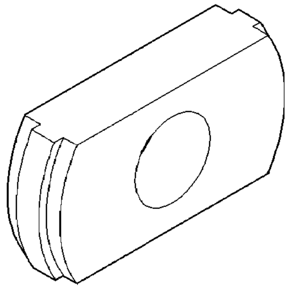


HOLDER 6719A

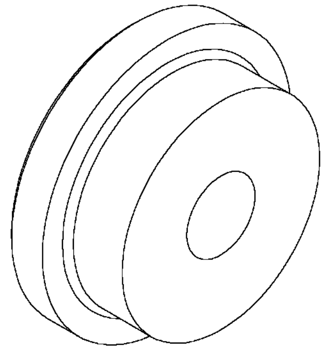


HANDLE C-4171

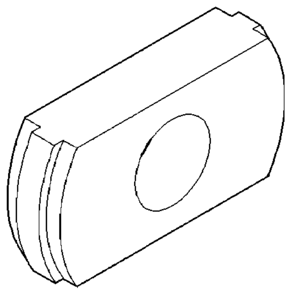
FRONT AXLE - C205F (Continued)



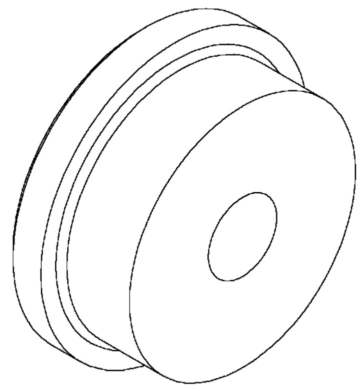
REMOVER 8401



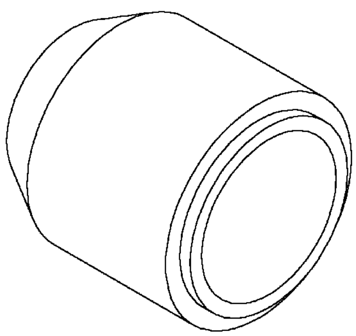
INSTALLER 8693



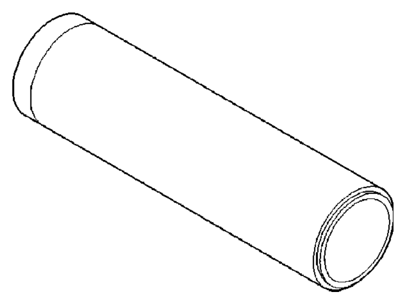
REMOVER 8831



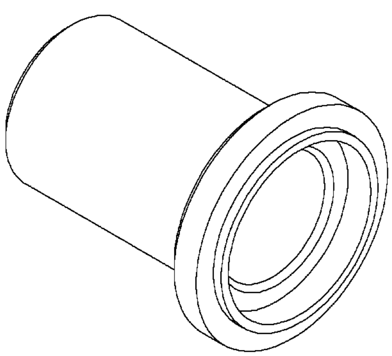
INSTALLER 8692



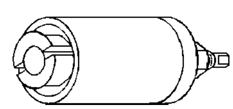
INSTALLER 8695



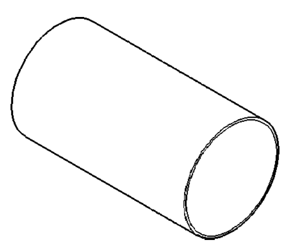
INSTALLER 6448



INSTALLER 8694

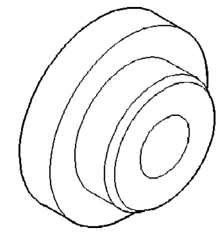


REMOVER C-4660-A

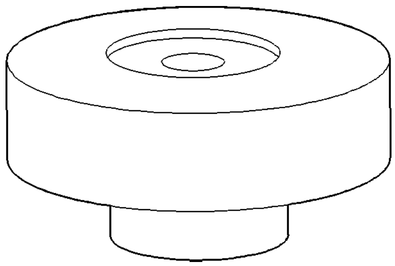


CUP 8150

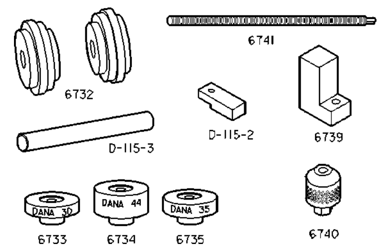
FRONT AXLE - C205F (Continued)



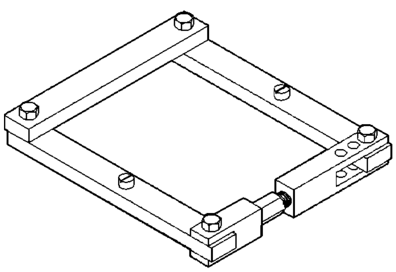
INSTALLER 5063



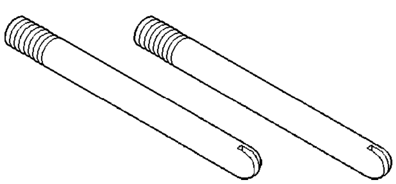
PINION BLOCK 8177



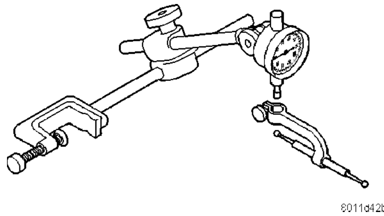
PINION DEPTH SET 6775



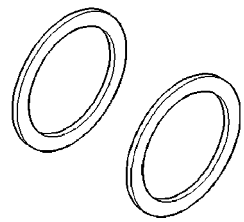
SPREADER W-129-B



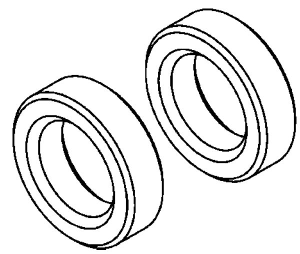
PILOTS C-3288-B



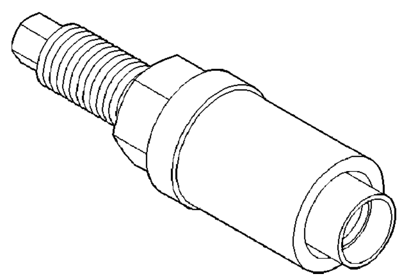
DIAL INDICATOR C-3339



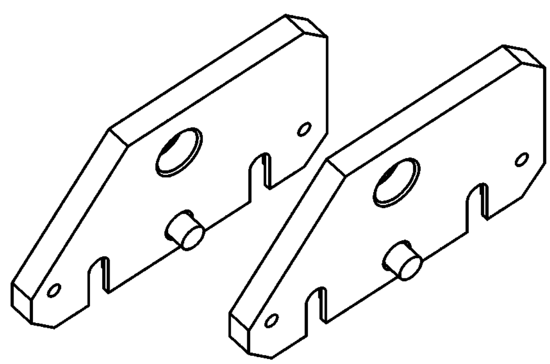
DUMMY SHIM 8107



DUMMY BEARING 8398



INSTALLER C-3718



ADAPTER PLATES 8142A

AXLE SHAFTS

REMOVAL

(1) Remove half shaft from vehicle.
(2) Remove skid plate, if equipped.
(3) Clean axle seal area.
(4) Remove snap ring from the axle shaft.
(5) Remove axle with Remove 8420A Collar 8420-3 and Slide Hammer C-3752 (Fig. 27).

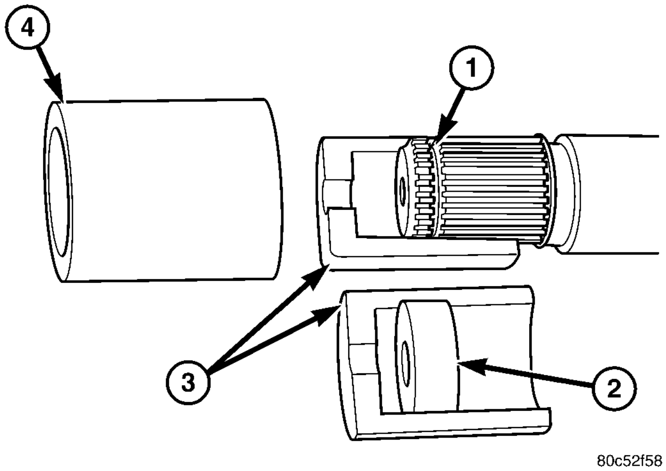


Fig. 27 AXLE SHAFT PULLER

1 - SNAP RING GROVE
2 - SLID HAMMER THREADS
3 - REMOVER BLOCKS
4 - REMOVER COLLAR

INSTALLATION

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(1) Lubricate bearing bore and seal lip with gear lubricant.
(2) Insert axle shaft through seal, bearing, and engage it into side gear splines. Push firmly on the axle shaft to engage the snap-ring.
(3) Check the differential fluid level and add fluid if necessary.
(4) Install skid plate, if necessary.
(5) Install half shaft.

AXLE SHAFT SEALS

REMOVAL

(1) Remove half shaft from vehicle.
(2) Remove skid plate, if equipped.
(3) Clean axle seal area.
(4) Remove axle shaft O-ring.
(5) Remove axle shaft.
(6) Remove axle shaft seal with a small pry bar.

INSTALLATION

(1) Clean axle shaft bore clean.
(2) Install a **new** axle shaft seal with Installer 8694 and Handle C-4171.
(3) Lubricate seal lip with gear lubricant.
(4) Insert axle shaft through seal, bearing, and engage it into side gear splines. Push firmly on the axle shaft to engage the snap-ring.

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(5) Install axle shaft O-ring.
(6) Check the differential fluid level and add fluid if necessary.
(7) Install skid plate, if necessary.
(8) Install half shaft.

AXLE BEARINGS

REMOVAL

(1) Remove half shaft from vehicle.
(2) Remove skid plate, if equipped.
(3) Clean axle seal area.
(4) Remove axle shaft O-ring.
(5) Remove axle shaft.
(6) Remove axle shaft seal.
(7) Install axle shaft bearing Remover C-4660-A in the bearing (Fig. 28). Then tighten the nut to spread the remover in the bearing.

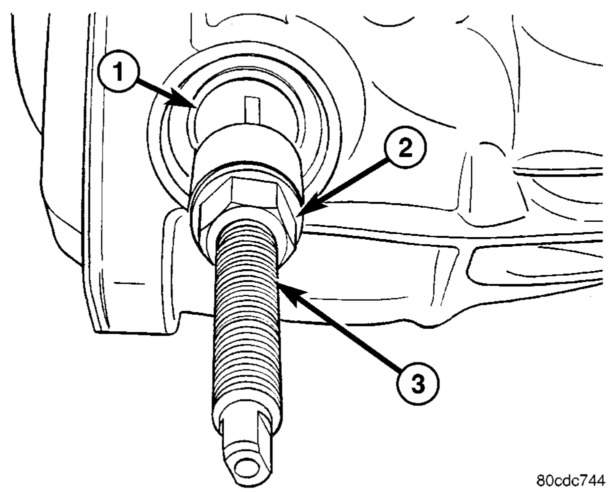


Fig. 28 BEARING REMOVER

1 - AXLE BEARING
2 - NUT
3 - REMOVER

(8) Install the bearing remove cup, bearing and nut (Fig. 29). Then tighten the nut to draw the bearing out.

AXLE BEARINGS (Continued)

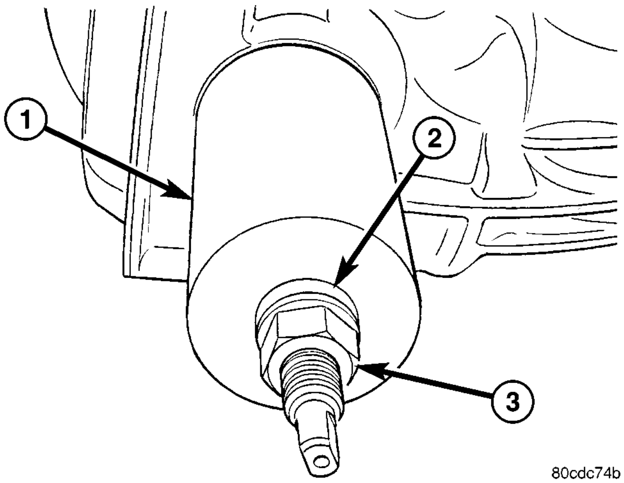


Fig. 29 BEARING REMOVER CUP

1 - REMOVER CUP
2 - BEARING
3 - NUT

(9) Inspect the axle shaft tube bore for roughness and burrs. Remove as necessary.

INSTALLATION

(1) Wipe the axle shaft tube bore clean.

(2) Install axle shaft bearing with Installer 5063 and Handle C-4171 (Fig. 30).

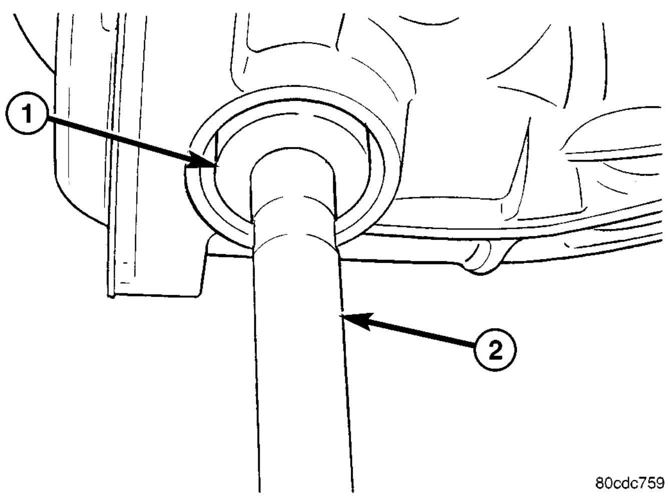


Fig. 30 BEARING INSTALLER

1 - INSTALLER
2 - HANDLE

(3) Install a **new** axle shaft seal with Installer 8694 and Handle C-4171.

(4) Lubricate seal lip with gear lubricant.

(5) Insert axle shaft through seal, bearing and engage it into side gear splines. Push firmly on the axle shaft to engage the snap-ring.

NOTE: Use care to prevent shaft splines from damaging axle shaft seal lip.

(6) Install axle shaft O-ring.

(7) Check the differential fluid level and add fluid if necessary.

(8) Install skid plate, if necessary.

(9) Install half shaft.

PINION SEAL

REMOVAL

(1) Remove skid plate, if equipped.

(2) Remove both half shafts.

(3) Mark the propeller shaft and pinion companion flange (Fig. 31) for installation reference.

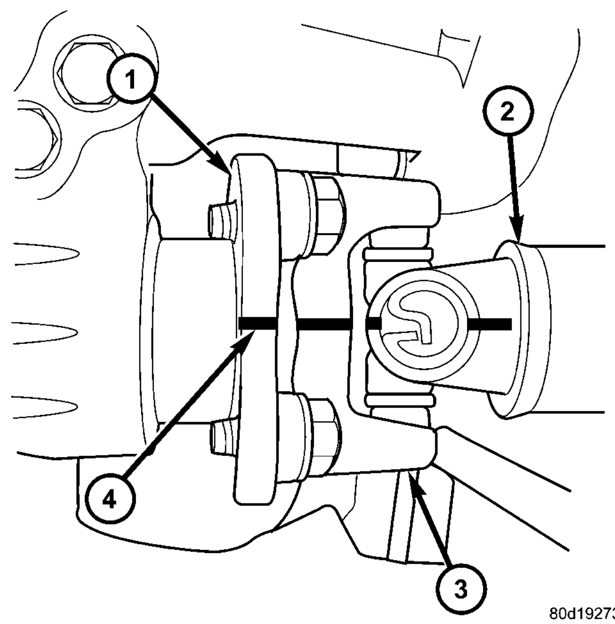


Fig. 31 COMPANION FLANGE

1 - COMPANION FLANGE
2 - PROPELLER SHAFT
3 - FLANGE YOKE
4 - REFERENCE MARK

(4) Remove the front propeller shaft.

(5) Rotate the pinion gear three or four times and verify pinion rotates smoothly.

(6) Record pinion rotating torque with an inch pound torque wrench, for installation reference (Fig. 32).

(7) Position Holder 6719 against the companion flange and install a four bolts and washers into the threaded holes and tighten the bolts.

(8) Remove the pinion nut.

(9) Remove the companion flange with Remover C-452 (Fig. 33).

(10) Remove pinion seal with a pry tool or a slide hammer mounted screw.

PINION SEAL (Continued)

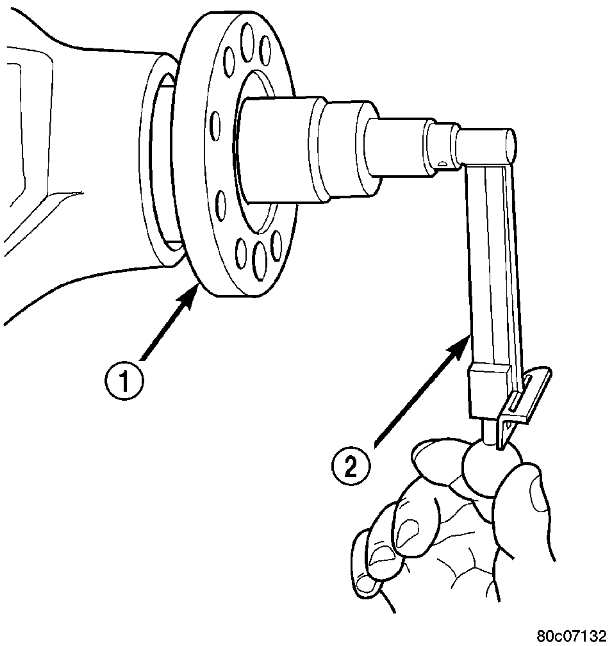


Fig. 32 PINION ROTATING TORQUE

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

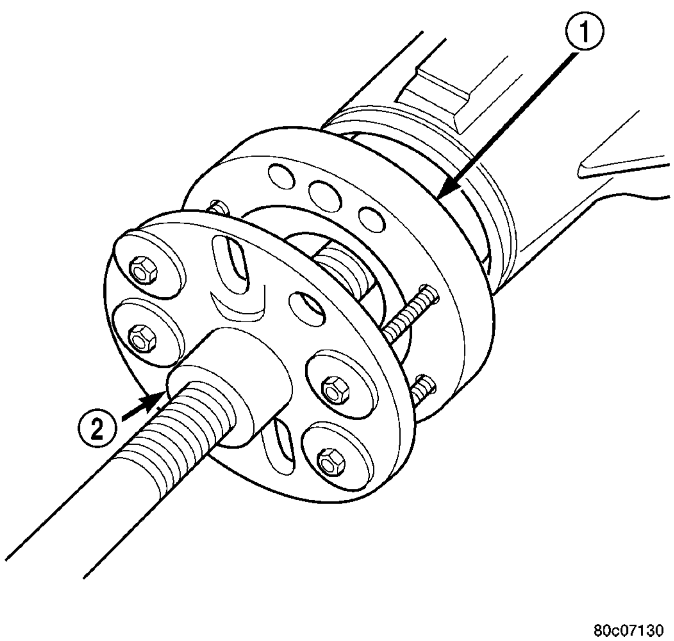


Fig. 33 COMPANION FLANGE REMOVER

1 - COMPANION FLANGE
2 - PULLER TOOL

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal.

(2) Install seal with Installer 8695 and Handle C-4171 (Fig. 34).

(3) Install companion flange onto the pinion with Installer C-3718 and Holder 6719A.

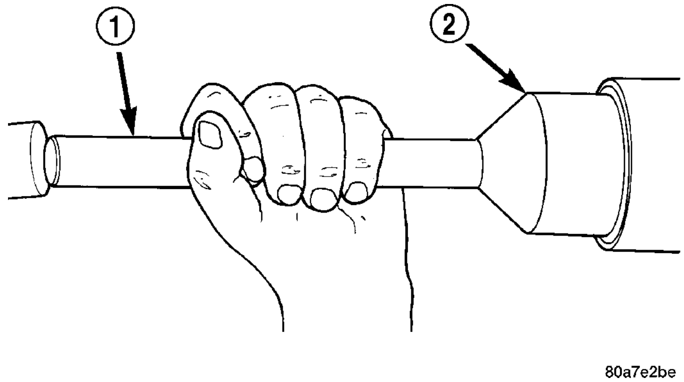


Fig. 34 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(4) Position holder against the companion flange and install four bolts and washers into the threaded holes. Tighten the bolt and washer so that the holder is held to the flange.

(5) Install a **new** pinion nut onto the pinion shaft and tighten the pinion nut until there is zero bearing end-play (Fig. 35).

CAUTION: Do not exceed 271 N·m (200 ft. lbs.) the minimum tightening torque when installing the companion flange at this point. Damage to the collapsible spacer or bearings may result.

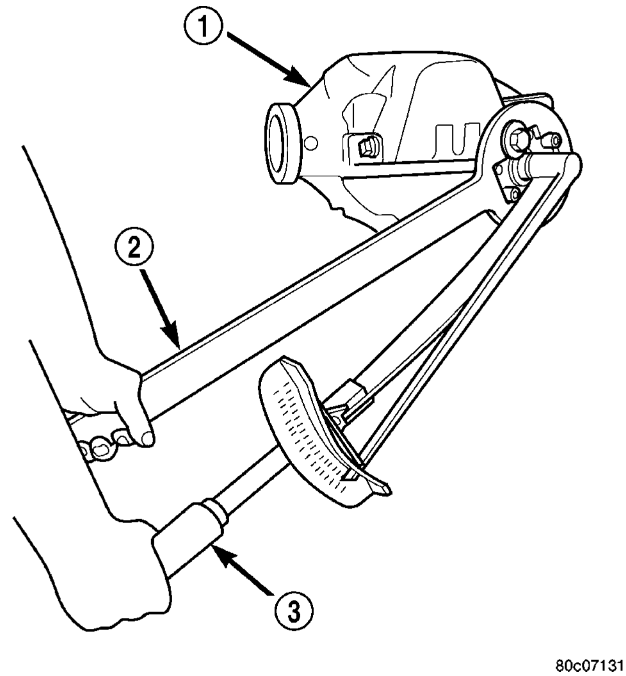


Fig. 35 COMPANION FLANGE HOLDER

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

PINION SEAL (Continued)

CAUTION: Never loosen pinion nut to decrease pinion bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed.

(6) Record pinion rotating torque using an inch pound torque wrench. The rotating torque should be equal to the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 36).

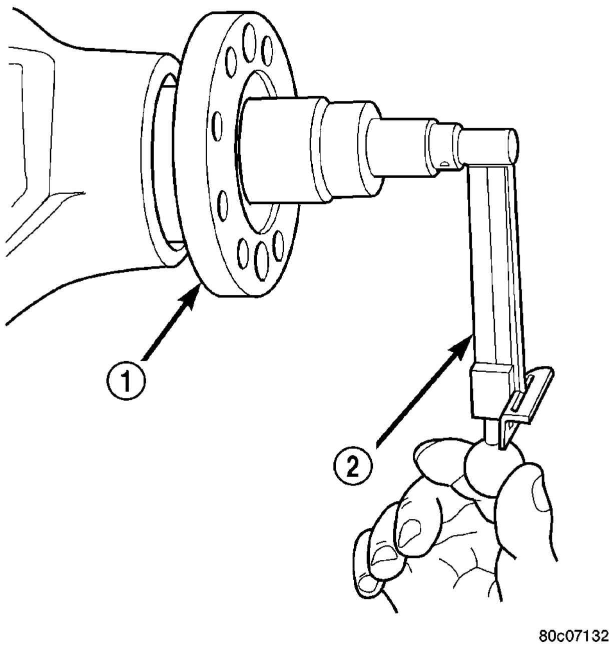


Fig. 36 PINION ROTATION TORQUE

1 - COMPANION FLANGE
2 - INCH POUND TORQUE WRENCH

(7) If rotating torque is low, tighten the pinion nut in 6.8 N·m (5 ft. lbs.) increments until the proper rotating torque is achieved.

CAUTION: If maximum tightening torque 475 N·m (350 ft. lbs.) is reached prior to reaching the required rotating torque, the collapsible spacer may have been damaged. Replace the collapsible spacer.

(8) Install propeller shaft with reference marks aligned.

(9) Add gear lubricant to differential housing if necessary.

(10) Install half shafts and skid plate if equipped.

DIFFERENTIAL

DESCRIPTION

The differential case is a one-piece design. The differential pinion shaft is retained with a snap ring. Differential bearing preload and ring gear backlash is adjusted by the use of adjusters. The adjuster are between the differential bearings and the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The stamped steel cover provides a means for inspection and servicing the differential.

OPERATION

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 37).

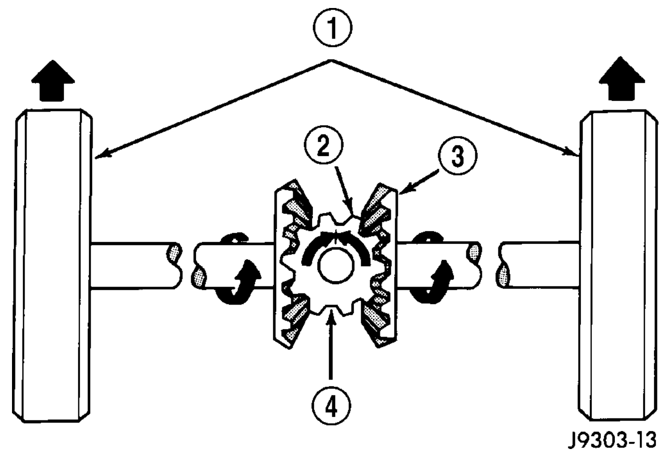


Fig. 37 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 38). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

REMOVAL

(1) Remove differential housing cover and drain fluid.

DIFFERENTIAL (Continued)

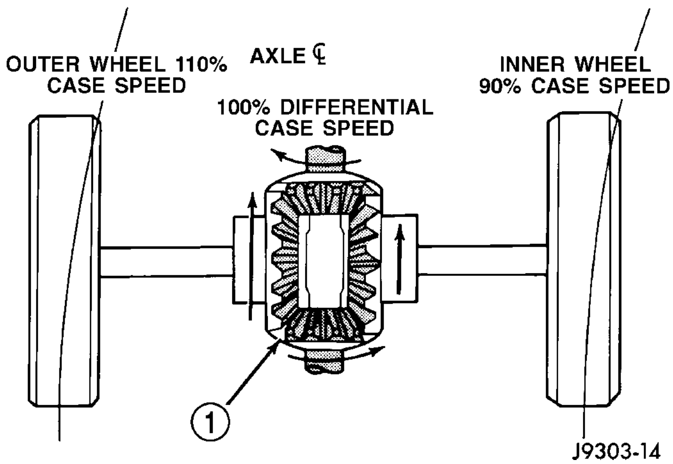


Fig. 38 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

(2) Remove axle shafts.

(3) Loosen bearing cap bolts.

NOTE: Differential bearing cap reference numbers are stamped on caps and machined flat on the housing. If reference numbers cannot be found, make new marks for later reference.

(4) Install Adapter Plates 8142-A onto the housing.

(5) Install Spreader W-129-B onto the adapter plates (Fig. 39) and tighten the turnbuckle finger-tight.

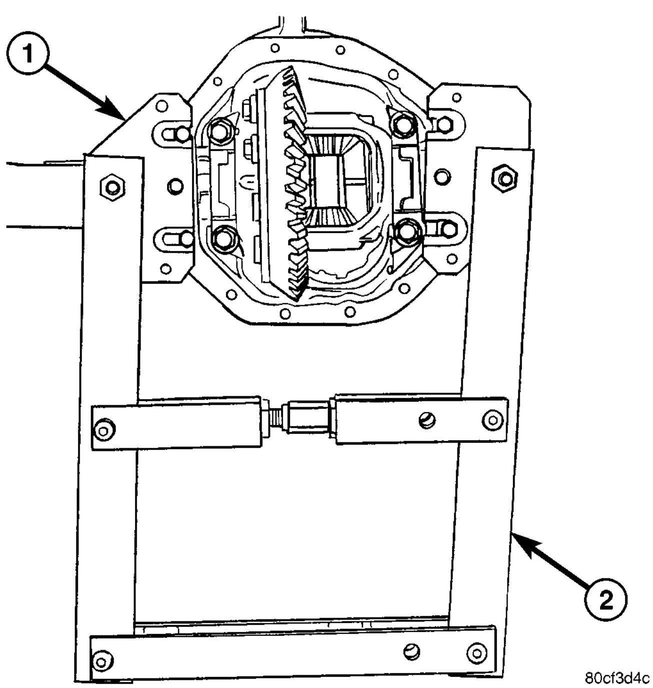


Fig. 39 ADAPTER PLATES AND SPREADER

1 - ADAPTER PLATE
2 - SPREADER

(6) Install a Pilot Stud L-4438 at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load the indicator plunger against the opposite side of the housing and zero the indicator.

(7) Spread the housing to remove the differential case from the housing (Fig. 40). Measure the distance with the dial indicator.

CAUTION: Never spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

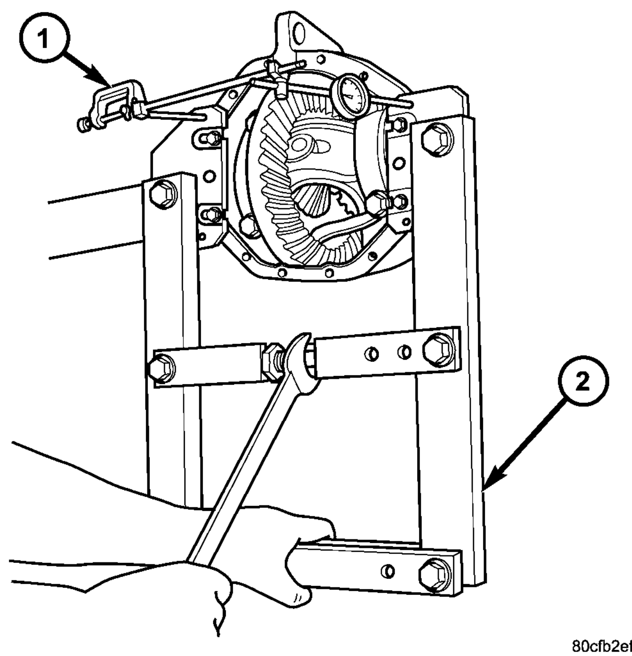


Fig. 40 DIAL INDICATOR LOCATION

1 - DIAL INDICATOR
2 - SPREADER

(8) Remove dial indicator.

(9) While holding the differential case in position, remove bearing cap bolts and caps.

(10) Remove differential from the housing (Fig. 41). Ensure differential bearing cups and shims remain in position on the differential bearings.

(11) Tag differential bearing cups and shims to indicate their location.

(12) Remove spreader from housing.

DISASSEMBLY

(1) Remove ring gear.

(2) Remove roll-pin holding mate shaft in housing.

(3) Remove pinion gear mate shaft.

(4) Rotate differential side gears and remove the pinion mate gears and thrust washers (Fig. 42).

(5) Remove the differential side gears and thrust washers.

DIFFERENTIAL (Continued)

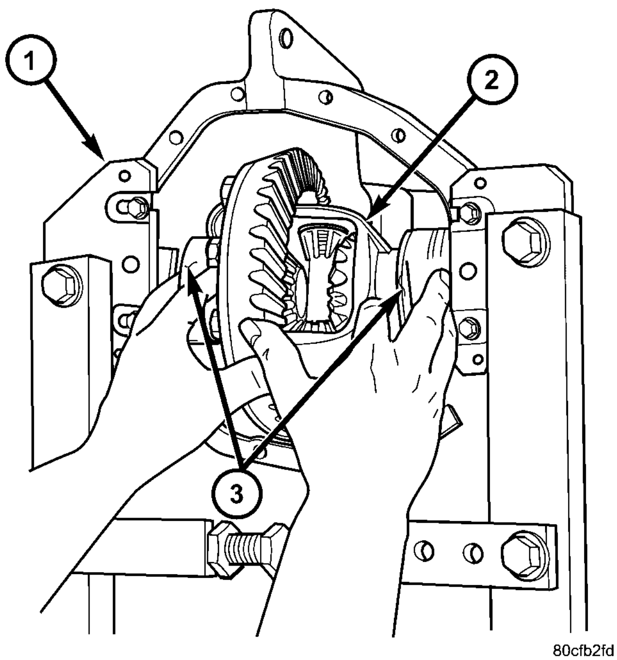


Fig. 41 DIFFERENTIAL

1 - HOUSING
2 - DIFFERENTIAL
3 - BEARING CUPS

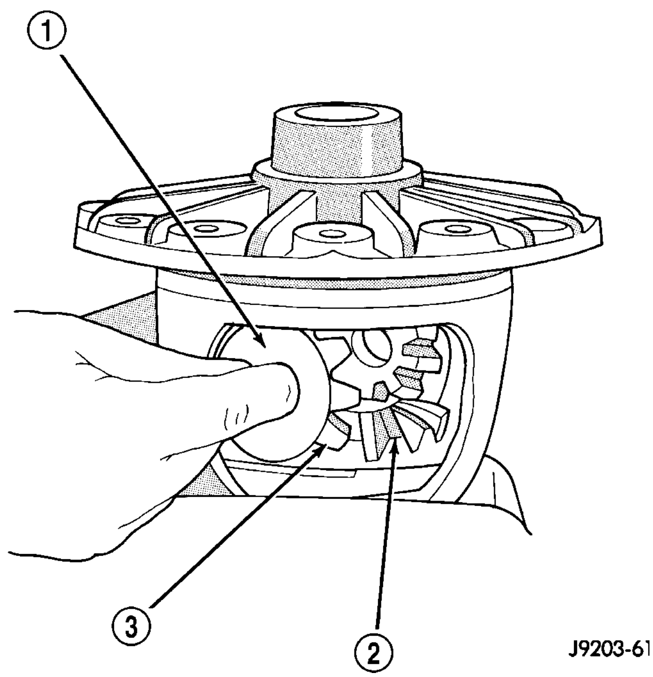


Fig. 42 PINION MATE GEAR

1 - THRUST WASHER
2 - SIDE GEAR
3 - PINION MATE GEAR

ASSEMBLY

(1) Install differential side gears and thrust washers.

(2) Install pinion mate gears and thrust washers.

(3) Install pinion gear mate shaft.

(4) Align the hole in the pinion gear mate shaft with the hole in the differential case.

(5) Install the roll-pin in the differential case a punch and hammer (Fig. 43). Peen the edge of the roll-pin hole in the differential case in two places 180° apart.

(6) Lubricate all differential components with hypoid gear lubricant.

(7) Install ring gear.

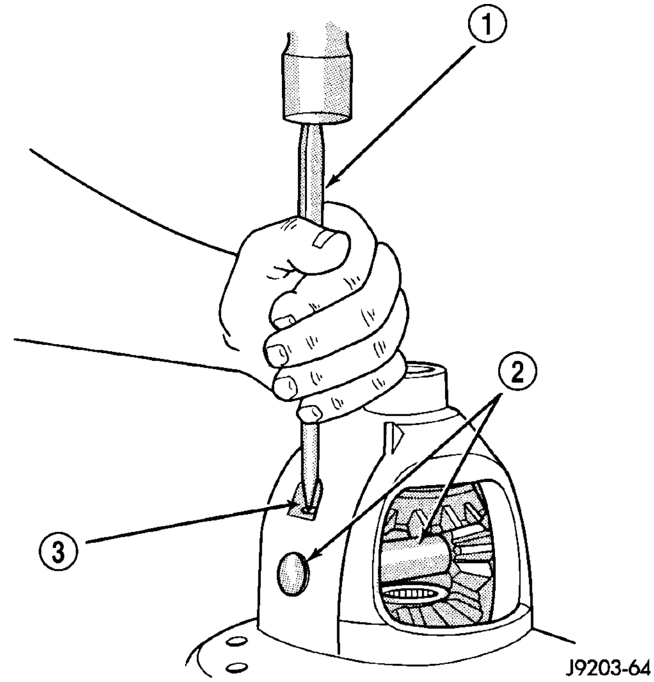


Fig. 43 PINION MATE SHAFT ROLL-PIN

1 - PUNCH
2 - PINION MATE SHAFT
3 - MATE SHAFT LOCKPIN

INSTALLATION

NOTE: If replacement differential bearings or differential case are replaced, Refer to adjustments for Differential Bearing Preload and Gear Backlash procedures.

(1) Install Spreader W-129-B with the Adapter Plates 8142-A and install the safety holddown clamps. Tighten the tool turnbuckle finger-tight.

(2) Install a Pilot Stud L-4438 at the left side of the differential housing. Attach Dial Indicator C-3339 to pilot stud. Load indicator plunger against the opposite side of the housing and zero the indicator.

DIFFERENTIAL (Continued)

(3) Spread housing and measure the distance with the dial indicator.

CAUTION: Never spread over 0.50 mm (0.020 in). If the housing is over-spread, it could be distorted or damaged.

(4) Remove dial indicator.

(5) Install differential case in the housing. Ensure differential bearing cups remain in position on the bearings and the differential preload shims are seated in the housing. Tap differential case to ensure bearings cups are seated in the housing.

(6) Install bearing caps to their original locations and loosely install cap bolts.

(7) Remove housing spreader.

(8) Tighten the bearing cap bolts to 61 N·m (45 ft. lbs.).

(9) Install axle shafts.

(10) Apply a bead of red Mopar Silicone Sealant or equivalent to the housing cover.

CAUTION: If cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

(11) Install cover and tighten bolts in a criss-cross pattern to 22 N·m (15 ft. lbs.).

(12) Fill differential with lubricant.

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential from housing.

(2) Remove bearings from the differential case with Puller/Press C-293-PA, Adapters C-293-48 and Plug C-293-3 (Fig. 44).

INSTALLATION

(1) Install differential case bearings with Installer C-3716-A and Handle C-4171 (Fig. 45).

(2) Install differential into the housing.

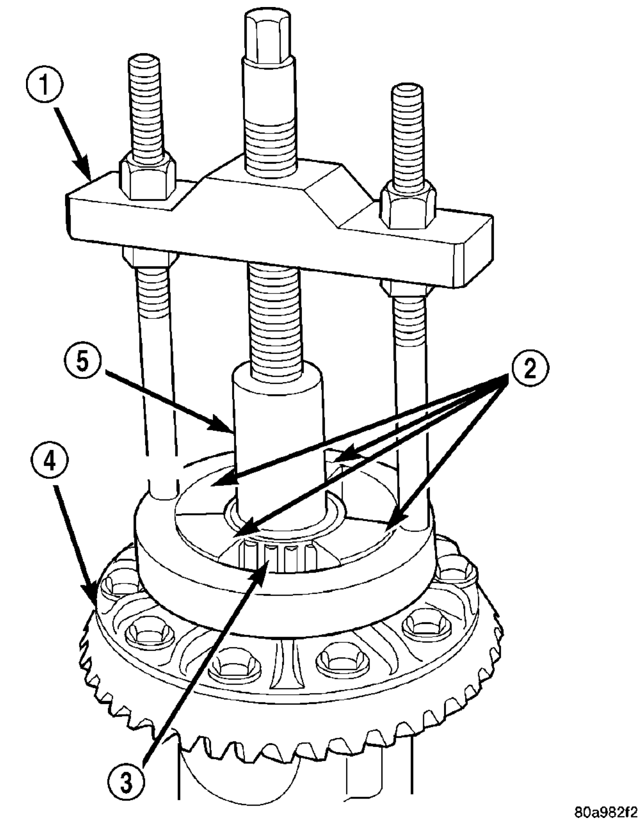


Fig. 44 DIFFERENTIAL CASE BEARING PULLER

1 - PULLER
2 - ADAPTERS
3 - BEARING
4 - DIFFERENTIAL
5 - PLUG

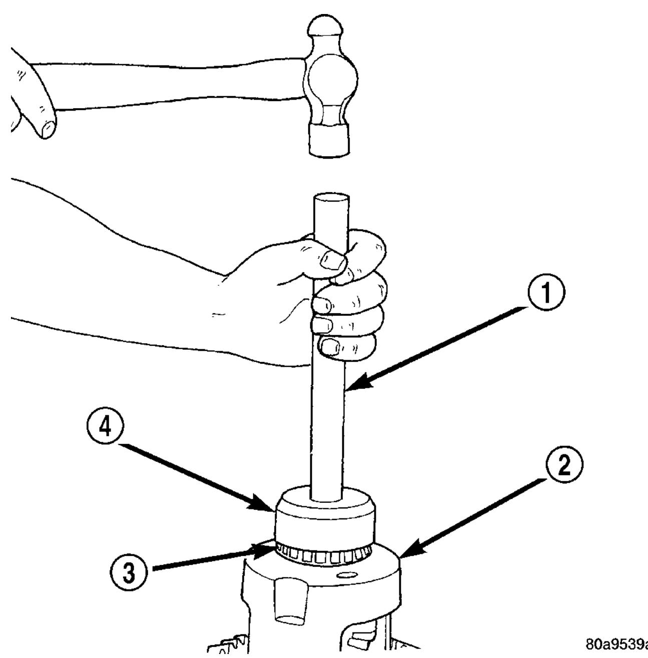


Fig. 45 DIFFERENTIAL CASE BEARINGS

1 - HANDLE
2 - DIFFERENTIAL
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR

REMOVAL

NOTE: The ring gear and pinion are serviced in a matched set. Never replace one without replacing the other.

(1) Remove differential from housing.
(2) Place differential case in a vise with soft jaw (Fig. 46).
(3) Remove bolts holding ring gear to differential case.
(4) Drive ring gear from differential case with a soft hammer (Fig. 46).

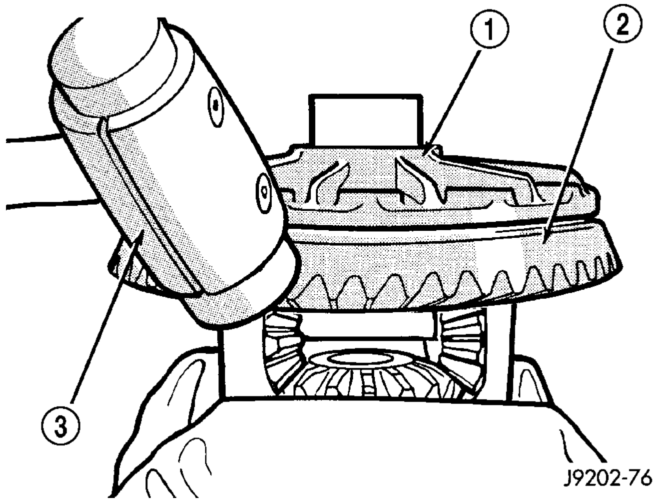


Fig. 46 RING GEAR

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(5) Mark the companion yoke and companion flange for installation reference.
(6) Remove companion flange bolts and tie the propeller shaft to the vehicle underbody.
(7) Rotate companion flange three or four times and verify flange rotates smoothly.
(8) Record pinion rotating torque an inch pound torque wrench for installation reference (Fig. 47).
(9) Install bolts into two of the threaded holes in the companion flange 180° apart.
(10) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so that the Holder 6719 is held to the flange.
(11) Remove the pinion nut.
(12) Remove the companion flange with Remover C-452 (Fig. 48).
(13) Remove pinion from differential housing.
(14) Remove pinion seal with a pry tool or a slide hammer mounted screw.

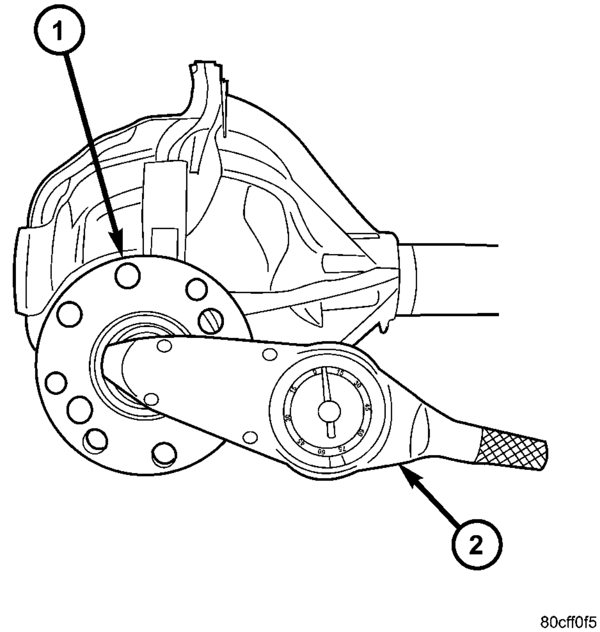


Fig. 47 PINION ROTATING TORQUE

1 - PINION COMPANION FLANGE
2 - TORQUE WRENCH

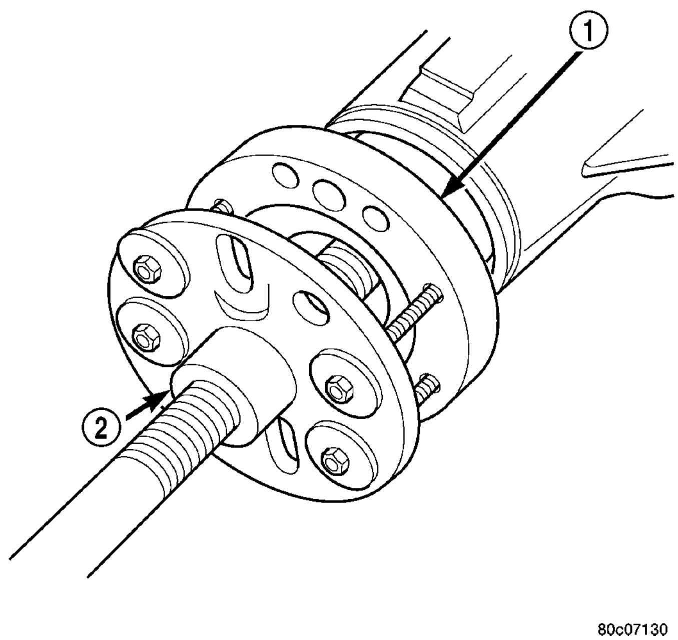


Fig. 48 COMPANION FLANGE REMOVER

1 - COMPANION FLANGE
2 - PULLER TOOL

(15) Remove oil slinger, if equipped and front pinion bearing.
(16) Remove front pinion bearing cup with Remover 8831 and Handle C-4171 (Fig. 49).
(17) Remove rear pinion bearing cup from housing (Fig. 50) with Remover 8401 and Handle C-4171.

PINION GEAR/RING GEAR (Continued)

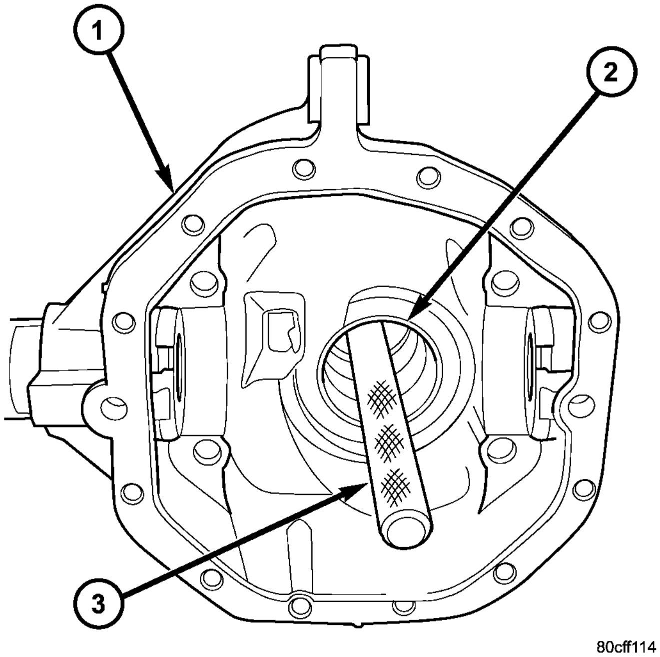


Fig. 49 FRONT PINION BEARING CUP

1 - HOUSING
2 - REMOVER
3 - HANDLE

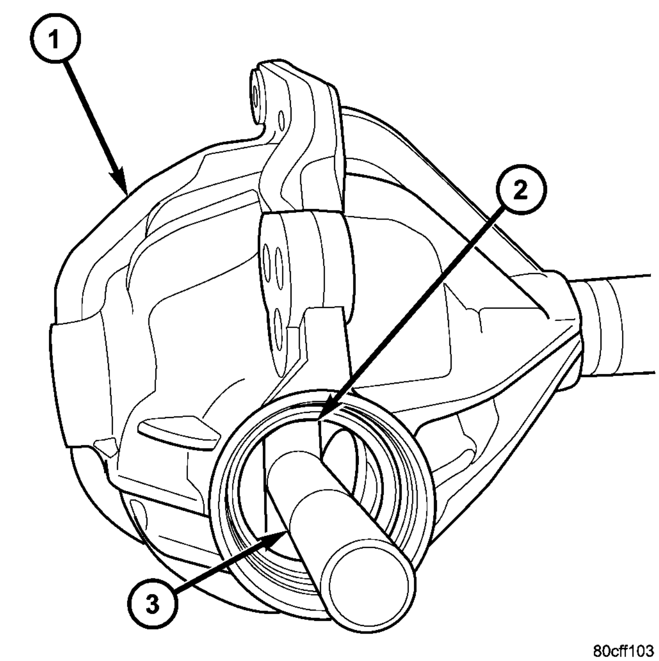


Fig. 50 REAR PINION BEARING CUP

1 - HOUSING
2 - REMOVER
3 - HANDLE

(18) Remove collapsible preload spacer (Fig. 51).

(19) Remove rear pinion bearing with Puller/Press C-293-PA and Adapters C-293-42 (Fig. 52).

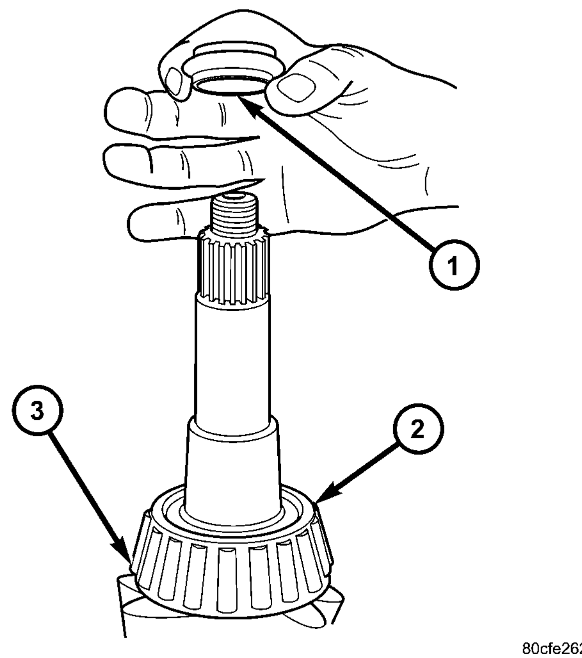


Fig. 51 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - REAR PINION BEARING
3 - PINION DEPTH SHIM

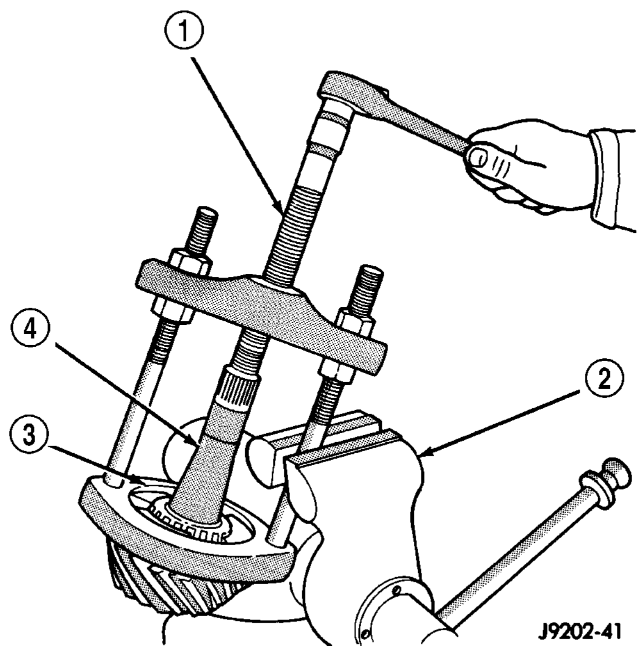


Fig. 52 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - ADAPTERS
4 - DRIVE PINION GEAR SHAFT

(20) Remove depth shims from the pinion shaft and record thickness of shims.

INSTALLATION

NOTE: The ring gear and pinion are serviced in a matched set. Never replace one gear without replacing the other matching gear. If ring and pinion gears or bearings are replaced, Refer to Adjustments for Pinion Gear Depth Setting.

(1) Apply Mopar Door Ease or equivalent lubricant to outside surface of the bearing cups.

(2) Install rear pinion bearing cup with Installer 8692 and Driver Handle C-4171 (Fig. 53) and verify cup is seated.

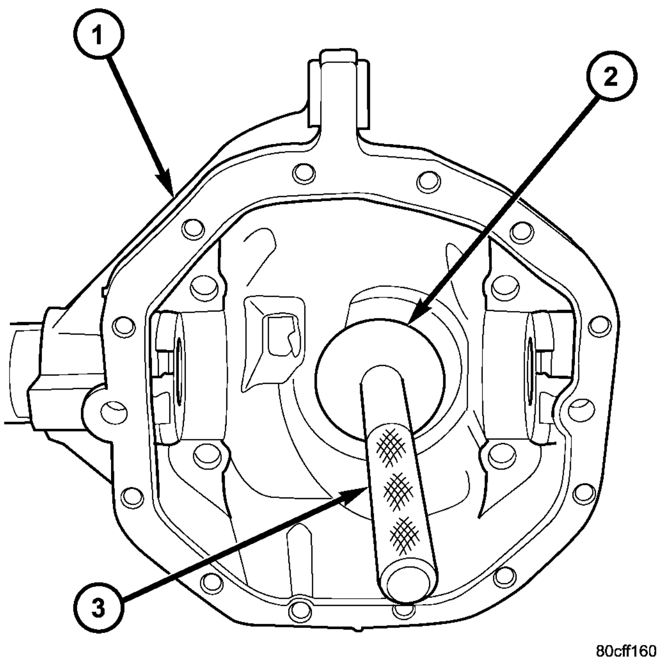


Fig. 53 REAR PINION BEARING CUP

1 - HOUSING
2 - INSTALLER
3 - HANDLE

(3) Install front pinion bearing cup with Installer 8693 and Handle C-4171 (Fig. 54) and verify cup is seated.

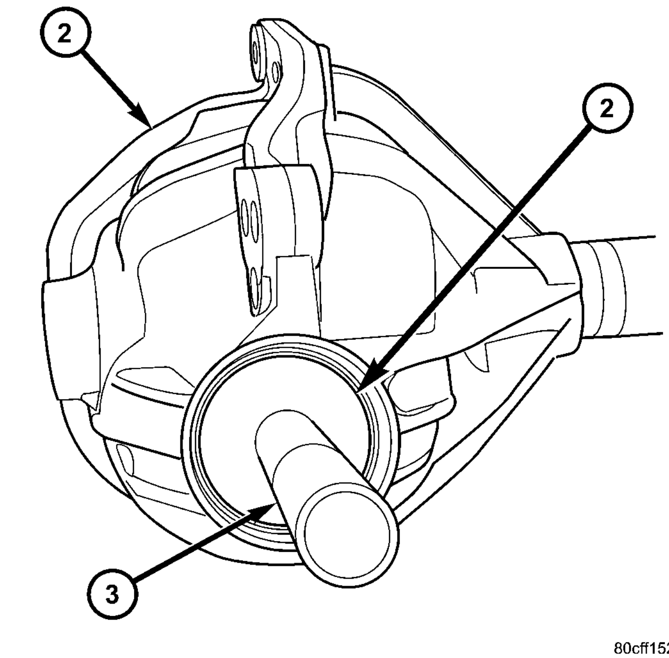


Fig. 54 FRONT PINION BEARING CUP

1 - HOUSING
2 - INSTALLER
3 - HANDLE

(4) Lubricate front pinion bearing and install bearing in the housing.

(5) Apply a light coating of gear lubricant on the lip of pinion seal.

(6) Install pinion seal with Installer 8695 and Handle C-4171 (Fig. 55).

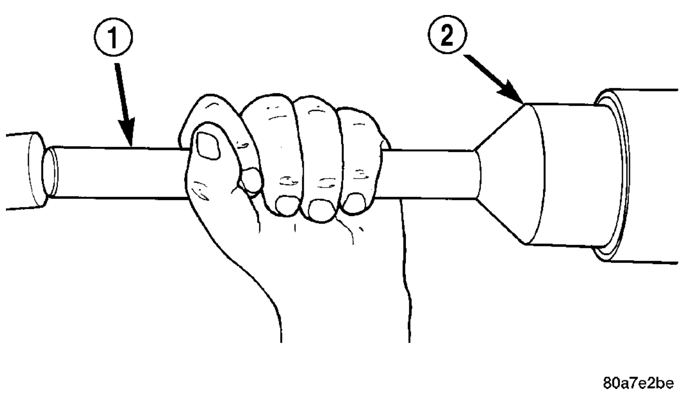


Fig. 55 PINION SEAL

1 - HANDLE
2 - INSTALLER

PINION GEAR/RING GEAR (Continued)

(7) Place pinion depth shim (Fig. 56) on the pinion shaft.

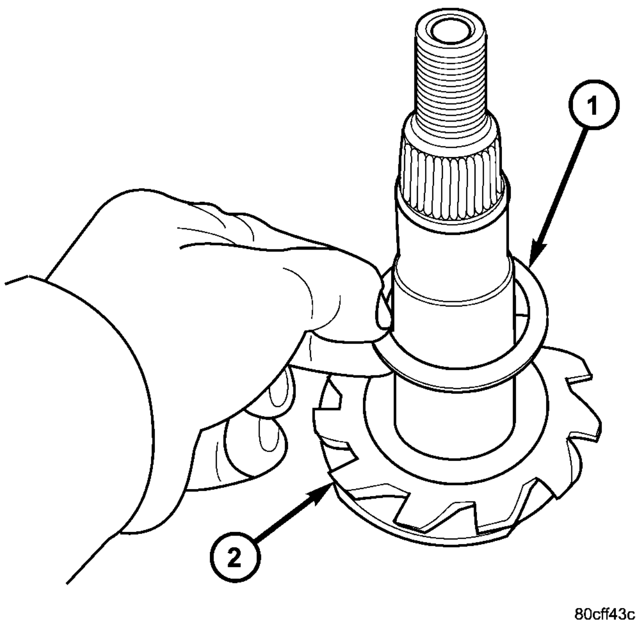


Fig. 56 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

(8) Install rear pinion bearing onto the pinion shaft with Installer 6448 and a press (Fig. 57).

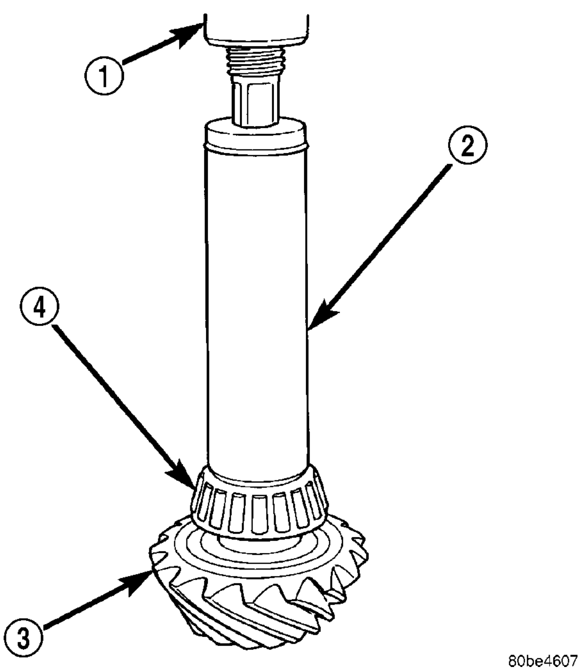


Fig. 57 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - PINION GEAR
4 - REAR PINION BEARING

(9) Install **new** collapsible spacer onto the pinion shaft (Fig. 58).

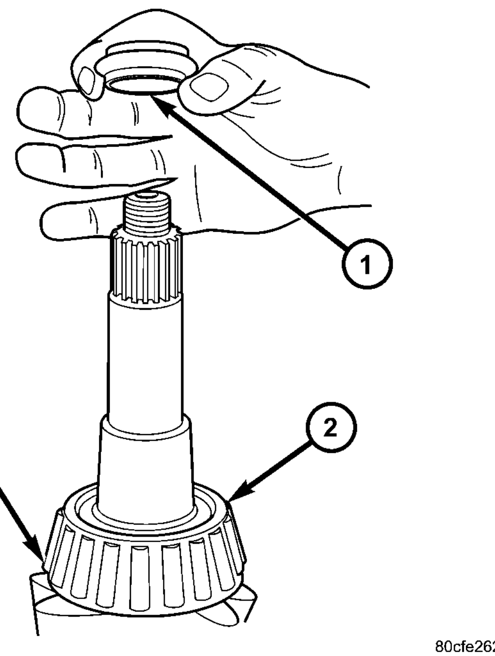


Fig. 58 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - REAR PINION BEARING
3 - PINION DEPTH SHIM

(10) Lubricate rear pinion bearing and install the pinion gear in the housing.

(11) Install companion flange with Installer C-3718 and Holder 6719.

(12) Install **new** pinion nut and tighten to 271 N·m (200 ft. lbs.) (Fig. 59).

(13) Using Holder 6719 and a torque wrench set at 475 N·m (350 ft. lbs.). Tighten pinion nut until bearing end play is taken up.

(14) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until desired rotating torque is achieved. Measure rotating torque frequently to avoid over-crushing the collapsible spacer (Fig. 60). The pinion rotating torque should be:

- Original Bearings: 1 to 2.5 N·m (10 to 20 in. lbs.)
- New Bearings: 2.0 to 2.8 N·m (18 to 25 in. lbs.)

CAUTION: Never loosen pinion nut to decrease pinion bearing rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed.

(15) Invert differential case and start two ring gear bolts to provide ring gear bolt hole alignment.

(16) Invert differential case in the vise.

PINION GEAR/RING GEAR (Continued)

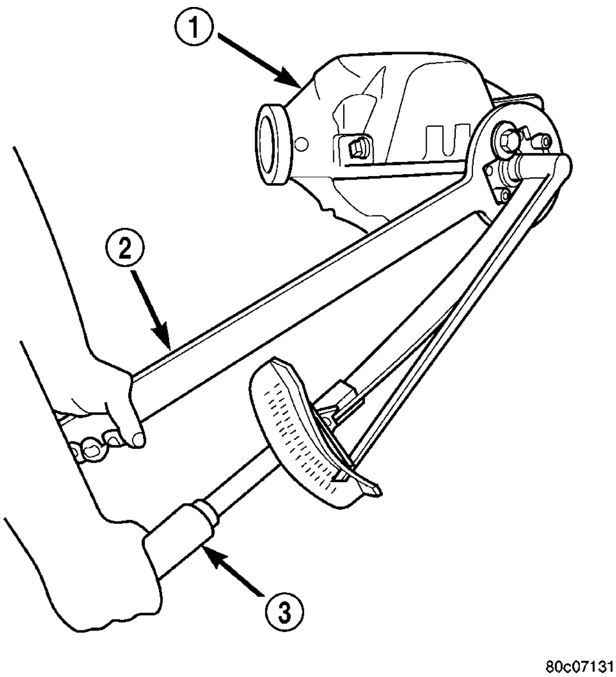


Fig. 59 PINION NUT

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

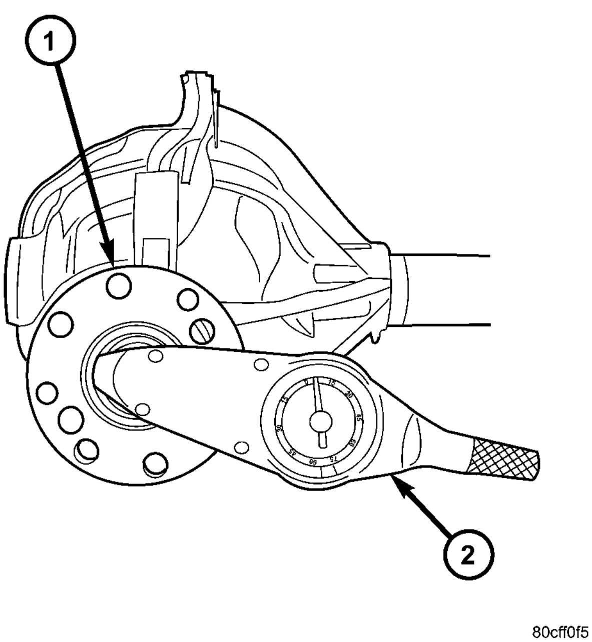


Fig. 60 PINION ROTATING TORQUE

1 - PINION COMPANION FLANGE
2 - TORQUE WRENCH

(17) Install **new** ring gear bolts and alternately tighten to 108 N·m (80 ft. lbs.) (Fig. 61).

CAUTION: Never reuse the ring gear bolts. The bolts can fracture causing extensive damage.

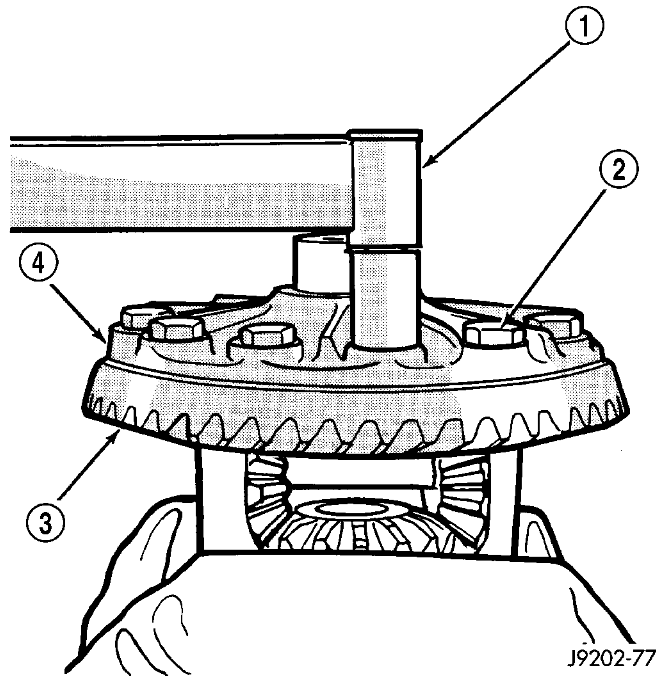


Fig. 61 RING GEAR BOLTS

1 - TORQUE WRENCH
2 - BOLTS
3 - RING GEAR
4 - DIFFERENTIAL CASE

(18) Install differential in housing and verify gear mesh, backlash and contact pattern.

(19) Install differential cover and fill with gear lubricant.

FRONT AXLE - 9 1/4 AA

TABLE OF CONTENTS

FRONT AXLE - 9 1/4 AA

DESCRIPTION

The axle consists of a cast iron center casting differential housing with axle shaft tubes extending from each side. The tubes are pressed into the differential housing and welded. The design has the centerline of the pinion set above the centerline of the ring gear. The axle has full-floating axle shafts, meaning the shaft are supported by the hub bearings. The axle has a vent used to relieve internal pressure caused by lubricant vaporization and internal expansion.

OPERATION

The axle receives power from the front propeller shaft. The propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, tooth contact, worn/damaged gears or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side gears and pinions can be checked by turning the vehicle. They usually do not cause noise during straight-ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion mate shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is

FRONT AXLE - 9 1/4 AA (Continued)

heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side-gear thrust washers. A worn pinion shaft bore will also cause low speed knock.

VIBRATION

Vibration at the front/rear of the vehicle is usually caused by:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out of balance wheels.
- Loose wheel lug nuts.
- Worn U-joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front end components or engine/transmission mounts. These components can contribute to what appears to be a vibration. Do not overlook engine accessories, brackets and drive belts.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged) can be caused by:

- High engine idle speed.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U-joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose.	1. Tighten loose nuts.
	2. Faulty, brinelled wheel bearing.	2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube.	1. Inspect axle tube alignment. Correct as necessary.
	2. Bent or sprung axle shaft.	2. Inspect and correct as necessary.
	3. End-play in pinion bearings.	3. Refer to pinion pre-load information and correct as necessary.
	4. Excessive gear backlash between the ring gear and pinion.	4. Check adjustment of the ring gear and pinion backlash. Correct as necessary.
	5. Improper adjustment of pinion gear bearings.	5. Adjust the pinion bearings pre-load.
	6. Loose pinion yoke nut.	6. Tighten the pinion yoke nut.
	7. Scuffed gear tooth contact surfaces.	7. Inspect and replace as necessary.

FRONT AXLE - 9 1/4 AA (Continued)

Condition	Possible Causes	Correction
Axle Shaft Broke	1. Misaligned axle tube.	1. Replace the broken shaft after correcting tube mis-alignment.
	2 Vehicle overloaded.	2. Replace broken shaft and avoid excessive weight on vehicle.
	3. Erratic clutch operation.	3. Replace broken shaft and avoid or correct erratic clutch operation.
	4. Grabbing clutch.	4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.
Loss Of Lubricant	1. Lubricant level too high.	1. Drain lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.

FRONT AXLE - 9 1/4 AA (Continued)

Condition	Possible Causes	Correction
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

REMOVAL

(1) Remove wheels and tires.
(2) Remove brake calipers and rotors.
(3) Disconnect ABS wheel speed sensors.
(4) Disconnect axle vent hose.
(5) Remove front propeller shaft.
(6) Disconnect stabilizer bar links at the axle brackets.
(7) Disconnect shock absorbers from axle brackets.
(8) Disconnect track bar from the axle bracket.
(9) Disconnect tie rod and drag link from the steering knuckles.
(10) Position suitable lifting device under the axle assembly.
(11) Secure axle to lifting device.
(12) Mark suspension alignment cams for installation reference.
(13) Disconnect upper and lower suspension arms from the axle bracket.
(14) Lower the axle. The coil springs will drop with the axle.
(15) Remove the coil springs from the axle bracket.

INSTALLATION

CAUTION: Suspension components with rubber bushings should be tightened with the weight of the vehicle on the suspension, at normal height. If springs are not at their normal ride position, vehicle ride comfort could be affected and premature bushing wear may occur. Rubber bushings must never be lubricated.

(1) Support the axle on a suitable lifting device.
(2) Secure axle to lifting device.
(3) Position the axle under the vehicle.
(4) Install springs, retainer clip and bolts.
(5) Raise axle and align it with the spring pads.

FRONT AXLE - 9 1/4 AA (Continued)

(6) Position upper and lower suspension arms in the axle brackets. Install bolts, nuts and align the suspension alignment cams to the reference marks. Do not tighten at this time.

(7) Connect track bar to the axle bracket and install the bolt. Do not tighten at this time.

(8) Install shock absorber and tighten bolts to 121 N·m (89 ft. lbs.).

(9) Install stabilizer bar link to the axle bracket. Tighten the nut to 68 N·m (50 ft. lbs.).

(10) Install drag link and tie rod to the steering knuckles and tighten the nuts to 108 N·m (80 ft. lbs.).

(11) Install ABS wheel speed sensors.

(12) Install rotors and brake calipers.

(13) Connect the axle vent hose.

(14) Install front propeller shaft.

(15) Check and add differential lubricant, if necessary.

(16) Install wheel and tire assemblies.

(17) Remove lower the vehicle.

(18) Tighten upper suspension arm nuts at axle to 149 N·m (110 ft. lbs.). Tighten upper suspension arm nuts at frame to 149 N·m (110 ft. lbs.).

(19) Tighten lower suspension arm nuts at axle to 190 N·m (140 ft. lbs.). Tighten the lower suspension arm nuts at frame to 190 N·m (140 ft. lbs.).

(20) Tighten track bar bolt at the axle bracket to 176 N·m (130 ft. lbs.).

(21) Check front wheel alignment.

ADJUSTMENTS

Ring and pinion gears are supplied as matched sets only. Compensation for pinion depth variance is achieved with a select shim. The shim is located between the rear pinion bearing and the pinion gear head.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 1).

(1) Assemble Pinion Height Block 6739, Pinion Block 8878 and rear pinion bearing onto Screw 6741 (Fig. 1).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 2).

(3) Install front pinion bearing and install the Cone-nut 6740 hand tight. Then check tool rotating torque with an inch pound torque wrench. The rotating torque should be 1.7-2.26 N·m (15-20 in. lbs.)

(4) Place Arbor Disc 8289 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 3).

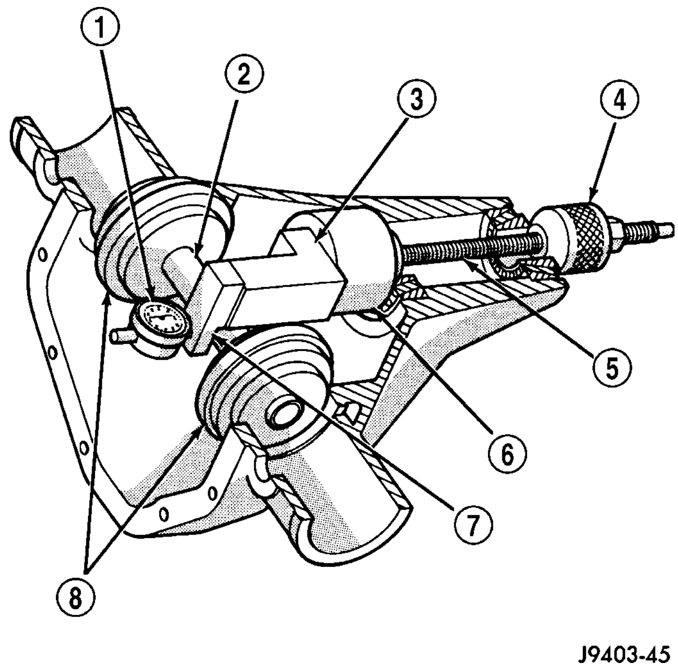


Fig. 1 PINION GEAR DEPTH GAUGE TOOLS

1 - DIAL INDICATOR
2 - ARBOR
3 - PINION HEIGHT BLOCK
4 - CONE
5 - SCREW
6 - PINION BLOCK
7 - SCOOTER BLOCK
8 - ARBOR DISC

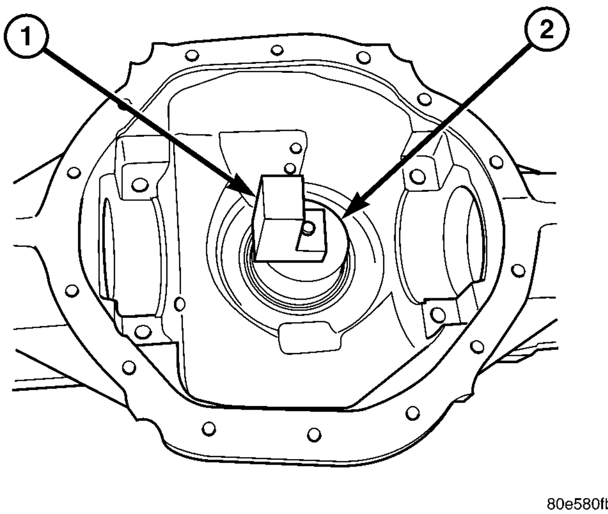


Fig. 2 PINION HEIGHT BLOCK

1. PINION HEIGHT BLOCK
2. PINION BLOCK

(5) Install differential bearing caps on arbor discs and snug the bearing cap bolts. Then cross tighten cap bolts to 85 N·m (63 ft. lbs.).

FRONT AXLE - 9 1/4 AA (Continued)

NOTE: Arbor should rotate freely in the arbor disc.

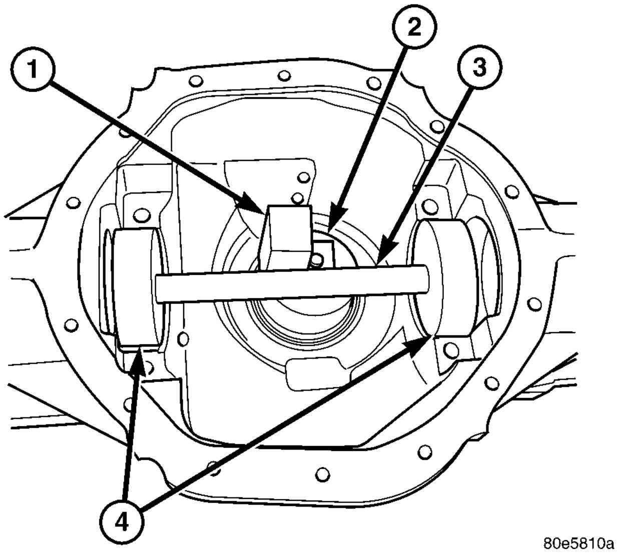


Fig. 3 GAUGE TOOLS IN HOUSING

1. PINION HEIGHT BLOCK
2. PINION BLOCK
3. ARBOR
4. ARBOR DISCS

(6) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(7) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

(8) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 4). Move the scooter block till dial indicator crests the arbor, then record the highest reading.

(9) Select a shim equal to the dial indicator reading.

(10) Install the select shim between the rear pinion bearing and the pinion gear head.

DIFFERENTIAL CASE BEARING PRELOAD AND GEAR BACKLASH

Backlash is adjusted by moving the adjusters in and out or both. By moving the adjusters the case/ring gear will move closer or further away from the pinion. In most cases this adjustment can be used to achieve the correct gear tooth pattern and set the case bearing preload.

(1) Remove adjuster lock bolts and adjuster locks (Fig. 5).

(2) Loosen the differential bearing caps.

(3) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(4) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 until they make contact with the differential bearings/cups.

(5) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

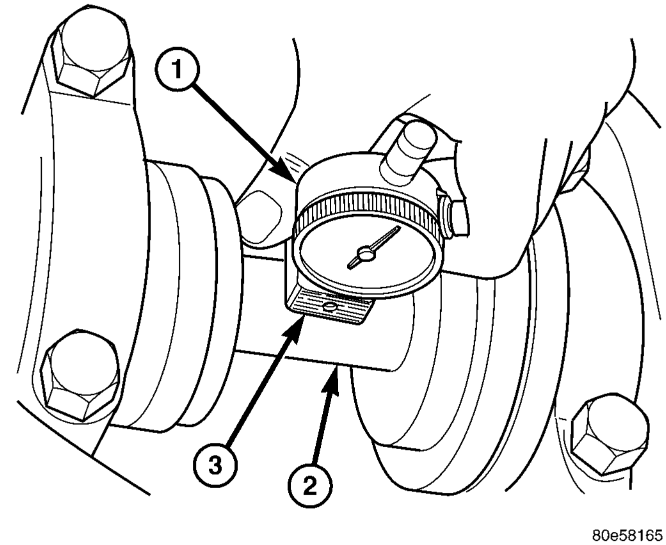


Fig. 4 PINION DEPTH MEASUREMENT

1. DIAL INDICATOR
2. ARBOR
3. SCOOTER BLOCK

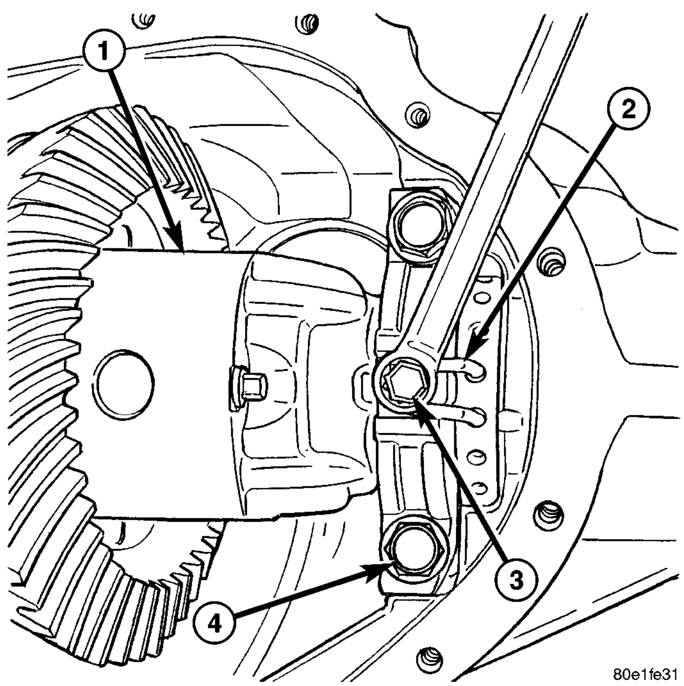


Fig. 5 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

FRONT AXLE - 9 1/4 AA (Continued)

(6) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(7) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(8) Rotate the pinion several times to seat the differential bearings.

(9) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup, then tighten it until it makes contact.

(10) Tighten pinion gear side adjuster an additional:

- **New Bearings:** 6 Adjuster Holes
- **Original Bearings:** 4 Adjuster Holes

(11) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(12) Tighten bearing cap bolts to 85 N·m (63 ft. lbs.).

(13) Tighten adjuster lock bolts to 25 N·m (18 ft. lbs.).

(14) Measure ring gear backlash with a Dial Indicator C-3339 and Dial Indicator Stud L-4438 at eight points around the drive side of the ring gear (Fig. 6). The backlash should be 0.08-0.25 mm (0.003-0.010 in) with a preferred backlash of 0.13-0.18 mm (0.005-0.007 in).

NOTE: Backlash measurement should not vary more than 0.05 mm (0.002 in) between measuring points. If measurement does vary inspect the gears for burrs, the differential case flange and ring gear mounting.

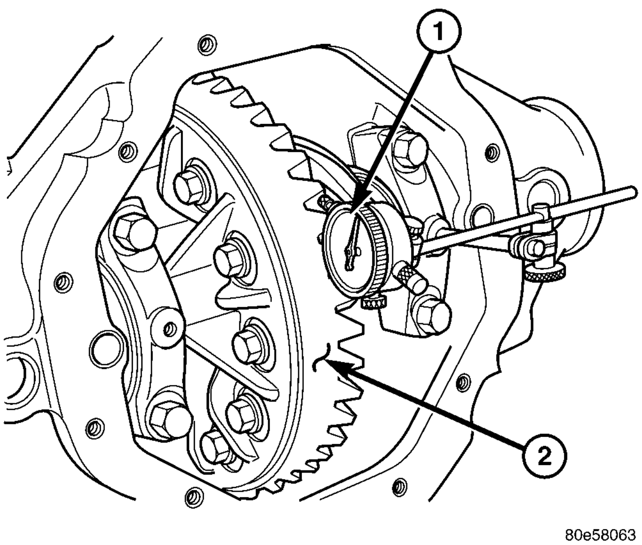


Fig. 6 RING GEAR BACKLASH

1 - DIAL INDICATOR
2 - RING GEAR

GEAR TOOTH CONTACT PATTERN

Gear tooth contact pattern is used to verify the correct running position of the ring and pinion gears. This will produce low noise and long gear life. Gears which are not positioned properly may be noisy and have shortened gear life.

(1) Wipe clean each tooth of the ring gear.

(2) Apply gear marking compound to all of the ring gear teeth.

(3) Verify bearing cap bolts are torque to specification.

(4) Apply the brakes lightly to create a 14 N·m (10 ft. lbs.) pinion rotating torque.

(5) Rotate the pinion/pinion yoke 4 full revolutions in each directions.

(6) Read gear tooth contact pattern:

- Gear contact pattern is correct (Fig. 7). Backlash and pinion depth is correct.

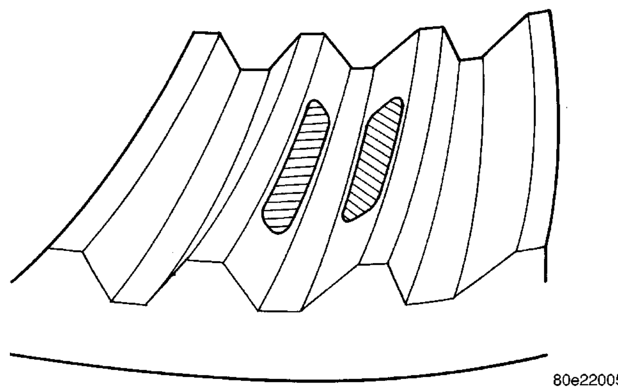


Fig. 7 CORRECT CONTACT PATTERN

- Ring gear too far away from pinion gear (Fig. 8). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

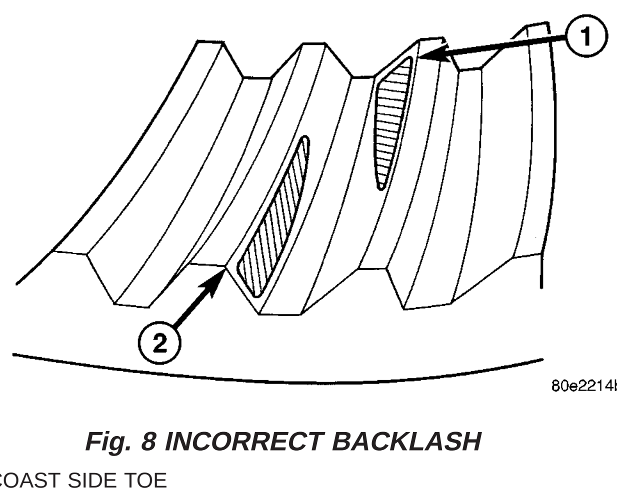


Fig. 8 INCORRECT BACKLASH

1 - COAST SIDE TOE
2 - DRIVE SIDE HEEL

FRONT AXLE - 9 1/4 AA (Continued)

• Ring gear too close to pinion gear (Fig. 9). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

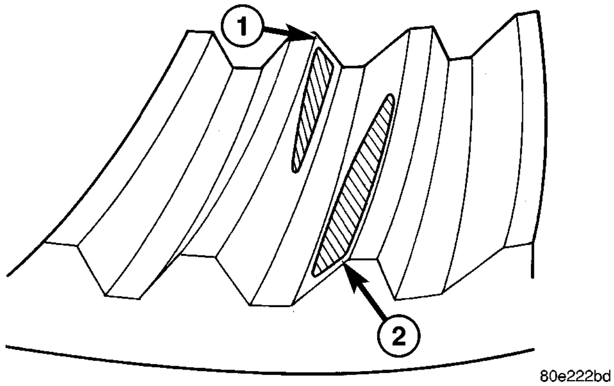


Fig. 9 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE HEEL

• Ring gear too far away from pinion gear (Fig. 10). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

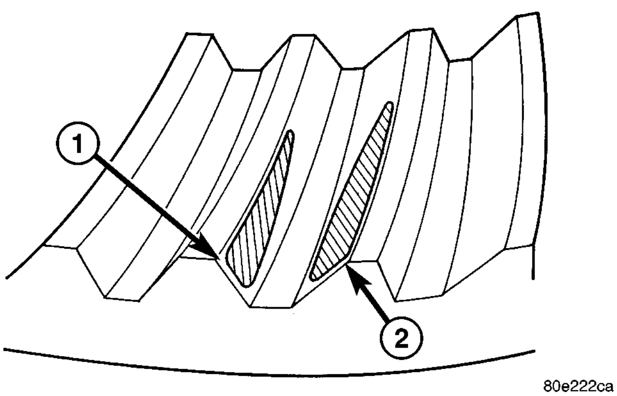


Fig. 10 INCORRECT BACKLASH

1 - DRIVE SIDE HEEL
2 - COAST SIDE HEEL

• Ring gear too close to pinion gear (Fig. 11). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

• Pinion gear set too low (Fig. 12). Increase pinion gear height, by increasing the pinion depth shim thickness.

• Pinion gear set too high (Fig. 13). Decrease pinion depth, by decreasing the pinion depth shim thickness.

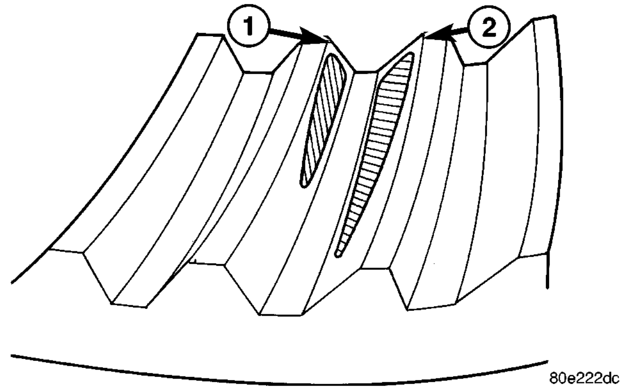


Fig. 11 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE TOE

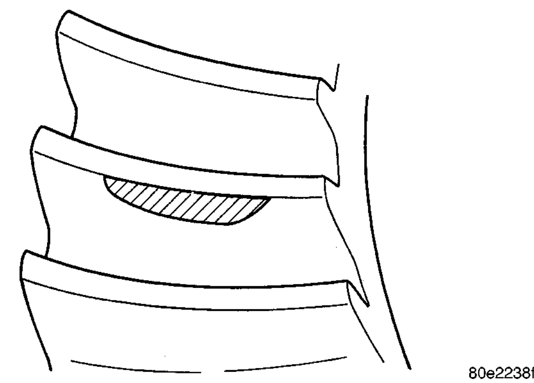


Fig. 12 LOW PINION HEIGHT

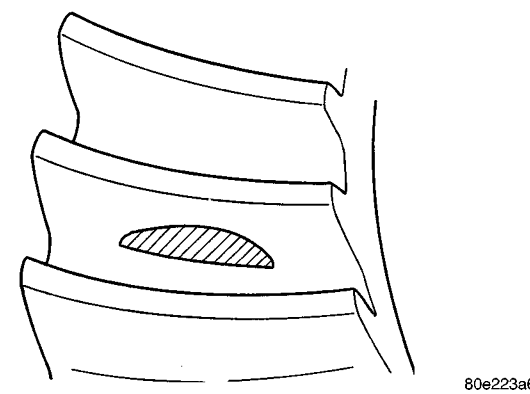


Fig. 13 HIGH PINION HEIGHT

FRONT AXLE - 9 1/4 AA (Continued)

SPECIFICATIONS

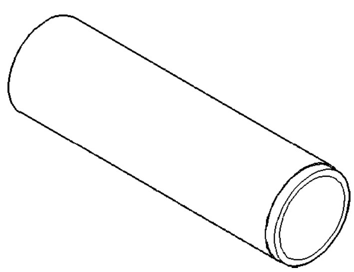
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.73, 4.10
Ring Gear Diameter	235 mm (9.25 in.)
Ring Gear Backlash	0.13-0.18 mm (0.005-0.007 in.)
Pinion Bearing Preload - New Bearing	1.7-2.8 N·m (15-25 in. lbs.)
Pinion Bearing Preload - Original Bearing	1.1-2.2 N·m (10-20 in. lbs.)
Pinion Bearing Preload + Differential Case Bearing Preload - New Bearing	3.4-5.6 N·m (30-50 in. lbs.)
Pinion Bearing Preload + Differential Case Bearing Preload - Original Bearing	2.8-5.1 N·m (25-45 in. lbs.)

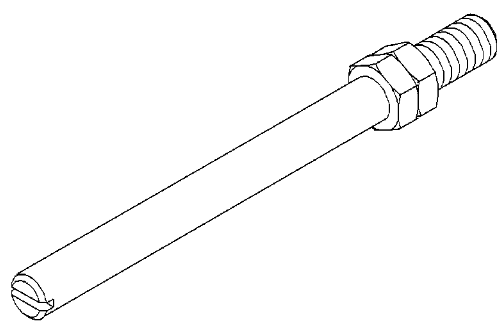
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fill Hole Plug	32	24	-
Differential Cover Bolts	40	30	-
Bearing Cap Bolts	85	63	-
Ring Gear Bolts	140	103	-
Axle Nut	356	263	-
Pinion Shaft Lock Bolt	52	38	-
Adjuster Lock Bolt	25	18	-

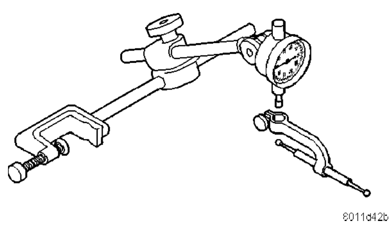
SPECIAL TOOLS



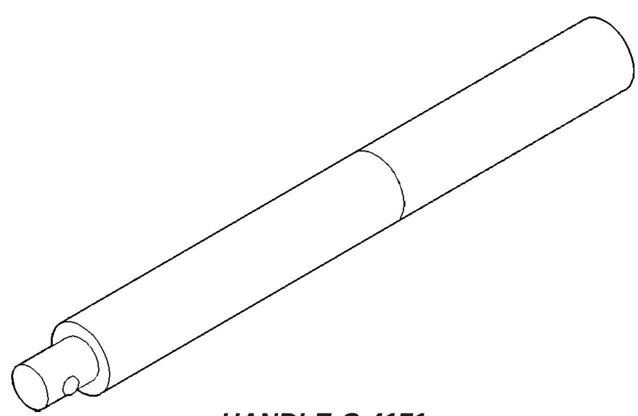
INSTALLER C-3095-A



DIAL INDICATOR STUD L-4438

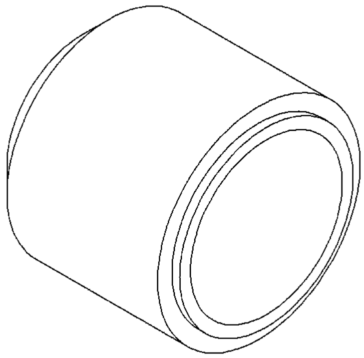


DIAL INDICATOR SET C-3339

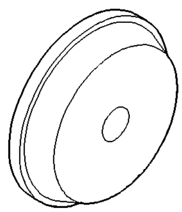


HANDLE C-4171

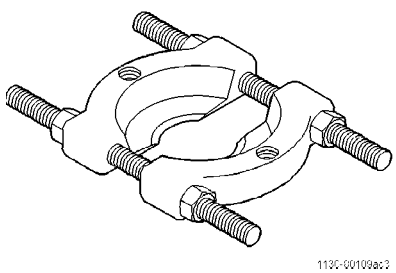
FRONT AXLE - 9 1/4 AA (Continued)



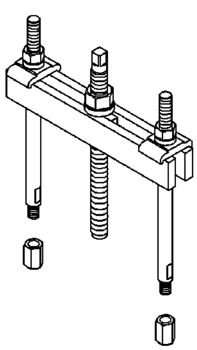
SEAL INSTALLER 8882



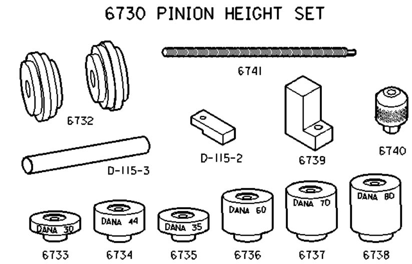
INSTALLER D-146



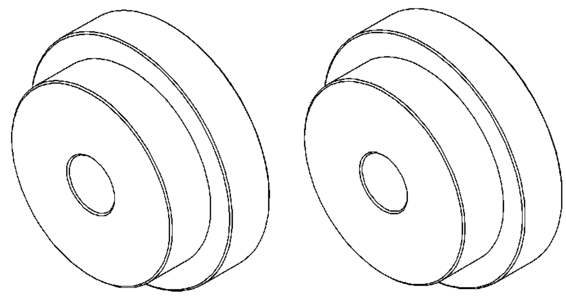
SPLITTER 1130



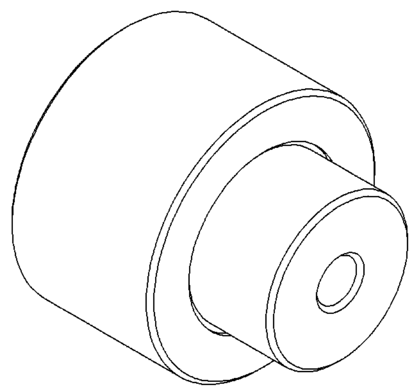
BRIDGE 938



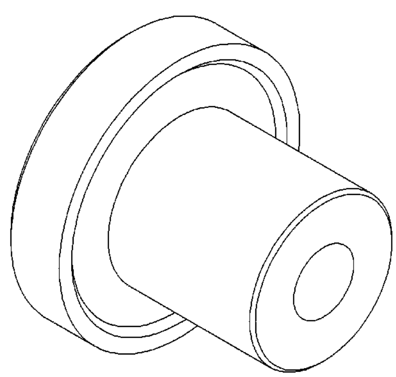
PINION DEPTH SET 6730



ARBOR DISCS 8289

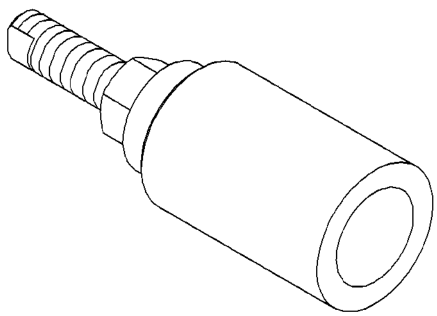


PINION BLOCK 8878

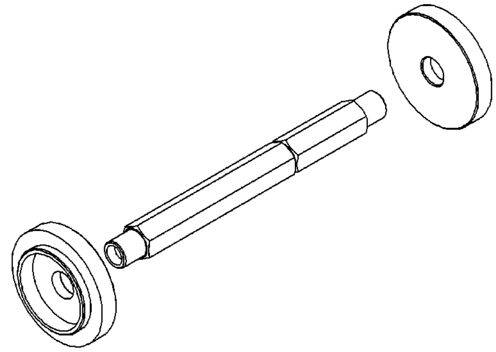


BEARING INSTALLER 8881

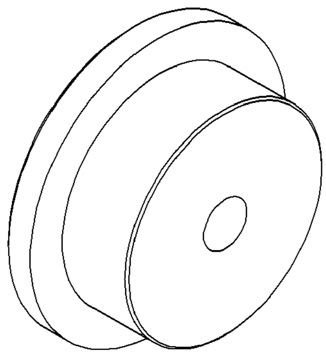
FRONT AXLE - 9 1/4 AA (Continued)



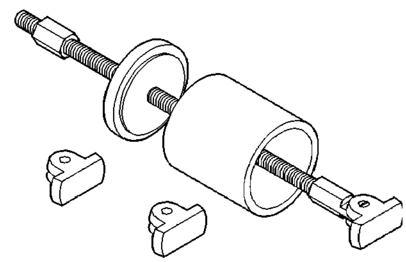
PINION INSTALLER 8982



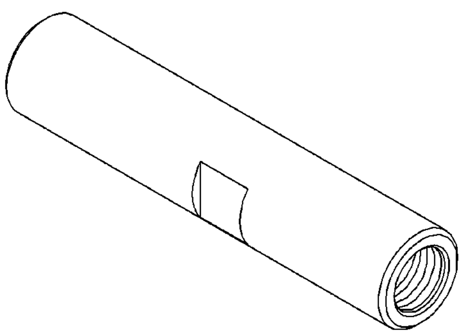
SEAL INSTALLER 8885



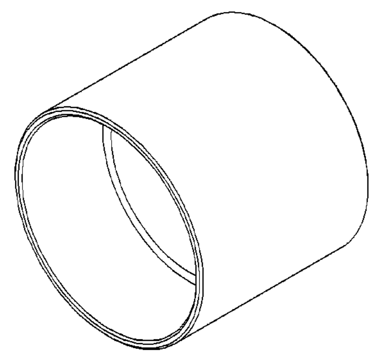
CUP INSTALLER 8886



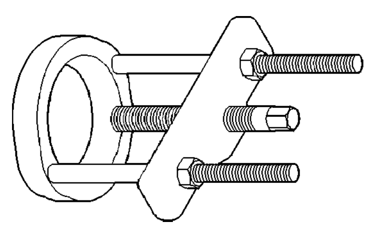
REMOVER/EXTRACTOR 6310



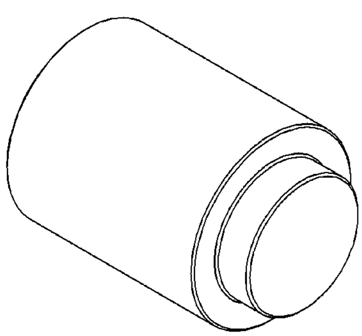
PINION DRIVER 8976



RECEIVER 8498

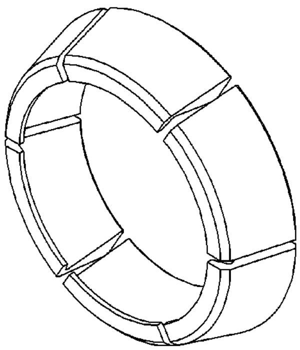


PULLER C-293-PA

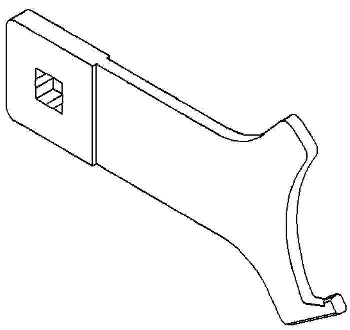


PLUG 8888

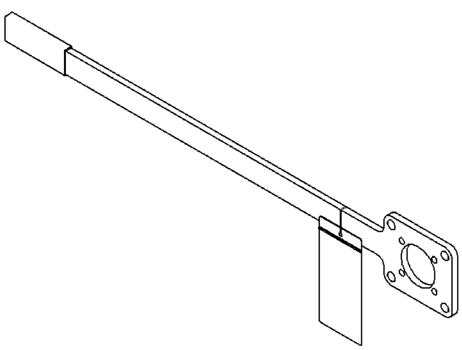
FRONT AXLE - 9 1/4 AA (Continued)



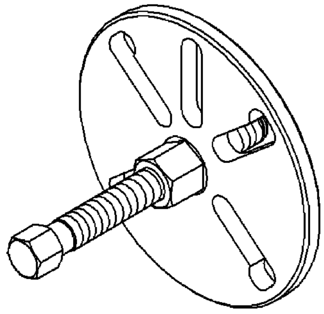
ADAPTERS 8879



ADJUSTER WRENCH 8883



FLANGE WRENCH 8979



FLANGE PULLER 8992

AXLE SHAFTS

REMOVAL

(1) Remove wheel and tire assembly.

(2) Remove brake caliper, rotor and ABS wheel speed sensor if equipped.

(3) Remove axle shaft cotter pin, hub nut and washer (Fig. 14).

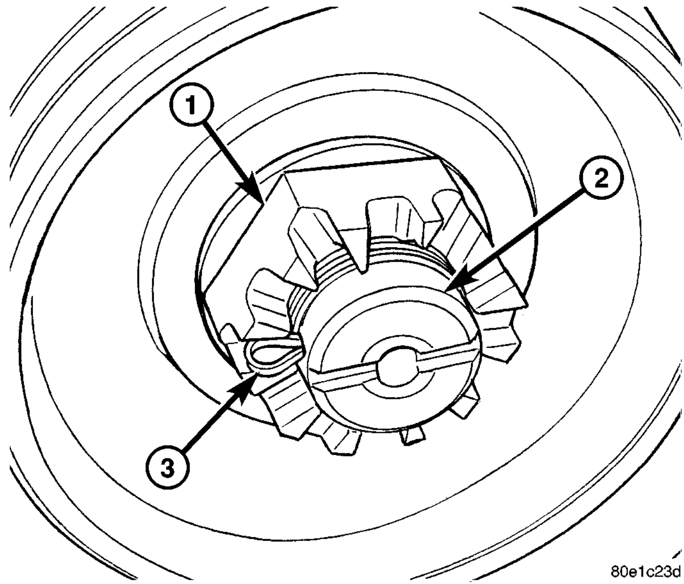


Fig. 14 AXLE NUT

1 - AXLE NUT
2 - AXLE
3 - COTTER PIN

(4) Remove the four hub bearing bolts (Fig. 15) from the back of the steering knuckle.

(5) Remove hub bearing from the steering knuckle.

(6) Remove axle shaft (Fig. 16) from steering knuckle and axle housing.

DISASSEMBLY

Single cardan U-joint components are not serviceable. If defective they must be replaced as a unit.

CAUTION: Clamp only the narrow forged portion of the yoke in the vise. To avoid distorting the yoke, do not over tighten the vise jaws.

(1) Remove the bearing cap retaining snap rings (Fig. 17).

NOTE: Saturate the bearing caps with penetrating oil prior to removal.

(2) Locate a socket with an inside diameter that is larger than the bearing cap. Place the socket (receiver) against the yoke and around the perimeter of the bearing cap to be removed.

AXLE SHAFTS (Continued)

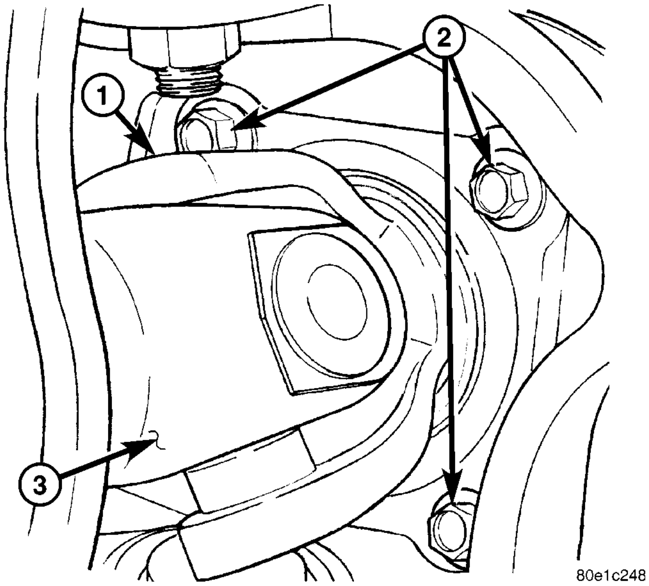


Fig. 15 HUB BEARING BOLTS

1 - STUB SHAFT
2 - BEARING BOLTS
3 - AXLE SHAFT

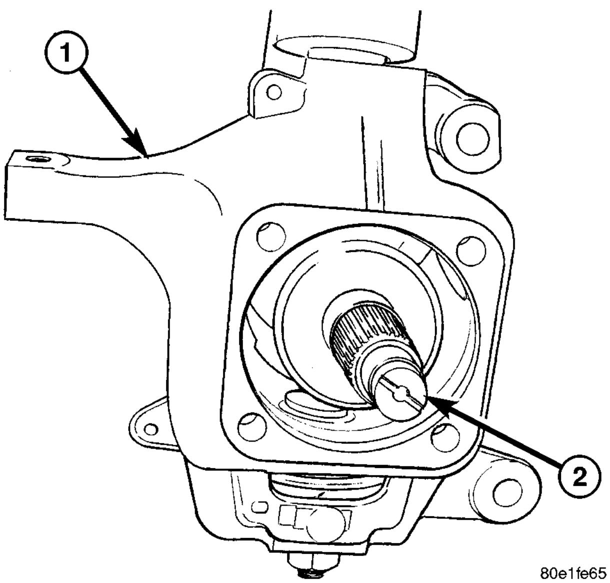


Fig. 16 STEERING KNUCKLE

1 - KNUCKLE
2 - AXLE SHAFT

(3) Locate a socket with an outside diameter that is smaller than the bearing cap. Place the socket (driver) against the opposite bearing cap.

(4) Position the yoke with the sockets in a vise (Fig. 18).

(5) Tighten the vise jaws to force the bearing cap into the larger socket (receiver).

(6) Release the vise jaws. Remove the sockets and bearing cap that was partially forced out of the yoke.

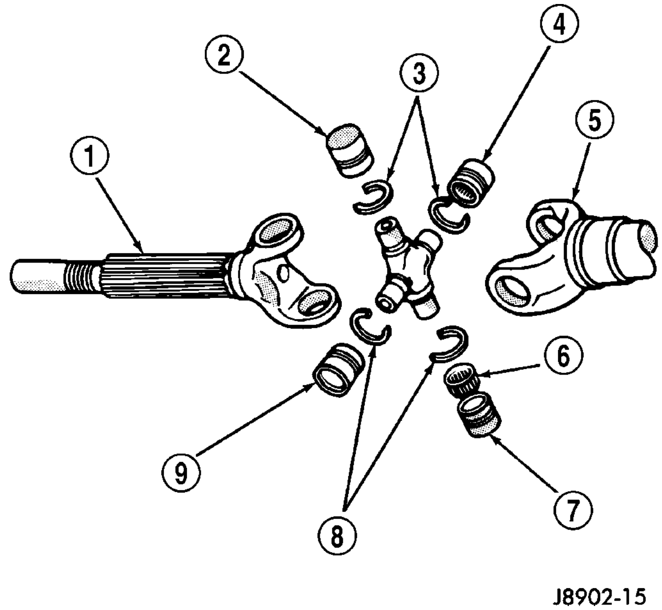


Fig. 17 AXLE SHAFT OUTER U-JOINT

1 - SHAFT YOKE
2 - BEARING CAP
3 - SNAP RINGS
4 - BEARING CAP
5 - SPINDLE YOKE
6 - BEARING
7 - BEARING CAP
8 - SNAP RINGS
9 - BEARING CAP

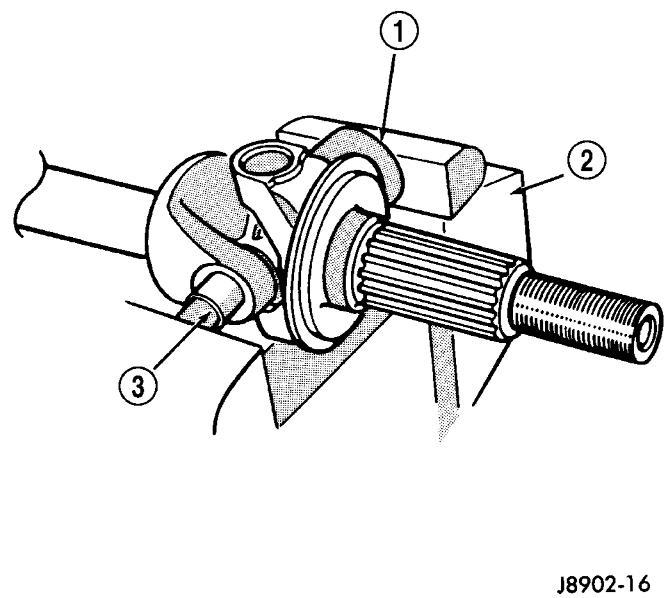


Fig. 18 YOKE BEARING CAP

1 - LARGE-DIAMETER SOCKET WRENCH
2 - VISE
3 - SMALL-DIAMETER SOCKET WRENCH

(7) Repeat the above procedure for the remaining bearing cap and remove spider from the propeller shaft yoke.

AXLE SHAFTS (Continued)

ASSEMBLY

(1) Pack the bearing caps 1/3 full of wheel bearing lubricant. Apply extreme pressure (EP), lithium-base lubricant to aid in installation.

(2) Position the spider in the yoke. Insert the seals and bearings. Tap the bearing caps into the yoke bores far enough to hold the spider in position.

(3) Place the socket (driver) against one bearing cap. Position the yoke with the socket in a vise.

(4) Tighten the vise to force the bearing caps into the yoke. Force the caps enough to install the retaining clips.

(5) Install the bearing cap retaining clips.

(6) Install axle shaft.

INSTALLATION

(1) Clean axle shaft and apply a thin film of Mopar Wheel Bearing Grease to the shaft splines and hub bore.

(2) Install axle shaft through the steering knuckle and into the differential side gears (Fig. 19).

CAUTION: Do not damage axle shaft seal during axle installtion.

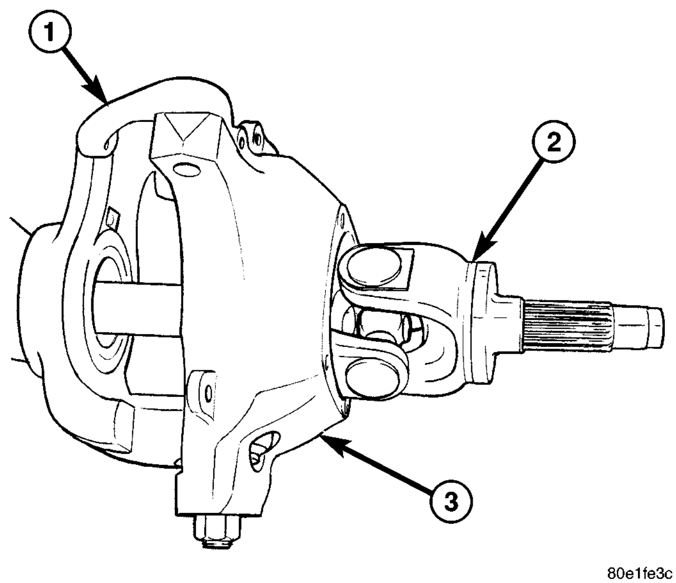


Fig. 19 AXLE SHAFT

1 - AXLE YOKE
2 - AXLE SHAFT
3 - KNUCKLE

(3) Install hub bearing in the knuckle.

(4) Install hub bearing bolts and tighten to 202 N·m (149 ft. lbs.).

(5) Install ABS wheel speed sensor, brake rotor and caliper.

(6) Install axle washer and nut. Tighten axle nut to 179 N·m (132 ft. lbs.).

(7) Rotate axle several 5 to 10 times to seat the wheel bearing.

(8) Tighten axle nut to final torque of 356 N·m (263 ft. lbs.).

(9) Align nut to next cotter pin hole and install new cotter pin.

(10) Install wheel and tire assembly.

AXLE SHAFT SEALS

REMOVAL

(1) Remove hub bearings and axle shafts.

(2) Remove differential from differential housing.

(3) Remove differential bearing adjusters (Fig. 20).

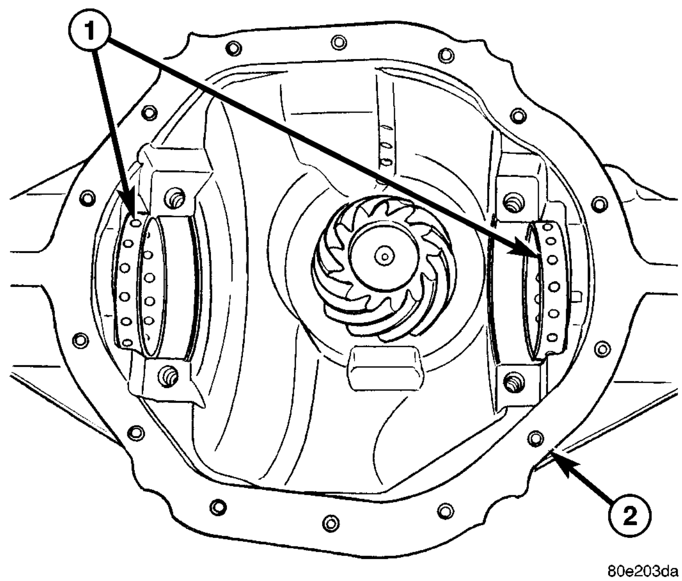


Fig. 20 ADJUSTERS

1 - DIFFERENTIAL CASE BEARING ADJUSTERS
2 - DIFFERENTIAL HOUSING

(4) Remove axle seals (Fig. 21) located behind adjusters with Receiver 8498 and Extractor 6310.

(5) Install Receiver 8498 into the adjuster bore.

(6) Install Extractor Rod 6310 with Extractor Foot 6310-9 through the receiver and the axle seal (Fig. 22).

(7) Install Extractor Plate 6310-2 and Nut 6310-7 on the extractor rod.

(8) Tighten nut on the extractor rod (Fig. 23) and pull the seal out and into the receiver.

INSTALLATION

(1) Install axle seal on Installer Cups 8885-2 and position cups with seals into the housing.

NOTE: Seal are installed with the axle guide facing outward.

AXLE SHAFT SEALS (Continued)

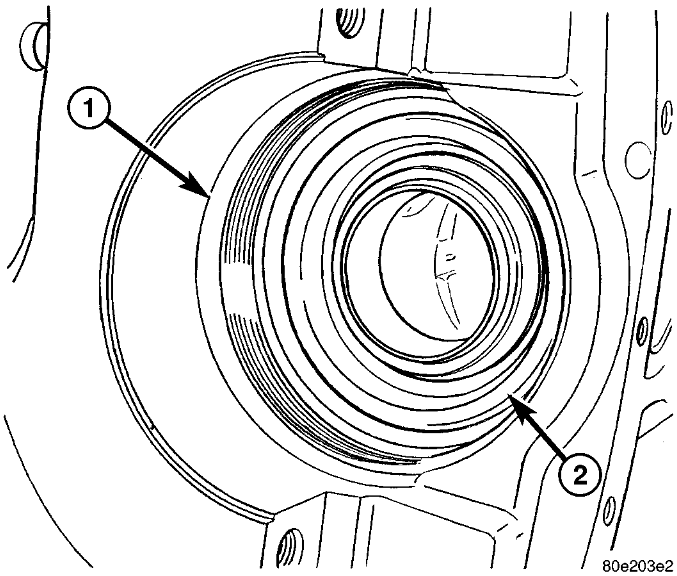


Fig. 21 AXLE SHAFT SEAL

1 - ADJUSTER THREADS
2 - SEAL

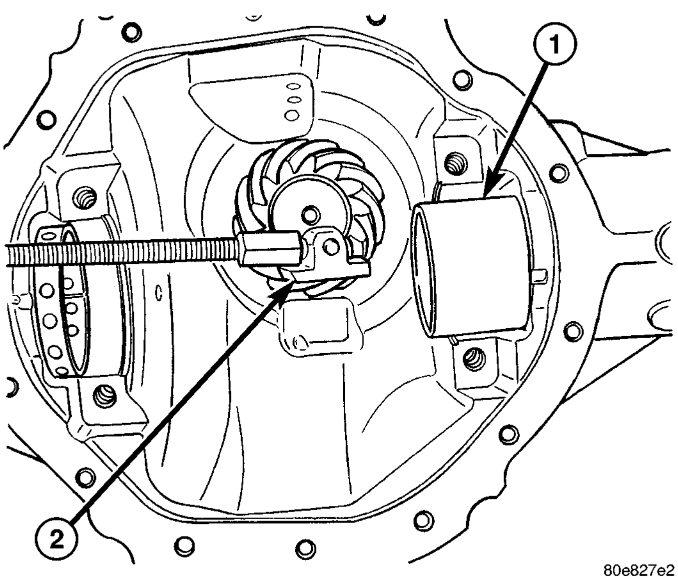


Fig. 22 SEAL RECEIVER

1 - RECEIVER
2 - EXTRACTOR FOOT

(2) Install Turnbuckle 8885-1 (Fig. 24) into the installer cups and expand the turnbuckle until the seal bottom out in the housing.

(3) Install differential into the axle housing.

(4) Install axle shaft and hub bearings

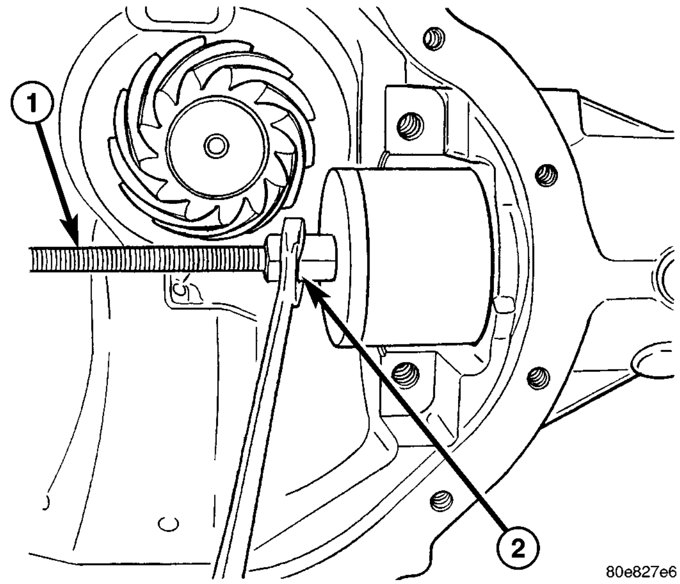


Fig. 23 SEAL EXTRACTOR

1 - EXTRACTOR ROD
2 - EXTRACTOR NUT

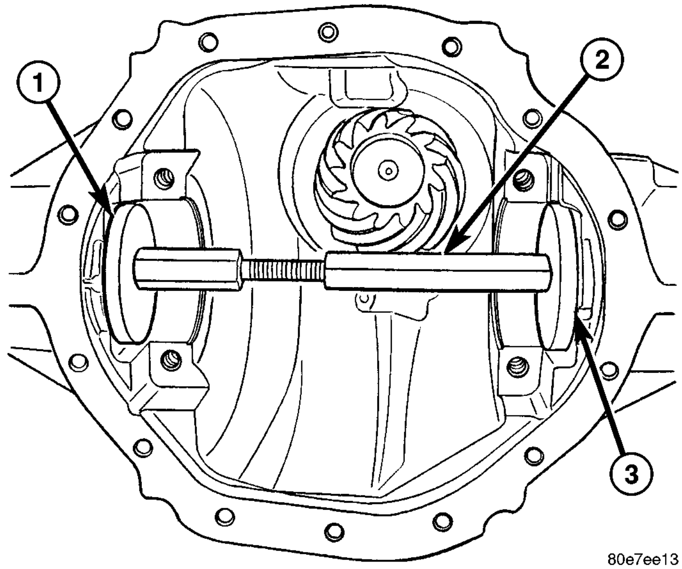


Fig. 24 AXLE SEAL INSTALLER

1 - INSTALLER CUP
2 - INSTALLER TURNBUCKLE
3 - INSTALLER CUP

PINION SEAL

REMOVAL

(1) Mark the propeller shaft and pinion flange for installation reference.

(2) Remove propeller shaft.

(3) Remove hub bearings and axle shafts.

(4) Rotate pinion gear three or four times.

(5) Measure and record the torque necessary to rotate (Fig. 25) the pinion gear with an inch pound torque wrench.

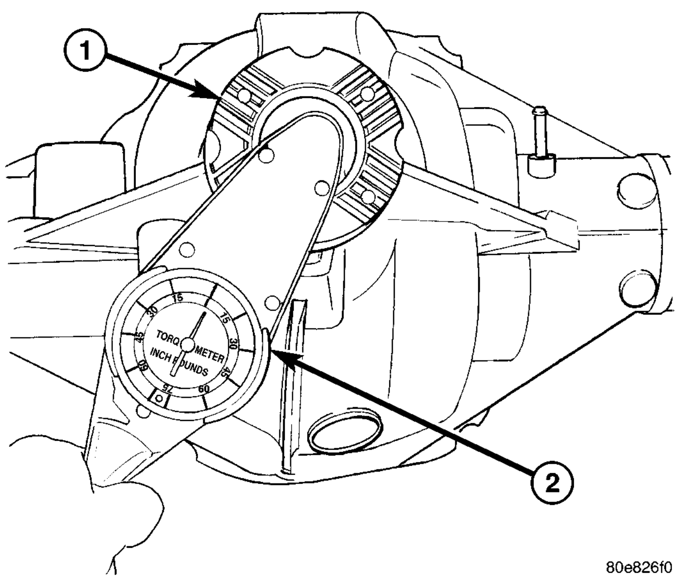


Fig. 25 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(6) Hold pinion flange with Flange Wrench 8979 (Fig. 26) and remove pinion flange nut and washer.

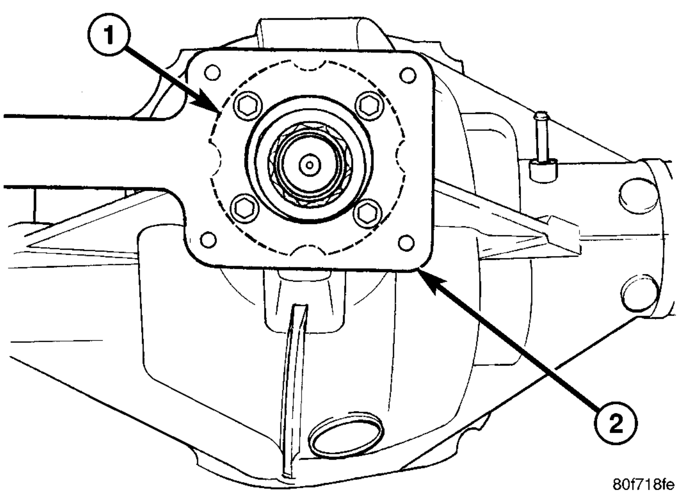


Fig. 26 FLANGE WRENCH

1 - PINION FLANGE
2 - WRENCH

(7) Remove pinion flange with Pinion Flange Puller 8992 (Fig. 27).

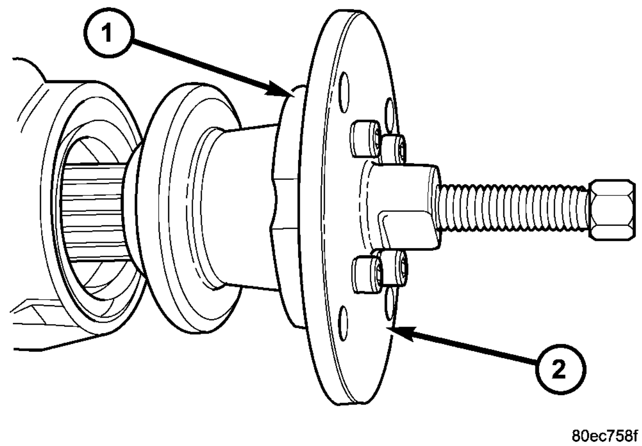


Fig. 27 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

(8) Remove pinion shaft seal with a pry tool or slide hammer mounted screw.

INSTALLATION

(1) Install **new** pinion seal with Installer 8882 and Handle C-4171 (Fig. 28).

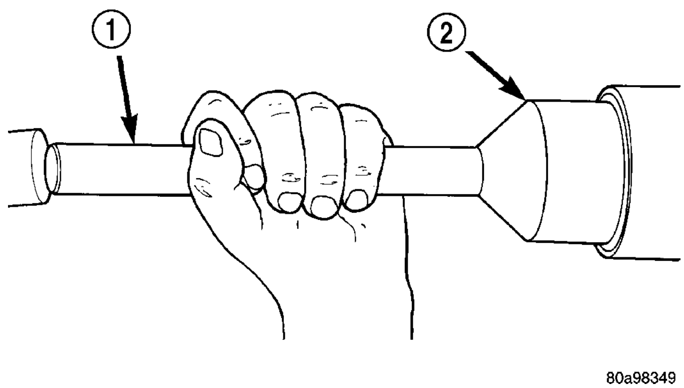


Fig. 28 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(2) Apply a light coat of teflon thread sealant to the pinion flange splines.

(3) Lightly tap the pinion flange onto the pinion until a few threads are showing.

(4) Install flange washer and **new** pinion nut.

(5) Hold flange with Flange Wrench 8979 and tighten pinion nut until pinion end play is taken up.

(6) Rotate pinion several times to seat bearings.

(7) Measure pinion rotating torque with an inch pound torque wrench and compare it to recorded measurement. Tighten pinion nut in small incre-

PINION SEAL (Continued)

ments, until pinion rotating torque is 0.40-0.57 N·m (3-5 in. lbs.) greater than recorded measurement.

(8) Rotate pinion several times then verify pinion rotating torque again.

(9) Install axle shafts and hub bearings.

(10) Install propeller shaft with reference marks aligned.

DIFFERENTIAL

DESCRIPTION

The differential case is a one-piece design. The differential pinion shaft is retained with a snap ring. Differential bearing preload and ring gear backlash is adjusted by the use of adjusters. The adjuster are between the differential bearings and the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The stamped steel cover provides a means for inspection and servicing the differential.

OPERATION

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 29).

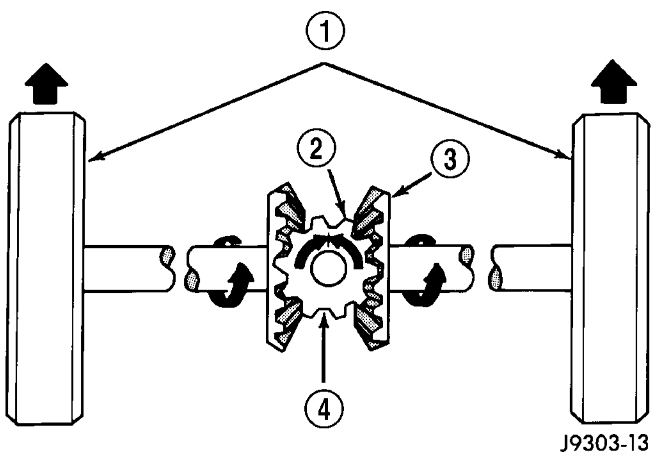


Fig. 29 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 30). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

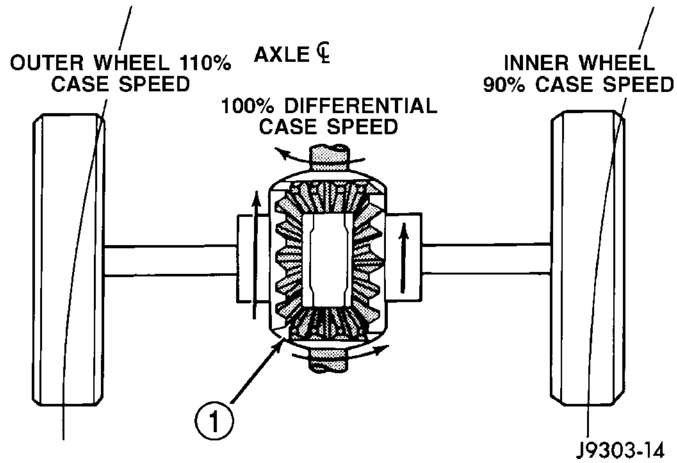


Fig. 30 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

REMOVAL

(1) Remove differential housing cover and drain lubricant from the housing.

(2) Remove hub bearings and axle shafts.

(3) Remove adjuster lock bolts and adjuster locks (Fig. 31).

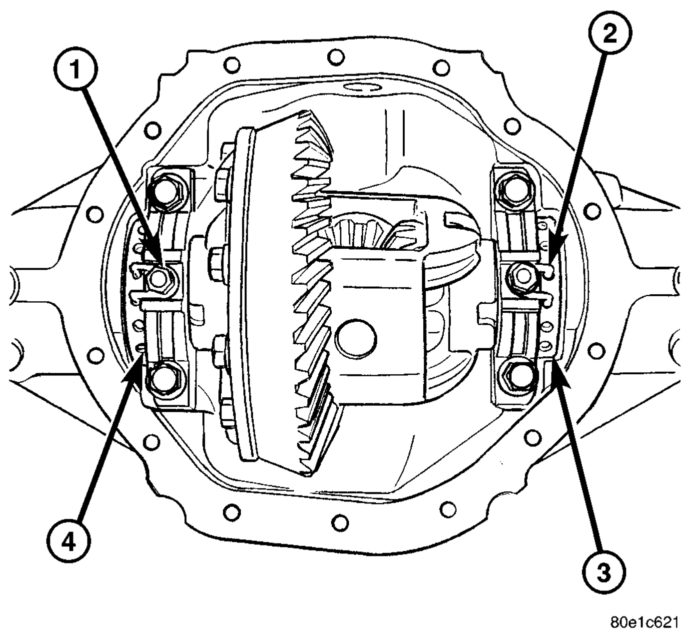


Fig. 31 ADJUSTERS AND LOCKS

1 - ADJUSTER LOCK BOLT
2 - ADJUSTER LOCK
3 - ADJUSTER
4 - BEARING CAP

DIFFERENTIAL (Continued)

(4) Mark bearing caps left and right for installation reference.

(5) Remove bearing cap bolts and remove bearing caps.

(6) Loosen differential bearing adjusters (Fig. 32) with Spanner Wrench 8883.

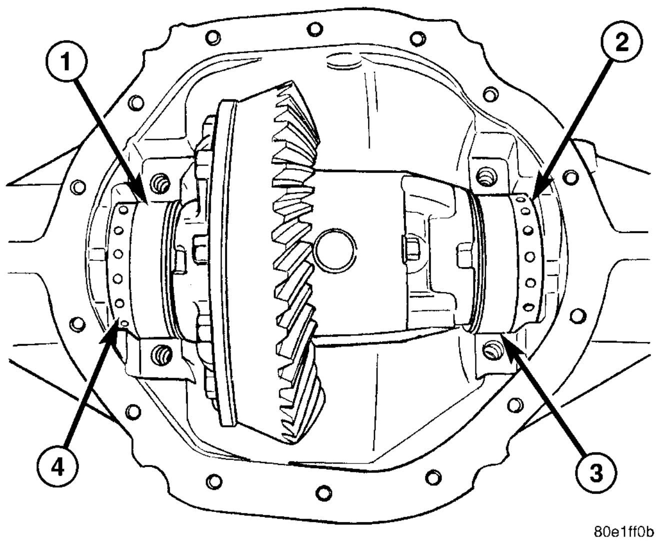


Fig. 32 ADJUSTERS

1 - BEARING CUP
2 - ADJUSTER
3 - BEARING CUP
4 - ADJUSTER

(7) Remove differential case from the housing.

(8) Remove bearing cups and tag them left and right for installation reference.

DISASSEMBLY

(1) Remove pinion shaft lock bolt.

(2) Remove pinion shaft (Fig. 33).

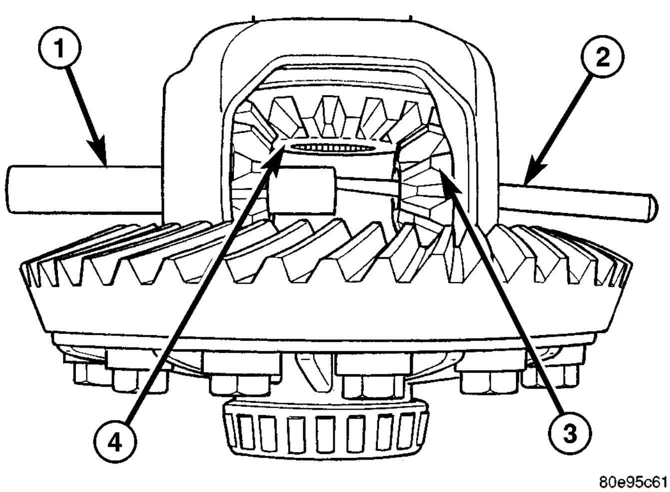


Fig. 33 PINION SHAFT

1 - PINION SHAFT
2 - PUNCH
3 - PINION GEAR
4 - SIDE GEAR

(3) Rotate differential pinion gears to differential window and remove pinion gears and thrust washers (Fig. 34).

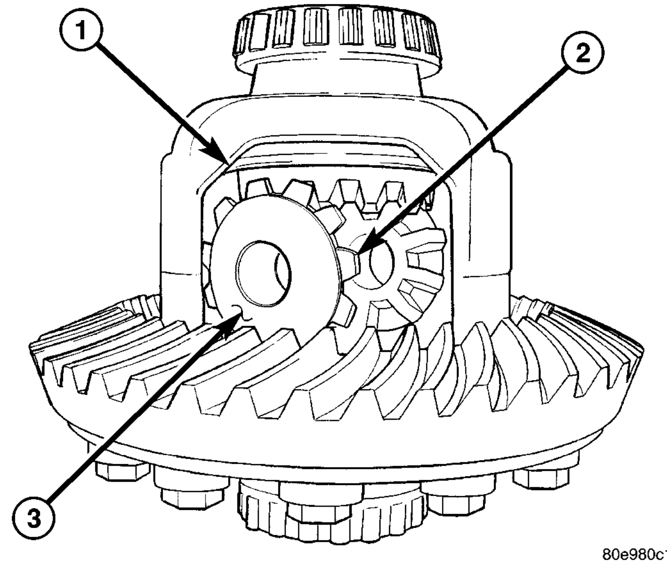


Fig. 34 PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - PINION GEAR
3 - THRUST GEAR

(4) Remove differential side gears and thrust washers (Fig. 35).

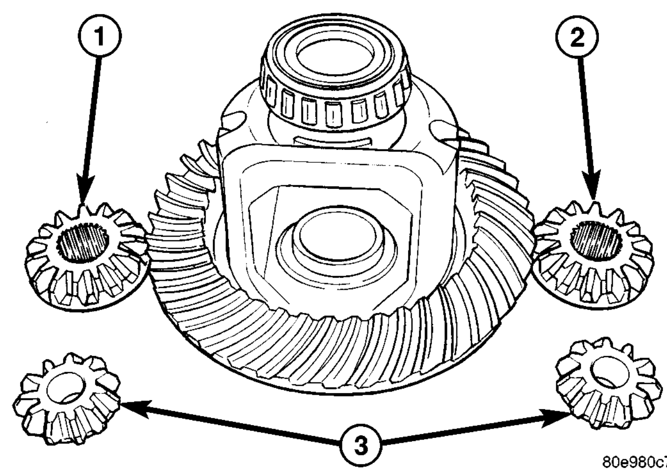


Fig. 35 SIDE GEARS

1 - SIDE GEAR
2 - SIDE GEAR
3 - PINION GEARS

DIFFERENTIAL (Continued)

ASSEMBLY

NOTE: If the same gears and thrust washers are being used, install them into their orignial locations.

(1) Lubricate all differential components with axle lubricant.

(2) Install differential side gears and thrust washers (Fig. 36).

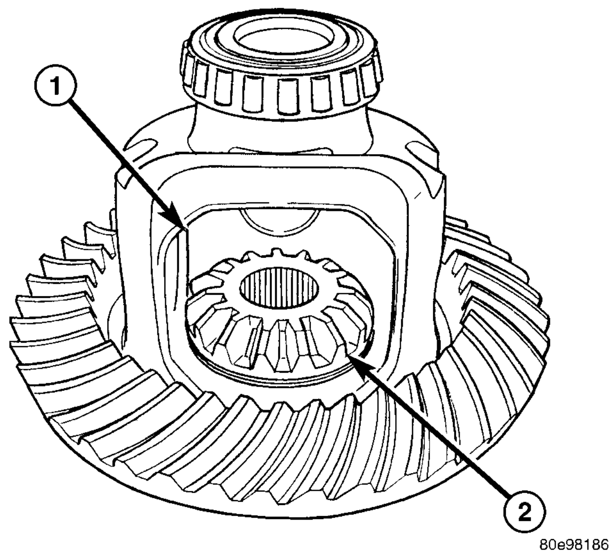


Fig. 36 SIDE GEARS

1 - DIFFERENTIAL WINDOW
2 - SIDE GEAR

(3) Rotate the one pinion gear with thrust washer into the differential case (Fig. 37). Then rotate the other pinion gear with thrust washer into the differential case.

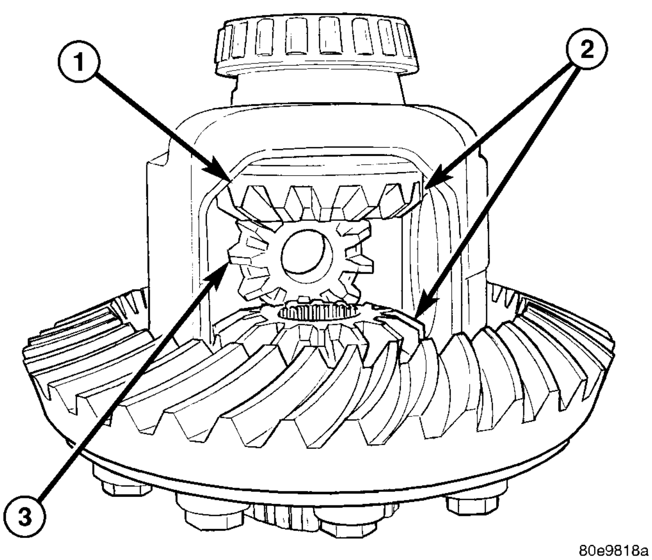


Fig. 37 PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - SIDE GEARS
3 - PINION GEAR

(4) Align hole in the pinion gears with hole in the differential case.

(5) Install pinion shaft.

(6) Install **new** pinion shaft lock bolt and tighten to 52 N·m (38 ft. lbs.).

INSTALLATION

(1) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth.

CAUTION: Do not use water, steam, kerosene or gasoline for cleaning.

(2) Lubricate differential case bearing.

(3) Install differential case with bearings cups into the housing.

(4) Install bearing caps and bolts (Fig. 38). Tighten the bearing cap bolts finger-tight.

NOTE: Do not torque bearing cap and bolts at this time.

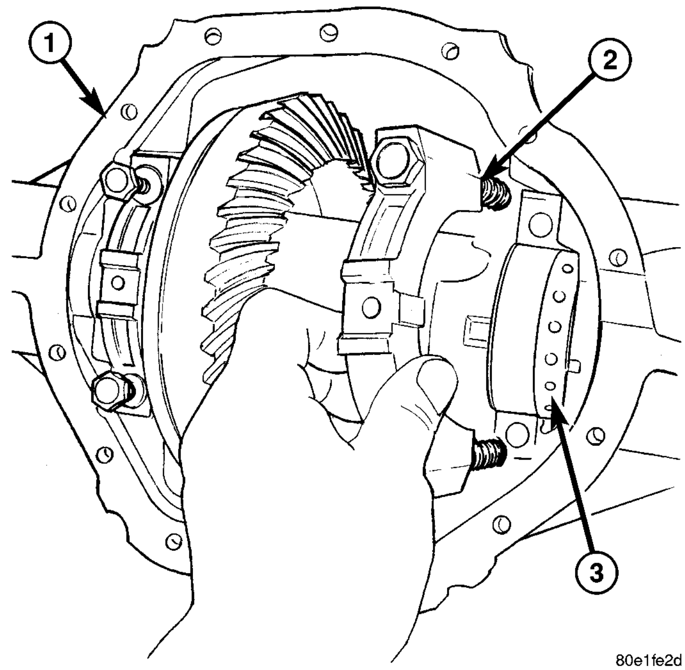


Fig. 38 CASE BEARING CAP

1 - DIFFERENTIAL HOUSING
2 - BEARING CAP
3 - ADJUSTER

(5) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(6) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 until they make contact with the differential bearings/cups.

DIFFERENTIAL (Continued)

(7) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

(8) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(9) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(10) Rotate the pinion several times to seat the differential bearings.

(11) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup.

(12) Tighten pinion gear side adjuster until it just makes contact with the bearing cup.

(13) Tighten pinion gear side adjuster an additional:

- **New Bearings:** 6 Adjuster Holes
- **Original Bearings:** 4 Adjuster Holes

(14) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(15) Tighten bearing cap bolts to 85 N·m (63 ft. lbs.).

(16) Tighten adjuster lock bolts to 25 N·m (18 ft. lbs.) (Fig. 39).

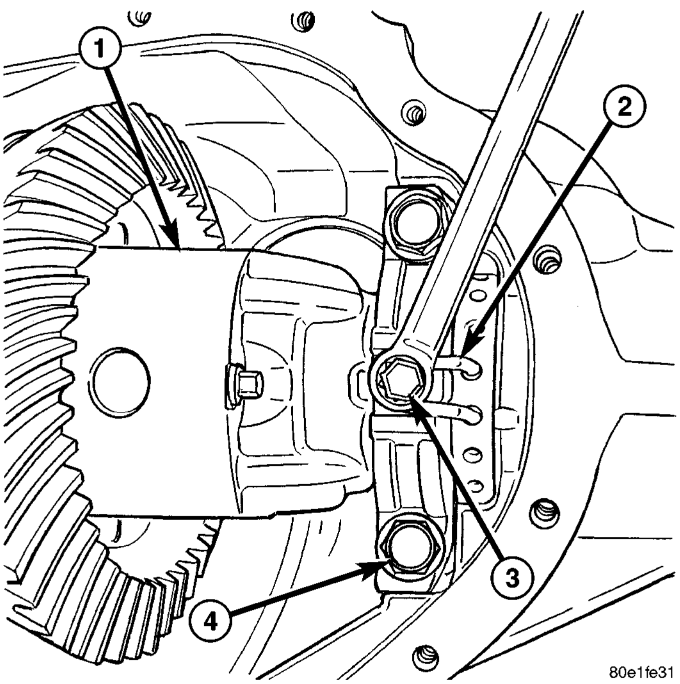


Fig. 39 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

(17) Measure ring gear backlash and check gear tooth contact pattern. Refer to Adjustments for procedure.

(18) Install axle shafts and hub bearings.

(19) Install differential housing gasket and cover. Tighten cover bolts to 40 N·m (30 ft. lbs.).

(20) Fill differential with lubricant, refer to Lubrication & Maintenance for capacity and lubricant type.

(21) Install fill plug and tighten to 32 N·m (24 ft. lbs.).

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove the differential case from the housing.

(2) Install Plug 8888 into the end of the case.

(3) Remove differental case bearings with Bearing Splitter 1130 and Bridge 938 (Fig. 40).

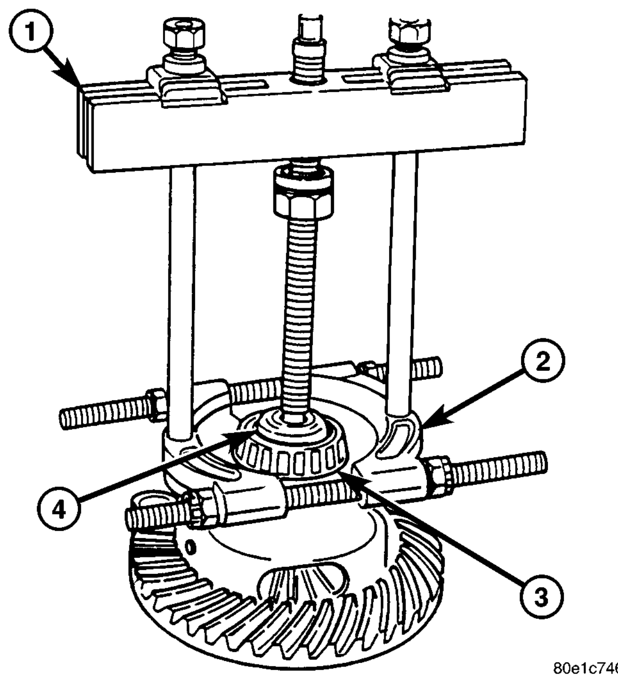


Fig. 40 DIFFERENTIAL CASE BEARING

1 - BRIDGE
2 - SPLITTER
3 - BEARING
4 - PLUG

DIFFERENTIAL CASE BEARINGS (Continued)

INSTALLATION

(1) Set differential case on Plug 8888.

(2) Install differenial case bearings with Installer 8881 and Handle C-4171 (Fig. 41).

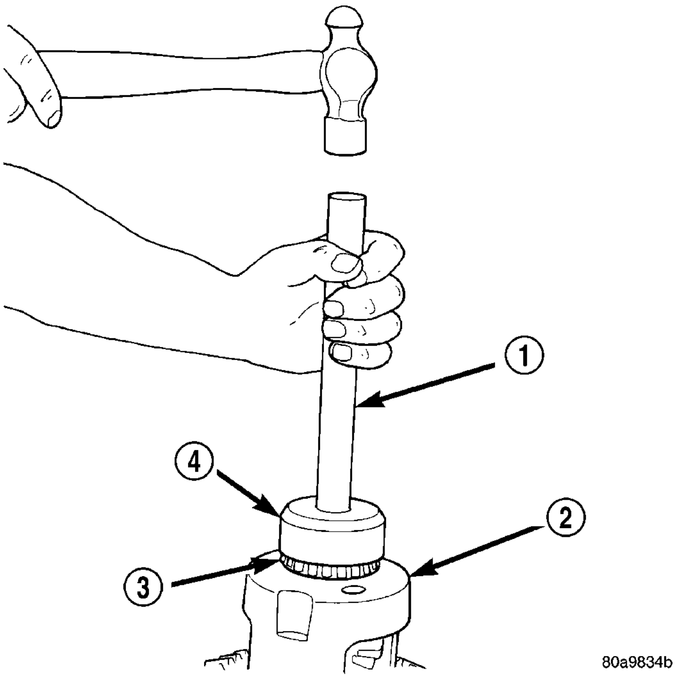


Fig. 41 DIFFERENTIAL CASE BEARINGS

1 - HANDLE
2 - DIFFERENTIAL CASE
3 - BEARING
4 - INSTALLER

(3) Install differentail case into housing.

PINION GEAR/RING GEAR

REMOVAL

NOTE: The ring and pinion gears are service in a matched set. Never replace the ring gear/pinion gear without replacing the other matching gear.

(1) Mark pinion flange and propeller shaft for installation alignment.

(2) Disconnect propeller shaft from pinion flange and remove propeller shaft.

(3) Remove axle shafts.

(4) Remove differential from housing.

(5) Place differential case in a vise with soft metal jaw protectors

(6) Remove bolts holding ring gear to differential case.

(7) Drive ring gear from differential case with a soft hammer (Fig. 42).

(8) Hold pinion flange with Flange Wrench 8979 (Fig. 43) and remove pinion flange nut and washer.

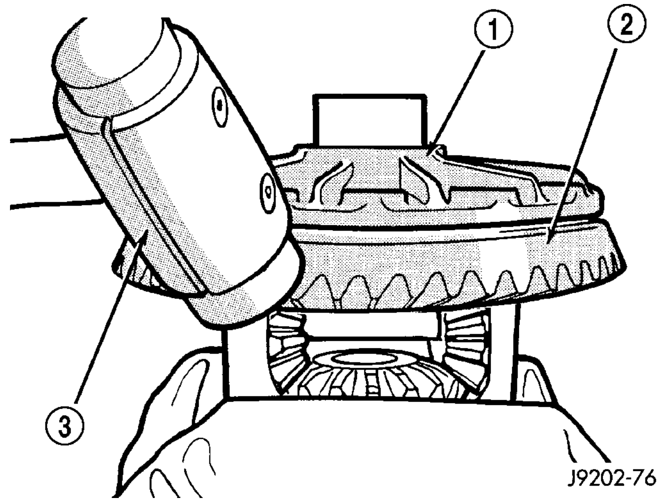


Fig. 42 RING GEAR

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - HAMMER

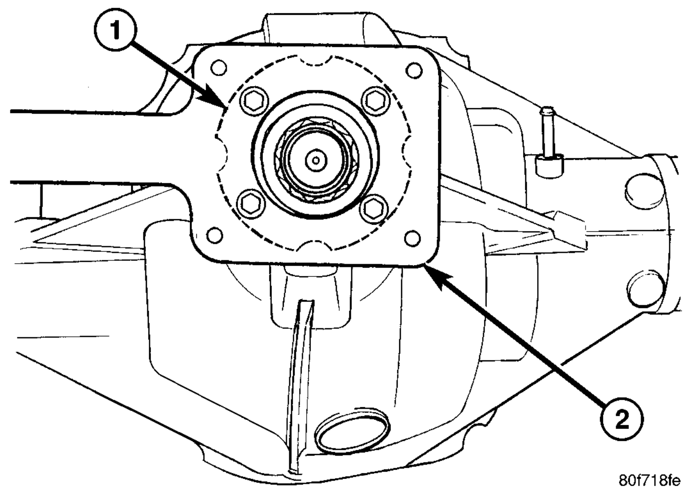


Fig. 43 FLANGE WRENCH

1 - PINION FLANGE
2 - WRENCH

(9) Remove pinion flange from pinion with Pinion Flange Puller 8992 (Fig. 44).

(10) Remove pinion gear from housing with Pinion Driver 8976 and a hammer (Fig. 45).

NOTE: Thread drive on shaft until it bottoms out.

(11) Remove pinion seal with a slide hammer or pry bar.

(12) Remove and discard front pinion bearing

CAUTION: Do not reuse front pinion bearing/cup.

(13) Remove collapsible spacer from the pinion shaft.

PINION GEAR/RING GEAR (Continued)

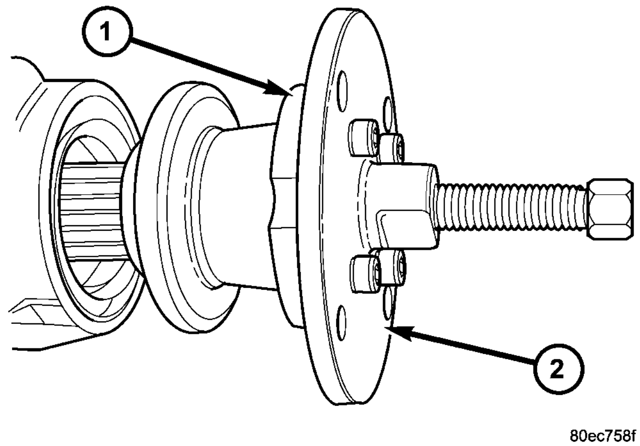


Fig. 44 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

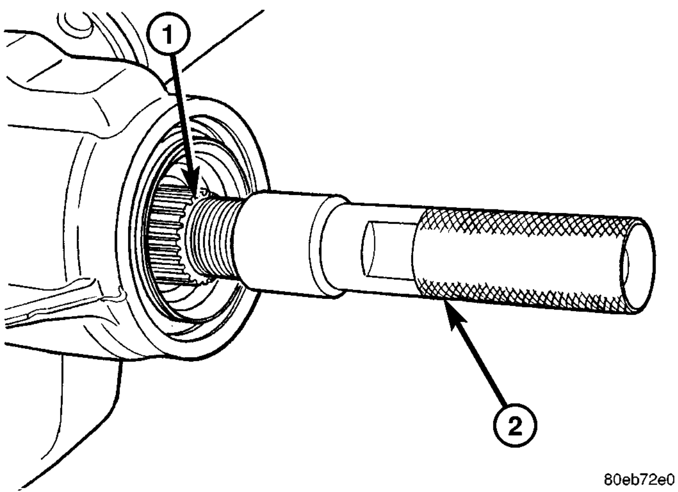


Fig. 45 PINION DRIVER

1 - PINION SHAFT
2 - PINION DRIVER

(14) Remove rear pinion bearing with Puller C-293-PA and Adapters 8879 (Fig. 46).

(15) Remove pinion depth shim from the pinion gear shaft and record thickness of the shims.

(16) Remove front pinion bearing cup from the housing with a punch and hammer and discard.

CAUTION: Do not reuse front pinion bearing/cup.

(17) Remove rear pinion bearing cup from the housing with a punch and hammer, if bearing is replaced.

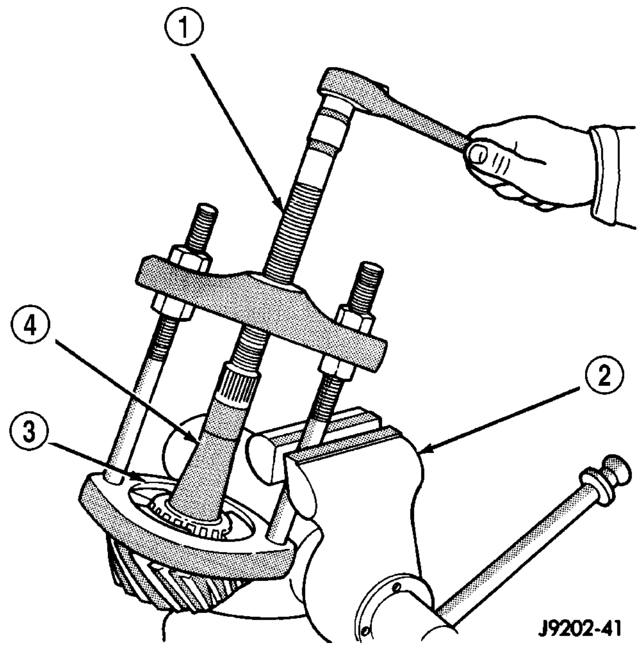


Fig. 46 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - PINION SHAFT
4 - ADAPTER BLOCKS

INSTALLATION

(1) Install front pinion bearing cup (Fig. 47) with Installer D-146 and Handle C-4171.

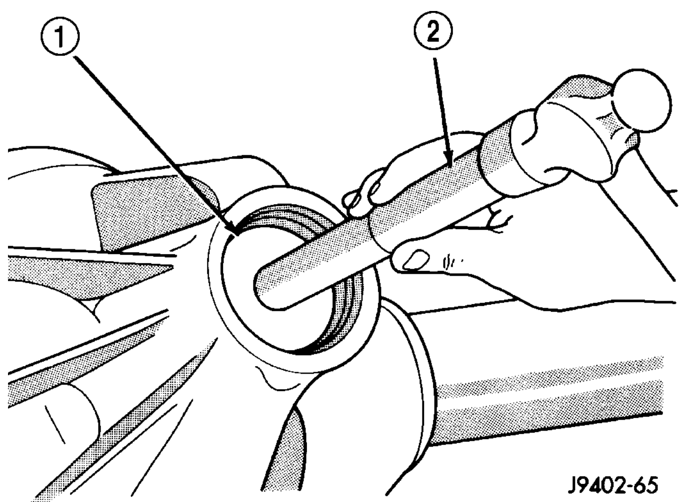


Fig. 47 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

PINION GEAR/RING GEAR (Continued)

(2) Install rear pinion bearing cup (Fig. 48) with Installer 8886 and Handle C-4171, if bearing is replaced.

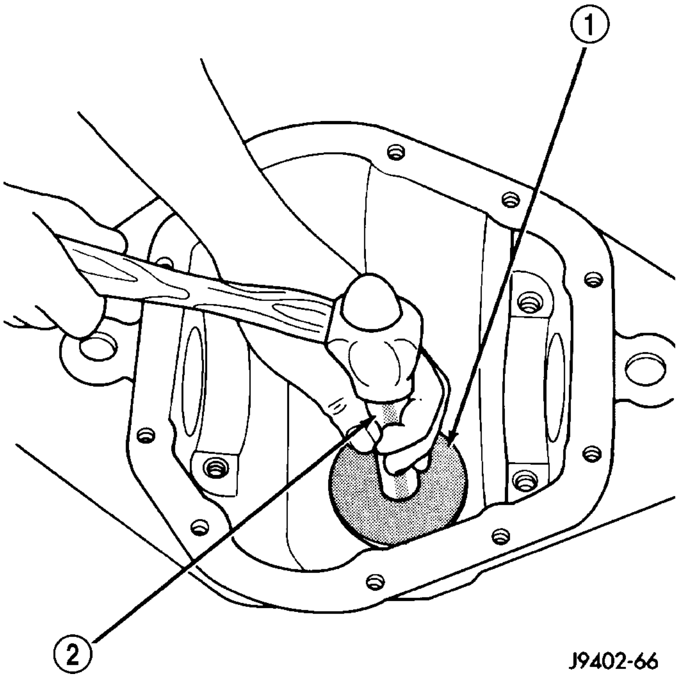


Fig. 48 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(3) Install pinion depth shim (Fig. 49) on the pinion gear shaft.

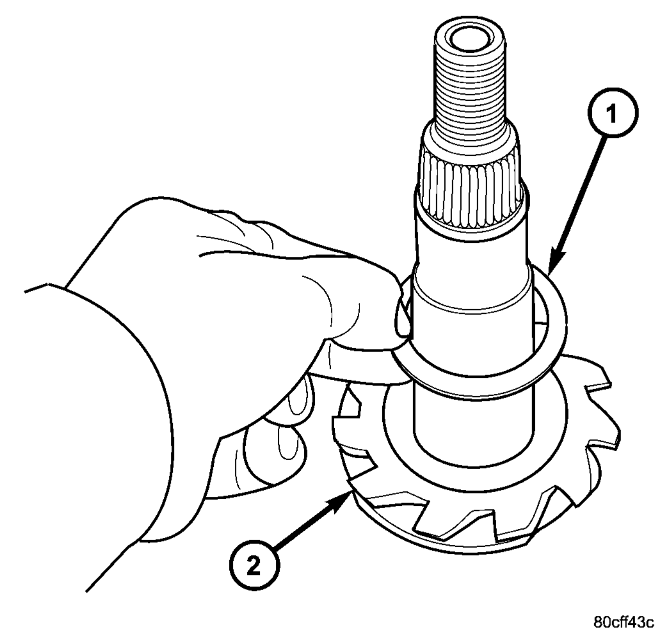


Fig. 49 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

(4) Install rear pinion bearing (Fig. 50) with Installer C-3095-A and a press.

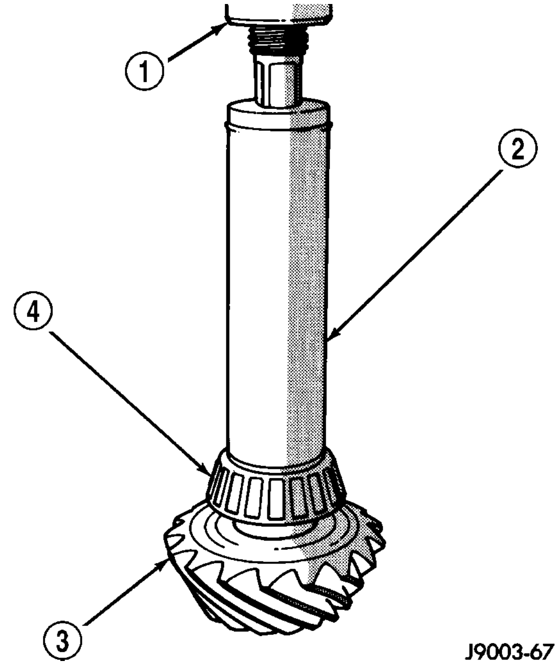


Fig. 50 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - PINION GEAR
4 - REAR PINION BEARING

(5) Install **new** collapsible spacer (Fig. 51).

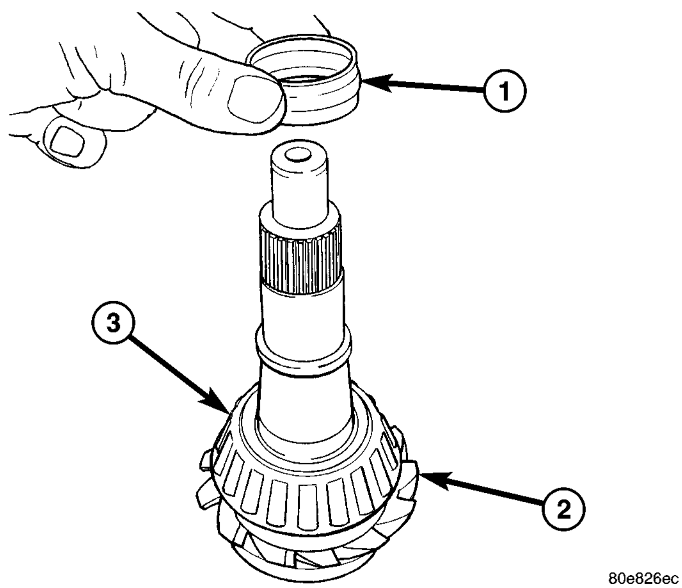


Fig. 51 COLAPSIBLE SPACER

1 - COLAPSIBLE SPACER
2 - PINION GEAR
3 - REAR PINION BEARING

(6) Lubricate pinion and bearings.

PINION GEAR/RING GEAR (Continued)

(7) Install pinion into the housing and place front pinion bearing onto the pinion shaft. Draw the pinion shaft into the front bearing with Installer 8982 (Fig. 52).

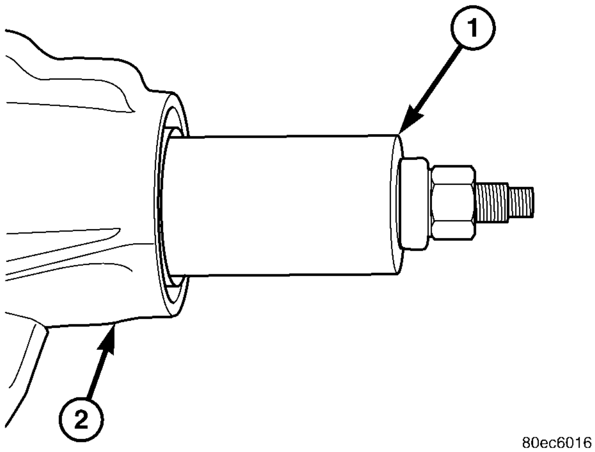


Fig. 52 PINION GEAR INSTALLER

1 - INSTALLER
2 - DIFFERENTIAL HOUSING

(8) Install **new** pinion seal (Fig. 53) with Installer 8882 and Handle C-4171.

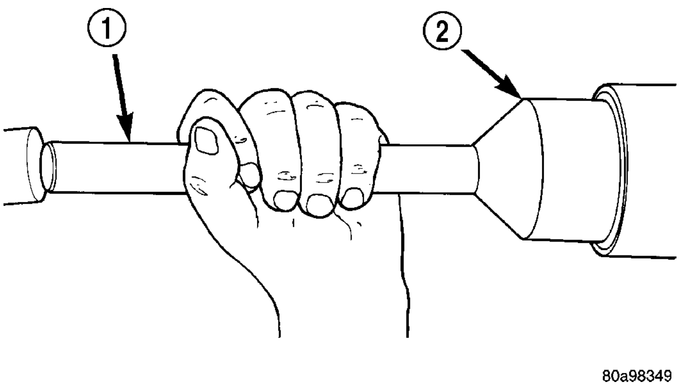


Fig. 53 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(9) Apply a light coat of teflon sealant to the pinion flange splines.

(10) Hold pinion and lightly tap the pinion flange onto the pinion shaft, until a few threads are showing.

(11) Install pinion flange washer and **new** pinion nut.

(12) Hold pinion flange with Flange Wrench 8979 and tighten pinion nut until end play is taken up.

(13) Rotate pinion several times to seat bearings.

(14) Measure pinion rotating torque with an inch pound torque wrench (Fig. 54). Tighten pinion nut in small increments until pinion rotating torque is:

- **New Pinion Bearings:** 1.7-2.8 N·m (15-25 in. lbs.)
- **Original Pinion Bearings:** 1.1-2.2 N·m (10-20 in. lbs.)

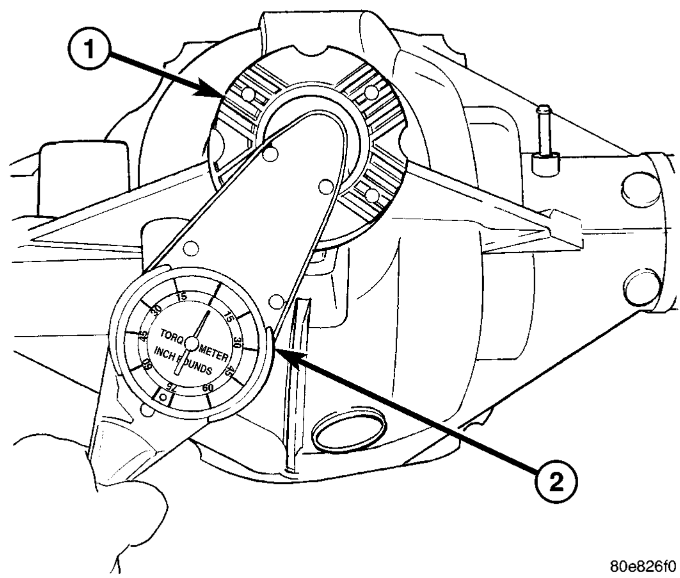


Fig. 54 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(15) Rotate pinion several times then verify pinion rotating torque again.

(16) Position the ring gear on differential case and start two **new** ring gear bolts.

(17) Install the rest of the **new** ring gear bolts and tighten them alternately to seat the ring gear.

(18) Torque ring gear bolts to 140 N·m (103 ft. lbs.).

(19) Install differential in housing.

(20) Measure final rotating torque with an inch pound torque wrench. The final pinion rotating torque plus differential case bearing preload is:

- **New Bearings:** 3.4-5.6 N·m (30-50 in. lbs.)
- **Original Bearings:** 2.8-5.1 N·m (25-45 in. lbs.)

(21) Install axle shafts.

(22) Verify ring gear backlash and gear contact pattern.

(23) Install the propeller shaft with the reference marks aligned.

(24) Install differential cover with gasket and tighten to 40 N·m (30 ft. lbs.).

(25) Fill differential with fluid and tighten fill plug to 32 N·m (24 ft. lbs.).

REAR AXLE - 9 1/4

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REAR AXLE - 9 1/4

DESCRIPTION

The axle consist of a cast iron center section with axle tubes extending from either side. The tubes are pressed into and welded to the differential housing to form a one-piece axle housing (Fig. 1). The axles are equipped with semi-floating axle shafts, meaning vehicle loads are supported by the axle shaft and bearings. The axle shafts are retained by C-locks in the differential side gears.

OPERATION

The axle receives power from the propeller shaft. The propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, tooth contact, worn/damaged gears, or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side gears and pinions can be checked by turning the vehicle. They usually do not cause noise during straight-ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion shaft can also cause a snapping or a knocking noise.

BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing

REAR AXLE - 9 1/4 (Continued)

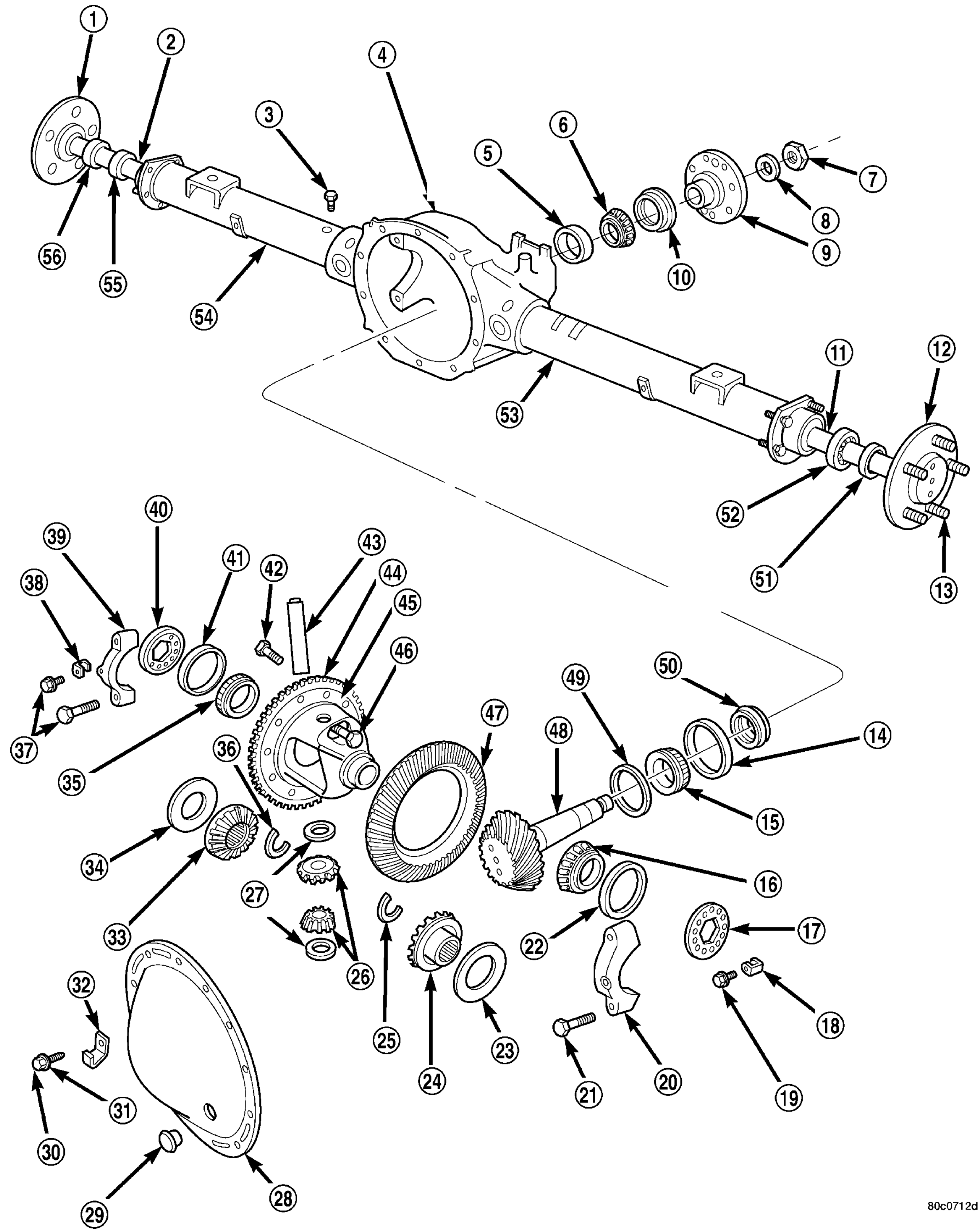


Fig. 1 9 1/4 AXLE

REAR AXLE - 9 1/4 (Continued)

1 - HUB
2 - AXLE SHAFT
3 - VENT FITTING
4 - DIFFERENTIAL HOUSING
5 - CUP
6 - FRONT PINION BEARING CONE
7 - NUT
8 - WASHER
9 - COMPANION FLANGE
10 - SEAL
11 - AXLE SHAFT
12 - HUB
13 - STUD
14 - BEARING CUP
15 - REAR PINION BEARING CONE
16 - DIFFERENTIAL BEARING
17 - ADJUSTER
18 - LOCK
19 - BOLT
20 - BEARING CAP
21 - CAP BOLT
22 - BEARING CUP
23 - THRUST WASHER
24 - SIDE GEAR
25 - C-LOCK
26 - DIFFERENTIAL POSITIONS
27 - THRUST WASHER
28 - COVER
29 - PLUG
30 - COVER BOLT
31 - WASHER
32 - CLIP
33 - SIDE GEAR
34 - THRUST WASHER
35 - DIFFERENTIAL BEARING CONE
36 - C-LOCK
37 - BOLT
38 - LOCK
39 - BEARING CUP
40 - ADJUSTER
41 - BEARING CUP
42 - BOLT
43 - PINION MATE SHAFT
44 - EXCITER RING
45 - DIFFERENTIAL CASE
46 - RING GEAR BOLT
47 - RING GEAR
48 - PINION
49 - PINION GEAR DEPTH SHIM
50 - PRELOAD COLLAPSIBLE SPACER
51 - SEAL
52 - AXLE SHAFT BEARING
53 - AXLE SHAFT TUBE
54 - AXLE TUBE
55 - AXLE SHAFT BEARING
56 - SEAL

noise will be higher pitched because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side–gear thrust washers. A worn pinion shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out-of-balance wheels.
- Loose wheel lug nuts.
- Worn U-joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front-end components or engine/transmission mounts. These components can contribute to what appears to be a rearend vibration. Do not overlook engine accessories, brackets and drive belts.

NOTE: All driveline components should be examined before starting any repair.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U-joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

REAR AXLE - 9 1/4 (Continued)

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose.	1. Tighten loose nuts.
	2. Faulty, brinelled wheel bearing.	2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube.	1. Inspect axle tube alignment. Correct as necessary.
	2. Bent or sprung axle shaft.	2. Inspect and correct as necessary.
Axle Shaft Broke	1. Misaligned axle tube.	1. Replace the broken shaft after correcting tube mis-alignment.
	2 Vehicle overloaded.	2. Replace broken shaft and avoid excessive weight on vehicle.
	3. Erratic clutch operation.	3. Replace broken shaft and avoid or correct erratic clutch operation.
	4. Grabbing clutch.	4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.

REAR AXLE - 9 1/4 (Continued)

Condition	Possible Causes	Correction
Loss Of Lubricant	1. Lubricant level too high.	1. Drain lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern. Adjust backlash or pinion depth.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

REAR AXLE - 9 1/4 (Continued)

REMOVAL

(1) Raise and support the vehicle.
(2) Position a lifting device under the axle.
(3) Secure axle to device.
(4) Remove wheels and tires assemblies.
(5) Remove RWAL sensor from the differential housing.
(6) Remove brake hose at the axle junction block.
(7) Disconnect parking brake cables and cable brackets.
(8) Remove brake calipers and rotors.
(9) Remove axle vent hose.
(10) Mark propeller shaft and companion flange for installation alignment reference.
(11) Remove propeller shaft.
(12) Remove shock absorbers from axle.
(13) Remove U-bolets from axle.
(14) Separate the axle from the vehicle.

INSTALLATION

(1) Raise axle with lifting device and align to the leaf spring centering bolts.
(2) Install axle U-bolts and tighten to 149 N·m (110 ft. lbs.).
(3) Install shock absorbers to axle and tighten to specification.
(4) Install the RWAL sensor to the differential housing.
(5) Connect the parking brake cables and cable brackets.
(6) Install brake rotors and calipers.
(7) Connect brake hose to the axle junction block.
(8) Install axle vent hose.
(9) Align propeller shaft and pinion companion flange reference marks and tighten companion flange bolts to 115 N·m (85 ft. lbs.).
(10) Install the wheels and tires.
(11) Fill differential to specifications.
(12) Remove lifting device from axle and lower the vehicle.

ADJUSTMENTS

Ring gear and pinion are supplied as matched sets only. The identifying numbers for the ring gear and pinion are painted onto the pinion gear shaft (Fig. 2) and the side of the ring gear. A plus (+) number, minus (–) number or zero (0) along with the gear set sequence number (01 to 99) is on each gear. This first number is the amount (in thousandths of an inch) the depth varies from the standard depth setting of a pinion marked with a (0). The next two numbers are the sequence number of the gear set. The standard depth provides the best teeth contact pattern. Refer to Backlash and Contact Pattern for additional information.

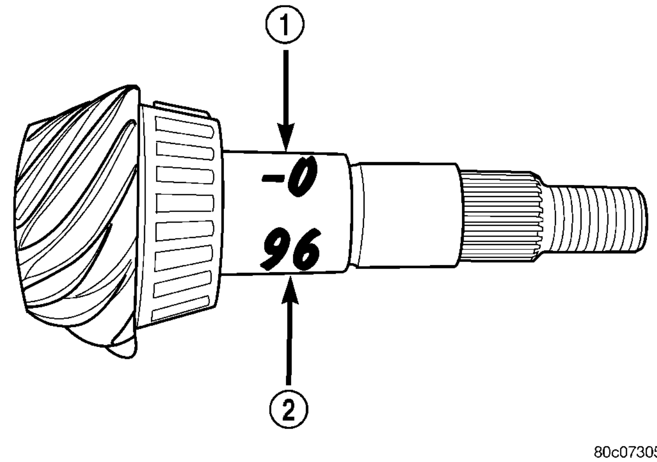


Fig. 2 PINION ID NUMBER

1 - VARIANCE NUMBER
2 - SEQUENCE NUMBER

Compensation for pinion depth variance is achieved with select shims. The shims are placed behind the rear pinion bearing. (Fig. 3).

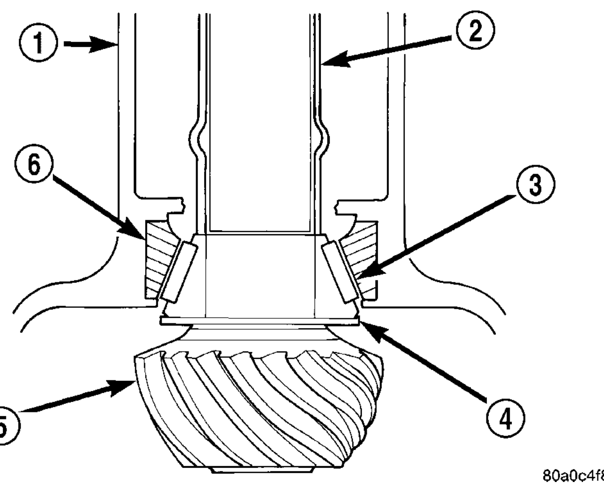


Fig. 3 ADJUSTMENT SHIM LOCATIONS

1 - DIFFERENTIAL HOUSING
2 - COLLAPSIBLE SPACER
3 - PINION BEARING
4 - PINION DEPTH SHIM
5 - PINION GEAR
6 - BEARING CUP

If a new gear set is being installed, note the depth variance painted onto both the original and replacement pinion. Add or subtract the thickness of the original depth shims to compensate for the difference in the depth variances. Refer to the Depth Variance chart.

Note where Old and New Pinion Marking columns intersect. Intersecting figure represents plus or minus the amount needed.

Note the painted number on the shaft of the drive pinion (–1, –2, 0, +1, +2, etc.). The numbers repre-

REAR AXLE - 9 1/4 (Continued)

sent thousands of an inch deviation from the standard. If the number is negative, add that value to the required thickness of the depth shims. If the number is positive, subtract that value from the thickness of the depth shim. If the number is 0 no change is necessary.

PINION GEAR DEPTH VARIANCE

Original Pinion Gear Depth Variance	Replacement Pinion Gear Depth Variance								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

PINION DEPTH MEASUREMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 4).

(1) Assemble Pinion Height Block 6739, Pinion Block 8542 and rear pinion bearing onto Screw 6741 (Fig. 4).

(2) Insert assembled height gauge components, rear bearing, and screw into the housing through pinion bearing cups (Fig. 5).

(3) Install front pinion bearing and Cone-Nut 6740 hand tight (Fig. 4).

(4) Place Arbor Disc 8541 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 6). Install differential bearing caps on arbor discs and tighten cap bolts to 41 N·m (30 ft. lbs.).

NOTE: Arbor Discs 8541 has different step diameters to fit other axles. Choose proper step for axle being serviced.

(5) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(6) Place Scooter Block/Dial Indicator in position in axle housing so dial probe and scooter block are flush against the rearward surface of the pinion height block (Fig. 4). Hold scooter block in place and zero the dial indicator. Tighten dial indicator face lock screw.

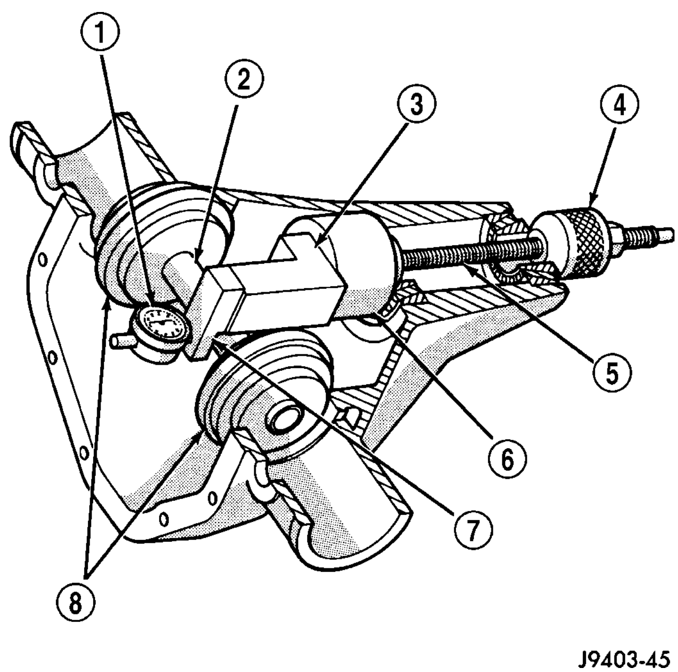


Fig. 4 PINION DEPTH GAUGE TOOLS

1 - DIAL INDICATOR
2 - ARBOR
3 - PINION HEIGHT BLOCK
4 - CONE
5 - SCREW
6 - PINION BLOCK
7 - SCOOTER BLOCK
8 - ARBOR DISC

REAR AXLE - 9 1/4 (Continued)

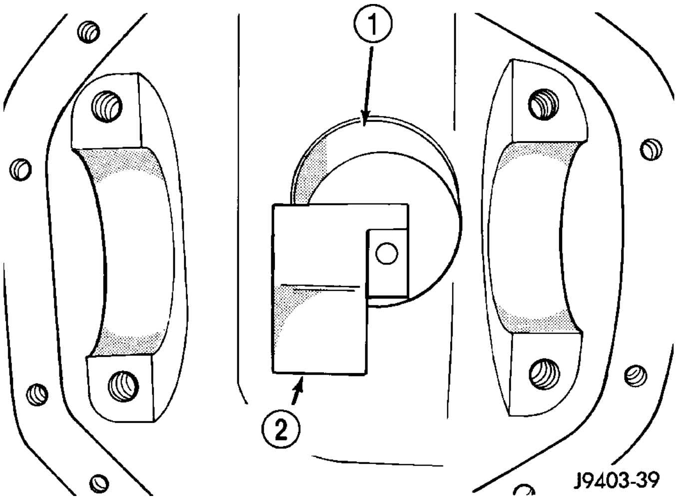


Fig. 5 PINION HEIGHT BLOCK

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

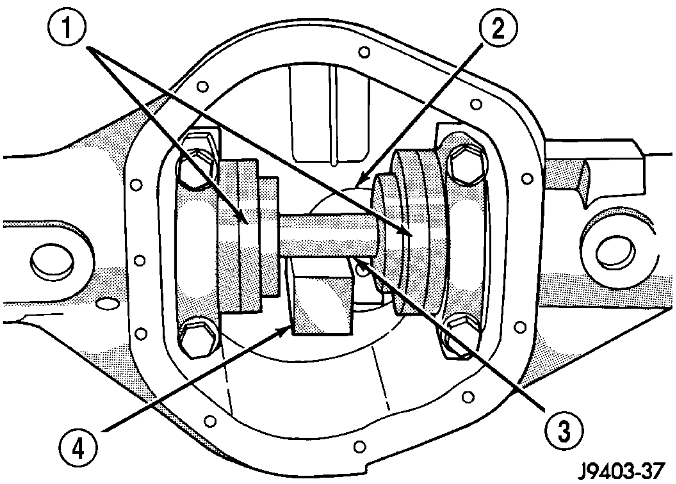


Fig. 6 PINION DEPTH TOOLS

1 - ARBOR DISC
2 - PINION BLOCK
3 - ARBOR
4 - PINION HEIGHT BLOCK

(7) Slide the dial indicator probe across the gap between the pinion height block and the arbor bar with the scooter block against the pinion height block (Fig. 7). Continue moving the dial probe to the crest of the arbor bar and record the highest reading.

(8) Select a shim equal to the dial indicator reading plus the drive pinion gear depth variance number marked on the shaft of the pinion. For example, if the depth variance is –2, add +0.002 in. to the dial indicator reading.

DIFFERENTIAL BEARING PRELOAD AND GEAR BACKLASH

The following must be considered when adjusting bearing preload and gear backlash:

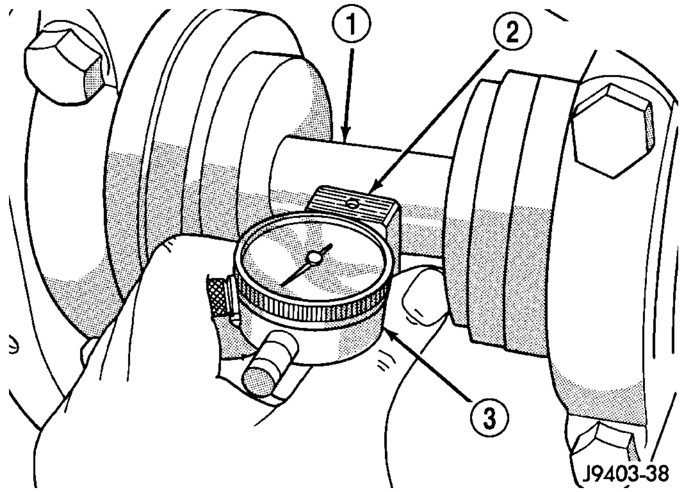


Fig. 7 PINION GEAR DEPTH MEASUREMENT

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

- The maximum ring gear backlash variation is 0.076 mm (0.003 in.).
- Mark the gears so the same teeth are meshed during all backlash measurements.
- Maintain the torque while adjusting the bearing preload and ring gear backlash.
- Excessive adjuster torque will introduce a high bearing load and cause premature bearing failure. Insufficient adjuster torque can result in excessive differential case free-play and ring gear noise.
- Insufficient adjuster torque will not support the ring gear correctly and can cause excessive differential case free-play and ring gear noise.

NOTE: The differential bearing cups will not always immediately follow the threaded adjusters as they are moved during adjustment. To ensure accurate bearing cup responses to the adjustments:

- **Maintain the gear teeth engaged (meshed) as marked.**
- **The bearings must be seated by rapidly rotating the pinion gear a half turn back and forth.**
- **Do this five to ten times each time the threaded adjusters are adjusted.**

(1) Throught the axle tube use Wrench C-4164 to adjust each threaded adjuster inward until the differential bearing free-play is eliminated. Allow some ring gear backlash approximately 0.25 mm (0.01 in.) between the ring and pinion gear. Seat the bearing cups with the procedure described above.

(2) Install dial indicator and position the plunger against the drive side of a ring gear tooth (Fig. 8). Measure the backlash at 4 positions, 90 degrees apart around the ring gear. Locate and mark the area of minimum backlash.

REAR AXLE - 9 1/4 (Continued)

(3) Rotate the ring gear to the position of the least backlash. Mark the gear so that all future backlash measurements will be taken with the same gear teeth meshed.

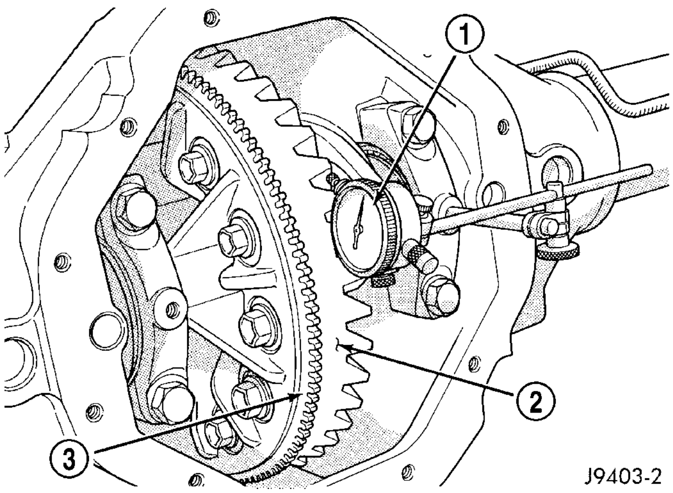


Fig. 8 RING GEAR BACKLASH

1 - DIAL INDICATOR
2 - RING GEAR
3 - EXCITER RING

(4) Loosen the right-side, tighten the left-side threaded adjuster. Obtain backlash of 0.076 to 0.102 mm (0.003-0.004 in.) with each adjuster tightened to 14 N·m (10 ft. lbs.). Seat the bearing cups with the procedure described above.

(5) Tighten the differential bearing cap bolts 136 N·m (100 ft. lbs.).

(6) Tighten the right-side threaded adjuster to 102 N·m (75 ft. lbs.). Seat the bearing cups with the procedure described above. Continue to tighten the right-side adjuster and seat bearing cups until the torque remains constant at 102 N·m (75 ft. lbs.)

(7) Measure the ring gear backlash. The range of backlash is 0.15 to 0.203 mm (0.006 to 0.008 in.).

(8) Continue increasing the torque at the right-side threaded adjuster until the specified backlash is obtained.

NOTE: The left-side threaded adjuster torque should have approximately 102 N·m (75 ft. lbs.). If the torque is considerably less, the complete adjustment procedure must be repeated.

(9) Tighten the left-side threaded adjuster until 102 N·m (75 ft. lbs.) torque is indicated. Seat the bearing rollers with the procedure described above. Do this until the torque remains constant.

(10) Install the threaded adjuster locks and tighten the lock screws to 10 N·m (90 in. lbs.).

GEAR CONTACT PATTERN

Gear tooth contact pattern is used to verify the correct running position of the ring and pinion gears. This will produce low noise and long gear life. Gears which are not positioned properly may be noisy and have shorten gear life.

(1) Wipe clean each tooth of the ring gear.

(2) Apply gear marking compound to all of the ring gear teeth.

(3) Verify bearing cap bolts are torque specification.

(4) Apply parking brakes lightly to create at 14 N·m (10 ft. lbs.) pinion rotating torque.

(5) Rotate the pinion/pinion yoke 4 full revolutions in each directions.

(6) Read gear tooth contact pattern:

- Gear contact pattern is correct (Fig. 9). Backlash and pinion depth is correct.

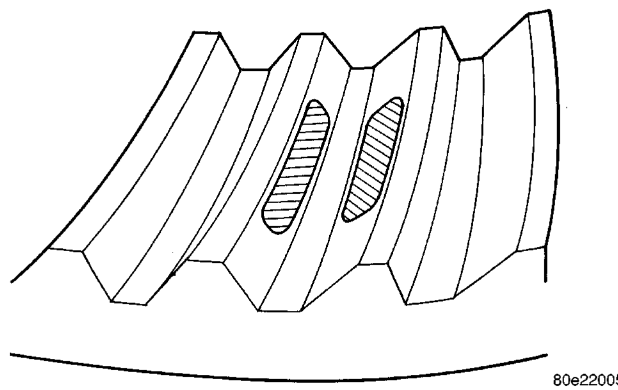


Fig. 9 CORRECT CONTACT PATTERN

- Ring gear too far away from pinion gear (Fig. 10). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

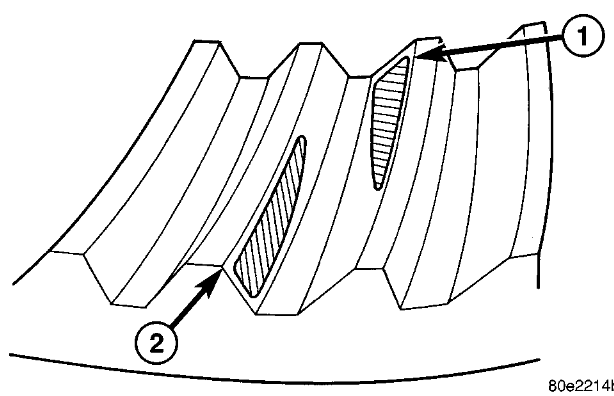


Fig. 10 INCORRECT BACKLASH

1 - COAST SIDE TOE
2 - DRIVE SIDE HEEL

REAR AXLE - 9 1/4 (Continued)

• Ring gear too close to pinion gear (Fig. 11). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

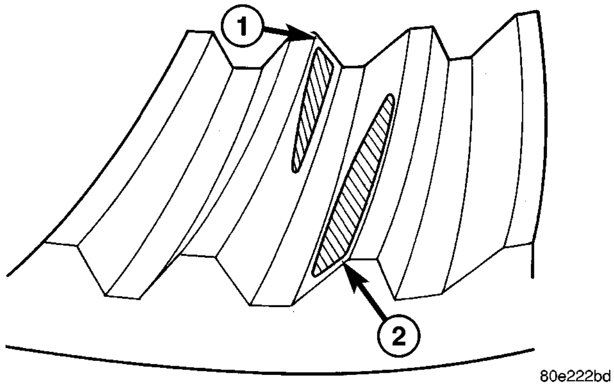


Fig. 11 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE HEEL

• Ring gear too far away from pinion gear (Fig. 12). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

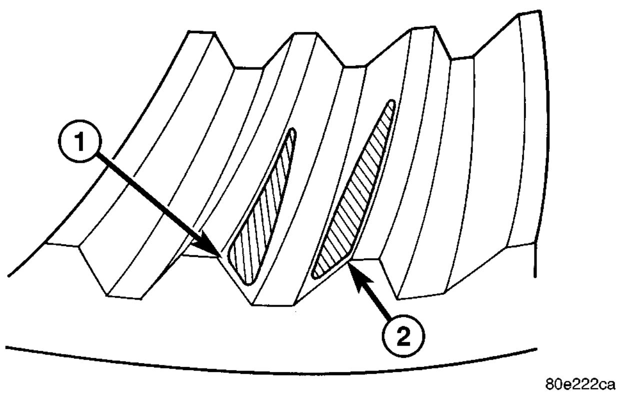


Fig. 12 INCORRECT BACKLASH

1 - DRIVE SIDE HEEL
2 - COAST SIDE HEEL

• Ring gear too close to pinion gear (Fig. 13). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

• Pinion gear set too low (Fig. 14). Increase pinion gear height, by increasing the pinion depth shim thickness.

• Pinion gear set too high (Fig. 15). Decrease pinion depth, by decreasing the pinion depth shim thickness.

SIDE GEAR CLEARANCE

When measuring side gear clearance, check each gear independently. If it necessary to replace a side gear, replace both gears as a matched set.

(1) Install the axle shafts and C-locks and pinion mate shaft.

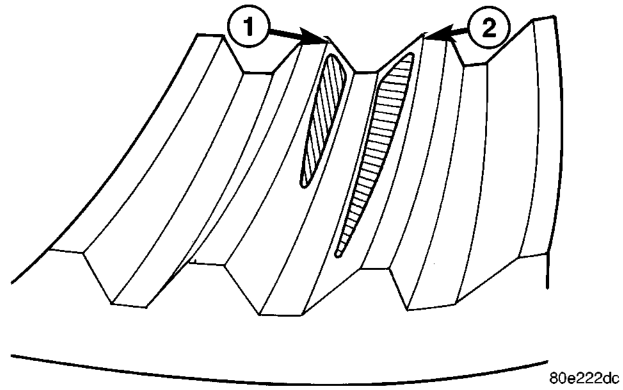


Fig. 13 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE TOE

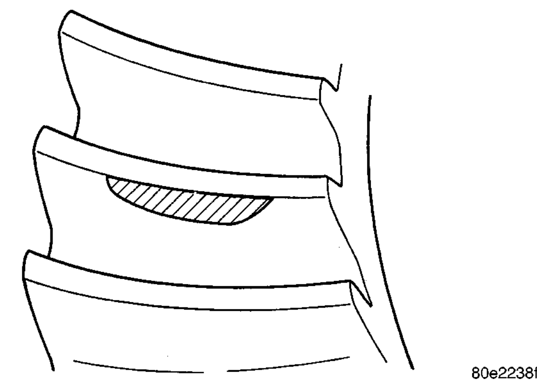


Fig. 14 LOW PINION HEIGHT

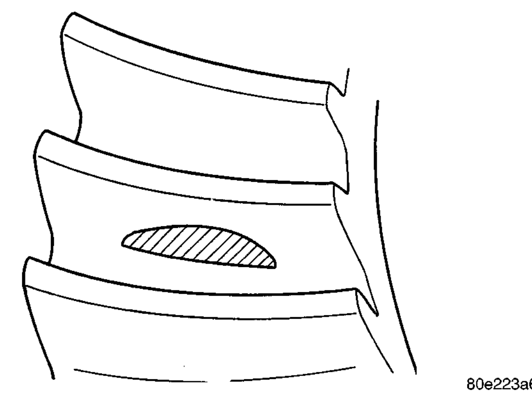


Fig. 15 HIGH PINION HEIGHT

(2) Measure each side gear clearance. Insert a matched pair of feeler gauge blades between the gear and differential housing on opposite sides of the hub (Fig. 16).

(3) If side gear clearances is no more than 0.005 inch. Determine if the axle shaft is contacting the pinion mate shaft. **Do not remove the feeler gauges, inspect the axle shaft with the feeler gauge inserted behind the side gear.** If the end of

REAR AXLE - 9 1/4 (Continued)

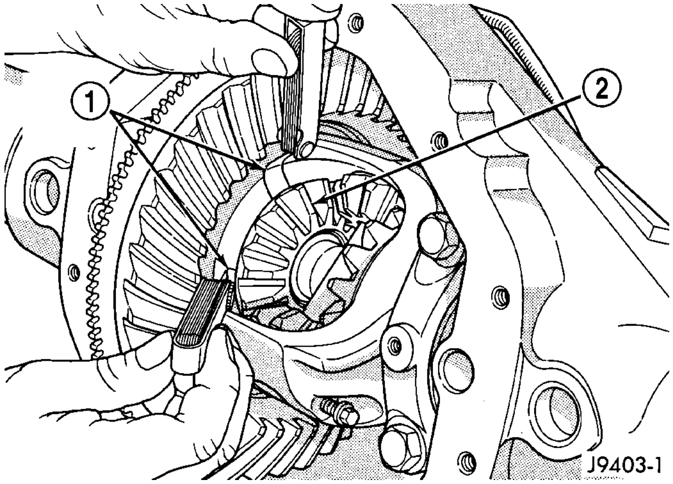


Fig. 16 SIDE GEAR CLEARANCE

1 - FEELER GAUGE
2 - SIDE GEAR

the axle shaft is not contacting the pinion mate shaft, the side gear clearance is acceptable.

(4) If clearance is more than 0.005 inch (axle shaft not contacting mate shaft), record the side gear clearance. Remove the thrust washer and measure its thickness with a micrometer. Add the washer thickness to the recorded side gear clearance. The sum of gear clearance and washer thickness will determine required thickness of replacement thrust washer (Fig. 17).

SIDE GEAR CLEARANCE	0.007
THRUST WASHER THICKNESS	+ 0.033
TOTAL	0.040
	0.040
REPLACEMENT WASHER THICKNESS	− 0.037
NEW SIDE GEAR CLEARANCE	0.003

J9203-31

Fig. 17 SIDE GEAR CALCULATIONS

In some cases, the end of the axle shaft will move and contact the mate shaft when the feeler gauge is inserted. The C-lock is preventing the side gear from sliding on the axle shaft.

(5) If there is no side gear clearance, remove the C-lock from the axle shaft. Use a micrometer to measure the thrust washer thickness. Record the thickness and re-install the thrust washer. Assemble the differential case without the C-lock installed and re-measure the side gear clearance.

(6) Compare both clearance measurements. If the difference is less than 0.012 inch (0.305 mm), add clearance recorded when the C-lock was installed to thrust washer thickness measured. The sum will determine the required thickness of the replacement thrust washer.

(7) If clearance is 0.012 inch (0.305 mm) or greater, both side gears must be replaced (matched set) and the clearance measurements repeated.

(8) If clearance (above) continues to be 0.012 inch (0.305 mm) or greater, the case must be replaced.

SPECIFICATIONS

AXLE SPECIFICATIONS

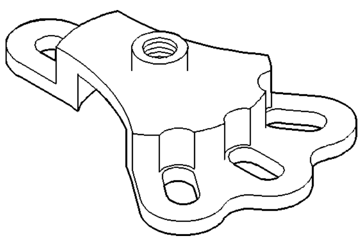
DESCRIPTION	SPECIFICATION
Axle Ratio	3.21, 3.55, 3.92
Differential Case Flange Runout	0.076 mm (0.003 in.)
Differential Case Clearance	0.12 mm (0.005 in.)
Ring Gear Diameter	235 mm (9.25 in.)
Ring Gear Backlash	0.12-0.20 mm (0.005-0.008 in.)
Ring Gear Runout	0.12 mm (0.005 in.)
Pinion Bearing Preload - New Bearings	1.7-4 N·m (15-35 in. lbs.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)

REAR AXLE - 9 1/4 (Continued)

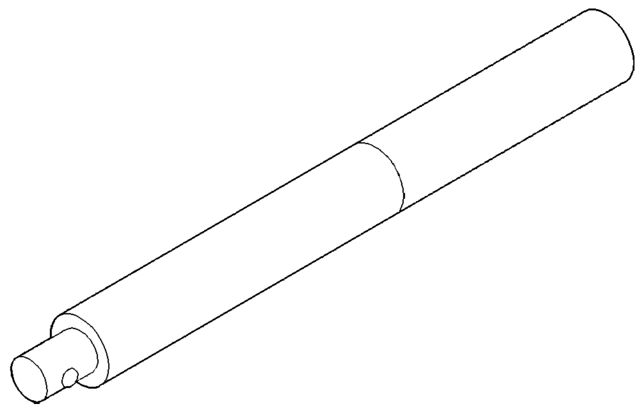
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Differential Cover Bolts	41	30	-
Bearing Cap Bolts	136	100	-
Ring Gear Bolts	157	115	-
Pinion Nut Minimum	285	210	-
Adjuster Lock Screw	10	7.5	90
Backing Plate Bolts	65	48	-
Pinion Mate Shaft Lock Screw	11	8	-
Axle U-Bolt Nuts	149	110	-

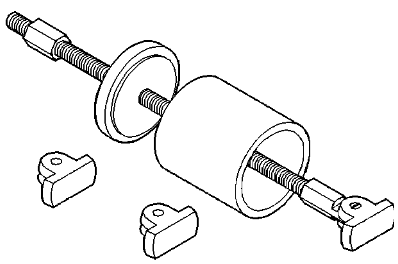
SPECIAL TOOLS



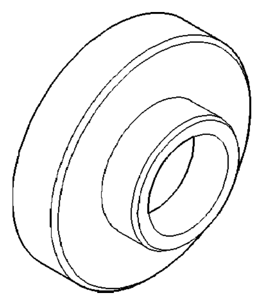
PULLER 6790



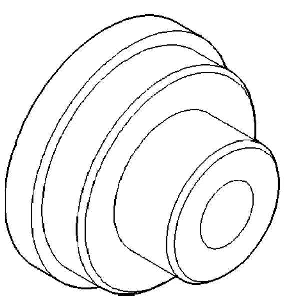
HANDLE C-4171



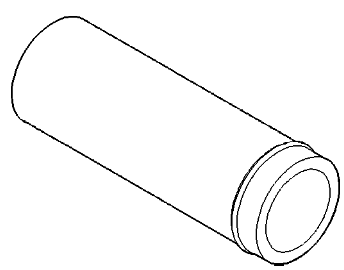
REMOVER 6310



INSTALLER C-4076-B

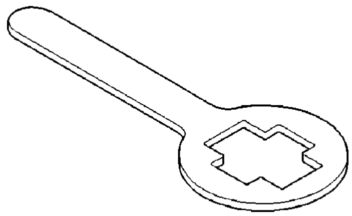


INSTALLER C-4198

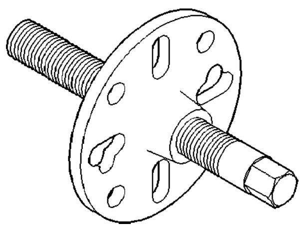


HANDLE C-4735-1

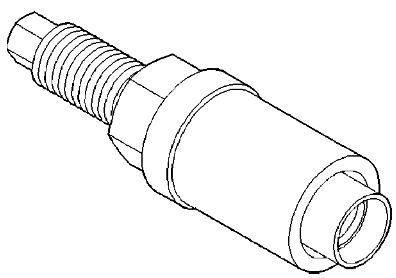
REAR AXLE - 9 1/4 (Continued)



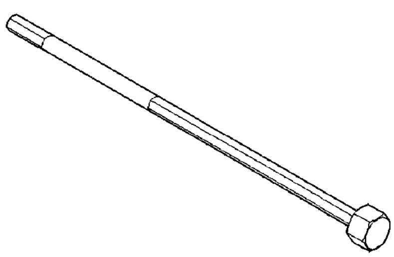
HOLDER 6719



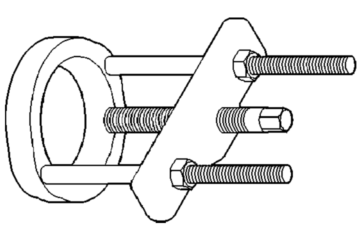
PULLER C-452



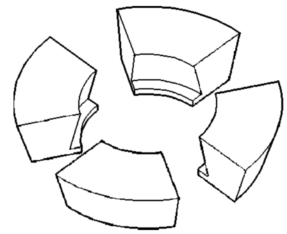
INSTALLER C-3718



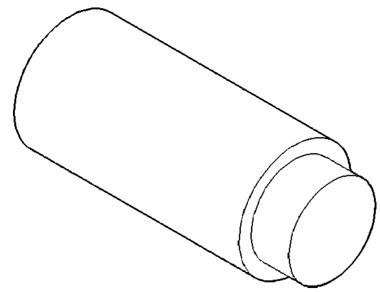
WRENCH C-4164



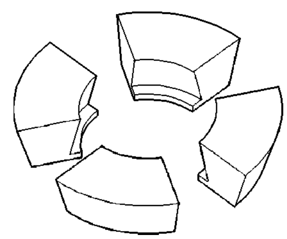
PULLER C-293-PA



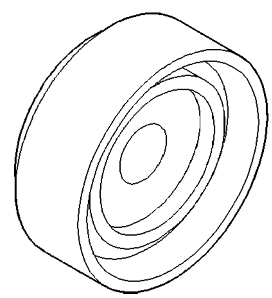
ADAPTERS C-293-37



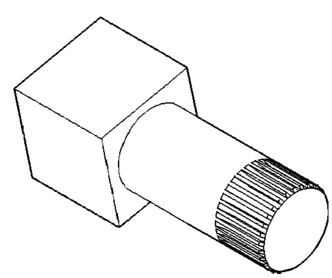
PLUG SP-3289



ADAPTERS C-293-47

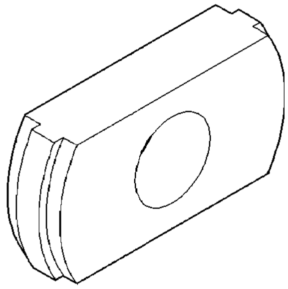


INSTALLER C-4340

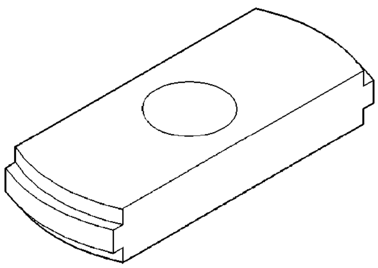


FIXTURE 8138

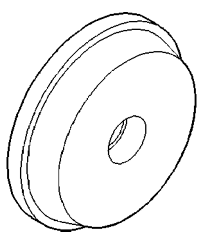
REAR AXLE - 9 1/4 (Continued)



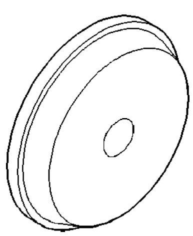
INSTALLER C-4345



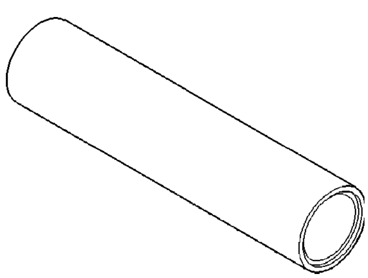
REMOVER C-4307



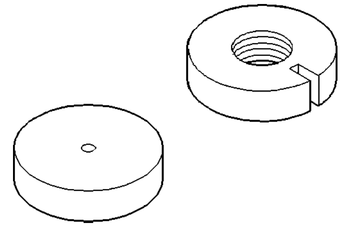
INSTALLER C-4308



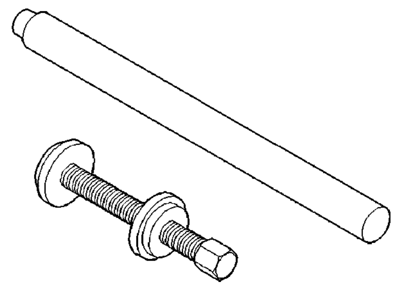
INSTALLER D-130



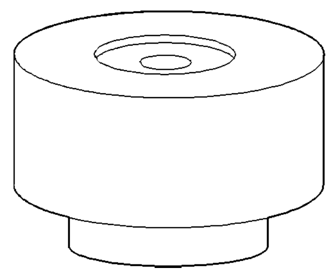
INSTALLER C-3095-A



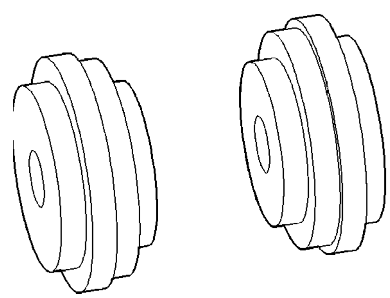
TRAC-LOK TOOLS 8140



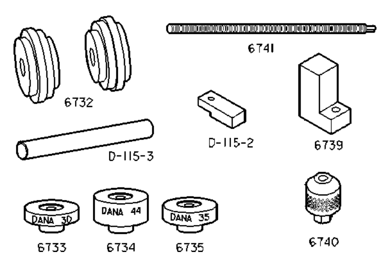
TRAC-LOK TOOLS 6960



PINION BLOCK 8540



ARBOR DISCS 8541



PINION GAUGE SET 6775

AXLE SHAFTS

REMOVAL

(1) Place transmission in neutral.

(2) Raise and support the vehicle.

(3) Remove wheel and tire assembly.

(4) Remove brake caliper, adapter and rotor (Fig. 18).

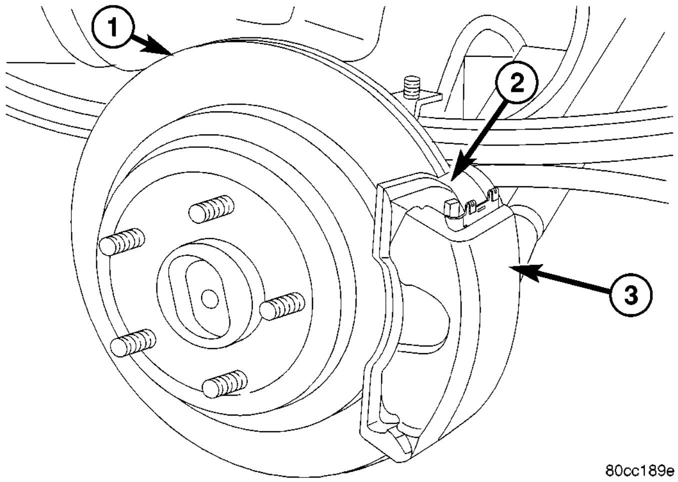


Fig. 18 REAR ROTOR

1 - ROTOR
2 - CALIPER ADAPTER
3 - CALIPER

(5) Remove differential housing cover and drain lubricant.

(6) Rotate differential case so pinion mate shaft lock screw is accessible. Remove lock screw and pinion mate shaft from differential case (Fig. 19).

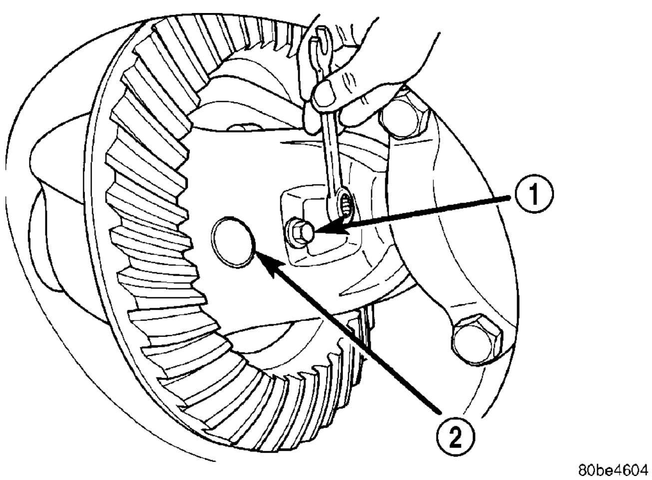


Fig. 19 PINION MATE SHAFT LOCK SCREW

1 - LOCK SCREW
2 - PINION MATE SHAFT

(7) Push axle shaft inward and remove axle shaft C-lock from the axle shaft (Fig. 20).

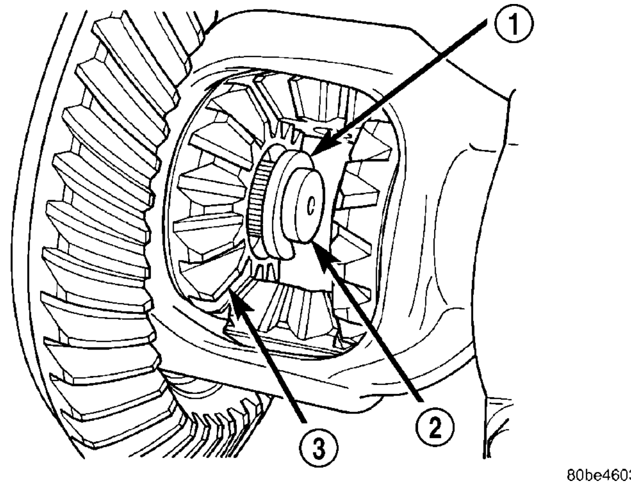


Fig. 20 AXLE SHAFT C-LOCK

1 - C-LOCK
2 - AXLE SHAFT
3 - SIDE GEAR

(8) Remove axle shaft (Fig. 21) carefully to prevent damage to the shaft bearing and seal in the axle tube.

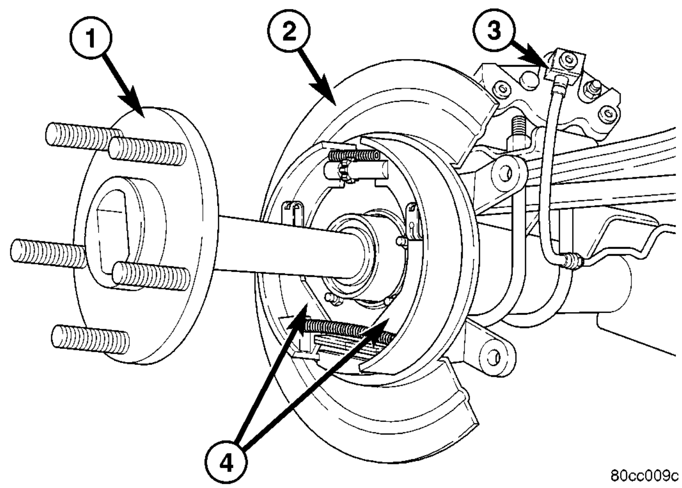


Fig. 21 AXLE SHAFT

1 - AXLE SHAFT
2 - SUPPORT PLATE
3 - CALIPER
4 - PARK BRAKE SHOE ASSEMBLY

INSTALLATION

(1) Lubricate bearing bore and seal lip with gear lubricant.

(2) Insall axle shaft and engage into side gear splines.

NOTE: Use care to prevent shaft splines from damaging axle shaft seal.

(3) Insert C-lock in end of axle shaft then push axle shaft outward to seat C-lock in side gear.

AXLE SHAFTS (Continued)

(4) Insert pinion shaft into differential case and through thrust washers and differential pinions.

(5) Align hole in shaft with hole in the differential case and install lock screw with Loctite® on the threads. Tighten lock screw to 11 N·m (8 ft. lbs.).

(6) Install differential cover and fill with gear lubricant to the bottom of the fill plug hole.

(7) Install brake rotor, caliper adapter and caliper.

(8) Install wheel and tire.

(9) Remove support and lower vehicle.

AXLE SHAFT SEALS

REMOVAL

(1) Remove axle shaft.

(2) Remove axle shaft seal (Fig. 22) from the axle tube with a small pry bar.

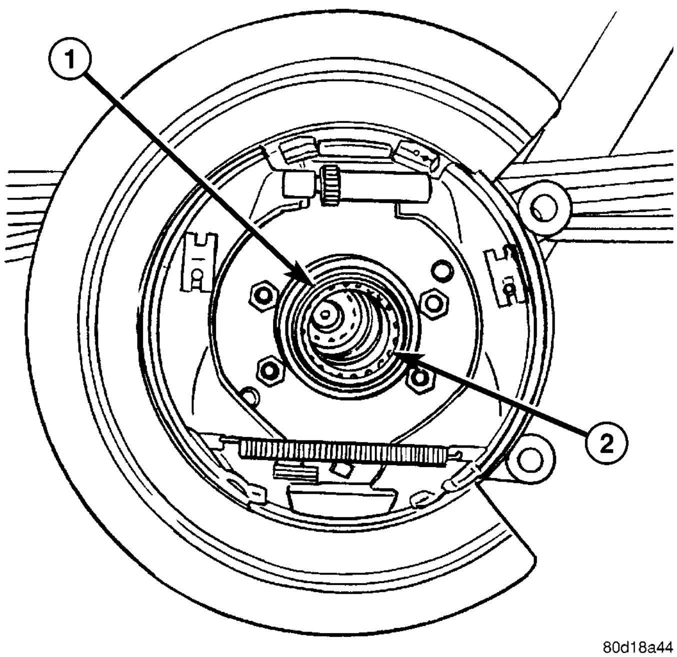


Fig. 22 AXLE SHAFT SEAL

1 - AXLE SEAL
2 - AXLE BEARING

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Coat the lip of the **new** seal with axle lubricant and install a seal with Installer C-4076-B and Handle C-4735-1.

NOTE: When tool contacts the axle tube, the seal is installed to the correct depth.

(3) Install the axle shaft.

(4) Install differential cover and fill with gear lubricant to the bottom of the fill plug hole.

AXLE BEARINGS

REMOVAL

(1) Remove axle shaft.

(2) Remove axle shaft seal from axle tube with a small pry bar.

NOTE: The seal and bearing can be removed at the same time with the bearing removal tool.

(3) Remove axle shaft bearing with Bearing Remover 6310 and Foot 6310-9 (Fig. 23).

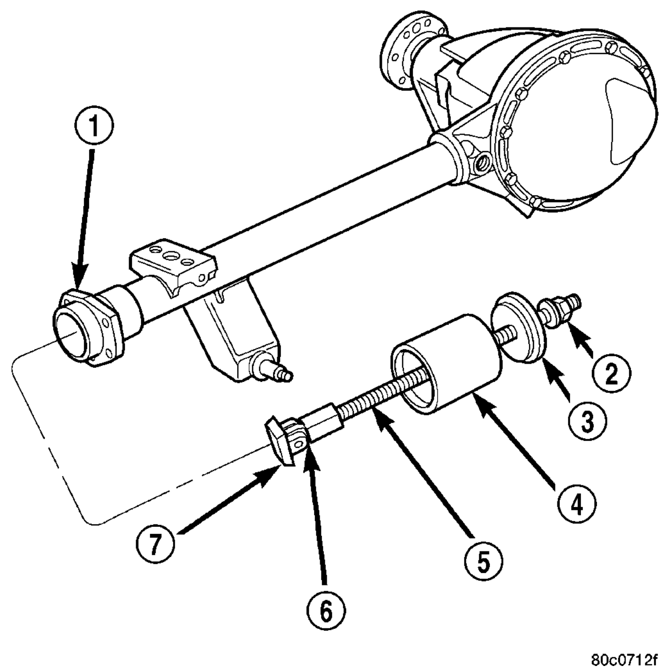


Fig. 23 AXLE SHAFT BEARING REMOVER

1 - AXLE SHAFT TUBE
2 - NUT
3 - GUIDE PLATE
4 - GUIDE
5 - THREADED ROD
6 - ADAPTER
7 - FOOT

INSTALLATION

(1) Wipe the axle tube bore clean. Remove any old sealer or burrs from the tube.

(2) Install axle shaft bearing with Installer C-4198 and Handle C-4171. Drive bearing in until tool contacts the axle tube.

NOTE: Bearing is installed with the bearing part number against the installer.

AXLE BEARINGS (Continued)

(3) Coat the lip of the **new** axle seal with axle lubricant and install with Installer C-4076-B and Handle C-4735-1.

NOTE: When tool contacts the axle tube, the seal is installed to the correct depth.

(4) Install the axle shaft.

(5) Install differential cover and fill with gear lubricant to the bottom of the fill plug hole.

PINION SEAL

REMOVAL

(1) Mark universal joint, companion flange and pinion shaft for installation reference.

(2) Remove propeller shaft from the companion flange.

(3) Remove the brake rotors to prevent any drag.

(4) Rotate companion flange three or four times and record pinion rotating torque with an inch pound torque wrench.

(5) Install two bolts into the companion flange threaded holes, 180° apart. Position Holder 6719A against the companion flange and install and tighten two bolts and washers into the remaining holes.

(6) Hold the companion flange with Holder 6719A and remove pinion nut and washer.

(7) Remove companion flange with Remover C-452 (Fig. 24).

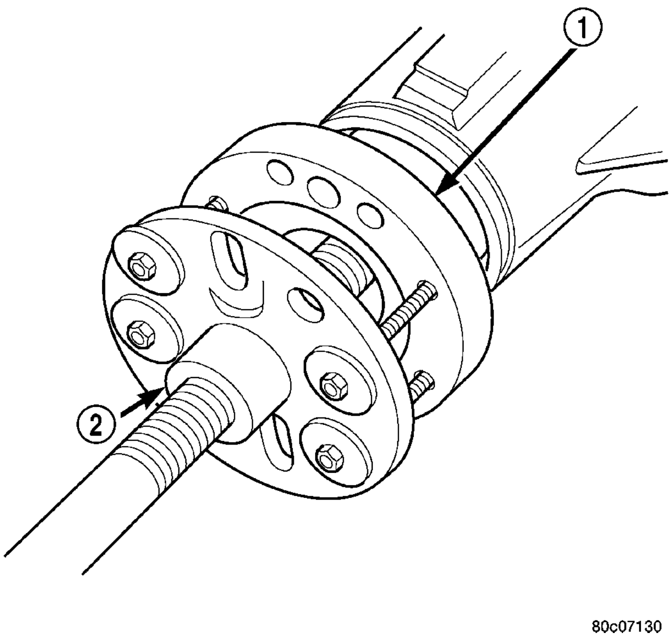


Fig. 24 COMPANION FLANGE

1 - COMPANION FLANGE
2 - PULLER

(8) Remove pinion seal with pry tool or slide-hammer mounted screw.

INSTALLATION

(1) Apply a light coating of gear lubricant on the lip of pinion seal.

(2) Install **new** pinion seal with Installer C-3860-A and Handle C-4171 (Fig. 25)

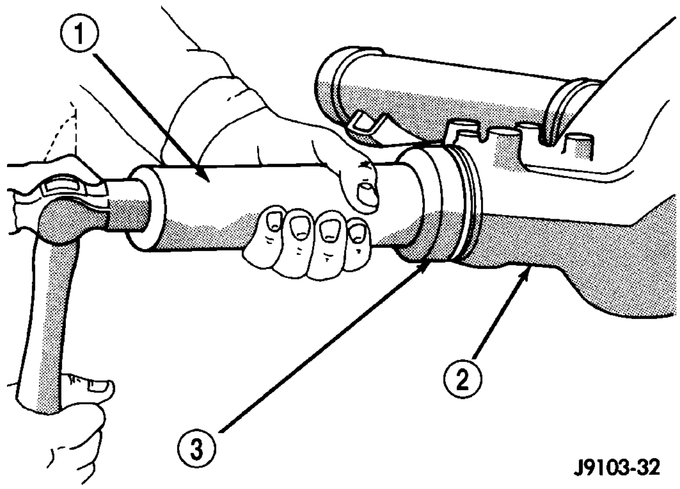


Fig. 25 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER
3 - HOUSING

(3) Install companion flange on the end of the shaft with the reference marks aligned.

(4) Install two bolts into the threaded holes in the companion flange, 180° apart.

(5) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so holder is held to the flange.

(6) Install companion flange on pinion shaft with Installer C-3718 and Holder 6719.

(7) Install pinion washer and a **new** pinion nut. The convex side of the washer must face outward.

CAUTION: Never exceed the minimum tightening torque 285 N·m (210 ft. lbs.) when installing the companion flange retaining nut at this point. Damage to collapsible spacer or bearings may result.

(8) Hold companion flange with Holder 6719 and tighten the pinion nut with a torque set to 285 N·m (210 ft. lbs.) (Fig. 26). Rotate pinion several revolutions to ensure the bearing rollers are seated.

(9) Rotate pinion with an inch pound torque wrench. Rotating torque should be equal to the reading recorded during removal plus an additional 0.56 N·m (5 in. lbs.) (Fig. 27).

PINION SEAL (Continued)

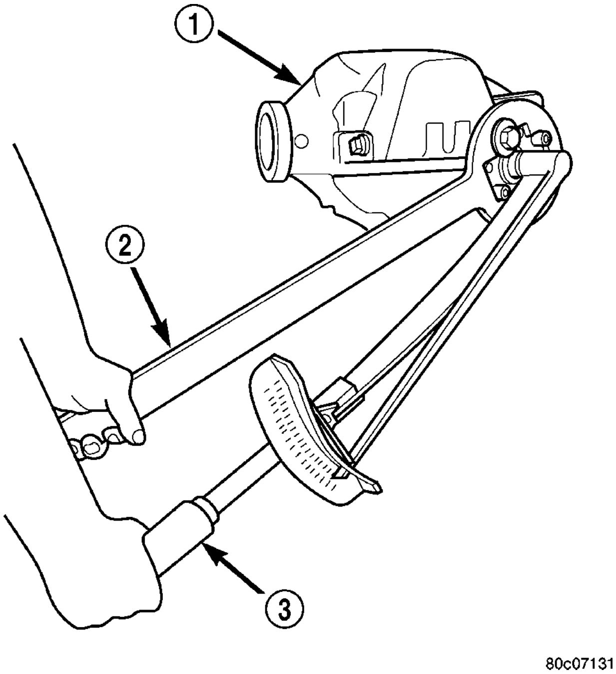


Fig. 26 TIGHTENING PINION NUT

1 - DIFFERENTIAL HOUSING
2 - COMPANION FLANGE HOLDER
3 - TORQUE WRENCH

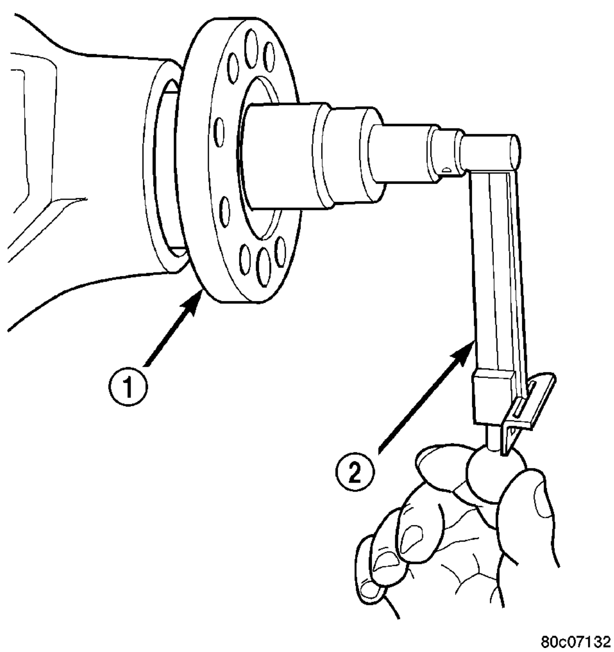


Fig. 27 PINION ROTATION TORQUE

1 - COMPANION FLANGE
2 - TORQUE WRENCH

CAUTION: Never loosen pinion nut to decrease pinion bearing rotating torque and never exceed specified preload torque. If rotating torque is exceeded, a new collapsible spacer must be installed.

(10) If rotating torque is low, use Holder 6719 to hold the companion flange and tighten pinion nut in 6.8 N·m (5 ft. lbs.) increments until proper rotating torque is achieved.

NOTE: The bearing rotating torque should be constant during a complete revolution of the pinion. If the rotating torque varies, this indicates a binding condition.

NOTE: The seal replacement is unacceptable if the final pinion nut torque is less than 285 N·m (210 ft. lbs.).

(11) Install propeller shaft with the installation reference marks aligned.
(12) Tighten the companion flange bolts to 108 N·m (80 ft. lbs.).
(13) Install brake rotors.
(14) Check the differential lubricant level.

DIFFERENTIAL

DESCRIPTION

The differential case is a one-piece design. The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The removable differential cover provides a means for inspection and service.

OPERATION

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 28).

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 29). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

REMOVAL

(1) Remove filler plug from the differential cover.

DIFFERENTIAL (Continued)

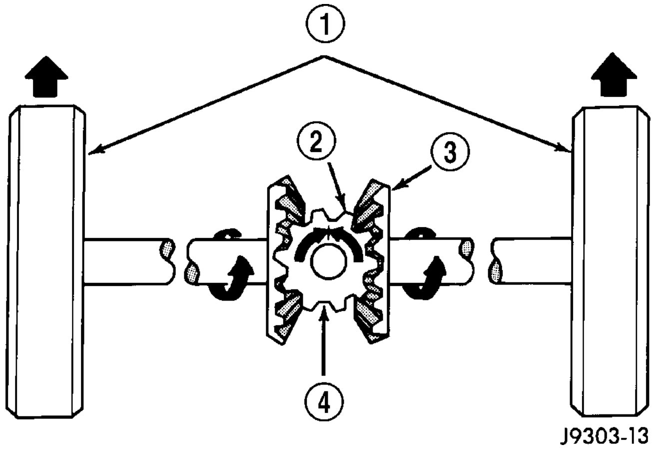


Fig. 28 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

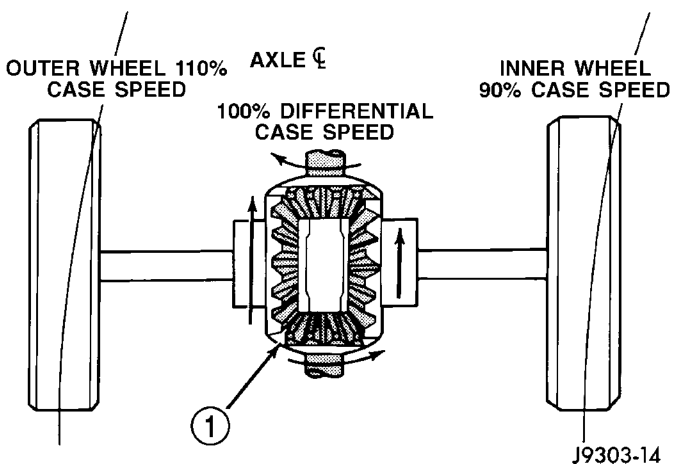


Fig. 29 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

(2) Remove differential cover and drain the lubricant.

(3) Clean housing cavity with flushing oil, light engine oil or a lint free cloth.

NOTE: Do not use steam, kerosene or gasoline to clean the housing.

(4) Remove axle shafts.

(5) Remove RWAL/ABS sensor from housing.

NOTE: Side play resulting from bearing races being loose on case hubs requires replacement of the differential case.

(6) Mark differential housing and bearing caps for installation reference (Fig. 30).

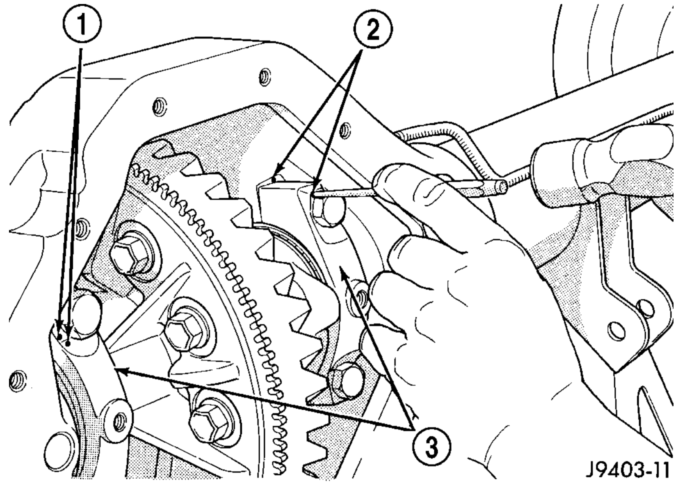


Fig. 30 REFERENCE MARKS

1 - REFERENCE MARKS
2 - REFERENCE MARK
3 - BEARING CAPS

(7) Remove bearing threaded adjuster lock from each bearing cap.

(8) Loosen differential bearing cap bolts.

(9) Loosen differential bearing adjusters through the axle tubes with Wrench C-4164 (Fig. 31).

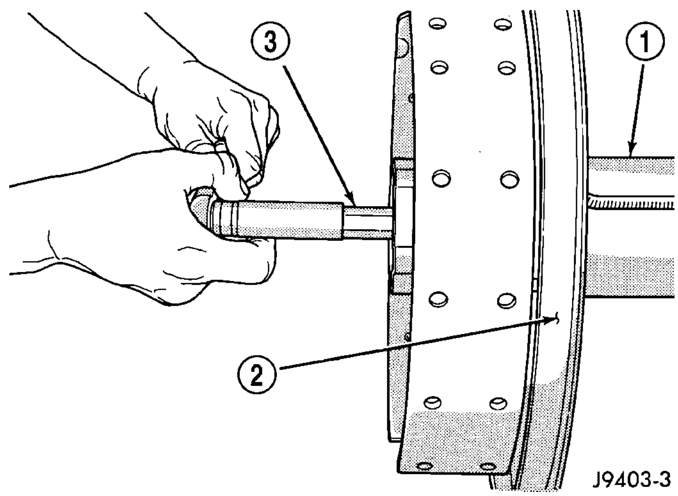


Fig. 31 THREADED ADJUSTER TOOL

1 - AXLE TUBE
2 - BACKING PLATE
3 - THREAD ADJUSTER WRENCH

(10) Hold differential case while removing bearing caps and adjusters.

(11) Remove differential case.

NOTE: Tag the differential bearing cups and threaded adjusters to indicate their location.

DIFFERENTIAL (Continued)

DISASSEMBLY

(1) Remove pinion shaft lock screw (Fig. 32).

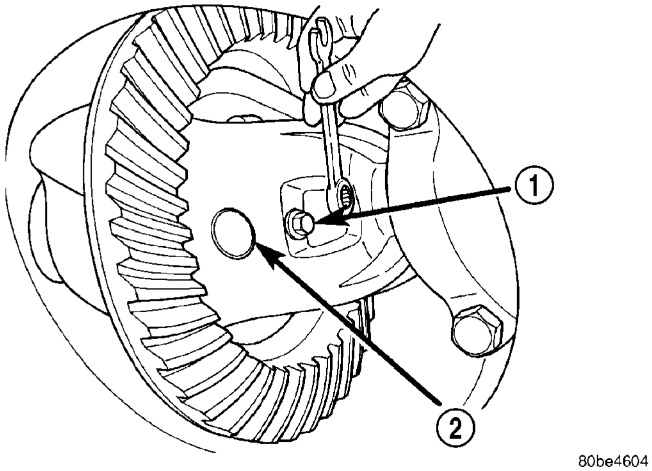


Fig. 32 SHAFT LOCK SCREW

1 - LOCK SCREW
2 - PINION SHAFT

(2) Remove pinion shaft.

(3) Rotate differential side gears and remove differential pinions and thrust washers (Fig. 33).

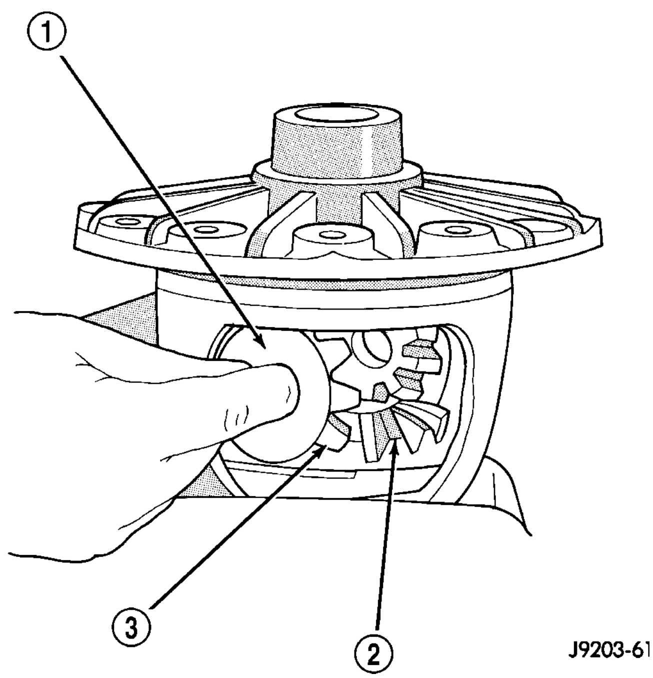


Fig. 33 DIFFERENTIAL GEARS

1 - THRUST WASHER
2 - SIDE GEAR
3 - DIFFERENTIAL PINION

(4) Remove differential side gears and thrust washers.

ASSEMBLY

(1) Install differential side gears and thrust washers.

(2) Install differential pinion and thrust washers.

(3) Install the pinion shaft.

(4) Align the hole in the pinion shaft with the hole in the differential case and install the pinion shaft lock screw.

(5) Lubricate all differential components with hypoid gear lubricant.

INSTALLATION

(1) Apply a coating of hypoid gear lubricant to the differential bearings, bearing cups, and threaded adjusters. A dab of grease can be used to keep the adjusters in position.

(2) Install differential assembly into the housing.

(3) Install differential bearing caps in their original locations (Fig. 34).

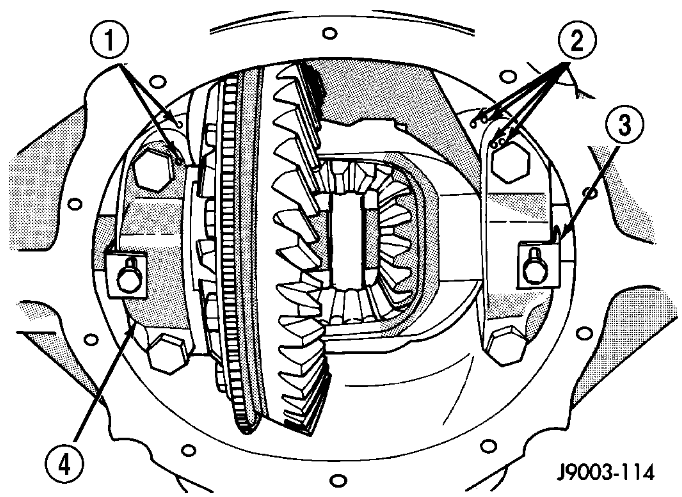


Fig. 34 BEARING CAPS

1 - REFERENCE MARKS
2 - REFERENCE MARKS
3 - ADJUSTER LOCK
4 - BEARING CAP

(4) Install bearing cap bolts and tighten the upper bolts to 14 N·m (10 ft. lbs.). Tighten the lower bolts finger-tight until the bolt head is seated.

(5) Perform the differential bearing preload and adjustment procedure.

NOTE: Be sure that all bearing cap bolts are tightened to their final torque of 136 N·m (100 ft.lbs.) before proceeding.

(6) Install axle shafts.

(7) Apply a 1/4 inch bead of red Mopar Silicone Rubber Sealant or equivalent to the housing cover (Fig. 35).

DIFFERENTIAL (Continued)

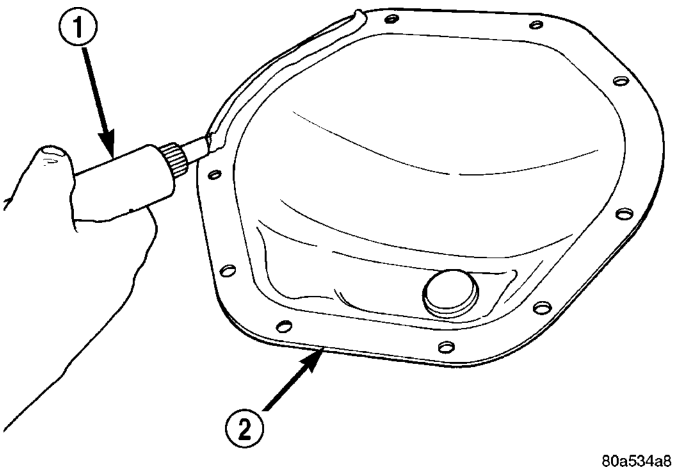


Fig. 35 COVER SEALANT

1 - SEALANT
2 - DIFFERENTIAL COVER

CAUTION: If cover is not installed within 3 to 5 minutes, the cover must be cleaned and new RTV applied or adhesion quality will be compromised.

(8) Install the cover and any identification tag and tighten cover bolts to 41 N·m (30 ft. lbs.).

(9) Fill differential with lubricant to bottom of the fill plug hole. Refer to the Lubricant Specifications for the correct quantity and type.

NOTE: Trac-lok™ differential equipped vehicles should be road tested by making 10 to 12 slow figure-eight turns. This maneuver will pump the lubricant through the clutch discs to eliminate a possible chatter noise complaint.

DIFFERENTIAL-TRAC-LOK

DESCRIPTION

The optional Trac-Lok® differential case has a one-piece design and the similar internal components as a standard differential, plus two clutch disc packs.The differential pinion mate shaft is retained with a threaded pin. Differential bearing preload and ring gear backlash are set and maintained by threaded adjusters at the outside of the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The removable differential cover provides a means for inspection and service.

OPERATION

This differential clutches are engaged by two concurrent forces. The first being the preload force exerted through Belleville spring washers within the clutch packs. The second is the separating forces generated by the side gears as torque is applied through the ring gear (Fig. 36).

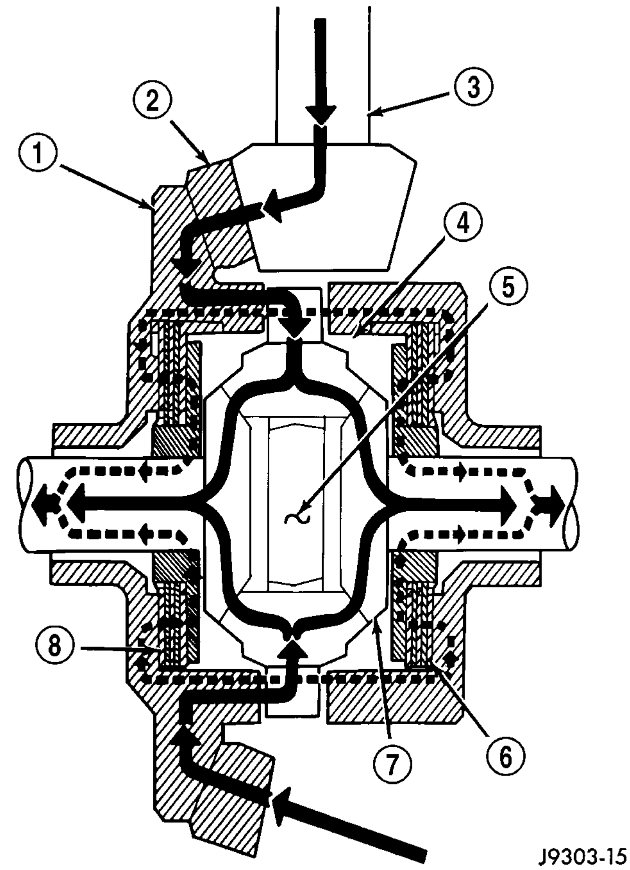


Fig. 36 TRAC-LOK LIMITED SLIP DIFFERENTIAL

1 - CASE
2 - RING GEAR
3 - DRIVE PINION
4 - PINION GEAR
5 - MATE SHAFT
6 - CLUTCH PACK
7 - SIDE GEAR
8 - CLUTCH PACK

This design provides the differential action needed for turning corners and for driving straight ahead during periods of unequal traction. When one wheel looses traction, the clutch packs transfer additional torque to the wheel having the most traction. This differential resist wheel spin on bumpy roads and provide more pulling power when one wheel looses traction. Pulling power is provided continuously until both wheels loose traction. If both wheels slip due to unequal traction, Trac-lok® operation is normal. In extreme cases of differences of traction, the wheel with the least traction may spin.

DIAGNOSIS AND TESTING

The most common problem is a chatter noise when turning corners. Before removing the unit for repair, drain, flush and refill the axle with the specified lubricant. A container of Mopar Trac-lok® Lubricant

DIFFERENTIAL-TRAC-LOK (Continued)

(friction modifier) should be added after repair service or during a lubricant change.

After changing the lubricant, drive the vehicle and make 10 to 12 slow, figure-eight turns. This maneuver will pump lubricant through the clutches. This will correct the condition in most instances. If the chatter persists, clutch damage could have occurred.

DIFFERENTIAL TEST

The differential can be tested without removing the differential case by measuring rotating torque. Make sure brakes are not dragging during this measurement.

(1) Place blocks in front and rear of both front wheels.

(2) Raise one rear wheel until it is completely off the ground.

(3) Engine off, transmission in neutral, and parking brake off.

(4) Remove wheel and bolt Special Tool 6790 or equivalent tool to studs.

(5) Use torque wrench on special tool to rotate wheel and read rotating torque (Fig. 37).

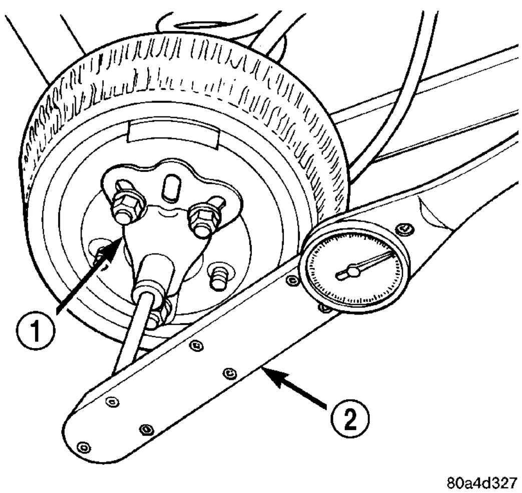


Fig. 37 ROTATING TORQUE TEST

1 - SPECIAL TOOL WITH BOLT IN CENTER HOLE
2 - TORQUE WRENCH

(6) If rotating torque is less than 41 N·m (30 ft. lbs.) or more than 271 N·m (200 ft. lbs.) on either wheel the unit should be serviced.

DISASSEMBLY

(1) Clamp Fixture 6965 in a vise and position the differential case on the fixture (Fig. 38).

(2) Remove ring gear if the ring gear is to be replaced.

(3) Remove pinion gear mate shaft lock screw.

(4) Remove pinion gear mate shaft with a drift and hammer.

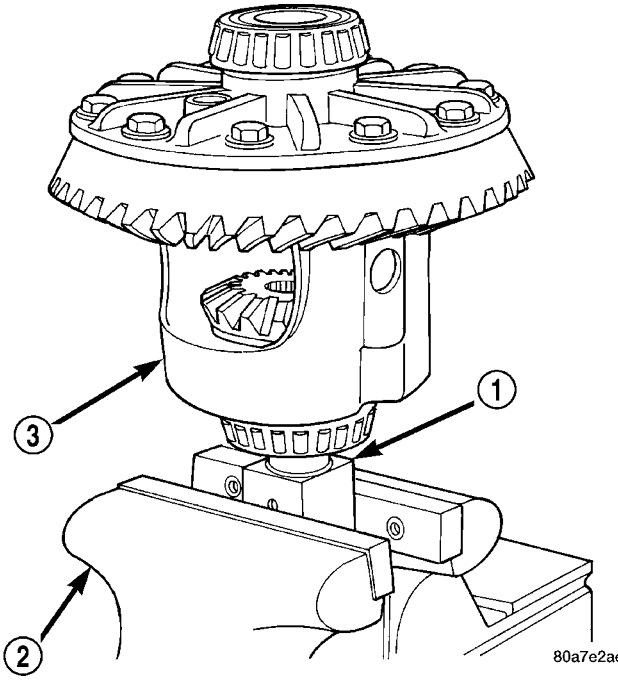


Fig. 38 DIFFERENTIAL CASE FIXTURE

1 - HOLDING FIXTURE
2 - VISE
3 - DIFFERENTIAL

(5) Install and lubricate Step Plate C-6960-3 (Fig. 39).

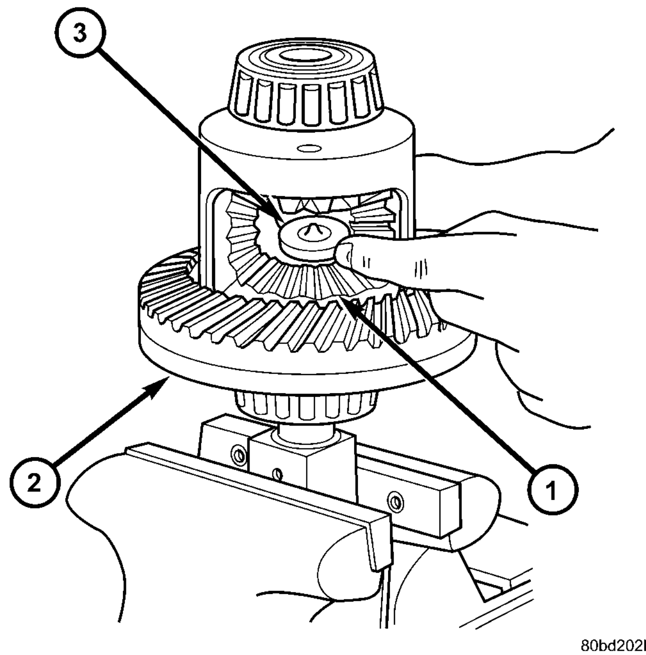


Fig. 39 STEP PLATE

1 - LOWER SIDE GEAR
2 - DIFFERENTIAL CASE
3 - DISC

(6) Assemble Threaded Adapter C-6960-1 into top side gear. Thread Forcing Screw C-6960-4 into adapter until it becomes centered in adapter plate.

DIFFERENTIAL-TRAC-LOK (Continued)

(7) Position a small screw driver in slot of Threaded Adapter Disc C-6960-1 (Fig. 40) to prevent adapter from turning.

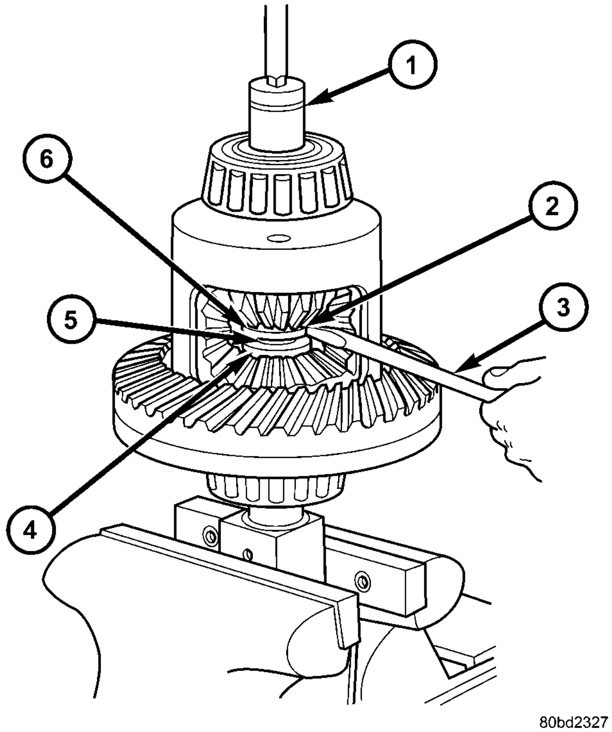


Fig. 40 THREAD ADAPTER DISC

1 - SOCKET
2 - SLOT IN DISC
3 - SCREWDRIVER
4 - LOWER DISC
5 - THREADED ROD
6 - UPPER DISC

(8) Install Forcing Screw C-6960-4 and tighten screw to 122 N·m (90 ft. lbs.) maximum to compress Belleville springs in clutch packs (Fig. 41).

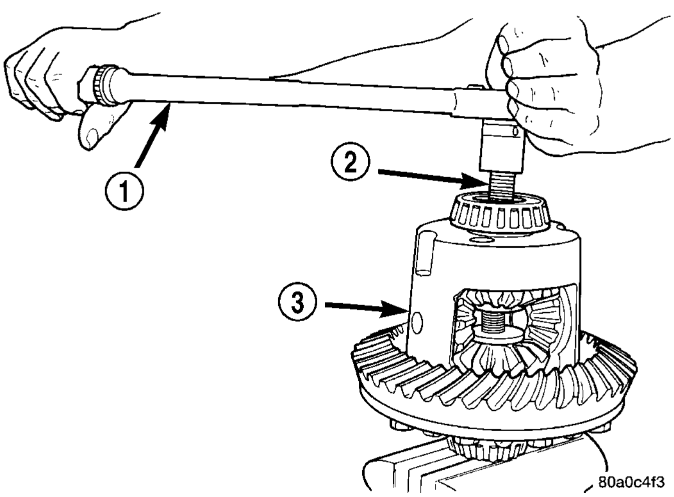


Fig. 41 COMPRESS BELLEVILLE SPRING

1 - TORQUE WRENCH
2 - FORCING SCREW
3 - DIFFERENTIAL CASE

(9) With a feeler gauge remove thrust washers from behind the pinion gears (Fig. 42).

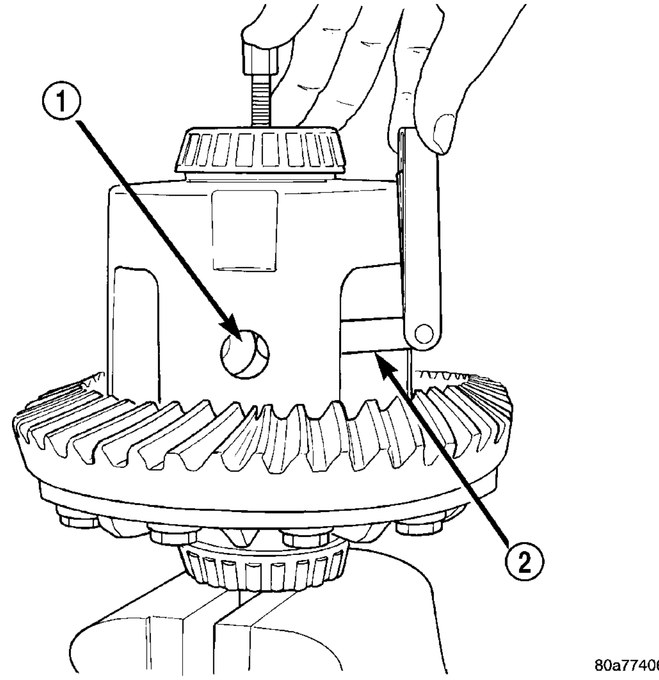


Fig. 42 PINION GEAR THRUST WASHER

1 - THRUST WASHER
2 - FEELER GAUGE

(10) Insert Turning Bar C-6960-2 into the pinion mate shaft hole in the case.

(11) Loosen Forcing Screw in small increments until clutch pack tension is relieved. Then turn the case with the turning bar (Fig. 43).

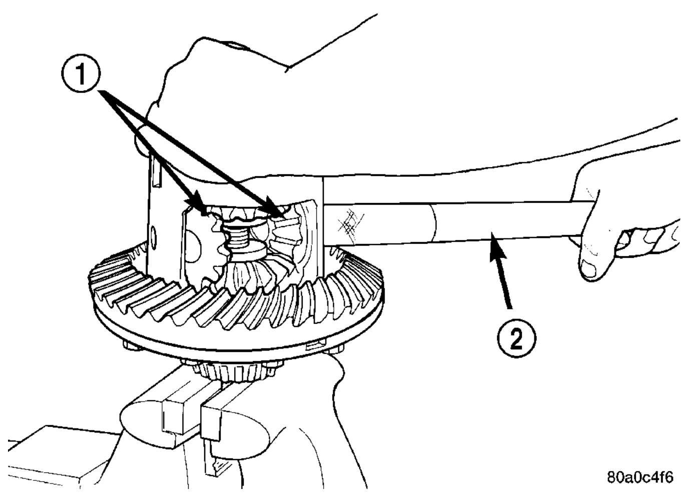


Fig. 43 TURNING BAR

1 - PINION GEARS
2 - TURNING BAR

(12) Rotate differential case until the pinion gears can be removed.

(13) Remove pinion gears from differential case.

DIFFERENTIAL-TRAC-LOK (Continued)

(14) Remove Forcing Screw, Step Plate and Threaded Adapter.

(15) Remove top side gear, clutch pack retainer and clutch pack. Keep plates in correct order during removal (Fig. 44).

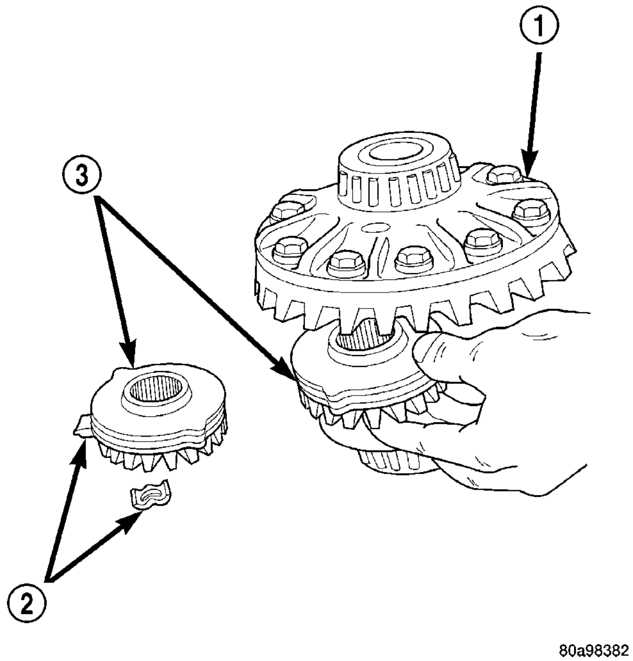


Fig. 44 SIDE GEARS AND CLUTCH DISCS

1 - DIFFERENTIAL CASE
2 - RETAINER
3 - SIDE GEAR AND CLUTCH DISC PACK

(16) Remove differential case from the Holding Fixture. Remove side gear, clutch pack retainer and clutch pack. Keep plates in correct order during removal.

ASSEMBLY

NOTE: New Plates and discs with fiber coating (no grooves or lines) must be presoaked in Friction Modifier before assembly. Soak plates and discs for a minimum of 20 minutes.

(1) Lubricate each component with gear lubricant before assembly.

(2) Assemble the clutch discs into packs and secure disc packs with retaining clips (Fig. 45).

(3) Position assembled clutch disc packs on the side gear hubs.

(4) Install clutch pack and side gear in the ring gear side of the differential case (Fig. 46).

NOTE: Verify clutch pack retaining clips are in position and seated in the case pockets.

(5) Position case on the Fixture 6965.

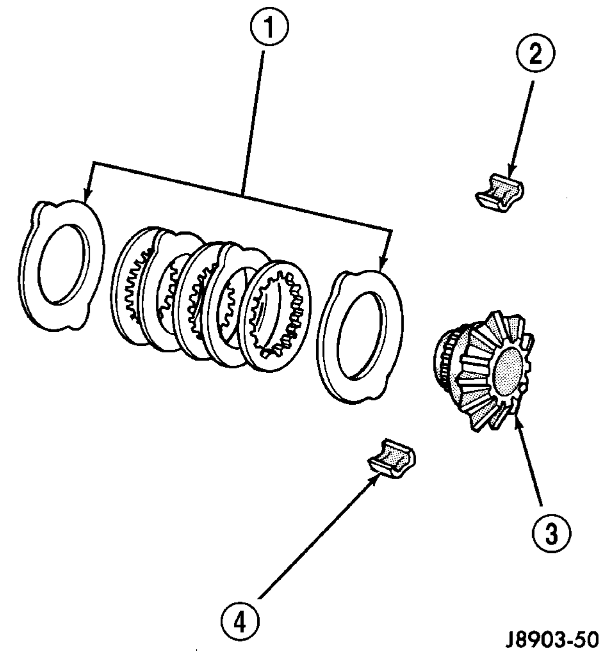


Fig. 45 CLUTCH DISC PACK

1 - CLUTCH PACK
2 - RETAINER
3 - SIDE GEAR
4 - RETAINER

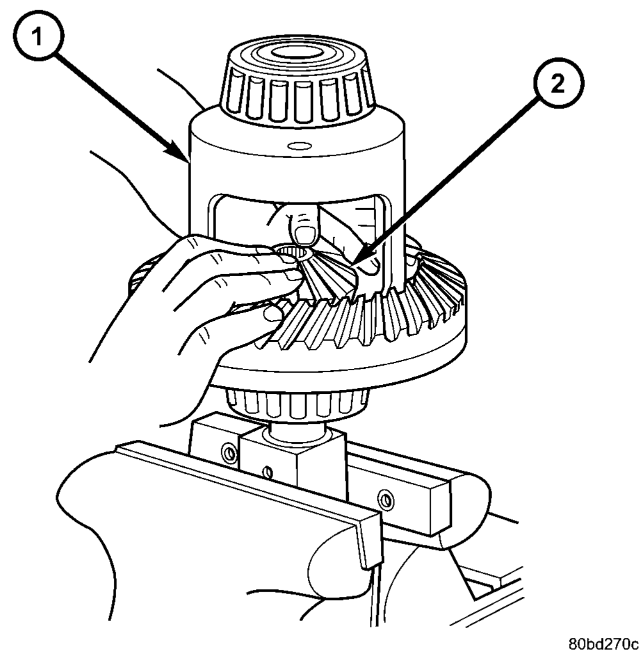


Fig. 46 CLUTCH PACK AND LOWER SIDE GEAR

1 - DIFFERENTIAL CASE
2 - LOWER SIDE GEAR AND CLUTCH PACK

DIFFERENTIAL-TRAC-LOK (Continued)

(6) Install lubricated Step Plate C-6960-3 in lower side gear.

(7) Install upper side gear and clutch disc pack (Fig. 47).

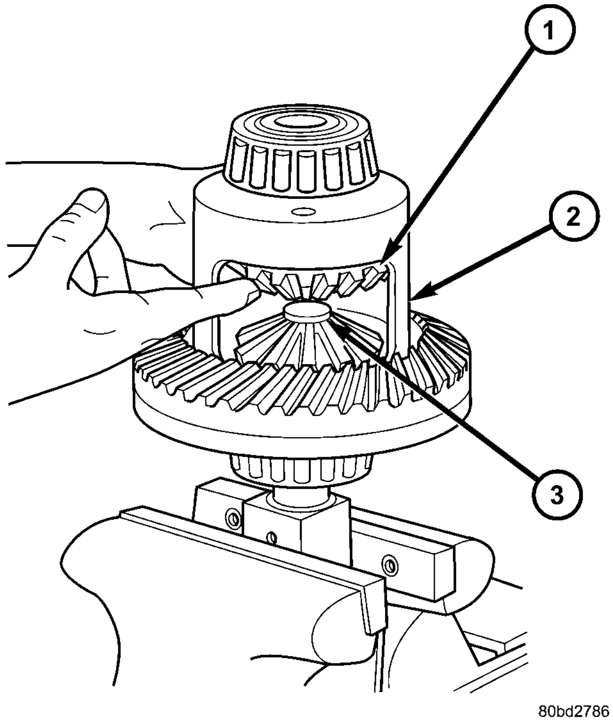


Fig. 47 CLUTCH PACK AND UPPER SIDE GEAR

1 - SIDE GEAR AND CLUTCH PACK
2 - DIFFERENTIAL CASE
3 - LOWER DISC

(8) Hold assembly in position. Insert Threaded Adapter C-6960-1 into top side gear.

(9) Install Forcing Screw C-6960-4 and tighten screw to slightly compress clutch disc.

(10) Place pinion gears in side gears and verify pinion mate shaft hole is aligned.

(11) Rotate case with Turning Bar C-6960-2 until pinion mate shaft holes in pinion gears align with holes in case.

NOTE: If necessary, slightly tighten the forcing screw in order to install the pinion gears.

(12) Tighten forcing screw to 122 N·m (90 ft. lbs.) maximum to compress the Belleville springs.

(13) Lubricate and install thrust washers behind pinion gears and align washers with a small screw driver. Insert mate shaft into each pinion gear to verify alignment.

(14) Remove forcing screw, step plate and threaded adapter.

(15) Install pinion gear mate shaft and align holes in shaft and case.

(16) Install pinion mate shaft lock screw finger tight to hold shaft during differential installation.

(17) Lubricate all differential components with hypoid gear lubricant.

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from axle housing.

(2) Remove differential bearings from the case with Puller/Press C-293-PA and Adapters C-293-47 and Plug C-293-3 (Fig. 48).

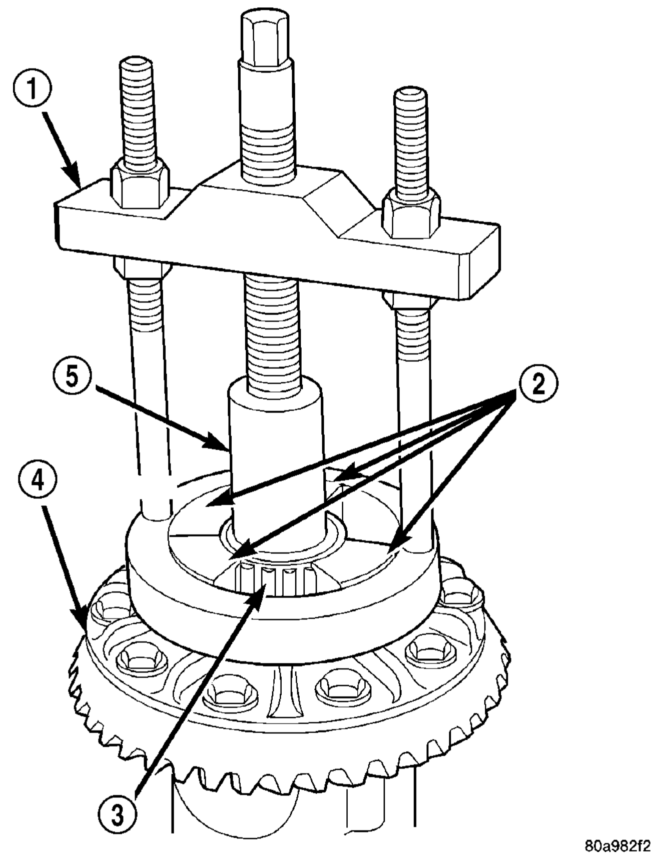


Fig. 48 DIFFERENTIAL BEARING PULLER

1 - PULLER
2 - ADAPTERS
3 - BEARING
4 - DIFFERENTIAL
5 - PLUG

DIFFERENTIAL CASE BEARINGS (Continued)

INSTALLATION

(1) Install differential side bearings with Installer C-4213 and Handle C-4171 (Fig. 49).

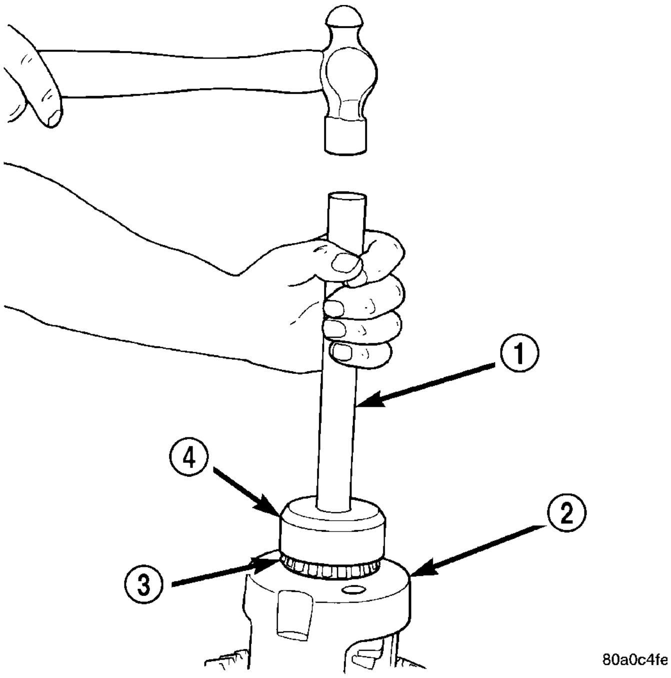


Fig. 49 DIFFERENTIAL CASE BEARING

1 - HANDLE
2 - DIFFERENTIAL
3 - BEARING
4 - INSTALLER

(2) Install differential case into housing.

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

NOTE: The ring gear and pinion are serviced in a matched set. Never replace one gear without replacing the other matching gear.

(1) Mark companion flange and propeller shaft for installation reference.

(2) Disconnect propeller shaft from the companion flange and tie propeller shaft to underbody.

(3) Remove axle shafts.

(4) Remove differential from the differential housing.

(5) Place differential case in a vise with soft metal jaw protectors..

(6) Remove ring gear bolts from the differential case.

(7) Drive ring gear off the differential case with a rawhide hammer (Fig. 50).

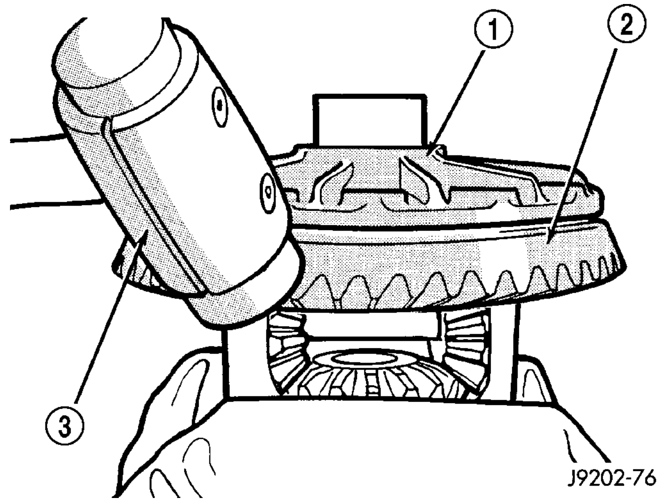


Fig. 50 RING GEAR

1 - CASE
2 - RING GEAR
3 - RAWHIDE HAMMER

(8) Install bolts into two of the threaded holes in the companion flange 180° apart.

(9) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.

(10) Use Holder 6719 to hold companion flange and remove the companion flange nut and washer.

(11) Remove companion flange with Remover C-452 (Fig. 51).

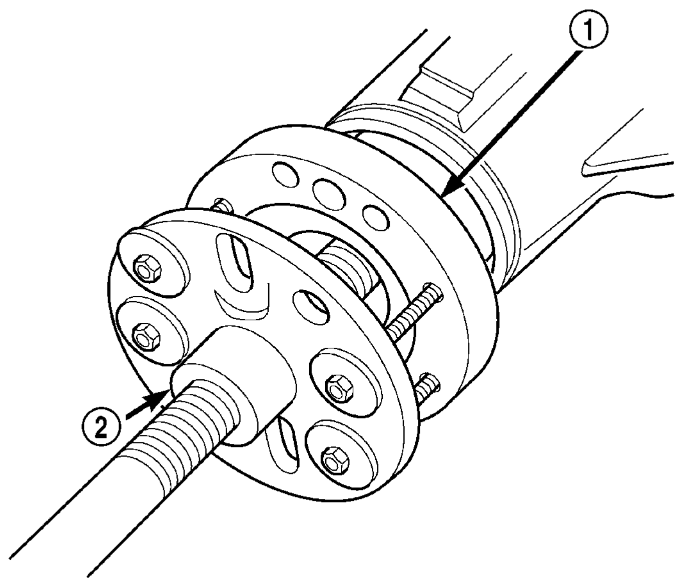


Fig. 51 COMPANION FLANGE

1 - COMPANION FLANGE
2 - REMOVER

(12) Remove pinion gear from the housing (Fig. 52).

PINION GEAR/RING GEAR/TONE RING (Continued)

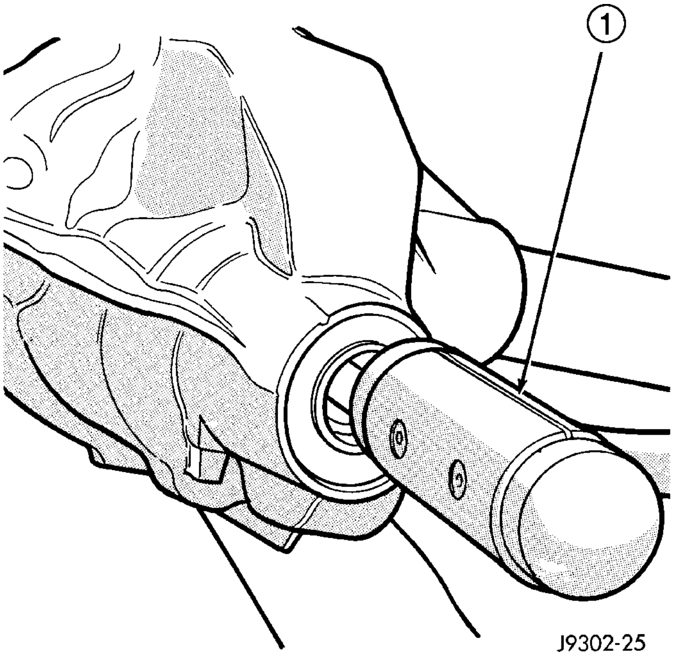


Fig. 52 PINION GEAR

1 - RAWHIDE HAMMER

(13) Remove pinion seal with a pry tool or slide-hammer mounted screw.

(14) Remove front pinion bearing and oil slinger if equipped.

(15) Remove front pinion bearing cup with Remover C-4345 and Handle C-4171 (Fig. 53).

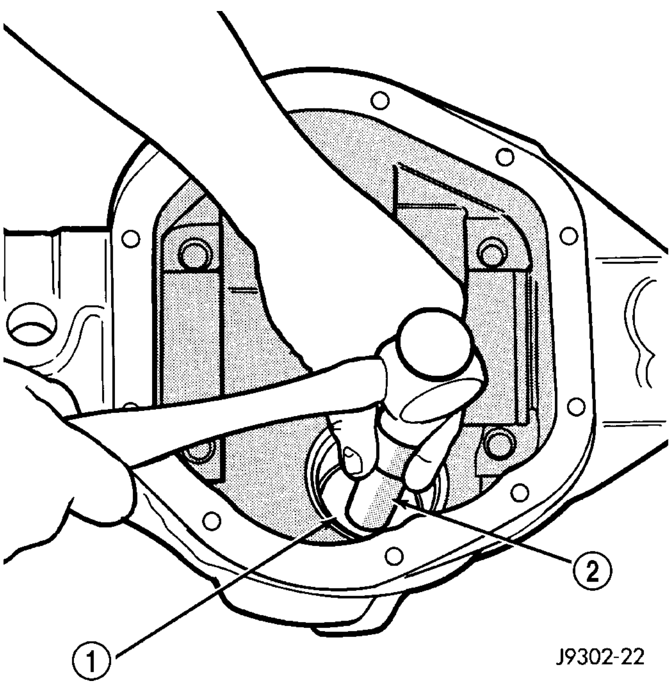


Fig. 53 FRONT PINION BEARING CUP

1 - REMOVER
2 - HANDLE

(16) Remove rear pinion bearing cup from housing (Fig. 54) with Remover C-4307 and Handle C-4171.

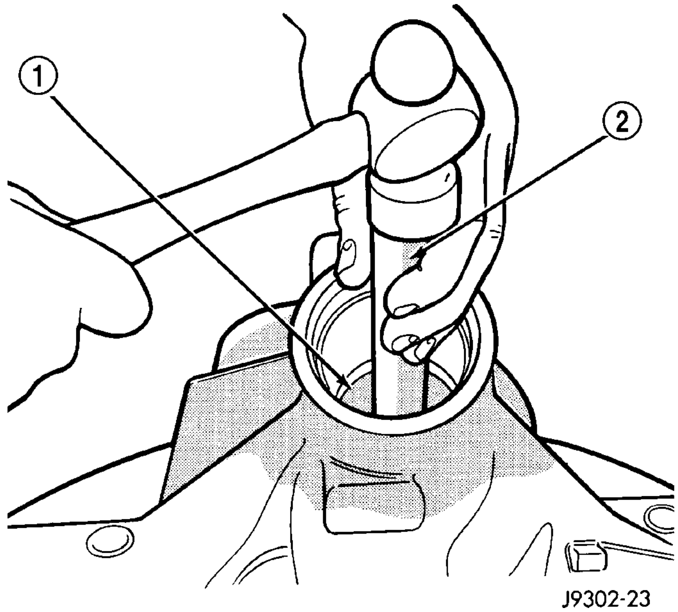


Fig. 54 REAR PINION BEARING CUP

1 - DRIVER
2 - HANDLE

(17) Remove collapsible spacer from the pinion shaft (Fig. 55).

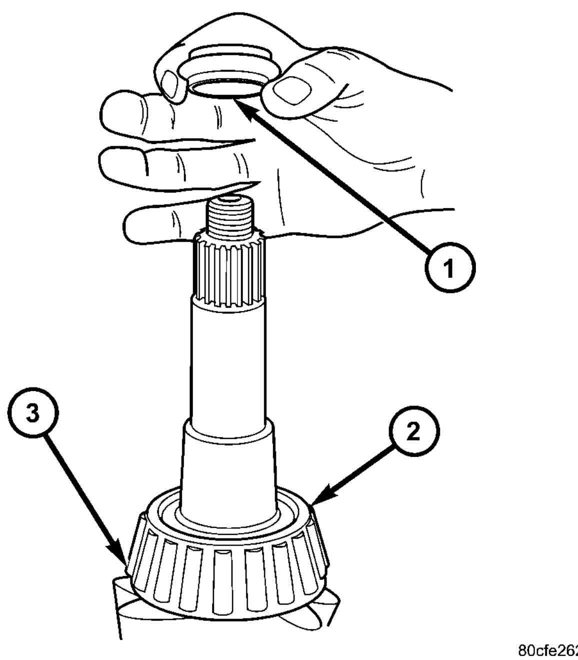


Fig. 55 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - REAR PINION BEARING
3 - PINION DEPTH SHIM

(18) Remove rear pinion bearing (Fig. 56) from the pinion shaft with Puller C-293-PA and Adapters C-293-37.

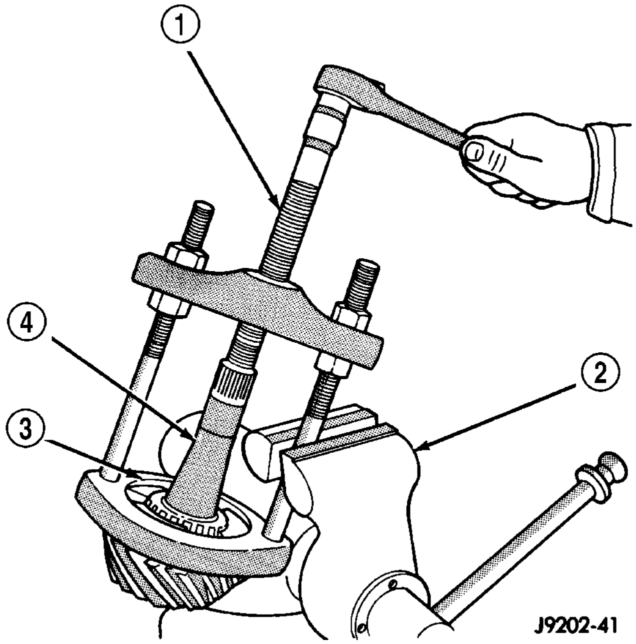


Fig. 56 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - ADAPTERS
4 - PINION SHAFT

(19) Remove pinion depth shim (Fig. 57) from the pinion shaft and record shim thickness.

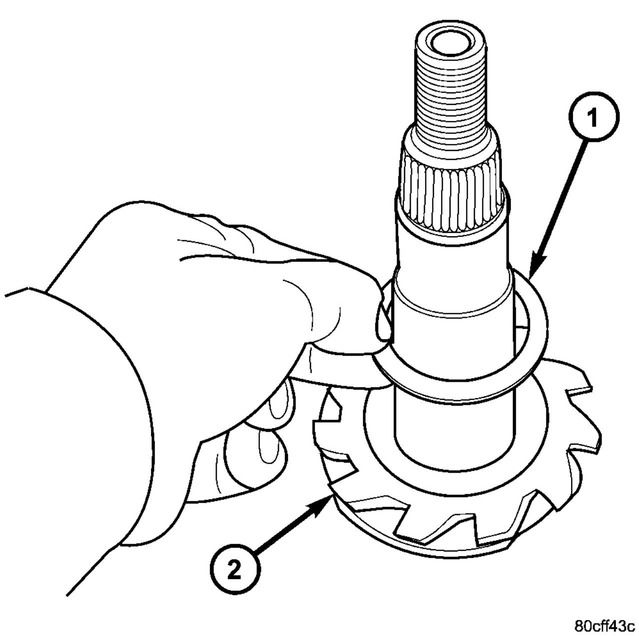


Fig. 57 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

INSTALLATION

NOTE: The ring gear and pinion are serviced in a matched set. Do not replace one gear without replacing the other matching gear. If ring and pinion gears or bearings are replaced, Refer to Adjustments for Pinion Gear Depth Setting.

(1) Apply Mopar Door Ease or equivalent stick lubricant to outside surface of the pinion bearing cups.

(2) Install rear pinion bearing cup (Fig. 58) with Installer C-4308 and Driver Handle C-4171 and verify cup is seated.

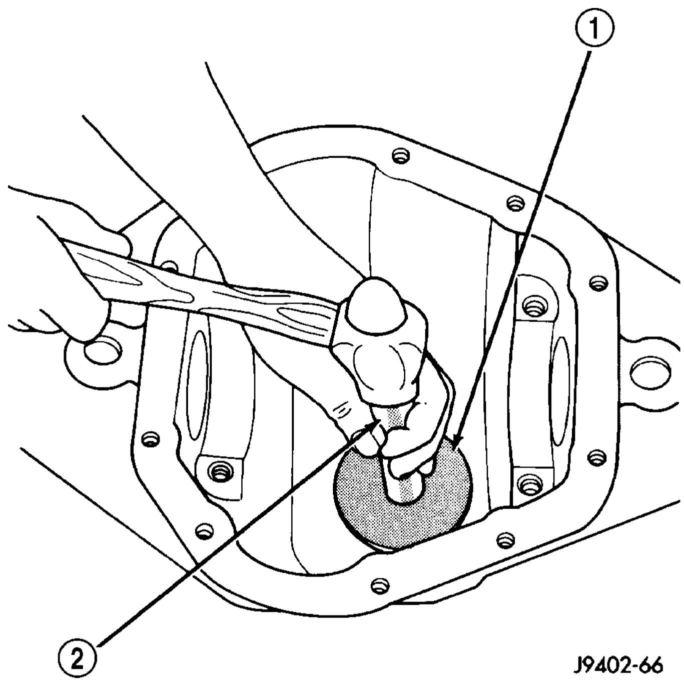


Fig. 58 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(3) Install front pinion bearing cup (Fig. 59) with Installer D-129 and Handle C-4171 and verify cup is seated.

(4) Lubricate and install front pinion bearing into the housing.

(5) Apply a light coating of gear lubricant on the lip of pinion seal. Install seal with Installer C-4076-B and Handle C-4735-1 (Fig. 60).

PINION GEAR/RING GEAR/TONE RING (Continued)

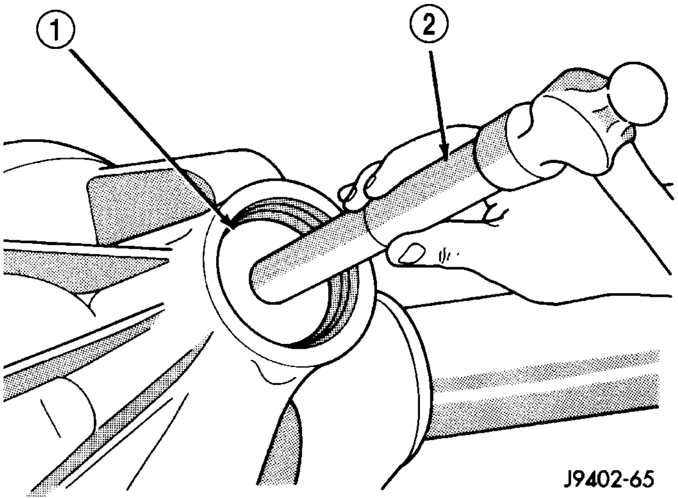


Fig. 59 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

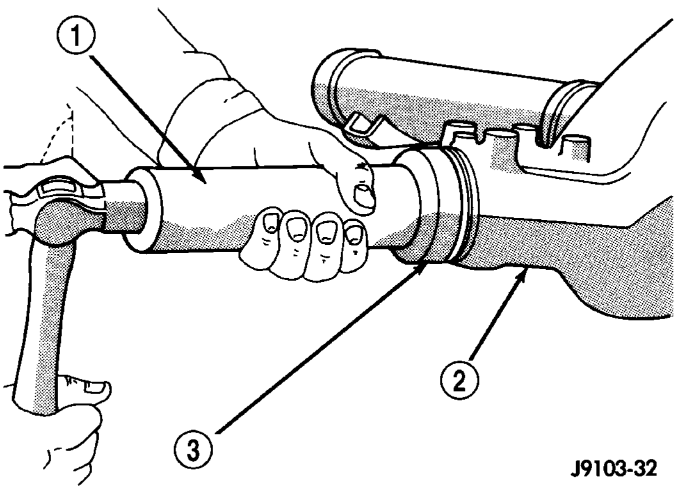


Fig. 60 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER
3 - HOUSING

(6) Install pinion depth shim (Fig. 61) on the pinion gear shaft.

(7) Install rear bearing on the pinion (Fig. 62) with Installer C-3095-A and a press.

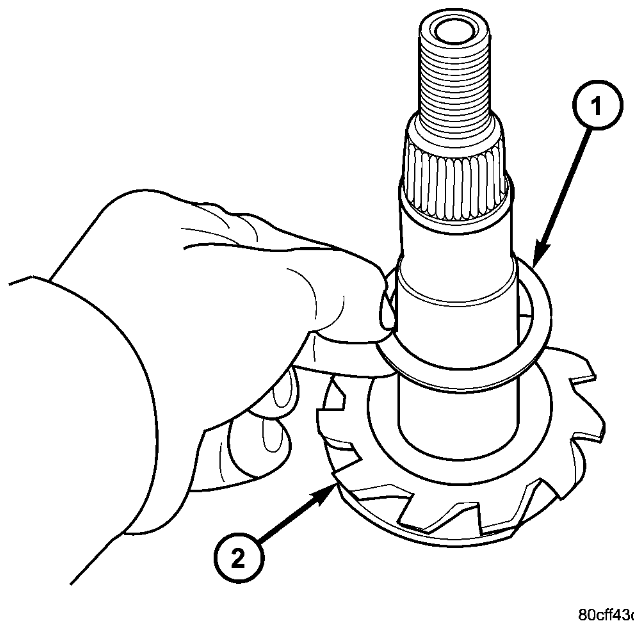


Fig. 61 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

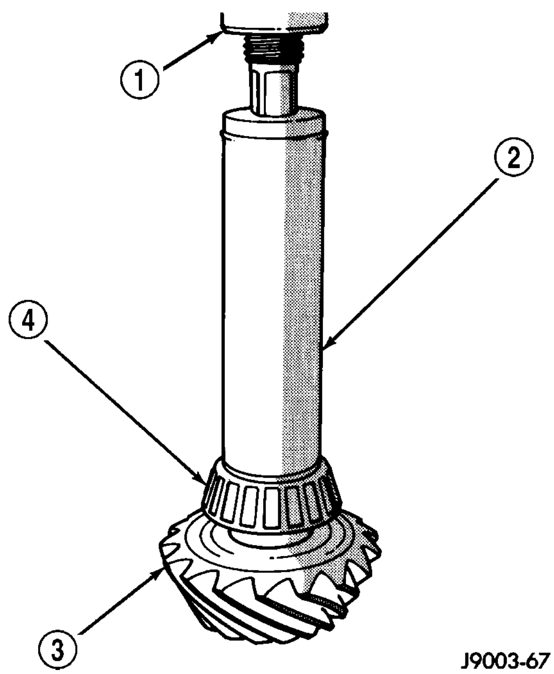


Fig. 62 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - PINION GEAR
4 - REAR PINION BEARING

PINION GEAR/RING GEAR/TONE RING (Continued)

(8) Install a **new** collapsible spacer on the pinion shaft (Fig. 63).

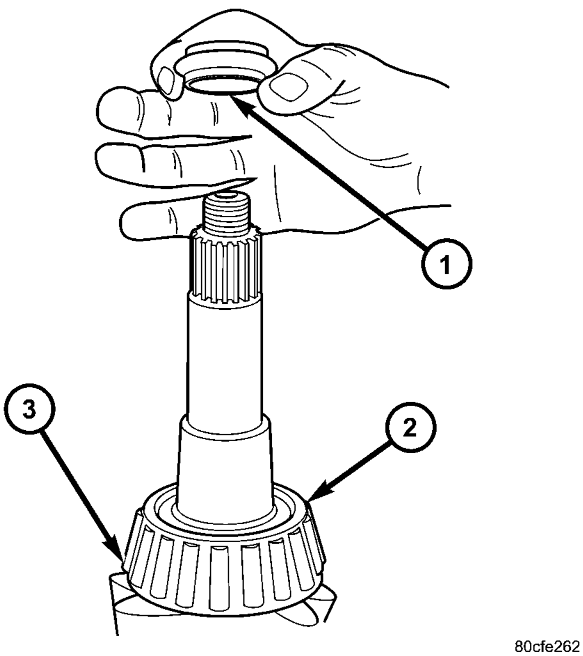


Fig. 63 COLLAPSIBLE SPACER

1 - COLLAPSIBLE SPACER
2 - REAR PINION BEARING
3 - PINION DEPTH SHIM

(9) Lubricate rear pinion bearing and install pinion gear into the housing.

(10) Install companion flange with Installer C-3718 and Holder 6719.

(11) Install bolts into two of the threaded holes in the companion flange 180° apart.

(12) Position Holder 6719 against the companion flange and install a bolt and washer into one of the remaining threaded holes. Tighten the bolts so the Holder 6719 is held to the flange.

(13) Install companion flange washer and a **new** nut on the pinion and tighten the nut until there is zero bearing end-play.

(14) With a torque wrench tighten the nut to 285 N·m (210 ft. lbs.) (Fig. 64).

CAUTION: Never loosen pinion nut to decrease pinion rotating torque and never exceed specified preload torque. If preload torque or rotating torque is exceeded a new collapsible spacer must be installed.

(15) Slowly tighten the nut in 6.8 N·m (5 ft. lbs.) increments until the desired rotating torque is achieved. Measure pinion rotating torque frequently to avoid over crushing the collapsible spacer.

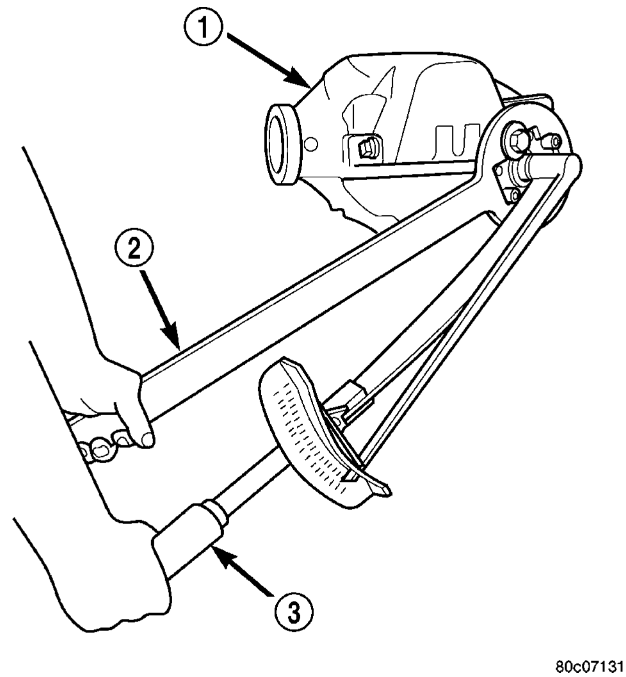


Fig. 64 PINION NUT

1 - DIFFERENTIAL HOUSING
2 - HOLDER
3 - TORQUE WRENCH

(16) Check pinion rotating torque with an inch pound torque wrench (Fig. 65). The pinion rotating torque should be:

- Original Bearings: 1 to 3 N·m (10 to 20 in. lbs.).
- New Bearings: 2 to 5 N·m (15 to 35 in. lbs.).

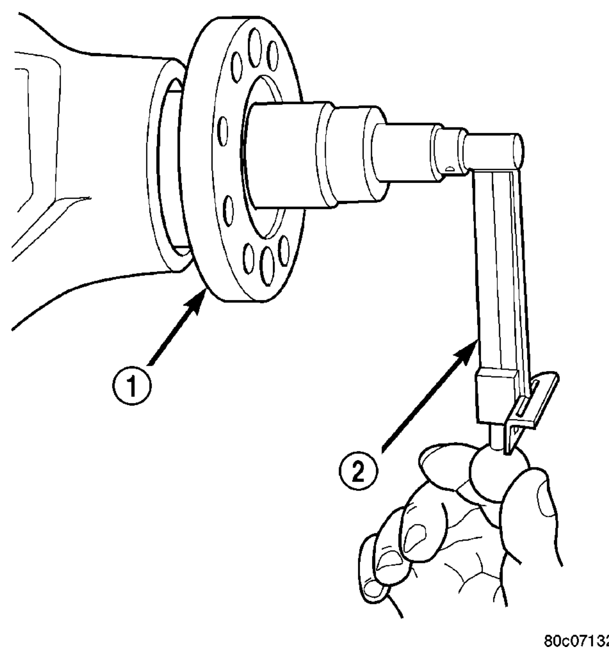


Fig. 65 PINION ROTATION TORQUE

1 - COMPANION FLANGE
2 - TORQUE WRENCH

PINION GEAR/RING GEAR/TONE RING (Continued)

(17) Position exciter ring on differential case. With a brass drift, slowly and evenly tap the exciter ring into position.

(18) Position ring gear on the differential case and start two ring gear bolts. This will provide case-to-ring gear bolt hole alignment.

(19) Invert the differential case in the vise.

(20) Install **new** ring gear bolts and alternately tighten to 156 N·m (115 ft. lbs.) (Fig. 66).

CAUTION: Never reuse the ring gear bolts. The bolts can fracture causing extensive damage.

(21) Install differential in housing and verify gear mesh, backlash and contact pattern.

(22) Install axle shafts.

(23) Install differential cover and fill with gear lubricant.

(24) Install propeller shaft with reference marks aligned.

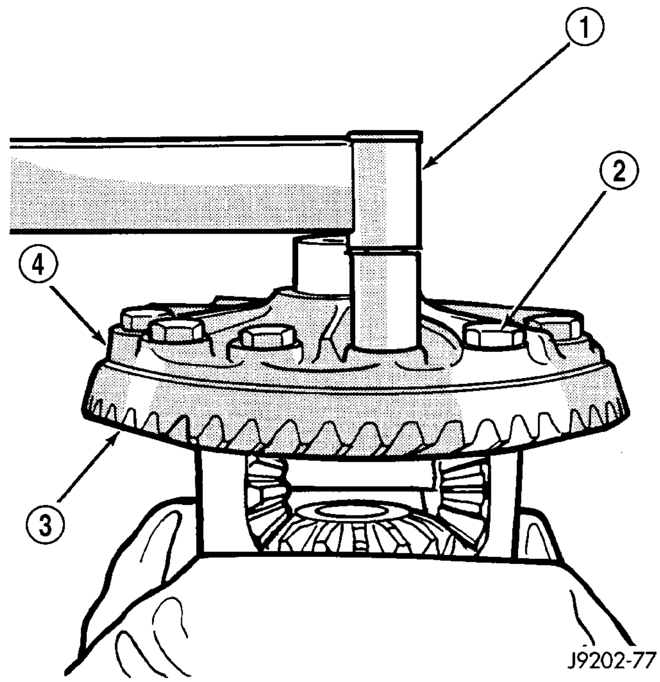


Fig. 66 RING GEAR BOLTS

1 - TORQUE WRENCH
2 - RING GEAR BOLTS
3 - RING GEAR
4 - DIFFERENTIAL CASE

REAR AXLE - 10 1/2 AA

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REAR AXLE - 10 1/2 AA

DESCRIPTION

The axle consists of a cast iron center casting differential housing with axle shaft tubes extending from each side. The tubes are pressed into the differential housing and welded. The design has the centerline of the pinion set below the centerline of the ring gear. The axle is a full floating axle where the loads are supported by the axle housing tubes. The axle has a vent used to relieve internal pressure caused by lubricant vaporization and internal expansion.

OPERATION

The axle receives power from the propeller shaft. The propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, tooth contact, worn/damaged gears, or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side gears and pinions can be checked by turning the vehicle. They usually do not cause noise during straight-ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion shaft can also cause a snapping or a knocking noise.

REAR AXLE - 10 1/2 AA (Continued)

BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side-gear thrust washers. A worn pinion shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out-of-balance wheels.
- Loose wheel lug nuts.
- Worn U-joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front-end components or engine/transmission mounts. These components can contribute to what appears to be a rearend vibration. Do not overlook engine accessories, brackets and drive belts.

NOTE: All driveline components should be examined before starting any repair.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U-joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube. 2. Bent or sprung axle shaft.	1. Inspect axle tube alignment. Correct as necessary. 2. Inspect and correct as necessary.

REAR AXLE - 10 1/2 AA (Continued)

Condition	Possible Causes	Correction
Axle Shaft Broke	1. Misaligned axle tube.	1. Replace the broken shaft after correcting tube mis-alignment.
	2 Vehicle overloaded.	2. Replace broken shaft and avoid excessive weight on vehicle.
	3. Erratic clutch operation.	3. Replace broken shaft and avoid or correct erratic clutch operation.
	4. Grabbing clutch.	4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.
Loss Of Lubricant	1. Lubricant level too high.	1. Drain lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.

REAR AXLE - 10 1/2 AA (Continued)

Condition	Possible Causes	Correction
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern. Adjust backlash or pinion depth.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

REMOVAL

(1) Raise and support the vehicle.
(2) Position a lifting device under the axle.
(3) Secure axle to device.
(4) Remove wheels and tires assemblies.
(5) Remove RWAL sensor from the differential housing.
(6) Remove brake hose at the axle junction block and axle vent hose.
(7) Disconnect parking brake cables and cable brackets.
(8) Remove brake calipers and rotors.
(9) Mark propeller shaft and companion flange for installation alignment reference.
(10) Remove propeller shaft.
(11) Remove shock absorbers from axle.
(12) Remove U-bolts from axle.
(13) Separate the axle from the vehicle.

INSTALLATION

(1) Raise axle with lifting device and align to the leaf spring centering bolts.
(2) Install axle U-bolts and tighten to 149 N·m (110 ft. lbs.).
(3) Install shock absorbers to axle and tighten to specification.
(4) Install the RWAL sensor to the differential housing.
(5) Connect the parking brake cables and cable brackets.
(6) Install brake calipers.
(7) Connect brake hose to the axle junction block and axle vent hose.
(8) Align propeller shaft and pinion companion flange reference marks and tighten companion flange bolts to 115 N·m (85 ft. lbs.).
(9) Install the wheels and tires.

REAR AXLE - 10 1/2 AA (Continued)

(10) Fill differential to specifications.

(11) Remove lifting device from axle and lower the vehicle.

ADJUSTMENTS

Ring and pinion gears are supplied as matched sets only. Compensation for pinion depth variance is achieved with a select shim. The shim is located between the rear pinion bearing and the pinion gear head.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 1).

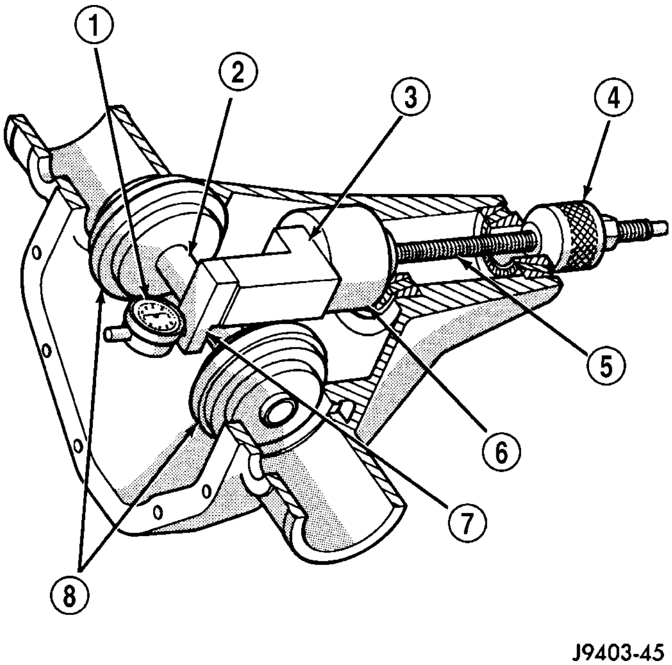


Fig. 1 PINION GEAR DEPTH GAUGE TOOLS

1 - DIAL INDICATOR
2 - ARBOR
3 - PINION HEIGHT BLOCK
4 - CONE
5 - SCREW
6 - PINION BLOCK
7 - SCOOTER BLOCK
8 - ARBOR DISC

(1) Assemble Pinion Height Block 6739, Pinion Block 8899 and rear pinion bearing onto Screw 6741 (Fig. 1).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 2).

(3) Install front pinion bearing and install the Cone-nut 6740 hand tight. Then check tool rotating torque with an inch pound torque wrench. The rotating torque should be 1.7-2.26 N·m (15-20 in. lbs.) (Fig. 1).

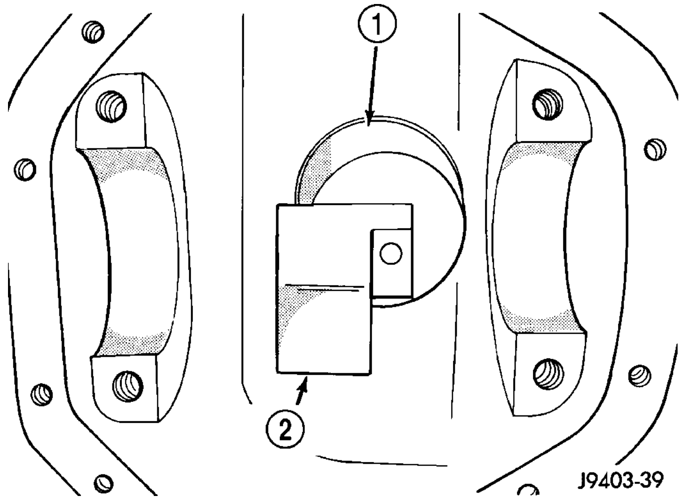


Fig. 2 PINION HEIGHT BLOCK

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

(4) Place Arbor Disc 6732 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 3).

(5) Install differential bearing caps on arbor discs and snug the bearing cap bolts. Then cross tighten cap bolts to 165 N·m (122 ft. lbs.).

NOTE: Arbor should rotate freely in the arbor discs.

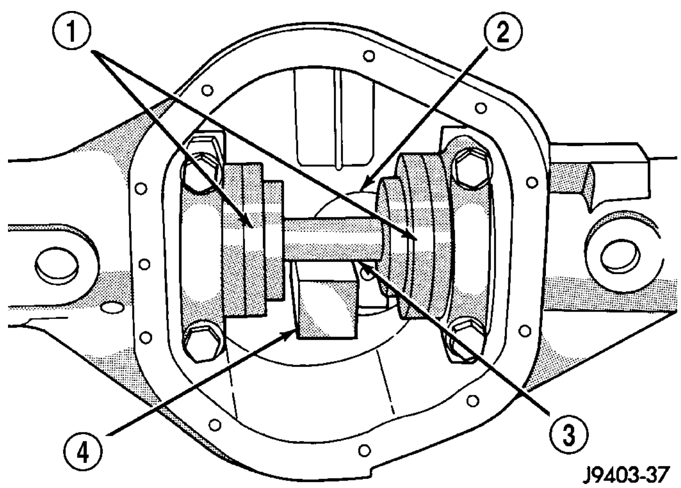


Fig. 3 GAUGE TOOLS IN HOUSING

1 - ARBOR DISC
2 - PINION BLOCK
3 - ARBOR
4 - PINION HEIGHT BLOCK

(6) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(7) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

REAR AXLE - 10 1/2 AA (Continued)

(8) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 4). Move the scooter block till dial indicator crests the arbor, then record the highest reading.

(9) Select a shim equal to the dial indicator reading.

(10) Install the select shim between the rear pinion bearing and the pinion gear head.

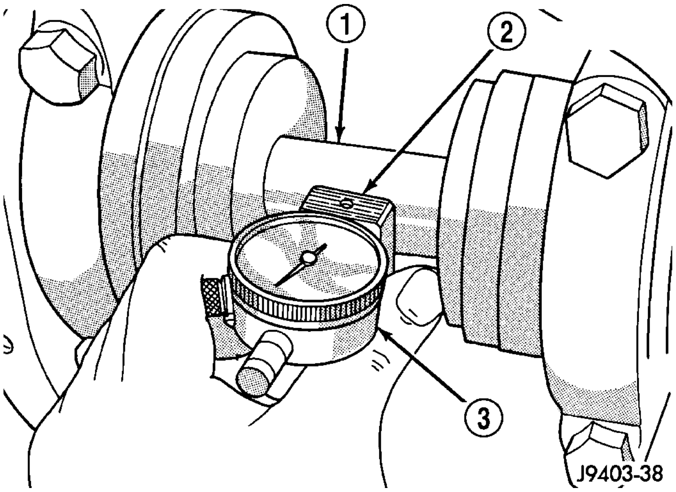


Fig. 4 PINION GEAR DEPTH MEASUREMENT

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL CASE BEARING PRELOAD AND GEAR BACKLASH

Backlash is adjusted by moving the adjusters in and out or both. By moving the adjusters the case/ring gear will move closer or further away from the pinion. In most cases this adjustment can be used to achieve the correct gear tooth pattern and set the case bearing preload.

(1) Remove adjuster lock bolts and adjuster locks (Fig. 5).

(2) Loosen the differential bearing caps.

(3) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(4) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 (Fig. 6) until they make contact with the differential bearings/cups.

(5) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

(6) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(7) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(8) Rotate the pinion several times to seat the deferential bearings.

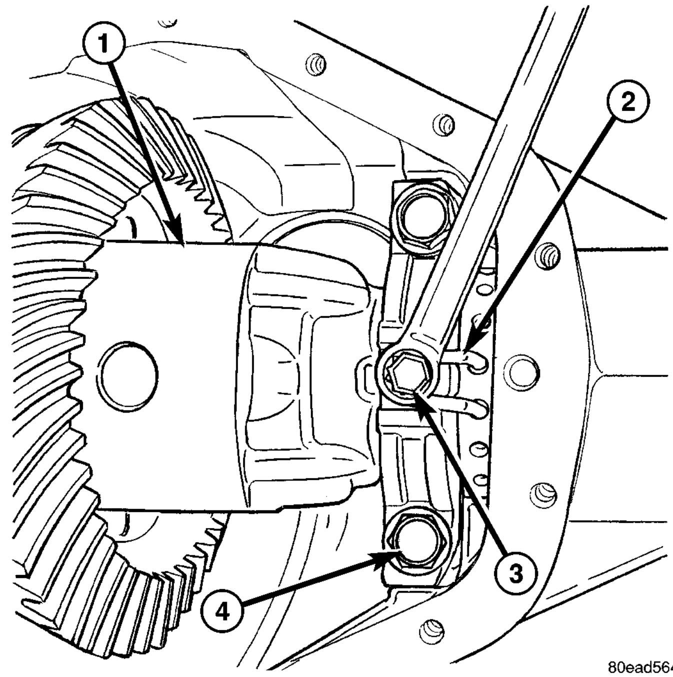


Fig. 5 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

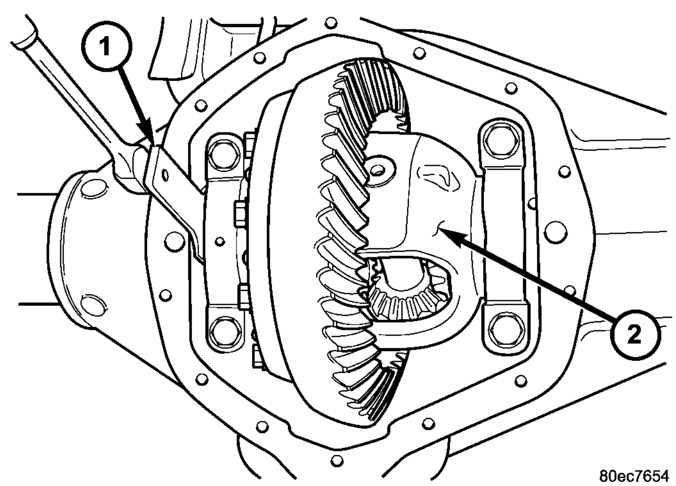


Fig. 6 ADJUSTER SPANNER WRENCH

1 - WRENCH
2 - DIFFERENTIAL

(9) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup, then tighten it until it makes contact.

(10) Tighten pinion gear side adjuster an additional:

- **New Bearings:** 6 Adjuster Holes
- **Original Bearings:** 4 Adjuster Holes

(11) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

REAR AXLE - 10 1/2 AA (Continued)

(12) Tighten bearing cap bolts to 115 N·m (85 ft. lbs.).

(13) Tighten adjuster lock bolts to 33 N·m (24 ft. lbs.).

(14) Measure ring gear backlash with a Dial Indicator C-3339 and Dial Indicator Stud L-4438 at eight points around the drive side of the ring gear (Fig. 7). The backlash should be 0.08-0.25 mm (0.003-0.010 in) with a preferred backlash of 0.13-0.18 mm (0.005-0.007 in).

NOTE: Backlash measurement should not vary more than 0.05 mm (0.002 in) between measuring points. If measurement does vary inspect the gears for burrs, the differential case flange and ring gear mounting.

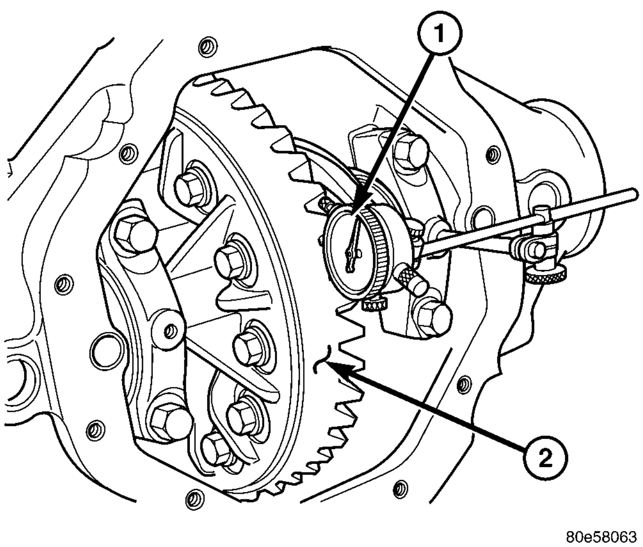


Fig. 7 RING GEAR BACKLASH

1 - DIAL INDICATOR
2 - RING GEAR

GEAR TOOTH CONTACT PATTERN

Gear tooth contact pattern is used to verify the correct running position of the ring and pinion gears. This will produce low noise and long gear life. Gears which are not positioned properly may be noisy and have shorten gear life.

(1) Wipe clean each tooth of the ring gear.

(2) Apply gear marking compound to all of the ring gear teeth.

(3) Verify bearing cap bolts are torque specification.

(4) Apply parking brakes lightly to create at 14 N·m (10 ft. lbs.) pinion rotating torque.

(5) Rotate the pinion/pinion yoke 4 full revolutions in each directions.

(6) Read gear tooth contact pattern:

• Gear contact pattern correct (Fig. 8). Backlash and pinion depth is correct.

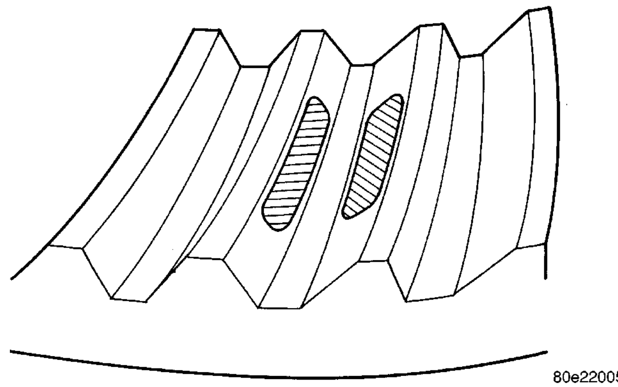


Fig. 8 CORRECT CONTACT PATTERN

• Ring gear too far away from pinion gear (Fig. 9). Decrease the backlash, by moving the ring closer to the pinion gear using the adjusters.

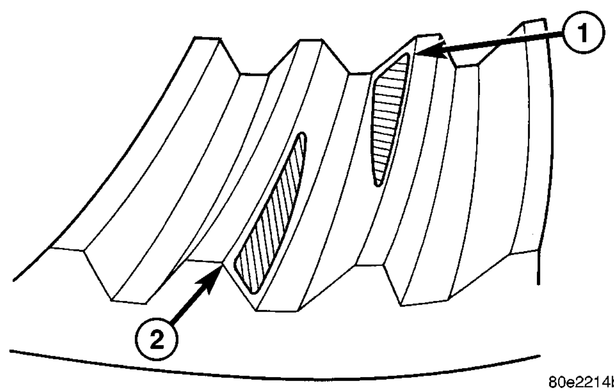


Fig. 9 INCORRECT BACKLASH

1 - COAST SIDE TOE
2 - DRIVE SIDE HEEL

• Ring gear too close to pinion gear (Fig. 10). Increase the backlash, by moving the ring away from the pinion gear using the adjusters.

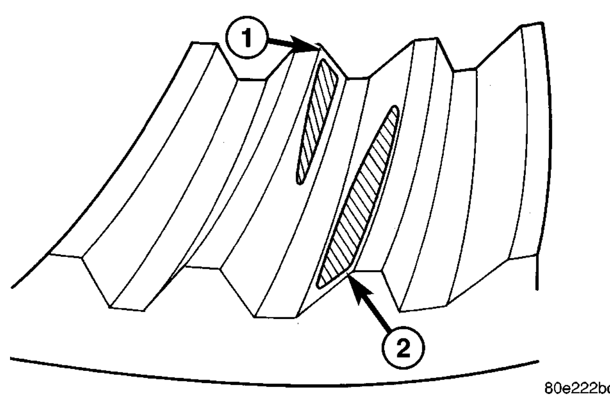


Fig. 10 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE HEEL

REAR AXLE - 10 1/2 AA (Continued)

• Ring gear too far away from pinion gear (Fig. 11). Decrease the backlash, by moving the ring closer to the pinion gear using the adjusters.

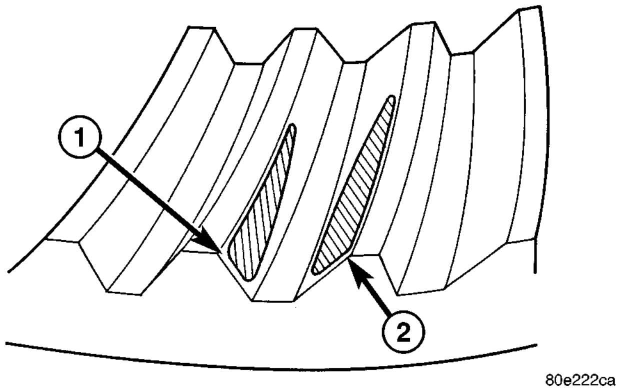


Fig. 11 INCORRECT BACKLASH

1 - DRIVE SIDE HEEL
2 - COAST SIDE HEEL

• Ring gear too close to pinion gear (Fig. 12). Increase the backlash, by moving the ring away from the pinion gear using the adjusters.

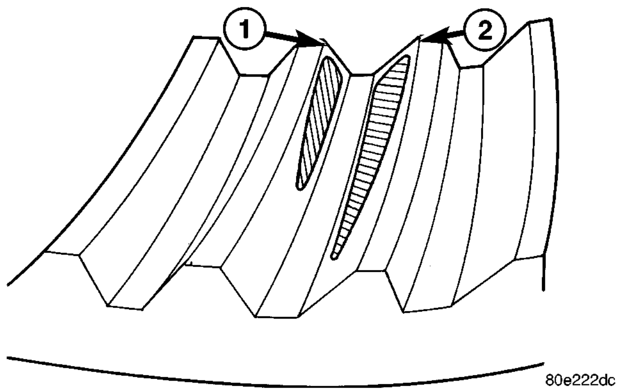


Fig. 12 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE TOE

• Pinion gear is set too low (Fig. 13). Increase the pinion gear height, by increasing the pinion depth shim thickness.

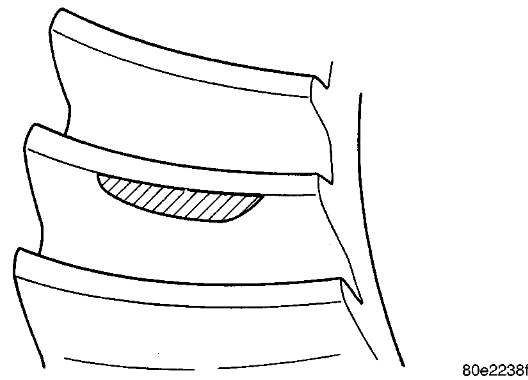


Fig. 13 LOW PINION HEIGHT

• Pinion gear is set too high (Fig. 14). Decrease the pinion depth, by decreasing the pinion depth shim thickness.

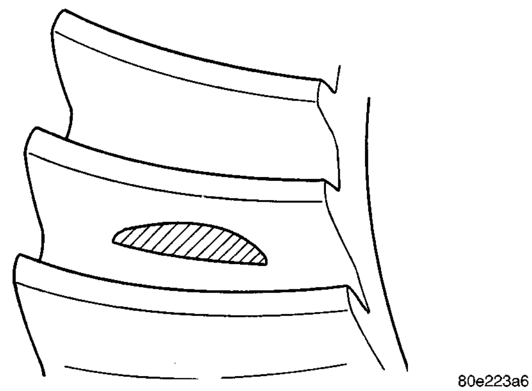


Fig. 14 HIGH PINION HEIGHT

REAR AXLE - 10 1/2 AA (Continued)

SPECIFICATIONS

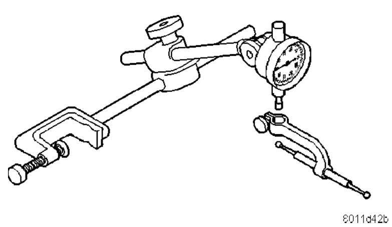
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.73, 4.10
Ring Gear Diameter	266 mm (10.5 in.)
Ring Gear Backlash	0.13-0.18 mm (0.005-0.007 in.)
Pinion Bearing Preload - New Bearings	1.69-2.82 N·m (15-25 in. lbs.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload + Diff Case Bearing Preload - New Bearings	3.4-5.6 N·m (30-50 in. lbs.)
Pinion Bearing Preload + Diff Case Bearing Preload - Original Bearings	2.8-5.1 N·m (25-45 in. lbs.)

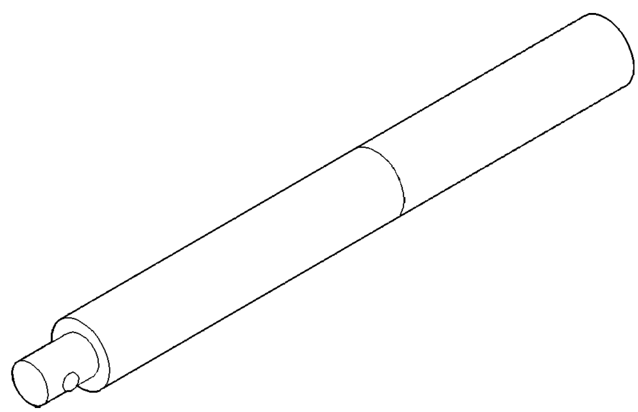
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fill Hole Plug	32	24	-
Differential Cover Bolts	40	30	-
Bearing Cap Bolts	165	122	-
Ring Gear Bolts	237	175	-
Axle Flange Bolts	129	95	-
Adjuster Lock Bolt	25	18	-

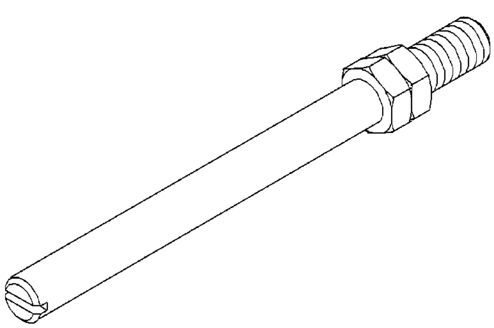
SPECIAL TOOLS



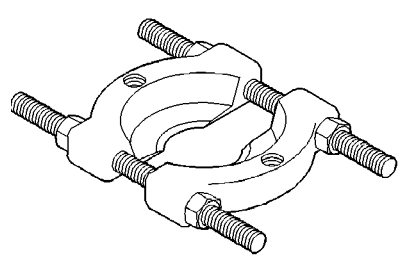
DIAL INDICATOR SET C-3339



HANDLE C-4171

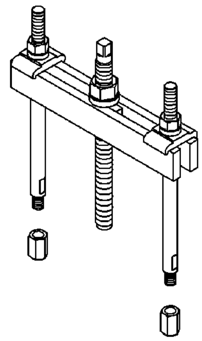


DIAL INDICATOR STUD L-4438

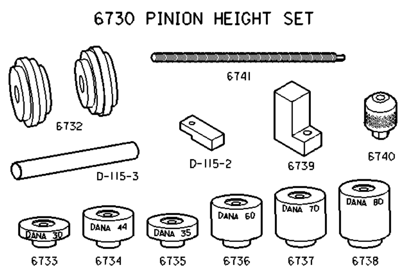


SPLITTER 1130

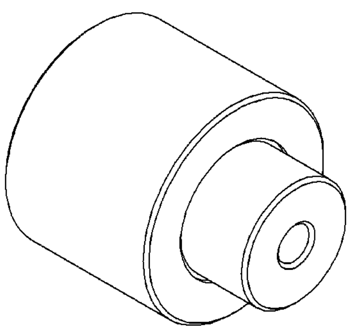
REAR AXLE - 10 1/2 AA (Continued)



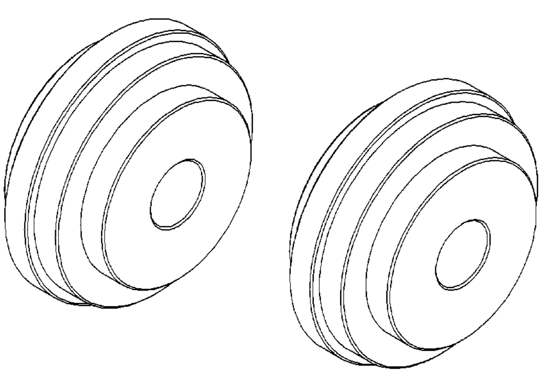
BRIDGE 938



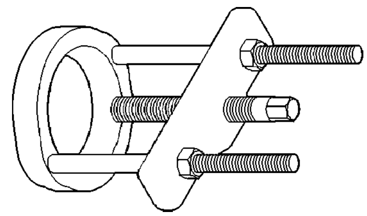
PINION DEPTH GAUGE 6730



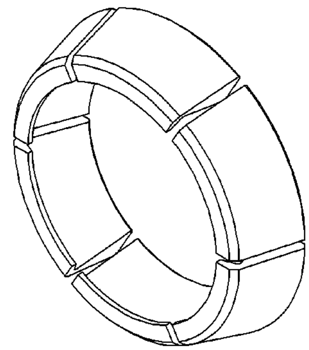
GAUGE BLOCK 8899



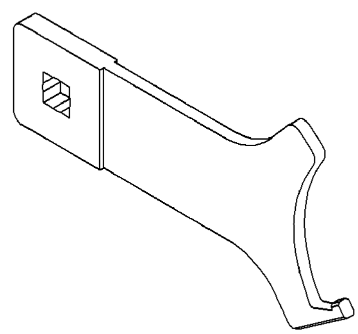
ARBOR DISCS 6732



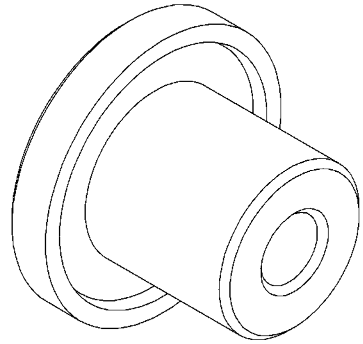
PULLER C-293-PA



ADAPTERS 8879

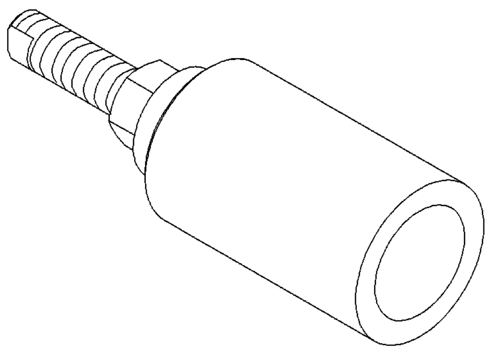


ADJUSTER WRENCH 8883

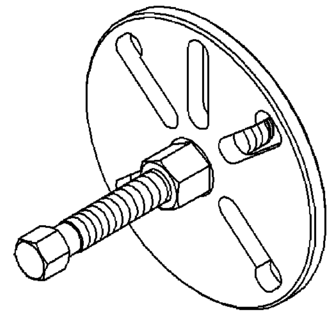


BEARING INSTALLER 8956

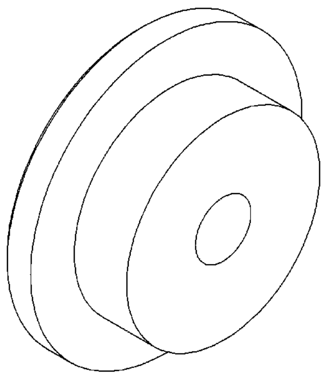
REAR AXLE - 10 1/2 AA (Continued)



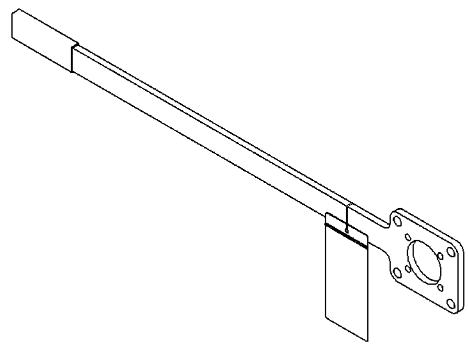
PINION INSTALLER 8981



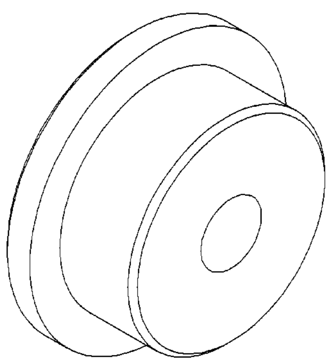
FLANGE PULLER 8992



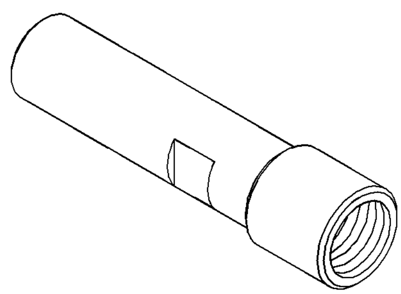
CUP INSTALLER 8959



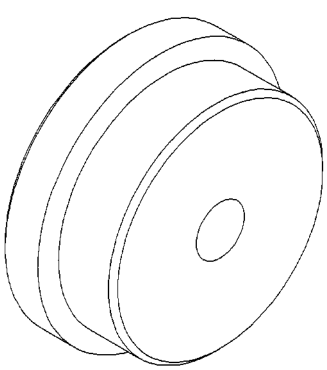
FLANGE WRENCH 8979



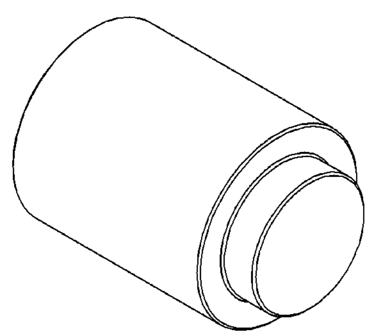
CUP INSTALLER 8960



PINION DRIVER 8977

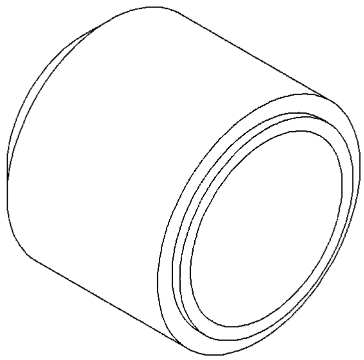


CUP INSTALLER 8961

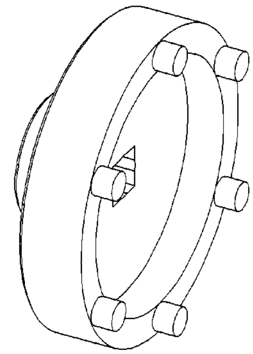


PLUG 8888

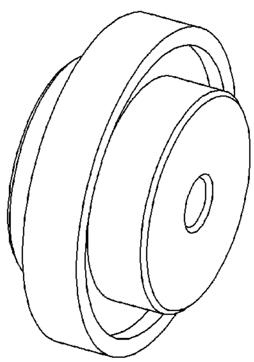
REAR AXLE - 10 1/2 AA (Continued)



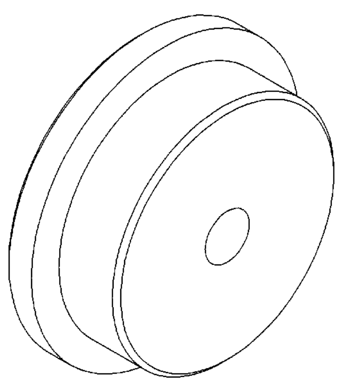
SEAL INSTALLER 8896



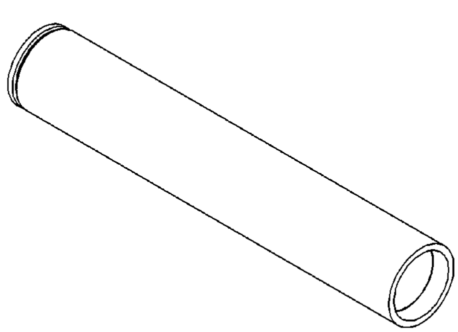
SOCKET 8954



SEAL INSTALLER 8963



CUP INSTALLER 8962



BEARING INSTALLER MD-998805

AXLE SHAFTS

REMOVAL

(1) Remove axle shaft flange bolts (Fig. 15).

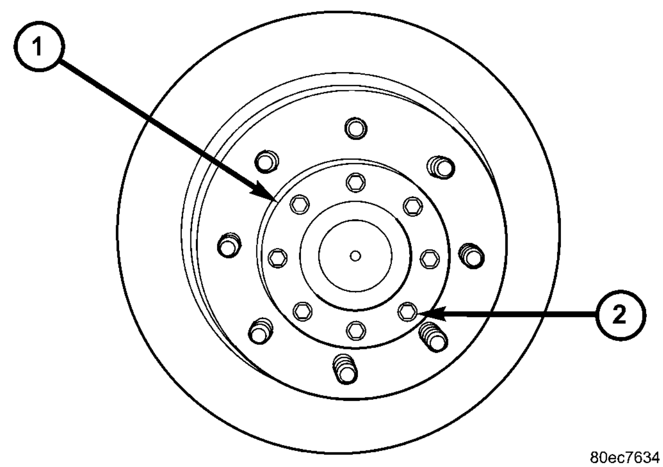


Fig. 15 AXLE FLANGE BOLTS

1 - AXLE FLANGE
2 - FLANGE BOLT

(2) Slide axle shaft out of the axle tube.
(3) Remove axle shaft gasket.

INSTALLATION

NOTE: Axle flange bolts must be replaced or use Mopar Lock N' Seal or Loctite® 242 on cleaned existing bolts.

(1) Clean axle flange and hub.
(2) Install new axle shaft gasket.
(3) Slide axle shaft into the axle tube.
(4) Install axle shaft flange bolts and tighten to 129 N·m (95 ft. lbs.).

AXLE BEARINGS

REMOVAL

(1) Remove axle shaft flange bolts and remove axle shaft.

(2) Remove retianer ring (Fig. 16) from the axle shaft tube.

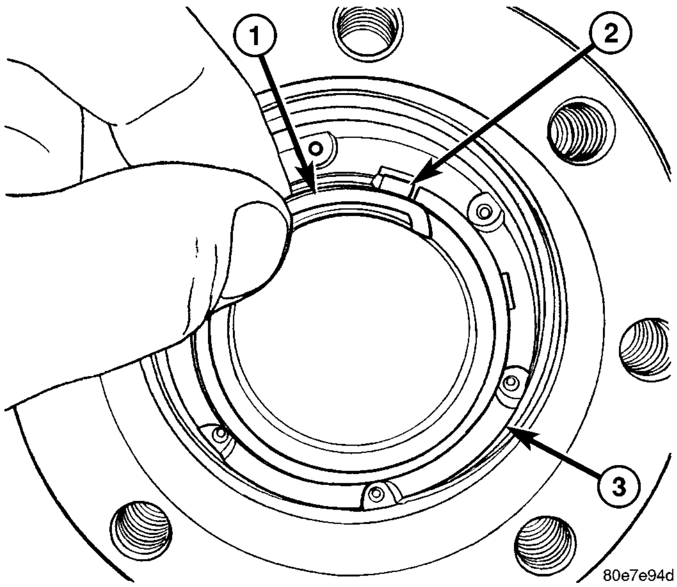


Fig. 16 RETAINER RING

1 - RETAINER RING
2 - LOCKING KEY
3 - BEARING NUT

(3) Remove hub bearing nut locking key (Fig. 17).

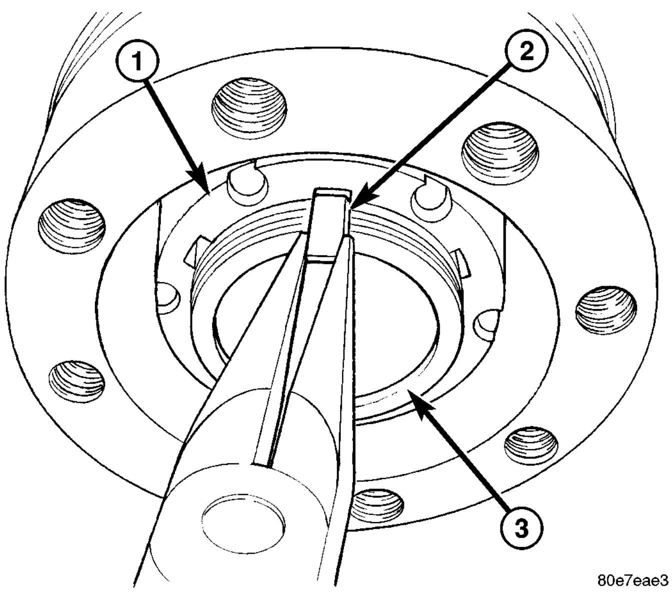


Fig. 17 LOCKING KEY

1 - BEARING NUT
2 - LOCKING KEY
3 - AXLE TUBE

(4) Remove hub bearing nut with Socket 8954.

(5) Remove hub and bearings from the axle.

(6) Pry out hub bearing seal from the back of the hub.

NOTE: The inner part of the seal may stay on the axle tube (Fig. 18). This part must also be removed.

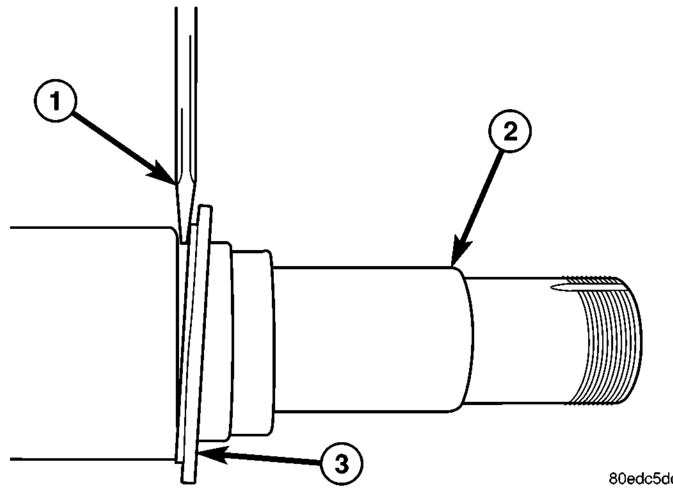


Fig. 18 INNER PART OF SEAL

1 - PRY BAR
2 - AXLE TUBE
3 - REMAINING SEAL

(7) Remove rear bearing.

(8) Remove hub bearing cups with a hammer and drift.

INSTALLATION

(1) Install outer hub bearing cup with Installer 8961 and Handle C-4171.

(2) Install inner hub bearing cup with Installer 8962 and Handle C-4171.

(3) Pack bearings with the appropriate grease.

(4) Install rear bearing and install **new** grease seal with Installer 8963 and Handle C-4171.

(5) Slide hub on the axle tube and install front bearing into the hub.

(6) Install hub bearing nut with Socket 8954 and tighten to 30 N·m (22 ft. lbs.) while rotating the hub (Fig. 19).

(7) Back off nut about 30° and align next hub nut key slot with axle tube key slot and install locking key.

NOTE: End play should be 0.025-0.25 mm (0.001-0.010 in.).

(8) Install retainer ring with ring end in the key slot.

(9) Install new axle shaft gasket and install axle shaft.

AXLE BEARINGS (Continued)

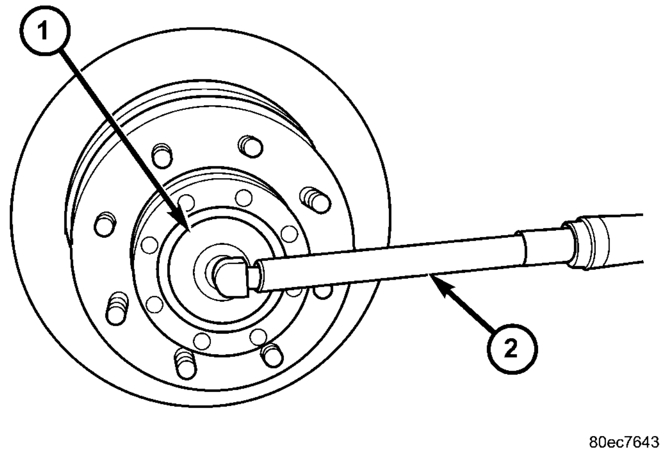


Fig. 19 HUB NUT SOCKET

1 - SOCKET
2 - TORQUE WRENCH

PINION SEAL

REMOVAL

(1) Remove axle shafts.

(2) Mark propeller shaft and pinion flange for installation reference and remove shaft.

(3) Rotate pinion gear three or four times.

(4) Measure and record the amount of torque necessary to rotate the pinion gear with an inch pound torque wrench (Fig. 20).

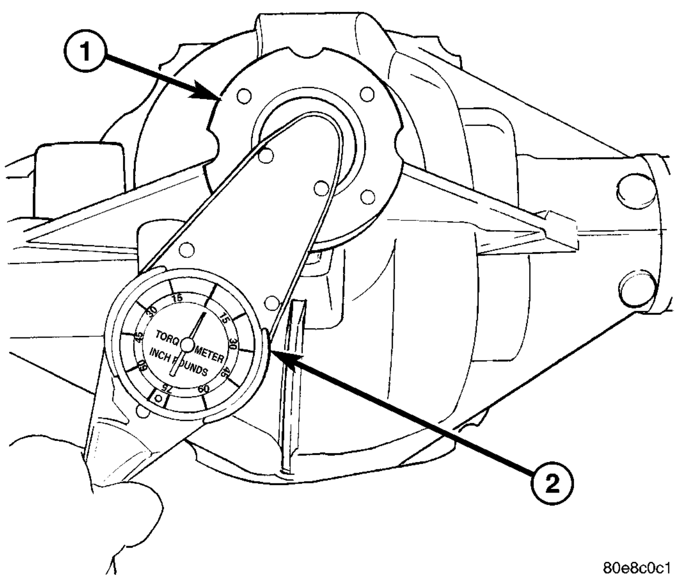


Fig. 20 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(5) Hold pinion flange with Flange Wrench 8979 (Fig. 21) and remove pinion flange nut and washer.

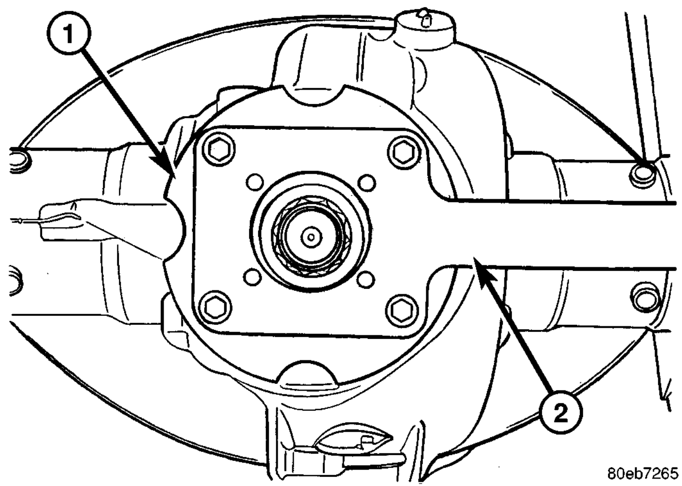


Fig. 21 FLANGE WRENCH

1 - PINION FLANGE
2 - FLANGE WRENCH

(6) Remove pinion flange with Pinion Flange Puller 8992 (Fig. 22).

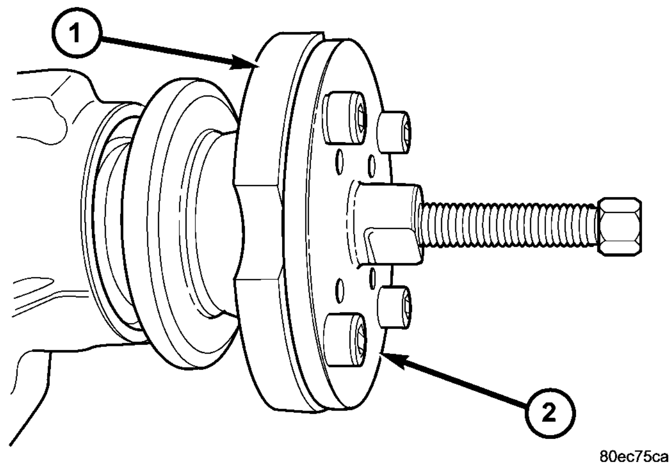


Fig. 22 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

(7) Remove pinion shaft seal with a pry tool or slide hammer mounted screw.

INSTALLATION

(1) Install **new** pinion seal with Installer 8896 and Handle C-4171 (Fig. 23).

(2) Apply a light coat of teflon sealant to the pinion flange splines.

(3) Lightly tap the pinion flange onto the pinion until a few threads are showing.

(4) Install flange washer and **new** pinion nut.

(5) Hold flange with Flange Wrench 8979 (Fig. 24) and tighten pinion nut until pinion end play is taken up.

PINION SEAL (Continued)

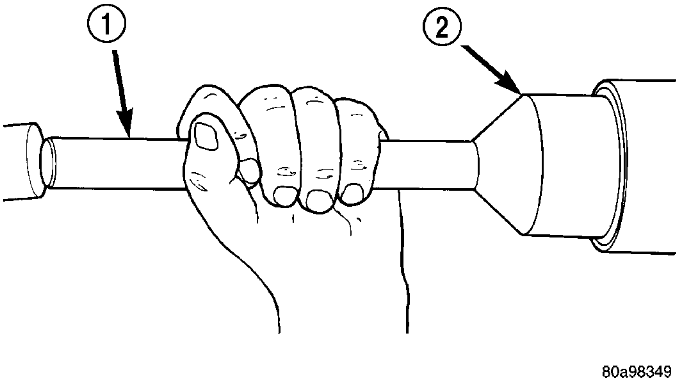


Fig. 23 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

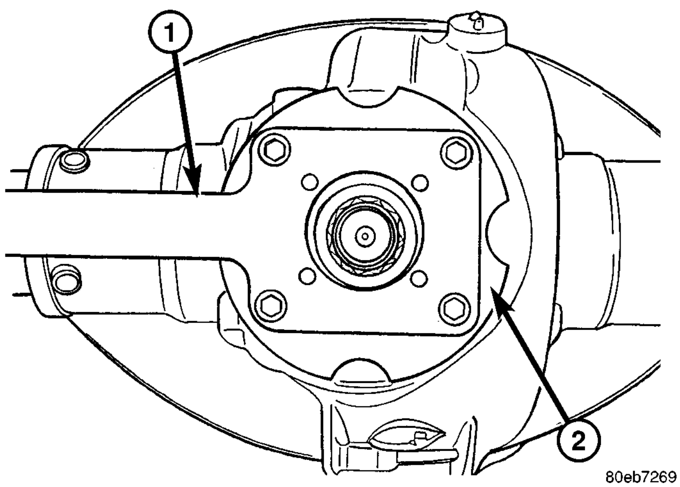


Fig. 24 FLANGE WRENCH

1 - FLANGE WRENCH
2 - PINION FLANGE

(6) Rotate pinion several times to seat bearings.

(7) Measure pinion rotating torque with an inch pound torque wrench and compare it to recorded measurement.

(8) Tighten pinion nut in small increments, until pinion rotating torque is 0.40-0.57 N·m (3-5 in. lbs.) greater than recorded measurement.

(9) Rotate pinion several times then verify pinion rotating torque again.

(10) Install axle shafts.

(11) Install propeller shaft with reference marks aligned.

(12) Check and fill differential if necessary.

DIFFERENTIAL

DESCRIPTION

The differential case is a one-piece design. The differential pinion shaft is retained with a snap ring. Differential bearing preload and ring gear backlash is adjusted by the use of adjusters. The adjuster are between the differential bearings and the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The stamped steel cover provides a means for inspection and servicing the differential.

OPERATION

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 25).

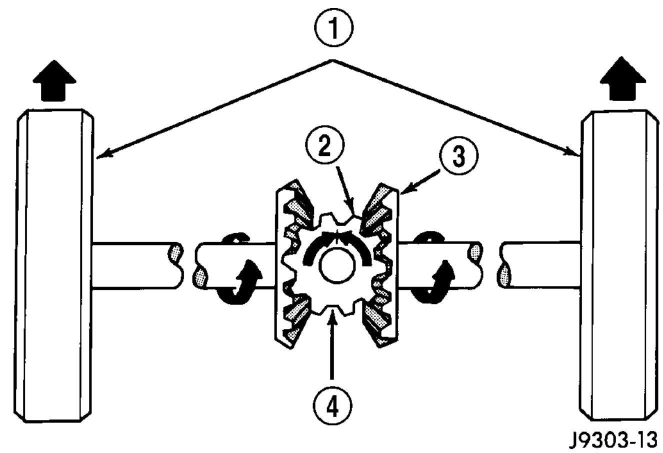


Fig. 25 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 26). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

DIFFERENTIAL (Continued)

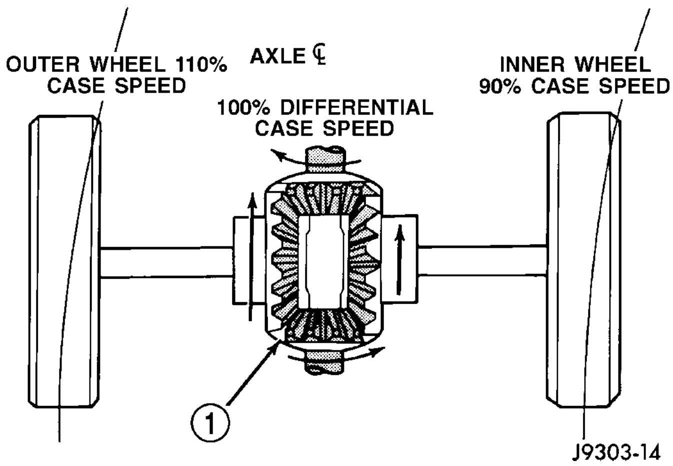


Fig. 26 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

REMOVAL

(1) Remove lubricant fill hole plug from the differential housing cover.

(2) Remove differential housing cover and drain the lubricant from housing.

(3) Remove axle shafts.

(4) Remove adjuster lock bolts and adjuster locks (Fig. 27).

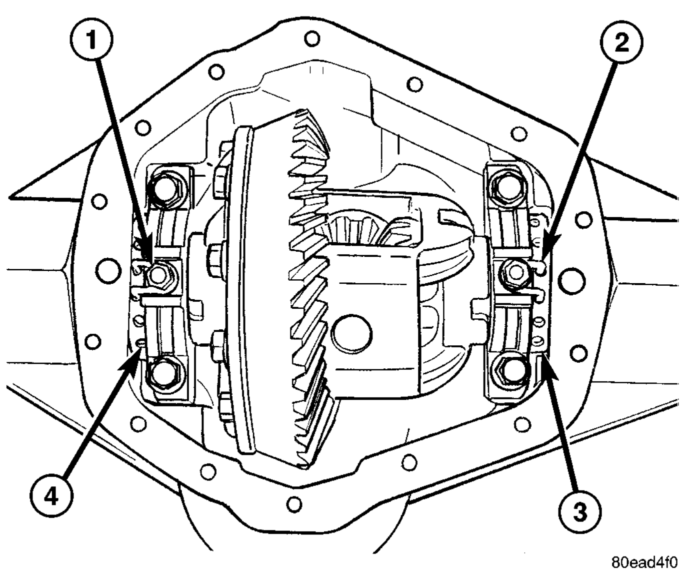


Fig. 27 ADJUSTER LOCKS

1 - LOCK BOLT
2 - ADJUSTER LOCK
3 - ADJUSTER
4 - BEARING CAP

(5) Mark bearing caps left and right for installation reference.

(6) Remove bearing cap bolts and remove bearing caps.

(7) Loosen differential bearing adjusters (Fig. 28) with Spanner Wrench 8883.

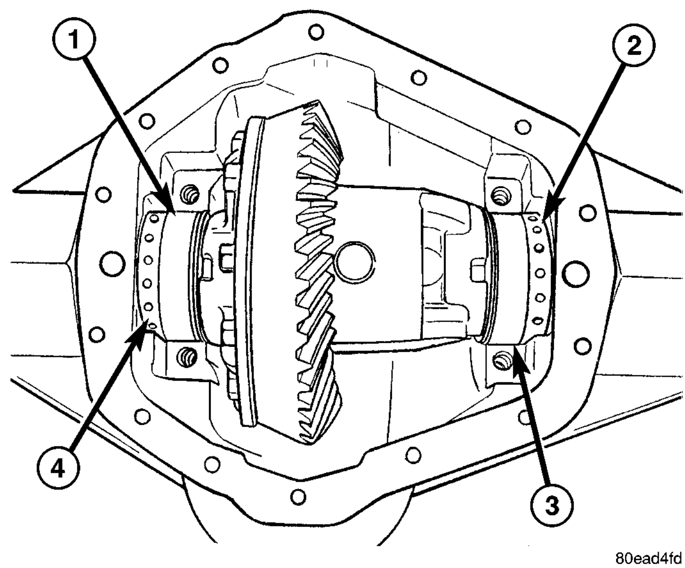


Fig. 28 BEARING ADJUSTERS

1 - BEARING CUP
2 - ADJUSTER
3 - BEARING CUP
4 - ADJUSTER

(8) Remove differential case from the housing.

(9) Remove bearing cups and tag them left and right for installation reference.

DISASSEMBLY

(1) Remove pinion shaft with a hammer and punch from the side with the hole in the pinion shaft (Fig. 29).

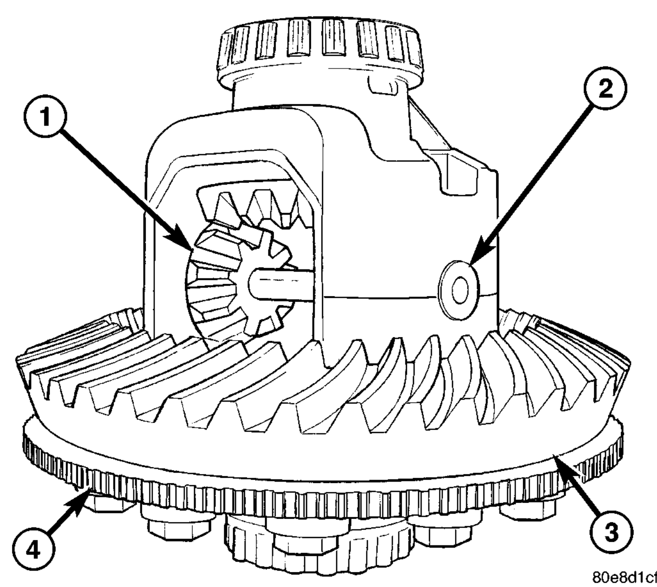


Fig. 29 PINION SHAFT

1 - PINION GEAR
2 - PINION SHAFT
3 - RING GEAR
4 - EXCITER RING

DIFFERENTIAL (Continued)

(2) Rotate one pinion gear with thrust washer (Fig. 30) to the differential window and remove the gear.

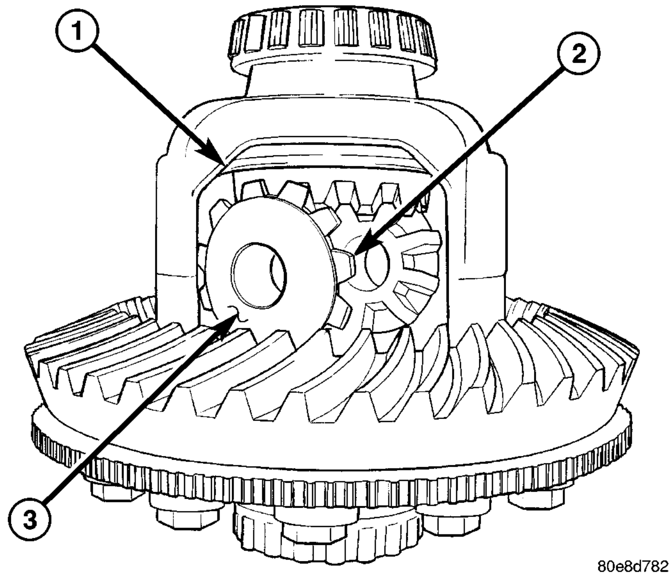


Fig. 30 FRIST PINION GEAR

1 - DIFFERNTIAL CASE WINDOW
2 - PINION GEAR
3 - THRUST WASHER

(3) Rotate the other pinion gear with thrust washer (Fig. 31) to the differential window and remove the gear.

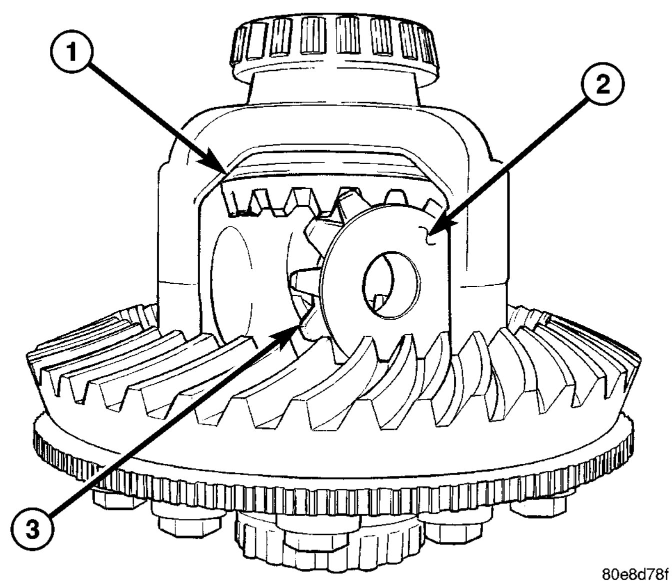


Fig. 31 SECOND PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - THRUST WASHER
3 - PINION GEAR

(4) Remove differential side gears and thrust washers (Fig. 32).

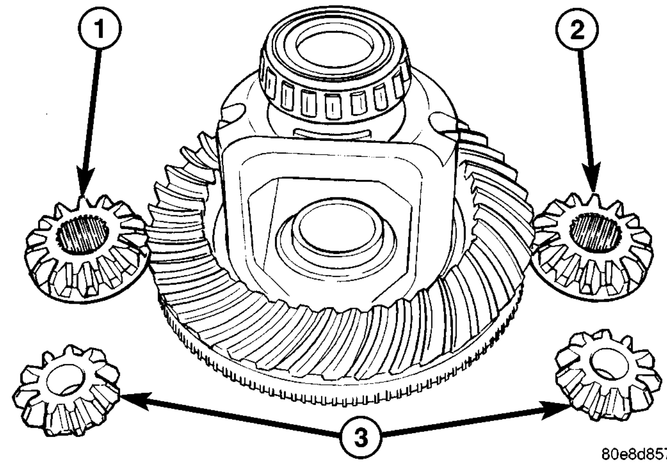


Fig. 32 SIDE GEARS

1 - SIDE GEAR
2 - SIDE GEAR
3 - PINION GEARS

ASSEMBLY

NOTE: If the same gears and thrust washers are being used, install them into their orignial locations.

(1) Lubricate all differential components with axle lubricant.

(2) Install differential side gears and thrust washers (Fig. 33).

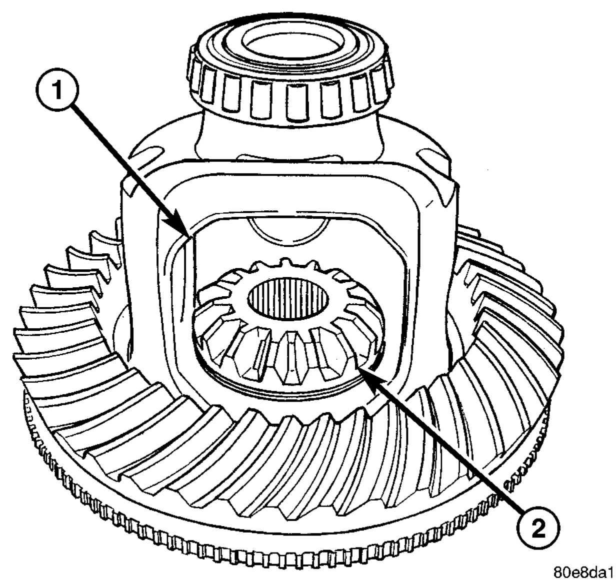


Fig. 33 SIDE GEAR

1 - DIFFERENTIAL WINDOW
2 - SIDE GEAR

(3) Install first pinion gear into the differential window and side gears. Rotate the pinion gear to the back of the case (Fig. 34).

DIFFERENTIAL (Continued)

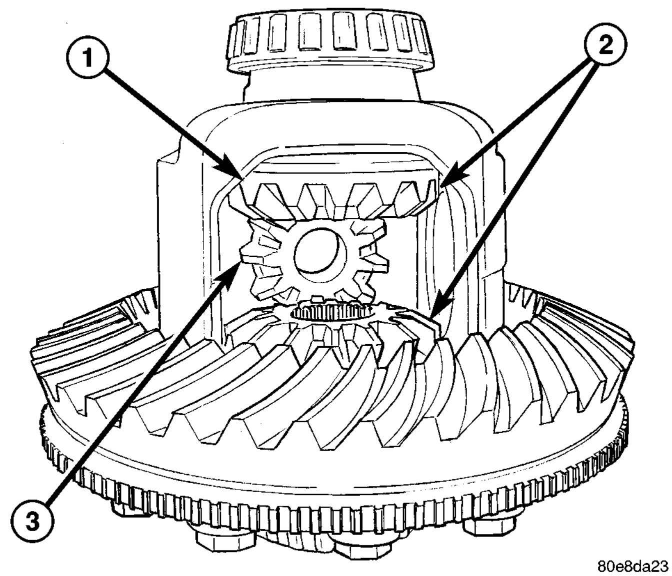


Fig. 34 PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - SIDE GEARS
3 - PINION GEAR

(4) Install the other pinion gear and thrust washer. Rotate the gears to align hole in the pinion gears with hole in the differential case.

(5) Slide pinion shaft into the case and through the pinion gears. Tap the shaft to seat the pinion shaft snap-ring into the case (Fig. 35).

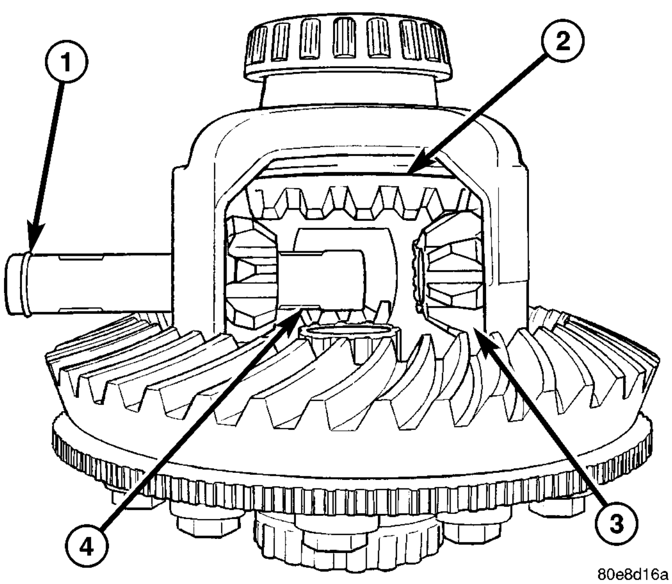


Fig. 35 PINION SHAFT INSTALLATION

1 - PINION SHAFT SNAP-RING
2 - SIDE GEAR
3 - PINION GEAR
4 - PINION SHAFT

INSTALLATION

(1) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth.

CAUTION: Do not use water, steam, kerosene or gasoline for cleaning.

(2) Lubricate differential case bearing.

(3) Install differential case with bearings cups into the housing.

NOTE: A light coat of grease on the cups will hold them in place during installation.

(4) Install bearing caps and bolts (Fig. 36). Tighten the bearing cap bolts finger-tight.

NOTE: Do not torque bearing cap and bolts at this time.

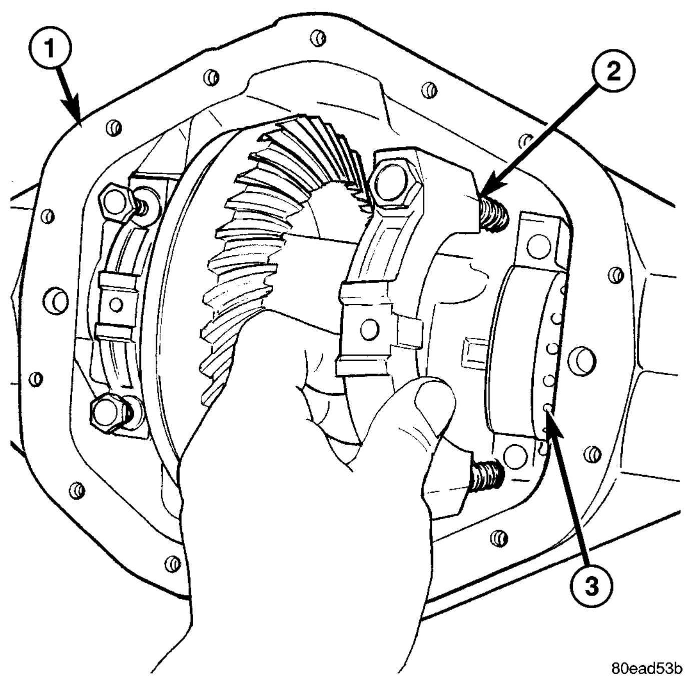


Fig. 36 CASE BEARING CAP

1 - DIFFERENTIAL HOUSING
2 - BEARING CAP
3 - ADJUSTER

(5) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(6) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 until they make contact with the differential bearings/cups.

(7) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

DIFFERENTIAL (Continued)

(8) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(9) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(10) Rotate the pinion several times to seat the differential bearings.

(11) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup.

(12) Tighten pinion gear side adjuster until it just makes contact with the bearing cup.

(13) Tighten pinion gear side adjuster an additional:

- **New Bearings** 6 Adjuster Holes
- **Original Bearings** 4 Adjuster Holes

(14) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(15) Tighten bearing cap bolts to 165 N·m (122 ft. lbs.).

(16) Tighten adjuster lock bolts to 25 N·m (18 ft. lbs.) (Fig. 37).

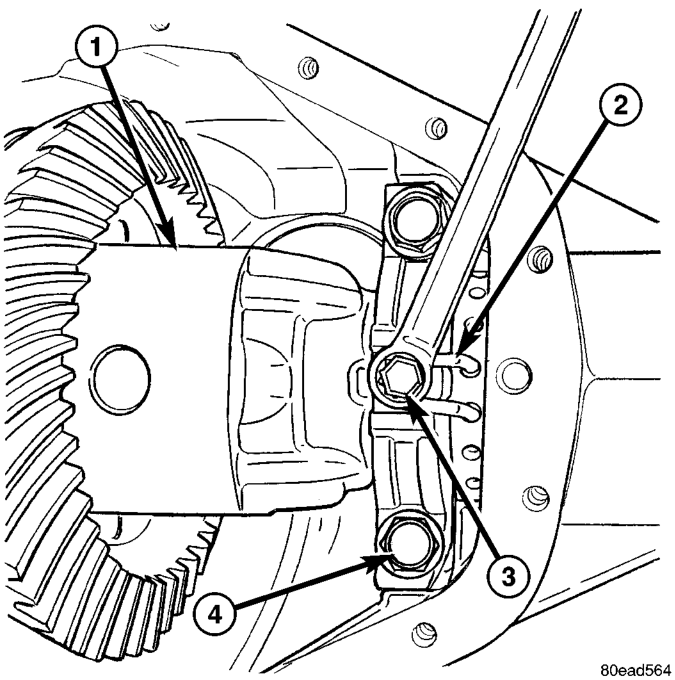


Fig. 37 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

(17) Measure ring gear backlash and check gear tooth contact pattern. Refer to Adjustments for procedure.

(18) Install axle shafts.

(19) Install differential housing gasket and cover. Tighten cover bolts to 40 N·m (30 ft. lbs.).

(20) Fill axle with lubricant, refer to Lubrication & Maintenance for capacity and lubricant type.

(21) Install fill plug and tighten to 32 N·m (24 ft. lbs.).

DIFFERENTIAL TRAC-RITE

DESCRIPTION

The Trac-Rite™ differential is a helical gear differential. The differential has two side gears, six pinion gears and six pinion brake shoes.

NOTE: The differential is seviced as an assembly only if damaged, but can be disassembled for cleaning. The assembly should be cleaned every time a bearing is changed due to damage.

OPERATION

When one wheel begins to spin the pinion gears on that side are forced toward the pinion brake shoes. The pinion brake shoes then cause frictional drag on the opposite pinion gears and the side gear. These friction forces transfer the power to the opposite wheel. Once the frictional forces are overcome, differentiation will occur. The torque will be continually biased by the frictional forces to the high traction wheel.

DISASSEMBLY

(1) Remove differential ring gear bolts.

(2) Remove differential case cover locating screws (Fig. 38).

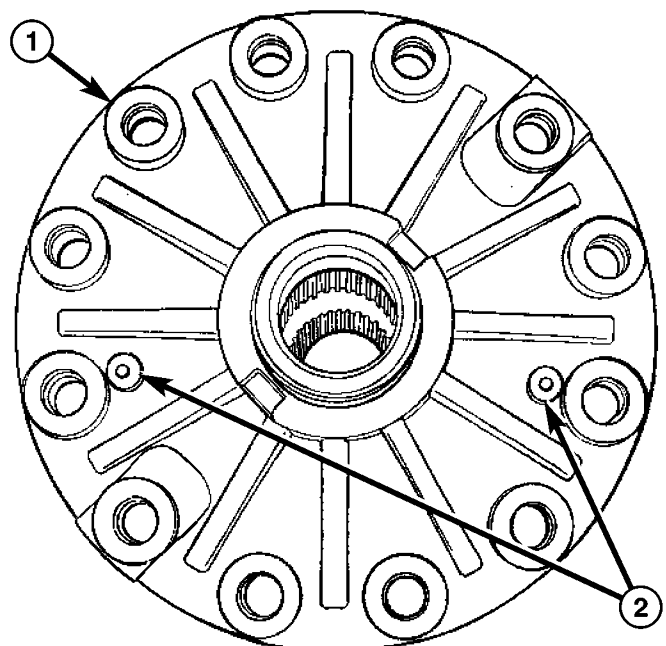


Fig. 38 LOCATION SCREWS

1 - DIFFERENTIAL COVER
2 - LOCATION SCREWS

(3) Remove differential case cover.

(4) Remove side gear and thrust washer (Fig. 39).

DIFFERENTIAL TRAC-RITE (Continued)

NOTE: Mark all component locations.

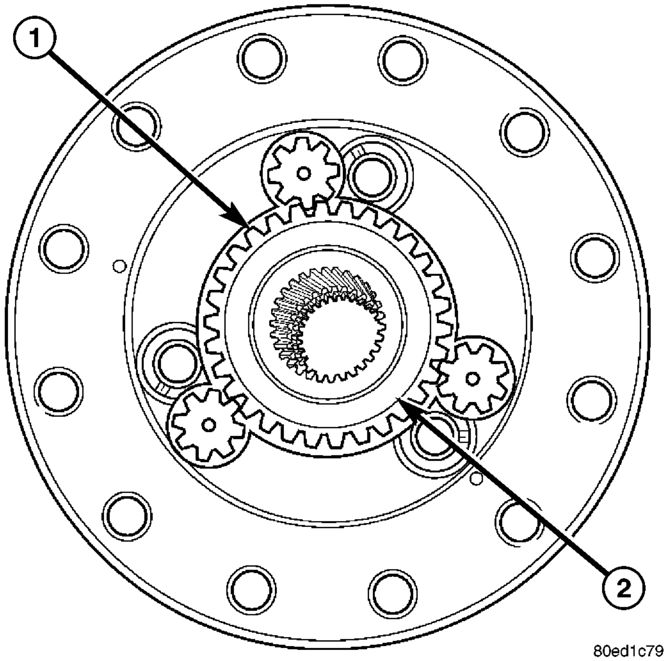


Fig. 39 SIDE GEAR AND THRUST WASHER

1 - SIDE GEAR
2 - THRUST WASHER

(5) Remove three pinion brake shoes (Fig. 40).

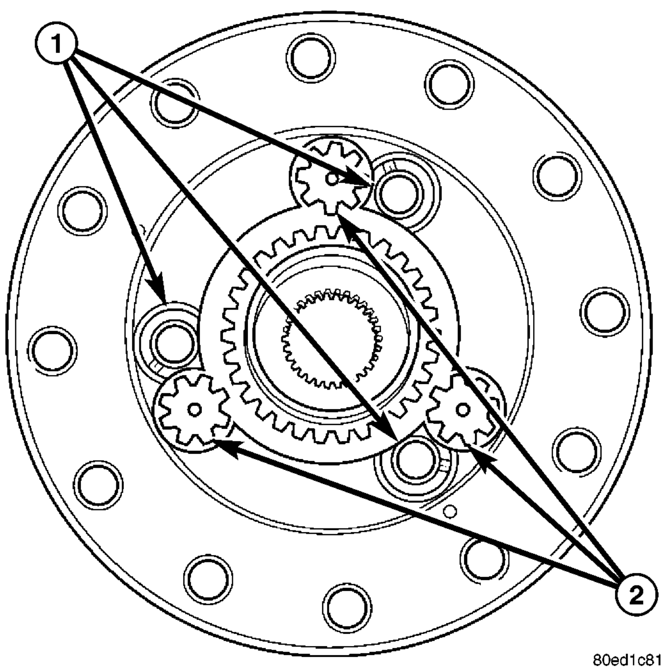


Fig. 40 PINION BRAKE SHOES

1 - BRAKE SHOES
2 - PINION GEARS

(6) Remove six pinion gears (Fig. 41).

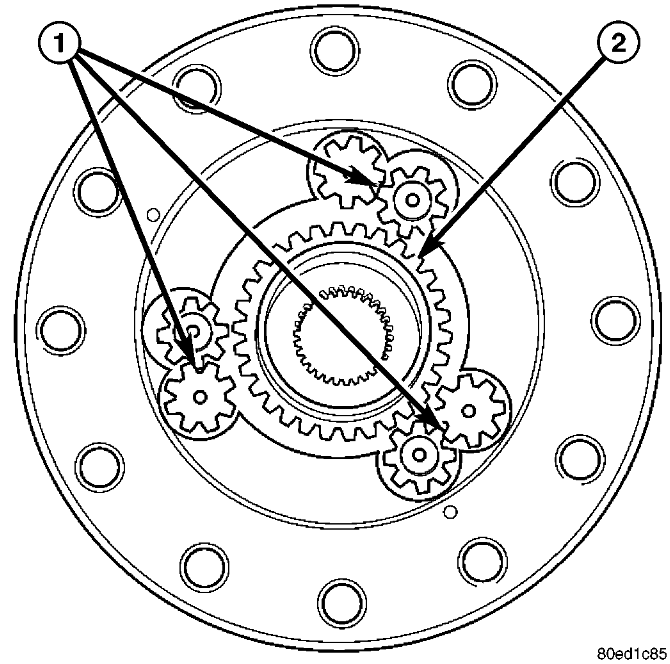


Fig. 41 PINION GEARS

1 - PINION GEARS
2 - SIDE GEAR

(7) Remove remaining side gear thrust washer and spacer.

(8) Remove remaining three pinion brake shoes.

CLEANING

Clean the differential case and gears with light oil or a lint free cloth.

NOTE: Never use water, steam, kerosene or gasoline for cleaning.

INSPECTION

NOTE: Minor corrosion, nicks or scratches can be smoothed with 400 grit emery cloth and polished out with crocus cloth.

(1) Inspect pinion gears teeth for chips and cracks (Fig. 42).

(2) Inspect pinion gears shafts and brake shoes for scratches, flat-spots or worn (Fig. 42).

(3) Inspect side gears teeth for chips and cracks (Fig. 43).

(4) Inspect pinion and side gear bores for scratches (Fig. 44).

NOTE: If any damage is found the differential must be replaced as an assembly. Individual components can not be replaced separately.

DIFFERENTIAL TRAC-RITE (Continued)

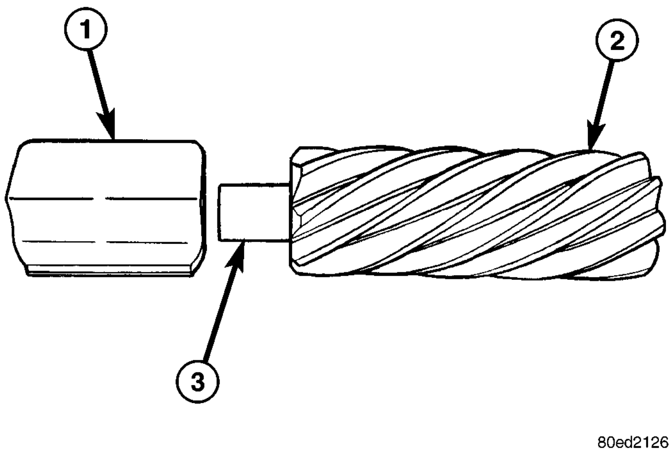


Fig. 42 PINION GEAR AND BRAKE SHOE

1 - BRAKE SHOES
2 - PINION GEAR
3 - PINION SHAFT

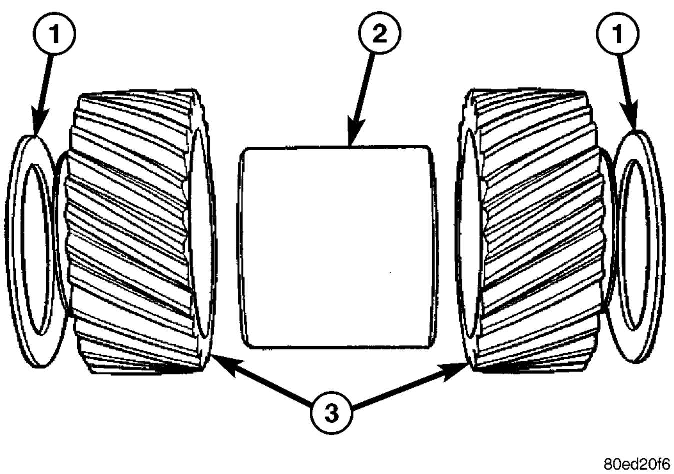


Fig. 43 SIDE GEARS

1 - THRUST WASHERS
2 - SPACER
3 - SIDE GEARS

ASSEMBLY

NOTE: Install all component in their original locations.

(1) Lubricate all gears and differential bores with differential lubricant.

(2) Install one set of pinion brake shoes into the case bores.

NOTE: Brake shoes can be installed upside down, but if install wrong pinion gear will not fit.

(3) Install side gear thrust washer, side gear and spacer (Fig. 45).

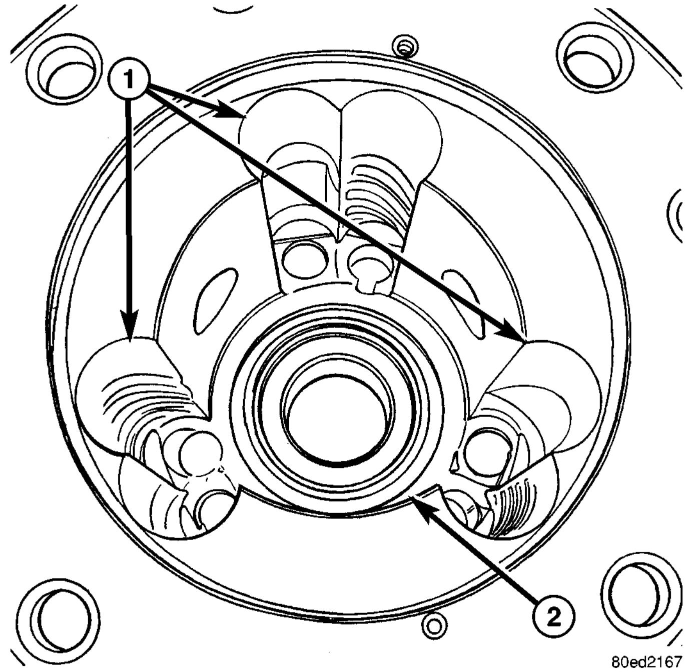


Fig. 44 PINION/SIDE GEAR BORE

1 - PINION BORES
2 - SIDE GEAR BORE

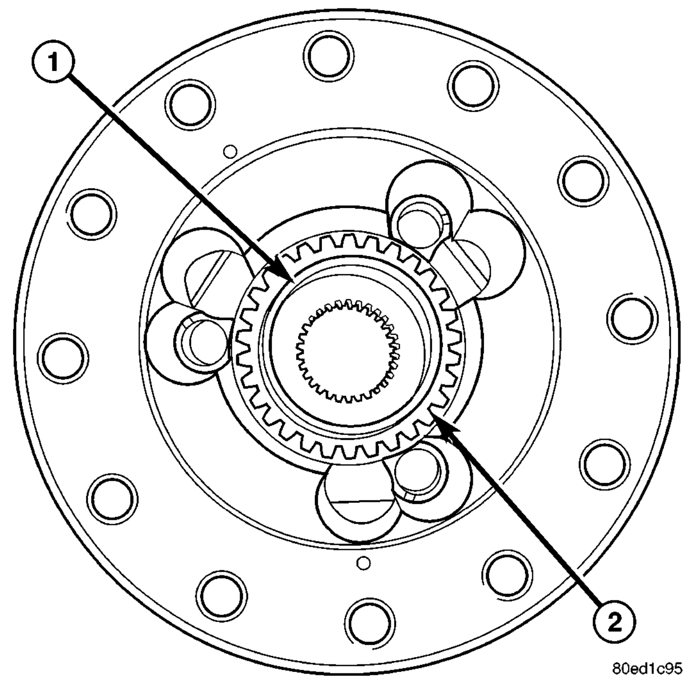


Fig. 45 SIDE GEAR AND SPACER

1 - SPACER
2 - SIDE SPACER

(4) Install one set of pinion gears into the bores next to the brake shoes, with the pinion shaft facing up.

(5) Install other side gear and thrust washer.

DIFFERENTIAL TRAC-RITE (Continued)

(6) Install other set of pinion gears into the brake shoes in the case.

(7) Install other set of brake shoes onto the pinion gears shafts (Fig. 46).

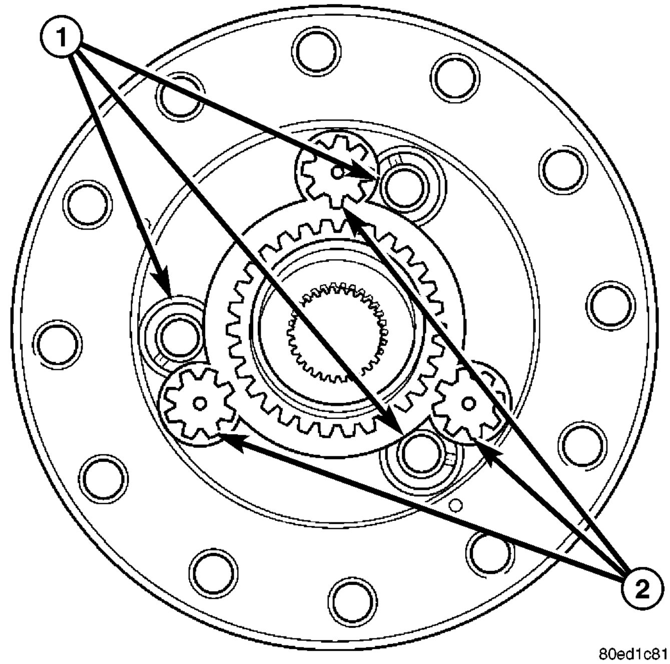


Fig. 46 PINION BRAKE SHOES

1 - BRAKE SHOES
2 - PINION GEARS

(8) Install differential cover and location screws.

(9) Install **new** ring gear bolts and tighten to 237 N·m (175 ft. lbs.).

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from the housing.

(2) Install Plug 8888 into the end of the case.

(3) Remove differental case bearings with Bearing Splitter 1130 and Bridge 938 (Fig. 47).

INSTALLATION

(1) Install differenial case bearings with Installer 8956 and Handle C-4171 (Fig. 48).

(2) Install differentail case into housing.

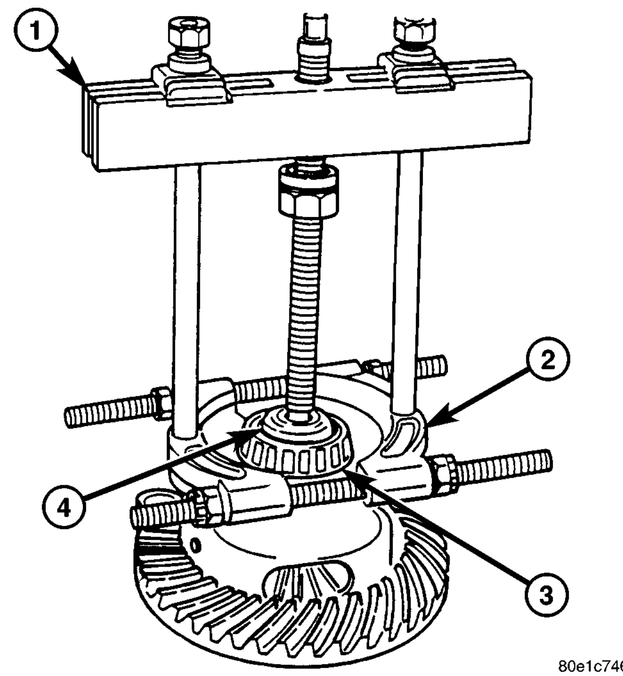


Fig. 47 DIFFERENTIAL CASE BEARING

1 - BRIDGE
2 - SPLITTER
3 - BEARING
4 - PLUG

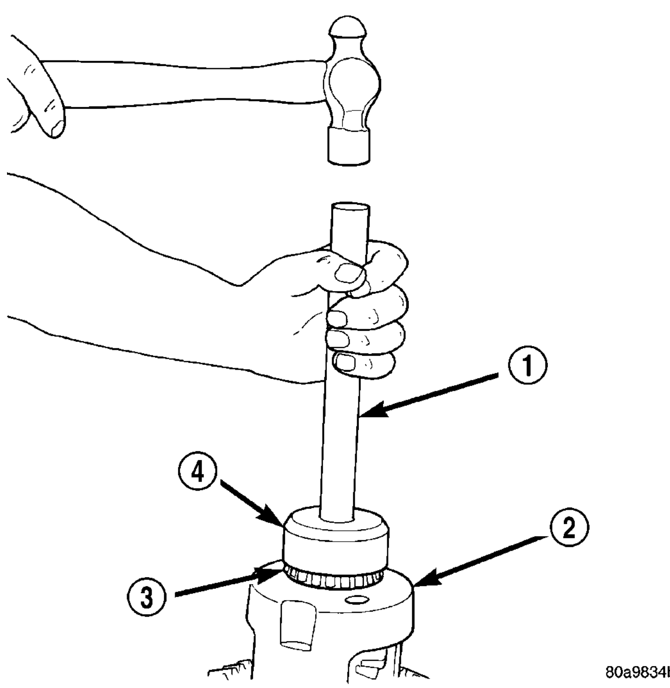


Fig. 48 DIFFERENTIAL CASE BEARINGS

1 - HANDLE
2 - DIFFERENTIAL CASE
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

NOTE: The ring and pinion gears are service in a matched set. Never replace the ring gear/pinion gear without replacing the other matching gear.

(1) Mark pinion flange and propeller shaft for installation alignment.

(2) Disconnect propeller shaft from pinion flange and remove propeller shaft.

(3) Remove differential from axle housing.

(4) Place differential on Plug 8888 and drive exciter ring off the differential case with a hammer and punch (Fig. 49).

NOTE: Do not remove the exciter ring if it is not being replaced.

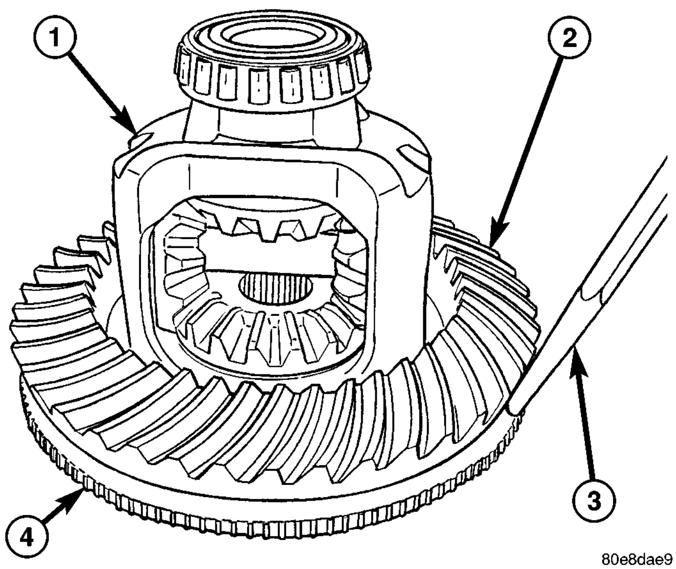


Fig. 49 EXCITER RING

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - PUNCH
4 - EXCITER RING

(5) Place differential case in a vise with soft metal jaw protectors

(6) Remove bolts holding ring gear to differential case.

(7) Drive ring gear from differential case with a soft hammer (Fig. 50).

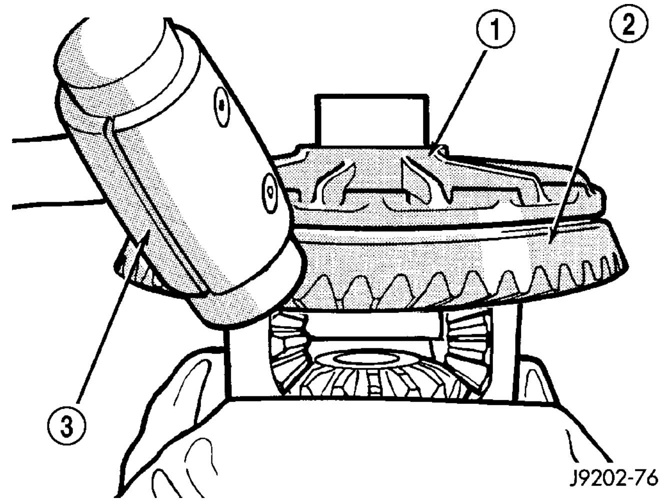


Fig. 50 RING GEAR

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - HAMMER

(8) Hold pinion flange with Flange Wrench 8979 (Fig. 51) and remove pinion flnage nut and washer.

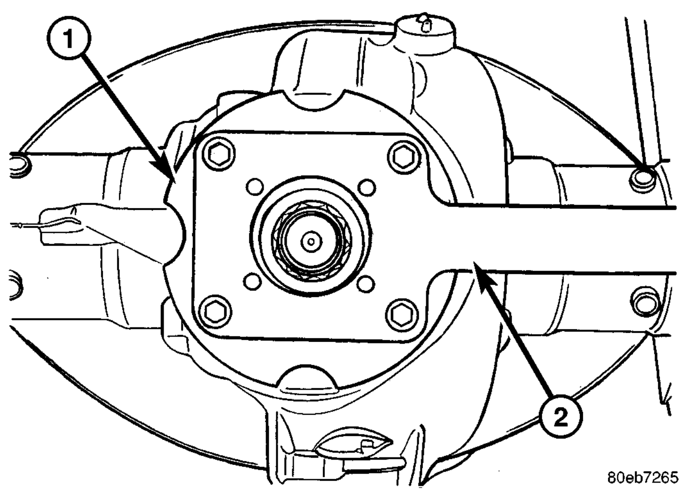


Fig. 51 FLANGE WRENCH

1 - PINION FLANGE
2 - FLANGE WRENCH

(9) Remove pinion flange from the pinion with Pinion Flange Puller 8992 (Fig. 52).

(10) Remove pinion gear from housing, with Pinion Driver 8977 (Fig. 53) and a hammer.

PINION GEAR/RING GEAR/TONE RING (Continued)

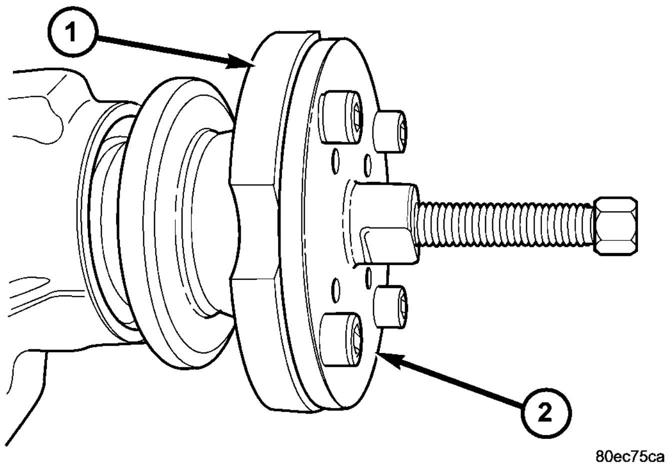


Fig. 52 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

NOTE: Thread the driver on the pinion shaft till it bottoms out.

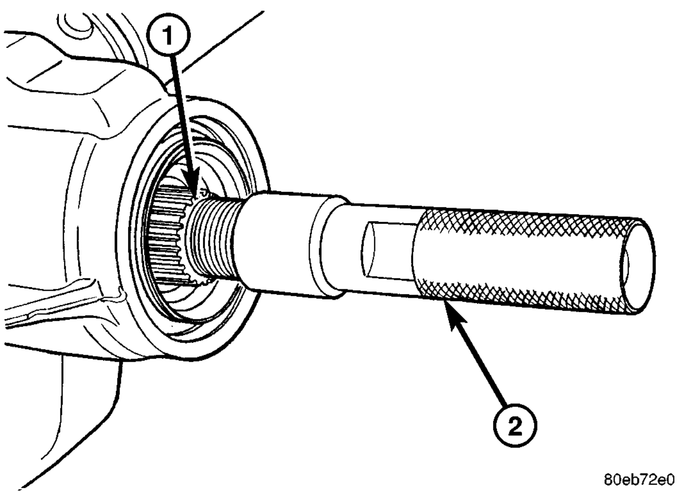


Fig. 53 PINION DRIVER

1 - PINION SHAFT
2 - PINION DRIVER

(11) Remove pinion seal with a slide hammer or pry bar.

(12) Remove and discard front pinion bearing.

CAUTION: Do not reuse front pinion bearing/cup.

(13) Remove collapsible spacer from the pinion shaft.

(14) Remove rear pinion bearing with Puller C-293-PA and Adapter Blocks 8879 (Fig. 54).

(15) Remove pinion depth shim from the pinion gear shaft and record thickness of the shims.

(16) Remove front pinion bearing cup from the housing with a punch and hammer and discard cup.

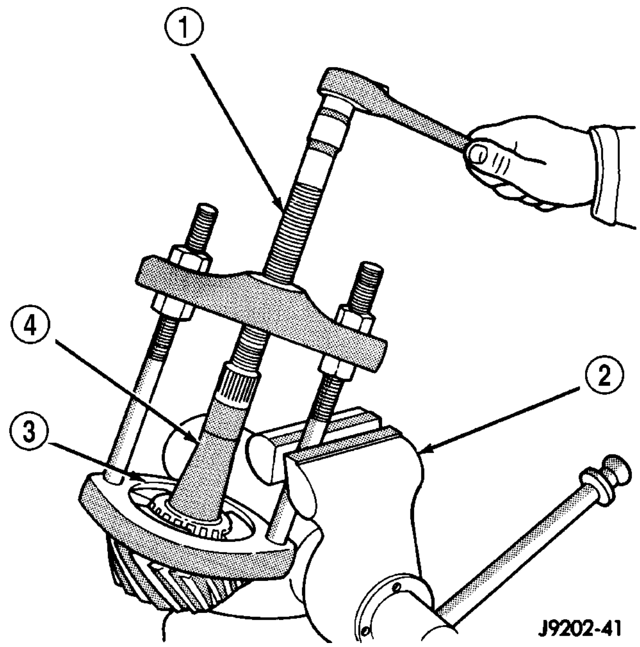


Fig. 54 REAR PINION BEARING

1 - PULLER
2 - VISE
3 - PINION SHAFT
4 - ADAPTER BLOCKS

CAUTION: Do not reuse front pinion bearing/cup.

(17) Remove rear pinion bearing cup from the housing with a punch and hammer, if bearing is going to be replaced.

INSTALLATION

(1) Install new front pinion bearing cup (Fig. 55) with Installer 8960 and Handle C-4171.

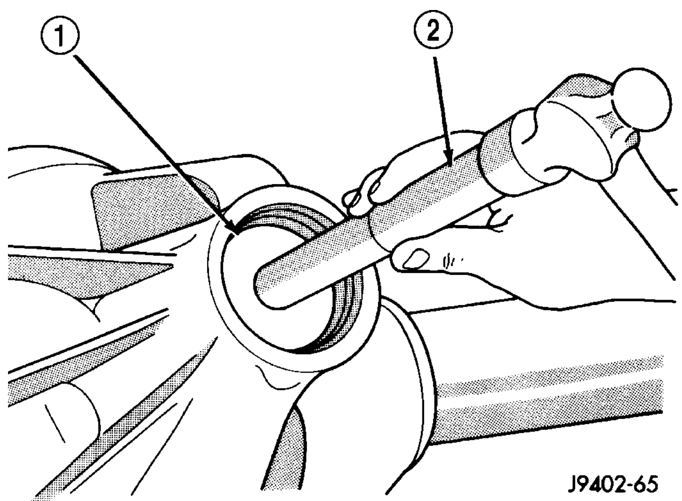


Fig. 55 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

PINION GEAR/RING GEAR/TONE RING (Continued)

(2) Install new rear pinion bearing cup (Fig. 56) with Installer 8959 and Handle C-4171.

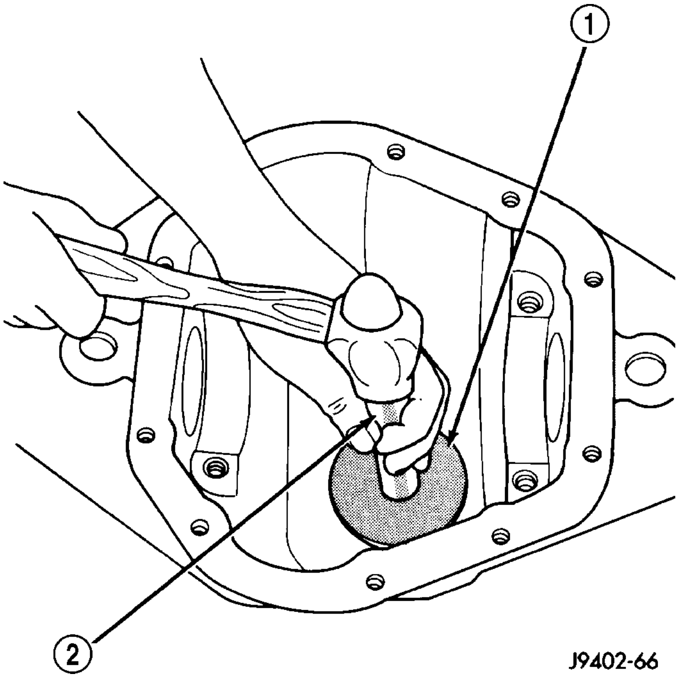


Fig. 56 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(3) Install pinion depth shim (Fig. 57) on the pinion gear shaft.

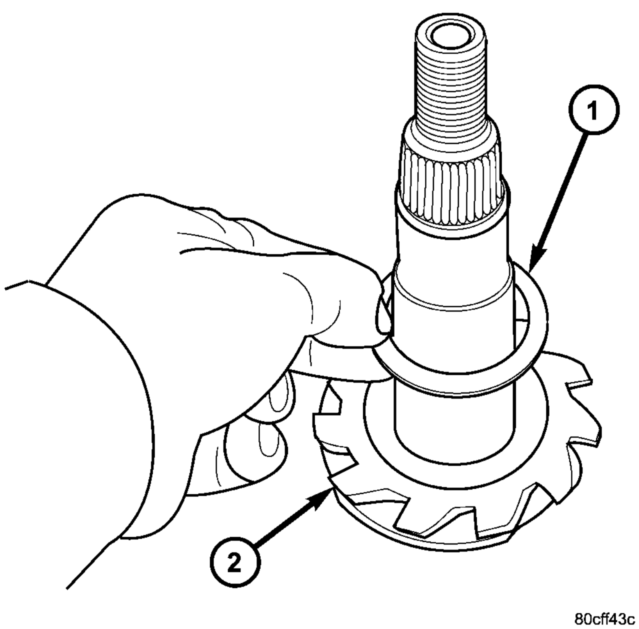


Fig. 57 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

(4) Install rear pinion bearing (Fig. 58) with Installer MD-998805 and a press.

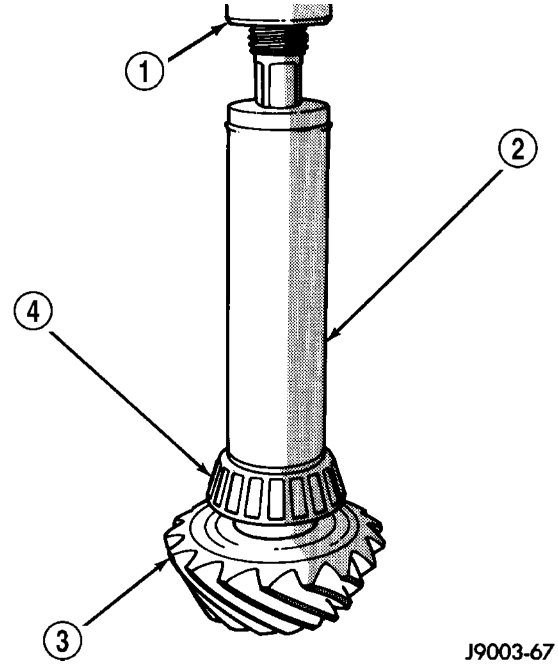


Fig. 58 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - PINION GEAR
4 - REAR PINION BEARING

(5) Install **new** collapsible spacer (Fig. 59).

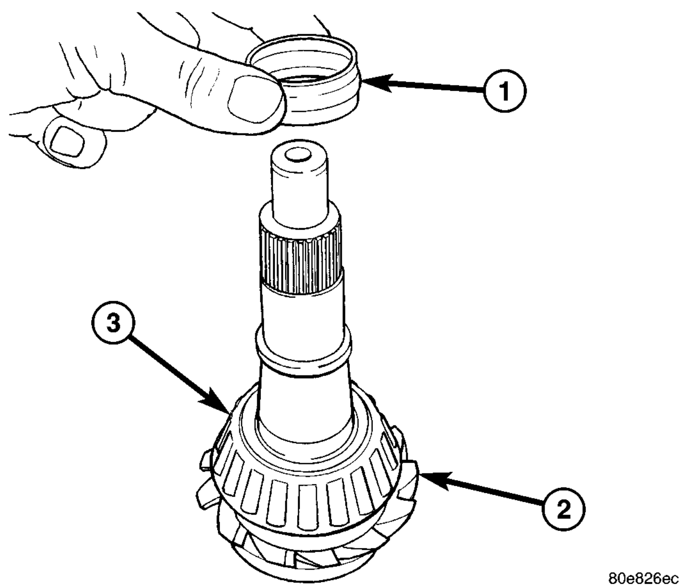


Fig. 59 COLLAPSIBLE SPACER

1 - COLAPSIBLE SPACER
2 - PINION GEAR
3 - REAR PINION BEARING

(6) Lubricate pinion and bearings.

PINION GEAR/RING GEAR/TONE RING (Continued)

(7) Install pinion into the housing and place front pinion bearing onto the pinion shaft. Draw the pinion shaft into the front bearing with Installer 8981 (Fig. 60).

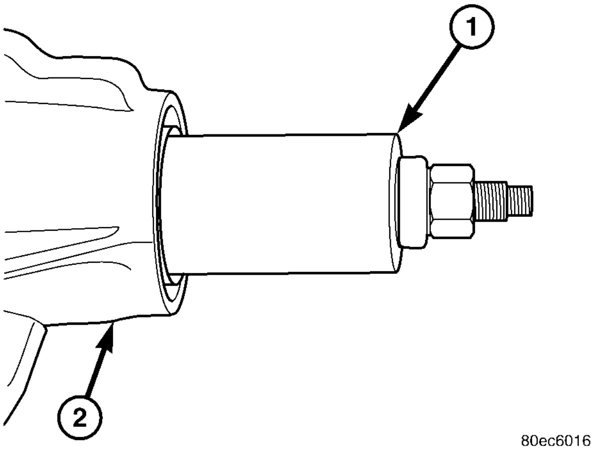


Fig. 60 PINION GEAR INSTALLER

1 - INSTALLER
2 - DIFFERENTIAL HOUSING

(8) Install **new** pinion seal (Fig. 61) with Installer 8896 and Handle C-4171.

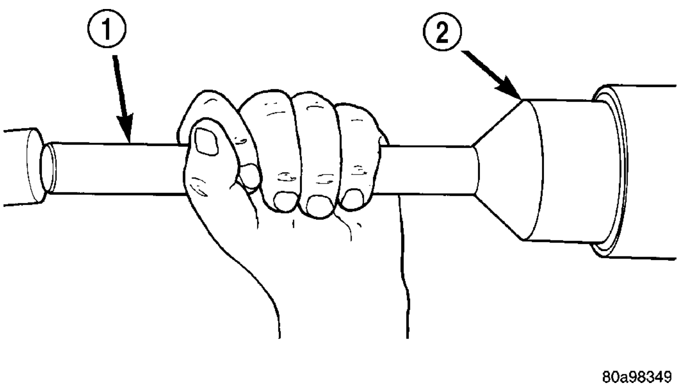


Fig. 61 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(9) Apply a light coat of teflon sealant to the pinion flange splines.

(10) Hold the pinion and lightly tap the pinion flange onto the pinion, until a few threads are showing.

(11) Install pinion flange washer and **new** pinion nut.

(12) Hold pinion flange with Flange Wrench 8979 (Fig. 62) and tighten pinion nut until pinion end play is taken up.

(13) Rotate pinion several times to seat bearings.

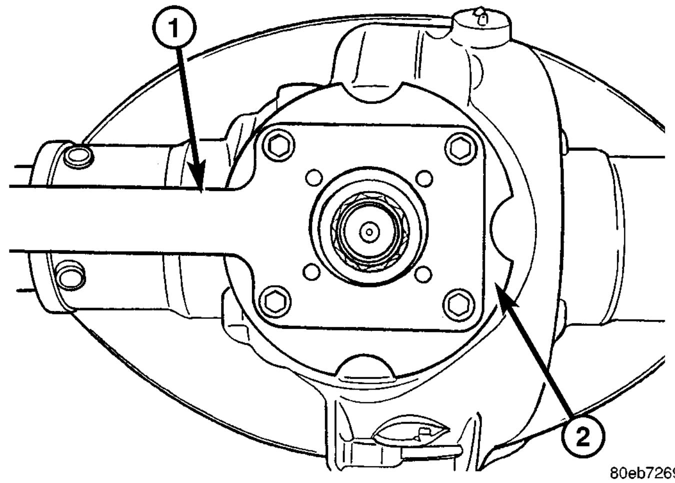


Fig. 62 FLANGE WRENCH

1 - FLANGE WRENCH
2 - PINION FLANGE

(14) Measure pinion rotating torque with an inch pound torque wrench (Fig. 63). Tighten pinion nut in small increments until pinion rotating torque is:

- **New Pinion Bearings:** 1.7-2.8 N·m (15-25 in. lbs.)
- **Original Pinion Bearings:** 1.1-2.2 N·m (10-20 in. lbs.)

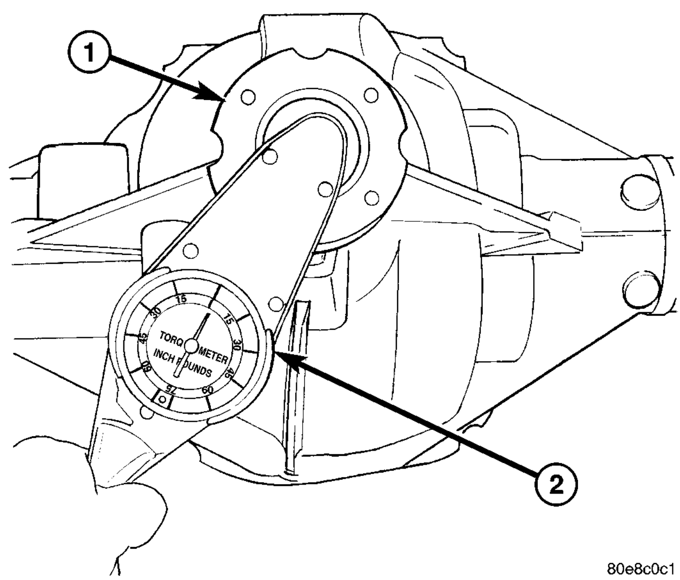


Fig. 63 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(15) Rotate pinion several times then verify pinion rotating torque again.

(16) Position the ring gear on differential case and start two **new** ring gear bolts.

(17) Install the rest of the **new** ring gear bolts and tighten them alternately to seat the ring gear.

PINION GEAR/RING GEAR/TONE RING (Continued)

(18) Torque ring gear bolts to 237 N·m (175 ft. lbs.).

(19) If exciter ring was removed, position differential assembly on differential Plug 8888 (Fig. 64) and place exciter ring on the differential case.

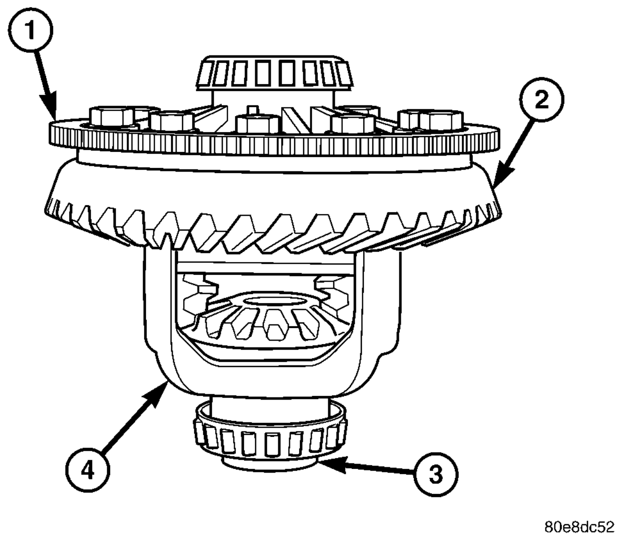


Fig. 64 EXCITER RING

1 - EXCITER RING
2 - RING GEAR
3 - DIFFERENTIAL PLUG
4 - DIFFERENTIAL CASE

(20) Install the exciter ring on the differential case evenly with a hammer and brass punch (Fig. 65). Drive the ring down until it is seated against the ring gear.

CAUTION: Do not damage exciter ring teeth during installation.

(21) Install differential into the housing.

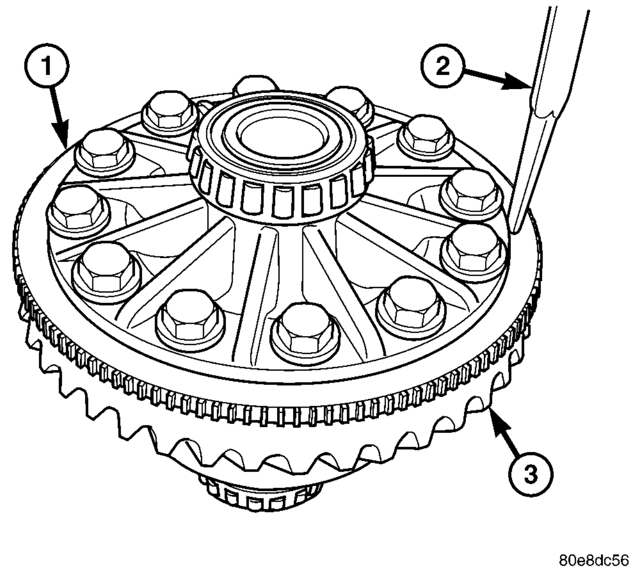


Fig. 65 EXCITER RING INSTALLATION

1 - EXCITER RING
2 - PUNSH
3 - RING GEAR

(22) Verify ring gear backlash and gear contact pattern.

(23) Measure final rotating torque with an inch pound torque wrench. The final pinion rotating torque plus differential case bearing preload is:

- **New Bearings:** 3.4-5.6 N·m (30-50 in. lbs.)
- **Original Bearings:** 2.8-5.1 N·m (25-45 in. lbs.)

(24) Install axle shafts.

(25) Install the propeller shaft with the reference marks aligned.

(26) Install differential cover with gasket and tighten bolts to 40 N·m (30 ft. lbs.).

(27) Fill differential with fluid and tighten fill plug to 32 N·m (24 ft. lbs.).

REAR AXLE - 11 1/2 AA

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REAR AXLE - 11 1/2 AA

DESCRIPTION

The axle consists of a cast iron center casting differential housing with axle shaft tubes extending from each side. The tubes are pressed into the differential housing and welded. The design has the centerline of the pinion set below the centerline of the ring gear. The axle is a full floating axle where the loads are supported by the axle housing tubes. The axle has a vent used to relieve internal pressure caused by lubricant vaporization and internal expansion.

OPERATION

The axle receives power from the propeller shaft. The propeller shaft is connected to the pinion gear which rotates the differential through the gear mesh with the ring gear bolted to the differential case. The engine power is transmitted to the axle shafts through the pinion mate and side gears. The side gears are splined to the axle shafts.

DIAGNOSIS AND TESTING

GEAR NOISE

Axle gear noise can be caused by insufficient lubricant, incorrect backlash, incorrect pinion depth, tooth contact, worn/damaged gears, or the carrier housing not having the proper offset and squareness.

Gear noise usually happens at a specific speed range. The noise can also occur during a specific type of driving condition. These conditions are acceleration, deceleration, coast, or constant load.

When road testing, first warm-up the axle fluid by driving the vehicle at least 5 miles and then accelerate the vehicle to the speed range where the noise is the greatest. Shift out-of-gear and coast through the peak-noise range. If the noise stops or changes greatly:

- Check for insufficient lubricant.
- Incorrect ring gear backlash.
- Gear damage.

Differential side gears and pinions can be checked by turning the vehicle. They usually do not cause noise during straight-ahead driving when the gears are unloaded. The side gears are loaded during vehicle turns. A worn pinion shaft can also cause a snapping or a knocking noise.

REAR AXLE - 11 1/2 AA (Continued)

BEARING NOISE

The axle shaft, differential and pinion bearings can all produce noise when worn or damaged. Bearing noise can be either a whining, or a growling sound.

Pinion bearings have a constant-pitch noise. This noise changes only with vehicle speed. Pinion bearing noise will be higher pitched because it rotates at a faster rate. Drive the vehicle and load the differential. If bearing noise occurs, the rear pinion bearing is the source of the noise. If the bearing noise is heard during a coast, the front pinion bearing is the source.

Worn or damaged differential bearings usually produce a low pitch noise. Differential bearing noise is similar to pinion bearing noise. The pitch of differential bearing noise is also constant and varies only with vehicle speed.

Axle shaft bearings produce noise and vibration when worn or damaged. The noise generally changes when the bearings are loaded. Road test the vehicle. Turn the vehicle sharply to the left and to the right. This will load the bearings and change the noise level. Where axle bearing damage is slight, the noise is usually not noticeable at speeds above 30 mph.

LOW SPEED KNOCK

Low speed knock is generally caused by a worn U-joint or by worn side–gear thrust washers. A worn pinion shaft bore will also cause low speed knock.

VIBRATION

Vibration at the rear of the vehicle is usually caused by a:

- Damaged drive shaft.
- Missing drive shaft balance weight(s).
- Worn or out-of-balance wheels.
- Loose wheel lug nuts.
- Worn U-joint(s).
- Loose/broken springs.
- Damaged axle shaft bearing(s).
- Loose pinion gear nut.
- Excessive pinion yoke run out.
- Bent axle shaft(s).

Check for loose or damaged front-end components or engine/transmission mounts. These components can contribute to what appears to be a rearend vibration. Do not overlook engine accessories, brackets and drive belts.

NOTE: All driveline components should be examined before starting any repair.

DRIVELINE SNAP

A snap or clunk noise when the vehicle is shifted into gear (or the clutch engaged), can be caused by:

- High engine idle speed.
- Transmission shift operation.
- Loose engine/transmission/transfer case mounts.
- Worn U-joints.
- Loose spring mounts.
- Loose pinion gear nut and yoke.
- Excessive ring gear backlash.
- Excessive side gear to case clearance.

The source of a snap or a clunk noise can be determined with the assistance of a helper. Raise the vehicle on a hoist with the wheels free to rotate. Instruct the helper to shift the transmission into gear. Listen for the noise, a mechanics stethoscope is helpful in isolating the source of a noise.

DIAGNOSTIC CHART

Condition	Possible Causes	Correction
Wheel Noise	1. Wheel loose. 2. Faulty, brinelled wheel bearing.	1. Tighten loose nuts. 2. Replace bearing.
Axle Shaft Noise	1. Misaligned axle tube. 2. Bent or sprung axle shaft.	1. Inspect axle tube alignment. Correct as necessary. 2. Inspect and correct as necessary.

REAR AXLE - 11 1/2 AA (Continued)

Condition	Possible Causes	Correction
Axle Shaft Broke	1. Misaligned axle tube.	1. Replace the broken shaft after correcting tube mis-alignment.
	2 Vehicle overloaded.	2. Replace broken shaft and avoid excessive weight on vehicle.
	3. Erratic clutch operation.	3. Replace broken shaft and avoid or correct erratic clutch operation.
	4. Grabbing clutch.	4. Replace broken shaft and inspect and repair clutch as necessary.
Differential Cracked	1. Improper adjustment of the differential bearings.	1. Replace case and inspect gears and bearings for further damage. Set differential bearing pre-load properly.
	2. Excessive ring gear backlash.	2. Replace case and inspect gears and bearings for further damage. Set ring gear backlash properly.
	3. Vehicle overloaded.	3. Replace case and inspect gears and bearings for further damage. Avoid excessive vehicle weight.
	4. Erratic clutch operation.	4. Replace case and inspect gears and bearings for further damage. Avoid erratic use of clutch.
Differential Gears Scored	1. Insufficient lubrication.	1. Replace scored gears. Fill differential with the correct fluid type and quantity.
	2. Improper grade of lubricant.	2. Replace scored gears. Fill differential with the correct fluid type and quantity.
	3. Excessive spinning of one wheel/tire.	3. Replace scored gears. Inspect all gears, pinion bores, and shaft for damage. Service as necessary.
Loss Of Lubricant	1. Lubricant level too high.	1. Drain lubricant to the correct level.
	2. Worn axle shaft seals.	2. Replace seals.
	3. Cracked differential housing.	3. Repair as necessary.
	4. Worn pinion seal.	4. Replace seal.
	5. Worn/scored yoke.	5. Replace yoke and seal.
	6. Axle cover not properly sealed.	6. Remove, clean, and re-seal cover.
Axle Overheating	1. Lubricant level low.	1. Fill differential to correct level.
	2. Improper grade of lubricant.	2. Fill differential with the correct fluid type and quantity.
	3. Bearing pre-loads too high.	3. Re-adjust bearing pre-loads.
	4. Insufficient ring gear backlash.	4. Re-adjust ring gear backlash.

REAR AXLE - 11 1/2 AA (Continued)

Condition	Possible Causes	Correction
Gear Teeth Broke	1. Overloading.	1. Replace gears. Examine other gears and bearings for possible damage.
	2. Erratic clutch operation.	2. Replace gears and examine the remaining parts for damage. Avoid erratic clutch operation.
	3. Ice-spotted pavement.	3. Replace gears and examine remaining parts for damage.
	4. Improper adjustments.	4. Replace gears and examine remaining parts for damage. Ensure ring gear backlash is correct.
Axle Noise	1. Insufficient lubricant.	1. Fill differential with the correct fluid type and quantity.
	2. Improper ring gear and pinion adjustment.	2. Check ring gear and pinion contact pattern. Adjust backlash or pinion depth.
	3. Unmatched ring gear and pinion.	3. Replace gears with a matched ring gear and pinion.
	4. Worn teeth on ring gear and/or pinion.	4. Replace ring gear and pinion.
	5. Loose pinion bearings.	5. Adjust pinion bearing pre-load.
	6. Loose differential bearings.	6. Adjust differential bearing pre-load.
	7. Mis-aligned or sprung ring gear.	7. Measure ring gear run-out. Replace components as necessary.
	8. Loose differential bearing cap bolts.	8. Inspect differential components and replace as necessary. Ensure that the bearing caps are torqued tot he proper specification.
	9. Housing not machined properly.	9. Replace housing.

REMOVAL

(1) Raise and support the vehicle.
(2) Position a lifting device under the axle.
(3) Secure axle to device.
(4) Remove wheels and tires assemblies.
(5) Remove RWAL sensor from the differential housing.
(6) Remove brake hose at the axle junction block and axle vent hose.
(7) Disconnect parking brake cables and cable brackets.
(8) Remove brake calipers.
(9) Mark propeller shaft and companion flange for installation alignment reference.
(10) Remove propeller shaft.
(11) Remove shock absorbers from axle.
(12) Remove U-bolets from axle.
(13) Separate the axle from the vehicle.

INSTALLATION

(1) Raise axle with lifting device and align to the leaf spring centering bolts.
(2) Install axle U-bolts and tighten to 149 N·m (110 ft. lbs.).
(3) Install shock absorbers to axle and tighten to specification.
(4) Install the RWAL sensor to the differential housing.
(5) Connect the parking brake cables and cable brackets.
(6) Connect brake hose to the axle junction block and axle vent hose.
(7) Align propeller shaft and pinion companion flange reference marks and tighten companion flange bolts to 115 N·m (85 ft. lbs.).
(8) Install the wheels and tires.
(9) Fill differential to specifications.

REAR AXLE - 11 1/2 AA (Continued)

(10) Remove lifting device from axle and lower the vehicle.

ADJUSTMENTS

Ring and pinion gears are supplied as matched sets only. Compensation for pinion depth variance is achieved with a select shim. The shim is located between the rear pinion bearing and the pinion gear head.

PINION DEPTH MEASUREMENT AND ADJUSTMENT

Measurements are taken with pinion bearing cups and pinion bearings installed in the housing. Take measurements with Pinion Gauge Set and Dial Indicator C-3339 (Fig. 1).

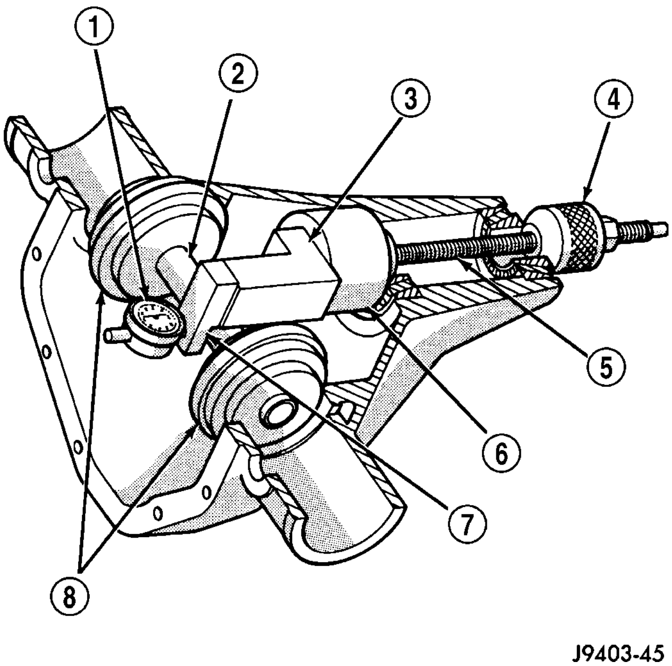


Fig. 1 PINION GEAR DEPTH GAUGE TOOLS

1 - DIAL INDICATOR
2 - ARBOR
3 - PINION HEIGHT BLOCK
4 - CONE
5 - SCREW
6 - PINION BLOCK
7 - SCOOTER BLOCK
8 - ARBOR DISC

(1) Assemble Pinion Height Block 6739, Pinion Block 8897 and rear pinion bearing onto Screw 6741 (Fig. 1).

(2) Insert assembled height gauge components, rear bearing and screw into the housing through pinion bearing cups (Fig. 2).

(3) Install front pinion bearing and install the Cone-nut 6740 hand tight. Then check tool rotating torque with an inch pound torque wrench. The rotating torque should be 1.7-2.26 N·m (15-20 in. lbs.). (Fig. 1).

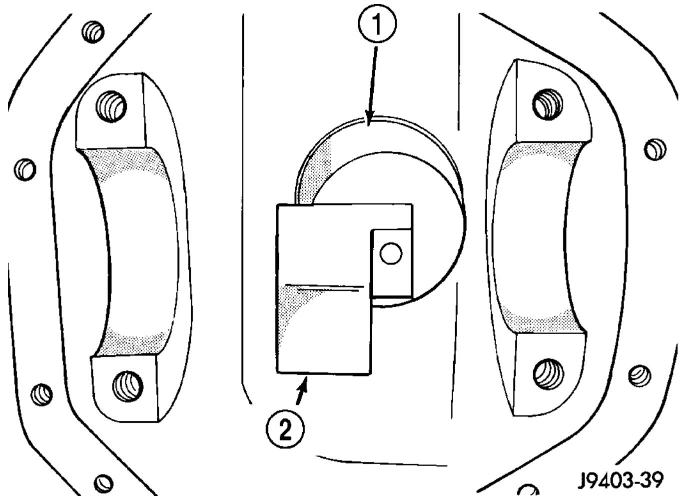


Fig. 2 PINION HEIGHT BLOCK

1 - PINION BLOCK
2 - PINION HEIGHT BLOCK

(4) Place Arbor Discs 8289 on Arbor D-115-3 in position in the housing side bearing cradles (Fig. 3).

(5) Install differential bearing caps on arbor discs and snug the bearing cap bolts. Then cross tighten cap bolts to 281 N·m (207 ft. lbs.).

NOTE: Arbor should rotate freely in the arbor discs.

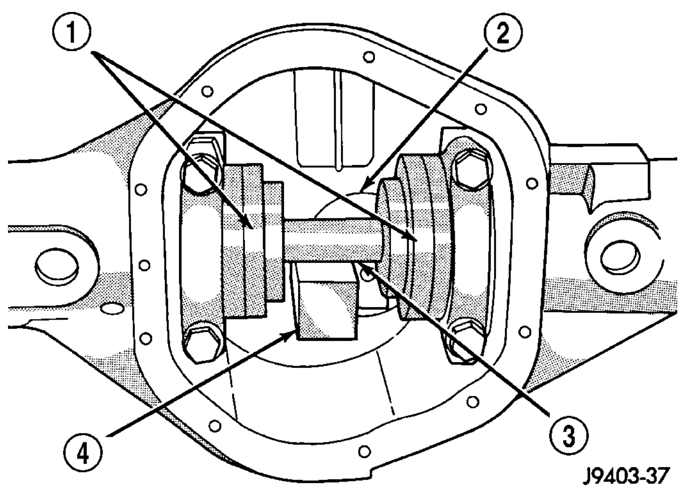


Fig. 3 GAUGE TOOLS IN HOUSING

1 - ARBOR DISC
2 - PINION BLOCK
3 - ARBOR
4 - PINION HEIGHT BLOCK

(6) Assemble Dial Indicator C-3339 into Scooter Block D-115-2 and secure set screw.

(7) Position Scooter Block/Dial Indicator flush on the pinion height block. Hold scooter block and zero the dial indicator.

REAR AXLE - 11 1/2 AA (Continued)

(8) Slowly slide the scooter block across the pinion height block over to the arbor (Fig. 4). Move the scooter block till dial indicator crests the arbor, then record the highest reading.

(9) Select a shim equal to the dial indicator reading.

(10) Install the select shim between the rear pinion bearing and the pinion gear head.

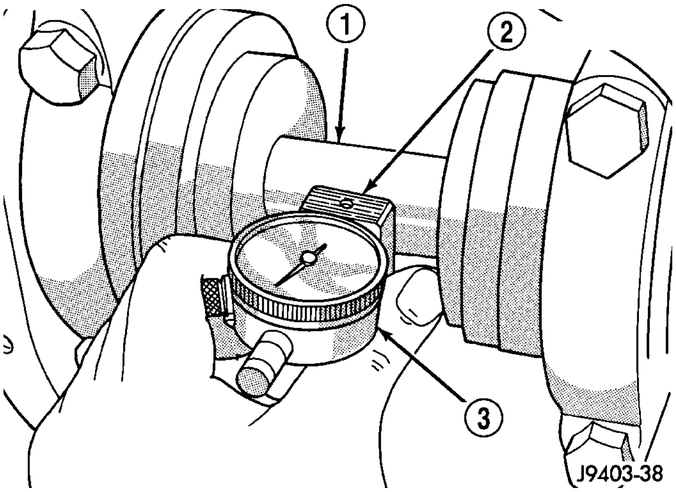


Fig. 4 PINION GEAR DEPTH MEASUREMENT

1 - ARBOR
2 - SCOOTER BLOCK
3 - DIAL INDICATOR

DIFFERENTIAL CASE BEARING PRELOAD AND GEAR BACKLASH

Backlash is adjusted by moving the adjusters in and out or both. By moving the adjusters the case/ring gear will move closer or further away from the pinion. In most cases this adjustment can be used to achieve the correct gear tooth pattern and set the case bearing preload.

(1) Remove adjuster lock bolts and adjuster locks (Fig. 5).

(2) Loosen the differential bearing caps.

(3) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(4) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 (Fig. 6) until they make contact with the differential bearings/cups.

(5) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

(6) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(7) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(8) Rotate the pinion several times to seat the deferential bearings.

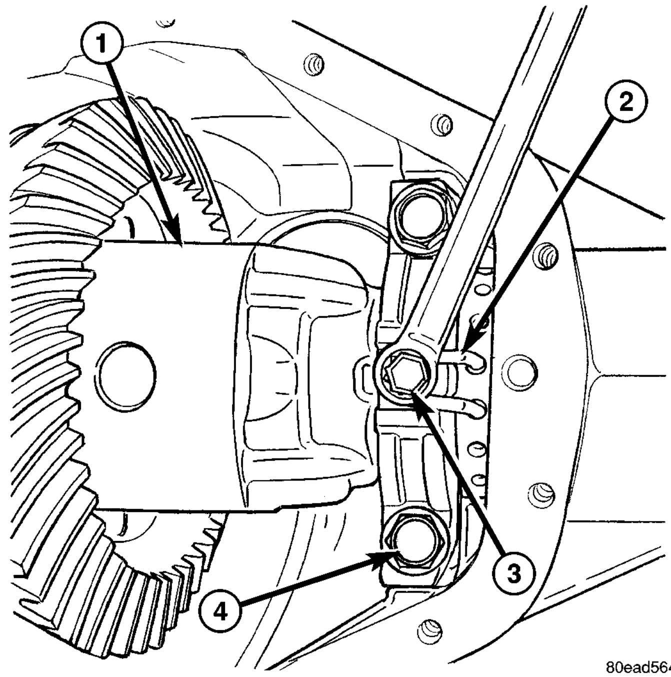


Fig. 5 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

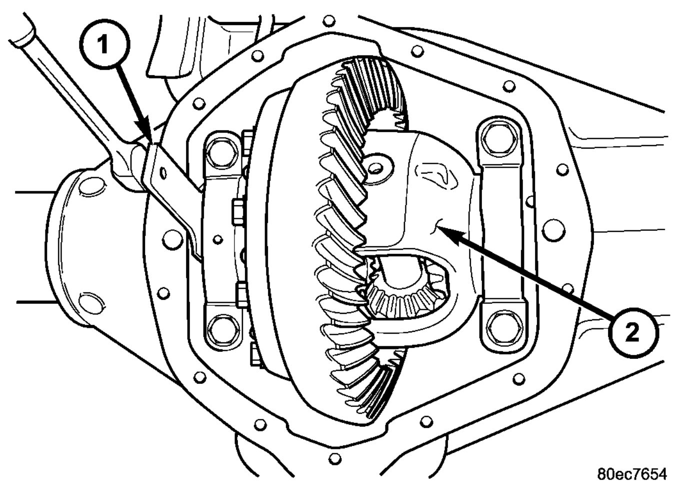


Fig. 6 ADJUSTER SPANNER WRENCH

1 - WRENCH
2 - DIFFERENTIAL

(9) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup, then tighten it until it makes contact.

(10) Tighten pinion gear side adjuster an additional:

- **New Bearings:** 6 Adjuster Holes
- **Original Bearings:** 4 Adjuster Holes

(11) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

REAR AXLE - 11 1/2 AA (Continued)

(12) Tighten bearing cap bolts to 115 N·m (85 ft. lbs.).

(13) Tighten adjuster lock bolts to 33 N·m (24 ft. lbs.).

(14) Measure ring gear backlash with a Dial Indicator C-3339 and Dial Indicator Stud L-4438 at eight points around the drive side of the ring gear (Fig. 7). The backlash should be 0.08-0.25 mm (0.003-0.010 in) with a preferred backlash of 0.13-0.18 mm (0.005-0.007 in).

NOTE: Backlash measurement should not vary more than 0.05 mm (0.002 in) between measuring points. If measurement does vary inspect the gears for burrs, the differential case flange and ring gear mounting.

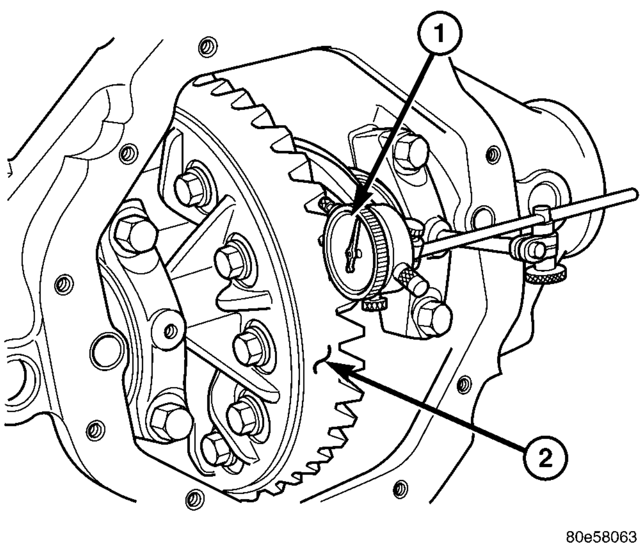


Fig. 7 RING GEAR BACKLASH

1 - DIAL INDICATOR
2 - RING GEAR

GEAR TOOTH CONTACT PATTERN

Gear tooth contact pattern is used to verify the correct running position of the ring and pinion gears. This will produce low noise and long gear life. Gears which are not positioned properly may be noisy and have shorten gear life.

(1) Wipe clean each tooth of the ring gear.

(2) Apply gear marking compound to all of the ring gear teeth.

(3) Verify bearing cap bolts are torque specification.

(4) Apply parking brakes lightly to create at 14 N·m (10 ft. lbs.) pinion rotating torque.

(5) Rotate the pinion/pinion yoke 4 full revolutions in each directions.

(6) Read gear tooth contact pattern:

• Gear contact pattern correct (Fig. 8). Backlash and pinion depth is correct.

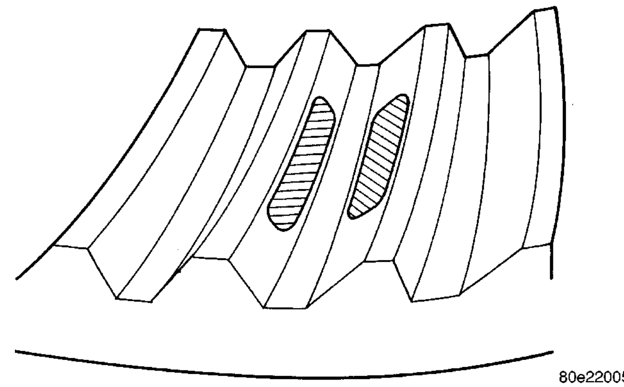


Fig. 8 CORRECT CONTACT PATTERN

• Ring gear too far away from pinion gear (Fig. 9). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

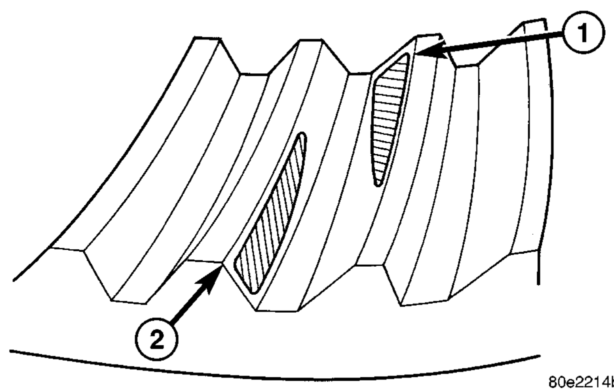


Fig. 9 INCORRECT BACKLASH

1 - COAST SIDE TOE
2 - DRIVE SIDE HEEL

• Ring gear too close to pinion gear (Fig. 10). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

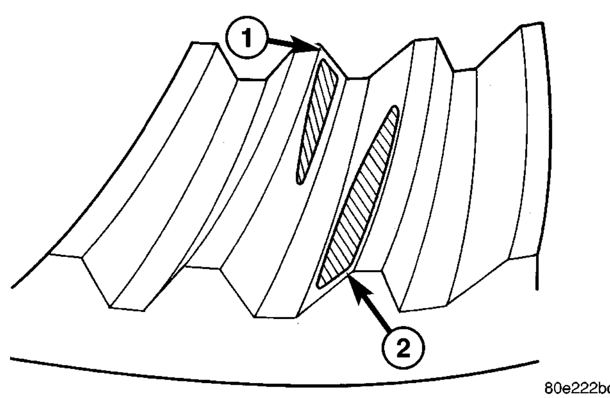


Fig. 10 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE HEEL

REAR AXLE - 11 1/2 AA (Continued)

• Ring gear too far away from pinion gear (Fig. 11). Decrease backlash, by moving the ring closer to the pinion gear using the adjusters.

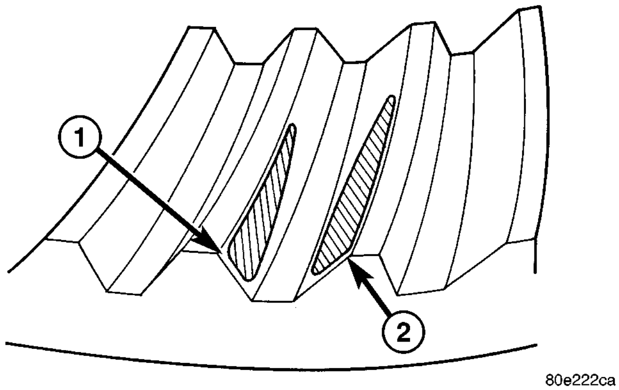


Fig. 11 INCORRECT BACKLASH

1 - DRIVE SIDE HEEL
2 - COAST SIDE HEEL

• Ring gear too close to pinion gear (Fig. 12). Increase backlash, by moving the ring away from the pinion gear using the adjusters.

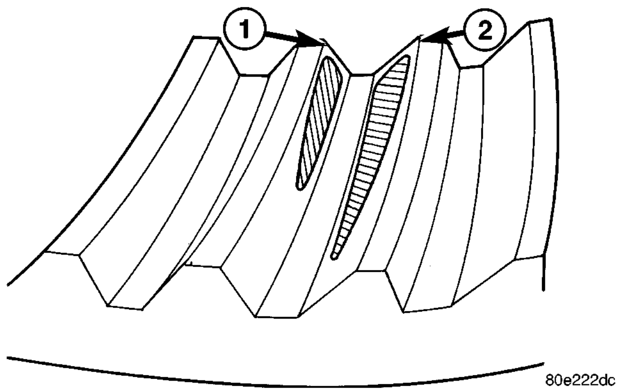


Fig. 12 INCORRECT BACKLASH

1 - DRIVE SIDE TOE
2 - COAST SIDE TOE

• Pinion gear is set too low (Fig. 13). Increase pinion gear height, by increasing the pinion depth shim thickness.

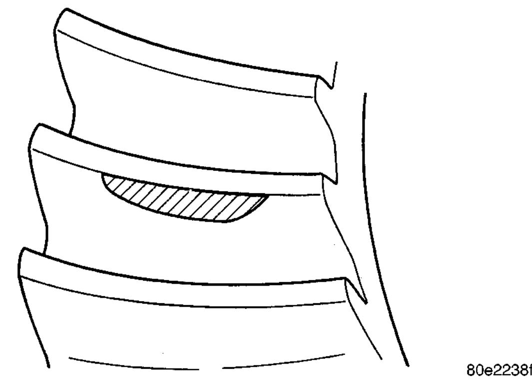


Fig. 13 LOW PINION HEIGHT

• Pinion gear is set too high (Fig. 14). Decrease pinion depth, by decreasing the pinion depth shim thickness.

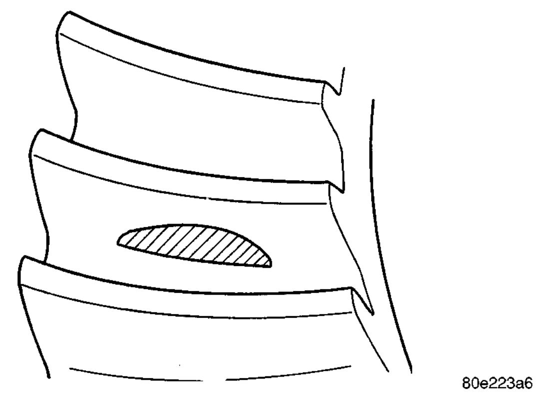


Fig. 14 HIGH PINION HEIGHT

REAR AXLE - 11 1/2 AA (Continued)

SPECIFICATIONS

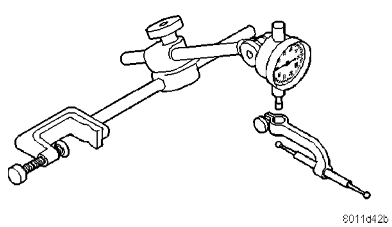
AXLE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Axle Ratio	3.73, 4.10
Ring Gear Diameter	292 mm (11.5 in.)
Ring Gear Backlash	0.13-0.18 mm (0.005-0.007 in.)
Pinion Bearing Preload - New Bearings	1.69-2.82 N·m (15-25 in. lbs.)
Pinion Bearing Preload - Original Bearings	1-2 N·m (10-20 in. lbs.)
Pinion Bearing Preload + Differential Case Bearing Preload - New Bearing	3.4-5.6 N·m (30-50 in. lbs.)
Pinion Bearing Preload + Differential Case Bearing Preload - Original Bearing	2.8-5.1 N·m (25-45 in. lbs.)

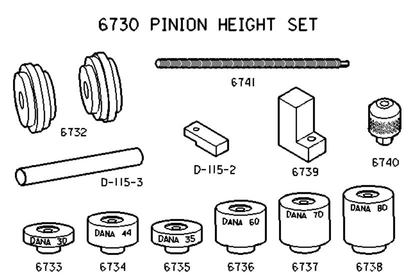
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fill Hole Plug	32	24	-
Differential Cover Bolts	40	30	-
Bearing Cap Bolts	281	207	-
Ring Gear Bolts	237	175	-
Axle Flange Bolts	129	95	-
Adjuster Lock Bolt	25	18	-

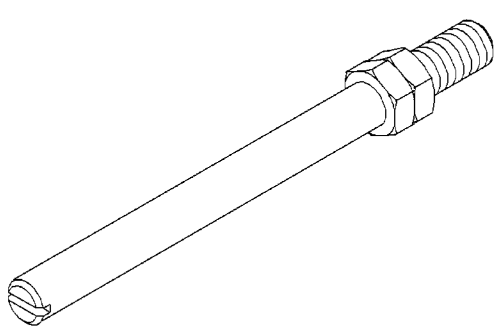
SPECIAL TOOLS



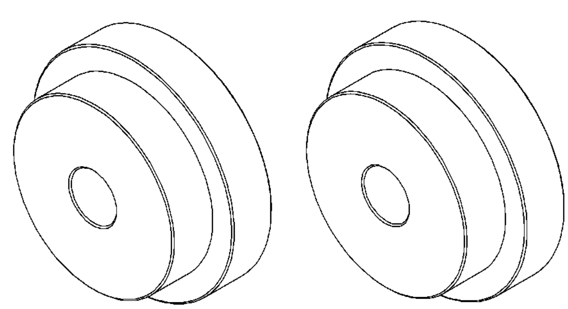
DIAL INDICATOR SET C-3339



PINION DEPTH GAUGE 6730

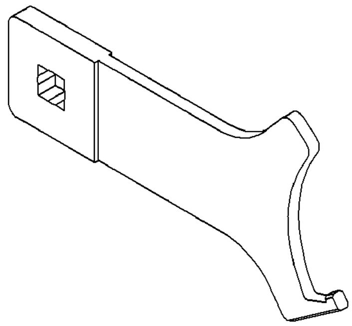


DIAL INDICATOR STUD L-4438

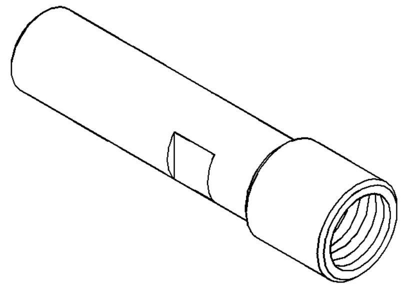


ARBOR DISCS 8289

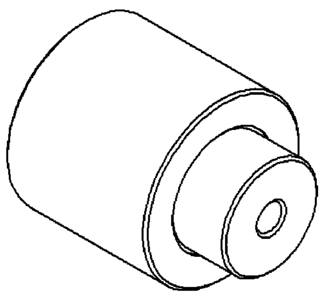
REAR AXLE - 11 1/2 AA (Continued)



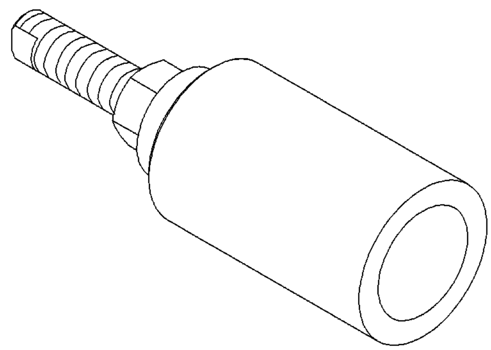
ADJUSTER WRENCH 8883



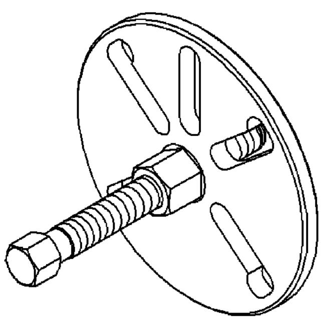
PINION DRIVER 8977



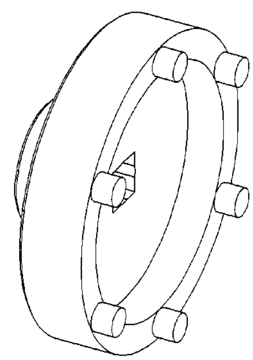
PINION BLOCK 8897



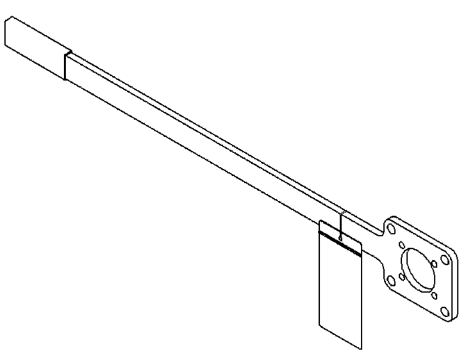
PINION INSTALLER 8981



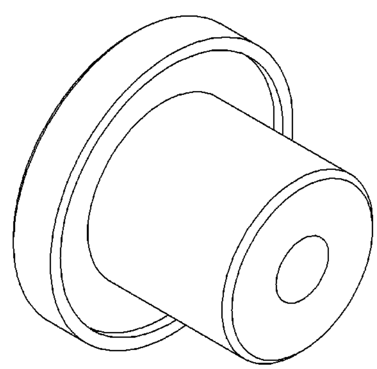
FLANGE PULLER 8992



SOCKET 8954

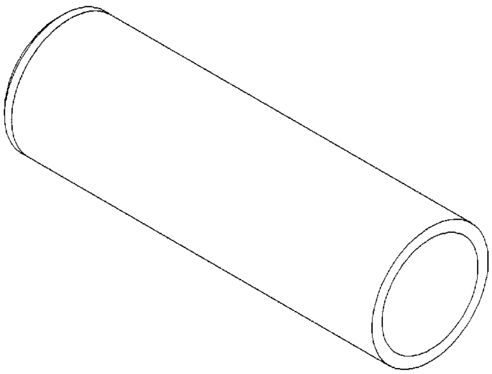


FLANGE WRENCH 8979

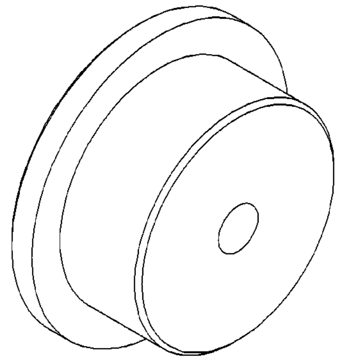


BEARING INSTALLER 8965

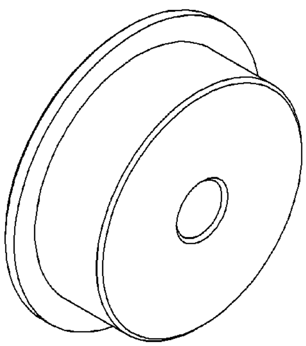
REAR AXLE - 11 1/2 AA (Continued)



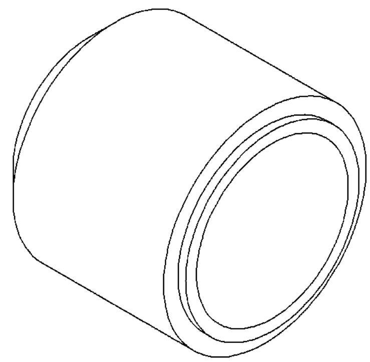
BEARING INSTALLER D-389



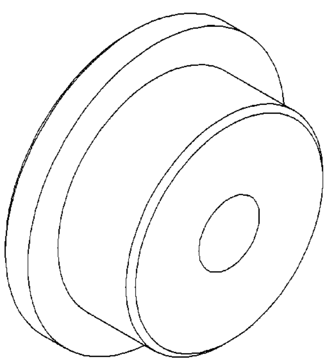
CUP INSTALLER 8968



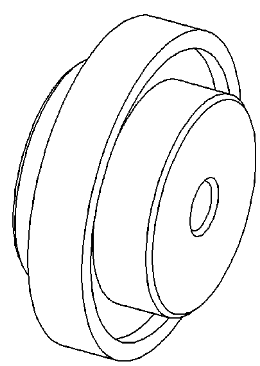
CUP INSTALLER 8153



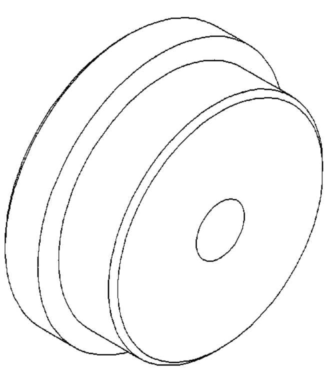
SEAL INSTALLER 8896



CUP INSTALLER 8960

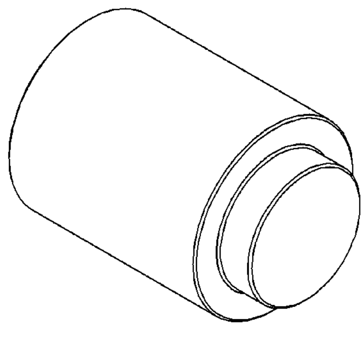


SEAL INSTALLER 8963

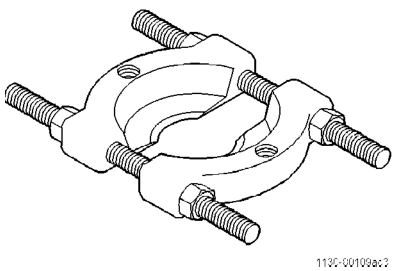


CUP INSTALLER 8961

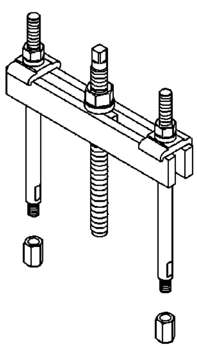
REAR AXLE - 11 1/2 AA (Continued)



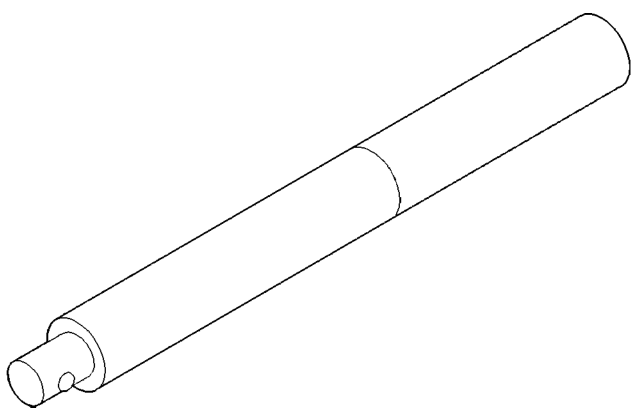
PLUG 8964



SPLITTER 1130



BRIDGE 938



HANDLE C-4171

AXLE SHAFTS

REMOVAL

(1) Remove axle shaft flange bolts (Fig. 15).

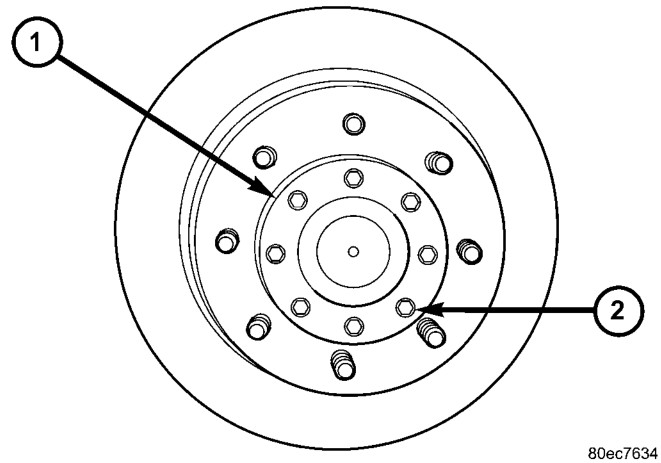


Fig. 15 AXLE FLANGE BOLTS

1 - AXLE FLANGE
2 - FLANGE BOLT

(2) Slide axle shaft out of the axle tube.
(3) Remove axle shaft gasket.

INSTALLATION

NOTE: Axle flange bolts must be replaced or use Mopar Lock N' Seal or Loctite® 242 on cleaned existing bolts.

(1) Clean axle flange and hub.
(2) Install new axle shaft gasket.
(3) Slide axle shaft into the axle tube.
(4) Install axle shaft flange bolts and tighten to 129 N·m (95 ft. lbs.).

AXLE BEARINGS

REMOVAL

(1) Remove axle shaft flange bolts and remove shaft.
(2) Remove retianer ring (Fig. 16) from the axle shaft tube.
(3) Remove hub bearing nut locking key (Fig. 17).
(4) Remove hub bearing nut with Socket 8954.
(5) Remove hub and bearings from the axle.
(6) Pry out hub bearing seal from the back of the hub.

AXLE BEARINGS (Continued)

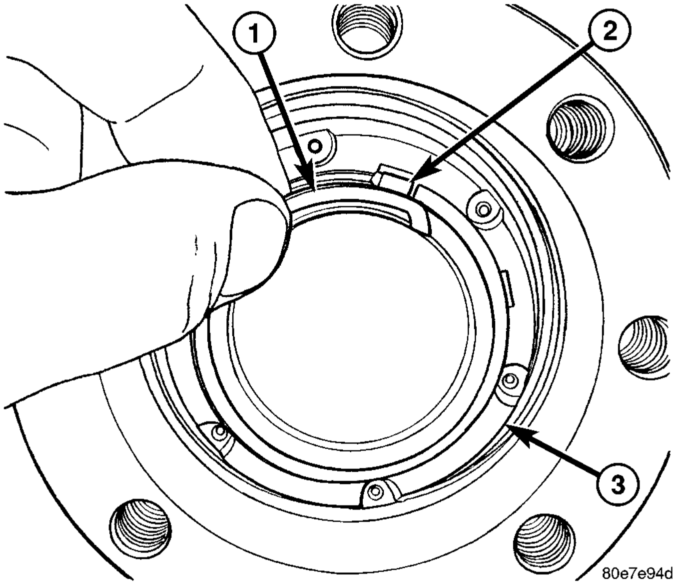


Fig. 16 RETAINER RING

1 - RETAINER RING
2 - LOCKING KEY
3 - BEARING NUT

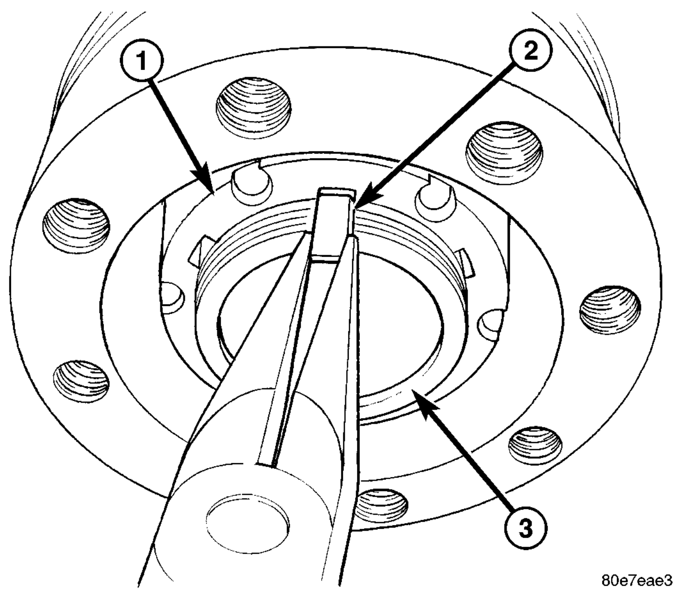


Fig. 17 LOCKING KEY

1 - BEARING NUT
2 - LOCKING KEY
3 - AXLE TUBE

NOTE: The inner part of the seal may stay on the axle tube (Fig. 18). This part must also be removed.

(7) Remove rear bearing.

(8) Remove hub bearing cups with a hammer and drift.

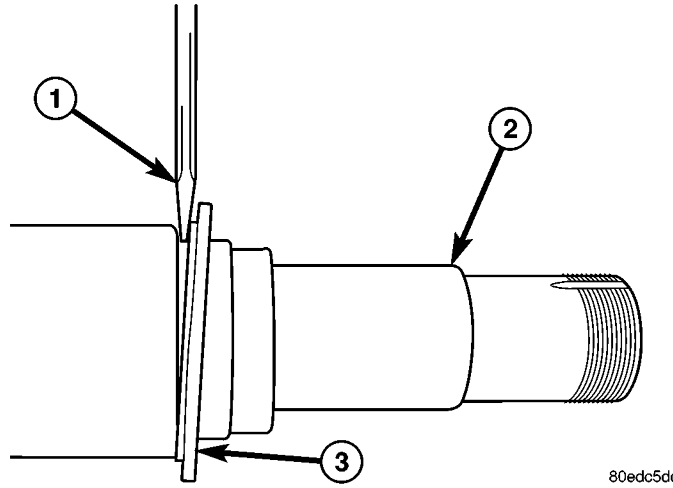


Fig. 18 INNER PART OF SEAL

1 - PRY BAR
2 - AXLE TUBE
3 - REMAINING SEAL

INSTALLATION

(1) Install outer hub bearing cup with Installer 8961 and Handle C-4171.

(2) Install inner hub bearing cup with Installer 8153 and Handle C-4171.

(3) Pack bearings with the appropriate wheel bearing grease.

(4) Install rear bearing and install **new** grease seal with Installer 8963 and Handle C-4171.

(5) Slide hub on the axle tube and install front bearing into the hub.

(6) Install hub bearing nut with Socket 8954 and tighten to 30 N·m (22 ft. lbs.) while rotating the hub (Fig. 19).

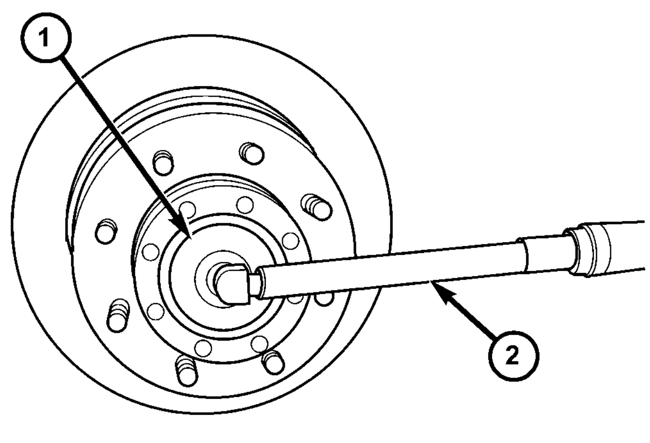


Fig. 19 HUB NUT SOCKET

1 - SOCKET
2 - TORQUE WRENCH

AXLE BEARINGS (Continued)

(7) Back off nut about 30° and align next hub nut key slot with axle tube key slot and install locking key.

NOTE: End play should be 0.025-0.25 mm (0.01-0.001 in.)

(8) Install retainer ring with ring end in the key slot.

(9) Install new axle shaft gasket and install the axle shaft.

PINION SEAL

REMOVAL

(1) Remove axle shafts.

(2) Mark the propeller shaft and pinion flange for installation reference.

(3) Remove propeller shaft.

(4) Rotate pinion gear three or four times.

(5) Measure and record the amount of torque necessary to rotate the pinion gear with an inch pound torque wrench (Fig. 20).

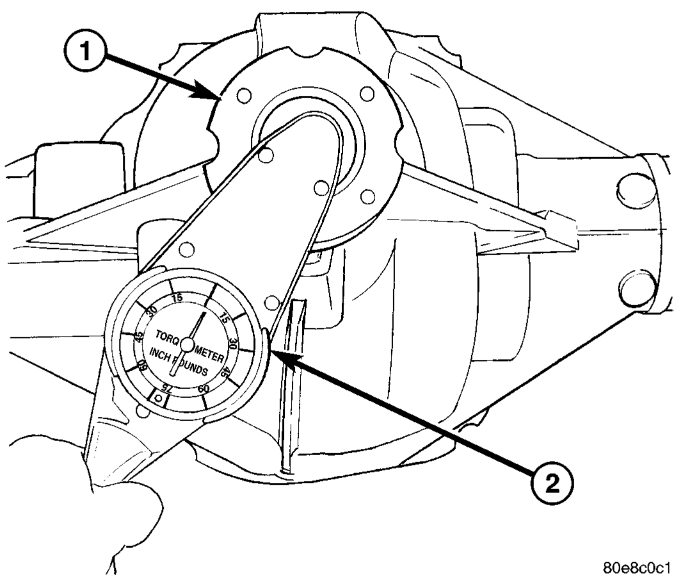


Fig. 20 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(6) Hold pinion flange with Flange Wrench 8979 (Fig. 21) and remove pinion flange nut.

(7) Remove pinion flange with Pinion Flange Puller 8992 (Fig. 22).

(8) Remove pinion shaft seal with a pry tool or slide hammer mounted screw.

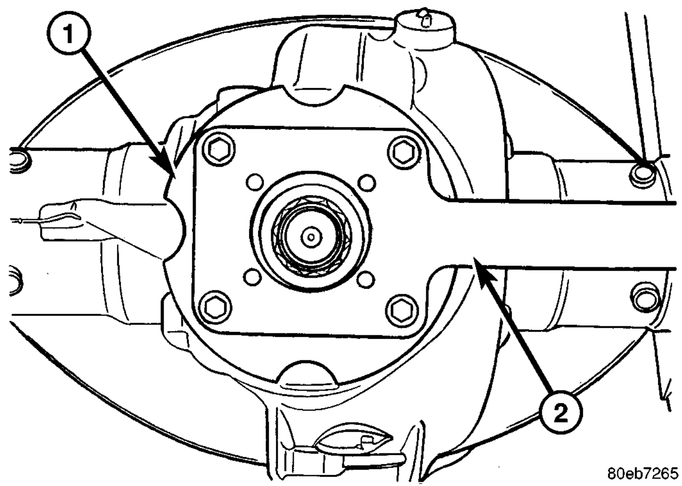


Fig. 21 FLANGE WRENCH

1 - PINION FLANGE
2 - FLANGE WRENCH

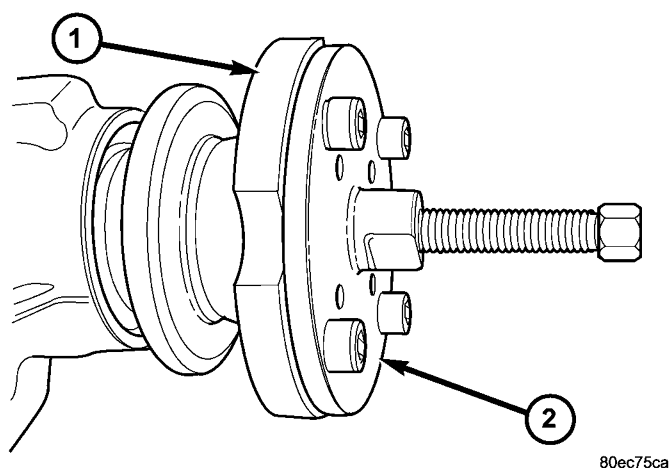


Fig. 22 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

INSTALLATION

(1) Install **new** pinion seal with Installer 8896 (Fig. 23).

(2) Apply a light coat of teflon sealant to the pinion flange splines.

(3) Lightly tap the pinion flange onto the pinion until a few threads are showing.

(4) Install flange washer and **new** pinion nut.

(5) Hold pinion flange with Flange Wrench 8979 (Fig. 24) and tighten pinion nut until pinion end play is taken up.

(6) Rotate pinion several times to seat bearings.

(7) Measure pinion rotating torque with an inch pound torque wrench and compare it to recorded measurement. Tighten pinion nut in small incre-

PINION SEAL (Continued)

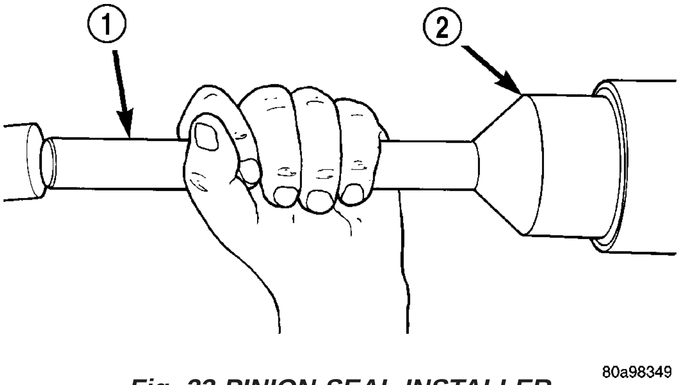


Fig. 23 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

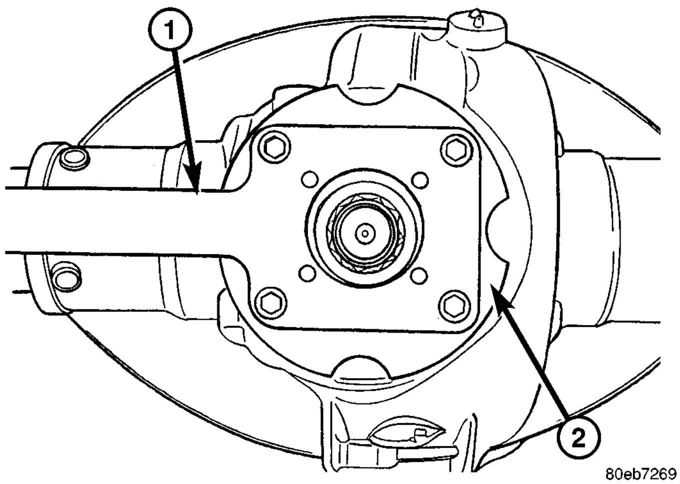


Fig. 24 FLANGE WRENCH

1 - FLANGE WRENCH
2 - PINION FLANGE

ments, until pinion rotating torque is 0.40-0.57 N·m (3-5 in. lbs.) greater than recorded measurement.

(8) Rotate pinion several times then verify pinion rotating torque again.

(9) Install axle shafts.

(10) Install propeller shaft with reference marks aligned.

(11) Check differential fluid level.

DIFFERENTIAL

DESCRIPTION

The differential case is a one-piece design. The differential pinion shaft is retained with a snap ring. Differential bearing preload and ring gear backlash is adjusted by the use of adjusters. The adjuster are between the differential bearings and the differential housing. Pinion bearing preload is set and maintained by the use of a collapsible spacer. The stamped steel cover provides a means for inspection and servicing the differential.

OPERATION

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (Fig. 25).

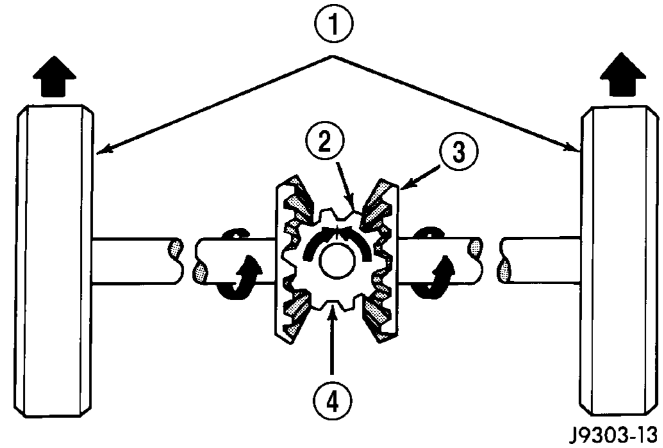


Fig. 25 DIFFERENTIAL-STRAIGHT AHEAD DRIVING

1 - IN STRAIGHT AHEAD DRIVING EACH WHEEL ROTATES AT 100% OF CASE SPEED
2 - PINION GEAR
3 - SIDE GEAR
4 - PINION GEARS ROTATE WITH CASE

When turning corners, the outside wheel must travel a greater distance than the inside wheel to complete a turn. To accomplish this, the differential allows the axle shafts to turn at unequal speeds (Fig. 26). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

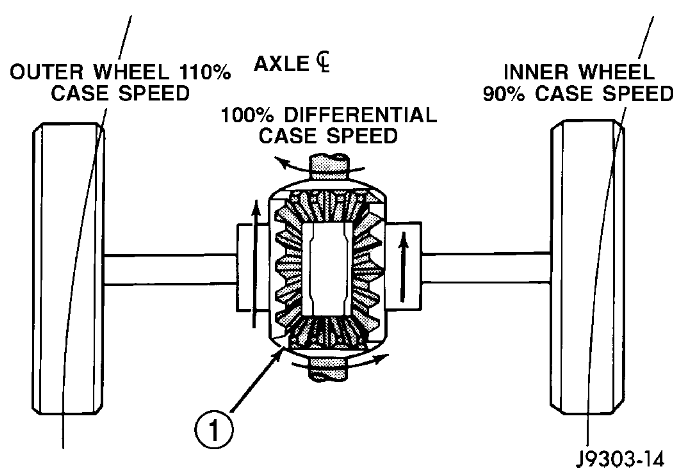


Fig. 26 DIFFERENTIAL-ON TURNS

1 - PINION GEARS ROTATE ON PINION SHAFT

DIFFERENTIAL (Continued)

REMOVAL

(1) Remove fill hole plug from the differential housing cover.

(2) Remove differential housing cover and drain the lubricant.

(3) Remove axle shafts.

(4) Remove adjuster lock bolts and adjuster locks (Fig. 27).

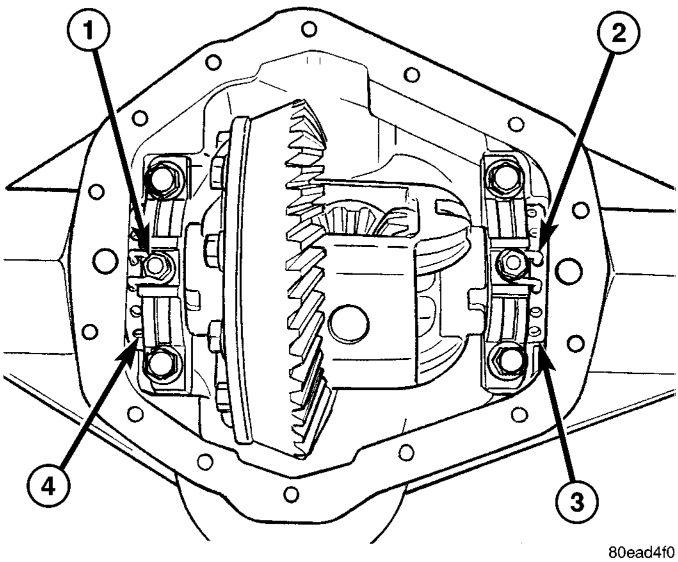


Fig. 27 ADJUSTER LOCKS

1 - LOCK BOLT
2 - ADJUSTER LOCK
3 - ADJUSTER
4 - BEARING CAP

(5) Mark bearing caps left and right for installation reference.

(6) Remove bearing cap bolts and remove bearing caps.

(7) Loosen differential bearing adjusters (Fig. 28) with Spanner Wrench 8883.

(8) Remove differential case from the housing.

(9) Remove bearing cups and tag them left and right for installation reference.

DISASSEMBLY

(1) Remove ring gear.

(2) Remove pinion shaft with a hammer and punch from the side with the hole in the pinion shaft (Fig. 29).

(3) Rotate one pinion gear with thrust washer (Fig. 30) to the differential window and remove the gear.

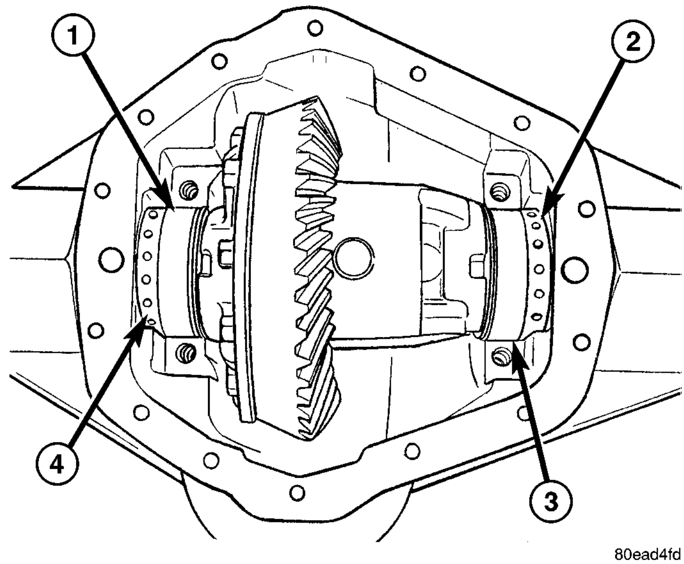


Fig. 28 ADJUSTERS

1 - BEARING CUP
2 - ADJUSTER
3 - BEARING CUP
4 - ADJUSTER

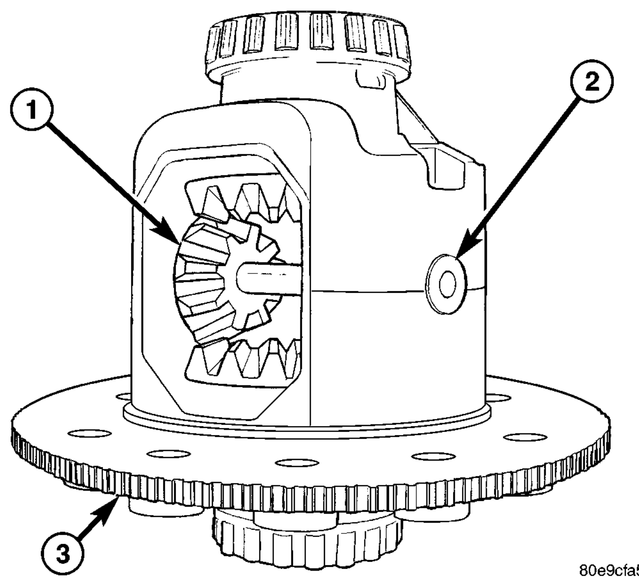


Fig. 29 PINION SHAFT

1 - PINION GEAR
2 - PINION SHAFT
3 - EXCITER RING

DIFFERENTIAL (Continued)

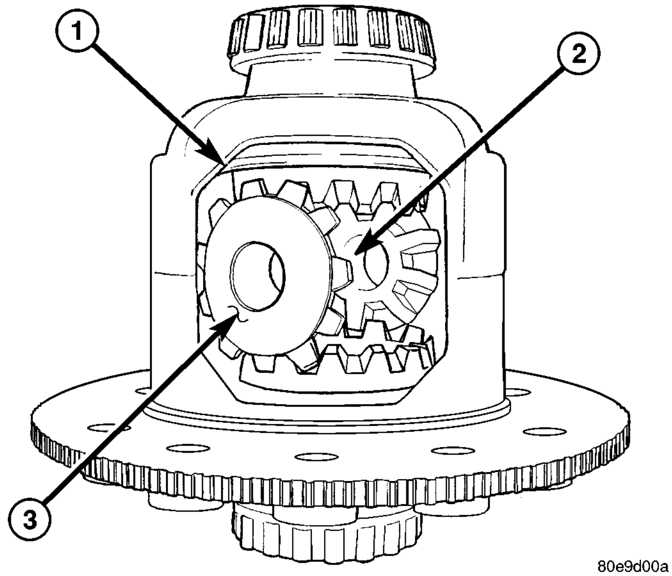


Fig. 30 FIRST PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - PINION GEAR
3 - THRUST WASHER

(4) Rotate the other pinion gear with thrust washer (Fig. 31) to the differential window and remove the gear.

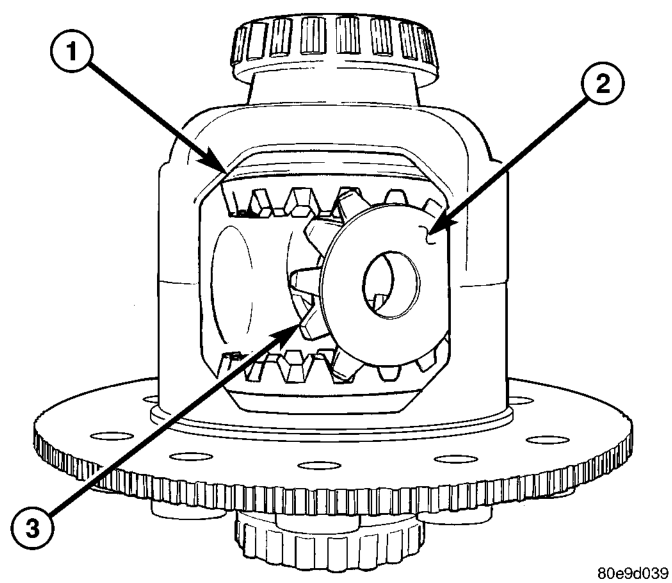


Fig. 31 SECOND PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - THRUST WASHER
3 - PINION GEAR

(5) Remove differential side gears and thrust washers (Fig. 32).

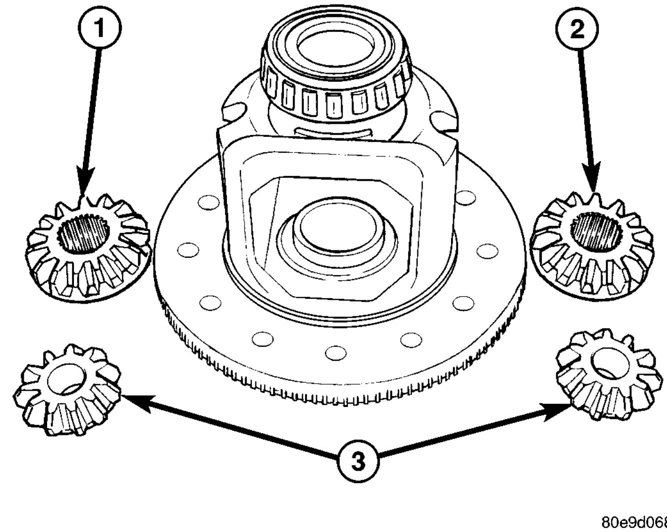


Fig. 32 SIDE GEARS

1 - SIDE GEAR
2 - SIDE GEAR
3 - PINION GEARS

ASSEMBLY

NOTE: If the same gears and thrust washers are being used, install them into their orignial locations.

(1) Lubricate all differential components with axle lubricant.

(2) Install differential side gears and thrust washers (Fig. 33).

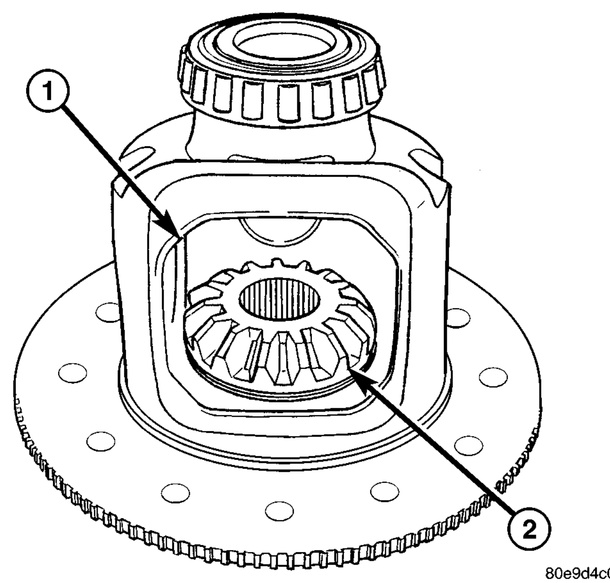


Fig. 33 SIDE GEAR

1 - DIFFERENTIAL WINDOW
2 - SIDE GEAR

DIFFERENTIAL (Continued)

(3) Install first pinion gear into the differential window and side gears. Rotate the pinion gear to the back of the case (Fig. 34).

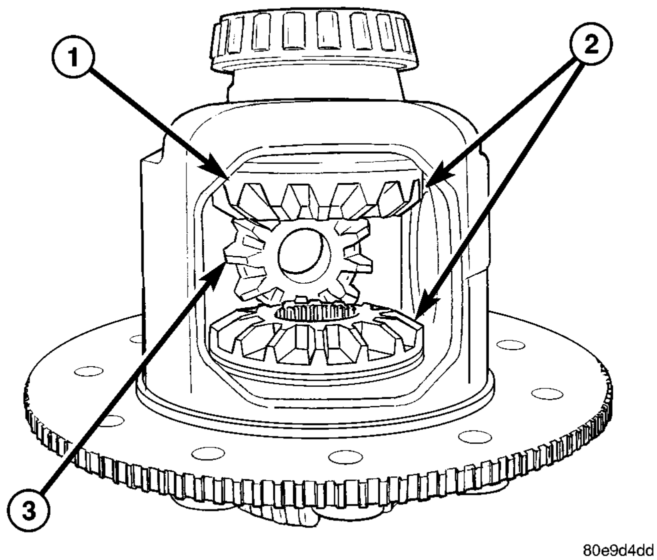


Fig. 34 PINION GEAR

1 - DIFFERENTIAL WINDOW
2 - SIDE GEARS
3 - PINION GEAR

(4) Install the other pinion gear and thrust washer. Rotate the gears to align hole in the pinion gears with hole in the differential case.

(5) Slide pinion shaft into the case and through the pinion gears. Tap the shaft to seat the pinion shaft snap-ring into the case (Fig. 35).

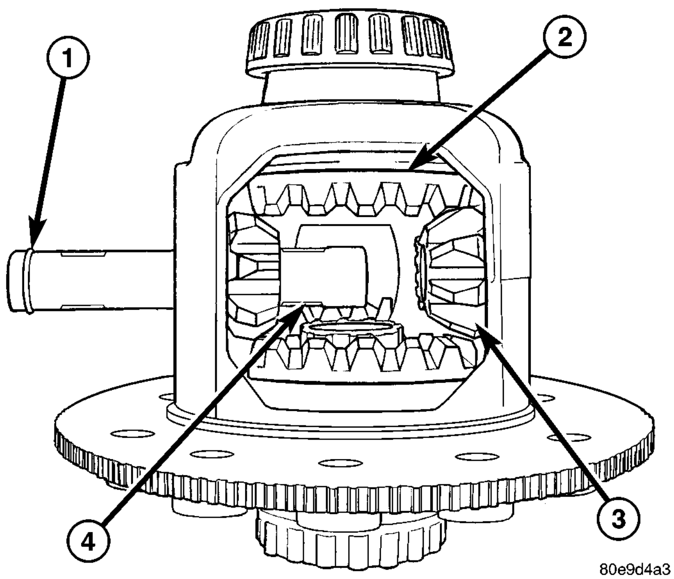


Fig. 35 PINION SHAFT INSTALLATION

1 - SNAP RING
2 - SIDE GEAR
3 - PINION GEAR
4 - PINION SHAFT

(6) Install ring gear.

INSTALLATION

(1) Clean the housing cavity with a flushing oil, light engine oil or lint free cloth.

CAUTION: Do not use water, steam, kerosene or gasoline for cleaning.

(2) Lubricate differential case bearing.

(3) Install differential case with bearings cups into the housing.

NOTE: A light coat of grease on the cups will hold them in place during installation.

(4) Install bearing caps and bolts (Fig. 36). Tighten the bearing cap bolts finger-tight.

NOTE: Do not torque bearing cap and bolts at this time.

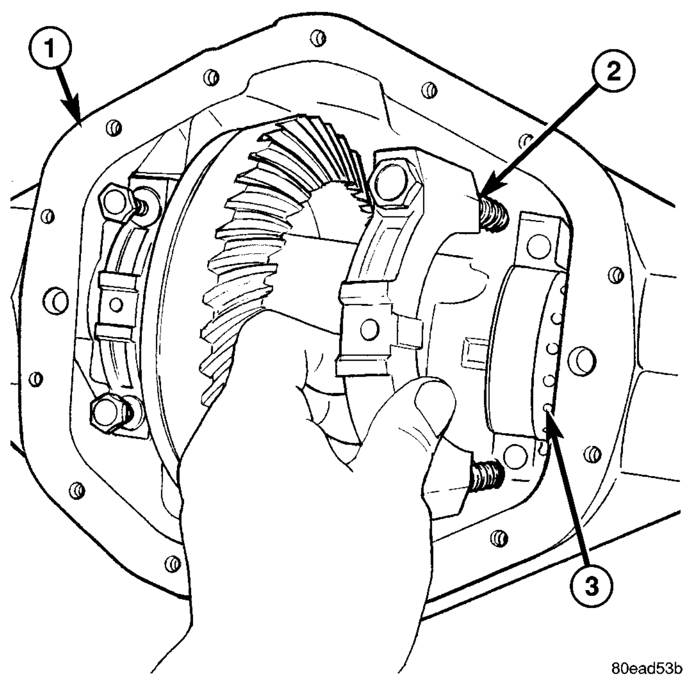


Fig. 36 CASE BEARING CAP

1 - DIFFERENTIAL HOUSING
2 - BEARING CAP
3 - ADJUSTER

(5) Slide differential case toward the pinion gear until the gears make contact/zero backlash. If zero backlash cannot be obtained, turn the pinion side adjuster until zero backlash is obtained.

(6) Holding the differential case toward the pinion gear, turn bearing adjusters with Spanner Wrench 8883 until they make contact with the differential bearings/cups.

(7) Back off the ring gear side adjuster 4 holes, to obtain initial ring gear backlash.

DIFFERENTIAL (Continued)

(8) Install ring gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(9) Tighten pinion gear side adjuster firmly against the differential case bearing cup.

(10) Rotate the pinion several times to seat the differential bearings.

(11) Loosen pinion gear side adjuster until it is no longer in contact with the bearing cup.

(12) Tighten pinion gear side adjuster until it just makes contact with the bearing cup.

(13) Tighten pinion gear side adjuster an additional:

- **New Bearings** 6 Adjuster Holes
- **Original Bearings** 4 Adjuster Holes

(14) Install pinion gear side adjuster lock and bolt. Do not tighten adjuster lock bolt at this time.

(15) Tighten bearing cap bolts to 281 N·m (207 ft. lbs.).

(16) Tighten adjuster lock bolts to 25 N·m (18 ft. lbs.) (Fig. 37).

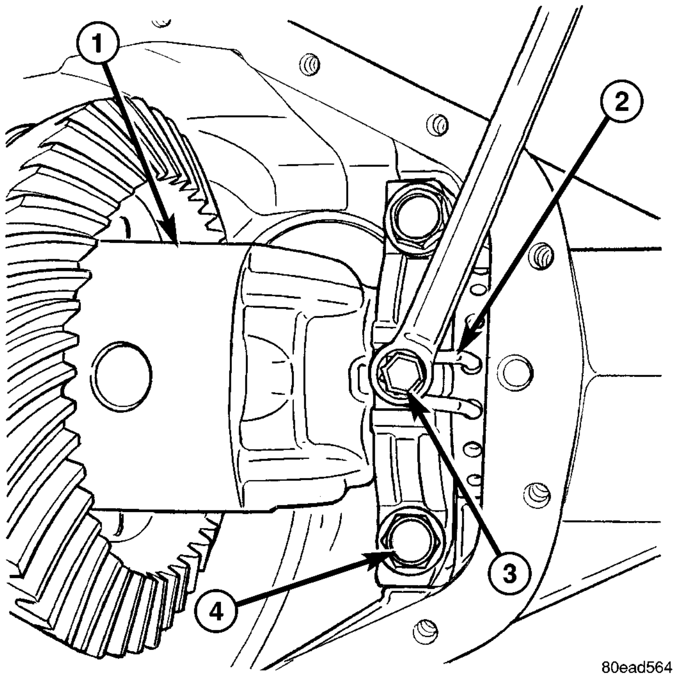


Fig. 37 ADJUSTER LOCK BOLT

1 - DIFFERENTIAL CASE
2 - ADJUSTER LOCK
3 - ADJUSTER LOCK BOLT
4 - BEARING CAP BOLT

(17) Measure ring gear backlash and check gear tooth contact pattern. Refer to Adjustments for procedure.

(18) Install axle shaft gasket and install axle shafts.

(19) Install differential housing gasket and cover. Tighten cover bolts to 40 N·m (30 ft. lbs.).

(20) Fill axle with lubricant, refer to Lubrication & Maintenance for capacity and lubricant type.

(21) Install fill plug and tighten to 32 N·m (24 ft. lbs.).

DIFFERENTIAL TRAC-RITE

DESCRIPTION

The Trac-Rite™ differential is a helical gear differential. The differential has two side gears, six pinion gears and six pinion brake shoes.

NOTE: The differential is seviced as an assembly only if damaged, but can be disassembled for cleaning. The assembly should be cleaned every time a bearing is changed due to damage.

OPERATION

When one wheel begins to spin the pinion gears on that side are forced toward the pinion brake shoes. The pinion brake shoes then cause frictional drag on the opposite pinion gears and the side gear. These friction forces transfer the power to the opposite wheel. Once the frictional forces are overcome, differentiation will occur. The torque will be continually biased by the frictional forces to the high traction wheel.

DISASSEMBLY

(1) Remove differential ring gear bolts.

(2) Remove differential case cover locating screws (Fig. 38).

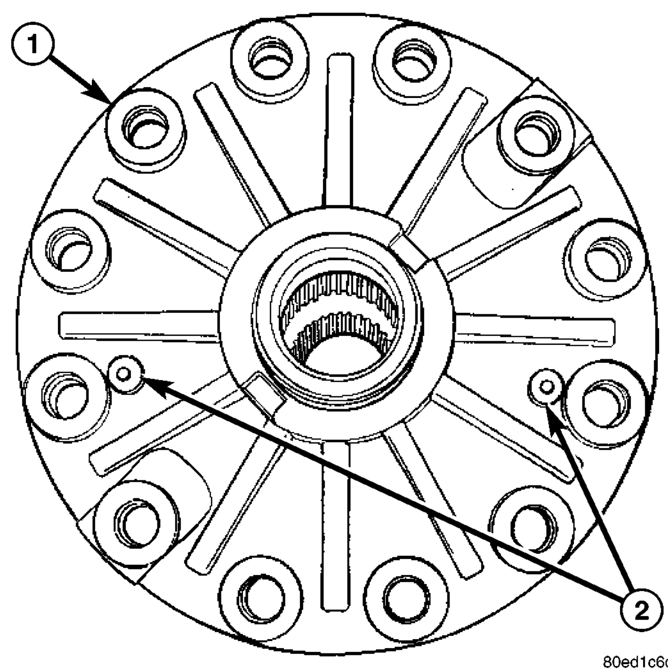


Fig. 38 LOCATION SCREWS

1 - DIFFERENTIAL COVER
2 - LOCATION SCREWS

(3) Remove differential case cover.

(4) Remove side gear and thrust washer (Fig. 39).

DIFFERENTIAL TRAC-RITE (Continued)

NOTE: Mark all component locations.

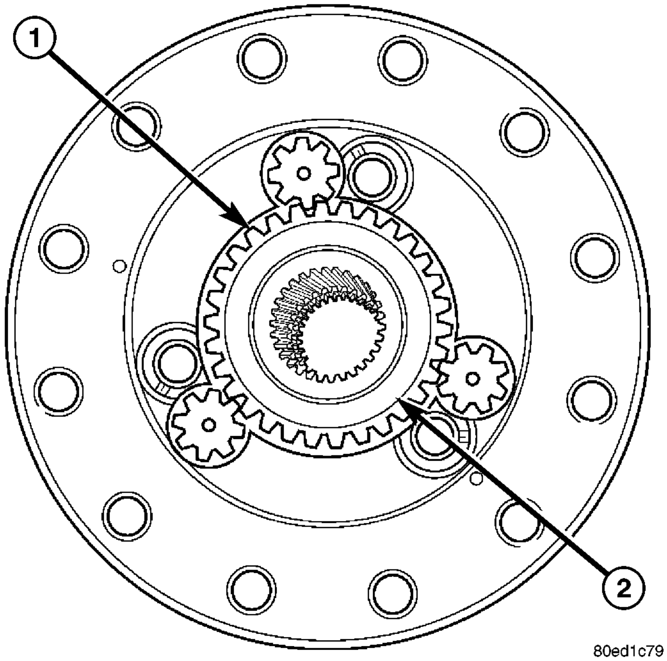


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Fig. 39 SIDE GEAR AND THRUST WASHER

1 - SIDE GEAR
2 - THRUST WASHER

(5) Remove three pinion brake shoes (Fig. 40).

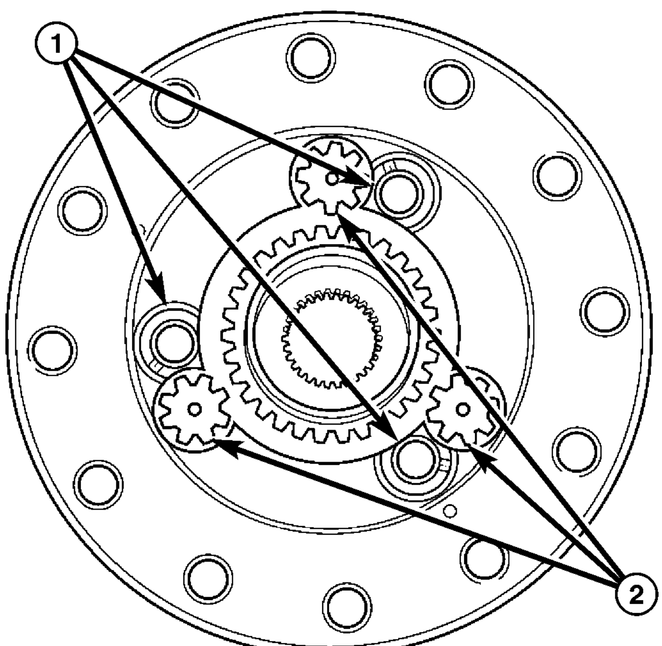

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Fig. 40 PINION BRAKE SHOES

1 - BRAKE SHOES
2 - PINION GEARS

(6) Remove six pinion gears (Fig. 41).

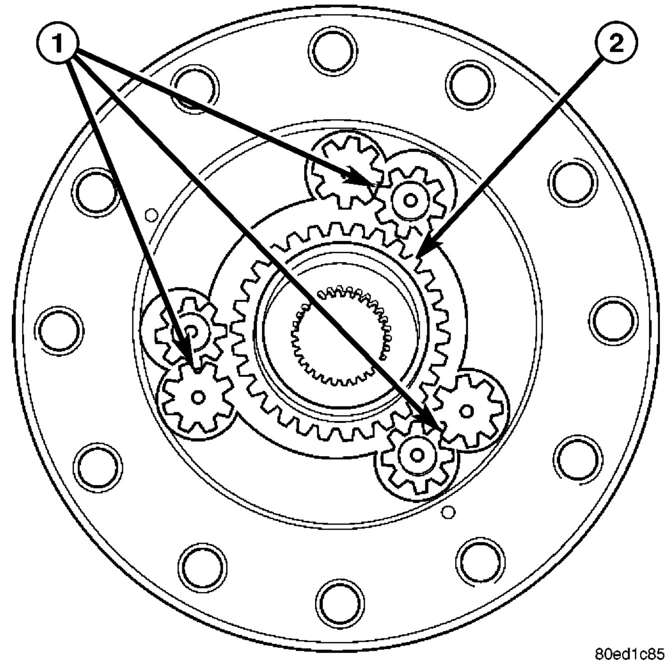

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Fig. 41 PINION GEARS

1 - PINION GEARS
2 - SIDE GEAR

(7) Remove remaining side gear thrust washer and spacer.

(8) Remove remaining three pinion brake shoes.

CLEANING

Clean the differential case and gears with light oil or a lint free cloth.

NOTE: Never use water, steam, kerosene or gasoline for cleaning.

INSPECTION

NOTE: Minor corrosion, nicks or scratches can be smoothed with 400 grit emery cloth and polished out with crocus cloth.

(1) Inspect pinion gears teeth for chips and cracks (Fig. 42).

(2) Inspect pinion gears shafts and brake shoes for scratches, flat-spots or worn (Fig. 42).

(3) Inspect side gears teeth for chips and cracks (Fig. 43).

(4) Inspect pinion and side gear bores for scratches (Fig. 44).

NOTE: If any damage is found the differential must be replaced as an assembly. Individual components can not be replaced separately.

DIFFERENTIAL TRAC-RITE (Continued)

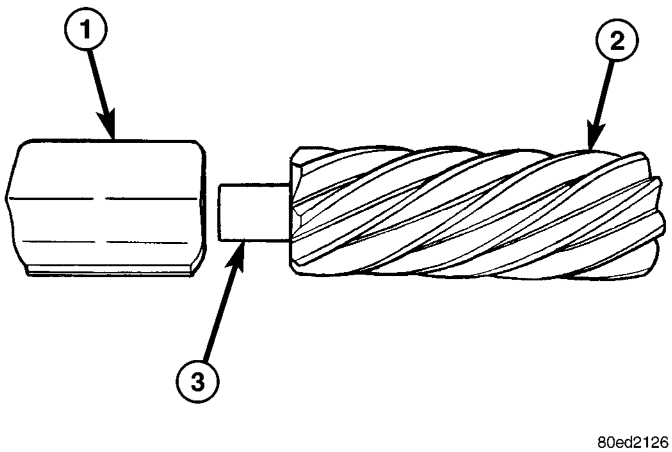

Fig. 42 PINION GEAR AND BRAKE SHOE

1 - BRAKE SHOES
2 - PINION GEAR
3 - PINION SHAFT

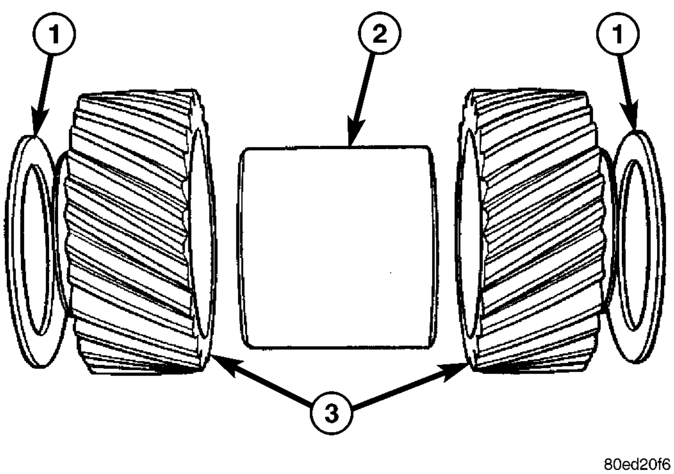

Fig. 43 SIDE GEARS

1 - THRUST WASHERS
2 - SPACER
3 - SIDE GEARS

ASSEMBLY

NOTE: Install all component in their original locations.

(1) Lubricate all gears and differential bores with differential lubricant.

(2) Install one set of pinion brake shoes into the case bores.

NOTE: Brake shoes can be installed upside down, but if install wrong pinion gear will not fit.

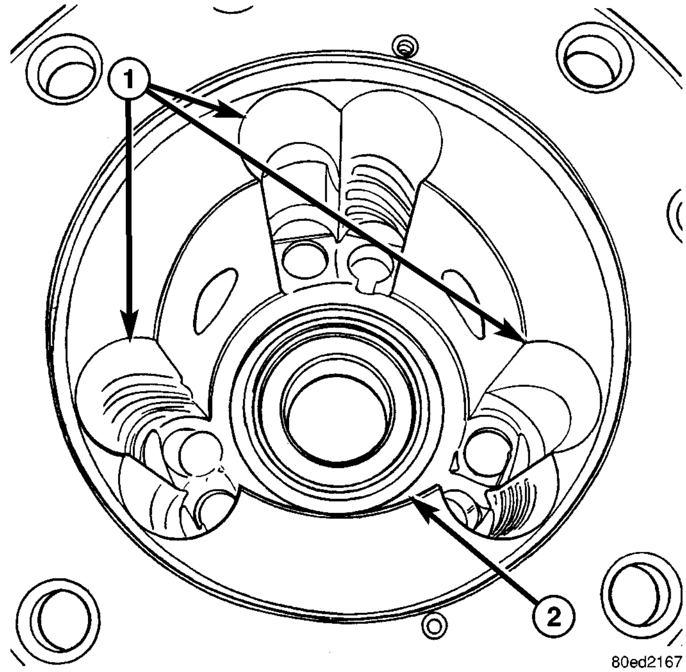

Fig. 44 PINION/SIDE GEAR BORE

1 - PINION BORES
2 - SIDE GEAR BORE

(3) Install side gear thrust washer, side gear and spacer (Fig. 45).

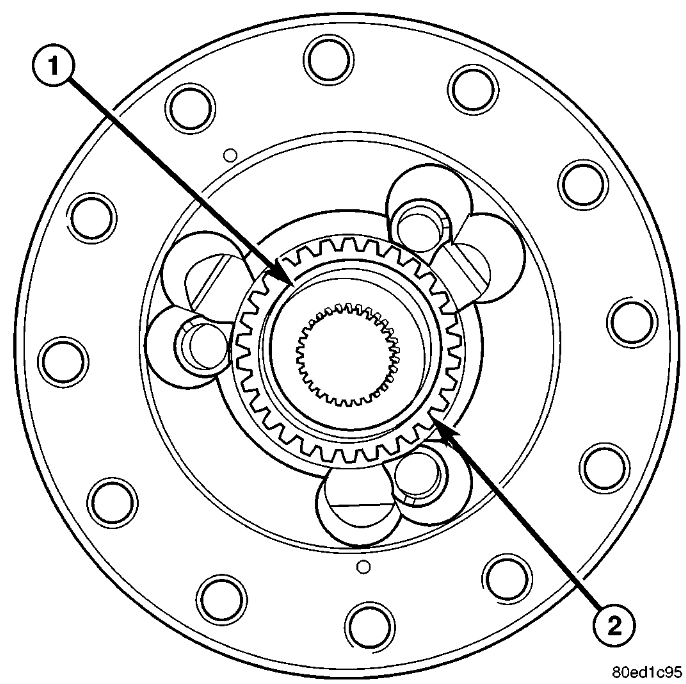

Fig. 45 SIDE GEAR AND SPACER

1 - SPACER
2 - SIDE SPACER

DIFFERENTIAL TRAC-RITE (Continued)

(4) Install one set of pinion gears into the bores next to the brake shoes, with the pinion shaft facing up.

(5) Install other side gear and thrust washer.

(6) Install other set of pinion gears into the brake shoes in the case.

(7) Install other set of brake shoes onto the pinion gears shafts (Fig. 46).

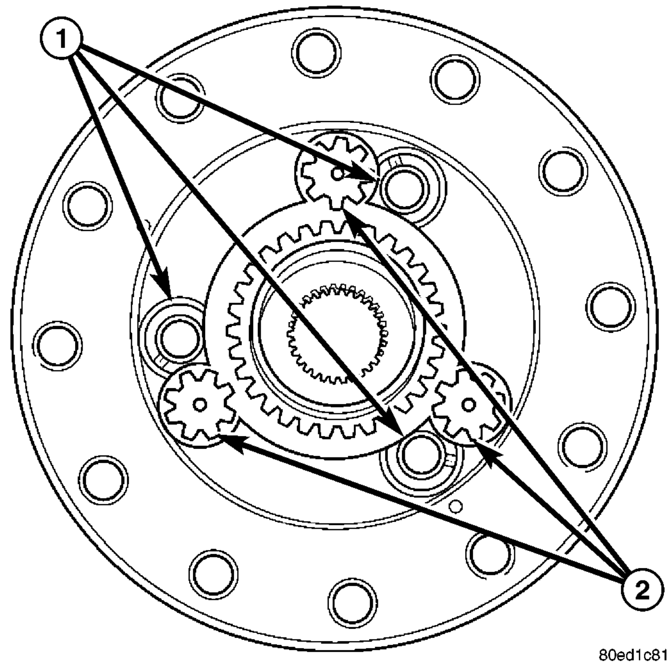

Fig. 46 PINION BRAKE SHOES

1 - BRAKE SHOES
2 - PINION GEARS

(8) Install differential cover and location screws.

(9) Install **new** ring gear bolts and tighten to 237 N·m (175 ft. lbs.).

DIFFERENTIAL CASE BEARINGS

REMOVAL

(1) Remove differential case from the housing.

(2) Install Plug 8964 into the end of the case.

(3) Remove differental case bearings with Bearing Splitter 1130 and Bridge 938 (Fig. 47).

INSTALLATION

(1) Install differenial case bearings with Installer 8965 and Handle C-4171 (Fig. 48).

(2) Install differentail case into housing.

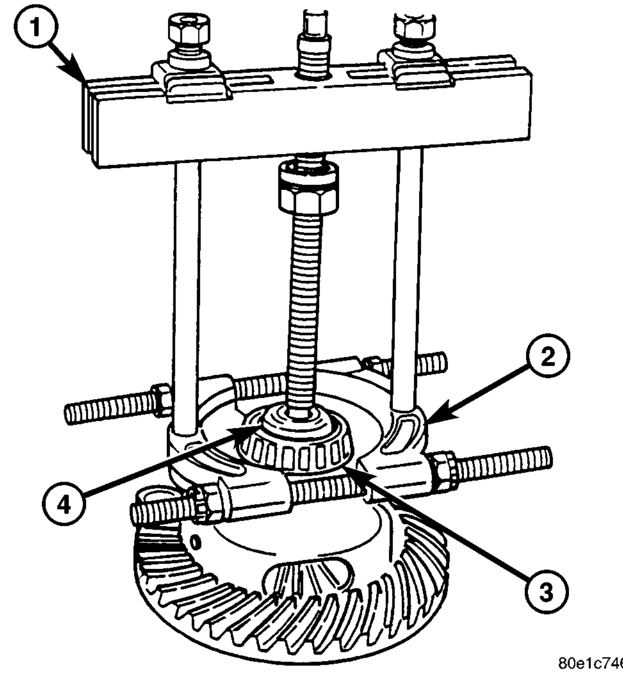

Fig. 47 DIFFERENTIAL CASE BEARING

1 - BRIDGE
2 - SPLITTER
3 - BEARING
4 - PLUG

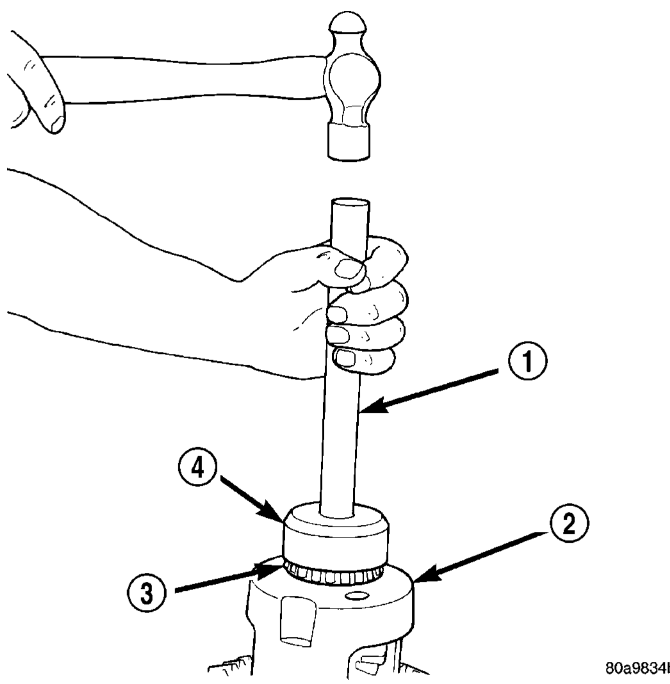

Fig. 48 DIFFERENTIAL CASE BEARINGS

1 - HANDLE
2 - DIFFERENTIAL CASE
3 - BEARING
4 - INSTALLER

PINION GEAR/RING GEAR/ TONE RING

REMOVAL

NOTE: The ring and pinion gears are service in a matched set. Never replace the ring gear/pinion gear without replacing the other matching gear.

(1) Mark pinion flange and propeller shaft for installation alignment.

(2) Disconnect propeller shaft from pinion flange and remove propeller shaft.

(3) Remove differential from the housing.

(4) Place differential on Plug 8964. Drive exciter ring off the differential case with a hammer and punch (Fig. 49).

NOTE: Do not remove the exciter ring if it is not being replaced.

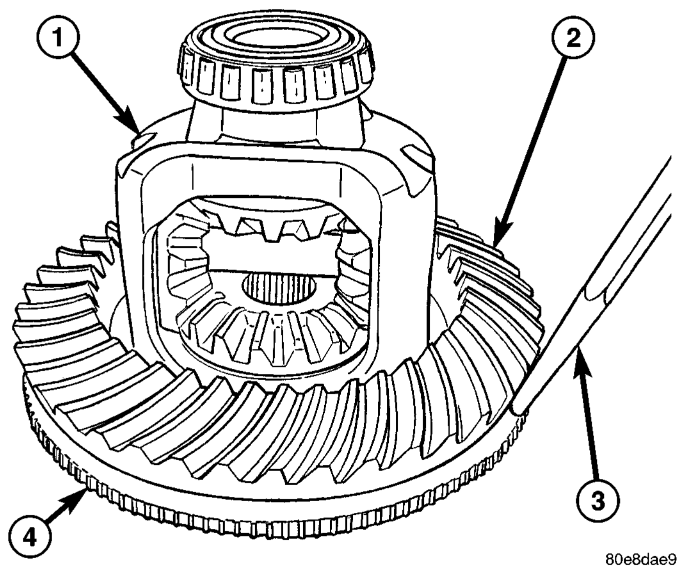

Fig. 49 EXCITER RING

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - PUNCH
4 - EXCITER RING

(5) Place differential case in a vise with soft metal jaw protectors

(6) Remove bolts holding ring gear to differential case.

(7) Drive ring gear from differential case with a soft hammer (Fig. 50).

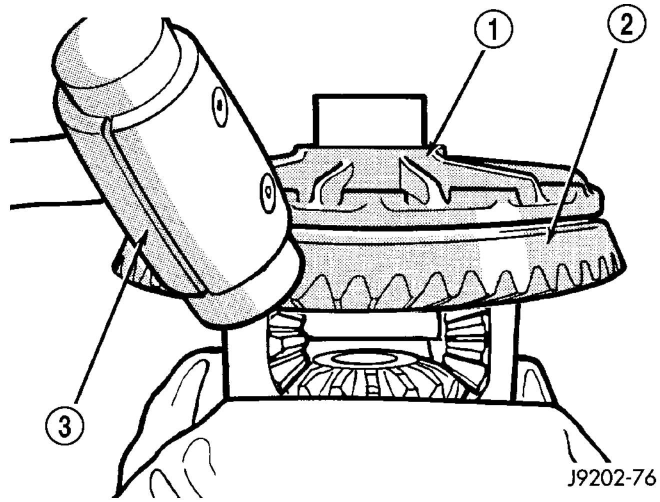

Fig. 50 RING GEAR

1 - DIFFERENTIAL CASE
2 - RING GEAR
3 - HAMMER

(8) Hold pinion flange with Flange Wrench 8979 (Fig. 51) and remove pinion flange nut.

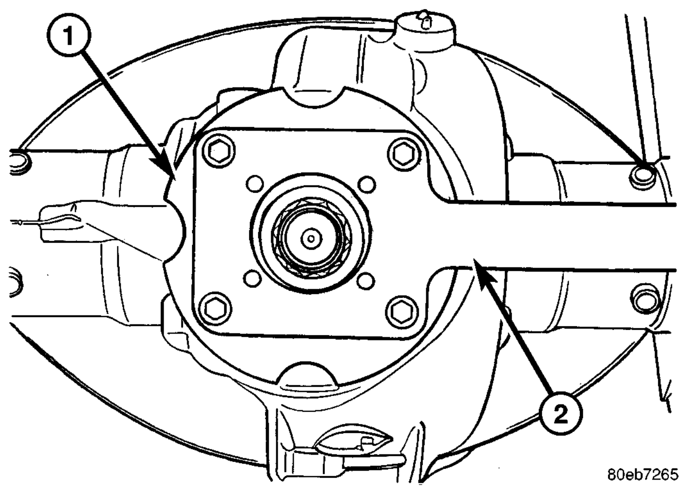

Fig. 51 FLANGE WRENCH

1 - PINION FLANGE
2 - FLANGE WRENCH

PINION GEAR/RING GEAR/TONE RING (Continued)

(9) Remove pinion flange from pinion with Pinion Flange Puller 8992 (Fig. 52).

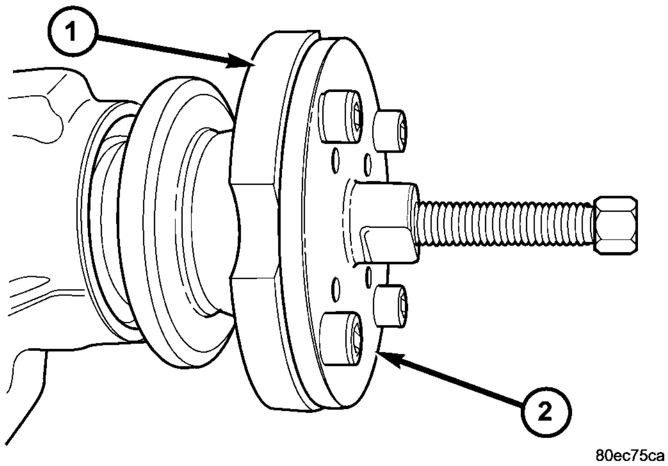

Fig. 52 PINION FLANGE PULLER

1 - PINION FLANGE
2 - PULLER

(10) Remove pinion gear from housing with Pinion Driver 8977 and a hammer (Fig. 53).

NOTE: Thread the driver on the pinion shaft till it bottoms out.

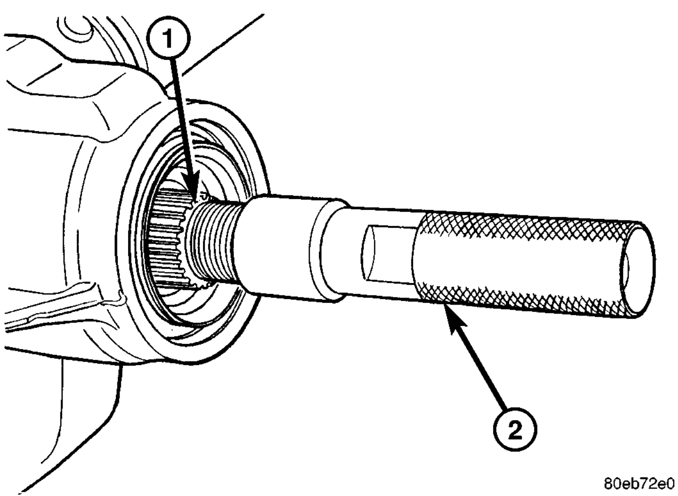

Fig. 53 PINION DRIVER

1 - PINION SHAFT
2 - PINION DRIVER

(11) Remove pinion seal with a slide hammer or pry bar.

(12) Remove front pinion bearing and discard bearing.

CAUTION: Do not reuse front pinion bearing/cup.

(13) Remove collapsible spacer from the pinion shaft.

(14) Remove rear pinion bearing with Bearing Splitter 1130 and a press (Fig. 54).

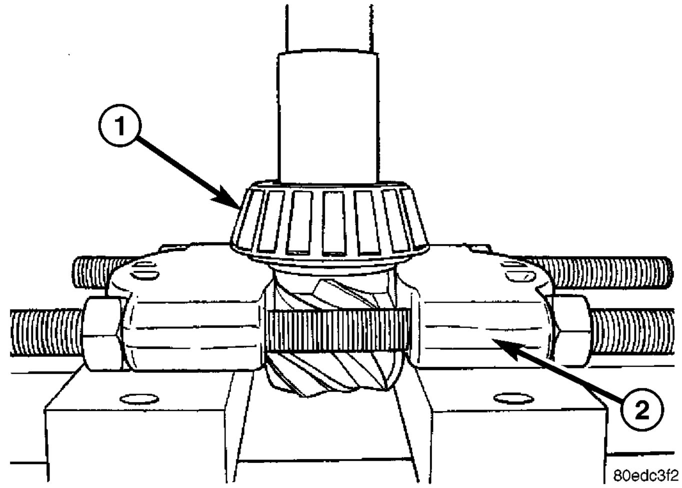

Fig. 54 BEARING SPLITTER

1 - PINION BEARING
2 - SPLITTER

(15) Remove pinion depth shim from the pinion gear shaft and record thickness of the shims.

(16) Remove front pinion bearing cup from the housing with a punch and hammer, and discard cup.

CAUTION: Do not reuse front pinion bearing/cup.

(17) Remove rear pinion bearing cup from the housing with a punch and hammer, if bearing is going to be replaced.

INSTALLATION

(1) Install new front pinion bearing cup (Fig. 55) with Installer 8960 and Handle C-4171.

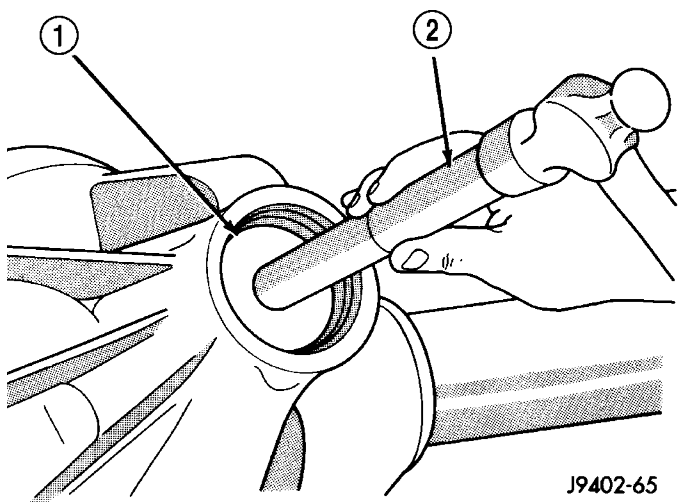

Fig. 55 FRONT PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

PINION GEAR/RING GEAR/TONE RING (Continued)

(2) Install new rear pinion bearing cup (Fig. 56) with Installer 8968 and Handle C-4171.

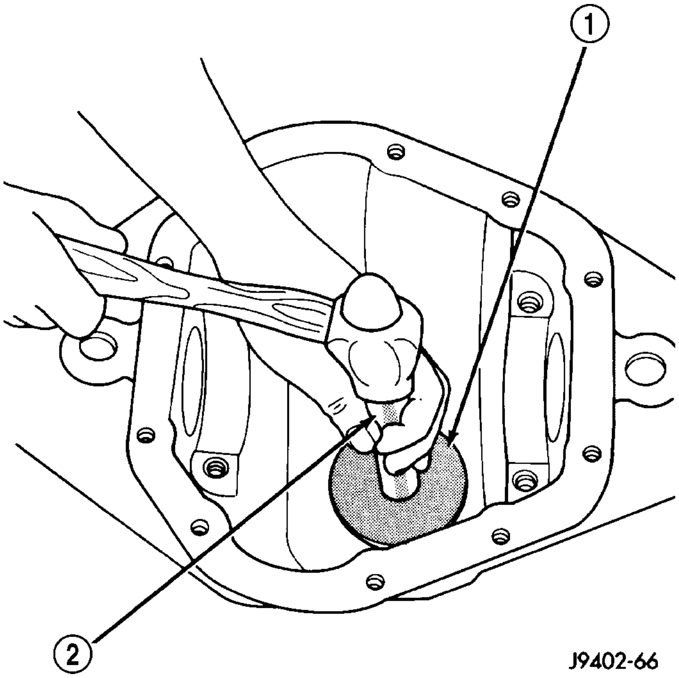

Fig. 56 REAR PINION BEARING CUP

1 - INSTALLER
2 - HANDLE

(3) Install pinion depth shim (Fig. 57) on the pinion gear shaft.

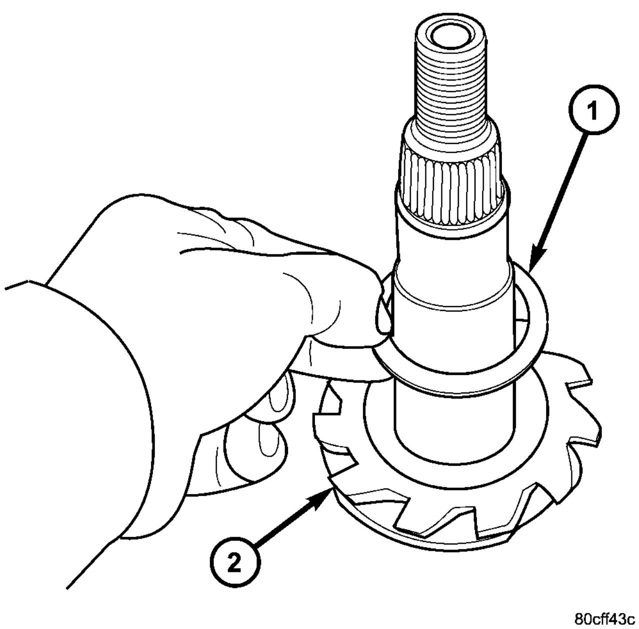

Fig. 57 PINION DEPTH SHIM

1 - PINION DEPTH SHIM
2 - PINION GEAR

(4) Install rear pinion bearing (Fig. 58) with Installer D-389 and a press.

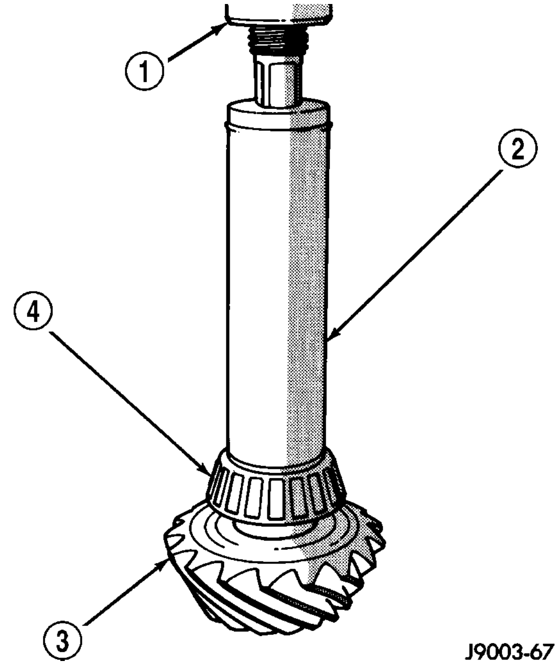

Fig. 58 REAR PINION BEARING

1 - PRESS
2 - INSTALLER
3 - PINION GEAR
4 - REAR PINION BEARING

(5) Install **new** collapsible spacer (Fig. 59).

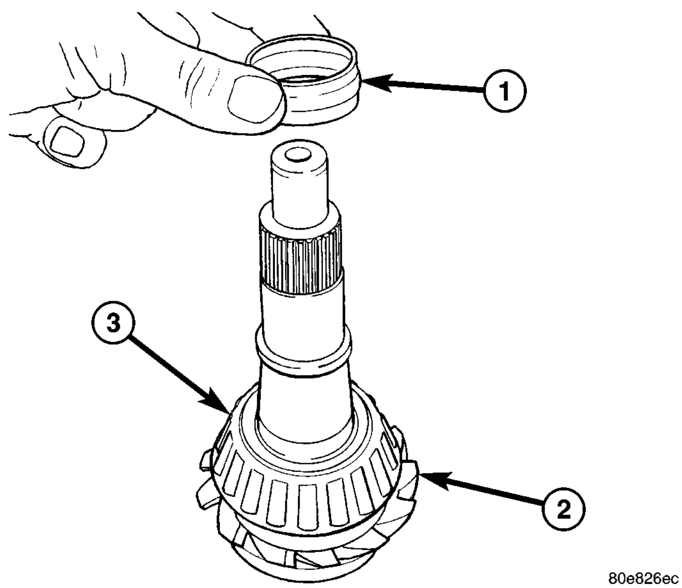

Fig. 59 COLLAPSIBLE SPACER

1 - COLAPSIBLE SPACER
2 - PINION GEAR
3 - REAR PINION BEARING

(6) Lubricate pinion and bearings.

PINION GEAR/RING GEAR/TONE RING (Continued)

(7) Install pinion into the housing and place front pinion bearing onto the pinion shaft. Draw the pinion shaft into the front bearing with Installer 8981 (Fig. 60).

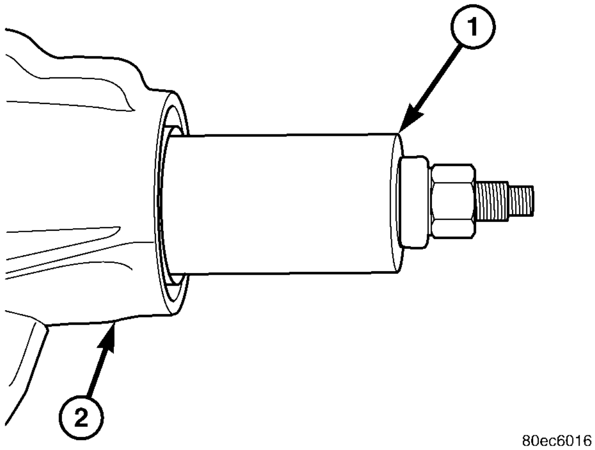

Fig. 60 PINION GEAR INSTALLER

1 - INSTALLER
2 - DIFFERENTIAL HOUSING

(8) Install **new** pinion seal (Fig. 61) with Installer 8896 and Handle C-4171.

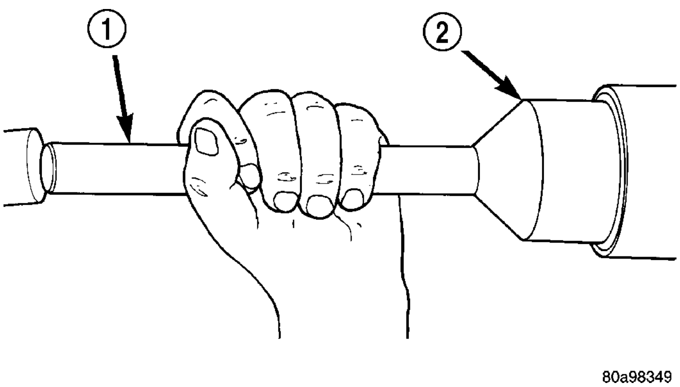

Fig. 61 PINION SEAL INSTALLER

1 - HANDLE
2 - INSTALLER

(9) Apply a light coat of teflon sealant to the pinion flange splines.

(10) Hold pinion and lightly tap the pinion flange onto the pinion, until a few threads are showing.

(11) Install pinion flange washer and **new** pinion nut.

(12) Hold pinion flange with Flange Wrench 8979 (Fig. 62) and tighten pinion nut until pinion end play is taken up.

(13) Rotate pinion several times to seat bearings.

(14) Measure pinion rotating torque with an inch pound torque wrench (Fig. 63). Tighten pinion nut in small increments until pinion rotating torque is:

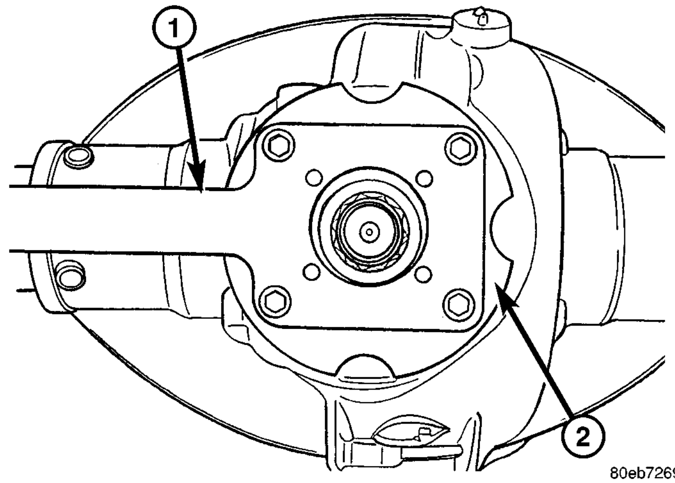

Fig. 62 FLANGE WRENCH

1 - FLANGE WRENCH
2 - PINION FLANGE

- **New Pinion Bearings:** 1.7-2.8 N·m (15-25 in. lbs.)
- **Original Pinion Bearings:** 1.1-2.2 N·m (10-20 in. lbs.)

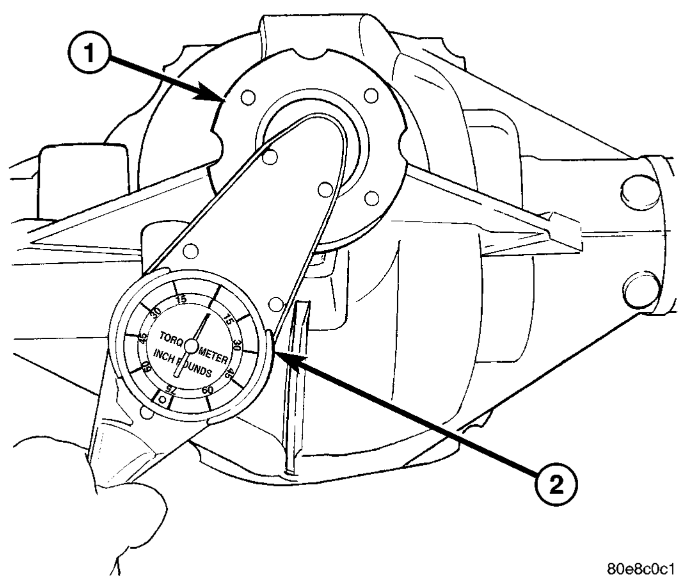

Fig. 63 PINION ROTATING TORQUE

1 - PINION FLANGE
2 - TORQUE WRENCH

(15) Rotate pinion several times then verify pinion rotating torque again.

(16) Position the ring gear on differential case and start two **new** ring gear bolts.

(17) Install the rest of the **new** ring gear bolts and tighten them alternately to seat the ring gear.

(18) Torque ring gear bolts to 237 N·m (175 ft. lbs.).

PINION GEAR/RING GEAR/TONE RING (Continued)

(19) If exciter ring was removed, position differential assembly on differential Plug 8965 (Fig. 64) and place exciter ring on the differential case.

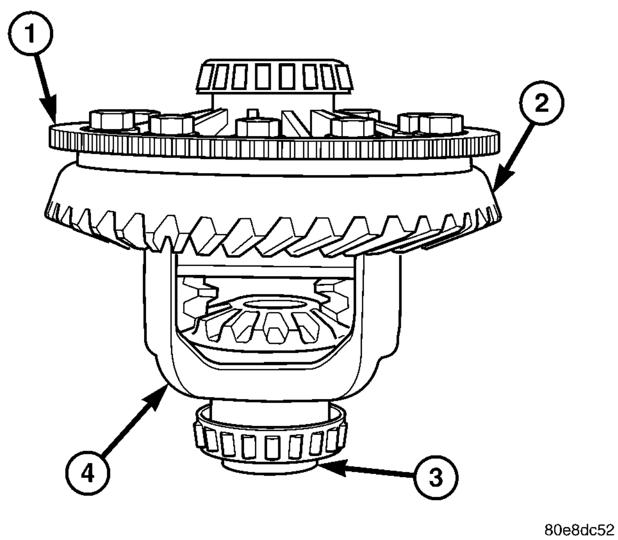

Fig. 64 EXCITER RING

1 - EXCITER RING
2 - RING GEAR
3 - DIFFERENTIAL PLUG
4 - DIFFERENTIAL CASE

(20) Install the exciter ring on the differential case evenly with a hammer and brass punch (Fig. 65). Drive the ring down until it is seated against the ring gear.

CAUTION: Do not damage exciter ring teeth during installation.

(21) Install differential in housing and verify gear backlash and gear contact pattern.

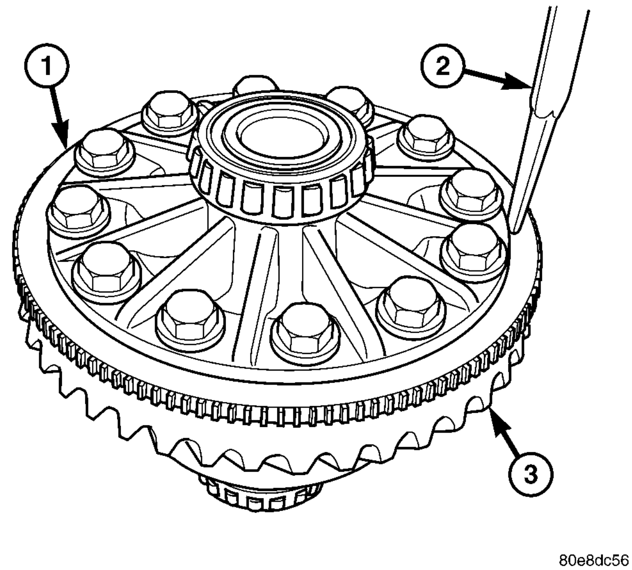

Fig. 65 EXCITER RING INSTALLATION

1 - EXCITER RING
2 - PUNSH
3 - RING GEAR

(22) Measure final rotating torque with an inch pound torque wrench. The final pinion rotating torque plus differential case bearing preload is:

- **New Bearings:** 3.4-5.6 N·m (30-50 in. lbs.)
- **Original Bearings:** 2.8-5.1 N·m (25-45 in. lbs.)

(23) Install axle shafts.

(24) Install the propeller shaft with the reference marks aligned.

(25) Install differential cover with gasket and tighten bolts to 40 N·m (30 ft. lbs.).

(26) Fill differential with fluid and tighten fill plug to 32 N·m (24 ft. lbs.).

BRAKES

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BRAKES - BASE

DIAGNOSIS AND TESTING - BASE BRAKE SYSTEM

Base brake components consist of the brake shoes, calipers, wheel cylinders, brake drums, rotors, brake lines, master cylinder, booster, and parking brake components.

Brake diagnosis involves determining if the problem is related to a mechanical, hydraulic, or vacuum operated component.

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

(1) Check condition of tires and wheels. Damaged wheels and worn, damaged, or underinflated tires can cause pull, shudder, vibration, and a condition similar to grab.

(2) If complaint was based on noise when braking, check suspension components. Jounce front and rear of vehicle and listen for noise that might be caused by loose, worn or damaged suspension or steering components.

(3) Inspect brake fluid level and condition. Note that the brake reservoir fluid level will decrease in proportion to normal lining wear. **Also note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.**

(a) If fluid level is abnormally low, look for evidence of leaks at calipers, wheel cylinders, brake lines, and master cylinder.

(b) If fluid appears contaminated, drain out a sample to examine. System will have to be flushed if fluid is separated into layers, or contains a substance other than brake fluid. The system seals

BRAKES - BASE (Continued)

and cups will also have to be replaced after flushing. Use clean brake fluid to flush the system.

(4) Check parking brake operation. Verify free movement and full release of cables and pedal. Also note if vehicle was being operated with parking brake partially applied.

(5) Check brake pedal operation. Verify that pedal does not bind and has adequate free play. If pedal lacks free play, check pedal and power booster for being loose or for bind condition. Do not road test until condition is corrected.

(6) Check booster vacuum check valve and hose.

(7) If components checked appear OK, road test the vehicle.

ROAD TESTING

(1) If complaint involved low brake pedal, pump pedal and note if it comes back up to normal height.

(2) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain firm under constant foot pressure.

(3) During road test, make normal and firm brake stops in 25-40 mph range. Note faulty brake operation such as low pedal, hard pedal, fade, pedal pulsation, pull, grab, drag, noise, etc.

(4) Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component.

Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

An internal leak in the ABS or RWAL system may also be the problem with no physical evidence.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up worn linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin brake drums or substandard brake lines and hoses can also cause a spongy pedal. The proper course of action is to bleed the system, and replace thin drums and substandard quality brake hoses if suspected.

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits.

The primary cause of pulsation are disc brake rotors with excessive lateral runout or thickness variation, or out of round brake drums. Other causes are loose wheel bearings or calipers and worn, damaged tires.

NOTE: Some pedal pulsation may be felt during ABS activation.

BRAKE DRAG

Brake drag occurs when the lining is in constant contact with the rotor or drum. Drag can occur at one wheel, all wheels, fronts only, or rears only.

Drag is a product of incomplete brake shoe release. Drag can be minor or severe enough to overheat the linings, rotors and drums.

Minor drag will usually cause slight surface charring of the lining. It can also generate hard spots in rotors and drums from the overheat-cool down process. In most cases, the rotors, drums, wheels and tires are quite warm to the touch after the vehicle is stopped.

Severe drag can char the brake lining all the way through. It can also distort and score rotors and drums to the point of replacement. The wheels, tires and brake components will be extremely hot. In severe cases, the lining may generate smoke as it chars from overheating.

Common causes of brake drag are:

- Seized or improperly adjusted parking brake cables.
- Loose/worn wheel bearing.
- Seized caliper or wheel cylinder piston.
- Caliper binding on corroded bushings or rusted slide surfaces.
- Loose caliper mounting.
- Drum brake shoes binding on worn/damaged support plates.
- Mis-assembled components.
- Long booster output rod.

If brake drag occurs at all wheels, the problem may be related to a blocked master cylinder return port, or faulty power booster (binds-does not release).

BRAKE FADE

Brake fade is usually a product of overheating caused by brake drag. However, brake overheating

BRAKES - BASE (Continued)

and resulting fade can also be caused by riding the brake pedal, making repeated high deceleration stops in a short time span, or constant braking on steep mountain roads. Refer to the Brake Drag information in this section for causes.

BRAKE PULL

Front brake pull condition could result from:

- Contaminated lining in one caliper
- Seized caliper piston
- Binding caliper
- Loose caliper
- Rusty caliper slide surfaces
- Improper brake shoes
- Damaged rotor

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull.

A common and frequently misdiagnosed pull condition is where direction of pull changes after a few stops. The cause is a combination of brake drag followed by fade at one of the brake units.

As the dragging brake overheats, efficiency is so reduced that fade occurs. Since the opposite brake unit is still functioning normally, its braking effect is magnified. This causes pull to switch direction in favor of the normally functioning brake unit.

An additional point when diagnosing a change in pull condition concerns brake cool down. Remember that pull will return to the original direction, if the dragging brake unit is allowed to cool down (and is not seriously damaged).

REAR BRAKE GRAB OR PULL

Rear grab or pull is usually caused by improperly adjusted or seized parking brake cables, contaminated lining, bent or binding shoes and support plates, or improperly assembled components. This is particularly true when only one rear wheel is involved. However, when both rear wheels are affected, the master cylinder or proportioning valve could be at fault.

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

This condition is generally caused by water soaked lining. If the lining is only wet, it can be dried by driving with the brakes very lightly applied for a mile or two. However, if the lining is both soaked and dirt contaminated, cleaning and/or replacement will be necessary.

BRAKE LINING CONTAMINATION

Brake lining contamination is mostly a product of leaking calipers or wheel cylinders, worn seals, driving through deep water puddles, or lining that has become covered with grease and grit during repair. Contaminated lining should be replaced to avoid further brake problems.

WHEEL AND TIRE PROBLEMS

Some conditions attributed to brake components may actually be caused by a wheel or tire problem.

A damaged wheel can cause shudder, vibration and pull. A worn or damaged tire can also cause pull.

Severely worn tires with very little tread left can produce a grab-like condition as the tire loses and recovers traction. Flat-spotted tires can cause vibration and generate shudder during brake operation. A tire with internal damage such as a severe bruise, cut, or ply separation can cause pull and vibration.

BRAKE NOISES

Some brake noise is common with rear drum brakes and on some disc brakes during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

BRAKE SQUEAK/SQUEAL

Brake squeak or squeal may be due to linings that are wet or contaminated with brake fluid, grease, or oil. Glazed linings and rotors with hard spots can also contribute to squeak. Dirt and foreign material embedded in the brake lining will also cause squeak/squeal.

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

Brake chatter is usually caused by loose or worn components, or glazed/burnt lining. Rotors with hard spots can also contribute to chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.

THUMP/CLUNK NOISE

Thumping or clunk noises during braking are frequently **not** caused by brake components. In many cases, such noises are caused by loose or damaged steering, suspension, or engine components. However, calipers that bind on the slide surfaces can generate a thump or clunk noise. In addition, worn out, improperly adjusted, or improperly assembled rear brake shoes can also produce a thump noise.

BRAKES - BASE (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - MANUAL BLEEDING

Use Mopar brake fluid, or an equivalent quality fluid meeting SAE J1703-F and DOT 3 standards only. Use fresh, clean fluid from a sealed container at all times.

(1) Remove reservoir filler caps and fill reservoir.

(2) If calipers, or wheel cylinders were overhauled, open all caliper and wheel cylinder bleed screws. Then close each bleed screw as fluid starts to drip from it. Top off master cylinder reservoir once more before proceeding.

(3) Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 1). Be sure end of bleed hose is immersed in fluid.

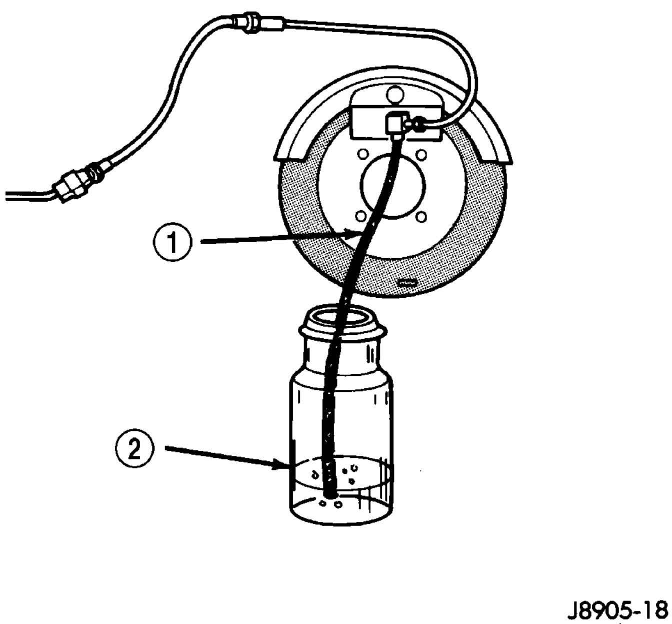


Fig. 1 Bleed Hose Setup

1 - BLEED HOSE
2 - FLUID CONTAINER PARTIALLY FILLED WITH FLUID

(4) Open up bleeder, then have a helper press down the brake pedal. Once the pedal is down close the bleeder. Repeat bleeding until fluid stream is clear and free of bubbles. Then move to the next wheel.

STANDARD PROCEDURE - PRESSURE BLEEDING

Use Mopar brake fluid, or an equivalent quality fluid meeting SAE J1703-F and DOT 3 standards only. Use fresh, clean fluid from a sealed container at all times.

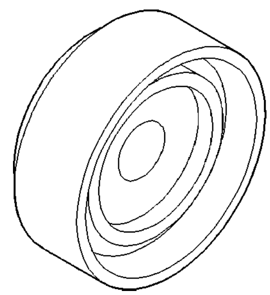
Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

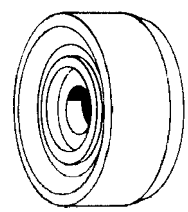
Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system.

SPECIAL TOOLS

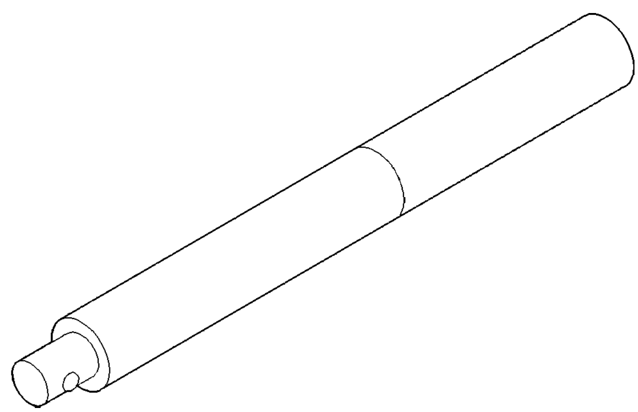
BASE BRAKES



INSTALLER, BRAKE CALIPER DUST BOOT C-4340

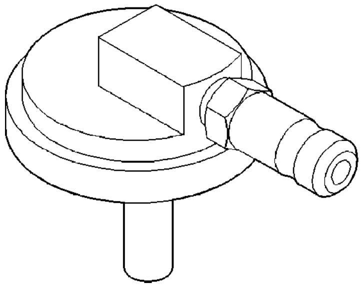


INSTALLER, BRAKE CALIPER DUST BOOT C-3716-A

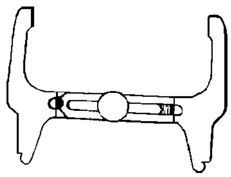


HANDLE C-4171

BRAKES - BASE (Continued)



CAP, MASTER CYLINDER PRESSURE BLEED 6921



GAUGE, BRAKE SAFE-SET C-3919

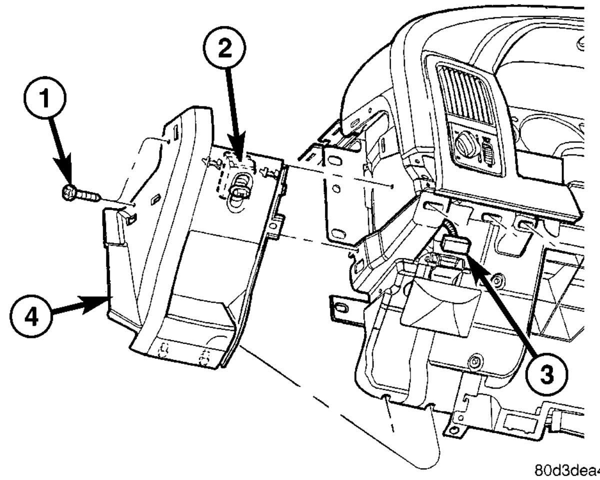


Fig. 2 LOWER DRIVERS SIDE BEZEL

1 - SCREWS (2)
2 - ADJUSTABLE PEDAL SWITCH
3 - PEDAL SWITCH ELECTRICAL CONNECTOR
4 - BEZEL

ADJUSTABLE PEDAL SWITCH

REMOVAL

(1) Remove the lower drivers side bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DR SIDE BEZEL - REMOVAL).

(2) Disconnect the electrical connector from the adjustable pedal switch.

(3) Remove the switch from the lower drivers side bezel by squeezing the retaining clips together and pushing the switch outwards (Fig. 2).

INSTALLATION

(1) Install the switch to the lower drivers side bezel by pushing the switch inwards seating the retaining clips to the lower drivers side bezel.

(2) Reconnect the electrical connector to the adjustable pedal switch.

(3) Install the lower drivers side bezel (Fig. 2) (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DR SIDE BEZEL - INSTALLATION).

HYDRAULIC/MECHANICAL

SPECIFICATIONS

SPECIFICATIONS - TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Brake Booster Mounting Nuts	38	28	—
Master Cylinder Mounting Nuts	18	—	160
Caliper Mounting Pins	32	24	—
Caliper Adapter Mounting Bolts	176	130	—
Junction Block Bolts To Frame	10	7.5	—
Brake Pedal Assembly Bracket Nuts	28	21	—

HYDRAULIC/MECHANICAL (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Support Plate Mounting Bolts/Nuts	64	47	—
Brake Line Fittings Master Cylinder	19	14	170
Brake Line Fittings Junction Block	19	14	170
Caliper Brake Line Banjo Bolt	27	20	245
Brake Hose Front Bolts To Frame	10	7.5	—
Brake Hose Front Fitting	19	14	250
Brake Hose Rear Fitting	19	14	250
Parking Brake Pedal Assembly	19	14	250
Hub/Bearing Bolts	163	120	—

BASE BRAKE

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Front Disc Brake Caliper Type	Dual Piston Sliding
Rear Disc Brake Caliper Type	Single Piston Sliding
Front Disc Brake Caliper	54 mm (2.00 in.)
Front Disc Brake Rotor	336×28 mm (13.2×1.1 in.)
Front/Rear Disc Brake Rotor Max. Runout	0.127 mm (0.005 in.)
Front/Rear Disc Brake Rotor Max. Thickness Variation	0.025 mm (0.001 in.)
Minimum Front Rotor Thickness	26.4 mm (1.039 in.)
Mininium Rear Rotor Thickness	28.39 mm (1.117 in)
Rear Disc Brake Caliper	1x54 mm (2.12 in)
Rear Disc Brake Rotor	350x22 mm (.86 in)
Brake Booster Type Gasoline Engines	Vacuum Dual Diaphragm

BRAKE LINES

STANDARD PROCEDURE

STANDARD PROCEDURE - DOUBLE INVERTED FLARING

A preformed metal brake tube is recommended and preferred for all repairs. However, double-wall steel tube can be used for emergency repair when factory replacement parts are not readily available.

(1) Cut off damaged tube with Tubing Cutter.

(2) Ream cut edges of tubing to ensure proper flare.

(3) Install replacement tube nut on the tube.

(4) Insert tube in flaring tool.

(5) Place gauge form over the end of the tube.

(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.

(7) Tighten the tool bar on the tube

(8) Insert plug on gauge in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc (Fig. 3).

(9) Tighten tool handle until plug gauge is squarely seated on jaws of flaring tool. This will start the inverted flare.

(10) Remove the plug gauge and complete the inverted flare.

STANDARD PROCEDURE - ISO FLARING

A preformed metal brake tube is recommended and preferred for all repairs. However, double-wall steel

BRAKE LINES (Continued)

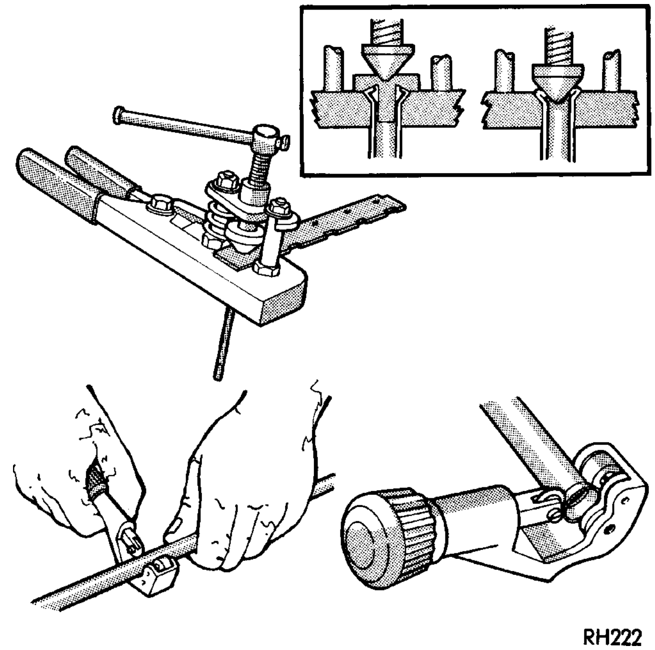


Fig. 3 Inverted Flare Tools

tube can be used for emergency repair when factory replacement parts are not readily available.

To make a ISO flare use an ISO flaring tool kit.

(1) Cut off damaged tube with Tubing Cutter.

(2) Remove any burrs from the inside of the tube.

(3) Install tube nut on the tube.

(4) Position the tube in the flaring tool flush with the top of the tool bar (Fig. 4). Then tighten the tool bar on the tube.

(5) Install the correct size adaptor on the flaring tool yoke screw.

(6) Lubricate the adaptor.

(7) Align the adaptor and yoke screw over the tube (Fig. 4).

(8) Turn the yoke screw in until the adaptor is squarely seated on the tool bar.

REMOVAL

REMOVAL - REAR BRAKE HOSE

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Raise and support the vehicle.

(3) Remove the brake line from the hose at the frame (Fig. 5).

(4) Remove the brake hose clip at the top of the hose located at the frame (Fig. 5).

(5) Remove the vent tube (Fig. 6).

(6) Remove the two brake lines at the bottom of the hose located at the axle (Fig. 6).

(7) Remove the mounting bolt for the brake hose at the axle (Fig. 6).

(8) Remove the hose.

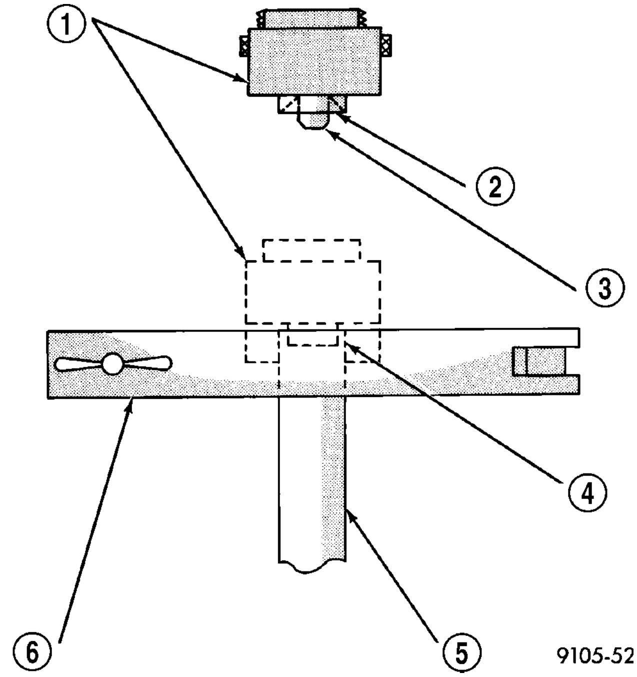


Fig. 4 ISO Flaring

1 - ADAPTER
2 - LUBRICATE HERE
3 - PILOT
4 - FLUSH WITH BAR
5 - TUBING
6 - BAR ASSEMBLY

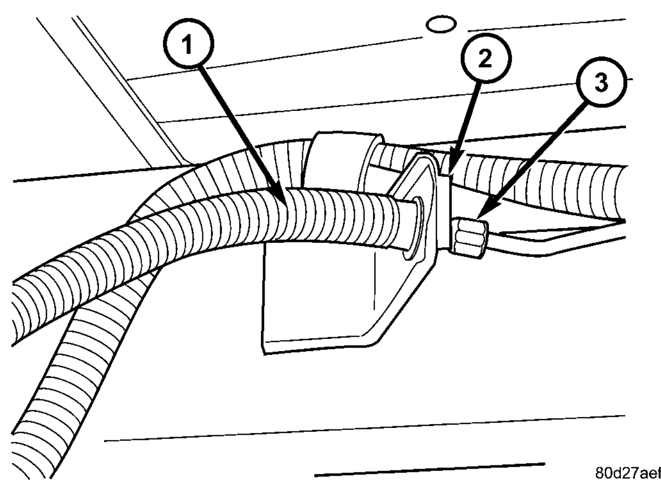


Fig. 5 BRAKE LINE CLIP

1 - BRAKE HOSE
2 - CLIP
3 - BRAKE LINE

REMOVAL - REAR TUBE / HOSE ASSEMBLY

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Raise and support the vehicle.

(3) Remove the brake line located at the axle.

(4) Remove the mounting bolt for the brake hose at the axle (Fig. 7).

BRAKE LINES (Continued)

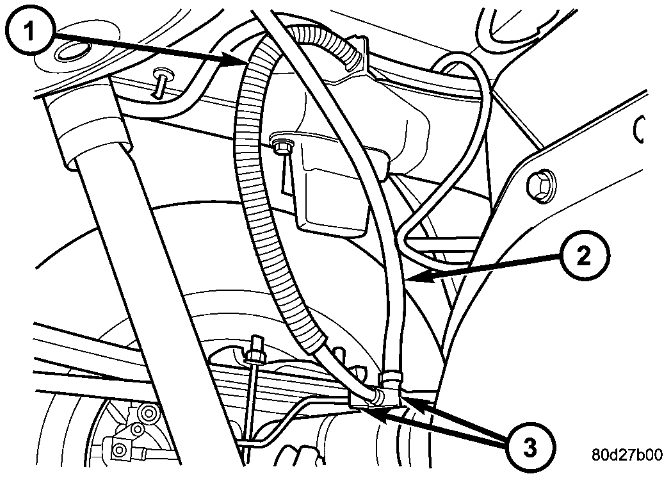


Fig. 6 REAR HOSE

1 - BRAKE HOSE
2 - VENT HOSE
3 - BRAKE LINES

(5) Remove the banjo bolt at the caliper (Fig. 7).
(6) Remove the hose.

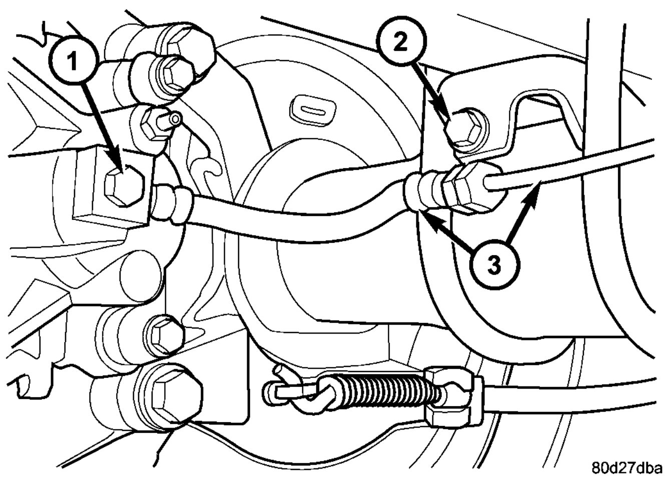


Fig. 7 BRAKE LINE WITH RUBBER HOSE

1 - BANJO BOLT
2 - MOUNTING BOLT
3 - REAR TUBE / HOSE ASSEMBLY

REMOVAL - FRONT HOSE

(1) Install a prop rod on the brake pedal to keep pressure on the brake system.
(2) Raise and support vehicle.
(3) Remove the tire and wheel assembly.
(4) Remove the brake hose from the brake line located at the frame (Fig. 8).
(5) Remove the brake hose banjo bolt at the caliper (Fig. 8).
(6) Remove the mounting bolt securing the brake hose to the frame and remove the wheel speed sensor wire from the brake hose (Fig. 8).
(7) Remove the hose.

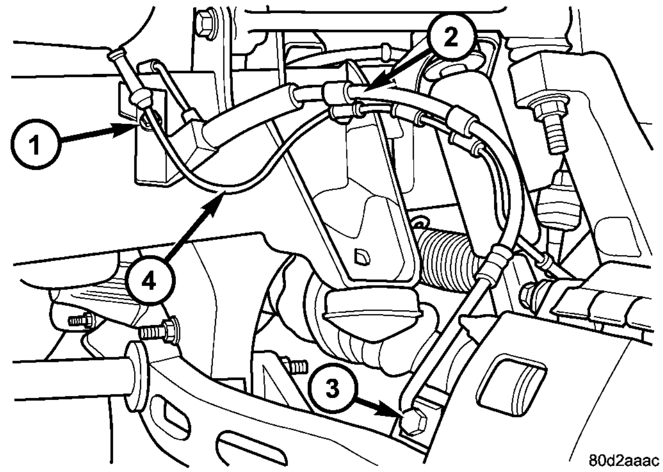


Fig. 8 BRAKE HOSE MOUNTED PASSENGER SIDE

1 - MOUNTING BOLT
2 - BRAKE HOSE
3 - BANJO BOLT
4 - WHEEL SPEED SENSOR WIRE

INSTALLATION

INSTALLATION - REAR BRAKE HOSE

(1) Install the hose.
(2) Install the mounting bolt for the brake hose at the axle (Fig. 6).
(3) Install the two brake lines at the bottom of the hose located at the axle (Fig. 6).
(4) Install the vent tube (Fig. 6).
(5) Install the brake hose clip at the top of the hose located at the frame (Fig. 5).
(6) Install the brake line to the hose at the frame (Fig. 5).
(7) Lower the vehicle and remove the support.
(8) Remove the prop rod.
(9) Bleed the brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

INSTALLATION - REAR TUBE / HOSE ASSEMBLY

(1) Install the hose.
(2) Install the banjo bolt at the caliper (Fig. 7).
(3) Install the mounting bolt for the brake hose at the axle (Fig. 7).
(4) Install the brake line located at the axle.
(5) Lower the vehicle and remove the support.
(6) Remove the prop rod.
(7) Bleed the brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

INSTALLATION - FRONT BRAKE HOSE

(1) Install the hose.
(2) Install the mounting bolt for the brake hose at the frame (Fig. 9).

BRAKE LINES (Continued)

(3) Install the brake hose banjo bolt at the caliper (Fig. 8).

(4) Reinstall the wheel speed sensor wire to the brake hose (Fig. 8).

(5) Remove the support and lower the vehicle.

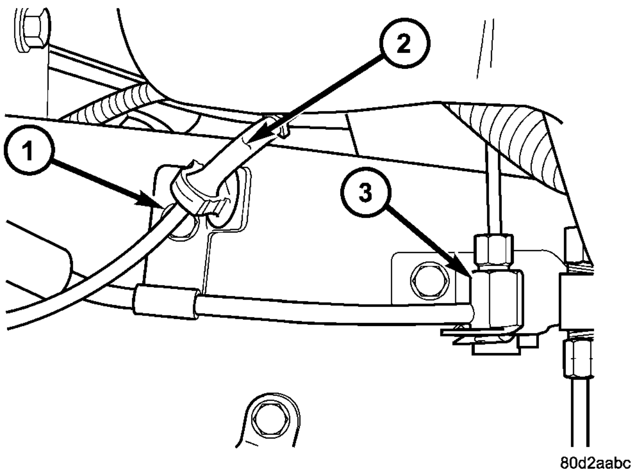


Fig. 9 BRAKE HOSE MOUNT DRIVERS SIDE

1 - MOUNTING BOLT
2 - WHEEL SPEED SENSOR WIRE
3 - BRAKE HOSE

(6) Remove the prop rod from the brake pedal.

(7) Bleed the brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

BRAKE PADS/SHOES

REMOVAL

(1) Raise and support vehicle.

(2) Remove the wheel and tire assemblies.

(3) Compress the caliper.

(4) Remove the caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(5) Remove the caliper by tilting the top up and off the caliper adapter (Fig. 10).

NOTE: Do not allow brake hose to support caliper assembly.

(6) Support and hang the caliper. (Fig. 11)

(7) Remove the inboard brake shoe from the caliper adapter (Fig. 12).

(8) Remove the outboard brake shoe from the caliper adapter (Fig. 13).

(9) Remove the anti-rattle springs from the caliper adapter (Fig. 14) and (Fig. 15).

NOTE: Anti-rattle springs are not interchangeable.

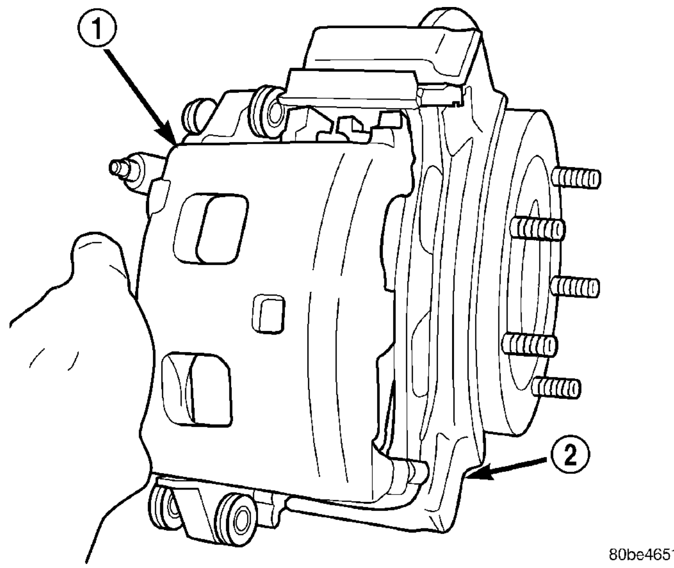


Fig. 10 Caliper

1 - CALIPER
2 - CALIPER ADAPTER

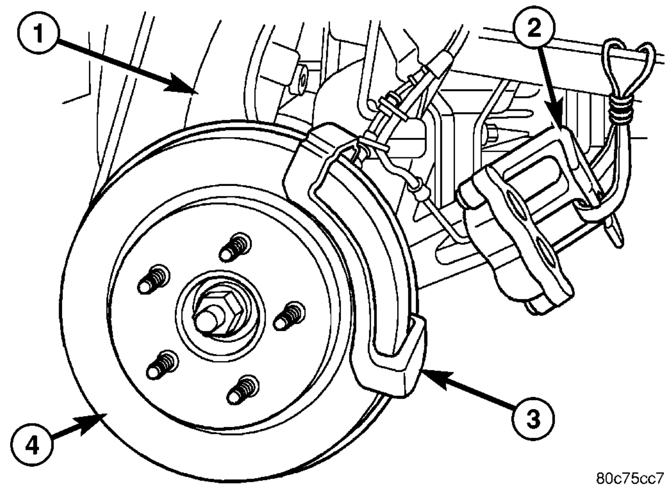


Fig. 11 DISC BRAKE CALIPER - FRONT

1 - STEERING KNUCKLE
2 - DISC BRAKE CALIPER
3 - CALIPER MOUNTING ADAPTER
4 - DISC BRAKE ROTOR

INSTALLATION

(1) Bottom pistons in caliper bore with C-clamp. Place an old brake shoe between a C-clamp and caliper piston.

(2) Clean caliper mounting adapter and anti-rattle springs.

(3) Lubricate anti-rattle springs with Mopar brake grease.

(4) Install anti-rattle springs.

NOTE: Anti-rattle springs are not interchangeable.

(5) Install inboard brake shoe in adapter.

BRAKE PADS/SHOES (Continued)

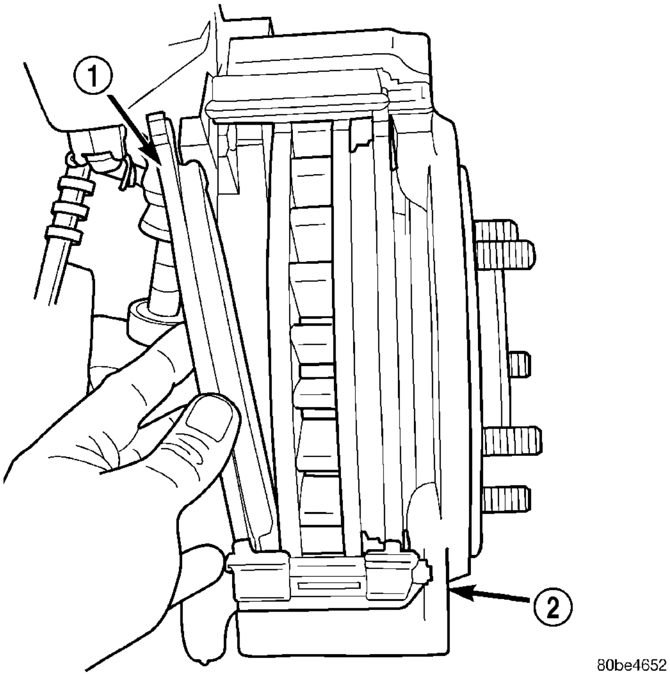


Fig. 12 Inboard Brake Shoe

1 - INBOARD SHOE
2 - CALIPER ADAPTER

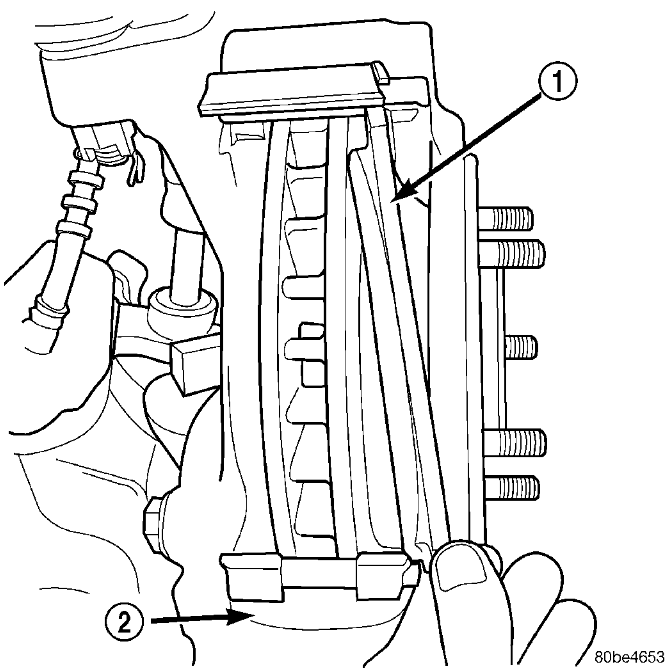


Fig. 13 Outboard Brake Shoe

1 - OUTBOARD SHOE
2 - CALIPER ADAPTER

(6) Install outboard brake shoe in adapter.

(7) Tilt the top of the caliper over rotor and under adapter. Then push the bottom of the caliper down onto the adapter.

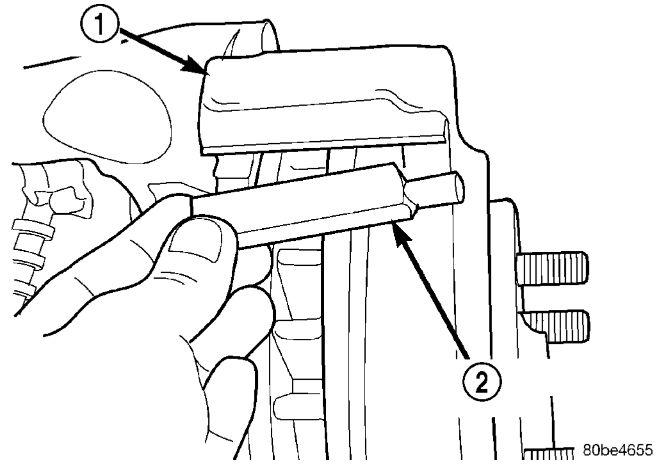


Fig. 14 Top Anti-Rattle Spring

1 - CALIPER ADAPTER
2 - ANTI-RATTLE SPRING

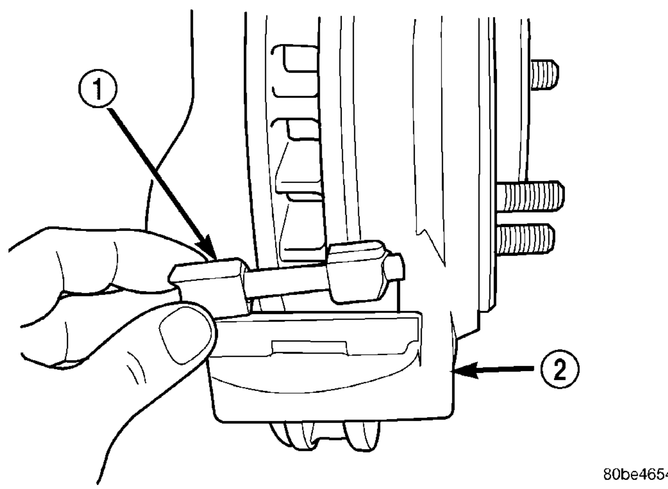


Fig. 15 Bottom Anti-Rattle Spring

1 - ANTI-RATTLE SPRING
2 - CALIPER ADAPTER

(8) Install caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(9) Install wheel and tire assemblies and lower vehicle, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(10) Apply brakes several times to seat caliper pistons and brake shoes and obtain firm pedal.

(11) Top off master cylinder fluid level.

DISC BRAKE CALIPERS

DESCRIPTION

The calipers are a single piston type in the rear and dual piston type in the front. The calipers are free to slide laterally, this allows continuous compensation for lining wear.

DISC BRAKE CALIPERS (Continued)

OPERATION

When the brakes are applied fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bore will be equal (Fig. 16).

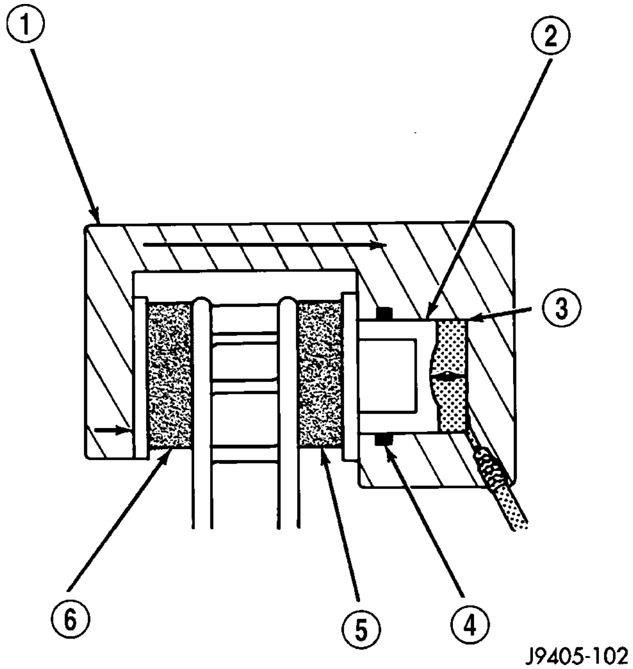


Fig. 16 Brake Caliper Operation

1 - CALIPER
2 - PISTON
3 - PISTON BORE
4 - SEAL
5 - INBOARD SHOE
6 - OUTBOARD SHOE

Fluid pressure applied to the piston is transmitted directly to the inboard brake pad. This forces the pad lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bore forces the caliper to slide inward on the mounting bolts. This action brings the outboard brake pad lining into contact with the outer surface of the disc brake rotor.

In summary, fluid pressure acting simultaneously on both piston and caliper, produces a strong clamping action. When sufficient force is applied, friction will attempt to stop the rotors from turning and bring the vehicle to a stop.

Application and release of the brake pedal generates only a very slight movement of the caliper and piston. Upon release of the pedal, the caliper and piston return to a rest position. The brake pads do not retract an appreciable distance from the rotor. In fact, clearance is usually at, or close to zero. The reasons for this are to keep road debris from getting between the rotor and lining and in wiping the rotor surface clear each revolution.

The caliper piston seal controls the amount of piston extension needed to compensate for normal lining wear.

During brake application, the seal is deflected outward by fluid pressure and piston movement (Fig. 17). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by the amount of seal deflection. Generally the amount is just enough to maintain contact between the piston and inboard brake pad.

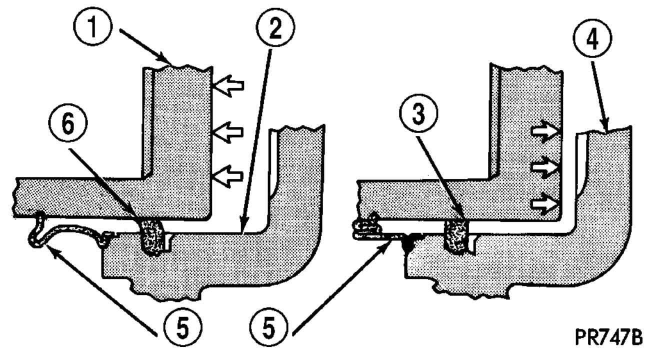


Fig. 17 Lining Wear Compensation By Piston Seal

1 - PISTON
2 - CYLINDER BORE
3 - PISTON SEAL BRAKE PRESSURE OFF
4 - CALIPER HOUSING
5 - DUST BOOT
6 - PISTON SEAL BRAKE PRESSURE ON

REMOVAL

REMOVAL - REAR

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

(2) Raise and support vehicle.

(3) Remove the wheel and tire assembly.

(4) Drain small amount of fluid from master cylinder brake reservoir with suction gun.

(5) Remove the brake hose banjo bolt if replacing caliper (Fig. 18).

(6) Remove the caliper mounting slide pin bolts (Fig. 18).

(7) Remove the caliper from vehicle.

REMOVAL - FRONT

CAUTION: Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose with result. Provide a suitable support to hang the caliper securely.

(1) Install prop rod on the brake pedal to keep pressure on the brake system.

DISC BRAKE CALIPERS (Continued)

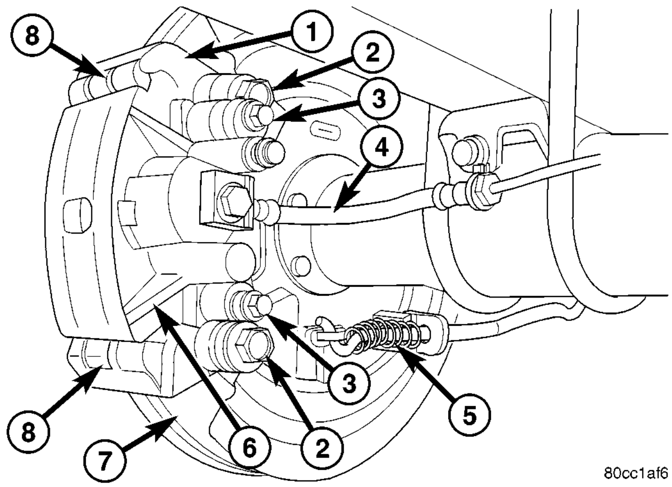


Fig. 18 DISC BRAKE CALIPER - REAR

1 - CALIPER ADAPTER
2 - CALIPER ADAPTER MOUNTING BOLTS
3 - CALIPER SLIDE BOLTS
4 - BRAKE HOSE
5 - CABLE
6 - CALIPER
7 - ROTOR
8 - ANTI-RATTLE CLIPS

(2) Raise and support the vehicle.

(3) Remove the tire and wheel assembly.

(4) Compress the disc brake caliper.

(5) Remove the banjo bolt and discard the copper washer.

(6) Remove the caliper slide pin bolts.

(7) Remove the disc brake caliper (Fig. 19) or (Fig. 20).

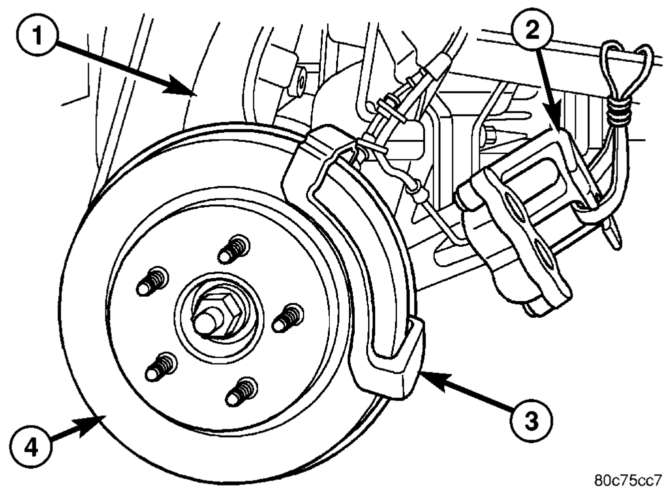


Fig. 19 DISC BRAKE CALIPER - FRONT

1 - STEERING KNUCKLE
2 - DISC BRAKE CALIPER
3 - CALIPER MOUNTING ADAPTER
4 - DISC BRAKE ROTOR

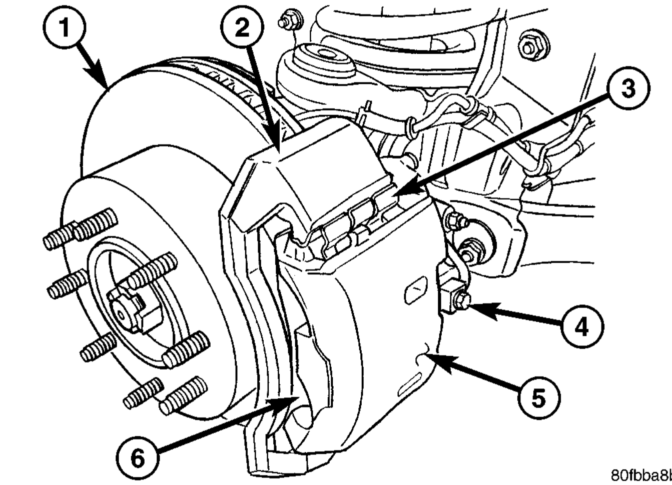


Fig. 20 8 LUG ROTOR & CALIPER ASSEMBLY

1 - ROTOR
2 - CALIPER ADAPTER
3 - ANTI-RATTLE CLIPS
4 - BRAKE HOSE WITH BANJO BOLT
5 - DISC BRAKE CALIPER
6 - OUTBOARD BRAKE PAD

DISASSEMBLY

(1) Drain the brake fluid from caliper.

(2) C-clamp a block of wood over one piston (Fig. 21).

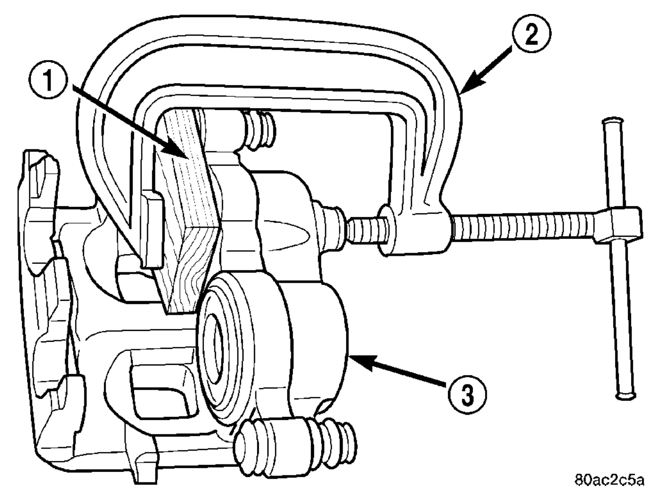


Fig. 21 C-Clamp One Piston

1 - BLOCK OF WOOD
2 - C-CLAMP
3 - CALIPER

(3) Take another piece of wood and pad it with one-inch thickness of shop towels. Place this piece in the outboard shoe side of the caliper in front of the other piston. This will cushion and protect caliper piston during removal (Fig. 22).

(4) To remove the caliper piston direct **short bursts of low pressure air** with a blow gun through the caliper brake hose port. Use only enough air pressure to ease the piston out.

DISC BRAKE CALIPERS (Continued)

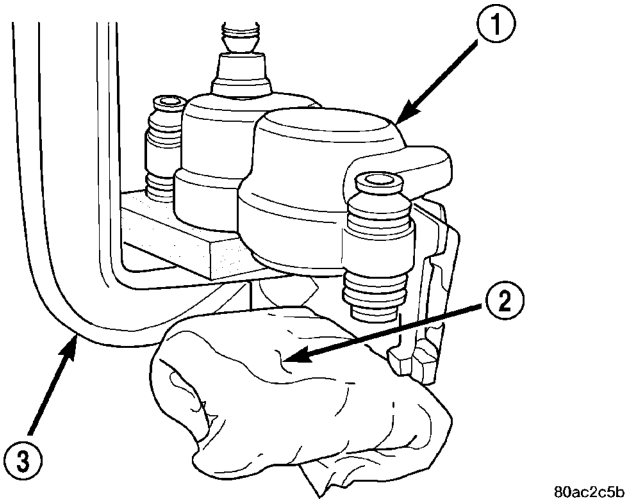


Fig. 22 Protect Caliper Piston

1 - CALIPER
2 - PADDED BLOCK OF WOOD
3 - C-CLAMP

CAUTION: Do not blow the piston out of the bore with sustained air pressure. This could result in a cracked piston.

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS COULD RESULT IN PERSONAL INJURY.

(5) Remove the C-clamp and block of wood from the caliper and clamp it over the dust boot of the first piston removed. This will seal the empty piston bore.

(6) Move the padded piece of wood in front of the other piston.

(7) Remove the second piston using the same procedure with **short bursts of low pressure air**.

(8) Remove piston dust boots with a suitable pry tool (Fig. 23).

(9) Remove piston seals from caliper (Fig. 24).

CAUTION: Do not scratch piston bore while removing the seals.

(10) Push caliper mounting bolt bushings out of the boot seals and remove the boot seals from the caliper (Fig. 25).

(11) Remove caliper bleed screw.

INSPECTION

The piston is made from a phenolic resin (plastic material) and should be smooth and clean.

The piston must be replaced if cracked or scored. Do not attempt to restore a scored piston surface by sanding or polishing.

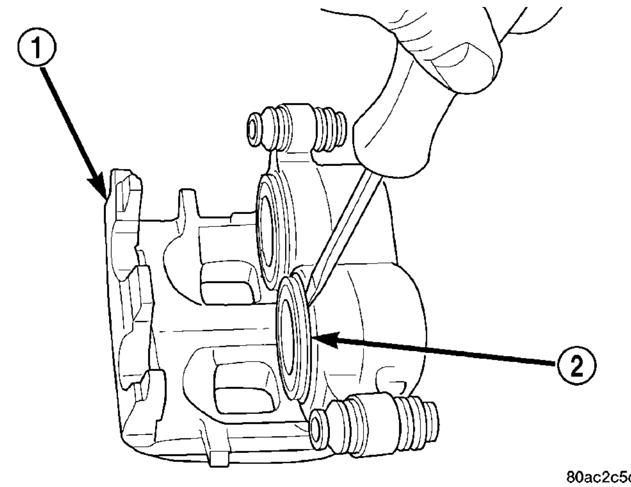


Fig. 23 Piston Dust Boot Removal

1 - CALIPER
2 - DUST BOOT

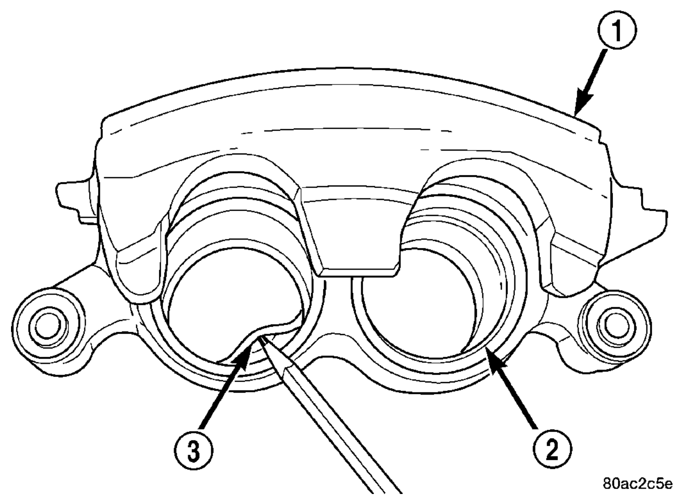


Fig. 24 Piston Seal

1 - CALIPER
2 - PISTON BORE
3 - PISTON SEAL

CAUTION: If the caliper piston is replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different.

The bore can be **lightly** polished with a brake hone to remove very minor surface imperfections (Fig. 26). The caliper should be replaced if the bore is severely corroded, rusted, scored, or if polishing would increase bore diameter more than 0.025 mm (0.001 inch).

DISC BRAKE CALIPERS (Continued)

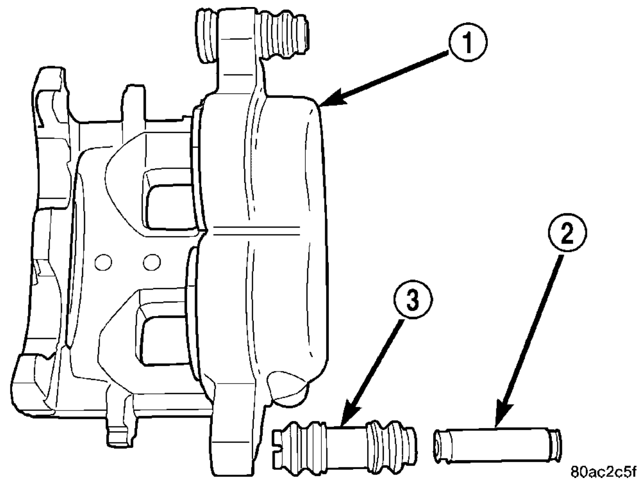


Fig. 25 Bushings And Boot Seals

1 - CALIPER
2 - BUSHING
3 - BOOT SEAL

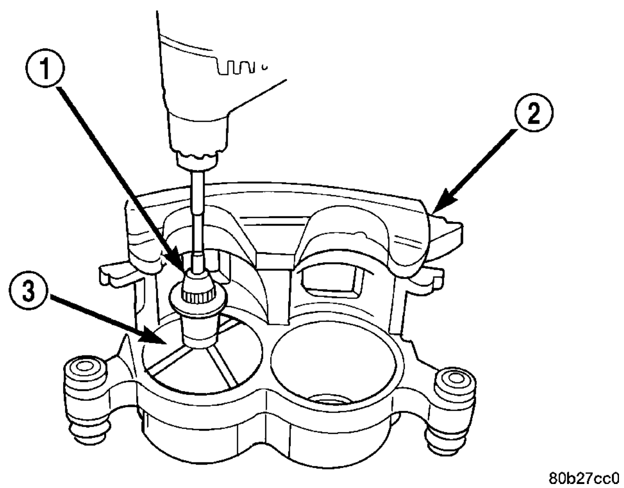


Fig. 26 Polishing Piston Bore

1 - HONE
2 - CALIPER
3 - PISTON BORE

ASSEMBLY

CAUTION: Dirt, oil, and solvents can damage caliper seals. Insure assembly area is clean and dry.

(1) Lubricate caliper pistons, piston seals and piston bores with clean, fresh brake fluid.

(2) Install new piston seals into caliper bores (Fig. 27).

NOTE: Verify seal is fully seated and not twisted.

(3) Lightly lubricate lip of new boot with silicone grease. Install boot on piston and work boot lip into the groove at the top of piston.

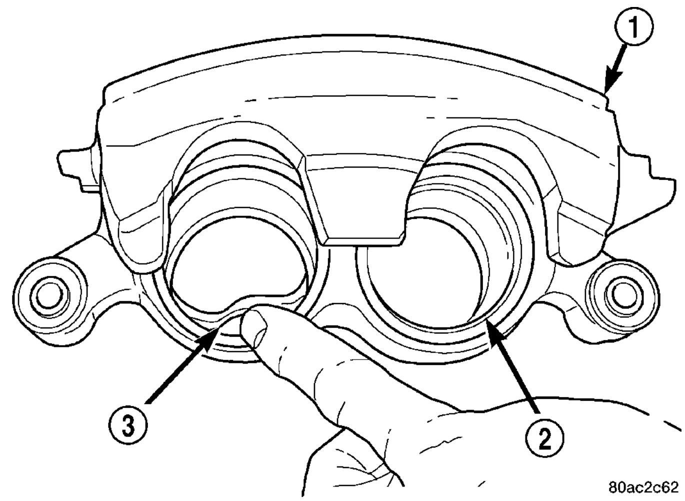


Fig. 27 Piston Seal

1 - CALIPER
2 - PISTON BORE
3 - PISTON SEAL

(4) Stretch boot rearward to straighten boot folds, then move boot forward until folds snap into place.

(5) Install piston into caliper bore and press piston down to the bottom of the caliper bore by hand or with hammer handle (Fig. 28).

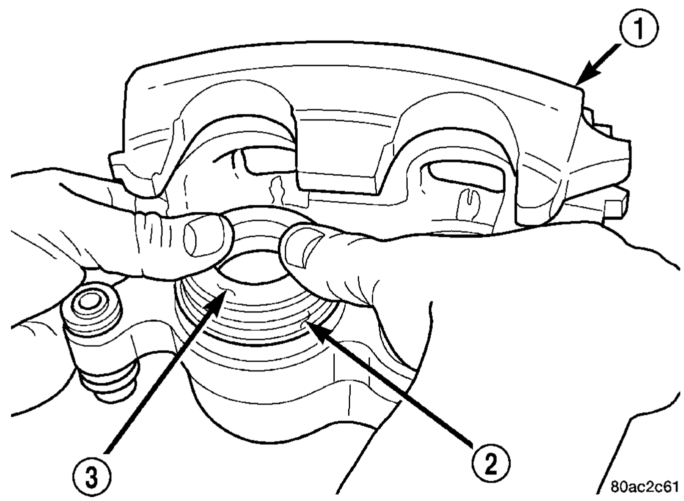


Fig. 28 Caliper Piston Installation

1 - CALIPER
2 - DUST BOOT
3 - PISTON

(6) Seat dust boot in caliper (Fig. 29) with Handle C-4171 and Installer:

- HD 56 mm caliper: Installer C-4340
- LD 54 mm caliper: Installer C-3716-A

(7) Install the second piston and dust boot.

(8) Lubricate caliper mounting bolt bushings, boot seals and bores with Mopar brake grease or Dow Corning® 807 grease only.

DISC BRAKE CALIPERS (Continued)

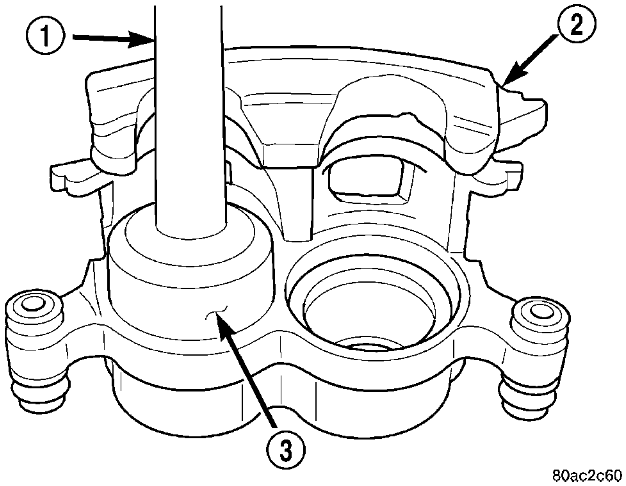


Fig. 29 Seating Dust Boot

1 - HANDLE
2 - CALIPER
3 - DUST BOOT INSTALLER

CAUTION: Use of alternative grease may cause damage to the boots seals.

(9) Install the boot seals into the caliper seal bores and center the seals in the bores.
(10) Install mounting bolt bushings into the boot seals and insure seal lip is engaged into the bushing grooves at either end of the bushing.
(11) Install caliper bleed screw.

INSTALLATION

INSTALLATION - REAR

(1) Install caliper to the caliper adapter.
(2) Coat the caliper mounting slide pin bolts with silicone grease. Then install and tighten the bolts to 15 N·m (11 ft. lbs.).
(3) Install the brake hose banjo bolt if removed.
(4) Install the brake hose to the caliper with **new seal washers** and tighten fitting bolt to 31 N·m (23 ft. lbs.).

CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.

(5) Remove the prop rod from the vehicle.
(6) Bleed the base brake system,(Refer to 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).
(7) Install the wheel and tire assemblies (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(8) Remove the supports and lower the vehicle.
(9) Verify a firm pedal before moving the vehicle.

INSTALLATION - FRONT

NOTE: Install a new copper washers on the banjo bolt when installing

(1) Install the disc brake caliper (Fig. 19) or (Fig. 20).

CAUTION: Verify brake hose is not twisted or kinked before tightening fitting bolt.

(2) Install the banjo bolt with new copper washers to the caliper. Tighten to 27 N·m (20 ft. lbs.)
(3) Install the caliper slide pin bolts. tighten to 32 N·m (24 ft. lbs.)
(4) Remove the prop rod.
(5) Bleed the base brake system, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL - STANDARD PROCEDURE).
(6) Install the tire and wheel assembly, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(7) Lower the vehicle.

DISC BRAKE CALIPER ADAPTER

REMOVAL

REMOVAL - REAR

(1) Raise and support the vehicle.
(2) Remove the wheel and tire assembly.
(3) Drain a small amount of fluid from master cylinder brake reservoir with a **clean** suction gun.
(4) Bottom the caliper pistons into the caliper by prying the caliper over.
(5) Remove the caliper mounting bolts (Fig. 30).
(6) Remove the disc brake caliper from the mount.

CAUTION: Never allow the disc brake caliper to hang from the brake hose. Damage to the brake hose will result. Provide a suitable support to hang the caliper securely.

(7) Remove the inboard and outboard brake pads (Fig. 30).
(8) Remove the anti-rattle clips (Fig. 30).
(9) Remove the caliper adapter mounting bolts (Fig. 30).

REMOVAL - FRONT

(1) Raise and support the vehicle.
(2) Remove the tire and wheel assembly.

DISC BRAKE CALIPER ADAPTER (Continued)

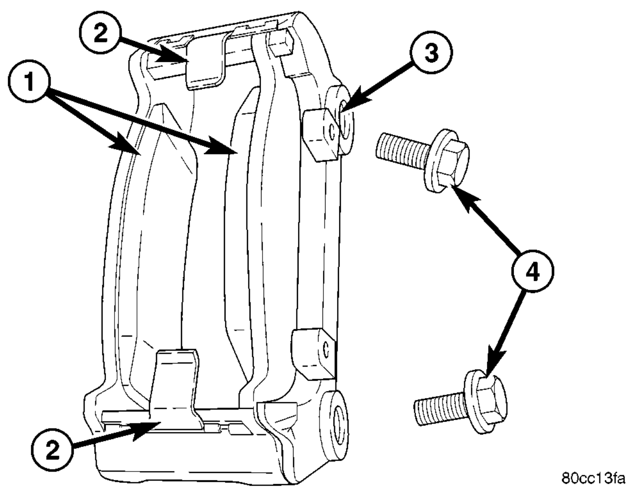


Fig. 30 CALIPER MOUNT

1 - DISC BRAKE PADS
2 - ANTI-RATTLE CLIPS
3 - CALIPER ADAPTER
4 - MOUNTING BOLTS

(3) Remove the disc brake caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(4) Remove the bolts securing the caliper adapter to the steering knuckle (Fig. 31)

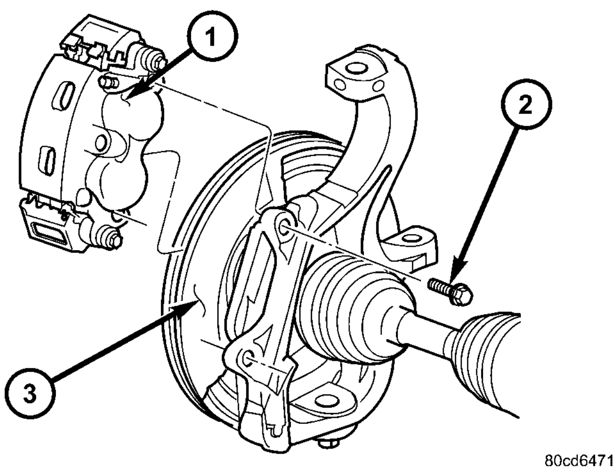


Fig. 31 CALIPER ADAPTER

1 - CALIPER ASSEMBLY
2 - MOUNTING BOLT
3 - DISC BRAKE ROTOR

(5) Remove the caliper adapter.

INSTALLATION

INSTALLATION - REAR

(1) Install the caliper adapter mounting bolts. Tighten the mounting bolts to 135 N·m (100 ft.lbs) (Fig. 30).

(2) Install the anti-rattle clips (Fig. 30).

(3) Install the inboard and outboard pads (Fig. 30).

(4) Install the caliper mounting bolts.

(5) Install the tire and wheel assembly

INSTALLATION - FRONT

(1) Install the caliper adapter to the steering knuckle (Fig. 31).

(2) Install the caliper adapter mounting bolts and tighten to 176 N·m (130 ft.lbs.) (Fig. 31).

(3) Install the disc brake caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(4) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(5) Remove the support and lower the vehicle.

DISC BRAKE CALIPER ADAPTER MOUNT

REMOVAL - REAR

(1) Remove wheel and tire assembly.

(2) Remove the disc brake caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(3) Remove the caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL).

(4) Remove the rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(5) Remove the axle shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - REMOVAL).

(6) Remove the park brake shoes (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - REMOVAL).

(7) Remove the parking brake cable from the brake lever.

(8) Remove the bolts attaching the support plate to the axle and remove the support plate (Fig. 54).

(9) Remove the caliper adapter mount from the axle housing (Fig. 32).

INSTALLATION

(1) Install the caliper adapter mount on the axle housing (Fig. 32).

(2) Install support plate on axle flange (Fig. 55). Tighten attaching bolts to 115 N·m (85 ft. lbs.).

(3) Install parking brake cable in the brake lever.

(4) Install the park brake shoes (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - INSTALLATION). (Fig. 55).

(5) Install axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - INSTALLATION).

DISC BRAKE CALIPER ADAPTER MOUNT (Continued)

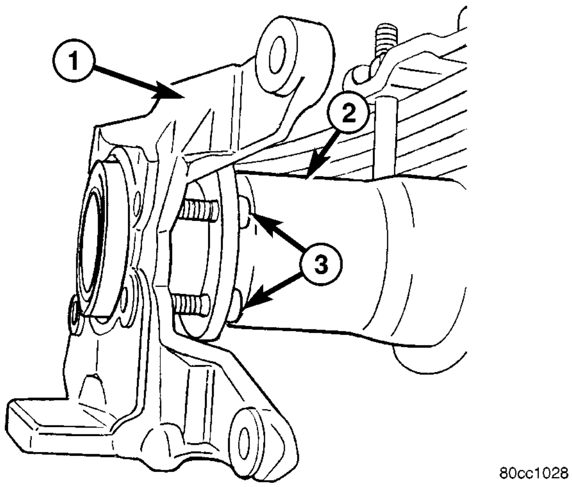


Fig. 32 CALIPER ADAPTER MOUNT - REAR

1 - CALIPER ADAPTER MOUNT
2 - AXLE TUBE
3 - MOUNTING STUDS

(6) Adjust brake shoes to drum with brake gauge (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - ADJUSTMENTS).

(7) Install the rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(8) Install the caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).

(9) Install the caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(10) Install wheel and tire assembly.

FLUID

DIAGNOSIS AND TESTING - BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

Swollen rubber parts indicate the presence of petroleum in the brake fluid.

To test for contamination, put a small amount of drained brake fluid in clear glass jar. If fluid separates into layers, there is mineral oil or other fluid contamination of the brake fluid.

If brake fluid is contaminated, drain and thoroughly flush system. Replace master cylinder, proportioning valve, caliper seals, wheel cylinder seals, Antilock Brakes hydraulic unit and all hydraulic fluid hoses.

STANDARD PROCEDURE - BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and caps before checking fluid level. If not cleaned, dirt could enter the fluid.

The fluid fill level is indicated on the side of the master cylinder reservoir (Fig. 33).

The correct fluid level is to the MAX indicator on the side of the reservoir. If necessary, add fluid to the proper level.

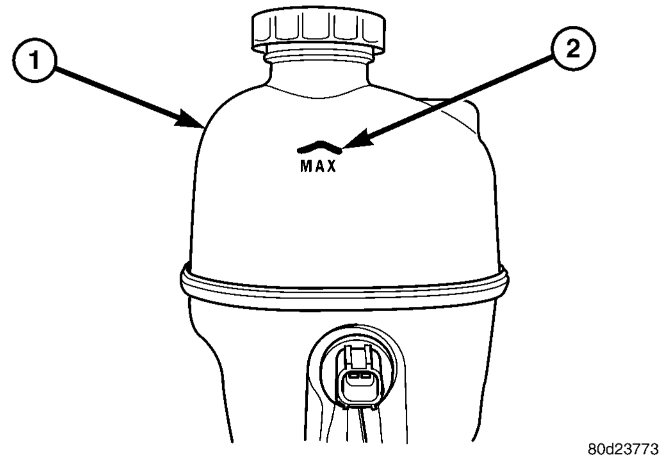


Fig. 33 FLUID LEVEL

1 - FLUID RESERVOIR
2 - MAX LEVEL MARK

SPECIFICATIONS

BRAKE FLUID

The brake fluid used in this vehicle must conform to DOT 3 specifications and SAE J1703 standards. No other type of brake fluid is recommended or approved for usage in the vehicle brake system. Use only Mopar brake fluid or an equivalent from a tightly sealed container.

CAUTION: Never use reclaimed brake fluid or fluid from an container which has been left open. An open container of brake fluid will absorb moisture from the air and contaminate the fluid.

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system. Petroleum based fluids would be items such as engine oil, transmission fluid, power steering fluid, etc.

FLUID RESERVOIR

REMOVAL

(1) Install the prop rod on the brake pedal to keep pressure on the brake system.

(2) Remove the reservoir cap and siphon fluid into a drain container (Fig. 34).

(3) Remove the electrical connector from the fluid level switch in the reservoir (Fig. 34).

(4) Remove the reservoir mounting bolt (Fig. 34).

(5) Remove the reservoir from the master cylinder by pulling upwards.

(6) Remove old grommets from cylinder body (Fig. 34).

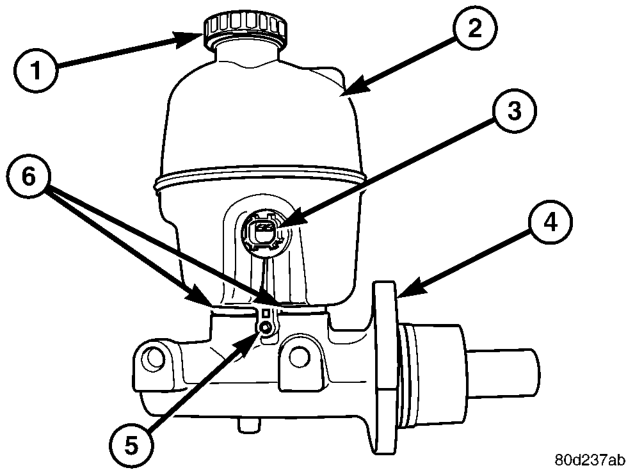


Fig. 34 FLUID RESERVOIR

1 - MASTER CYLINDER CAP
2 - FLUID RESERVOIR
3 - FLUID LEVEL SWITCH
4 - MASTER CYLINDER
5 - MOUNTING BOLT
6 - GROMMETS

INSTALLATION

CAUTION: Do not use any type of tool to install the grommets. Tools may cut, or tear the grommets creating a leak problem after installation. Install the grommets using finger pressure only.

(1) Lubricate the new grommets with clean brake fluid and Install new grommets in cylinder body. Use finger pressure to install and seat grommets.

(2) Start the reservoir in grommets. Then rock the reservoir back and forth while pressing downward to seat it into the grommets.

(3) Install the mounting bolt for the reservoir to the master cylinder.

(4) Reconnect the electrical connector to the fluid reservoir level switch.

(5) Remove the prop rod from the vehicle.

(6) Fill and bleed base brake system,(Refer to 5 - BRAKES - STANDARD PROCEDURE).

BRAKE JUNCTION BLOCK

REMOVAL

(1) Remove the brake lines from the junction block (Fig. 35).

(2) Remove the junction block mounting bolt and remove the junction block from the bracket (Fig. 35).

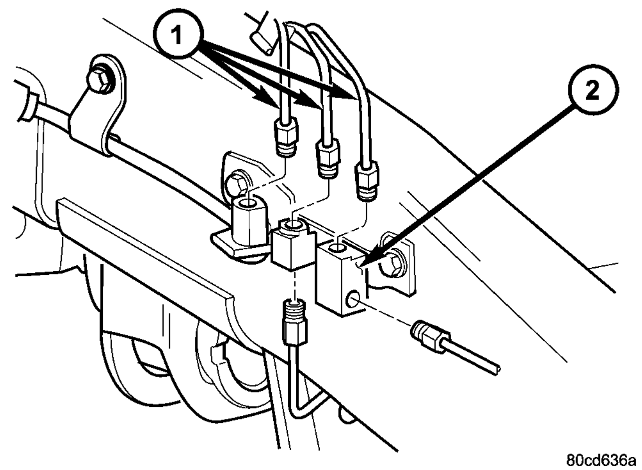


Fig. 35 JUNCTION BLOCK

1 - BRAKE LINES
2 - JUNCTION BLOCK

INSTALLATION

(1) Position the junction block on the bracket and install the mounting bolt. Tighten the mounting bolt to 23 N·m (210 in. lbs.) (Fig. 35).

(2) Install the brake lines into the junction block and tighten to 19-23 N·m (170-200 in. lbs.) (Fig. 35).

(3) Bleed the base brake system, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL - STANDARD PROCEDURE).

MASTER CYLINDER

DESCRIPTION

A two-piece master cylinder is used on all models. The cylinder body containing the primary and secondary pistons is made of aluminum. The removable fluid reservoir is made of nylon reinforced with glass fiber. The reservoir stores reserve brake fluid for the hydraulic brake circuits and has a switch for indicating low fluid levels. The reservoir is the only serviceable component.

The fluid compartments of the nylon reservoir are interconnected to permit fluid level equalization. However, the equalization feature does not affect cir-

MASTER CYLINDER (Continued)

cuit separation in the event of a front or rear brake malfunction. The reservoir compartments will retain enough fluid to operate the functioning hydraulic circuit.

Care must be exercised when removing/installing the master cylinder connecting lines. The threads in the cylinder fluid ports can be damaged if care is not exercised. Start all brake line fittings by hand to avoid cross threading.

The cylinder reservoir can be replaced when necessary. However, the aluminum body section of the master cylinder is not a repairable component.

NOTE: If diagnosis indicates that an internal malfunction has occurred, the aluminum body section must be replaced as an assembly.

OPERATION

The master cylinder bore contains a primary and secondary piston. The primary piston supplies hydraulic pressure to the front brakes. The secondary piston supplies hydraulic pressure to the rear brakes.

DIAGNOSIS AND TESTING - MASTER CYLINDER/POWER BOOSTER

(1) Start engine and check booster vacuum hose connections. A hissing noise indicates vacuum leak. Correct any vacuum leak before proceeding.

(2) Stop engine and shift transmission into Neutral.

(3) Pump brake pedal until all vacuum reserve in booster is depleted.

(4) Press and hold brake pedal under light foot pressure. The pedal should hold firm, if the pedal falls away master cylinder is faulty (internal leakage).

(5) Start engine and note pedal action. It should fall away slightly under light foot pressure then hold firm. If no pedal action is discernible, power booster, vacuum supply, or vacuum check valve is faulty. Proceed to the POWER BOOSTER VACUUM TEST.

(6) If the POWER BOOSTER VACUUM TEST passes, rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close the throttle and immediately turn off ignition to stop engine.

(7) Wait a minimum of 90 seconds and try brake action again. Booster should provide two or more vacuum assisted pedal applications. If vacuum assist is not provided, booster is faulty.

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 36).

(2) Start and run engine at curb idle speed for one minute.

(3) Observe the vacuum supply. If vacuum supply is not adequate, repair vacuum supply.

(4) Clamp hose shut between vacuum source and check valve.

(5) Stop engine and observe vacuum gauge.

(6) If vacuum drops more than one inch HG (33 millibars) within 15 seconds, booster diaphragm or check valve is faulty.

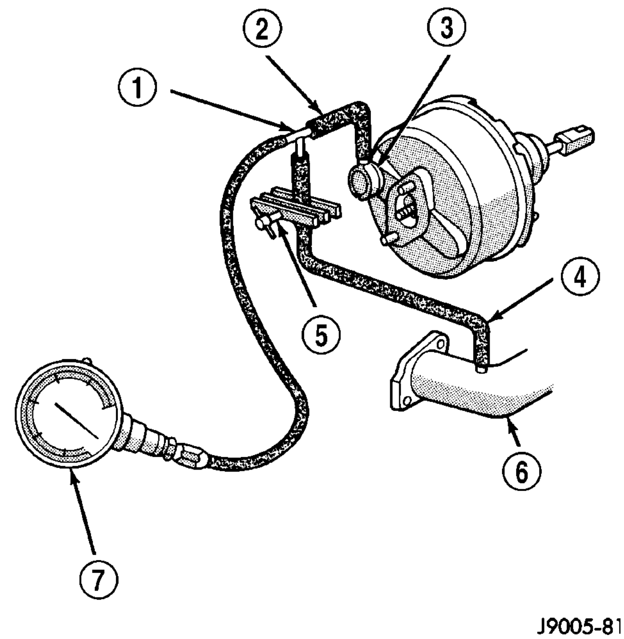


Fig. 36 Typical Booster Vacuum Test Connections

1 - TEE FITTING
2 - SHORT CONNECTING HOSE
3 - CHECK VALVE
4 - CHECK VALVE HOSE
5 - CLAMP TOOL
6 - INTAKE MANIFOLD
7 - VACUUM GAUGE

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster.

(3) Use a hand operated vacuum pump for test.

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 37).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

STANDARD PROCEDURE - MASTER CYLINDER BLEEDING

A new master cylinder should be bled before installation on the vehicle. Required bleeding tools include bleed tubes and a wood dowel to stroke the pistons. Bleed tubes can be fabricated from brake line.

MASTER CYLINDER (Continued)

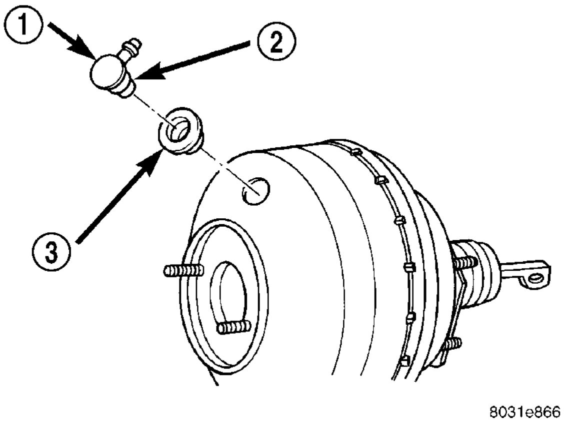


Fig. 37 Vacuum Check Valve And Seal

1 - BOOSTER CHECK VALVE
2 - APPLY TEST VACUUM HERE
3 - VALVE SEAL

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into reservoir (Fig. 38).

(3) Fill reservoir with fresh brake fluid.

(4) Press cylinder pistons inward with wood dowel. Then release pistons and allow them to return under spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.

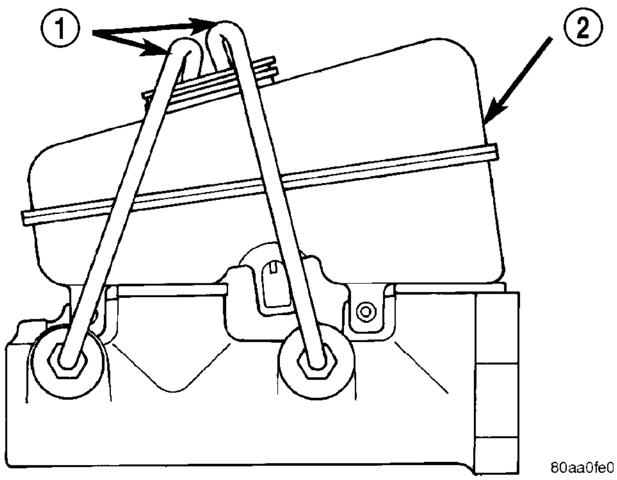


Fig. 38 Master Cylinder Bleeding–Typical

1 - BLEEDING TUBES
2 - RESERVOIR

REMOVAL

REMOVAL - ALL EXCEPT HYDROBOOST

(1) Remove the brake lines from the master cylinder (Fig. 39).

(2) Disconnect the electrical connector for the low fluid level.

(3) Remove the mounting nuts from the master cylinder (Fig. 39).

(4) Remove the master cylinder.

NOTE: Using care remove the master cylinder directly forward in order not to dislodge the output rod from its seat inside the booster.

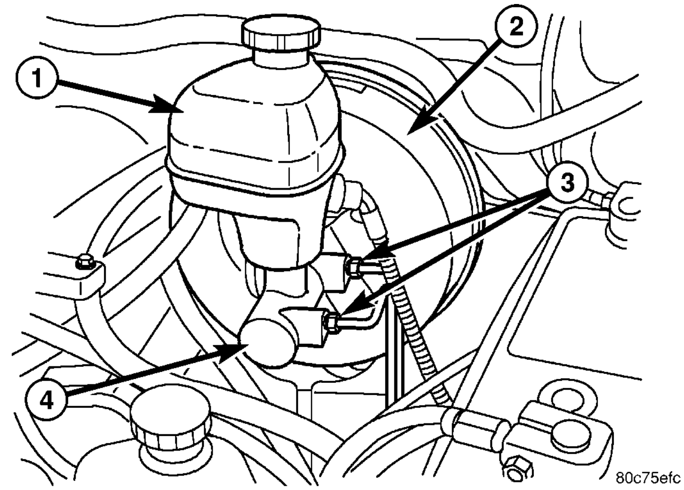


Fig. 39 MASTER CYLINDER

1 - MASTER CYLINDER RESERVOIR
2 - POWER BRAKE BOOSTER
3 - BRAKE LINES
4 - MASTER CYLINDER

REMOVAL - HYDROBOOST

(1) Remove the brake lines from the master cylinder (Fig. 40).

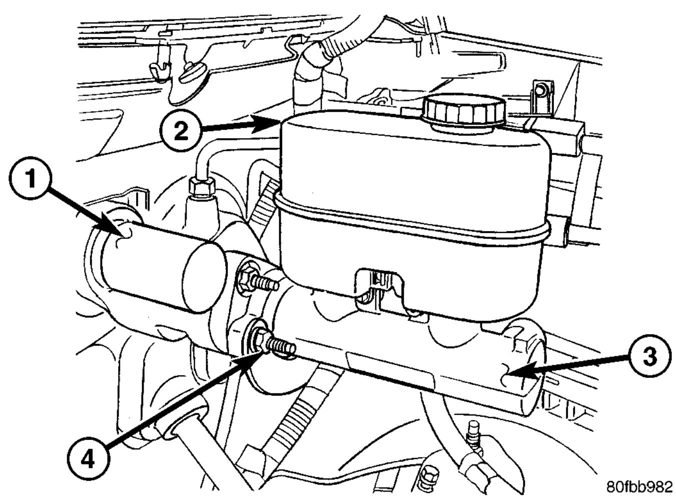


Fig. 40 HYDROBOOST MASTER CYLINDER

1 - HYDROBOOST UNIT
2 - MASTER CYLINDER RESERVOIR
3 - MASTER CYLINDER
4 - MOUNTING NUTS

(2) Disconnect the electrical connector for the low fluid level.

(3) Remove the mounting nuts from the master cylinder (Fig. 40).

(4) Remove the master cylinder.

NOTE: Using care remove the master cylinder directly forward in order not to dislodge the output rod from its seat inside the booster.

(4) Reconnect the elctrical connector for the low fluid level switch.

(5) Fill and bleed the base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

INSTALLATION

INSTALLATION - ALL EXCEPT HYDROBOOST

NOTE: If master cylinder is replaced bleed cylinder before installation.

NOTE: Make sure the output rod of the brake booster is in position before mounting of the master cylinder "This position will enable the output rod to enter inside of the master cylinder plunger sleeve during installation". Proper position is obtained when the output rod is centered perpendicular to the master cylinder mounting hole (Fig. 41).

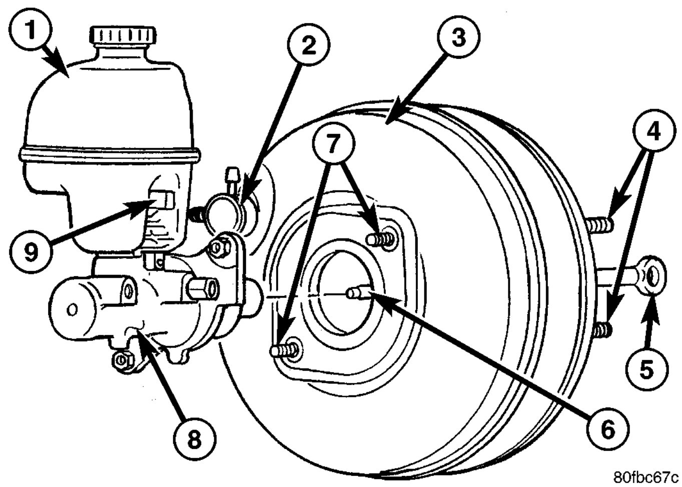


Fig. 41 OUTPUT ROD ORIENTATION

1 - MASTER CYLINDER RESERVOIR
2 - CHECK VALVE
3 - BOOSTER
4 - BOOSTER MOUNTING STUDS
5 - INPUT ROD
6 - OUTPUT ROD
7 - MASTER CYLINDER MOUNTING STUDS
8 - MASTER CYLINDER
9- ELECTRICAL CONNECTOR

NOTE: Before installing the master cylinder, pump the brake pedal several times with the engine off to remove vacuum from the booster.

(1) Install the master cylinder on the booster mounting studs.

(2) Install new mounting nuts and tighten to 25 N·m (221 in. lbs.)

(3) Install the brake lines and tighten to 19 N·m (170 in. lbs.)

INSTALLATION - HYDROBOOST

NOTE: If master cylinder is replaced bleed cylinder before installation.

NOTE: Make sure the output rod of the brake booster is in position before mounting of the master cylinder "This position will enable the output rod to enter inside of the master cylinder plunger sleeve during installation". Proper position is obtained when the output rod is centered perpendicular to the master cylinder mounting hole (Fig. 41).

(1) Install the master cylinder on the booster mounting studs (Fig. 40).

(2) Install new mounting nuts and tighten to 25 N·m (221 in. lbs.)

(3) Install the brake lines and tighten to 19 N·m (170 in. lbs.)

(4) Reconnect the elctrical connector for the low fluid level switch.

(5) Fill and bleed the base brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

PEDAL

DESCRIPTION

NOTE: The brake pedal is serviced as a complete assembly including accelerator pedal and the bracket.

A suspended-type brake pedal is used. The pedal is attached to the pedal support bracket with a pivot shaft pin and bushings. If the bushings become dry a spray lubricant can be used to eliminate noises. The booster push rod is attached to the pedal with a clip. The pedal, bushings, pivot pin and support bracket are not serviceable components (Fig. 42).

OPERATION

The brake pedal is attached to the booster push rod. When the pedal is depressed, the primary booster push rod is depressed which move the booster secondary rod. The booster secondary rod depress the master cylinder piston.

PEDAL (Continued)

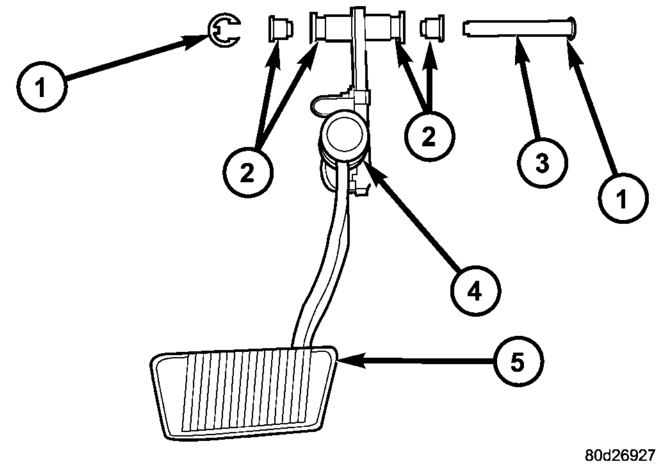


Fig. 42 BRAKE PEDAL

1 - CLIP
2 - BUSHINGS
3 - PIVOT SHAFT PIN
4 - PEDAL ASSEMBLY
ADJUSTABLE PEDAL SHOWN
NON ADJUSTABLE PEDAL IS SIMILIAR
5 - PAD

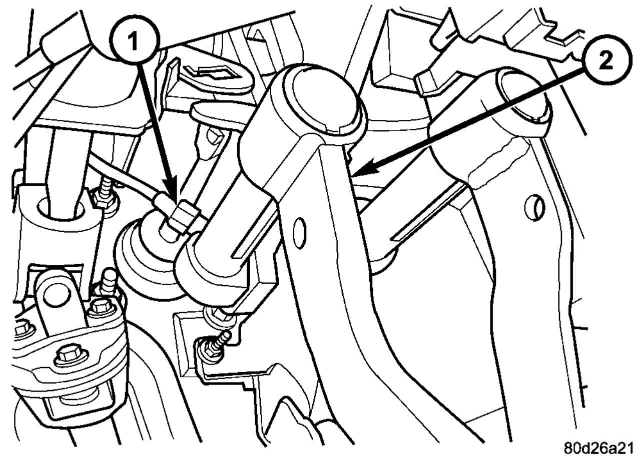


Fig. 43 PEDAL/CABLE

1 - CABLE
2 - BRAKE PEDAL ASSEMBLY

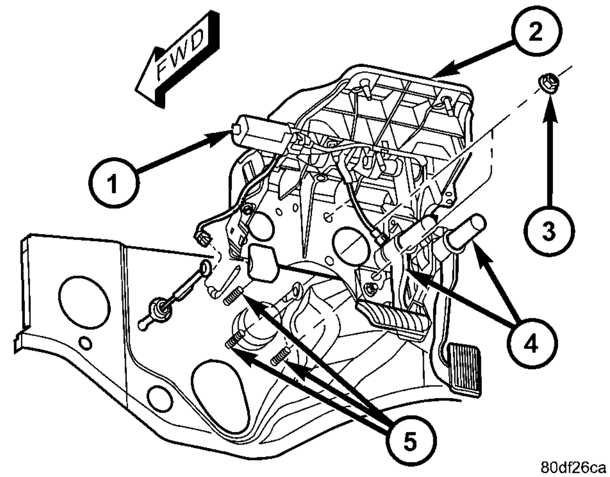


Fig. 44 PEDAL ASSEMBLY (ADJUSTABLE PEDALS SHOWN)

1 - ADJUSTABLE PEDAL MOTOR
2 - PEDAL ASSEMBLY BRACKET
3 - MOUNTING NUT
4 - BRAKE & ACCELERATOR PEDAL
5 - BRAKE BOOSTER MOUNTING STUDS

REMOVAL

NOTE: The brake pedal is serviced as a complete assembly including accelerator pedal and the bracket.

(1) Disconnect the negative battery cable.

(2) Remove the steering column opening cover(Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the brake lamp switch and discard(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(4) **On vehicles equipped with adjustable pedals.** Disconnect the adjuster cable to the pedal (Fig. 43).

(5) Remove the steering column (Refer to 19 - STEERING/COLUMN - REMOVAL).

(6) Remove the brake booster (Fig. 44)(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - REMOVAL).

(7) Disconnect the electrical connectors.

(8) Remove the module mounting bolts.

(9) Disconnect the accelerator pedal cable.

(10) Remove the pedal assembly mounting nuts/fasteners (Fig. 44).

INSTALLATION

(1) Install the pedal assembly to the vehicle (Fig. 44).

(2) Install the mounting bolts (Fig. 44) and tighten to 28 N·m (21 ft. lbs.).

(3) Reconnect the accelerator cable to the pedal.

(4) Install the module mounting bolts and tighten to 38 N·m (28 ft. lbs.).

(5) Reconnect the electrical connectors.

(6) Install the brake booster (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - INSTALLATION).

(7) Install the steering column (Refer to 19 - STEERING/COLUMN - INSTALLATION).

(8) Install a new brake lamp switch. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(9) **On vehicles equipped with adjustable brake pedal.**Reconnect the electrical connector to the motor and the adjuster cable at the pedal.

PEDAL (Continued)

(10) Install the steering column opening cover (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(11) Reconnect the negative battery cable.

ADJUSTABLE PEDAL MOTOR

DESCRIPTION

The Adjustable Pedals System (APS) is designed to enable the fore and aft repositioning of the brake and accelerator pedals. This results in improved ergonomics in relation to the steering wheel for taller and shorter drivers. Being able to adjust the pedal positions also allows the driver to set steering wheel tilt and seat position to the most comfortable position. The position of the brake and accelerator pedals can be adjusted without compromising safety or comfort in actuating the pedals.

Change of pedal position is accomplished by means of a motor driven screw. Operating the adjustable pedal switch activates the pedal drive motor (Fig. 45). The pedal drive motor turns a screw that changes the position of the brake and accelerator pedals. The pedal can be moved rearward (closer to the driver) or forward (away from driver). The brake pedal is moved on its drive screw to a position where the driver feels most comfortable.

The accelerator pedal is moved at the same time and the same distance as the brake pedal.

Neither the pedal drive motor (Fig. 45) nor drive mechanism are subject to the mechanical stress of brake or accelerator application.

- SYSTEM FEATURES:
  - Range of Adjustment: The pedals may be adjusted up to 3 in. (75 mm)
  - Pedal Adjustment Speed: 0.5 in./sec (12.5 mm/sec)
  - Pedal Adjustment Inhibitors: Pedal adjustment is inhibited when the vehicle is in reverse or when cruise control is activated.

REMOVAL

(1) Disconnect the negative battery cable.

(2) Remove the kneeblocker (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(3) Remove the brake light switch and discard (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(4) Disconnect the adjustable pedal cables from the brake and accelerator pedals.

(5) Disconnect the electrical connector.

(6) Unclip the cable fasteners to the support.

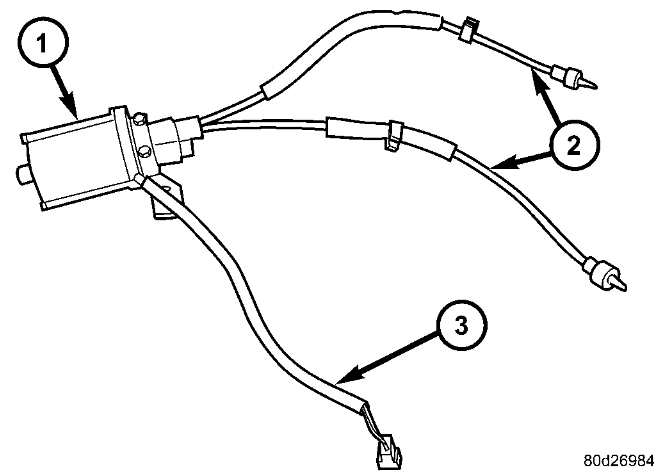


Fig. 45 ADJUSTABLE PEDAL MOTOR

1 - ADJUSTABLE PEDAL MOTOR
2 - CABLES
3 - ELECTRICAL CONNECTOR

(7) Remove the one mounting bolt for the adjustable pedal motor (Fig. 46).

(8) Remove the adjustable pedal motor with the cables.

NOTE: Adjustable pedal cables are not serviceable. If they need service the adjustable pedal motor with the cables must be installed.

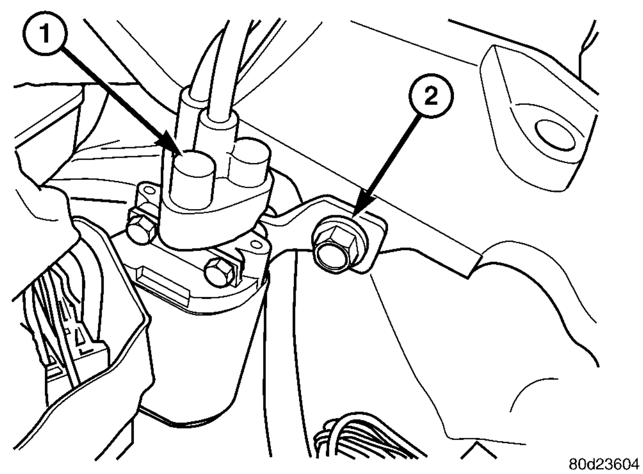


Fig. 46 ADJUSTABLE PEDAL MOTOR

1 - ADJUSTABLE PEDAL MOTOR
2 - MOUNTING BOLT

INSTALLATION

NOTE: Adjustable pedal cables are not serviceable. If they need service the adjustable pedal motor with the cables must be installed.

(1) Install the adjustable pedal motor with the cables.

ADJUSTABLE PEDAL MOTOR (Continued)

(2) Install the one mounting bolt for the adjustable pedal motor (Fig. 46).
(3) Clip the cable fasteners to the support.
(4) Reconnect the electrical connector.
(5) Reconnect the adjustable pedal cables to the brake and accelerator pedals.
(6) Install the new brake light switch (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ BRAKE LAMP SWITCH - REMOVAL).
(7) Install the kneeblocker (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).
(8) Reconnect the negative battery cable.
(9) Check for proper operation of the pedals.

POWER BRAKE BOOSTER

DESCRIPTION

All models use a tandem diaphragm, power brake booster.

NOTE: The power brake booster is not a repairable component. The booster must be replaced as an assembly if diagnosis indicates a malfunction has occurred.

OPERATION

The booster unit consists of a single housing divided into two by a tandem diaphragm. The outer edge of the diaphragm is secured to the housing. The booster push rod, which connects the booster to the brake pedal and master cylinder, is attached to the center of the diaphragm. A check valve is used in the booster outlet connected to the engine intake manifold. Power assist is generated by utilizing a combination of vacuum and atmospheric pressure to boost brake assist.

REMOVAL

(1) Remove master cylinder. (Refer to 5 - BRAKES/ HYDRAULIC/MECHANICAL/MASTER CYLINDER - REMOVAL).
(2) Disconnect vacuum line at booster.
(3) Remove clip securing booster push rod to brake pedal (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/PEDAL - REMOVAL). (Fig. 47).
(4) Remove the nuts from the booster mounting studs (Fig. 47).
(5) Remove the booster and gasket from front cowl panel.

INSTALLATION

(1) Guide the booster studs into the cowl panel holes and seat the booster on the panel (Fig. 47).

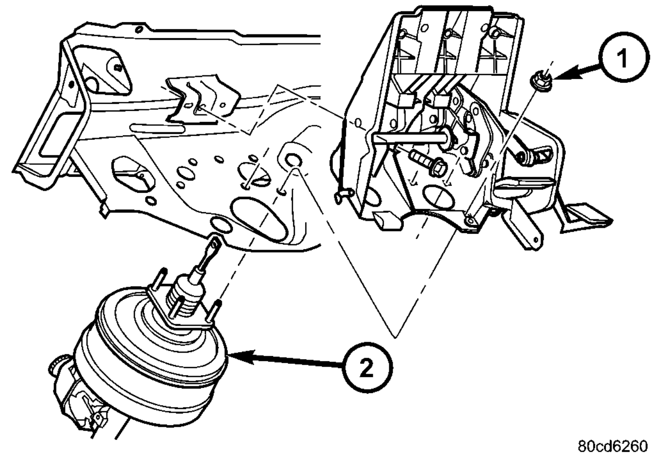


Fig. 47 POWER BRAKE BOOSTER

1 - MOUNTING NUT
2 - POWER BRAKE BOOSTER

(2) Install and tighten new booster attaching nuts to 28 N·m (250 in. lbs.).
(3) Install the booster push rod on brake pedal and install clip (Fig. 47).
(4) Install the booster check valve if removed and connect the vacuum hose to the check valve.
(5) Install the master cylinder. (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/MASTER CYLINDER - INSTALLATION).
(6) Fill and bleed the brake system. (Refer to 5 - BRAKES - STANDARD PROCEDURE).

HYDRO-BOOST BRAKE BOOSTER

DIAGNOSIS AND TESTING - HYDRAULIC BOOSTER

The hydraulic booster uses hydraulic pressure from the power steering pump. Before diagnosing a booster problem, first verify the power steering pump is operating properly. Perform the following checks.

- Check the power steering fluid level.
- Check the brake fluid level.
- Check all power steering hoses and lines for leaks and restrictions.
- Check power steering pump pressure.

NOISES

The hydraulic booster unit will produce certain characteristic booster noises. The noises may occur when the brake pedal is used in a manner not associated with normal braking or driving habits.

HYDRO-BOOST BRAKE BOOSTER (Continued)

HISSING

A hissing noise may be noticed when above normal brake pedal pressure is applied, 40 lbs. or above. The noise will be more noticeable if the vehicle is not moving. The noise will increase with the brake pedal pressure and an increase of system operating temperature.

CLUNK-CHATTER-CLICKING

A clunk-chatter-clicking may be noticed when the brake pedal is released quickly, after above normal brake pedal pressure is applied 50-100 lbs..

BOOSTER FUNCTION TEST

With the engine off depress the brake pedal several times to discharge the accumulator. Then depress the brake pedal using 40 lbs. of force and start the engine. The brake pedal should fall and then push back against your foot. This indicates the booster is operating properly.

ACCUMULATOR LEAKDOWN

(1) Start the engine, apply the brakes and turn the steering wheel from lock to lock. This will ensure the accumulator is charged. Turn off the engine and let the vehicle sit for one hour. After one hour there should be at least two power assisted brake application with the engine off. If the system does not retain a charge the booster must be replaced.

(2) With the engine off depress the brake pedal several times to discharge the accumulator. Grasp the accumulator and see if it wobbles or turns. If it does the accumulator has lost a gas charge and the booster must be replaced.

SEAL LEAKAGE

If the booster leaks from any of the seals the booster assembly must be replaced (Fig. 48).

- **INPUT ROD SEAL:** Fluid leakage from rear end of the booster.
- **PISTON SEAL:** Fluid leakage from vent at front of booster.
- **HOUSING SEAL:** Fluid leakage between housing and housing cover.
- **SPOOL VALVE SEAL:** Fluid leakage near spool plug.
- **RETURN PORT FITTING SEAL:** Fluid leakage from port fitting.

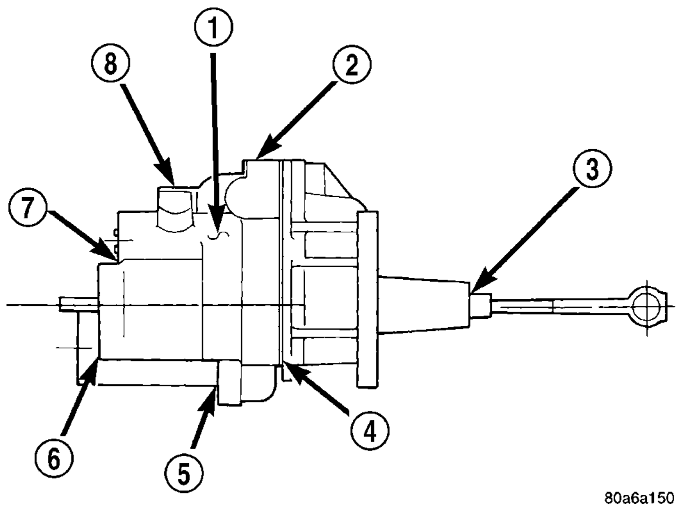


Fig. 48 Hydraulic Booster Seals

1 - PUMP
2 - GEAR
3 - INPUT SEAL
4 - HOUSING SEAL
5 - ACCUMULATOR SEAL
6 - PISTON SEAL
7 - SPOOL PLUG SEAL
8 - RETURN

HYDRAULIC BOOSTER DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Slow Brake Pedal Return	1. Excessive seal friction in booster.	1. Replace booster.
	2. Faulty spool valve action.	2. Replace booster.
	3. Restriction in booster return hose.	3. Replace hose.
	4. Damaged input rod.	4. Replace booster.
Excessive Brake Pedal Effort.	1. Internal or external seal leakage.	1. Replace booster.
	2. Faulty steering pump.	2. Replace pump.

HYDRO-BOOST BRAKE BOOSTER (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Brakes Self Apply	1. Dump valve faulty.	1. Replace booster.
	2. Contamination in hydraulic system.	2. Flush hydraulic system and replace booster.
	3. Restriction in booster return hose.	3. Replace hose.
Booster Chatter, Pedal Vibration	1. Slipping pump belt.	1. Replace power steering belt.
	2. Low pump fluid level.	2. Fill pump and check for leaks.
Grabbing Brakes	1. Low pump flow.	1. Test and repair/replace pump.
	2. Faulty spool valve action.	2. Replace booster.

STANDARD PROCEDURE - BLEEDING

The hydraulic booster is generally self-bleeding, this procedure will normally bleed the air from the booster. Normal driving and operation of the unit will remove any remaining trapped air.

(1) Fill power steering pump reservoir.

(2) Disconnect fuel shutdown relay and crank the engine for several seconds, Refer to Fuel System for relay location and WARNING.

(3) Check fluid level and add if necessary.

(4) Connect fuel shutdown relay and start the engine.

(5) Turn the steering wheel slowly from lock to lock twice.

(6) Stop the engine and discharge the accumulator by depressing the brake pedal 5 times.

(7) Start the engine and turn the steering wheel slowly from lock to lock twice.

(8) Turn off the engine and check fluid level and add if necessary.

NOTE: If fluid foaming occurs, wait for foam to dissipate and repeat steps 7 and 8.

REMOVAL

NOTE: If the booster is being replaced because the power steering fluid is contaminated, flush the power steering system before replacing the booster.

(1) With engine off depress the brake pedal 5 times to discharge the accumulator.

(2) Remove brake lines from master cylinder.

(3) Remove mounting nuts from the master cylinder.

(4) Remove the bracket from the hydraulic booster lines and master cylinder mounting studs.

(5) Remove the master cylinder.

(6) Remove the return hose and the two pressure lines from the hydraulic booster (Fig. 49).

(7) Remove the booster push rod clip, washer and rod remove from the brake pedal.

(8) Remove the mounting nuts from the hydraulic booster and remove the booster.

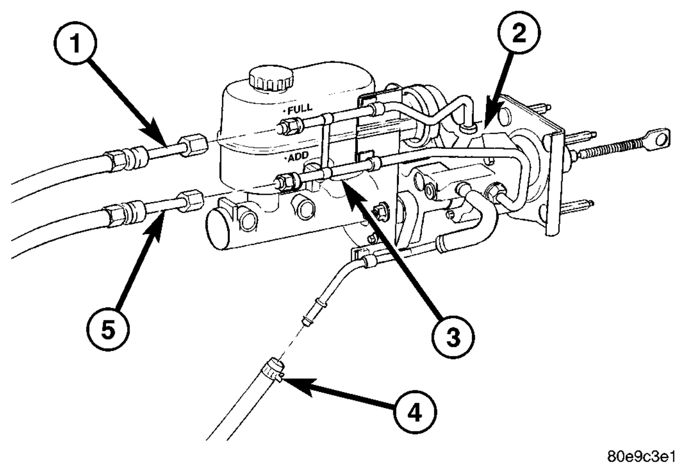


Fig. 49 HYDRO-BOOST UNIT

1 - INLET HOSE
2 - HYDRO-BOOST UNIT
3 - MASTER CYLINDER UNIT
4 - RETURN HOSE
5 - OUTLET HOSE

INSTALLATION

(1) Install the hydraulic booster and tighten the mounting nuts to 28 N·m (21 ft. lbs.).

(2) Install the booster push rod, washer and clip onto the brake pedal.

(3) Install the master cylinder on the mounting studs. and tighten the mounting nuts to 23 N·m (17 ft. lbs.).

(4) Install the brake lines to the master cylinder and tighten to 19-200 N·m (170-200 in. lbs.).

(5) Install the hydraulic booster line bracket onto the master cylinder mounting studs.

(6) Install the master cylinder mounting nuts and tighten to 23 N·m (17 ft. lbs.).

HYDRO-BOOST BRAKE BOOSTER (Continued)

(7) Install the hydraulic booster pressure lines to the bracket and booster.

(8) Tighten the pressure lines to 41 N·m (30 ft. lbs.).

NOTE: Inspect o-rings on the pressure line fittings to insure they are in good condition before installation. Replace o-rings if necessary.

(9) Install the return hose to the booster.

(10) Bleed base brake system, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL - STANDARD PROCEDURE).

(11) Fill the power steering pump with fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

CAUTION: MOPAR (MS-9602) ATF+4 is to be used in the power steering system. No other power steering or automatic transmission fluid is to be used in the system. Damage may result to the power steering pump and system if any other fluid is used, and do not overfill.

(12) Bleed the hydraulic booster (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - STANDARD PROCEDURE).

ROTORS

REMOVAL

REMOVAL - REAR

(1) Raise and support the vehicle

(2) Remove the tire and wheel assembly.

(3) Remove the disc brake caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(4) Remove the caliper adapter bolts (Fig. 50).(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL)

(5) Remove the retianing clips and rotor assembly (Fig. 50).

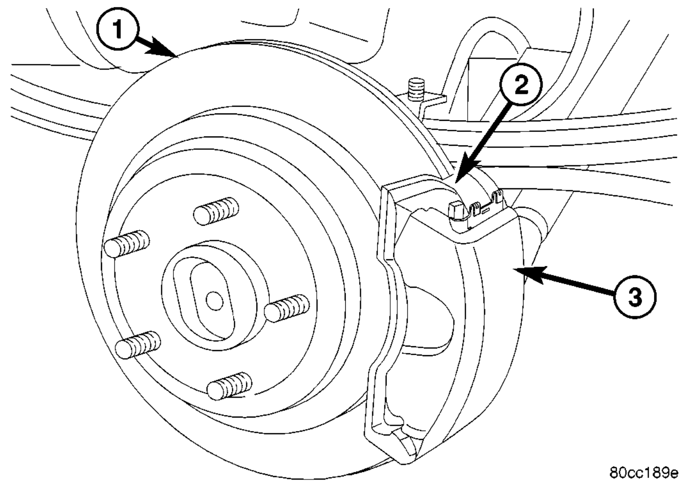


Fig. 50 REAR ROTOR

1 - ROTOR
2 - CALIPER ADAPTER
3 - CALIPER

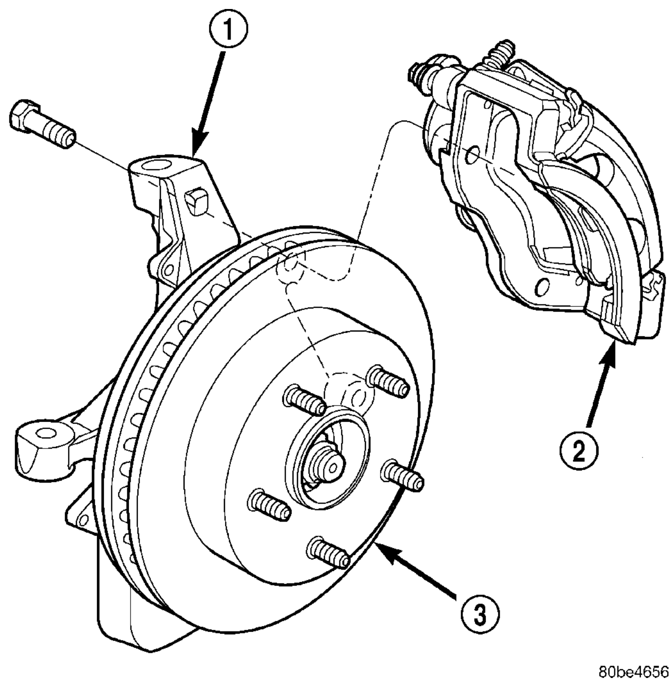


Fig. 51 Caliper Adapter Assembly

1 - KNUCKLE
2 - CALIPER
3 - ROTOR

REMOVAL - FRONT

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the caliper from the steering knuckle, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL) and remove caliper adapter assembly (Fig. 51).

NOTE: Do not allow brake hose to support caliper adapter assembly.

(4) Remove the rotor from the hub/bearing wheel studs (Fig. 52) or (Fig. 53).

INSTALLATION

INSTALLATION - REAR

(1) Install the rotor to the axleshaft (Fig. 50).

ROTORS (Continued)

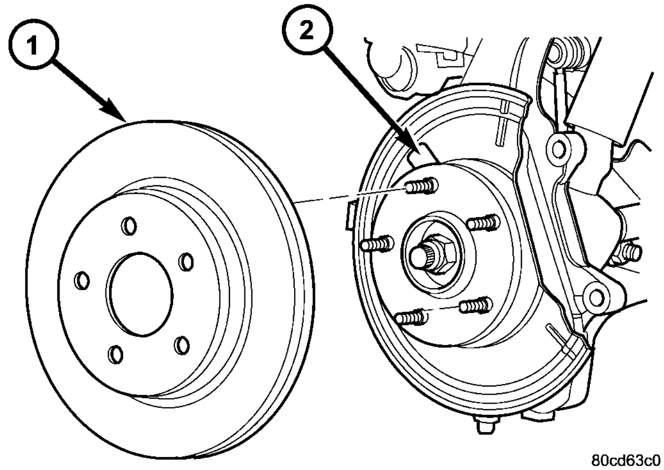


Fig. 52 FRONT ROTOR

1 - ROTOR
2 - HUB/BEARING

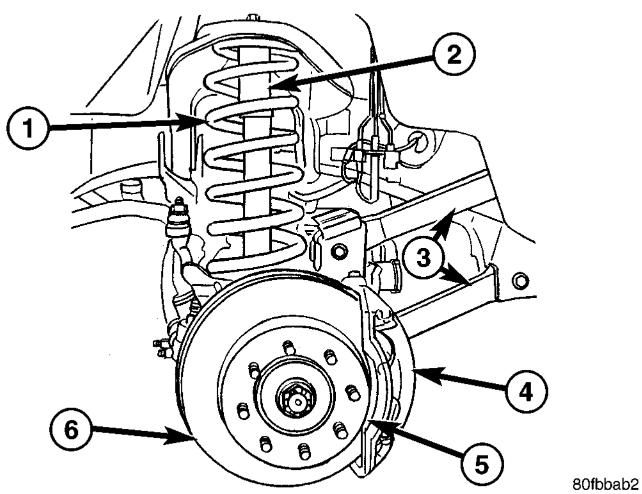


Fig. 53 8 LUG ROTOR ASSEMBLY

1 - SPRING
2 - SHOCK
3 - UPPER AND LOWER SUSPENSION ARMS
4 - DISC BRAKE CALIPER
5 - DISC BRAKE CALIPER ADAPTER
6 - ROTOR

(2) Install the caliper adapter (Fig. 50) (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).

(3) Install the caliper adapter bolts (Fig. 50) and tighten the mounting bolts to 135 N·m (100 ft.lbs).

(4) Install the disc brake caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(5) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(6) Lower the vehicle.

INSTALLATION - FRONT

(1) On models with all-wheel antilock system (ABS), check condition of tone wheel on hub/bearing. If teeth on wheel are damaged, hub/bearing assembly will have to be replaced (tone wheel is not serviced separately).

(2) Install the rotor onto the hub/bearing wheel studs.

(3) Install the caliper adapter assembly,(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION) and tighten adapter bolts to:

(4) Install the wheel and tire assembly, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE) and lower the vehicle.

(5) Apply the brakes several times to seat brake pads. Be sure to obtain firm pedal before moving vehicle.

SUPPORT PLATE

REMOVAL

(1) Remove wheel and tire assembly.

(2) Remove the disc brake caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(3) Remove the caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - REMOVAL).

(4) Remove the rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(5) Remove the axle shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - REMOVAL).

(6) Remove the park brake shoes (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - REMOVAL).

(7) Remove the parking brake cable from the brake lever.

(8) Remove the bolts attaching the support plate to the axle and remove the support plate (Fig. 54).

INSTALLATION

(1) Install support plate on axle flange (Fig. 55). Tighten attaching bolts to 115 N·m (85 ft. lbs.).

(2) Install parking brake cable in the brake lever.

(3) Install the park brake shoes (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - INSTALLATION). (Fig. 55).

(4) Install axle shaft, (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/AXLE SHAFTS - INSTALLATION).

(5) Adjust brake shoes to drum with brake gauge (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - ADJUSTMENTS).

SUPPORT PLATE (Continued)

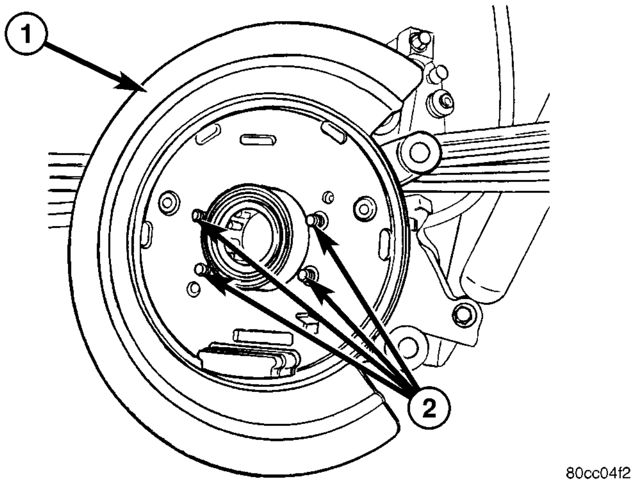


Fig. 54 SUPPORT PLATE

1 - SUPPORT PLATE
2 - MOUNTING STUDS

(6) Install the rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(7) Install the caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPER ADAPTER - INSTALLATION).

(8) Install the caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(9) Install the wheel and tire assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

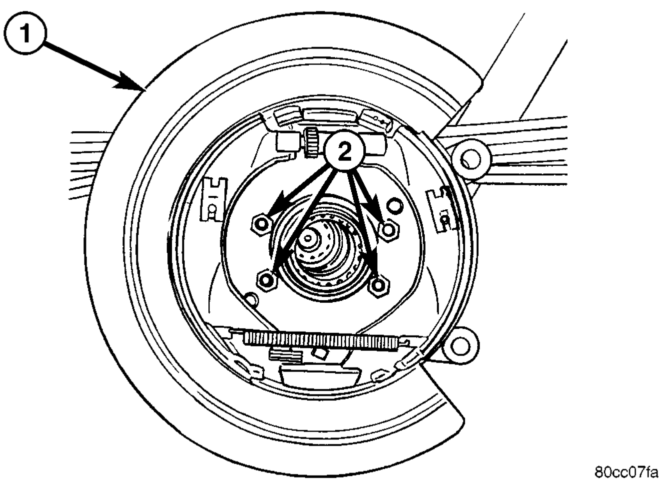


Fig. 55 SUPPORT PLATE WITH BRAKES MOUNTED

1 - SUPPORT PLATE
2 - MOUNTING NUTS

PARKING BRAKE

DESCRIPTION

The parking brakes are operated by a system of cables and levers attached to a primary and secondary shoe positioned within the drum section of the rotor.

The drum-in-hat design utilizes an independent set of shoes to park the vehicle (Fig. 56).

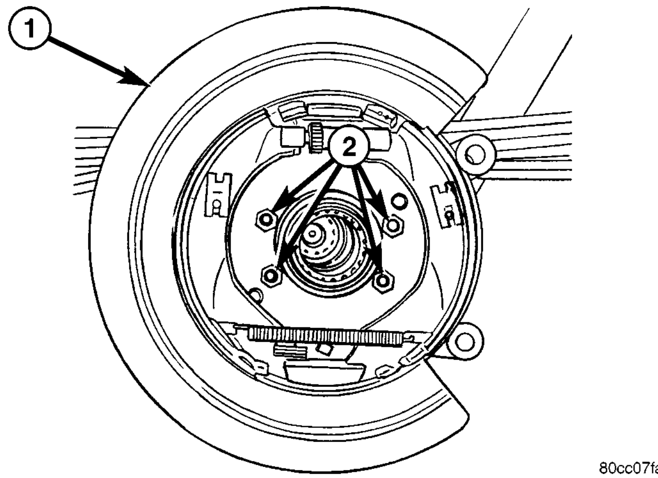


Fig. 56 SUPPORT PLATE WITH BRAKES MOUNTED

1 - SUPPORT PLATE
2 - MOUNTING NUTS

OPERATION

To apply the parking brake the pedal is depressed. This creates tension in the cable which pulls forward on the park brake lever. The lever pushes the park brake shoes outward and into contact with the drum section of the rotor. The contact of shoe to rotor parks the vehicle.

A torsion locking mechanism is used to hold the pedal in an applied position. Parking brake release is accomplished by the hand release.

A parking brake switch is mounted on the parking brake lever and is actuated by movement of the lever. The switch, which is in circuit with the red warning light in the dash, will illuminate the warning light whenever the parking brake is applied.

Parking brake adjustment is controlled by a cable tensioner mechanism. The cable tensioner, once adjusted at the factory, should not need further adjustment under normal circumstances. Adjustment may be required if a new tensioner, or cables are installed, or disconnected.

CABLES

REMOVAL

REMOVAL - FRONT PARKING BRAKE CABLE

(1) Raise and support vehicle.
(2) Lockout the parking brake cable (Fig. 58).
(3) Loosen adjusting nut to create slack in front cable.
(4) Remove the front cable from the cable connector.
(5) Compress cable end fitting at underbody bracket and remove the cable from the bracket.
(6) Lower vehicle.
(7) Push ball end of cable out of pedal clevis with small screwdriver.
(8) Compress cable end fitting at the pedal bracket and remove the cable (Fig. 57).

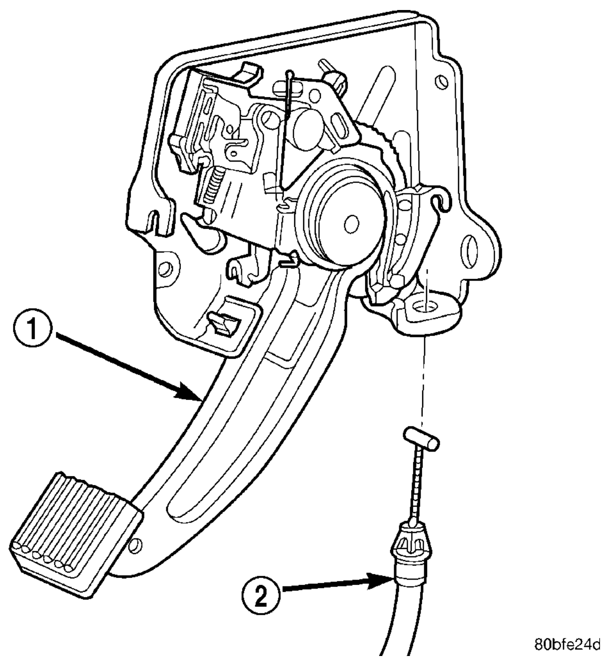


Fig. 57 Parking Brake Pedal

1 - PARK BRAKE PEDAL
2 - FRONT CABLE

(9) Remove the left cowl trim and sill plate.
(10) Pull up the carpet and remove the cable from the body clip.
(11) Pull up on the cable and remove the cable with the body grommet.

REMOVAL - REAR PARK BRAKE CABLE

(1) Raise and support the vehicle.
(2) Lockout the parking brake cable (Fig. 58).
(3) Loosen cable adjuster nut.
(4) Remove the rear park brake cable from the intermediate park brake cable.

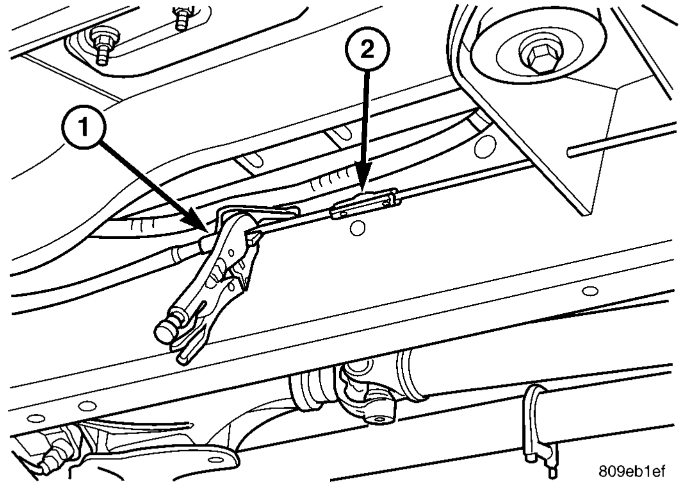


Fig. 58 LOCK OUT PARKING CABLE

1 - LOCKING PLIERS
2 - PARKING BRAKE CABLE

(5) Compress tabs on cable end fitting on the rear park brake cable to the frame mount bracket. Then pull the cable through the bracket.
(6) Disengage the park brake cable from behind the rotor assembly. (Fig. 59).

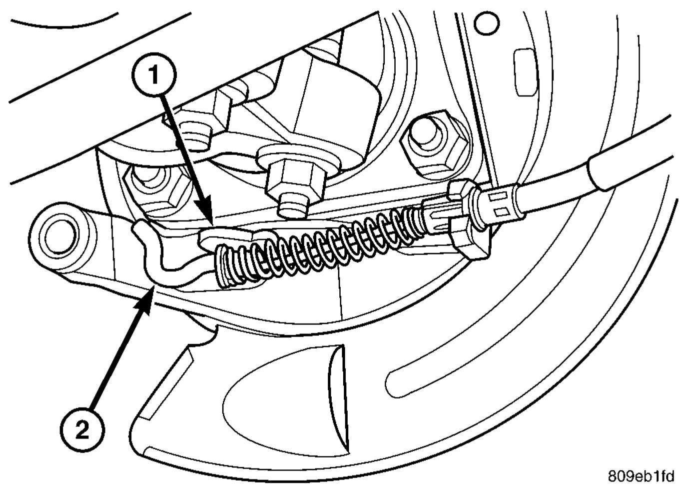


Fig. 59 DISENGAGEMENT OF CABLE

1 - LEVER
2 - CABLE END

(7) Compress cable tabs on each cable end fitting at the brake cable support plate.
(8) Remove the cables from the brake cable support plates.

REMOVAL - RIGHT REAR CABLE

(1) Raise and support the vehicle.
(2) Lockout the parking brake cable (Fig. 58).
(3) Loosen the brake cable at the equalizer and adjuster nut.
(4) Remove the right cable from the front cable.
(5) Remove the right cable from the equalizer.

CABLES (Continued)

(6) Remove the cable from the frame bracket.
(7) Remove the cable from the axle bracket.
(8) Remove the cable bracket from the shock bracket.
(9) Remove the brake cable from the brake lever. (Fig. 60)

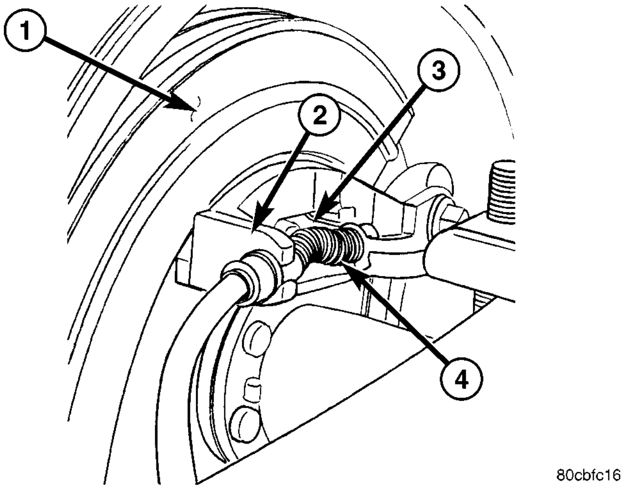


Fig. 60 CABLE MOUNT

1 - SUPPORT PLAT
2 - CABLE MOUNT
3 - PARK BRAKE LEVER
4 - CABLE

REMOVAL - LEFT REAR CABLE

(1) Raise and support the vehicle.
(2) Lockout the parking brake cable (Fig. 58).
(3) Loosen the brake cable at the equalizer and adjuster nut.
(4) Remove the left brake cable from the equalizer.
(5) Remove the brake cable from the frame bracket.
(6) Remove the brake cable from the brake lever. (Fig. 61)

INSTALLATION

INSTALLATION - FRONT PARKING BRAKE CABLE

(1) From inside the vehicle, insert the cable end fitting into the hole in the pedal assembly.
(2) Seat the cable retainer in the pedal assembly.
(3) Engage the cable ball end in clevis on the pedal assembly.
(4) Route the cable through the floorpan and install the body grommet.
(5) Place the carpet down and install the left cowl trim and sill plate.
(6) Raise and support the vehicle.
(7) Route the cable through the underbody bracket and seat the cable end fitting in the bracket.

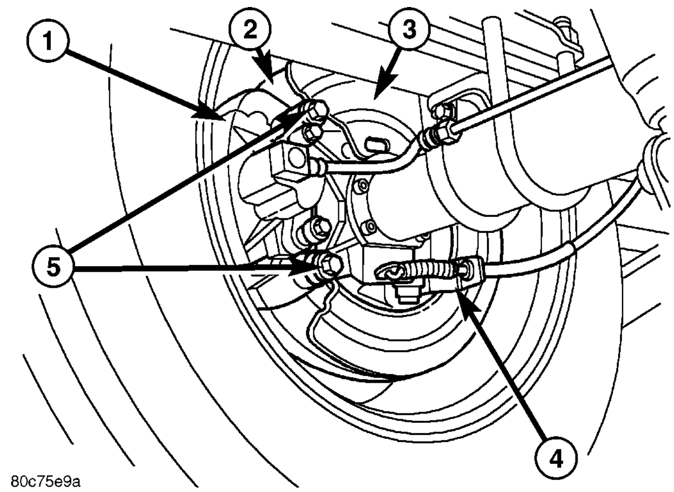


Fig. 61 REAR DISC BRAKE

1 - DISC BRAKE CALIPER
2 - DISC BRAKE ROTOR
3 - DUST SHIELD
4 - REAR PARKING BRAKE CABLE
5 - DISC BRAKE CALIPER MOUNTING BOLTS

(8) Connect the cable to the cable connector.
(9) Perform the park brake adjustment procedure, (Refer to 5 - BRAKES/PARKING BRAKE/CABLE TENSIONER - ADJUSTMENTS).
(10) Lower the vehicle.

INSTALLATION - REAR PARK BRAKE CABLE

(1) Push each cable end through the brake cable support plate hole until the cable end fitting tabs lock into place.

NOTE: Pull on the cable to ensure it is locked into place.

(2) Push the cable through the frame bracket.
(3) Lock the left cable end fitting tabs into the frame bracket hole.
(4) Install the rear cables into the tensioner rod behind the rear of the brake assembly.
(5) Install the cable to the intermediate cable connector.
(6) Release and remove the lock out device.
(7) Perform the park brake adjustment procedure, (Refer to 5 - BRAKES/PARKING BRAKE/CABLE TENSIONER - ADJUSTMENTS).
(8) Remove the supports and lower the vehicle.

INSTALLATION - RIGHT REAR CABLE

(1) Install the brake cable to the brake lever. (Fig. 62)
(2) Install the cable bracket to the shock bracket.
(3) Install the cable to the axle bracket.
(4) Install the cable to the frame bracket.
(5) Install the right cable to the equalizer.

CABLES (Continued)

(6) Install the right cable to the front cable.

(7) Adjust the brake cable at the equalizer and using the adjuster nut.

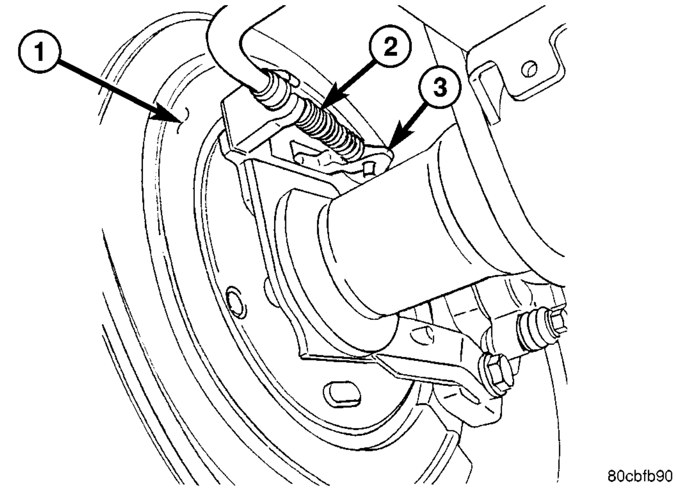


Fig. 62 PARKING BRAKE CABLE

1 - SUPPORT PLAT
2 - CABLE
3 - LEVER

INSTALLATION - LEFT REAR CABLE

(1) Install the brake cable to the brake lever (Fig. 61).

(2) Install the brake cable to the frame bracket.

(3) Install the left brake cable to the equalizer.

(4) Adjust the brake cable at the equalizer and adjuster nut.

SHOES

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the tire and wheel assembly.

(3) Remove the disc brake caliper,(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - REMOVAL).

(4) Remove the disc brake rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(5) Lockout the parking brake cable (Fig. 63).

(6) Disengage the park brake cable from behind the rotor assembly to allow easier disassembly of the park brake shoes (Fig. 64).

(7) Remove the axleshaft (Fig. 65) (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/ AXLE SHAFTS - REMOVAL).

(8) Disassemble the rear park brake shoes (Fig. 56).

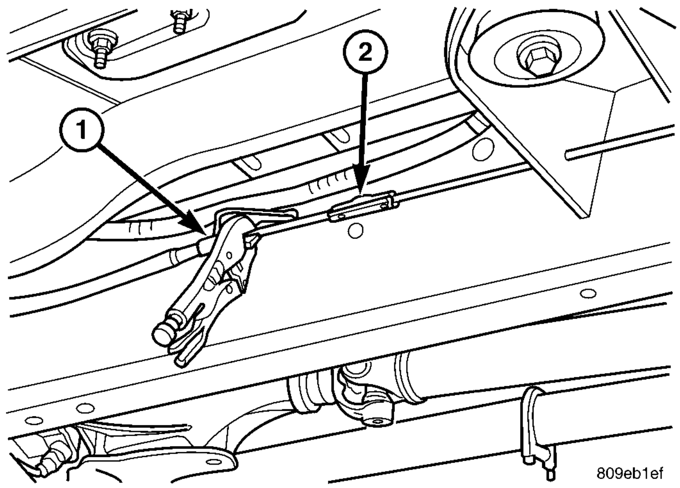


Fig. 63 LOCK OUT PARKING CABLE

1 - LOCKING PLIERS
2 - PARKING BRAKE CABLE

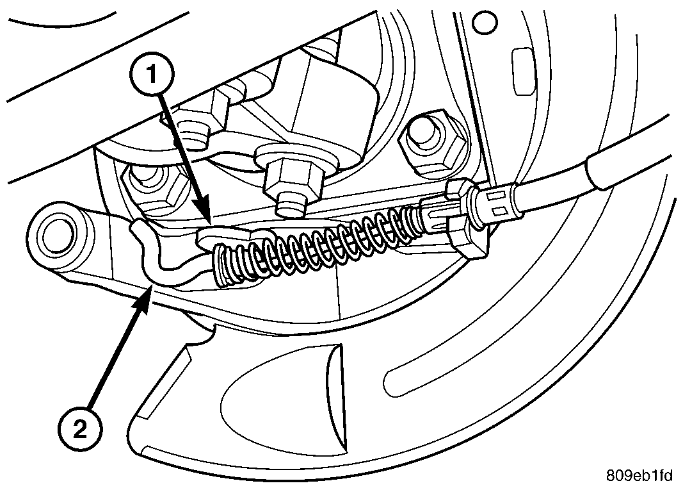


Fig. 64 DISENGAGEMENT OF CABLE

1 - LEVER
2 - CABLE END

CLEANING - REAR DRUM IN HAT BRAKE

Clean the individual brake components, including the support plate exterior, with a water dampened cloth or with brake cleaner. Do not use any other cleaning agents. Remove light rust and scale from the brake shoe contact pads on the support plate with fine sandpaper.

INSPECTION - REAR DRUM IN HAT BRAKE

As a general rule, riveted brake shoes should be replaced when worn to within 0.78 mm (1/32 in.) of the rivet heads. Bonded lining should be replaced when worn to a thickness of 1.6 mm (1/16 in.).

Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across its entire width. Shoes exhibiting contact only on one side should be

SHOES (Continued)

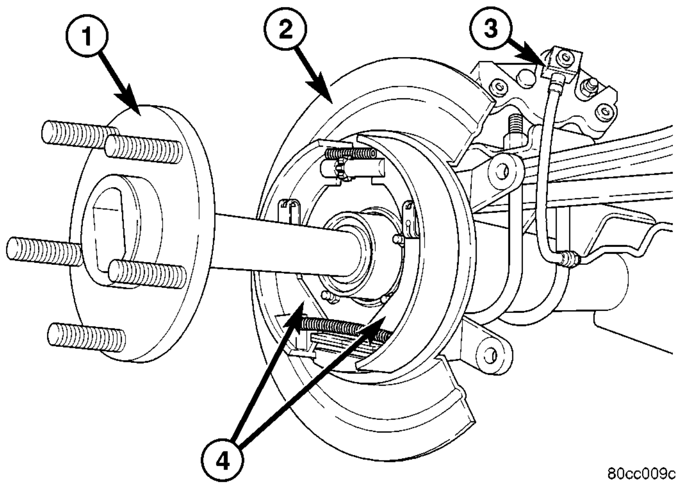


Fig. 65 AXLE SHAFT

1 - AXLE SHAFT
2 - SUPPORT PLATE
3 - CALIPER
4 - PARK BRAKE SHOE ASSEMBLY

replaced and the drum checked for runout or taper (Fig. 66).

Inspect the adjuster screw assembly. Replace the assembly if the star wheel or threads are damaged, or the components are severely rusted or corroded (Fig. 66).

Discard the brake springs and retainer components if worn, distorted or collapsed. Also replace the springs if a brake drag condition had occurred. Overheating will distort and weaken the springs.

Inspect the brake shoe contact pads on the support plate, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted (Fig. 66).

INSTALLATION

NOTE: On a new vehicle or after parking brake lining replacement, it is recommended that the parking brake system be conditioned prior to use. This is done by making one stop from 25 mph on dry pavement or concrete using light to moderate force on the parking brake foot pedal.

(1) Reassemble the rear park brake shoes (Fig. 56).

(2) Install the axleshaft (Fig. 65) (Refer to 3 - DIFFERENTIAL & DRIVELINE/REAR AXLE - 9 1/4/ AXLE SHAFTS - INSTALLATION).

(3) Install the park brake cable to the lever behind the support plate.

(4) Unlock the park brake cable.

(5) Install the disc brake rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

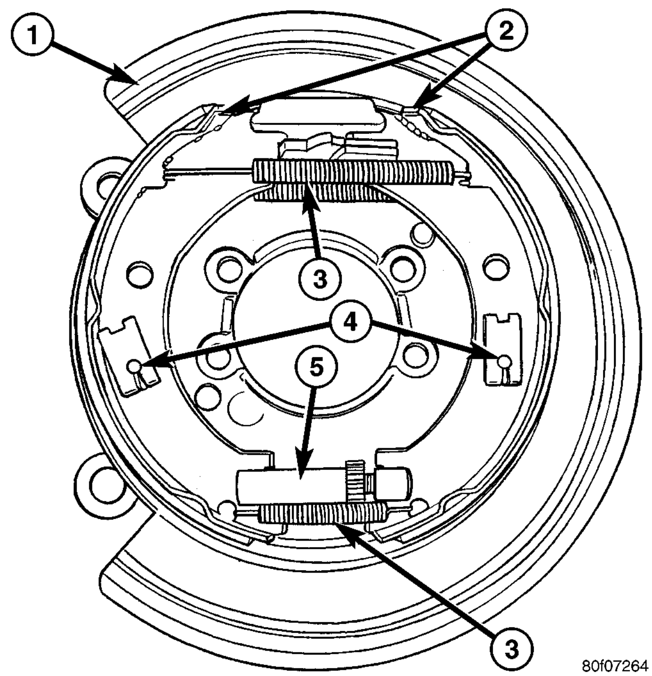


Fig. 66 PARK BRAKE SHOES

(6) Install the disc brake caliper (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(7) Adjust the rear brake shoes (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - ADJUSTMENTS).

(8) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Lower the vehicle.

ADJUSTMENTS

ADJUSTMENT - PARKING BRAKE SHOES

CAUTION: Before adjusting the park brake shoes be sure that the park brake pedal is in the fully released position. If park brake pedal is not in the fully released position, the park brake shoes can not be accurately adjusted.

(1) Raise vehicle.

(2) Remove tire and wheel.

(3) Remove disc brake caliper from caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ DISC BRAKE CALIPERS - REMOVAL).

(4) Remove rotor from the axleshaft (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

SHOES (Continued)

NOTE: When measuring the brake drum diameter, the diameter should be measured in the center of the area in which the park brake shoes contact the surface of the brake drum.

(5) Using Brake Shoe Gauge, Special Tool C-3919, or equivalent, **accurately** measure the inside diameter of the park brake drum portion of the rotor (Fig. 67).

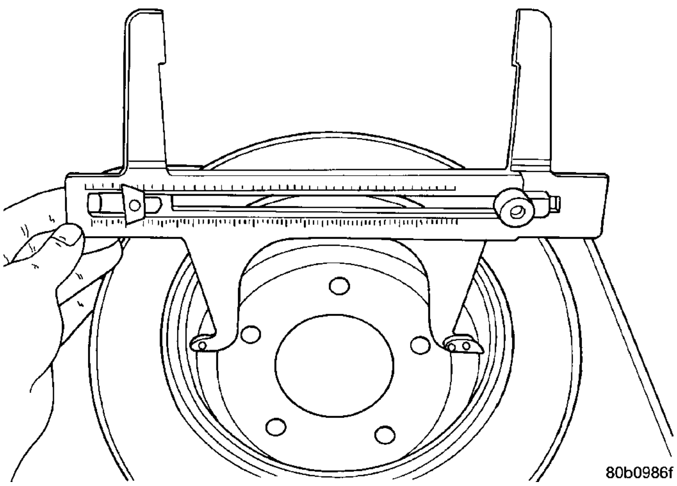


Fig. 67 Measuring Park Brake Drum Diameter

(6) Using a ruler that reads in 64th of an inch, accurately read the measurement of the inside diameter of the park brake drum from the special tool (Fig. 68).

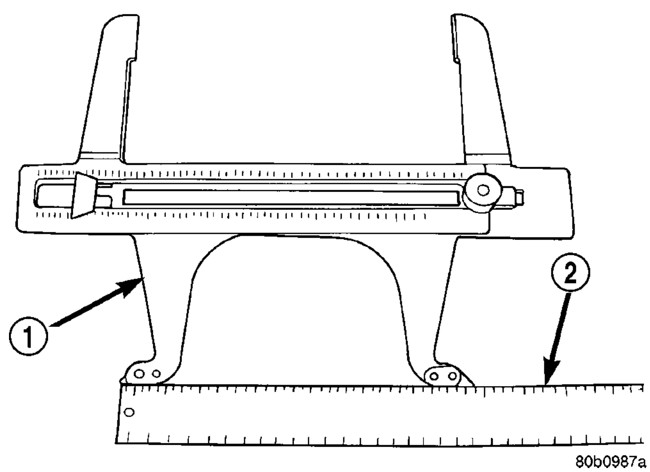


Fig. 68 Reading Park Brake Drum Diameter

1 - SPECIAL TOOL C-3919
2 - RULER

(7) Reduce the inside diameter measurement of the brake drum that was taken using Special Tool C-3919 by 1/64 of an inch. Reset Gauge, Brake Shoe, Special Tool C-3919 or the equivalent used, so that the outside measurement jaws are set to the reduced measurement (Fig. 69).

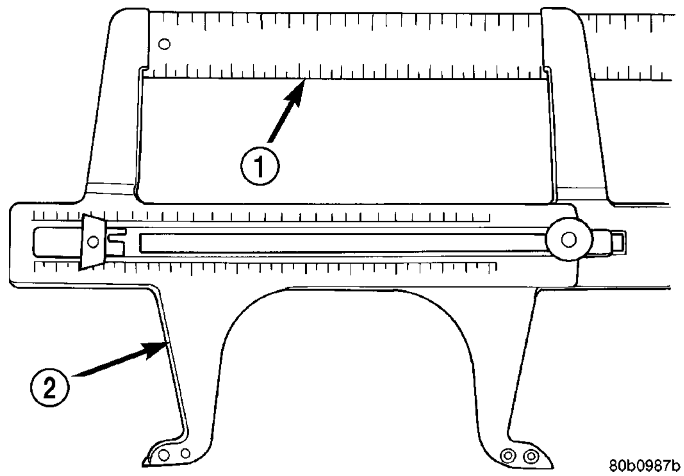


Fig. 69 Setting Gauge To Park Brake Shoe Measurement

1 - RULER
2 - SPECIAL TOOL C-3919

(8) Place Gauge, Brake Shoe, Special Tool C-3919, or equivalent over the park brake shoes. The special tool must be located diagonally across at the top of one shoe and bottom of opposite shoe (widest point) of the park brake shoes.

(9) Using the star wheel adjuster, adjust the park brake shoes until the lining on the park brake shoes just touches the jaws on the special tool.

(10) Repeat step 8 above and measure shoes in both directions.

(11) Install brake rotor on the axleshaft (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(12) Rotate rotor to verify that the park brake shoes are not dragging on the brake drum. If park brake shoes are dragging, remove rotor and back off star wheel adjuster one notch and recheck for brake shoe drag against drum. Continue with the previous step until brake shoes are not dragging on brake drum.

(13) Install disc brake caliper on caliper adapter (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/DISC BRAKE CALIPERS - INSTALLATION).

(14) Install wheel and tire.

(15) Tighten the wheel mounting nuts in the proper sequence until all nuts are torqued to half the specified torque. Then repeat the tightening sequence to the full specified torque of 129 N·m (95 ft. lbs.).

(16) Lower vehicle.

(17) Apply and release the park brake pedal one time. This will seat and correctly adjust the park brake cables.

CAUTION: Before moving vehicle, pump brake pedal several times to ensure the vehicle has a firm enough pedal to stop the vehicle.

SHOES (Continued)

NOTE: On a new vehicle or after parking brake lining replacement, it is recommended that the parking brake system be conditioned prior to use. This is done by making one stop from 25 mph on dry pavement or concrete using light to moderate force on the parking brake foot pedal.

(18) Road test the vehicle to ensure proper function of the vehicle's brake system.

ADJUSTMENT - WITH ADJUSTING TOOL

Adjustment can be made with a standard brake gauge or with adjusting tool. Adjustment is performed with the complete brake assembly installed on the backing plate.

(1) Be sure parking brake lever is fully released.

(2) Raise vehicle so rear wheels can be rotated freely.

(3) Remove plug from each access hole in brake support plates.

(4) Loosen parking brake cable adjustment nut until there is slack in front cable.

(5) Insert adjusting tool through support plate access hole and engage tool in teeth of adjusting screw star wheel (Fig. 70).

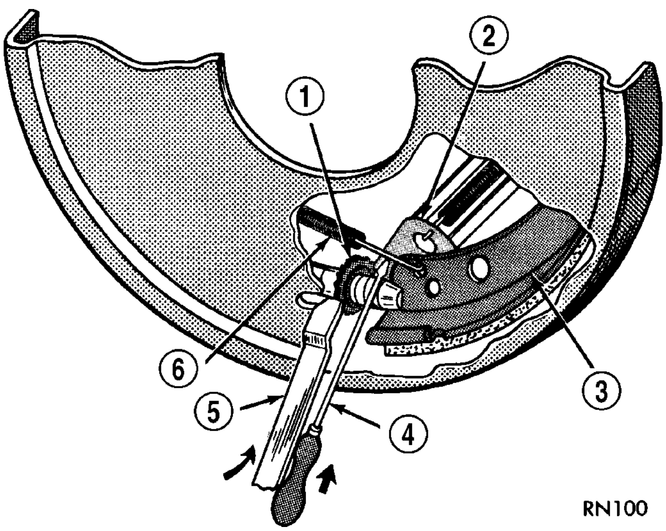


Fig. 70 Brake Adjustment

1 - STAR WHEEL
2 - LEVER
3 - BRAKE SHOE WEB
4 - SCREWDRIVER
5 - ADJUSTING TOOL
6 - ADJUSTER SPRING

(6) Rotate adjuster screw star wheel (move tool handle upward) until slight drag can be felt when wheel is rotated.

(7) Push and hold adjuster lever away from star wheel with thin screwdriver.

(8) Back off adjuster screw star wheel until brake drag is eliminated.

(9) Repeat adjustment at opposite wheel. Be sure adjustment is equal at both wheels.

(10) Install support plate access hole plugs.

(11) Adjust parking brake cable and lower vehicle.

(12) Depress park brake pedal and make sure park brakes hold the vehicle staionary.

(13) Release park brake pedal.

PEDAL

REMOVAL

(1) Release the parking brake.

(2) Raise the vehicle.

(3) Loosen the cable tensioner nut at the equalizer to create slack in the front cable.

(4) Lower the vehicle.

(5) Remove the knee bolster, (Refer to 23 - BODY/ INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(6) Disconnect the brake lamp wire from the switch on the pedal assembly.

(7) Roll the carpet back, loosen the front cable grommet from the floorpan and the cable retainer.

(8) Disengage the release rod (Fig. 71) from the arm on the pedal assembly.

(9) Remove the bolts/nuts from the pedal assembly and remove the assembly.

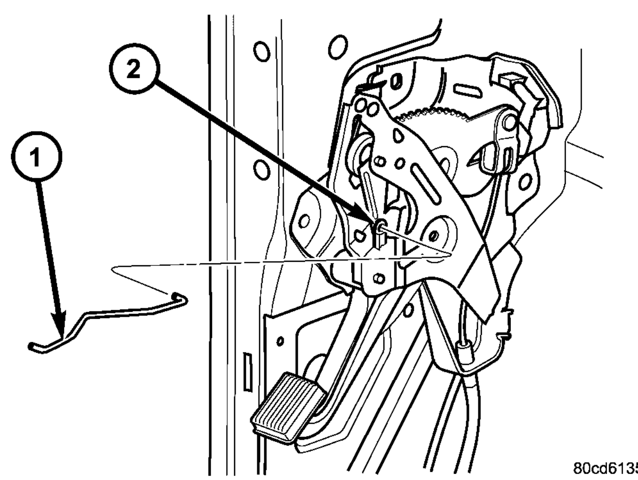


Fig. 71 PARKING BRAKE PEDAL

1 - RELEASE ROD
2 - PEDAL ASSEMBLY

INSTALLATION

(1) Position the replacement pedal assembly on the dash and cowl.

(2) Install the bolts/nuts and tighten to 28 N·m (21 ft. lbs.) (Fig. 72).

(3) Install the park brake release rod.

(4) Connect the front cable to the arm on the pedal assembly.

PEDAL (Continued)

(5) Tighten the front cable grommet to the floorpan and the cable retainer, roll the carpet back.

(6) Connect the wires to the brake lamp switch.

(7) Install the knee bolster, (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(8) Raise the vehicle.

(9) Adjust the parking brake cable tensioner (Refer to 5 - BRAKES/PARKING BRAKE/CABLE TENSIONER - ADJUSTMENTS).

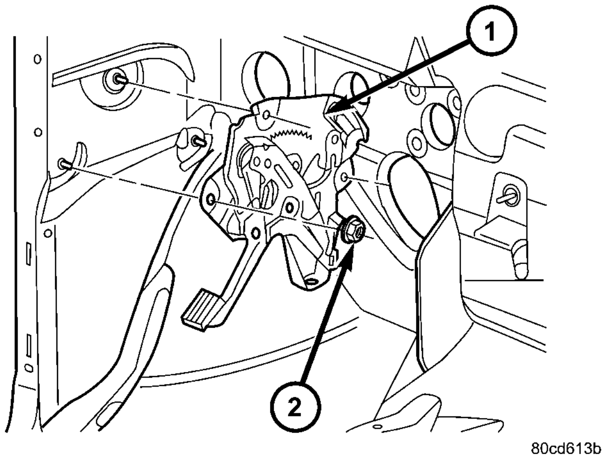


Fig. 72 PARKING BRAKE ASSEMBLY

1 - PEDAL ASSEMBLY
2 - MOUNTING NUT

CABLE TENSIONER

ADJUSTMENTS

ADJUSTMENT

NOTE: Tensioner adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform adjustment only as described in the following procedure. This is necessary to avoid faulty park brake operation.

(1) Raise the vehicle.

(2) Back off the cable tensioner adjusting nut to create slack in the cables.

(3) Remove the rear wheel/tire assemblies. Then remove the brake rotors (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Verify the brakes are in good condition and operating properly.

(5) Verify the park brake cables operate freely and are not binding, or seized.

(6) Check the rear brake shoe adjustment with standard brake gauge (Refer to 5 - BRAKES/PARKING BRAKE/SHOES - ADJUSTMENTS).

(7) Install the rotors (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION) and verify that the rotors rotate freely without drag.

(8) Install the wheel/tire assemblies, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Lower the vehicle enough for access to the park brake foot pedal. Then fully apply the park brakes.

NOTE: Leave park brakes applied until adjustment is complete.

(10) Raise the vehicle again.

(11) Mark the tensioner rod 6.35 mm (1/4 in.) from edge of the tensioner (Fig. 73).

(12) Tighten the adjusting nut on the tensioner rod until the mark is no longer visible.

CAUTION: Do not loosen, or tighten the tensioner adjusting nut for any reason after completing adjustment.

(13) Lower the vehicle until the rear wheels are 15-20 cm (6-8 in.) off the shop floor.

(14) Release the park brake foot pedal and verify that rear wheels rotate freely without drag. Then lower the vehicle.

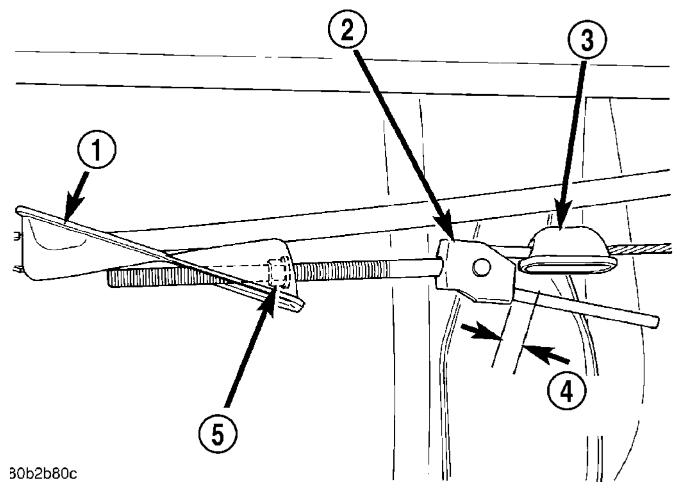


Fig. 73 Adjustment Mark

1 - TENSIONER CABLE BRACKET
2 - TENSIONER
3 - CABLE CONNECTOR
4 - 6.35mm
(1/4 IN.)
5 - ADJUSTER NUT

RELEASE HANDLE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the driver side outboard end of the instrument panel to access and unsnap the plastic retainer clip that secures the park brake release linkage rod to the park brake mechanism on the left cowl side inner panel.

(3) Disengage the park brake release linkage rod end from the park brake mechanism.

(4) Lift the park brake release handle to access and unsnap the plastic retainer clip that secures the park brake release linkage rod to the lever on the back of the park brake release handle.

(5) Lower the park brake release handle and reach under the driver side outboard end of the instrument panel to disengage the park brake release linkage rod end from the lever on the back of the park brake release handle.

(6) Lift the park brake release handle to access the handle mounting bracket.

(7) Using a trim stick or another suitable wide flat-bladed tool, gently pry each of the park brake release handle mounting bracket latch tabs away from the retaining notches in the instrument panel receptacle (Fig. 74).

(8) With both of the park brake release handle mounting bracket latches released, slide the handle and bracket assembly down and out of the instrument panel receptacle.

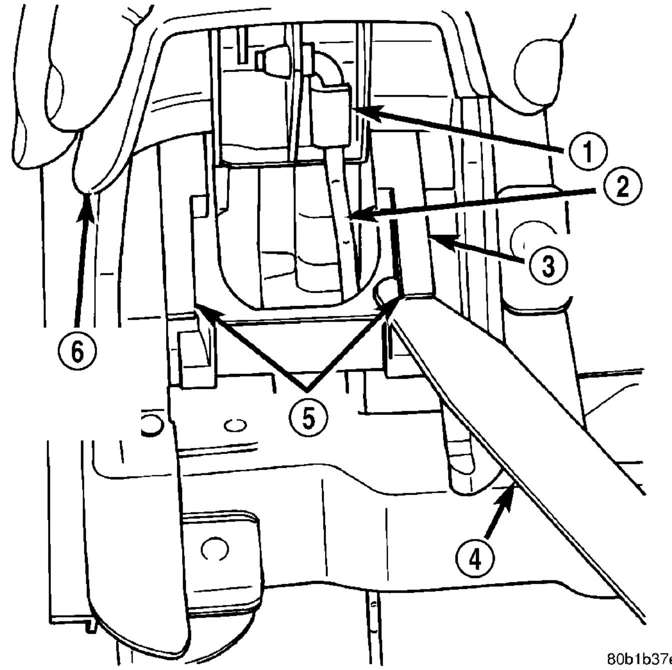


Fig. 74 Park Brake Release Handle Remove/Install

1 - CLIP
2 - ROD
3 - MOUNTING BRACKET
4 - TRIM STICK
5 - LATCH TABS
6 - PARK BRAKE RELEASE HANDLE

INSTALLATION

(1) Position the park brake release handle to the instrument panel.

(2) Slide the handle and bracket assembly up into the instrument panel receptacle until both of the park brake release handle mounting bracket latches are engaged with the notches in the instrument panel receptacle.

(3) Lower the park brake release handle and reach under the driver side outboard end of the instrument panel to engage the park brake release linkage rod end with the lever on the back of the park brake release handle.

(4) Lift the park brake release handle to access and snap the plastic retainer clip that secures the park brake release linkage rod to the lever on the back of the park brake release handle over the linkage rod.

(5) Reach under the driver side outboard end of the instrument panel to access and engage the park brake release linkage rod end to the park brake mechanism.

(6) Snap the plastic retainer clip that secures the park brake release linkage rod to the park brake mechanism on the left cowl side inner panel over the linkage rod.

(7) Reconnect the battery negative cable.

BRAKES - ABS

TABLE OF CONTENTS

BRAKES - ABS

DESCRIPTION

The antilock brake system (ABS) is an electronically operated, three channel brake control system. The vehicle has Electronic Variable Brake Proportioning (EVBP) designed into the system which eliminates the combination/proportioning valve.

The system is designed to prevent wheel lockup and maintain steering control during braking. Preventing lockup is accomplished by modulating fluid pressure to the wheel brake units.

The hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem. The ABS electrical system is separate from other electrical circuits in the vehicle. A specially programmed controller antilock brake unit operates the system components.

ABS system major components include:

- Controller Antilock Brakes (CAB)
- Hydraulic Control Unit (HCU)
- Wheel Speed Sensors (WSS)
- ABS Warning Light

OPERATION

Battery voltage is supplied to the CAB. The CAB performs a system initialization procedure at start up. A check of the ABS motor is performed at 15 miles per hour. Initialization consists of a static and dynamic self check of system electrical components.

The static and dynamic checks occurs at ignition start up. During the dynamic check, the CAB briefly cycles solenoids to verify operation. An audible noise may be heard during this self check. This noise should be considered normal. The ABS motor and pump are then checked at a speed of 15 mile per hour.

If an ABS component exhibits a fault during initialization, the CAB illuminates the amber warning light and registers a fault code in the microprocessor memory.

The CAB monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the CAB will not activate any ABS components as long as sensor inputs indicate normal braking.

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

BRAKES - ABS (Continued)

The purpose of the antilock system is to prevent wheel lockup. Preventing lockup helps maintain vehicle braking action and steering control.

The antilock CAB activates the system whenever sensor signals indicate periods of wheel slip.

The antilock system prevents lockup during a wheel slip condition by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. Sensors at each front wheel convert wheel speed into electrical signals. These signals are transmitted to the CAB for processing and determination of wheel slip and deceleration rate.

The ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem. A speed sensor input signal indicating a wheel slip condition activates the CAB antilock program.

There are Two solenoid valves (Isolation and Dump valve) which are used in each antilock control channel. The valves are all located within the HCU valve body and work in pairs to either increase, hold, or decrease apply pressure as needed in the individual control channels.

During an ABS stop the ISO valve is energized which acts to prevent further pressure build-up to the calipers. Then the Dump valve dumps off pressure until the wheel unlocks. This will continue until the wheels quit slipping altogether.

STANDARD PROCEDURE - ABS BRAKE BLEEDING

ABS system bleeding requires conventional bleeding methods plus use of the DRB scan tool. The procedure involves performing a base brake bleeding, followed by use of the scan tool to cycle and bleed the HCU pump and solenoids. A second base brake bleeding procedure is then required to remove any air remaining in the system.

(1) Perform base brake bleeding,(Refer to 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).

(2) Connect scan tool to the Data Link Connector.

(3) Select ANTILOCK BRAKES, followed by MISCELLANEOUS, then ABS BRAKES. Follow the instructions displayed. When scan tool displays TEST COMPLETE, disconnect scan tool and proceed.

(4) Perform base brake bleeding a second time,(Refer to 5 - BRAKES - STANDARD PROCEDURE) OR (Refer to 5 - BRAKES - STANDARD PROCEDURE).

(5) Top off master cylinder fluid level and verify proper brake operation before moving vehicle.

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
ABS Assembly Mounting Bolts	15	11	—
ABS Assembly CAB Screws	3.5	—	31
ABS Assembly Brake Line Fittings	19	—	170
Wheel Speed Sensors Front Sensor Bolt	21	—	190
Wheel Speed Sensors Bracket To Knuckle	6.7	—	60
Wheel Speed Sensors Rear Sensor Stud	22.5	—	200
Controller Mounting Screws	6	—	53
RWAL Module Mounting Bolts	15	11	—

BRAKES - ABS (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
RWAL Valve Brake Line Fittings	19	—	170
Rear Wheel Speed Sensor Mounting Bolt	24	—	200

FRONT WHEEL SPEED SENSOR

DESCRIPTION

The ABS brake system uses 3 wheel speed sensors. A sensor is mounted to each front hub/bearings. The third sensor is mounted on top of the rear axle differential housing.

OPERATION

The Wheel Speed Sensor consists of a magnet surrounded by windings from a single strand of wire. The sensor sends a small AC signal to the CAB. This signal is generated by magnetic induction. The magnetic induction is created when a toothed sensor ring (exciter ring or tone wheel) passes the stationary magnetic WSS.

When the ring gear is rotated, the exciter ring passes the tip of the WSS. As the exciter ring tooth approaches the tip of the WSS, the magnetic lines of force expand, causing the magnetic field to cut across the sensor's windings. This, in turn causes current to flow through the WSS circuit (Fig. 1) in one direction. When the exciter ring tooth moves away from the sensor tip, the magnetic lines of force collapse cutting the winding in the opposite direction. This causes the current to flow in the opposite direction. Every time a tooth of the exciter ring passes the tip of the WSS, an AC signal is generated. Each AC signal (positive to negative signal or sinewave) is interpreted by the CAB. It then compares the frequency of the sinewave to a time value to calculate vehicle speed. The CAB continues to monitor the frequency to determine a deceleration rate that would indicate a possible wheel-locking tendency.

The signal strength of any magnetic induction sensor is directly affected by:

- Magnetic field strength; the stronger the magnetic field, the stronger the signal
- Number of windings in the sensor; more windings provide a stronger signal
- Exciter ring speed; the faster the exciter ring/tone wheel rotates, the stronger the signal will be
- Distance between the exciter ring teeth and WSS; the closer the WSS is to the exciter ring/tone wheel, the stronger the signal will be

The rear WSS is not adjustable. A clearance specification has been established for manufacturing tolerances. If the clearance is not within these specifications, then either the WSS or other components may be damaged. The clearance between the WSS and the exciter ring is 0.005 – 0.050 in.

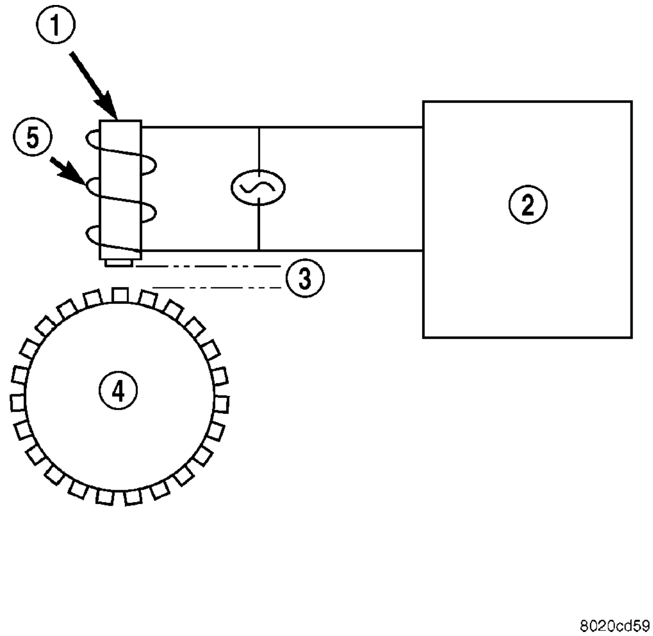


Fig. 1 Operation of the Wheel Speed Sensor

1 - MAGNETIC CORE
2 - CAB
3 - AIR GAP
4 - EXCITER RING
5 - COIL

The assembly plant performs a "Rolls Test" on every vehicle that leaves the assembly plant. One of the test performed is a test of the WSS. To properly test the sensor, the assembly plant connects test equipment to the Data Link Connector (DLC). This connector is located to the right of the steering column and attached to the lower portion of the instrument panel (Fig. 2). The rolls test terminal is spliced to the WSS circuit. The vehicle is then driven on a set of rollers and the WSS output is monitored for proper operation.

REMOVAL

(1) Remove the front rotor (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(2) Remove the wheel speed sensor mounting bolt from the hub. (Fig. 3)

FRONT WHEEL SPEED SENSOR (Continued)

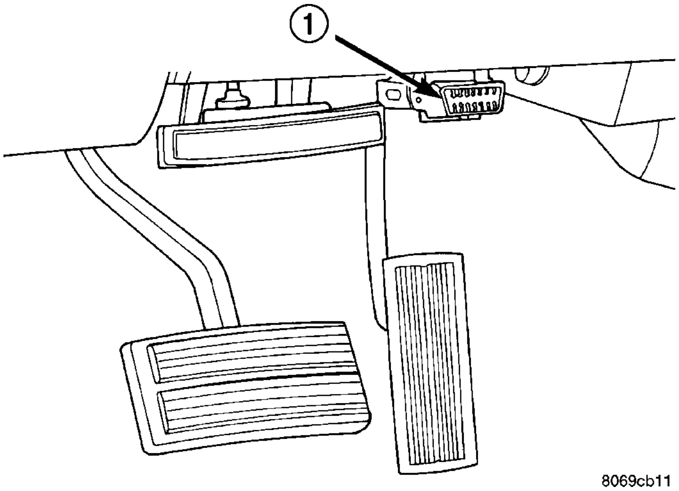


Fig. 2 Data Link Connector - Typical

1 - 16–WAY DATA LINK CONNECTOR

(3) Remove the wheel speed sensor from the hub.

(4) Remove the wiring from the clips and disconnect the electrical connector.

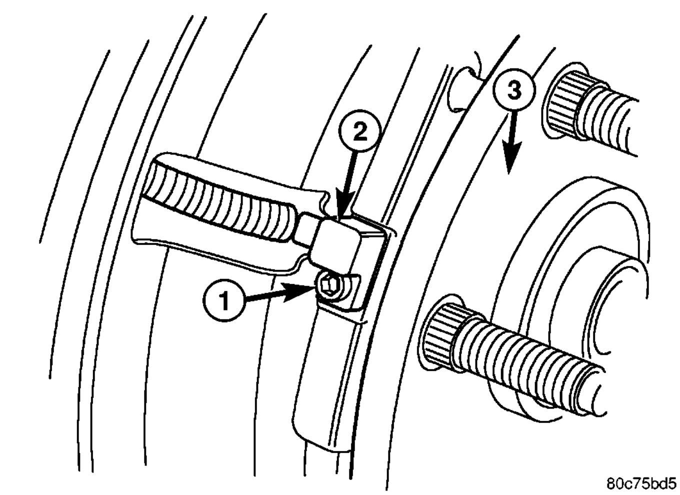


Fig. 3 WHEEL SPEED SENSOR

1 - WHEEL SPEED SENSOR MOUNTING BOLT
2 - WHEEL SPEED SENSOR
3 - HUB/BEARING

INSTALLATION

(1) Install the wiring to the clips and Reconnect the electrical connector.

(2) Install the wheel speed sensor to the hub.

(3) Install the wheel speed sensor mounting bolt to the hub. Tighten the bolt to 21 N·m (190 in. lbs.).

(4) Install the front rotor and brake caliper assembly (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

REAR WHEEL SPEED SENSOR

DIAGNOSIS AND TESTING - REAR WHEEL ANTILOCK

Diagnosis of base brake conditions which are mechanical in nature should be performed first. This includes brake noise, lack of power assist, parking brake, or vehicle vibration during normal braking.

The RWAL brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the system inputs and outputs circuits to verify the system is operating properly. If the CAB senses a malfunction in the system it will set a DTC into memory and trigger the warning lamp.

NOTE: The MDS or DRB III scan tool is used to diagnose the RWAL system. For test procedures refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Remove the brake line mounting nut and remove the brake line from the sensor stud.

(3) Remove the mounting stud from the sensor and shield (Fig. 4).

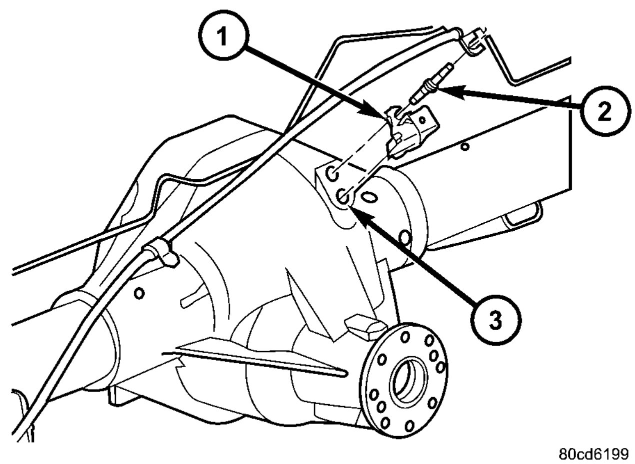


Fig. 4 REAR WHEEL SPEED SENSOR

1 - WHEEL SPEED SENSOR
2 - MOUNTING BOLT
3 - AXLE HOUSING

(4) Remove the sensor and shield from the differential housing.

(5) Disconnect the sensor wire harness and remove the sensor.

REAR WHEEL SPEED SENSOR (Continued)

INSTALLATION

(1) Connect the harness to the sensor. **Be sure the seal is securely in place between the sensor and the wiring connector.**

(2) Install the O-ring on the sensor (if removed).

(3) Insert the sensor in the differential housing.

(4) Install the sensor shield.

(5) Install the sensor mounting stud and tighten to 24 N·m (200 in. lbs.).

(6) Install the brake line on the sensor stud and install the nut.

(7) Lower the vehicle.

TONE WHEEL

DIAGNOSIS AND TESTING - REAR WHEEL SPEED SENSOR

Diagnosis of base brake conditions which are mechanical in nature should be performed first. This includes brake noise, lack of power assist, parking brake, or vehicle vibration during normal braking.

The Antilock brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the system inputs and outputs circuits to verify the system is operating properly. If the CAB senses a malfunction in the system it will set a DTC into memory and trigger the warning lamp.

NOTE: The MDS or DRB III scan tool is used to diagnose the Antilock Brake system. For test procedures refer to the Chassis Diagnostic Manual.

HYDRAULIC/MECHANICAL

DESCRIPTION - ELECTRONIC VARIABLE BRAKE PROPORTIONING

Vehicles equipped with ABS use electronic variable brake proportioning (EVBP) to balance front-to-rear braking. The EVBP is used in place of a rear proportioning valve. The EVBP system uses the ABS system to control the slip of the rear wheels in partial braking range. The braking force of the rear wheels is controlled electronically by using the inlet and outlet valves located in the integrated control unit (ICU).

OPERATION - ELECTRONIC VARIABLE BRAKE PROPORTIONING

EVBP is able to decrease, hold and increase rear brake pressure without activating full ABS control. Upon entry into EVBP the inlet valve for the rear brake circuit is switched on so that the fluid supply from the master cylinder is shut off. In order to decrease the rear brake pressure, the outlet valve for the rear brake circuit is pulsed. This allows fluid to enter the low pressure accumulator (LPA) in the hydraulic control unit (HCU) resulting in a drop in fluid pressure to the rear brakes. In order to increase the rear brake pressure, the outlet valve is switched off and the inlet valve is pulsed. This increases the pressure to the rear brakes.

The EVBP will remain functional during many ABS fault modes. If both the red BRAKE and amber ABS warning indicators are illuminated, the EVBP may not be functioning.

HCU (HYDRAULIC CONTROL UNIT)

DESCRIPTION

The HCU consists of a valve body, pump motor, low pressure accumulators, inlet valves, outlet valves and noise attenuators.

OPERATION

Accumulators in the valve body store extra fluid released to the system for ABS mode operation. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

The valves modulate brake pressure during antilock braking and are controlled by the CAB.

The HCU provides three channel pressure control to the front and rear brakes. One channel controls the rear wheel brakes in tandem. The two remaining channels control the front wheel brakes individually.

During antilock braking, the solenoid valves are opened and closed as needed.

During normal braking, the HCU solenoid valves and pump are not activated. The master cylinder and power booster operate the same as a vehicle without an ABS brake system.

NOTE: The three modes mentioned below do occur but not necessarily in the order listed everytime.

During antilock braking, solenoid valve pressure modulation occurs in three stages, pressure increase, pressure hold, and pressure decrease. The valves are all contained in the valve body portion of the HCU.

PRESSURE DECREASE

The outlet valve is opened and the inlet valve is closed during the pressure decrease cycle.

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the CAB closes the inlet

HCU (HYDRAULIC CONTROL UNIT) (Continued)

then opens the outlet valve, which also opens the return circuit to the accumulators. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the CAB closes the outlet valve and begins a pressure increase or hold cycle as needed.

PRESSURE HOLD

Both solenoid valves are closed in the pressure hold cycle but only the inlet valve is energized. Fluid apply pressure in the control channel is maintained at a constant rate. The CAB maintains the hold cycle until sensor inputs indicate a pressure change is necessary.

PRESSURE INCREASE

The inlet valve is open and the outlet valve is closed during the pressure increase cycle. The pressure increase cycle is used to reapply thew brakes. This cycle controls re-application of fluid apply pressure.

REMOVAL

(1) Install a prop rod on the brake pedal to keep pressure on the brake system.

(2) Disconnect the battery cables from the battery.

(3) Remove the battery.

(4) Disconnect the two electrical harness connectors (Fig. 5).

(5) Remove the five brake lines from the HCU (Fig. 5).

(6) Remove HCU/CAB mounting bolts and remove the HCU/CAB (Fig. 5).

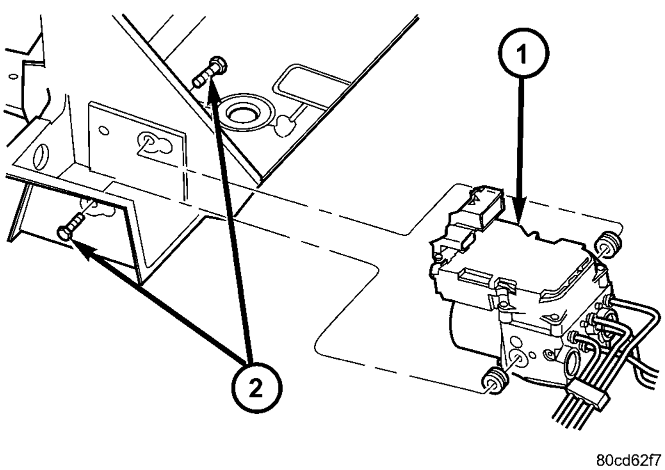


Fig. 5 HYDRAULIC CONTROL UNIT

1 - HYDRAULIC CONTROL UNIT
2 - MOUNTING BOLTS

INSTALLATION

NOTE: If the CAB is being replaced with a new CAB is must be reprogrammed with the use of a DRB III.

(1) Install HCU/CAB on the mounts and Tighten the bolts to 15N·m (11 ft. lbs.) (Fig. 5).

(2) Install the five brake lines to the HCU and tighten to 19 N·m (170 in. lbs.) (Fig. 5).

(3) Install the two electrical harness connectors to the HCU/CAB and push down on the release to secure the connectors.

(4) Install the battery.

(5) Install the battery cables to the battery.

(6) Remove the prop rod on the brake pedal.

(7) Bleed ABS brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

RWAL VALVE

DESCRIPTION

Rear Wheel Antilock (RWAL) brake system is standard equipment on 1500 series vehicles. The RWAL brake system is designed to prevent rear wheel lock-up on virtually all types of road surfaces. RWAL braking is desirable because a vehicle which is stopped without locking the rear wheels will retain directional stability. This allows the driver to retain greater control of the vehicle during braking.

The valve is located on the drivers side inner fender under the hood. The valve modulates hydraulic pressure to the rear brakes.

The RWAL components include:

- RWAL Valve
- Controller Antilock brake (CAB)
- Rear Wheel Speed Sensor (WSS)

OPERATION

When the brakes are applied, hydraulic fluid is routed from the master cylinder's secondary circuit to the RWAL valve. From there hydraulic fluid is routed to the rear brakes. The Controller Antilock Brake (CAB) contains an Electronic Variable Brake Proportioning (EVBP) control algorithm, which proportions the applied braking force to the rear wheels during braking. The EVBP function of the RWAL system takes the place of a conventional hydraulic proportioning valve. The CAB monitors the rear wheel speed through the rear wheel speed sensor and calculates an estimated vehicle deceleration. When an established deceleration threshold is exceeded, an isolation valve is closed to hold the applied brake pressure to the rear brakes constant. Upon further increases in the estimated vehicle deceleration, the isolation valve is selectively opened to increase rear

RWAL VALVE (Continued)

brake pressure in proportion to the front brake pressure. If impending rear wheel lock-up is sensed, the CAB signals the RWAL valve to modulate hydraulic brake pressure to the rear wheels to prevent lock-up.

NORMAL BRAKING Since the RWAL valve also performs the EVBP or proportioning function, vehicle deceleration under normal braking may be sufficient to trigger the EVBP function of the RWAL system without full RWAL activity as would normally occur during an impending rear wheel lock-up. As previously mentioned, the isolation valve is selectively closed and opened to increase rear brake pressure in proportion to the front brake pressure under EVBP control. Slight brake pedal pulsations may be noticed as the isolation valve is opened.

REMOVAL

(1) Install a prop rod on the brake pedal to keep pressure on the brake system.

(2) Disconnect the battery cables from the battery.

(3) Remove the battery.

(4) Disconnect the electrical harness connector (Fig. 6).

(5) Remove the brake lines from the rwal valve (Fig. 6).

(6) Remove rwal valve mounting nuts and remove the rwal valve (Fig. 6).

INSTALLATION

(1) Install rwal valve and Tighten the nuts to 15 N·m (11 ft. lbs.) (Fig. 6).

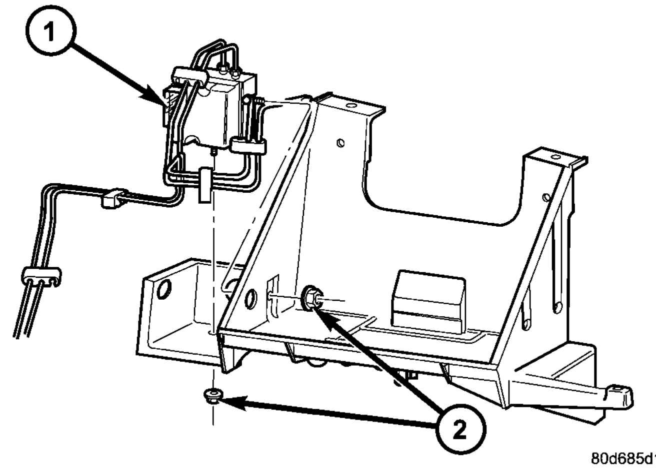


Fig. 6 RWAL VALVE

1 - RWAL VALVE
2 - MOUNTING NUTS

(2) Install the brake lines to the rwal valve and tighten to 19 N·m (170 in. lbs.) (Fig. 6).

(3) Install the electrical harness connector to the rwal valve and secure the connector.

(4) Install the battery.

(5) Install the battery cables to the battery.

(6) Remove the prop rod on the brake pedal.

(7) Bleed ABS brake system (Refer to 5 - BRAKES - STANDARD PROCEDURE).

CLUTCH

TABLE OF CONTENTS

CLUTCH

DESCRIPTION

The clutch mechanism consists of a flywheel, a single, dry-type disc, and a diaphragm style clutch cover (Fig. 1). A hydraulic linkage is used to operate the clutch release bearing and fork. The flywheel is bolted to the rear flange of the crankshaft. The clutch pressure plate is bolted to the flywheel with the clutch disc located between these two components. The clutch system provides the mechanical, but still easily detachable, link between the engine and the transmission. The system is designed to ensure that the full torque output of the engine is transfered to the transmission while isolating the transmission from the engine firing pulses to minimize concerns such as gear rattle.

OPERATION

Leverage, clamping force and friction are what make the clutch work. The disc serves as the friction element and a diaphragm spring and pressure plate provide the clamping force. The clutch pedal, hydraulic linkage, release lever and bearing provide the leverage.

The clutch master cylinder push rod is connected to the clutch pedal. When the clutch pedal is depressed, the slave cylinder is operated by the clutch master cylinder mounted on the dash panel. The release fork is actuated by the hydraulic slave cylinder mounted on the transmission housing. The release bearing is operated by a release fork pivoting on a ball stud mounted in the transmission housing. The release bearing then depresses the pressure plate spring fingers, releasing pressure on the clutch disc and allowing the engine crankshaft to spin independently of the transmission input shaft (Fig. 2).

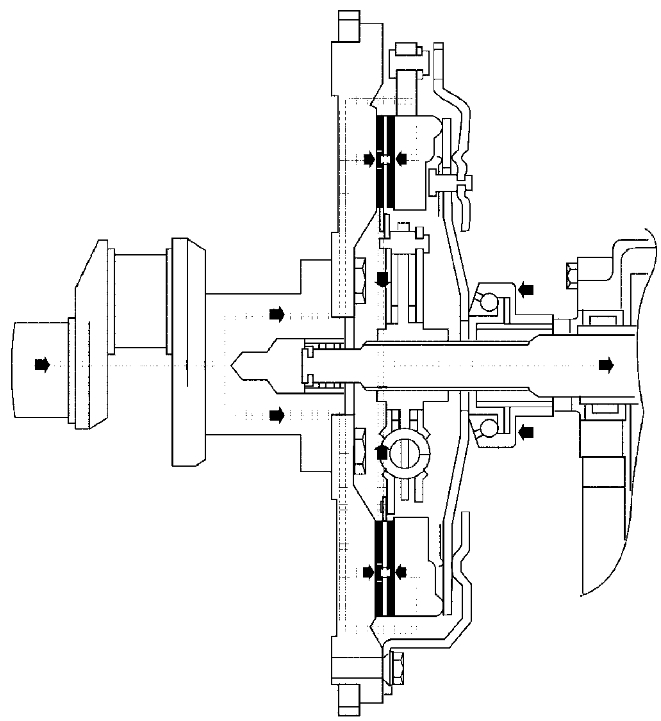


Fig. 1 ENGINE POWERFLOW

CLUTCH (Continued)

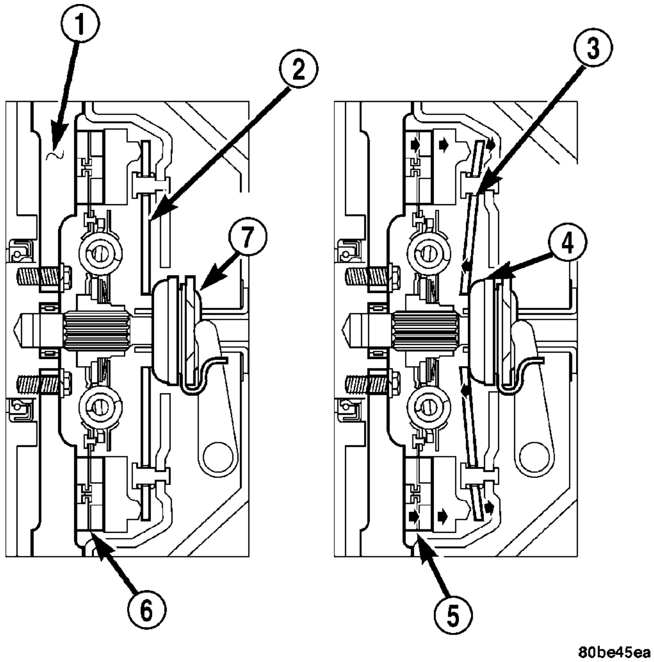


Fig. 2 CLUTCH OPERATION

1 - FLYWHEEL
2 - PRESSURE PLATE FINGERS
3 - PIVOT POINT
4 - RELEASE BEARING PUSHED IN
5 - CLUTCH DISC ENGAGED
6 - CLUTCH DISC ENGAGED
7 - RELEASE BEARING

WARNING

WARNING:: EXERCISE CARE WHEN SERVICING CLUTCH COMPONENTS. FACTORY INSTALLED CLUTCH DISCS DO NOT CONTAIN ASBESTOS FIBERS. DUST AND DIRT ON CLUTCH PARTS MAY CONTAIN ASBESTOS FIBERS FROM AFTERMARKET COMPONENTS. BREATHING EXCESSIVE CONCENTRATIONS OF THESE FIBERS CAN CAUSE SERIOUS BODILY HARM. WEAR A RESPIRATOR DURING SERVICE AND NEVER CLEAN CLUTCH COMPONENTS WITH COMPRESSED AIR OR WITH A DRY BRUSH. EITHER CLEAN THE COMPONENTS WITH A WATER DAMPENED RAGS OR USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR REMOVING ASBESTOS FIBERS AND DUST. DO NOT CREATE DUST BY SANDING A CLUTCH DISC. REPLACE THE DISC IF THE FRICTION MATERIAL IS DAMAGED OR CONTAMINATED. DISPOSE OF ALL DUST AND DIRT CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS. THIS WILL HELP MINIMIZE EXPOSURE TO YOURSELF AND TO OTHERS. FOLLOW ALL RECOMMENDED SAFETY PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE ENVIRONMENTAL SAFETY AGENCY (EPA), FOR THE HANDLING AND DISPOSAL OF PRODUCTS CONTAINING ASBESTOS.

DIAGNOSIS AND TESTING

A road test and component inspection is recommended to determine a clutch problem. During a road test, drive the vehicle at normal speeds. Shift the transmission through all gear ranges and observe clutch action. If the clutch chatters, grabs, slips or does not release properly, remove and inspect the clutch components. If the problem is noise or hard shifting, further diagnosis may be needed as the transmission or another driveline component may be at fault.

CLUTCH CONTAMINATION

Fluid contamination is a frequent cause of clutch malfunctions. Oil, water or clutch fluid on the clutch disc and pressure plate surfaces will cause chatter, slip and grab. Inspect components for oil, hydraulic fluid or water/road splash contamination.

Oil contamination indicates a leak at either the rear main seal or transmission input shaft. Clutch fluid leaks are usually from damaged slave cylinder push rod seals. Heat buildup caused by slippage between the pressure plate, disc and flywheel can bake the oil residue onto the components. The glaze-like residue ranges in color from amber to black.

Road splash contamination is dirt/water entering the clutch housing due to loose bolts, housing cracks. Driving through deep water puddles can force water/road splash into the housing through such openings.

IMPROPER RELEASE OR CLUTCH ENGAGEMENT

Clutch release or engagement problems can be caused by worn or damage clutch components. A visual inspection of the release components will usually reveal the problem part.

Release problems can result in hard shifting and noise. Look for leaks at the clutch cylinders and interconnecting line and loose slave cylinder bolts. Also worn/loose release fork, pivot stud, clutch disc, pressure plate or release bearing.

Engagement problems can result in slip, chatter/shudder and noisy operation. The causes may be clutch disc contamination, wear, distortion or flywheel damage. Visually inspect to determine the actual cause of the problem.

CLUTCH MISALIGNMENT

Clutch components must be in proper alignment with the crankshaft and transmission input shaft. Misalignment caused by excessive runout or warpage of any clutch component will cause grab, chatter and improper clutch release.

CLUTCH (Continued)

CLUTCH COVER AND DISC RUNOUT

Check the clutch disc before installation. Axial (face) runout of a **new** disc should not exceed 0.50 mm (0.020 in.). Measure runout about 6 mm (1/4 in.) from the outer edge of the disc facing. Obtain another disc if runout is excessive.

Check condition of the clutch before installation. A warped cover or diaphragm spring will cause grab and incomplete release or engagement. Be careful when handling the cover and disc. Impact can distort the cover, diaphragm spring, release fingers and the hub of the clutch disc.

Use an alignment tool when positioning the disc on the flywheel. The tool prevents accidental misalignment which could result in cover distortion and disc damage.

A frequent cause of clutch cover distortion (and consequent misalignment) is improper bolt tightening.

FLYWHEEL RUNOUT

Check flywheel runout whenever misalignment is suspected. Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator.

Common causes of runout are:

- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. Minor flywheel scoring can be cleaned up by hand with 180 grit emery or with turning equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar Lock And Seal or equivalent. Tighten flywheel bolts to specified torque only. Overtightening can distort the flywheel hub causing runout.

DIAGNOSIS CHART

The diagnosis charts Diagnosis Chart describe common clutch problems, causes and correction. Fault conditions are listed at the top of each chart. Conditions, causes and corrective action are outlined in the indicated columns.

The charts are provided as a convenient reference when diagnosing faulty clutch operation.

DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Disc facing worn out	1. Normal wear.	1. Replace cover and disc.
	2. Driver frequently rides (slips) the clutch. Results in rapid overheating and wear.	2. Replace cover and disc.
	3. Insufficient clutch cover diaphragm spring tension.	3. Replace cover and disc.
Clutch disc facing contaminated with oil, grease, or clutch fluid.	1. Leak at rear main engine seal or transmission input shaft seal.	1. Replace appropriate seal.
	2. Excessive amount of grease applied to the input shaft splines.	2. Remove grease and apply the correct amount of grease.
	3. Road splash, water entering housing.	3. Replace clutch disc. Clean clutch cover and reuse if in good condition.
	4. Slave cylinder leaking.	4. Replace hydraulic clutch linkage.
Clutch is running partially disengaged.	1. Release bearing sticking or binding and does not return to the normal running position.	1. Verify failure. Replace the release bearing and transmission front bearing retainer as necessary.

CLUTCH (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Flywheel below minimum thickness specification.	1. Improper flywheel machining. Flywheel has excessive taper or excessive material removal.	1. Replace flywheel.
Clutch disc, cover and/or diaphragm spring warped or distorted.	1. Rough handling. Impact bent cover, spring, or disc. 2. Improper bolt tightening procedure.	1. Replace disc or cover as necessary. 2. Tighten clutch cover using proper procedure.
Facing on flywheel side of disc torn, gouged, or worn.	1. Flywheel surface scored or nicked. 2. Clutch disc sticking or binding on transmission input shaft.	1. Correct surface condition if possible. Replace flywheel and disc as necessary. 2. Inspect components and correct/replace as necessary.
Clutch disc facing burnt. Flywheel and cover pressure plate surfaces heavily glazed.	1. Frequent operation under high loads or hard acceleration conditions. 2. Driver frequently rides (slips) clutch. Results in rapid wear and overheating of disc and cover.	1. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause. 2. Correct condition of flywheel and pressure plate surface. Replace clutch cover and disc. Alert driver to problem cause.
Clutch disc binds on input shaft splines.	1. Clutch disc hub splines damaged during installation. 2. Input shaft splines rough, damaged, or corroded.	1. Clean, smooth, and lubricate hub splines if possible. Replace disc if necessary. 2. Clean, smooth, and lubricate shaft splines if possible. Replace input shaft if necessary.
Clutch disc rusted to flywheel and/or pressure plate.	1. Clutch not used for an extended period of time (e.g. long term vehicle storage).	1. Sand rusted surfaces with 180 grit sanding paper. Replace clutch cover and flywheel if necessary.
Pilot bearing seized, loose, or rollers are worn.	1. Bearing cocked during installation. 2. Bearing defective. 3. Bearing not lubricated. 4. Clutch misalignment.	1. Install a new bearing. 2. Install a new bearing. 3. Install a new bearing. 4. Inspect clutch and correct as necessary. Install and lubricate a new bearing.

CLUTCH (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Clutch will not disengage properly.	1. Low hydraulic linkage fluid level.	1. Add hydraulic linkage fluid.
	2. Clutch cover loose.	2. Follow proper bolt tightening procedure.
	3. Clutch disc bent or distorted.	3. Replace clutch disc.
	4. Clutch cover diaphragm spring bent or warped.	4. Replace clutch cover.
	5. Clutch disc installed backwards.	5. Remove and install clutch disc correctly.
	6. Release fork bent or fork pivot loose or damaged.	6. Replace fork or pivot as necessary.
	7. Clutch master or slave cylinder failure.	7. Replace hydraulic linkage assembly.
Clutch pedal squeak.	1. Pivot pin loose.	1. Tighten pivot pin if possible. Replace clutch pedal if necessary.
	2. Master cylinder bushing not lubricated.	2. Lubricate master cylinder bushing.
	3. Pedal bushings worn out or cracked.	3. Replace and lubricate bushings.
	4. Rough surface on front bearing retainer.	4. Replace front bearing retainer.
Clutch master or slave cylinder plunger dragging andør binding	1. Master or slave cylinder components worn or corroded.	1. Replace clutch hydraulic linkage assembly.
Release bearing is noisy.	1. Release bearing defective or damaged.	1. Replace release bearing.
Contact surface of release bearing damaged.	1. Clutch cover incorrect or release fingers bent or distorted.	1. Replace clutch cover and release bearing.
	2. Release bearing defective or damaged.	2. Replace the release bearing.
	3. Release bearing misaligned.	3. Check and correct runout of clutch components. Check front bearing sleeve for damage/ alignment. Repair as necessary.
Partial engagement of clutch disc. One side of disc is worn and the other side is glazed and lightly worn.	1. Clutch pressure plate position incorrect.	1. Replace clutch disc and cover.
	2. Clutch cover, spring, or release fingers bent or distorted.	2. Replace clutch disc and cover.
	3. Clutch disc damaged or distorted.	2. Replace clutch disc.
	4. Clutch misalignment.	4. Check alignment and runout of flywheel, disc, pressure plate, andør clutch housing. Correct as necessary.

CLUTCH (Continued)

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Slave Cylinder Nuts	23	17	-
Clutch Master Cylinder Nuts	28	21	-
Pressure Plate Bolts - V6 & V8	50	37	-
Pressure Plate Bolts - V10	30	22.5	-
Pressure Plate Bolts - Diesel	30	22.5	-
Release Bearing Pivot	23	17	-
Flywheel Bolts	95	70	-

CLUTCH DISC

REMOVAL

(1) Support engine with wood block and adjustable jack stand, to prevent strain on engine mounts.

(2) Remove transmission and transfer case, if equipped.

(3) If pressure plate will be reused, mark the position on flywheel with paint or scriber (Fig. 3). Also note location marks on the pressure next to the bolt holes. The mark will be a L or a circle with an X in it.

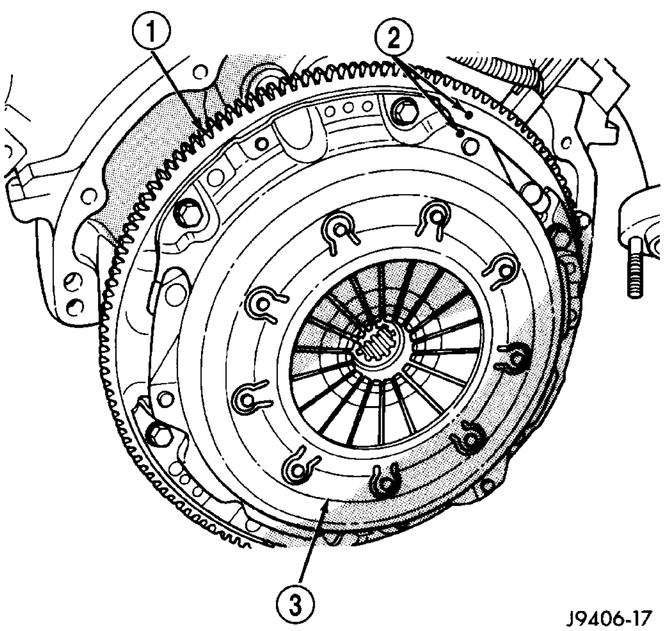


Fig. 3 PRESSURE PLATE POSITION-TYPICAL

1 - FLYWHEEL
2 - ALIGNMENT MARKS
3 - PRESSURE PLATE

(4) Insert clutch alignment tool through clutch disc and into pilot bushing, to hold disc in place while removing bolts.

(5) Loosen pressure plate bolts evenly, a few threads at a time and in a diagonal pattern to prevent warping the plate.

(6) Remove bolts completely and remove pressure plate, disc and alignment tool.

INSTALLATION

(1) Check runout and free operation of new clutch disc.

(2) Lubricate crankshaft pilot bearing with a NLGI - 2 rated grease.

(3) Install clutch alignment tool in clutch disc hub with the raised side of hub is facing away from the flywheel.

NOTE: Flywheel side is imprinted on the disc face.

(4) Install alignment tool in pilot bearing and position disc on the flywheel.

(5) Position pressure plate over disc and onto the flywheel (Fig. 4).

(6) Align and hold pressure plate in position and install bolts finger tight.

(7) Tighten bolts evenly and a few threads at a time in a diagonal pattern.

CAUTION: Bolts must be tightened evenly and to specified torque to avoid warping pressure plate cover.

(8) Tighten pressure plate bolts to:

- V6 & V8 Engines - 50 N·m (37 ft. lbs.)
- V10 & Diesel Engines - 30 N·m (22.5 ft. lbs.)

(9) Remove release lever and release bearing from clutch housing. Apply Mopar high temperature bearing grease to bore of release bearing, release lever contact surfaces and release lever pivot stud (Fig. 5).

CLUTCH DISC (Continued)

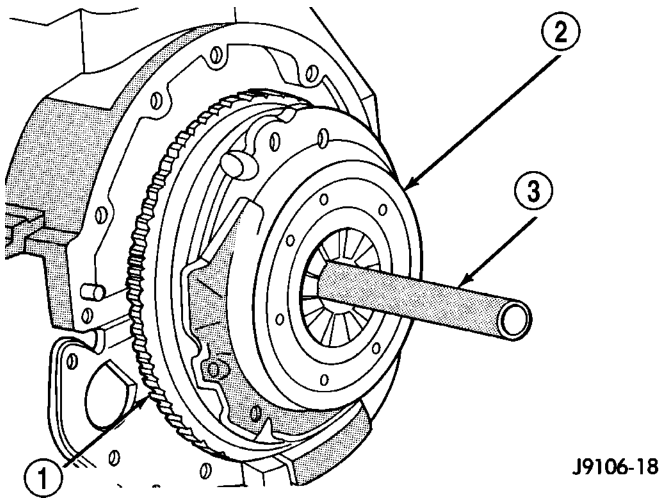


Fig. 4 CLUTCH DISC AND PRESSURE PLATE

1 - FLYWHEEL
2 - PRESSURE PLATE AND DISC
3 - ALIGNMENT TOOL

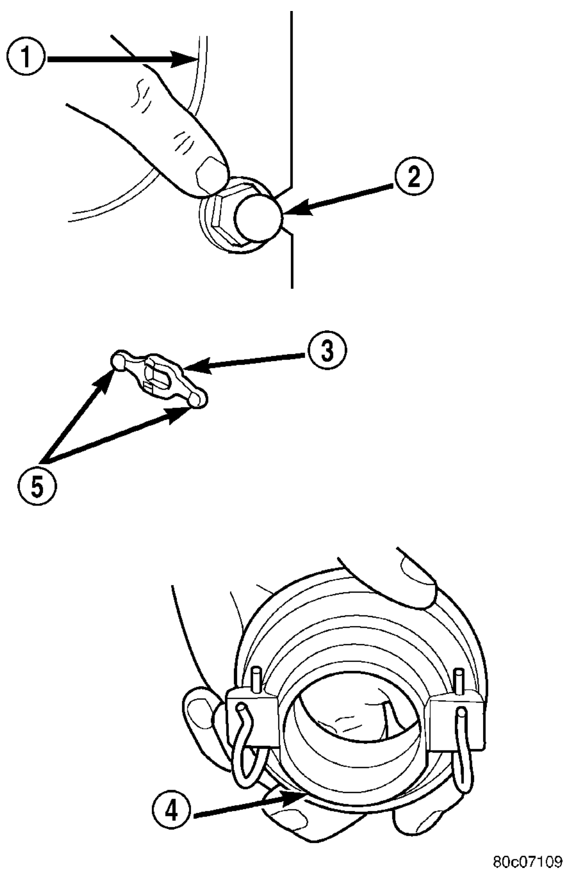


Fig. 5 LUBRICATION POINTS

1 - CLUTCH HOUSING
2 - FORK PIVOT BALL
3 - RELEASE FORK
4 - RELEASE BEARING BORE
5 - LUBE POINTS

(10) Apply light coat of Mopar high temperature bearing grease to splines of transmission input shaft and to release bearing slide surface of the transmission front bearing retainer (Fig. 6).

CAUTION: Do not over lubricate shaft splines. This can result in grease contamination of the disc.

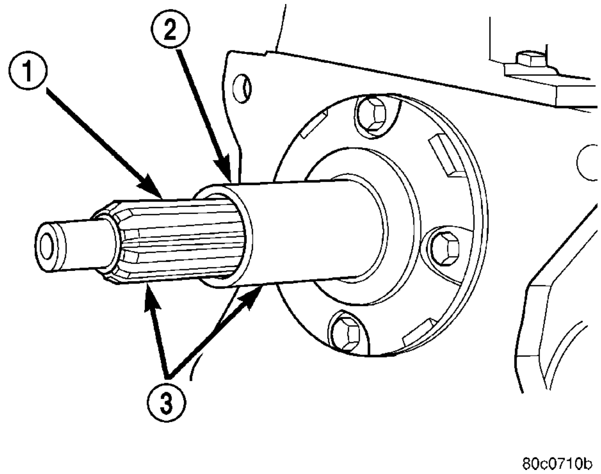


Fig. 6 INPUT SHAFT LUBRICATION POINTS

1 - INPUT SHAFT
2 - BEARING RETAINER
3 - SPLINE AND RELEASE BEARING SURFACE

(11) Wipe pilot bearing surface clean.

(12) Install release lever and bearing in clutch housing. Verify spring clips that retain fork on pivot ball and release bearing on fork are installed properly (Fig. 7).

NOTE: If release lever is installed correctly, the lever part number will be toward the bottom of the transmission and right side up. There is also a stamped "I" in the lever which goes to the pivot ball side of the transmission.

(13) Install transmission and transfer case if equipped.

CLUTCH DISC (Continued)

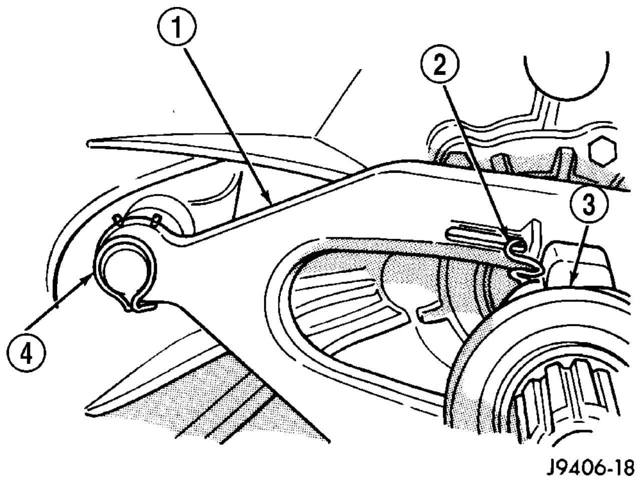


Fig. 7 FORK, BEARING AND SPRING CLIPS

1 - FORK
2 - SPRING CLIP
3 - BEARING
4 - SPRING CLIP

(14) Check fluid level in clutch master cylinder.

CLUTCH HOUSING

DIAGNOSIS AND TESTING

The clutch housing maintains alignment between the crankshaft and transmission input shaft. Misalignment can cause clutch noise, hard shifting, incomplete release and chatter. Also premature pilot bearing, cover release fingers and clutch disc wear. In severe cases, it can cause premature wear of the transmission input shaft and front bearing.

NOTE: Only the NV4500 clutch housing can be checked using the following bore and face runout procedures. The NV5600 clutch housing is a integral part of the transmission and can only be checked off the vehicle.

CLUTCH HOUSING BORE RUNOUT

CAUTION: On diesel engines if housing bore runout exceeds 0.015 inch, the clutch housing/transmission adapter plate must be replaced. On gas engines if housing bore runout exceeds 0.053 in. the clutch housing must be replaced.

NOTE: Offset dowels are available for gas engines to correct housing bore runout. They are not available for diesel engines.

(1) Remove the clutch housing.
(2) Remove the clutch cover and disc.
(3) Replace one of the flywheel bolts with an appropriate size threaded rod that is 10 in. (25.4 cm) long (Fig. 8). The rod will be used to mount the dial indicator.

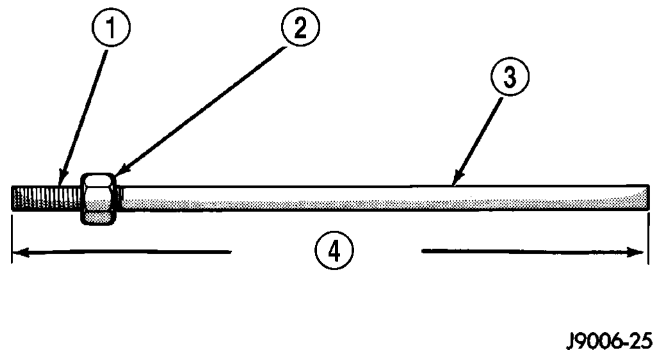


Fig. 8 DIAL INDICATOR MOUNTING STUD

1 - 7/16 - 20 THREAD
2 - NUT
3 - STUD OR THREADED ROD
4 - 10 INCHES LONG

(4) Remove release fork from the clutch housing.
(5) Install clutch housing. Tighten the housing bolts nearest the alignment dowels first.
(6) Mount dial indicator on the threaded rod and position indicator plunger on the clutch housing bore (Fig. 9).

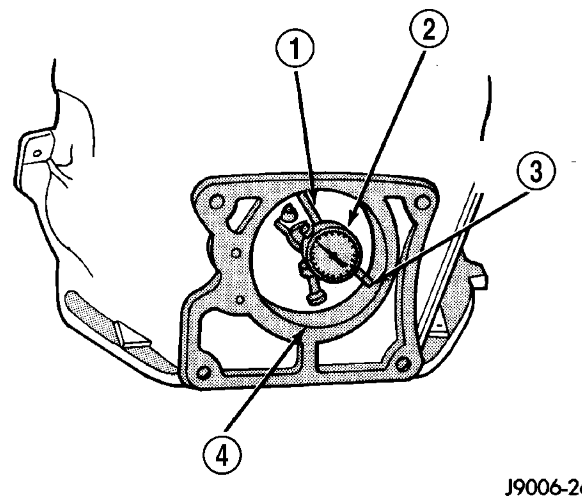


Fig. 9 CLUTCH HOUSING BORE RUNOUT

1 - MOUNTING STUD OR ROD
2 - DIAL INDICATOR
3 - INDICATOR PLUNGER
4 - CLUTCH HOUSING BORE

(7) Rotate crankshaft until indicator plunger is at the topof the housing bore. Zero the indicator at this point.
(8) Rotate crankshaft and record indicator readings at eight points (45° apart) around the bore (Fig. 10). Take measurement at least twice for accuracy.

CLUTCH HOUSING (Continued)

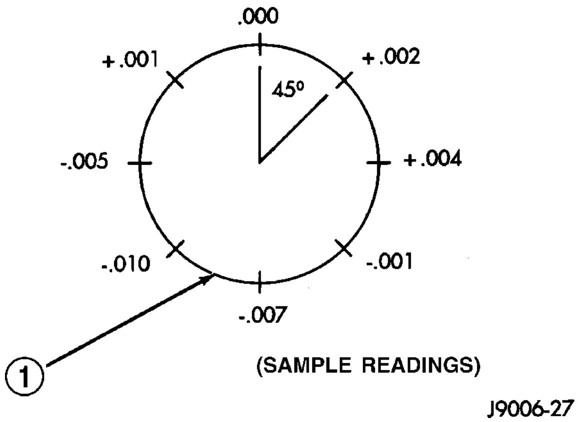


Fig. 10 MEASUREMENT POINTS AND READINGS

1 - CLUTCH HOUSING BORE CIRCLE

(9) Subtract each reading from the one 180° opposite to determine runout and direction. Bore runout example (Fig. 10):

- 0.000 – (–0.007) = 0.007 in.
- +0.002 – (–0.010) = 0.012 in.
- +0.004 – (–0.005) = 0.009 in.
- –0.001 – (+0.001) = –0.002 in.

In this example the largest or total indicator reading (TIR) difference is 0.012 inch. This means the housing bore is offset from the crankshaft centerline by 0.006 in. which is 1/2 of 0.012 inch. The dowels needed to correct this have an offset of 0.007 in. (Fig. 11).

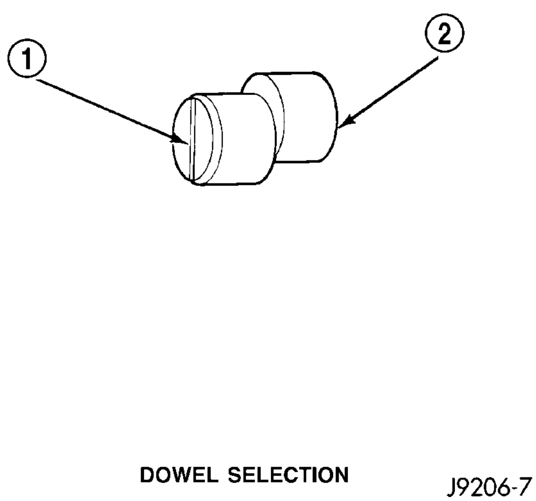


Fig. 11 ALIGNMENT DOWEL SELECTION

1 - SLOT DIRECTION OF OFFSET

2 - OFFSET DOWEL

TIR VALUE	OFFSET DOWEL REQUIRED
0.011 - 0.021 inch	0.007 inch
0.022 - 0.035 inch	0.014 inch
0.036 - 0.052 inch	0.021 inch

Remove housing and install dowels with the slotted side facing out so they can be turned with a screwdriver. Then install the housing and mount the dial indicator and check bore runout again. Rotate the dowels until the TIR is less than 0.010 inch.

Clutch Housing Face Runout

(1) Position dial indicator towards the housing face (Fig. 12) with indicator plunger on the rim of the housing bore.

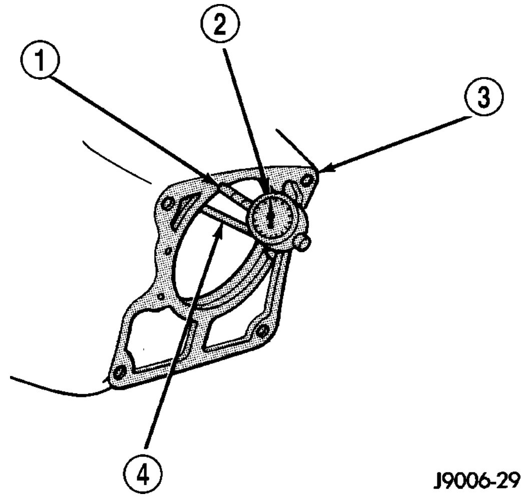


Fig. 12 DIAL INDICATOR LOCATION

1 - INDICATOR PLUNGER
2 - DIAL INDICATOR
3 - CLUTCH HOUSING FACE
4 - INDICATOR MOUNTING STUD OR ROD

(2) Rotate crankshaft until indicator plunger is at the 10 O'clock position and zero the dial indicator.

(3) Measure and record face runout readings at four points 90° apart (Fig. 13). Take measurement at least twice for accuracy.

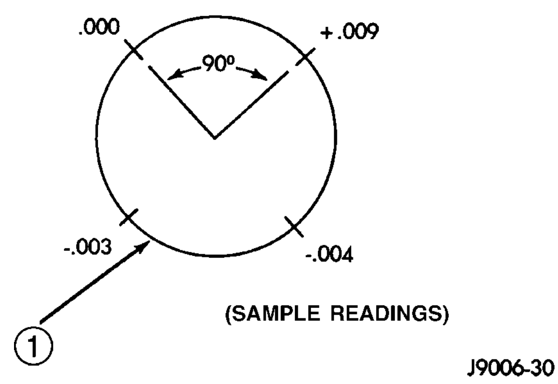


Fig. 13 MEASUREMENT POINTS AND READINGS

1 - CLUTCH HOUSING FACE CIRCLE (AT RIM OF BORE)

(4) Subtract lowest reading from highest to determine total runout. If low reading was **minus** 0.004 in. and highest reading was **plus** 0.009 in. the total runout is 0.013 inch.

CLUTCH HOUSING (Continued)

NOTE: Maximum acceptable face runout is 0.010 inch.

To correct this example (Fig. 13) the shims needed between the clutch housing and transmission are:

- 0.009 in. at the 0.000 corner
- 0.012 in. at the –0.003 corner
- 0.013 in. at the –0.004 corner

After installing the clutch assembly and housing, tighten the housing bolts nearest the alignment dowels first.

NOTE: Shims can be made from shim stock or similar materials of the required thickness (Fig. 14).

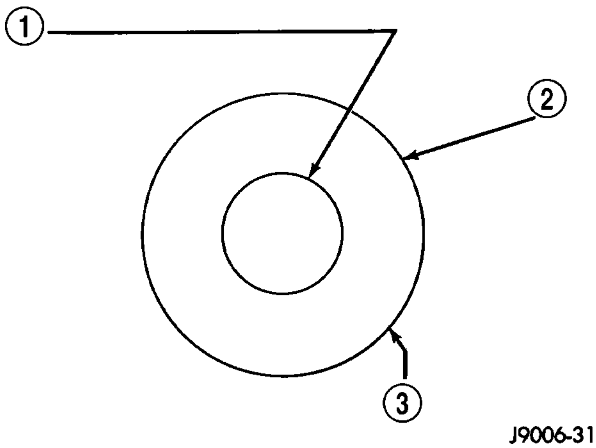


Fig. 14 ALIGNMENT SHIMS

1 - CUT/DRILL BOLT HOLE TO SIZE
2 - SHIM STOCK
3 - MAKE SHIM 1-INCH DIAMETER

REMOVAL

(1) Remove transmission and transfer case (Fig. 15).

(2) Remove the starter from the clutch housing.

(3) Remove clutch housing bolts and remove housing from the engine.

INSTALLATION

(1) Clean housing mounting surface of engine block with wax and grease remover.

(2) Verify that clutch housing alignment dowels are in good condition and properly seated.

(3) Transfer slave cylinder, release fork and boot, fork pivot stud and wire/hose brackets to new housing.

(4) Align and install clutch housing on transmission (Fig. 16). Tighten housing bolts closest to alignment dowels first and to the following torque values:

- 1/4in. diameter "A" bolts - 4.5 N·m (40 in.lb.).
- 3/8in. diameter "A" bolts - 47.5 N·m (35 ft.lb.).
- 7/16in. diameter "A" bolts - 68 N·m (50 ft.lb.).
- "B" bolts for 5.9L TD/8.0L applications - 47.5 N·m (35 ft.lb.).
- "C" bolts for 5.9L TD applications - 47.5 N·m (35 ft.lb.).

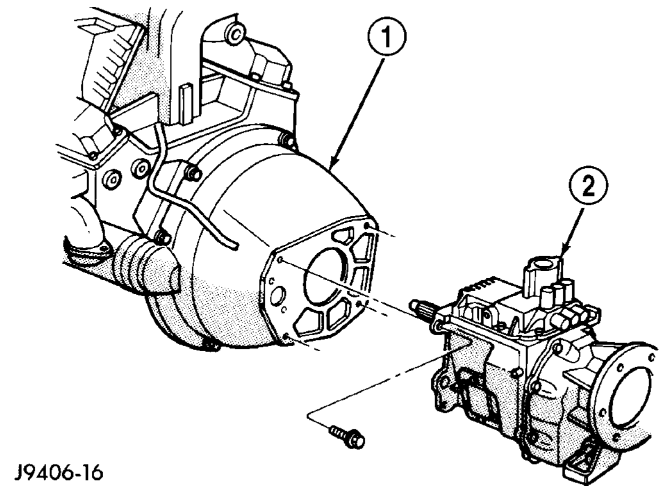


Fig. 15 TRANSMISSION/CLUTCH HOUSING-NV4500

1 - CLUTCH HOUSING
2 - TRANSMISSION

- "C" bolts for 8.0L applications - 74.5 N·m (55 ft.lb.).

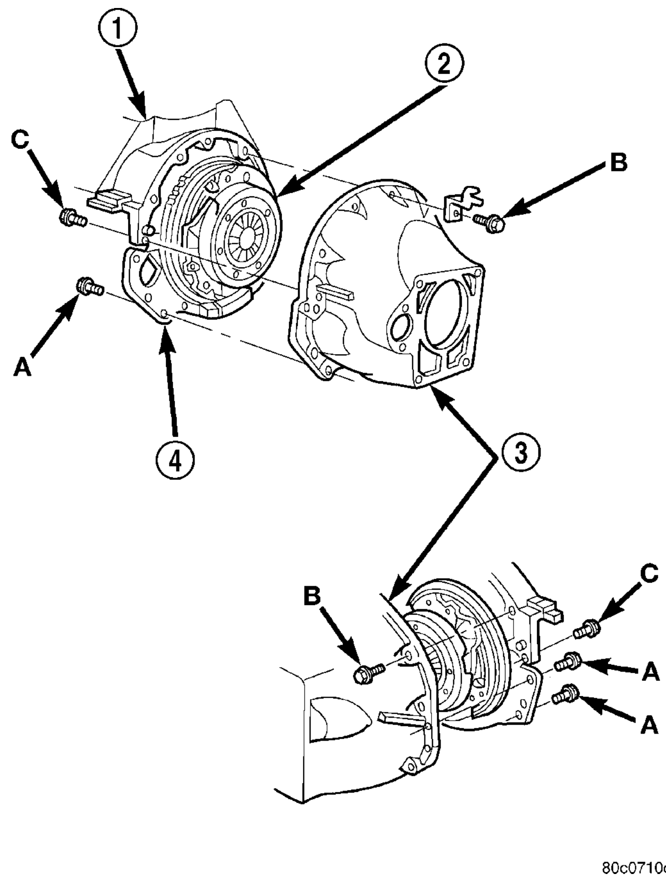


Fig. 16 CLUTCH HOUSING INSTALLATION-NV4500

1 - ENGINE BLOCK
2 - CLUTCH DISC AND COVER
3 - CLUTCH HOUSING
4 - DUST COVER

(5) Install the starter to the clutch housing.

CLUTCH HOUSING (Continued)

(6) Install the clutch housing dust shield to the clutch housing.

(7) Install transmission and transfer case, if equipped.

CLUTCH RELEASE BEARING

REMOVAL

(1) Remove transmission and transfer case, if equipped.

(2) Remove spring clip.

(3) Disconnect release bearing from release fork and remove bearing (Fig. 17).

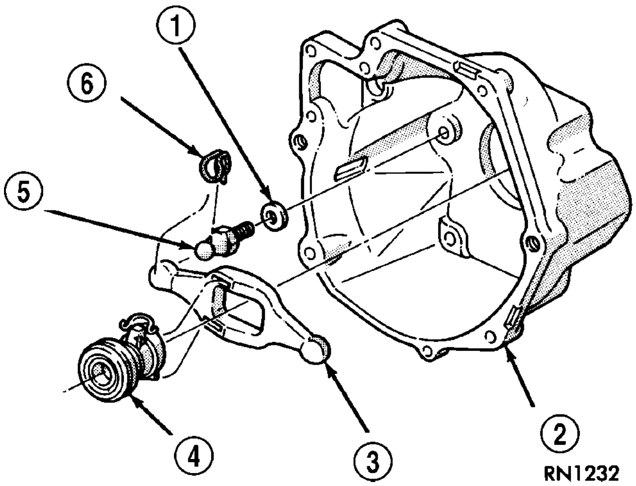


Fig. 17 CLUTCH RELEASE COMPONENTS

1 - CONED WASHER
2 - CLUTCH HOUSING
3 - RELEASE FORK
4 - RELEASE BEARING AND SLEEVE
5 - PIVOT 23 N·m (200 IN. LBS.)
6 - SPRING CLIP

INSTALLATION

(1) Inspect bearing slide surface on transmission front bearing retainer. Replace retainer if slide surface is scored, worn, or cracked.

(2) Inspect release lever and pivot stud. Be sure stud is secure and in good condition. Be sure fork is not distorted or worn. Replace fork spring clips if bent or damaged.

(3) Lubricate input shaft splines, bearing retainer slide surface, lever pivot ball stud, and release lever pivot surface with Mopar® high temperature bearing grease.

(4) Install release fork and release bearing (Fig. 18). Be sure fork and bearing are properly secured by spring clips. Also be sure that the release fork is installed properly. The rear side of the release lever has one end with a raised area. This raised area goes toward the slave cylinder side of the transmission.

(5) Install clutch housing, if removed.

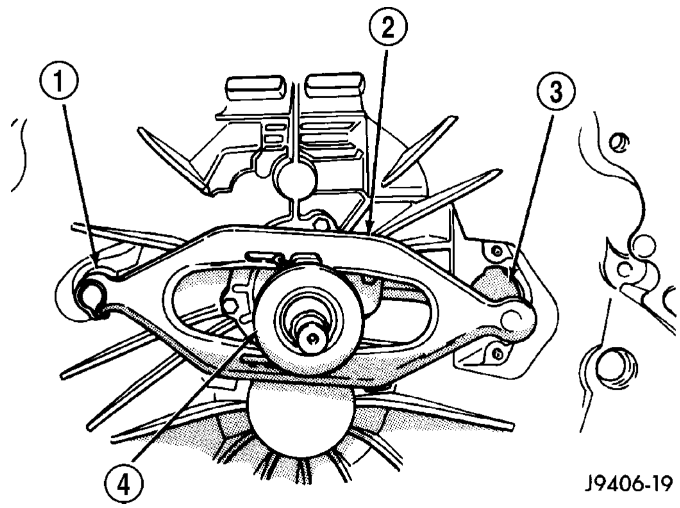


Fig. 18 Clutch Release Fork And

1 - PIVOT BALL
2 - FORK
3 - SLAVE CYLINDER OPENING
4 - BEARING

(6) Install transmission and transfer case.

(7) Check clutch master cylinder fluid level.

FLYWHEEL

DIAGNOSIS AND TESTING

Check flywheel runout whenever misalignment is suspected. Flywheel runout should not exceed 0.08 mm (0.003 in.). Measure runout at the outer edge of the flywheel face with a dial indicator. Mount the indicator on a stud installed in place of one of the flywheel bolts.

Common causes of runout are:

- heat warpage
- improper machining
- incorrect bolt tightening
- improper seating on crankshaft flange shoulder
- foreign material on crankshaft flange

Flywheel machining is not recommended. The flywheel clutch surface is machined to a unique contour and machining will negate this feature. Minor flywheel scoring can be cleaned up by hand with 180 grit emery or with surface grinding equipment. Remove only enough material to reduce scoring (approximately 0.001 - 0.003 in.). Heavy stock removal is **not recommended.** Replace the flywheel if scoring is severe and deeper than 0.076 mm (0.003 in.). Excessive stock removal can result in flywheel cracking or warpage after installation; it can also weaken the flywheel and interfere with proper clutch release.

Clean the crankshaft flange before mounting the flywheel. Dirt and grease on the flange surface may cock the flywheel causing excessive runout. Use new bolts when remounting a flywheel and secure the bolts with Mopar Lock And Seal or equivalent. Tighten flywheel bolts to specified torque only. Over-tightening can distort the flywheel hub causing runout.

REMOVAL

(1) Remove transmission.
(2) Remove pressure plate and clutch.
(3) Remove flywheel bolts and remove flywheel.

DISASSEMBLY

NOTE: If the teeth are worn or damaged, the flywheel should be replaced as an assembly. This is the recommended repair. In cases where a new flywheel is not readily available, (V10/Diesel Engine only) a replacement ring gear can be installed. The following procedure must be observed to avoid damaging the flywheel and replacement gear.

WARNING: WEAR PROTECTIVE GOGGLES OR SAFETY GLASSES WHILE CUTTING RING GEAR.

(1) Mark position of the old gear for alignment reference on the flywheel. Use a scriber for this purpose.
(2) Remove the old gear by cutting most of the way through it (at one point) with an abrasive cut-off wheel. Then complete removal with a cold chisel or punch.

ASSEMBLY

NOTE: The ring gear is a shrink fit on the flywheel. This means the gear must be expanded by heating in order to install it. The method of heating and expanding the gear is extremely important. Every surface of the gear must be heated at the same time to produce uniform expansion. An oven or similar enclosed heating device must be used. Temperature required for uniform expansion is approximately 375° F.

CAUTION: Do not use an oxy/acetylene torch to remove the old gear, or to heat and expand a new gear. The high temperature of the torch flame can cause localized heating that will damage the flywheel. In addition, using the torch to heat a replacement gear will cause uneven heating and expansion. The torch flame can also anneal the gear teeth resulting in rapid wear and damage after installation.

WARNING: WEAR PROTECTIVE GOGGLES OR SAFETY GLASSES AND HEAT RESISTENT GLOVES WHEN HANDLING A HEATED RING GEAR.

(1) The heated gear must be installed evenly to avoid misalignment or distortion.
(2) Position and install the heated ring gear on the flywheel with a shop press and a suitable press plates.
(3) Place flywheel on work bench and let it cool in normal shop air. Allow the ring gear to cool down completely before installation it on the engine.

CAUTION: Do not use water or compressed air to cool the flywheel. The rapid cooling produced by water or compressed air will distort or crack the new gear.

INSTALLATION

(1) Install flywheel on the crank shaft.
(2) Install flywheel bolts and tighten to 95 N·m (70 ft. lbs.).
(3) Install clutch.
(4) Install transmission.

PILOT BEARING

REMOVAL

(1) Remove transmission.
(2) Remove clutch disc.
(3) Use a suitable blind hole puller to remove pilot bearing.

INSTALLATION

(1) Clean bearing bore with solvent and wipe dry with shop towel.
(2) Install new bearing with clutch alignment tool (Fig. 19). Drive bearing into place with the letter side of the bearing facing the transmission. Bearing should be flush with edge of bearing bore.

CAUTION: Do not allow bearing to become cocked and do not recess bearing.

PILOT BEARING (Continued)

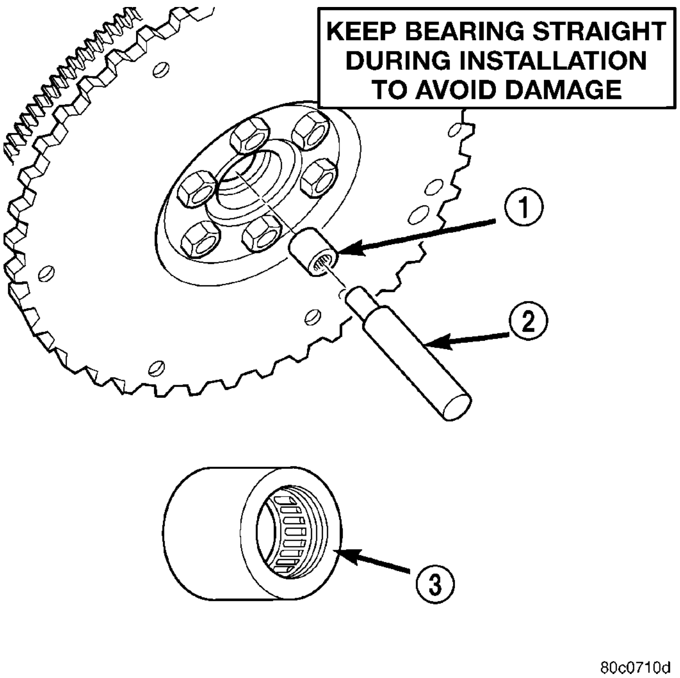


Fig. 19 PILOT BEARING

1 - PILOT BEARING
2 - ALIGNMENT TOOL
3 - LETTER SIDE MUST FACE TRANSMISSION

(3) Install clutch disc, pressure plate and transmission.

LINKAGE

REMOVAL

CAUTION: The hydraulic linkage has a quick disconnect at the slave cylinder. This fitting should never be disconnected or tampered with. Once the hydraulic line is connected to the slave cylinder, it should never be disconnected.

(1) Raise and support vehicle.
(2) Remove nuts attaching slave cylinder to studs on clutch housing (Fig. 20).
(3) Remove slave cylinder from clutch housing.
(4) Remove plastic clip securing the hydraulic line to the dash panel from the lower dash panel flange.
(5) Remove plastic clip securing hydraulic line to the dash panel from the upper dash panel stud.
(6) Lower vehicle.
(7) Disconnect clutch pedal interlock switch wires (Fig. 21).
(8) Remove clutch master cylinder rod pin.
(9) Verify that cap on clutch master cylinder reservoir is tight. This will avoid spillage during removal.
(10) Remove clutch master cylinder nuts holding the to the dash panel.

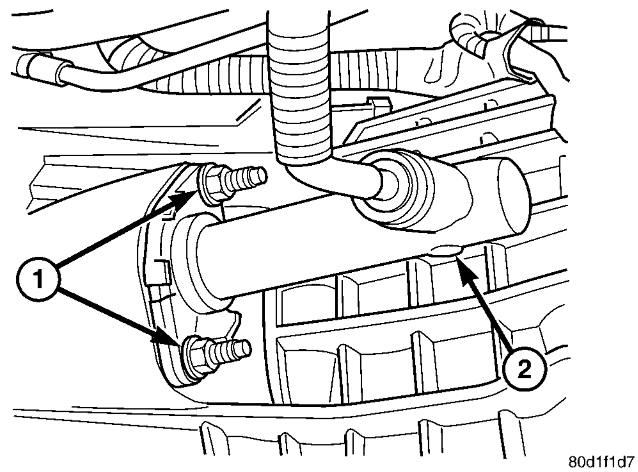


Fig. 20 SLAVE CYLINDER

1 - MOUNTING NUTS
2 - SLAVE CYLINDER

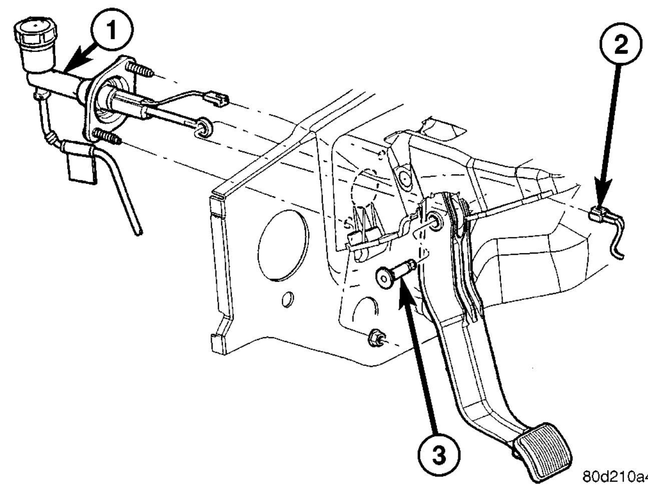


Fig. 21 CLUTCH MASTER CYLINDER

1 - MASTER CYLINDER
2 - INTERLOCK CONNECTOR
3 - ROD PIN

(11) Remove clutch cylinders, reservoir and connecting lines from vehicle.

INSTALLATION

(1) Position cylinders and connecting line in vehicle engine compartment. Position clutch hydraulic line against the dash panel and behind all engine hoses and wiring.
(2) Apply a light coating of grease to the inside diameter of the master cylinder push rod eye.
(3) Install clutch master cylinder on dash panel and tighten clutch master cylinder nuts to 28 N·m (21 ft. lbs.).
(4) Install clutch master cylinder push rod pin.
(5) Connect clutch pedal position interlock switch wires.

LINKAGE (Continued)

(6) Install plastic clip securing hydraulic line to the dash panel into the lower dash panel flange.

(7) Install plastic clip securing hydraulic line to the dash panel onto the upper dash panel stud.

(8) Raise vehicle.

(9) Install slave cylinder and verify cylinder rod is properly seated in release lever.

(10) Install and tighten slave cylinder nuts to 23 N·m (17 ft. lbs.).

(11) If **new** clutch linkage is being installed, connect the clutch hydraulic line to the clutch slave cylinder.

CAUTION: Once the clutch hydraulic line is connected to the slave cylinder, it should never be disconnected.

(12) Lower vehicle.

(13) Operate linkage several times to verify proper operation.

CLUTCH PEDAL POSITION SWITCH

DESCRIPTION

A clutch pedal position (interlock) switch is mounted on the clutch master cylinder push rod (Fig. 22). The switch is actuated by clutch pedal movement.

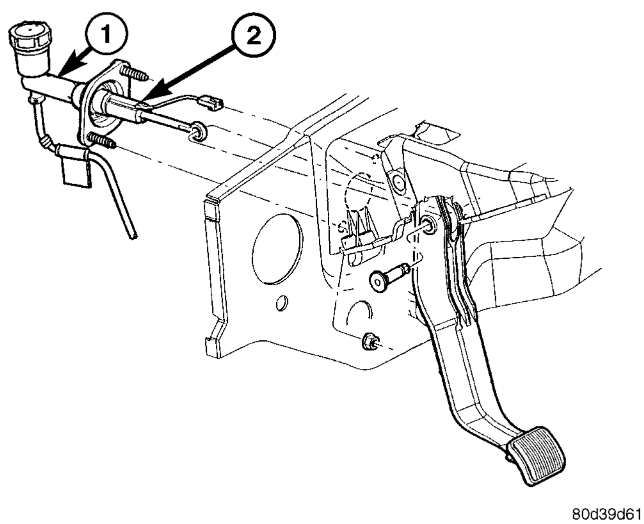


Fig. 22 LOCATION, CLUTCH PEDAL POSITION SWITCH

1 - CLUTCH MASTER CYLINDER
2 - CLUTCH PEDAL POSITION SWITCH

OPERATION

The clutch pedal position switch is used to prevent starter motor engagement unless the clutch pedal is depressed.

An input from this switch is also used to either shut down and/or prevent operation of the speed control system when the clutch pedal is depressed.

The position switch is an integral part of the clutch master cylinder push rod and is not serviced separately.

DIAGNOSIS AND TESTING

(1) Locate clutch switch 2-wire electrical connector. This will be the test point. This connector is attached to pedal support bracket located under instrument panel to left of clutch pedal (Fig. 23). Disconnect wiring at this point.

(2) Check for switch continuity with an ohmmeter while operating clutch pedal up and down. Continuity should be broken and reapplied each time pedal is pressed.

(3) If continuity is not present, or is always present at any pedal position, replace switch. Switch is not serviced separately. Replace clutch master cylinder.

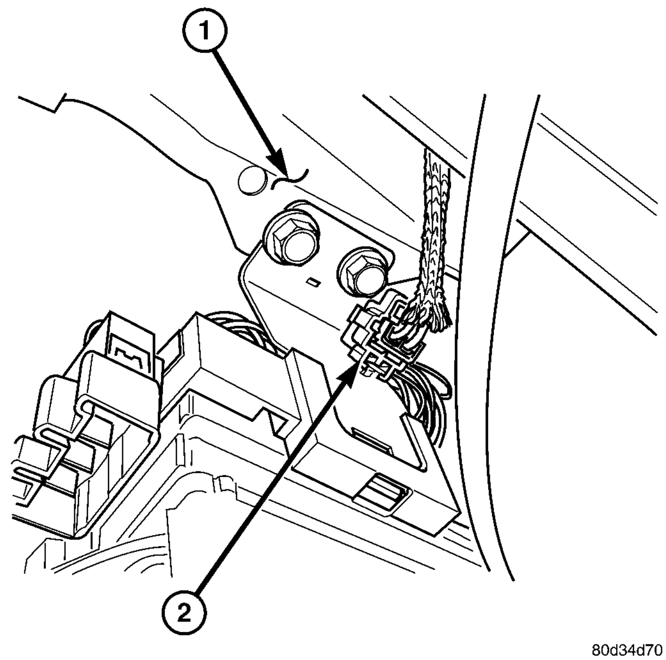


Fig. 23 CLUTCH SWITCH TEST POINT

1 - PEDAL SUPPORT BRACKET
2 - ELECTRICAL CONNECTOR

COOLING

TABLE OF CONTENTS

COOLING

DESCRIPTION

DESCRIPTION - COOLING SYSTEM FLOW 3.7L/4.7L ENGINE

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system is pressurized and uses a centrifugal water pump to circulate coolant through the system and a coolant deaeration and reserve system that utilizes a pressurized degas bottle (hot bottle).

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures (Fig. 1).

DESCRIPTION - COOLING SYSTEM FLOW - 5.9L ENGINE

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling system uses a coolant recovery / reserve system that utilizes an ambient overflow bottle.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures (Fig. 2).

COOLING (Continued)

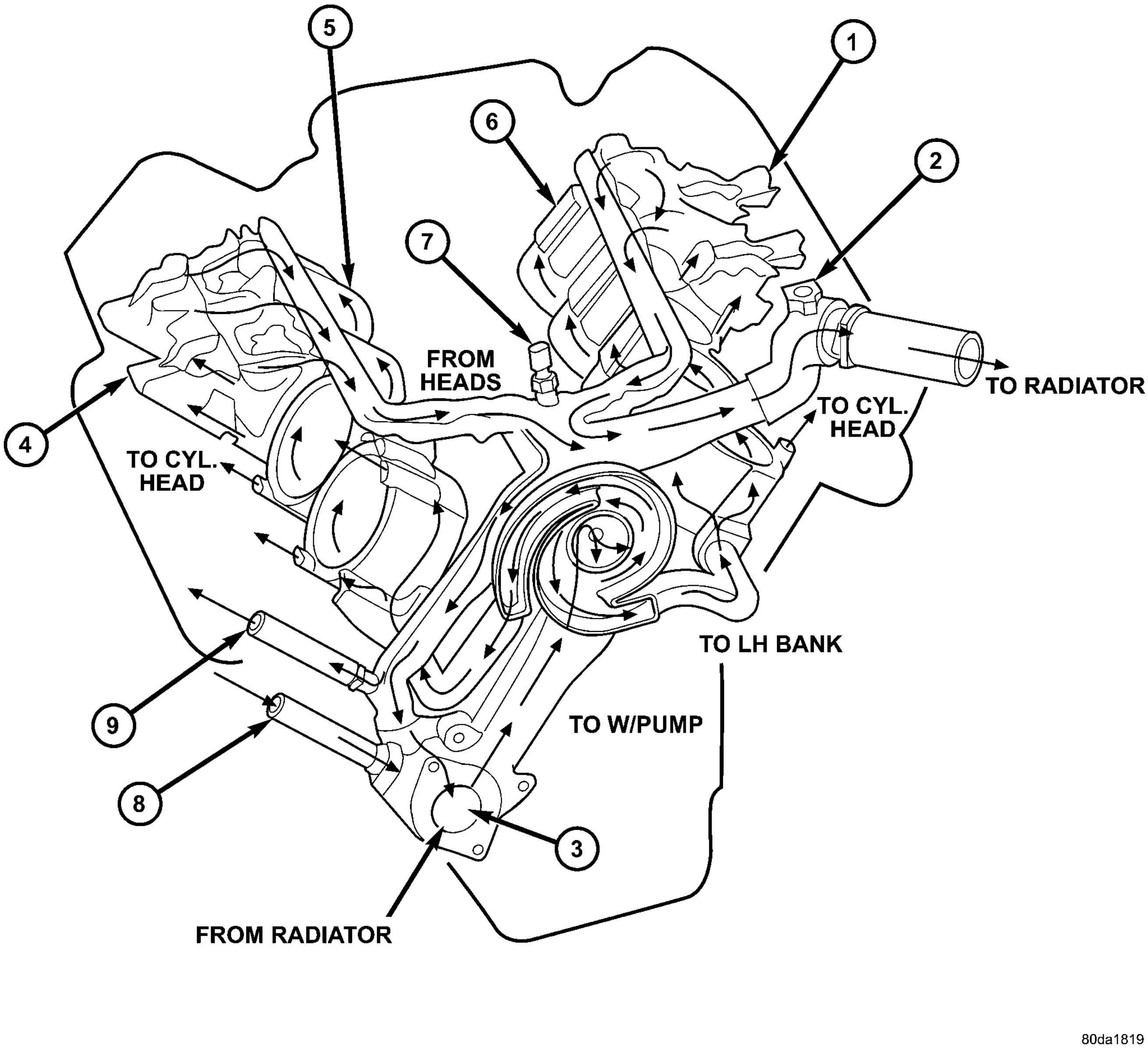


Fig. 1 Engine Cooling System Flow - 3.7L/4.7L

1 - LH CYL. HEAD
2 - BLEED
3 - THERMOSTAT LOCATION
4 - RH CYL. HEAD
5 - RH BANK CYL. BLOCK
6 - LH BANK CYL. BLOCK
7 - COOLANT TEMP. SENSOR
8 - FROM HEATER CORE
9 - TO HEATER CORE

DESCRIPTION—COOLING SYSTEM FLOW - 5.9L DIESEL

The diesel engine cooling system consists of :

- Cross-flow radiator
- Belt driven water pump
- Belt driven mechanical cooling fan
- Electronic viscous fan drive
- Fan shroud
- Radiator pressure cap
- Vertically mounted thermostat
- Coolant reserve/recovery system
- Transmission oil cooler
- Coolant

Coolant flow circuits for the 5.9L diesel engine are shown in (Fig. 3).

COOLING (Continued)

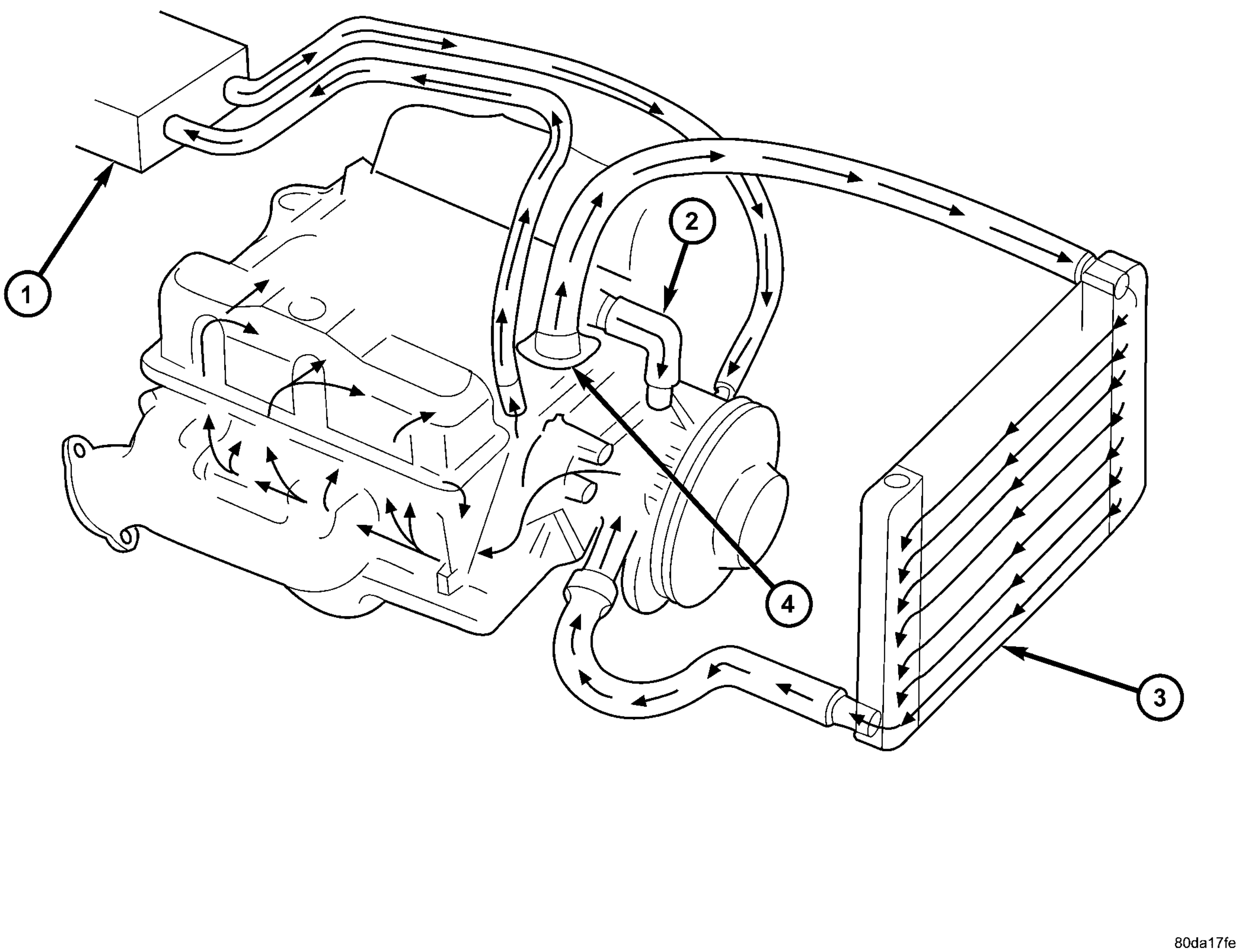


Fig. 2 ENGINE COOLING SYSTEM FLOW - 5.9L

1 - HEATER
2 - BYPASS*
3 - CROSSFLOW RADIATOR
4 - THERMOSTAT LOCATION

DESCRIPTION - HOSE CLAMPS

The cooling system utilizes spring type hose clamps. If a spring type clamp replacement is necessary, replace with the original Mopar® equipment spring type clamp.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only a original equipment clamp with matching number or letter and ensure the clamp has the same size width (Fig. 4).

OPERATION

OPERATION—COOLING SYSTEM

The cooling system regulates engine operating temperature. It allows the engine to reach normal operating temperature as quickly as possible. It also maintains normal operating temperature and prevents overheating.

The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid (if equipped). The cooling

COOLING (Continued)

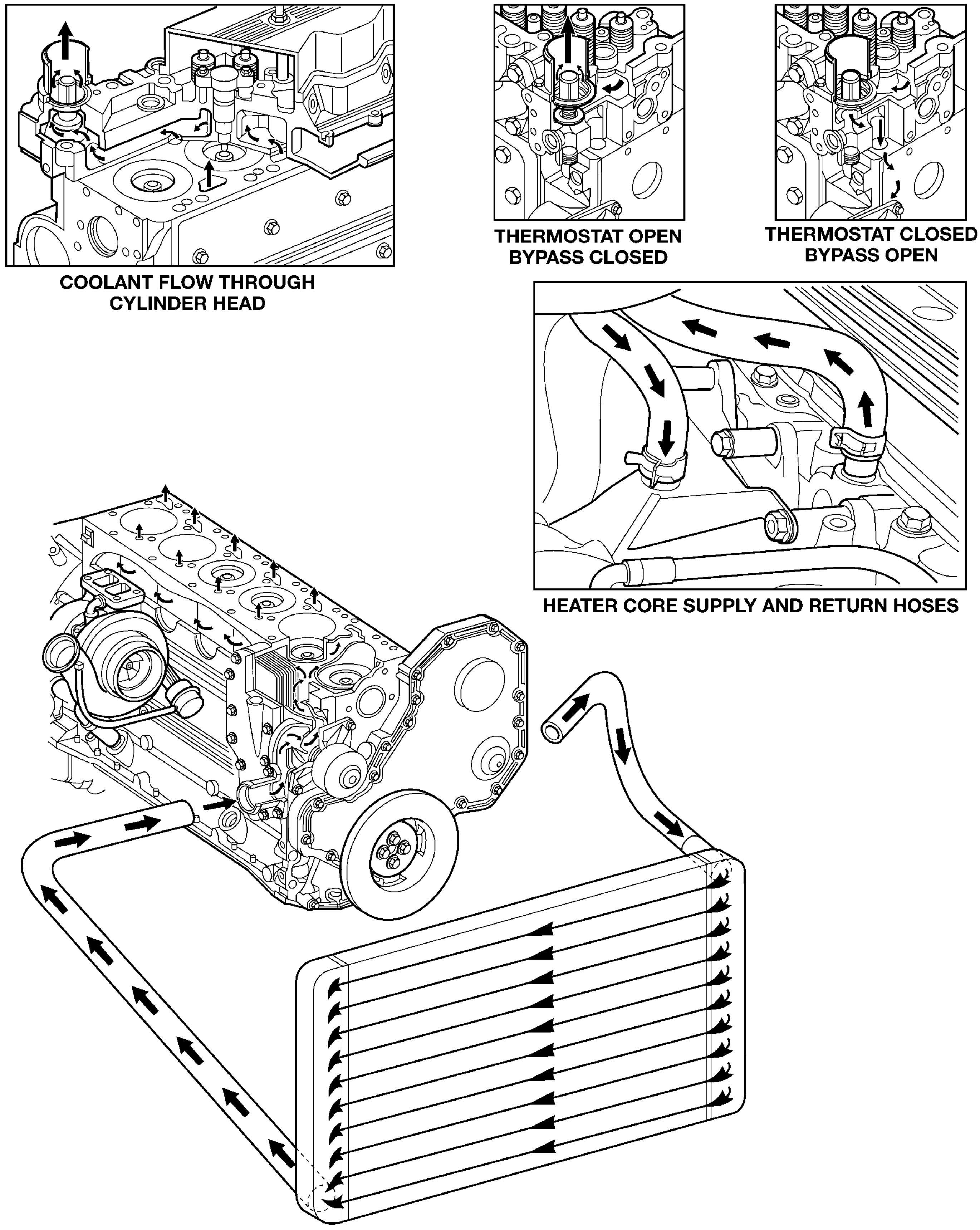


Fig. 3 Cooling System Circulation—Diesel Engine

COOLING (Continued)

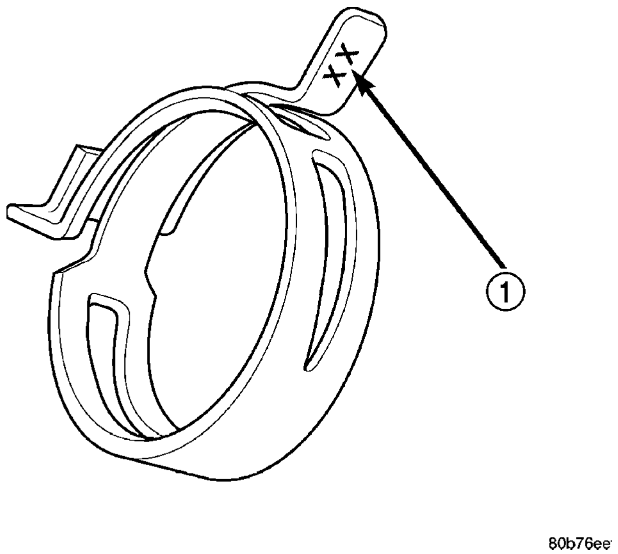


Fig. 4 Spring Clamp Size Location

1 - SPRING CLAMP SIZE LOCATION

system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

5.9L, 5.9L Diesel, and 8.0L engines utilize an ambient overflow bottle for coolant recovery/reserve. The 3.7L and 4.7L engines utilize a pressurized degas bottle for coolant deaeration and reserve. This degas bottle has coolant flowing through it continuously, supplied by a vent in the hot side radiator tank and returning to the heater return hose.

An optional factory installed maximum duty cooling package is available on most models. This package will provide additional cooling capacity for vehicles used under extreme conditions such as trailer towing in high ambient temperatures.

OPERATION—HOSE CLAMPS

The spring type hose clamp applies constant tension on a hose connection. To remove a spring type hose clamp, only use constant tension clamp pliers designed to compress the hose clamp.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ON-BOARD DIAGNOSTICS (OBD)

COOLING SYSTEM RELATED DIAGNOSTICS

The Engine Control Module (ECM) has been programmed to monitor certain cooling system components:

- If the engine has remained cool for too long a period, such as with a stuck open thermostat, a Diagnostic Trouble Code (DTC) can be set.
- If an open or shorted condition has developed in the electronically controlled viscous fan clutch circuit, a Diagnostic Trouble Code (DTC) can be set.
- If fan speed is not detected a DTC will be set.
- Coolant temperature sensor circuit problems can set a DTC.

If the problem is sensed in a monitored circuit often enough to indicated an actual problem, a DTC is stored. The DTC will be stored in the ECM memory for eventual display to the service technician. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

ACCESSING DIAGNOSTIC TROUBLE CODES

To read DTC's and to obtain cooling system data, (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION).

ERASING TROUBLE CODES

After the problem has been repaired, use the DRBIII® scan tool to erase a DTC. Refer to the appropriate Powertrain Diagnostic Procedures service information for operation of the DRBIII® scan tool.

DIAGNOSIS AND TESTING—COOLING SYSTEM - TESTING FOR LEAKS

ULTRAVIOLET LIGHT METHOD

A leak detection additive is available through the parts department that can be added to cooling system. The additive is highly visible under ultraviolet light (black light). Pour one ounce of additive into cooling system. Place heater control unit in HEAT position. Start and operate the engine until the radiator upper hose is warm to the touch. Aim the commercially available black light tool at the components to be checked. If leaks are present, the black light will cause the additive to glow a bright green color.

The black light can be used in conjunction with a pressure tester to determine if any external leaks exist (Fig. 5).

PRESSURE TESTER METHOD

The engine should be at normal operating temperature. Recheck the system cold if the cause of coolant loss is not located during the warm engine examination.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING.

Carefully remove the radiator pressure cap from the filler neck and check the coolant level. Push down on the cap to disengage it from the stop tabs. Wipe the inside of the filler neck and examine the

COOLING (Continued)

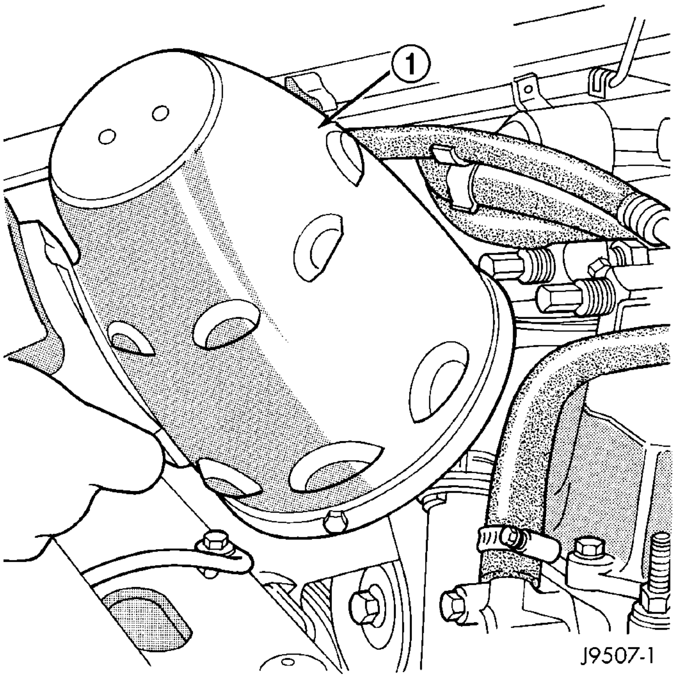


Fig. 5 Leak Detection Using Black Light—Typical

1 - TYPICAL BLACK LIGHT TOOL

lower inside sealing seat for nicks, cracks, paint, dirt and solder residue. Inspect the radiator-to- reserve/ overflow tank hose for internal obstructions. Insert a wire through the hose to be sure it is not obstructed.

Inspect the cams on the outside of the filler neck. If the cams are damaged, seating of the pressure cap valve and tester seal will be affected.

Attach pressure tester (7700 or an equivalent) to radiator filler neck.

Operate the tester pump to apply 103.4 kPa (15 psi) pressure to the system. If the hoses enlarge excessively or bulges while testing, replace as necessary. Observe the gauge pointer and determine the condition of the cooling system according to following criteria:

Holds Steady: If the pointer remains steady for two minutes, serious coolant leaks are not present in system. However, there could be an internal leak that does not appear with normal system test pressure. If it is certain that coolant is being lost and leaks cannot be detected, inspect for interior leakage or perform Internal Leakage Test. Refer to INTERNAL LEAKAGE INSPECTION.

Drops Slowly: Indicates a small leak or seepage is occurring. Examine all of the connections for seepage or slight leakage with a flashlight. Inspect the radiator, hoses, gasket edges and heater. Seal the small leak holes with a Sealer Lubricant (or equivalent). Repair the leak holes and inspect the system again with pressure applied.

Drops Quickly: Indicates that serious leakage is occurring. Examine the system for external leakage. If leaks are not visible, inspect for internal leakage. Large radiator leak holes should be repaired by a reputable radiator repair shop.

INTERNAL LEAKAGE INSPECTION

Remove the engine oil pan drain plug and drain a small amount of engine oil. If coolant is present in the pan, it will drain first because it is heavier than oil. An alternative method is to operate engine for a short period to churn the oil. After this is done, remove the engine dipstick and inspect for water globules. Also inspect the transmission dipstick for water globules and transmission fluid cooler for leakage.

WARNING: WITH RADIATOR PRESSURE TESTER TOOL INSTALLED ON RADIATOR, DO NOT ALLOW PRESSURE TO EXCEED 145 kPa (21 PSI). PRESSURE WILL BUILD UP QUICKLY IF A COMBUSTION LEAK IS PRESENT. TO RELEASE PRESSURE, ROCK TESTER FROM SIDE TO SIDE. WHEN REMOVING TESTER, DO NOT TURN TESTER MORE THAN 1/2 TURN IF SYSTEM IS UNDER PRESSURE.

Operate the engine without the pressure cap on the radiator until the thermostat opens. Attach a Pressure Tester to the filler neck. If pressure builds up quickly it indicates a combustion leak exists. This is usually the result of a cylinder head gasket leak or crack in engine. Repair as necessary.

If there is not an immediate pressure increase, pump the Pressure Tester. Do this until indicated pressure is within system range of 110 kPa (16 psi). Fluctuation of the gauge pointer indicates compression or combustion leakage into cooling system.

Because the vehicle is equipped with a catalytic converter, **do not** short out cylinders to isolate compression leak.

If the needle on dial of the pressure tester does not fluctuate, race engine a few times to check for an abnormal amount of coolant or steam. This would be emitting from exhaust pipe. Coolant or steam from exhaust pipe may indicate a faulty cylinder head gasket, cracked engine cylinder block or cylinder head.

A convenient check for exhaust gas leakage into cooling system is provided by a commercially available Block Leak Check tool. Follow manufacturers instructions when using this product.

COMBUSTION LEAKAGE TEST—WITHOUT PRESSURE TESTER

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

COOLING (Continued)

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAIN-COCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

Drain sufficient coolant to allow thermostat removal. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL). Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

Add coolant to radiator to bring level to within 6.3 mm (1/4 in) of the top of the thermostat housing.

CAUTION: Avoid overheating. Do not operate engine for an excessive period of time. Open drain-cock immediately after test to eliminate boil over.

Start engine and accelerate rapidly three times, to approximately 3000 rpm while observing coolant. If internal engine combustion gases are leaking into cooling system, bubbles will appear in coolant. If bubbles do not appear, internal combustion gas leakage is not present.

DIAGNOSIS AND TESTING - COOLING SYSTEM DIESEL ENGINE

COOLING SYSTEM DIAGNOSIS—DIESEL ENGINE

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOWNOTE: Information on dash cluster is displayed based on broadcast data from ECM. DTC will be set for engine sensor circuit concern.	1. Vehicle is equipped with a heavy duty cooling system.	1. None. System operating normally.
	2. Thermostat stuck open	2. Inspect and test thermostat.
	3. Coolant level low.	3. Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)
	4. Temperature gauge not functioning correctly.	4. Check cluster (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING)

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH. COOLANT MAY OR MAY NOT BE LEAKING FROM SYSTEMNOTE: Information on dash cluster is displayed based on broadcast data from ECM. DTC will be set for engine sensor circuit concern.	1. Vehicle overloaded, high ambient (outside) temperatures with A/C turned on, stop and go driving or prolonged operation at idle speeds.	1. Temporary condition, repair not required. Notify customer of vehicle operation instructions located in Owners Manual.
	2. Temperature gauge not functioning correctly.	2. Check cluster (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING)
	3. Air trapped in cooling system	3. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE) and refill (Refer to 7 - COOLING - STANDARD PROCEDURE)
	4. Radiator cap faulty.	4. Replace radiator cap.
	5. Plugged A/C or radiator cooling fins.	5. Clean all debris away from A/C and radiator cooling fins.
	6. Coolant mixture incorrect.	6. Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE) refill with correct mixture (Refer to 7 - COOLING - STANDARD PROCEDURE).
	7. Thermostat stuck shut.	7. Inspect and test thermostat. Replace thermostat if necessary.
	8. Bug screen or winter front being used.	8. Remove bug screen or winter front.
	9. Electronically controlled viscous fan drive not operating properly.	9. Check viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)
	10. Cylinder head gasket leaking.	10. Check for leaking head gaskets (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	11. Heater core leaking.	11. Replace heater core.
	12. Cooling system hoses leaking.	12. Tighten clamps or Replace hoses.
	13. Brakes dragging.	13. Check brakes. (Refer to 5 - BRAKES/HYDRAULIC/ MECHANICAL - DIAGNOSIS AND TESTING)
	14. Accessory drive belt.	14. Inspect. Replace as necessary.
	15. Water Pump.	15. Inspect and replace as necessary.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READING INCONSISTENT (ERRATIC, CYCLES OR FLUCTUATES)NOTE: Information on dash cluster is displayed based on broadcast data from ECM. DTC will be set for engine sensor circuit concern.	1. Heavy duty cooling system, extreme cold ambient (outside) temperature or heater blower motor in high position.	1. None. System operating normally.
	2. Temperature gauge or sensor defective.	2. Check cluster or engine coolant temp sensor (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING)
	3. Temporary heavy usage or load.	3. None. Normal condition.
	4. Air trapped in cooling system.	4. Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
	5. Water pump	5. Replace water pump.
	6. Air leak on suction side of water pump.	6. Check for leak. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING)
RADIATOR CAP LEAKING STEAM AND /OR COOLANT INTO RESERVOIR BOTTLE. (TEMPERATURE GAUGE MAY READ HIGH)	1. Radiator cap defective.	1. Replace radiator cap.
	2. Radiator neck surface damaged.	2. Replace radiator.
HOSE OR HOSES COLLAPSE WHEN ENGINE IS COOLING.	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reservoir/overflow system.	1. Replace radiator cap, check vent hose between radiator and reservoir bottle for blockage also check reservoir bottle vent for blockage.
NOISY FAN	1. Fan blade(s) loose, damaged.	1. Replace fan blade assembly.
	2. Electronically controlled viscous fan drive.	2. None. Normal condition.
	3. Fan blades striking surrounding objects.	3. Locate contact point and repair as necessary.
	4. Electronically controlled viscous fan drive bearing.	4. Check viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)
	5. Electronically controlled viscous fan stuck on	5. Check viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)
	6. Obstructed air flow through radiator.	6. Remove obstruction.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE AIR CONDITIONER PERFORMANCE (COOLING SYSTEM SUSPECTED)	1. Radiator and/or A/C condenser air flow obstructed.	1. Remove obstruction and/or clean.
	2. Electronically controlled viscous fan drive not working.	2. Check fan drive. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)
	3. Air seals around radiator damaged or missing.	3. Inspect air seals, repair or replace as necessary.
INADEQUATE HEATER PERFORMANCE. GAUGE MAY OR MAY NOT READ LOW.	1. Heavy duty cooling system, and cooler ambient temperatures.	1. None. Normal condition.
	2. Obstruction in heater hoses.	2. Remove hoses, remove obstruction.
	3. Electronically controlled viscous fan stuck on	Check fan drive. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)
	4. Water pump damaged.	4. Replace water pump.
HEAT ODOR	1. Damaged or missing drive line heat shields.	1. Repair or replace damaged or missing heat shields.
	2. Electronically controlled viscous fan drive damaged.	2. Check thermal viscous fan drive. (Refer to 7 - COOLING/ENGINE/ FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING)

DIAGNOSIS AND TESTING - PRELIMINARY CHECKS

ENGINE COOLING SYSTEM OVERHEATING

Establish what driving conditions caused the complaint. Abnormal loads on the cooling system such as the following may be the cause:

- PROLONGED IDLE
- VERY HIGH AMBIENT TEMPERATURE
- SLIGHT TAIL WIND AT IDLE
- SLOW TRAFFIC
- TRAFFIC JAMS
- HIGH SPEED OR STEEP GRADES

Driving techniques that avoid overheating are:

- Idle with A/C off when temperature gauge is at end of normal range.
- Increasing engine speed for more air flow is recommended.

TRAILER TOWING:

Consult Trailer Towing section of owners manual. Do not exceed limits.

RECENT SERVICE OR ACCIDENT REPAIR:

Determine if any recent service has been performed on vehicle that may effect the cooling system. This may be:

- Engine adjustments (incorrect timing)
- Slipping engine accessory drive belt(s)
- Brakes (possibly dragging)
- Changed parts. Incorrect water pump or pump rotating in wrong direction due to belt not correctly routed
- Reconditioned radiator or cooling system refilling (possibly under filled or air trapped in system).
- Service to electrically controlled viscous fan clutch

NOTE: If investigation reveals none of the previous items as a cause for an engine overheating complaint, refer to COOLING SYSTEM DIAGNOSIS CHART BELOW.

These charts are to be used as a quick-reference only. Refer to COOLING SYSTEM DIAGNOSIS CHART

COOLING (Continued)

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS LOW	1. Has a Diagnostic Trouble Code (DTC) been set indicating a stuck open thermostat?	1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for On-Board Diagnostics and DTC information. Replace thermostat if necessary.
	2. Is the temperature sending unit connected?	2. Check the temperature sensor connector. (Refer to 8 - ELECTRICAL/ INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL) Repair connector if necessary.
	3. Is the temperature gauge operating OK?	3. Check gauge operation. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/ ENGINE TEMPERATURE GAUGE - DESCRIPTION). Repair as necessary.
	4. Coolant level low in cold ambient temperatures accompanied with poor heater performance.	4. Check coolant level in the coolant reserve/overflow tank or degas bottle and the radiator. Inspect system for leaks. Repair leaks as necessary. Refer to the Coolant section of the manual text for WARNINGS and CAUTIONS associated with removing the radiator cap.
	5. Improper operation of internal heater doors or heater controls.	5. Inspect heater and repair as necessary. (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING) for procedures.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
TEMPERATURE GAUGE READS HIGH OR THE COOLANT WARNING LAMP ILLUMINATES. COOLANT MAY OR MAY NOT BE LOST OR LEAKING FROM THE COOLING SYSTEM	1. Trailer is being towed, a steep hill is being climbed, vehicle is operated in slow moving traffic, or engine is being idled with very high ambient (outside) temperatures and the air conditioning is on. Higher altitudes could aggravate these conditions.	1. This may be a temporary condition and repair is not necessary. Turn off the air conditioning and attempt to drive the vehicle without any of the previous conditions. Observe the temperature gauge. The gauge should return to the normal range. If the gauge does not return to the normal range, determine the cause for overheating and repair. Refer to Possible Causes (2-18).
	2. Is the temperature gauge reading correctly?	2. Check gauge. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL). Repair as necessary.
	3. Is the temperature warning illuminating unnecessarily?	3. (Refer to 8 - ELECTRICAL/ INSTRUMENT CLUSTER - SCHEMATIC - ELECTRICAL).
	4. Coolant low in coolant reserve/overflow tank and radiator?	4. Check for coolant leaks and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	5. Pressure cap not installed tightly. If cap is loose, boiling point of coolant will be lowered. Also refer to the following Step 6.	5. Tighten cap
	6. Poor seals at the radiator cap.	6. (a) Check condition of cap and cap seals. Refer to Radiator Cap. Replace cap if necessary.
		(b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator (5.9L) or degas bottle (3.7L, 4.7L).
	7. Coolant level low in radiator but not in coolant reserve/ overflow tank. This means the radiator is not drawing coolant from the coolant reserve/ overflow tank as the engine cools (5.9L).	7. (a) Check condition of radiator cap and cap seals. Refer to Radiator Cap in this Group. Replace cap if necessary.
		(b) Check condition of radiator filler neck. If neck is bent or damaged, replace radiator.
		(c) Check condition of the hose from the radiator to the coolant tank. It should fit tight at both ends without any kinks or tears. Replace hose if necessary.
		(d) Check coolant reserve/overflow tank and tanks hoses for blockage. Repair as necessary.
	8. Incorrect coolant concentration	8. Check coolant. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
	9. Coolant not flowing through system	9. Check for coolant flow at radiator filler neck with some coolant removed, engine warm and thermostat open. Coolant should be observed flowing through radiator. If flow is not observed, determine area of obstruction and repair as necessary.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	10. Radiator or A/C condenser fins are dirty or clogged.	10. Remove insects and debris. (Refer to 7 - COOLING - STANDARD PROCEDURE).
	11. Radiator core is corroded or plugged.	11. Have radiator re-cored or replaced.
	12. Fuel or ignition system problems.	12. Refer to 14 - Fuel System or 8 - Electrical for diagnosis and testing procedures.
	13. Dragging brakes.	13. Check and correct as necessary. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING) for correct procedures.
	14. Bug screen or cardboard is being , reducing airflow.	14. Remove bug screen or cardboard.
	15. Thermostat partially or completely shut.	15. Check thermostat operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL) .
	16. Viscous fan drive not operating properly.	16. Check fan drive operation and replace as necessary. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
	17. Cylinder head gasket leaking.	17. Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	18. Heater core leaking.	18. Check heater core for leaks. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING). Repair as necessary.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
Temperature gauge reading is inconsistent (flucttuates, cycles or is erratic)	1. During cold weather operation, with the heater blower in the high position, the gauge reading may drop slightly.	1. A normal condition. No correction necessary.
	2. Temperature gauge or engine mounted gauge sensor defective or shorted. Also, corroded or loose wiring in this circuit.	2. Check operation of gauge and repair if necessary. (Refer to 8 - ELECTRICAL/ INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).
	3. Gauge reading rises when vehicle is brought to a stop after heavy use (engine still running)	3. A normal condition. No correction is necessary. Gauge should return to normal range after vehicle is driven.
	4. Gauge reading high after re-starting a warmed up (hot) engine.	4. A normal condition. No correction is necessary. The gauge should return to normal range after a few minutes of engine operation.
	5. Coolant level low in radiator (air will build up in the cooling system causing the thermostat to open late).	5. Check and correct coolant leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	6. Cylinder head gasket leaking allowing exhaust gas to enter cooling system causing a thermostat to open late.	6. (a) Check for cylinder head gasket leaks. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING). (b) Check for coolant in the engine oil. Inspect for white steam emitting from the exhaust system. Repair as necessary.
	7. Water pump impeller loose on shaft.	7. Check water pump and replace as necessary. (Refer to 7 - COOLING/ ENGINE/WATER PUMP - REMOVAL).
	8. Loose accessory drive belt. (water pump slipping)	8. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). Check and correct as necessary.
	9. Air leak on the suction side of the water pump allows air to build up in cooling system causing thermostat to open late.	9. Locate leak and repair as necessary.
PRESSURE CAP IS BLOWING OFF STEAM AND/OR COOLANT TO COOLANT TANK. TEMPERATURE GAUGE READING MAY BE ABOVE NORMAL BUT NOT HIGH. COOLANT LEVEL MAY BE HIGH IN COOLANT RESERVE/ OVERFLOW TANK	1. Pressure relief valve in radiator cap is defective.	1. Check condition of radiator cap and cap seals. (Refer to 7 - COOLING/ENGINE/ RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace cap as necessary.
COOLANT LOSS TO THE GROUND WITHOUT PRESSURE CAP BLOWOFF. GAUGE READING HIGH OR HOT	1. Coolant leaks in radiator, cooling system hoses, water pump or engine.	1. Pressure test and repair as necessary. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
DETONATION OR PRE-IGNITION (NOT CAUSED BY IGNITION SYSTEM). GAUGE MAY OR MAY NOT BE READING HIGH	1. Engine overheating.	1. Check reason for overheating and repair as necessary.
	2. Freeze point of coolant not correct. Mixture is too rich or too lean.	2. Check coolant concentration. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
HOSE OR HOSES COLLAPSE WHILE ENGINE IS RUNNING	1. Vacuum created in cooling system on engine cool-down is not being relieved through coolant reserve/overflow system.	1. (a) Radiator cap relief valve stuck. (Refer to 7 - COOLING/ENGINE/RADIATOR PRESSURE CAP - DIAGNOSIS AND TESTING). Replace if necessary
(b) Hose between coolant reserve/overflow tank and radiator is kinked. Repair as necessary.		
(c) Vent at coolant reserve/overflow tank is plugged. Clean vent and repair as necessary.		
		(d) Reserve/overflow tank is internally blocked or plugged. Check for blockage and repair as necessary.
NOISY VISCOUS FAN/DRIVE	1. Fan blades loose.	1. Replace fan blade assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)
	2. Fan blades striking a surrounding object.	2. Locate point of fan blade contact and repair as necessary.
	3. Air obstructions at radiator or air conditioning condenser.	3. Remove obstructions and/or clean debris or insects from radiator or A/C condenser.
	4. Thermal viscous fan drive has defective bearing.	4. Replace fan drive. Bearing is not serviceable. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
	5. A certain amount of fan noise may be evident on models equipped with a thermal viscous fan drive. Some of this noise is normal.	5. (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DESCRIPTION) for an explanation of normal fan noise.

COOLING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
INADEQUATE HEATER PERFORMANCE. THERMOSTAT FAILED IN OPEN POSITION	1. Has a Diagnostic trouble Code (DTC) been set?	1. (Refer to 25 - EMISSIONS CONTROL - DESCRIPTION) for correct procedures and replace thermostat if necessary
	2. Coolant level low	2. (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	3. Obstructions in heater hose/fittings	3. Remove heater hoses at both ends and check for obstructions
	4. Heater hose kinked	4. Locate kinked area and repair as necessary
	5. Water pump is not pumping water to/through the heater core. When the engine is fully warmed up, both heater hoses should be hot to the touch. If only one of the hoses is hot, the water pump may not be operating correctly or the heater core may be plugged. Accessory drive belt may be slipping causing poor water pump operation.	5. (Refer to 7 - COOLING/ENGINE/ WATER PUMP - REMOVAL). If a slipping belt is detected, (Refer to 7 - COOLING/ ACCESSORY DRIVE/DRIVE BELTS - DIAGNOSIS AND TESTING). If heater core obstruction is detected, (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING/HEATER CORE - REMOVAL).
STEAM IS COMING FROM THE FRONT OF VEHICLE NEAR THE GRILL AREA WHEN WEATHER IS WET, ENGINE IS WARMED UP AND RUNNING, AND VEHICLE IS STATIONARY. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. During wet weather, moisture (snow, ice or rain condensation) on the radiator will evaporate when the thermostat opens. This opening allows heated water into the radiator. When the moisture contacts the hot radiator, steam may be emitted. This usually occurs in cold weather with no fan or airflow to blow it away.	1. Occasional steam emitting from this area is normal. No repair is necessary.
COOLANT COLOR	1. Coolant color is not necessarily an indication of adequate corrosion or temperature protection. Do not rely on coolant color for determining condition of coolant.	1. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION). Adjust coolant mixture as necessary.
COOLANT LEVEL CHANGES IN COOLANT RESERVE/ OVERFLOW TANK. TEMPERATURE GAUGE IS IN NORMAL RANGE	1. Level changes are to be expected as coolant volume fluctuates with engine temperature. If the level in the tank was between the FULL and ADD marks at normal operating temperature, the level should return to within that range after operation at elevated temperatures.	1. A normal condition. No repair is necessary.

COOLING (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - COOLANT LEVEL CHECK

NOTE: Do not remove radiator cap for routine coolant level inspections. The coolant level can be checked at coolant recovery bottle or the coolant degas bottle.

WARNING: DO NOT REMOVE OR LOOSEN THE RADIATOR CAP WITH THE COOLING SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT OR HIGH PRESSURE STEAM CAN OCCUR.

The 5.9L, 5.9L Diesel, and 8.0L engine coolant reserve / overflow system provides a quick method for determining the coolant level without removing the radiator pressure cap. With the engine at normal operating temperature and idling, observe the level of the coolant on the external level indicator on the side of the coolant reserve / overflow bottle. The coolant level should be between the MIN and MAX marks. If the coolant is below the MIN mark, add a 50/50 mixture of antifreeze and water to the bottle until the level reaches the MIN mark. **Do Not Overfill the bottle by adding fluid above the MAX line.** This may cause coolant to spill onto the ground during subsequent vehicle operation.

The 3.7L/4.7L/5.9L engine coolant degas system provides a quick method for determining the coolant level with out removing the radiator pressure cap. With a cold engine, observe the level of coolant in the degas bottle. The level should be in the COLD FILL RANGE. **DO NOT OVERFILL** the bottle by adding fluid above the COLD FILL RANGE. This may cause coolant to spill onto the ground during subsequent vehicle operation.

STANDARD PROCEDURE - COOLING SYSTEM CLEANING/REVERSE FLUSHING

CLEANING

Drain the cooling system and refill with water. Run the engine with the radiator cap installed until the upper radiator hose is hot. Stop the engine and drain the water from system. If the water is dirty, fill the system with water, run the engine and drain the system. Repeat this procedure until the water drains clean.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the cooling system. This is done using air pressure in the opposite direction of normal coolant flow. It is usually only necessary with very dirty systems with evidence of partial plugging.

REVERSE FLUSHING RADIATOR

Disconnect the radiator hoses from the radiator inlet and outlet. Attach a section of the radiator hose to the radiator bottom outlet fitting and insert the flushing gun. Connect a water supply hose and air supply hose to the flushing gun.

CAUTION: Internal radiator pressure must not exceed 138 kPa (20 psi) as damage to radiator may result.

Allow the radiator to fill with water. When the radiator is filled, apply air in short blasts. Allow the radiator to refill between blasts. Continue this reverse flushing until clean water flows out through the rear of the radiator cooling tube passages.

REVERSE FLUSHING ENGINE

Drain the cooling system. Remove the thermostat housing and thermostat. Install the thermostat housing. Disconnect the radiator upper hose from the radiator and attach the flushing gun to the hose. Disconnect the radiator lower hose from the water pump and attach a lead-away hose to the water pump inlet fitting.

CAUTION: On vehicles equipped with a heater water control valve, be sure the heater control valve is closed (heat off). This will prevent coolant flow with scale and other deposits from entering the heater core.

Connect the water supply hose and air supply hose to flushing gun. Allow the engine to fill with water. When the engine is filled, apply air in short blasts, allowing the system to fill between air blasts. Continue until clean water flows through the lead away hose.

Remove the lead away hose, flushing gun, water supply hose and air supply hose. Remove the thermostat housing and install the thermostat. Install the thermostat housing with a replacement gasket. Refer to Thermostat Replacement. Connect the radiator hoses. Refill the cooling system with the correct antifreeze/water mixture. Refer to Refilling the Cooling System.

CHEMICAL CLEANING

In some instances, use a radiator cleaner (Mopar® Radiator Kleen or equivalent) before flushing. This will soften scale and other deposits and aid flushing operation.

COOLING (Continued)

CAUTION: Follow manufacturers instructions when using these products.

STANDARD PROCEDURE—DRAINING COOLING SYSTEM 3.7L/4.7L/5.7L ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS (Fig. 6) OR LOOSEN THE RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

(1) With the engine cold, raise the vehicle on a hoist and locate the radiator draincock.

NOTE: Radiator draincock is located on the left/ lower side of radiator facing to rear of vehicle.

(2) Attach one end of a hose to the draincock. Put the other end into a clean container. Remove the radiator cap, open the draincock and drain the cooling system.

(3) If draining the entire engine is required, remove the cylinder block drain plugs.

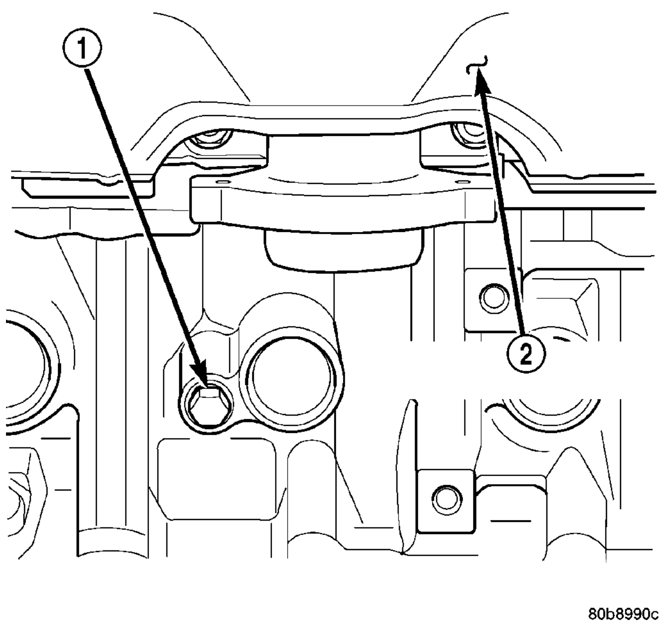


Fig. 6 Drain Plug - 3.7L/4.7L Engine

1 - CYLINDER BLOCK DRAIN PLUG
2 - EXHAUST MANIFOLD AND HEAT SHIELD

STANDARD PROCEDURE - REFILLING COOLING SYSTEM 3.7L/4.7L/5.7L ENGINE

DO NOT WASTE REUSABLE COOLANT. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Install the cylinder block drain plugs (if removed). Coat the threads with Mopar® Thread Sealant with Teflon.

(2) Close the radiator draincock.

CAUTION: Failure to purge air from the cooling system can result in an overheating condition and severe engine damage.

(3) Fill system using a 50/50 mixture antifreeze and low mineral content water. Stop filling when the level in the degas bottle has reached the top of the COLD FILL RANGE.

(4) Start and operate the engine until the thermostat opens (upper radiator hose is warm to the touch).

(5) If necessary, add a 50/50 mixture of anti-freeze and water to the degass bottle to maintain the proper coolant level in the degas bottle.

(6) Install the radiator cap.

STANDARD PROCEDURE—DRAINING COOLING SYSTEM 5.9L/8.0L ENGINE

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(1) Attach one end of a hose to the draincock. Put the other end into a clean container.

(2) **DO NOT REMOVE THE RADIATOR CAP** when draining the coolant from the reservoir/overflow tank. Open radiator draincock and when the tank is empty, remove the radiator cap and continue draining the cooling system.

(3) If draining the entire engine, remove the cylinder block drain plugs. Refer to (Fig. 7).

STANDARD PROCEDURE—REFILLING COOLING SYSTEM 5.9L/8.0L ENGINE

WARNING: DO NOT REMOVE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN RADIATOR DRAINCOCK WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

Clean cooling system prior to refilling. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(1) Install cylinder block drain plugs. Coat the threads with Mopar® Thread Sealant with Teflon.

(2) Close radiator petcock.

COOLING (Continued)

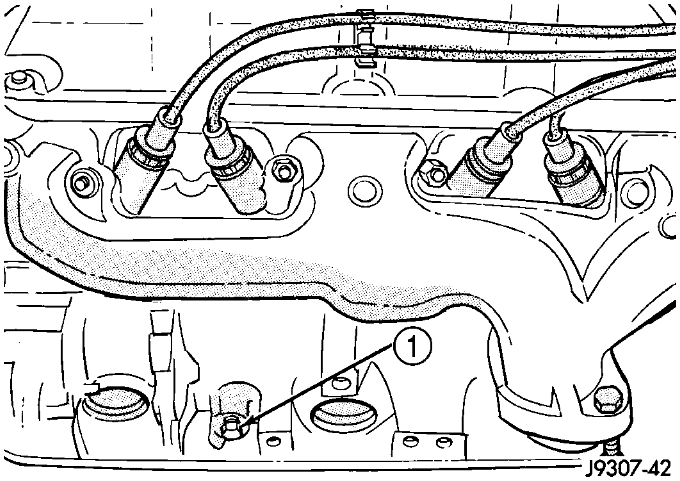


Fig. 7 Cylinder Block Drain Plug - 5.9L Engines

1 - BLOCK DRAIN PLUG

(3) Fill cooling system with a 50/50 mixture of water and antifreeze.

(4) Fill coolant reserve/overflow tank to MAX mark on bottle.

(5) Start and operate engine until thermostat opens (upper radiator hose warm to touch).

(6) If necessary, add a 50/50 water and antifreeze mixture to the coolant reserve/overflow tank. This is done to maintain coolant level between the MAX and MIN marks. The level in the reserve/overflow tank may drop below the MIN mark after three or four warm-up and cool-down cycles.

STANDARD PROCEDURE—DRAINING COOLING SYSTEM 5.9L DIESEL ENGINE

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN PLUG WITH SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

DO NOT WASTE reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Start the engine and place the heater control temperature selector in the Full-On position.

(2) Turn the ignition off.

(3) Do not remove radiator cap when draining coolant from reserve/overflow tank. Open radiator drain plug and when tank is empty, remove radiator cap. If the coolant reserve/overflow tank does not drain, (Refer to 7 - COOLING - DIAGNOSIS AND TESTING). The coolant need not be removed from tank unless the system is being refilled with fresh mixture.

(4) Remove radiator pressure cap.

STANDARD PROCEDURE—REFILLING COOLING SYSTEM 5.9L DIESEL ENGINE

Clean cooling system prior to refilling (Refer to 7 - COOLING - STANDARD PROCEDURE).

(1) Close radiator drain plug.

CAUTION: Due to the use of the one-way check valve, the engine must not be operating when refilling the cooling system.

NOTE: The diesel engine is equipped with two one-way check valves (jiggle pins). The check valves are used as a servicing feature and will vent air when the system is being filled. Water pressure (or flow) will hold the valves closed.

(2) Fill the cooling system with a 50/50 mixture of water and antifreeze.

(3) Fill coolant reserve/overflow tank to the FULL mark.

(4) Start and operate engine until thermostat opens. Upper radiator hose should be warm to touch.

(5) If necessary, add 50/50 water and antifreeze mixture to the coolant reserve/overflow tank to maintain coolant level. This level should be between the ADD and FULL marks. The level in the reserve/overflow tank may drop below the ADD mark after three or four warm-up and cool-down cycles.

STANDARD PROCEDURE - ADDING ADDITIONAL COOLANT

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

For 5.9L engines, do not remove the radiator cap to add coolant to the system. When adding coolant to maintain the correct level, do so only at the reserve/overflow bottle. Remove the radiator cap only for testing or when refilling the system after service. Removing the cap unnecessarily can cause loss of coolant and allow air to enter the system, which produces corrosion.

COOLING (Continued)

WARNING: DO NOT REMOVE OR LOOSEN THE RADIATOR CAP WITH THE COOLING SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT OR HIGH PRESSURE STEAM CAN OCCUR.

For 3.7L / 4.7L/5.9L engines, remove the radiator cap from the coolant degas bottle to add coolant.

SPECIFICATIONS

TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Automatic Belt Tensioner to Block—Bolts	41	30	—
Automatic Belt Tensioner Pulley—Bolt	61	45	—
Block Heater—Bolt	2	—	17
Generator/Compressor Mounting Bracket—Bolts			
# 1 and 2	54	40	—
# 3	40	30	—
Fan Shroud to Radiator Mounting—Bolts	6	—	55
Radiator to Support - Bolts	8.5	—	75
Fan Blade to Viscous Fan Drive—Bolts	24	18	—
Idler Pulley—Bolt	54	40	—
Thermostat Housing—Bolts - All Except 5.9L	13	—	112
Thermostat Housing—Bolts - 5.9L	23	16	—
Power Steering Oil Cooler — Bolts	6	—	55
Transmission Auxiliary Oil Cooler—Bolts	6	—	55
Transmission Oil Cooler Tube Nuts	31.5	24	—
Coolant Bottle — Bolts	8.5	—	75
Transmission Oil Cooler to Transmission - 5.9L/46RE - Tube Nuts	31.5	24	—
Transmission Oil Cooler to Transmission - 3.7L/4.7L/ 45RFE - Tube Nuts	20	18	—
Water Pump—Bolts	24	18	—
Water Pump — Bolts - 4.7L	58	43	—

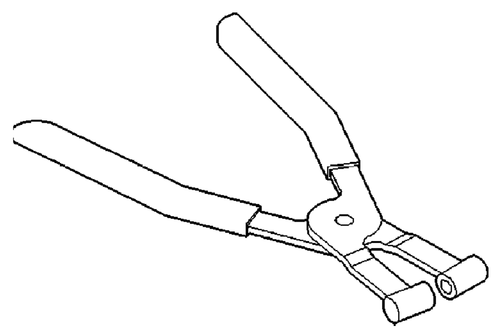
SPECIFICATIONS -

SPECIFICATIONS

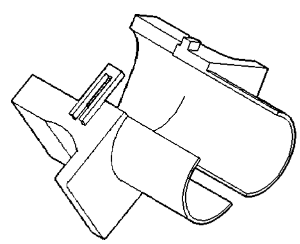
DESCRIPTION	SPECIFICATION
3.7/4.7L Engine	15.4L (16.2 qts.)- to the middle of the cold fill range
5.7L Engine	15.4L (16.2 qts.)- to the middle of the cold fill range
5.9L Engine	15.5L (16.3 qts.)- to the MIN mark after 3 warm up, cool down cycles
8.0L Engine	24L (25.3 qts.)
5.9L Diesel Engine	28L (29.5 qts.)

SPECIAL TOOLS

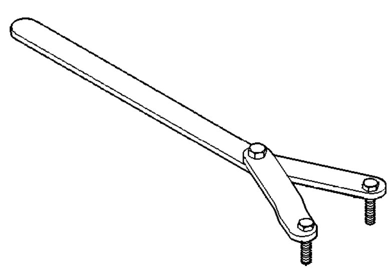
COOLING



Pliers Constant Pressure Hose Clamp - 6094

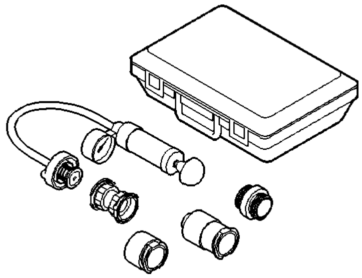


3/8” Quick Connect Release Tool - 6935

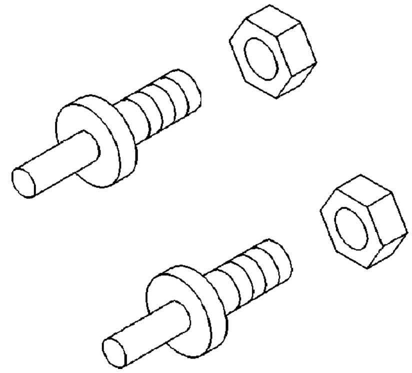


SPANNER WRENCH—6958

COOLING (Continued)



Cooling System Pressure Tester - 7700A



Adapter Pins 8346

ACCESSORY DRIVE

TABLE OF CONTENTS

BELT TENSIONERS - 3.7L / 4.7L

DESCRIPTION

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate, and greatly reduced belt life.

It is not necessary to adjust belt tension on the 3.7L or 4.7L engine. These engines are equipped with an automatic belt tensioner (Fig. 1). The tensioner maintains correct belt tension at all times. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 3.7L or 4.7L engines.

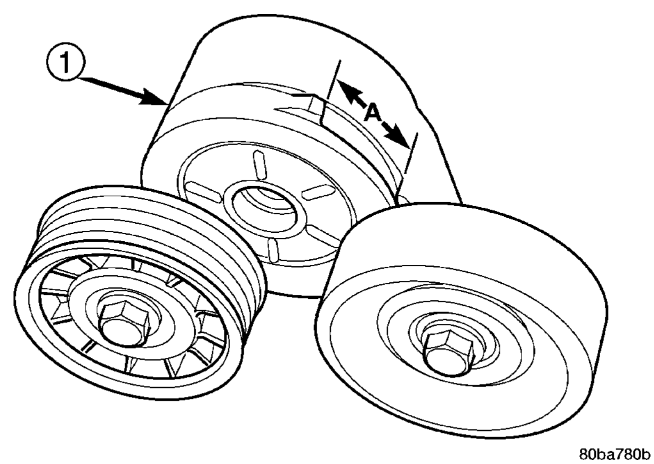


Fig. 1 AUTOMATIC BELT TENSIONER

1 - AUTOMATIC TENSIONER ASSEMBLY

OPERATION

The automatic belt tensioner maintains belt tension by using internal spring pressure, a pivoting arm and pulley to press against the drive belt.

REMOVAL

On 3.7L and 4.7L engines, the tensioner is equipped with an indexing tang on back of tensioner and an indexing stop on tensioner housing. If a new belt is being installed, tang must be within approximately 24 mm (.94 inches) of indexing stop. Belt is considered new if it has been used 15 minutes or less.

If the above specification cannot be met, check for:

- The wrong belt being installed (incorrect length/width)
- Worn bearings on an engine accessory (A/C compressor, power steering pump, water pump, idler pulley or generator)
- A pulley on an engine accessory being loose
- Misalignment of an engine accessory
- Belt incorrectly routed.

BELT TENSIONERS - 3.7L / 4.7L (Continued)

NOTE: A used belt should be replaced if tensioner indexing arrow has moved to the minimum tension indicator. Tensioner travel stops at this point.

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove tensioner assembly from mounting bracket (Fig. 2).

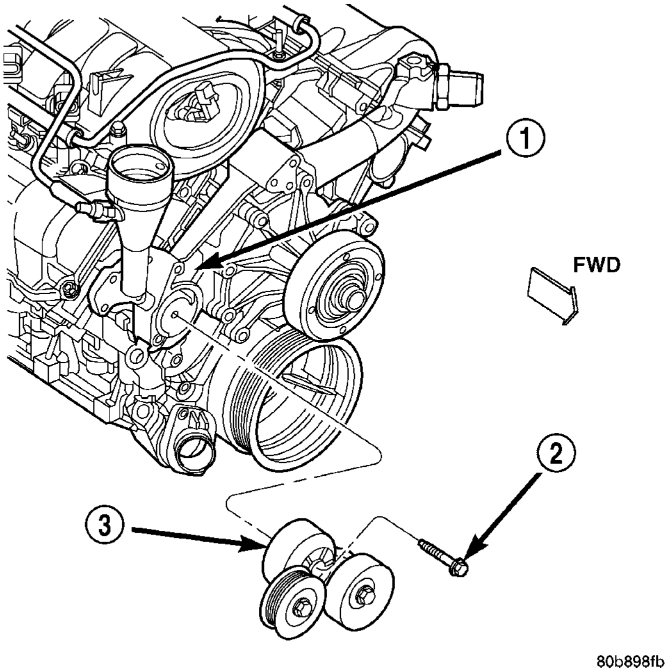


Fig. 2 AUTOMATIC BELT TENSIONER - 3.7L/4.7L ENGINE

1 - TIMING CHAIN COVER
2 - BOLT TORQUE TO 41 N·m (30 FT LBS)
3 - AUTOMATIC BELT TENSIONER

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY EXCEPT FOR PULLEY ON TENSIONER.

(3) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) An indexing slot is located on back of tensioner. Align this slot to the head of the bolt on the front cover. Install the mounting bolt. Tighten bolt to 41 N·m (30 ft. lbs.).

(3) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Check belt indexing marks (Fig. 1).

BELT TENSIONERS - 5.9L

DESCRIPTION

Correct drive belt tension is required to ensure optimum performance of the belt driven engine accessories. If specified tension is not maintained, belt slippage may cause; engine overheating, lack of power steering assist, loss of air conditioning capacity, reduced generator output rate, and greatly reduced belt life.

It is not necessary to adjust belt tension on the 3.9L or 5.9L engines. These engines are equipped with an automatic belt tensioner (Fig. 3). The tensioner maintains correct belt tension at all times. Due to use of this belt tensioner, do not attempt to use a belt tension gauge on 3.9L or 5.9L engines.

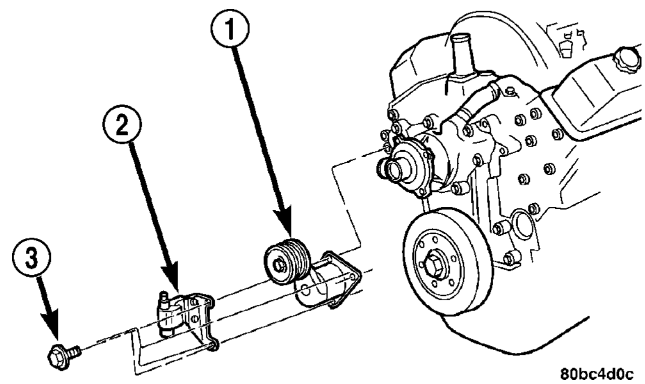


Fig. 3 Automatic Belt Tensioner - 5.9L Engines

1 - AUTOMATIC TENSIONER
2 - COIL AND BRACKET
3 - SCREW AND WASHER

OPERATION

The automatic belt tensioner maintains belt tension by using internal spring pressure, a pivoting arm and pulley to press against the drive belt.

REMOVAL

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY (EXCEPT FOR PULLEY).

(1) Remove accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Disconnect wiring and secondary cable from ignition coil.

(3) Remove ignition coil from coil mounting bracket (two bolts). Do not remove coil mounting bracket from cylinder head.

(4) Remove tensioner assembly from mounting bracket (one nut) (Fig. 4).

BELT TENSIONERS - 5.9L (Continued)

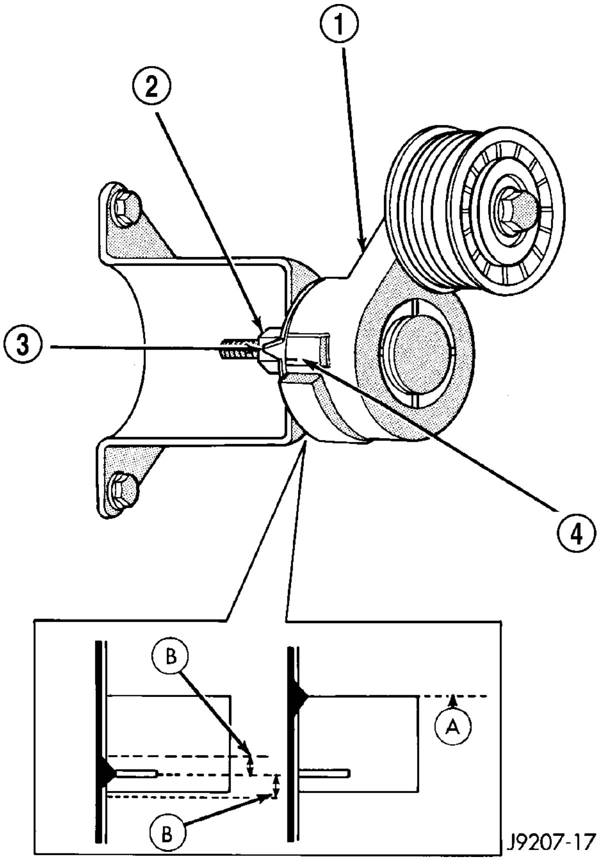


Fig. 4 Tensioner Indexing Marks And Mounting Nut

1 - TENSIONER ASSEMBLY
2 - TENSIONER MOUNTING NUT
3 - INDEXING ARROW
4 - INDEXING MARK

(5) Remove pulley bolt. Remove pulley from tensioner.

INSTALLATION

(1) Install pulley and pulley bolt to tensioner. Tighten bolt to 61 N·m (45 ft. lbs.) torque.

(2) Install tensioner assembly to mounting bracket. An indexing tab is located on back of tensioner. Align this tab to slot in mounting bracket. Tighten nut to 67 N·m (50 ft. lbs.) torque.

(3) Connect all wiring to ignition coil.

CAUTION: To prevent damage to coil case, coil mounting bolts must be torqued.

(4) Install coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(5) Install drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Check belt indexing marks (Fig. 4).

BELT TENSIONERS - 5.9L DIESEL

DESCRIPTION

Drive belts on all engines are equipped with a spring loaded automatic belt tensioner (Fig. 5). This tensioner maintains constant belt tension at all times and requires no maintenance or adjustment.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner.

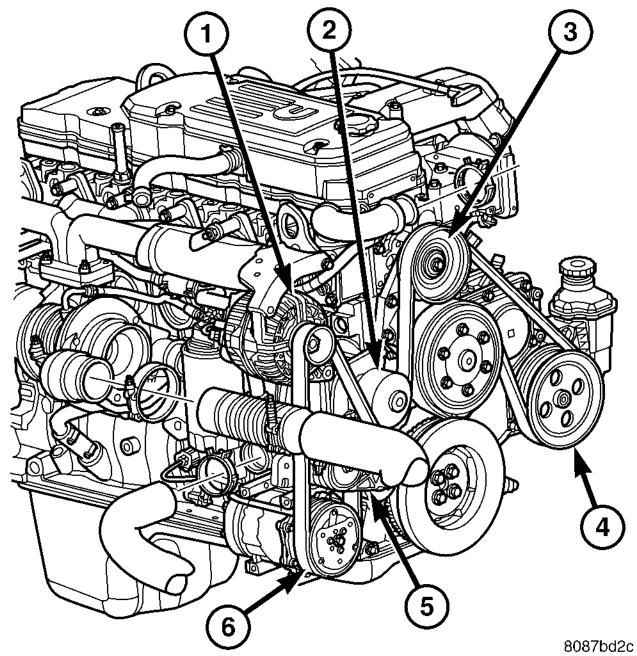


Fig. 5 Belt

1 - GENERATOR
2 - WATER PUMP
3 - IDLER
4 - POWER STEERING PUMP
5 - AUTOMATIC TENSIONER
6 - A/C COMPRESSOR

OPERATION

WARNING: THE AUTOMATIC BELT TENSIONER ASSEMBLY IS SPRING LOADED. DO NOT ATTEMPT TO DISASSEMBLE THE TENSIONER ASSEMBLY.

The automatic belt tensioner maintains correct belt tension using a coiled spring within the tensioner housing. The spring applies pressure to the tensioner arm pressing the arm into the belt, tensioning the belt.

BELT TENSIONERS - 5.9L DIESEL (Continued)

REMOVAL

WARNING: BECAUSE OF HIGH SPRING PRESSURE, DO NOT ATTEMPT TO DISASSEMBLE AUTOMATIC TENSIONER. UNIT IS SERVICED AS AN ASSEMBLY.

(1) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove tensioner mounting bolt (Fig. 6) and remove tensioner.

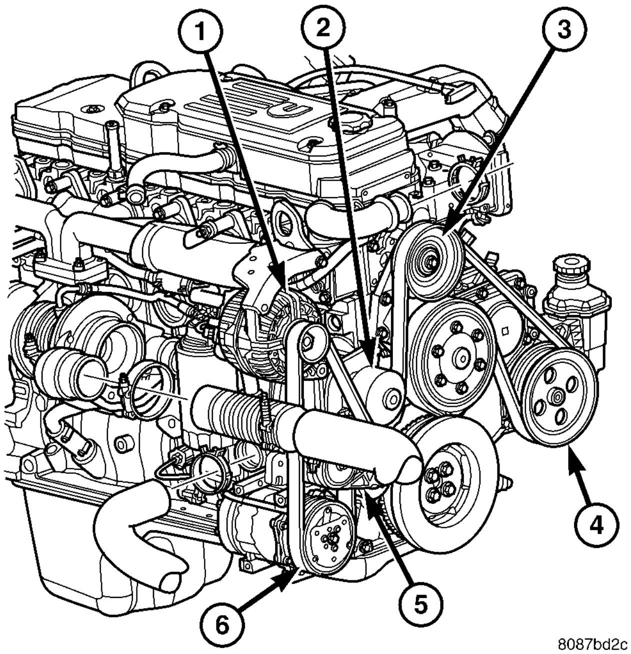


Fig. 6 AUTOMATIC BELT TENSIONER DIESEL ENGINE-TYPICAL

1 - GENERATOR
2 - WATER PUMP
3 - IDLER
4 - POWER STEERING PUMP
5 - AUTOMATIC TENSIONER
6 - A/C COMPRESSOR

INSTALLATION

(1) Install tensioner assembly to mounting bracket. A dowel is located on back of tensioner. Align this dowel to hole in tensioner mounting bracket. Tighten bolt to 43 N·m (32 ft. lbs.) torque.

(2) Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

DRIVE BELTS - 3.7L / 4.7L

DIAGNOSIS AND TESTING - ACCESSORY DRIVE BELT

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 7), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 7). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

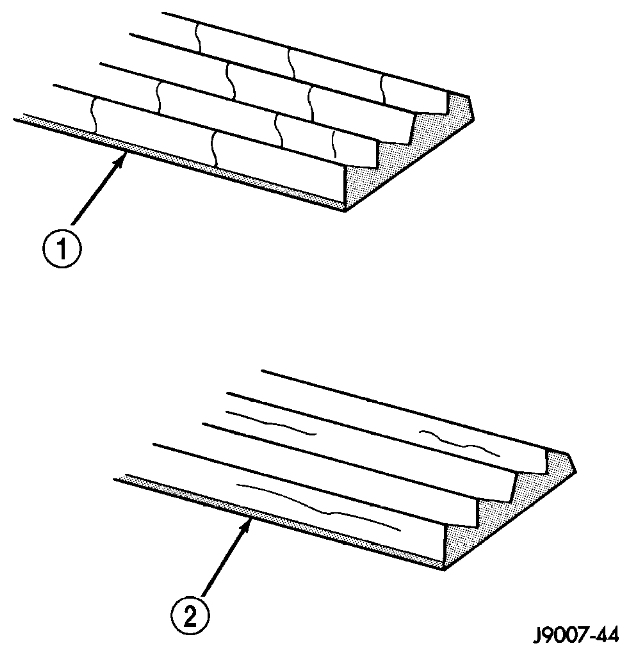


Fig. 7 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

DRIVE BELTS - 3.7L / 4.7L (Continued)

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves. 2. Installation damage	1. Remove foreign objects from pulley grooves. Replace belt. 2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned 2. Abrasive environment 3. Rusted pulley(s) 4. Sharp or jagged pulley groove tips 5. Belt rubber deteriorated	1. Align pulley(s) 2. Clean pulley(s). Replace belt if necessary 3. Clean rust from pulley(s) 4. Replace pulley. Inspect belt. 5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension 2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol) 3. Driven component bearing failure (seizure) 4. Belt glazed or hardened from heat and excessive slippage	1. Inspect/Replace tensioner if necessary 2. Replace belt and clean pulleys 3. Replace faulty component or bearing 4. Replace belt.
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove 2. Pulley groove tip has worn away rubber to tensile member	1. Replace belt 2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Incorrect belt tension 2. Pulley(s) not within design tolerance 3. Foreign object(s) in grooves 4. Pulley misalignment 5. Belt cordline is broken	1. Inspect/Replace tensioner if necessary 2. Replace pulley(s) 3. Remove foreign objects from grooves 4. Align component 5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension 2. Tensile member damaged during belt installation 3. Severe misalignment 4. Bracket, pulley, or bearing failure	1. Replace Inspect/Replace tensioner if necessary 2. Replace belt 3. Align pulley(s) 4. Replace defective component and belt

DRIVE BELTS - 3.7L / 4.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt

REMOVAL

CAUTION: DO NOT LET TENSIONER ARM SNAP BACK TO THE FREEARM POSITION, SEVER DAMAGE MAY OCCUR TO THE TENSIONER.

Belt tension is not adjustable. Belt adjustment is maintained by an automatic (spring load) belt tensioner.

(1) Disconnect negative battery cable from battery.

(2) Rotate belt tensioner until it contacts it's stop. Remove belt, then slowly rotate the tensioner into the freearm position. (Fig. 8).

INSTALLATION

Belt tension is not adjustable. Belt adjustment is maintained by an automatic (spring load) belt tensioner.

(1) Check condition of all pulleys.

CAUTION: When installing the serpentine accessory drive belt, the belt MUST be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction (Fig. 8).

(2) Install new belt (Fig. 8). Route the belt around all pulleys except the idler pulley. Rotate the tensioner arm until it contacts it's stop position. Route the belt around the idler and slowly let the tensioner rotate into the belt. Make sure the belt is seated onto all pulleys.

(3) With the drive belt installed, inspect the belt wear indicator (Fig. 9). On 4.7L Engines only, the gap between the tang and the housing stop (measurement A) must not exceed 24 mm (.94 inches). If the measurement exceeds this specification replace the serpentine accessory drive belt.

DRIVE BELTS - 3.7L / 4.7L (Continued)

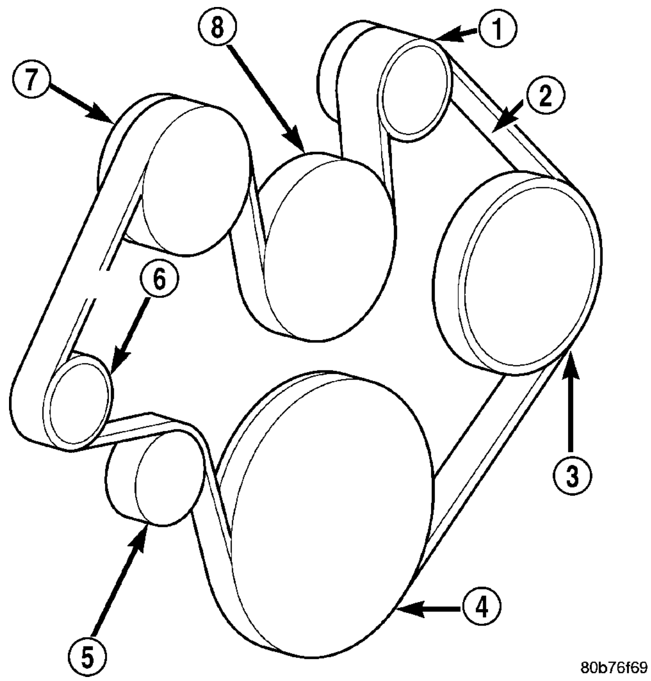


Fig. 8 BELT ROUTING 3.7L / 4.7L

1 - GENERATOR PULLEY
2 - ACCESSORY DRIVE BELT
3 - POWER STEERING PUMP PULLEY
4 - CRANKSHAFT PULLEY
5 - IDLER PULLEY
6 - TENSIONER
7 - A/C COMPRESSOR PULLEY
8 - WATER PUMP PULLEY

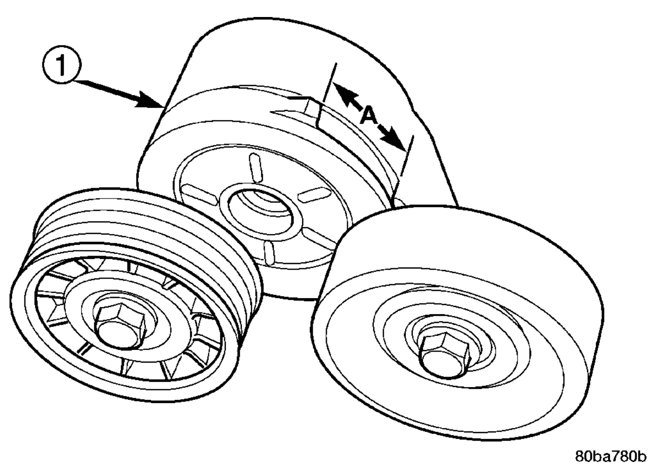


Fig. 9 Accessory Drive Belt Wear Indicator–4.7L Engine

1 - AUTOMATIC TENSIONER ASSEMBLY

DRIVE BELTS - 5.9L

DIAGNOSIS AND TESTING - ACCESSORY DRIVE BELT

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 10), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 10). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

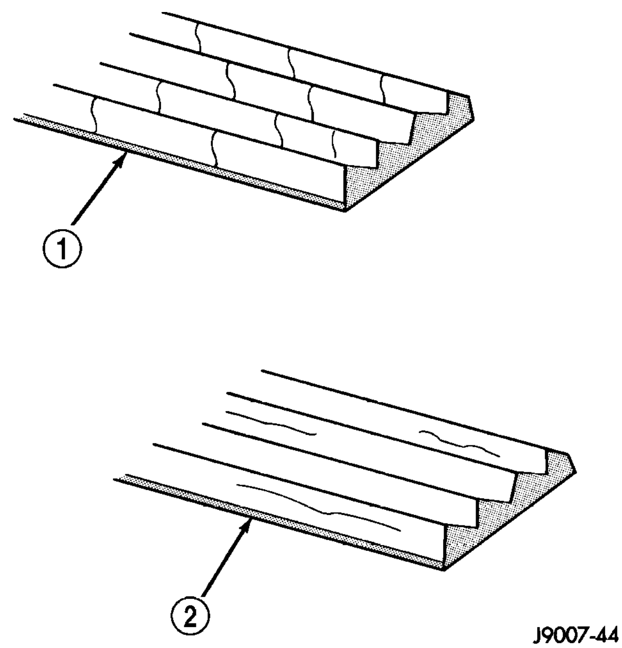


Fig. 10 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

DRIVE BELTS - 5.9L (Continued)

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves.	1. Remove foreign objects from pulley grooves. Replace belt.
	2. Installation damage	2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned	1. Align pulley(s)
	2. Abrasive environment	2. Clean pulley(s). Replace belt if necessary
	3. Rusted pulley(s)	3. Clean rust from pulley(s)
	4. Sharp or jagged pulley groove tips	4. Replace pulley. Inspect belt.
	5. Belt rubber deteriorated	5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension	1. Inspect/Replace tensioner if necessary
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	2. Replace belt and clean pulleys
	3. Driven component bearing failure (seizure)	3. Replace faulty component or bearing
	4. Belt glazed or hardened from heat and excessive slippage	4. Replace belt.
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Pulley(s) not within design tolerance	2. Replace pulley(s)
	3. Foreign object(s) in grooves	3. Remove foreign objects from grooves
	4. Pulley misalignment	4. Align component
	5. Belt cordline is broken	5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension	1. Replace Inspect/Replace tensioner if necessary
	2. Tensile member damaged during belt installation	2. Replace belt
	3. Severe misalignment	3. Align pulley(s)
	4. Bracket, pulley, or bearing failure	4. Replace defective component and belt

DRIVE BELTS - 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISE (Objectionable squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt

REMOVAL

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label.This label is located in the engine compartment.

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

Drive belts on these engines are equipped with a spring loaded automatic belt tensioner (Fig. 11). This belt tensioner will be used on all belt configurations, such as with or without power steering or air conditioning. For more information, (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - DESCRIPTION).

(1) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 11).

(2) Rotate tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from idler pulley first.

(4) Remove belt from vehicle.

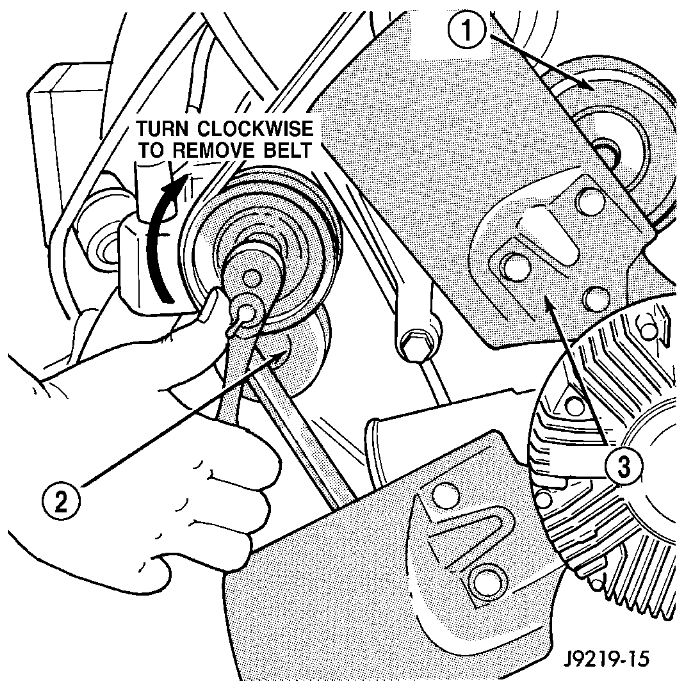


Fig. 11 Belt Tensioner - 5.9L Gas Engines

1 - IDLER PULLEY
2 - TENSIONER
3 - FAN BLADE

DRIVE BELTS - 5.9L (Continued)

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 12) (Fig. 13) for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** idler pulley. This pulley is located between generator and A/C compressor.

(2) Attach a socket/wrench to pulley mounting bolt of automatic tensioner (Fig. 11).

(3) Rotate socket/wrench clockwise. Place belt over idler pulley. Let tensioner rotate back into place. Remove wrench. Be sure belt is properly seated on all pulleys.

(4) Check belt indexing marks (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - DESCRIPTION).

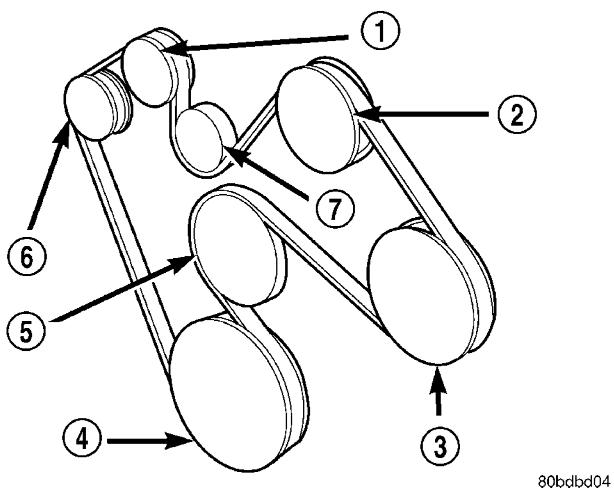


Fig. 12 Belt Routing - 5.9L Engines with A/C

1 - GENERATOR PULLEY
2 - A/C PULLEY
3 - POWER STEERING PULLEY
4 - CRANKSHAFT PULLEY
5 - WATER PUMP PULLEY
6 - TENSIONER PULLEY
7 - IDLER PULLEY

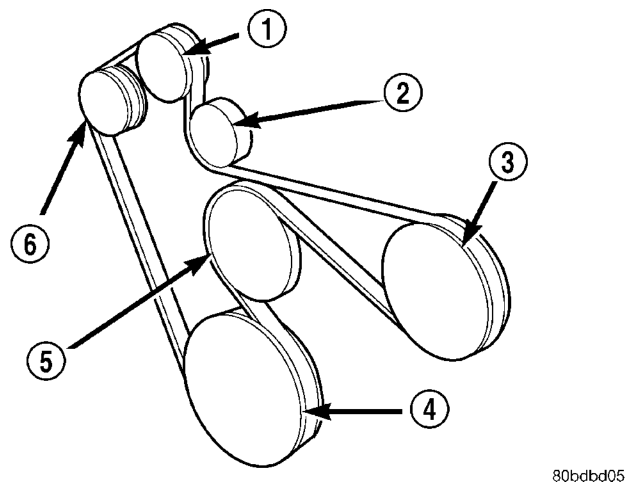


Fig. 13 Belt Routing - 5.9L Engines Without A/C

1 - GENERATOR PULLEY
2 - IDLER PULLEY
3 - POWER STEERING PULLEY
4 - CRANKSHAFT PULLEY
5 - WATER PUMP PULLEY
6 - TENSIONER PULLEY

DRIVE BELTS - 5.9L DIESEL

DIAGNOSIS AND TESTING—ACCESSORY DRIVE BELT

VISUAL DIAGNOSIS

When diagnosing serpentine accessory drive belts, small cracks that run across the ribbed surface of the belt from rib to rib (Fig. 14), are considered normal. These are not a reason to replace the belt. However, cracks running along a rib (not across) are **not** normal. Any belt with cracks running along a rib must be replaced (Fig. 14). Also replace the belt if it has excessive wear, frayed cords or severe glazing.

DRIVE BELTS - 5.9L DIESEL (Continued)

Refer to ACCESSORY DRIVE BELT DIAGNOSIS CHART for further belt diagnosis.

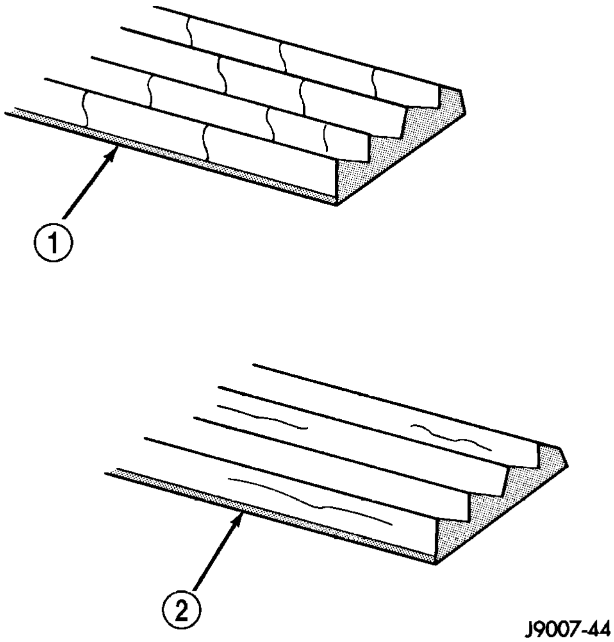


Fig. 14 Belt Wear Patterns

1 - NORMAL CRACKS BELT OK
2 - NOT NORMAL CRACKS REPLACE BELT

NOISE DIAGNOSIS

Noises generated by the accessory drive belt are most noticeable at idle. Before replacing a belt to resolve a noise condition, inspect all of the accessory drive pulleys for alignment, glazing, or excessive end play.

ACCESSORY DRIVE BELT DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
RIB CHUNKING (One or more ribs has separated from belt body)	1. Foreign objects imbedded in pulley grooves.	1. Remove foreign objects from pulley grooves. Replace belt.
	2. Installation damage	2. Replace belt
RIB OR BELT WEAR	1. Pulley misaligned	1. Align pulley(s)
	2. Abrasive environment	2. Clean pulley(s). Replace belt if necessary
	3. Rusted pulley(s)	3. Clean rust from pulley(s)
	4. Sharp or jagged pulley groove tips	4. Replace pulley. Inspect belt.
	5. Belt rubber deteriorated	5. Replace belt
BELT SLIPS	1. Belt slipping because of insufficient tension	1. Inspect/Replace tensioner if necessary
	2. Belt or pulley exposed to substance that has reduced friction (belt dressing, oil, ethylene glycol)	2. Replace belt and clean pulleys
	3. Driven component bearing failure (seizure)	3. Replace faulty component or bearing
	4. Belt glazed or hardened from heat and excessive slippage	4. Replace belt.

DRIVE BELTS - 5.9L DIESEL (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LONGITUDAL BELT CRACKING	1. Belt has mistracked from pulley groove	1. Replace belt
	2. Pulley groove tip has worn away rubber to tensile member	2. Replace belt
″GROOVE JUMPING″ (Belt does not maintain correct position on pulley)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Pulley(s) not within design tolerance	2. Replace pulley(s)
	3. Foreign object(s) in grooves	3. Remove foreign objects from grooves
	4. Pulley misalignment	4. Align component
	5. Belt cordline is broken	5. Replace belt
BELT BROKEN (Note: Identify and correct problem before new belt is installed)	1. Incorrect belt tension	1. Replace Inspect/Replace tensioner if necessary
	2. Tensile member damaged during belt installation	2. Replace belt
	3. Severe misalignment	3. Align pulley(s)
	4. Bracket, pulley, or bearing failure	4. Replace defective component and belt
NOISE (Objectional squeal, squeak, or rumble is heard or felt while drive belt is in operation)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Bearing noise	2. Locate and repair
	3. Belt misalignment	3. Align belt/pulley(s)
	4. Belt to pulley mismatch	4. Install correct belt
	5. Driven component induced vibration	5. Locate defective driven component and repair
TENSION SHEETING FABRIC FAILURE (Woven fabric on outside, circumference of belt has cracked or separated from body of belt)	1. Tension sheeting contacting stationary object	1. Correct rubbing condition
	2. Excessive heat causing woven fabric to age	2. Replace belt
	3. Tension sheeting splice has fractured	3. Replace belt
CORD EDGE FAILURE (Tensile member exposed at edges of belt or separated from belt body)	1. Incorrect belt tension	1. Inspect/Replace tensioner if necessary
	2. Belt contacting stationary object	2. Replace belt
	3. Pulley(s) out of tolerance	3. Replace pulley
	4. Insufficient adhesion between tensile member and rubber matrix	4. Replace belt

DRIVE BELTS - 5.9L DIESEL (Continued)

NOTE: The engine speed sensor face is very close to the accessory drive belt. Inspect engine speed sensor and wire harness for damage when accessory drive belt has been replaced due to failure or abnormal conditions.

REMOVAL

CAUTION: Do not attempt to check belt tension with a belt tension gauge on vehicles equipped with an automatic belt tensioner. Refer to Automatic Belt Tensioner in this group.

NOTE: The belt routing schematics are published from the latest information available at the time of publication. If anything differs between these schematics and the Belt Routing Label, use the schematics on Belt Routing Label.This label is located in the engine compartment.

Drive belts on diesel engines are equipped with a spring loaded automatic belt tensioner. **displays the tensioner for vehicles without air conditioning.**

This belt tensioner will be used on all belt configurations, such as with or without air conditioning. For more information, (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - DESCRIPTION).

(1) A 1/2 inch square hole is provided in the automatic belt tensioner. Attach a 1/2 inch drive-long handle ratchet to this hole.

(2) Rotate ratchet and tensioner assembly clockwise (as viewed from front) until tension has been relieved from belt.

(3) Remove belt from water pump pulley first.

(4) Remove belt from vehicle.

INSTALLATION

CAUTION: When installing the accessory drive belt, the belt must be routed correctly. If not, engine may overheat due to water pump rotating in wrong direction. Refer to (Fig. 15) for correct engine belt routing. The correct belt with correct length must be used.

(1) Position drive belt over all pulleys **except** water pump pulley.

(2) Attach a 1/2 inch ratchet to tensioner.

(3) Rotate ratchet and belt tensioner clockwise. Place belt over water pump pulley. Let tensioner rotate back into place. Remove ratchet. Be sure belt is properly seated on all pulleys.

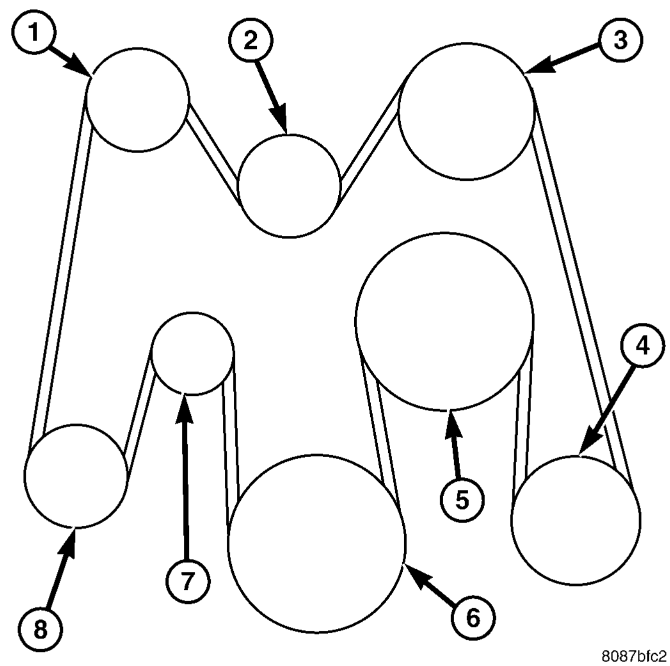


Fig. 15 Belt Routing–5.9L Diesel Engine

1 - GENERATOR PULLEY
2 - WATER PUMP PULLEY
3 - IDLER PULLEY
4 - POWER STEERING PUMP PULLEY
5 - RADIATOR FAN PULLEY
6 - CRANKSHAFT PULLEY
7 - AUTOMATIC TENSIONER
8 - A/C COMPRESSOR PUMP PULLEY

ENGINE

TABLE OF CONTENTS

COOLANT

DESCRIPTION

DESCRIPTION - ENGINE COOLANT

ETHYLENE-GLYCOL MIXTURES

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 year/ 100,000Mil;e Formula (ethylene-glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain a freeze point of -37°C (-35°F).

The required ethylene-glycol (antifreeze) and water mixture depends upon the climate and vehicle operating conditions. The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. **If percentage is lower than 44 percent, engine parts may be eroded by cavitation, and cooling system components may be severely damaged by corrosion.** Maximum protection against freezing is provided with a 68% antifreeze concentration, which prevents freezing down to -67.7° C (-90° F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water.

Use of 100 percent ethylene-glycol will cause formation of additive deposits in the system, as the corrosion inhibitive additives in ethylene-glycol require the presence of water to dissolve. The deposits act as insulation, causing temperatures to rise to as high as 149° C (300° F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at 22° C (-8° F).

PROPYLENE-GLYCOL MIXTURES

It's overall effective temperature range is smaller than that of ethylene-glycol. The freeze point of 50/50 propylene-glycol and water is -32° C (-26° F). 5° C higher than ethylene-glycol's freeze point. The boiling point (protection against summer boil-over) of propylene-glycol is 125° C (257° F) at 96.5 kPa (14 psi), compared to 128° C (263° F) for ethylene-glycol. Use of propylene-glycol can result in boil-over or freeze-up on a cooling system designed for ethylene-glycol. Propylene glycol also has poorer heat transfer characteristics than ethylene glycol. This can increase cylinder head temperatures under certain conditions.

Propylene-glycol/ethylene-glycol Mixtures can cause the destabilization of various corrosion inhibitors, causing damage to the various cooling system

COOLANT (Continued)

components. Also, once ethylene-glycol and propylene-glycol based coolants are mixed in the vehicle, conventional methods of determining freeze point will not be accurate. Both the refractive index and specific gravity differ between ethylene glycol and propylene glycol.

DESCRIPTION - HOAT COOLANT

WARNING: ANTIFREEZE IS AN ETHYLENE-GLYCOL BASE COOLANT AND IS HARMFUL IF SWALLOWED OR INHALED. IF SWALLOWED, DRINK TWO GLASSES OF WATER AND INDUCE VOMITING. IF INHALED, MOVE TO FRESH AIR AREA. SEEK MEDICAL ATTENTION IMMEDIATELY. DO NOT STORE IN OPEN OR UNMARKED CONTAINERS. WASH SKIN AND CLOTHING THOROUGHLY AFTER COMING IN CONTACT WITH ETHYLENE-GLYCOL. KEEP OUT OF REACH OF CHILDREN. DISPOSE OF GLYCOL BASE COOLANT PROPERLY, CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA. DO NOT OPEN A COOLING SYSTEM WHEN THE ENGINE IS AT OPERATING TEMPERATURE OR HOT UNDER PRESSURE, PERSONAL INJURY CAN RESULT. AVOID RADIATOR COOLING FAN WHEN ENGINE COMPARTMENT RELATED SERVICE IS PERFORMED, PERSONAL INJURY CAN RESULT.

CAUTION: Use of Propylene-Glycol based coolants is not recommended, as they provide less freeze protection and less corrosion protection.

The cooling system is designed around the coolant. The coolant must accept heat from engine metal, in the cylinder head area near the exhaust valves and engine block. Then coolant carries the heat to the radiator where the tube/fin radiator can transfer the heat to the air.

The use of aluminum cylinder blocks, cylinder heads, and water pumps requires special corrosion protection. Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769), or the equivalent ethylene-glycol base coolant with organic corrosion inhibitors (called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% ethylene-glycol and 50% distilled water to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

CAUTION: Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (MS-9769) may not be mixed with any other type of antifreeze. Mixing of coolants other than specified (non-HOAT or other HOAT), may result in engine damage that may not be covered under the new vehicle warranty, and decreased corrosion protection.

COOLANT PERFORMANCE

The required ethylene-glycol (antifreeze) and water mixture depends upon climate and vehicle operating conditions. The coolant performance of various mixtures follows:

Pure Water-Water can absorb more heat than a mixture of water and ethylene-glycol. This is for purpose of heat transfer only. Water also freezes at a higher temperature and allows corrosion.

100 percent Ethylene-Glycol-The corrosion inhibiting additives in ethylene-glycol need the presence of water to dissolve. Without water, additives form deposits in system. These act as insulation causing temperature to rise to as high as 149°C (300°F). This temperature is hot enough to melt plastic and soften solder. The increased temperature can result in engine detonation. In addition, 100 percent ethylene-glycol freezes at -22°C (-8°F).

50/50 Ethylene-Glycol and Water-Is the recommended mixture, it provides protection against freezing to -37°C (-34°F). The antifreeze concentration **must always** be a minimum of 44 percent, year-round in all climates. If percentage is lower, engine parts may be eroded by cavitation. Maximum protection against freezing is provided with a 68 percent antifreeze concentration, which prevents freezing down to -67.7°C (-90°F). A higher percentage will freeze at a warmer temperature. Also, a higher percentage of antifreeze can cause the engine to overheat because specific heat of antifreeze is lower than that of water.

CAUTION: Richer antifreeze mixtures cannot be measured with normal field equipment and can cause problems associated with 100 percent ethylene-glycol.

COOLANT SELECTION AND ADDITIVES

The use of aluminum cylinder blocks, cylinder heads and water pumps requires special corrosion protection. Only Mopar® Antifreeze/Coolant, 5 Year/100,000 Mile Formula (glycol base coolant with corrosion inhibitors called HOAT, for Hybrid Organic Additive Technology) is recommended. This coolant offers the best engine cooling without corrosion when mixed with 50% distilled water to obtain to obtain a freeze point of -37°C (-35°F). If it loses color or becomes contaminated, drain, flush, and replace with fresh properly mixed coolant solution.

COOLANT (Continued)

CAUTION: Do not use coolant additives that are claimed to improve engine cooling.

OPERATION

Coolant flows through the engine block absorbing the heat from the engine, then flows to the radiator where the cooling fins in the radiator transfers the heat from the coolant to the atmosphere. During cold weather the ethylene-glycol or propylene-glycol coolant prevents water present in the cooling system from freezing within temperatures indicated by mixture ratio of coolant to water.

COOLANT RECOVERY CONTAINER-5.9L

DESCRIPTION

The coolant reserve/overflow tank is mounted on top of the fan shroud, and is made of high temperature plastic (Fig. 1).

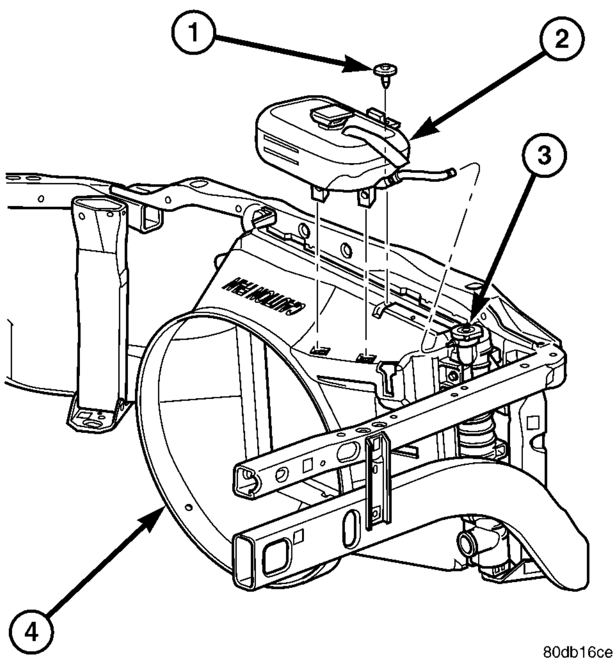


Fig. 1 Coolant Recovery Bottle — 5.9L

1 - SCREW
2 - COOLANT RECOVERY CONTAINER
3 - RADIATOR/RADIATOR CAP
4 - FAN SHROUD

OPERATION

The coolant reserve/overflow system works in conjunction with the radiator pressure cap. It utilizes thermal expansion and contraction of coolant to keep coolant free of trapped air. It provides a volume for expansion and contraction of coolant. It also provides a convenient and safe method for checking coolant level and adjusting level at atmospheric pressure. This is done without removing the radiator pressure cap. The system also provides some reserve coolant to the radiator to cover minor leaks and evaporation or boiling losses.

As the engine cools, a vacuum is formed in the cooling system of both the radiator and engine. Coolant will then be drawn from the coolant tank and returned to a proper level in the radiator.

REMOVAL

(1) Remove recovery hose from radiator.

(2) Remove the coolant container to fan shroud mounting bolt.

(3) Tilt the container backward towards the engine to disengage the mounting pin locking features and lift the container away from the fan shroud (Fig. 1).

INSTALLATION

(1) Align the coolant container mounting pins into the slots on the fan shroud and push the container onto the fan shroud.

(2) Secure the container to the fan shroud with the bolt. Tighten to 8.5N·m (75 in-lbs).

NOTE: Ensure that the locking feature on the mounting pins has engaged.

(3) Connect the recovery hose to the radiator (Fig. 1).

COOLANT DEGAS CONTAINER-3.7L/4.7L

DESCRIPTION

The coolant degas container is mounted on top of the fan shroud and is made of high temperatyre plastic (Fig. 2).

OPERATION

The coolant degas system works in parallel with the radiator. It is fed through a vent line connected to the top of the radiator inlet tank and returns to the engine/coolant pump via the heater return hoses. This plumbing arrangement, together with the inlet thermostat, provides for constant flow through the degas container whenever the engine is running. The air space in the top of the degas container serves several functions. It provides a volume for the expansion of coolant during engine operation. It provides a space for quick de-aeration of the coolant. Since the container is the highest point in the cooling system, any air trapped in the coolant will quickly be transported to the degas container and be separated out.

COOLANT DEGAS CONTAINER-3.7L/4.7L (Continued)

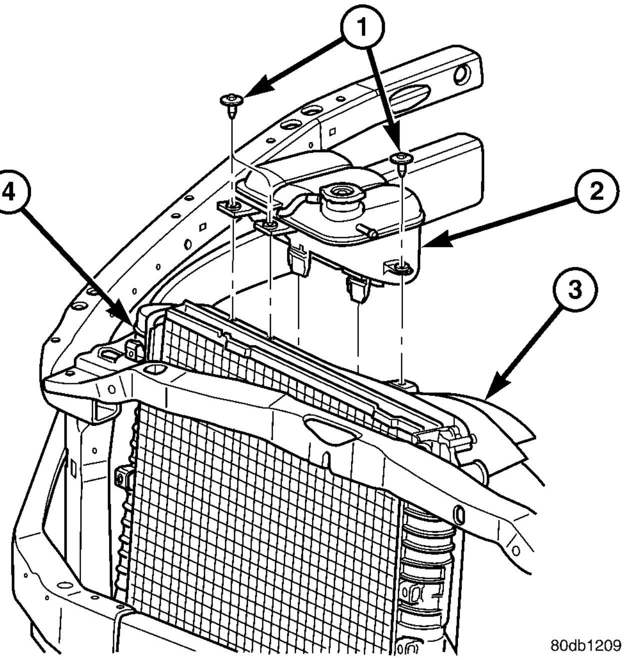


Fig. 2 Coolant Degas Container

1 - SCREWS
2 - COOLANT DEGAS CONTAINER
3 - FAN SHROUD
4 - RADIATOR

The air space also acts as sort of a spring that provides constant system pressurization in conjunction with the radiator cap on top of the container. By returning coolant to the pump side of the inlet thermostat, the degas container also supplies greater pressure to the coolant pump, providing for enhanced coolant flow at high engine speeds.

The degas container also provides a convenient and safe method for checking the coolant level with out removing the radiator pressure cap. The degas container does not require a separate overflow container since it was designed with enough volume to provide a coolant reserve and also protect for any after-boil conditions.

REMOVAL

(1) Drain enough coolant from the system so that the degas container is empty. Refer to Draining Cooling System 3.7L/4.7L Engines in this group

(2) Loosen the clamps securing the supply and return hoses to the container and remove the hoses.

(3) Remove the coolant container to fan shroud mounting bolts.

(4) Tilt the container back towards the engine to disengage the mounting pin locking features and lift the container away from the fan shroud.

INSTALLATION

(1) Align the mounting pins into the slots on the fan shroud and push the container into the fan shroud.

(2) Secure the coolant container to the fan shroud with bolts. Tighten to 8.5 N-m (75 in. lbs).

NOTE: Ensure the locking feature on the mounting pins has engaged.

(3) Connect the supply and return hoses to the container and ensure that the hose clamps are positioned properly.

(4) Refill the cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

RADIATOR FAN

REMOVAL

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

(1) Disconnect negative battery cable from battery.

(2) Remove coolant reserve/overflow container from fan shroud and lay aside. **Do Not** disconnect the hoses or drain coolant from the container.

(3) The thermal viscous fan drive/fan blade assembly is attached (threaded) to the water pump hub shaft (Fig. 4). Remove the fan blade/viscous fan drive assembly from the water pump by turning the mounting nut counterclockwise as viewed from the front. Threads on the viscous fan drive are **RIGHT-HAND.** A 36 MM Fan Wrench should be used to prevent pulley from rotating (Fig. 3).

(4) **Do Not** attempt to remove the fan/viscous fan drive assembly from the vehicle at this time.

(5) **Do Not** unbolt the fan blade assembly (Fig. 4) from viscous fan drive at this time.

(6) Remove the fan shroud-to-radiator mounting bolts.

(7) Pull the lower shroud mounts out of the radiator tank clips.

(8) Remove the fan shroud and fan blade/viscous fan drive assembly as a complete unit from vehicle.

(9) After removing the fan blade/viscous fan drive assembly, **do not** place the viscous fan drive in a horizontal position. If stored horizontally, silicone

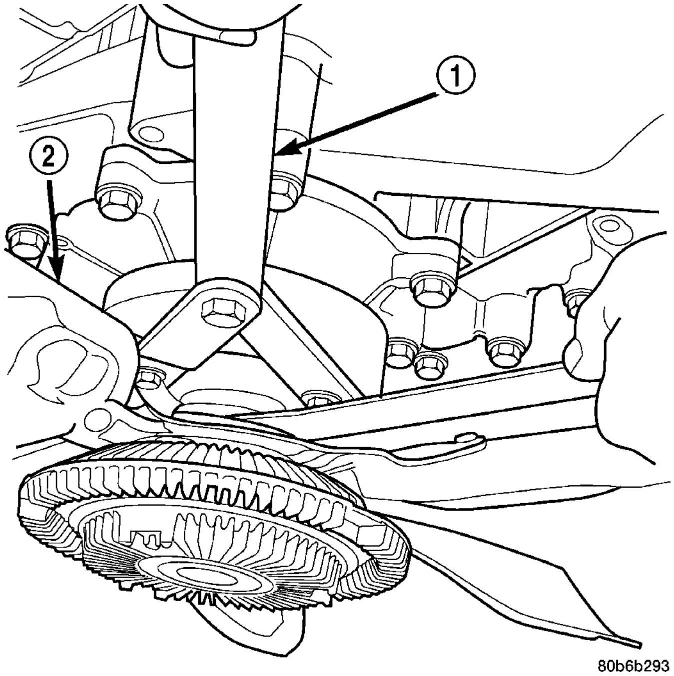


Fig. 3 Using Special Tool 6958 Spanner Wrench

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

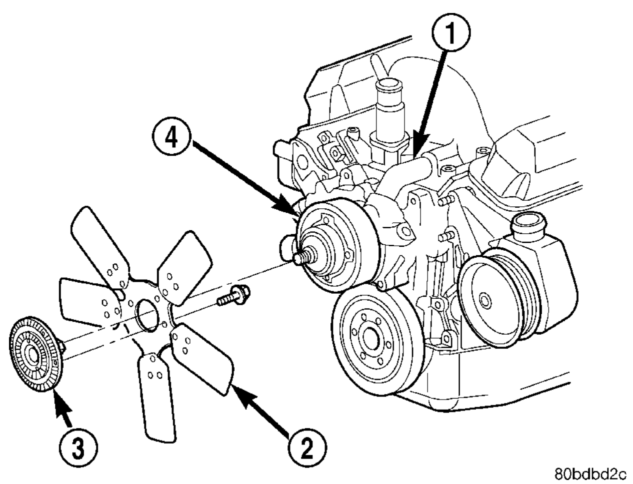


Fig. 4 Fan Blade/Viscous Fan Drive - Gas Engines - Typical

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

fluid in the viscous fan drive could drain into its bearing assembly and contaminate lubricant.

CAUTION: Do not remove water pump pulley-to-water pump bolts. This pulley is under spring tension.

(10) Remove four bolts securing fan blade assembly to viscous fan drive (Fig. 4).

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CLEANING

Clean the fan blades using a mild soap and water. Do not use an abrasive to clean the blades.

INSPECTION

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF FAN IS NOT WITHIN SPECIFICATIONS.

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

(1) Remove fan blade assembly from viscous fan drive unit (six bolts).

(2) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.

(3) Inspect fan assembly for cracks, bends, or broken welds. Replace fan if any damage is found.

INSTALLATION

(1) Install fan blade assembly to the viscous fan drive. Tighten the bolts (Fig. 4) to 24 N·m (18 ft. lbs.) torque.

(2) Position the fan shroud and the fan blade/viscous fan drive assembly to the vehicle as a complete unit.

(3) Install the fan shroud.

(4) Install the fan blade/viscous fan drive assembly to the water pump shaft (Fig. 4).

(5) Install the coolant reserve/overflow container to the fan shroud.

(6) Connect the negative battery cable.

NOTE:
Viscous Fan Drive Fluid Pump Out Requirement: After installing a new viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

RADIATOR FAN - 5.9L DIESEL

REMOVAL

CAUTION: If the electronically controlled viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect wiring harness and connectors for damage.

(1) Disconnect the battery negative cables.
(2) Remove the fan shroud lower half. by unsnapping the fastening tabs.

CAUTION: Do not remove the fan pulley bolts. This pulley is under spring tension.

(3) Disconnect electrical connector.
(4) The electronically controlled viscous fan drive/fan blade assembly is attached (threaded) to the fan hub shaft (Fig. 5). Remove the fan blade/fan drive assembly from fan pulley by turning the mounting nut counterclockwise (as viewed from front). Threads on the viscous fan drive are **RIGHT-HAND.** A Snap-On 36 MM Fan Wrench (number SP346 from Snap-On Cummins Diesel Tool Set number 2017DSP) can be used. Place a bar or screwdriver between the fan pulley bolts to prevent pulley from rotating.
(5) Remove the fan shroud and the fan blade/viscous drive as an assembly from vehicle from under the vehicle.
(6) Remove fan blade-to-viscous fan drive mounting bolts.
(7) Inspect the fan for cracks, loose or bent fan blades.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CLEANING

Clean the fan blades using a mild soap and water. Do not use an abrasive to clean the blades.

INSPECTION

WARNING: DO NOT ATTEMPT TO BEND OR STRAIGHTEN FAN BLADES IF FAN IS NOT WITHIN SPECIFICATIONS.

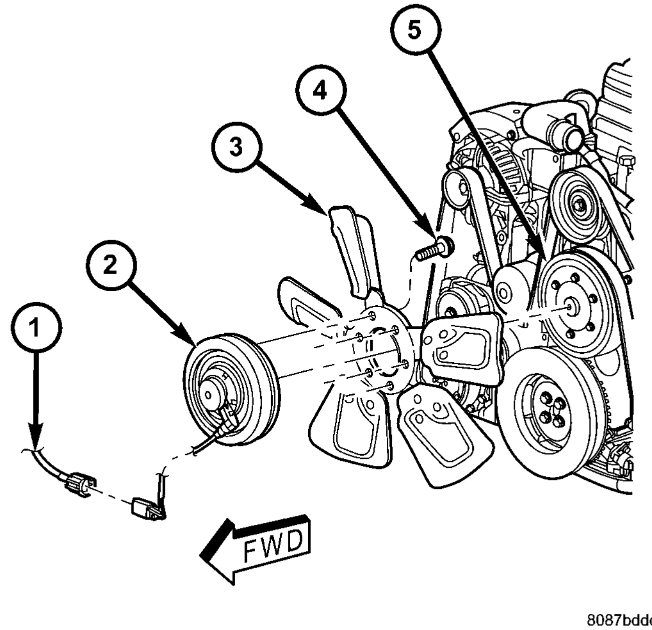


Fig. 5 Fan Blade/Viscous Fan Drive

1 - ELECTRICAL CONNECTOR
2 - VISCOUS FAN DRIVE
3 - FAN BLADE
4 - BOLT
5 - FAN DRIVE

CAUTION: If fan blade assembly is replaced because of mechanical damage, water pump and viscous fan drive should also be inspected. These components could have been damaged due to excessive vibration.

(1) Remove fan blade assembly from viscous fan drive unit (six bolts).
(2) Lay fan on a flat surface with leading edge facing down. With tip of blade touching flat surface, replace fan if clearance between opposite blade and surface is greater than 2.0 mm (.090 inch). Rocking motion of opposite blades should not exceed 2.0 mm (.090 inch). Test all blades in this manner.
(3) Inspect fan assembly for cracks, bends, or broken welds. Replace fan if any damage is found.

INSTALLATION

(1) Install fan blade assembly to electrically controlled viscous fan drive. Tighten mounting bolts to 23 N·m (17 ft. lbs.) torque.
(2) Position the fan blade/viscous fan drive to the vehicle as an assembly.
(3) Install viscous fan drive assembly on fan hub shaft (Fig. 5). Tighten mounting nut to 33 N·m (24 ft. lbs.) torque.
(4) Connect electrical connector.

RADIATOR FAN - 5.9L DIESEL (Continued)

(5) Install the lower fan shroud into position and verify the locking tabs have seated.

(6) Connect the battery negative cables.

NOTE:
Viscous Fan Drive Fluid Pump Out Requirement: After installing a new viscous fan drive, bring the engine speed up to approximately 2000 rpm and hold for approximately two minutes. This will ensure proper fluid distribution within the drive.

ENGINE BLOCK HEATER

DESCRIPTION

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

An optional engine block heater is available with all models. The heater is equipped with a power cord. The cord is attached to an engine compartment component with tie-straps. The heater warms the engine providing easier engine starting and faster warm-up in low temperatures. The heater is mounted in a core hole of the engine cylinder block in place of a freeze plug with the heating element immersed in engine coolant. The 5.9L gas powered engine has the block heater located on the right side of engine next to the oil filter (Fig. 6). The 3.7L/4.7L gas powered engines have the block heater located to the rear on the right side of the engine (Fig. 7).

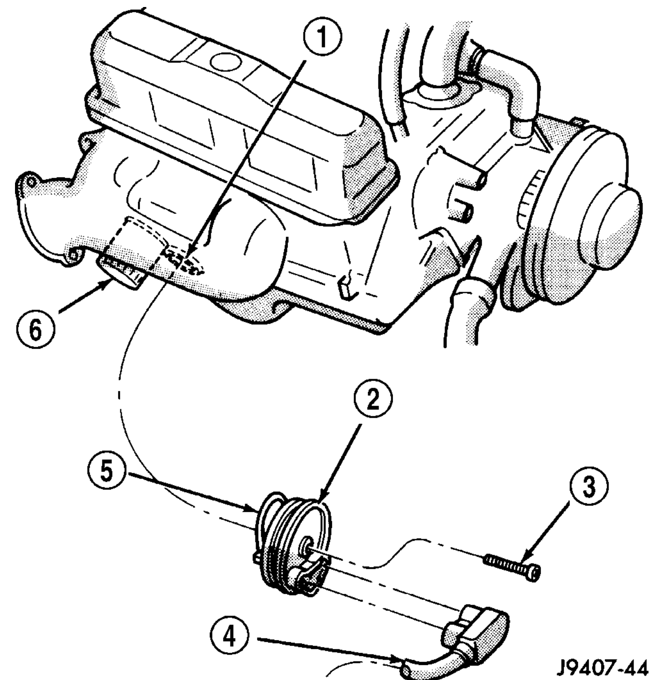


Fig. 6 Engine Block Heater - 5.9L

1 - FREEZE PLUG HOLE
2 - BLOCK HEATER
3 - SCREW
4 - POWER CORD (120V AC)
5 - HEATING COIL
6 - OIL FILTER

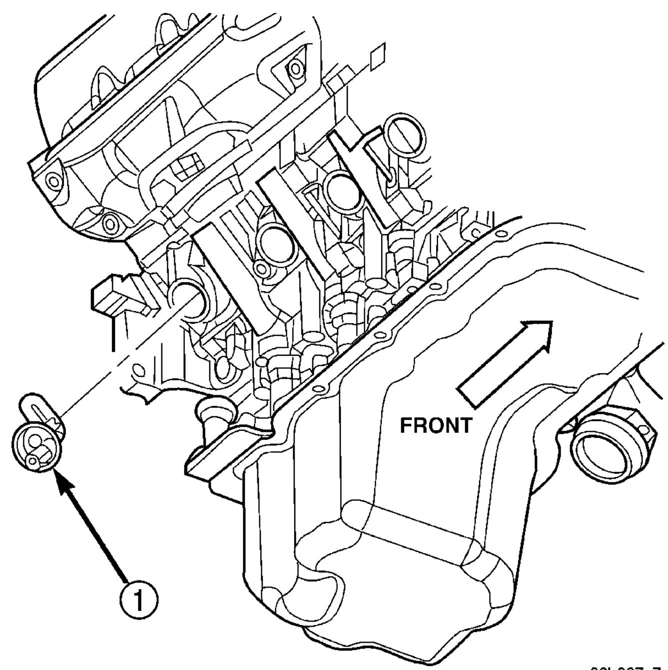


Fig. 7 Engine Block Heater - 3.7L/4.7L

1 - ENGINE BLOCK HEATER

OPERATION

The heater warms the engine coolant providing easier engine starting and faster warm-up in low temperatures. Connecting the power cord to a grounded 110-120 volt AC electrical outlet with a grounded three wire extension cord provides the electricity needed to heat the element.

DIAGNOSIS AND TESTING — ENGINE BLOCK HEATER

If the unit does not operate, possible causes can be either the power cord or the heater element. Test the power cord for continuity with a 110-volt voltmeter or 110-volt test light. Test heater element continuity with an ohmmeter or a 12-volt test light.

CAUTION: To prevent damage, the power cord must be secured in it's retainer clips and away from any components that may cause abrasion or damage, such as linkages, exhaust components, etc.

ENGINE BLOCK HEATER (Continued)

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain the coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the power cord from the heater by unplugging (Fig. 8).

(4) Loosen (but do not completely remove) the screw at center of block heater (Fig. 8).

(5) Remove the block heater by carefully prying from side-to-side. Note the direction of the heating element coil (up or down). The element coil must be installed correctly to prevent damage.

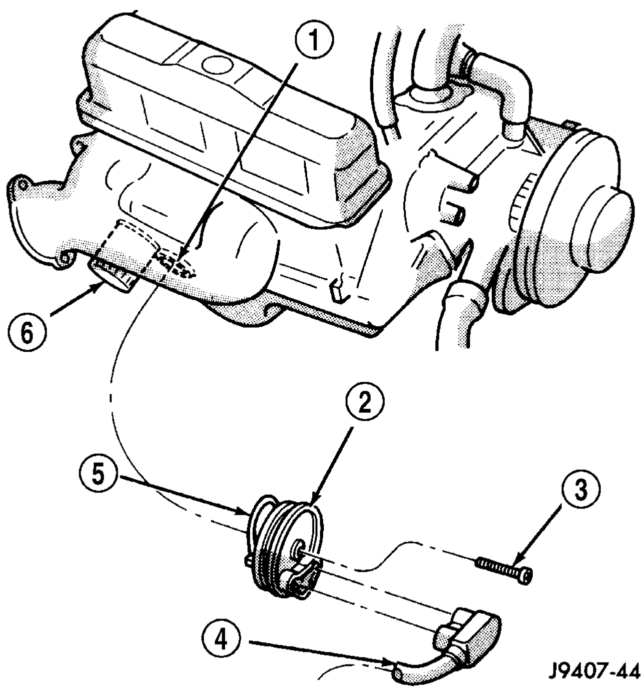


Fig. 8 Engine Block Heater

1 - FREEZE PLUG HOLE
2 - BLOCK HEATER
3 - SCREW
4 - POWER CORD (120V AC)
5 - HEATING COIL
6 - OIL FILTER

INSTALLATION

(1) Clean and inspect the block heater hole.

(2) Install the new O-ring seal(s) to heater.

(3) Insert the block heater into cylinder block and position the element properly.

(4) With the heater fully seated, tighten center screw to 2 N·m (17 in. lbs.).

(5) Fill the cooling system with the recommended coolant. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(6) Start and warm the engine.

(7) Check the block heater for leaks.

ENGINE BLOCK HEATER - 5.9L DIESEL

DESCRIPTION

WARNING: DO NOT OPERATE ENGINE UNLESS BLOCK HEATER CORD HAS BEEN DISCONNECTED FROM POWER SOURCE AND SECURED IN PLACE. THE POWER CORD MUST BE SECURED IN ITS RETAINING CLIPS AND ROUTED AWAY FROM EXHAUST MANIFOLDS AND MOVING PARTS.

An optional engine block heater is available on all models. The heater is equipped with a power cord. The heater is mounted in a threaded hole of the engine cylinder block with the heating element immersed in engine coolant. The cord is attached to an engine compartment component with tie-straps.

The 5.9L diesel engine has the block heater located on the right side of the engine below the exhaust manifold next to the oil cooler (Fig. 9).

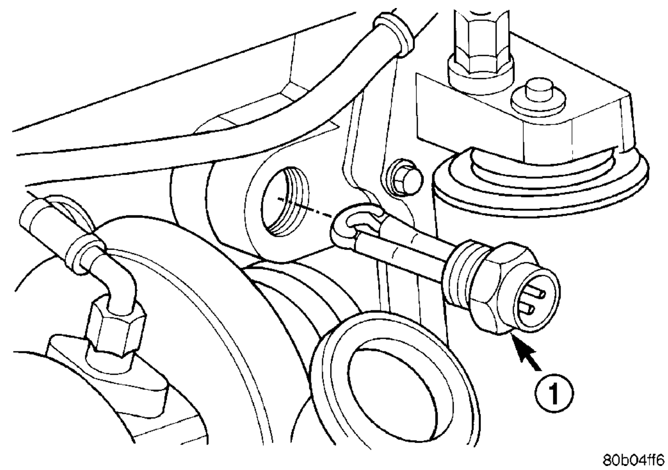


Fig. 9 Engine Block Heater–5.9L Diesel Engine

1 - BLOCK HEATER

OPERATION

The heater warms the engine coolant providing easier engine starting and faster warm-up in low temperatures. Connecting the power cord to a grounded 110-120 volt AC electrical outlet with a grounded three wire extension cord provides the electricity needed to heat the element.

REMOVAL

(1) Disconnect the battery negative cables.

(2) Drain coolant from radiator and cylinder block (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Unscrew the power cord retaining cap and disconnect cord from heater element.

ENGINE BLOCK HEATER - 5.9L DIESEL (Continued)

(4) Using a suitable size socket, loosen and remove the block heater element (Fig. 10).

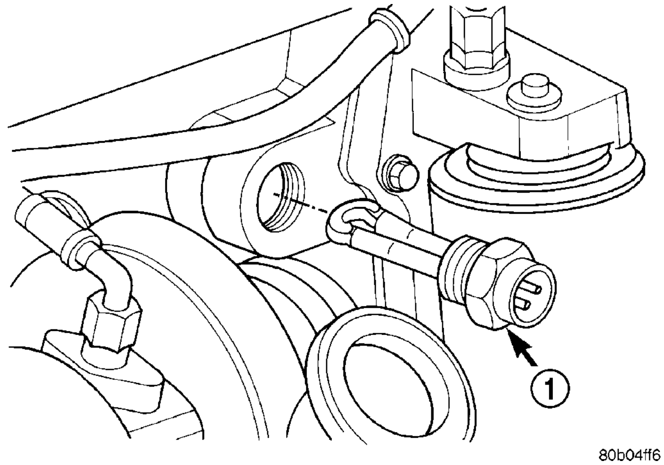


Fig. 10 Block Heater-Diesel Engine

1 - BLOCK HEATER

INSTALLATION

(1) Clean and inspect the threads in the cylinder block.

(2) Coat heater element threads with Mopar® Thread Sealer with Teflon.

(3) Screw block heater into cylinder block and tighten to 43 N·m (32 ft. lbs.).

(4) Connect block heater cord and tighten retaining cap.

(5) Fill cooling system with recommended coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(6) Start and warm the engine.

(7) Check block heater for leaks.

ENGINE COOLANT TEMPERATURE SENSOR

DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to sense engine coolant temperature. The sensor protrudes into an engine water jacket.

The ECT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as engine coolant temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

At key-on, the Powertrain Control Module (PCM) sends out a regulated 5 volt signal to the ECT sensor. The PCM then monitors the signal as it passes through the ECT sensor to the sensor ground (sensor return).

When the engine is cold, the PCM will operate in Open Loop cycle. It will demand slightly richer air-fuel mixtures and higher idle speeds. This is done until normal operating temperatures are reached.

The PCM uses inputs from the ECT sensor for the following calculations:

- for engine coolant temperature gauge operation through CCD or PCI (J1850) communications
- Injector pulse-width
- Spark-advance curves
- ASD relay shut-down times
- Idle Air Control (IAC) motor key-on steps
- Pulse-width prime-shot during cranking
- O2 sensor closed loop times
- Purge solenoid on/off times
- EGR solenoid on/off times (if equipped)
- Leak Detection Pump operation (if equipped)
- Radiator fan relay on/off times (if equipped)
- Target idle speed

REMOVAL

3.7L V-6

The Engine Coolant Temperature (ECT) sensor on the 3.7L engine is installed into a water jacket at front of intake manifold near rear of generator (Fig. 11).

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain the cooling system.

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor from the intake manifold.

4.7L V-8

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE ENGINE COOLANT TEMPERATURE (ECT) SENSOR.

The Engine Coolant Temperature (ECT) sensor on the 4.7L V-8 engine is located near the front of the intake manifold (Fig. 12).

(1) Partially drain the cooling system. Refer to 7, COOLING.

(2) Disconnect the electrical connector from the ECT sensor.

(3) Remove the sensor from the intake manifold.

ENGINE COOLANT TEMPERATURE SENSOR (Continued)

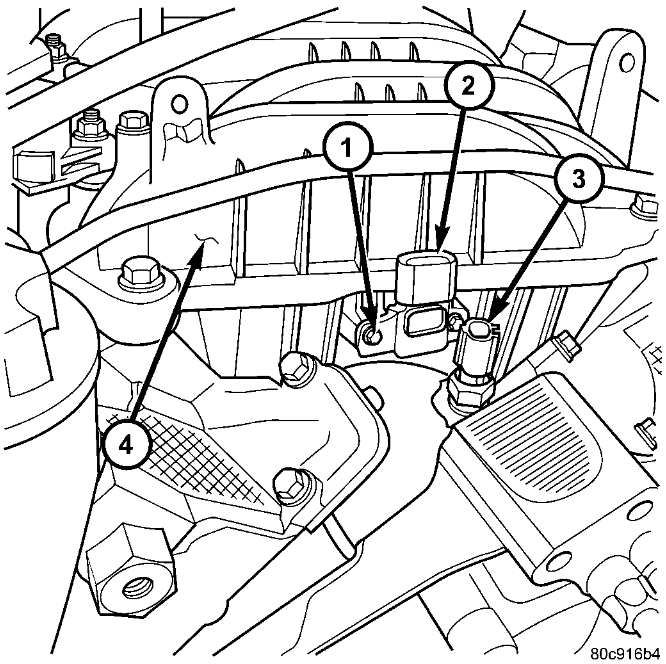


Fig. 11 MAP SENSOR / ECT SENSOR - 3.7L V-6

1 - MOUNTING SCREWS
2 - MAP SENSOR
3 - ECT SENSOR
4 - FRONT OF INTAKE MANIFOLD

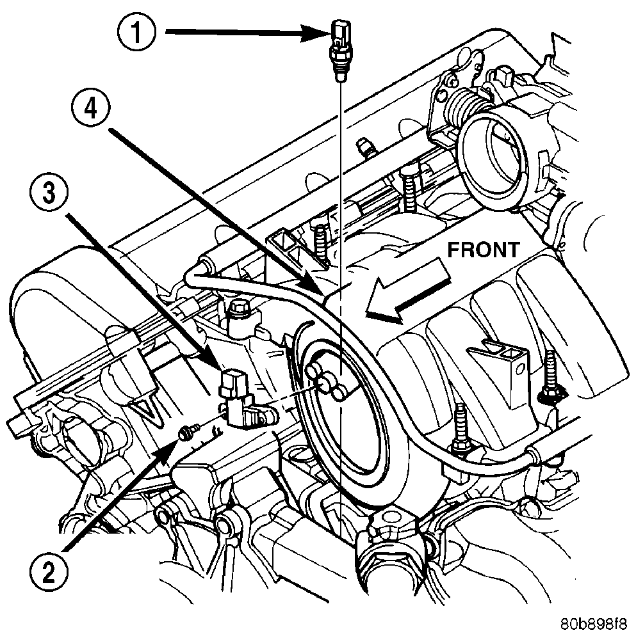


Fig. 12 ECT SENSOR - 4.7L V-8

1 - ECT SENSOR
2 - MOUNTING BOLTS (2)
3 - MAP SENSOR
4 - INTAKE MANIFOLD

5.7L V-8

The Engine Coolant Temperature (ECT) sensor on the 5.7L engine is located under the air conditioning compressor (Fig. 13). It is installed into a water jacket at the front of the cylinder block (Fig. 14).

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain the cooling system.
(2) Remove fan belt. Refer to Accessory Drive in Cooling section.
(3) Carefully unbolt air conditioning compressor from front of engine. Do not disconnect any A/C hoses from compressor. Temporarily support compressor to gain access to ECT sensor. Refer to Heating and Air Conditioning section for information.
(4) Disconnect electrical connector from sensor (Fig. 14).
(5) Remove sensor from cylinder block.

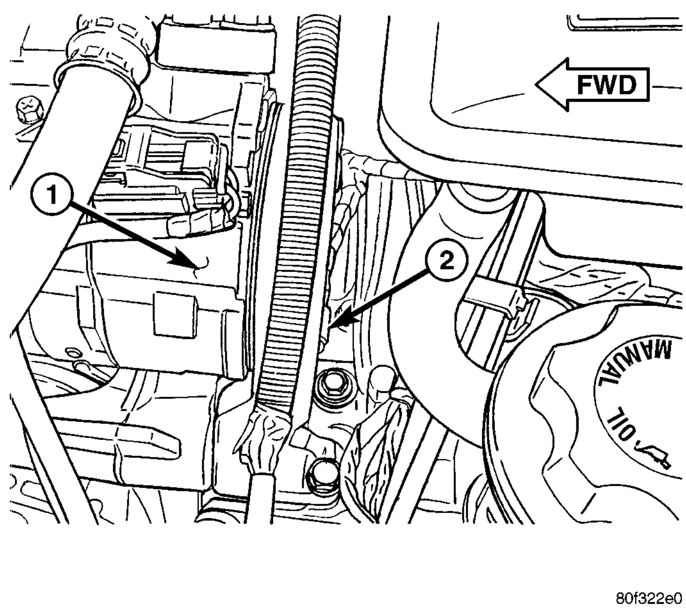


Fig. 13 ECT LOCATION - 5.7L V-8

1 - TOP OF AIR CONDITIONING COMPRESSOR
2 - ECT SENSOR LOCATION

5.9L Diesel

The Engine Coolant Temperature (ECT) sensor on the 5.9L diesel engine is located near the thermostat housing (Fig. 15).

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain the cooling system.

ENGINE COOLANT TEMPERATURE SENSOR (Continued)

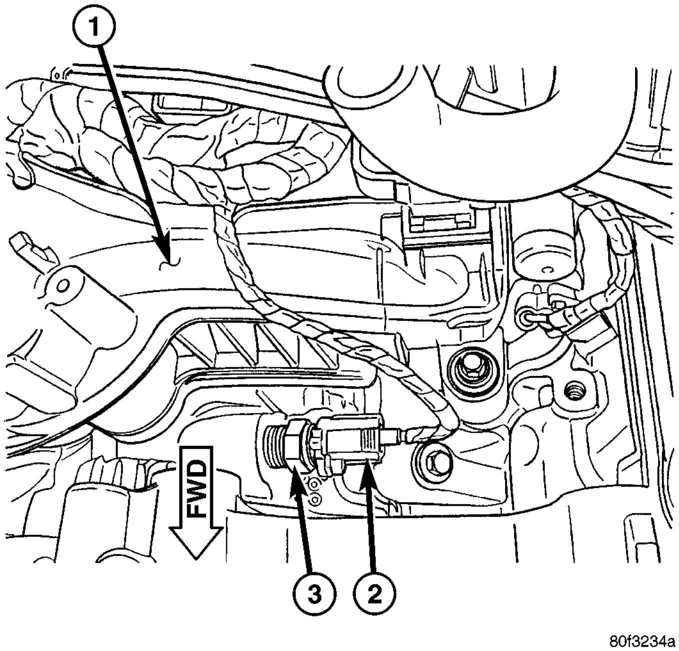


Fig. 14 ECT REMOVE / INSTALL 5.7L V-8

1 - FRONT OF INTAKE MANIFOLD
2 - ELECTRICAL CONNECTOR
3 - ECT SENSOR

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor from the cylinder head.

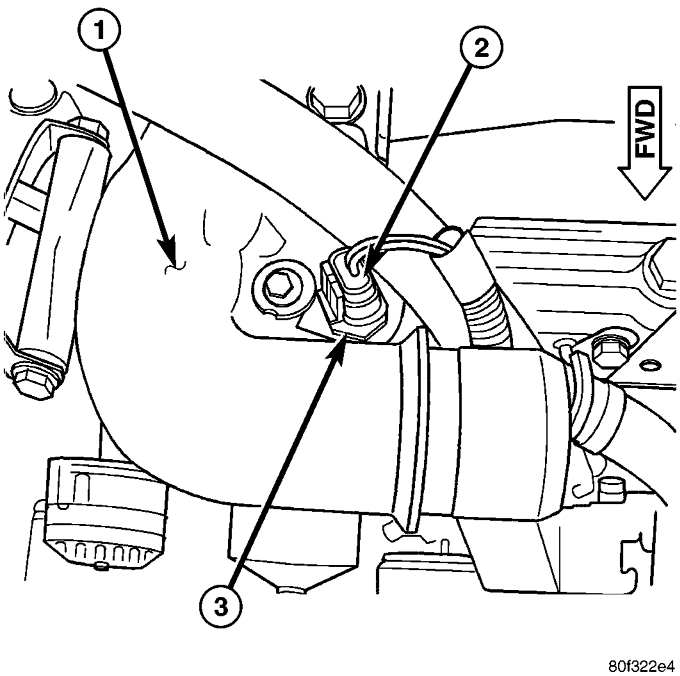


Fig. 15 ECT LOCATION - 5.9L DIESEL

1 - THERMOSTAT HOUSING
2 - ELECTRICAL CONNECTOR
3 - ECT SENSOR

5.9L V-8 Gas

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR. REFER TO GROUP 7, COOLING.

(1) Partially drain the cooling system. Refer to 7, COOLING.

(2) Disconnect the electrical connector from the sensor (Fig. 16).

(3) **Engines with air conditioning:** When removing the connector from the sensor, do not pull directly on the wiring harness. The connector is snapped onto the sensor. It is not equipped with a lock type tab.

(4) Remove the sensor from the intake manifold.

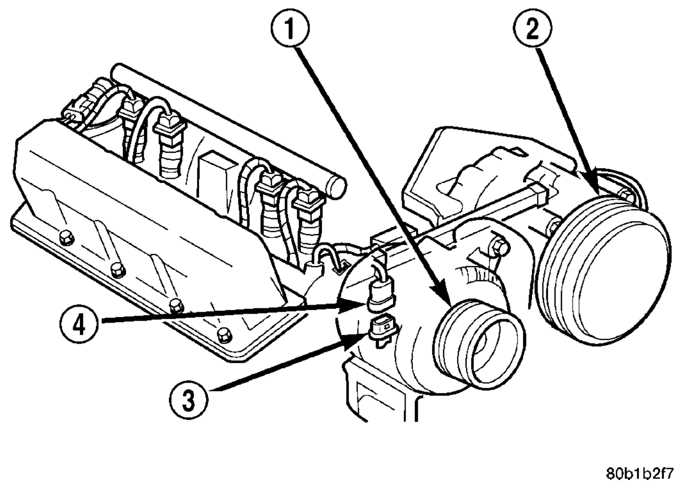


Fig. 16 ECT SENSOR - 5.9L V-8

1 - GENERATOR
2 - A/C COMPRESSOR
3 - ENGINE COOLANT TEMPERATURE SENSOR
4 - ELEC. CONN.

8.0L V-10

The Engine Coolant Temperature (ECT) sensor on the 8.0L V-10 engine is threaded into the thermostat housing (Fig. 17).

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. COOLING SYSTEM MUST BE PARTIALLY DRAINED BEFORE REMOVING THE COOLANT TEMPERATURE SENSOR.

(1) Partially drain the cooling system.

(2) Disconnect the electrical connector from the sensor.

(3) Remove the sensor from the cylinder head.

ENGINE COOLANT TEMPERATURE SENSOR (Continued)

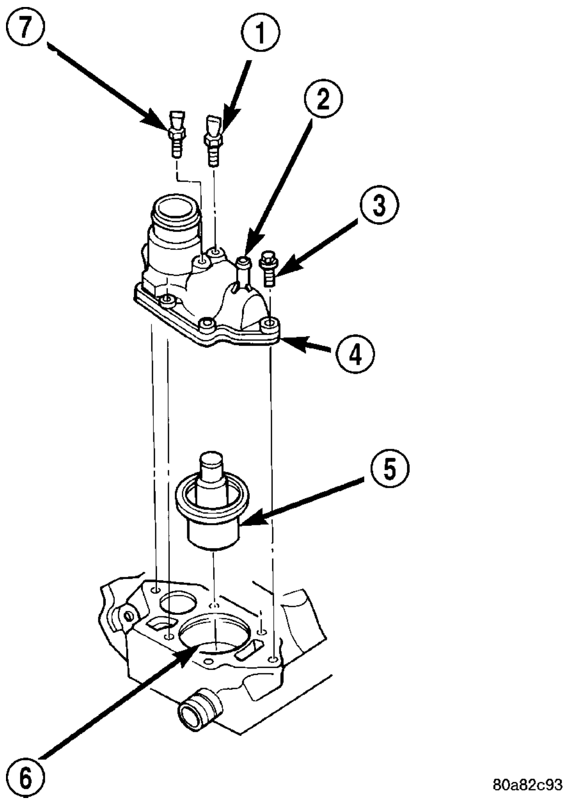


Fig. 17 ECT SENSOR - 8.0L V-10

1 - ENGINE COOLANT TEMP. SENSOR (FOR PCM)
2 - HEATER SUPPLY FITTING
3 - BOLTS (6)
4 - HOUSING WITH INTEGRAL SEAL
5 - THERMOSTAT
6 - RUBBER LIP SEAL
7 - TEMP. GAUGE SENDING UNIT

INSTALLATION

3.7L V-6

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
(4) Connect electrical connector to sensor.
(5) Replace any lost engine coolant. Refer to 7, COOLING.

4.7L V-8

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
(4) Connect electrical connector to sensor.
(5) Replace any lost engine coolant. Refer to 7, COOLING.

5.7L V-8

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
(4) Connect electrical connector to sensor.
(5) Replace any lost engine coolant. Refer to 7, COOLING.

5.9L Diesel

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 18 N·m (13 ft. lbs.) torque.
(4) Connect electrical connector to sensor.
(5) Replace any lost engine coolant. Refer to 7, COOLING.

5.9L V-8 Gas

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 6–8 N·m (55–75 in. lbs.) torque.
(4) Connect electrical connector to sensor. The sensor connector is symmetrical (not indexed). It can be connected to sensor in either direction.
(5) Refill cooling system. Refer to 7, COOLING.

8.0L V-10

(1) Apply thread sealant to sensor threads.
(2) Install sensor to engine.
(3) Tighten sensor to 11 N·m (8 ft. lbs.) torque.
(4) Connect electrical connector to sensor.
(5) Replace any lost engine coolant. Refer to 7, COOLING.

ENGINE COOLANT THERMOSTAT- 5.7L/5.9L

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing.

The thermostat on the 5.7L and 5.9L gas powered engine is located beneath the thermostat housing at the front of the intake manifold (Fig. 18).

The thermostat is a wax pellet driven, reverse poppet choke type.

Coolant leakage into the pellet container will cause the thermostat to fail in the open position. Thermostats very rarely stick. Do not attempt to free a thermostat with a prying device.

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, unreliable warmup performance, increased exhaust emissions and crankcase condensation that can result in sludge formation.

ENGINE COOLANT THERMOSTAT- 5.7L/5.9L (Continued)

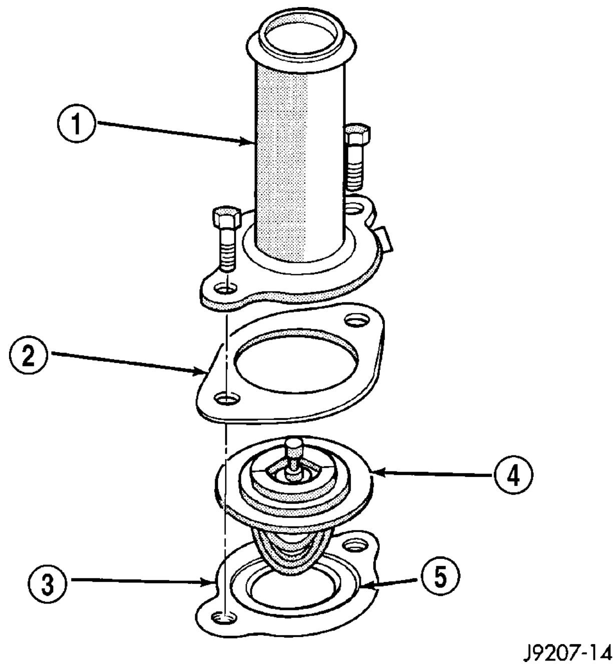


Fig. 18 Thermostat - 5.7L/5.9L Gas Powered Engines

1 - THERMOSTAT HOUSING
2 - GASKET
3 - INTAKE MANIFOLD
4 - THERMOSTAT
5 - MACHINED GROOVE

OPERATION

The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open.

DIAGNOSIS AND TESTING—THERMOSTAT

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes.

The DTC can also be accessed through the DRBIII® scan tool. Refer to the appropriate Powertrain Diagnostic Procedures information for diagnostic information and operation of the DRBIII® scan tool.

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE COOLING SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

If the thermostat is being replaced, be sure that the replacement is the specified thermostat for the vehicle model and engine type.

Factory installed thermostat housings on 5.9L engine is installed on a gasket with an anti-stick coating. This will aid in gasket removal and clean-up.

(1) Disconnect the negative battery cable.

(2) Drain the cooling system until the coolant level is below the thermostat (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Air Conditioned vehicles: Remove the support bracket (generator mounting bracket-to-intake manifold) located near the rear of the generator (Fig. 19).

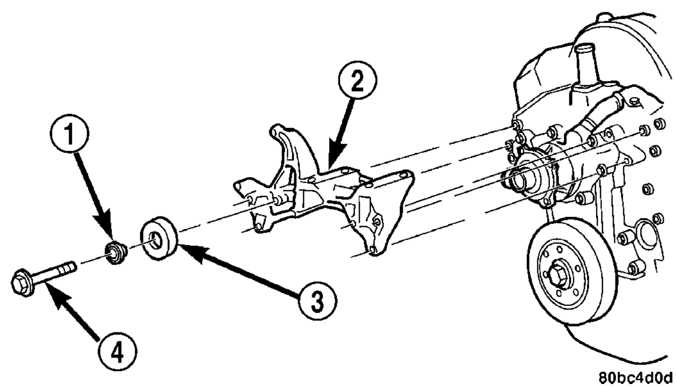


Fig. 19 Generator Support Bracket – 5.9L Engine

1 - IDLER PULLEY BUSHING
2 - A/C AND/OR GENERATOR MOUNTING BRACKET
3 - IDLER PULLEY
4 - SCREW AND WASHER

NOTE: On air conditioning equipped vehicles, the generator must be partially removed.

(4) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) (Fig. 20).

(5) Remove the generator mounting bolts. Do not remove any of the wiring at the generator. If equipped with 4WD, unplug the 4WD indicator lamp wiring harness (located near rear of generator).

(6) Remove the generator. Position the generator to gain access for the thermostat gasket removal.

ENGINE COOLANT THERMOSTAT- 5.7L/5.9L (Continued)

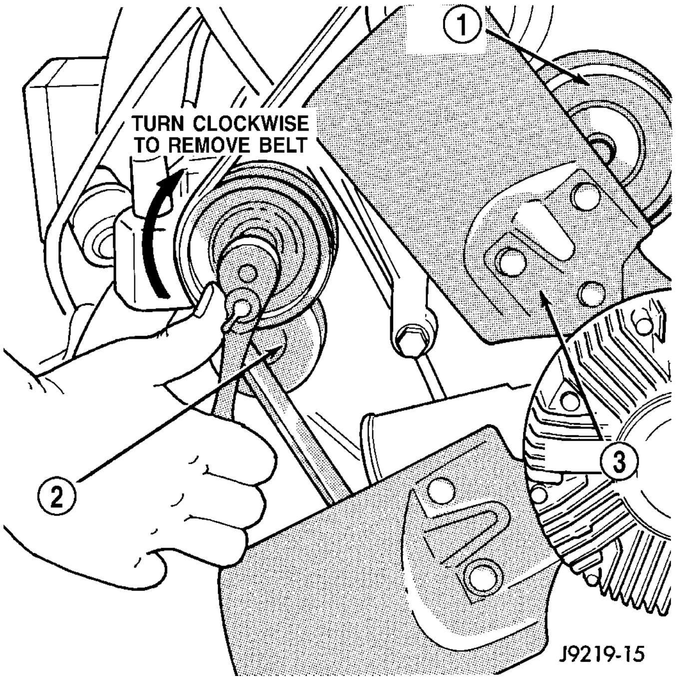


Fig. 20 Automatic Belt Tensioner – 5.9L Engines

1 - IDLER PULLEY
2 - TENSIONER
3 - FAN BLADE

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of the constant tension clamps (Fig. 21). If replacement is necessary, use only an original equipment clamp with a matching number, letter and width.

(7) Remove the radiator upper hose clamp and upper hose at the thermostat housing.

(8) Position the wiring harness (behind thermostat housing) to gain access to the thermostat housing.

(9) Remove the thermostat housing mounting bolts, thermostat housing, gasket and thermostat (Fig. 22). Discard old gasket.

INSTALLATION

(1) Clean the mating areas of the intake manifold and thermostat housing.

(2) Install the thermostat (spring side down) into the recessed machined groove on the intake manifold (Fig. 22).

(3) Install the gasket on the intake manifold and over the thermostat (Fig. 22).

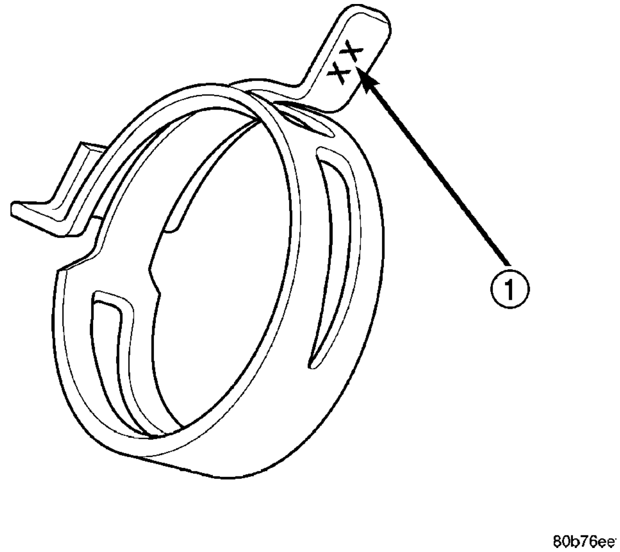


Fig. 21 SPRING CLAMP SIZE LOCATION

1 - SPRING CLAMP SIZE LOCATION

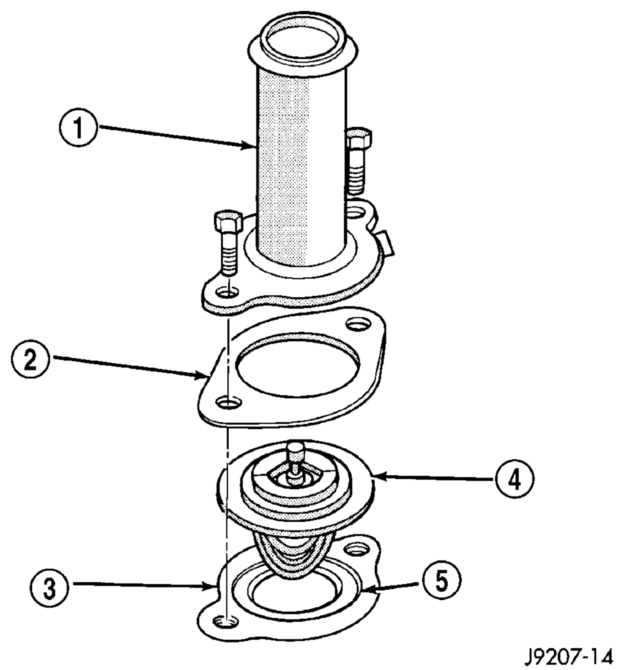


Fig. 22 Thermostat – 5.9L Engines

1 - THERMOSTAT HOUSING
2 - GASKET
3 - INTAKE MANIFOLD
4 - THERMOSTAT
5 - MACHINED GROOVE

(4) Position the thermostat housing to the intake manifold. **Note:** The word FRONT stamped on housing (Fig. 23). For adequate clearance, this **must** be placed towards the front of the vehicle. The housing is slightly angled forward after the installation to the intake manifold.

(5) Install the housing-to-intake manifold bolts. Tighten the bolts to 23 N·m (200 in. lbs.).

ENGINE COOLANT THERMOSTAT- 5.7L/5.9L (Continued)

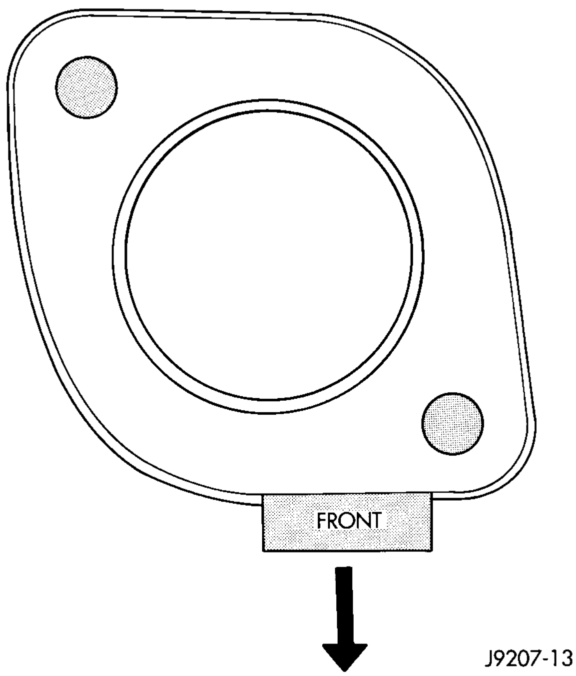


Fig. 23 Thermostat Position—5.9L Engines

(6) Install the radiator upper hose to the thermostat housing.

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in wrong direction. Refer to (Fig. 24) for the correct 5.9L engine belt routing. The correct belt with correct length must be used.

(7) Air Conditioned vehicles; Install the generator. Tighten the bolts to 41 N·m (30 ft. lbs.).

(8) Install the support bracket (generator mounting bracket-to-intake manifold). (Fig. 19). Tighten the bolts to 54 N·m (40 ft. lbs.).

(9) Install the accessory drive belt (Fig. 20)(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect battery negative cable.

(12) Start and warm the engine. Check for leaks.

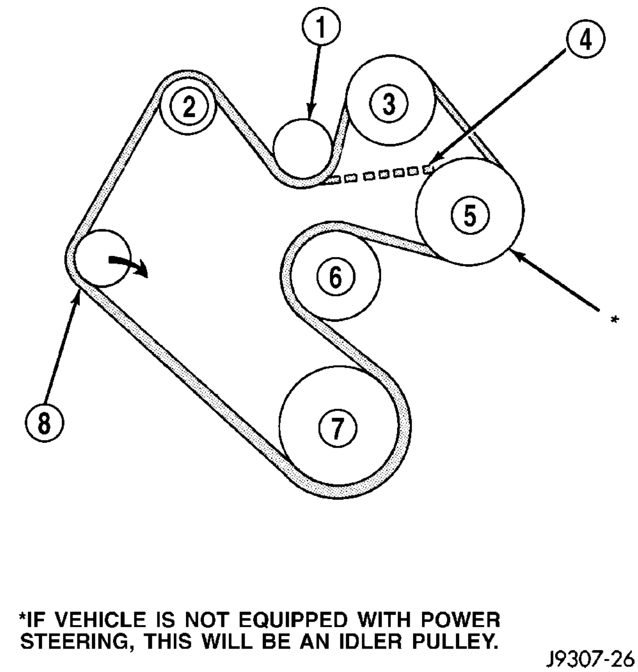


Fig. 24 Belt Routing – 5.9L Engines

1 - IDLER PULLEY
2 - GENERATOR PULLEY
3 - A/C COMPRESSOR PULLEY
4 - IF W/OUT A/C
5 - POWER STEERING PUMP PULLEY
6 - WATER PUMP PULLEY
7 - CRANKSHAFT PULLEY
8 - AUTOMATIC TENSIONER

ENGINE COOLANT THERMOSTAT - 3.7L/4.7L

DESCRIPTION

CAUTION: Do not operate the engine without a thermostat, except for servicing or testing.

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warm up and overall temperature control. On the 3.7L4.7L engine the thermostat is designed to block the flow of the coolant bypass journal by 50% instead of completely blocking the flow. This design controls coolant temperature more accurately (Fig. 25).

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes other problems. These are: longer engine warmup time, unreliable warmup performance, increased exhaust

ENGINE COOLANT THERMOSTAT - 3.7L/4.7L (Continued)

emissions and crankcase condensation. This condensation can result in sludge formation.

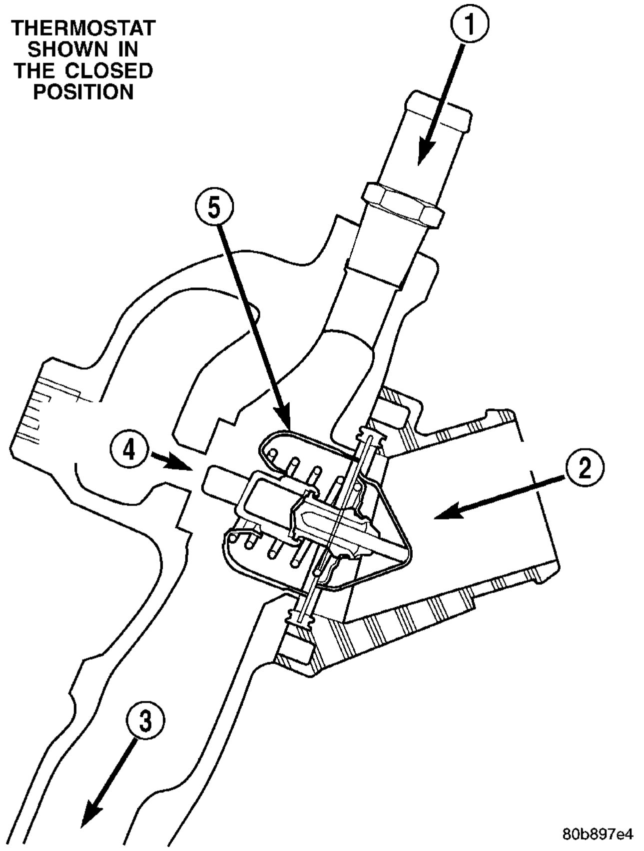


Fig. 25 Thermostat Cross Section View 3.7L/4.7L

1 - FROM HEATER AND DEGAS CONTAINER
2 - FROM RADIATOR
3 - TO WATER PUMP
4 - ENGINE BYPASS
5 - THERMOSTAT

OPERATION

The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open.

DIAGNOSIS AND TESTING—THERMOSTAT

ON-BOARD DIAGNOSTICS

All **gasoline powered models** are equipped with On-Board Diagnostics for certain cooling system components. Refer to On-Board Diagnostics (OBD) in the Diagnosis section of this group for additional information. If the powertrain control module (PCM) detects low engine coolant temperature, it will record a Diagnostic Trouble Code (DTC) in the PCM memory. Do not change a thermostat for lack of heat as indicated by the instrument panel gauge or by poor heater performance unless a DTC is present. Refer to the Diagnosis section of this group for other probable causes.

The DTC can also be accessed through the DRBIII® scan tool. Refer to the appropriate Powertrain Diagnostic Procedures information for diagnostic information and operation of the DRBIII® scan tool.

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE COOLING SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

If the thermostat is being replaced, be sure that the replacement is the specified thermostat for the vehicle model and engine type.

(1) Disconnect the negative battery cable.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Raise and support the vehicle.

(4) Remove the splash shield.

(5) Remove the lower radiator hose clamp and the lower radiator hose at the thermostat housing.

(6) Remove the thermostat housing mounting bolts, thermostat housing and thermostat (Fig. 26).

INSTALLATION

(1) Clean the mating areas of the timing chain cover and the thermostat housing.

(2) Install the thermostat (spring side down) into the recessed machined groove on the timing chain cover (Fig. 26).

(3) Position the thermostat housing on the timing chain cover.

(4) Install the housing-to-timing chain cover bolts. Tighten the bolts to 13 N·m (112 in. lbs.).

CAUTION: The housing must be tightened evenly and the thermostat must be centered into the recessed groove in the timimg chain cover. If not, it may result in a cracked housing, damaged timing chain cover threads or coolant leaks.

(5) Install the lower radiator hose on the thermostat housing.

(6) Install the splash shield.

(7) Lower the vehicle.

(8) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(9) Connect negative battery cable.

(10) Start and warm the engine. Check for leaks.

ENGINE COOLANT THERMOSTAT - 3.7L/4.7L (Continued)

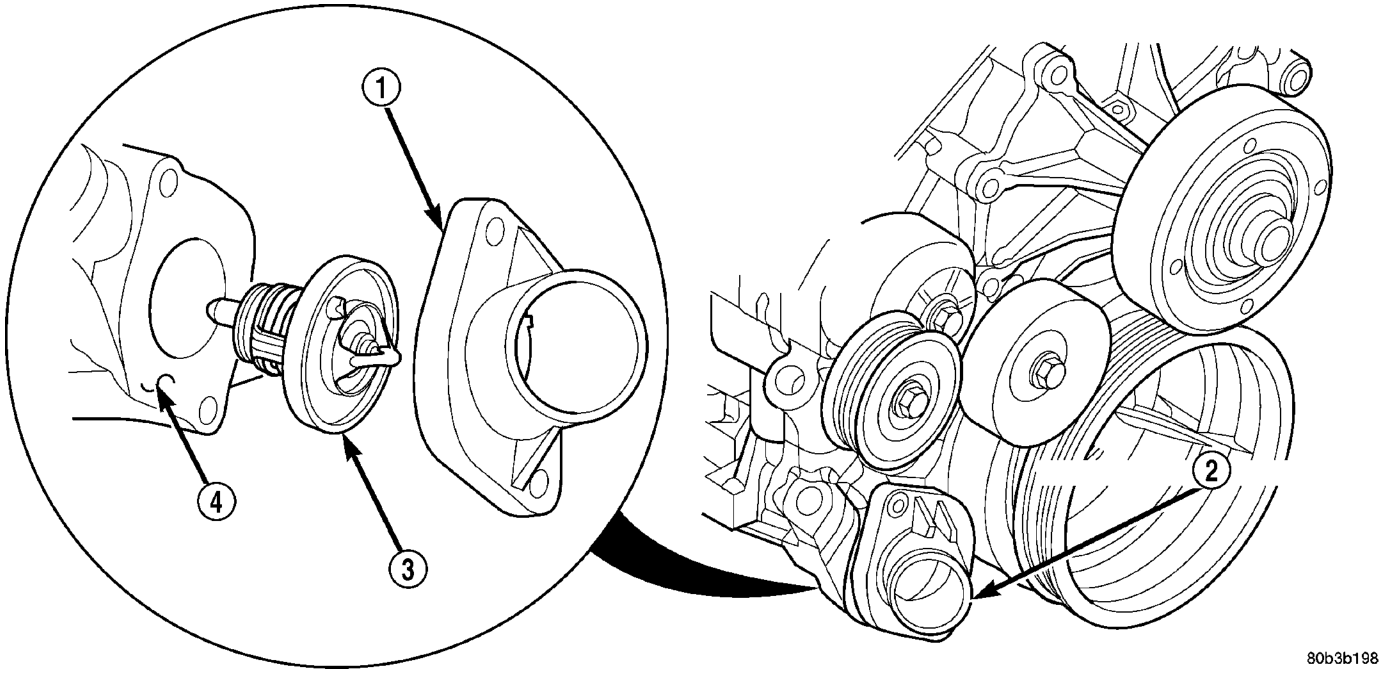


Fig. 26 Thermostat and Thermostat Housing 3.7L/4.7L

1 - THERMOSTAT HOUSING
2 - THERMOSTAT LOCATION
3 - THERMOSTAT AND GASKET
4 - TIMING CHAIN COVER

ENGINE COOLANT THERMOSTAT - 5.9L DIESEL

DESCRIPTION

CAUTION: Do not operate an engine without a thermostat, except for servicing or testing. An engine with the thermostat removed will operate in the radiator bypass mode, causing an overheat condition.

The thermostat of the 5.9L diesel engine is located in the front of the cylinder head, underneath the thermostat housing (Fig. 27).

The same thermostat is used for winter and summer seasons. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat will cause overheating.

OPERATION

The wax pellet is located in a sealed container at the spring end of the thermostat. When heated, the pellet expands, overcoming closing spring tension and water pump pressure to force the valve to open.

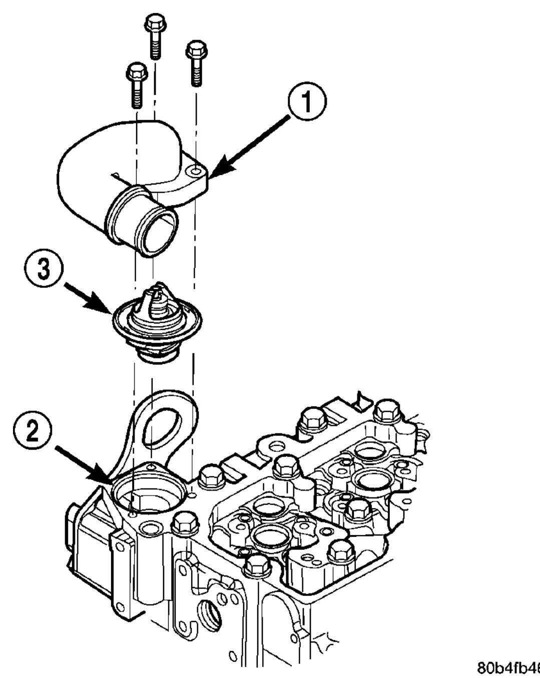


Fig. 27 Thermostat–5.9L Diesel-Typical

1 - THERMOSTAT HOUSING
2 - CYLINDER HEAD
3 - THERMOSTAT

DIAGNOSIS AND TESTING—THERMOSTAT

The cooling system used with the diesel engine provides the extra coolant capacity and extra cooling protection needed for higher GVWR (Gross Vehicle Weight Rating) and GCWR (Gross Combined Weight Rating) vehicles.

ENGINE COOLANT THERMOSTAT - 5.9L DIESEL (Continued)

This system capacity will not effect warm up or cold weather operating characteristics if the thermostat is operating properly. This is because coolant will be held in the engine until it reaches the thermostat “set” temperature.

Diesel engines, due to their inherent efficiency are slower to warm up than gasoline powered engines, and will operate at lower temperatures when the vehicle is unloaded. Because of this, lower temperature gauge readings for diesel versus gasoline engines may, at times be normal.

Typically, complaints of low engine coolant temperature are observed as low heater output when combined with cool or cold outside temperatures.

To help promote faster engine warm-up, the electric engine block heater must be used with cool or cold outside temperatures. This will help keep the engine coolant warm when the vehicle is parked. Use the block heater if the outside temperature is below 4°C (40°F). **Do not use the block heater if the outside temperature is above 4°C (40°F).**

A “Cold Weather Cover” is available from the parts department through the Mopar Accessories product line. This accessory cover is designed to block airflow entering the radiator and engine compartment to promote faster engine warm-up. It attaches to the front of the vehicle at the grill opening. **The cover is to be used with cool or cold temperatures only. If used with high outside temperatures, serious engine damage could result.** Refer to the literature supplied with the cover for additional information.

(1) To determine if the thermostat is defective, it must be removed from the vehicle (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT THERMOSTAT - REMOVAL).

(2) After the thermostat has been removed, examine the thermostat and inside of thermostat housing for contaminants. If contaminants are found, the thermostat may already be in a “stuck open” position. Flush the cooling system before replacing thermostat (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Place the thermostat into a container filled with water.

(4) Place the container on a hot plate or other suitable heating device.

(5) Place a commercially available radiator thermometer into the water.

(6) Apply heat to the water while observing the thermostat and thermometer.

(7) The thermostat will begin to open at 85.5 — 89.4°C. (186 —193°F). If the valve starts to move before this temperature is reached, it is opening too early. Replace thermostat. The thermostat should be fully open (valve will stop moving) at 97°C (207°F). If the valve is still moving when the water temperature reaches 97°C (207°F), it is opening too late. Replace thermostat. If the valve refuses to move at any time, replace thermostat.

REMOVAL

WARNING: DO NOT LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND PRESSURIZED. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(1) Disconnect the battery negative cables.

(2) Drain cooling system until coolant level is below thermostat (Refer to 7 - COOLING - STANDARD PROCEDURE).

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(3) Remove radiator hose clamp and hose from thermostat housing.

(4) Remove the three (3) water outlet-to-cylinder head bolts and remove the water outlet connector (Fig. 28).

(5) Clean the mating surfaces of the water outlet connector and clean the thermostat seat groove at the top of the thermostat housing (Fig. 28).

INSTALLATION

(1) Inspect thermostat seal for cuts or nicks. Replace if damaged.

(2) Install the thermostat into the groove in the top of the cylinder head (Fig. 28).

(3) Install the thermostat housing and bolts. Tighten the bolts to 10 N·m (88 in. lbs.) torque.

(4) Install the radiator upper hose and clamp.

(5) Fill the cooling system with coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(6) Connect the battery negative cables.

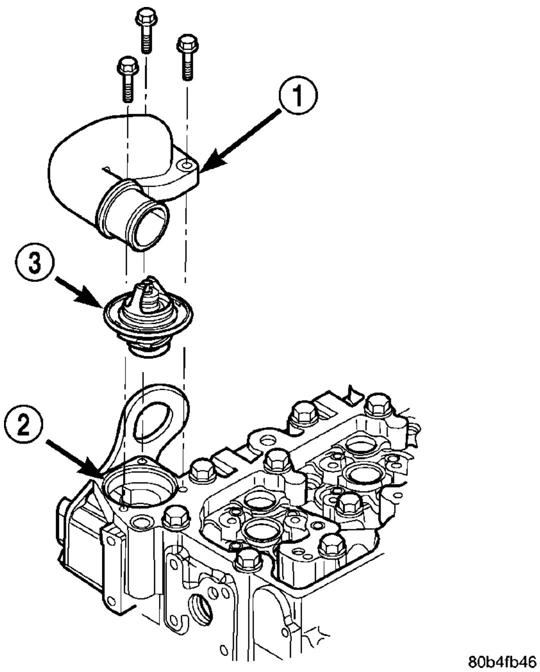


Fig. 28 Thermostat Removal/Installation

1 - THERMOSTAT HOUSING
2 - CYLINDER HEAD
3 - THERMOSTAT

(7) Start the engine and check for coolant leaks. Run engine to check for proper thermostat operation.

FAN DRIVE VISCOUS CLUTCH

DESCRIPTION

The thermal viscous fan drive (Fig. 29) is a silicone-fluid- filled coupling used to connect the fan blades to the water pump shaft. The coupling allows the fan to be driven in a normal manner. This is done at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds.

OPERATION

A thermostatic bimetallic spring coil is located on the front face of the viscous fan drive unit (a typical viscous unit is shown in (Fig. 30). This spring coil reacts to the temperature of the radiator discharge air. It engages the viscous fan drive for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of engine speed.

Only when sufficient heat is present, will the viscous fan drive engage. This is when the air flowing through the radiator core causes a reaction to the bimetallic coil. It then increases fan speed to provide the necessary additional engine cooling.

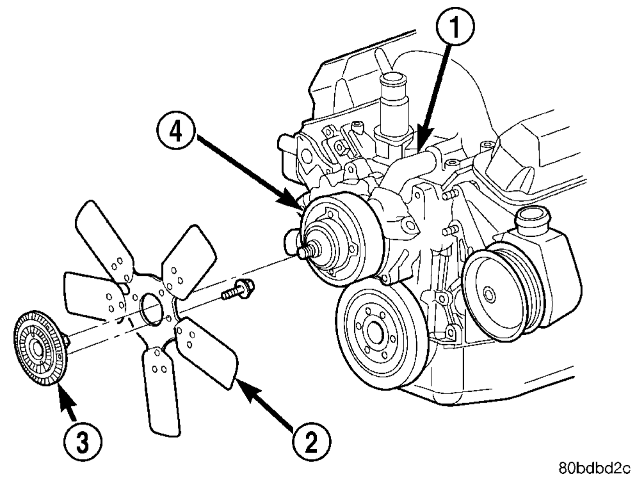


Fig. 29 Viscous Fan

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

Once the engine has cooled, the radiator discharge temperature will drop. The bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

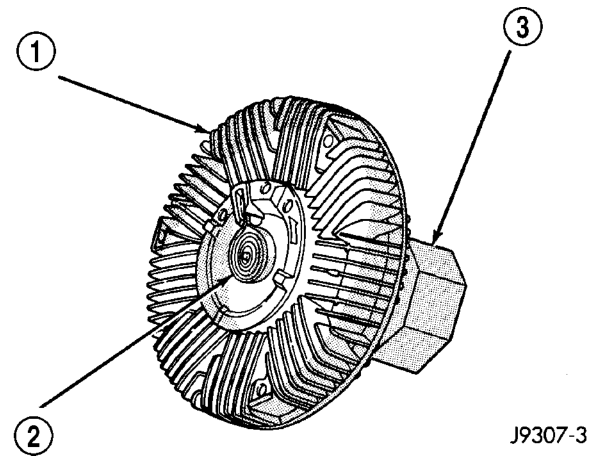


Fig. 30 Viscous Fan Drive—Typical

1 - VISCOUS FAN DRIVE
2 - THERMOSTATIC SPRING
3 - MOUNTING NUT TO WATER PUMP HUB

DIAGNOSIS AND TESTING - VISCOUS FAN DRIVE

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

• The underhood temperature is above the engagement point for the viscous drive coupling. This may

FAN DRIVE VISCOUS CLUTCH (Continued)

occur when ambient (outside air temperature) is very high.

• Engine loads and temperatures are high such as when towing a trailer.

• Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

VISCOUS DRIVE

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

WARNING: BE SURE THAT THERE IS ADEQUATE FAN BLADE CLEARANCE BEFORE DRILLING.

(1) Drill a 3.18-mm (1/8-in) diameter hole in the top center of the fan shroud.

(2) Obtain a dial thermometer with an 8 inch stem (or equivalent). It should have a range of -18°-to-105°C (0°-to-220° F). Insert thermometer through the hole in the shroud. Be sure that there is adequate clearance from the fan blades.

(3) Connect a tachometer and an engine ignition timing light. The timing light is to be used as a strobe light. This step cannot be used on the diesel engine.

(4) Block the air flow through the radiator. Secure a sheet of plastic in front of the radiator. Use tape at the top to secure the plastic and be sure that the air flow is blocked.

(5) Be sure that the air conditioner (if equipped) is turned off.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(6) Start the engine and operate at 2400 rpm. Within ten minutes the air temperature (indicated on the dial thermometer) should be up to 88° C (190° F). Fan drive **engagement** should start to occur at/between:

• 3.7L Automatic — 93° C - 99°C (200° F - 210° F)

• 3.7L Manual/4.7L Automatic/5.9L — 85° to 91° C (185° to 195° F)

• 4.7L Manual — 74° to 79° C (165° to 175° F)

• Engagement is distinguishable by a definite **increase** in fan flow noise (roaring). The timing light also will indicate an increase in the speed of the fan.

(7) When viscous drive engagement is verified, remove the plastic sheet. Fan drive **disengagement** should start to occur at or between:

• 3.7L Automatic — 76°C to 81°C (168° F to 178° F)

• 3.7L Manual/4.7L Auto/ 5.9L — 67°C to 73°C (153° F to 163° F)

• 4.7L Manual — 56°C to 62°C (133° F to 143° F)

• 8.0L engine — 88° to 96° C (190° to 205° F) A definite **decrease** of fan flow noise (roaring) should be noticed. If not, replace the defective viscous fan drive unit.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found. Also inspect water pump bearing and shaft assembly for any related damage due to a viscous fan drive malfunction.

FAN DRIVE VISCOUS CLUTCH - 5.9L DIESEL

DESCRIPTION

The electronically controlled thermal viscous fan drive (Fig. 31) is attached to the fan drive pulley mounted to the engine. The coupling allows the fan to be driven in a normal manner. The fan speed is controlled by the electronic control module.

OPERATION

The Engine Control Module (ECM) controls the level of engagment of the electronically controlled viscous fan clutch by monitoring coolant temperature, intake manifold temperature, and air conditioning status. Based on cooling requirements, the ECM sends a signal to the viscous fan clutch to increase or decrease the fan speed.

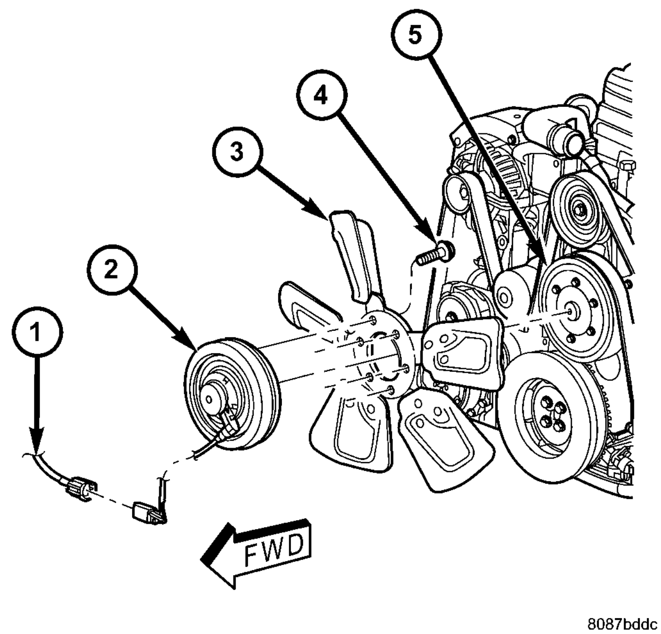


Fig. 31 Fan Blade/Viscous Fan Drive

1 - ELECTRICAL CONNECTOR
2 - VISCOUS FAN DRIVE
3 - FAN BLADE
4 - BOLT
5 - FAN DRIVE

Fan speed is monitored by the ECM. A lack of fan speed will set a DTC. Circuit concerns will also set fan clutch DTC's.

Fan speed and duty cycle percent can be monitored with the DRB III..

DIAGNOSIS AND TESTING - ELECTRONICLY CONTOLLED VISCOUS FAN DRIVE

NOISE

NOTE: It is normal for fan noise to be louder (roaring) when:

- Fan duty cycle high. This may occur when ambient (outside air temperature) is very high.
- Engine loads and temperatures are high such as when towing a trailer.
- Cool silicone fluid within the fan drive unit is being redistributed back to its normal disengaged (warm) position. This can occur during the first 15 seconds to one minute after engine start-up on a cold engine.

LEAKS

Viscous fan drive operation is not affected by small oil stains near the drive bearing. If leakage appears excessive, replace the fan drive unit.

ELECTRONICALLY CONTROLLED VISCOUS DRIVE

If the fan assembly free-wheels without drag (the fan blades will revolve more than five turns when spun by hand), replace the fan drive. This spin test must be performed when the engine is cool.

For the following test, the cooling system must be in good condition. It also will ensure against excessively high coolant temperature.

The Electronic Viscous Fan drive can be tested using the DRB III scan tool.

(1) Set the parking brake and verify the transmission is in park or neutral.

(2) Stat and allow engine to reach normal operating termeratures.

(3) With engine idling, connect the DRB III and select appropraite model year and engine option.

(4) Lacate and select actuator tests, then select PWM Viscous Fan.

(5) Monitor fan speed and duty cycle; verify that the fan speed increments are proportional to the duty cycle precentage during the actuation event.

CAUTION: Some engines equipped with serpentine drive belts have reverse rotating fans and viscous fan drives. They are marked with the word REVERSE to designate their usage. Installation of the wrong fan or viscous fan drive can result in engine overheating.

CAUTION: If the viscous fan drive is replaced because of mechanical damage, the cooling fan blades should also be inspected. Inspect for fatigue cracks, loose blades, or loose rivets that could have resulted from excessive vibration. Replace fan blade assembly if any of these conditions are found.

RADIATOR

DESCRIPTION

The radiator is a aluminum cross-flow design with horizontal tubes through the radiator core and vertical plastic side tanks (Fig. 32).

This radiator does not contain an internal transmission oil cooler

OPERATION

The radiator supplies sufficient heat transfer using the cooling fins interlaced between the horizontal tubes in the radiator core to cool the engine.

RADIATOR (Continued)

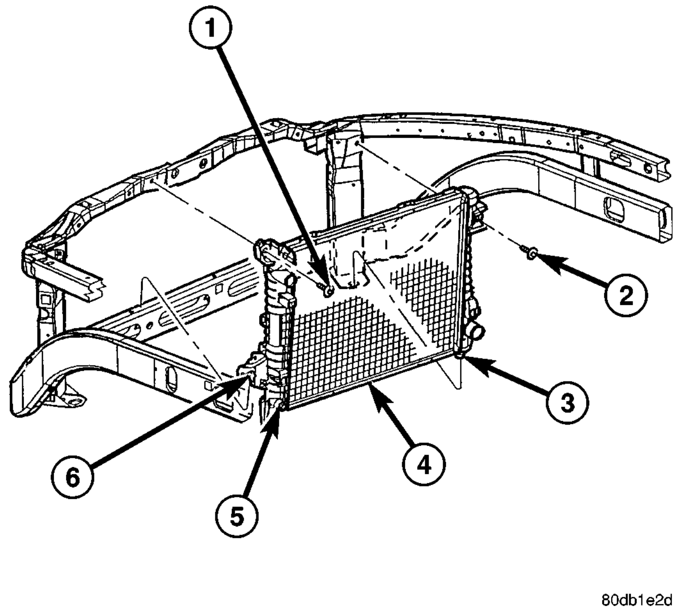


Fig. 32 Radiator — Typical

1 - SCREW
2 - SCREW
3 - LOWER MOUNT
4 - RADIATOR
5 - DRAINCOCK
6 -LOWER MOUNT

DIAGNOSIS AND TESTING—RADIATOR COOLANT FLOW

Use the following procedure to determine if coolant is flowing through the cooling system.

(1) Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP. THIS WILL ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes, the coolant is circulating.

REMOVAL

(1) Disconnect battery negative cables.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter and the correct width.

(3) Remove the hose clamps and hoses from radiator.

(4) Remove the coolant reserve/overflow tank hose from the radiator filler neck.

(5) Remove the coolant reserve/overflow tank (5.9L) or the coolant degas container(3.7L/4.7L) from the fan shroud (pull straight up). The tank slips into slots on the fan shroud.

(6) Unclip the power steering hoses from the fan shroud.

(7) Disconnect the electrical connectors at the windshield washer reservoir tank and remove the tank.

(8) Remove the fan shroud mounting bolts and pull up and out of the radiator tank clips (Fig. 33). Position shroud rearward over the fan blades towards engine.

(9) Disconnect the transmission cooler lines from the transmission cooler, then plug the transmission lines and cooler to prevent leakage.

(10) Disconnect the power steering lines from the power steering cooler, then plug the power steering lines and cooler to prevent leakage.

(11) Remove the two radiator upper mounting bolts (Fig. 34).

(12) Lift the radiator straight up and out of the engine compartment. Take care not to damage cooling fins or tubes on the radiator and oil coolers when removing.

RADIATOR (Continued)

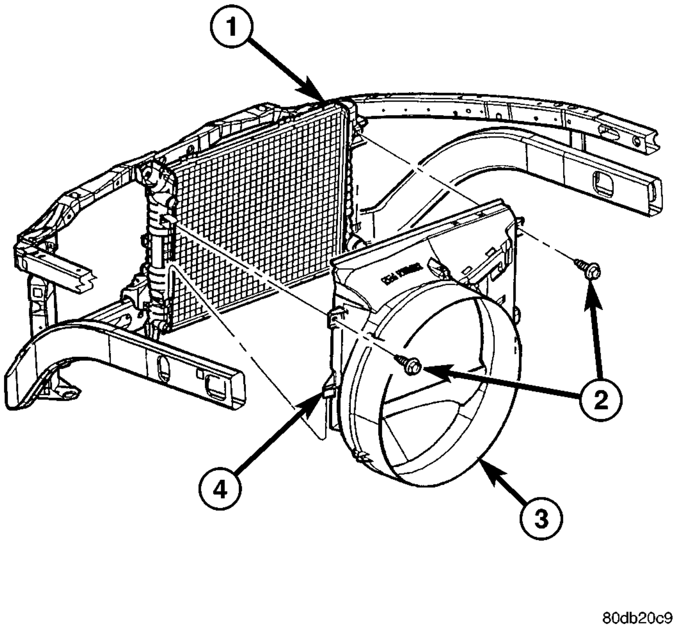


Fig. 33 Fan Shroud

1 - RADIATOR
2 - SCREWS
3 - FAN SHROUD
4 - SLIDE MOUNT

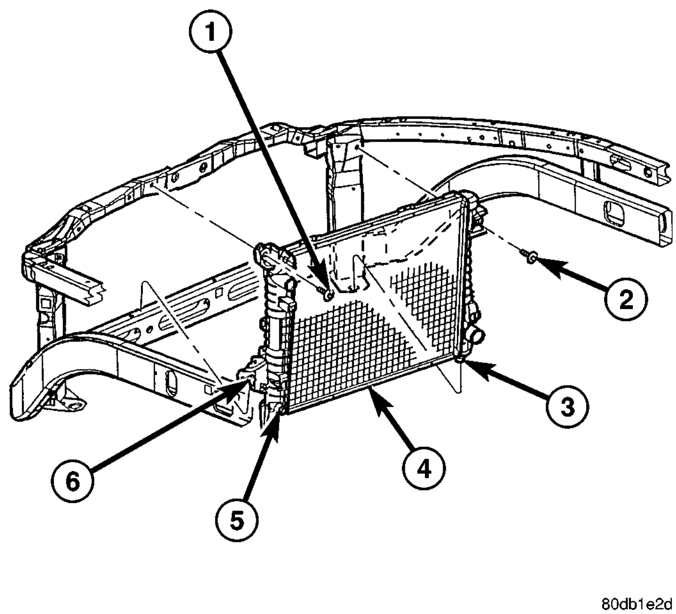


Fig. 34 Radiator

1 - SCREW
2 - SCREW
3 - LOWER MOUNT
4 - RADIATOR
5 - DRAINCOCK
6 -LOWER MOUNT

NOTE: The radiator is equipped with one alignment dowel on the bottom of the outlet tank and one retaining bracket on the front side of the inlet tank. Both features have rubber insulators attached to them that must be present. The alignment dowel fits into a hole at the bottom of the front end sheet metal vertical support post and the support bracket rests on top of the lower radiator closure tube.

CLEANING

Clean radiator fins are necessary for good heat transfer. The radiator and oil cooler fins should be cleaned when an accumulation of debris has occurred. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or oil coolers of debris.

INSPECTION

Inspect the radiator side tanks for cracks, broken or missing fittings also inspect the joint where the tanks seam up to the radiator core for signs of leakage and/or deteriorating seals.

Inspect radiator core for corroded, bent or missing cooling fins. Inspect the core for bent or damaged cooling tubes.

INSTALLATION

(1) Position the fan shroud over the fan blades rearward towards engine.

(2) Install the rubber insulators to the lower radiator mounting features (alignment dowel and support bracket at the lower part of the radiator).

(3) Lower the radiator into position while guiding the alignment dowel into the vertical post bracket. Position and seat the lower radiator support bracket onto the lower radiator closure tube.

(4) Install the upper radiator mounting bolts. Tighten bolts to 8.5 N·m (75 in. lbs.).

(5) Connect the lower radiator hose and install the clamp in the proper position.

(6) Connect the power steering hoses to the power steering oil cooler and install the clamps.

(7) Connect the transmission oil cooler lines to the transmission oil cooler and install the secondary latches.

(8) Position the fan shroud into the mounting clips on the radiator tanks and secure with bolts. Tighten the bolts to 8.5 N·m (75 in. lbs.).

(9) Secure the power steering hoses into the clip on the lower fan shroud.

(10) Install the windshield washer reservoir tank and connect the hose and electrical connector.

(11) Install coolant reserve/overflow container hose(s) to radiator filler neck and secure properly with clamps.

RADIATOR (Continued)

(12) Install coolant reserve/overflow container or degas container to fan shroud and tighten the bolts to 8.5 N·m (75 in. lbs.).

(13) Connect upper radiator hose and install clamp.

(14) Install battery negative cable.

(15) Fill cooling system with coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(16) Operate the engine until it reaches normal operating temperature. Check cooling system fluid levels.

RADIATOR - 5.9L DIESEL

DESCRIPTION

The radiator is a aluminum cross-flow design with horizontal tubes through the radiator core and vertical plastic side tanks (Fig. 35).

This radiator does not contain an internal transmission oil cooler

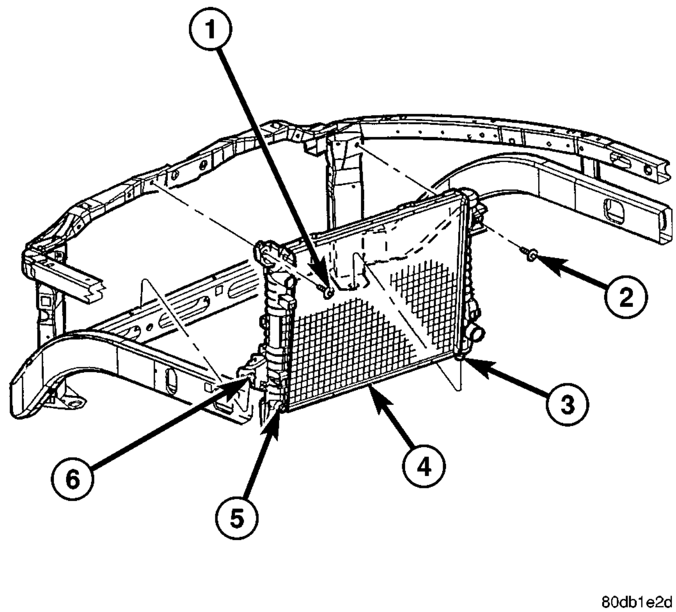


Fig. 35 Radiator — Typical

1 - SCREW
2 - SCREW
3 - LOWER MOUNT
4 - RADIATOR
5 - DRAINCOCK
6 -LOWER MOUNT

OPERATION

The radiator supplies sufficient heat transfer using the cooling fins interlaced between the horizontal tubes in the radiator core to cool the engine.

DIAGNOSIS AND TESTING—RADIATOR COOLANT FLOW

Use the following procedure to determine if coolant is flowing through the cooling system.

(1) Idle engine until operating temperature is reached. If the upper radiator hose is warm to the touch, the thermostat is opening and coolant is flowing to the radiator.

WARNING: HOT, PRESSURIZED COOLANT CAN CAUSE INJURY BY SCALDING. USING A RAG TO COVER THE RADIATOR PRESSURE CAP, OPEN RADIATOR CAP SLOWLY TO THE FIRST STOP. THIS WILL ALLOW ANY BUILT-UP PRESSURE TO VENT TO THE RESERVE/OVERFLOW TANK. AFTER PRESSURE BUILD-UP HAS BEEN RELEASED, REMOVE CAP FROM FILLER NECK.

(2) Drain a small amount of coolant from the radiator until the ends of the radiator tubes are visible through the filler neck. Idle the engine at normal operating temperature. If coolant is flowing past the exposed tubes, the coolant is circulating.

REMOVAL

(1) Disconnect both battery negative cables.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM COOLANT CAN OCCUR.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP, SUCH AS SPECIAL CLAMP TOOL (NUMBER 6094). SNAP-ON CLAMP TOOL (NUMBER HPC-20) MAY BE USED FOR LARGER CLAMPS. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter.

(3) Remove air box and turbocharger inlet tube.

(4) Remove coolant tank hose, washer bottle hose and the positive battery cable from the fastening clips located on top of the radiator.

(5) Remove hose clamps and hoses from radiator.

RADIATOR - 5.9L DIESEL (Continued)

(6) Remove the power steering cooler mounting bolts and position the power steering cooler out of the way.

(7) Disconnect the transmission cooler lines at the transmission. The transmission cooler will remain on the radiator and can be removed as an assembly.

(8) Remove the lower shroud assembly and the electronic viscous fan wiring from the upper shroud assembly.

(9) Remove the two radiator upper mounting bolts (Fig. 36).

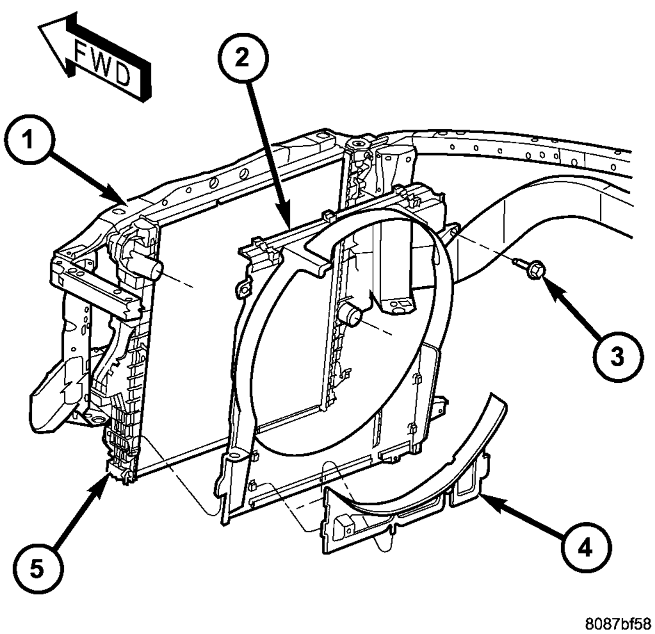


Fig. 36 Fan Shroud Mounting—5.9L Diesel Engine

1 - RADIATOR SUPPORT
2 - UPPER FAN SHROUD
3 - BOLTS (2)
4 - LOWER FAN SHROUD
5 - RADIATOR

(10) Lift radiator straight up and out of engine compartment. The bottom of the radiator is equipped with two alignment dowels that fit into holes in the lower radiator support panel. Rubber biscuits (insulators) are installed to these dowels. Take care not to damage cooling fins or tubes on the radiator and air conditioning condenser when removing.

CLEANING

Clean radiator fins are necessary for good heat transfer. The radiator and oil cooler fins should be cleaned when an accumulation of debris has occurred. With the engine cold, apply cold water and compressed air to the back (engine side) of the radiator to flush the radiator and/or oil coolers of debris.

INSPECTION

Inspect the radiator side tanks for cracks, broken or missing fittings also inspect the joint where the tanks seam up to the radiator core for signs of leakage and/or deteriorating seals.

Inspect radiator core for corroded, bent or missing cooling fins. Inspect the core for bent or damaged cooling tubes.

INSTALLATION

(1) Install rubber insulators to alignment dowels at lower part of radiator.

(2) Lower the radiator into position while guiding the two alignment dowels into lower radiator support. Different alignment holes are provided in the lower radiator support for each engine application.

(3) Install two upper radiator mounting bolts. Tighten bolts to 11 N·m (95 in. lbs.) torque.

(4) Connect both radiator hoses and install hose clamps.

(5) Connect transmission cooler lines to radiator tank. Inspect quick connect fittings for debris and install until an audible “click” is heard. Pull apart to verify connection.

(6) Position power steering cooler on the radiator and tighten nuts to 8.5M·N (75 in. lbs.)

(7) Attach electronic viscous fan wiring to upper shroud ands install lower shroud.

(8) Position coolant recover tank hose, washer bottle hose and the positive battery cable into the clips located on the top of the radiator.

(9) Install air box and turbocharger inlet hose. Tighten clamps to 4 N·M (35 in. lbs.).

(10) Position heater controls to **full heat** position.

(11) Fill cooling system with coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(12) Operate engine until it reaches normal temperature. Check cooling system and automatic transmission (if equipped) fluid levels.

RADIATOR PRESSURE CAP

DESCRIPTION

All cooling systems are equipped with a pressure cap (Fig. 37). For 5.9L engines, the pressure cap is located on top of the radiator outlet tank. For the 3.7L/4.7L engines, the pressure cap is located on top of the coolant degas container. The cap releases pressure at some point within a range of 97-to-124 kPa (14-to-18 psi). The pressure relief point (in pounds) is engraved on top of the cap

The cooling system will operate at pressures slightly above atmospheric pressure. This results in a higher coolant boiling point allowing increased radiator cooling capacity. The cap contains a spring-

RADIATOR PRESSURE CAP (Continued)

loaded pressure relief valve. This valve opens when system pressure reaches the release range of 97-to-124 kPa (14-to-18 psi).

A rubber gasket seals the radiator filler neck. This is done to maintain vacuum during coolant cool-down and to prevent leakage when system is under pressure.

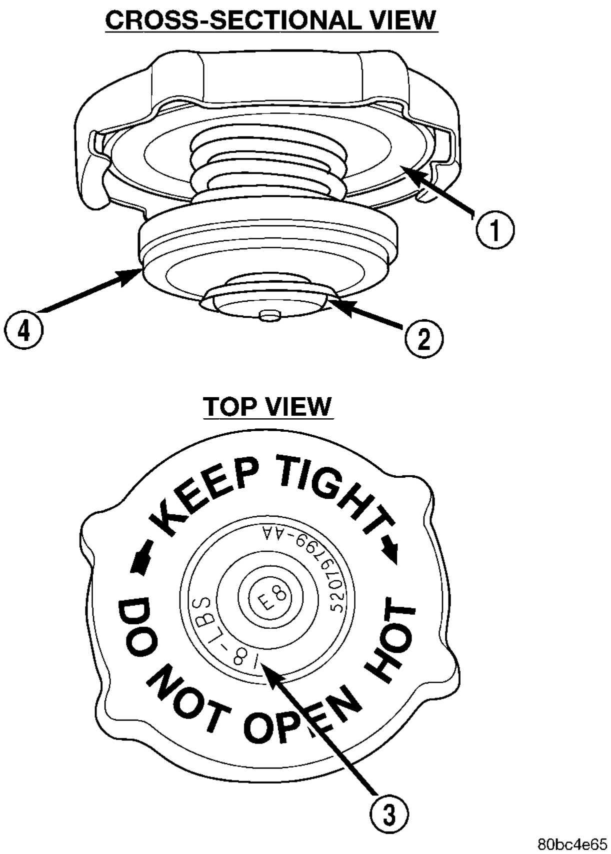


Fig. 37 Radiator Pressure Cap - Typical

1 - FILLER NECK SEAL
2 - VACUUM VENT VALVE
3 - PRESSURE RATING
4 - PRESSURE VALVE

OPERATION

A vent valve in the center of the cap will remain shut as long as the cooling system is pressurized. As the coolant cools, it contracts and creates a vacuum in the cooling system. This causes the vacuum valve to open and coolant in the reserve/overflow container to be drawn through the recovery hose connecting the filler neck and reserve/overflow container. If the vacuum valve is stuck shut, or the recovery hose is kinked, radiator hoses will collapse on cool down.

For the 3.7L/4.7L engine, the vacuum valve will open and relieve the vacuum pressure in the cooling system.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—RADIATOR CAP-TO-FILLER NECK SEAL

The pressure cap upper gasket (seal) pressure relief can be tested by removing overflow hose from the radiator filler neck tube. Attach the hose of the pressure tester tool 7700 (or equivalent) to the tube. It will be necessary to disconnect hose from its adapter for the filler neck. Pump air into radiator. The pressure cap upper gasket should relieve at 69 to 124kPa (10 to 18 psi) and hold pressure at a minimum of 55 kPa (8 psi).

WARNING: THE WARNING WORDS —DO NOT OPEN HOT— ON RADIATOR PRESSURE CAP, ARE A SAFETY PRECAUTION. WHEN HOT, PRESSURE BUILDS UP IN COOLING SYSTEM. TO PREVENT SCALDING OR INJURY, RADIATOR CAP SHOULD NOT BE REMOVED WHILE SYSTEM IS HOT AND/OR UNDER PRESSURE.

Do not remove the radiator cap at any time **except** for the following purposes:

(1) Check and adjust antifreeze freeze point.
(2) Refill the system with new antifreeze.
(3) Conducting service procedures.
(4) Checking for vacuum leaks.

WARNING: IF VEHICLE HAS BEEN RUN RECENTLY, WAIT AT LEAST 15 MINUTES BEFORE REMOVING RADIATOR CAP. WITH A RAG, SQUEEZE RADIATOR UPPER HOSE TO CHECK IF SYSTEM IS UNDER PRESSURE. PLACE A RAG OVER CAP AND WITHOUT PUSHING CAP DOWN, ROTATE IT COUNTERCLOCKWISE TO FIRST STOP. ALLOW FLUID TO ESCAPE THROUGH THE COOLANT RESERVE/OVERFLOW HOSE INTO RESERVE/OVERFLOW TANK. SQUEEZE RADIATOR UPPER HOSE TO DETERMINE WHEN PRESSURE HAS BEEN RELEASED. WHEN COOLANT AND STEAM STOP BEING PUSHED INTO TANK AND SYSTEM PRESSURE DROPS, REMOVE RADIATOR CAP COMPLETELY.

DIAGNOSIS AND TESTING - RADIATOR CAP

Remove the cap from the radiator. Be sure that the sealing surfaces are clean. Moisten the rubber gasket with water and install the cap on the pressure tester 7700 or an equivalent (Fig. 38).

Operate the tester pump to bring the pressure to 104 kPa (15 psi) on the gauge. If the pressure cap fails to hold pressure of at least 97 kPa (14 psi) replace the cap. Refer to the following **CAUTION**.

RADIATOR PRESSURE CAP (Continued)

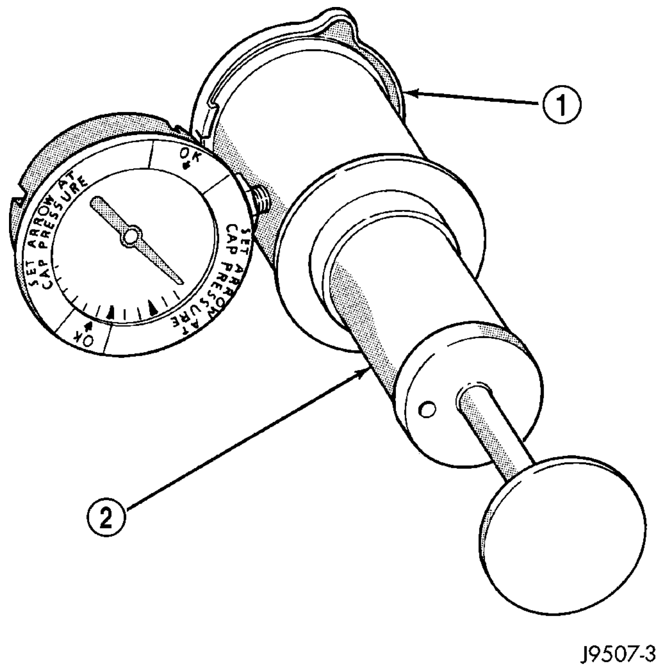


Fig. 38 Pressure Testing Radiator Cap - Typical

1 - PRESSURE CAP
2 - TYPICAL COOLING SYSTEM PRESSURE TESTER

The pressure cap may test properly while positioned on tool 7700 (or equivalent). It may not hold pressure or vacuum when installed on the radiator. If so, inspect the radiator filler neck and radiator cap's top gasket for damage. Also inspect for dirt or distortion that may prevent the cap from sealing properly.

CAUTION: Radiator pressure testing tools are very sensitive to small air leaks which will not cause cooling system problems. A pressure cap that does not have a history of coolant loss should not be replaced just because it leaks slowly when tested with this tool. Add water to tool. Turn tool upside down and recheck pressure cap to confirm that cap needs replacement.

CLEANING

Use only a mild soap and water to clean the radiator cap. Using any type of solvent may cause damage to the seal in the radiator cap.

INSPECTION

Hold cap at eye level, right side up. The vent valve (Fig. 39) at bottom of cap should closed. A slight downward pull on the vent valve should open it. If the rubber gasket has swollen and prevents vent valve from opening, replace cap.

Hold cap at eye level, upside down. If any light can be seen between vent valve and rubber gasket, replace cap. A replacement cap must be the type designed for a coolant reserve/overflow system with a completely sealed diaphragm spring and a rubber gasket. This gasket is used to seal to radiator filler neck top surface. Use of proper cap will allow coolant return to radiator.

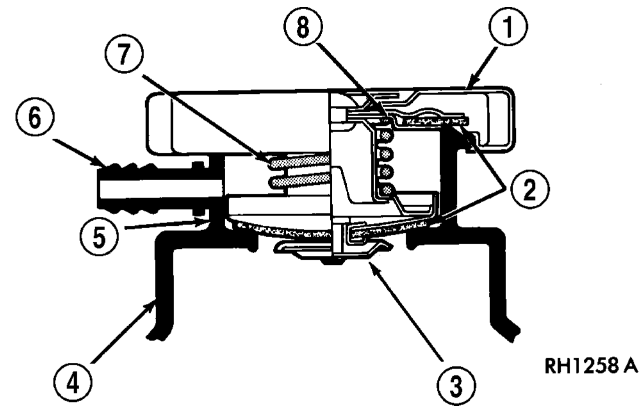


Fig. 39 Radiator Pressure Cap

1 - STAINLESS-STEEL SWIVEL TOP
2 - RUBBER SEALS
3 - VENT VALVE
4 - RADIATOR TANK
5 - FILLER NECK
6 - OVERFLOW NIPPLE
7 - MAIN SPRING
8 - GASKET RETAINER

WATER PUMP - 5.9L

DESCRIPTION

The water pump is located on the engine front cover, and has an integral pulley attached (Fig. 40).

The water pump impeller is pressed onto the rear of a shaft that rotates in a bearing pressed into the water pump body. The body has a small hole for ventilation. The water pump seals are lubricated by antifreeze in the coolant mixture. Additional lubrication is not necessary.

OPERATION

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

DIAGNOSIS AND TESTING—WATER PUMP

A quick test to determine if pump is working is to check if heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

WATER PUMP - 5.9L (Continued)

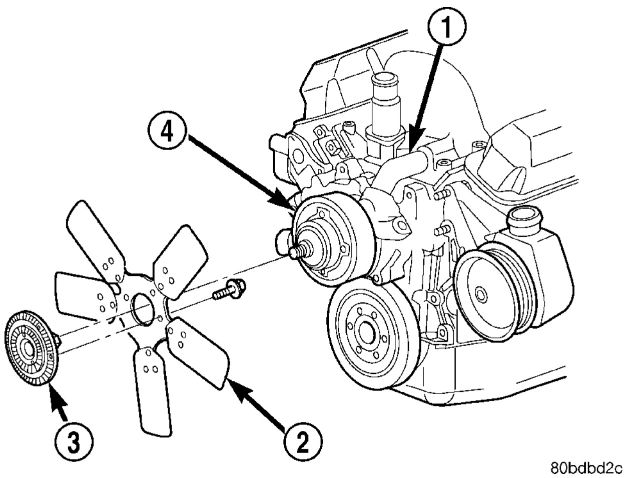


Fig. 40 Water Pump Location — Typical

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

REMOVAL

The water pump on all models can be removed without discharging the air conditioning system (if equipped).

The water pump on all gas powered engines is bolted directly to the engine timing chain case/cover.

On the 5.9L gas powered engine, a gasket is used as a seal between the water pump and timing chain case/cover.

If water pump is replaced because of bearing/shaft damage or leaking shaft seal, the mechanical cooling fan assembly should also be inspected. Inspect for fatigue cracks, loose blades or loose rivets that could have resulted from excessive vibration. Replace fan if any of these conditions are found. Also check condition of the thermal viscous fan drive (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - DIAGNOSIS AND TESTING).

(1) Disconnect the negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.

(3) Remove the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)

(4) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL) (Fig. 41).

(5) Remove the lower radiator hose and heater hose from the water pump.

(6) Loosen the heater hose coolant return tube mounting bolt (Fig. 42) and remove the tube from the water pump. Discard the old tube O-ring.

(7) Remove the water pump mounting bolts (Fig. 43).

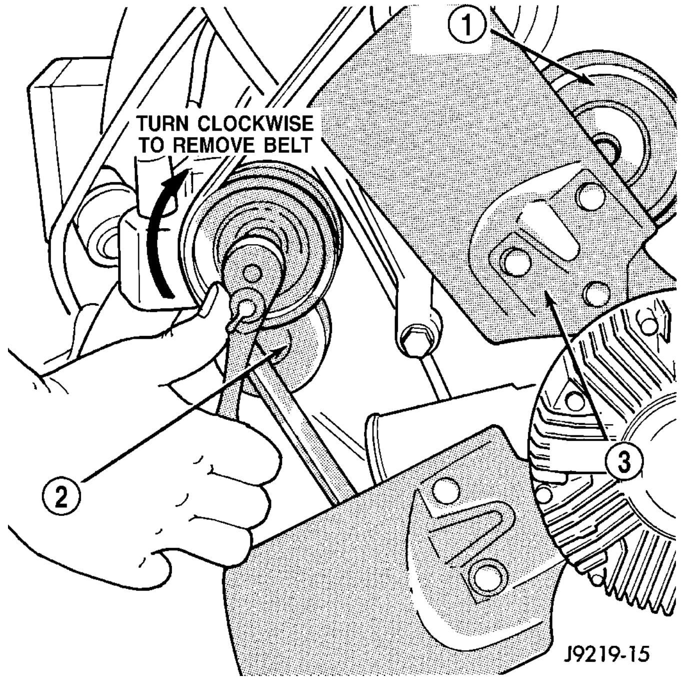


Fig. 41 Belt Tensioner 5.9L V-8 Engine

1 - IDLER PULLEY
2 - TENSIONER
3 - FAN BLADE

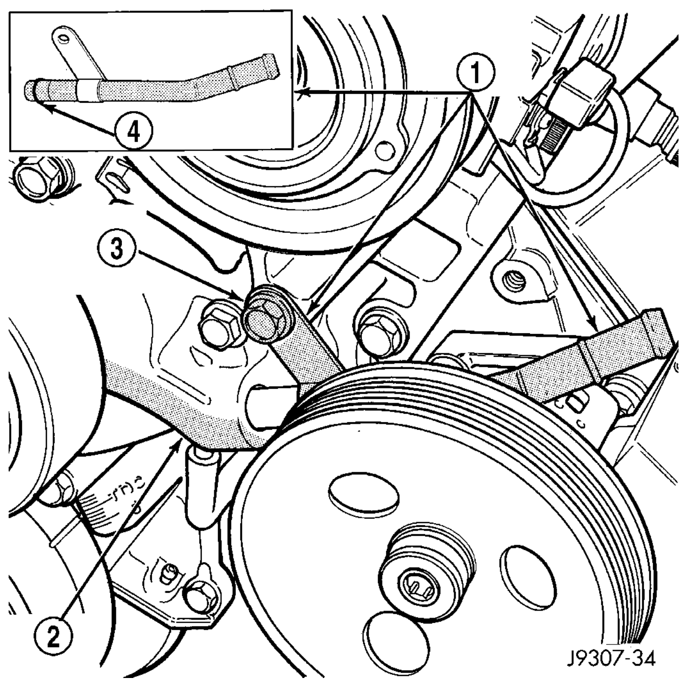


Fig. 42 Coolant Return Tube 5.9L

1 - COOLANT RETURN TUBE
2 - WATER PUMP
3 - TUBE MOUNTING BOLT
4 - O-RING

(8) Loosen the clamp at the water pump end of bypass hose (Fig. 42). Slip the bypass hose from the

WATER PUMP - 5.9L (Continued)

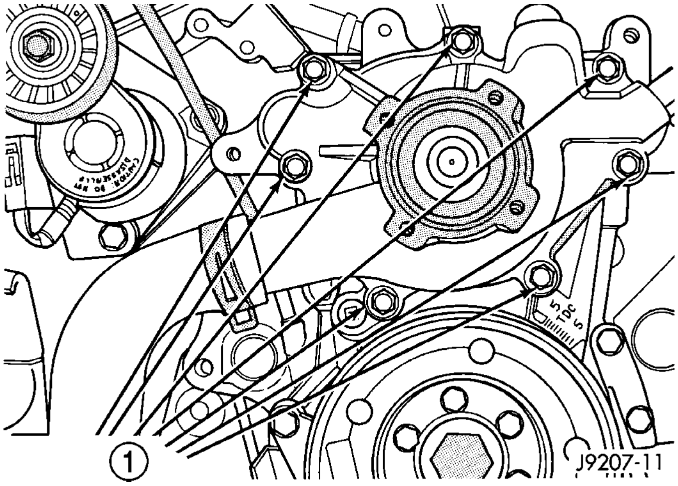


Fig. 43 Water Pump Bolts - 5.9L V-8 Gas Engine - Typical

1 - WATER PUMP MOUNTING BOLTS

water pump while removing pump from vehicle. Do not remove the clamp from the bypass hose.

(9) Discard the old gasket.

CAUTION: Do not pry the water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

CLEANING

Clean gasket mating surfaces as necessary.

INSPECTION

Visually inspect the water pump and replace if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from the shaft seal. This is evident by traces of coolant below the vent hole
- Loose or rough turning bearing.
- Impeller rubbing the pump body

INSTALLATION

(1) Clean the gasket mating surfaces.

(2) Using a new gasket, install the water pump to the engine as follows: Guide the water pump tube into the bypass hose as the pump is being installed. Install the water pump bolts (Fig. 43). Tighten the water pump mounting bolts to 40 N·m (30 ft. lbs.) torque.

(3) Position the bypass hose clamp to the bypass hose.

(4) Spin the water pump to be sure that the pump impeller does not rub against the timing chain case/cover.

(5) Install a new o-ring to the heater hose coolant return tube (Fig. 42). Coat the new o-ring with anti-freeze before installation.

(6) Install the coolant return tube and its mounting bolt to the engine (Fig. 42). Be sure the slot in the tube bracket is bottomed to mounting bolt. This will properly position return tube.

(7) Connect the radiator lower hose to the water pump.

(8) Connect the heater hose and hose clamp to the coolant return tube.

(9) Install drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) (Fig. 41).

(10) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION)

(11) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(12) Connect negative battery cable.

(13) Start and warm the engine. Check for leaks.

WATER PUMP - 3.7L/4.7L

DESCRIPTION

DESCRIPTION—WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold, radiator core, cooling system hoses and heater core. The pump is driven from the engine crankshaft by a single serpentine drive belt.

The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has two small holes to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant mixture. No additional lubrication is necessary.

Both heater hoses are connected to fittings on the timing chain front cover. The water pump is also mounted directly to the timing chain cover and is equipped with a non serviceable integral pulley (Fig. 44).

DESCRIPTION—WATER PUMP BYPASS

The 3.7L and 4.7L engine uses an internal water/coolant bypass system. The design uses galleries in the timing chain cover to circulate coolant during engine warm-up preventing the coolant from flowing through the radiator. The thermostat uses a stub shaft located at the rear of the thermostat (Fig. 45) to control flow through the bypass gallery.

OPERATION

OPERATION—WATER PUMP

A centrifugal water pump circulates coolant through the water jackets, passages, intake manifold,

WATER PUMP - 3.7L/4.7L (Continued)

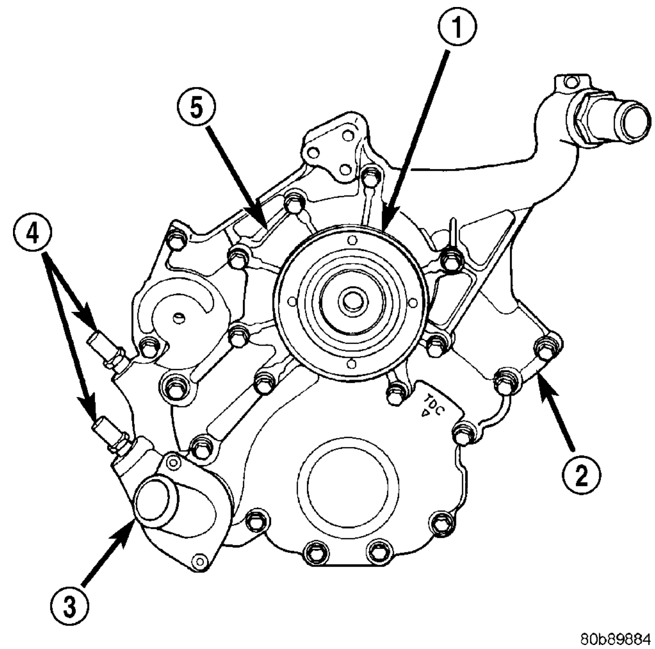


Fig. 44 Water Pump and Timing Chain Cover

1 - INTEGRAL WATER PUMP PULLEY
2 - TIMING CHAIN COVER
3 - THERMOSTAT HOUSING
4 - HEATER HOSE FITTINGS
5 - WATER PUMP

radiator core, cooling system hoses and heater core, this coolant absorbs the heat generated when the engine is running. The pump is driven by the engine crankshaft via a drive belt.

OPERATION—WATER PUMP BYPASS

When the thermostat is in the closed position the bypass gallery is not obstructed allowing 100% flow. When the thermostat is in the open position the stub shaft enters the bypass gallery obstructing bypass coolant flow by 50%. This design allows the coolant to reach operating temperature quickly when cold, while adding extra cooling during normal temperature operation.

REMOVAL

The water pump on 3.7L/4.7L engines is bolted directly to the engine timing chain case cover.

(1) Disconnect the negative battery cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove fan/viscous fan drive assembly from water pump (Fig. 46) (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL). Do not attempt to remove fan/viscous fan drive assembly from vehicle at this time.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES.

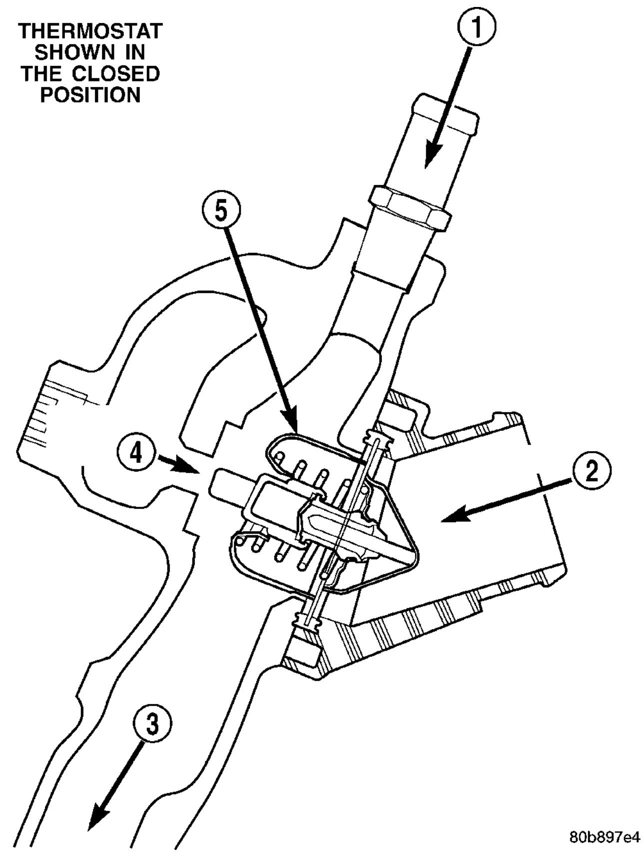


Fig. 45 Water/Coolant Bypass Flow and Thermostat

1 - FROM HEATER AND DEGAS CONTAINER
2 - FROM RADIATOR
3 - TO WATER PUMP
4 - ENGINE BYPASS
5 - THERMOSTAT

WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

CAUTION: A number or letter is stamped into the tongue of constant tension clamps. If replacement is necessary, use only an original equipment clamp with matching number or letter and width.

(4) If the water pump is being replaced, do not unbolt the fan blade assembly from the thermal viscous fan drive.

(5) Remove the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(6) Remove accessory drive belt (Fig. 47) (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) Remove the lower radiator hose clamp and remove the lower hose at the water pump.

(8) Remove the water pump mounting bolts.

WATER PUMP - 3.7L/4.7L (Continued)

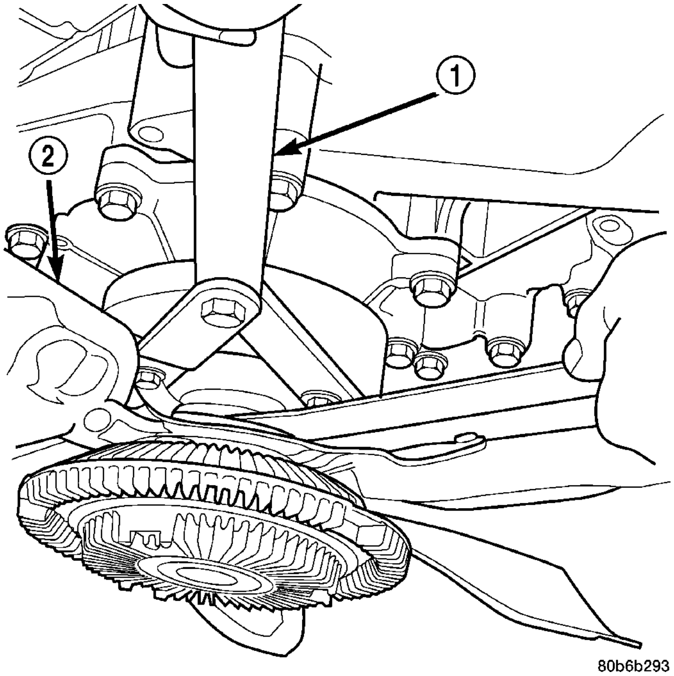


Fig. 46 Viscous Fan and Fan Drive 4.7L Engine

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

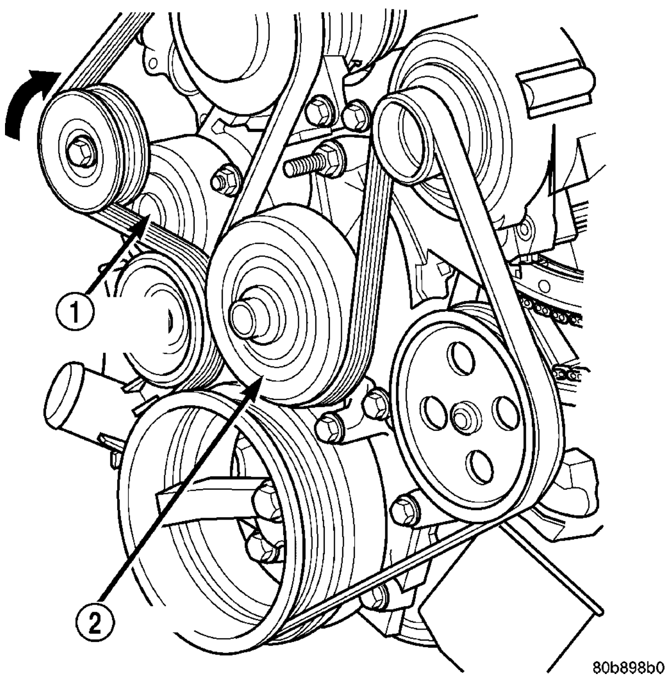


Fig. 47 Automatic Belt Tensioner—4.7L

1 - AUTOMATIC TENSIONER
2 - WATER PUMP PULLEY

CAUTION: Do not pry water pump at timing chain case/cover. The machined surfaces may be damaged resulting in leaks.

(9) Remove the water pump and gasket. Discard gasket.

CLEANING

Clean the gasket mating surface. Use caution not to damage the gasket sealing surface.

INSPECTION

Inspect the water pump assembly for cracks in the housing, water leaks from shaft seal, worn bearing or impeller rubbing either the pump body or timing chain case/cover.

INSTALLATION

The water pump on 3.7L/4.7L engine is bolted directly to the engine timing chain case cover.

(1) Clean the gasket mating surfaces.

(2) Using a new gasket, position water pump and install the mounting bolts. (Fig. 48). Tighten the water pump mounting bolts to 58 N·m (43 ft. lbs.).

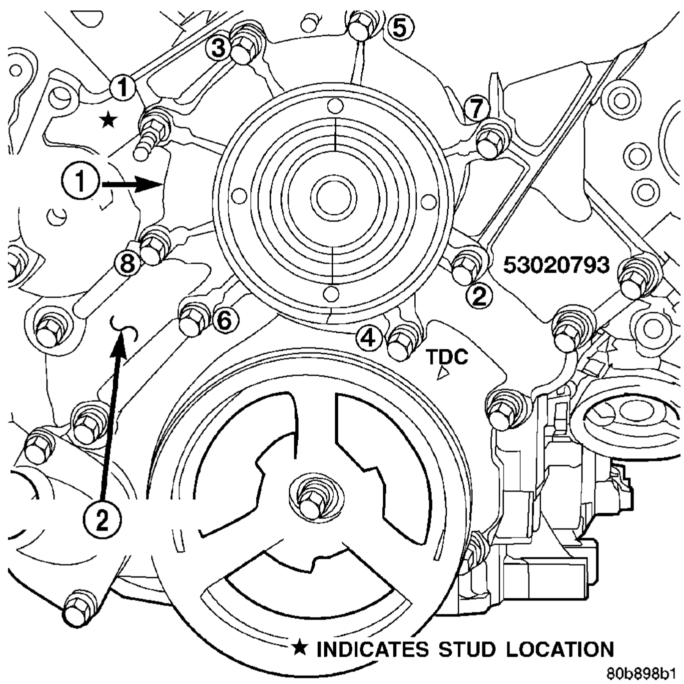


Fig. 48 Water Pump Installation—3.7L/4.7L Typical

1 - WATER PUMP
2 - TIMING CHAIN COVER

(3) Spin the water pump to be sure that the pump impeller does not rub against the timing chain case/cover.

(4) Connect the radiator lower hose to the water pump.

(5) Relax the tension from the belt tensioner (Fig. 47). Install the drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

WATER PUMP - 3.7L/4.7L (Continued)

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction. Refer to (Fig. 49) for the correct belt routing. Or, refer to the Belt Routing Label located in the engine compartment. The correct belt with correct length must be used.

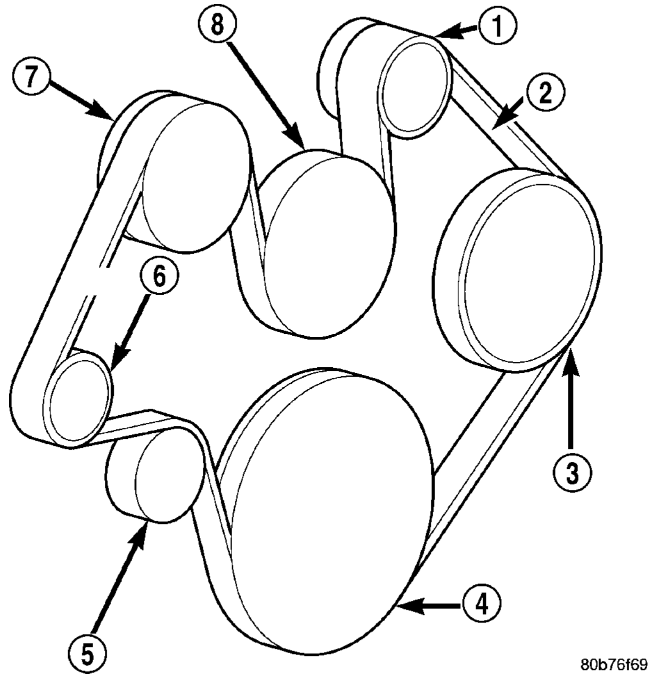


Fig. 49 Belt Routing 3.7L

1 - GENERATOR PULLEY
2 - ACCESSORY DRIVE BELT
3 - POWER STEERING PUMP PULLEY
4 - CRANKSHAFT PULLEY
5 - IDLER PULLEY
6 - TENSIONER
7 - A/C COMPRESSOR PULLEY
8 - WATER PUMP PULLEY

(6) Install the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(7) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Connect the negative battery cable.

(9) Start and warm the engine. Check for leaks.

WATER PUMP - 5.9L DIESEL

DESCRIPTION

The water pump is mounted to the front of the engine block between the automatic belt tensioner and the fan drive pulley.

The water pump impeller is pressed onto the rear of a shaft that rotates in a bearing pressed into the water pump body. The body has a small hole for ventilation. The water pump seals are lubricated by antifreeze in the coolant mixture. Additional lubrication is not necessary.

OPERATION

The diesel engine water pump draws coolant from radiator outlet and circulates it through engine, heater core and back to radiator inlet. The crankshaft pulley drives the water pump with a serpentine drive belt.

DIAGNOSIS AND TESTING—WATER PUMP

A quick test to determine if pump is working is to check if heater warms properly. A defective water pump will not be able to circulate heated coolant through the long heater hose to the heater core.

REMOVAL

(1) Disconnect battery negative cables.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove water pump mounting bolts (Fig. 50).

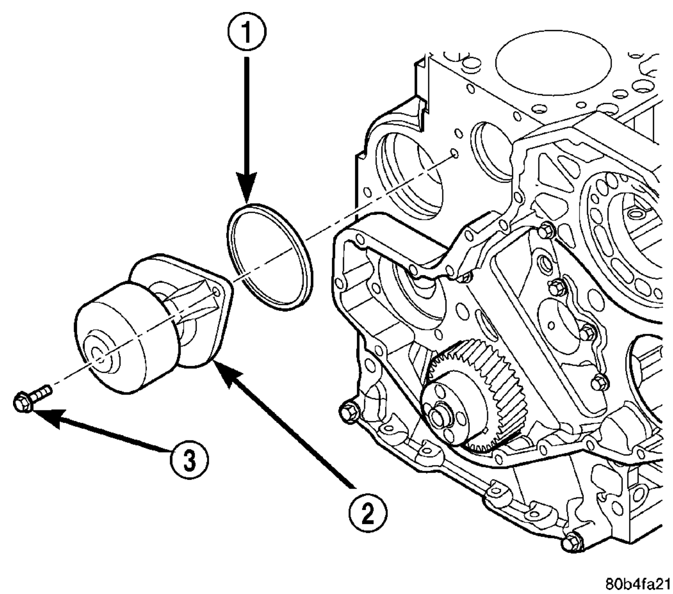


Fig. 50 Water Pump Removal/Installation

1 - O-RING SEAL (SQUARE)
2 - WATER PUMP
3 - BOLT (2)

(5) Clean water pump sealing surface on cylinder block.

CLEANING

Clean gasket mating surfaces as necessary.

WATER PUMP - 5.9L DIESEL (Continued)

INSPECTION

Visually inspect the water pump and replace if it has any of the following conditions:

- The body is cracked or damaged
- Water leaks from the shaft seal. This is evident by traces of coolant below the vent hole
- Loose or rough turning bearing.
- Impeller rubbing the pump body

INSTALLATION

(1) Install new O-ring seal in groove on water pump (Fig. 51).

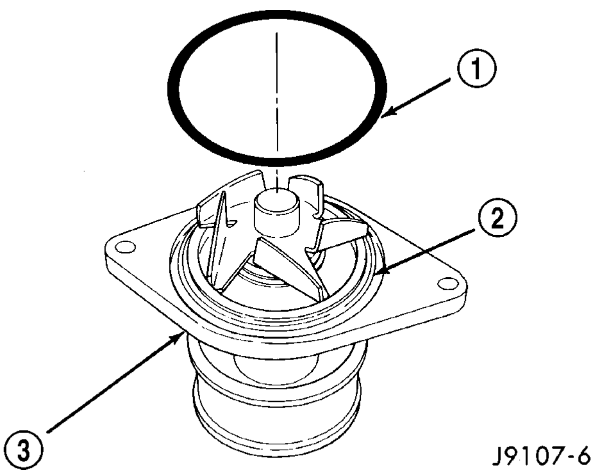


Fig. 51 Pump O-ring Seal

1 - O-RING SEAL
2 - GROOVE
3 - WATER PUMP

(2) Install water pump. Tighten mounting bolts to 24 N·m (18 ft. lbs.) torque.

(3) Install accessory drive belt. Refer to procedure in this group.

(4) Install the bolt retaining the wiring harness near top of water pump.

(5) Fill cooling system. Refer to Refilling Cooling System in this section.

(6) Connect both battery cables.

(7) Start and warm the engine. Check for leaks.

WATER PUMP INLET TUBE - 5.9L

REMOVAL

REMOVAL - WATER PUMP BYPASS HOSE WITH AIR CONDITIONING

If equipped with A/C, the generator and A/C compressor along with their common mounting bracket (Fig. 52) must be partially removed. Removing the generator or A/C compressor from their mounting bracket is not necessary. Also, discharging the A/C system is not necessary. **Do not** remove any refrigerant lines from A/C compressor.

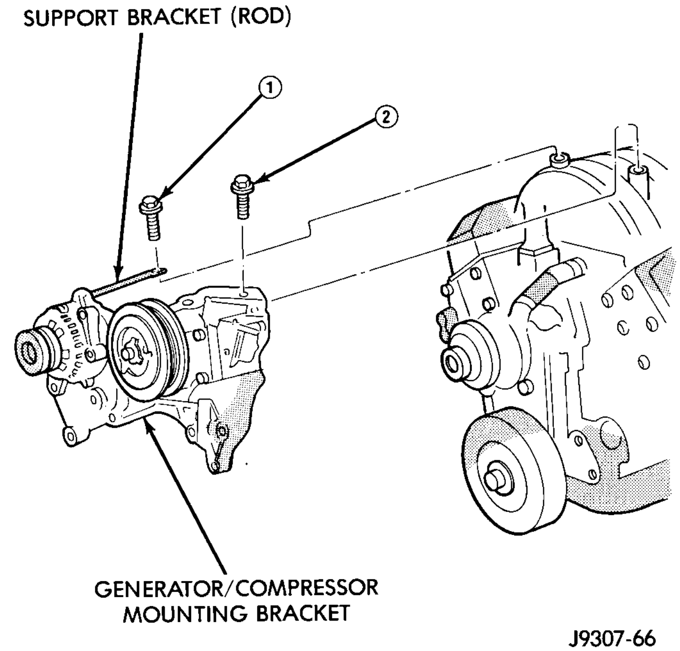


Fig. 52 Generator - A/C Compressor Mounting Bracket - Typical

WARNING: THE A/C SYSTEM IS UNDER PRESSURE EVEN WITH THE ENGINE OFF. REFER TO REFRIGERANT WARNINGS IN SECTION 24 - HEATING AND AIR CONDITIONING.

(1) Disconnect the negative battery cable.

(2) Partially drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(3) Remove the upper radiator hose clamp at the radiator. A special clamp tool must be used to remove the constant tension clamps. Removethe hose at the radiator.

(4) Unplug the wiring harness from the A/C compressor.

(5) Remove the air cleaner assembly.

(6) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) The drive belt idler pulley must be removed to gain access to one of the A/C compressor/generator bracket mounting bolts. Remove the idler pulley bolt and remove idler pulley (Fig. 53).

(8) Remove the engine oil dipstick tube mounting bolt at the side of the A/C-generator mounting bracket.

(9) Disconnect the throttle body control cables.

WATER PUMP INLET TUBE - 5.9L (Continued)

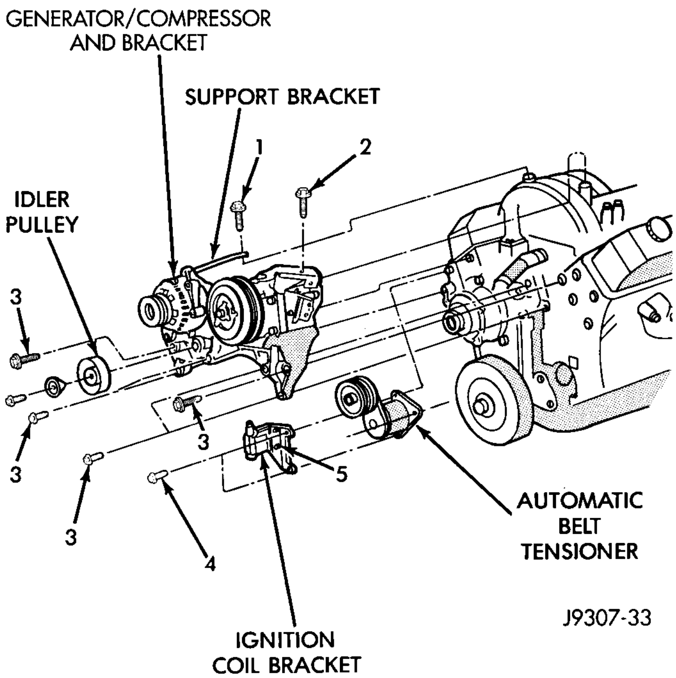


Fig. 53 Idler Pulley - 5.9L V-8 Gas Engine

(10) Remove the heater hose coolant return tube mounting bolt (Fig. 54) (Fig. 55) and remove the tube from the engine. Discard the old tube O-ring.

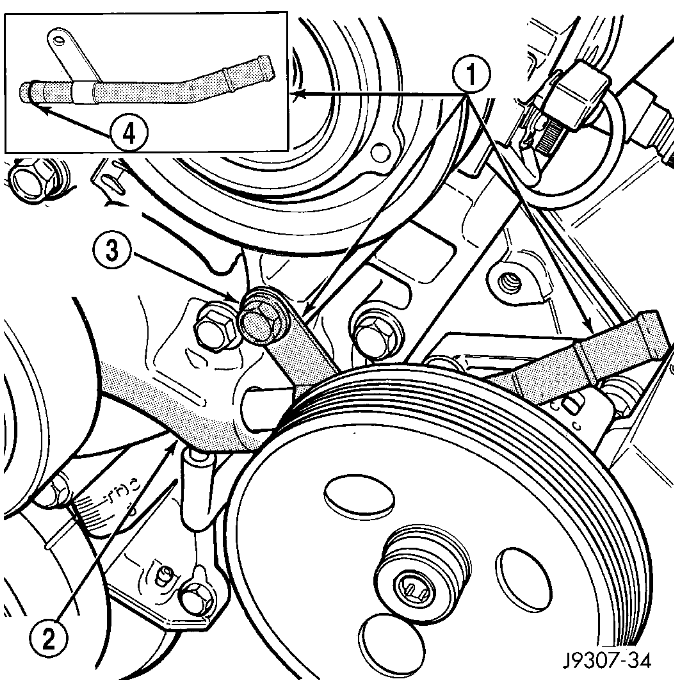


Fig. 54 Coolant Return

1 - COOLANT RETURN TUBE
2 - WATER PUMP
3 - TUBE MOUNTING BOLT
4 - O-RING

(11) Remove the bracket-to-intake manifold bolts (number 1 and 2 (Fig. 52).

(12) Remove the remaining bracket-to-engine bolts (Fig. 55).

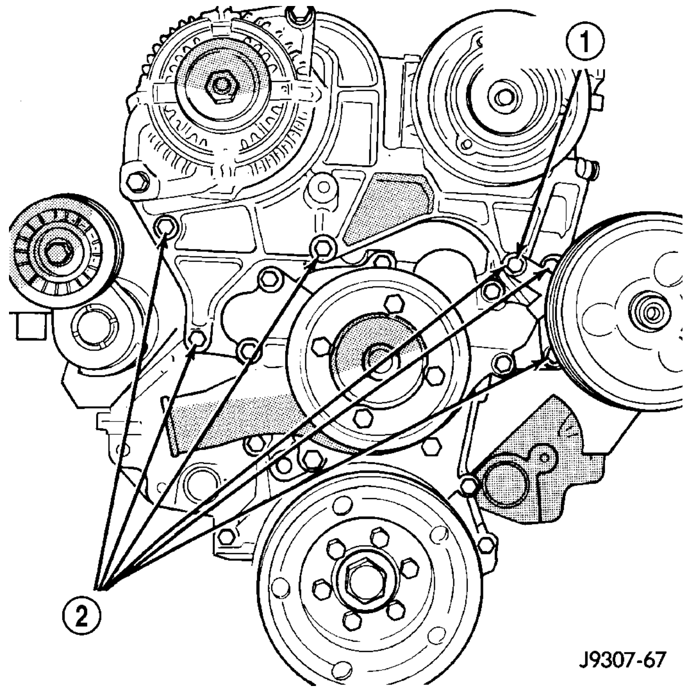


Fig. 55 Bracket Bolts - 5.9L V-8 Gas

1 - COOLANT TUBE MOUNTING BOLT
2 - BRACKET MOUNTING BOLTS

(13) Lift and position the generator and A/C compressor (along with their common mounting bracket) to gain access to the bypass hose. A block of wood may be used to hold the assembly in position.

(14) Loosen and position both hose clamps to the center of the bypass hose. A special clamp tool must be used to remove the constant tension clamps. Remove the hose from the vehicle.

REMOVAL - WATER PUMP BYPASS HOSE WITHOUT AIR CONDITIONING

A water pump bypass hose (Fig. 56) is used between the intake manifold and water pump on all gas powered engines. To test for leaks, (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).

(1) Partially drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE). Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

WARNING: CONSTANT TENSION HOSE CLAMPS ARE USED ON MOST COOLING SYSTEM HOSES. WHEN REMOVING OR INSTALLING, USE ONLY TOOLS DESIGNED FOR SERVICING THIS TYPE OF CLAMP. ALWAYS WEAR SAFETY GLASSES WHEN SERVICING CONSTANT TENSION CLAMPS.

WATER PUMP INLET TUBE - 5.9L (Continued)

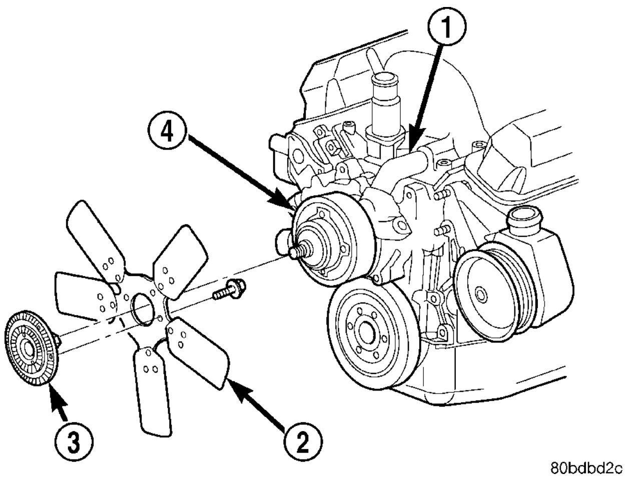


Fig. 56 Water Pump Bypass Hose - Typical

1 - WATER PUMP BYPASS HOSE
2 - FAN BLADE ASSEMBLY
3 - VISCOUS FAN DRIVE
4 - WATER PUMP AND PULLEY

CAUTION: A number or letter is stamped into the tongue of the constant tension clamps. If replacement is necessary, use only an original equipment clamp with a matching number or letter and width.

(2) Loosen both of the bypass hose clamps and position them to the center of the hose.
(3) Removethe hose from the vehicle.

INSTALLATION

INSTALLATION - WATER PUMP BYPASS HOSE WITH AIR CONDITIONING

(1) Position the bypass hose clamps to the center of the bypass hose.
(2) Install the bypass hose to the engine.
(3) Secure both of the hose clamps.
(4) Install the generator-A/C mounting bracket assembly to the engine. Tighten bolt number 1 (Fig. 53) to 41 N·m (30 ft. lbs.). Tighten bolt number 2 (Fig. 53) to 28 N·m (20 ft. lbs.). Tighten bracket mounting bolts (Fig. 53) (Fig. 53) to 40 N·m (30 ft. lbs.).
(5) Install a new O-ring to the heater hose coolant return tube. Coat the new O-ring with antifreeze before installation.
(6) Install the coolant return tube and its mounting bolt to the engine.
(7) Connect the throttle body control cables.
(8) Install the oil dipstick mounting bolt.
(9) Install the idler pulley. Tighten the bolt to 41 N·m (30 ft. lbs.) (Fig. 57).
(10) Install the drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

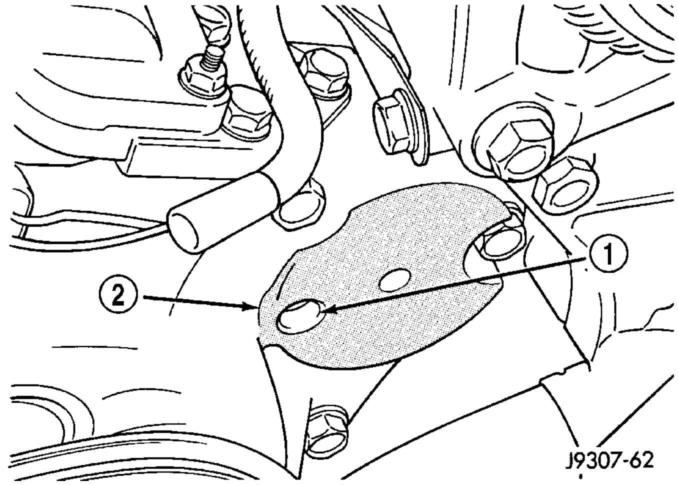


Fig. 57 Tensioner Mounting

1 - DOWEL PIN HOLE
2 - TENSIONER MOUNTING BRACKET

CAUTION: When installing the serpentine accessory drive belt, the belt must be routed correctly. If not, the engine may overheat due to the water pump rotating in the wrong direction (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). The correct belt with the correct length must be used.

(11) Install the air cleaner assembly.
(12) Install the upper radiator hose to the radiator.
(13) Connect the throttle cable to the clip at the radiator fan shroud.
(14) Connect the wiring harness to the A/C compressor.
(15) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(16) Start and warm the engine. Check for leaks.

INSTALLATION - WATER PUMP BYPASS HOSE WITHOUT AIR CONDITIONING

(1) Position the bypass hose clamps to the center of the bypass hose.
(2) Install the bypass hose tothe engine.
(3) Secure both of the hose clamps.
(4) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(5) Start and warm the engine. Check for leaks.

WATER PUMP - 5.7L

REMOVAL

(1) Disconnect negative battery cable.
(2) Drain coolant.
(3) Remove serpentine belt.
(4) Remove fan clutch assembly.
(5) Remove coolant fill bottle.

WATER PUMP - 5.7L (Continued)

(6) Disconnect washer bottle wiring and hose.
(7) Remove fan shroud assembly.
(8) Remove A/C compressor and genterator brace.
(9) Remove idler pulleys.
(10) Remove belt tensioner assembly.
(11) Remove upper and lower radiator hoses.
(12) Remove heater hoses.
(13) Remove water pump mounting bolts and remove pump.

INSTALLATION

(1) Install water pump and mounting bolts. Tighten moubting bolts to 24 N·m (18 ft. lbs.).
(2) Install heater hoses.
(3) Install upper and lower radiator hoses.
(4) Install belt tensioner assembly.
(5) Install idler pulleys.
(6) Install A/C compressor and alternator brace. Tighten bolt and nuts to 28 N·m (21 ft. lbs.).
(7) Install fan shroud assembly.
(8) Connect washer bottle wiring and hose.
(9) Install coolant fill bottle.
(10) Install fan clutch assembly.
(11) Install serpentine belt.
(12) Connect negative battery cable.
(13) Fill coolant.
(14) Pressure test coolant system

TRANSMISSION

TABLE OF CONTENTS

TRANS COOLER

DESCRIPTION

DESCRIPTION

An air-to-oil transmission oil cooler is standard on all engine packages. The transmission oil cooler is mounted to the front of the radiator above the power steering cooler (Fig. 1).

DESCRIPTION

An air-to-oil transmission oil cooler is standard on all engine packages. The transmission oil cooler is mounted to the front of the radiator above the power steering cooler (Fig. 2).

OPERATION

Transmission oil is routed through the cooler where heat is removed from the transmission oil before returning to the transmission. Vehicles equipped with the 5.9L engine have an internal thermostat that controls fluid flow through the cooler-.When the transmission fluid is cold (less than operating temperature) the fluid is routed through the cooler bypass. when the transmission fluid reaches operating temperatures and above, the thermostat closes off the bypass allowing fluid flow through the cooler. The thermostat is serviceable.

NOTE: Vehicles with the 3.7L/4.7L engines are not equipped with the oil cooler thermostat.

REMOVAL

(1) Disconnect the battery negative cable.
(2) Place a drain pan under the oil cooler lines.

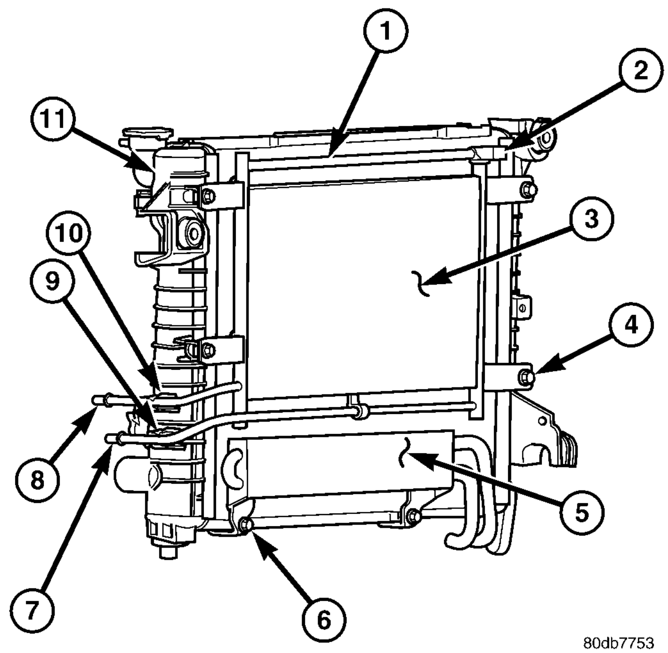


Fig. 1 Cooling Module — 5.9L Gas

1 - TRANS OIL COOLER BYPASS (5.9L only)
2 - OIL COOLER THERMOSTATIC BYPASS VALVE (5.9L only)
3 -TRANS OIL COOLER
4 - OIL COOLER MOUNTING BOLT (4)
5 - POWER STEERING COOLER
6 - POWER STEERING COOLER MOUNTING BOLT(2)
7 - TRANS OIL COOLER OUTLET
8 - TRANS OIL COOLER INLET
9 - COOLER LINE CLIP
10 - COOLER LINE CLIP
11 - RADIATOR

(3) Disconnect the transmission oil cooler line quick-connect fitting at the cooler outlet using the quick connect release tool 6935. Plug the cooler lines to prevent oil leakage.
(4) Unsnap the transmission cooler tubes from the radiator tank clips.

TRANS COOLER (Continued)

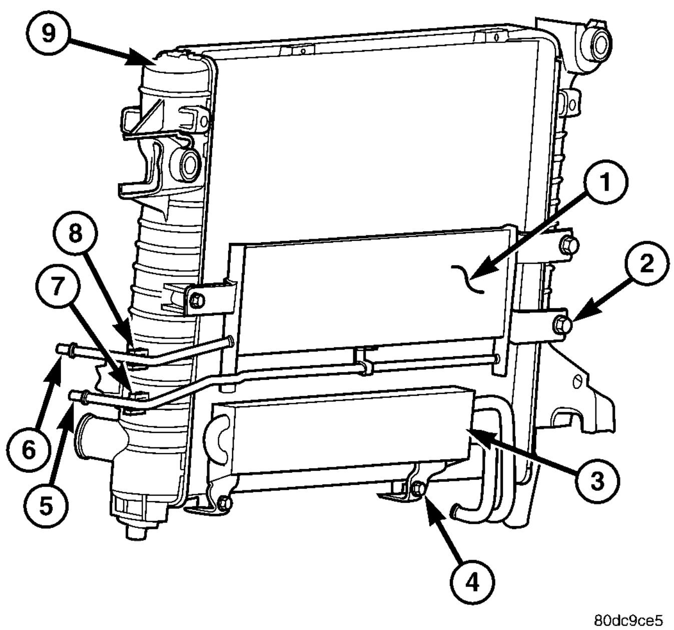


Fig. 2 Cooling Module - 3.7L/4.7L/5.7L

1 - TRANS OIL COOLER
2 - TRANS OIL COOLER MOUNTING BOLT (3)
3 - POWER STEERING OIL COOLER
4 - POWER STEERING OIL COOLER MOUNTING BOLT
5 - TRANS OIL COOLER OUTLET
6 - TRANS OIL COOLER INLET
7 - COOLER LINE CLIP
8 - COOLER LINE CLIP
9 - RADIATOR

(5) Remove the bolts attaching the transmission cooler to the radiator.

(6) Remove oil cooler from the vehicle. Take care not to damage the radiator core or transmission cooler tubes.

DISASSEMBLY - 5.9L ONLY

NOTE: The transmission oil cooler uses an internal thermostat to control transmission oil flow through the cooler. This thermostat is servicable.

(1) Remove the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).

(2) Remove the snap ring retaining the thermostat end plug (Fig. 3).

(3) Remove the end plug, thermostat and spring from transmission oil cooler (Fig. 3).

ASSEMBLY - 5.9L ONLY

(1) Throughly clean the thermostat bore on the transmission oil cooler.

(2) Install the new spring, thermostat, end plug and snap ring.

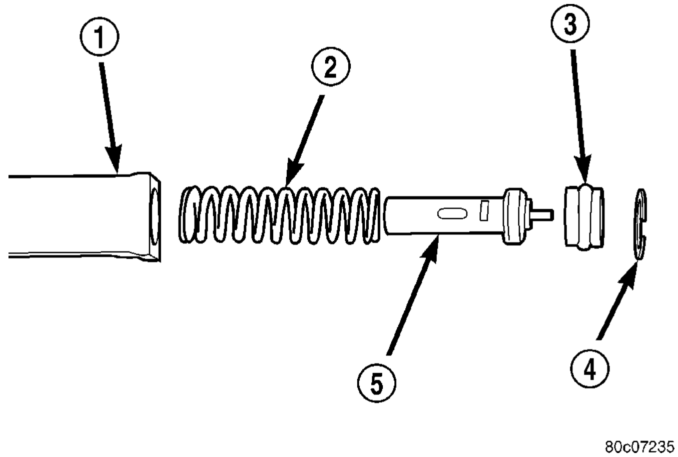


Fig. 3 Transmission Oil Cooler Thermostat Removal/Installation

1 - THERMOSTAT HOUSING
2 - SPRING
3 - END PLUG
4 - SNAP RING
5 - THERMOSTAT

(3) Install the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).

INSTALLATION

(1) Position the transmission cooler tubes to the front of the radiator.

(2) Snap the transmission cooler tubes into the clips on the side of the radiator tank.

(3) Install the transmission cooler attaching bolts. Tighten the bolts to 16 N·m (140 in. lbs.).

(4) inspect the quick connect fittings for debris and install the quick connect fitting on the cooler tube until an audible “click” is heard. Pull apart the connection to verify proper installation and install the secondary latches.

(5) Connect the battery negative cable.

(6) Start the engine and check all fittings for leaks.

(7) Check the fluid level in the automatic transmission. Refer to the appropriate transmission section(Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/545RFE/FLUID - STANDARD PROCEDURE) or(Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/FLUID - STANDARD PROCEDURE).

TRANS COOLER - 5.9L DIESEL

DESCRIPTION

All diesel models equipped with an automatic transmission are equipped with both a main water-to-oil cooler and a separate air-to-oil cooler. Both cool-

TRANS COOLER - 5.9L DIESEL (Continued)

ers are supplied as standard equipment on diesel engine powered models when equipped with an automatic transmission.

The main water-to-oil transmission oil cooler is mounted to a bracket on the intake side of the engine (Fig. 4).

The air-to-oil cooler is located in front of and to the left side of the radiator (Fig. 5).

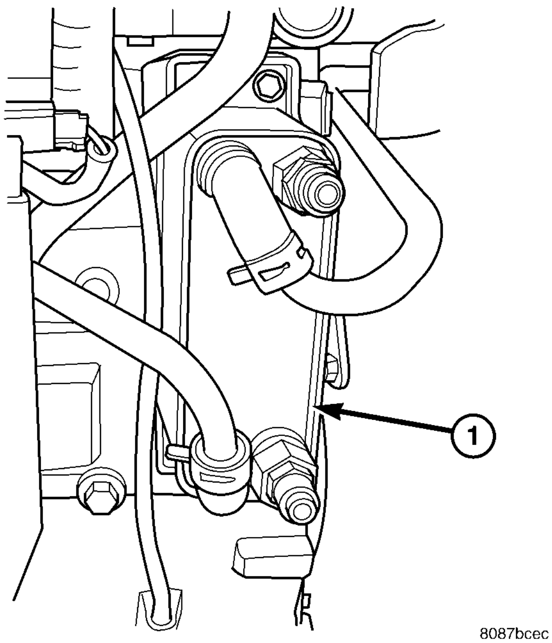


Fig. 4 Transmission Water-To-Oil Cooler—Diesel Engine—Typical

1 - TRANSMISSION WATER-TO-OIL COOLER

OPERATION

The transmission oil is routed through the main cooler first, then the auxiliary cooler where additional heat is removed from the transmission oil before returning to the transmission. The cooler has an internal thermostat that controls fluid flow through the cooler. When the transmission fluid is cold (less then operating temperature), the fluid is routed through the cooler bypass. When the transmission fluid reaches operating temperatures and above, the thermostat closes off the bypass allowing fluid flow through the cooler. The thermostat is servicable.

REMOVAL

REMOVAL—AIR TO OIL COOLER

(1) Remove Charge Air Cooler (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/ CHARGE AIR COOLER AND PLUMBING - REMOVAL).

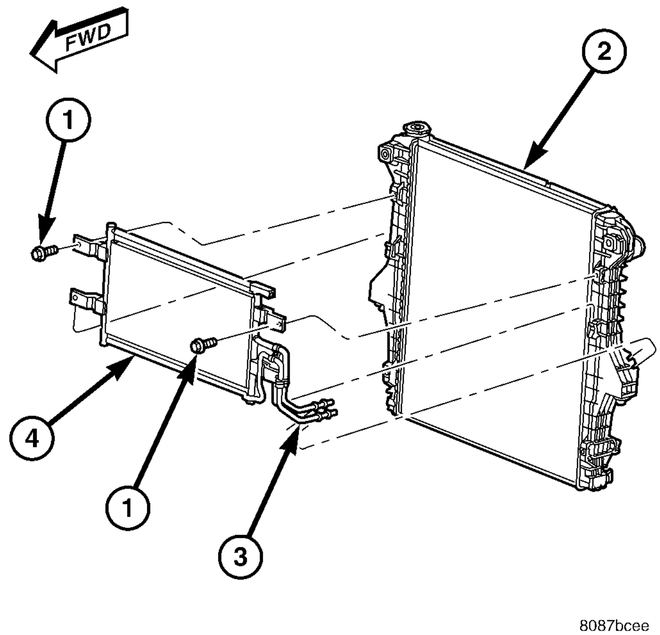


Fig. 5 Auxiliary Transmission Oil Cooler—Diesel Engine

1 - MOUNTING BOLTS
2 - RADIATOR
3 - QUICK-CONNECT FITTINGS
4 - TRANSMISSION OIL COOLER

(2) Place a drain pan under the oil cooler.

(3) Raise the vehicle.

(4) Disconnect the oil cooler quick-connect fittings from the transmission lines.

(5) Remove the charge air cooler-to-oil cooler bolt (Fig. 6).

(6) Remove two mounting nuts.

(7) Remove the oil cooler and line assembly towards the front of vehicle. Cooler must be rotated and tilted into position while removing.

REMOVAL—WATER TO OIL COOLER

CAUTION: If a leak should occur in the water-to-oil cooler mounted to the side of the engine block, engine coolant may become mixed with transmission fluid. Transmission fluid may also enter engine cooling system. Both cooling system and transmission should be drained and inspected in case of oil cooler leakage.

(1) Disconnect both battery negative cables.

(2) Remove starter (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - REMOVAL).

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Disconnect coolant lines from cooler.

TRANS COOLER - 5.9L DIESEL (Continued)

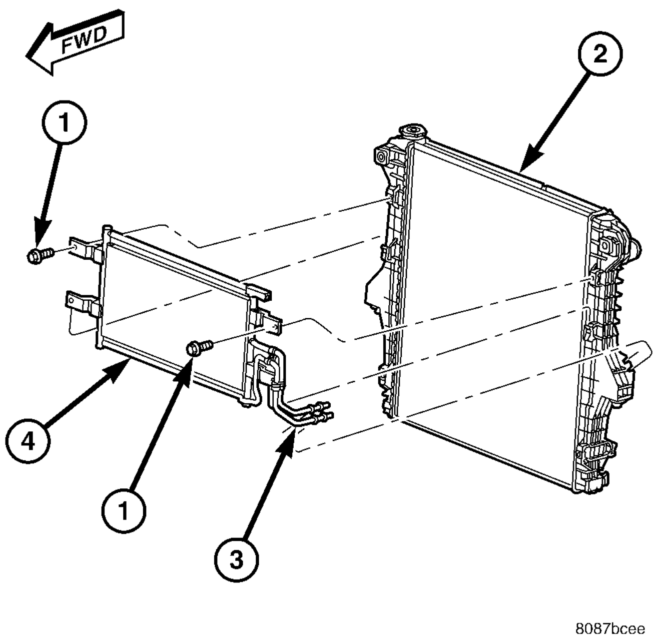


Fig. 6 Auxiliary Transmission Oil Cooler—Diesel Engine

1 - MOUNTING BOLTS
2 - RADIATOR
3 - QUICK-CONNECT FITTINGS
4 - TRANSMISSION OIL COOLER

(5) Disconnect transmission oil lines from cooler. Plug cooler lines to prevent oil leakage.

(6) Remove cooler bracket to transmission bolt.

(7) Remove two cooler bracket to cooler bolts.

(8) Remove cooler assembly from vehicle. (Fig. 7)

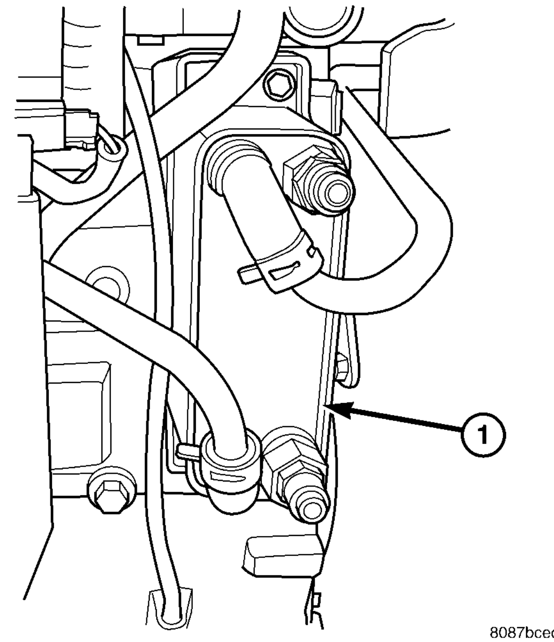


Fig. 7 Transmission Water-To- Oil Cooler—Diesel

1 - TRANSMISSION WATER-TO-OIL COOLER

(6) Check the fluid level in the automatic transmission (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 47RE/FLUID - STANDARD PROCEDURE).

INSTALLATION

INSTALLATION—AIR TO OIL COOLER

(1) Carefully position the oil cooler assembly to the vehicle.

(2) Install two nuts and one bolt. Tighten to 11 N·m (95 in. lbs.) torque.

(3) Connect the quick-connect fittings to the transmission cooler lines.

(4) Install Charge Air Cooler (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/CHARGE AIR COOLER AND PLUMBING - INSTALLATION).

(5) Start the engine and check all fittings for leaks.

INSTALLATION

(1) Position oil cooler on cylinder block.

(2) Install two mounting bolts to cooler at the cylinder block. Torque bolts to 77N·m (57 ft. lbs.)

(3) Install cooler bracket to transmission adapter bolt. Tighten to 24N·M (18 ft. lbs.).

(4) Connect transmission oil lines to cooler.

(5) Connect coolant hoses to cooler.

(6) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(7) Connect battery negative cables.

(8) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(9) Check transmission oil level and fill as necessary (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 47RE/FLUID - STANDARD PROCEDURE).

AUDIO

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AUDIO

DESCRIPTION

An audio system is standard factory-installed equipment on this model. Several combinations of radio receivers and speaker systems are offered. The audio system uses an ignition switched source of battery current so that the system will only operate when the ignition switch is in the RUN or ACCESSORY positions.

The audio system includes the following components:

- Antenna
- Power amplifier (with premium speaker system only)
- Radio noise suppression components
- Radio receiver
- Remote radio switches (if equipped)
- Speakers

Certain functions and features of the audio system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communication Interface (PCI) bus network. The data bus network allows the sharing of sensor information. For diagnosis of these electronic modules or of the data bus network, the use of a DRB III® scan tool and the proper Diagnostic Procedures manual are recommended.

Refer to the appropriate wiring information for complete standard and premium audio system circuit diagrams. The wiring information includes proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices, and grounds.

OPERATION

The audio system components are designed to provide audio entertainment and information through the reception, tuning and amplification of locally broadcast radio signals in both the Amplitude Modulating (AM) and Frequency Modulating (FM) commercial frequency ranges.

The audio system components operate on battery current received through a fuse in the Integrated Power Module (IPM) on a fused ignition switch output (run-acc) circuit so that the system will only operate when the ignition switch is in the Run or Accessory positions.

On vehicles that are equipped with the optional remote radio switches, the Instrument Cluster receives hard wired resistor multiplexed inputs from the remote radio switches. The programming in the

AUDIO (Continued)

Instrument Cluster allows it to process those inputs and send the proper messages to the radio receiver over the Programmable Communication Interface (PCI) bus network to control the radio volume up or down, station seek up or down, preset station advance, and mode advance functions.

Refer to the owner's manual for more information on the features, use and operation of each of the available audio systems.

DIAGNOSIS AND TESTING - AUDIO

Any diagnosis of the Audio system should begin with the use of the DRB III® diagnostic tool. For information on the use of the DRB III®, refer to the appropriate Diagnostic Service Manual.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

AUDIO SYSTEM DIAGNOSIS TABLE

CONDITION	POSSIBLE CAUSES	CORRECTION
NO AUDIO	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw (IOD) fuse in the Integrated Power Module (IPM). Replace fuses, if required.
	2. Radio/amplifier (if equipped) connector faulty.	2. Check for loose or corroded radio/amplifier connector. Repair, if required.
	3. Wiring faulty.	3. Check for shorted or open wires. Repair wiring, if required.
	4. Radio/amplifier (if equipped) ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio/amplifier (if equipped) faulty.	5. Refer to appropriate Diagnostic Service Manual.
	6. Speakers faulty.	6. Replace speaker as necessary.
NO RADIO DISPLAY	1. Fuse faulty.	1. Check radio fuse and Ignition-Off Draw (IOD) fuse in Integrated Power Module (IPM). Replace fuses, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Radio ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Refer to appropriate Diagnostic Service Manual.

AUDIO (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
CLOCK WILL NOT KEEP SET TIME	1. Fuse faulty.	1. Check Ignition-Off Draw (IOD) fuse in the Integrated Power Module (IPM). Replace fuse, if required.
	2. Radio connector faulty.	2. Check for loose or corroded radio connector. Repair, if required.
	3. Wiring faulty.	3. Check for battery voltage at radio connector. Repair wiring, if required.
	4. Radio ground faulty.	4. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	5. Radio faulty.	5. Refer to appropriate Diagnostic Service Manual.
POOR RADIO RECEPTION	1. Antenna faulty.	1. (Refer to 8 - ELECTRICAL/AUDIO/ANTENNA BODY & CABLE - DIAGNOSIS AND TESTING).
	2. Radio ground faulty.	2. Check for continuity between radio chassis and a known good ground. There should be continuity. Repair ground, if required.
	3. Radio noise suppression faulty.	3. Repair or replace ground strap as necessary.
	4. Radio faulty.	4. Refer to appropriate Diagnostic Service Manual.
NO/POOR TAPE OPERATION	1. Faulty tape.	1. Insert known good tape and test operation.
	2. Foreign objects behind tape door.	2. Remove foreign objects and test operation.
	3. Dirty cassette tape head.	3. Clean head with Mopar Cassette Head Cleaner.
	4. Faulty tape deck.	4. Exchange or replace radio, if required.
NO COMPACT DISC OPERATION	1. Faulty CD.	1. Insert known good CD and test operation.
	2. Foreign material on CD.	2. Clean CD and test operation.
	3. Condensation on CD or optics.	3. Allow temperature of vehicle interior to stabilize and test operation.
	4. Faulty CD player.	4. Refer to appropriate Diagnostic Service Manual.

AMPLIFIER

DESCRIPTION

The optional Infinity premium speaker system includes a separate Infinity audio power amplifier. The amplifier is a six channel unit and is rated at 240 total output watts. The amplifier is located behind the glove box.

OPERATION

The power amplifier electronically increases the frequency response of the normal audio signal output from the radio amplifier in order to improve the acoustic performance of the speakers. On vehicles equipped with an amplifier, the amplifier section of the radio becomes a pre-amplifier.

The amplifier receives audio signal inputs for speaker channels from the radio, then sends amplified audio outputs through six separate channels with dedicated feed and return circuits to the individual speakers.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove glove box (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

AMPLIFIER (Continued)

(3) Remove instrument panel center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(4) Remove instrument panel lower right center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER RIGHT CENTER BEZEL - REMOVAL).

(5) Disconnect electrical harness connector from amplifier (Fig. 1).

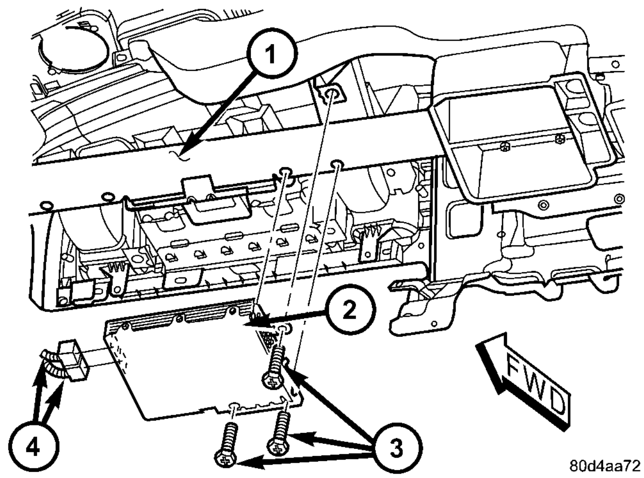

Fig. 1 AMPLIFIER MOUNTING

1 - INSTRUMENT PANEL
2 - AMPLIFIER
3 - MOUNTING BOLTS
4 - ELECTRICAL CONNECTOR

(6) Remove mounting bolts.

INSTALLATION

(1) Connect electrical harness connector and install amplifier.

(2) Install mounting bolts. Tighten to 10 N·m (90 in. lbs.).

(3) Install instrument panel lower right center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER RIGHT CENTER BEZEL - INSTALLATION).

(4) Install instrument panel center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(5) Install glove box (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(6) Connect battery negative cable.

ANTENNA BODY & CABLE

DESCRIPTION

The antenna body and cable is secured below the fender panel by the antenna cap nut through a mounting hole in the right front fender. The primary coaxial antenna cable is then routed beneath the fender sheet metal and through a entry hole in the right cowl side panel into the interior of the vehicle. Inside the vehicle, the primary coaxial cable is connected to a secondary instrument panel antenna coaxial cable with an in-line connector that is located behind the right kick panel. The secondary coaxial cable is then routed behind the instrument panel to the back of the radio.

OPERATION

The antenna body and cable connects the antenna mast to the radio. The radio antenna is an electromagnetic circuit component used to capture radio frequency signals that are broadcast by local commercial radio stations in both the Amplitude Modulating (AM) and Frequency Modulating (FM) frequency ranges. These electromagnetic radio frequency signals induce small electrical modulations into the antenna as they move past the mast. The antenna body transfers the weak electromagnetic radio waves induced into the rigid antenna mast into the center conductor of the flexible primary antenna coaxial cable. The braided outer shield of the antenna coaxial cable is grounded through both the antenna body and the radio chassis, effectively shielding the radio waves as they are conducted to the radio. The radio then tunes and amplifies the weak radio signals into stronger electrical signals in order to operate the audio system speakers.

DIAGNOSIS AND TESTING - ANTENNA BODY AND CABLE

The following four tests are used to diagnose the antenna with an ohmmeter:

- **Test 1** - Mast to ground test
- **Test 2** - Tip-of-mast to tip-of-conductor test
- **Test 3** - Body ground to battery ground test
- **Test 4** - Body ground to antenna coaxial cable shield test.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The ohmmeter test lead connections for each test are shown in the illustration (Fig. 2).

ANTENNA BODY & CABLE (Continued)

NOTE: This model has a two-piece antenna coaxial cable. Tests 2 and 4 must be conducted in two steps to isolate an antenna cable problem. First, test the primary antenna cable (integral to the antenna body and cable) from the coaxial cable connector behind the right side kick panel to the antenna body. Then, test the secondary antenna cable (instrument panel antenna cable) from the coaxial cable connector behind the right side kick panel to the coaxial cable connector at the radio.

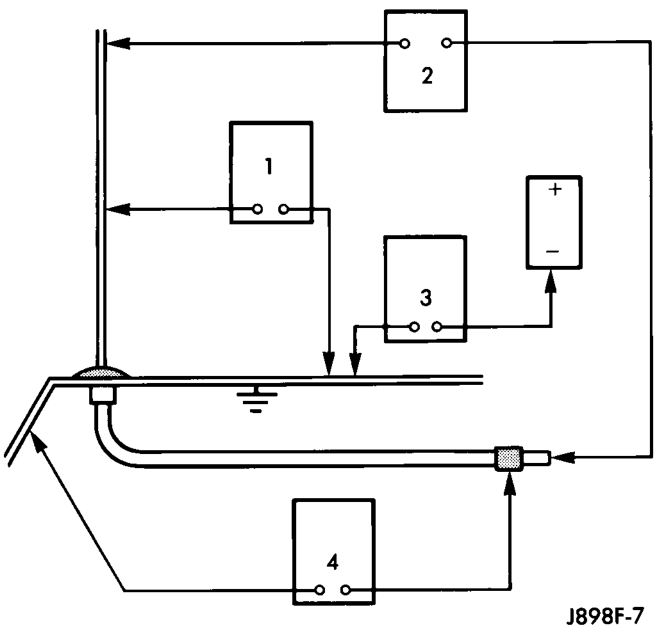

Fig. 2 Antenna Tests - Typical

TEST 1

Test 1 determines if the antenna mast is insulated from ground. Proceed as follows:

(1) Disconnect and isolate the antenna coaxial cable connector behind the right side kick panel.

(2) Touch one ohmmeter test lead to the tip of the antenna mast. Touch the other test lead to known ground. Check the ohmmeter reading for continuity.

(3) There should be no continuity. If OK, go to Test 2. If not OK, replace the faulty antenna body and cable.

TEST 2

Test 2 checks the antenna conductor components for an open circuit. This test should be performed first on the entire antenna circuit, from the antenna mast to the center conductor of the coaxial cable connector at the radio. If an open circuit is detected, each of the three antenna conductor components (antenna mast, antenna body and cable, instrument panel antenna cable) should be isolated and tested individually to locate the exact component that is the source of the open circuit. To begin this test, proceed as follows:

(1) Disconnect the instrument panel antenna cable coaxial connector from the back of the radio.

(2) Touch one ohmmeter test lead to the tip of the antenna mast. Touch the other test lead to the center conductor pin of the instrument panel antenna cable coaxial connector for the radio. Check the ohmmeter reading for continuity.

(3) There should be continuity. The ohmmeter should register only a fraction of an ohm resistance. High or infinite resistance indicates a damaged or open antenna conductor. If OK, go to Test 3. If not OK, isolate and test each of the individual antenna conductor components. Replace only the faulty antenna conductor component.

TEST 3

Test 3 checks the condition of the vehicle body ground connection. To begin this test, proceed as follows:

(1) This test must be performed with the battery positive cable disconnected from the battery. Disconnect and isolate both battery cables, negative cable first.

(2) Reconnect the battery negative cable.

(3) Touch one ohmmeter test lead to a good clean ground point on the vehicle fender. Touch the other test lead to the battery negative terminal post. Check the ohmmeter reading for continuity.

(4) There should be continuity. The ohmmeter should register less than one ohm resistance. High or infinite resistance indicates a loose, corroded, or damaged connection between the battery negative terminal and the vehicle body. If OK, go to Test 4. If not OK, check the battery negative cable connection to the vehicle body and the radio noise suppression ground strap connections to the engine and the vehicle body for being loose or corroded. Clean or tighten these connections as required.

TEST 4

Test 4 checks the condition of the connection between the antenna coaxial cable shield and the vehicle body ground as follows:

(1) Disconnect and isolate the antenna coaxial cable connector behind the right side kick panel.

(2) Touch one ohmmeter test lead to a good clean ground point on the vehicle fender. Touch the other test lead to the outer crimp on the antenna coaxial cable connector. Check the ohmmeter reading for continuity.

(3) There should be continuity. The ohmmeter should register less than one ohm resistance. High or infinite resistance indicates a loose, corroded, or damaged connection between the antenna body and the vehicle body or between the antenna body and the antenna coaxial cable shield. If not OK, clean the

ANTENNA BODY & CABLE (Continued)

antenna body to fender mating surfaces and tighten the antenna cap nut to specifications.

(4) Check the resistance again with an ohmmeter. If the resistance is still more then one ohm, replace the faulty antenna body and cable.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the right side kick panel.

(3) Disconnect antenna body cable from instrument panel cable.

(4) Securely tie a suitable length of cord or twine to the antenna half of the coaxial cable connector. This cord will be used to pull the cable back into position during installation.

(5) Remove the antenna mast.

(6) Remove the antenna cap nut using an antenna nut wrench (Special Tool C-4816) (Fig. 3).

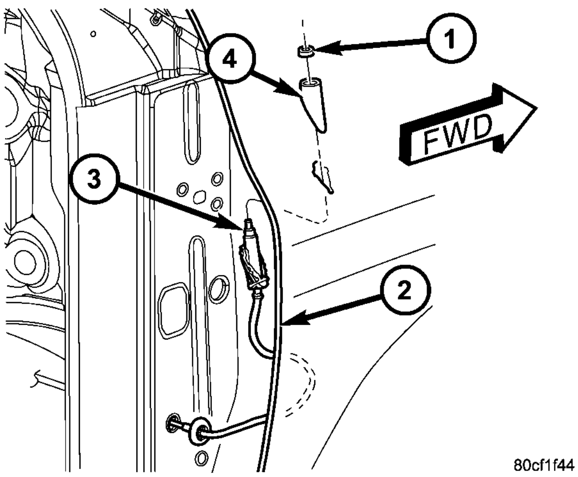

Fig. 3 ANTENNA BODY AND CABLE

1 - NUT
2 - FENDER
3 - ANTENNA BODY AND CABLE
4 - ADAPTER

(7) Remove the antenna adapter.

(8) With the right door open, pull the antenna body assembly out through the opening between the fender and body.

INSTALLATION

(1) Tie the cord that was used during the removal procedure to the cable being installed.

(2) Using the cord, pull the antenna cable through the hole in the door opening and seat grommet into place.

(3) Connect the antenna body and cable to the instrument panel cable.

(4) Install the right side kick panel.

(5) Insert the antenna body through the hole in the fender and install adapter.

(6) Install the antenna cap nut. Tighten to 7 N·m (65 in. lbs.).

(7) Install the antenna mast.

(8) Connect the battery negative cable.

INSTRUMENT PANEL ANTENNA CABLE

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL).

(3) Remove the instrument panel center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(4) Remove the instrument panel lower right center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER RIGHT CENTER BEZEL - REMOVAL).

(5) Remove the radio (Refer to 8 - ELECTRICAL/AUDIO/RADIO - REMOVAL).

CAUTION: Pulling the antenna cable straight out of the radio without pulling on the locking antenna connector could damage the cable or radio.

(6) Disconnect the antenna cable by pulling the locking antenna connector away from the radio (Fig. 4)

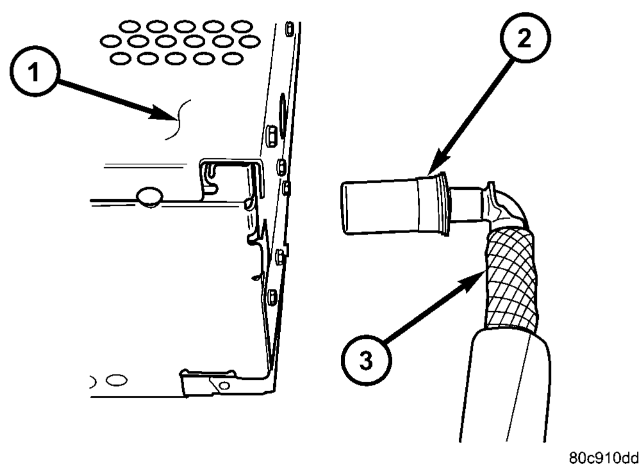

Fig. 4 ANTENNA TO RADIO

1 - RADIO
2 - LOCKING ANTENNA CONNECTOR
3 - INSTRUMENT PANEL ANTENNA CABLE

(7) Remove antenna cable from instrument panel by pulling on retaining fasteners (Fig. 5).

INSTRUMENT PANEL ANTENNA CABLE (Continued)

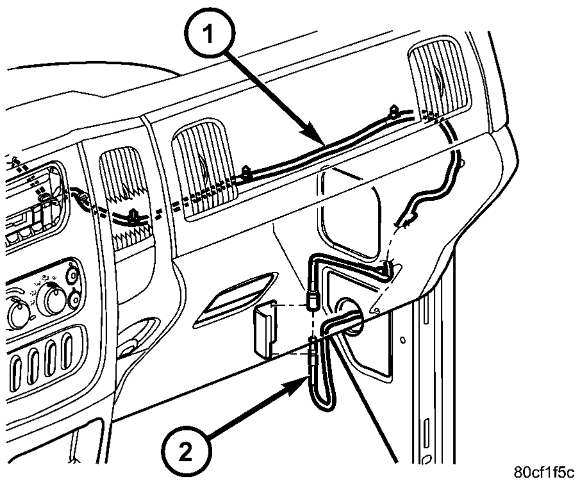

Fig. 5 INSTRUMENT PANEL ANTENNA CABLE

1 - INSTRUMENT PANEL ANTENNA CABLE
2 - ANTENNA BODY AND CABLE

INSTALLATION

(1) Install antenna cable to instrument panel by pressing retaining fasteners into position.

(2) Connect instrument panel antenna cable to antenna body and cable.

(3) Install radio (Refer to 8 - ELECTRICAL/AUDIO/RADIO - INSTALLATION).

(4) Install the instrument panel lower right center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/IP LOWER RIGHT CENTER BEZEL - INSTALLATION).

(5) Install the instrument panel center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(6) Install the glove box (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION).

(7) Connect the battery negative cable.

RADIO

DESCRIPTION

Available factory-installed radio receivers for this model include:

- AM/FM/cassette with CD changer control feature (RBB sales code)
- AM/FM/cassette/CD/graphic equalizer with CD changer control feature (RAZ sales code)
- AM/FM/CD with CD changer control feature (RBK sales code)
- AM/FM/CD with 6 CD changer (RBQ sales code)
- AM/FM/cassette/CD (RBY sales code) - export only

All factory-installed radio receivers can communicate on the Programmable Communications Interface (PCI) data bus network. All factory-installed receivers are stereo Electronically Tuned Radios (ETR) and include an electronic digital clock function.

These radio receivers can only be serviced by an authorized radio repair station. See the latest Warranty Policies and Procedures manual for a current listing of authorized radio repair stations.

OPERATION

The radio receiver operates on ignition switched battery current that is available only when the ignition switch is in the On or Accessory positions. The electronic digital clock function of the radio operates on fused battery current supplied through the IOD fuse, regardless of the ignition switch position.

For more information on the features, setting procedures, and control functions for each of the available factory-installed radio receivers, refer to the owner's manual.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove center instrument panel bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(3) Remove radio mounting screws (Fig. 6).

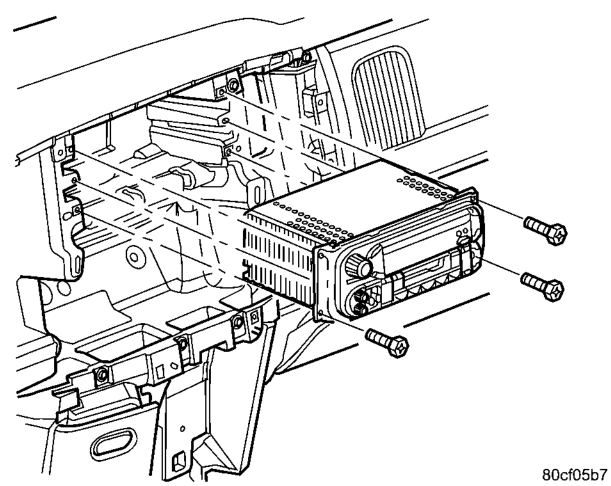

Fig. 6 RADIO

(4) Disconnect electrical harness connector.

CAUTION: Pulling the antenna cable straight out of the radio without pulling on the locking antenna connector could damage the cable or radio.

(5) Disconnect the antenna cable by pulling the locking antenna connector away from the radio (Fig. 7)

RADIO (Continued)

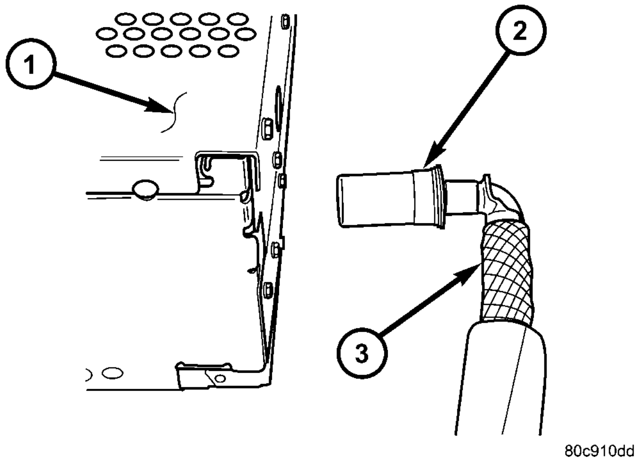

Fig. 7 ANTENNA TO RADIO

1 - RADIO
2 - LOCKING ANTENNA CONNECTOR
3 - INSTRUMENT PANEL ANTENNA CABLE

INSTALLATION

(1) Install antenna cable to radio.

(2) Connect electrical harness connector to radio.

(3) Install radio to instrument panel.

(4) Install instrument panel center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(5) Connect battery negative cable.

RADIO NOISE SUPPRESSION GROUND STRAP

DESCRIPTION

Radio noise suppression devices are factory-installed standard equipment on this vehicle. Radio Frequency Interference (RFI) and ElectroMagnetic Interference (EMI) can be produced by any on-board or external source of electromagnetic energy. These electromagnetic energy sources can radiate electromagnetic signals through the air, or conduct them through the vehicle electrical system.

When the audio system converts RFI or EMI to an audible acoustic wave form, it is referred to as radio noise. This undesirable radio noise is generally manifested in the form of “buzzing,” “hissing,” “popping,” “clicking,” “crackling,” and/or “whirring” sounds. In most cases, RFI and EMI radio noise can be suppressed using a combination of vehicle and component grounding, filtering and shielding techniques. This vehicle is equipped with factory-installed radio noise suppression devices that were designed to minimize exposure to typical sources of RFI and EMI; thereby, minimizing radio noise complaints.

Factory-installed radio noise suppression is accomplished primarily through circuitry or devices that are integral to the factory-installed radios, audio power amplifiers and other on-board electrical components such as generators, wiper motors, blower motors, and fuel pumps that have been found to be potential sources of RFI or EMI. External radio noise suppression devices that are used on this vehicle to control RFI or EMI, and can be serviced, include the following:

- **Engine-to-body ground strap** - This length of braided ground strap has an eyelet terminal connector crimped to each end. One end is secured to the engine cylinder head(s). The other is secured to the plenum at the exhaust heat shield forward/outer attaching stud.
- **Resistor-type spark plugs** - This type of spark plug has an internal resistor connected in series between the spark plug terminal and the center electrode to help reduce the production of electromagnetic radiation that can result in radio noise.

OPERATION

There are two common strategies that can be used to suppress Radio Frequency Interference (RFI) and ElectroMagnetic Interference (EMI) radio noise. The first suppression strategy involves preventing the production of RFI and EMI electromagnetic signals at their sources. The second suppression strategy involves preventing the reception of RFI and EMI electromagnetic signals by the audio system components.

The use of braided ground straps in key locations is part of the RFI and EMI prevention strategy. These ground straps ensure adequate ground paths, particularly for high current components such as many of those found in the starting, charging, ignition, engine control and transmission control systems. An insufficient ground path for any of these high current components may result in radio noise caused by induced voltages created as the high current seeks alternative ground paths through components or circuits intended for use by, or in close proximity to the audio system components or circuits.

Preventing the reception of RFI and EMI is accomplished by ensuring that the audio system components are correctly installed in the vehicle. Loose, corroded or improperly soldered wire harness connections, improperly routed wiring and inadequate audio system component grounding can all contribute to the reception of RFI and EMI. A properly grounded antenna body and radio chassis, as well as a shielded antenna coaxial cable with clean and tight connections will each help reduce the potential for reception of RFI and EMI.

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

REMOVAL

BED TO CAB

(1) Disconnect and isolate the battery negative cable.

(2) Remove the attaching bolts and strap (Fig. 8).

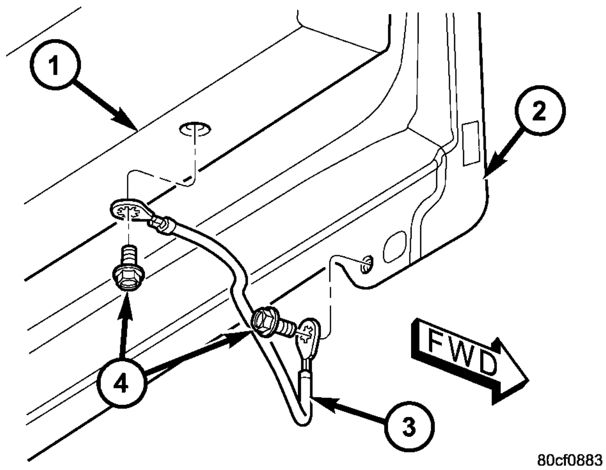

Fig. 8 BED TO CAB GROUND STRAP

1 - BED
2 - CAB
3 - GROUND STRAP
4 - MOUNTING BOLTS

ENGINE TO HEAT SHIELD - 3.7L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the attaching bolts from the cylinder heads (Fig. 9).

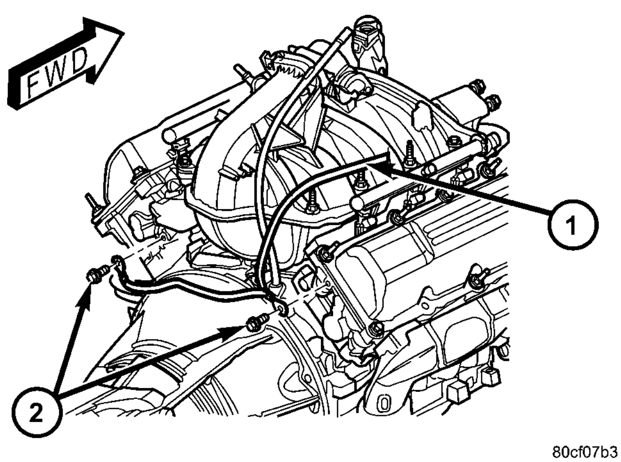

Fig. 9 ENGINE GROUND STRAP - 3.7L

1 - GROUND STRAP
2 - MOUNTING BOLTS

(3) Remove nut from heat shield and remove strap (Fig. 10).

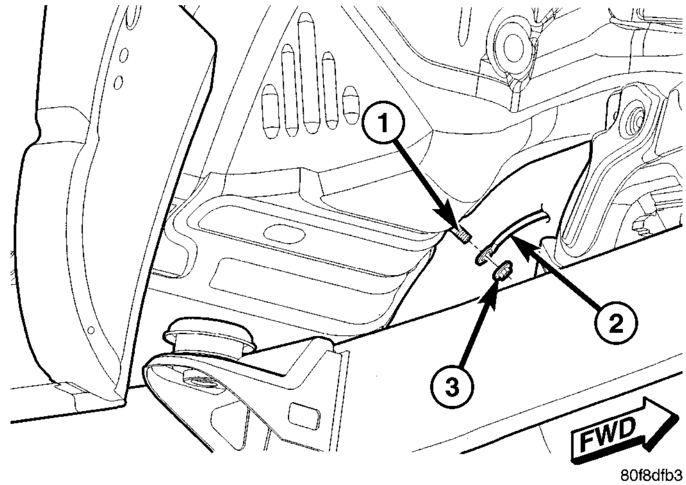

Fig. 10 GROUND STRAP TO HEAT SHIELD

1 - STUD
2 - GROUND STRAP
3 - NUT

ENGINE TO HEAT SHIELD - 4.7L AND 5.7L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the attaching bolts from the cylinder heads (Fig. 11).

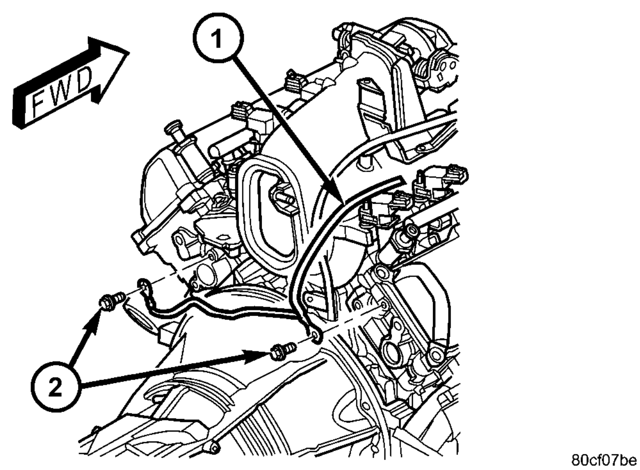

Fig. 11 ENGINE GROUND STRAP - 4.7L AND 5.7L

1 - GROUND STRAP
2 - MOUNTING BOLTS

(3) Remove nut from heat shield and remove strap (Fig. 10).

ENGINE TO HEAT SHIELD - 5.9L AND 8.0L ENGINE

(1) Disconnect and isolate the battery negative cable.

(2) Remove the attaching bolts from the cylinder heads (Fig. 12).

(3) Remove nut from heat shield and remove strap (Fig. 10).

RADIO NOISE SUPPRESSION GROUND STRAP (Continued)

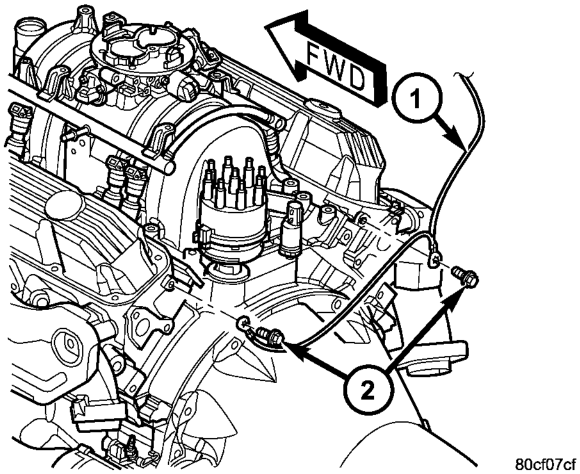

Fig. 12 ENGINE GROUND STRAP - 5.9L (8.0L SIMILAR)

1 - GROUND STRAP
2 - MOUNTING BOLTS

INSTALLATION

BED TO CAB

(1) Install the ground strap and retaining bolts. Tighten to 5 N·m (45 in. lbs.).

(2) Connect the battery negative cable.

ENGINE TO HEAT SHIELD

(1) Install the retaining nut and ground strap to the plenum. Tighten to 8 N·m (70 in. lbs.).

(2) Install the retaining bolt and ground strap to the engine cylinder heads. Tighten to 12 N·m (106 in. lbs.).

(3) Connect the battery negative cable.

REMOTE SWITCHES

DESCRIPTION

A remote radio control switch option is available on some models. Two rocker-type switches are mounted on the back (instrument panel side) of the steering wheel spokes (Fig. 13). The switch on the left spoke is the seek switch and has seek up, seek down, and preset station advance functions. The switch on the right spoke is the volume control switch and has volume up, and volume down functions. The switch on the right spoke also includes a “mode” control that allows the driver to sequentially select AM radio, FM radio, cassette player, CD player or CD changer (if equipped).

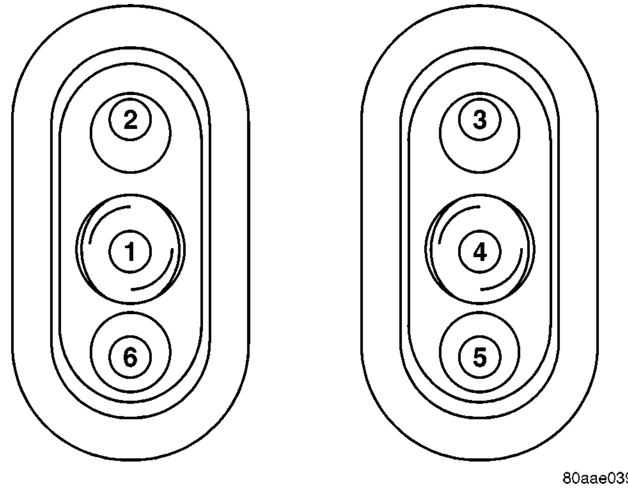

Fig. 13 Remote Radio Switch Operational View

1 - PRESET SEEK
2 - SEEK UP
3 - VOLUME UP
4 - MODE
5 - VOLUME DOWN
6 - SEEK DOWN

OPERATION

The six switches in the two remote radio switch units are normally open, resistor multiplexed momentary switches that are hard wired to the Integrated Power Module (IPM) through the clockspring. The IPM sends a five volt reference signal to both switch units on one circuit, and senses the status of all of the switches by reading the voltage drop on a second circuit.

When the IPM senses an input (voltage drop) from any one of the remote radio switches, it sends the proper switch status messages on the Programmable Communication Interface (PCI) data bus network to the radio receiver. The electronic circuitry within the radio receiver is programmed to respond to these remote radio switch status messages by adjusting the radio settings as requested. For diagnosis of the IPM or the PCI data bus, the use of a DRB III® scan tool and the proper Diagnostic Procedures manual are recommended.

For more information on the features and control functions for each of the remote radio switches, refer to the owner’s manual.

REMOTE SWITCHES (Continued)

DIAGNOSIS AND TESTING - REMOTE SWITCHES

Any diagnosis of the Audio system should begin with the use of the DRB III® diagnostic tool. For information on the use of the DRB III®, refer to the appropriate Diagnostic Service Manual.

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Remove the remote radio switch(es) (Fig. 14) from the steering wheel (Refer to 8 - ELECTRICAL/AUDIO/REMOTE SWITCHES - REMOVAL).

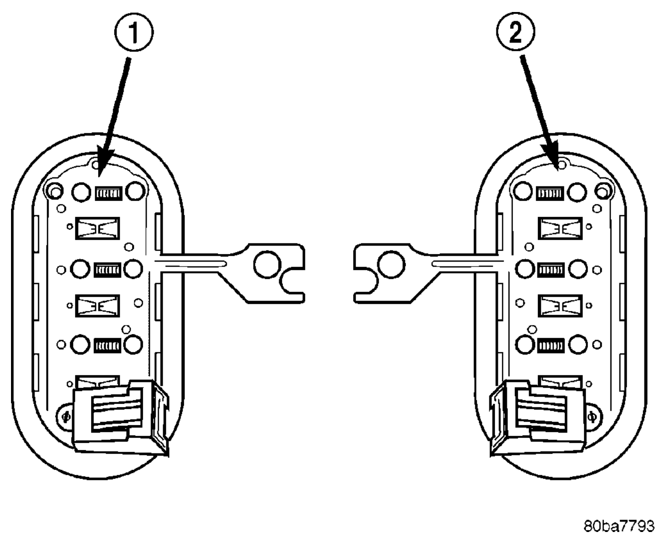

Fig. 14 Remote Radio Switches

1 - BLACK (LEFT) SWITCH
2 - WHITE (RIGHT) SWITCH

(2) Use an ohmmeter to check the switch resistances as shown in the Remote Radio Switch Test chart. If the remote radio switch resistances check OK, go to Step 3. If not OK, replace the faulty switch.

REMOTE RADIO SWITCH TEST TABLE

Switch	Switch Position	Resistance
Right (White)	Volume Up	1.210 Kilohms ± 1%
Right (White)	Volume Down	3.010 Kilohms ± 1%
Right (White)	Mode Advance	0.0511 Kilohms ± 1%
Left (Black)	Seek Up	0.261 Kilohms ± 1%
Left (Black)	Seek Down	0.681 Kilohms ± 1%
Left (Black)	Pre-Set Station Advance	0.162 Kilohms ± 1%

(3) Reconnect the battery negative cable. Turn the ignition switch to the On position. Check for 5 volts at the radio control mux circuit cavities of the steering wheel wire harness connectors for both remote radio switches. If OK, go to Step 4. If not OK, repair the open or shorted radio control mux circuit to the Integrated Power Module (IPM) as required.

(4) Disconnect and isolate the battery negative cable. Disconnect the 22-way instrument panel wire harness connector from the IPM. Check for continuity between the remote radio switch ground circuit cavities of the steering wheel wire harness connectors for both remote radio switches and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted remote radio switch ground circuit to the IPM as required.

(5) Check for continuity between the remote radio switch ground circuit cavities of the steering wheel wire harness connectors for both remote radio switches and the 22-way instrument panel wire harness connector for the IPM. There should be continuity. If OK, refer to the proper Diagnostic Procedures manual to test the IPM and the PCI data bus. If not OK, repair the open remote radio switch ground circuit as required.

REMOTE SWITCHES (Continued)

REMOVAL

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the driver airbag from the vehicle (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Remove the speed control switches (Refer to 8 - ELECTRICAL/SPEED CONTROL/SWITCH - REMOVAL).

(4) Unplug the wire harness connector from the remote radio switch(es).

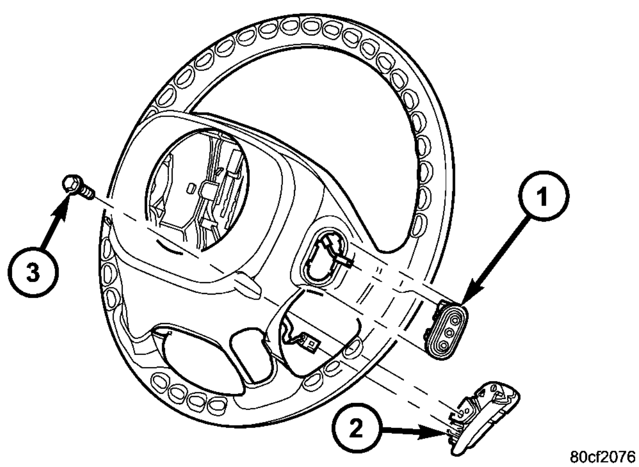

Fig. 15 REMOTE SWITCHES

1 - REMOTE SWITCH
2 - SPEED CONTROL SWITCH
3 - BOLT

(5) Depress the tabs on each side of each switch and push the switch through the rear steering wheel cover (Fig. 15).

INSTALLATION

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install remote radio switch to the steering wheel.

(2) Connect the wire harness to the remote radio switch.

(3) Install the speed control switches (Refer to 8 - ELECTRICAL/SPEED CONTROL/SWITCH - INSTALLATION).

(4) Install the driver airbag

(5) Connect the battery negative cable.

SPEAKER

DESCRIPTION

STANDARD

The standard equipment speaker system includes speakers in four locations. One 15.2 X 22.8 centimeter (6 X 9 inch) full-range speaker is located in each front door. There is also one full-range 13.3 centimeter (5.25 inch) diameter full-range speaker located in each rear door.

PREMIUM

The optional premium speaker system features eleven Premium model speakers in seven locations. Each of the standard speakers is replaced with Premium model speakers. One 8.8 centimeter (3.50 inch) diameter speaker is located on each end of the instrument panel top pad. One 6.3 centimeter (2.50 inch) diameter speaker is located in the center of the instrument panel top pad. One 15.2 X 22.8 centimeter (6 X 9 inch) Premium speaker is located in each front door. There is also one coaxial 13.3 centimeter (5.25 inch) diameter Premium full-range speaker located in each rear door. The premium speaker system also includes a power amplifier mounted behind the glove box. The total available power of the premium speaker system is 240 watts.

OPERATION

Two wires connected to each speaker, one feed circuit (+) and one return circuit (–), allow the audio output signal electrical current to flow through the voice coil. For complete circuit diagrams, refer to the

SPEAKER (Continued)

appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

DIAGNOSIS AND TESTING - SPEAKER

Any diagnosis of the Audio system should begin with the use of the DRB III® diagnostic tool. For information on the use of the DRB III®, refer to the appropriate Diagnostic Service Manual.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: The speaker output of the radio is a "floating ground" system. Do not allow any speaker lead to short to ground, as damage to the radio and/or amplifier may result.

(1) If all speakers are inoperative, check the fuses in the Integrated Power Module (IPM). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check the amplifier fuse (if equipped) in the IPM. If OK, go to Step 3. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(3) Turn the ignition switch to the ON position. Turn the radio receiver ON. Adjust the balance and fader control controls to check the performance of each individual speaker. Note the speaker locations that are not performing correctly. Go to Step 4.

(4) Turn the radio receiver OFF. Turn the ignition OFF. Disconnect and isolate the battery negative cable. If vehicle is **not** equipped with a amplifier, remove the radio receiver. If vehicle is equipped with an amplifier. disconnect wire harness connector at output side of amplifier. Go to Step 5.

(5) Check both the speaker feed (+) circuit and return (-) circuit cavities for the inoperative speaker at the radio receiver wire harness connector for continuity to ground. There should be no continuity. If OK, go to Step 6. If not OK, repair the shorted speaker feed (+) and/or return (-) circuits(s) to the speaker as required.

(6) Disconnect wire harness connector at the inoperative speaker. Check for continuity between the speaker feed (+) circuit cavities of the radio receiver wire harness connector or if equipped, the amplifier wire harness connector and the speaker wire harness connector. Repeat the check between the speaker return (-) circuit cavities of the radio receiver wire harness connector and the speaker wire harness connector. In each case, there should be continuity. If OK, replace the faulty speaker. If not OK, repair the open speaker feed (+) and/or return (-) circuits(s) as required.

REMOVAL

FRONT DOOR SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove front door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Remove speaker mounting screws (Fig. 16).

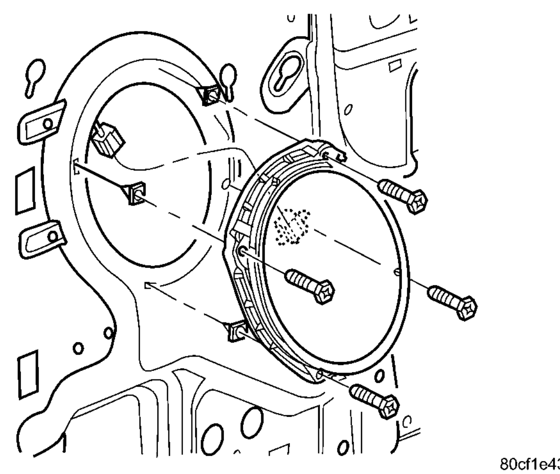

Fig. 16 FRONT DOOR SPEAKER

(4) Disconnect electrical harness connector and remove speaker.

SPEAKER (Continued)

INSTRUMENT PANEL CENTER SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL).

(3) Remove speaker mounting screws (Fig. 17).

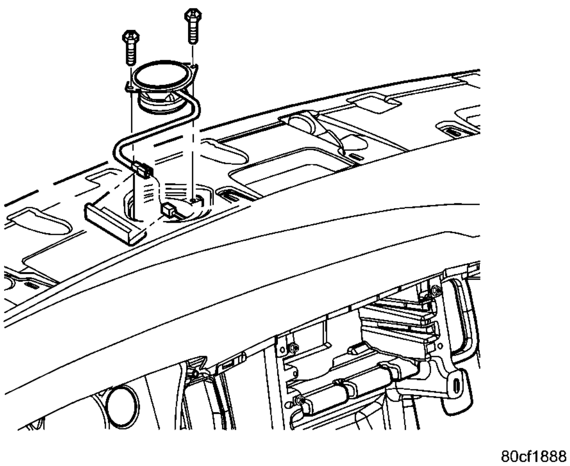

Fig. 17 INSTRUMENT PANEL CENTER SPEAKER

(4) Disconnect electrical harness connector and remove speaker.

INSTRUMENT PANEL END SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL).

(3) Remove speaker mounting screws (Fig. 18)

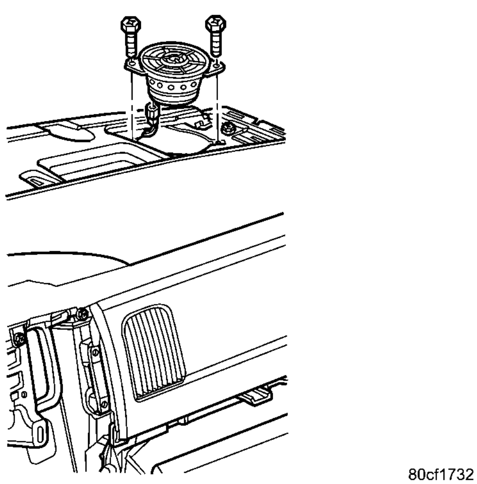

Fig. 18 INSTRUMENT PANEL END SPEAKER

(4) Disconnect electrical harness connector and remove speaker.

REAR CAB SIDE SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove B-pillar lower trim (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(3) Remove speaker mounting screws (Fig. 19).

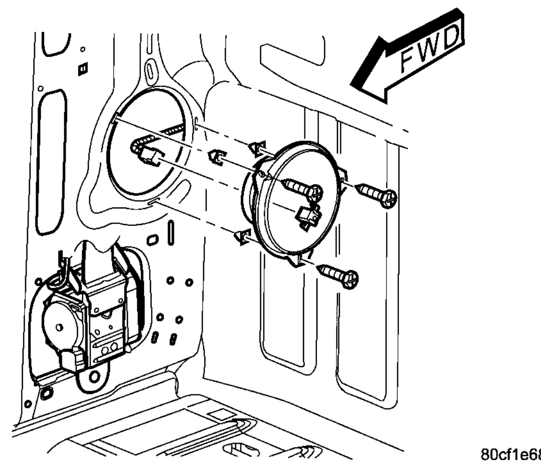

Fig. 19 REAR CAB SIDE SPEAKER

(4) Disconnect electrical harness connector and remove speaker.

REAR DOOR SPEAKER

(1) Disconnect and isolate the battery negative cable.

(2) Remove rear door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL).

(3) Remove speaker mounting screws (Fig. 20).

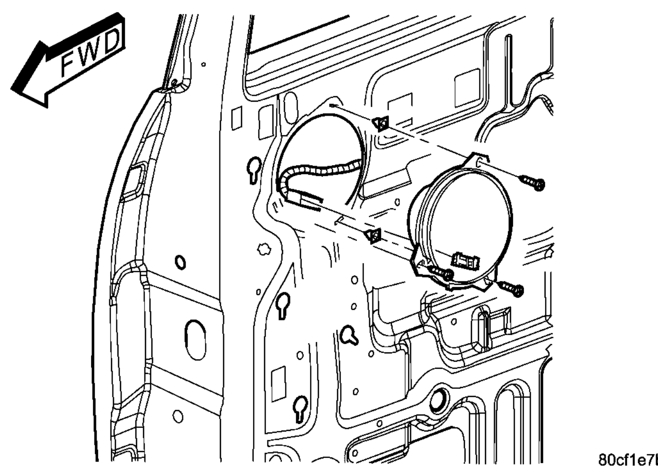

Fig. 20 REAR DOOR SPEAKER

(4) Disconnect electrical harness connector and remove speaker.

SPEAKER (Continued)

INSTALLATION

FRONT DOOR SPEAKER

(1) Connect electrical harness connector and install speaker.

(2) Install front door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

INSTRUMENT PANEL CENTER SPEAKER

(1) Connect electrical harness connector and install speaker.

(2) Install instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION).

(3) Connect battery negative cable.

INSTRUMENT PANEL END SPEAKER

(1) Connect electrical harness connector and install speaker.

(2) Install instrument panel top cover (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION).

(3) Connect battery negative cable.

REAR CAB SIDE SPEAKER

(1) Connect electrical harness connector and install speaker.

(2) Install B-pillar lower trim (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(3) Connect battery negative cable.

REAR DOOR SPEAKER

(1) Connect electrical harness connector and install speaker.

(2) Install rear door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

CHIME/BUZZER

TABLE OF CONTENTS

CHIME/BUZZER

DESCRIPTION

The chime module is located within the instrument cluster and is not serviceable. The chime system provides the driver with warning chimes for:

- Air Bag
- Seat Belt
- Low Fuel
- Door Ajar
- Low Wash
- Park Brake
- Over Speed
- Turn Signal On
- Key-In Ignition
- Exterior Lamps ON
- Warning Lamp Announcement
- Transmission Over Temperature

OPERATION

FASTEN SEAT BELT

The seat belt reminder system uses both visual and audible signals. The Instrument Cluster monitors the driver seat belt buckle switch. When the ignition switch transitions from OFF to RUN and the driver seat belt has not been buckled, the Instrument Cluster will illuminate the seat belt indicator lamp and sound the chime. The system will always illuminate the seat belt reminder lamp for four to eight seconds when the ignition switch is turned to the ON position. The CHIME will sound during the same time interval if the driver's seat belt is not fastened. The warning lamp will remain illuminated as long as the seat belt remains unbuckled, and the ignition switch is in the RUN position. Passenger seat belts are not connected to the system.

HEADLAMPS REMINDER

The Instrument Cluster monitors the multiplex headlamp switch. The headlamp audible warning will alert the driver that the exterior lamps have been left on. If the ignition switch is left off, the driver's door open, and the headlamp switch is in the park lamp or headlamp position, the chime will sound until the headlamp switch is turned off, the door is closed or the battery protection time out expires.

KEY IN IGNITION REMINDER

The Instrument Cluster monitors the ignition switch. The chime will activate if the drivers door is opened and the key is in the ignition switch, with the ignition switch in either the OFF, LOCK, or the accessory (ACC) position. The chime will continue until the key is removed from the ignition switch or the door is closed.

DOOR AJAR CHIME

The Instrument Cluster monitors the door ajar switches. A chime will sound once when the door is opened, the ignition is in RUN position and vehicle speed is present.

TURN SIGNAL ON

The Instrument Cluster monitors the multiplex multifunction switch. The instrument cluster shall remind the driver that either turn signal has been left on by a continuous chime after the turn signal indicator is left ON for 1.0 miles and the vehicle speed is 15 mph or greater.

LOW FUEL REMINDER

When the fuel level drops to approximately 1/8 tank, the fuel symbol will light and a single chime will sound. The light will remain on until fuel is added.

OVER SPEED

During any ignition ON, the Instrument Cluster maintains the most recently received speed. If the vehicle speed exceeds a preprogramed limit set in the instrument cluster it will activate a single chime.

WARNING LAMP ANNOUNCEMENT

The Instrument Cluster monitors critical engine and transmission system parameters. If any of the systems are out of their operating parameters, the instrument cluster will illuminate a lamp and activate and audible chime.

CHIME/BUZZER (Continued)

LOW WASH INDICATOR

The Front Control Module (FCM) monitors the washer reservoir. When the fluid is low the FCM transmits a J1850 message over the bus. The instrument cluster will chime and illuminate the LOW WASH indicator. The indicator will remain on until the fluid level is corrected.

AIR BAG

The Instrument Cluster monitors air bag system via the J1850 bus communications from the air bag module. The air bag module will transmit a message once per second, over the J1850 bus, as to whether the warning indicator should be on or off. The warning indicator indicates a part of the air bag system is inoperative and needs to be serviced. It **does not** indicate that the air bag system will not deploy. If the instrument cluster does not receive a message from the air bag module for 3 consecutive seconds, the Instrument will illuminate the warning indicator. The air bag module transmits a J1850 message requesting the instrument cluster to perform a bulb check each time the ignition is turned to the on position

DIAGNOSIS AND TESTING - CHIME CONDITIONS

NOTE: The Chime/Buzzer Warning System is Diagnosed using a DRBIII® Scan Tool. Refer to the proper Body Diagnostic Procedures Manual.

Visually inspect the related wiring harness connectors. Look for broken, bent, pushed out, or corroded terminals. If any of the conditions are present, repair as necessary. If not use the DRBIII® scan tool and the proper Body Diagnostic Procedure manual. For complete circuit diagrams, refer to **Instrument Cluster** in Wiring Systems.

ELECTRONIC CONTROL MODULES

TABLE OF CONTENTS

COMMUNICATION

DESCRIPTION

The DaimlerChrysler Programmable Communication Interface (PCI) data bus system is a single wire multiplex system used for vehicle communications on many DaimlerChrysler Corporation vehicles. Multiplexing is a system that enables the transmission of several messages over a single channel or circuit. All DaimlerChrysler vehicles use this principle for communication between various microprocessor-based electronic control modules. The PCI data bus exceeds the Society of Automotive Engineers (SAE) J1850 Standard for Class B Multiplexing.

COMMUNICATION (Continued)

Many of the electronic control modules in a vehicle require information from the same sensing device. In the past, if information from one sensing device was required by several controllers, a wire from each controller needed to be connected in parallel to that sensor. In addition, each controller utilizing analog sensors required an Analog/Digital (A/D) converter in order to ″read″ these sensor inputs. Multiplexing reduces wire harness complexity, sensor current loads and controller hardware because each sensing device is connected to only one controller, which reads and distributes the sensor information to the other controllers over the data bus. Also, because each controller on the data bus can access the controller sensor inputs to every other controller on the data bus, more function and feature capabilities are possible.

In addition to reducing wire harness complexity, component sensor current loads and controller hardware, multiplexing offers a diagnostic advantage. A multiplex system allows the information flowing between controllers to be monitored using a diagnostic scan tool. The DaimlerChrysler system allows an electronic control module to broadcast message data out onto the bus where all other electronic control modules can ″hear″ the messages that are being sent. When a module hears a message on the data bus that it requires, it relays that message to its microprocessor. Each module ignores the messages on the data bus that are being sent to other electronic control modules.

OPERATION

Data exchange between modules is achieved by serial transmission of encoded data over a single wire broadcast network. The wire colors used for the PCI data bus circuits are yellow with a violet tracer, or violet with a yellow tracer, depending upon the application. The PCI data bus messages are carried over the bus in the form of Variable Pulse Width Modulated (VPWM) signals. The PCI data bus speed is an average 10.4 Kilo-bits per second (Kbps). By comparison, the prior two-wire Chrysler Collision Detection (CCD) data bus system is designed to run at 7.8125 Kbps.

The voltage network used to transmit messages requires biasing and termination. Each module on the PCI data bus system provides its own biasing and termination. Each module (also referred to as a node) terminates the bus through a terminating resistor and a terminating capacitor. There are two types of nodes on the bus. The dominant node terminates the bus through a 1 KW resistor and a 3300 pF capacitor. The Powertrain Control Module (PCM) is the only dominant node for the PCI data bus system. A standard node terminates the bus through an 11 KW resistor and a 330 pF capacitor.

The modules bias the bus when transmitting a message. The PCI bus uses low and high voltage levels to generate signals. Low voltage is around zero volts and the high voltage is about seven and one-half volts. The low and high voltage levels are generated by means of variable-pulse width modulation to form signals of varying length. The Variable Pulse Width Modulation (VPWM) used in PCI bus messaging is a method in which both the state of the bus and the width of the pulse are used to encode bit information. A ″zero″ bit is defined as a short low pulse or a long high pulse. A ″one″ bit is defined as a long low pulse or a short high pulse. A low (passive) state on the bus does not necessarily mean a zero bit. It also depends upon pulse width. If the width is short, it stands for a zero bit. If the width is long, it stands for a one bit. Similarly, a high (active) state does not necessarily mean a one bit. This too depends upon pulse width. If the width is short, it stands for a one bit. If the width is long, it stands for a zero bit.

In the case where there are successive zero or one data bits, both the state of the bus and the width of the pulse are changed alternately. This encoding scheme is used for two reasons. First, this ensures that only one symbol per transition and one transition per symbol exists. On each transition, every transmitting module must decode the symbol on the bus and begin timing of the next symbol. Since timing of the next symbol begins with the last transition detected on the bus, all of the modules are re-synchronized with each symbol. This ensures that there are no accumulated timing errors during PCI data bus communication.

The second reason for this encoding scheme is to guarantee that the zero bit is the dominant bit on the bus. When two modules are transmitting simultaneously on the bus, there must be some form of arbitration to determine which module will gain control. A data collision occurs when two modules are transmitting different messages at the same time. When a module is transmitting on the bus, it is reading the bus at the same time to ensure message integrity. When a collision is detected, the module that transmitted the one bit stops sending messages over the bus until the bus becomes idle.

Each module is capable of transmitting and receiving data simultaneously. The typical PCI bus message has the following four components:

- **Message Header** - One to three bytes in length. The header contains information identifying the message type and length, message priority, target module(s) and sending module.
- **Data Byte(s)** - This is the actual message that is being sent.

COMMUNICATION (Continued)

• **Cyclic Redundancy Check (CRC) Byte** - This byte is used to detect errors during a message transmission.

• **In-Frame Response (IFR) byte(s)** - If a response is required from the target module(s), it can be sent during this frame. This function is described in greater detail in the following paragraph.

The IFR consists of one or more bytes, which are transmitted during a message. If the sending module requires information to be received immediately, the target module(s) can send data over the bus during the original message. This allows the sending module to receive time-critical information without having to wait for the target module to access the bus. After the IFR is received, the sending module broadcasts an End of Frame (EOF) message and releases control of the bus.

The PCI data bus can be monitored using the DRBIII® scan tool. It is possible, however, for the bus to pass all DRBIII® tests and still be faulty if the voltage parameters are all within the specified range and false messages are being sent.

CONTROLLER ANTILOCK BRAKE

DESCRIPTION

The Controler Antilock Brake (CAB) is mounted to the Hydraulic Control Unit (HCU) and operates the ABS system (Fig. 1).

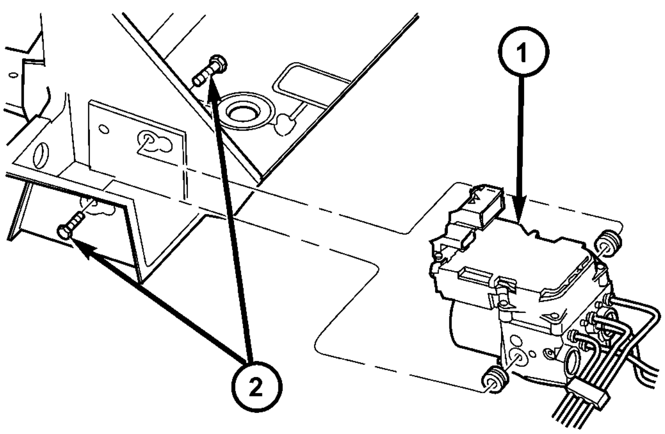

Fig. 1 HYDRAULIC CONTROL UNIT

1 - HYDRAULIC CONTROL UNIT
2 - MOUNTING BOLTS

OPERATION

The CAB voltage source is through the ignition switch in the RUN position. The CAB contains a self check program that illuminates the ABS warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB III scan tool. ABS faults remain in memory until cleared, or until after the vehicle is started approximately 50 times. Stored faults are **not** erased if the battery is disconnected.

NOTE: If the CAB is being replaced with a new CAB is must be reprogrammed with the use of a DRB III.

REMOVAL

(1) Remove the negative battery cable from the battery.

(2) Pull up on the CAB harness connector release and remove connector.

(3) Remove the CAB mounting bolts.

(4) Remove the pump connector from the CAB.

(5) Remove the CAB from the HCU.

INSTALLATION

NOTE: If the CAB is being replaced with a new CAB is must be reprogrammed with the use of a DRB III.

(1) Install CAB to the HCU.

(2) Install the pump connector to the CAB.

(3) Install mounting bolts. Tighten to 2 N·m (16 in. lbs.).

(4) Install the wiring harness connector to the CAB and push down on the release to secure the connector.

(5) Install negative battery cable to the battery.

DATA LINK CONNECTOR

DESCRIPTION - DATA LINK CONNECTOR

The Data Link Connector (DLC) is located at the lower edge of the instrument panel near the steering column.

OPERATION - DATA LINK CONNECTOR

The 16–way data link connector (diagnostic scan tool connector) links the Diagnostic Readout Box (DRB) scan tool or the Mopar Diagnostic System (MDS) with the Powertrain Control Module (PCM).

ENGINE CONTROL MODULE

DESCRIPTION - ECM

The Engine Control Module (ECM) is bolted to the left side of the engine below the intake manifold (Fig. 2).

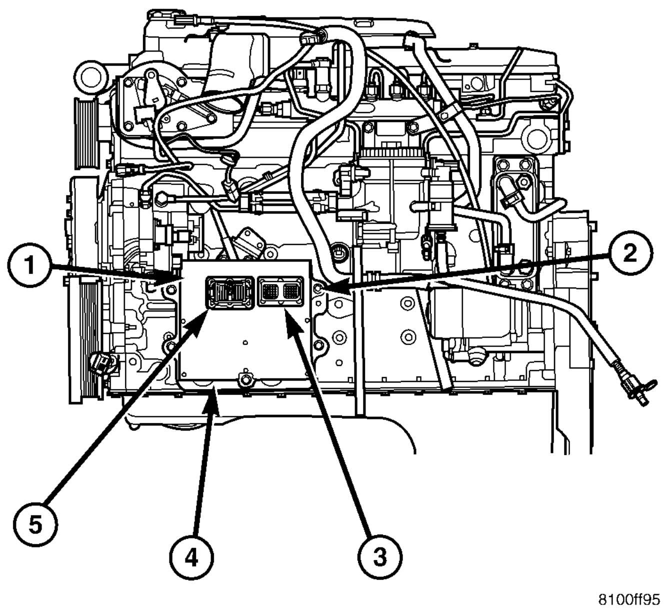

Fig. 2 DIESEL ECM

1 - ENGINE CONTROL MODULE (ECM)
2 - ECM MOUNTING BOLT
3 - 50-WAY CONNECTOR
4 - SUPPORT PLATE
5 - 60-WAY CONNECTOR

OPERATION - ECM

The main function of the Engine Control Module (ECM) is to electrically control the fuel system. The Powertrain Control Module (PCM) **does not control** the fuel system.

The ECM can adapt its programming to meet changing operating conditions. **If the ECM has been replaced, flashed or re-calibrated, the ECM must learn the Accelerator Pedal Position Sensor (APPS) idle voltage. Failure to learn this voltage may result in unnecessary diagnostic trouble codes. Refer to ECM Removal/Installation for learning procedures.**

The ECM receives input signals from various switches and sensors. Based on these inputs, the ECM regulates various engine and vehicle operations through different system components. These components are referred to as **ECM Outputs.** The sensors and switches that provide inputs to the ECM are considered **ECM Inputs.**

NOTE: ECM Inputs:

- Accelerator Pedal Position Sensor (APPS) Volts
- APPS1 Signal — For off engine APPS
- APPS2 Signal — For off engine APPS
- APPS Idle Validation Switches #1 and #2
- Battery voltage
- Camshaft Position Sensor (CMP)
- CCD bus (+) circuits
- CCD bus (-) circuits
- Crankshaft Position Sensor (CKP)
- Data link connection for DRB scan tool
- Engine Coolant Temperature (ECT) sensor
- Ground circuits
- Fuel Pressure Sensor
- Battery Temperature
- Fan speed
- Inlet Air Temperature Sensor/Pressure Sensor
- Intake Air Temperature Sensor/MAP Sensor
- Oil Pressure SWITCH
- Power ground
- Sensor return
- Signal ground
- Water-In-Fuel (WIF) sensor

NOTE: ECM Outputs:

After inputs are received by the ECM, certain sensors, switches and components are controlled or regulated by the ECM. These are considered **ECM Outputs.** These outputs are for:

- CCD bus (+) circuits
- CCD bus (-) circuits
- CKP and APPS outputs to the PCM
- Data link connection for DRB scan tool
- Five volt sensor supply
- Fuel transfer (lift) pump
- Intake manifold air heater relays #1 and #2 control circuits
- Malfunction indicator lamp (Check engine lamp) (databus)
- Oil Pressure Swith/warning lamp (databus)
- Fuel Control Actuator
- Wait-to-start warning lamp (databus)
- Fan Clutch PWM
- Water-In-Fuel (WIF) warning lamp (databus)

REMOVAL

The Engine Control Module (ECM) is bolted to a support bracket near the fuel filter. The support bracket mounts to the block with four capscrews and vibration isolators. A ground wire is fastened to the bracket. The other end of the wire is fastened to the engine block.

(1) Record any Diagnostic Trouble Codes (DTC's) found in the ECM.

ENGINE CONTROL MODULE (Continued)

To avoid possible voltage spike damage to either the Engine Control Module ECM, ignition key must be off, and negative battery cables must be disconnected before unplugging ECM connectors.

(2) Disconnect both negative battery cables at both batteries.

(3) Remove the 50–way and 60–way connector bolts at the ECM. Note: Tthe connector bolt is a female allen head. As bolt is being removed, very carfully remove connectors from the ECM.

(4) Remove five ECM mounting bolts and remove ECM form the vehicle (Fig. 3).

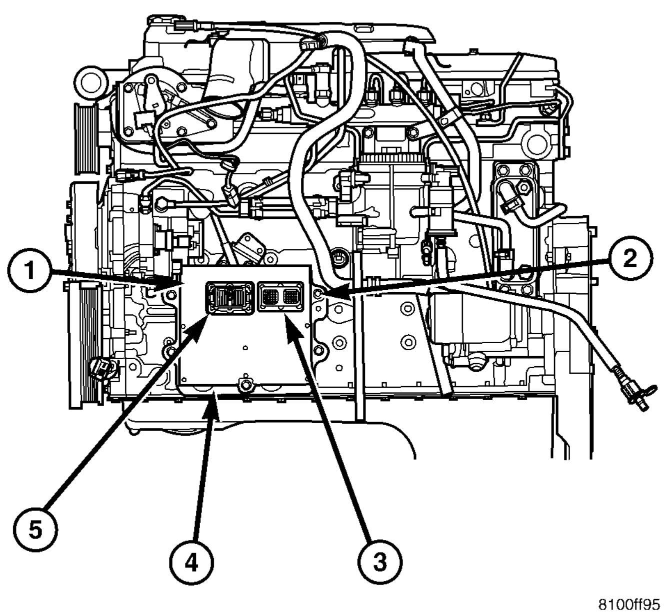

Fig. 3 DIESEL ECM

1 - ENGINE CONTROL MODULE (ECM)
2 - ECM MOUNTING BOLT
3 - 50-WAY CONNECTOR
4 - SUPPORT PLATE
5 - 60-WAY CONNECTOR

INSTALLATION

Do not apply paint to ECM. Poor ground will result.

(1) Position ECM to ECM support bracket and install five mounting bolts. Tighten bolts to 24 N·m (18 ft. lbs.).

(2) Check pin connectors in ECM and the 50–way and 60–way connectors for corrosion or damage. Repair as necessary.

(3) Clean pins in the 50–way and 60–way electrical connectors with a quick-dry electrical contact cleaner.

(4) Very carefully install the 50–way and 60–way connectors to ECM. Tighten connector allen bolts.

(5) Install both negative battery cables.

(6) **Turn key to ON position. Without starting engine, slowly press throttle pedal to floor and then slowly release. This step must be done (one time) to ensure accelerator pedal position sensor calibration has been learned by ECM. If not done, possible DTC's may be set.**

(7) Use DRB scan tool to erase any stored companion DTC's from ECM.

FRONT CONTROL MODULE

DESCRIPTION

The Front Control Module (FCM) is a micro controller based module located in the left front corner of the engine compartment. On this model the integrated power module must be positioned aside in order to access the front control module. The front control module mates to the power distribution center to form the Integrated Power Module (IPM). The integrated power module connects directly to the battery and provides the primary means of circuit protection and power distribution for all vehicle electrical systems. The front control module controls power to some of these vehicle systems electrical and electromechanical loads based on inputs received from hard wired switch inputs and data received on the PCI bus circuit (J1850).

For information on the **Integrated Power Module Refer to the Power Distribution Section** of the service manual.

OPERATION

As messages are sent over the PCI bus circuit, the front control module reads these messages and controls power to some of the vehicles electrical systems by completing the circuit to ground (low side driver) or completing the circuit to 12 volt power (high side driver). The following functions are **Controlled** by the Front Control Module:

- Headlamp Power with Voltage Regulation
- Windshield Wiper "ON/OFF" Relay Actuation
- Windshield Wiper "HI/LO" Relay Actuation
- Windshield Washer Pump Motor
- Fog Lamp Relay Actuation
- Park Lamp Relay Actuation
- Horn Relay Actuation

The following inputs are **Received/Monitored** by the Front Control Module:

- B+ Connection Detection
- Power Ground
- Ambient Temperature Sensing
- Ignition Switch Run
- Washer Fluid Level Switch
- Windshield Wiper Park Switch
- PCI Bus Circuit

DIAGNOSIS AND TESTING - FRONT CONTROL MODULE

The front control module is a printed circuit board based module with a on-board micro-processor. The front control module interfaces with other electronic modules in the vehicle via the Programmable Communications Interface (PCI) data bus (J1850). In order to obtain conclusive testing the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to, or receive outputs from the front control module must be checked. All PCI (J1850) communication faults must be resolved prior to further diagnosing any front control module related issues.

The front control module was designed to be diagnosed with an appropriate diagnostic scan tool, such as the DRB III®. The most reliable, efficient, and accurate means to diagnose the front control module requires the use of a DRB III® scan tool and the proper Body Diagnostic Procedures manual.

Before any testing of the front control module is attempted, the battery should be fully charged and all wire harness and ground connections inspected around the affected areas on the vehicle.

REMOVAL

(1) Disconnect the positive and negative battery cables from the battery.

(2) Partially remove the integrated power module from the engine compartment (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - REMOVAL).

(3) Remove the front control module retaining screws.

(4) Using both hands, pull the front control module **straight** from the integrated power module assembly to disconnect the 49-way electrical connector and remove the front control module from the vehicle.

INSTALLATION

(1) Install the front control module on the integrated power module assembly by pushing the 49-way electrical connector straight in.

(2) Install the front control module retaining screws. Torque the screws to 7 in. lbs.

(3) Install the integrated power module (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - INSTALLATION).

(4) Connect the positive and negative battery cables.

HEATED SEAT MODULE

DESCRIPTION

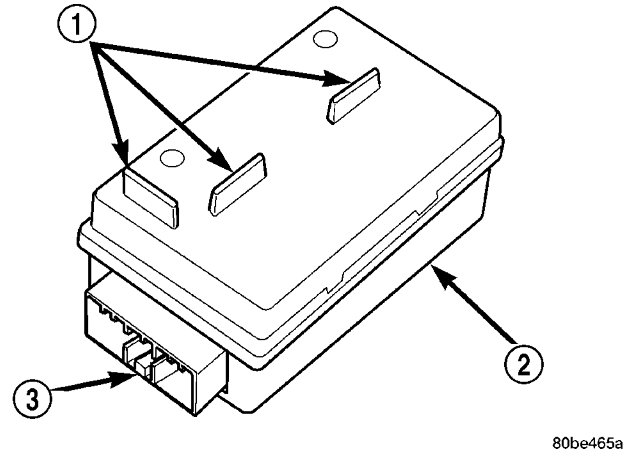

Fig. 4 Heated Seat Module

1 - MOUNTING TABS (NOT USED ON DR)
2 - HEATED SEAT MODULE
3 - ELECTRICAL CONNECTOR RECEPTACLE

The heated seat module is also known as the Seat Heat Interface Module. The heated seat module (Fig. 4) is located under the drivers front seat cushion, where it is secured to a mounting bracket. The heated seat module has a single connector receptacle that allows the module to be connected to all of the required inputs and outputs through the seat wire harness.

The heated seat module is an electronic microprocessor controlled device designed and programmed to use inputs from the battery, the two heated seat switches and the two heated seat sensors to operate and control the heated seat elements in both front seats and the two heated seat indicator lamp Light-Emitting Diodes (LEDs) in each heated seat switch. The heated seat module is also programmed to perform self-diagnosis of certain heated seat system functions and provide feedback of that diagnosis through the heated seat switch indicator lamps.

The heated seat module cannot be repaired. If the heated seat module is damaged or faulty, the entire module must be replaced.

OPERATION

The heated seat module operates on fused battery current received from the integrated power module. Inputs to the module include a resistor multiplexed heated seat switch request circuit for each of the two heated seat switches and the heated seat sensor inputs from the seat cushions of each front seat. In response to those inputs the heated seat module controls battery current feeds to the heated seat ele-

HEATED SEAT MODULE (Continued)

ments and sensors, and controls the ground for the heated seat switch indicator lamps.

When a heated seat switch (Driver or Passenger) is depressed a signal is received by the heated seat module, the module energizes the proper indicator LED (Low or High) in the switch by grounding the indicator lamp circuit to indicate that the heated seat system is operating. At the same time, the heated seat module energizes the selected heated seat sensor circuit and the sensor provides the module with an input indicating the surface temperature of the selected seat cushion.

The Low heat set point is about 36° C (96.8° F), and the High heat set point is about 42° C (107.6° F). If the seat cushion surface temperature input is below the temperature set point for the selected temperature setting, the heated seat module energizes an N-channel Field Effect Transistor (N-FET) within the module which energizes the heated seat elements in the selected seat cushion and back. When the sensor input to the module indicates the correct temperature set point has been achieved, the module de-energizes the N-FET which de-energizes the heated seat elements. The heated seat module will continue to cycle the N-FET as needed to maintain the selected temperature set point.

If the heated seat module detects a heated seat sensor value input that is out of range or a shorted or open heated seat element circuit, it will notify the vehicle operator or the repair technician of this condition by flashing the High and/or Low indicator lamps in the affected heated seat switch. Refer to **Diagnosis and Testing Heated Seat System** in Heated Systems for flashing LED diagnosis and testing procedures. Refer to **Diagnosis and Testing Heated Seat Module** in this section for heated seat module diagnosis and testing procedures.

DIAGNOSIS AND TESTING - HEATED SEAT MODULE

If a heated seat fails to heat and one or both of the indicator lamps on a heated seat switch flash, refer to **Diagnosis and Testing Heated Seat System** in Heated Seats for the location of flashing LED heated seat system diagnosis and testing procedures. If a heated seat heats but one or both indicator lamps on the heated seat switch fail to operate, test the heated seat switch. Refer to **Diagnosis and Testing Heated Seat Switch** in Heated Seats for heated seat switch diagnosis and testing procedures. If the heated seat switch checks OK, proceed as follows.

(1) Check the heated seat element (Refer to 8 - ELECTRICAL/HEATED SEATS/HEATED SEAT ELEMENT - DIAGNOSIS AND TESTING).

(2) Check the heated seat sensor (Refer to 8 - ELECTRICAL/HEATED SEATS/HEATED SEAT SENSOR - DIAGNOSIS AND TESTING).

(3) Check the heated seat switch (Refer to 8 - ELECTRICAL/HEATED SEATS/DRIVER HEATED SEAT SWITCH - DIAGNOSIS AND TESTING).

NOTE: Refer to Wiring for the location of complete heated seat system wiring diagrams and connector pin-out information.

(4) Using a voltmeter, backprobe the appropriate heated seat module connector, do not disconnect. Check for voltage at the appropriate pin cavities. 12v should be present. If OK go to Step 5, if Not, Repair the open or shorted voltage supply circuit as required.

(5) Using a ohmmeter, backprobe the appropriate heated seat module connector, do not disconnect. Check for proper continuity to ground on the ground pin cavities. Continuity should be present. If OK replace the heated seat module with a known good unit and retest system, if Not OK, Repair the open or shorted ground circuit as required.

REMOVAL

(1) Position the driver seat to the full rearward and inclined position.

(2) Working under the driver front seat, remove the two heated seat module retaining screws. Due to the fact that the retaining screws are installed with the seat cushion pan removed, a small right angle screwdriver will be required to access and remove the screws.

(3) Disconnect the seat wire harness connector from the connector receptacle on the back of the heated seat module. Depress the connector retaining tab and pull straight apart.

(4) Remove the heated seat module from under the front seat.

INSTALLATION

(1) Position the heated seat module under the front seat.

(2) Connect the seat wire harness connector on the connector receptacle on the back of the heated seat module.

(3) Working under the driver front seat, install the heated seat module retaining screws.

(4) Re-position the driver seat.

POWERTRAIN CONTROL MODULE

DESCRIPTION

DESCRIPTION - PCM

The Powertrain Control Module (PCM) is located in the right-rear section of the engine compartment under the cowl (Fig. 5).

Two different PCM's are used (JTEC and NGC). These can be easily identified. JTEC's use three 32–way connectors, NGC's use four 38–way connectors

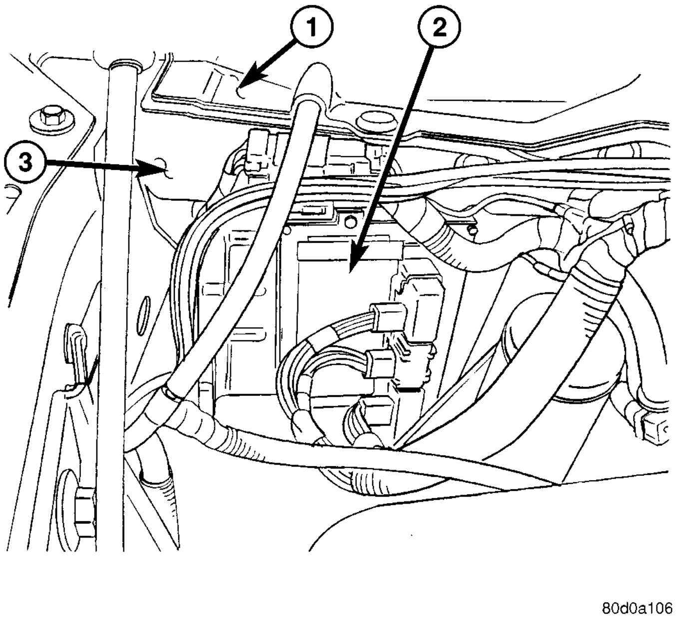

Fig. 5 POWERTRAIN CONTROL MODULE (PCM) LOCATION

1 - COWL GRILL
2 - PCM
3 - COWL (RIGHT-REAR)

DESCRIPTION - MODES OF OPERATION

As input signals to the Powertrain Control Module (PCM) change, the PCM adjusts its response to the output devices. For example, the PCM must calculate different injector pulse width and ignition timing for idle than it does for wide open throttle (WOT).

The PCM will operate in two different modes: **Open Loop and Closed Loop**.

During Open Loop modes, the PCM receives input signals and responds only according to preset PCM programming. Input from the oxygen (O2S) sensors is not monitored during Open Loop modes.

During Closed Loop modes, the PCM will monitor the oxygen (O2S) sensors input. This input indicates to the PCM whether or not the calculated injector pulse width results in the ideal air-fuel ratio. This ratio is 14.7 parts air-to-1 part fuel. By monitoring the exhaust oxygen content through the O2S sensor, the PCM can fine tune the injector pulse width. This is done to achieve optimum fuel economy combined with low emission engine performance.

The fuel injection system has the following modes of operation:

- Ignition switch ON
- Engine start-up (crank)
- Engine warm-up
- Idle
- Cruise
- Acceleration
- Deceleration
- Wide open throttle (WOT)
- Ignition switch OFF

The ignition switch On, engine start-up (crank), engine warm-up, acceleration, deceleration and wide open throttle modes are Open Loop modes. The idle and cruise modes, (with the engine at operating temperature) are Closed Loop modes.

IGNITION SWITCH (KEY-ON) MODE

This is an Open Loop mode. When the fuel system is activated by the ignition switch, the following actions occur:

- The PCM pre-positions the idle air control (IAC) motor.
- The PCM determines atmospheric air pressure from the MAP sensor input to determine basic fuel strategy.
- The PCM monitors the engine coolant temperature sensor input. The PCM modifies fuel strategy based on this input.
- Intake manifold air temperature sensor input is monitored.
- Throttle position sensor (TPS) is monitored.
- The auto shutdown (ASD) relay is energized by the PCM for approximately three seconds.
- The fuel pump is energized through the fuel pump relay by the PCM. The fuel pump will operate for approximately three seconds unless the engine is operating or the starter motor is engaged.
- The O2S sensor heater element is energized via the ASD or O2S heater relay. The O2S sensor input is not used by the PCM to calibrate air-fuel ratio during this mode of operation.

ENGINE START-UP MODE

This is an Open Loop mode. The following actions occur when the starter motor is engaged.

The PCM receives inputs from:

POWERTRAIN CONTROL MODULE (Continued)

- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal

The PCM monitors the crankshaft position sensor. If the PCM does not receive a crankshaft position sensor signal within 3 seconds of cranking the engine, it will shut down the fuel injection system.

The fuel pump is activated by the PCM through the fuel pump relay.

Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.

The PCM determines the proper ignition timing according to input received from the crankshaft position sensor.

ENGINE WARM-UP MODE

This is an Open Loop mode. During engine warm-up, the PCM receives inputs from:

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)

Based on these inputs the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM adjusts engine idle speed through the idle air control (IAC) motor and adjusts ignition timing.
- The PCM operates the A/C compressor clutch through the A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low–pressure A/C switches. Refer to Heating and Air Conditioning for additional information.
- When engine has reached operating temperature, the PCM will begin monitoring O2S sensor input. The system will then leave the warm-up mode and go into closed loop operation.

IDLE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At idle speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal
- Battery voltage
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off.
- The PCM monitors the O2S sensor input and adjusts air-fuel ratio by varying injector pulse width. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by increasing and decreasing spark advance.
- The PCM operates the A/C compressor clutch through the A/C compressor clutch relay. This is done if A/C has been selected by the vehicle operator and specified pressures are met at the high and low–pressure A/C switches. Refer to Heating and Air Conditioning for additional information.

CRUISE MODE

When the engine is at operating temperature, this is a Closed Loop mode. At cruising speed, the PCM receives inputs from:

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Oxygen (O2S) sensors

Based on these inputs, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then adjust

POWERTRAIN CONTROL MODULE (Continued)

the injector pulse width by turning the ground circuit to each individual injector on and off.

- The PCM monitors the O2S sensor input and adjusts air-fuel ratio. It also adjusts engine idle speed through the idle air control (IAC) motor.
- The PCM adjusts ignition timing by turning the ground path to the coil(s) on and off.
- The PCM operates the A/C compressor clutch through the clutch relay. This happens if A/C has been selected by the vehicle operator and requested by the A/C thermostat.

ACCELERATION MODE

This is an Open Loop mode. The PCM recognizes an abrupt increase in throttle position or MAP pressure as a demand for increased engine output and vehicle acceleration. The PCM increases injector pulse width in response to increased throttle opening.

DECELERATION MODE

When the engine is at operating temperature, this is an Open Loop mode. During hard deceleration, the PCM receives the following inputs.

- Air conditioning select signal (if equipped)
- Air conditioning request signal (if equipped)
- Battery voltage
- Engine coolant temperature sensor
- Crankshaft position sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal
- Park/neutral switch (gear indicator signal—auto. trans. only)
- Vehicle speed

If the vehicle is under hard deceleration with the proper rpm and closed throttle conditions, the PCM will ignore the oxygen sensor input signal. The PCM will enter a fuel cut-off strategy in which it will not supply a ground to the injectors. If a hard deceleration does not exist, the PCM will determine the proper injector pulse width and continue injection.

Based on the above inputs, the PCM will adjust engine idle speed through the idle air control (IAC) motor.

The PCM adjusts ignition timing by turning the ground path to the coil on and off.

WIDE OPEN THROTTLE MODE

This is an Open Loop mode. During wide open throttle operation, the PCM receives the following inputs.

- Battery voltage
- Crankshaft position sensor
- Engine coolant temperature sensor
- Intake manifold air temperature sensor
- Manifold absolute pressure (MAP) sensor
- Throttle position sensor (TPS)
- Camshaft position sensor signal

During wide open throttle conditions, the following occurs:

- Voltage is applied to the fuel injectors with the ASD relay via the PCM. The PCM will then control the injection sequence and injector pulse width by turning the ground circuit to each individual injector on and off. The PCM ignores the oxygen sensor input signal and provides a predetermined amount of additional fuel. This is done by adjusting injector pulse width.
- The PCM adjusts ignition timing by turning the ground path to the coil(s) on and off.

IGNITION SWITCH OFF MODE

When ignition switch is turned to OFF position, the PCM stops operating the injectors, ignition coil, ASD relay and fuel pump relay.

DESCRIPTION - 5 VOLT SUPPLIES

Two different Powertrain Control Module (PCM) five volt supply circuits are used; primary and secondary.

DESCRIPTION - IGNITION CIRCUIT SENSE

This circuit ties the ignition switch to the Powertrain Control Module (PCM).

DESCRIPTION - POWER GROUNDS

The Powertrain Control Module (PCM) has 2 main grounds. Both of these grounds are referred to as power grounds. All of the high-current, noisy, electrical devices are connected to these grounds as well as all of the sensor returns. The sensor return comes into the sensor return circuit, passes through noise suppression, and is then connected to the power ground.

The power ground is used to control ground circuits for the following PCM loads:

- Generator field winding
- Fuel injectors
- Ignition coil(s)
- Certain relays/solenoids
- Certain sensors

DESCRIPTION - SENSOR RETURN

The Sensor Return circuits are internal to the Powertrain Control Module (PCM).

Sensor Return provides a low–noise ground reference for all engine control system sensors. Refer to Power Grounds for more information.

POWERTRAIN CONTROL MODULE (Continued)

OPERATION

OPERATION - PCM

The PCM operates the fuel system. The PCM is a pre-programmed, triple microprocessor digital computer. It regulates ignition timing, air-fuel ratio, emission control devices, charging system, certain transmission features, speed control, air conditioning compressor clutch engagement and idle speed. The PCM can adapt its programming to meet changing operating conditions.

The PCM receives input signals from various switches and sensors. Based on these inputs, the PCM regulates various engine and vehicle operations through different system components. These components are referred to as Powertrain Control Module (PCM) Outputs. The sensors and switches that provide inputs to the PCM are considered Powertrain Control Module (PCM) Inputs.

The PCM adjusts ignition timing based upon inputs it receives from sensors that react to: engine rpm, manifold absolute pressure, engine coolant temperature, throttle position, transmission gear selection (automatic transmission), vehicle speed, power steering pump pressure, and the brake switch.

The PCM adjusts idle speed based on inputs it receives from sensors that react to: throttle position, vehicle speed, transmission gear selection, engine coolant temperature and from inputs it receives from the air conditioning clutch switch and brake switch.

Based on inputs that it receives, the PCM adjusts ignition coil dwell. The PCM also adjusts the generator charge rate through control of the generator field and provides speed control operation.

NOTE: PCM Inputs:

- ABS module (if equipped)
- A/C request (if equipped with factory A/C)
- A/C select (if equipped with factory A/C)
- A/C pressure transducer
- Auto shutdown (ASD) sense
- Battery temperature sensor
- Battery voltage
- Brake switch
- J1850 bus (+) circuits
- J1850 bus (-) circuits
- Camshaft position sensor signal
- Crankshaft position sensor
- Data link connection for DRB scan tool
- EATX module (if equipped)
- Engine coolant temperature sensor
- Fuel level (through J1850 circuitry)
- Generator (battery voltage) output
- Ignition circuit sense (ignition switch in on/off/crank/run position)
- Intake manifold air temperature sensor
- Knock sensors (2 on 3.7L engine)
- Leak detection pump (switch) sense (if equipped)
- Manifold absolute pressure (MAP) sensor
- Oil pressure
- Oxygen sensors
- Park/neutral switch (auto. trans. only)
- Power ground
- Power steering pressure switch (if equipped)
- Sensor return
- Signal ground
- Speed control multiplexed single wire input
- Throttle position sensor
- Transfer case switch (4WD range position)
- Vehicle speed signal

NOTE: PCM Outputs:

- A/C clutch relay
- Auto shutdown (ASD) relay
- J1850 bus (+/-) circuits for: speedometer, voltmeter, fuel gauge, oil pressure gauge/lamp, engine temp. gauge and speed control warn. lamp
- Data link connection for DRB scan tool
- EGR valve control solenoid (if equipped)
- EVAP canister purge solenoid
- Five volt sensor supply (primary)
- Five volt sensor supply (secondary)
- Fuel injectors
- Fuel pump relay
- Generator field driver (-)
- Generator field driver (+)
- Idle air control (IAC) motor
- Ignition coil(s)
- Leak detection pump (if equipped)
- Malfunction indicator lamp (Check engine lamp). Driven through J1850 circuits.
- Oxygen sensor heater relays
- Oxygen sensors (pulse width modulated)
- Radiator cooling fan relay (pulse width modulated)
- Speed control vacuum solenoid
- Speed control vent solenoid
- Tachometer (if equipped). Driven through J1850 circuits.
- Transmission convertor clutch circuit. Driven through J1850 circuits.

OPERATION - 5 VOLT SUPPLIES

Primary 5–volt supply:

- supplies the required 5 volt power source to the Crankshaft Position (CKP) sensor.
- supplies the required 5 volt power source to the Camshaft Position (CMP) sensor.
- supplies a reference voltage for the Manifold Absolute Pressure (MAP) sensor.

POWERTRAIN CONTROL MODULE (Continued)

• supplies a reference voltage for the Throttle Position Sensor (TPS) sensor.

Secondary 5–volt supply:

• supplies the required 5 volt power source to the oil pressure sensor.

• supplies the required 5 volt power source for the Vehicle Speed Sensor (VSS) (if equipped).

• supplies the 5 volt power source to the transmission pressure sensor (certain automatic transmissions).

OPERATION - IGNITION CIRCUIT SENSE

The ignition circuit sense input tells the PCM the ignition switch has energized the ignition circuit.

Battery voltage is also supplied to the PCM through the ignition switch when the ignition is in the RUN or START position. This is referred to as the ″ignition sense″ circuit and is used to ″wake up″ the PCM. Voltage on the ignition input can be as low as 6 volts and the PCM will still function. Voltage is supplied to this circuit to power the PCM's 8-volt regulator and to allow the PCM to perform fuel, ignition and emissions control functions.

REMOVAL

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

The PCM is located in the engine compartment attached to the dash panel (Fig. 6).

To avoid possible voltage spike damage to the PCM, ignition key must be off, and negative battery cable must be disconnected before unplugging PCM connectors.

(1) Disconnect negative battery cable at battery.

(2) Remove cover over electrical connectors. Cover snaps onto PCM.

(3) Carefully unplug the three 32–way connectors (four 38–way connectors if equipped with NGC) from PCM (Fig. 7).

(4) Remove three PCM mounting bolts (Fig. 7) and remove PCM from vehicle.

INSTALLATION

USE THE DRB SCAN TOOL TO REPROGRAM THE NEW POWERTRAIN CONTROL MODULE (PCM) WITH THE VEHICLES ORIGINAL IDENTIFICATION NUMBER (VIN) AND THE VEHICLES ORIGINAL MILEAGE. IF THIS STEP IS NOT DONE, A DIAGNOSTIC TROUBLE CODE (DTC) MAY BE SET.

(1) Install PCM and 3 mounting bolts to vehicle.

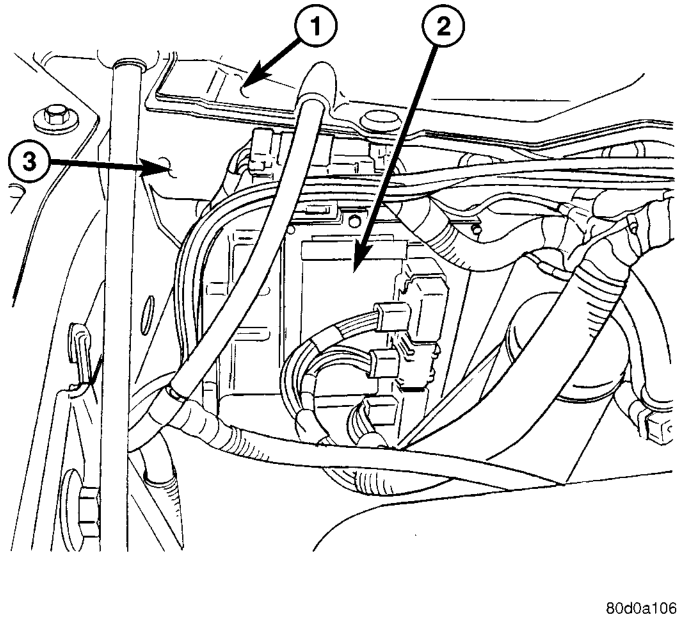

Fig. 6 PCM LOCATION

1 - COWL GRILL
2 - PCM
3 - COWL (RIGHT-REAR)

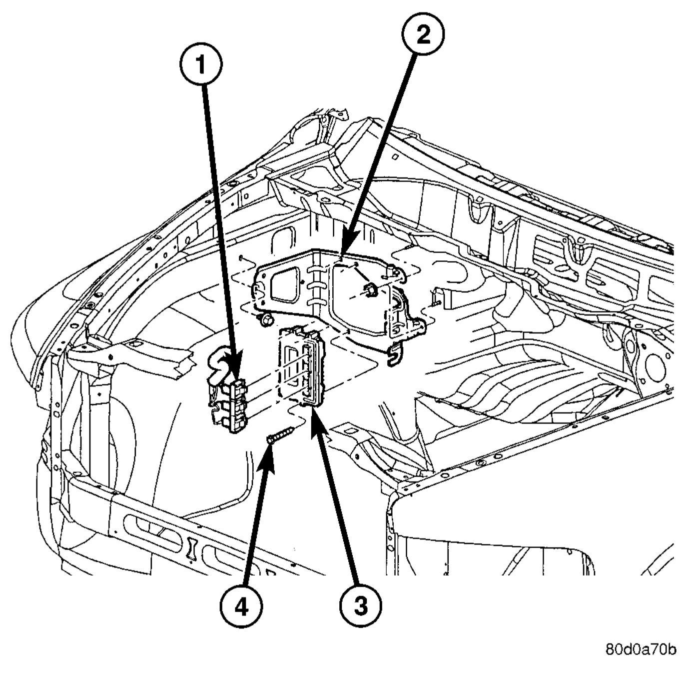

Fig. 7 PCM REMOVAL / INSTALLATION

1 - THREE 32-WAY CONNECTORS WITH JTEC (FOUR 38-WAY CONNECTORS WITH NGC)
2 - PCM MOUNTING BRACKET
3 - PCM
4 - PCM MOUNTING SCREWS (3)

POWERTRAIN CONTROL MODULE (Continued)

(2) Tighten bolts. Refer to torque specifications.

(3) Check pin connectors in the PCM and the three 32–way connectors (four 38–way connectors if equipped with NGC) for corrosion or damage. Also, the pin heights in connectors should all be same. Repair as necessary before installing connectors.

(4) Install three 32–way connectors (four 38–way connectors if equipped with NGC).

(5) Install cover over electrical connectors. Cover snaps onto PCM.

(6) Install negative battery cable.

(7) Use the DRB scan tool to reprogram new PCM with vehicles original Vehicle Identification Number (VIN) and original vehicle mileage.

SENTRY KEY IMMOBILIZER MODULE

DESCRIPTION

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a central processing unit, which includes the Sentry Key Immobilizer System (SKIS) program logic. The SKIS programming enables the SKIM to program and retain in memory the codes of at least two, but no more than eight electronically coded Sentry Key transponders. The SKIS programming also enables the SKIM to communicate over the Programmable Communication Interface (PCI) bus network with the Powertrain Control Module (PCM), and/or the DRBIII® scan tool.

OPERATION

The SKIM transmits and receives RF signals through a tuned antenna enclosed within a molded plastic ring that is integral to the SKIM housing. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the ignition lock cylinder housing. This antenna ring must be located within eight millimeters (0.31 inches) of the Sentry Key in order to ensure proper RF communication between the SKIM and the Sentry Key transponder.

For added system security, each SKIM is programmed with a unique “Secret Key” code and a security code. The SKIM keeps the “Secret Key” code in memory. The SKIM also sends the “Secret Key” code to each of the programmed Sentry Key transponders. The security code is used by the assembly plant to access the SKIS for initialization, or by the dealer technician to access the system for service. The SKIM also stores in its memory the Vehicle Identification Number (VIN), which it learns through a PCI bus message from the PCM during initialization.

The SKIM and the PCM both use software that includes a rolling code algorithm strategy, which helps to reduce the possibility of unauthorized SKIS disarming. The rolling code algorithm ensures security by preventing an override of the SKIS through the unauthorized substitution of the SKIM or the PCM. However, the use of this strategy also means that replacement of either the SKIM or the PCM units will require a system initialization procedure to restore system operation.

When the ignition switch is turned to the ON or START positions, the SKIM transmits an RF signal to excite the Sentry Key transponder. The SKIM then listens for a return RF signal from the transponder of the Sentry Key that is inserted in the ignition lock cylinder. If the SKIM receives an RF signal with valid “Secret Key” and transponder identification codes, the SKIM sends a “valid key” message to the PCM over the PCI bus. If the SKIM receives an invalid RF signal or no response, it sends “invalid key” messages to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages.

The SKIM also sends messages to the Instrument Cluster which controls the VTSS indicator LED. The SKIM sends messages to the Instrument Cluster to turn the LED on for about three seconds when the ignition switch is turned to the ON position as a bulb test. After completion of the bulb test, the SKIM sends bus messages to keep the LED off for a duration of about one second. Then the SKIM sends messages to turn the LED on or off based upon the results of the SKIS self-tests. If the VTSS indicator LED comes on and stays on after the bulb test, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative.

If the SKIM detects an invalid key when the ignition switch is turned to the ON position, it sends messages to flash the VTSS indicator LED. The SKIM can also send messages to flash the LED as an indication to the customer that the SKIS has been placed in it’s “Customer Learn” programming mode. See Sentry Key Immobilizer System Transponder Programming in this section for more information on the “Customer Learn” programming mode.

For diagnosis or initialization of the SKIM and the PCM, a DRBIII® scan tool and the proper Powertrain Diagnostic Procedures manual are required. The SKIM cannot be repaired and, if faulty or damaged, the unit must be replaced.

STANDARD PROCEDURE - PCM/SKIM PROGRAMMING

NOTE: There are two procedures for transfering the secret key to the SKIM:

- **When ONLY the SKIM module is replaced, the secret key is transfered from the PCM to the SKIM. The ORGINAL KEYS may then be programmed to the SKIM.**
- **When ONLY the PCM is replaced, then the secret key is transfered from the SKIM to the PCM. The ORGINAL KEYS may be used.**
- **When BOTH the SKIM and the PCM are replaced the secret key is transferred from the SKIM to the PCM, and NEW KEYS must be programmed.**

NOTE: Before replacing the Powertrain Control Module (PCM) for a failed driver, control circuit, or ground circuit, be sure to check the related component/circuit integrity for failures not detected due to a double fault in the circuit. Most PCM driver/control circuit failures are caused by internal component failures (i.e. relay and solenoids) and shorted circuits (i.e. pull-ups, drivers and switched circuits). These failures are difficult to detect when a double fault has occurred and only one Diagnostic Trouble Code (DTC) has set.

When a PCM (SBEC) and the Sentry Key Immobilizer Module (SKIM) are replaced at the same time perform the following steps in order:

(1) Program the new PCM (SBEC).

(2) Program the new SKIM.

(3) Replace all ignition keys and program them to the new SKIM.

PROGRAMMING THE PCM (SBEC)

The Sentry Key Immobilizer System (SKIS) Secret Key is an ID code that is unique to each SKIM. This code is programmed and stored in the SKIM, PCM and transponder chip (ignition keys). When replacing the PCM it is necessary to program the secret key into the new PCM using the DRBIII® scan tool. Perform the following steps to program the secret key into the PCM.

(1) Turn the ignition switch on (transmission in park/neutral).

(2) Use the DRBIII® scan tool and select THEFT ALARM, SKIM then MISCELLANEOUS.

(3) Select PCM REPLACED (GAS ENGINE).

(4) Enter secured access mode by entering the vehicle four-digit PIN.

(5) Select ENTER to update PCM VIN.

NOTE: If three attempts are made to enter secure access mode using an incorrect PIN, secured access mode will be locked out for one hour. To exit this lockout mode, turn the ignition to the RUN position for one hour then enter the correct PIN. (Ensure all accessories are turned OFF. Also monitor the battery state and connect a battery charger if necessary).

(6) Press ENTER to transfer the secret key (the SKIM will send the secret key to the PCM).

(7) Press Page Back to get to the Select System menu and select ENGINE, MISCELLANEOUS, and SRI MEMORY CHECK.

(8) The DRBIII® scan tool will ask, Is odometer reading between XX and XX? Select the YES or NO button on the DRB III® scan tool. If NO is selected, the DRBIII® scan tool will read, Enter odometer Reading<From I.P. odometer>. Enter the odometer reading from the instrument cluster and press ENTER.

PROGRAMMING THE SKIM

(1) Turn the ignition switch on (transmission in park/neutral).

(2) Use the DRBIII® scan tool and select THEFT ALARM, SKIM then MISCELLANEOUS.

(3) Select SKIM REPLACED (GAS ENGINE).

(4) Program the vehicle four-digit PIN into SKIM.

(5) Select COUNTRY CODE and enter the correct country.

NOTE: Be sure to enter the correct country code. If the incorrect country code is programmed into the SKIM, the SKIM must be replaced.

(6) Select YES to update the VIN (the SKIM will learn the VIN from the PCM).

(7) Press ENTER to transfer the secret key (the PCM will send the secret key information to the SKIM).

(8) Program ignition keys to the SKIM.

NOTE: If the PCM and the SKIM are replaced at the same time, all vehicle keys will need to be replaced and programmed to the new SKIM.

PROGRAMMING IGNITION KEYS TO THE SKIM

(1) Turn the ignition switch on (transmission in park/neutral).

(2) Use the DRBIII® scan tool and select THEFT ALARM, SKIM then MISCELLANEOUS.

(3) Select PROGRAM IGNITION KEY'S.

(4) Enter secured access mode by entering the vehicle four-digit PIN.

SENTRY KEY IMMOBILIZER MODULE (Continued)

NOTE: A maximum of eight keys can be learned to each SKIM. Once a key is learned to a SKIM, it (the key) cannot be transferred to another vehicle.

(5) If ignition key programming is unsuccessful, the DRBIII® scan tool will display one of the following messages:

(a) Programming Not Attempted - The DRBIII® scan tool attempts to read the programmed key status and there are no keys programmed into SKIM memory.

(b) Programming Key Failed (Possible Used Key From Wrong Vehicle) - SKIM is unable to program key due to one of the following:

- Faulty ignition key transponder.
- Ignition key is programmed to another vehicle.

(c) 8 Keys Already Learned, Programming Not Done - SKIM transponder ID memory is full.

(6) Obtain ignition keys to be programmed from customer (8 keys maximum).

(7) Using the DRBIII® scan tool, erase all ignition keys by selecting MISCELLANEOUS and ERASE ALL CURRENT IGN. KEYS.

(8) Program all ignition keys.

Learned Key In Ignition - Ignition key transponder ID is currently programmed in SKIM memory.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the steering column upper and lower shrouds. Refer to Steering, Column, Shroud, Removal.

(3) Disconnect the steering column wire harness connector from the Sentry Key Immobilizer Module (SKIM)

(4) Remove the screw securing the SKIM module to the steering column (Fig. 8).

(5) Release the SKIM antenna ring retaining clips from around the ignition switch lock cylinder housing and remove the SKIM.

INSTALLATION

NOTE: If the SKIM is replaced with a new unit, a DRBIII® scan tool MUST be used to initialize the new SKIM and to program at least two Sentry Key transponders. (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY - STANDARD PROCEDURE).

(1) Slide the SKIM antenna ring around the ignition switch lock cylinder housing and clip in place (Fig. 8).

(2) Install the retaining screw.

(3) Connect the steering column wire harness connector to the Sentry Key Immobilizer Module (SKIM).

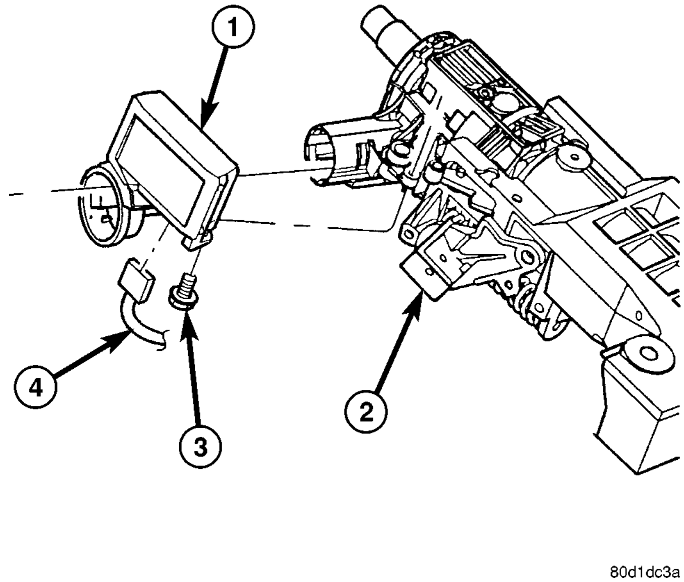

Fig. 8 SENTRY KEY IMMOBILIZER MODULE (SKIM)

1 - SENTRY KEY IMMOBILIZER MODULE (SKIM)
2 - STEERING COLUMN
3 - SCREW
4 - WIRING HARNES

(4) Install the steering column upper and lower shrouds. Refer to Steering, Column, Shroud, Installation.

(5) Connect the battery negative cable.

TRANSFER CASE CONTROL MODULE

DESCRIPTION

The Transfer Case Control Module (TCCM) (Fig. 9) is a microprocessor-based assembly, controlling the 4X4 transfer case shift functions via the actuation of a shift motor and utilizing the feedback of a mode sensor assembly. Communication is via the PCI serial bus. Inputs include user selectable 4X4 modes that include 2WD, 4HI, 4LO, and Neutral. The logic and driver circuitry is contained in a molded plastic housing with an embedded heat-sink and is located behind the left side of the lower instrument panel.

OPERATION

The Transfer Case Control Module (TCCM) utilizes the input from the transfer case mounted mode sensor, the instrument panel mounted selector switch, and the following information from the vehicle's PCI serial bus to determine if a shift is allowed.

- Engine RPM and Vehicle Speed

TRANSFER CASE CONTROL MODULE (Continued)

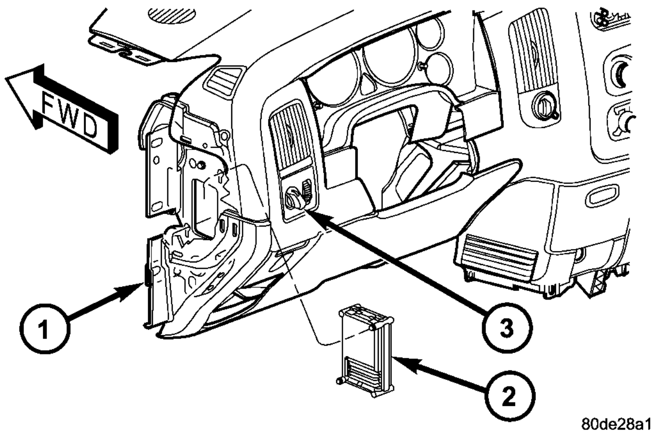

Fig. 9 Transfer Case Control Module (TCCM) Location

1 - INSTRUMENT PANEL
2 - TRANSFER CASE CONTROL MODULE (TCCM)
3 - TRANSFER CASE SELECTOR SWITCH

- Diagnostic Requests
- Manual Transmission and Brake Applied
- PRNDL
- Ignition Status
- ABS Messages

Once the TCCM determines that a requested shift is allowed, it actuates the bi-directional shift motor as necessary to achieve the desired transfer case operating mode. The TCCM also monitors the mode sensor while controlling the shift motor to determine the status of the shift attempt.

Several items can cause the requested shift not to be completed. If the TCCM has recognized a fault (DTC) of some variety, it will begin operation in one of four Functionality Levels. These levels are:

- **Level Zero** - Normal Operation.
- **Level One** - Only Mode Shifts Are Allowed.
- **Level Two** - Only Mode Shifts and Shifts Into LOW Are Allowed (No Neutral Shifts Are Allowed).
- **Level Three** - No Shifts Are Allowed

The TCCM can also be operating in one of three possible power modes. These power modes are:

- **Full Power Mode** is the normal operational mode of the module. This mode is achieved by normal PCI bus traffic being present and the ignition being in the RUN position.
- **Reduced Power Mode** will be entered when the ignition has been powered off. In this state, the module will shut down power supplied to external devices, and to electronic interface inputs and outputs. From this state the module can enter either Sleep Mode or Full Power Mode. To enter this mode, the module must receive an ignition message denoting that the ignition is off, or not receive any messages for 5 ±0.5 seconds. To exit this mode, the module must receive one ignition message that denotes that the ignition is in the RUN position.
- **Sleep Mode** will be entered, from the Reduced Power Mode, when no PCI traffic has been sensed for 20 ±1 seconds. If during Sleep Mode the module detects PCI bus traffic, it will revert to the Reduced Power mode while monitoring for ignition messages. It will remain in this state as long as there is traffic other than run or start messages, and will return to Sleep mode if the bus goes without traffic for 20 ±1 seconds.

SHIFT REQUIREMENTS

If the TCCM is in full power mode and at functionality level zero, it uses the following criteria to determine if a shift is allowed.

If any of the driver controllable conditions are not met once the shift request is recognized, the TCCM will solidly illuminate the source position's LED and flash the desired position's LED for all shifts except NEUTRAL. The NEUTRAL shift LED strategy will be discussed later.

Mode shifts will be allowed regardless of transmission gear or vehicle speed, whenever the following conditions are met:

- Front and rear wheel speed are within 21 km/hr (13 mph).
- A change in the Selector switch state indicates that a mode shift has been requested.
- A valid mode sensor signal is being sensed by the TCCM.
- Proper transmit/receive messages are occurring on the PCI bus.
- Ignition key switch is in the RUN position.

Range shifts will be allowed only if all of the following conditions are met:

- Front and rear wheel speed are within 21 km/hr (13 mph).
- A change in the Selector Switch state indicating a range shift has been requested.
- Transmission in NEUTRAL signal must be recognized for at least 1.5 seconds ±100 msec. (Automatic transmissions only)
- Proper transmit/receive messages are occurring on the PCI bus.
- Clutch signal is recognized for 500 msec ± 50 msec (Manual transmissions only).
- Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).
- Ignition key switch is in the RUN position.
- A valid mode sensor signal is being sensed by the TCCM.

A **shift into transfer case Neutral** will be allowed only if all of the following conditions are met:

- Front and rear wheel speed are within 21 km/hr (13 mph).

TRANSFER CASE CONTROL MODULE (Continued)

• The recessed Neutral Selection switch has been depressed continuously for 4.0 seconds ±100 msec while all shift conditions have been continuously met.
• Transmission in NEUTRAL signal recognized from the bus. (Automatic transmissions only)
• Clutch signal is recognized from the bus (Manual transmissions only).
• Proper message transmissions/receptions are occurring on the PCI bus.
• Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).
• Ignition key switch is in the RUN position, engine off.
• Foot Brake is applied.
• A valid mode sensor signal is being sensed by the TCCM.

A **shift out of transfer case Neutral** will be allowed only if all of the following conditions are met:
• Front and rear wheel speed are within 21 km/hr (13 mph).
• The recessed Neutral Selection switch has been depressed continuously for 1.0 seconds ±100 msec while all shift conditions have been continuously met.
• Transmission in NEUTRAL signal recognized from the bus.(Automatic transmissions only)
• Clutch signal is recognized from the bus (Manual transmissions only).
• Proper message transmissions/receptions are occurring on the PCI bus.
• Vehicle speed is less than or equal to 4.8 km/hr (3 miles per hour).
• Ignition key switch is in the RUN position.
• Foot Brake is applied.
• A valid mode sensor signal is being sensed by the TCCM.

SHIFT SEQUENCES

Once all the driver controllable conditions for the requested shift have been met, the TCCM begins a shift timer with a maximum duration of 1 second per 'D' channel transition. If the shift timer expires before the TCCM recognizes to correct mode sensor code, the shift is considered to have been blocked. The blocked shift will increment the blocked shift counter by one. The TCCM strategy for handling blocked shifts will be described later. The process the TCCM performs for the various shifts will be described first.

RANGE AND MODE SHIFTS

The process for performing all the range and mode shifts are the same. The following steps describe the process.
• Allow time for Selector Switch debounce; 250 msec ±50 msec.
• Extinguish the source gear's LED while flashing desired transfer case position's LED.
• Engage the shift motor for a maximum of 1 second ±100 msec per 'D' channel transition in the destination gear's direction while monitoring the mode sensor channel transitions.
• Disengage the shift motor when the correct mode sensor code is recognized.
• Solidly illuminate the selected gear's LED.
• Transmit a bus message that the transfer case shift is complete.
• If the desired mode sensor code is not received after the shift timer expires (ie. a blocked or other condition exists), stop driving the motor and wait for 200 msec ±50 msec. The shift motor is then reversed in the direction back toward the source gear for up to 1.0 seconds ±100 msec. per 'D' channel. The TCCM waits for 2.0 seconds ±50 msec. and repeats the attempt to shift to the desired position.

The exception to the preceding sequence is when a shift from 4L to 2WD/AWD is requested. If 2WD/AWD is requested from the 4L position, the transfer case is first driven to the 4H position. If the 4H position is reached, the transfer case is then driven back to the 2WD/AWD position and the shift is considered complete. If the transfer case does not reach any the 4H position, but is in the 2WD/AWD 'D' channel, or the 2WD/AWD between gear position on the 4H side of 2WD/AWD, the shift is also considered complete.

SHIFT OUT OF NEUTRAL

• Extinguish the Neutral LED.
• Engage the shift motor for a maximum of 1 second ±100 msec toward the transfer case 4H mode position while monitoring the mode sensor channel transitions.
• Disengage the shift motor when the correct mode sensor code is recognized.
• Extinguish the Neutral LED.
• Transmit a bus message that the transfer case shift is complete.
• If the desired mode sensor code is not received after the shift timer expires (ie. a blocked or other condition exists), stop driving the motor and wait for 200 msec ±50 msec. The shift motor is then reversed in the direction back toward the source gear for up to 1.0 seconds 100 msec. The TCCM waits for 2.0 seconds ±50 msec. and repeats the attempt to shift to the desired position.
• When the Neutral button is released, if the 4H position is the desired position, the shift is complete. Illuminate the 4H LED.
• Otherwise when the Neutral button is released, if all of the shift requirements are being met then engage the shift motor towards the desired position for 1 second ±100 msec per 'D' channel. (if require-

ments for shifting are not met, illuminate the 4H LED and flash the destination LED as an indication to the driver that all of the driver controllable shift conditions are not being met). If this requires another range or mode shift, begin the range/mode shift process.

• If the desired mode sensor code is not received after the shift timer expires (i.e. a blocked or other condition exists), refer to the section on Blocked Shift Strategy.

BLOCKED SHIFT STRATEGY

When a shift is commanded, the shift motor will be driven towards its destination position, except in the case of shifting out of Neutral if 4L was selected (the transfer case will shift to the 4H position first, before proceeding to 4L). If the shift is blocked on the way to the destination, the TCCM may attempt to drive the motor back to the original position. This process will be allowed to occur 5 times. If the transfer case has reached a non-NEUTRAL 'D' channel during the shift re-attempts, the LED for the achieved gear position is illuminated and the shift attempts are stopped. To re-attempt the desired shift, the selector switch will need to be rotated to the current position until the switch debounce timer expires then a shift will need to be requested again.

At the end of the 5th blocked attempt, the shift motor is driven towards the last known 'D' channel position. If this motor drive allows the transfer case to reach the 2WD/AWD 'D' channel, or the 2WD/AWD between gear position on the 4H side of 2WD/AWD, the shift is considered complete and the shift attempts are ended.

If the mode sensor is in the NEUTRAL region at the expiration of the shift timer, the TCCM will continue to make the shift attempts according to the blocked shift strategy independent of whether or not the driver controlled conditions are met.

For shifts from NEUTRAL, if all 5 attempts fail to reach the desired position (which by default is 4H), the motor will be driven to stall in the direction of 4H or 4L, depending on the achieved position. If the transfer case has reached the 2WD/AWD or 4L between gear position nearest the NEUTRAL positions and the shift conditions are no longer being met, the transfer case will be driven toward the corresponding 'D' channel. Otherwise, the transfer case will be driven in the direction opposite the last attempt with the desired target being 4H or 4L.

If the transfer case reaches the 2WD/AWD 'D' channel when being driven in the 4H direction, then one final 1.0 second drive toward 4H is attempted. If the transfer case then reaches any of the 4H positions, the shift is considered complete and the 4H LED is illuminated. If the transfer case is still the 2WD/AWD position, the shift is considered complete and the 2WD/AWD LED is illuminated.

NOTE: If after the 5th blocked shift and reversal attempt, if the transfer case position is in the NEUTRAL region, shift attempts will continue until a non-NEUTRAL 'D' channel is reached.

SHIFT REVERSAL TARGETS

If the shift timer expires (1 second per 'D' channel) and the transfer case has not reached the desired position, all shifts will attempt to return to their original position with the exceptions of:

• If the intended shift is going to the High rail from Low and can't make it, but it can make the 2WD/AWD position, the motor stops at that position. The TCCM will not attempt to cross back over NEUTRAL if it does not have to. This means that there was a block on the first attempt to go to 4H and the transfer case has made it through NEUTRAL to a known good position, then the motor will go back only to the 2WD/4WD position and execute the remainder of the attempts from there.

• For shifts out of NEUTRAL, any time a shift is commanded out of NEUTRAL, the system needs to get out. The TCCM should never go to NEUTRAL unless the driver is commanding it and all required conditions are being met

ENCODER DRIFT CORRECTION

Whenever a shift is completed, the TCCM stores the position in memory as the transfer case's intended position. The TCCM continuously monitors the mode sensor and if the mode sensor drifts toward into a NEUTRAL region sensor position for 2.0 seconds, the TCCM will perform a motor drive to correct the drift. The transfer case will be driven toward the intended position for 1.0 seconds 100 msec. The TCCM will wait for 2.0 seconds ±50 msec. and repeat the attempt to shift to the desired position. This will continue until the intended position is reached.

SHIFT MOTOR BRAKING

Two modes of shift motor braking are employed to improve shift performance, static and dynamic. Static shift motor braking is utilized under the following conditions:

• Whenever the transfer case is in the 2WD/AWD or 4L 'D' channel position.

• Whenever an invalid mode sensor code is present.

Static motor braking is achieved by applying +12V on both shift motor wires.

NOTE: Static Shift Motor Braking is independent of ignition key position.

TRANSFER CASE CONTROL MODULE (Continued)

SHIFT ATTEMPT LIMIT

To protect the transfer case system, the TCCM will impose a limit on the number of shifts that can occur over a calibrated time period. The system will monitor the number of 'D' channel segment transitions that occur in any 30 second time period. If the number of segment transitions is 30 or greater, the system will go into a default mode. The default mode of operation for shifting is that the number of allowed 'D' channel transitions permitted to occur will be 3 over each 15 second ±100 msec calibrated window of time. After 5 minutes ±100 msec, the motor can be assumed to have cooled down and the system will revert to normal operation. The following rules also apply to the shift limit:

- The attempt limit will not prevent shifts coming out of NEUTRAL, they will be allowed regardless of the counter/timer.
- Any shift that is in progress when the counter reaches a maximum count in time will be allowed to complete before the default mode is entered. D-channel transitions during this period will not be counted towards the default mode limit.
- A block, regardless of the direction, whether towards destination or back towards reversal target (shift timer expiring), will count as a value of 2 transitions towards the 30 segment transitions to go into default mode as defined above. Current attempt limit values are 30 transitions in 30 seconds and default mode values are 3 transitions every 15 seconds for 5 minutes.

TRANSMISSION CONTROL MODULE

DESCRIPTION

The Transmission Control Module (TCM) (Fig. 10) may be sub-module within the Powertrain Control Module (PCM) or a standalone module, depending on the vehicle engine. The PCM, and TCM when equipped, is located at the right rear of the engine compartment, near the right inner fender.

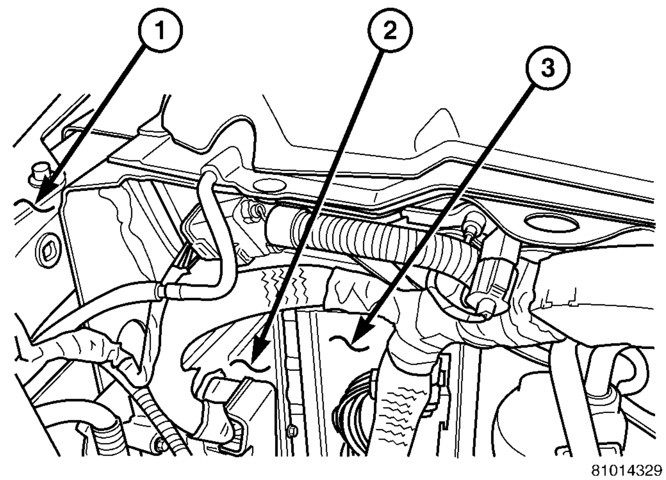

Fig. 10 PCM/TCM Location

1 - RIGHT FENDER
2 - TRANSMISSION CONTROL MODULE
3 - POWERTRAIN CONTROL MODULE

OPERATION

The Transmission Control Module (TCM) controls all electronic operations of the transmission. The TCM receives information regarding vehicle operation from both direct and indirect inputs, and selects the operational mode of the transmission. Direct inputs are hardwired to, and used specifically by the TCM. Indirect inputs are shared with the TCM via the vehicle communication bus.

Some examples of **direct inputs** to the TCM are:

- Battery (B+) voltage
- Ignition "ON" voltage
- Transmission Control Relay (Switched B+)
- Throttle Position Sensor
- Crankshaft Position Sensor
- Transmission Range Sensor
- Pressure Switches
- Transmission Temperature Sensor
- Input Shaft Speed Sensor
- Output Shaft Speed Sensor
- Line Pressure Sensor

Some examples of **indirect inputs** to the TCM are:

- Engine/Body Identification
- Manifold Pressure
- Target Idle
- Torque Reduction Confirmation
- Engine Coolant Temperature
- Ambient/Battery Temperature
- DRBIII® Scan Tool Communication

Based on the information received from these various inputs, the TCM determines the appropriate shift schedule and shift points, depending on the present operating conditions and driver demand. This is possible through the control of various direct and indirect outputs.

Some examples of TCM **direct outputs** are:

- Transmission Control Relay
- Solenoids
- Torque Reduction Request

Some examples of TCM **indirect outputs** are:

- Transmission Temperature (to PCM)
- PRNDL Position (to BCM)

In addition to monitoring inputs and controlling outputs, the TCM has other important responsibilities and functions:

- Storing and maintaining Clutch Volume Indexes (CVI)
- Storing and selecting appropriate Shift Schedules
- System self-diagnostics
- Diagnostic capabilities (with DRBIII® scan tool)

TRANSMISSION CONTROL MODULE (Continued)

NOTE: If the TCM has been replaced, the "Quick Learn Procedure" must be performed. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)

BATTERY FEED

A fused, direct battery feed to the TCM is used for continuous power. This battery voltage is necessary to retain memory in the TCM. When the battery (B+) is disconnected, this memory is lost. When the battery (B+) is restored, this memory loss is detected by the TCM and a Diagnostic Trouble Code (DTC) is set.

CLUTCH VOLUME INDEXES (CVI)

An important function of the TCM is to monitor Clutch Volume Indexes (CVI). CVIs represent the volume of fluid needed to compress a clutch pack.

The TCM monitors gear ratio changes by monitoring the Input and Output Speed Sensors. The Input, or Turbine Speed Sensor sends an electrical signal to the TCM that represents input shaft rpm. The Output Speed Sensor provides the TCM with output shaft speed information.

By comparing the two inputs, the TCM can determine transmission gear position. This is important to the CVI calculation because the TCM determines CVIs by monitoring how long it takes for a gear change to occur (Fig. 11).

Gear ratios can be determined by using the DRBIII® Scan Tool and reading the Input/Output Speed Sensor values in the "Monitors" display. Gear ratio can be obtained by dividing the Input Speed Sensor value by the Output Speed Sensor value.

For example, if the input shaft is rotating at 1000 rpm and the output shaft is rotating at 500 rpm, then the TCM can determine that the gear ratio is 2:1. In direct drive (3rd gear), the gear ratio changes to 1:1. The gear ratio changes as clutches are applied and released. By monitoring the length of time it takes for the gear ratio to change following a shift request, the TCM can determine the volume of fluid used to apply or release a friction element.

The volume of transmission fluid needed to apply the friction elements are continuously updated for adaptive controls. As friction material wears, the volume of fluid need to apply the element increases.

Certain mechanical problems within the input clutch assembly can cause inadequate or out-of-range element volumes. Also, defective Input/Output Speed Sensors and wiring can cause these conditions. The following chart identifies the appropriate clutch volumes and when they are monitored/updated:

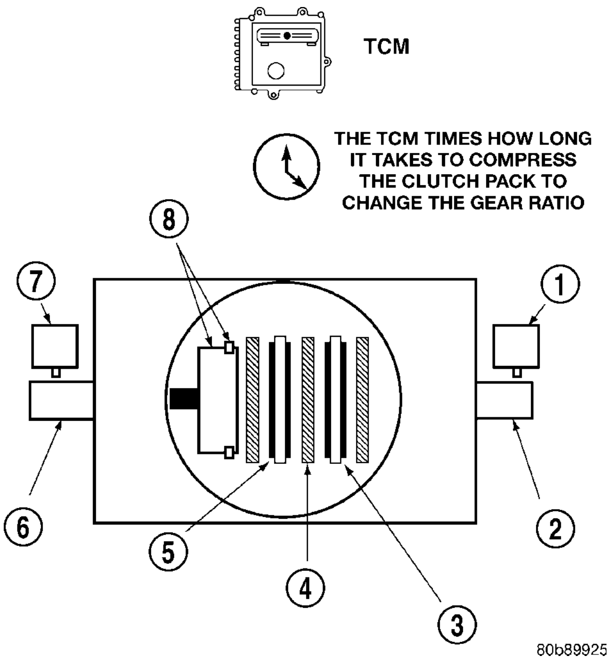

Fig. 11 Example of CVI Calculation

1 - OUTPUT SPEED SENSOR
2 - OUTPUT SHAFT
3 - CLUTCH PACK
4 - SEPARATOR PLATE
5 - FRICTION DISCS
6 - INPUT SHAFT
7 - INPUT SPEED SENSOR
8 - PISTON AND SEAL

CLUTCH VOLUMES		
Clutch	**When Updated**	**Proper Clutch Volume**
L/R	2-1 or 3-1 downshift	45 to 134
2C	3-2 kickdown shift	25 to 85
OD	2-3 upshift	30 to 100
4C	3-4 upshift	30 to 85
UD	4-3 kickdown shift	30 to 100

SHIFT SCHEDULES

As mentioned earlier, the TCM has programming that allows it to select a variety of shift schedules. Shift schedule selection is dependent on the following:

- Shift lever position
- Throttle position
- Engine load
- Fluid temperature
- Software level

As driving conditions change, the TCM appropriately adjusts the shift schedule. Refer to the following chart to determine the appropriate operation expected, depending on driving conditions.

TRANSMISSION CONTROL MODULE (Continued)

Schedule	Condition	Expected Operation
Extreme Cold	Oil temperature below -16° F	-Park, Reverse, Neutral and 1st and 3rd gear only in D position, 2nd gear only in Manual 2 or L -No EMCC
Super Cold	Oil temperature between -12° F and 10° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - Early 4-3 coastdown shift - High speed 4-2, 3-2, 2-1 kickdown shifts are prevented -Shifts at high throttle openings willl be early. - No EMCC
Cold	Oil temperature between 10° F and 36° F	-Shift schedule is the same as Super Cold except that the 2-3 upshifts are not delayed.
Warm	Oil temperature between 40° F and 80° F	- Normal operation (upshift, kickdowns, and coastdowns) - No EMCC
Hot	Oil temperature between 80° F and 240° F	- Normal operation (upshift, kickdowns, and coastdowns) - Normal EMCC operation
Overheat	Oil temperature above 240° F or engine coolant temperature above 244° F	- Delayed 2-3 upshift - Delayed 3-4 upshift - 3rd gear FEMCC from 30-48 mph - 3rd gear PEMCC above 35 mph - Above 25 mph the torque converter will not unlock unless the throttle is closed or if a wide open throttle 2nd PEMCC to 1 kickdown is made

STANDARD PROCEDURE

STANDARD PROCEDURE - TCM QUICK LEARN

The quick learn procedure requires the use of the DRB® scan tool.

This program allows the electronic transmission system to recalibrate itself. This will provide the proper transmission operation. The quick learn procedure should be performed if any of the following procedures are performed:

- Transmission Assembly Replacement
- Transmission Control Module Replacement
- Solenoid Pack Replacement
- Clutch Plate and/or Seal Replacement
- Valve Body Replacement or Recondition

To perform the Quick Learn Procedure, the following conditions must be met:

- The brakes must be applied
- The engine speed must be above 500 rpm
- The throttle angle (TPS) must be less than 3 degrees
- The shift lever position must stay in PARK until prompted to shift to overdrive
- The shift lever position must stay in overdrive after the Shift to Overdrive prompt until the DRB® indicates the procedure is complete
- The calculated oil temperature must be above 60° and below 200°

STANDARD PROCEDURE - DRIVE LEARN

When a transmission is repaired and a Quick Learn procedure has been performed on the Transmission Control Module (TCM), the following Drive Learn procedure can be performed to fine tune any shifts which are particularly objectionable.

NOTE: It is not necessary to perform the complete Drive Learn procedure every time the TCM is Quick Learned. Perform only the portions which target the objectionable shift.

TRANSMISSION CONTROL MODULE (Continued)

LEARN A SMOOTH 1ST NEUTRAL TO DRIVE SHIFT

Perform this procedure only if the complaint is for a delayed or harsh shift the first time the transmission is put into gear after the vehicle is allowed to set with the engine not running for at least 10 minutes. Use the following steps to have the TCM learn the 1st N-D UD CVI.

NOTE: The transmission oil temperature must be between 80 - 110°F (27 - 43°C).

(1) Start the engine only when the engine and ignition have been off for at least ten (10) minutes.

(2) With the vehicle at a stop and the service brake applied, record the 1st N-D UD CVI while performing a Neutral to Drive shift. The 1st N-D UD CVI accounts for air entrapment in the UD clutch that may occur after the engine has been off for a period of time.

(3) Repeat Step 1 and Step 2 until the recorded 1st N-D UD CVI value stabilizes.

NOTE: It is important that this procedure be performed when the transmission temperature is between 80 - 110°F (27 - 43°C). If this procedure takes too long to complete fully for the allowed transmission oil temperature, the vehicle may be returned to the customer with an explanation that the shift will improve daily during normal vehicle usage. The TCM also learns at higher oil temperatures, but these values (line pressure correction values) are not available for viewing on the DRB® III.

LEARN A SMOOTH NEUTRAL TO DRIVE GARAGE SHIFT

Perform this procedure if the complaint is for a delayed or harsh shift when the transmission is put into gear after the vehicle has had its first shift. Use the following steps to have the TCM learn the Norm N-D UD CVI.

NOTE: The transmission oil temperature must be between 80 - 110°F (27 - 43°C) to learn the UD CVI. Additional learning occurs at temperatures as low as 0°F and as high as 200°F. This procedure may be performed at any temperature that experiences poor shift quality. Although the UD CVI may not change, shift quality should improve.

(1) Start the vehicle engine and shift to drive.

(2) Move the vehicle forward to a speed of at least 16 km/h (10 MPH) and come to a stop. This ensures no air is present in the UD hydraulic circuit.

(3) Perform repeated N-D shifts at a stop while pausing in Neutral for at least 2-3 seconds and monitor Norm N-D UD CVI volume until the value stabilizes. The value will change during the N-D shift. This is normal since the UD value is different for the N-D shift then the normal value shown which is used for 4-3 coastdown and kickdowns. Perform repeated shifts in this temperature range until the Norm N-D UD CVI value stabilizes and the N-D shifts become smooth.

LEARN THE 1ST 2-3 SHIFT AFTER A RESTART OR SHIFT TO REVERSE

Use the following steps to have the TCM learn the 1st 2-3 shift OD CVI.

NOTE: The transmission oil temperature must be above 80°F (27°C).

(1) With the vehicle engine running, select reverse gear for over 2 seconds.

(2) Shift the transmission to Drive and accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform a 2-3 shift while noting the 1st 2-3 OD CVI.

(3) Repeat Step 1 and Step 2 until the 1st 2-3 upshift becomes smooth and the 1st 2-3 OD CVI stabilizes.

LEARN A SMOOTH 2-3 AND 3-4 UPSHIFT

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the OD and 4C CVI's.

(1) Accelerate the vehicle from a stop at a steady 15 degree throttle opening and perform multiple 1-2, 2-3, and 3-4 upshifts. The 2nd 2-3 shift following a restart or shift to reverse will be shown during the shift as a value between the 1st 2-3 OD CVI and the normal OD CVI. Updates to the normal OD CVI will occur after the 2nd shift into 3rd gear, following a restart or shift to reverse.

(2) Repeat Step 1 until the 2-3 and 3-4 shifts become smooth and the OD and 4C CVI become stable.

LEARN A SMOOTH 4-3 COASTDOWN AND PART THROTTLE 4-3 KICKDOWN

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the UD shift volume.

(1) At a vehicle speed between 64-97 km/h (40-60 MPH), perform repeated 4-3 kickdown shifts.

TRANSMISSION CONTROL MODULE (Continued)

(2) Repeat Step 1 until the UD volume becomes somewhat stable and the shift becomes smooth.

LEARN A SMOOTH 1-2 UPSHIFT AND 3-2 KICKDOWN

Use the following steps to have the TCM learn the 2C shift volume.

NOTE: The transmission oil temperature must be above 110°F (43°C).

(1) With a vehicle speed below 48 km/h (30 MPH) and the transmission in 3rd gear, perform multiple 3-2 kickdowns.

(2) Repeat Step 1 until the 3-2 kickdowns become smooth and the 2C CVI becomes stable.

LEARN A SMOOTH MANUAL 2-1 PULLDOWN SHIFT AS WELL AS A NEUTRAL TO REVERSE SHIFT

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the LR volume.

(1) With the vehicle speed around 40-48 km/h (25-30 MPH) in Manual 2nd, perform manual pull-downs to Low or 1st gear at closed throttle.

(2) Repeat Step 1 until the LR CVI becomes stable and the manual 2-1 becomes smooth.

LEARN A SMOOTH NEUTRAL TO REVERSE SHIFT

NOTE: The transmission oil temperature must be above 110°F (43°C).

(1) With the vehicle at a stop, perform Neutral to Reverse shifts until the shift is smooth. An unlearned Neutral to Reverse shift may be harsh or exhibit a double bump.

(2) If any of the shifts are still not smooth after the clutch volume stabilizes, an internal transmission problem may be present.

LEARN A SMOOTH 4-5 UPSHIFT

NOTE: The transmission oil temperature must be above 110°F (43°C).

Use the following steps to have the TCM learn the Alt 2C CVI.

(1) Accelerate the vehicle through 88 km/h (55mph) at a steady 10-15 degree throttle opening and perform multiple 4-5 upshifts.

(2) Repeat Step 1 until the 4-5 shift become smooth and theAlt 2C CVI become stable. There is a separate 2C volume used and learned for 4-5 shifts, 2CA. It is independent of the 2C CVI learned on 3-2 kickdowns.

ENGINE SYSTEMS

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BATTERY SYSTEM

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BATTERY SYSTEM

DESCRIPTION

A single 12-volt battery is standard factory-installed equipment on gasoline engine equipped models. Diesel engine equipped vehicles utilize two 12-volt batteries connected in parallel. All of the components of the battery system are located within the engine compartment of the vehicle. The battery system for this vehicle, covers the following related components, which are covered in further detail later in this section of the service manual:

- **Battery** - The storage battery provides a reliable means of storing a renewable source of electrical energy within the vehicle.
- **Battery Cables** - The battery cables connect the battery terminal posts to the vehicle electrical system.
- **Battery Holddown** - The battery holddown hardware secures the battery in the battery tray in the engine compartment.
- **Battery Tray** - The battery tray provides a secure mounting location in the vehicle for the battery and an anchor point for the battery holddown hardware.

BATTERY SYSTEM (Continued)

For battery system maintenance schedules and jump starting procedures, see the owner's manual in the vehicle glove box. Optionally, refer to the Lubrication and Maintenance section of this manual for the proper battery jump starting procedure. While battery charging can be considered a maintenance procedure, the battery charging procedure and related information are located later in this section of the service manual. This was done because the battery must be fully-charged before any battery system diagnosis or testing procedures can be performed.

OPERATION

The battery system is designed to provide a safe, efficient, reliable and mobile means of delivering and storing electrical energy. This electrical energy is required to operate the engine starting system, as well as to operate many of the other vehicle accessory systems for limited durations while the engine and/or the charging system are not operating. The battery system is also designed to provide a reserve of electrical energy to supplement the charging system for short durations while the engine is running and the electrical current demands of the vehicle exceed the output of the charging system. In addition to delivering, and storing electrical energy for the vehicle, the battery system serves as a capacitor and voltage stabilizer for the vehicle electrical system. It absorbs most abnormal or transient voltages caused by the switching of any of the electrical components or circuits in the vehicle.

DIAGNOSIS AND TESTING - BATTERY SYSTEM

The battery, starting, and charging systems in the vehicle operate with one another and must be tested as a complete system. In order for the engine to start and the battery to maintain its charge properly, all of the components that are used in these systems must perform within specifications. It is important that the battery, starting, and charging systems be thoroughly tested and inspected any time a battery needs to be charged or replaced. The cause of abnormal battery discharge, overcharging or early battery failure must be diagnosed and corrected before a battery is replaced and before a vehicle is returned to service. The service information for these systems has been separated within this service manual to make it easier to locate the specific information you are seeking. However, when attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used for the battery, starting, and charging systems include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, a volt/ohmmeter, a battery charger, a carbon pile rheostat (load tester), a 12-volt test lamp and/or special service tools may be required. All OBD-sensed systems are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects. Always check the PCM for stored trouble codes before returning the vehicle to service. Refer to Charging System for the proper charging system test procedures. Refer to Starting System for the proper starting system test procedures.

MICRO 420 BATTERY TESTER

The Micro 420 automotive battery tester is designed to help the dealership technician diagnose a defective battery. Follow the instruction manual supplied with the tester to properly diagnose a battery. If the instruction manual is not available, refer to the standard procedure in this section, which includes the directions for using the Micro 420 battery tester.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY SEEMS WEAK OR DEAD WHEN ATTEMPTING TO START THE ENGINE.	1. The electrical system ignition-off draw is excessive.	1. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the excessive ignition-off draw, as required.
	2. The charging system is faulty.	2. Determine if the charging system is performing to specifications. Refer to Charging System for additional charging system diagnosis and testing procedures. Repair the faulty charging system, as required.
	3. The battery is discharged.	3. Determine the battery state-of-charge using the Micro 420 battery tester. Refer to the Standard Procedures in this section for additional test procedures. Charge the faulty battery, as required.
	4. The battery terminal connections are loose or corroded.	4. Refer to Battery Cables for the proper battery cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.
	5. The battery has an incorrect size or rating for this vehicle.	5. Refer to Battery System Specifications for the proper size and rating. Replace an incorrect battery, as required.
	6. The battery is faulty.	6. Determine the battery cranking capacity using the Micro 420 battery tester. Refer to the Standard Procedures in this section for additional test procedures. Replace the faulty battery, as required.
	7. The starting system is faulty.	7. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.
	8. The battery is physically damaged.	8. Inspect the battery for loose terminal posts or a cracked and leaking case. Replace the damaged battery, as required.

BATTERY SYSTEM (Continued)

BATTERY SYSTEM DIAGNOSIS		
CONDITION	POSSIBLE CAUSES	CORRECTION
THE BATTERY STATE OF CHARGE CANNOT BE MAINTAINED.	1. The battery has an incorrect size or rating for this vehicle.	1. Refer to Battery System Specifications for the proper specifications. Replace an incorrect battery, as required.
	2. The battery terminal connections are loose or corroded.	2. Refer to Battery Cable for the proper cable diagnosis and testing procedures. Clean and tighten the battery terminal connections, as required.
	3. The electrical system ignition-off draw is excessive.	3. Refer to the IGNITION-OFF DRAW TEST Standard Procedure for the proper test procedures. Repair the faulty electrical system, as required.
	4. The battery is faulty.	4. Test the battery using the Micro 420 battery tester. Refer to Standard Procedures for additional test procedures. Replace the faulty battery, as required.
	5. The starting system is faulty.	5. Determine if the starting system is performing to specifications. Refer to Starting System for the proper starting system diagnosis and testing procedures. Repair the faulty starting system, as required.
	6. The charging system is faulty.	6. Determine if the charging system is performing to specifications. Refer to Charging System for additional charging system diagnosis and testing procedures. Repair the faulty charging system, as required.
	7. Electrical loads exceed the output of the charging system.	7. Inspect the vehicle for aftermarket electrical equipment which might cause excessive electrical loads.
	8. Slow driving or prolonged idling with high-amperage draw systems in use.	8. Advise the vehicle operator, as required.
THE BATTERY WILL NOT ACCEPT A CHARGE.	1. The battery is faulty.	1. Test the battery using the Micro 420 battery tester. Charge or replace the faulty battery, as required.

ABNORMAL BATTERY DISCHARGING

Any of the following conditions can result in abnormal battery discharging:

1. A faulty or incorrect charging system component. Refer to Charging System for additional charging system diagnosis and testing procedures.
2. A faulty or incorrect battery. Use Micro 420 battery tester and refer to Battery System for additional battery diagnosis and testing procedures.
3. A faulty circuit or component causing excessive ignition-off draw.
4. Electrical loads that exceed the output of the charging system. This can be due to equipment installed after manufacture, or repeated short trip use.
5. A faulty or incorrect starting system component. Refer to Starting System for the proper starting system diagnosis and testing procedures.
6. Corroded or loose battery posts and/or terminal clamps.
7. Slow driving speeds (heavy traffic conditions) or prolonged idling, with high-amperage draw systems in use.

CLEANING

The following information details the recommended cleaning procedures for the battery and related com-

BATTERY SYSTEM (Continued)

ponents. In addition to the maintenance schedules found in this service manual and the owner's manual, it is recommended that these procedures be performed any time the battery or related components must be removed for vehicle service.

(1) Clean the battery cable terminal clamps of all corrosion. Remove any corrosion using a wire brush or a post and terminal cleaning tool, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 1).

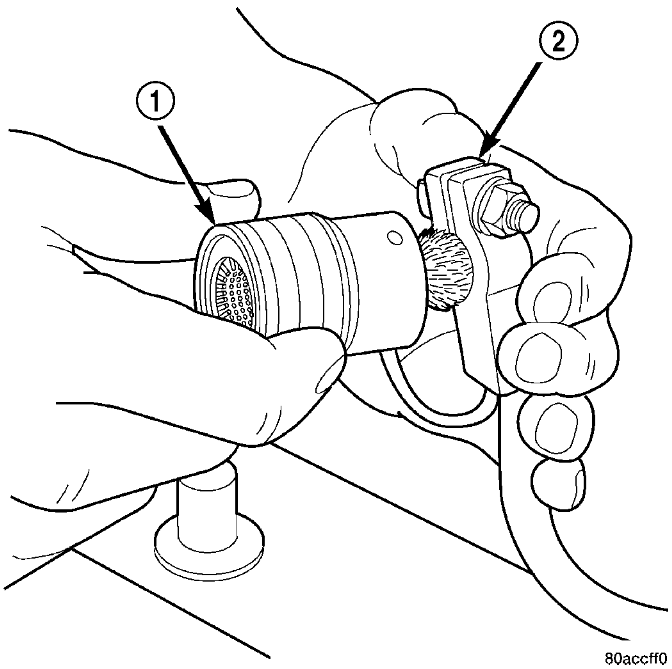


Fig. 1 Clean Battery Cable Terminal Clamp - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE

(2) Clean the battery tray and battery holddown hardware of all corrosion. Remove any corrosion using a wire brush and a sodium bicarbonate (baking soda) and warm water cleaning solution. Paint any exposed bare metal.

(3) If the removed battery is to be reinstalled, clean the outside of the battery case and the top cover with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film (Fig. 2). Rinse the battery with clean water. Ensure that the cleaning solution does not enter the battery cells through the vent holes. If the battery is being replaced, refer to Battery System Specifications for the factory-installed battery specifications. Confirm that the replacement battery is the correct size and has the correct ratings for the vehicle.

(4) Clean the battery thermal guard with a sodium bicarbonate (baking soda) and warm water cleaning solution using a stiff bristle parts cleaning brush to remove any acid film.

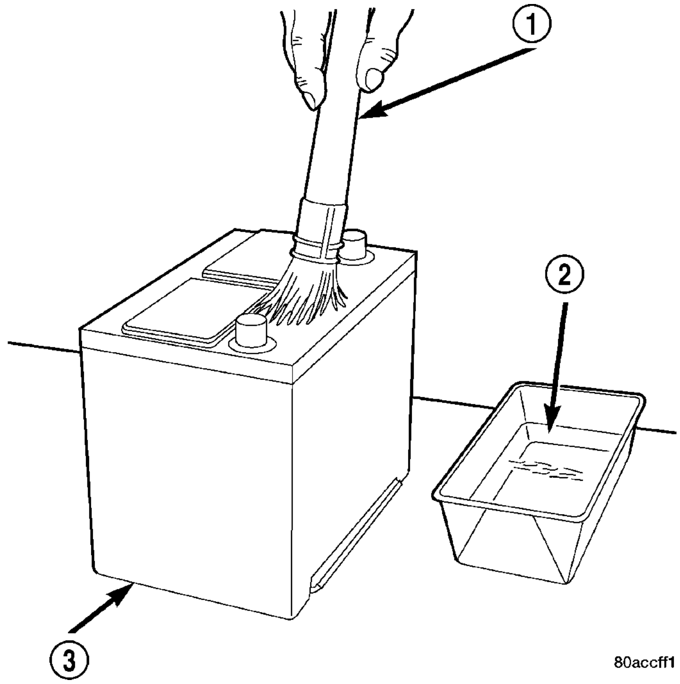


Fig. 2 Clean Battery - Typical

1 - CLEANING BRUSH
2 - WARM WATER AND BAKING SODA SOLUTION
3 - BATTERY

(5) Clean any corrosion from the battery terminal posts with a wire brush or a post and terminal cleaner, and a sodium bicarbonate (baking soda) and warm water cleaning solution (Fig. 3).

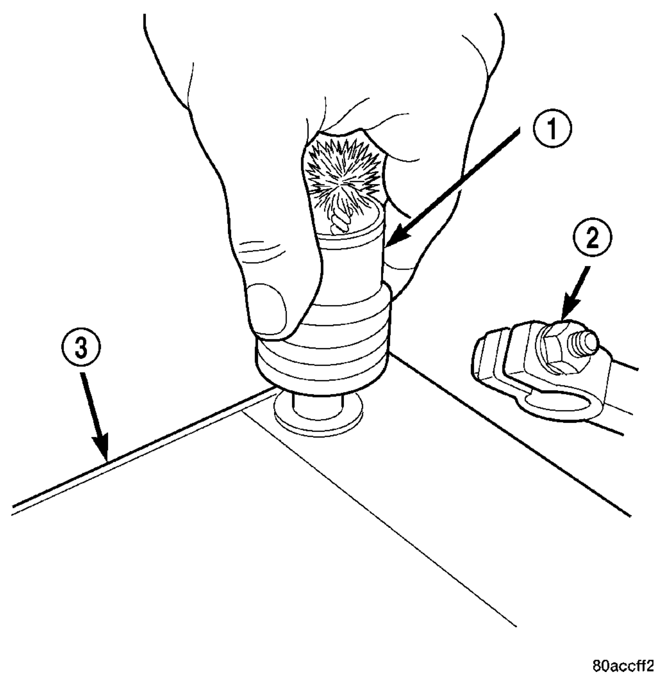


Fig. 3 Clean Battery Terminal Post - Typical

1 - TERMINAL BRUSH
2 - BATTERY CABLE
3 - BATTERY

BATTERY SYSTEM (Continued)

INSPECTION

The following information details the recommended inspection procedures for the battery and related components. In addition to the maintenance schedules found in this service manual and the owner's manual, it is recommended that these procedures be performed any time the battery or related components must be removed for vehicle service.

(1) Inspect the battery cable terminal clamps for damage. Replace any battery cable that has a damaged or deformed terminal clamp.

(2) Inspect the battery tray and battery holddown hardware for damage. Replace any damaged parts.

(3) Slide the thermal guard off of the battery case (if equipped). Inspect the battery case for cracks or other damage that could result in electrolyte leaks. Also, check the battery terminal posts for looseness. Batteries with damaged cases or loose terminal posts must be replaced.

(4) Inspect the battery thermal guard (if equipped) for tears, cracks, deformation or other damage. Replace any battery thermal guard that has been damaged.

(5) Inspect the battery built-in test indicator sight glass (if equipped) for an indication of the battery condition. If the battery is discharged, charge as required. Refer to Standard Procedures for the proper battery built-in indicator test procedures. Also refer to Standard Procedures for the proper battery charging procedures.

SPECIFICATIONS

The battery Group Size number, the Cold Cranking Amperage (CCA) rating, and the Reserve Capacity (RC) rating or Ampere-Hours (AH) rating can be found on the original equipment battery label. Be certain that a replacement battery has the correct Group Size number, as well as CCA, and RC or AH ratings that equal or exceed the original equipment specification for the vehicle being serviced. Battery sizes and ratings are discussed in more detail below.

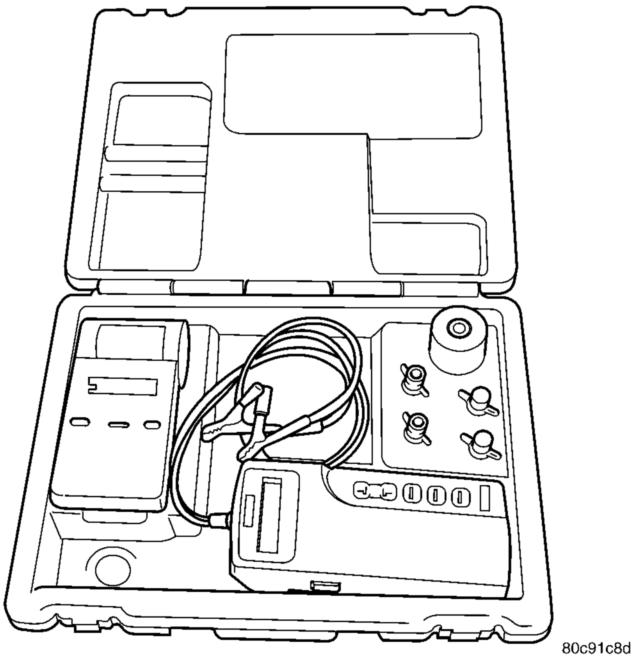
- **Group Size -** The outside dimensions and terminal placement of the battery conform to standards established by the Battery Council International (BCI). Each battery is assigned a BCI Group Size number to help identify a correctly-sized replacement.
- **Cold Cranking Amperage -** The Cold Cranking Amperage (CCA) rating specifies how much current (in amperes) the battery can deliver for thirty seconds at -18° C (0° F). Terminal voltage must not fall below 7.2 volts during or after the thirty second discharge period. The CCA required is generally higher as engine displacement increases, depending also upon the starter current draw requirements.
- **Reserve Capacity -** The Reserve Capacity (RC) rating specifies the time (in minutes) it takes for battery terminal voltage to fall below 10.5 volts, at a discharge rate of 25 amperes. RC is determined with the battery fully-charged at 26.7° C (80° F). This rating estimates how long the battery might last after a charging system failure, under minimum electrical load.
- **Ampere-Hours -** The Ampere-Hours (AH) rating specifies the current (in amperes) that a battery can deliver steadily for twenty hours, with the voltage in the battery not falling below 10.5 volts. This rating is also sometimes identified as the twenty-hour discharge rating.

BATTERY CLASSIFICATIONS & RATINGS					
Part Number	BCI Group Size Classification	Cold Cranking Amperage	Reserve Capacity	Ampere - Hours	Load Test Amperage
56029449AB	65	600	120 Minutes	66	300
56029451AB	65	750	150 Minutes	75	375
56028450AA	65	600	120 Minutes	66	300
56028452AA	65	750	150 Minutes	75	375
56028452AB	65	700	130 Minutes	70	350
56029396AA	65	700	130 Minutes	70	350
56029382AA	65	700	130 Minutes	70	350

BATTERY SYSTEM (Continued)

SPECIAL TOOLS

BATTERY SYSTEM SPECIAL TOOLS



Micro 420 Battery Tester

BATTERY

DESCRIPTION

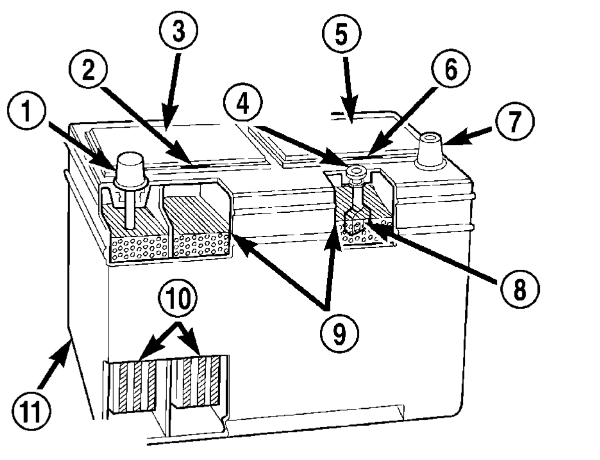


Fig. 4 Low-Maintenance Battery - Typical

1 - POSITIVE POST
2 - VENT
3 - CELL CAP
4 - TEST INDICATOR (IF EQUIPPED)
5 - CELL CAP
6 - VENT
7 - NEGATIVE POST
8 - GREEN BALL
9 - ELECTROLYTE LEVEL
10 - PLATE GROUPS
11 - LOW-MAINTENANCE BATTERY

A large capacity, low-maintenance storage battery (Fig. 4) is standard factory-installed equipment on this model. Models equipped with a diesel engine must utilize two 12-volt batteries connected in parallel. Male post type terminals made of a soft lead material protrude from the top of the molded plastic battery case to provide the means for connecting the battery to the vehicle electrical system. The battery positive terminal post is physically larger in diameter than the negative terminal post to ensure proper battery connection. The letters **POS** and **NEG** are also molded into the top of the battery case adjacent to their respective positive and negative terminal posts for identification confirmation. Refer to Battery Cables for more information on the battery cables that connect the battery to the vehicle electrical system.

The battery is made up of six individual cells that are connected in series. Each cell contains positively charged plate groups that are connected with lead straps to the positive terminal post, and negatively charged plate groups that are connected with lead straps to the negative terminal post. Each plate consists of a stiff mesh framework or grid coated with lead dioxide (positive plate) or sponge lead (negative plate). Insulators or plate separators made of a non-conductive material are inserted between the positive and negative plates to prevent them from contacting or shorting against one another. These dissimilar metal plates are submerged in a sulfuric acid and water solution called an electrolyte.

The factory-installed battery has a built-in test indicator (hydrometer). The color visible in the sight glass of the indicator will reveal the battery condition. Refer to Standard Procedures for the proper built-in indicator test procedures. **The factory-installed low-maintenance battery has non-removable battery cell caps.** Water cannot be added to this battery. The battery is not sealed and has vent holes in the cell caps. The chemical composition of the metal coated plates within the low-maintenance battery reduces battery gassing and water loss, at normal charge and discharge rates. Therefore, the battery should not require additional water in normal service. Rapid loss of electrolyte can be caused by an overcharging condition.

DIAGNOSIS AND TESTING - BATTERY

The battery must be completely charged and the terminals should be properly cleaned and inspected before diagnostic procedures are performed. Refer to Battery System Cleaning for the proper cleaning procedures, and Battery System Inspection for the proper battery inspection procedures. Refer to Standard Procedures for the proper battery charging procedures.

BATTERY (Continued)

MICRO 420 BATTERY TESTER

The Micro 420 automotive battery tester is designed to help the dealership technician diagnose the cause of a defective battery. Follow the instruction manual supplied with the tester to properly diagnose a battery. If the instruction manual is not available, refer to the standard procedure in this section, which includes the directions for using the Micro 420 battery tester.

WARNING: IF THE BATTERY SHOWS SIGNS OF FREEZING, LEAKING OR LOOSE POSTS, DO NOT TEST, ASSIST-BOOST, OR CHARGE. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

WARNING: EXPLOSIVE HYDROGEN GAS FORMS IN AND AROUND THE BATTERY. DO NOT SMOKE, USE FLAME, OR CREATE SPARKS NEAR THE BATTERY. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

WARNING: THE BATTERY CONTAINS SULFURIC ACID, WHICH IS POISONOUS AND CAUSTIC. AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN THE EVENT OF CONTACT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF THE REACH OF CHILDREN.

A battery that will not accept a charge is faulty, and must be replaced. Further testing is not required. A fully-charged battery must be load tested to determine its cranking capacity. A battery that is fully-charged, but does not pass the load test, is faulty and must be replaced. Always test battery using the Micro 420 battery tester before attempting to replace a battery under the manufactures warranty provisions.

NOTE: Completely discharged batteries may take several hours to accept a charge. Refer to Standard Procedures for the proper battery charging procedures.

STANDARD PROCEDURE

STANDARD PROCEDURE - BATTERY CHARGING

Battery charging can be performed fast or slow, in terms of time. **Slow** battery charging is the best means of restoring a battery to full potential. Fast battery charging should only be performed when absolutely necessary due to time restraints. A battery is fully-charged when:

- All of the battery cells are gassing freely during battery charging.
- A green color is visible in the sight glass of the battery built-in test indicator.
- Three hydrometer tests, taken at one-hour intervals, indicate no increase in the temperature-corrected specific gravity of the battery electrolyte.
- Open-circuit voltage of the battery is 12.65 volts or above.

WARNING: NEVER EXCEED TWENTY AMPERES WHEN CHARGING A COLD (-1° C [30° F] OR LOWER) BATTERY. THE BATTERY MAY ARC INTERNALLY AND EXPLODE. PERSONAL INJURY AND/OR VEHICLE DAMAGE MAY RESULT.

CAUTION: Always disconnect and isolate the battery negative cable before charging a battery. Do not exceed sixteen volts while charging a battery. Damage to the vehicle electrical system components may result.

CAUTION: Battery electrolyte will bubble inside the battery case during normal battery charging. Electrolyte boiling or being discharged from the battery vents indicates a battery overcharging condition. Immediately reduce the charging rate or turn off the charger to evaluate the battery condition. Damage to the battery may result from overcharging.

CAUTION: The battery should not be hot to the touch. If the battery feels hot to the touch, turn off the charger and let the battery cool before continuing the charging operation. Damage to the battery may result.

NOTE: Models equipped with the diesel engine are equipped with two 12-volt batteries, connected in parallel (positive-to-positive and negative-to-negative). In order to ensure proper charging of each battery, these batteries MUST be disconnected from each other, as well as from the vehicle electrical system while being charged.

Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the battery charger and the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by

BATTERY (Continued)

the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

After the battery has been charged to 12.4 volts or greater, perform a load test to determine the battery cranking capacity. Refer to Standard Procedures for the proper battery load test procedures. If the battery will endure a load test, return the battery to service. If the battery will not endure a load test, it is faulty and must be replaced.

Clean and inspect the battery hold downs, tray, terminals, posts, and top before completing battery service. Refer to Battery System Cleaning for the proper battery system cleaning procedures, and Battery System Inspection for the proper battery system inspection procedures.

CHARGING A COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a completely discharged battery. Unless this procedure is properly followed, a good battery may be needlessly replaced.

(1) Measure the voltage at the battery posts with a voltmeter, accurate to 1/10 (0.10) volt (Fig. 5). If the reading is below ten volts, the battery charging current will be low. It could take some time before the battery accepts a current greater than a few milliamperes. Such low current may not be detectable on the ammeters built into many battery chargers.

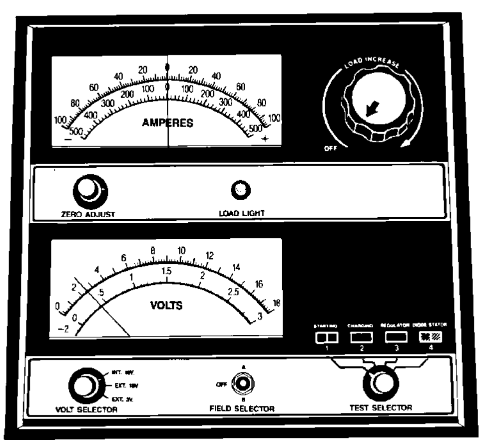


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Fig. 5 Voltmeter - Typical

(2) Disconnect and isolate the battery negative cable. Connect the battery charger leads. Some battery chargers are equipped with polarity-sensing circuitry. This circuitry protects the battery charger and the battery from being damaged if they are improperly connected. If the battery state-of-charge is too low for the polarity-sensing circuitry to detect, the battery charger will not operate. This makes it appear that the battery will not accept charging current. See the instructions provided by the manufacturer of the battery charger for details on how to bypass the polarity-sensing circuitry.

(3) Battery chargers vary in the amount of voltage and current they provide. The amount of time required for a battery to accept measurable charging current at various voltages is shown in the Charge Rate Table. If the charging current is still not measurable at the end of the charging time, the battery is faulty and must be replaced. If the charging current is measurable during the charging time, the battery may be good and the charging should be completed in the normal manner.

CHARGE RATE TABLE	
Voltage	Hours
16.0 volts maximum	up to 4 hours
14.0 to 15.9 volts	up to 8 hours
13.9 volts or less	up to 16 hours

CHARGING TIME REQUIRED

The time required to charge a battery will vary, depending upon the following factors:

- **Battery Capacity** - A completely discharged heavy-duty battery requires twice the charging time of a small capacity battery.
- **Temperature** - A longer time will be needed to charge a battery at -18° C (0° F) than at 27° C (80° F). When a fast battery charger is connected to a cold battery, the current accepted by the battery will be very low at first. As the battery warms, it will accept a higher charging current rate (amperage).
- **Charger Capacity** - A battery charger that supplies only five amperes will require a longer charging time. A battery charger that supplies twenty amperes or more will require a shorter charging time.
- **State-Of-Charge** - A completely discharged battery requires more charging time than a partially discharged battery. Electrolyte is nearly pure water in a completely discharged battery. At first, the charging current (amperage) will be low. As the battery charges, the specific gravity of the electrolyte will gradually rise.

The Battery Charging Time Table gives an indication of the time required to charge a typical battery at room temperature based upon the battery state-of-charge and the charger capacity.

BATTERY (Continued)

BATTERY CHARGING TIME TABLE			
Charging Amperage	5 Amps	10 Amps	20 Amps
Open Circuit Voltage	Hours Charging @ 21° C (70° F)		
12.25 to 12.49	6 hours	3 hours	1.5 hours
12.00 to 12.24	10 hours	5 hours	2.5 hours
10.00 to 11.99	14 hours	7 hours	3.5 hours
Below 10.00	18 hours	9 hours	4.5 hours

STANDARD PROCEDURE - BUILT-IN INDICATOR TEST

If equipped, an indicator (hydrometer) built into the top of the battery case provides visual information for battery testing (Fig. 6). Like a hydrometer, the built-in indicator measures the specific gravity of the battery electrolyte. The specific gravity of the electrolyte reveals the battery state-of-charge; however, it will not reveal the cranking capacity of the battery. A load test must be performed to determine the battery cranking capacity. Refer to Standard Procedures for the proper battery load test procedures.

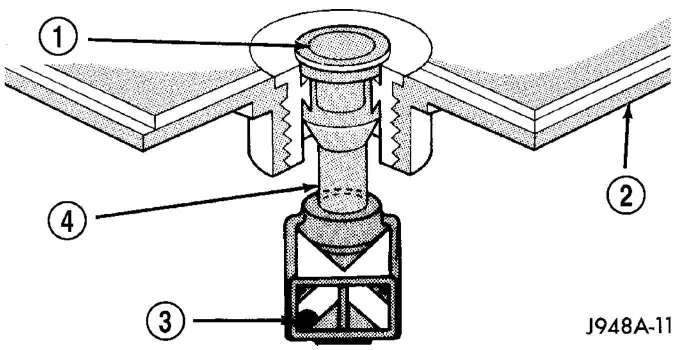

Fig. 6 Built-In Indicator

1 - SIGHT GLASS
2 - BATTERY TOP
3 - GREEN BALL
4 - PLASTIC ROD

Before testing, visually inspect the battery for any damage (a cracked case or cover, loose posts, etc.) that would cause the battery to be faulty. In order to obtain correct indications from the built-in indicator, it is important that the battery be level and have a clean sight glass. Additional light may be required to view the indicator. **Do not use open flame as a source of additional light.**

To read the built-in indicator, look into the sight glass and note the color of the indication (Fig. 7). The battery condition that each color indicates is described in the following list:

- **Green** - Indicates 75% to 100% battery state-of-charge. The battery is adequately charged for further testing or return to service. If the starter will not crank for a minimum of fifteen seconds with a fully-charged battery, the battery must be load tested. Refer to Standard Procedures for the proper battery load test procedures.
- **Black or Dark** - Indicates 0% to 75% battery state-of-charge. The battery is inadequately charged and must be charged until a green indication is visible in the sight glass (12.4 volts or more), before the battery is tested further or returned to service. Refer to Standard Procedures for the proper battery charging procedures. Also refer to Diagnosis and Testing for more information on the possible causes of the discharged battery condition.
- **Clear or Bright** - Indicates a low battery electrolyte level. The electrolyte level in the battery is below the built-in indicator. A maintenance-free battery with non-removable cell caps must be replaced if the electrolyte level is low. Water must be added to a low-maintenance battery with removable cell caps before it is charged. Refer to Standard Procedures for the proper battery filling procedures. A low electrolyte level may be caused by an overcharging condition. Refer to Charging System for the proper charging system diagnosis and testing procedures.

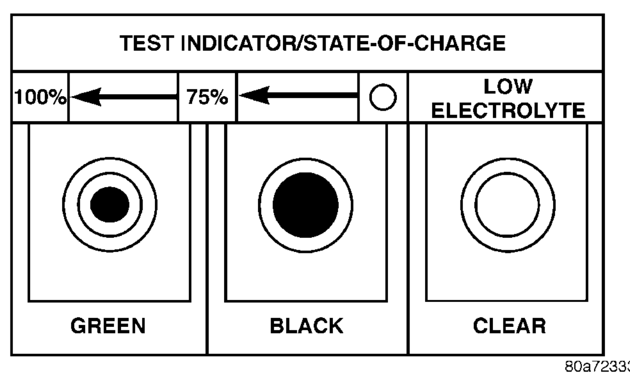

Fig. 7 Built-In Indicator Sight Glass Chart

STANDARD PROCEDURE - OPEN-CIRCUIT VOLTAGE TEST

A battery open-circuit voltage (no load) test will show the approximate state-of-charge of a battery. This test can be used in place of the hydrometer test when a hydrometer is not available, or for maintenance-free batteries with non-removable cell caps.

Before proceeding with this test, completely charge the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

(1) Before measuring the open-circuit voltage, the surface charge must be removed from the battery.

BATTERY (Continued)

Turn on the headlamps for fifteen seconds, then allow up to five minutes for the battery voltage to stabilize.

(2) Disconnect and isolate both battery cables, negative cable first.

(3) Using a voltmeter connected to the battery posts (see the instructions provided by the manufacturer of the voltmeter), measure the open-circuit voltage (Fig. 8).

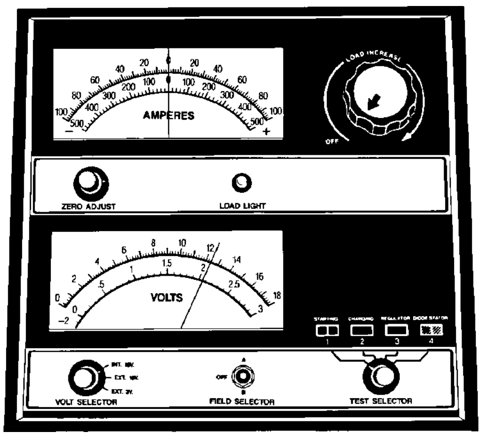

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Fig. 8 Testing Open-Circuit Voltage - Typical

See the Open-Circuit Voltage Table. This voltage reading will indicate the battery state-of-charge, but will not reveal its cranking capacity. If a battery has an open-circuit voltage reading of 12.4 volts or greater, it may be load tested to reveal its cranking capacity (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).

OPEN CIRCUIT VOLTAGE TABLE	
Open Circuit Voltage	Charge Percentage
11.7 volts or less	0%
12.0 volts	25%
12.2 volts	50%
12.4 volts	75%
12.6 volts or more	100%

STANDARD PROCEDURE - IGNITION-OFF DRAW TEST

The term Ignition-Off Draw (IOD) identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. A normal vehicle electrical system will draw from five to thirty-five milliamperes (0.005 to 0.035 ampere) with the ignition switch in the Off position, and all non-ignition controlled circuits in proper working order. Up to thirty-five milliamperes are needed to enable the memory functions for the Powertrain Control Module (PCM), digital clock, electronically tuned radio, and other modules which may vary with the vehicle equipment.

A vehicle that has not been operated for approximately twenty days, may discharge the battery to an inadequate level. When a vehicle will not be used for twenty days or more (stored), remove the IOD fuse from the Integrated Power Module (IPM). This will reduce battery discharging.

Excessive IOD can be caused by:

- Electrical items left on.
- Faulty or improperly adjusted switches.
- Faulty or shorted electronic modules and components.
- An internally shorted generator.
- Intermittent shorts in the wiring.

If the IOD is over thirty-five milliamperes, the problem must be found and corrected before replacing a battery. In most cases, the battery can be charged and returned to service after the excessive IOD condition has been corrected.

(1) Verify that all electrical accessories are off. Turn off all lamps, remove the ignition key, and close all doors. If the vehicle is equipped with an illuminated entry system or an electronically tuned radio, allow the electronic timer function of these systems to automatically shut off (time out). This may take up to three minutes. See the Electronic Module Ignition-Off Draw Table for more information.

ELECTRONIC MODULE IGNITION-OFF DRAW (IOD) TABLE			
Module	Time Out? (If Yes, Interval And Wake-Up Input)	IOD	IOD After Time Out
Radio	No	1 to 3 milliamperes	N/A
Audio Power Amplifier	No	up to 1 milliampere	N/A
Powertrain Control Module (PCM)	No	0.95 milliampere	N/A

BATTERY (Continued)

ELECTRONIC MODULE IGNITION-OFF DRAW (IOD) TABLE			
Module	Time Out? (If Yes, Interval And Wake-Up Input)	IOD	IOD After Time Out
ElectroMechanical Instrument Cluster (EMIC)	No	0.44 milliampere	N/A
Combination Flasher	No	0.08 milliampere	N/A

(2) Determine that the underhood lamp is operating properly, then disconnect the lamp wire harness connector or remove the lamp bulb.

(3) Disconnect the battery negative cable.

(4) Set an electronic digital multi-meter to its highest amperage scale. Connect the multi-meter between the disconnected battery negative cable terminal clamp and the battery negative terminal post. Make sure that the doors remain closed so that the illuminated entry system is not activated. The multi-meter amperage reading may remain high for up to three minutes, or may not give any reading at all while set in the highest amperage scale, depending upon the electrical equipment in the vehicle. The multi-meter leads must be securely clamped to the battery negative cable terminal clamp and the battery negative terminal post. If continuity between the battery negative terminal post and the negative cable terminal clamp is lost during any part of the IOD test, the electronic timer function will be activated and all of the tests will have to be repeated.

(5) After about three minutes, the high-amperage IOD reading on the multi-meter should become very low or nonexistent, depending upon the electrical equipment in the vehicle. If the amperage reading remains high, remove and replace each fuse or circuit breaker in the Integrated Power Module (IPM), one at a time until the amperage reading becomes very low, or nonexistent. Refer to the appropriate wiring information in this service manual for complete Integrated Power Module fuse, circuit breaker, and circuit identification. This will isolate each circuit and identify the circuit that is the source of the high-amperage IOD. If the amperage reading remains high after removing and replacing each fuse and circuit breaker, disconnect the wire harness from the generator. If the amperage reading now becomes very low or nonexistent, refer to Charging System for the proper charging system diagnosis and testing procedures. After the high-amperage IOD has been corrected, switch the multi-meter to progressively lower amperage scales and, if necessary, repeat the fuse and circuit breaker remove-and-replace process to identify and correct all sources of excessive IOD. It is now safe to select the lowest milliampere scale of the multi-meter to check the low-amperage IOD.

CAUTION: Do not open any doors, or turn on any electrical accessories with the lowest milliampere scale selected, or the multi-meter may be damaged.

(6) Observe the multi-meter reading. The low-amperage IOD should not exceed thirty-five milliamperes (0.035 ampere). If the current draw exceeds thirty-five milliamperes, isolate each circuit using the fuse and circuit breaker remove-and-replace process in Step 5. The multi-meter reading will drop to within the acceptable limit when the source of the excessive current draw is disconnected. Repair this circuit as required; whether a wiring short, incorrect switch adjustment, or a component failure is at fault.

STANDARD PROCEDURE - USING MICRO 420 BATTERY TESTER

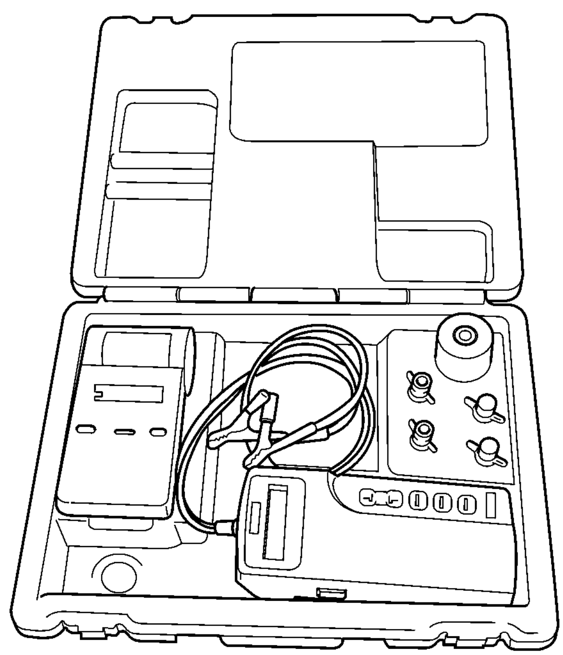

Fig. 9 MICRO 420 BATTERY TESTER

Always use the Micro 420 Instruction Manual that was supplied with the tester as a reference. If the Instruction Manual is not available the following procedure can be used:

BATTERY (Continued)

WARNING: ALWAYS WEAR APPROPRIATE EYE PROTECTION AND USE EXTREME CAUTION WHEN WORKING WITH BATTERIES.

BATTERY TESTING

(1) If testing the battery OUT-OF-VEHICLE, clean the battery terminals with a wire brush before testing. If the battery is equipped with side post terminals, install and tighten the supplied lead terminal stud adapters. Do not use steel bolts. Failure to properly install the stud adapters, or using stud adapters that are dirty or worn-out may result in false test readings.

(2) If testing the battery IN-THE-VEHICLE, make certain all of the vehicle accessory loads are OFF, including the ignition. **The preferred test position is at the battery terminal**. If the battery is not accessible, you may test using both the positive and negative jumper posts. Select TESTING AT JUMPER POST when connecting to that location.

(3) Connect the tester (Fig. 9) to the battery or jumper posts, the red clamp to positive (+) and the black clamp to negative (–).

NOTE: Multiple batteries connected in parallel must have the ground cable disconnected to perform a battery test. Failure to disconnect may result in false battery test readings.

(4) Using the ARROW key select **in** or **out** of vehicle testing and press ENTER to make a selection.

(5) If not selected, choose the Cold Cranking Amp (CCA) battery rating. Or select the appropriate battery rating for your area (see menu). The tester will then run its self programmed test of the battery and display the results. Refer to the test result table noted below.

CAUTION: If REPLACE BATTERY is the result of the test, this may mean a poor connection between the vehicle's cables and battery exists. After disconnecting the vehicle's battery cables from the battery, retest the battery using the OUT-OF-VEHICLE test before replacing.

(6) While viewing the battery test result, press the CODE button and the tester will prompt you for the last 4 digits of the VIN. Use the UP/DOWN arrow buttons to scroll to the correct character; then press ENTER to select and move to the next digit. Then press the ENTER button to view the SERVICE CODE. Pressing the CODE button a second time will return you to the test results.

BATTERY TEST RESULTS	
GOOD BATTERY	Return to service
GOOD - RECHARGE	Fully charge battery and return to service
CHARGE & RETEST	Fully charge battery and retest battery
REPLACE BATTERY	Replace the battery and retest complete system
BAD-CELL REPLACE	Replace the battery and retest complete system

NOTE: The SERVICE CODE is required on every warranty claim submitted for battery replacement.

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Loosen the battery negative cable terminal clamp pinch-bolt hex nut.

(3) Disconnect the battery negative cable terminal clamp from the battery negative terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post (Fig. 10).

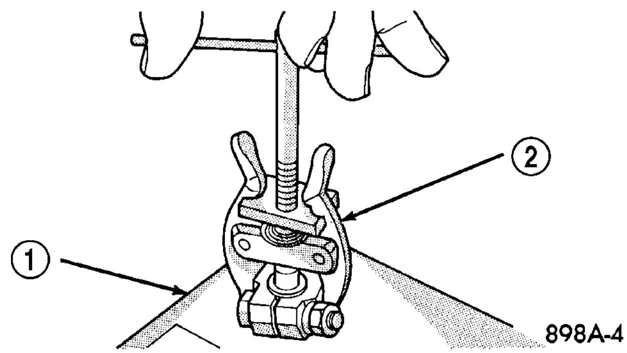

Fig. 10 Removing Battery Cable Terminal Clamp

1 - BATTERY
2 - BATTERY TERMINAL PULLER

(4) Loosen the battery positive cable terminal clamp pinch-bolt hex nut.

(5) Disconnect the battery positive cable terminal clamp from the battery positive terminal post. If necessary, use a battery terminal puller to remove the terminal clamp from the battery post (Fig. 10).

(6) Remove the battery hold down retaining bolt.

WARNING: WEAR A SUITABLE PAIR OF RUBBER GLOVES (NOT THE HOUSEHOLD TYPE) WHEN REMOVING A BATTERY BY HAND. SAFETY GLASSES SHOULD ALSO BE WORN. IF THE BATTERY IS CRACKED OR LEAKING, THE ELECTROLYTE CAN BURN THE SKIN AND EYES.

BATTERY (Continued)

(7) Remove the battery from the battery tray.

INSTALLATION

(1) Clean and inspect the battery.

(2) Position the battery onto the battery tray. Ensure that the battery positive and negative terminal posts are correctly positioned. The battery cable terminal clamps must reach the correct battery terminal post without stretching the cables.

(3) Position the battery hold down and install the retaining bolt.

CAUTION: Be certain that the battery cable terminal clamps are connected to the correct battery terminal posts. Reversed battery polarity may damage electrical components of the vehicle.

(4) Clean the battery cable terminal clamps and the battery terminal posts.

(5) Reconnect the battery positive cable terminal clamp to the battery positive terminal post. Tighten the terminal clamp pinch-bolt hex nut to 4 N·m (35 in. lbs.).

(6) Reconnect the battery negative cable terminal clamp to the battery negative terminal post. Tighten the terminal clamp pinch-bolt hex nut to 4 N·m (35 in. lbs.).

(7) Apply a thin coating of petroleum jelly or chassis grease to the exposed surfaces of the battery cable terminal clamps and the battery terminal posts.

(8) Obtain a DRB III® scan tool and check the PCM for any stored battery disconnect trouble code, if required.

BATTERY HOLDDOWN

DESCRIPTION

The battery hold down hardware includes a bolt and a molded plastic hold down bracket which meshes with the battery tray when properly installed. The battery tray and hold down hardware combine to form a very stable and secure battery hold down assembly.

OPERATION

The battery holddown secures the battery in the battery tray. This holddown is designed to prevent battery movement during the most extreme vehicle operation conditions. Periodic removal and lubrication of the battery holddown hardware is recommended to prevent hardware seizure at a later date.

CAUTION: Never operate a vehicle without a battery holddown device properly installed. Damage to the vehicle, components and battery could result.

REMOVAL

(1) Loosen and remove the battery hold down retaining bolt.

(2) Remove the battery hold down bracket from the battery case.

INSTALLATION

(1) Clean and inspect the battery hold down hardware (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - CLEANING).

(2) Position the battery hold down bracket in the battery tray. Be certain that the hold down bracket is properly positioned in the battery tray before tightening the hold down hardware.

(3) Install and tighten the battery hold down retaining bolt.

BATTERY CABLES

DESCRIPTION

The battery cables are large gauge, stranded copper wires sheathed within a heavy plastic or synthetic rubber insulating jacket. The wire used in the battery cables combines excellent flexibility and reliability with high electrical current carrying capacity. Refer to Wiring for the location of the proper battery cable wire gauge information.

The battery cables cannot be repaired and, if damaged or faulty they must be replaced. Both the battery positive and negative cables are available for service replacement only as a unit with the battery positive cable wire harness or the battery negative cable wire harness, which may include portions of the wiring circuits for the generator and other components on some models.

Most models feature a stamped brass clamping type female battery terminal crimped onto one end of the battery cable wire and then solder-dipped. A pinch-bolt and hex nut are installed at the open end of the female battery terminal clamp. The battery positive cable also includes a red molded rubber protective cover for the female battery terminal clamp. Large eyelet type terminals are crimped onto the opposite end of the battery cable wire and then solder-dipped. The battery positive cable wires have a red insulating jacket to provide visual identification and feature a larger female battery terminal clamp to allow connection to the larger battery positive terminal post. The battery negative cable wires have a black insulating jacket and a smaller female battery terminal clamp.

OPERATION

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables

BATTERY CABLES (Continued)

also provide a return path for electrical current generated by the charging system for restoring the voltage potential of the battery. The female battery terminal clamps on the ends of the battery cable wires provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the ends of the battery cable wires opposite the female battery terminal clamps provide secure and reliable connection of the battery to the vehicle electrical system.

DIAGNOSIS AND TESTING - BATTERY CABLES

A voltage drop test will determine if there is excessive resistance in the battery cable terminal connections or the battery cables. If excessive resistance is found in the battery cable connections, the connection point should be disassembled, cleaned of all corrosion or foreign material, then reassembled. Following reassembly, check the voltage drop for the battery cable connection and the battery cable again to confirm repair.

When performing the voltage drop test, it is important to remember that the voltage drop is giving an indication of the resistance between the two points at which the voltmeter probes are attached. **EXAMPLE:** When testing the resistance of the battery positive cable, touch the voltmeter leads to the battery positive cable terminal clamp and to the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud. If you probe the battery positive terminal post and the battery positive cable eyelet terminal at the starter solenoid B(+) terminal stud, you are reading the combined voltage drop in the battery positive cable terminal clamp-to-terminal post connection and the battery positive cable.

VOLTAGE DROP TEST

WARNING: MODELS EQUIPPED WITH A DIESEL ENGINE HAVE AN AUTOMATIC SHUTDOWN (ASD) RELAY LOCATED IN THE POWER DISTRIBUTION CENTER (PDC). REMOVAL OF THE ASD RELAY MAY NOT PREVENT THE DIESEL ENGINE FROM STARTING. BE CERTAIN TO DISCONNECT THE FUEL SHUTDOWN SOLENOID WIRE HARNESS CONNECTOR TO PREVENT THE ENGINE FROM STARTING. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing this test, be certain that the following procedures are accomplished:

- The battery is fully-charged and tested (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - STANDARD PROCEDURE).
- Fully engage the parking brake.
- If the vehicle is equipped with an automatic transmission, place the gearshift selector lever in the Park position. If the vehicle is equipped with a manual transmission, place the gearshift selector lever in the Neutral position and block the clutch pedal in the fully depressed position.
- Verify that all lamps and accessories are turned off.
- To prevent a gasoline engine from starting, remove the Automatic ShutDown (ASD) relay. The ASD relay is located in the Integrated Power Module (IPM), in the engine compartment. See the fuse and relay layout label on the underside of the IPM cover for ASD relay identification and location.

(1) Connect the positive lead of the voltmeter to the battery negative terminal post. Connect the negative lead of the voltmeter to the battery negative cable terminal clamp (Fig. 11). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection between the battery negative cable terminal clamp and the battery negative terminal post.

NOTE: If the vehicle is equipped with two 12v batteries, step #1 must be performed twice, once for each battery.

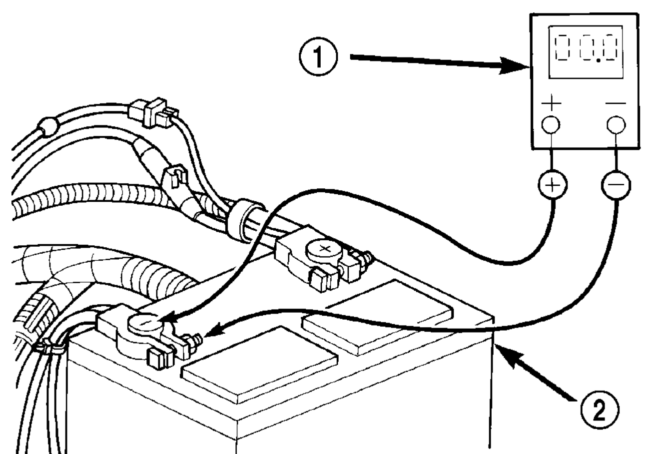

Fig. 11 Test Battery Negative Connection Resistance - Typical

1 - VOLTMETER
2 - BATTERY

(2) Connect the positive lead of the voltmeter to the battery positive terminal post. Connect the negative lead of the voltmeter to the battery positive cable terminal clamp (Fig. 12). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If voltage is detected, correct the poor connection

BATTERY CABLES (Continued)

between the battery positive cable terminal clamp and the battery positive terminal post.

NOTE: If the vehicle is equipped with two 12v batteries, step #2 must be performed twice, once for each battery.

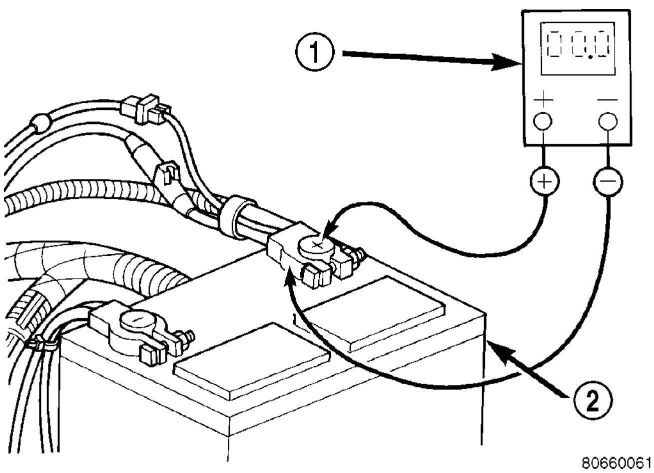

Fig. 12 Test Battery Positive Connection Resistance - Typical

1 - VOLTMETER
2 - BATTERY

(3) Connect the voltmeter to measure between the battery positive cable terminal clamp and the starter solenoid B(+) terminal stud (Fig. 13). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery positive cable eyelet terminal connection at the starter solenoid B(+) terminal stud. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery positive cable.

NOTE: If the vehicle is equipped with two 12v batteries, step #3 must be performed twice, once for each battery.

(4) Connect the voltmeter to measure between the battery negative cable terminal clamp and a good clean ground on the engine block (Fig. 14). Rotate and hold the ignition switch in the Start position. Observe the voltmeter. If the reading is above 0.2 volt, clean and tighten the battery negative cable eyelet terminal connection to the engine block. Repeat the test. If the reading is still above 0.2 volt, replace the faulty battery negative cable.

NOTE: If the vehicle is equipped with two 12v batteries, step #4 must be performed twice, once for each battery.

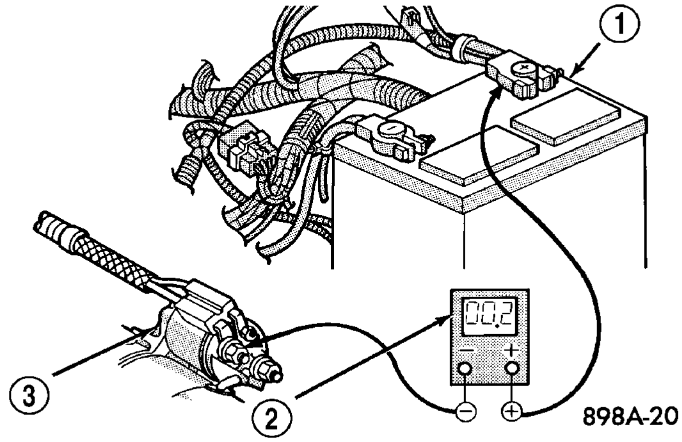

Fig. 13 Test Battery Positive Cable Resistance - Typical

1 - BATTERY
2 - VOLTMETER
3 - STARTER MOTOR

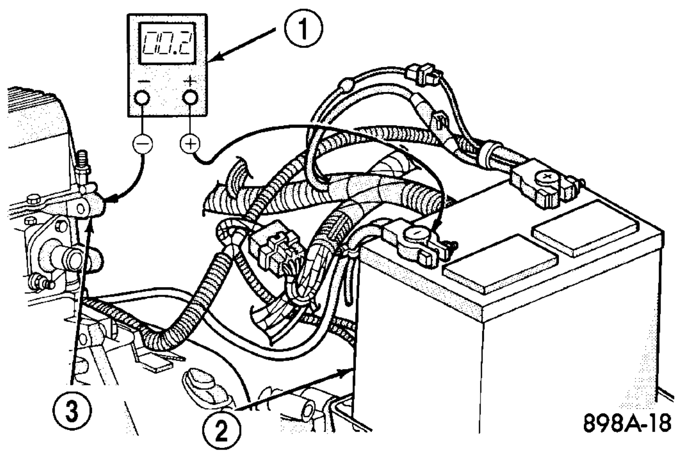

Fig. 14 Test Ground Circuit

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

REMOVAL

(1) Turn the ignition switch to the Off position. Be certain that all electrical accessories are turned off.

(2) Disconnect and isolate the remote battery negative cable terminal.

(3) Remove the battery from the vehicle. Refer to the procedure in this group.

(4) One at a time, trace the battery cable retaining pushpins, fasteners and routing clips until the cable is free from the vehicle.

(5) Remove the battery cable from the engine compartment.

BATTERY CABLES (Continued)

INSTALLATION

(1) Position the battery cable in the engine compartment.

(2) One at a time, install the battery cable retaining pushpins, fasteners and routing clips until the cable is installed exactly where it was in the vehicle. Refer to Wiring for illustrations.

(3) Install the battery in the vehicle. Refer to the procedure in this group.

(4) Connect the battery negative cable terminal.

BATTERY TRAY

DESCRIPTION

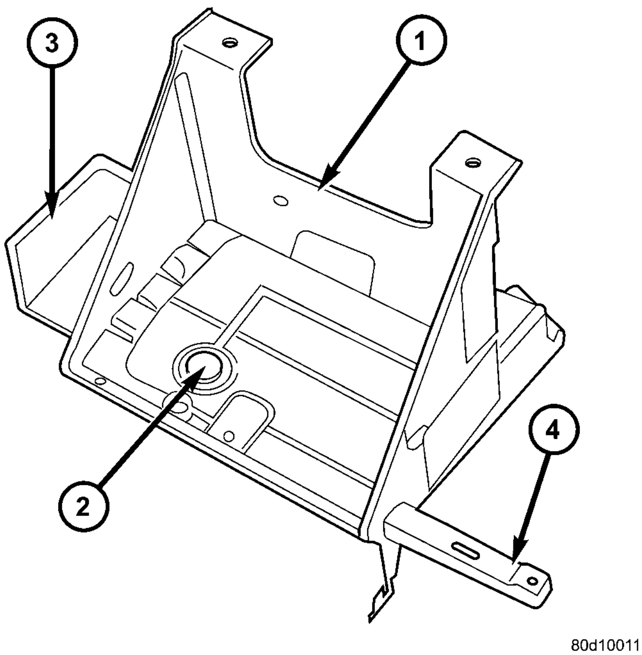

Fig. 15 DR Battery Tray

1 - BATTERY TRAY ASSEMBLY
2 - BATTERY TEMPERATURE SENSOR
3 - ANTI-LOCK BRAKE CONTROLLER MOUNTING LOCATION
4 - INTEGRATED POWER MODULE MOUNTING SANCTION

The molded plastic tray battery tray is located in the left front corner of the engine compartment. On this model, the battery tray also provides an anchor point for the anti-lock brake controller, cruise control servo (if equipped) and the integrated power module (Fig. 15). The battery hold down hardware is contained within the battery tray. A hole in the bottom of the battery tray is fitted with a battery temperature sensor. Refer to Charging System for more information on the battery temperature sensor.

OPERATION

The battery tray and the battery hold down hardware combine to secure and stabilize the battery in the engine compartment, which prevents battery movement during even the most extreme vehicle operation. Unrestrained battery movement during vehicle operation could result in damage to the vehicle, the battery, or both.

REMOVAL

LEFT SIDE

(1) Remove the battery from the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(2) Remove the integrated power module (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTELLIGENT POWER MODULE - REMOVAL).

(3) Disconnect the wire harness retainers from the battery tray assembly.

(4) Remove the anti-lock brake controller (if equipped) retaining bolts and support the brake controller with mechanics wire. It is not necessary to completely remove the anti-lock brake control unit.

(5) Remove the left front wheelhouse splash shield(Refer to 23 - BODY/EXTERIOR/LF WHEELHOUSE SPLASH SHIELD - REMOVAL).

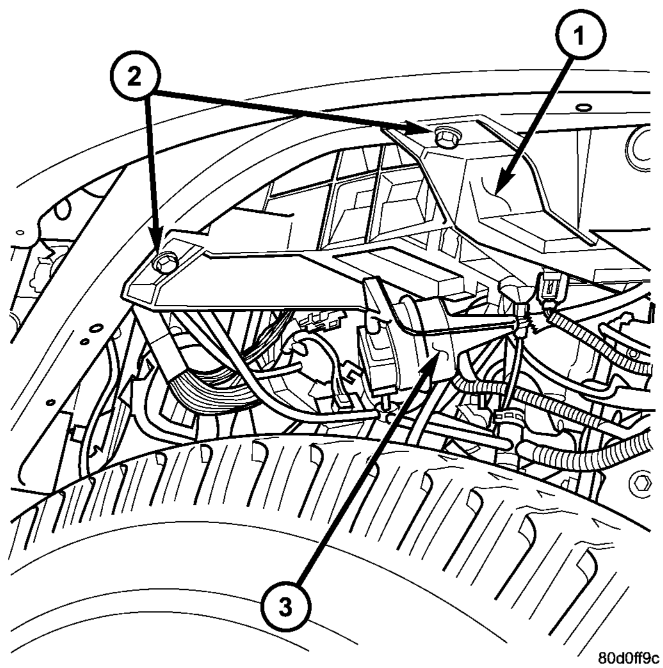

Fig. 16 Lower Battery Tray Retaining Bolts

1 - BATTERY TRAY ASSEMBLY
2 - BATTERY TRAY RETAINING BOLTS
3 - CRUISE CONTROL SERVO

BATTERY TRAY (Continued)

(6) Mark the location of the cruise servo (if equipped) and remove the retaining screws. Position the servo out of the way.

(7) Remove the battery temperature sensor from the battery tray (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - REMOVAL).

(8) Disconnect the purge solenoid from its mounting bracket.

(9) Disconnect the left front fender ground wire.

(10) Remove the remaining battery tray retaining bolts (Fig. 16).

(11) Remove the battery tray from the vehicle.

RIGHT SIDE

(1) Remove the battery from the battery tray (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(2) Remove the right front wheelhouse splash shield.

(3) Disconnect the right front fender ground wire.

(4) Remove fasteners from grid heater relay bracket.

(5) Remove air box.

(6) Remove the remaining battery tray retaining bolts (Fig. 17).

(7) Remove the battery tray from the vehicle.

INSTALLATION

LEFT SIDE

(1) Position the battery tray assembly and install the retaining bolts.

(2) Connect the left front fender ground wire.

(3) Install the purge solenoid on its mounting bracket.

(4) Install the battery temperature sensor in the battery tray (Refer to 8 - ELECTRICAL/CHARGING/BATTERY TEMPERATURE SENSOR - INSTALLATION).

(5) Install the cruise servo (if equipped) and retaining screws.

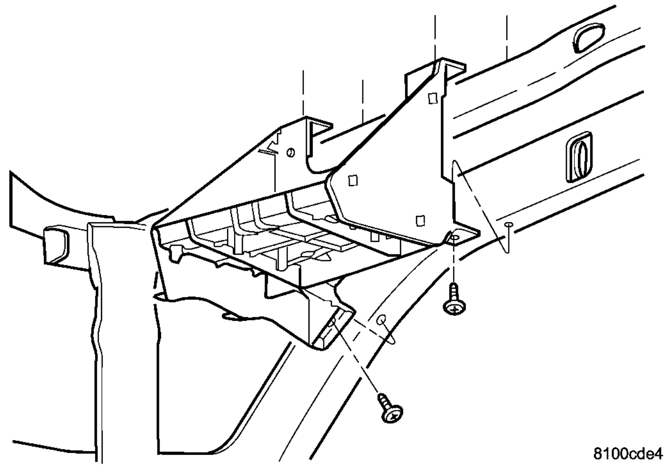

Fig. 17 RIGHT SIDE BATTERY TRAY

(6) Install the left front wheelhouse splash shield (Refer to 23 - BODY/EXTERIOR/LF WHEELHOUSE SPLASH SHIELD - INSTALLATION).

(7) Install the anti-lock brake controller (if equipped).

(8) Connect the wire harness retainers on the battery tray assembly.

(9) Install the integrated power module (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTELLIGENT POWER MODULE - INSTALLATION).

(10) Install the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

RIGHT SIDE

(1) Position the battery tray assembly and install the retaining bolts.

(2) Connect the right front fender ground wire.

(3) Install the air box.

(4) Install the grid heater relay bracket.

(5) Install the right front wheelhouse splash shield.

(6) Install the battery (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

CHARGING

TABLE OF CONTENTS

CHARGING

DESCRIPTION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM). Electronic Control Module (ECM) for diesel engines.
- Ignition switch
- Battery (refer to 8, Battery for information)
- Battery temperature sensor
- Check Gauges Lamp (if equipped)
- Voltmeter (refer to 8, Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to 8, Wiring Diagrams for information)

OPERATION

The charging system is turned on and off with the ignition switch. The system is on when the engine is running and the ASD relay is energized. When the ASD relay is on, voltage is supplied to the ASD relay sense circuit at the PCM (ECM Diesel). This voltage is connected through the PCM (ECM Diesel) and supplied to one of the generator field terminals (Gen. Source +) at the back of the generator.

The amount of direct current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM (ECM Diesel). This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM (ECM Diesel) to vary the battery charging rate. This is done by cycling the ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD-sensed systems, including EVR (field control) circuitry, are monitored by the PCM (ECM Diesel). Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects.

The Check Gauges Lamp (if equipped) monitors: **charging system voltage,** engine coolant temperature and engine oil pressure. If an extreme condition is indicated, the lamp will be illuminated. This is done as reminder to check the three gauges. The signal to activate the lamp is sent via the CCD bus circuits. The lamp is located on the instrument panel. Refer to 8, Instrument Panel and Gauges for additional information.

DIAGNOSIS AND TESTING - CHARGING SYSTEM

The following procedures may be used to diagnose the charging system if:

- the check gauges lamp (if equipped) is illuminated with the engine running
- the voltmeter (if equipped) does not register properly
- an undercharged or overcharged battery condition occurs.

Remember that an undercharged battery is often caused by:

- accessories being left on with the engine not running

CHARGING (Continued)

- a faulty or improperly adjusted switch that allows a lamp to stay on. Refer to Ignition-Off Draw Test in 8, Battery for more information.

INSPECTION

The PCM (Powertrain Control Module), or ECM (Diesel) monitors critical input and output circuits of the charging system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the On-Board Diagnostic (OBD) system. Some charging system circuits are checked continuously, and some are checked only under certain conditions.

Refer to Diagnostic Trouble Codes in; Powertrain Control Module; Electronic Control Modules for more DTC information. This will include a complete list of DTC's including DTC's for the charging system.

To perform a complete test of the charging system, refer to the appropriate Powertrain Diagnostic Procedures service manual and the DRB® scan tool. Perform the following inspections before attaching the scan tool.

(1) Inspect the battery condition. Refer to 8, Battery for procedures.

(2) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(3) Inspect all fuses in both the fuseblock and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(4) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

(5) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in 7, Cooling System.

(6) Inspect automatic belt tensioner (if equipped). Refer to 7, Cooling System for information.

(7) Inspect generator electrical connections at generator field, battery output, and ground terminal (if equipped). Also check generator ground wire connection at engine (if equipped). They should all be clean and tight. Repair as required.

SPECIFICATIONS

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES
DENSO	56029700AA	136	3.7L / 4.7L
DENSO	56029701AA	136	5.9L Gas
BOSCH	56041120AC	136	3.7L / 4.7L
BOSCH	56028238AB	136	5.9L Gas
DENSO	56028560AA	136	8.0L
DENSO	56028696AA	136	5.7L Gas/5.9L Diesel
BOSCH	56028699AA	136	5.7L Gas/5.9L Diesel

SPECIFICATIONS - TORQUE - GENERATOR / CHARGING SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Generator Mounting Bolts - 5.7L	41	30	-
Generator Support Bracket Bolt/Nuts - 5.7L	41	30	-
Generator Mounting Bolts - 8.0L	41	30	-
Generator Upper Mounting Bolt - 5.9L Diesel Engine	41	30	-
Generator Upper Mounting Bolt - 5.9L Gas Engine	41	30	-

CHARGING (Continued)

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Generator Lower Pivot Bolt / Nut - 5.9L Gas Engine	41	30	-
Generator Vertical Mounting Bolt - 3.7L / 4.7L Engines	55	40	-
Generator (long) Horizontal Mounting Bolt - 3.7L / 4.7L Engines	55	40	-
Generator (short) Horizontal Mounting Bolt - 3.7L / 4.7L Engines	74	55	-
Generator B+ Output Cable Terminal Nut	12	-	108

BATTERY TEMPERATURE SENSOR

DESCRIPTION

The Battery Temperature Sensor (BTS) is attached to the battery tray located under the battery.

OPERATION

The BTS is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the PCM (ECM Diesel) to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

The PCM sends 5 volts to the sensor and is grounded through the sensor return line. As temperature increases, resistance in the sensor decreases and the detection voltage at the PCM increases.

The BTS is also used for OBD II diagnostics. Certain faults and OBD II monitors are either enabled or disabled, depending upon BTS input (for example, disable purge and enable Leak Detection Pump (LDP) and O2 sensor heater tests). Most OBD II monitors are disabled below 20°F.

REMOVAL

The battery temperature sensor is located under the vehicle battery and is attached (snapped into) a mounting hole on battery tray (Fig. 1).

(1) Remove battery. Refer to 8, Battery for procedures.

(2) Pry sensor straight up from battery tray mounting hole to gain access to electrical connector (Fig. 1).

(3) Disconnect sensor from engine wire harness electrical connector.

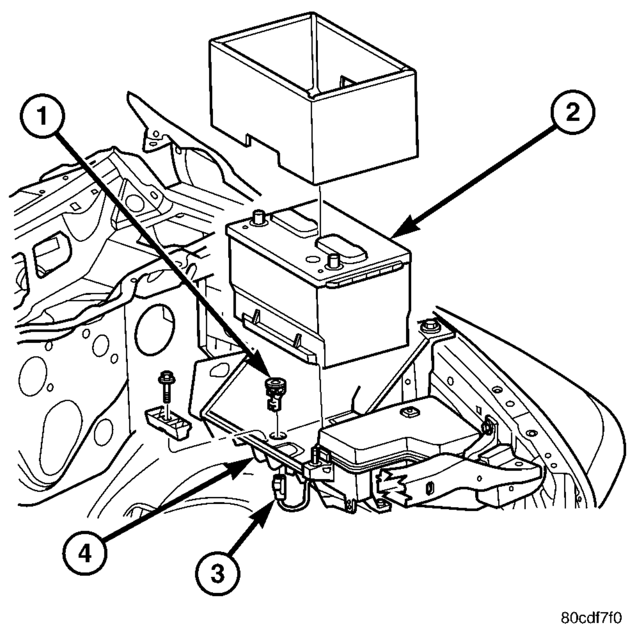

Fig. 1 BATTERY TEMPERATURE SENSOR LOCATION

1 - BATTERY TEMP. SENSOR
2 - BATTERY
3 - SENSOR ELEC. CONNECT.
4 - BATTERY TRAY

INSTALLATION

The battery temperature sensor is located under the vehicle battery and is attached (snapped into) a mounting hole on battery tray.

(1) Pull electrical connector up through mounting hole in top of battery tray.

(2) Connect sensor.

(3) Snap sensor into battery tray.

(4) Install battery. Refer to 8, Battery for procedures.

GENERATOR

DESCRIPTION

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

OPERATION

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The stator winding connections deliver the induced alternating current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified direct current is delivered to the vehicle electrical system through the generator battery terminal.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. Be certain that the replacement generator has the same output rating and part number as the original unit. Refer to Generator Ratings in the Specifications section at the back of this group for amperage ratings and part numbers.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

REMOVAL

3.7L / 4.7L

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.

(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.

(3) Unsnap plastic insulator cap from B+ output terminal (Fig. 2).

(4) Remove B+ terminal mounting nut at rear of generator (Fig. 2). Disconnect terminal from generator.

(5) Disconnect field wire connector at rear of generator (Fig. 2) by pushing on connector tab.

(6) Remove 1 rear vertical generator mounting bolt (Fig. 3).

(7) Remove 2 front horizontal generator mounting bolts (Fig. 3).

(8) Remove generator from vehicle.

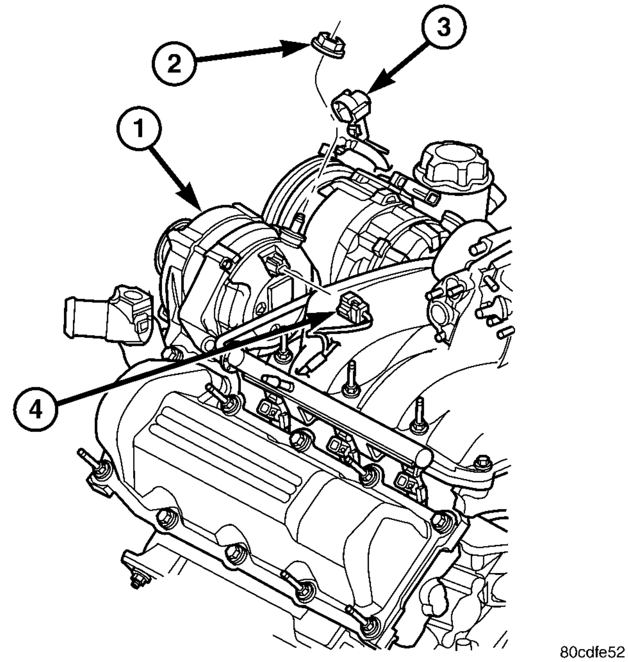

Fig. 2 GENERATOR CONNECTORS - 3.7L / 4.7L

1 - GENERATOR
2 - B+ NUT
3 - PLASTIC INSULATOR CAP
4 - FIELD WIRE CONNECTOR

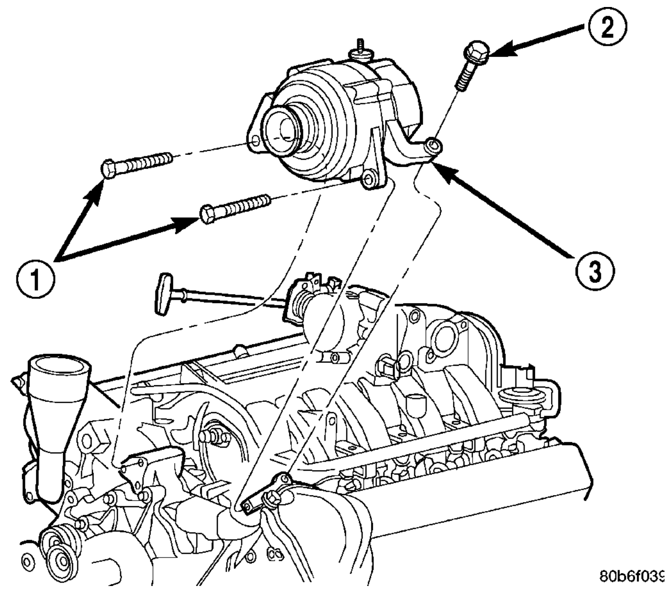

Fig. 3 REMOVE / INSTALL GENERATOR - 3.7L / 4.7L

1 - LOWER BOLTS
2 - REAR BOLT
3 - GENERATOR

GENERATOR (Continued)

5.7L

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.
(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.
(3) Unsnap plastic insulator cap from B+ output terminal.
(4) Remove B+ terminal mounting nut at rear of generator. Disconnect terminal from generator.
(5) Disconnect field wire connector at rear of generator by pushing on connector tab.
(6) Remove generator support bracket nuts and bolt (Fig. 4) and remove support bracket.
(7) Remove 2 generator mounting bolts (Fig. 5).
(8) Remove generator from vehicle.

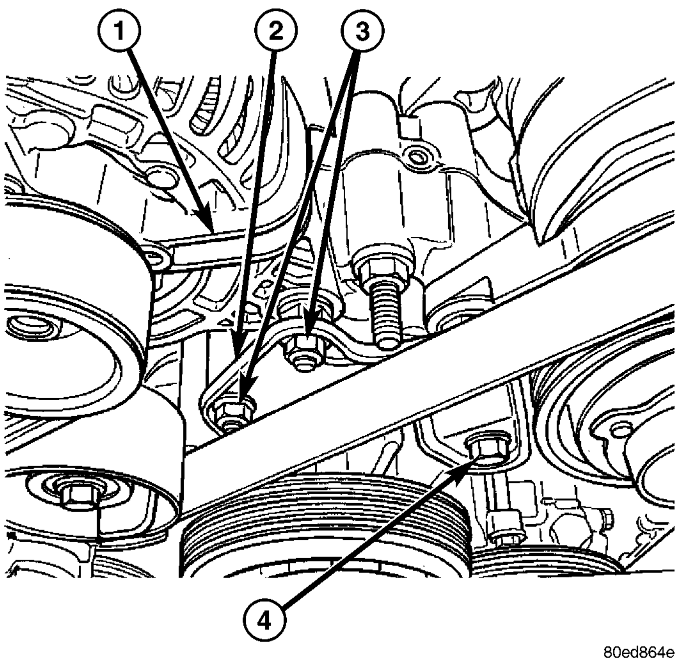

Fig. 4 GENERATOR SUPPORT BRACKET- 5.7L

1 - GENERATOR
2 - SUPPORT BRACKET
3 - BRACKET NUTS
4 - BRACKET BOLT

5.9L Diesel

WARNING: DISCONNECT BOTH NEGATIVE CABLES FROM BOTH BATTERIES BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

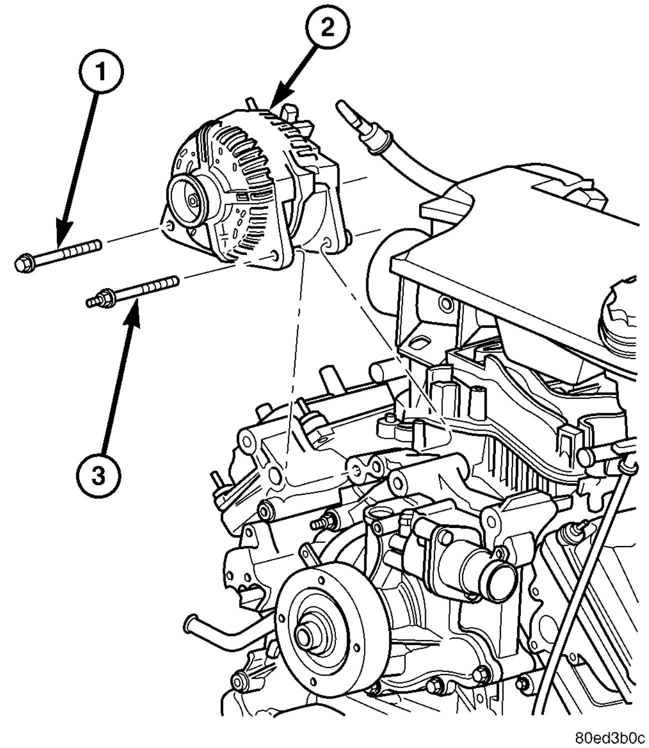

Fig. 5 REMOVE / INSTALL GENERATOR - 5.7L

1 - MOUNTING BOLT
2 - GENERATOR
3 - MOUNTING STUD / BOLT

(1) Disconnect both negative battery cables at both batteries.
(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.
(3) Unsnap plastic insulator cap from B+ output terminal.
(4) Remove B+ terminal mounting nut at rear of generator (Fig. 7). Disconnect terminal from generator.
(5) Disconnect field wire connector at rear of generator by pushing on connector tab.
(6) Remove upper mounting bracket bolt (Fig. 6).
(7) Remove lower mounting bracket bolt and nut (Fig. 6).
(8) Remove generator from vehicle.

5.9L Gas

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.
(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.

GENERATOR (Continued)

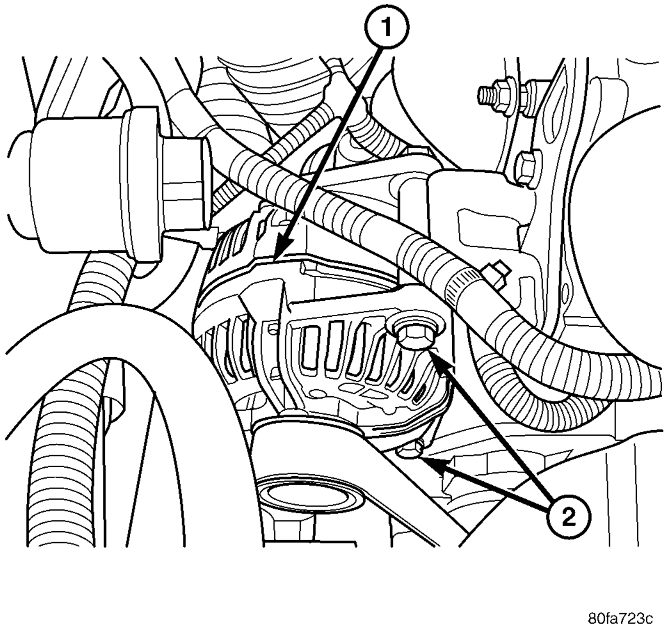

Fig. 6 5.9L DIESEL GENERATOR

1 - GENERATOR
2 - MOUNTING BOLTS

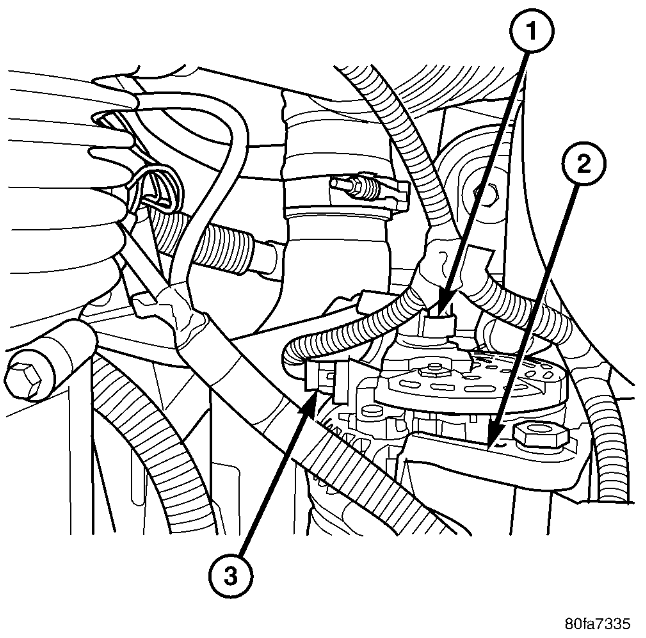

Fig. 7 5.9L DIESEL GENER. CONNECTORS

1 - B+ CONNECTOR
2 - GENERATOR
3 - FIELD WIRE CONNECTOR

(3) Unsnap plastic insulator cap from B+ output terminal (Fig. 8).

(4) Remove B+ terminal mounting nut at rear of generator (Fig. 8). Disconnect terminal from generator.

(5) Disconnect field wire connector at rear of generator (Fig. 8) by pushing on connector tab.

(6) Remove 1 upper generator mounting bolt (Fig. 9).

(7) Remove 1 lower generator mounting bolt / nut (Fig. 9).

(8) Remove generator from vehicle.

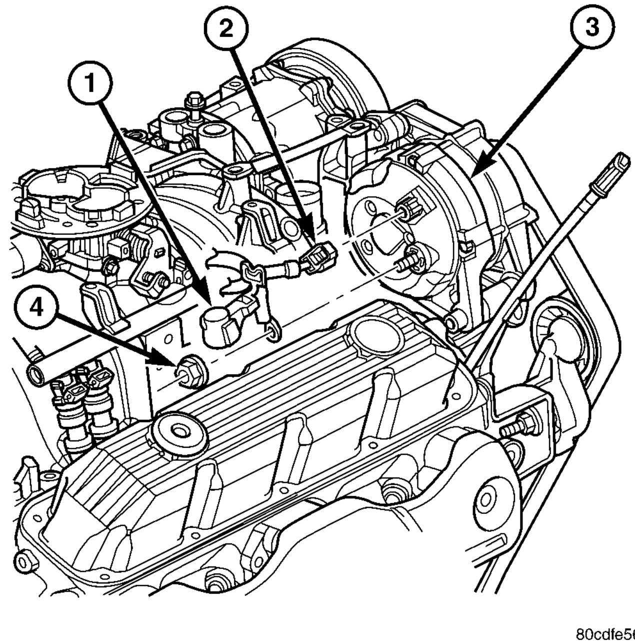

Fig. 8 GENERATOR CONNECTORS - 5.9L GAS

1 - PLASTIC INSULATOR CAP
2 - FIELD WIRE CONNECTOR
3 - GENERATOR
4 - B+ NUT

8.0L

WARNING: DISCONNECT NEGATIVE CABLE FROM BATTERY BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.

(1) Disconnect negative battery cable at battery.

(2) Remove generator drive belt. Refer to 7, Cooling System for procedure.

(3) Unsnap plastic insulator cap from B+ output terminal.

(4) Remove B+ terminal mounting nut at rear of generator. Disconnect terminal from generator.

(5) Disconnect field wire connector at rear of generator by pushing on connector tab.

(6) Remove upper mounting bolt and nut (Fig. 10).

(7) Remove lower mounting bolt (Fig. 10).

GENERATOR (Continued)

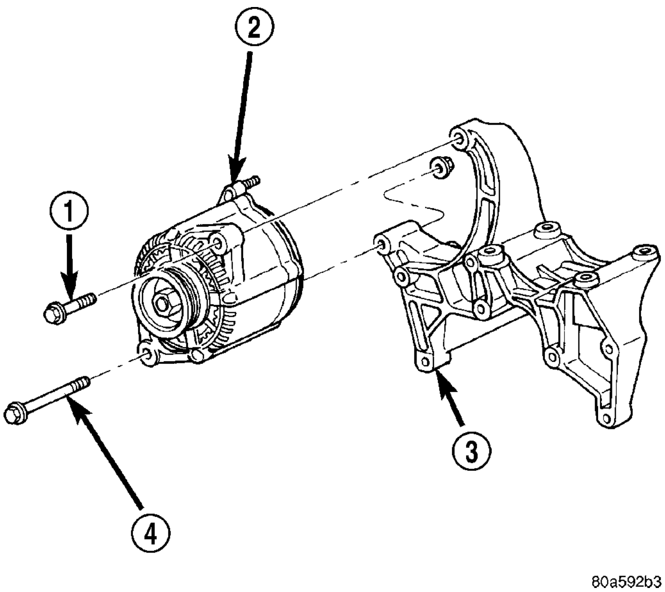

Fig. 9 REMOVE / INSTALL GENERATOR - 5.9L GAS

1 - MOUNTING BOLT
2 - GENERATOR
3 - MOUNTING BRACKET
4 - MOUNTING BOLT/NUT

(8) Remove generator from vehicle.

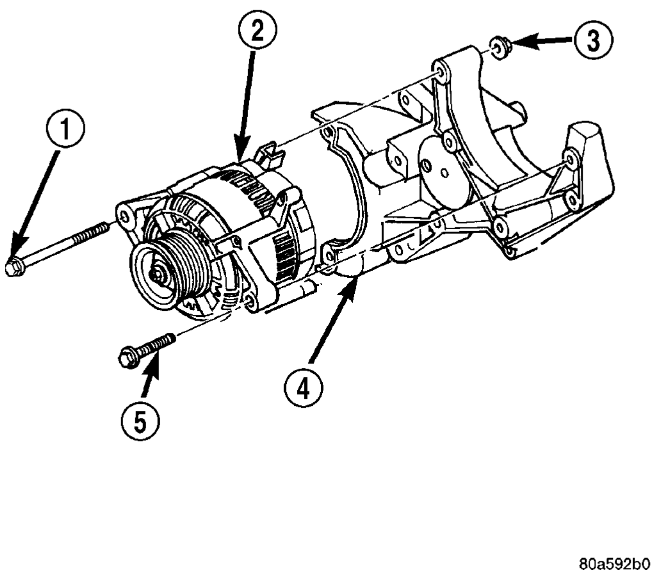

Fig. 10 REMOVE / INSTALL GENERATOR – 8.0L ENGINE

1 - MOUNTING BOLT
2 - GENERATOR
3 - NUT
4 - MOUNTING BRACKET
5 - MOUNTING BOLT

INSTALLATION

3.7L / 4.7L

(1) Position generator to engine and install 2 horizontal bolts and 1 vertical bolt.

(2) Tighten all 3 bolts. Refer to Torque Specifications.

(3) Snap field wire connector into rear of generator.

(4) Install B+ terminal eyelet to generator output stud. Tighten mounting nut. Refer to Torque Specifications.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump may be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(5) Install generator drive belt. Refer to 7, Cooling System for procedure.

(6) Install negative battery cable to battery.

5.7L

(1) Position generator to engine and install 2 mounting bolts.

(2) Tighten bolts. Refer to Torque Specifications.

(3) Position support bracket to front of generator and install bolt and nuts. Tighten bolt / nuts. Refer to Torque Specifications.

(4) Snap field wire connector into rear of generator.

(5) Install B+ terminal eyelet to generator output stud. Tighten mounting nut. Refer to Torque Specifications.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump may be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(6) Install generator drive belt. Refer to 7, Cooling System for procedure.

GENERATOR (Continued)

(7) Install negative battery cable to battery.

5.9L Diesel

(1) Position generator to upper and lower mounting brackets and install upper bolt and lower bolt / nut.

(2) Tighten all bolts / nut. Refer to Torque Specifications.

(3) Snap field wire connector into rear of generator.

(4) Install B+ terminal eyelet to generator output stud. Tighten mounting nut. Refer to Torque Specifications.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump may be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(5) Install generator drive belt. Refer to 7, Cooling System for procedure.

(6) Install both negative battery cables to both batteries.

8.0L

(1) Position generator to engine and install lower bolt and upper bolt / nut.

(2) Tighten all bolts / nut. Refer to Torque Specifications.

(3) Snap field wire connector into rear of generator.

(4) Install B+ terminal eyelet to generator output stud. Tighten mounting nut. Refer to Torque Specifications.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump may be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(5) Install generator drive belt. Refer to 7, Cooling System for procedure.

(6) Install negative battery cable to battery.

5.9L Gas

(1) Position generator to engine and install upper bolt and lower bolt / nut.

(2) Tighten all bolts / nut. Refer to Torque Specifications.

(3) Snap field wire connector into rear of generator.

(4) Install B+ terminal eyelet to generator output stud. Tighten mounting nut. Refer to Torque Specifications.

CAUTION: Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

CAUTION: When installing a serpentine accessory drive belt, the belt MUST be routed correctly. The water pump may be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in 7, Cooling System.

(5) Install generator drive belt. Refer to 7, Cooling System for procedure.

(6) Install negative battery cable to battery.

VOLTAGE REGULATOR

DESCRIPTION

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the PCM (Powertrain Control Module) (within the ECM for diesel engines). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

OPERATION

The amount of direct current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage (B+) and battery temperature (refer to Battery Temperature Sensor for more information). It then determines a target charging voltage. If sensed battery voltage is 0.5 volts or lower than the target voltage, the PCM grounds the field winding until sensed battery voltage is 0.5 volts above target voltage. A circuit in the PCM cycles the ground side of the generator field up to 100 times per second (100Hz), but has the capability to ground the field control wire 100% of the time (full field) to achieve the target voltage. If the charging rate cannot be monitored (limp-in), a duty cycle of 25% is used by the PCM in order to have some generator output. Also refer to Charging System Operation for additional information.

STARTING

TABLE OF CONTENTS

STARTING

DESCRIPTION

The starting system consists of:

- Starter relay
- Starter motor (including an integral starter solenoid)

Other components to be considered as part of starting system are:

- Battery
- Battery cables
- Ignition switch and key lock cylinder
- Clutch pedal position switch (manual transmission)
- Park/neutral position switch (automatic transmission)
- Wire harnesses and connections.

The Battery, Starting, and Charging systems operate in conjunction with one another, and must be tested as a complete system. For correct operation of starting/charging systems, all components used in these 3 systems must perform within specifications. When attempting to diagnose any of these systems, it is important that you keep their interdependency in mind.

The diagnostic procedures used in each of these groups include the most basic conventional diagnostic methods, to the more sophisticated On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM). Use of an induction-type milliampere ammeter, volt/ohmmeter, battery charger, carbon pile rheostat (load tester), and 12-volt test lamp may be required.

Certain starting system components are monitored by the PCM and may produce a Diagnostic Trouble Code (DTC). Refer to Diagnostic Trouble Codes in Emission Control for a list of codes.

OPERATION

The starting system components form two separate circuits. A high-amperage feed circuit that feeds the starter motor between 150 and 350 amperes (700 amperes - diesel engine), and a low-amperage control circuit that operates on less than 20 amperes. The high-amperage feed circuit components include the battery, the battery cables, the contact disc portion of the starter solenoid, and the starter motor. The low-amperage control circuit components include the ignition switch, the clutch pedal position switch (manual transmission), the park/neutral position switch (automatic transmission), the starter relay, the electromagnetic windings of the starter solenoid, and the connecting wire harness components.

If the vehicle is equipped with a manual transmission, it has a clutch pedal position switch installed in series between the ignition switch and the coil battery terminal of the starter relay. This normally open switch prevents the starter relay from being energized when the ignition switch is turned to the Start position, unless the clutch pedal is depressed. This feature prevents starter motor operation while the clutch disc and the flywheel are engaged. The starter relay coil ground terminal is always grounded on vehicles with a manual transmission.

If the vehicle is equipped with an automatic transmission, battery voltage is supplied through the low-amperage control circuit to the coil battery terminal of the starter relay when the ignition switch is turned to the Start position. The park/neutral position switch is installed in series between the starter relay coil ground terminal and ground. This normally

STARTING (Continued)

open switch prevents the starter relay from being energized and the starter motor from operating unless the automatic transmission gear selector is in the Neutral or Park positions.

When the starter relay coil is energized, the normally open relay contacts close. The relay contacts connect the relay common feed terminal to the relay normally open terminal. The closed relay contacts energize the starter solenoid coil windings.

The energized solenoid pull-in coil pulls in the solenoid plunger. The solenoid plunger pulls the shift lever in the starter motor. This engages the starter overrunning clutch and pinion gear with the starter ring gear.

As the solenoid plunger reaches the end of its travel, the solenoid contact disc completes the high-amperage starter feed circuit and energizes the solenoid plunger hold-in coil. Current now flows between the solenoid battery terminal and the starter motor, energizing the starter.

Once the engine starts, the overrunning clutch protects the starter motor from damage by allowing the starter pinion gear to spin faster than the pinion shaft. When the ignition switch is released to the On position, the starter relay coil is de-energized. This causes the relay contacts to open. When the relay contacts open, the starter solenoid plunger hold-in coil is de-energized.

When the solenoid plunger hold-in coil is de-energized, the solenoid plunger return spring returns the plunger to its relaxed position. This causes the contact disc to open the starter feed circuit, and the shift lever to disengage the overrunning clutch and pinion gear from the starter ring gear.

DIAGNOSIS AND TESTING - STARTING SYSTEM

The battery, starting, and charging systems operate in conjunction with one another, and must be tested as a complete system. For correct starting/charging system operation, all of the components involved in these 3 systems must perform within specifications.

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER FAILS TO OPERATE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery, if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits, if required.
	3. Starter relay faulty.	3. Refer to Starter Relay in Diagnosis and Testing. Replace starter relay if required.
	4. Ignition switch faulty.	4. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch if required.
	5. Clutch pedal position switch faulty.	5. Refer to Clutch Pedal Position Switch.
	6. Park/Neutral position switch faulty or misadjusted.	6. Refer to Park/Neutral Position Switch. Replace park/neutral position switch if required.
	7. Starter solenoid faulty.	7. Refer to Starter Motor. Replace starter motor assembly if required.
	8. Starter motor faulty.	8. If all other starting system components and circuits test OK, replace starter motor.
STARTER ENGAGES, FAILS TO TURN ENGINE.	1. Battery discharged or faulty.	1. Refer to Battery. Charge or replace battery if required.
	2. Starting circuit wiring faulty.	2. Refer to 8, Wiring Diagrams. Test and repair starter feed and/or control circuits if required.
	3. Starter motor faulty.	3. If all other starting system components and circuits test OK, replace starter motor assembly.
	4. Engine seized.	4. Refer to Engine Diagnosis in the Diagnosis and Testing section of 9, Engine.

STARTING (Continued)

Starting System Diagnosis		
CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER ENGAGES, SPINS OUT BEFORE ENGINE STARTS.	1. Starter ring gear faulty.	1. Refer to Starter Motor Removal and Installation. Remove starter motor to inspect starter ring gear. Replace starter ring gear if required.
	2. Starter motor faulty.	2. If all other starting system components and circuits test OK, replace starter motor assembly.
STARTER DOES NOT DISENGAGE.	1. Starter motor improperly installed.	1. Refer to Starter Motor Removal and Installation. Tighten starter mounting hardware to correct torque specifications.
	2. Starter relay faulty.	2. Refer to Starter Relay Diagnosis and Testing. Replace starter relay if required.
	3. Ignition switch faulty.	3. Refer to Ignition Switch and Key Lock Cylinder. Replace ignition switch if required.
	4. Starter motor faulty.	4. If all other starting system components and circuits test OK, replace starter motor.

INSPECTION

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. Before removing any unit from starting system for repair or diagnosis, perform the following inspections:

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO 8, PASSIVE RESTRAINT SYSTEMS, BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

- **Battery** - Visually inspect battery for indications of physical damage and loose or corroded cable connections. Determine state-of-charge and cranking capacity of battery. Charge or replace battery if required. Refer to **Battery** in 8, Battery. **Note: If equipped with diesel engine, a dual battery system may be used, and both batteries must be inspected.**
- **Ignition Switch** - Visually inspect ignition switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Ignition Switch and Key Lock Cylinder.**
- **Clutch Pedal Position Switch** - If equipped with manual transmission, visually inspect clutch pedal position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Clutch Pedal Position Switch** in 6, Clutch.
- **Park/Neutral Position Switch** - If equipped with automatic transmission, visually inspect park/neutral position switch for indications of physical damage and loose or corroded wire harness connections. Refer to **Park/Neutral Position Switch** in 21, Transmission.
- **Starter Relay** - Visually inspect starter relay for indications of physical damage and loose or corroded wire harness connections.
- **Starter Motor** - Visually inspect starter motor for indications of physical damage and loose or corroded wire harness connections.
- **Starter Solenoid** - Visually inspect starter solenoid for indications of physical damage and loose or corroded wire harness connections.
- **Wiring** - Visually inspect wire harnesses for damage. Repair or replace any faulty wiring, as required. Refer to 8, Wiring Diagrams.

TESTING

COLD CRANKING TEST

For complete starter wiring circuit diagrams, refer to 8, Wiring Diagrams. The battery must be fully-charged and load-tested before proceeding. Refer to **Battery** in 8, Battery.

(1) Connect volt-ampere tester to battery terminals (Fig. 1). See instructions provided by manufacturer of volt-ampere tester being used. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, tester should be connected to battery on left side of vehicle only. Also, tester current reading must be taken from positive battery cable lead that connects to starter motor.**

(2) Fully engage parking brake.

(3) If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped

STARTING (Continued)

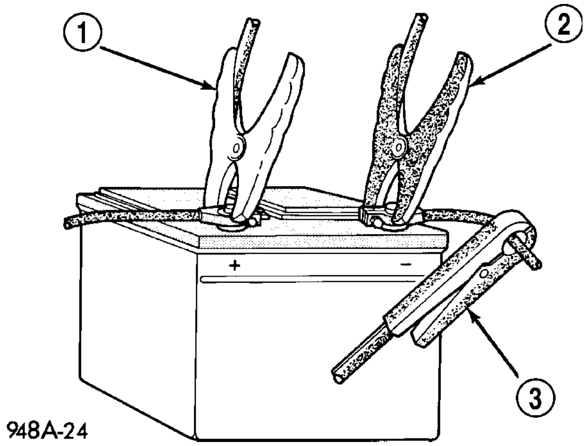

Fig. 1 VOLTS-AMPS TESTER CONNECTIONS - TYPICAL

1 - POSITIVE CLAMP
2 - NEGATIVE CLAMP
3 - INDUCTION AMMETER CLAMP

with automatic transmission, place gearshift selector lever in Park position.

(4) Verify that all lamps and accessories are turned off.

(5) To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

WARNING: IF EQUIPPED WITH DIESEL ENGINE, ATTEMPT TO START ENGINE A FEW TIMES BEFORE PROCEEDING WITH FOLLOWING STEP.

(6) Rotate and hold ignition switch in Start position. Note cranking voltage and current (amperage) draw readings shown on volt-ampere tester.

(a) If voltage reads below 9.6 volts, refer to **Starter Motor** in Diagnosis and Testing. If starter motor is OK, refer to **Engine Diagnosis** in 9, Engine for further testing of engine. If starter motor is not OK, replace faulty starter motor.

(b) If voltage reads above 9.6 volts and current (amperage) draw reads below specifications, refer to **Feed Circuit Test** in this section.

(c) If voltage reads 12.5 volts or greater and starter motor does not turn, refer to **Control Circuit Testing** in this section.

(d) If voltage reads 12.5 volts or greater and starter motor turns very slowly, refer to **Feed Circuit Test** in this section.

NOTE: A cold engine will increase starter current (amperage) draw reading, and reduce battery voltage reading.

FEED CIRCUIT TEST

The starter feed circuit test (voltage drop method) will determine if there is excessive resistance in high-amperage feed circuit. For complete starter wiring circuit diagrams, refer 8, Wiring Diagrams.

When performing these tests, it is important to remember that voltage drop is giving an indication of resistance between two points at which voltmeter probes are attached.

Example: When testing resistance of positive battery cable, touch voltmeter leads to positive battery cable clamp and cable connector at starter solenoid. If you probe positive battery terminal post and cable connector at starter solenoid, you are reading combined voltage drop in positive battery cable clamp-to-terminal post connection and positive battery cable.

The following operation will require a voltmeter accurate to 1/10 (0.10) volt. Before performing tests, be certain that following procedures are accomplished:

- Battery is fully-charged and load-tested. Refer to **Battery** in 8, Battery.
- Fully engage parking brake.
- If equipped with manual transmission, place gearshift selector lever in Neutral position and block clutch pedal in fully depressed position. If equipped with automatic transmission, place gearshift selector lever in Park position.
- Verify that all lamps and accessories are turned off.
- To prevent a gasoline engine from starting, remove Automatic ShutDown (ASD) relay. To prevent a diesel engine from starting, remove Fuel Pump Relay. These relays are located in Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(1) Connect positive lead of voltmeter to negative battery cable terminal post. Connect negative lead of voltmeter to negative battery cable clamp (Fig. 2). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, procedure must be performed twice, once for each battery.**

(2) Connect positive lead of voltmeter to positive battery terminal post. Connect negative lead of voltmeter to battery positive cable clamp (Fig. 3). Rotate and hold ignition switch in Start position. Observe voltmeter. If voltage is detected, correct poor contact between cable clamp and terminal post. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed twice, once for each battery.**

STARTING (Continued)

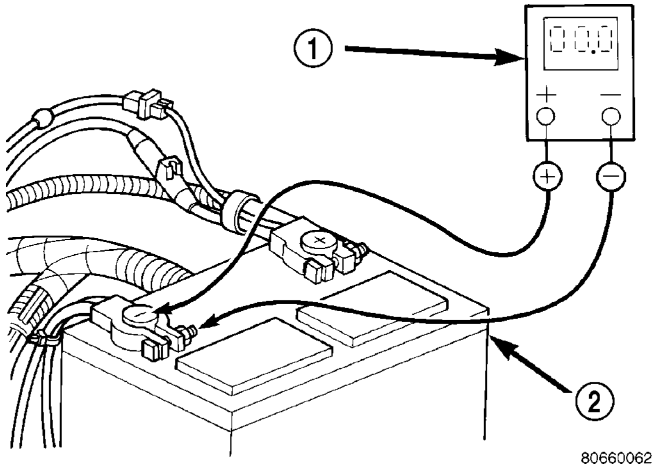

Fig. 2 TEST BATTERY NEGATIVE CONNECTION RESISTANCE - TYPICAL

1 - VOLTMETER
2 - BATTERY

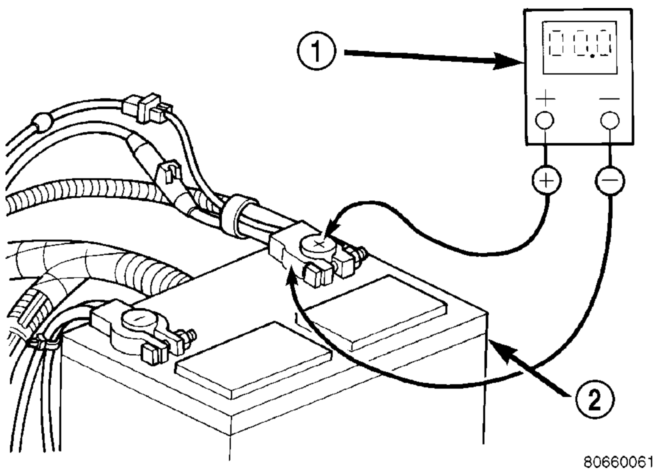

Fig. 3 TEST BATTERY POSITIVE CONNECTION RESISTANCE - TYPICAL

1 - VOLTMETER
2 - BATTERY

(3) Connect voltmeter to measure between battery positive terminal post and starter solenoid battery terminal stud (Fig. 4). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery cable connection at solenoid. Repeat test. If reading is still above 0.2 volt, replace faulty positive battery cable. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed on driver side battery only.**

(4) Connect voltmeter to measure between negative battery terminal post and a good clean ground on engine block (Fig. 5). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten negative battery cable attachment on engine block. Repeat test. If reading is still above 0.2 volt, replace faulty negative battery cable. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed twice, once for each battery.**

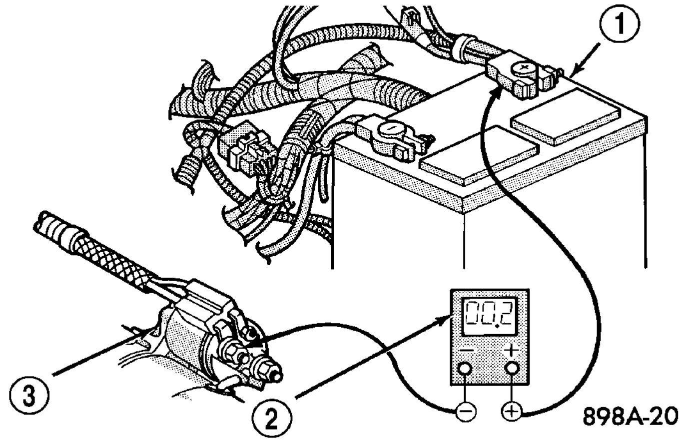

Fig. 4 TEST BATTERY POSITIVE CABLE RESISTANCE - TYPICAL

1 - BATTERY
2 - VOLTMETER
3 - STARTER MOTOR

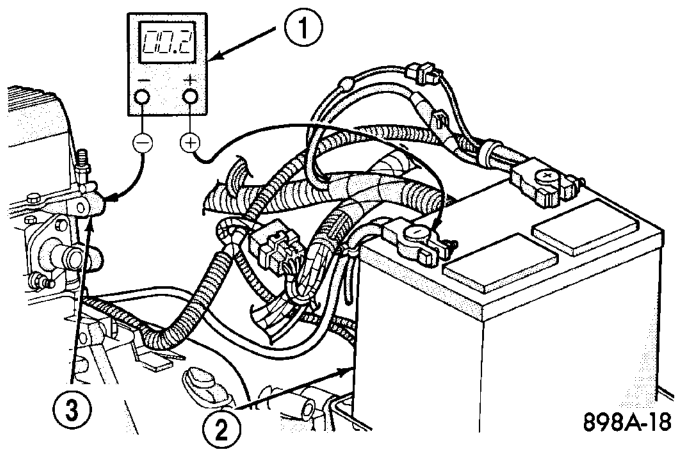

Fig. 5 TEST GROUND CIRCUIT RESISTANCE - TYPICAL

1 - VOLTMETER
2 - BATTERY
3 - ENGINE GROUND

(5) Connect positive lead of voltmeter to starter housing. Connect negative lead of voltmeter to negative battery terminal post (Fig. 6). Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, correct poor starter to engine block ground contact. **Note: Certain diesel equipped models use dual batteries. If equipped with dual battery system, this procedure must be performed on driver side battery only.**

STARTING (Continued)

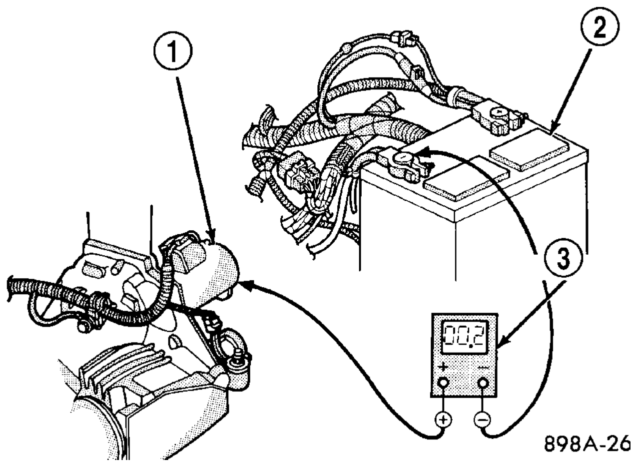

Fig. 6 TEST STARTER GROUND - TYPICAL

1 - STARTER MOTOR
2 - BATTERY
3 - VOLTMETER

(6) If equipped with dual battery system (certain diesel equipped models), connect positive lead of voltmeter to positive battery cable clamp on battery located on left side of vehicle. Connect negative lead of voltmeter to positive battery terminal post on battery located on right side of vehicle. Rotate and hold ignition switch in Start position. Observe voltmeter. If reading is above 0.2 volt, clean and tighten battery cables at both batteries. Repeat test. If reading is still above 0.2 volt, replace faulty positive battery cable.

If resistance tests detect no feed circuit problems, refer to **Starter Motor** in the Diagnosis and Testing.

CONTROL CIRCUIT TESTING

The starter control circuit components should be tested in the order in which they are listed, as follows:

- **Starter Relay** - Refer to **Starter Relay** Diagnosis and Testing.
- **Starter Solenoid** - Refer to **Starter Motor** Diagnosis and Testing.
- **Ignition Switch** - Refer to **Ignition Switch and Key Lock Cylinder**
- **Clutch Pedal Position Switch -** If equipped with manual transmission, refer to **Clutch Pedal Position Switch** in 6, Clutch.
- **Park/Neutral Position Switch -** If equipped with automatic transmission, refer to **Park/Neutral Position Switch** in 21, Transmission.
- **Wire harnesses and connections -** Refer to 8, Wiring Diagrams.

SPECIFICATIONS

STARTING SYSTEM

Starter Motor and Solenoid			
Manufacturer	Denso	Denso	Denso
Part Number	56028715AD	56027703AD	4741012
Engine Application	3.7L / 4.7L / 5.7L / 5.9L	8.0L	5.9L Diesel
Power Rating	1.4 Kilowatt / 1.9 Horsepower	1.4 Kilowatt / 1.9 Horsepower	2.7 Kilowatt / 3.6 Horsepower
Voltage	12 Volts	12 Volts	12 Volts
Number of Brushes	4	4	4
Drive Type	Gear Reduction	Gear Reduction	Conventional
Free Running Test Voltage	11 Volts	11 Volts	11 Volts
Free Running Test Amperage Draw	73 Amperes	73 Amperes	200 Amperes
Free Running Test Minimum Speed	3601 rpm	3601 rpm	3000
Solenoid Closing Maximum Voltage Required	7.5 Volts	7.5 Volts	8.0 Volts
* Cranking Amperage Draw Test	125 - 250 Amperes	125 - 250 Amperes	450 - 700 Amperes
* Test at operating temperature. Cold engine, tight (new) engine, or heavy oil will increase starter amperage draw.			

STARTING (Continued)

SPECIFICATIONS - TORQUE - STARTING SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Battery Cable Eyelet Nut at Solenoid (large nut - gas engines)	25	19	221
Battery Cable Eyelet Nut at Solenoid (large nut - diesel engine)	14	-	120
Starter Solenoid Nut (small nut - diesel engine)	6	-	55
Starter Mounting Bolts - Gas Engines	68	50	-
Starter Mounting Nut - Gas Engines	68	50	-
Starter Mounting Bolts - Diesel	43	32	-

STARTER MOTOR

DIAGNOSIS AND TESTING - STARTER MOTOR

Correct starter motor operation can be confirmed by performing the following free running bench test. This test can only be performed with starter motor removed from vehicle. Refer to Specifications for starter motor specifications.

(1) Remove starter motor from vehicle. Refer to Starter Motor Removal and Installation.

(2) Mount starter motor securely in a soft-jawed bench vise. The vise jaws should be clamped on the mounting flange of starter motor. Never clamp on starter motor by field frame.

(3) Connect a suitable volt-ampere tester and a 12-volt battery to starter motor in series, and set ammeter to 100 ampere scale. See instructions provided by manufacturer of volt-ampere tester being used.

(4) Install jumper wire from solenoid terminal to solenoid battery terminal. The starter motor should operate. If starter motor fails to operate, replace faulty starter motor assembly.

(5) Adjust carbon pile load of tester to obtain free running test voltage. Refer to Specifications for starter motor free running test voltage specifications.

(6) Note reading on ammeter and compare reading to free running test maximum amperage draw. Refer to Specifications for starter motor free running test maximum amperage draw specifications.

(7) If ammeter reading exceeds maximum amperage draw specification, replace faulty starter motor assembly.

STARTER SOLENOID

This test can only be performed with starter motor removed from vehicle.

(1) Remove starter motor from vehicle. Refer to Starter Motor Removal and Installation.

(2) Disconnect wire from solenoid field coil terminal.

(3) Check for continuity between solenoid terminal and solenoid field coil terminal with a continuity tester (Fig. 7). There should be continuity. If OK, go to Step 4. If not OK, replace faulty starter motor assembly.

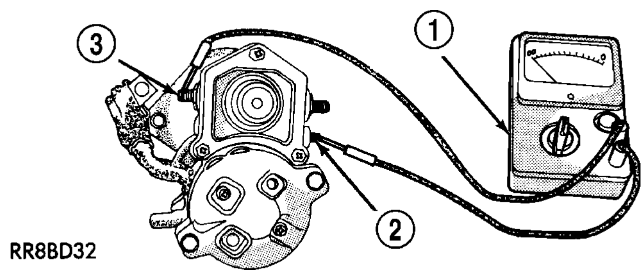

Fig. 7 CONTINUITY BETWEEN SOLENOID AND FIELD COIL TERMINALS - TYPICAL

1 - OHMMETER
2 - SOLENOID TERMINAL
3 - FIELD COIL TERMINAL

(4) Check for continuity between solenoid terminal and solenoid case (Fig. 8). There should be continuity. If not OK, replace faulty starter motor assembly.

REMOVAL

3.7L / 4.7L

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) Note: If equipped with 4WD and certain transmissions, a support bracket is used between front axle and side of transmission. Remove 2 support bracket bolts at transmission. Pry support bracket slightly to gain access to lower starter mounting bolt.

STARTER MOTOR (Continued)

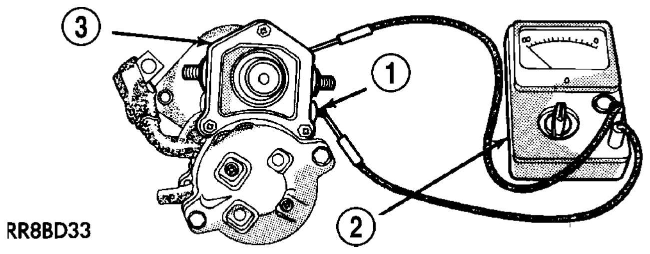

Fig. 8 CONTINUITY BETWEEN SOLENOID TERMINAL AND CASE - TYPICAL

1 - SOLENOID TERMINAL
2 - OHMMETER
3 - SOLENOID

(4) Remove 1 bolt and 1 nut if equipped with a manual transmission (Fig. 9).

(5) Remove 2 bolts if equipped with an automatic transmission (Fig. 10).

(6) Move starter motor towards front of vehicle far enough for nose of starter pinion housing to clear housing. Always support starter motor during this process, do not let starter motor hang from wire harness.

(7) Tilt nose downwards and lower starter motor far enough to access and remove nut that secures battery positive cable wire harness connector eyelet to solenoid battery terminal stud. Do not let starter motor hang from wire harness.

(8) Remove battery positive cable wire harness connector eyelet from solenoid battery terminal stud.

(9) Disconnect battery positive cable wire harness connector from solenoid terminal connector receptacle.

(10) Remove starter motor.

5.7L Gas

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) Note: If equipped with 4WD and certain transmissions, a support bracket is used between front axle and side of transmission. Remove 2 support bracket bolts at transmission. Pry support bracket slightly to gain access to lower starter mounting bolt.

(4) Remove 2 mounting bolts (Fig. 11).

(5) Move starter motor towards front of vehicle far enough for nose of starter pinion housing to clear housing. Always support starter motor during this process, do not let starter motor hang from wire harness.

(6) Tilt nose downwards and lower starter motor far enough to access and remove nut that secures battery positive cable wire harness connector eyelet to solenoid battery terminal stud. Do not let starter motor hang from wire harness.

(7) Remove battery positive cable wire harness connector eyelet from solenoid battery terminal stud.

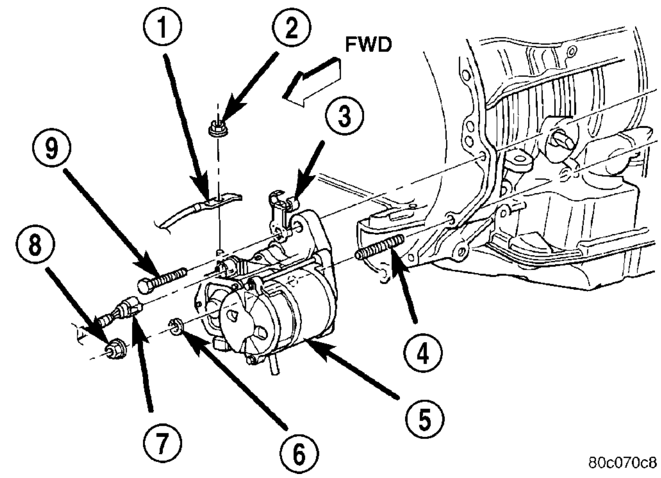

Fig. 9 STARTER R/I - 3.7L/4.7L - MAN. TRANS.

1 - EYELET TERMINAL
2 - NUT
3 - BRACKET
4 - STUD
5 - STARTER MOTOR
6 - LOCK WASHER
7 - WIRE HARNESS CONNECTOR
8 - NUT
9 - SCREW AND WASHER (2)

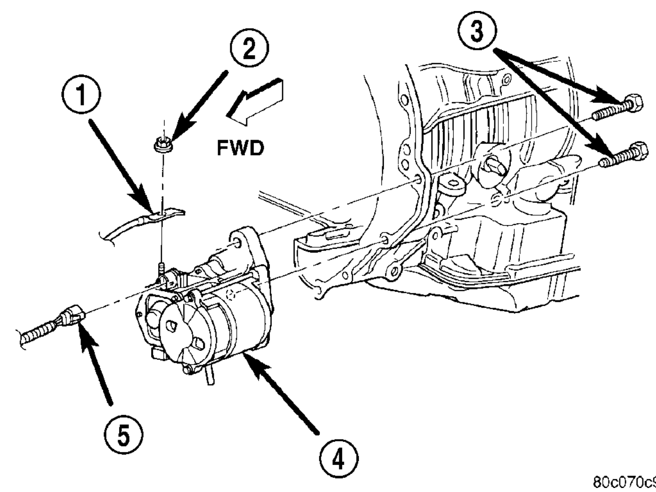

Fig. 10 STARTER R/I - 3.7L/4.7L - AUTO. TRANS.

1 - EYELET TERMINAL
2 - NUT
3 - SCREW AND WASHER (2)
4 - STARTER MOTOR
5 - WIRE HARNESS CONNECTOR

(8) Disconnect battery positive cable wire harness connector from solenoid terminal connector receptacle.

(9) Remove starter motor.

5.9L Diesel

(1) Disconnect and isolate both negative battery cables at both batteries.

(2) Raise and support vehicle.

(3) Remove 3 starter mounting bolts (Fig. 12).

STARTER MOTOR (Continued)

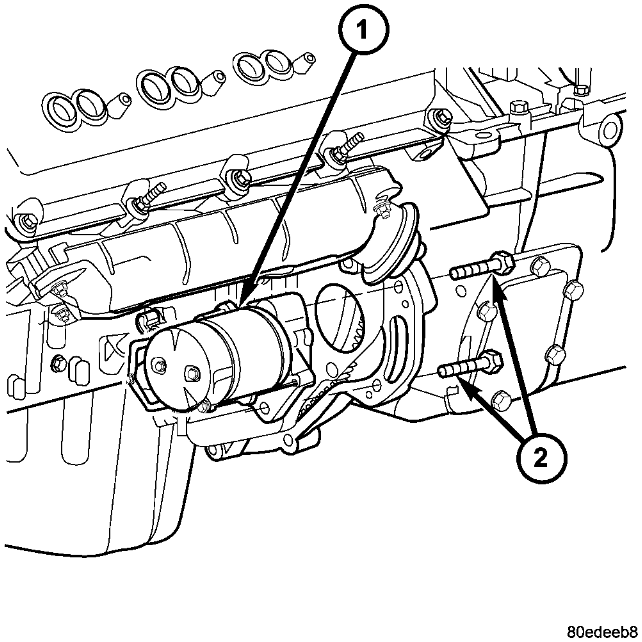

Fig. 11 STARTER R/I - 5.7L

1 - STARTER MOTOR
2 - MOUNTING BOLTS

(4) Move starter motor towards front of vehicle far enough for nose of starter pinion housing to clear housing. Always support starter motor during this process. Do not let starter motor hang from wire harness.

(5) Tilt nose downwards and lower starter motor far enough to access and remove nuts securing starter wiring harness to starter (Fig. 13). Do not let starter motor hang from wire harness.

(6) Remove starter motor from engine. Note: Certain diesel engines use an aluminum spacer (Fig. 12). Note position and orientation of spacer before removal.

5.9L Gas

(1) Disconnect and isolate negative battery cable.

(2) Raise and support vehicle.

(3) Note: If equipped with 4WD and certain transmissions, a support bracket is used between front axle and side of transmission. Remove 2 support bracket bolts at transmission. Pry support bracket slightly to gain access to lower starter mounting bolt.

(4) Remove nut and lock washer securing starter motor to mounting stud (Fig. 14).

(5) While supporting starter motor, remove upper mounting bolt from starter motor.

(6) If equipped with automatic transmission, slide cooler tube bracket forward on tubes far enough for starter motor mounting flange to be removed from lower mounting stud.

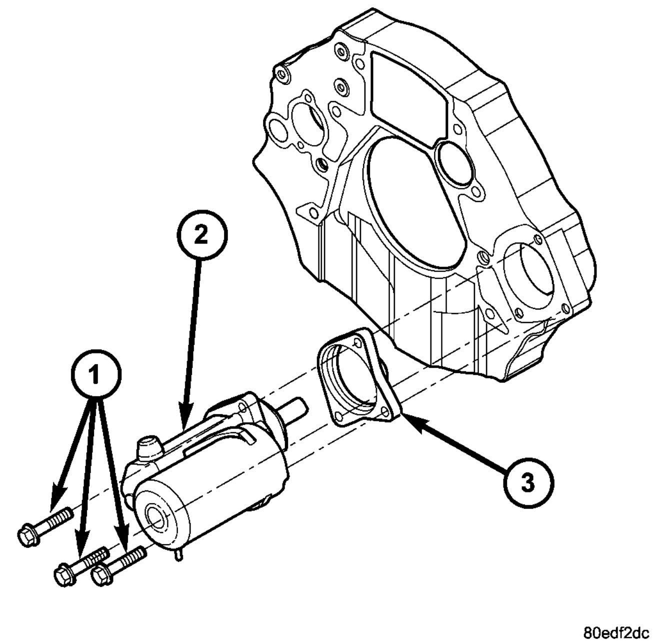

Fig. 12 STARTER R/I - 5.9L DIESEL

1 - MOUNTING BOLTS (3)
2 - STARTER MOTOR
3 - SPACER (CERTAIN TRANSMISSIONS)

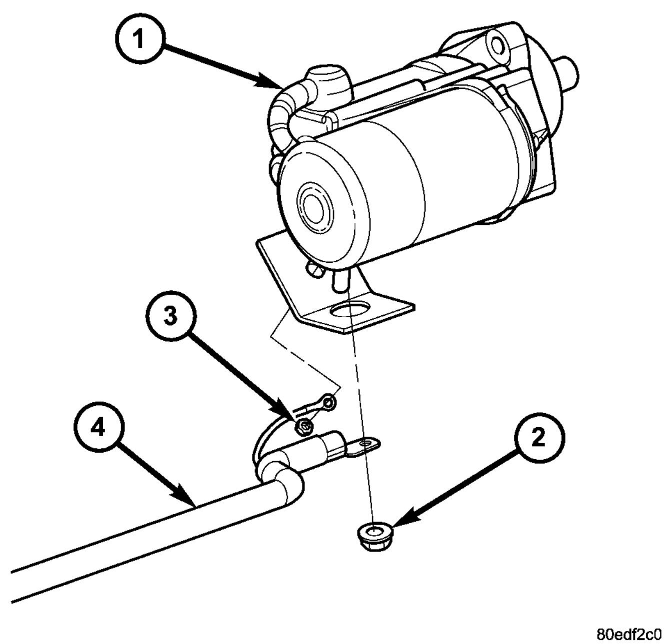

Fig. 13 STARTER ELECTRICAL CONNECTORS - 5.9L DIESEL

1 - STARTER MOTOR
2 - BATTERY CABLE NUT
3 - SOLENOID NUT
4 - HARNESS ASSEMBLY

(7) Move starter motor towards front of vehicle far enough for nose of starter pinion housing to clear

STARTER MOTOR (Continued)

housing. Always support starter motor during this process, do not let starter motor hang from wire harness.

(8) Tilt nose downwards and lower starter motor far enough to access and remove nut that secures battery positive cable wire harness connector eyelet to solenoid battery terminal stud. Do not let starter motor hang from wire harness.

(9) Remove battery positive cable wire harness connector eyelet from solenoid battery terminal stud.

(10) Disconnect battery positive cable wire harness connector from solenoid terminal connector receptacle.

(11) Remove starter motor.

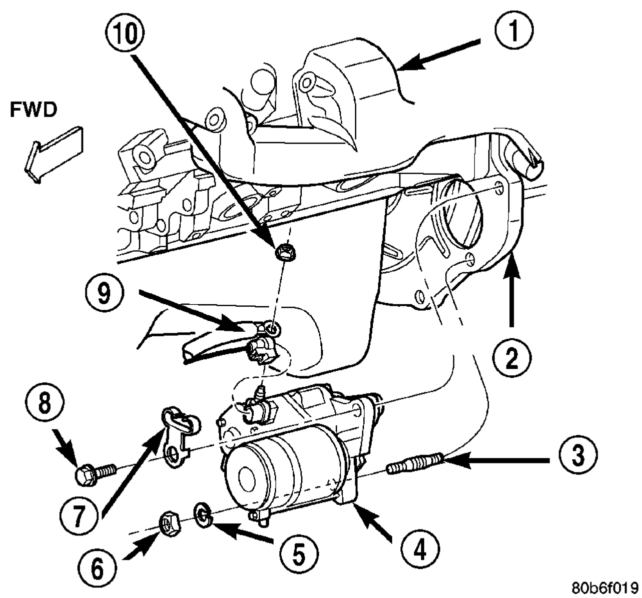

Fig. 14 STARTER R/I - 5.9L GAS

1 - ENGINE
2 - STARTER MOUNTING FLANGE
3 - STUD
4 - STARTER MOTOR
5 - LOCK WASHER
6 - NUT
7 - BRACKET
8 - BOLT
9 - POSITIVE BATTERY CABLE WIRE HARNESS
10 - POSITIVE BATTERY CABLE WIRE HARNESS NUT

INSTALLATION

3.7L / 4.7L

(1) Connect solenoid wire to starter motor (snaps on).

(2) Position battery cable to solenoid stud. Install and tighten battery cable eyelet nut. Refer to Torque Specifications. Do not allow starter motor to hang from wire harness.

(3) Position starter motor to transmission.

(4) If equipped with automatic transmission, slide cooler tube bracket into position.

(5) Install and tighten both bolts (auto. trans.), or 1 nut and 1 bolt (man. trans.). Refer to Torque Specifications.

(6) Lower vehicle.

(7) Connect negative battery cable.

5.7L

(1) Connect solenoid wire to starter motor (snaps on).

(2) Position battery cable to solenoid stud. Install and tighten battery cable eyelet nut. Refer to Torque Specifications. Do not allow starter motor to hang from wire harness.

(3) Position starter motor to engine.

(4) If equipped with automatic transmission, slide cooler tube bracket into position.

(5) Install and tighten both mounting bolts. Refer to Torque Specifications.

(6) Lower vehicle.

(7) Connect negative battery cable.

5.9L Diesel

(1) **If Equipped:** Position and hold aluminum spacer to rear of starter while positioning starter to engine.

(2) Connect solenoid wire to starter motor. Tighten nut.

(3) Position battery cable to starter stud. Install and tighten battery cable nut. Refer to Torque Specifications. Do not allow starter motor to hang from wire harness.

(4) Position starter motor to transmission.

(5) If equipped with automatic transmission, slide cooler tube bracket into position.

(6) Install and tighten 3 starter mounting bolts. Refer to Torque Specifications.

(7) Lower vehicle.

(8) Connect both negative battery cables to both batteries.

5.9L Gas

(1) Connect solenoid wire to starter motor (snaps on).

(2) Position battery cable to solenoid stud. Install and tighten battery cable eyelet nut. Refer to Torque Specifications. Do not allow starter motor to hang from wire harness.

(3) Position starter motor to transmission.

(4) If equipped with automatic transmission, slide cooler tube bracket into position.

(5) Install and tighten both bolts (auto. trans.), or 1 nut and 1 bolt (man. trans.). Refer to Torque Specifications.

(6) Lower vehicle.

(7) Connect negative battery cable.

STARTER MOTOR RELAY

DESCRIPTION

The starter relay is an electromechanical device that switches battery current to the pull-in coil of the starter solenoid when ignition switch is turned to Start position. The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. See PDC cover for relay identification and location.

The starter relay is a International Standards Organization (ISO) relay. Relays conforming to ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The starter relay cannot be repaired or adjusted. If faulty or damaged, it must be replaced.

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor or diode, and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When electromagnetic coil is energized, it draws the movable contact away from normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When electromagnetic coil is de-energized, spring pressure returns movable contact to normally closed position. The resistor or diode is connected in parallel with electromagnetic coil within relay, and helps to dissipate voltage spikes produced when coil is de-energized.

DIAGNOSIS AND TESTING - STARTER RELAY

The starter relay (Fig. 15) is located in Power Distribution Center (PDC). Refer to PDC cover for relay identification and location. For complete starter relay wiring circuit diagrams, refer to 8, Wiring Diagrams.

(1) Remove starter relay from PDC.

(2) A relay in de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 5 ohms. If OK, go to Step 4. If not OK, replace faulty relay.

(4) Connect 12V battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform Relay Circuit Test that follows. If not OK, replace faulty relay.

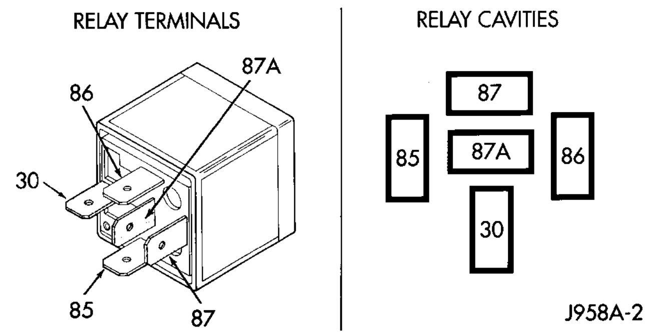

Fig. 15 TYPE 1 RELAY

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair open circuit to fuse in PDC as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to common feed terminal (30) in the energized position. This terminal supplies battery voltage to starter solenoid field coils. There should be continuity between cavity for relay terminal 87 and starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair open circuit to starter solenoid as required.

(4) The coil battery terminal (86) is connected to electromagnet in relay. It is energized when ignition switch is held in Start position. On vehicles with manual transmission, clutch pedal must be fully depressed for this test. Check for battery voltage at cavity for relay terminal 86 with ignition switch in Start position, and no voltage when ignition switch is released to On position. If OK, go to Step 5. If not OK with automatic transmission, check for open or short circuit to ignition switch and repair, if required. If circuit to ignition switch is OK, refer to **Ignition Switch and Key Lock Cylinder**. If not OK with a manual transmission, check circuit between relay and clutch pedal position switch for open or a short. If circuit is OK, refer to **Clutch Pedal Position Switch** in 6 , Clutch.

STARTER MOTOR RELAY (Continued)

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with manual transmission, it is grounded at all times. On vehicles with automatic transmission, it is grounded through park/neutral position switch only when gearshift selector lever is in Park or Neutral positions. Check for continuity to ground at cavity for relay terminal 85. If not OK with manual transmission, repair circuit to ground as required. If not OK with automatic transmission, check for pen or short circuit to park/neutral position switch and repair, if required. If circuit to park/neutral position switch is OK, refer to **Park/Neutral Position Switch** in 21, Transmission.

REMOVAL

The starter relay is located in the Power Distribution Center (PDC) (Fig. 16). Refer to label on PDC cover for relay location.

(1) Disconnect and isolate negative battery cable.

(2) Remove cover from Power Distribution Center (PDC) for relay identification and location.

(3) Remove starter relay from PDC.

(4) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(5) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

(1) Push down firmly on starter relay until terminals are fully seated into PDC receptacle.

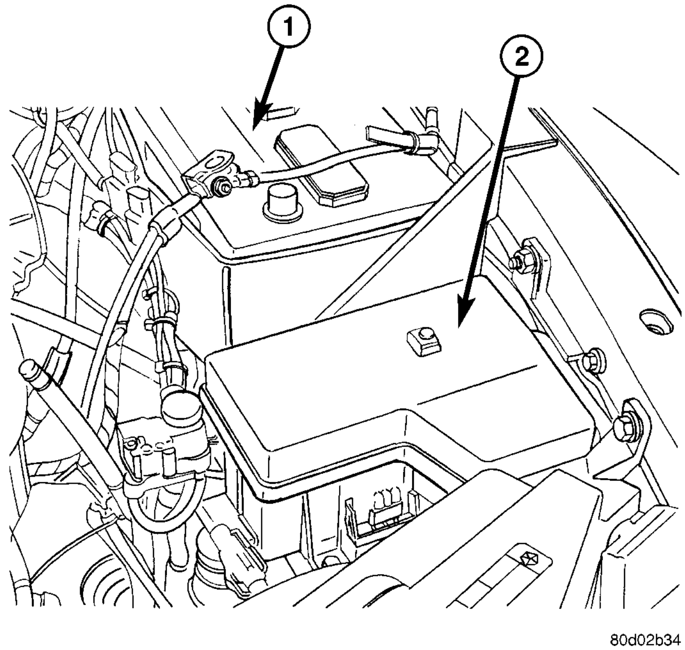

Fig. 16 PDC LOCATION

1 - BATTERY
2 - PDC (POWER DISTRIBUTION CENTER)

(2) Install PDC cover.

(3) Connect battery cable.

HEATED SYSTEMS

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HEATED MIRRORS

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HEATED MIRRORS

DESCRIPTION - HEATED MIRROR SYSTEM

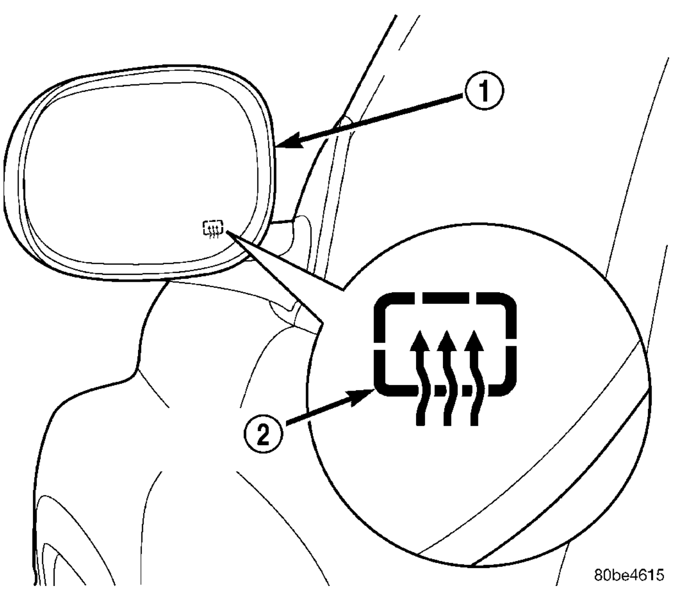

Fig. 1 HEATED MIRROR- typical

1 - POWER HEATED OUTSIDE REAR VIEW MIRROR
2 - REAR WINDOW DEFOGGER ICON

Electrically heated outside rear view mirrors are an additional factory-installed option on models that are equipped with factory-installed dual power mirrors. Vehicles with this option can be visually identified by the International Control and Display Symbol icon for rear window defogger, which appears on the lower inboard corner of each outside mirror glass (Fig. 1); or, by the heated mirror switch that is located in the lower left corner of the a/c heater control unit face plate. The heated mirror system helps the vehicle operator maintain outside rear view mirror visibility during inclement operating conditions by keeping both outside mirror glasses clear of ice, snow, or fog. The heated mirror system for this vehicle includes the following major components:

- The heated mirror switch, including the heated mirror system solid state electronic control logic and timer circuitry, the heated mirror relay and the heated mirror system indicator lamp. All of these components are integral to the a/c heater control unit on the instrument panel.
- The two outside mirror heating grids, which are integral to the power outside mirror units.

Following are general descriptions of the major components in the heated mirror system. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated mirror system.

OPERATION - HEATED MIRROR SYSTEM

The solid state electronic control logic and timer circuitry for the heated mirror system receives battery current from a fuse in the Junction Block (JB) only when the ignition switch is in the On or Start positions. After the heated mirror system is turned On, the electronic control logic and timer circuitry will automatically turn the system off after a programmed time interval of about fifteen minutes. After the initial time interval has expired, if the

HEATED MIRRORS (Continued)

heated mirror switch is depressed and released a second time during the same ignition cycle, the electronic control logic and timer circuitry will automatically turn the heated mirror system off after a programmed time interval of about five minutes. The heated mirror system will be shut off automatically if the ignition switch is turned to the Off or Accessory positions. After the heated mirror system is turned On, it can also be turned off manually by depressing and releasing the heated mirror switch a second time.

When the heated mirror system is turned On, the heated mirror system control logic and timer circuitry energizes the heated mirror system indicator lamp and the heated mirror relay. When energized, the heated mirror relay supplies fused ignition switch output (run/start) current from a fuse in the JB to the outside mirror heating grids located behind the mirror glass of each of the outside rear view mirrors. When energized, each of the outside mirror heating grids produces enough heat to warm the glass of the outside rear view mirrors.

DIAGNOSIS AND TESTING - HEATED MIRROR SYSTEM

If only one of the outside mirror heating grids is inoperative, perform continuity checks on the circuits and heater grid for that mirror only. If both outside mirror heating grids are inoperative, proceed with the heated mirror system diagnosis as follows. (Refer to Appropriate Wiring Information).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The operation of the heated mirror system can be confirmed in one of the following manners:

1. Turn the ignition switch to the On position. While monitoring the instrument panel voltmeter, momentarily depress and release the heated mirror switch. When the heated mirror system is turned On, a distinct voltmeter needle deflection should be noted.
2. Turn the ignition switch to the On position. Momentarily depress and release the heated mirror switch to turn the heated mirror system On. The heated mirror operation can be checked by feeling the outside rear view mirror glass. A distinct difference in temperature between the unheated and heated mirror glass can be detected within three to four minutes of system operation.

The above checks will confirm system operation. Illumination of the heated mirror system indicator lamp means that there is electrical current available at the heated mirror relay, but does not confirm that the electrical current is reaching the outside mirror heating grids.

If the heated mirror system does not operate, the problem should be isolated in the following manner:

(1) Confirm that the ignition switch is in the On position.

(2) Check the fuses in the Power Distribution Center (PDC) and in the Junction Block (JB). The fuses must be tight in their receptacles and all electrical connections must be secure.

When the above steps have been completed and both outside mirror heating grids are still inoperative, one or more of the following is faulty:

- Heated mirror switch, electronic control logic and timer circuitry, and heated mirror relay.
- Heated mirror wire harness circuits or connectors.
- Outside mirror heating grid (both mirror grids would have to be faulty).

If turning On the heated mirror system produces a severe voltmeter deflection or fuse failures, check for a shorted circuit between the output of the heated mirror relay and the outside mirror heating grids.

HEATED SEAT SYSTEM

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HEATED SEAT SYSTEM

DESCRIPTION

Individually controlled, electrically heated front seats are available as a factory-installed option on some DR models. Vehicles with this option can be visually identified by the leather trim seats and two separate heated seat switches mounted in the lower center of the instrument panel. The heated seat system allows the front seat driver and passenger to select from two different levels of electrical seat heating, or no seat heating to suit their individual comfort requirements. The heated seat system for this vehicle includes the following major components, which are described in further detail later in this section:

- **Heated Seat Switches** - Two heated seat switches are used per vehicle. One switch is used for each front seat. The switches are mounted in the instrument panel, below the radio (Fig. 1). Each switch also includes two Light-Emitting Diode (LED) indicator lamps and an incandescent back lighting bulb.
- **Heated Seat Module** - also referred to as the Seat Heat Interface Module (SHIM), this module contains the solid state electronic control and diagnostic logic circuitry for the heated seat system. One heated seat module is used per vehicle and is mounted under the drivers front seat cushion (Fig. 1). Refer to the Electronic Control Modules section of the service manual for additional heated seat module information.
- **Heated Seat Elements** - Four heated seat elements are used per vehicle. One element is used for each front seat back and one element and sensor assembly is used for each front seat cushion (Fig. 1). The heating elements are integral to the individual front seat and seat back cushions and cannot be removed once installed at the factory. Replacement seat heating elements are available, without having to replace the entire seat cushion or trim cover. Refer to the detailed procedure later in this section.
- **Heated Seat Sensors** - Two heated seat sensors are used per vehicle. One heated seat temperature sensor is used for each front seat cushion. The sensors are integral to the individual front seat cushion heating elements (Fig. 1) and cannot be removed once installed at the factory. Replacement seat heating elements with the sensors are available, without having to replace the entire seat cushion or trim cover. Refer to the detailed procedure later in this section.

Following are general descriptions and operations of the major components in the heated seat system. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the heated seat system. Refer to **Wiring** for the location of complete heated seat system wiring diagrams.

HEATED SEAT SYSTEM (Continued)

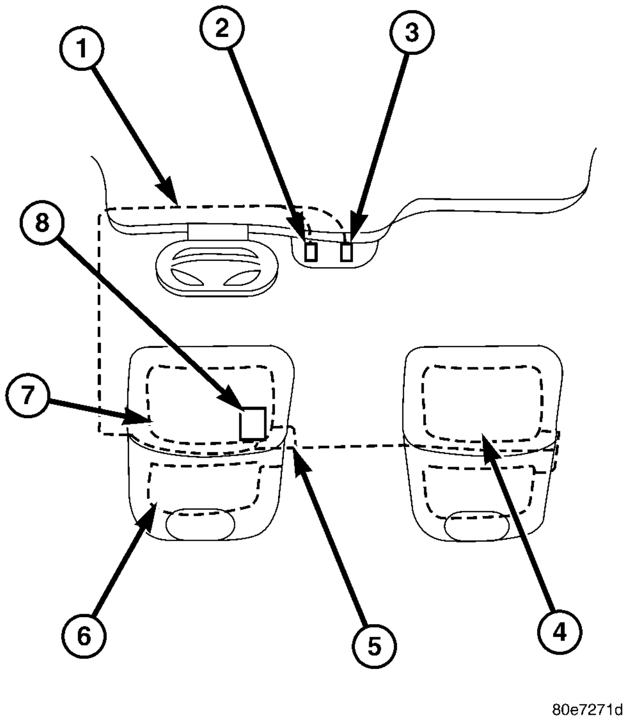

Fig. 1 DR Heated Seat System Diagram

1 - WIRE HARNESS
2 - DRIVER HEATED SEAT SWITCH
3 - PASSENGER HEATED SEAT SWITCH
4 - PASSENGER HEATED SEAT CUSHION ELEMENT
5 - SEAT CUSHION/BACK ELEMENT ELECTRICAL CONNECTOR LOCATION
6 - DRIVER HEATED SEAT BACK ELEMENT
7 - DRIVER HEATED SEAT CUSHION ELEMENT
8 - HEATED SEAT MODULE

OPERATION

The heated seat module receives fused battery current through the Integrated Power Module only when the engine is running. The heated seat switches receive battery current through fuse #48 in the Integrated Power Module only when the ignition switch is in the On position. The heated seat module shares a common ground circuit with each of the heated seat elements. The heated seat system will only operate when the surface temperature of the seat cushion is below the designed temperature set points of the system.

The heated seat system will also automatically turn off whenever the ignition switch is turned to any position except On, or if the engine quits running. If the ignition switch is turned to the Off position or if the engine quits running while a heated seat is ON, the heated seat will remain Off after the engine is restarted until a heated seat switch is depressed again. This helps prevent the vehicles battery from being drained by the heated seat system.

The heated seat module monitors inputs from the heated seat sensors and the heated seat switches. In response to these inputs the heated seat module uses its internal programming to control 12v to the heated seat elements in both front seats and to control the heated seat LED indicator lamps located in both of the heated seat switches. The heated seat module is also programmed to provide self-diagnostics, if a problem with the heated seat system is detected. If the module detects certain failures within the heated seat system, it will provide a visual indication of the failure by flashing the indicator lamps in the appropriate heated seat switch. The heated seat module will automatically turn off the heated seat elements if it detects a short or open in the heated seat element circuit or a heated seat sensor value that is out of range.

DIAGNOSIS AND TESTING - HEATED SEAT SYSTEM

HEATED SEAT SYSTEM SELF-DIAGNOSIS

The heated seat system is capable of performing some self-diagnostics. The following table depicts the various monitored failures which will be reported to the vehicle operator or technician by flashing the individual heated seat switch Light Emitting Diode (LED) indicator lamps. Refer to the HEATED SEAT SYSTEM SELF-DIAGNOSIS table for failure identification. The drivers heated seat switch indicator lamps will flash if a failure occurs in the driver heated seat, and the passengers heated seat switch indicator lamps will flash for a passenger heated seat failure. If a monitored heated seat system failure occurs, the switch indicator lamps will flash at a pulse rate of about one-half second on, followed by about one-half second off for a duration of about one minute after the switch for the faulty heated seat is depressed in either the Low or High direction. This process will repeat every time the faulty heated seat switch is actuated until the problem has been corrected.

HEATED SEAT SYSTEM SELF-DIAGNOSIS

Monitored Failure	Switch High Indicator Lamp	Switch Low Indicator Lamp
Heated Seat Element Shorted	Flashing	Flashing
Heated Seat Element Open	Flashing	Off
Heated Seat Sensor Value Out of Range	Off	Flashing

HEATED SEAT SYSTEM (Continued)

Diagnostic logic is built into the heated seat module to help the person trying to locate the problem by the most efficient means possible. Anytime a problem is suspected, locate the diagnosis and testing procedure for the component in question and follow the steps until the specific problem is located and resolved. Once the problem is thought to be corrected, verify correct system operation. If the heated seat system is functioning correctly return the vehicle to service.

If a problem could not be verified such as not finding anything wrong when following the diagnostic procedure, this is a good indication that a INTERMITTENT problem may be present. You must then attempt to find the intermittent problem, such as moving the heating element within the seat while testing continuity or wiggling the wire harness's/electrical connectors under the seat while testing continuity. Always, eliminate all other potential problems before attempting to replace the heated seat module.

PRELIMINARY TEST

Refer to **Wiring** for the location of complete heated seat system wiring diagrams. Before testing the individual components in the heated seat system, perform the following preliminary checks:

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

- If the heated seat switch back lighting and the cluster illumination lamps do not illuminate with the headlamps or park lamps turned On, refer to the **Instrument Cluster** section of the service manual for the location of cluster illumination lamp diagnosis and testing procedures. If the heated seat switch back lighting does not illuminate, but the cluster illumination lamps do illuminate with the headlamps or park lamps turned On, refer to **Diagnosis and Testing the Heated Seat Switch** in this section for the location of the heated seat switch diagnosis and testing procedures.
- If a single LED indicator lamp for one heated seat switch does not operate and the heated seat elements do heat, refer to **Diagnosis and Testing the Heated Seat Switch** in this section for heated seat switch diagnosis and testing procedures.
- If both LED indicator lamps for a heated seat switch operate, but the heated seat elements do not heat, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules for heated seat module diagnosis and testing procedures.
- If the indicator lamp on either heated seat switch remains illuminated after the heated seat has been turned Off, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules for heated seat module diagnosis and testing procedures.

HEATED SEAT ELEMENT

DESCRIPTION

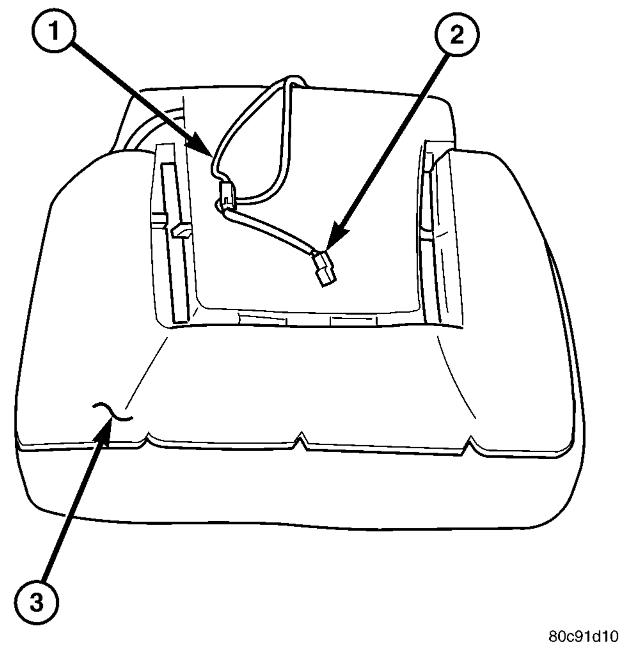

Fig. 2 Heating Element Installed on Seat Cushion Foam

1 - SEAT BACK WIRE HARNESS
2 - HEATED SEAT WIRE HARNESS CONNECTOR
3 - HEATED SEAT CUSHION ELEMENT

Vehicles equipped with the optional heated seat system have two sets of electrically operated heating element grids located in each front seat, one set for the seat cushion and the other set for the seat back. Each of the heated seat element grids consists of a single length of resistor wire that is routed in a zigzag pattern and captured between a covering and the adhesive foam rubber backing. Short pigtail wires with connectors (Fig. 2) are soldered to each end of each resistor wire element grid, which connect all of

HEATED SEAT ELEMENT (Continued)

the element grids to the heated seat module through the seat wire harness.

One temperature sensor is used for each front seat, and it is located in the center insert area of the seat cushion element. The heated seat sensors and their pigtail wires are also captured between a covering and the adhesive foam rubber backing. The heated seat sensors are Negative Thermal Coefficient (NTC) thermistors. The sensors for both front seats receive a voltage feed from a single output of the heated seat module, but the module receives individual sensor inputs from the driver side and passenger side sensors.

The heated seat elements and sensors should not be repaired. If damaged or faulty, the heated seat element assembly must be replaced.

OPERATION

One end of the heated seat element resistor wire is connected to ground at all times through a splice in the heated seat module ground circuit. Battery current is directed to the other end of the heated seat element resistor wire by the energized N-channel Field Effect Transistor (N-FET) located within the heated seat module. The heated seat module will energize the N-FET only when the heated seat switch is in the Low or High position and the heated seat sensor indicates that the seat cushion surface temperature is below the selected (Low or High) temperature set point. As electrical current passes through the heating element grid, the resistance of the wire used in the element disperses some of that electrical current in the form of heat. The heat produced by the heated seat element grid then radiates through the seat trim cover, warming its occupant.

The resistance of the heated seat sensor increases and decreases as the surface temperature of the seat cushion cover changes. The heated seat module supplies each sensor with a 5v voltage feed, then uses the sensor resistance to determine when the heated seat element grids need to be cycled on or off in order to maintain the selected temperature set point.

DIAGNOSIS AND TESTING - HEATED SEAT ELEMENT

The heated seat module will self-diagnose shorted or open heated seat element circuits and sensor circuits. Refer to Heated Seat System Diagnosis and Testing in this section for additional diagnosis and testing procedures. To manually check the heated seat element, proceed as follows. The wire harness connectors for the seat cushion and seat back heating elements and sensor are located on the right side of the seat, near the edge of the seat cushion frame. The proper connector can be identified by the foam wrapping.

NOTE: When checking heated seat elements for continuity, be certain to move the heating element being checked. Moving the element, such as sitting in the seat will eliminate the possibility of an intermittent open in the element which would only be evident if the element was in a certain position. Failure to check the element in various positions could result in an incomplete test.

(1) Position the appropriate seat in the full forward position.

(2) Make certain the ignition switch is in the OFF position.

(3) Disconnect the heated seat element connector which requires testing. Check for continuity between the two heated seat element circuit cavities while moving the appropriate seat cushion. Refer to **Wiring** for the location of complete heated seat system wiring diagrams. There should be continuity. If OK, the elements within the seat assembly test OK, go to Step 4. If not OK, replace the faulty seat heating element, refer to the procedure in this section.

(4) Test the seat wire harness between the heated seat module connector and the appropriate heated seat wire harness connector for shorted or open circuits. If OK, element is OK, proceed with testing the heated seat sensor and module. If not OK, repair the shorted or open seat wire harness as required.

REMOVAL

Do not remove the heating element from the seat or seat back cushion. The original element is permanently attached to the seat cushions and cannot be removed without damaging the cushion. The replacement heating element is designed to be applied directly over the original seat heating element.

(1) Disconnect and isolate the negative battery cable.

(2) Remove the appropriate seat cushion or seat back trim cover. Refer to the Body section of this manual for the procedures.

(3) Disconnect the inoperative heated seat cushion or seat back element electrical connectors.

(4) Locate the wires leading from the inoperative heating element and cut them off flush with the edge of the original heating element.

INSTALLATION

(1) Peel off the adhesive backing on the back of the replacement heating element and stick directly over the original heating element (Fig. 3).

CAUTION: During the installation of the replacement heating element, be careful not to fold or crease the element assembly. Folds or creases will cause premature failure.

HEATED SEAT ELEMENT (Continued)

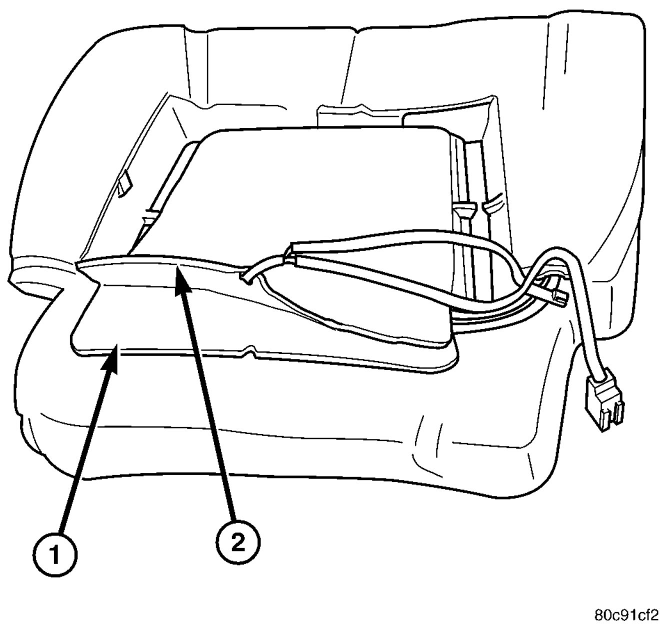

Fig. 3 Heating Element Installation

1 - ORIGINAL (INOPERATIVE) HEATING ELEMENT
2 - REPLACEMENT HEATING ELEMENT

(2) Connect the new heating element electrical connectors (Fig. 2).

(3) Connect the battery negative cable.

(4) Verify heated seat system operation.

(5) Install the appropriate seat cushion or seat back trim cover. Make certain the seat wire harness is correctly routed through the seat and seat back.

HEATED SEAT SENSOR

DESCRIPTION

The heated seat temperature sensor is a Negative Temperature Coefficient (NTC) thermistor. One temperature sensor is used for each seat. This temperature sensor is located in the seat cushion heating element on all models.

The heated seat temperature sensor cannot be repaired or adjusted and must be replaced if defective. The heated seat cushion element must be replaced if the temperature sensor is defective. Refer to the procedure in this section of the service manual.

OPERATION

When the temperature of the seat cushion cover rises, the resistance of the sensor decreases. The heated seat module supplies five-volts to one side of each sensor, and monitors the voltage drop through the sensor on a return circuit. The heated seat module uses this temperature sensor input to monitor the temperature of the seat, and regulates the current flow to the seat heating elements accordingly.

DIAGNOSIS AND TESTING - HEATED SEAT SENSOR

NOTE: Any resistance values (OHMS Ω) given in the following text are supplied using the automatic range generated by a FLUKE® automotive meter. If another type of measuring device is used, the values generated may not be the same as the results shown here, or may have to be converted to the range used here.

(1) Position the driver seat in the full rearward position.

(2) Unclip the heated seat module from the bottom of the drivers seat cushion pan.

(3) Back-probe the heated seat module wire harness connector, do not disconnect. Check cavity (#7 for passenger, #8 for driver seat) for a range in voltage from approx. 1.72 – 3.0 volts. It should be within this range, If OK check the heated seat element. If NOT OK, check for the proper 5 volt supply to the heated seat sensor, from the module. Refer to Wiring for specific information. If 5 volts is not being supplied to the sensor from the module, replace the heated seat module.

(4) Test the seat wire harness between the heated seat module connector and the heated seat wire harness connector for shorted or open circuits. If OK, refer to **Diagnosis and Testing the Heated Seat Module** in Electronic Control Modules, for the proper heated seat module diagnosis and testing procedures. If not OK, repair the shorted or open heated seat wire harness as required.

REMOVAL

(1) For heated seat sensor replacement procedure (Refer to 8 - ELECTRICAL/HEATED SEATS/ HEATED SEAT ELEMENT - REMOVAL).

HEATED SEAT SWITCH

DESCRIPTION

The momentary, bidirectional rocker-type heated seat switch (Fig. 4) provides a resistor-multiplexed signal to the heated seat module via a mux circuit. Each switch has a center neutral position and momentary Low and High positions so that both the driver and the front seat passenger can select a preferred level of seat heating. Each heated seat switch has two Light-Emitting Diode (LED) indicator lamps, which indicate the selected mode (Low or High) of the seat heater. These indicator lamps also provide

HEATED SEAT SWITCH (Continued)

diagnostic feedback for the heated seat system. Each switch also has an incandescent bulb, which provides dimmer controlled back lighting of the switch when the headlamps or park lamps are on.

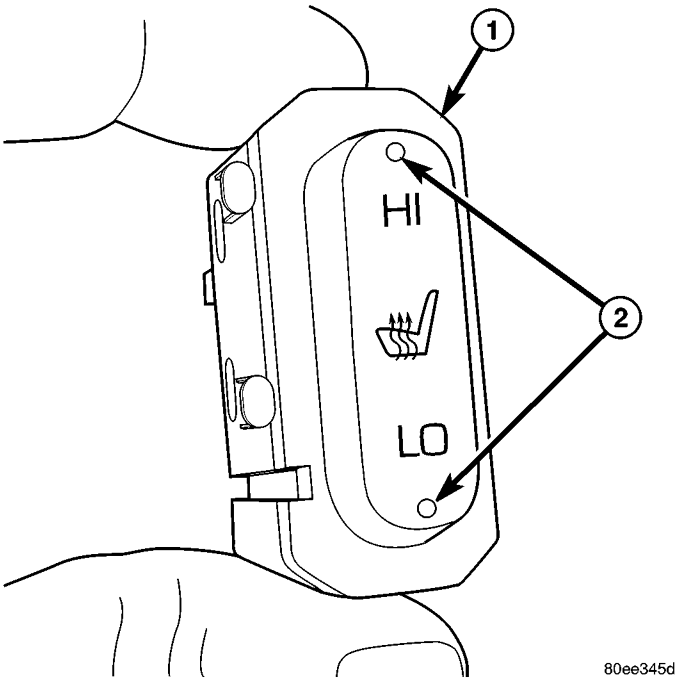

Fig. 4 HEATED SEAT SWITCH

1 - HEATED SEAT SWITCH
2 - LIGHT-EMITTING DIODE (LED) INDICATOR LAMPS

The heated seat switches are both mounted in the instrument panel center bezel, located in the lower center of the instrument panel. The two switches are snapped into the mounting holes of the heated seat switch bezel, and the heated seat switch bezel is secured with screws to the instrument panel center bezel. The heated seat switches are differentiated by the keyway in the connector receptacle on the backs of the switches and keyway on the switch housing. The instrument panel wire harness connectors for the heated seat switches are keyed to match the connector receptacles on the switches so that the two heated seat switches can only be connected to the proper heated seat electrical.

The two LED indicator lamps and the incandescent bulb in each heated seat switch cannot be repaired. If the indicator lamps or back lighting bulb are faulty or damaged, the individual heated seat switch must be replaced.

OPERATION

The heated seat switches receive battery current through a fused ignition switch output (run) circuit when the ignition switch is in the On position. Depressing the heated seat switch rocker to its momentary High or Low position provides a hard-wired resistance signal to the heated seat module. This signal tells the module to energize the heated seat element of the selected seat and maintain the requested temperature setting. If the heated seat switch is depressed to a different position (Low or High) than the currently selected state, the heated seat module will change states to support the new selection. If a heated seat switch is depressed a second time, the heated seat module interprets the second input as a request to turn the seat heater OFF.

The High and Low LED indicator lamps in the heated seat switches receive battery current through a fused ignition switch output (run) circuit when the ignition switch is in the On position. The ground side of each indicator lamp is controlled by the heated seat module. This control of the switch indicator lamps also allows the module to provide diagnostic feedback to the vehicle operator or technician to indicate heated seat system faults by flashing the indicator lamps on and off. One side of the incandescent back lighting bulb in each heated seat switch is connected to ground at all times. The other side of the incandescent bulb is connected to the fused panel lamps dimmer switch signal circuit. These bulbs are energized when the park lamps or headlamps are turned on, and their illumination intensity is controlled by the panel lamps dimmer switch.

DIAGNOSIS AND TESTING - HEATED SEAT SWITCH

Refer to **Wiring Diagrams** for connector pin-outs and the location of complete heated seat system wiring diagrams.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) If the problem being diagnosed involves inoperative heated seat switch back lighting and the cluster illumination lamps operate, go to Step 2. If the problem being diagnosed involves inoperative heated seat switch back lighting and the cluster illumination lamps are also inoperative, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the problem being diagnosed involves

HEATED SEAT SWITCH (Continued)

inoperative heated seat switch indicator lamps and the heated seat elements do not heat, proceed. If the problem being diagnosed involves inoperative heated seat switch indicator lamps and the heated seat elements do heat, go to Step 6. If the problem being diagnosed involves a heated seat switch indicator lamp that remains illuminated after the heated seat has been turned Off, (Refer to 8 - ELECTRICAL/ ELECTRONIC CONTROL MODULES/MEMORY HEATED SEAT/MIRROR MODULE - DIAGNOSIS AND TESTING).

(2) Disconnect and isolate the battery negative cable. Remove the heated seat switch and bezel unit from the instrument panel. Disconnect the heated seat switch to be tested. Check for continuity between the ground circuit cavity of the heated seat switch and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit to ground as required.

(3) Reconnect the battery negative cable. Turn the park lamps on with the headlamp switch. Rotate the panel lamps dimmer thumb wheel on the headlamp switch upward to just before the interior lamps detent. Check for battery voltage at the fused panel lamps dimmer circuit cavity of the heated seat switch. If OK, go to Step 4. If not OK, repair the open fused panel lamps dimmer switch signal circuit to the fuse in the Integrated Power Module as required.

(4) Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run) circuit cavity of the heated seat switch. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (run) circuit as required.

(5) Check the continuity and resistance values of the heated seat switch in the Neutral, Low and High positions as shown in the Heated Seat Switch Continuity chart. If OK, refer to Step 6. If not OK, replace the faulty heated seat switch.

HEATED SEAT SWITCH CONTINUITY

Switch Position	Continuity Between	Resistance
Neutral	4 & 6	2.2 Kilohms
Low	4 & 6	.415 Kilohms
High	4 & 6	33 Ohms

(6) Replace the inoperative heated seat switch with a known good unit and test the operation of the switch indicator lamps. If OK, discard the faulty heated seat switch. If not OK, (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ MEMORY HEATED SEAT/MIRROR MODULE - DIAGNOSIS AND TESTING).

REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Wait two minutes for the system reserve capacitor to discharge before beginning any airbag or instrument panel service.

(3) Remove the center bezel from the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(4) Remove the screws that secure the heated seat switch bezel to the instrument panel center bezel.

(5) Remove the heated seat switch bezel and both switches from the instrument panel as a unit.

(6) From the back of the heated seat switch bezel, gently pry the switch free and push the heated seat switch out through the front of the bezel.

INSTALLATION

NOTE: When installing the heated seat switches, be certain they are installed in the proper mounting holes of the heated seat switch bezel. The heated seat switches are differentiated by the keyway in the connector receptacle on the backs of the switches and keyway on the switch housing (Fig. 4).

(1) From the back of the heated seat switch bezel, gently push the heated seat switch in through the front of the bezel.

(2) Position the heated seat switch bezel to the instrument panel center bezel and install the retaining screws.

(3) Install the center bezel on the instrument panel (Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(4) Connect the battery negative cable.

(5) Verify vehicle and system operation.

HORN

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HORN SYSTEM

DESCRIPTION

The dual-note horn system features dual electromagnetic horn units. The horn system includes the following major components:

- **Horn** - The two horns are located on the left side of the engine compartment below the Integrated Power Module (IPM).
- **Horn Switch** - The horn switch is molded into the driver airbag trim cover.

OPERATION

The horn system operates on battery current received through a fuse in the Integrated Power Module (IPM). The horn system circuit is designed so that the system will remain operational, regardless of the ignition switch position.

DIAGNOSIS AND TESTING - HORN SYSTEM

The most reliable, efficient, and accurate means to diagnose the horn system requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the horns are being sent the proper hard wired outputs for them to perform their functions.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

In most cases, any problem involving continually sounding horns can be quickly alleviated by removing the horn fuse from the Integrated Power Module (IPM).

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

HORN

DIAGNOSIS AND TESTING - HORN

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Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

HORN (Continued)

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the wire harness connectors from the horns (Fig. 1).

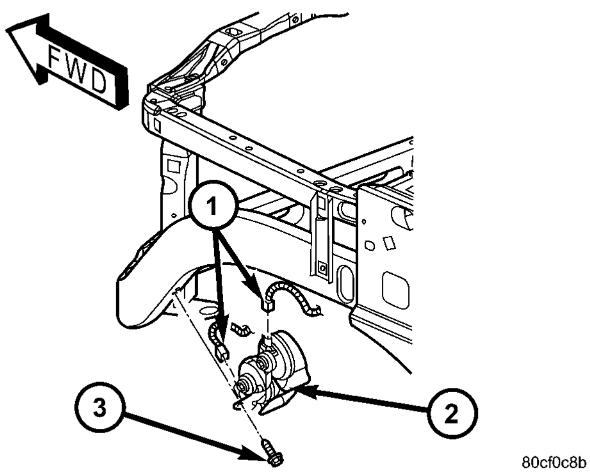

Fig. 1 HORN

1 - WIRE HARNESS CONNECTORS
2 - HORNS
3 - MOUNTING BOLT

(3) Remove mounting bolt and remove horns.

INSTALLATION

(1) Position horns and install mounting bolt. Tighten the bolt to 10 N·m (85 in. lbs.).

(2) Connect wire harness connectors.

(3) Connect battery negative cable.

HORN SWITCH

DESCRIPTION

The horn switch is molded into the driver airbag. The horn switch can not be serviced separately. For service procedures, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

DIAGNOSIS AND TESTING - HORN SWITCH

The most reliable, efficient, and accurate means to diagnose the horn system requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the horns are being sent the proper hard wired outputs for them to perform their functions.

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, SIDE AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

IGNITION CONTROL

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IGNITION CONTROL

DESCRIPTION

The ignition system is controlled by the Powertrain Control Module (PCM) on all engines.

3.7L V-6 ENGINE

The 3.7L V-6 engine uses a separate ignition coil for each cylinder. The one-piece coil bolts directly to the cylinder head. Rubber boots seal the secondary terminal ends of the coils to the top of all 6 spark plugs. A separate electrical connector is used for each coil.

Because of coil design, spark plug cables (secondary cables) are not used. A distributor is not used with the 3.7L engine.

Two knock sensors (one for each cylinder bank) are used to help control spark knock.

IGNITION CONTROL (Continued)

The Auto Shutdown (ASD) relay provides battery voltage to each ignition coil.

The ignition system consists of:

- 6 Spark Plugs
- 6 Separate Ignition Coils
- 2 Knock Sensors
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position, 2 knock and MAP Sensors

4.7L V-8 ENGINE

The 4.7L V-8 engine uses a separate ignition coil for each cylinder. The one-piece coil bolts directly to the cylinder head. Rubber boots seal the secondary terminal ends of the coils to the top of all 8 spark plugs. A separate electrical connector is used for each coil.

Because of coil design, spark plug cables (secondary cables) are not used. A distributor is not used with the 4.7L engine.

Two knock sensors (one for each cylinder bank) are used to help control spark knock.

The Auto Shutdown (ASD) relay provides battery voltage to each ignition coil.

The ignition system consists of:

- 8 Spark Plugs
- 8 Separate Ignition Coils
- 2 Knock Sensors
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position, 2 knock and MAP Sensors

5.7L V-8 ENGINE

For additional information, also refer to Ignition Coil Description and Operation.

The 5.7L V-8 engine is equipped with 16 spark plugs. Two plugs are used for each cylinder. The 5.7L is also equipped with 8 separate and independent ignition coils. The one-piece coil bolts directly to the cylinder head cover and attaches the coils secondary output terminal directly to a spark plug using a rubber boot seal. Each coil is also equipped with a second output terminal. This second terminal connects a conventional spark plug cable directly to a spark plug on the opposite cylinder bank. A separate primary electrical connector is used for each coil.

Eight conventional spark plug cables are used with the 5.7L. These cables connect a coil on one cylinder bank, directly to a spark plug on the opposite cylinder bank. The cables are placed and routed in a special plastic loom to keep them separated. This loom is clipped to the intake manifold. To prevent a miss-match of cables, a corresponding spark plug / coil number is displayed on each plug cable: 1/6, 2/3, 4/7 and 5/8. These numbers can also be found on the top of the intake manifold to the right of the throttle body (Fig. 1).

Two knock sensors (one for each cylinder bank) are used to help control spark knock.

The 5.7L engine will not use a conventional distributor.

The ignition system consists of:

- 16 Spark Plugs (2 per cylinder)
- 8 Separate, Dual-Secondary Output, Ignition Coils
- 2 Knock Sensors
- 8 Secondary Ignition Cables
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position, 2 knock and MAP Sensors

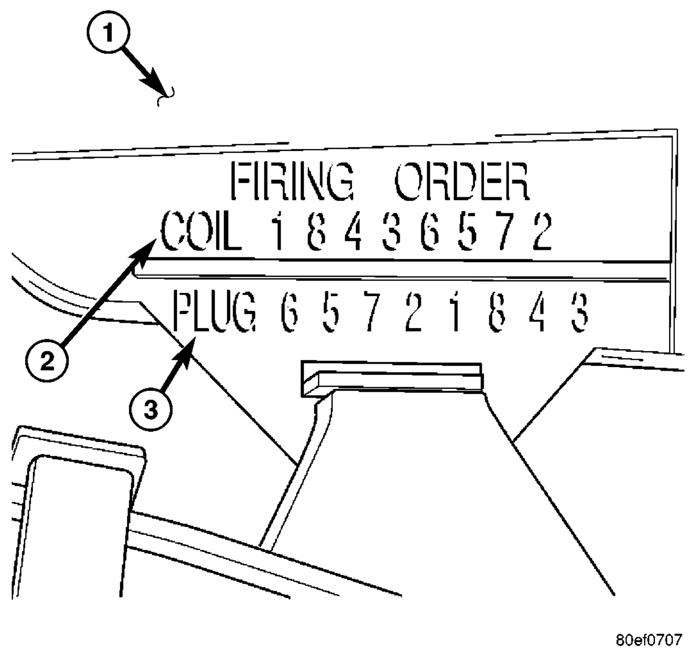


Fig. 1 FIRING ORDER / CABLE ROUTING - 5.7L V-8 ENGINE

1 - TOP OF INTAKE MANIFOLD
2 - CYLINDER FIRING ORDER (IGNITION COIL NUMBER)
3 - CORRESPONDING SPARK PLUG NUMBER

5.9L V-8 ENGINE

The 5.9L V-8 ignition system will use a conventional distributor and 1 remotely mounted coil. Conventional spark plug cables are used with the 5.9L.

Knock sensors are not used with the 5.9L engine.

The ignition system consists of:

- 8 Spark Plugs
- 1 Ignition Coil
- Secondary Ignition Cables
- Distributor (contains rotor and camshaft position sensor)
- Powertrain Control Module (PCM)

IGNITION CONTROL (Continued)

• Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

8.0L V-10 ENGINE

. The 8.0L V-10 engine is equipped with 2 remote coil packs. Conventional spark plug cables are used with the 8.0L engine. The 8.0L engine will not use a conventional distributor

The ignition coils are individually fired, but each coil is a dual output. Refer to Ignition Coil for additional information.

Knock sensors are not used with the 8.0L engine. The ignition system consists of:

- 10 Spark Plugs
- 2 Ignition Coil packs containing 10 individual coils
- 10 Secondary Ignition Cables
- Powertrain Control Module (PCM)
- Also to be considered part of the ignition system are certain inputs from the Crankshaft Position, Camshaft Position, Throttle Position and MAP Sensors

SPECIFICATIONS

SPECIFICATIONS - TORQUE - IGNITION

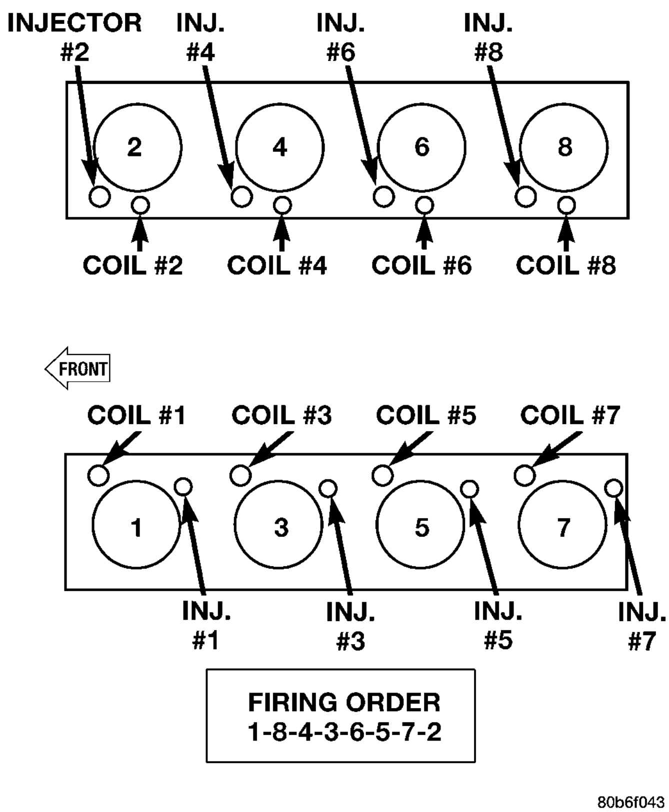
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Position Sensor - 3.7L V-6 Engine	12	-	106
Camshaft Position Sensor - 4.7L V-8 Engine	12	-	106
Camshaft Position Sensor - 5.7L V-8 Engine	12	9	105
Camshaft Position Sensor - 8.0L V-10 Engine	6	-	50
Crankshaft Position Sensor - 3.7L V-6 Engine	28	21	205
Crankshaft Position Sensor - 4.7L V-8 Engine	28	21	205
Crankshaft Position Sensor - 5.7L V-8 Engine	12	9	105
Crankshaft Position Sensor - 5.9L V-8 Engine	8	-	70
Crankshaft Position Sensor - 8.0L V-10 Engine	8	-	70
Distributor Hold Down Bolt - 5.9L V-8 Engine	23	17	-
Ignition Coil Mounting - 5.9L V-8 Engine (if tapped bolts are used)	5	-	50
Ignition Coil Mounting - 5.9L V-8 Engine (if nuts/bolts are used)	11	-	100
Ignition Coil Mounting - 3.7L V-6 Engine	8	-	70
Ignition Coil Mounting - 4.7L V-8 Engine	8	-	70
Ignition Coil Mounting - 5.7L V-8 Engine	12	9	105 (± 20)
Ignition Coil Mounting - 8.0L V-10 Engine	10	-	90
* Knock Sensor - 3.7L V-6 Engine	20	15	176
* Knock Sensor - 4.7L V-8 Engine	20	15	176
* Knock Sensor - 5.7L V-8 Engine	20	15	176
Spark Plugs - 3.7L V-6 Engine	27	20	-
Spark Plugs - 4.7L V-8 Engine	27	20	-
** Spark Plugs - 5.7L V-8 Engine	18 (± 3)	13 (± 2)	-
Spark Plugs - 5.9L V-8 Engine	41	30	-
Spark Plugs - 8.0L V-10 Engine	41	30	-
* Do not apply any sealant, thread-locker or adhesive to bolts. Poor sensor performance may result.			
** Torque critical tapered design. Do not exceed 15 ft. lbs.			

IGNITION CONTROL (Continued)

ENGINE FIRING ORDER - 3.7L V-6

1 - 6 - 5 - 4 - 3 - 2

ENGINE FIRING ORDER – 4.7L V-8



FIRING ORDER / CABLE ROUTING – 5.7L V-8 ENGINE

Eight conventional spark plug cables are used with the 5.7L. These cables connect a coil on one cylinder bank, directly to a spark plug on the opposite cylinder bank. The cables are placed and routed in a special plastic loom to keep them separated. This loom is clipped to the intake manifold. To prevent a miss-match of cables, a corresponding spark plug / coil number is displayed on each plug cable: 1/6, 2/3, 4/7 and 5/8. These numbers can also be found on the top of the intake manifold to the right of the throttle body (Fig. 2).

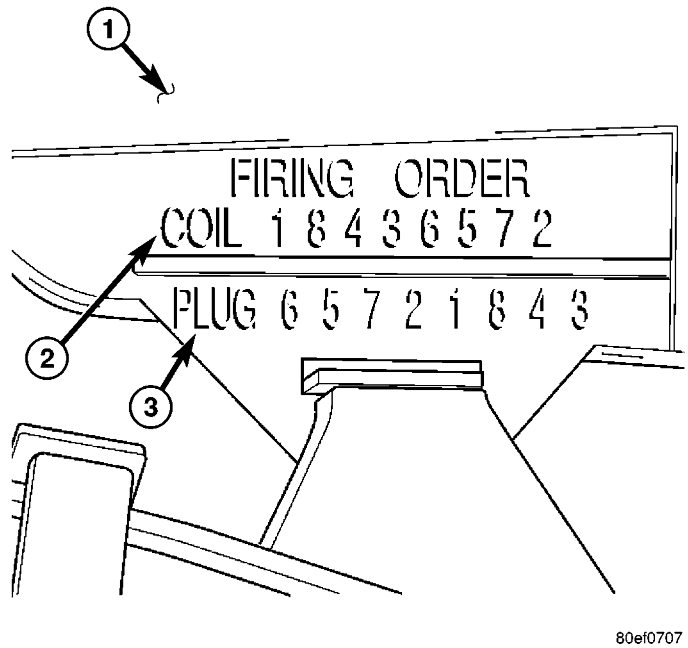
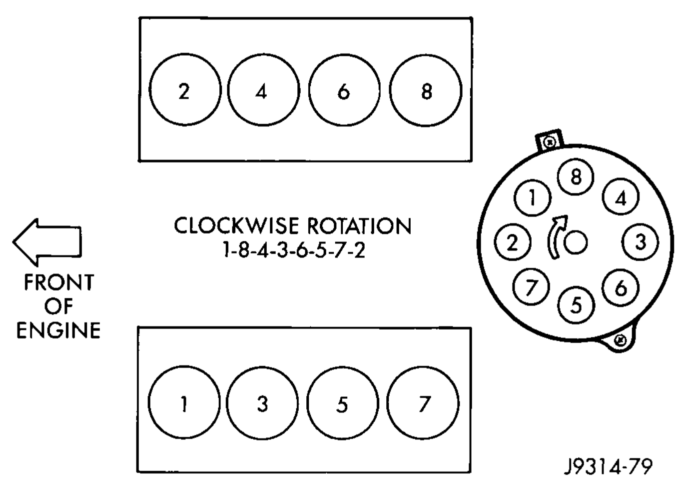


Fig. 2 FIRING ORDER / CABLE ROUTING - 5.7L V-8 ENGINE

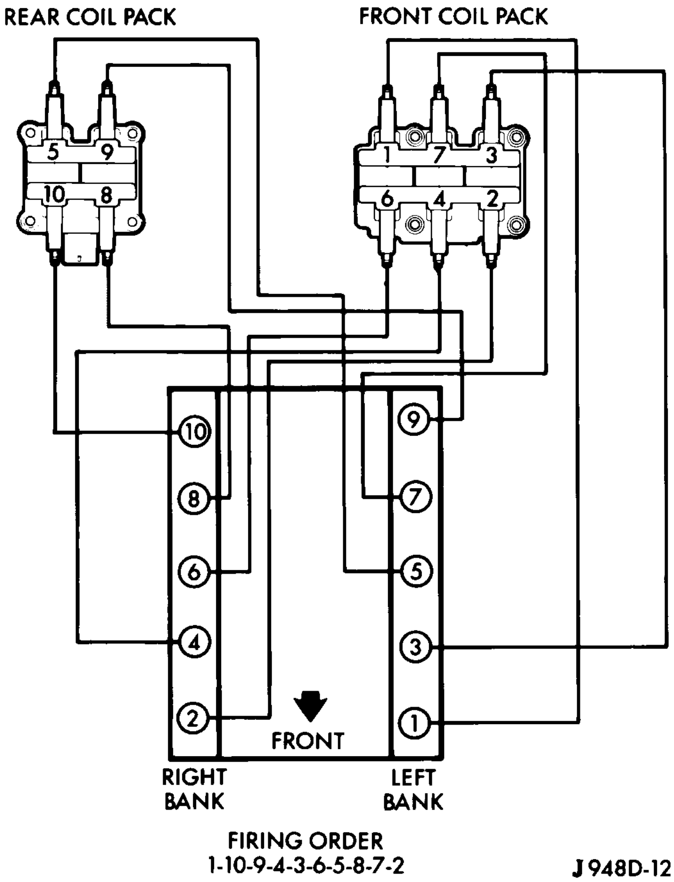
1 - TOP OF INTAKE MANIFOLD
2 - CYLINDER FIRING ORDER (IGNITION COIL NUMBER)
3 - CORRESPONDING SPARK PLUG NUMBER

ENGINE FIRING ORDER - 5.9L V-8



IGNITION CONTROL (Continued)

SPARK PLUG CABLE ORDER – 8.0L V-10 ENGINE



SPARK PLUG CABLE ORDER – 8.0L V-10 ENGINE

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
3.7L V-6	ZFR6F - 11G (NGK)	1.1 (0.042 in.)
4.7L V-8	RC12MCC4	1.01 mm (.040 in.)
5.7L V-8	Champion - RE14MCC4	1.14 mm (.045 in.)
5.9L V-8	RC12LC4	1.01 mm (.040 in.)
8.0L V-10	QC9MC4	1.14 mm (.045 in.)

IGNITION CONTROL (Continued)

IGNITION COIL RESISTANCE - 3.7L V-6

PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
0.6 - 0.9 Ohms	6,000 - 9,000 Ohms

IGNITION COIL RESISTANCE - 4.7L V-8

PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
0.6 - 0.9 Ohms	6,000 - 9,000 Ohms

IGNITION COIL RESISTANCE - 5.7L V-8

PRIMARY RESISTANCE @ 21-27°C (70-80°F)
0.558 - 0.682 Ohms (Plus or Minus 10% @ 70-80° F)

IGNITION COIL RESISTANCE - 5.9L

COIL MANUFACTURER	PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

IGNITION COIL RESISTANCE – 8.0L V-10 ENGINE

Primary Resistance: 0.53-0.65 Ohms. Test across the primary connector. Refer to text for test procedures.
Secondary Resistance: 10.9-14.7K Ohms. Test across the individual coil towers. Refer to text for test procedures.

IGNITION TIMING

Ignition timing is not adjustable on any engine.

AUTOMATIC SHUT DOWN RELAY

DESCRIPTION - PCM OUTPUT

The 5–pin, 12–volt, Automatic Shutdown (ASD) relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

OPERATION

OPERATION - PCM OUTPUT

The ASD relay supplies battery voltage (12+ volts) to the fuel injectors and ignition coil(s). With certain emissions packages it also supplies 12–volts to the oxygen sensor heating elements.

The ground circuit for the coil within the ASD relay is controlled by the Powertrain Control Module (PCM). The PCM operates the ASD relay by switching its ground circuit on and off.

The ASD relay will be shut–down, meaning the 12–volt power supply to the ASD relay will be de-activated by the PCM if:

- the ignition key is left in the ON position. This is if the engine has not been running for approximately 1.8 seconds.
- there is a crankshaft position sensor signal to the PCM that is lower than pre-determined values.

OPERATION - ASD SENSE - PCM INPUT

A 12 volt signal at this input indicates to the PCM that the ASD has been activated. The relay is used to connect the oxygen sensor heater element, ignition coil and fuel injectors to 12 volt + power supply.

This input is used only to sense that the ASD relay is energized. If the Powertrain Control Module (PCM) does not see 12 volts at this input when the ASD should be activated, it will set a Diagnostic Trouble Code (DTC).

AUTOMATIC SHUT DOWN RELAY (Continued)

DIAGNOSIS AND TESTING - ASD AND FUEL PUMP RELAYS

The following description of operation and tests apply only to the Automatic Shutdown (ASD) and fuel pump relays. The terminals on the bottom of each relay are numbered. Two different types of relays may be used, (Fig. 3) or (Fig. 4).

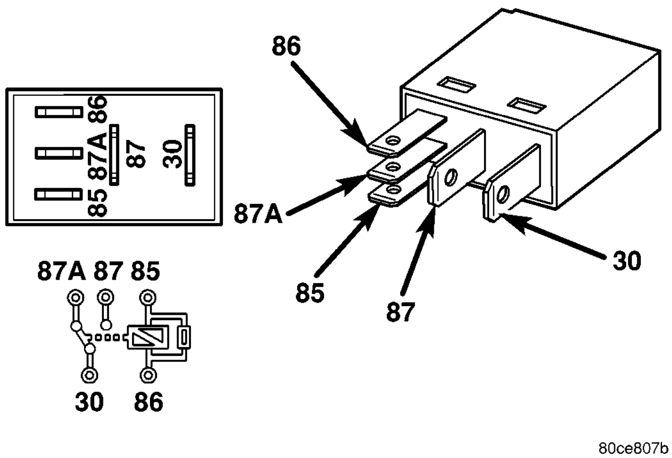


Fig. 3 TYPE 1 RELAY (ISO MICRO RELAY)

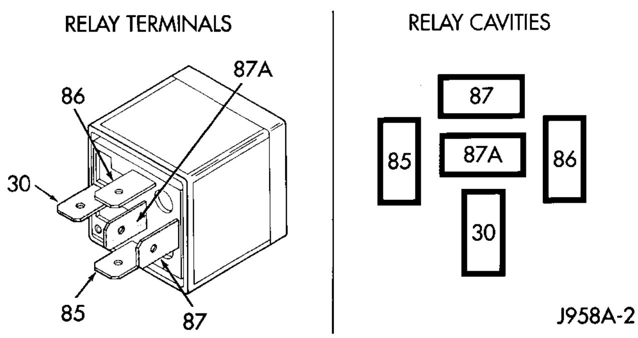


Fig. 4 ASD AND FUEL PUMP RELAY TERMINALS—TYPE 2

TERMINAL LEGEND

NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

- Terminal number 30 is connected to battery voltage. For both the ASD and fuel pump relays, terminal 30 is connected to battery voltage at all times.
- The PCM grounds the coil side of the relay through terminal number 85.
- Terminal number 86 supplies voltage to the coil side of the relay.
- When the PCM de-energizes the ASD and fuel pump relays, terminal number 87A connects to terminal 30. This is the Off position. In the off position, voltage is not supplied to the rest of the circuit. Terminal 87A is the center terminal on the relay.
- When the PCM energizes the ASD and fuel pump relays, terminal 87 connects to terminal 30. This is the On position. Terminal 87 supplies voltage to the rest of the circuit.

The following procedure applies to the ASD and fuel pump relays.

(1) Remove relay from connector before testing.

(2) With the relay removed from the vehicle, use an ohmmeter to check the resistance between terminals 85 and 86. The resistance should be 75 ohms +/- 5 ohms.

(3) Connect the ohmmeter between terminals 30 and 87A. The ohmmeter should show continuity between terminals 30 and 87A.

(4) Connect the ohmmeter between terminals 87 and 30. The ohmmeter should not show continuity at this time.

(5) Connect one end of a jumper wire (16 gauge or smaller) to relay terminal 85. Connect the other end of the jumper wire to the ground side of a 12 volt power source.

(6) Connect one end of another jumper wire (16 gauge or smaller) to the power side of the 12 volt power source. **Do not attach the other end of the jumper wire to the relay at this time.**

WARNING: DO NOT ALLOW OHMMETER TO CONTACT TERMINALS 85 OR 86 DURING THIS TEST. DAMAGE TO OHMMETER MAY RESULT.

(7) Attach the other end of the jumper wire to relay terminal 86. This activates the relay. The ohmmeter should now show continuity between relay terminals 87 and 30. The ohmmeter should not show continuity between relay terminals 87A and 30.

(8) Disconnect jumper wires.

(9) Replace the relay if it did not pass the continuity and resistance tests. If the relay passed the tests, it operates properly. Check the remainder of the ASD and fuel pump relay circuits. Refer to 8, Wiring Diagrams.

REMOVAL

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 5). Refer to label on PDC cover for relay location.

(1) Remove PDC cover.

(2) Remove relay from PDC.

AUTOMATIC SHUT DOWN RELAY (Continued)

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

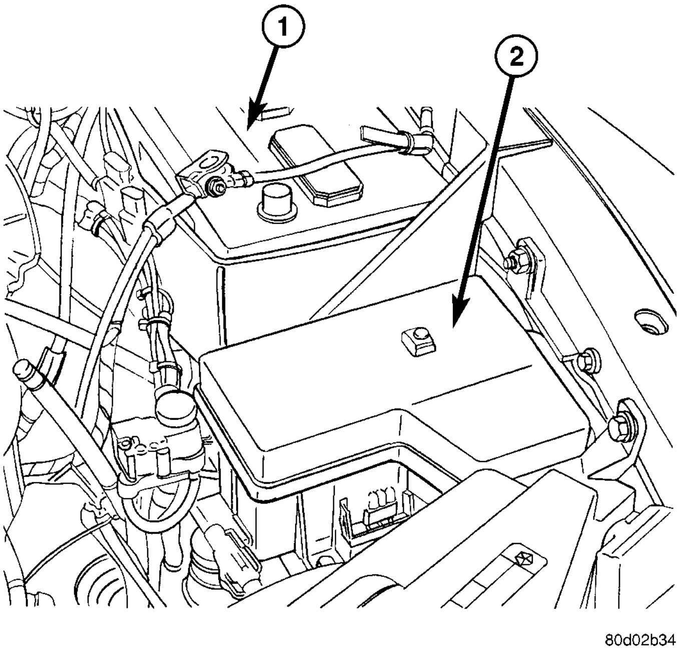


Fig. 5 PDC LOCATION

1 - BATTERY
2 - PDC (POWER DISTRIBUTION CENTER)

INSTALLATION

The ASD relay is located in the Power Distribution Center (PDC) (Fig. 5). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

CAMSHAFT POSITION SENSOR

DESCRIPTION

3.7L V-6

The Camshaft Position Sensor (CMP) on the 3.7L 6-cylinder engine is bolted to the right-front side of the right cylinder head.

4.7L V-8

The Camshaft Position Sensor (CMP) on the 4.7L V-8 engine is bolted to the right-front side of the right cylinder head.

5.7L V-8

The Camshaft Position Sensor (CMP) on the 5.7L V-8 engine is located below the generator on the timing chain / case cover on the right/front side of engine.

5.9L Diesel

The Camshaft Position Sensor (CMP) on the 5.9L diesel engine is located below the fuel injection pump. It is bolted to the back of the timing gear cover.

5.9L V-8 Gas

The Camshaft Position Sensor (CMP) on the 5.9L V-8 engine is located inside the distributor.

8.0L V–10

The Camshaft Position Sensor (CMP) on the 8.0L V-10 engine is located on the timing chain / case cover on the left/front side of engine.

OPERATION

3.7L V-6

The Camshaft Position Sensor (CMP) sensor on the 3.7L V-6 engine contains a hall effect device referred to as a sync signal generator. A rotating target wheel (tonewheel) for the CMP is located at the front of the camshaft for the right cylinder head (Fig. 6). This sync signal generator detects notches located on a tonewheel. As the tonewheel rotates, the notches pass through the sync signal generator. The signal from the CMP sensor is used in conjunction with the Crankshaft Position Sensor (CKP) to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the tonewheel notch enters the tip of the CMP, the interruption of magnetic field causes the voltage to switch high, resulting in a sync signal of approximately 5 volts.

When the trailing edge of the tonewheel notch leaves then tip of the CMP, the change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

4.7L V-8

The CMP sensor on the 4.7L engine contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects notches located on a tonewheel. The tonewheel is located at the front of the camshaft for the right cylinder head (Fig. 7). As the tonewheel rotates, the notches pass through the sync signal generator. The pattern of the notches (viewed counter-clockwise from front of engine) is: 1 notch, 2 notches, 3 notches,

CAMSHAFT POSITION SENSOR (Continued)

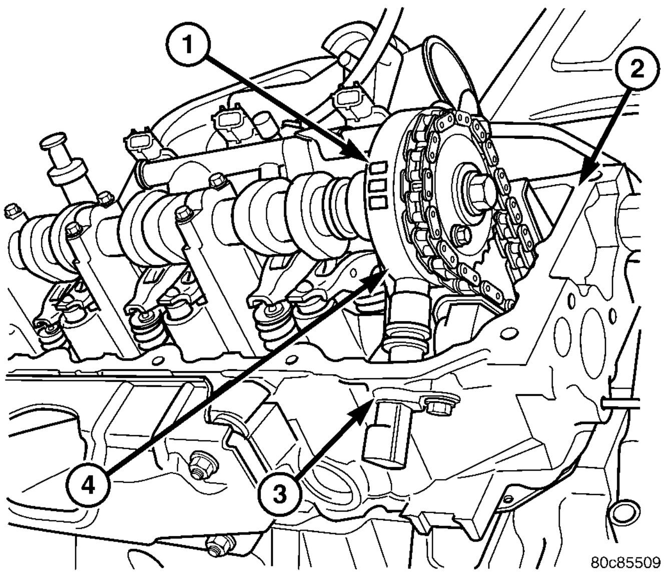


Fig. 6 CMP OPERATION- 3.7L V-6

1 - NOTCHES
2 - RIGHT CYLINDER HEAD
3 - CMP
4 - TONEWHEEL (TARGET WHEEL)

3 notches, 2 notches 1 notch, 3 notches and 1 notch. The signal from the CMP sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

5.7L V-8

The CMP sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders. The sensor generates electrical pulses. These pulses (signals) are sent to the Powertrain Control Module (PCM). The PCM will then determine crankshaft position from both the camshaft position sensor and crankshaft position sensor.

The tonewheel is located at the front of the camshaft (Fig. 8). As the tonewheel rotates, notches (Fig. 8) pass through the sync signal generator.

When the cam gear is rotating, the sensor will detect the notches. Input voltage from the sensor to the PCM will then switch from a low (approximately 0.3 volts) to a high (approximately 5 volts). When the sensor detects a notch has passed, the input voltage switches back low to approximately 0.3 volts.

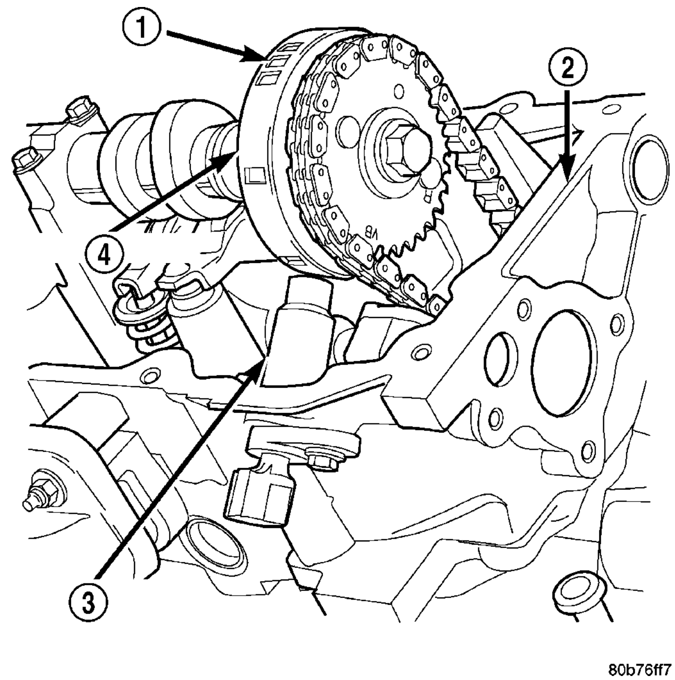


Fig. 7 CMP AND TONEWHEEL OPERATION - 4.7L V-8

1 - NOTCHES
2 - RIGHT CYLINDER HEAD
3 - CAMSHAFT POSITION SENSOR
4 - TONEWHEEL

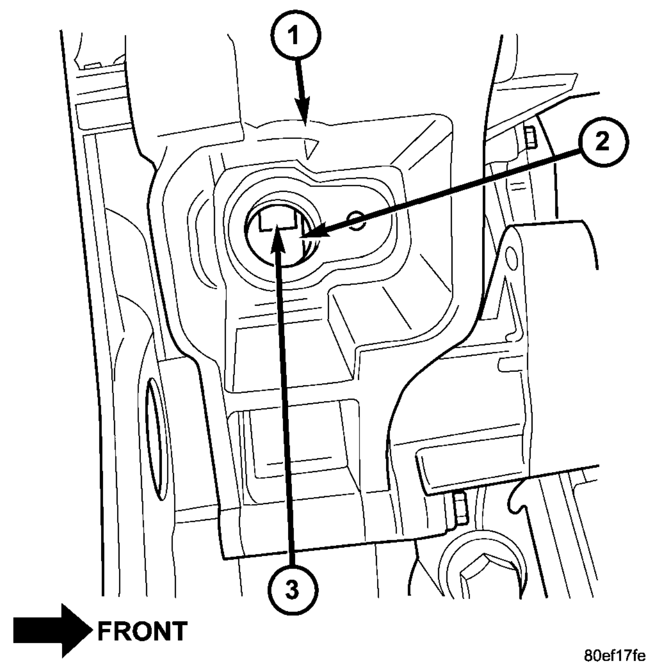


Fig. 8 CMP OPERATION - 5.7L ENGINE

1 - TIMING CHAIN COVER
2 - TONEWHEEL
3 - NOTCHES

CAMSHAFT POSITION SENSOR (Continued)

5.9L V-8 Gas

The CMP sensor on the 5.9L V-8 engine contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) (Fig. 9) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the Crankshaft Position (CKP) sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

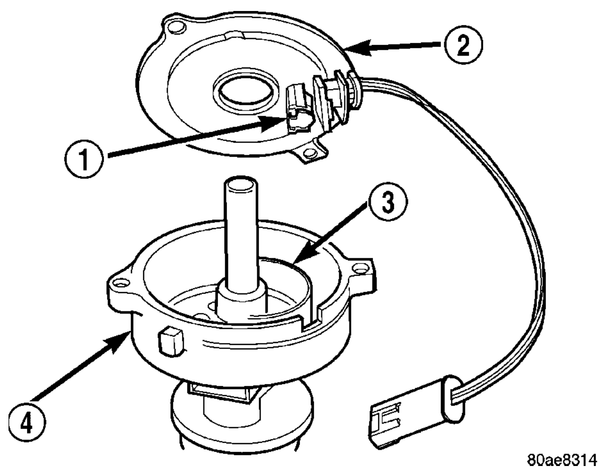


Fig. 9 CMP / PULSE RING - 5.9L GAS ENGINE

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

5.9L Diesel

The Camshaft Position Sensor (CMP) contains a hall effect device. A rotating target wheel (tonewheel) for the CMP is located on the front timing gear. This hall effect device detects notches located on the tonewheel. As the tonewheel rotates, the notches pass the tip of the CMP.

When the leading edge of the tonewheel notch passes the tip of the CMP, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a signal of approximately 5 volts.

When the trailing edge of the tonewheel notch passes the tip of the CMP, the following occurs: The change of the magnetic field causes the signal voltage to switch low to 0 volts.

The CMP (Fig. 10) provides a signal to the Engine Control Module (ECM) at all times when the engine is running. The ECM uses the CMP information primarily on engine start-up. Once the engine is running, the ECM uses the CMP as a backup sensor for engine speed. The Crankshaft Position Sensor (CKP) is the primary engine speed indicator for the engine after the engine is running.

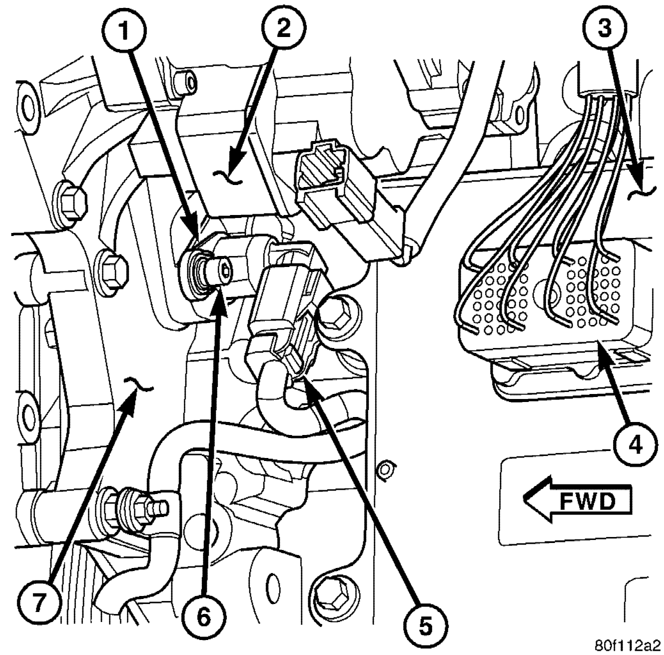


Fig. 10 5.9L DIESEL CMP

1 - CMP
2 - FUEL INJECTION PUMP (BOTTOM)
3 - ELECTRONIC CONTROL MODULE (ECM)
4 - ECM ELEC. CONNECTOR
5 - CMP ELEC. CONNECTOR
6 - CMP MOUNTING BOLT
7 - BACK OF TIMING GEAR COVER

8.0L V-10

The CMP sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders. The sensor generates electrical pulses. These pulses (signals) are sent to the Powertrain Control Module (PCM). The PCM will then determine crankshaft position from both the camshaft position sensor and crankshaft position sensor.

A low and high area are machined into the camshaft drive gear (Fig. 11). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 11) exists between the face of sensor and the high machined area of cam gear.

CAMSHAFT POSITION SENSOR (Continued)

When the cam gear is rotating, the sensor will detect the machined low area. Input voltage from the sensor to the PCM will then switch from a low (approximately 0.3 volts) to a high (approximately 5 volts). When the sensor detects the high machined area, the input voltage switches back low to approximately 0.3 volts.

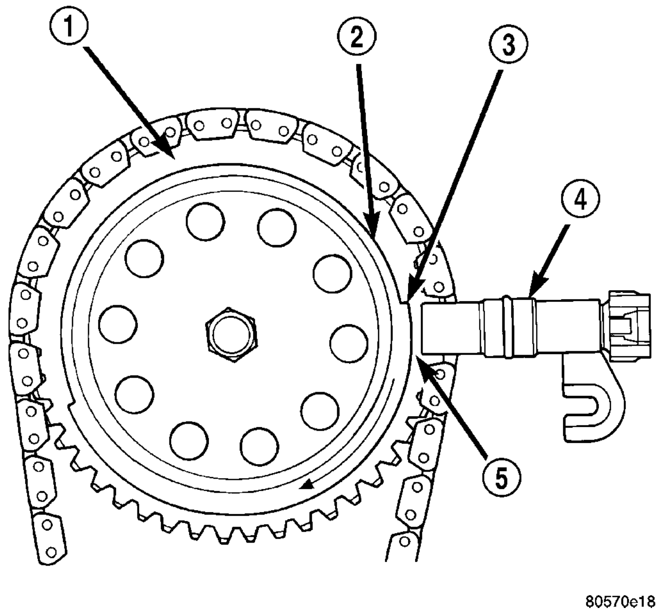


Fig. 11 CMP SENSOR OPERATION – 8.0L V-10 ENGINE

1 - CAM DRIVE GEAR
2 - LOW MACHINED AREA
3 - HIGH MACHINED AREA
4 - CAMSHAFT POSITION SENSOR
5 - AIR GAP

REMOVAL

3.7L V-6

The Camshaft Position Sensor (CMP) on the 3.7L V-6 engine is bolted to the front/top of the right cylinder head (Fig. 12).

(1) Disconnect electrical connector at CMP sensor.

(2) Remove sensor mounting bolt (Fig. 12).

(3) Carefully twist sensor from cylinder head.

(4) Check condition of sensor o-ring.

4.7L V-8

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 13).

(1) Raise and support vehicle.

(2) Disconnect electrical connector at CMP sensor (Fig. 13).

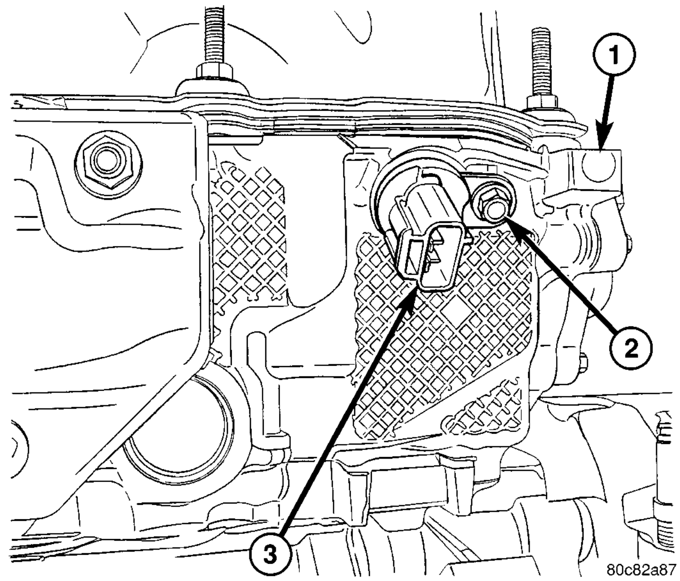


Fig. 12 CMP LOCATION - 3.7L

1 - RIGHT/FRONT OF RIGHT CYLINDER HEAD
2 - CMP MOUNTING BOLT
3 - CMP LOCATION

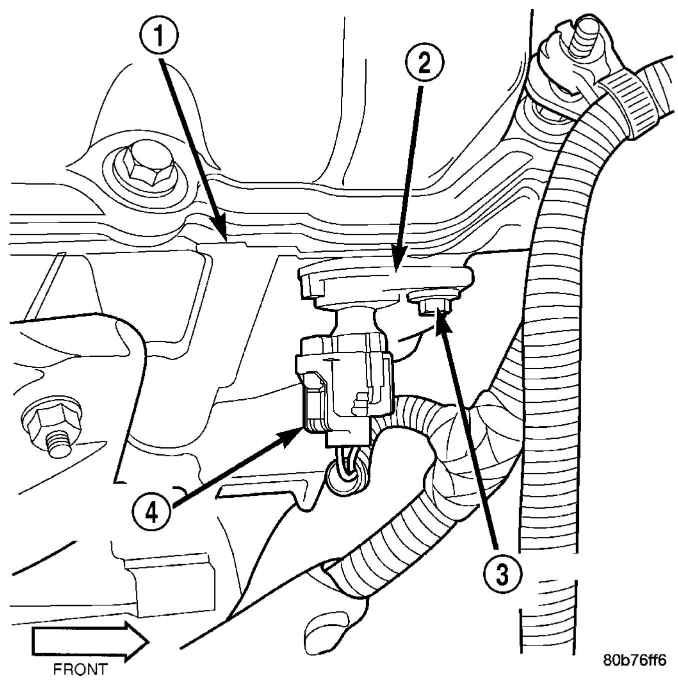


Fig. 13 CMP LOCATION - 4.7L

1 - RIGHT CYLINDER HEAD
2 - CAMSHAFT POSITION SENSOR
3 - MOUNTING BOLT
4 - ELEC. CONNECTOR

(3) Remove sensor mounting bolt (Fig. 13).

(4) Carefully twist sensor from cylinder head.

(5) Check condition of sensor o-ring.

CAMSHAFT POSITION SENSOR (Continued)

5.7L V-8

The Camshaft Position Sensor (CMP) on the 5.7L V-8 engine is located on right side of timing chain cover below generator (Fig. 14).

(1) Disconnect electrical connector at CMP sensor.
(2) Remove sensor mounting bolt (Fig. 15).
(3) Carefully twist sensor from cylinder head.
(4) Check condition of sensor o-ring.

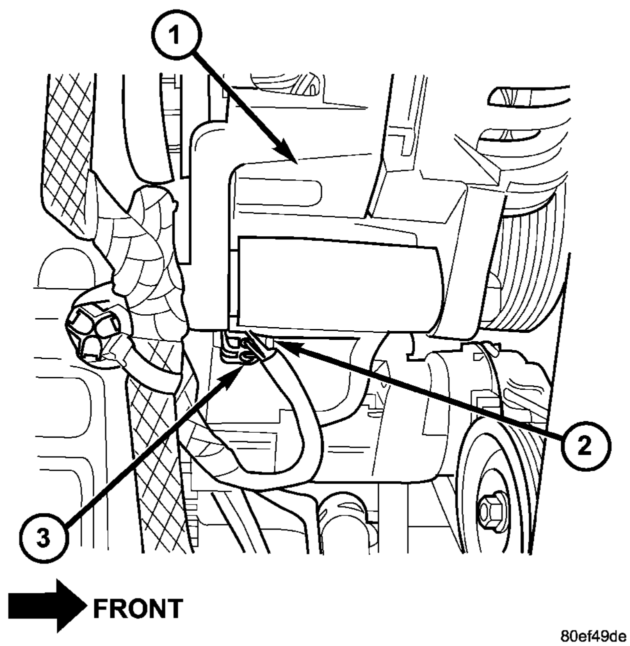


Fig. 14 CMP LOCATION – 5.7L

1 - GENERATOR
2 - CMP LOCATION
3 - ELECTRICAL CONNECTOR

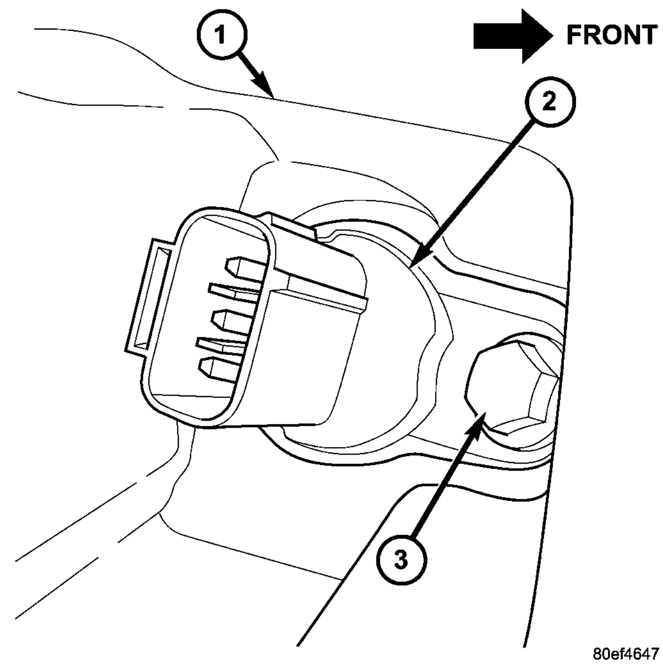


Fig. 15 CMP REMOVAL / INSTALLATION – 5.7L V-8

1 - TIMING CHAIN COVER (RIGHT/FRONT)
2 - CMP SENSOR
3 - MOUNTING BOLT

5.9L Diesel

The Camshaft Position Sensor (CMP) on the 5.9L diesel engine is located below the fuel injection pump. It is bolted to the back of the timing gear cover (Fig. 16).

(1) Disconnect electrical connector at CMP sensor (Fig. 16).
(2) Remove sensor mounting bolt.
(3) Carefully twist sensor from timing gear cover.
(4) Check condition of sensor o-ring.

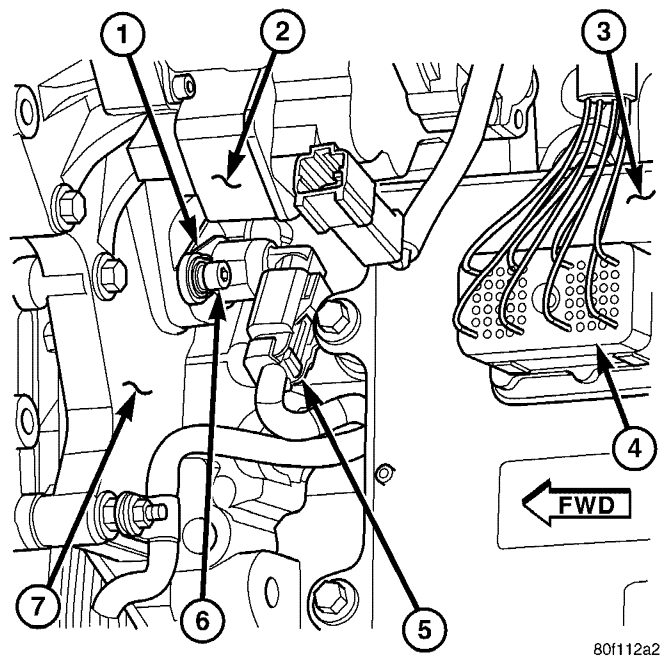


Fig. 16 5.9L DIESEL CMP

1 - CMP
2 - FUEL INJECTION PUMP (BOTTOM)
3 - ELECTRONIC CONTROL MODULE (ECM)
4 - ECM ELEC. CONNECTOR
5 - CMP ELEC. CONNECTOR
6 - CMP MOUNTING BOLT
7 - BACK OF TIMING GEAR COVER

5.9L V-8 Gas

The Camshaft Position Sensor (CMP) is located inside the distributor (Fig. 17).

Distributor removal is not necessary to remove camshaft position sensor.

(1) Disconnect negative cable from battery.
(2) Remove air cleaner tubing at throttle body, and at air filter housing.
(3) Remove distributor cap from distributor (two screws).

CAMSHAFT POSITION SENSOR (Continued)

(4) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(5) Remove distributor rotor from distributor shaft.

(6) Lift camshaft position sensor assembly from distributor housing (Fig. 17).

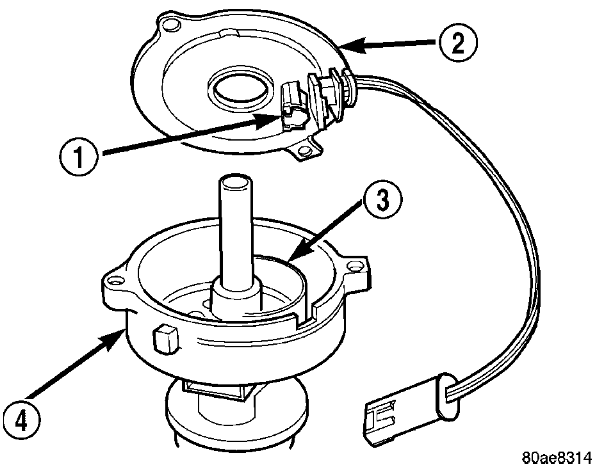


Fig. 17 DISTRIBUTOR AND CMP LOCATION - 5.9L

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

8.0L V–10

The camshaft position sensor is located on the timing chain case/cover on the left-front side of the engine (Fig. 18).

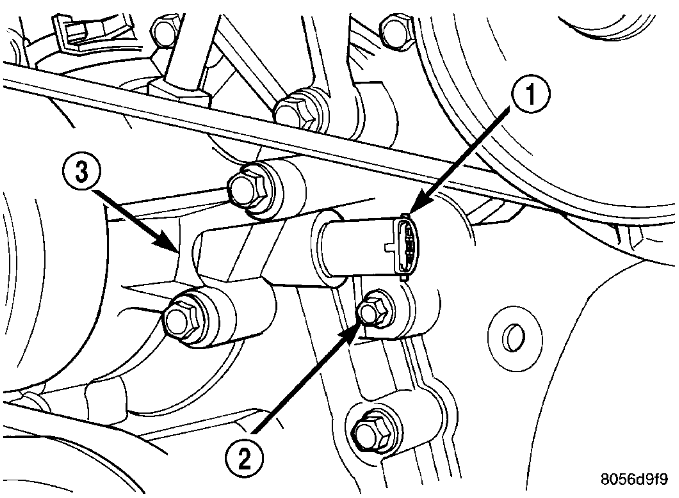


Fig. 18 CMP LOCATION - 8.0L

1 - CAMSHAFT POSITION SENSOR
2 - MOUNTING BOLT
3 - TIMING CHAIN CASE/COVER

A thin plastic rib is molded into the face of the sensor (Fig. 19) to position the depth of sensor to the upper cam gear (sprocket). This rib can be found on both the new replacement sensors and sensors that were originally installed to the engine. The first time the engine has been operated, part of this rib may be sheared (ground) off. Depending on parts tolerances, some of the rib material may still be observed after removal.

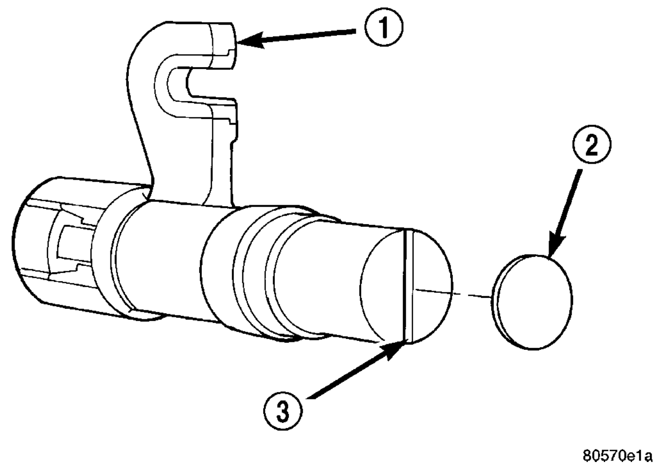


Fig. 19 SENSOR DEPTH POSITIONING RIB – 8.0L V-10 ENGINE

1 - CAMSHAFT POSITION SENSOR
2 - PAPER SPACER
3 - RIB MATERIAL (FOR SENSOR DEPTH POSITIONING)

Refer to either of the following procedures; Replacing Old Sensor With Original, or Replacing With New Sensor:

REPLACING OLD SENSOR WITH ORIGINAL

If the original camshaft position sensor is to be removed and installed, such as when servicing the timing chain, timing gears or timing chain cover, use this procedure.

(1) Disconnect sensor harness connector from sensor.

(2) Remove sensor mounting bolt (Fig. 18).

(3) Carefully pry sensor from timing chain case/cover in a rocking action with two small screwdrivers.

(4) Remove sensor from vehicle.

(5) Check condition of sensor o-ring (Fig. 20).

REPLACING WITH NEW SENSOR

If a new replacement camshaft position sensor is to be installed, use this procedure.

(1) Disconnect sensor wiring harness connector from sensor.

(2) Remove sensor mounting bolt (Fig. 18).

(3) Carefully pry sensor from timing chain case/cover in a rocking action with two small screwdrivers.

(4) Remove sensor from vehicle.

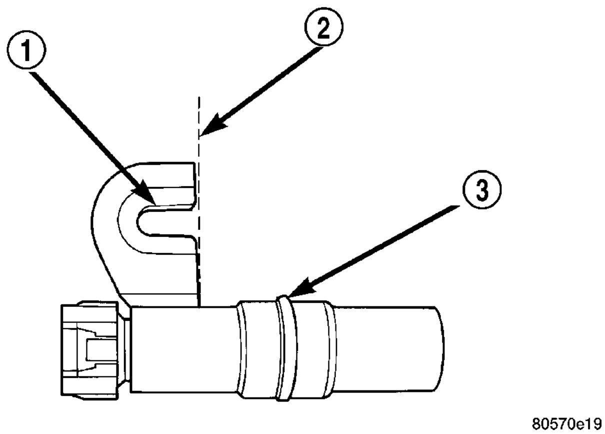


Fig. 20 CAMSHAFT SENSOR O-RING – 8.0L

1 - SLOTTED MOUNTING HOLE
2 - SCRIBE LINE
3 - CAMSHAFT POSITION SENSOR O-RING

INSTALLATION

3.7L V-6

The Camshaft Position Sensor (CMP) on the 3.7L V-6 engine is bolted to the front/top of the right cylinder head (Fig. 12).

(1) Clean out machined hole in cylinder head.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into cylinder head with a slight rocking and twisting action.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten. Refer to torque specifications.

(5) Connect electrical connector to sensor.

4.7L V-8

The Camshaft Position Sensor (CMP) on the 4.7L V-8 engine is bolted to the front/top of the right cylinder head (Fig. 13).

(1) Clean out machined hole in cylinder head.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into cylinder head with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten. Refer to Torque Specifications.

(5) Connect electrical connector to sensor.

5.7L V-8

The Camshaft Position Sensor (CMP) on the 5.7L V-8 engine is bolted to the right / front side of the timing chain cover (Fig. 14) or (Fig. 15).

(1) Clean out machined hole in cylinder head.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into cylinder head with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to timing chain cover. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten. Refer to Torque Specifications.

(5) Connect electrical connector to sensor.

5.9L Diesel

The CMP is located on the back of the timing gear cover (Fig. 16).

(1) Clean out machined hole in back of timing gear cover.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into timing gear cover with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to back of timing chain cover. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten. Refer to Torque Specifications.

(5) Connect electrical connector to sensor.

5.9L Gas

The camshaft position sensor is located inside the distributor (Fig. 17).

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.

(2) Connect engine wiring harness to sensor pigtail harness.

(3) Install rotor.

(4) Install distributor cap. Tighten 2 mounting screws.

(5) Install air filter tubing.

(6) Connect battery cable.

CAMSHAFT POSITION SENSOR (Continued)

8.0L V–10

If Replacing Old Sensor With Original

The camshaft position sensor is located on the timing chain case/cover on the left-front side of the engine (Fig. 18).

When installing a used camshaft position sensor, the sensor depth must be adjusted to prevent contact with the camshaft gear (sprocket).

(1) Observe the face of the sensor. If any of the original rib material remains (Fig. 19), it must be cut down flush to the face of the sensor with a razor knife. Remove only enough of the rib material until the face of the sensor is flat. Do not remove more material than necessary as damage to sensor may result. Due to a high magnetic field and possible electrical damage to the sensor, never use an electric grinder to remove material from sensor.

(2) From the parts department, obtain a peel-and-stick paper spacer (Fig. 19). These special paper spacers are of a certain thickness and are to be used as a tool to set sensor depth.

(3) Clean the face of sensor and apply paper spacer (Fig. 19).

(4) Apply a small amount of engine oil to the sensor o-ring (Fig. 20).

A low and high area are machined into the camshaft drive gear (Fig. 21). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 21) exists between the face of sensor and the high machined area of cam gear.

Before the sensor is installed, the cam gear may have to be rotated. This is to allow the high machined area on the gear to be directly in front of the sensor mounting hole opening on the timing gear cover.

Do not install sensor with gear positioned at low area (Fig. 22) or (Fig. 21). When the engine is started, the sensor will be broken.

(5) Using a 1/2 in. wide metal ruler, measure the distance from the cam gear to the face of the sensor mounting hole opening on the timing gear cover (Fig. 22).

(6) If the dimension is approximately 1.818 inches, it is OK to install sensor. Proceed to step Step 9.

(7) If the dimension is approximately 2.018 inches, the cam gear will have to be rotated.

(8) Attach a socket to the vibration damper mounting bolt and rotate engine until the 1.818 inch dimension is attained.

(9) Install the sensor into the timing case/cover with a slight rocking action until the paper spacer contacts the camshaft gear. Do not install the sensor mounting bolt. Do not twist the sensor into position as damage to the o-ring or tearing of the paper spacer may result.

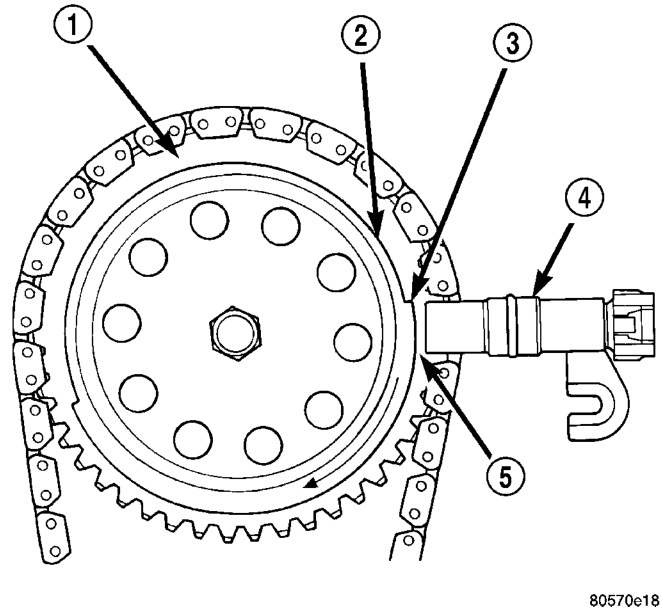


Fig. 21 SENSOR OPERATION – 8.0L V-10 ENGINE

1 - CAM DRIVE GEAR
2 - LOW MACHINED AREA
3 - HIGH MACHINED AREA
4 - CAMSHAFT POSITION SENSOR
5 - AIR GAP

(10) Scratch a scribe line into the timing chain case/cover to indicate depth of sensor (Fig. 20).

(11) Remove the sensor from timing chain case/cover.

(12) Remove paper spacer from sensor. This step must be followed to prevent the paper spacer from getting into the engine lubrication system.

(13) Again, apply a small amount of engine oil to sensor o-ring.

(14) Again, install the sensor into the timing case/cover with a slight rocking action until the sensor is aligned to scribe line.

(15) Install sensor mounting bolt and tighten to 6 N·m (50 in. lbs.) torque.

(16) Connect engine wiring harness to sensor.

Replacing With a New Sensor

(1) Apply a small amount of engine oil to the sensor o-ring (Fig. 20).

A low and high area are machined into the camshaft drive gear (Fig. 21). The sensor is positioned in the timing gear cover so that a small air gap (Fig. 21) exists between the face of sensor and the high machined area of cam gear.

Before the sensor is installed, the cam gear may have to be rotated. This is to allow the high machined area on the gear to be directly in front of the sensor mounting hole opening on the timing gear cover.

CAMSHAFT POSITION SENSOR (Continued)

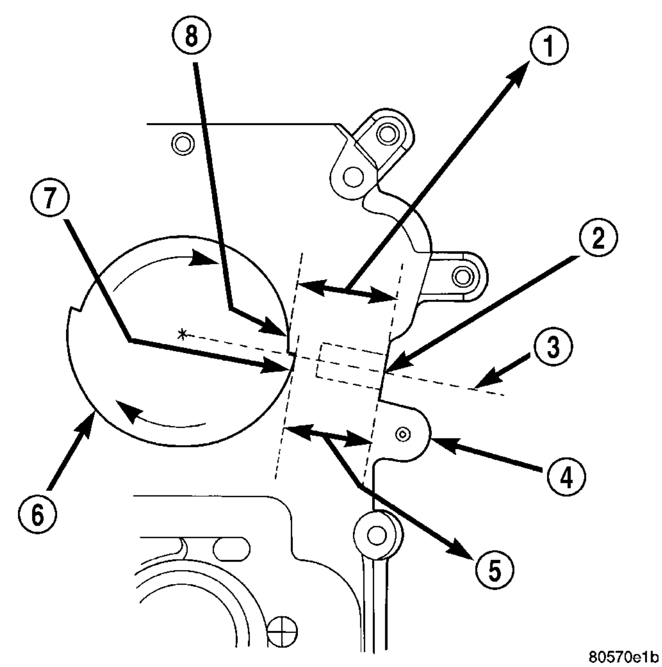


Fig. 22 SENSOR DEPTH DIMENSIONS – 8.0L V-10 ENGINE

1 - 2.018′′ DO NOT INSTALL SENSOR
2 - SENSOR MOUNTING HOLE OPENING
3 - SENSOR CENTER LINE
4 - TIMING CHAIN COVER
5 - 1.818′′ OK TO INSTALL SENSOR
6 - CAM DRIVE GEAR
7 - HIGH MACHINED AREA
8 - LOW MACHINED AREA

Do not install sensor with gear positioned at low area (Fig. 22) or (Fig. 21). When the engine is started, the sensor will be broken.

(2) Using a 1/2 in. wide metal ruler, measure the distance from the cam gear to the face of the sensor mounting hole opening on the timing gear cover (Fig. 22).

(3) If the dimension is approximately 1.818 inches, it is OK to install sensor. Proceed to step Step 9.

(4) If the dimension is approximately 2.018 inches, the cam gear will have to be rotated.

(5) Attach a socket to the vibration damper mounting bolt and rotate engine until the 1.818 inch dimension is attained.

(6) Install the sensor into the timing case/cover with a slight rocking action. Do not twist the sensor into position as damage to the o-ring may result. Push the sensor all the way into the cover until the rib material on the sensor (Fig. 19) contacts the camshaft gear.

(7) Install the mounting bolt and tighten to 6 N·m (50 in. lbs.) torque.

(8) Connect sensor wiring harness to engine harness.

When the engine is started, the rib material will be sheared off the face of sensor. This will automatically set sensor air gap.

DISTRIBUTOR

DESCRIPTION

All 5.9L V-8 engines are equipped with a camshaft driven mechanical distributor (Fig. 23) containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 23).

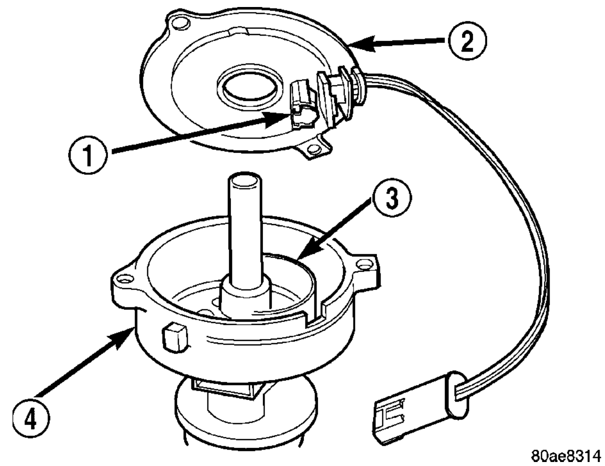


Fig. 23 DISTRIBUTOR AND CAMSHAFT POSITION SENSOR - 5.9L

1 - SYNC SIGNAL GENERATOR
2 - CAMSHAFT POSITION SENSOR
3 - PULSE RING
4 - DISTRIBUTOR ASSEMBLY

OPERATION

The distributor does not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the Powertrain Control Module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable.**

The distributor is held to the engine in the conventional method using a holddown clamp and bolt. **Although the distributor can be rotated, it will have no effect on ignition timing.**

All distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

DISTRIBUTOR (Continued)

REMOVAL

CAUTION: Base ignition timing is not adjustable on any engine. Distributors do not have built in centrifugal or vacuum assisted advance. Base ignition timing and timing advance are controlled by the Powertrain Control Module (PCM). Because a conventional timing light can not be used to adjust distributor position after installation, note position of distributor before removal.

(1) Disconnect negative cable from battery.

(2) Remove air cleaner tubing.

(3) Remove distributor cap from distributor (two screws).

(4) Mark the position of distributor housing in relationship to engine or dash panel. This is done to aid in installation.

(5) Before distributor is removed, the number one cylinder must be brought to the Top Dead Center (TDC) firing position.

(6) Attach a socket to the Crankshaft Vibration Damper mounting bolt.

(7) Slowly rotate engine clockwise, as viewed from front, until indicating mark on crankshaft vibration damper is aligned to 0 degree (TDC) mark on timing chain cover (Fig. 24).

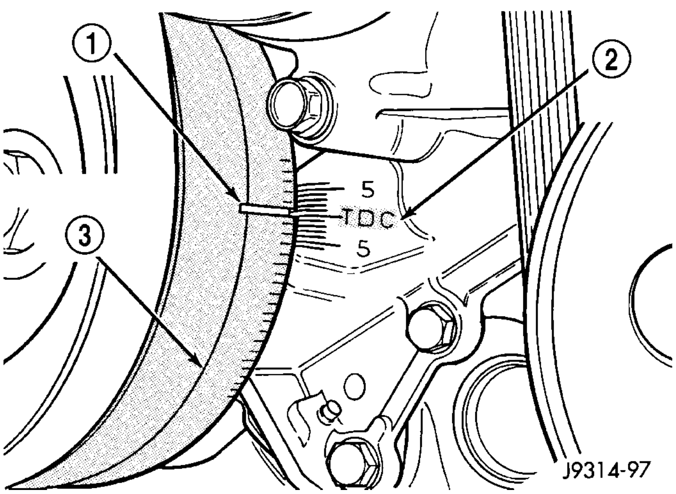


Fig. 24 DAMPER-TO-COVER ALIGNMENT MARKS — TYPICAL

1 - ALIGNMENT MARK
2 - TIMING CHAIN COVER MARKS
3 - CRANKSHAFT VIBRATION DAMPER

(8) The distributor rotor should now be aligned to the CYL. NO. 1 alignment mark (stamped) into the camshaft position sensor (Fig. 25). If not, rotate the crankshaft through another complete 360 degree turn. Note the position of the number one cylinder spark plug cable (on the cap) in relation to rotor. Rotor should now be aligned to this position.

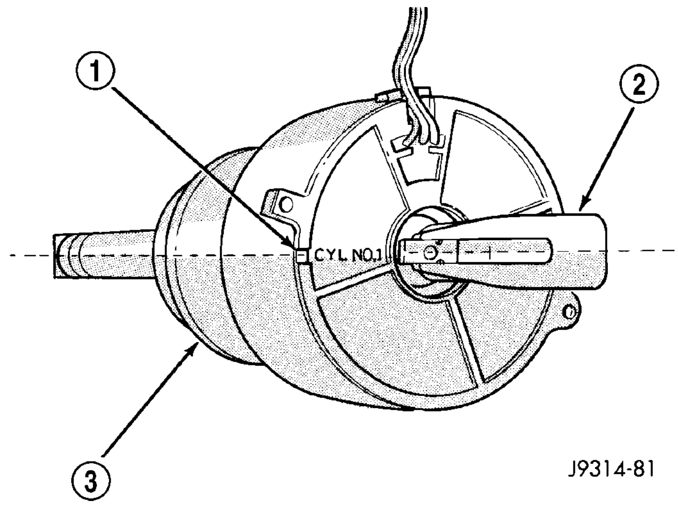


Fig. 25 ROTOR ALIGNMENT MARK

1 - CAMSHAFT POSITION SENSOR ALIGNMENT MARK
2 - ROTOR
3 - DISTRIBUTOR

(9) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(10) Remove distributor rotor from distributor shaft.

(11) Remove distributor holddown clamp bolt and clamp (Fig. 26). Remove distributor from vehicle.

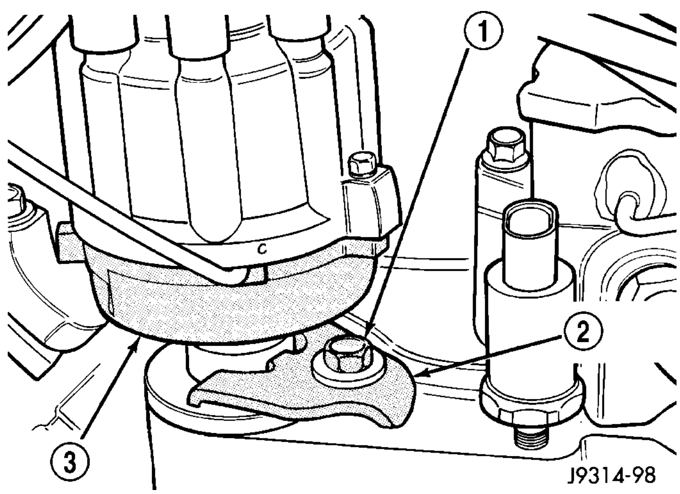


Fig. 26 DISTRIBUTOR HOLDDOWN CLAMP

1 - CLAMP BOLT
2 - HOLDDOWN CLAMP
3 - DISTRIBUTOR HOUSING

CAUTION: Do not crank engine with distributor removed. Distributor/crankshaft relationship will be lost.

DISTRIBUTOR (Continued)

INSTALLATION

If engine has been cranked while distributor is removed, establish the relationship between distributor shaft and number one piston position as follows:

Rotate crankshaft in a clockwise direction, as viewed from front, until number one cylinder piston is at top of compression stroke (compression should be felt on finger with number one spark plug removed). Then continue to slowly rotate engine clockwise until indicating mark (Fig. 24) is aligned to 0 degree (TDC) mark on timing chain cover.

(1) Clean top of cylinder block for a good seal between distributor base and block.

(2) Lightly oil the rubber o-ring seal on the distributor housing.

(3) Install rotor to distributor shaft.

(4) Position distributor into engine to its original position. Engage tongue of distributor shaft with slot in distributor oil pump drive gear. Position rotor to the number one spark plug cable position.

(5) Install distributor holddown clamp and clamp bolt. Do not tighten bolt at this time.

(6) Rotate the distributor housing until rotor is aligned to CYL. NO. 1 alignment mark on the camshaft position sensor (Fig. 25).

(7) Tighten clamp holddown bolt (Fig. 26) to 22.5 N·m (200 in. lbs.) torque.

(8) Connect camshaft position sensor wiring harness to main engine harness.

(9) Install distributor cap. Tighten mounting screws.

(10) Refer to the following, Checking Distributor Position.

Checking Distributor Position

To verify correct distributor rotational position, the DRB scan tool must be used.

WARNING: WHEN PERFORMING THE FOLLOWING TEST, THE ENGINE WILL BE RUNNING. BE CAREFUL NOT TO STAND IN LINE WITH THE FAN BLADES OR FAN BELT. DO NOT WEAR LOOSE CLOTHING.

(1) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(2) Gain access to SET SYNC screen on DRB.

(3) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in “closed loop” mode).

(4) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct distributor position.

(5) If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen but do not remove distributor holddown clamp bolt. Rotate distributor until IN RANGE appears on screen. Continue to rotate distributor until achieving as close to 0° as possible. After adjustment, tighten clamp bolt to 22.5 N·m (200 in. lbs.) torque.

Do not attempt to adjust ignition timing using this method. Rotating distributor will have no effect on ignition timing. All ignition timing values are controlled by Powertrain Control Module (PCM).

After testing, install air cleaner tubing.

DISTRIBUTOR CAP

DIAGNOSIS AND TESTING - DISTRIBUTOR CAP - 5.9L V-8

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 27) or (Fig. 28). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

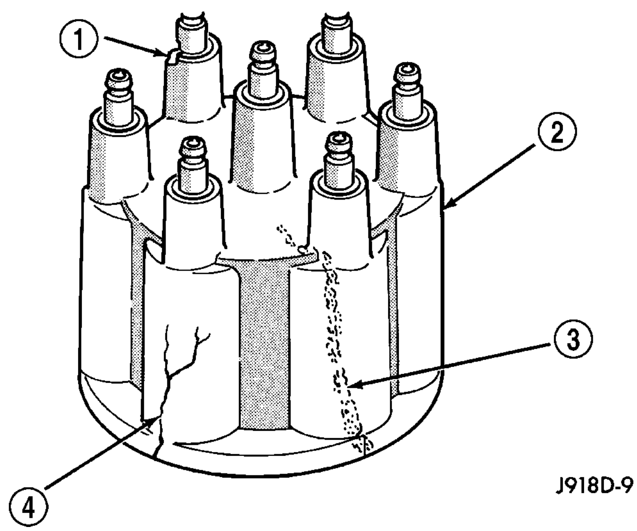


Fig. 27 CAP INSPECTION—EXTERNAL—TYPICAL

1 - BROKEN TOWER
2 - DISTRIBUTOR CAP
3 - CARBON PATH
4 - CRACK

DISTRIBUTOR CAP (Continued)

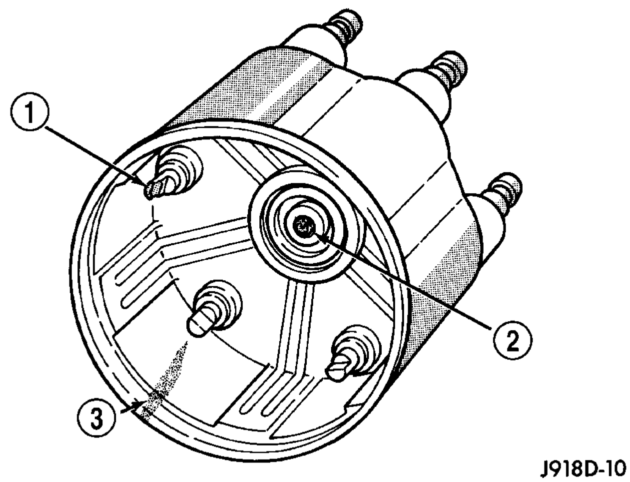


Fig. 28 CAP INSPECTION—INTERNAL—TYPICAL

1 - CHARRED OR ERODED TERMINALS
2 - WORN OR DAMAGED ROTOR BUTTON
3 - CARBON PATH

DISTRIBUTOR ROTOR

DIAGNOSIS AND TESTING - DISTRIBUTOR ROTOR - 5.9L V-8

Visually inspect the rotor (Fig. 29) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

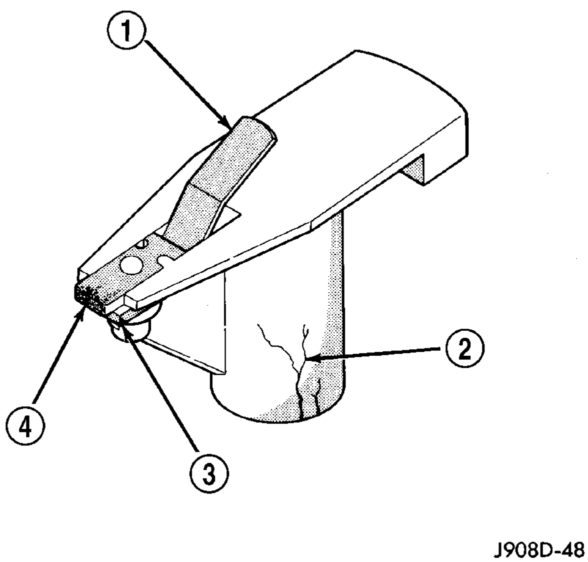


Fig. 29 ROTOR INSPECTION—TYPICAL

1 - INSUFFICIENT SPRING TENSION
2 - CRACKS
3 - EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 - ROTOR TIP CORRODED

IGNITION COIL

DESCRIPTION

3.7L V-6

The 3.7L V-6 engine uses 6 dedicated, and individually fired coil for each spark plug (Fig. 30). Each coil is mounted directly into the cylinder head and onto the top of each spark plug (Fig. 31).

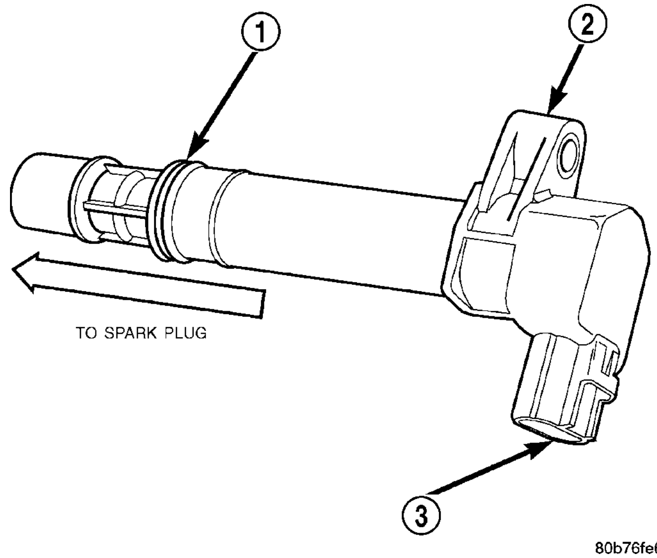


Fig. 30 IGNITION COIL - 3.7L V-6/ 4.7L V-8

1 - O-RING
2 - IGNITION COIL
3 - ELECTRICAL CONNECTOR

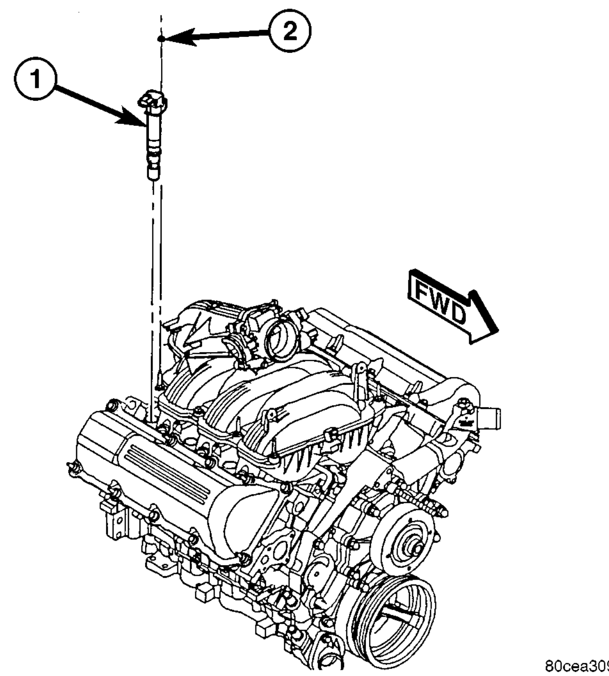


Fig. 31 IGNITION COIL LOCATION - 3.7L V-6

1 - IGNITION COIL
2 - COIL MOUNTING NUT

IGNITION COIL (Continued)

4.7L V-8

The 4.7L V–8 engine uses 8 dedicated, and individually fired coil (Fig. 30) for each spark plug. Each coil is mounted directly to the top of each spark plug (Fig. 32).

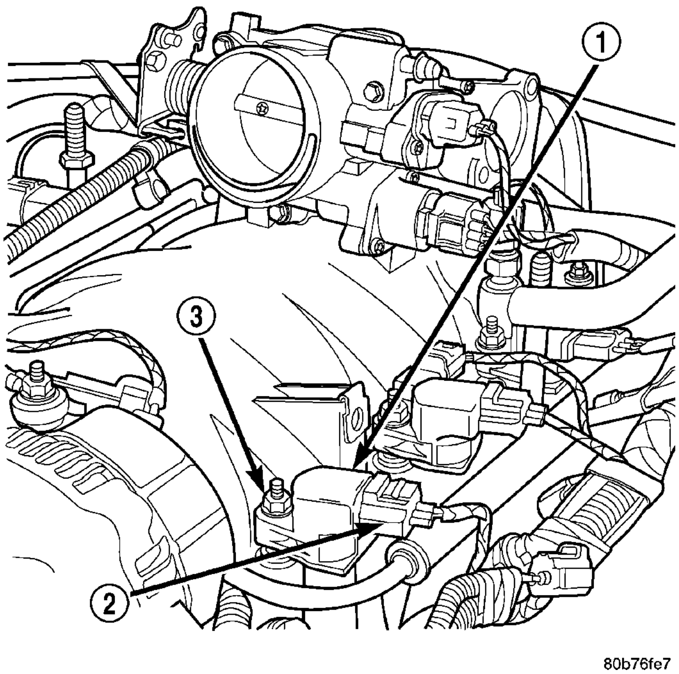


Fig. 32 IGNITION COIL LOCATION - 4.7L V-8

1 - IGNITION COIL
2 - COIL ELECTRICAL CONNECTOR
3 - COIL MOUNTING STUD/NUT

5.7L V-8

The 5.7L V–8 engine uses 8 dedicated, and individually fired coil (Fig. 33) for each pair of spark plugs. Each coil is mounted directly to the top of each spark plug (Fig. 34). Each coil is bolted to the valve cover.

5.9L V-8

A single ignition coil is used (Fig. 35) or (Fig. 36). The coil is not oil filled. The coil windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the coil to be mounted on the engine.

8.0L V-10

Two separate coil packs containing a total of five independent coils are attached to a common mounting bracket. They are located above the right engine valve cover (Fig. 37). The coil packs are not oil filled. The front coil pack contains three independent epoxy filled coils. The rear coil pack contains two independent epoxy filled coils.

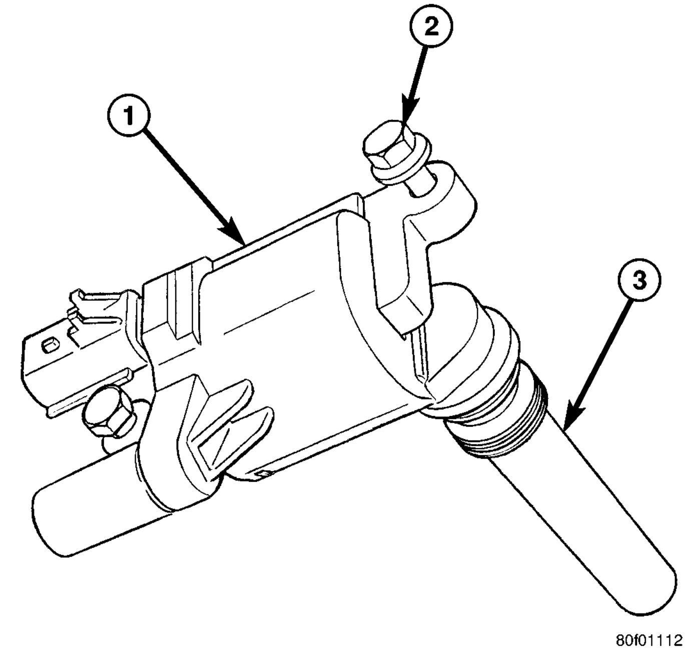


Fig. 33 IGNITION COIL - 5.7L V-8

1 - IGNITION COIL
2 - MOUNTING BOLTS (2)
3 - BOOT TO SPARK PLUG

OPERATION

3.7L V-6

Battery voltage is supplied to the 6 individual ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes each ignition coil ground circuit at a determined time for ignition coil operation.

Base ignition timing is not adjustable. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used with the 3.7L V-6 engine.

IGNITION COIL (Continued)

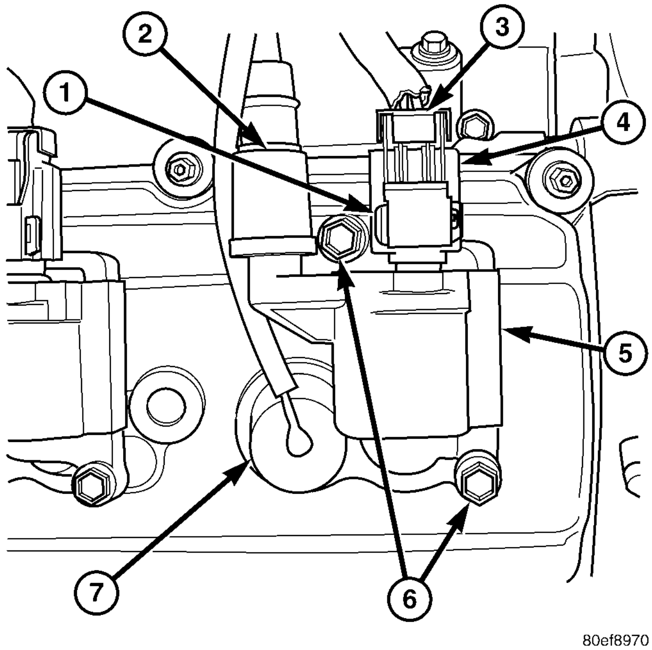


Fig. 34 IGNITION COIL R/I — 5.7L V-8

1 - SLIDE LOCK (SLIDE OUTWARD TO UNLOCK)
2 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK SPARK PLUG)
3 - RELEASE LOCK / TAB (PUSH HERE)
4 - ELEC. CONNECTOR
5 - IGNITION COIL
6 - COIL MOUNTING BOLTS (2)
7 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK IGNITION COIL)

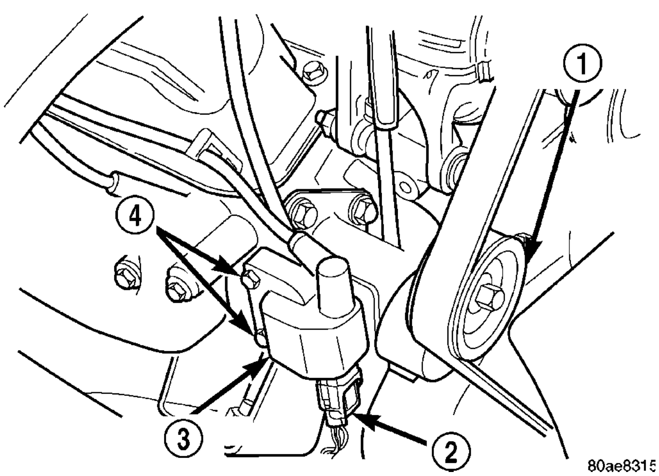


Fig. 35 IGNITION COIL LOCATION - 5.9L V-8 (EXCEPT HDC)

1 - ACCESSORY DRIVE BELT TENSIONER
2 - COIL CONNECTOR
3 - IGNITION COIL
4 - COIL MOUNTING BOLTS

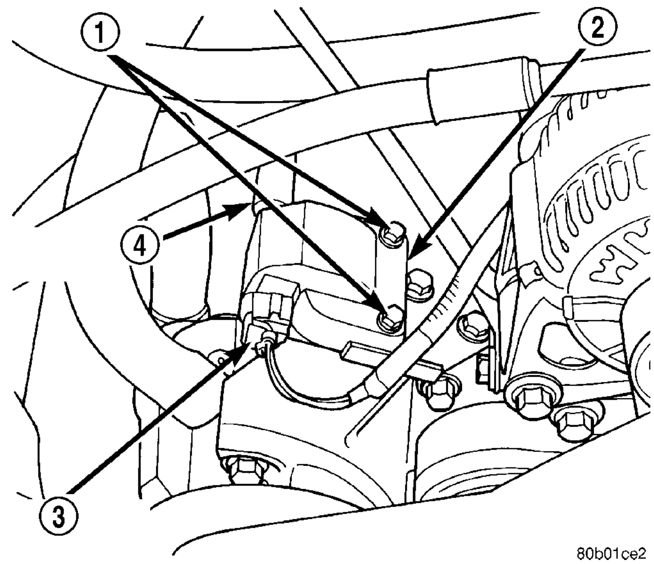


Fig. 36 IGNITION COIL LOCATION – 5.9L HDC V-8

1 - COIL MOUNTING BOLTS
2 - IGNITION COIL
3 - COIL ELEC. CONNECTOR
4 - SECONDARY CABLE

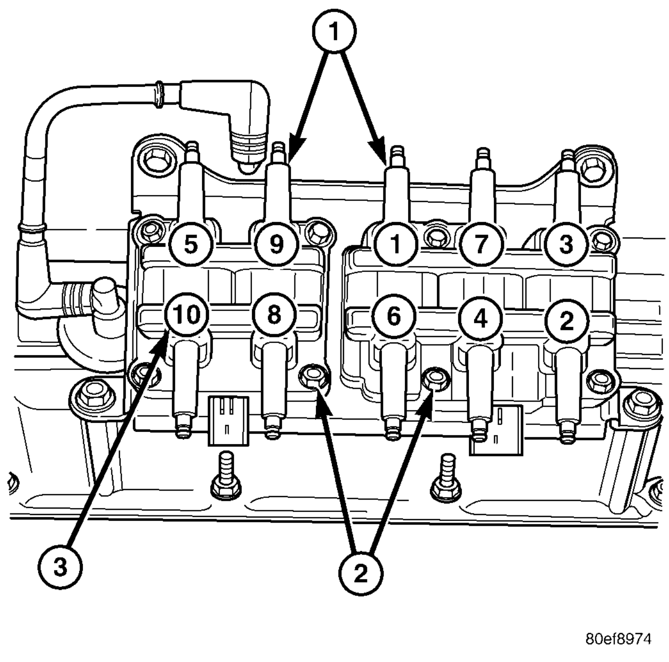


Fig. 37 8.0L V-10 COIL PACKS

1 - IGNTITION COILS
2 - COIL MOUNTING BOLTS (8)
3 - ENGINE CYLINDER NUMBER

IGNITION COIL (Continued)

4.7L V-8

Battery voltage is supplied to the 8 individual ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes each ignition coil ground circuit at a determined time for ignition coil operation.

Base ignition timing is not adjustable. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used with the 4.7L V-8 engine.

5.7L V-8

The ignition system is controlled by the Powertrain Control Module (PCM) on all engines.

A “wasted spark” system is used on the 5.7L engine combining paired, or dual-firing coils, and 2 spark plugs per cylinder. The coils and spark plugs are connected with paired, secondary high-voltage cables.

Each cylinder is equipped with 1 dual-output coil. Meaning one coil mounts directly over one of the dual spark plugs for 1 high-voltage output. A second high-voltage output is supplied directly from the same coil (using a plug cable) to one of the dual spark plugs on a corresponding (paired) cylinder on the opposite cylinder bank.

Each coil fires 2 spark plugs simultaneously on each of the cylinder banks (one cylinder on compression stroke and one cylinder on exhaust stroke). **EXAMPLE :** When the #1 cylinder is on compression stroke and ready for spark, the #1 coil will fire one of the dual spark plugs on the #1 cylinder (directly below the coil). The other dual spark plug on the #1 cylinder will be fired by the #6 coil. At the same time, the #1 coil will fire a “wasted spark” to one of the dual spark plugs at the #6 cylinder as coil #6 also fires a “wasted spark” to one of the dual spark plugs at the #6 cylinder.

The firing order is paired at cylinders 1/6, 2/3, 4/7, 5/8. Basic cylinder firing order is 1–8–4–3–6–5–7–2.

Battery voltage is supplied to all of the ignition coils positive terminals from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

Base ignition timing is not adjustable on the 5.7L V-8 engine. By controlling the coil ground circuits, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

The PCM adjusts ignition timing based on inputs it receives from:

- The engine coolant temperature sensor
- The crankshaft position sensor (engine speed)
- The camshaft position sensor (crankshaft position)
- The manifold absolute pressure (MAP) sensor
- The throttle position sensor
- Transmission gear selection

5.9L V-8

A single ignition coil is used. The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

Base ignition timing is not adjustable on any engine. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

Conventional spark plug cables (secondary cables) are used with the 5.9L V-8 engine.

8.0L V-10

When one of the 5 independent coils discharges, it fires two paired cylinders at the same time (one cylinder on compression stroke and the other cylinder on exhaust stroke).

Coil firing is paired together on cylinders:

- Number 5 and 10
- Number 9 and 8
- Number 1 and 6
- Number 7 and 4
- Number 3 and 2

The ignition system is controlled by the Powertrain Control Module (PCM) on all engines.

Battery voltage is supplied to all of the ignition coils positive terminals from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

Conventional spark plug cables (secondary cables) are used with the 8.0L V-10 engine.

Base ignition timing is not adjustable on the 8.0L V-10 engine. By controlling the coil ground circuits, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

IGNITION COIL (Continued)

The PCM adjusts ignition timing based on inputs it receives from:

- The engine coolant temperature sensor
- The crankshaft position sensor (engine speed)
- The camshaft position sensor (crankshaft position)
- The manifold absolute pressure (MAP) sensor
- The throttle position sensor
- Transmission gear selection

REMOVAL

3.7L V-6

An individual ignition coil is used for each spark plug (Fig. 30). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 31). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately. An o-ring (Fig. 30) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 31).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

4.7L V-8

An individual ignition coil is used for each spark plug (Fig. 30). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 32). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately. An o-ring (Fig. 30) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector (Fig. 32) from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 32).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

5.7L V-8

Before removing or disconnecting any spark plug cables, note their original position. Remove cables one-at-a-time. To prevent ignition crossfire, spark plug cables **MUST** be placed in cable tray (routing loom) into their original position.

An individual ignition coil (Fig. 33) is used at each cylinder. The coil mounts to the top of the valve cover with 2 bolts (Fig. 34). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Unlock electrical connector (Fig. 34) by moving slide lock first. Press on release lock (Fig. 34) while pulling electrical connector from coil.

(3) Disconnect secondary high-voltage cable from coil with a twisting action.

(4) Clean area at base of coil with compressed air before removal.

(5) Remove 2 mounting bolts (note that mounting bolts are retained to coil).

(6) Carefully pull up coil from cylinder head opening with a slight twisting action.

(7) Remove coil from vehicle.

(8) Before installing spark plug cables to either the spark plugs or coils, or before installing a coil to a spark plug, apply dielectric grease to inside of boots.

5.9L V-8

The coil is not oil filled. The coil windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the coil to be mounted on the engine. If the coil is replaced, it must be replaced with the same type.

5.9L V-8 LDC-Gas Engines: The coil is mounted to a bracket that is bolted to the front of the right engine cylinder head (Fig. 35). This bracket is mounted on top of the automatic belt tensioner bracket using common bolts.

IGNITION COIL (Continued)

WARNING: 5.9L V-8 LDC-GAS ENGINES: DO NOT REMOVE THE COIL MOUNTING BRACKET-TO-CYLINDER HEAD MOUNTING BOLTS. THE COIL MOUNTING BRACKET IS UNDER ACCESSORY DRIVE BELT TENSION. IF THIS BRACKET IS TO BE REMOVED FOR ANY REASON, ALL BELT TENSION MUST FIRST BE RELIEVED. REFER TO THE BELT SECTION OF GROUP 7, COOLING SYSTEM.

5.9L V-8 HDC-Gas Engine: The coil is mounted to a bracket that is bolted to the air injection pump (AIR pump) mounting bracket (Fig. 36).

(1) Disconnect primary coil connector from ignition coil.

(2) Disconnect secondary cable from ignition coil.

(3) Remove ignition coil from coil mounting bracket (two bolts).

8.0L V-10

Two separate coil packs containing a total of five independent coils are attached to a common mounting bracket located above the right engine valve cover (Fig. 37). The front and rear coil packs can be serviced separately.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coils.

(2) Remove secondary spark plug cables from coil packs. Note position of cables before removal.

(3) Disconnect primary wiring harness connectors at coil packs.

(4) Remove four (4) coil pack-to-coil mounting bracket bolts for coil pack being serviced (Fig. 37).

(5) Remove coil(s) from mounting bracket.

INSTALLATION

3.7L V-6

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install coil mounting stud nut. Refer to torque specifications.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube.

4.7L V-8

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install coil mounting stud nut. Refer to torque specifications.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube.

5.7L V-8

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Before installing spark plug cables to either the spark plugs or coils, or before installing a coil to a spark plug, apply dielectric grease to inside of boots.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Twist coil into position.

(4) Install 2 coil mounting bolts. Refer to torque specifications.

(5) Connect electrical connector to coil by snapping into position.

(6) Install cable to coil. To prevent ignition crossfire, spark plug cables **MUST** be placed in cable tray (routing loom) into their original position. Refer to Spark Plug Cable Removal for a graphic.

(7) If necessary, install throttle body air tube.

5.9L V-8

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

(1) Install ignition coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect all wiring to ignition coil.

8.0L V-10

(1) Position coil packs to mounting bracket (primary wiring connectors face downward).

(2) Install coil pack mounting bolts. Tighten bolts to 10 N·m (90 in. lbs.) torque.

(3) Install coil pack-to-engine mounting bracket (if necessary).

(4) Connect primary wiring connectors to coil packs (four wire connector to front coil pack and three wire connector to rear coil pack).

(5) Connect secondary spark plug cables to coil packs. Refer to (Fig. 38) for correct cable order.

IGNITION COIL (Continued)

(6) If necessary, install throttle body air tube or box.

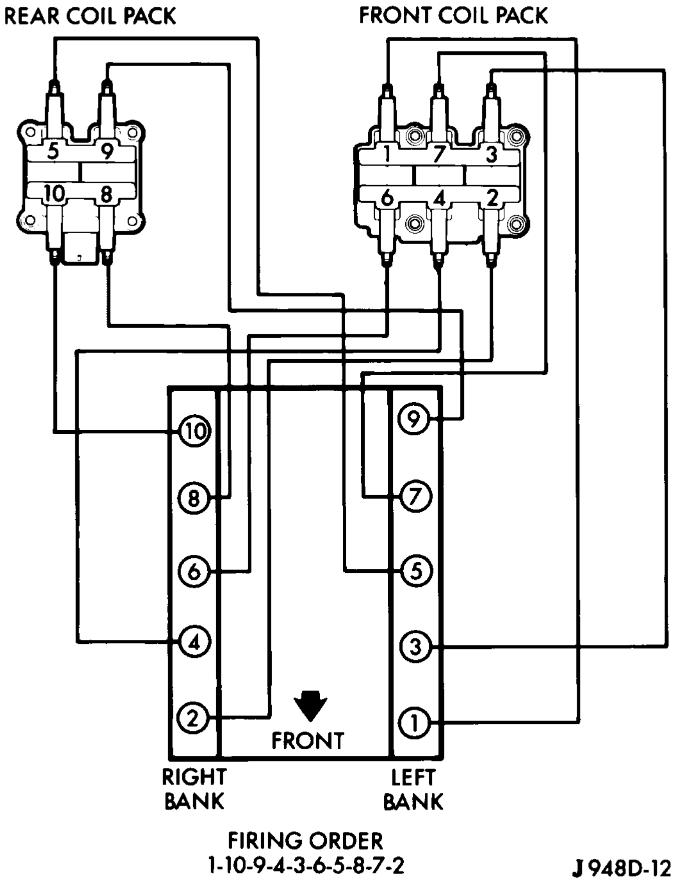


Fig. 38 SPARK PLUG CABLE ORDER - 8.0L V-10

KNOCK SENSOR

DESCRIPTION

The sensors are used only with 3.7L V-6, 4.7L V-8 and 5.7L V-8 engines. On 3.7L V-6 and 4.7L V-8 engines, the 2 knock sensors are bolted into the cylinder block under the intake manifold.

On 5.7L V-8 engines, 2 knock sensors are also used. These are bolted into each side of the cylinder block (outside) under the exhaust manifold.

OPERATION

3.7L V-6 / 4.7L V-8 / 5.7L V-8 Engines Only

Two knock sensors are used; one for each cylinder bank. When the knock sensor detects a knock in one of the cylinders on the corresponding bank, it sends an input signal to the Powertrain Control Module (PCM). In response, the PCM retards ignition timing for all cylinders by a scheduled amount.

Knock sensors contain a piezoelectric material which constantly vibrates and sends an input voltage (signal) to the PCM while the engine operates. As the intensity of the crystal's vibration increases, the knock sensor output voltage also increases.

The voltage signal produced by the knock sensor increases with the amplitude of vibration. The PCM receives the knock sensor voltage signal as an input. If the signal rises above a predetermined level, the PCM will store that value in memory and retard ignition timing to reduce engine knock. If the knock sensor voltage exceeds a preset value, the PCM retards ignition timing for all cylinders. It is not a selective cylinder retard.

The PCM ignores knock sensor input during engine idle conditions. Once the engine speed exceeds a specified value, knock retard is allowed.

Knock retard uses its own short term and long term memory program.

Long term memory stores previous detonation information in its battery-backed RAM. The maximum authority that long term memory has over timing retard can be calibrated.

Short term memory is allowed to retard timing up to a preset amount under all operating conditions (as long as rpm is above the minimum rpm) except at Wide Open Throttle (WOT). The PCM, using short term memory, can respond quickly to retard timing when engine knock is detected. Short term memory is lost any time the ignition key is turned off.

NOTE: Over or under tightening the sensor mounting bolts will affect knock sensor performance, possibly causing improper spark control. Always use the specified torque when installing the knock sensors.

REMOVAL

3.7L V-6 / 4.7L V-8

The 2 knock sensors are bolted into the cylinder block under the intake manifold (Fig. 39). or (Fig. 40).

NOTE: The left sensor is identified by an identification tag (LEFT). It is also identified by a larger bolt head. The Powertrain Control Module (PCM) must have and know the correct sensor left/right positions. Do not mix the sensor locations.

(1) Disconnect knock sensor dual pigtail harness from engine wiring harness. This connection is made near rear of engine.

(2) Remove intake manifold. Refer to Engine section.

(3) Remove sensor mounting bolts (Fig. 39), or (Fig. 40). Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

KNOCK SENSOR (Continued)

(4) Remove sensors from engine.

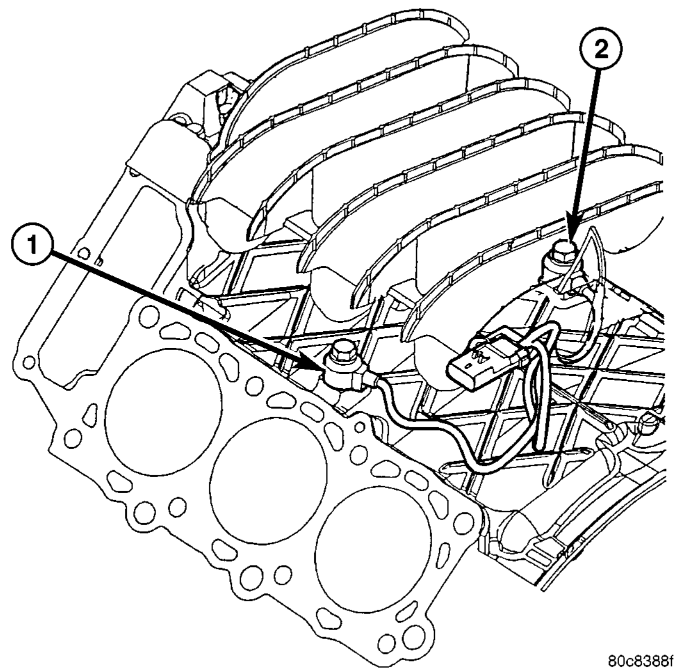


Fig. 39 KNOCK SENSOR — 3.7L V-6

1 - KNOCK SENSORS (2)
2 - MOUNTING BOLTS

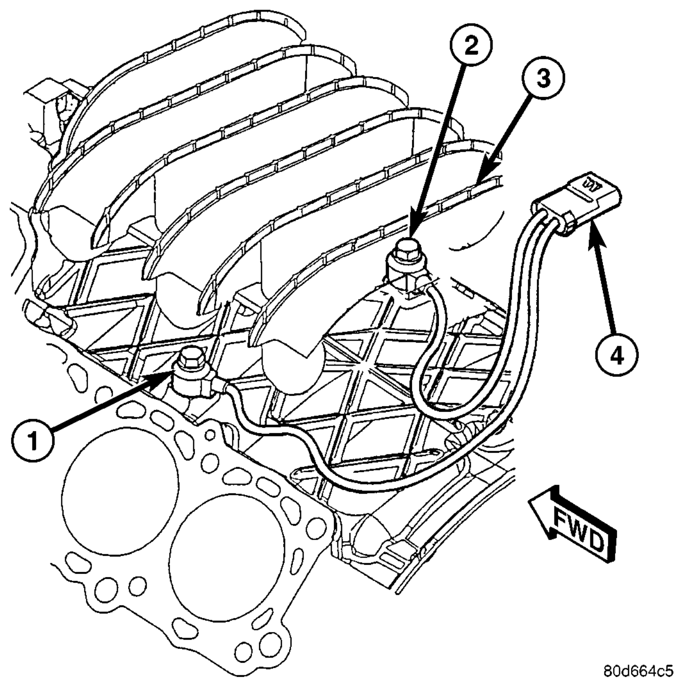


Fig. 40 KNOCK SENSOR — 4.7L V-8

1 - KNOCK SENSORS (2)
2 - MOUNTING BOLTS
3 - INTAKE MANIFOLD (CUTAWAY)
4 - PIGTAIL CONNECTOR

5.7L V8

Two sensors are used. Each sensor is bolted into the outside of cylinder block below the exhaust manifold (Fig. 41).

(1) Raise vehicle.

(2) Disconnect knock sensor electrical connector.

(3) Remove sensor mounting bolt (Fig. 41). Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

(4) Remove sensor from engine.

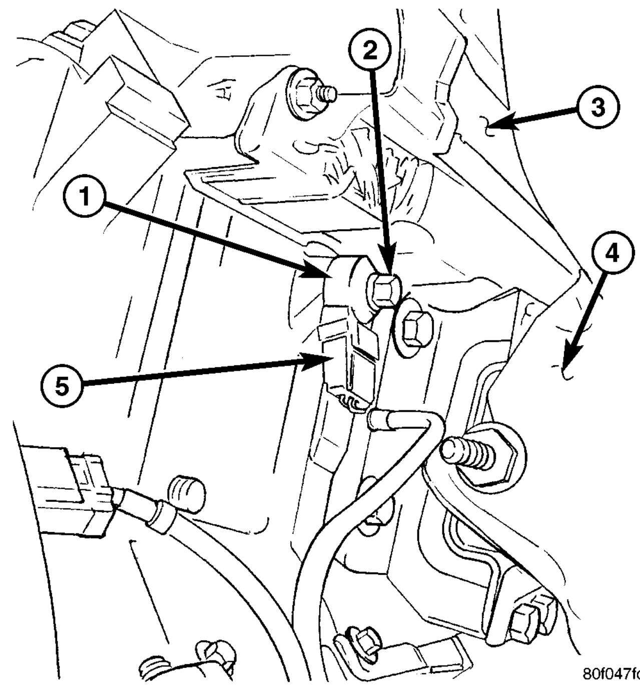


Fig. 41 5.7L KNOCK SENSOR (RIGHT SENSOR SHOWN)

1 - KNOCK SENSOR (RIGHT SENSOR SHOWN)
2 - MOUNTING BOLT
3 - EXHAUST MANIFOLD
4 - RIGHT ENGINE MOUNT
5 - ELEC. CONNECTOR

INSTALLATION

3.7L V-6 / 4.7L V-8

NOTE: The left sensor is identified by an identification tag (LEFT). It is also identified by a larger bolt head. The Powertrain Control Module (PCM) must have and know the correct sensor left/right positions. Do not mix the sensor locations.

(1) Thoroughly clean knock sensor mounting holes.

(2) Install sensors into cylinder block.

KNOCK SENSOR (Continued)

NOTE: Over or under tightening the sensor mounting bolts will affect knock sensor performance, possibly causing improper spark control. Always use the specified torque when installing the knock sensors. The torque for the knock senor bolt is relatively light for an 8mm bolt.

NOTE: Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

(3) Install and tighten mounting bolts. Refer to torque specification.
(4) Install intake manifold. Refer to Engine section.
(5) Connect knock sensor wiring harness to engine harness at rear of intake manifold.

5.7L V-8

(1) Thoroughly clean knock sensor mounting hole.
(2) Install sensor into cylinder block.

NOTE: Over or under tightening the sensor mounting bolts will affect knock sensor performance, possibly causing improper spark control. Always use the specified torque when installing the knock sensors. The torque for the knock senor bolt is relatively light for an 8mm bolt.

NOTE: Note foam strip on bolt threads. This foam is used only to retain the bolts to sensors for plant assembly. It is not used as a sealant. Do not apply any adhesive, sealant or thread locking compound to these bolts.

(3) Install and tighten mounting bolt. Refer to torque specification.
(4) Install electrical connector to sensor.

SPARK PLUG

DESCRIPTION

Resistor type spark plugs are used on all engines.

Sixteen spark plugs (2 per cylinder) are used with 5.7L V-8 engines.

DIAGNOSIS AND TESTING - SPARK PLUG CONDITIONS

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

Always use the recommended torque when tightening spark plugs. Incorrect torque can distort the spark plug and change plug gap. It can also pull the plug threads and do possible damage to both the spark plug and the cylinder head.

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in the Lubrication and Maintenance section.

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

Spark plug resistance values range from 6,000 to 20,000 ohms (when checked with at least a 1000 volt spark plug tester). **Do not use an ohmmeter to check the resistance values of the spark plugs. Inaccurate readings will result.**

NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 42). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance may be affected by MMT deposits.

SPARK PLUG (Continued)

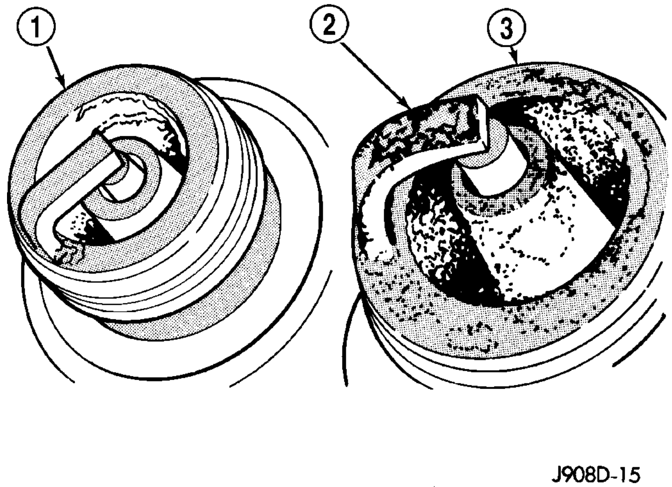


Fig. 42 NORMAL OPERATION AND COLD (CARBON) FOULING

1 - NORMAL
2 - DRY BLACK DEPOSITS
3 - COLD (CARBON) FOULING

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 42). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be caused by a clogged air cleaner element or repeated short operating times (short trips).

WET FOULING OR GAS FOULING

A spark plug coated with excessive wet fuel or oil is wet fouled. In older engines, worn piston rings, leaking valve guide seals or excessive cylinder wear can cause wet fouling. In new or recently overhauled engines, wet fouling may occur before break-in (normal oil control) is achieved. This condition can usually be resolved by cleaning and reinstalling the fouled plugs.

OIL OR ASH ENCRUSTED

If one or more spark plugs are oil or oil ash encrusted (Fig. 43), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 44). This short circuits the electrodes. Spark plugs with

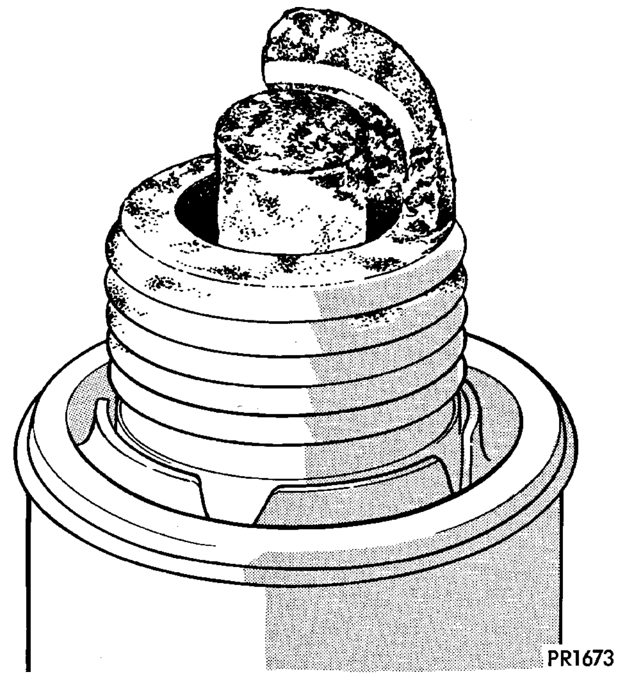


Fig. 43 OIL OR ASH ENCRUSTED

electrode gap bridging can be cleaned using standard procedures.

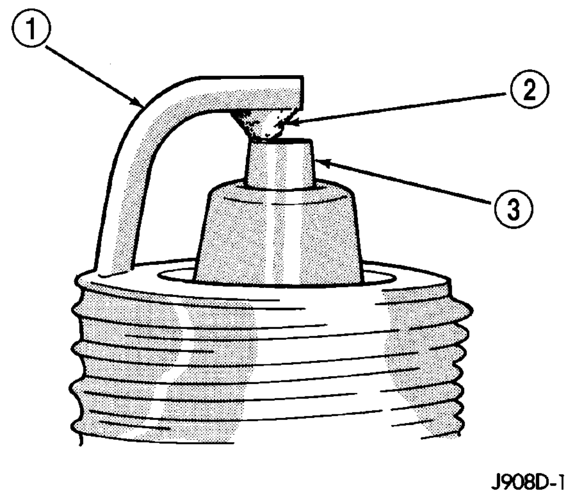


Fig. 44 ELECTRODE GAP BRIDGING

1 - GROUND ELECTRODE
2 - DEPOSITS
3 - CENTER ELECTRODE

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 45). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered nor-

SPARK PLUG (Continued)

mal in condition and can be cleaned using standard procedures.

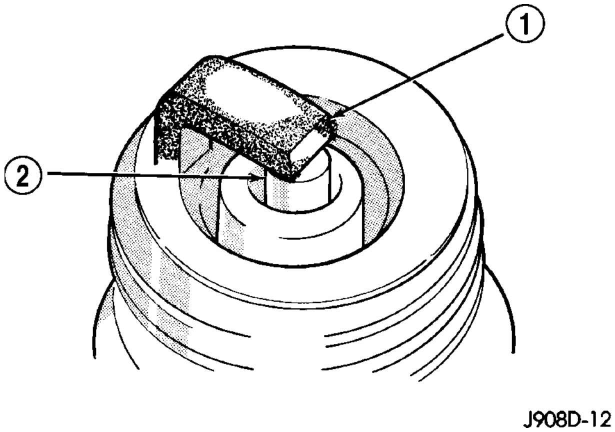


Fig. 45 SCAVENGER DEPOSITS

1 - GROUND ELECTRODE COVERED WITH WHITE OR YELLOW DEPOSITS
2 - CENTER ELECTRODE

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 46). Spark plugs with this condition must be replaced.

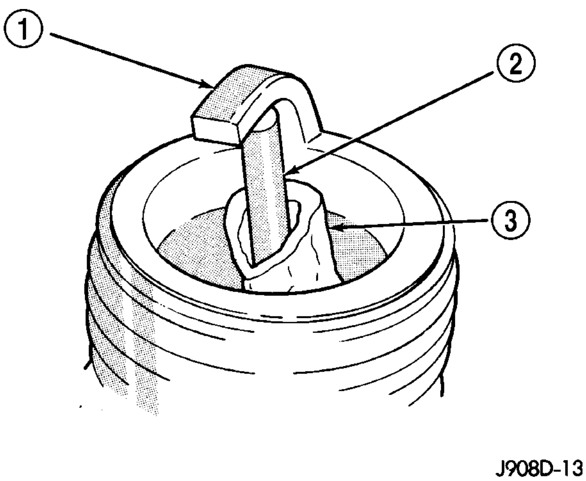


Fig. 46 CHIPPED ELECTRODE INSULATOR

1 - GROUND ELECTRODE
2 - CENTER ELECTRODE
3 - CHIPPED INSULATOR

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 47). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

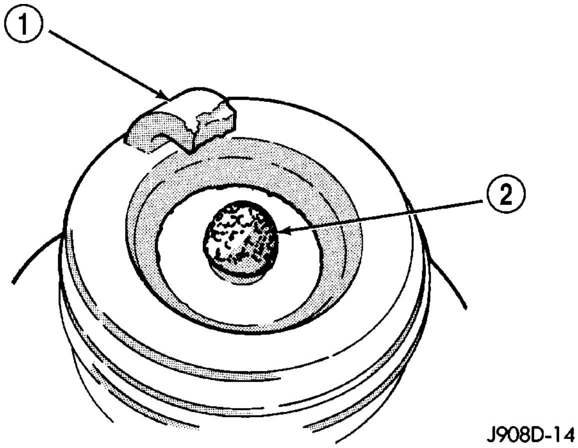


Fig. 47 PREIGNITION DAMAGE

1 - GROUND ELECTRODE STARTING TO DISSOLVE
2 - CENTER ELECTRODE DISSOLVED

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 48). The increase in electrode gap will be considerably in excess of 0.001 inch per 2000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

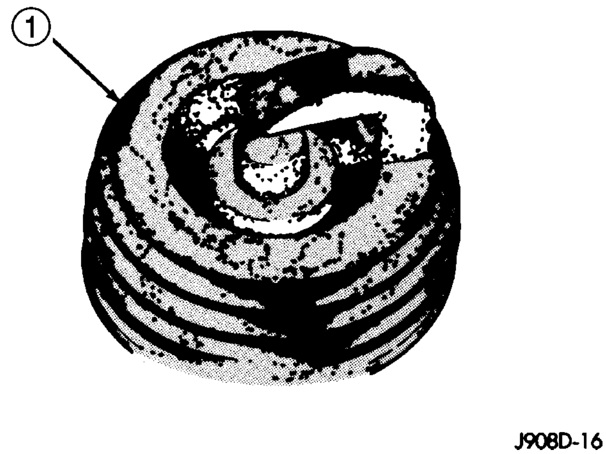


Fig. 48 SPARK PLUG OVERHEATING

1 - BLISTERED WHITE OR GRAY COLORED INSULATOR

SPARK PLUG (Continued)

REMOVAL

3.7L V-6

Each individual spark plug is located under each ignition coil. Each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

(1) Remove necessary air filter tubing at throttle body.

(2) Prior to removing ignition coil, spray compressed air around coil base at cylinder head.

(3) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.

(4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. Also check condition of ignition coil o-ring and replace as necessary.

(5) Inspect spark plug condition. Refer to Diagnostics and Testing - Spark Plug Conditions.

4.7L V-8

Each individual spark plug is located under each ignition coil. Each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

(1) Remove necessary air filter tubing at throttle body.

(2) Prior to removing ignition coil, spray compressed air around coil base at cylinder head.

(3) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.

(4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. Also check condition of ignition coil o-ring and replace as necessary.

(5) Inspect spark plug condition. Refer to Diagnostics and Testing - Spark Plug Conditions.

5.7L V-8

Eight of the 16 spark plugs are located under an ignition coil; the other 8 are not. If spark plug being removed is under coil, coil must be removed to gain access to spark plug. Refer to Ignition Coil Removal/Installation and observe all CAUTIONS and WARNINGS.

Before removing or disconnecting any spark plug cables, note their original position. Remove cables one-at-a-time. To prevent ignition crossfire, spark plug cables **MUST** be placed in cable tray (routing loom) into their original position. Refer to Spark Plug Cable Removal for a graphic.

Before installing spark plug cables to either the spark plugs or coils, apply dielectric grease to inside of boots.

(1) Remove necessary air filter tubing at throttle body.

(2) Prior to removing ignition coil (if coil removal is necessary), spray compressed air around coil base at cylinder head cover.

(3) Prior to removing spark plug, spray compressed air into cylinder head opening. This will help prevent foreign material from entering combustion chamber.

(4) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert.

(5) Inspect spark plug condition. Refer to Diagnostics and Testing - Spark Plug Conditions.

5.9L V-8

On 5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 49).

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 50). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.

(3) Remove the spark plug using a quality socket with a rubber or foam insert.

(4) Inspect the spark plug condition. Refer to Diagnostics and Testing - Spark Plug Conditions.

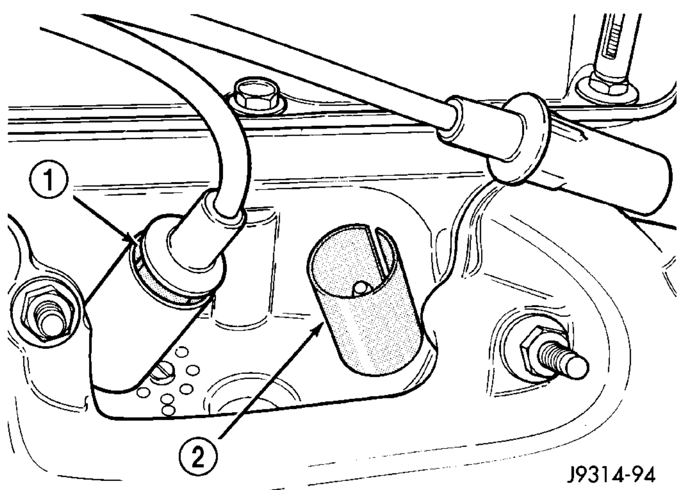


Fig. 49 HEAT SHIELDS - 5.9L V-8

1 - AIR GAP
2 - SPARK PLUG BOOT HEAT SHIELD

SPARK PLUG (Continued)

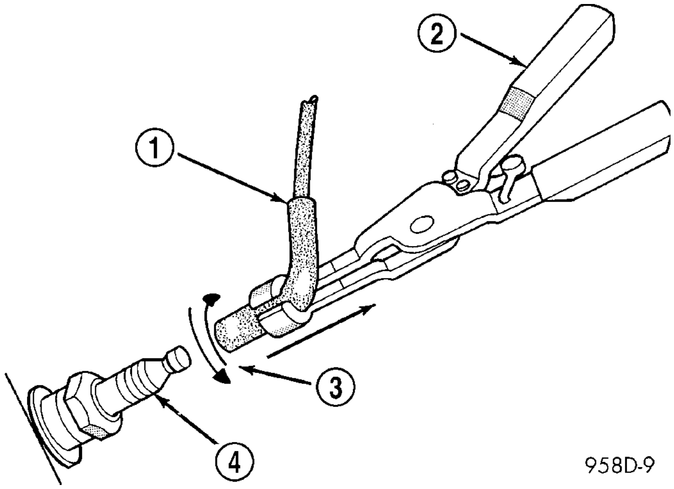


Fig. 50 CABLE REMOVAL - 5.9L / 8.0L

1 - SPARK PLUG CABLE AND BOOT
2 - SPARK PLUG BOOT PULLER
3 - TWIST AND PULL
4 - SPARK PLUG

8.0L V-10

(1) Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 50). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(2) Prior to removing the spark plug, spray compressed air around the spark plug hole and the area around the spark plug. This will help prevent foreign material from entering the combustion chamber.

(3) Remove the spark plug using a quality socket with a rubber or foam insert.

(4) Inspect the spark plug condition. Refer to Diagnostics and Testing - Spark Plug Conditions.

CLEANING

CLEANING AND ADJUSTMENT

The plugs may be cleaned using commercially available spark plug cleaning equipment. After cleaning, file center electrode flat with a small point file or jewelers file before adjusting gap.

CAUTION: Never use a motorized wire wheel brush to clean spark plugs. Metallic deposits will remain on spark plug insulator and will cause plug misfire.

Adjust spark plug gap with a gap gauging tool (Fig. 51).

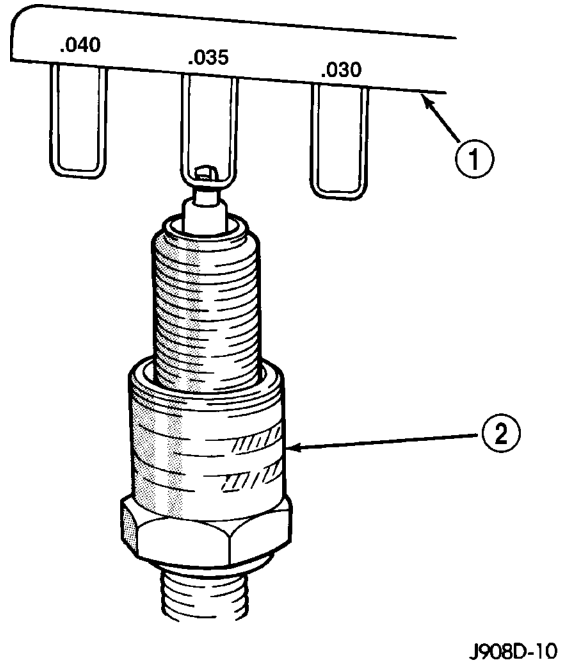


Fig. 51 SETTING SPARK PLUG GAP - TYPICAL

1 - GAUGE TOOL
2 - SPARK PLUG

INSTALLATION

3.7L V-6

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs. Refer to torque specifications.

(3) Before installing ignition coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(4) Install ignition coil(s). Refer to Ignition Coil Removal/Installation.

SPARK PLUG (Continued)

4.7L V-8

CAUTION: The 4.7L V–8 engine is equipped with copper core ground electrode spark plugs. They must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs. Refer to torque specifications.

(3) Before installing ignition coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(4) Install ignition coil(s). Refer to Ignition Coil Removal/Installation.

5.7L V-8

(1) Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

(2) Start the spark plug into cylinder head by hand to avoid cross threading aluminum threads. To aid in installation, attach a piece of rubber hose, or an old spark plug boot to spark plug.

(3) The 5.7L V-8 is equipped with torque critical design spark plugs. Do not exceed 15 ft. lbs. torque. Tighten spark plugs. Refer to torque specifications.

(4) Before installing spark plug cables to either the spark plugs or coils, apply dielectric grease to inside of boots.

(5) To prevent ignition crossfire, spark plug cables **MUST** be placed in cable tray (routing loom) into their original position. Refer to Spark Plug Cable Removal for a graphic.

(6) Install ignition coil(s) to necessary spark plugs. Refer to Ignition Coil Installation.

(7) Install spark plug cables to remaining spark plugs. Remember to apply dielectric grease to inside of boots.

5.9L V-8

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs. Refer to torque specifications.

(3) Install spark plug cables to spark plugs. On 5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 53). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 53).

8.0L V-10

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs. Refer to torque specifications.

(3) Install spark plug cables to spark plugs.

IGNITION COIL CAPACITOR

DESCRIPTION

One coil capacitor is used. It is located in the right-rear section of the engine compartment.

OPERATION

The coil capacitor(s) help dampen the amount of conducted electrical noise to the camshaft position sensor, crankshaft position sensor, and throttle position sensor. This noise is generated on the 12V supply wire to the ignition coils and fuel injectors.

REMOVAL

The coil capacitor is located in the right-rear section of the engine compartment. It is attached with a mounting stud and nut.

(1) Disconnect electrical connector at capacitor (Fig. 52).

(2) Remove mounting nut and remove ground strap.

(3) Remove capacitor.

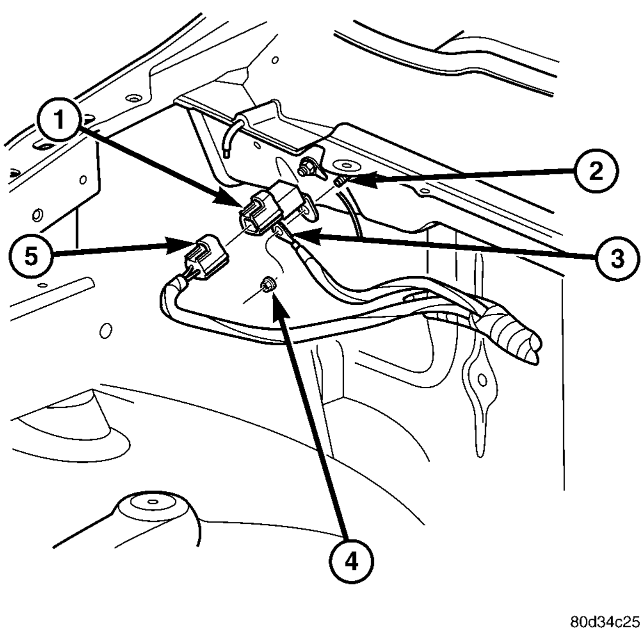


Fig. 52 CAPACITOR LOCATION

1 - COIL CAPACITOR
2 - MOUNTING STUD
3 - GROUND STRAP
4 - MOUNTING NUT
5 - ELEC. CONNECT.

INSTALLATION

(1) Position capacitor to mounting stud.

(2) Position ground strap to mounting stud.

(3) Tighten nut to 7 N·m (60 in. lbs.) torque.

(4) Connect electrical connector to coil capacitor.

SPARK PLUG CABLE

DESCRIPTION

Spark plug cables are sometimes referred to as secondary ignition wires, or secondary ignition cables.

Plug cables are used only on the 5.7L V-8, 5.9L V-8 and 8.0L V-10 engines.

OPERATION

The spark plug cables transfer electrical current from the ignition coil(s) and/or distributor, to individual spark plugs at each cylinder. The resistive spark plug cables are of nonmetallic construction. The cables provide suppression of radio frequency emissions from the ignition system.

Plug cables are used only on the 5.7L V-8, 5.9L V-8 and 8.0L V-10 engines.

DIAGNOSIS AND TESTING - SPARK PLUG CABLES

Cable routing is important on certain engines. To prevent possible ignition crossfire, be sure the cables are clipped into the plastic routing looms. Refer to Spark Plug Cable Removal for addditional information. Try to prevent any one cable from contacting another. Before removing cables, note their original location and routing. Never allow one cable to be twisted around another.

Check the spark plug cable connections for good contact at the coil(s), distributor cap towers (if applicaple), and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil, distributor and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

Clean high voltage ignition cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

On 5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 53). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 53).

TESTING

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

SPARK PLUG CABLE (Continued)

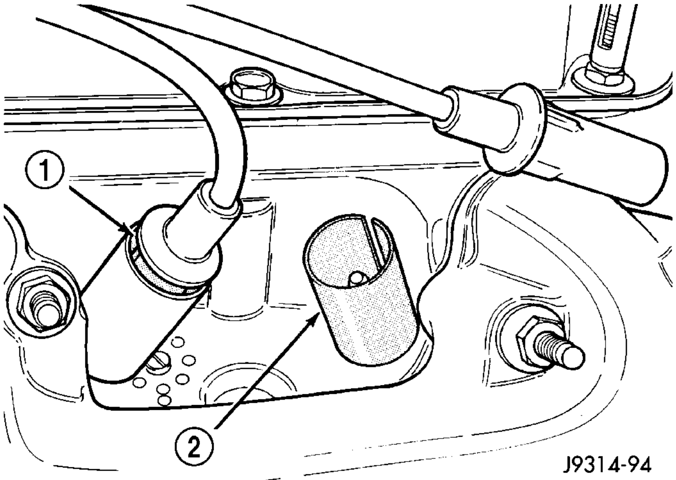


Fig. 53 HEAT SHIELDS - 5.9L V-8

1 - AIR GAP
2 - SPARK PLUG BOOT HEAT SHIELD

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

Except 5.7L V-8 : With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operating properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. If equipped, remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable (if applicaple), do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

REMOVAL

5.9L V-8 / 8.0L V-10

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 54). Grasp the boot (not the cable) and pull it off with a steady, even force.

On 5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 53). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 53).

SPARK PLUG CABLE (Continued)

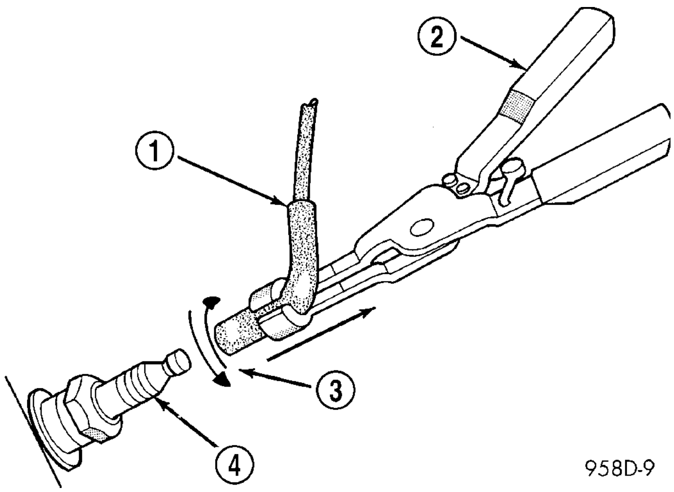


Fig. 54 CABLE REMOVAL - 5.9L V-8 / 8.0L V-10

1 - SPARK PLUG CABLE AND BOOT
2 - SPARK PLUG BOOT PULLER
3 - TWIST AND PULL
4 - SPARK PLUG

5.7L V-8

Spark plug cables on the 5.7L engine are paired on cylinders 1/6, 2/3, 4/7 and 5/8. Before removing or disconnecting any spark plug cables, note their original position (Fig. 55). Remove cables one-at-a-time. To prevent ignition crossfire, spark plug cables **MUST** be placed in cable tray (routing loom) into their original position. The cable retention clips (Fig. 55) must also be securly locked.

Before installing spark plug cables to either the spark plugs or coils, apply dielectric grease to inside of boots.

If cable tray removal is necessary, release the 4 tray-to-manifold retention clips (Fig. 55).

INSTALLATION

Install cables into the proper engine cylinder firing order sequence. Refer to Specifications.

When replacing the spark plug and coil cables, route the cables correctly and secure them in the proper retainers. Failure to route the cables properly may cause the radio to reproduce ignition noise. It could also cause cross-ignition of the plugs, or, may short-circuit the cables to ground.

When installing new cables, make sure a positive connection is made. A snap should be felt when a good connection is made between the plug cable and the distributor cap tower.

5.7L V-8

Refer to Spark Plug Cable Removal for information.

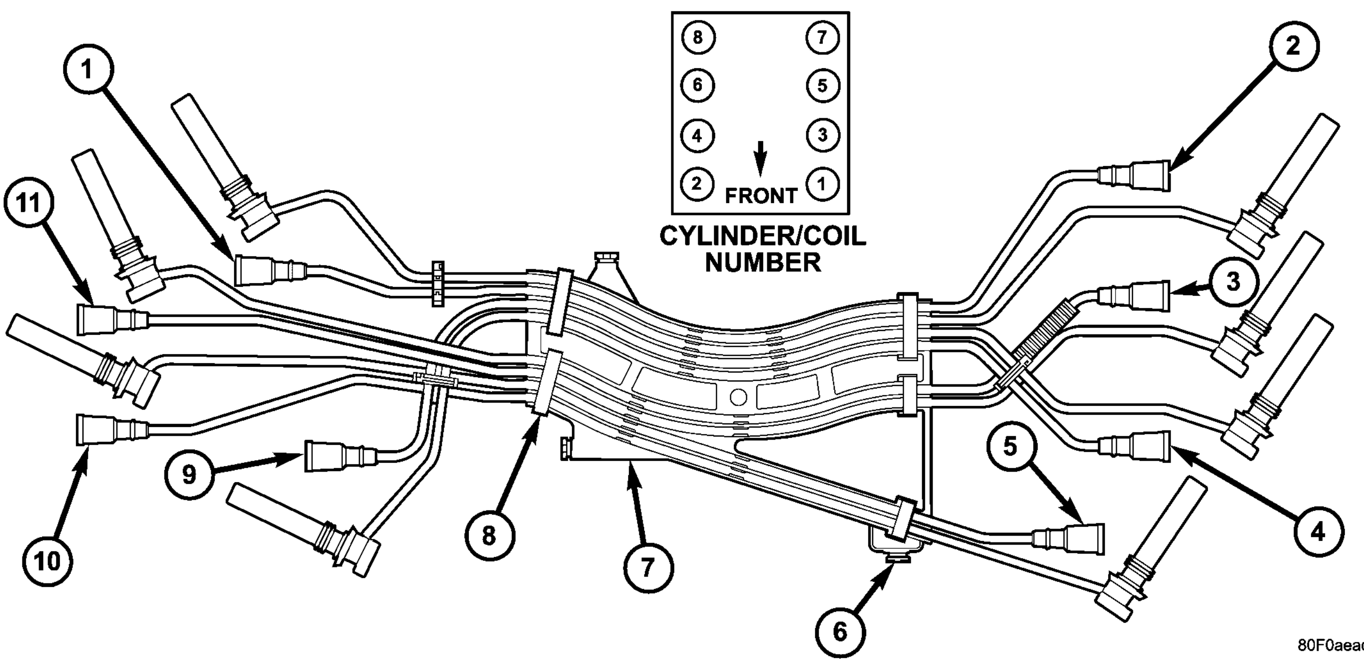


Fig. 55 5.7L SPARK PLUG CABLE ROUTING

1 - #8 COIL-TO- #5 SPARK PLUG (MARKED 5/8)
2 - #5 COIL-TO- #8 SPARK PLUG (MARKED 5/8)
3 - #7 COIL-TO- #4 SPARK PLUG (MARKED 4/7)
4 - #3 COIL-TO- #2 SPARK PLUG (MARKED 2/3)
5 - #1 COIL-TO- #6 SPARK PLUG (MARKED 1/6)
6 - CLIPS (TRAY-TO-MANIFOLD RETENTION)
7 - CABLE TRAY
8 - CLIPS (SPARK PLUG CABLE-TO-TRAY- RETENTION)
9 - #2 COIL-TO- #3 SPARK PLUG (MARKED 2/3)
10 - #6 COIL-TO- #1 SPARK PLUG (MARKED 1/6)
11 - #4 COIL-TO- #7 SPARK PLUG (MARKED 4/7)

INSTRUMENT CLUSTER

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INSTRUMENT CLUSTER

DESCRIPTION

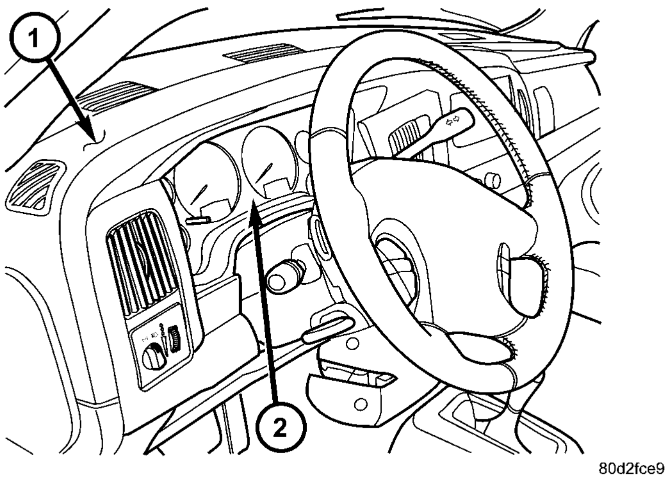

Fig. 1 Instrument Cluster

1 - INSTRUMENT PANEL
2 - INSTRUMENT CLUSTER

The instrument cluster for this model is an ElectroMechanical Instrument Cluster (EMIC) that is located in the instrument panel above the steering column opening, directly in front of the driver (Fig. 1). The remainder of the EMIC, including the mounts and the electrical connections, are concealed within the instrument panel behind the cluster bezel. Besides analog gauges and indicators, the EMIC module incorporates two blue-green digital Vacuum Fluorescent Display (VFD) units for displaying odometer/trip odometer information, engine hours, automatic transmission gear selector position (PRNDL), several warning or reminder indications and certain diagnostic information. The instrument cluster for this model also includes the hardware and software necessary to serve as the electronic body control module and is sometimes referred to as the Cab Compartment Node or CCN.

The EMIC gauges and indicators are visible through a dedicated opening in the cluster bezel on the instrument panel and are protected by a clear plastic cluster lens (Fig. 2) that is integral to a cluster lens, hood and mask unit. Just behind the cluster lens is the cluster hood and an integral cluster mask, which are constructed of molded black plastic. The cluster hood serves as a visor and shields the face of the cluster from ambient light and reflections to reduce glare, while the cluster mask serves to separate and define the individual gauges and indicators of the EMIC. A black plastic odometer/trip odometer

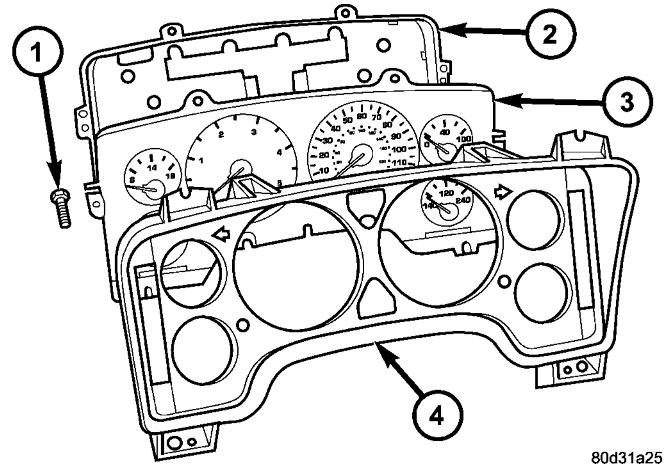

Fig. 2 Instrument Cluster Components

1 - SCREW (9)
2 - REAR COVER
3 - CLUSTER HOUSING
4 - LENS, HOOD & MASK

switch button protrudes through dedicated holes in the cluster mask and the cluster lens, located near the lower edge of the cluster just to the left of the tachometer. The molded plastic EMIC lens, hood and mask unit has four integral mounting tabs, one each on the upper and lower outboard corners of the unit. These mounting tabs are used to secure the EMIC to the molded plastic instrument panel cluster carrier with four screws.

The rear of the cluster housing and the EMIC electronic circuitry are protected by a molded plastic rear cover, which is secured to the cluster housing with a single screw, while eight screws installed around the outside perimeter of the rear cover secure it to the cluster lens, hood and mask unit. The rear cover includes clearance holes for service access to each of the eleven incandescent bulb and bulb holder units installed on the cluster circuit board for general illumination lighting and for the cluster connector receptacles. The connector receptacles on the back of the cluster electronic circuit board connect the EMIC to the vehicle electrical system through three take outs with connectors from the instrument panel wire harness. The EMIC also has an integral interface connector on the back of the cluster circuit board that joins it to the optional external RKE receiver through a connector receptacle that is integral to that unit. The rear cover includes a molded receptacle and two latch features to secure the RKE receiver on vehicles that are so equipped.

Sandwiched between the rear cover and the lens, hood and mask unit is the cluster housing. The

INSTRUMENT CLUSTER (Continued)

molded plastic cluster housing serves as the carrier for the cluster circuit board and circuitry, the cluster connector receptacles, the RKE interface connector, the gauges, a Light Emitting Diode (LED) for each cluster indicator, two VFD units, an audible tone generator, the cluster overlay, the gauge pointers, the odometer/trip odometer switch and the switch button. The cluster overlay is a laminated plastic unit. The dark, visible, outer surface of the overlay is marked with all of the gauge dial faces and graduations, but this layer is also translucent. The darkness of this outer layer prevents the cluster from appearing cluttered or busy by concealing the cluster indicators that are not illuminated, while the translucence of this layer allows those indicators and icons that are illuminated to be readily visible. The underlying layer of the overlay is opaque and allows light from the LED for each of the various indicators and the incandescent illumination lamps behind it to be visible through the outer layer of the overlay only through predetermined stencil-like cutouts. A rectangular opening in the overlay at the base of both the speedometer and tachometer dial faces has a smoked clear lens through which the illuminated VFD units can be viewed.

Several versions of the EMIC module are offered on this model. These versions accommodate all of the variations of optional equipment and regulatory requirements for the various markets in which the vehicle will be offered. The microprocessor-based EMIC utilizes integrated circuitry and information carried on the Programmable Communications Interface (PCI) data bus network along with several hard wired analog and multiplexed inputs to monitor sensors and switches throughout the vehicle. In response to those inputs, the internal circuitry and programming of the EMIC allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the PCI data bus. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION - PCI BUS).

Besides typical instrument cluster gauge and indicator support, the electronic functions and features that the EMIC supports or controls include the following:

- **Audible Warnings** - The EMIC electronic circuit board is equipped with an audible tone generator and programming that allows it to provide various audible alerts to the vehicle operator, including chime tones and beep tones. An electromechanical relay is also soldered onto the circuit board to produce audible clicks that emulate the sound of a conventional turn signal or hazard warning flasher. (Refer to 8 - ELECTRICAL/CHIME/BUZZER - DESCRIPTION).
- **Brake Lamp Control** - The EMIC provides electronic brake lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for brake lamp control, excluding control of the Center High Mounted Stop Lamp (CHMSL), which remains controlled by a direct hard wired output of the brake lamp switch.
- **Brake Transmission Shift Interlock Control** - The EMIC monitors inputs from the brake lamp switch, ignition switch, and the Transmission Range Sensor (TRS), then controls a high-side driver output to operate the Brake Transmission Shift Interlock (BTSI) solenoid that locks and unlocks the automatic transmission gearshift selector lever on the steering column.
- **Cargo Lamp Control** - The EMIC provides direct control of cargo lamp operation with a load shedding (battery saver) feature which will automatically turn off the cargo lamp if it remains on after a timed interval.
- **Central Locking** - The EMIC provides support for the central locking feature of the power lock system. This feature will lock or unlock all doors based upon the input from the door cylinder lock switch. Door cylinder lock switches are used only on models equipped with the optional Vehicle Theft Security System (VTSS).
- **Door Lock Inhibit** - The EMIC inhibits locking of the doors with the power lock switch when the key is in the ignition switch and the driver side front door is ajar. However, operation of the door locks is not inhibited under the same conditions when the Lock button of the optional RKE transmitter is depressed.
- **Enhanced Accident Response** - The EMIC monitors an input from the Airbag Control Module (ACM) and, following an airbag deployment, will immediately disable the power lock output, unlock all doors by activating the power unlock output, then enables the power lock output if the power lock switch input remains inactive for two seconds. This feature, like all other enhanced accident response features, is dependent upon a functional vehicle electrical system following the vehicle impact event.
- **Exterior Lighting Control** - The EMIC provides electronic head lamp and/or park lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate exterior lamp control of standard head and park lamps, as well as optional front fog lamps. This includes support for headlamp beam selection and the optical horn feature, also known as flash-to-pass.
- **Exterior Lighting Fail-safe** - In the absence of a headlamp switch input, the EMIC will turn on the

INSTRUMENT CLUSTER (Continued)

cluster illumination lamps and provide electronic headlamp low beam and park lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for default exterior lamp operation. The FCM will also provide default park lamp and headlamp low beam operation and the EMIC will turn on the cluster illumination lamps if there is a failure of the electronic data bus communication between the EMIC and the FCM.

- **Heated Seat Control** - The EMIC monitors inputs from the ignition switch and electronic engine speed messages from the Powertrain Control Module (PCM) to control a high side driver output to the heated seat switch Light Emitting Diode (LED) indicators. This input allows the heated seat switches to wake up the heated seat module if the switch is actuated. The EMIC will de-energize the heated seat switch LED indicators, which deactivates the heated seat system, if the ignition switch is turned to any position except On or Start, or if the engine speed message indicates zero. (Refer to 8 - ELECTRICAL/HEATED SEATS - DESCRIPTION).
- **Interior Lamp Load Shedding** - The EMIC provides a battery saver feature which will automatically turn off all interior lamps that remain on after a timed interval of about fifteen minutes.
- **Interior Lamps - Enhanced Accident Response** - The EMIC monitors inputs from the Airbag Control Module (ACM) and the Powertrain Control Module (PCM) to automatically turn on the interior lighting after an airbag deployment event ten seconds after the vehicle speed is zero. The interior lighting remains illuminated until the ignition switch is turned to the Off position, at which time the interior lighting returns to normal operation and control. This feature, like all other enhanced accident response features, is dependent upon a functional vehicle electrical system following the vehicle impact event.
- **Interior Lighting Control** - The EMIC monitors inputs from the interior lighting switch, the door ajar switches, the cargo lamp switch, the reading lamp switches, and the Remote Keyless Entry (RKE) module to provide courtesy lamp control. This includes support for timed illuminated entry with theater-style fade-to-off and courtesy illumination defeat features.
- **Lamp Out Indicator Control** - The EMIC monitors electronic lamp outage messages from the Front Control Module (FCM) located on the Integrated Power Module (IPM) in order to provide lamp out indicator control for the headlamps (low and high beams), turn signal lamps, and the brake lamps (excluding CHMSL).
- **Panel Lamps Dimming Control** - The EMIC provides a hard wired 12-volt Pulse-Width Modulated (PWM) output that synchronizes the dimming level of all panel lamps dimmer controlled lamps with that of the cluster illumination lamps.
- **Parade Mode** - The EMIC provides a parade mode (also known as funeral mode) that allows all Vacuum-Fluorescent Display (VFD) units in the vehicle to be illuminated at full (daytime) intensity while driving during daylight hours with the exterior lamps turned on.
- **Power Locks** - The EMIC monitors inputs from the power lock switches and the Remote Keyless Entry (RKE) receiver module (optional) to provide control of the power lock motors through high side driver outputs to the power lock motors. This includes support for rolling door locks (also known as automatic door locks), automatic door unlock, a door lock inhibit mode, and central locking (with the optional Vehicle Theft Security System only). (Refer to 8 - ELECTRICAL/POWER LOCKS - DESCRIPTION).
- **Remote Keyless Entry** - The EMIC supports the optional Remote Keyless Entry (RKE) system features, including support for the RKE Lock, Unlock (with optional driver-door-only unlock, and unlock-all-doors), Panic, audible chirp, optical chirp, illuminated entry modes, an RKE programming mode, as well as optional Vehicle Theft Security System (VTSS) arming (when the proper VTSS arming conditions are met) and disarming.
- **Remote Radio Switch Interface** - The EMIC monitors inputs from the optional remote radio switches and then provides the appropriate electronic data bus messages to the radio to select the radio operating mode, volume control, preset station scan and station seek features.
- **Rolling Door Locks** - The EMIC provides support for the power lock system rolling door locks feature (also known as automatic door locks). This feature will automatically lock all unlocked doors each time the vehicle speed reaches twenty-four kilometers-per-hour (fifteen miles-per-hour) and, following an automatic lock event, will automatically unlock all doors once the ignition is turned to the Off position and the driver side front door is opened.
- **Turn Signal & Hazard Warning Lamp Control** - The EMIC provides electronic turn and hazard lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for turn and hazard lamp control. The EMIC also provides an audible click at one of two rates to emulate normal and bulb out turn or hazard flasher operation based upon electronic lamp outage messages from the FCM, and provides an audible turn signal on chime warning if a turn is signalled continuously for more than about 1.6 kilometers (one mile) and

INSTRUMENT CLUSTER (Continued)

the vehicle speed remains greater than about twenty-four kilometers-per-hour (fifteen miles-per-hour).

• **Vacuum Fluorescent Display Synchronization** - The EMIC transmits electronic panel lamp dimming level messages which allows all other electronic modules on the PCI data bus with Vacuum Fluorescent Display (VFD) units to coordinate their illumination intensity with that of the EMIC VFD units.

• **Vehicle Theft Security System** - The EMIC monitors inputs from the door cylinder lock switch(es), the door ajar switches, the ignition switch, and the Remote Keyless Entry (RKE) receiver module, then provides electronic horn and lighting request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate VTSS alarm output features.

• **Wiper/Washer System Control** - The EMIC provides electronic wiper and/or washer request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate wiper and washer system features. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - DESCRIPTION).

The EMIC houses six analog gauges and has provisions for up to twenty-three indicators (Fig. 3) or (Fig. 4). The EMIC includes the following analog gauges:

• **Coolant Temperature Gauge**
• **Fuel Gauge**
• **Oil Pressure Gauge**
• **Speedometer**
• **Tachometer**
• **Voltage Gauge**

Some of the EMIC indicators are automatically configured when the EMIC is connected to the vehicle electrical system for compatibility with certain optional equipment or equipment required for regulatory purposes in certain markets. While each EMIC may have provisions for indicators to support every available option, the configurable indicators will not be functional in a vehicle that does not have the equipment that an indicator supports. The EMIC includes provisions for the following indicators (Fig. 3) or (Fig. 4):

• **Airbag Indicator (with Airbag System only)**
• **Antilock Brake System (ABS) Indicator (with ABS or Rear Wheel Anti-Lock [RWAL] brakes only)**
• **Brake Indicator**
• **Cargo Lamp Indicator**
• **Check Gauges Indicator**
• **Cruise Indicator (with Speed Control only)**
• **Door Ajar Indicator**
• **Electronic Throttle Control (ETC) Indicator (with 5.7L Gasoline Engine only)**
• **Gear Selector Indicator (with Automatic Transmission only)**
• **High Beam Indicator**
• **Lamp Out Indicator**
• **Low Fuel Indicator**
• **Malfunction Indicator Lamp (MIL)**
• **Overdrive-Off Indicator (with Automatic Transmission only)**
• **Seatbelt Indicator**
• **Security Indicator (with Sentry Key Immobilizer & Vehicle Theft Security Systems only)**
• **Service Four-Wheel Drive Indicator (with Four-Wheel Drive only)**
• **Transmission Overtemp Indicator (with Automatic Transmission only)**
• **Turn Signal (Right and Left) Indicators**
• **Upshift Indicator (with Manual Transmission only)**
• **Washer Fluid Indicator**
• **Wait-To-Start Indicator (with Diesel Engine only)**
• **Water-In-Fuel Indicator (with Diesel Engine only)**

Each indicator in the EMIC, except those located within one of the VFD units, is illuminated by a dedicated LED that is soldered onto the EMIC electronic circuit board. The LED units are not available for service replacement and, if damaged or faulty, the entire EMIC must be replaced. Cluster illumination is accomplished by dimmable incandescent back lighting, which illuminates the gauges for visibility when the exterior lighting is turned on. Each of the incandescent bulbs is secured by an integral bulb holder to the electronic circuit board from the back of the cluster housing.

Hard wired circuitry connects the EMIC to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the EMIC through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The EMIC modules for this model are serviced only as complete units. The EMIC module cannot be adjusted or repaired. If a gauge, an LED indicator, a VFD unit, the electronic circuit board, the circuit board hardware, the cluster overlay, or the EMIC housing are damaged or faulty, the entire EMIC mod-

INSTRUMENT CLUSTER (Continued)

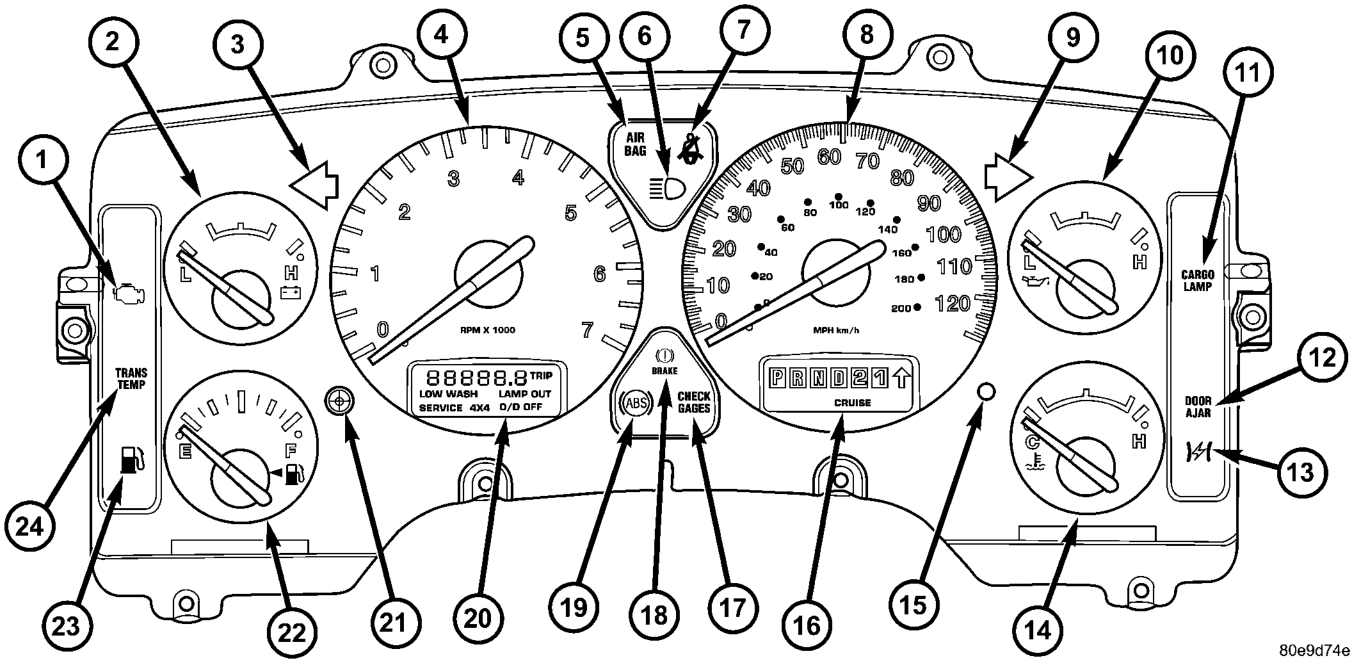

Fig. 3 Gauges & Indicators - Gasoline Engine

1 - MALFUNCTION INDICATOR LAMP
2 - VOLTAGE GAUGE
3 - LEFT TURN INDICATOR
4 - TACHOMETER
5 - AIRBAG INDICATOR
6 - HIGH BEAM INDICATOR
7 - SEATBELT INDICATOR
8 - SPEEDOMETER
9 - RIGHT TURN INDICATOR
10 - OIL PRESSURE GAUGE
11 - CARGO LAMP INDICATOR
12 - DOOR AJAR INDICATOR
13 - ELECTRONIC THROTTLE CONTROL (ETC) INDICATOR
14 - ENGINE TEMPERATURE GAUGE
15 - SECURITY INDICATOR
16 - GEAR SELECTOR INDICATOR DISPLAY (INCLUDES CRUISE & UPSHIFT INDICATORS)
17 - CHECK GAUGES INDICATOR
18 - BRAKE INDICATOR
19 - ABS INDICATOR
20 - ODOMETER/TRIP ODOMETER DISPLAY (INCLUDES ENGINE HOURS, WASHER FLUID, LAMP OUTAGE, OVERDRIVE-OFF & SERVICE 4x4 INDICATORS)
21 - ODOMETER/TRIP ODOMETER SWITCH BUTTON
22 - FUEL GAUGE
23 - LOW FUEL INDICATOR
24 - TRANSMISSION OVERTEMP INDICATOR

ule must be replaced. The cluster lens, hood and mask unit and the individual incandescent lamp bulbs with holders are available for individual service replacement.

OPERATION

The ElectroMechanical Instrument Cluster (EMIC) in this model also includes the hardware and software necessary to serve as the electronic body control module and is sometimes referred to as the Cab Compartment Node or CCN. The following information deals primarily with the instrument cluster functions of this unit. Additional details of the electronic body control functions of this unit may be found within the service information for the system or component that the EMIC controls. For example: Additional details of the audible warning functions of the EMIC are found within the Chime/Buzzer service information.

The EMIC is designed to allow the vehicle operator to monitor the conditions of many of the vehicle components and operating systems. The gauges and indicators in the EMIC provide valuable information about the various standard and optional powertrains, fuel and emissions systems, cooling systems, lighting systems, safety systems and many other convenience items. The EMIC is installed in the instrument panel so that all of these monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access for service. The microprocessor-based EMIC hardware and software uses various inputs to control the gauges and indicators visible on the face of the cluster. Some of these inputs are hard wired, but most are in the form of electronic messages that are transmitted by other electronic modules over the Programmable Communications Interface (PCI) data bus network. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - OPERATION).

INSTRUMENT CLUSTER (Continued)

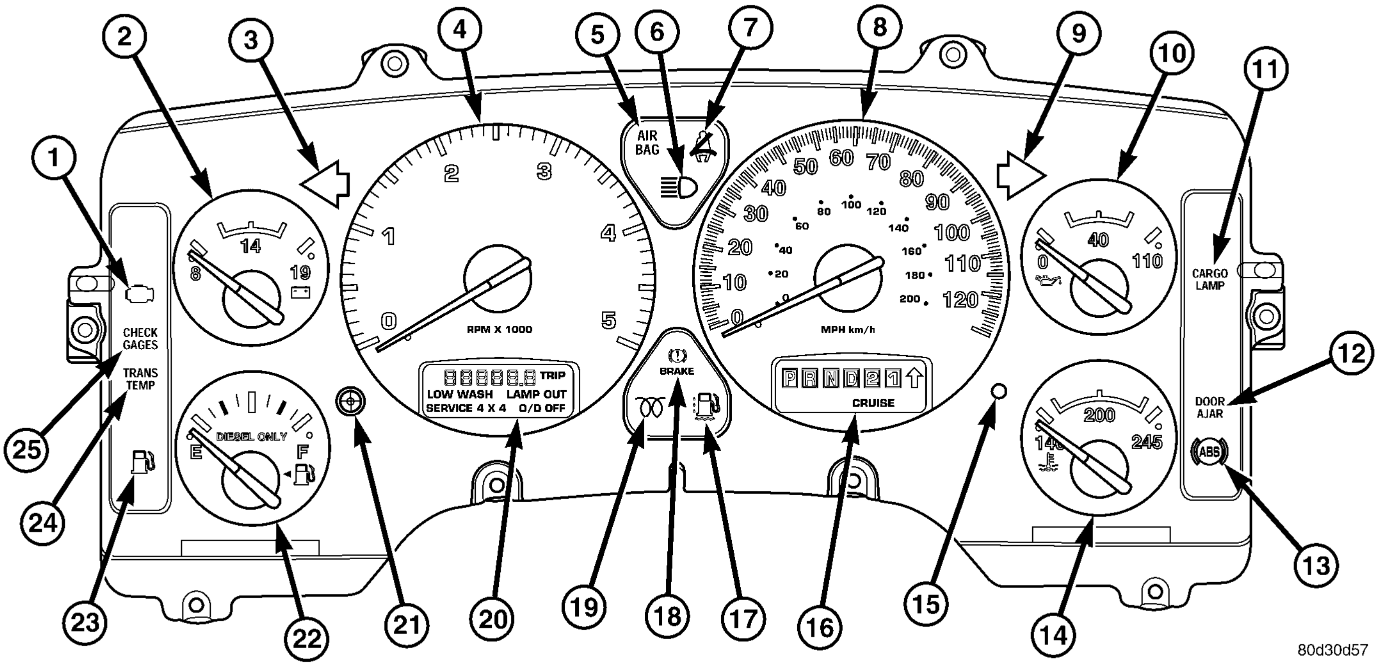

Fig. 4 Gauges & Indicators - Diesel Engine

1 - MALFUNCTION INDICATOR LAMP
2 - VOLTAGE GAUGE
3 - LEFT TURN INDICATOR
4 - TACHOMETER
5 - AIRBAG INDICATOR
6 - HIGH BEAM INDICATOR
7 - SEATBELT INDICATOR
8 - SPEEDOMETER
9 - RIGHT TURN INDICATOR
10 - OIL PRESSURE GAUGE
11 - CARGO LAMP INDICATOR
12 - DOOR AJAR INDICATOR
13 - ABS INDICATOR
14 - ENGINE TEMPERATURE GAUGE
15 - SECURITY INDICATOR
16 - GEAR SELECTOR INDICATOR DISPLAY (INCLUDES CRUISE & UPSHIFT INDICATORS)
17 - WATER-IN-FUEL INDICATOR
18 - BRAKE INDICATOR
19 - WAIT-TO-START INDICATOR
20 - ODOMETER/TRIP ODOMETER DISPLAY (INCLUDES ENGINE HOURS, WASHER FLUID, LAMP OUTAGE, OVERDRIVE-OFF & SERVICE 4x4 INDICATORS)
21 - ODOMETER/TRIP ODOMETER SWITCH BUTTON
22 - FUEL GAUGE
23 - LOW FUEL INDICATOR
24 - TRANSMISSION OVERTEMP INDICATOR
25 - CHECK GAUGES INDICATOR

The EMIC microprocessor smooths the input data using algorithms to provide gauge readings that are accurate, stable and responsive to operating conditions. These algorithms are designed to provide gauge readings during normal operation that are consistent with customer expectations. However, when abnormal conditions exist such as high coolant temperature, the algorithm can drive the gauge pointer to an extreme position and the microprocessor can sound a chime through the on-board audible tone generator to provide distinct visual and audible indications of a problem to the vehicle operator. The instrument cluster circuitry may also produce audible warnings for other electronic modules in the vehicle based upon electronic tone request messages received over the PCI data bus. Each audible warning is intended to provide the vehicle operator with an audible alert to supplement a visual indication.

The EMIC circuitry operates on battery current received through a fused B(+) fuse in the Integrated Power Module (IPM) on a non-switched fused B(+) circuit, and on battery current received through a fused ignition switch output (run-start) fuse in the IPM on a fused ignition switch output (run-start) circuit. This arrangement allows the EMIC to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in the On or Start positions. The EMIC circuitry is grounded through a ground circuit and take out of the instrument panel wire harness with an eyelet terminal connector that is secured by a ground screw to a ground location near the center of the instrument panel structural support.

The EMIC also has a self-diagnostic actuator test capability, which will test each of the PCI bus message-controlled functions of the cluster by lighting the appropriate indicators, positioning the gauge nee-

INSTRUMENT CLUSTER (Continued)

dles at several predetermined calibration points across the gauge faces, and illuminating all segments of the odometer/trip odometer and gear selector indicator Vacuum-Fluorescent Display (VFD) units. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). See the owner's manual in the vehicle glove box for more information on the features, use and operation of the EMIC.

GAUGES

All gauges receive battery current through the EMIC circuitry only when the ignition switch is in the On or Start positions. With the ignition switch in the Off position battery current is not supplied to any gauges, and the EMIC circuitry is programmed to move all of the gauge needles back to the low end of their respective scales. Therefore, the gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions.

All of the EMIC gauges are air core magnetic units. Two fixed electromagnetic coils are located within each gauge. These coils are wrapped at right angles to each other around a movable permanent magnet. The movable magnet is suspended within the coils on one end of a pivot shaft, while the gauge needle is attached to the other end of the shaft. One of the coils has a fixed current flowing through it to maintain a constant magnetic field strength. Current flow through the second coil changes, which causes changes in its magnetic field strength. The current flowing through the second coil is changed by the EMIC circuitry in response to messages received over the PCI data bus. The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets.

The gauges are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control each gauge require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for each gauge may be found elsewhere in this service information.

VACUUM-FLUORESCENT DISPLAYS

The Vacuum-Fluorescent Display (VFD) units are soldered to the EMIC electronic circuit board. With the ignition switch in the Off or Accessory positions, the odometer display is activated when the driver door is opened (Rental Car mode) and is deactivated when the driver door is closed. Otherwise, both display units are active when the ignition switch is in the On or Start positions, and inactive when the ignition switch is in the Off or Accessory positions.

The illumination intensity of the VFD units is controlled by the EMIC circuitry based upon an input from the headlamp switch and a dimming level input received from the headlamp dimmer switch. The EMIC synchronizes the illumination intensity of other VFD units with that of the units in the EMIC by sending electronic dimming level messages to other electronic modules in the vehicle over the PCI data bus.

The EMIC VFD units have several display capabilities including odometer, trip odometer, engine hours, gear selector indication (PRNDL) for models with an automatic transmission, several warning or reminder indications, and various diagnostic information when certain fault conditions exist. An odometer/trip odometer switch on the EMIC circuit board is used to control some of the display modes. This switch is actuated manually by depressing the odometer/trip odometer switch button that extends through the lower edge of the cluster lens, just left of the tachometer. Actuating this switch momentarily with the ignition switch in the On position will toggle the VFD between the odometer and trip odometer modes. Depressing the switch button for about two seconds while the VFD is in the trip odometer mode will reset the trip odometer value to zero. While in the odometer mode with the ignition switch in the On position and the engine not running, depressing this switch for about six seconds will display the engine hours information. Holding this switch depressed while turning the ignition switch from the Off position to the On position will initiate the EMIC self-diagnostic actuator test. Refer to the appropriate diagnostic information for additional details on this VFD function. The EMIC microprocessor remembers which display mode is active when the ignition switch is turned to the Off position, and returns the VFD display to that mode when the ignition switch is turned On again.

The VFD units are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control some of the VFD functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for the odometer, the trip odometer, the gear selector indicator and the various warning and reminder indicator functions of the VFD may be found elsewhere in this service information.

INDICATORS

Indicators are located in various positions within the EMIC and are all connected to the EMIC electronic circuit board. The cargo lamp indicator, door

INSTRUMENT CLUSTER (Continued)

ajar indicator, high beam indicator, and turn signal indicators operate based upon hard wired inputs to the EMIC. The brake indicator is controlled by PCI data bus messages from the Controller Antilock Brake (CAB) as well as by hard wired park brake switch inputs to the EMIC. The seatbelt indicator is controlled by the EMIC programming, PCI data bus messages from the Airbag Control Module (ACM), and a hard wired seat belt switch input to the EMIC. The Malfunction Indicator Lamp (MIL) is normally controlled by PCI data bus messages from the Powertrain Control Module (PCM); however, if the EMIC loses PCI data bus communication, the EMIC circuitry will automatically turn the MIL on until PCI data bus communication is restored. The EMIC uses PCI data bus messages from the Front Control Module (FCM), the PCM, the diesel engine only Engine Control Module (ECM), the ACM, the CAB, and the Sentry Key Immobilizer Module (SKIM) to control all of the remaining indicators.

The various EMIC indicators are controlled by different strategies; some receive fused ignition switch output from the EMIC circuitry and have a switched ground, while others are grounded through the EMIC circuitry and have a switched battery feed. However, all indicators are completely controlled by the EMIC microprocessor based upon various hard wired and electronic message inputs. All indicators are illuminated at a fixed intensity, which is not affected by the selected illumination intensity of the EMIC general illumination lamps.

In addition, certain indicators in this instrument cluster are automatically configured or self-configured. This feature allows the configurable indicators to be enabled by the EMIC circuitry for compatibility with certain optional equipment. The EMIC defaults for the ABS indicator and airbag indicator are enabled, and these configuration settings must be programmatically disabled in the EMIC using a DRBIII® scan tool for vehicles that do not have this equipment. The automatically configured or self-configured indicators remain latent in each EMIC at all times and will be active only when the EMIC receives the appropriate PCI message inputs for that optional system or equipment.

The hard wired indicator inputs may be diagnosed using conventional diagnostic methods. However, the EMIC circuitry and PCI bus message controlled indicators are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic message inputs to the EMIC that control an indicator requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific details of the operation for each indicator may be found elsewhere in this service information.

CLUSTER ILLUMINATION

The EMIC has several illumination lamps that are illuminated when the exterior lighting is turned on with the headlamp switch. The illumination intensity of these lamps is adjusted when the interior lighting thumbwheel on the headlamp switch is rotated (down to dim, up to brighten) to one of six available minor detent positions. The EMIC monitors a resistor multiplexed input from the headlamp switch on a dimmer input circuit. In response to that input, the EMIC electronic circuitry converts a 12-volt input it receives from a fuse in the Integrated Power Module (IPM) on a hard wired panel lamps dimmer switch signal circuit into a 12-volt Pulse Width Modulated (PWM) output. The EMIC uses this PWM output to power the cluster illumination lamps and the VFD units on the EMIC circuit board, then provides a synchronized PWM output on the various hard wired fused panel lamps dimmer switch signal circuits to control and synchronize the illumination intensity of other incandescent illumination lamps in the vehicle. The cluster illumination lamps are grounded at all times.

The EMIC also sends electronic dimming level messages over the PCI data bus to other electronic modules in the vehicle to control and synchronize the illumination intensity of their VFD units to that of the EMIC VFD units. In addition, the thumbwheel on the headlamp switch has a Parade Mode position to provide a parade mode. The EMIC monitors the request for this mode from the headlamp switch, then sends an electronic dimming level message over the PCI data bus to illuminate all VFD units in the vehicle at full (daytime) intensity for easier visibility when driving in daylight with the exterior lighting turned on.

The hard wired headlamp switch and EMIC panel lamps dimmer inputs and outputs may be diagnosed using conventional diagnostic methods. However, proper testing of the PWM output of the EMIC and the electronic dimming level messages sent by the EMIC over the PCI data bus requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

INPUT AND OUTPUT CIRCUITS

HARD WIRED INPUTS

The hard wired inputs to the EMIC include the following:

- **Brake Lamp Switch Output**
- **Driver Cylinder Lock Switch Sense**
- **Driver Door Ajar Switch Sense**

INSTRUMENT CLUSTER (Continued)

- **Driver Door Lock Switch MUX - with Power Locks**
- **Fused B(+) - Ignition-Off Draw**
- **Fused B(+) - Power Lock Feed - with Power Locks**
- **Fused Ignition Switch Output (Accessory-Run)**
- **Fused Ignition Switch Output (Off-Run-Start)**
- **Fused Ignition Switch Output (Run-Start)**
- **Headlamp Dimmer Switch MUX**
- **Headlamp Switch MUX**
- **Horn Relay Control**
- **Key-In Ignition Switch Sense**
- **Left Rear Door Ajar Switch Sense**
- **Panel Lamps Dimmer Switch Signal**
- **Park Brake Switch Sense**
- **Passenger Door Ajar Switch Sense**
- **Passenger Door Lock Switch MUX - with Power Locks**
- **Radio Control MUX**
- **Right Rear Door Ajar Switch Sense**
- **RKE Supply - with RKE**
- **Seat Belt Switch Sense**
- **Transmission Range Sensor MUX - with Auto Trans**
- **Turn/Hazard Switch MUX**
- **Washer/Beam Select Switch MUX**
- **Wiper Switch MUX**

Refer to the appropriate wiring information for additional details.

HARD WIRED OUTPUTS

The hard wired outputs of the EMIC include the following:

- **Accessory Switch Bank Illumination Driver**
- **BTSI Driver - with Auto Trans**
- **Cargo Lamp Driver**
- **Dome/Overhead Lamp Driver**
- **Driver Door Unlock Driver - with Power Locks**
- **Headlamp Switch Illumination Driver**
- **Heated Seat Switch Indicator Driver - with Heated Seats**
- **Heater-A/C Control Illumination Driver**
- **Left Door Lock Driver - with Power Locks**
- **Left Rear Door Unlock Driver - with Power Locks**
- **Map/Glove Box Lamp Driver**
- **Radio Illumination Driver**
- **Right Door Lock Driver - with Power Locks**
- **Right Door Unlock Driver - with Power Locks**
- **Transfer Case Switch Illumination Driver - with Four-Wheel Drive**

Refer to the appropriate wiring information for additional details.

GROUNDS

The EMIC receives and supplies a ground path to several switches and sensors through the following hard wired circuits:

- **Ground - Illumination (2 Circuits)**
- **Ground - Power Lock - with Power Locks**
- **Ground - Signal**
- **Headlamp Switch Return**
- **Multi-Function Switch Return**
- **Transmission Range Sensor Return - with Auto Trans**

Refer to the appropriate wiring information for additional details.

COMMUNICATION

The EMIC has provisions for the following communication circuits:

- **PCI Data Bus**
- **RKE Program Serial Data - with RKE**
- **RKE Transmit Serial Data - with RKE**

Refer to the appropriate wiring information for additional details.

DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER

If all of the instrument cluster gauges and/or indicators are inoperative, refer to PRELIMINARY DIAGNOSIS. If an individual gauge or Programmable Communications Interface (PCI) data bus message-controlled indicator is inoperative, refer to ACTUATOR TEST. If an individual hard wired indicator is inoperative, refer to the diagnosis and testing information for that specific indicator.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

INSTRUMENT CLUSTER (Continued)

CAUTION: Instrument clusters used in this model automatically configure themselves for compatibility with the features and optional equipment in the vehicle in which they are initially installed. The instrument cluster is programmed to do this by embedding the Vehicle Identification Number (VIN) and other information critical to proper cluster operation into electronic memory. This embedded information is learned through electronic messages received from other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus, and through certain hard wired inputs received when the cluster is connected to the vehicle electrically. Once configured, the instrument cluster memory may be irreparably damaged and certain irreversible configuration errors may occur if the cluster is connected electrically to another vehicle; or, if an electronic module from another vehicle is connected that provides data to the instrument cluster (including odometer values) that conflicts with that which was previously learned and stored. Therefore, the practice of exchanging (swapping) instrument clusters and other electronic modules in this vehicle with those removed from another vehicle must always be avoided. Failure to observe this caution may result in instrument cluster damage, which is not reimbursable under the terms of the product warranty. Service replacement instrument clusters are provided with the correct VIN, and the certified odometer and engine hours values embedded into cluster memory, but will otherwise be automatically configured for compatibility with the features and optional equipment in the vehicle in which they are initially installed.

NOTE: Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. If the problem being diagnosed involves improper illumination of the cruise indicator, the electronic throttle control indicator, the overdrive-off indicator, the service four-wheel drive indicator, the transmission overtemp indicator, the upshift indicator, the security indicator or the gear selector indicator, disconnect and isolate the battery negative cable. After about five minutes, reconnect the battery negative cable and turn the ignition switch to the On position. The instrument cluster should automatically relearn the equipment in the vehicle and properly configure the configurable indicators accordingly.

PRELIMINARY DIAGNOSIS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fused B(+) fuse (Fuse 28 - 10 ampere) in the Integrated Power Module (IPM). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse (Fuse 28 - 10 ampere) in the IPM. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit between the IPM and the battery as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit between the instrument cluster and the IPM as required.

(4) Check for continuity between the signal ground circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster and a good ground. There should be continuity. If OK, refer to ACTUATOR TEST. If not OK, repair the open ground circuit to ground (G202) as required.

INSTRUMENT CLUSTER (Continued)

ACTUATOR TEST

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The instrument cluster actuator test will put the instrument cluster into its self-diagnostic mode. In this mode the instrument cluster can perform a self-diagnostic test that will confirm that the instrument cluster circuitry, the gauges, and the indicators are capable of operating as designed. During the actuator test the instrument cluster circuitry will position each of the gauge needles at various calibration points, illuminate all of the segments in the Vacuum Fluorescent Display (VFD) units, turn all of the indicators on and off again, display any Diagnostic Trouble Code (DTC) information, and display the number of ignition key cycles that have occurred since the DTC was detected. It is suggested that a note pad and pencil be used to write down any fault information that is displayed during the test for reference.

Successful completion of the actuator test will confirm that the instrument cluster is operational. However, there may still be a problem with the PCI data bus, the Powertrain Control Module (PCM), the Engine Control Module (ECM), the Front Control Module (FCM), the Transmission Control Module (TCM), the Transfer Case Control Module (TCCM), the Airbag Control Module (ACM), the Controller Anti-lock Brake (CAB), or the inputs to one of these electronic control modules. Use a DRBIII® scan tool to diagnose these components. Refer to the appropriate diagnostic information.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the odometer/trip odometer switch button.

(3) While still holding the odometer/trip odometer switch button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Release the odometer/trip odometer switch button.

(5) The instrument cluster will simultaneously illuminate all of the operational segments in both VFD units, perform a bulb check of each operational LED indicator. The VFD segments and LED indicators remain illuminated as each gauge needle is swept to several calibration points and back. If a VFD segment or an LED indicator fails to illuminate, or if a gauge needle fails to sweep through the calibration points and back during this test, the instrument cluster must be replaced. Following these tests, the actuator test will proceed as described in Step 6.

(6) The text “C Code” is displayed in the odometer VFD for about three seconds. If there is no stored fault information, the display will show two pairs of zeroes in the format “00” “00”, which indicate that the display of fault information is done. If there is stored fault information, two sets of two-digit alpha and alpha-numeric fault codes will appear in the odometer display for a three second interval. The first pair of digits represents a Diagnostic Trouble Code (DTC), or fault code for the instrument cluster. The second pair of digits is a counter for the number of ignition key cycles that have occurred since the displayed DTC was set. The instrument cluster will continue to display additional sets of two pairs of digits at three second intervals until all of the stored codes have been displayed, which is again signaled by a code of “00” “00”. Refer to the Instrument Cluster Failure Message table for a description of each fault code that the instrument cluster displays. If an instrument cluster fault is displayed, use a DRBIII® scan tool to diagnose the problem. Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
01	Airbag warning indicator output circuit shorted.	Refer to the appropriate diagnostic information.
02	Airbag warning indicator output circuit open.	Refer to the appropriate diagnostic information.
03	ABS indicator output circuit shorted.	Refer to the appropriate diagnostic information.
04	ABS indicator output circuit open.	Refer to the appropriate diagnostic information.
05	MIL indicator output circuit shorted.	Refer to the appropriate diagnostic information.
06	MIL indicator output circuit open.	Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
07	Wait to start indicator circuit shorted.	Refer to the appropriate diagnostic information.
08	Wait to start indicator circuit open.	Refer to the appropriate diagnostic information.
0B	BTSI output circuit shorted or open.	Refer to the appropriate diagnostic information.
22	Headlamp switch input circuit shorted.	Refer to the appropriate diagnostic information.
23	Headlamp switch input circuit open.	Refer to the appropriate diagnostic information.
24	Turn hazard switch input circuit shorted.	Refer to the appropriate diagnostic information.
25	Turn hazard swiitch inpot circuit open.	Refer to the appropriate diagnostic information.
27	Courtesy/dome output circuit shorted or open.	Refer to the appropriate diagnostic information.
28	Glovebox/map lamp output circuit shorted or open.	Refer to the appropriate diagnostic information.
29	Cargo lamp output circuit shorted or open.	Refer to the appropriate diagnostic information.
40	Wiper switch input circuit shorted.	Refer to the appropriate diagnostic information.
41	Wiper switch input circuit open.	Refer to the appropriate diagnostic information.
42	Wash/beam input circuit shorted.	Refer to the appropriate diagnostic information.
60	Passenger door lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
61	Passenger door lock switch input circuit open.	Refer to the appropriate diagnostic information.
62	Passenger door lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
63	Driver door lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
64	Driver door lock switch input circuit open.	Refer to the appropriate diagnostic information.
65	Driver door lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
66	All door lock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
67	All door unlock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
68	Driver door unlock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
6C	Driver cylinder lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
6E	Driver cylinder lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
80	Incorrect odometer value found.	Refer to the appropriate diagnostic information.
81	Remote radio switch input circuit high.	Refer to the appropriate diagnostic information.
82	Remote radio switch stuck.	Refer to the appropriate diagnostic information.
A0	Internal module FLASH memory checksum failure.	Refer to the appropriate diagnostic information.
A1	Internal module bootloader failure.	Refer to the appropriate diagnostic information.
A3	Battery voltage open.	Refer to the appropriate diagnostic information.
A5	TCCM messages not received.	Refer to the appropriate diagnostic information.
A7	VIN checksum error.	Refer to the appropriate diagnostic information.
A8	VIN previously stored.	Refer to the appropriate diagnostic information.
A9	PCI bus internal failure.	Refer to the appropriate diagnostic information.
AA	PCM messages not received.	Refer to the appropriate diagnostic information.
AB	TCM messages not received.	Refer to the appropriate diagnostic information.
AC	ABS messages not received.	Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
AD	FCM messages not received.	Refer to the appropriate diagnostic information.
AE	ACM messages not received.	Refer to the appropriate diagnostic information.
AF	SKIM messages not received.	Refer to the appropriate diagnostic information.
B0	RKE fob batteries low.	Refer to the appropriate diagnostic information.
B1	RKE module communication link.	Refer to the appropriate diagnostic information.
00	Done	All Diagnostic Trouble Codes (DTC) have been displayed.

(7) The actuator test is now completed. The instrument cluster will automatically exit the self-diagnostic mode and return to normal operation at the completion of the test, if the ignition switch is turned to the Off position during the test, or if a vehicle speed message indicating that the vehicle is moving is received from the PCM over the PCI data bus during the test.

(8) Go back to Step 1 to repeat the test, if necessary.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the instrument cluster to the instrument panel structural support (Fig. 5).

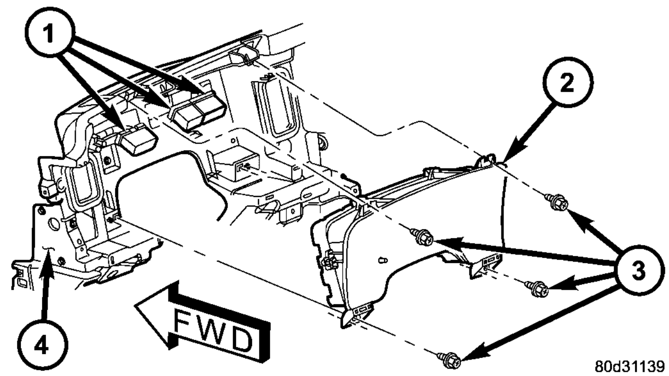

Fig. 5 Instrument Cluster Remove/Install

1 - WIRE HARNESS CONNECTOR (3)
2 - INSTRUMENT CLUSTER
3 - SCREW (4)
4 - INSTRUMENT PANEL STRUCTURAL SUPPORT

(4) Pull the instrument cluster rearward far enough to access and disconnect the instrument panel wire harness connectors for the cluster from the connector receptacles on the back of the cluster housing.

(5) Remove the instrument cluster from the instrument panel.

DISASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include the incandescent instrument cluster illumination lamp bulbs (including the integral bulb holders), and the cluster lens, hood and mask unit. Following are the procedures for disassembling these components from the instrument cluster unit.

INSTRUMENT CLUSTER (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp bulb and bulb holder units. If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, the RKE receiver module must be removed from the instrument cluster rear cover to access the lower center cluster illumination lamp, which is located on the circuit board directly behind the RKE module. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - REMOVAL).

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board (Fig. 6).

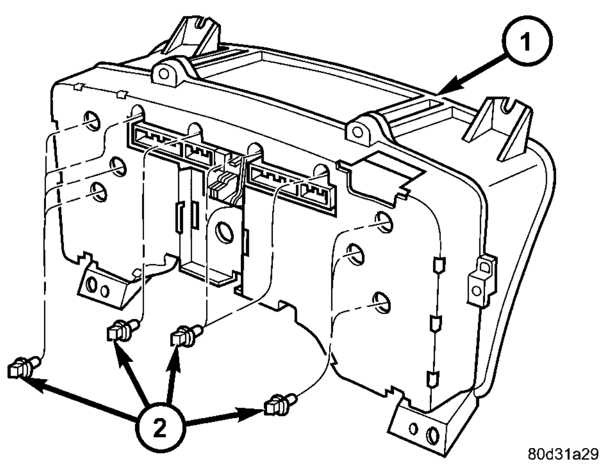

Fig. 6 Cluster Bulb Remove/Install

1 - INSTRUMENT CLUSTER
2 - BULB & HOLDER (11)

(4) Pull the bulb and bulb holder unit straight back to remove it from the bulb mounting hole in the cluster electronic circuit board.

CLUSTER LENS, HOOD, AND MASK

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) From the back of the instrument cluster, remove the eight screws around the outer perimeter of the rear cover that secure the lens, hood, and mask unit to the cluster housing (Fig. 7).

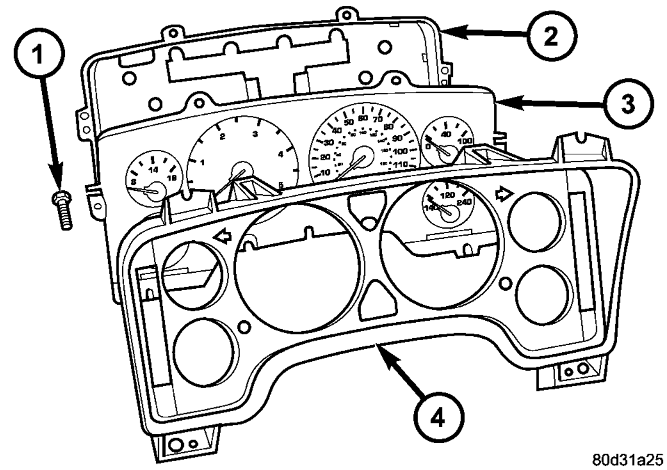

Fig. 7 Instrument Cluster Components

1 - SCREW (9)
2 - REAR COVER
3 - CLUSTER HOUSING
4 - LENS, HOOD & MASK

(4) Remove the lens, hood, and mask unit from the face of the instrument cluster.

ASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include the incandescent instrument cluster illumination lamp bulbs (including the integral bulb holders), and the cluster lens, hood and mask unit. Following are the procedures for assembling these components to the instrument cluster unit.

INSTRUMENT CLUSTER (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp bulb and bulb holder units. If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, and the RKE receiver module was removed from the instrument cluster rear cover to access the lower center cluster illumination lamp, reinstall the RKE module after the bulb is replaced on the circuit board. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - INSTALLATION).

CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the instrument cluster, the electronic circuit board and/or the gauges.

(1) Insert the bulb and bulb holder unit straight into the correct bulb mounting hole in the cluster electronic circuit board (Fig. 6).

(2) With the bulb holder fully seated against the cluster electronic circuit board, turn the bulb holder clockwise about sixty degrees to lock it into place.

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

CLUSTER LENS, HOOD, AND MASK

(1) Position the cluster lens, hood, and mask unit over the face of the instrument cluster (Fig. 7). Be certain that the odometer/trip odometer switch button is inserted through the proper clearance holes in the mask and the lens.

(2) From the back of the instrument cluster, install and tighten the eight screws around the outer perimeter of the rear cover that secure the lens, hood, and mask unit to the cluster housing. Tighten the screws to 1 N·m (10 in. lbs.).

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the instrument cluster to the instrument panel.

(2) Reconnect the instrument panel wire harness connectors for the cluster to the connector receptacles on the back of the cluster housing.

(3) Position the instrument cluster into the instrument panel.

(4) Install and tighten the four screws that secure the instrument cluster to the instrument panel structural support (Fig. 5). Tighten the screws to 4 N·m (31 in. lbs.).

(5) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(6) Reconnect the battery negative cable.

INSTRUMENT CLUSTER (Continued)

NOTE: Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. If the problem being diagnosed involves improper illumination of the cruise indicator, the electronic throttle control indicator, the overdrive-off indicator, the service four-wheel drive indicator, the transmission overtemp indicator, the upshift indicator, the security indicator or the gear selector indicator, disconnect and isolate the battery negative cable. After about five minutes, reconnect the battery negative cable and turn the ignition switch to the On position. The instrument cluster should automatically relearn the equipment in the vehicle and properly configure the configurable indicators accordingly.

ABS INDICATOR

DESCRIPTION

An Antilock Brake System (ABS) indicator is standard equipment on all instrument clusters. However, the instrument cluster can be programmed to disable this indicator on vehicles that are not equipped with the ABS or Rear Wheel Anti-Lock (RWAL) brake systems, which are not available in some markets. On vehicles equipped with a gasoline engine, the ABS indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. On vehicles equipped with a diesel engine, the ABS indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The ABS indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Failure of Anti-lock Braking System” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The ABS indicator is serviced as a unit with the instrument cluster.

OPERATION

The ABS indicator gives an indication to the vehicle operator when the ABS system is faulty or inoperative. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus. The ABS indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the ABS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ABS indicator is illuminated by the cluster for about two seconds as a bulb test.
- **ABS Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the ABS indicator will be illuminated. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error** - If the cluster receives no lamp-on or lamp-off messages from the CAB for three consecutive seconds, the ABS indicator is illuminated. The indicator remains illuminated until the cluster receives a valid message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the ABS indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.
- **ABS Diagnostic Test** - The ABS indicator is blinked on and off by lamp-on and lamp-off messages from the CAB during the performance of the ABS diagnostic tests.

The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ABS indicator fails to light due to an open or short in the cluster ABS indicator circuit, the cluster sends a message notifying the CAB of the condition, then the instrument cluster and the CAB will each store a DTC. For proper diagnosis of the antilock brake system, the CAB, the PCI data bus, or the electronic message inputs to the instrument clus-

ABS INDICATOR (Continued)

ter that control the ABS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

AIRBAG INDICATOR

DESCRIPTION

An airbag indicator is standard equipment on all instrument clusters. However, the instrument cluster can be programmed to disable this indicator on vehicles that are not equipped with the airbag system, which is not available in some markets. The airbag indicator is located near the upper edge of the instrument cluster, between the tachometer and the speedometer. The airbag indicator consists of a stencil-like cutout of the words “AIR BAG” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “AIR BAG” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The airbag indicator is serviced as a unit with the instrument cluster.

OPERATION

The airbag indicator gives an indication to the vehicle operator when the airbag system is faulty or inoperative. The airbag indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus. The airbag indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the airbag indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the airbag indicator is illuminated for about six seconds. The entire six second bulb test is a function of the ACM.
- **ACM Lamp-On Message** - Each time the cluster receives a lamp-on message from the ACM, the airbag indicator will be illuminated. The indicator remains illuminated for about twelve seconds or until the cluster receives a lamp-off message from the ACM, whichever is longer.
- **Communication Error** - If the cluster receives no airbag messages for three consecutive seconds, the airbag indicator is illuminated. The indicator remains illuminated until the cluster receives a single lamp-off message from the ACM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the airbag indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry. The actuator test illumination of the airbag indicator is a function of the instrument cluster.

The ACM continually monitors the airbag system circuits and sensors to decide whether the system is in good operating condition. The ACM then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the ACM sends a lamp-on message after the bulb test, it indicates that the ACM has detected a system malfunction and/or that the airbags and seat belt tensioners may not deploy when required, or may deploy when not required. The ACM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the airbag indicator fails to illuminate due to an open or short in the cluster airbag indicator circuit, the cluster sends a message notifying the ACM of the condition, the instrument cluster and the ACM will each store a DTC, and the cluster will flash the seatbelt indicator on and off as a backup to notify the vehicle operator. For proper diagnosis of the airbag system, the ACM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the airbag indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

BRAKE/PARK BRAKE INDICATOR

DESCRIPTION

A brake indicator is standard equipment on all instrument clusters. The brake indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The brake indicator consists of stencil-like cutouts of the word “BRAKE” and the International Control and Display Symbol icon for “Brake Failure” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “BRAKE” text and the icon to appear in red through

BRAKE/PARK BRAKE INDICATOR (Continued)

the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The brake indicator is serviced as a unit with the instrument cluster.

OPERATION

The brake indicator gives an indication to the vehicle operator when the parking brake is applied, when there are certain brake hydraulic system malfunctions as indicated by a low brake hydraulic fluid level condition, or when the brake fluid level switch is disconnected. The brake indicator can also give an indication when certain faults are detected in the Antilock Brake System (ABS). This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus, and a hard wired input from the park brake switch. The brake indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the brake indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the brake indicator is illuminated by the instrument cluster for about two seconds as a bulb test.
- **Brake Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the brake indicator will be illuminated. The CAB can also send brake lamp-on messages as feedback during ABS diagnostic procedures. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Park Brake Switch Input** - Each time the cluster detects ground on the park brake switch sense circuit (park brake switch closed = park brake applied or not fully released) while the ignition switch is in the On position, the brake indicator flashes on and off. The indicator continues to flash until the park brake switch sense input to the cluster is an open circuit (park brake switch open = park brake fully released), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the brake indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The park brake switch on the park brake pedal mechanism provides a hard wired ground input to the instrument cluster circuitry through the park brake switch sense circuit whenever the park brake is applied or not fully released. The CAB continually monitors the ABS system circuits and sensors, including the brake fluid level switch on the brake master cylinder reservoir, to decide whether the system is in good operating condition. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a brake hydraulic system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects.

For further diagnosis of the brake indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). The park brake switch input to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the brake fluid level switch, the ABS, the CAB, the PCI data bus, or the electronic message inputs to the instrument cluster that control the brake indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - BRAKE INDICATOR

The diagnosis found here addresses an inoperative brake indicator condition. If there are problems with several indicators in the instrument cluster, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the brake indicator stays on with the ignition switch in the On position and the park brake released, or comes on while driving, the brake system must be diagnosed and repaired prior to performing the following tests. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If no brake system problem is found, the following procedures will help to locate a shorted or open circuit, or a faulty park brake switch input. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

BRAKE/PARK BRAKE INDICATOR (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

INDICATOR ILLUMINATES DURING BULB TEST, BUT DOES NOT WHEN PARK BRAKE APPLIED

(1) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the park brake switch from the switch terminal. Apply the parking brake. Check for continuity between the park brake switch terminal and a good ground. There should be continuity. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavities of the body wire harness connector for the park brake switch and the instrument panel wire harness connector for the instrument cluster. There should be continuity. If not OK, repair the open park brake switch sense circuit between the park brake switch and the instrument cluster as required.

INDICATOR REMAINS ILLUMINATED - BRAKE SYSTEM CHECKS OK

(1) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the park brake switch from the switch terminal. Check for continuity between the terminal of the park brake switch and a good ground. There should be no continuity with the park brake released, and continuity with the park brake applied. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavity of the body wire harness connector for the park brake switch and a good ground. There should be no continuity. If not OK, repair the shorted park brake switch sense circuit between the park brake switch and the instrument cluster as required.

CARGO LAMP INDICATOR

DESCRIPTION

A cargo lamp indicator is standard equipment on all instrument clusters. The cargo lamp indicator is located on the right side of the instrument cluster, to the right of the oil pressure gauge. The cargo lamp indicator consists of a stencil-like cutout of the words “CARGO LAMP” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “CARGO LAMP” text to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The cargo lamp indicator is serviced as a unit with the instrument cluster.

OPERATION

The cargo lamp indicator gives an indication to the vehicle operator when the exterior cargo lamp is illuminated. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, a hard wired multiplex input received by the cluster from the headlamp panel lamps dimmer switch on the headlamp dimmer switch mux circuit, and electronic unlock request messages received from the optional Remote Keyless Entry (RKE) receiver module. The cargo lamp indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow only this indicator to operate whenever the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the cargo lamp indicator for the following reasons:

- **Bulb Test -** Each time the ignition switch is turned to the On position the cargo lamp indicator is illuminated for about two seconds as a bulb test.
- **Cargo Lamp-On Input -** Each time the cluster detects a cargo lamp-on input from the headlamp switch on the headlamp dimmer switch mux circuit, the cargo lamp and the cargo lamp indicator will be illuminated. The cargo lamp and indicator remain illuminated until the cluster receives a cargo lamp-off

CARGO LAMP INDICATOR (Continued)

input from the headlamp switch, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the cargo lamp indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the headlamp dimmer switch circuit to determine the proper interior lamps features and panel lamps illumination levels to provide. The cluster then energizes and de-energizes a low side driver circuit to control the exterior cargo lamp. Each time the instrument cluster energizes the cargo lamp driver and the ignition switch is in the On or start positions, the cluster also turns on the cargo lamp indicator. For further diagnosis of the cargo lamp indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the cargo lamp or the headlamp switch inputs to the instrument cluster that control the cargo lamp indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

CHECK GAUGES INDICATOR

DESCRIPTION

A check gauges indicator is standard equipment on all instrument clusters. On vehicles equipped with a gasoline engine, the check gauges indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. On vehicles equipped with a diesel engine, the check gauges indicator is located on the left side of the instrument cluster, to the left of the voltage gauge. The check gauges indicator consists of a stencil-like cutout of the words “CHECK GAGES” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “CHECK GAGES” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The check gauges indicator is serviced as a unit with the instrument cluster.

OPERATION

The check gauges indicator gives an indication to the vehicle operator when certain instrument cluster gauge readings reflect a condition requiring immediate attention. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The check gauges indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the check gauges indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the check gauges indicator is illuminated for about two seconds as a bulb test.
- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature of a gasoline engine is about 122° C (252° F) or higher, or of a diesel engine is about 112° C (233° F) or higher, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine coolant temperature of a gasoline engine is below about 122° C (252° F), or of a diesel engine is below about 112° C (233° F), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine oil pressure is about 41 kPa (6 psi) or lower, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine oil pressure is above about 41 kPa (6 psi), or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the indicator on in response to an engine oil pressure low message if the engine speed is greater than zero.
- **System Voltage Low (Charge Fail) Message** - Each time the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 11.5 volts (charge fail condition), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is greater than about

CHECK GAUGES INDICATOR (Continued)

12.0 volts (but less than 16.0 volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **System Voltage High Message** - Each time the cluster receives a message from the PCM or ECM indicating the electrical system voltage is greater than about 16.0 volts, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 15.5 volts (but greater than 11.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the check gauges indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine temperature, oil pressure, and electrical system voltage, then sends the proper messages to the instrument cluster. On vehicles with a diesel engine, the ECM continually monitors the engine temperature, oil pressure, and electrical system voltage, then sends the proper messages to the instrument cluster. For further diagnosis of the check gauges indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the check gauges indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

CRUISE INDICATOR

DESCRIPTION

A cruise indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional speed control system, this indicator is electronically disabled. The cruise indicator consists of the word “CRUISE”, which appears in the lower portion of the gear selector indicator Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The word “CRUISE” appears in a blue-green color and at the same lighting level as the gear selector indicator information when it is illuminated by the instrument cluster electronic circuit board. The cruise indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The cruise indicator gives an indication to the vehicle operator when the speed control system is turned On, regardless of whether the speed control is engaged. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The cruise indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the cruise indicator for the following reasons:

- **Cruise Lamp-On Message** - Each time the cluster receives a cruise lamp-on message from the PCM indicating the speed control system has been turned On, the cruise indicator is illuminated. The indicator remains illuminated until the cluster receives a cruise lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the cruise indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the speed control switches to determine the proper outputs to the speed control servo. The PCM then sends the proper cruise indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the cruise indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the speed control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the cruise indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DOOR AJAR INDICATOR

DESCRIPTION

A door ajar indicator is standard equipment on all instrument clusters. The door ajar indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The door ajar indicator consists of a stencil-like cutout of the words “DOOR AJAR” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “DOOR AJAR” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The door ajar indicator is serviced as a unit with the instrument cluster.

OPERATION

The door ajar indicator gives an indication to the vehicle operator that one or more of the passenger compartment doors may be open or not completely latched. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and hard wired inputs received by the cluster from the door ajar switches located in each door latch unit. The door ajar indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the door ajar indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the door ajar indicator is illuminated for about two seconds as a bulb test.
- **Door Ajar Switch Input** - Each time the cluster detects ground on any one of the door ajar switch sense circuits (door ajar switch closed = door is open or not completely latched) the door ajar indicator will be illuminated. The indicator remains illuminated until all of the door ajar switch sense inputs to the cluster are an open circuit (door ajar switch open = door fully closed), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the door ajar indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the door ajar switches to determine the status of the doors. For further diagnosis of the door ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the door ajar switches and circuits, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOOR AJAR SWITCH - DIAGNOSIS AND TESTING).

ENGINE TEMPERATURE GAUGE

DESCRIPTION

An engine coolant temperature gauge is standard equipment on all instrument clusters. The engine coolant temperature gauge is located in the lower right quadrant of the instrument cluster, below the oil pressure gauge. The engine coolant temperature gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “C” (or Cold) to “H” (or Hot) for gasoline engines. On vehicles with a diesel engine, the scale reads from “60”° C to “120”° C in markets where a metric instrument cluster is specified, or from “140”° F to “245”° F in all other markets. An International Control and Display Symbol icon for “Engine Coolant Temperature” is located on the cluster overlay, directly below the left end of the gauge scale. The engine coolant temperature gauge graphics are black against a white field except for two red graduations at the high end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The engine coolant temperature gauge is serviced as a unit with the instrument cluster.

OPERATION

The engine coolant temperature gauge gives an indication to the vehicle operator of the engine coolant temperature. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by

ENGINE TEMPERATURE GAUGE (Continued)

the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The engine coolant temperature gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Temperature Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is between the low end of normal [about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines] and the high end of normal [about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines], the gauge needle is moved to the actual relative temperature position on the gauge scale.
- **Engine Temperature Low Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is below the low end of normal [about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines], the gauge needle is held at the graduation on the far left end of the gauge scale. The gauge needle remains at the left end of the gauge scale until the cluster receives a message from the PCM or ECM indicating that the engine temperature is above about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is above about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines, the gauge needle is moved into the red zone at the far right end of gauge scale, the check gauges indicator is illuminated, and a single chime tone is sounded. The gauge needle remains in the red zone and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine temperature is below about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the check gauges indicator is cycled off and then on again by the appropriate engine temperature messages from the PCM or ECM.
- **Communication Error** - If the cluster fails to receive an engine temperature message, it will hold the gauge needle at the last indication for about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the low end of the gauge scale.
- **Actuator Test** - Each time the cluster is put through the actuator test, the engine coolant temperature gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. On vehicles with a diesel engine, the ECM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. The PCM or ECM then sends the proper engine coolant temperature messages to the instrument cluster. For further diagnosis of the engine coolant temperature gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a high engine temperature gauge reading, it may indicate that the engine or the engine cooling system requires service. For proper diagnosis of the engine coolant temperature sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the engine coolant temperature gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ETC INDICATOR

DESCRIPTION

An Electronic Throttle Control (ETC) indicator is standard equipment on all gasoline engine instrument clusters. However, on vehicles not equipped with the optional 5.7 liter gasoline engine, this indicator is electronically disabled. The ETC indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The ETC indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Electronic Throttle Control” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque

ETC INDICATOR (Continued)

layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The ETC indicator is serviced as a unit with the instrument cluster.

OPERATION

The Electronic Throttle Control (ETC) indicator gives an indication to the vehicle operator when the ETC system is faulty or inoperative. The ETC indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The ETC indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the ETC indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ETC indicator is illuminated for about six seconds. The entire six second bulb test is a function of the PCM.
- **ETC Lamp-On Message** - Each time the cluster receives a lamp-on message from the PCM, the ETC indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM message. The indicator remains illuminated solid or continues to flash for about twelve seconds or until the cluster receives a lamp-off message from the PCM, whichever is longer. If the indicator is illuminated solid with the engine running the vehicle will usually remain drivable. If the indicator is flashing with the engine running the vehicle may require towing. A flashing indicator means the ETC system requires immediate service.
- **Communication Error** - If the cluster receives no ETC lamp messages for three consecutive seconds, the ETC indicator is illuminated. The indicator remains illuminated until the cluster receives a single lamp-off message from the PCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the ETC indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry. The actuator test illumination of the ETC indicator is a function of the PCM.

The PCM continually monitors the ETC system circuits and sensors to decide whether the system is in good operating condition. The PCM then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the PCM sends a lamp-on message after the bulb test, it indicates that the PCM has detected a system malfunction and/or that the ETC system is inoperative. The PCM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ETC indicator fails to illuminate due to an open or short in the cluster ETC indicator circuit, the cluster sends a message notifying the PCM of the condition, the instrument cluster and the PCM will each store a DTC. For proper diagnosis of the ETC system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the ETC indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

FUEL GAUGE

DESCRIPTION

A fuel gauge is standard equipment on all instrument clusters. The fuel gauge is located in the lower left quadrant of the instrument cluster, below the voltage gauge. The fuel gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “E” (or Empty) to “F” (or Full). An International Control and Display Symbol icon for “Fuel” is located on the cluster overlay, directly below the right end of the gauge scale. An arrowhead pointed to the left side of the vehicle is imprinted on the cluster overlay next to the “Fuel” icon in the fuel gauge to provide the driver with a reminder as to the location of the fuel filler access. On vehicles equipped with a diesel engine, text that specifies “DIESEL ONLY” is located across the fuel gauge below the gauge scale, but above the hub of the gauge needle. The fuel gauge graphics are black against a white field except for a single red graduation at the low end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The fuel gauge is serviced as a unit with the instrument cluster.

FUEL GAUGE (Continued)

OPERATION

The fuel gauge gives an indication to the vehicle operator of the level of fuel in the fuel tank. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The fuel gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Percent Tank Full Message -** Each time the cluster receives a message from the PCM or ECM indicating the percent tank full, the cluster programming applies an algorithm to calculate the proper gauge needle position, then moves the gauge needle to the proper relative position on the gauge scale. The algorithm is used to dampen gauge needle movement against the negative effect that fuel sloshing within the fuel tank can have on accurate inputs from the fuel tank sending unit to the PCM or ECM.
- **Less Than Twenty Percent Tank Full Message -** Each time the cluster receives messages from the PCM or ECM indicating the percent tank full is about twenty percent or less for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, the gauge needle is moved to the one-eighth graduation or below on the gauge scale, the low fuel indicator is illuminated, and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM or ECM indicating that the percent tank full is greater than about twenty percent for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM or ECM.
- **Less Than Empty Percent Tank Full Message -** Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is less than empty, the gauge needle is moved to the far left end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is a short circuit.
- **More Than Full Percent Tank Full Message -** Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is more than full, the gauge needle is moved to the far left end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is an open circuit.
- **Communication Error -** If the cluster fails to receive a percent tank full message, it will hold the gauge needle at the last indication about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the low end of the gauge scale.
- **Actuator Test -** Each time the cluster is put through the actuator test, the fuel gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel tank sending unit to determine the level of the fuel in the fuel tank. On vehicles with a diesel engine, the ECM continually monitors the fuel tank sending unit to determine the level of the fuel in the fuel tank. The PCM or ECM then sends the proper fuel level messages to the instrument cluster. For further diagnosis of the fuel gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the fuel gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

GEAR SELECTOR INDICATOR

DESCRIPTION

An electronic automatic transmission gear selector indicator is standard factory-installed equipment on this model. The gear selector indicator information is displayed in a Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated.

GEAR SELECTOR INDICATOR (Continued)

The gear selector indicator displays the following characters from left to right: "P," "R," "N," "D," "2," and "1." Respectively, these characters represent the park, reverse, neutral, drive, second gear, and first gear positions of the transmission gear selector lever on the steering column. The VFD illuminates a rectangular box around the character that represents the currently selected lever position.

The gear selector indicator characters and graphics appear in the same blue-green color and at the same lighting level as the odometer/trip odometer information when illuminated by the instrument cluster electronic circuit board. During daylight hours (exterior lamps Off) the gear selector indicator VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a "Parade" mode position of the panel lamps dimmer thumbwheel allows the VFD to be illuminated at full brightness when the vehicle is driven in daylight hours with the exterior lamps turned On. The gear selector indicator VFD is serviced as a unit with the instrument cluster.

OPERATION

The electronic gear selector indicator gives an indication to the vehicle operator of the transmission gear that has been selected with the automatic transmission gear selector lever. This indicator is controlled by the instrument cluster circuit board based upon cluster programming. The cluster circuitry automatically configures itself for the proper transmission and automatic transmission model based upon the hard wired transmission range sensor mux circuit input to the cluster. The gear selector indicator information is displayed by a dedicated Vacuum Fluorescent Display (VFD) unit on the instrument cluster electronic circuit board, and the VFD will not display the gear selector indicator information after the ignition switch is turned to the Off position. The instrument cluster circuitry configures the gear selector indicator VFD based upon the following inputs from the transmission range sensor:

- **Open Circuit -** If the cluster is configured for an automatic transmission and the transmission range sensor mux circuit is open, the cluster circuitry controls the gear selector indicator display based upon electronic messages received from the electronic Transmission Control Module (TCM) over the Programmable Communications Interface (PCI) data bus. If the transmission range sensor mux circuit is open and no electronic messages are received from the TCM within two seconds, the instrument cluster circuitry will not display any gear selector position until the condition is resolved or until the ignition switch is turned to the Off position, whichever occurs first.
- **Resolved Circuit -** If the transmission range sensor mux circuit is resolved, the cluster circuitry controls the gear selector indicator display based upon the resistance value of the hard wired input from the transmission range sensor. If the cluster is configured for an automatic transmission with a transmission range sensor input and detects a short to ground or an open in the transmission range sensor mux input, the instrument cluster circuitry will not display any gear selector position in the VFD. The VFD display for the short-to-ground and open circuit conditions will continue until the condition is resolved or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test -** Each time the cluster is put through the actuator test, the gear selector indicator VFD will display all of its characters at once during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

On models with a TCM, the TCM continually monitors the transmission range sensor, then sends the proper gear selector indicator position messages to the instrument cluster. On models without a TCM, the instrument cluster continually monitors the hard wired transmission range sensor multiplexed input. For further diagnosis of the gear selector indicator or the instrument cluster circuitry that controls this function, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For further diagnosis of the transmission range sensor on models without a TCM, (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING) or (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING). On models with a TCM, for proper diagnosis of the transmission range sensor, the TCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the gear selector indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

HIGH BEAM INDICATOR

DESCRIPTION

A high beam indicator is standard equipment on all instrument clusters. The high beam indicator is located near the upper edge of the instrument cluster, between the tachometer and the speedometer. The high beam indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "High Beam" in the opaque layer of the

HIGH BEAM INDICATOR (Continued)

instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when the it is not illuminated. A blue Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in blue through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The high beam indicator is serviced as a unit with the instrument cluster.

OPERATION

The high beam indicator gives an indication to the vehicle operator whenever the headlamp high beams are illuminated. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and a hard wired multiplex input received by the cluster from the headlamp beam select switch circuitry of the multi-function switch on the washer/beam select switch mux circuit. The high beam indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the high beam indicator for the following reasons:

- **High Beam Headlamps-On Input** - Each time the cluster detects a high beam headlamps-on input from the headlamp beam select switch circuitry of the multi-function switch on the washer/beam select switch mux circuit, the headlamp high beams and the high beam indicator will be illuminated. The headlamp high beams and the high beam indicator remain illuminated until the cluster receives a high beam headlamps-off input from the multi-function switch, or until the exterior lamp load shedding (battery saver) timed interval expires, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the high beam indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the headlamp switch and the multi-function switch to determine the proper headlamp low beam and high beam control. The instrument cluster then sends the proper low beam and high beam lamp-on and lamp-off messages to the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus and turns the high beam indicator on or off accordingly. For further diagnosis of the high beam indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the headlamps, or the headlamp switch and multi-function switch inputs to the instrument cluster that control the high beam indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LAMP OUT INDICATOR

DESCRIPTION

A lamp out indicator is standard equipment on all instrument clusters. The lamp out indicator consists of the words “LAMP OUT”, which appear in the lower portion of the odometer/trip odometer Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words “LAMP OUT” appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The lamp out indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The lamp out indicator gives an indication to the vehicle operator when an exterior lamp has failed. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. The lamp out indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the lamp out indicator for the following reasons:

- **Lamp Out Indicator Lamp-On Message** - Each time the cluster receives a lamp out indicator lamp-on message from the FCM indicating that an inoperative headlamp (low or high beam), turn signal

LAMP OUT INDICATOR (Continued)

lamp, or brake lamp (excluding Center High Mounted Stop Lamp [CHMSL]) circuit has been detected, the lamp out indicator is illuminated. The indicator remains illuminated until the cluster receives a lamp out indicator lamp-off message from the FCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the lamp out indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The FCM monitors each of the headlamp, turn signal lamp, and brake lamp (except CHMSL) circuits to determine the condition of these exterior lamps. The FCM then sends the proper lamp out indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the lamp out indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the exterior lighting system circuits, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the lamp out indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LOW FUEL INDICATOR

DESCRIPTION

A low fuel indicator is standard equipment on all instrument clusters. The low fuel indicator is located on the left side of the instrument cluster, to the left of the fuel gauge. The low fuel indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Fuel” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The low fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The low fuel indicator gives an indication to the vehicle operator when the level of fuel in the fuel tank becomes low. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The low fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the low fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the low fuel indicator is illuminated for about two seconds as a bulb test.
- **Less Than Twenty Percent Tank Full Message** - Each time the cluster receives messages from the PCM or ECM indicating the percent tank full is about twenty percent or less for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, the fuel gauge needle is moved to the one-eighth graduation or below on the gauge scale, the low fuel indicator is illuminated and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM or ECM indicating that the percent tank full is greater than about twenty percent for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM or ECM.
- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is less than empty, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is a short circuit.
- **More Than Full Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is more than full, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is an open circuit.

LOW FUEL INDICATOR (Continued)

- **Actuator Test** - Each time the cluster is put through the actuator test, the low fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel tank sending unit to determine the level of fuel in the fuel tank. On vehicles with a diesel engine, the ECM continually monitors the fuel tank sending unit to determine the level of fuel in the fuel tank. The PCM or ECM then sends the proper fuel level messages to the instrument cluster. For further diagnosis of the low fuel indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the low fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

MALFUNCTION INDICATOR LAMP (MIL)

DESCRIPTION

A Malfunction Indicator Lamp (MIL) is standard equipment on all instrument clusters. The MIL is located on the left side of the instrument cluster, to the left of the voltage gauge. The MIL consists of a stencil-like cutout of the International Control and Display Symbol icon for “Engine” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The MIL is serviced as a unit with the instrument cluster.

OPERATION

The Malfunction Indicator Lamp (MIL) gives an indication to the vehicle operator when the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or the Engine Control Module (ECM) on vehicles with a diesel engine has recorded a Diagnostic Trouble Code (DTC) for an On-Board Diagnostics II (OBDII) emissions-related circuit or component malfunction. The MIL is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the PCM or ECM over the Programmable Communications Interface (PCI) data bus. The MIL Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the MIL for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the indicator is illuminated for about two seconds as a bulb test. The entire two second bulb test is a function of the PCM or ECM.
- **MIL Lamp-On Message** - Each time the cluster receives a MIL lamp-on message from the PCM or ECM, the indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM or ECM message. For some DTC’s, if a problem does not recur, the PCM or ECM will send a lamp-off message automatically. Other DTC’s may require that a fault be repaired and the PCM or ECM be reset before a lamp-off message will be sent. For more information on the PCM, the ECM, and the DTC set and reset parameters, (Refer to 25 - EMISSIONS CONTROL - OPERATION).
- **Communication Error** - If the cluster receives no lamp-on message from the PCM or ECM for ten seconds, the MIL is illuminated by the instrument cluster to indicate a loss of bus communication. The indicator remains controlled and illuminated by the cluster until a valid lamp-on message is received from the PCM or ECM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the MIL indicator will be turned on during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. On vehicles with a diesel engine, the ECM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. The PCM or ECM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the MIL or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the MIL after the bulb test, it may indicate that a malfunction has occurred and that the fuel and emis-

MALFUNCTION INDICATOR LAMP (MIL) (Continued)

sions systems may require service. For proper diagnosis of the fuel and emissions systems, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the MIL, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ODOMETER

DESCRIPTION

An odometer and trip odometer are standard equipment in all instrument clusters. The odometer, trip odometer, and engine hours information are displayed in a common electronic, blue-green Vacuum-Fluorescent Display (VFD). The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents it from being clearly visible when it is not illuminated. However, the odometer, trip odometer, and engine hours information are not displayed simultaneously. The trip odometer reset switch on the instrument cluster circuit board toggles the display between odometer and trip odometer modes by depressing the odometer/trip odometer switch button that extends through the lower edge of the cluster lens, just left of the odometer VFD. When the trip odometer information is displayed, the word “TRIP” is also illuminated in the upper right corner of the VFD in a blue-green color and at the same lighting level as the trip odometer information. The engine hours information replaces the selected odometer or trip odometer information whenever the ignition switch is in the On position and the engine is not running.

The odometer, trip odometer, and engine hours information is stored in the instrument cluster memory. This information can be increased when the proper inputs are provided to the instrument cluster, but the information cannot be decreased. The odometer can display values up to 999,999 kilometers (999,999 miles). The odometer latches at these values, and will not roll over to zero. The trip odometer can display values up to 9,999.9 kilometers (9,999.9 miles) before it rolls over to zero. The odometer display does not have a decimal point and will not show values less than a full unit (kilometer or mile), while the trip odometer display does have a decimal point and will show tenths of a unit (kilometer or mile). The unit of measure (kilometers or miles) for the odometer and trip odometer display is not shown in the VFD. The unit of measure for the instrument cluster odometer/trip odometer is selected at the time that it is manufactured, and cannot be changed. Engine hours are displayed in the format, “hr9999”. The cluster will accumulate values up to 9,999 hours before the display rolls over to zero.

The odometer has a “Rental Car” mode, which will illuminate the odometer information in the VFD whenever the driver side front door is opened with the ignition switch in the Off or Accessory positions. During daylight hours (exterior lamps are Off) the VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a “Parade” mode position of the panel lamps dimmer thumbwheel allows the VFD to be illuminated at full brightness if the exterior lamps are turned On during daylight hours.

The VFD, the trip odometer switch, and the trip odometer switch button are serviced as a unit with the instrument cluster.

OPERATION

The odometer and trip odometer give an indication to the vehicle operator of the distance the vehicle has traveled. The engine hours give an indication of the cumulative engine-on time. This indicator is controlled by the instrument cluster circuitry based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The odometer, trip odometer and engine hours information is displayed by the instrument cluster Vacuum Fluorescent Display (VFD). The VFD will display the odometer information whenever any door is opened with the ignition switch in the Off or Accessory positions, and will display the last previously selected odometer or trip odometer information when the ignition switch is turned to the On or Start positions. The instrument cluster circuitry controls the VFD and provides the following features:

- **Odometer/Trip Odometer Display Toggling** - Actuating the trip odometer reset switch button momentarily with the VFD illuminated will toggle the display between the odometer and trip odometer information. Each time the VFD is illuminated with the ignition switch in the On or Start positions, the display will automatically return to the last mode previously selected (odometer or trip odometer).
- **Engine Hours Display Toggling** - When the trip odometer reset switch button is pressed and held for longer than about six seconds with the ignition switch in the On position and the engine speed message from the PCM is zero, the trip odometer information will be momentarily displayed, then the engine hours information will be displayed. The VFD

ODOMETER (Continued)

must be displaying the odometer information when the trip odometer reset switch button is pressed in order to toggle to the engine hours display. The engine hours will remain displayed for about thirty seconds, until the engine speed message is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Trip Odometer Reset -** When the trip odometer reset switch button is pressed and held for longer than about two seconds with the ignition switch in the On or Start positions, the trip odometer will be reset to 0.0 kilometers (miles). The VFD must be displaying the trip odometer information in order for the trip odometer information to be reset.
- **Communication Error -** If the cluster fails to receive a distance message during normal operation, it will hold and display the last data received until the ignition switch is turned to the Off position. If the cluster does not receive a distance message within one second after the ignition switch is turned to the On position, it will display the last distance message stored in the cluster memory. If the cluster is unable to display distance information due to an error internal to the cluster, the VFD display will be dashes.
- **Actuator Test -** Each time the cluster is put through the actuator test, the odometer VFD will display all of its segments simultaneously during the VFD portion of the test to confirm the functionality of each of the VFD segments and the cluster control circuitry.

The PCM continually monitors the vehicle speed pulse information received from the vehicle speed sensor and engine speed pulse information received from the crankshaft position sensor, then sends the proper distance and engine speed messages to the instrument cluster. For further diagnosis of the odometer/trip odometer or the instrument cluster circuitry that controls these functions, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the crankshaft position sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the odometer/trip odometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OIL PRESSURE GAUGE

DESCRIPTION

An oil pressure gauge is standard equipment on all instrument clusters. The oil pressure gauge is located in the upper right quadrant of the instrument cluster, above the coolant temperature gauge. The oil pressure gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “L” (or Low) to “H” (or High) for gasoline engines. On vehicles with a diesel engine the scale reads from “0” kPa to “760” kPa in markets where a metric instrument cluster is specified, or from “0” psi to “110” psi in all other markets. An International Control and Display Symbol icon for “Engine Oil” is located on the cluster overlay, directly below the left end of the gauge scale. The oil pressure gauge graphics are black against a white field except for two red graduations at the low end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The oil pressure gauge is serviced as a unit with the instrument cluster.

OPERATION

The oil pressure gauge gives an indication to the vehicle operator of the engine oil pressure. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The oil pressure gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Oil Pressure Message -** The instrument cluster circuitry restricts the oil pressure gauge needle operation in order to provide readings that are consistent with customer expectations. Each time the cluster receives a message from the PCM or ECM indicating the engine oil pressure is above about 41 kPa (6 psi) the cluster holds the gauge needle at a point near the middle increment within the normal range on the gauge scale.
- **Engine Oil Pressure Low Message -** Each time the cluster receives a message from the PCM or

OIL PRESSURE GAUGE (Continued)

ECM indicating the engine oil pressure is below about 41 kPa (6 psi), the gauge needle is moved to the graduation at the far left end of the gauge scale, the check gauges indicator is illuminated, and a single chime tone is generated. The gauge needle remains at the left end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine oil pressure is above about 41 kPa (6 psi), or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the check gauges indicator on in response to an engine oil pressure low message if the engine speed message is greater than zero.

- **Communication Error** - If the cluster fails to receive an engine oil pressure message, it will hold the gauge needle at the last indication about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the left end of the gauge scale.
- **Actuator Test** - Each time the cluster is put through the actuator test, the oil pressure gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine oil pressure sensor to determine the engine oil pressure. On vehicles with a diesel engine, the ECM continually monitors the engine oil pressure sensor to determine the engine oil pressure. The PCM or ECM then sends the proper engine oil pressure messages to the instrument cluster. For further diagnosis of the oil pressure gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a low oil pressure gauge reading, it may indicate that the engine or the engine oiling system requires service. For proper diagnosis of the engine oil pressure sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the oil pressure gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OVERDRIVE OFF INDICATOR

DESCRIPTION

An overdrive off indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional overdrive automatic transmission, this indicator is electronically disabled. The overdrive off indicator consists of the words “O/D OFF”, which appear in the lower portion of the odometer/trip odometer indicator Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words “O/D OFF” appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The overdrive off indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The overdrive off indicator gives an indication to the vehicle operator when the Off position of the overdrive off switch has been selected, disabling the electronically controlled overdrive feature of the automatic transmission. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The overdrive off indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the overdrive off indicator for the following reasons:

- **Overdrive Off Lamp-On Message** - Each time the cluster receives an overdrive off lamp-on message from the PCM indicating that the Off position of the overdrive off switch has been selected, the overdrive off indicator will be illuminated. The indicator remains illuminated until the cluster receives an overdrive off lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the overdrive off indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the overdrive off switch to determine the proper outputs to the automatic transmission. The PCM then sends the proper overdrive off lamp-on and lamp-off messages to the

OVERDRIVE OFF INDICATOR (Continued)

instrument cluster. For further diagnosis of the overdrive off indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the overdrive control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the overdrive off indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SEATBELT INDICATOR

DESCRIPTION

A seatbelt indicator is standard equipment on all instrument clusters. The seatbelt indicator is located on the upper edge of the instrument cluster, between the tachometer and the speedometer. The seatbelt indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Seat Belt” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The seatbelt indicator is serviced as a unit with the instrument cluster.

OPERATION

The seatbelt indicator gives an indication to the vehicle operator of the status of the driver side front seatbelt. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and a hard wired input from the seatbelt switch in the driver side front seatbelt buckle through the seat belt indicator driver circuit. The seatbelt indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the seatbelt indicator for the following reasons:

- **Seatbelt Reminder Function** - Each time the cluster receives a battery current input on the fused ignition switch output (run-start) circuit, the indicator will be illuminated as a seatbelt reminder for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. This reminder function will occur regardless of the status of the seatbelt switch input to the cluster.
- **Driver Side Front Seatbelt Not Buckled** - Following the seatbelt reminder function, each time the cluster detects an open circuit on the seat belt indicator driver circuit (seatbelt switch open = seatbelt unbuckled) with the ignition switch in the Start or On positions, the indicator will be illuminated. The seatbelt indicator remains illuminated until the seat belt indicator driver input to the cluster is closed to ground (seatbelt switch closed = seatbelt buckled), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Airbag Indicator Backup** - If the instrument cluster detects a fault in the airbag indicator circuit it will send a message indicating the fault to the Airbag Control Module (ACM), store a Diagnostic Trouble Code (DTC) in the cluster memory, then flash the seatbelt indicator on and off. The cluster will continue to flash the seatbelt indicator until the airbag indicator circuit fault is resolved, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the seatbelt indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The seatbelt switch is connected in series between ground and the seat belt indicator driver input to the instrument cluster. The seatbelt switch input to the instrument cluster circuitry may be diagnosed using conventional diagnostic tools and methods. For further diagnosis of the seatbelt indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

SECURITY INDICATOR

DESCRIPTION

A security indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional Vehicle Theft Security System (VTSS), this indicator is electronically disabled. The security indicator is located in the lower right quadrant of the instrument cluster, between the speedometer and the coolant temperature gauge. The security indicator consists of a small round cutout in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illumi-

SECURITY INDICATOR (Continued)

nated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the indicator to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The security indicator is serviced as a unit with the instrument cluster.

OPERATION

The security indicator gives an indication to the vehicle operator when the Vehicle Theft Security System (VTSS) is arming or is armed. On models equipped with the Sentry Key Immobilizer System (SKIS), the security indicator also gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, hard wired inputs to the cluster from the various security system components, electronic messages received by the cluster from the Remote Keyless Entry (RKE) receiver module over a dedicated serial bus, and electronic messages received by the cluster from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus. The security indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the security indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position, the SKIM tells the cluster to illuminate the SKIS indicator for about two seconds as a bulb test.
- **VTSS Indication** - During the sixteen second VTSS arming function, the cluster will flash the security indicator on and off repeatedly at a steady, fast rate to indicate that the VTSS is in the process of arming. Following successful VTSS arming, the cluster flashes the security indicator on and off continuously at a slower rate to indicate that the VTSS is armed. The security indicator continues flashing at the slower rate until the VTSS is disarmed or triggered. If the VTSS has alarmed and rearmed, the cluster will flash the security indicator at a steady, slow rate for about thirty seconds after the VTSS is disarmed.
- **SKIM Lamp-On Message** - Each time the cluster receives a lamp-on message from the SKIM, the security indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the SKIM message. The indicator remains illuminated solid or continues to flash until the cluster receives a lamp-off message from the SKIM, or until the ignition switch is turned to the Off position, whichever occurs first. For more information on the SKIS and the security indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/SENTRY KEY IMMOBILIZER SYSTEM - OPERATION).
- **Communication Error** - If the cluster receives no SKIS lamp-on or lamp-off messages from the SKIM for twenty consecutive seconds, the SKIS indicator is illuminated by the instrument cluster. The indicator remains controlled and illuminated by the cluster until a valid SKIS lamp-on or lamp-off message is received from the SKIM.
- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the security indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster circuitry controls the security indicator whenever the ignition switch is in the Off position and the VTSS is arming, armed, or alarming. Whenever the ignition switch is in the On or Start positions, the SKIM performs a self-test to decide whether the SKIS is in good operating condition and whether a valid key is present in the ignition lock cylinder. The SKIM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the security indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster flashes the SKIS indicator upon ignition On, or turns on the SKIS indicator solid after the bulb test, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. For proper diagnosis of the VTSS, the SKIS, the SKIM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the security indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SERVICE 4WD INDICATOR

DESCRIPTION

A service 4WD indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional four-wheel drive system and electronically shifted transfer case, this indicator is electronically disabled. The service 4WD indicator consists of the words “SERVICE 4x4”, which appears in the lower portion of the odometer/trip odometer

SERVICE 4WD INDICATOR (Continued)

Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words “SERVICE 4x4” appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The service 4WD indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The service 4WD indicator gives an indication to the vehicle operator when the Transfer Case Control Module (TCCM) has recorded a Diagnostic Trouble Code (DTC) for an electronic transfer case circuit or component malfunction. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the TCCM over the Programmable Communications Interface (PCI) data bus. The service 4WD indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the service 4WD indicator for the following reasons:

- **Service 4WD Lamp-On Message** - Each time the cluster receives a service 4WD lamp-on message from the TCCM, the indicator will be illuminated. The indicator remains illuminated until the cluster receives a service 4WD lamp-off message from the TCCM, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error** - If the cluster receives no messages from the TCCM for five seconds, the service 4WD indicator is illuminated by the instrument cluster to indicate a loss of TCCM communication. The indicator remains controlled and illuminated by the cluster until a valid message is received from the TCCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the service 4WD indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The TCCM continually monitors the electronic transfer case switch and circuits to determine the condition of the system. The TCCM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the service 4WD indicator or the instrument cluster circuitry that controls the VFD, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the TCCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the service 4WD indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SPEEDOMETER

DESCRIPTION

A speedometer is standard equipment on all instrument clusters. The speedometer is located next to the tachometer, just to the right of center in the instrument cluster. The speedometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 210 degree primary scale on the gauge dial face that reads left-to-right either from “0” to “120” mph, or from “0” to “200” km/h, depending upon the market for which the vehicle is manufactured. Each version also has a secondary inner scale on the gauge dial face that provides the equivalent opposite units from the primary scale. Text appearing on the cluster overlay just below the hub of the speedometer needle abbreviates the unit of measure for the primary scale (i.e.: MPH or km/h), followed by the unit of measure for the secondary scale. The speedometer graphics are black (primary scale) and blue (secondary scale) against a white field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear dark blue and the blue graphics appear light blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The speedometer is serviced as a unit with the instrument cluster.

OPERATION

The speedometer gives an indication to the vehicle operator of the vehicle road speed. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The speedometer is an

SPEEDOMETER (Continued)

air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Vehicle Speed Message** - Each time the cluster receives a vehicle speed message from the PCM it will calculate the correct vehicle speed reading and position the gauge needle at that relative speed position on the gauge scale. The cluster will receive a new vehicle speed message and reposition the gauge pointer accordingly about every 88 milliseconds. The gauge needle will continue to be positioned at the actual vehicle speed position on the gauge scale until the ignition switch is turned to the Off position.
- **Communication Error** - If the cluster fails to receive a speedometer message, it will hold the gauge needle at the last indication for about three seconds, or until the ignition switch is turned to the Off position, whichever occurs first. After three seconds, the gauge needle will return to the left end of the gauge scale.
- **Actuator Test** - Each time the cluster is put through the actuator test, the speedometer needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the vehicle speed sensor to determine the vehicle road speed. The PCM then sends the proper vehicle speed messages to the instrument cluster. For further diagnosis of the speedometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the speedometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TACHOMETER

DESCRIPTION

A tachometer is standard equipment on all instrument clusters. The tachometer is located to the left of the speedometer, just to the left of center in the instrument cluster. The tachometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 210 degree scale on the gauge dial face that reads left-to-right from “0” to “7” for gasoline engines. On vehicles with a diesel engine, the scale reads from “0” to “5”. The text “RPM X 1000” imprinted on the cluster overlay directly below the hub of the tachometer needle identifies that each number on the tachometer scale is to be multiplied by 1000 rpm. The tachometer graphics are black against a white field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The tachometer is serviced as a unit with the instrument cluster.

OPERATION

The tachometer gives an indication to the vehicle operator of the engine speed. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The tachometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Speed Message** - Each time the cluster receives an engine speed message from the PCM or ECM it will calculate the correct engine speed reading and position the gauge needle at that relative speed position on the gauge scale. The cluster will receive a new engine speed message and reposition the gauge pointer accordingly about every 88 milliseconds. The gauge needle will continually be repositioned at the relative engine speed position on the gauge scale until the engine stops running, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error** - If the cluster fails to receive an engine speed message, it will hold the gauge needle at the last indication for about three seconds, or until the ignition switch is turned to the Off position, whichever occurs first. After three sec-

TACHOMETER (Continued)

onds, the gauge needle will return to the left end of the gauge scale.

• **Actuator Test** - Each time the cluster is put through the actuator test, the tachometer needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the crankshaft position sensor to determine the engine speed. On vehicles with a diesel engine, the ECM continually monitors the engine speed sensor to determine the engine speed. The PCM or ECM then sends the proper engine speed messages to the instrument cluster. For further diagnosis of the tachometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the crankshaft position sensor, the engine speed sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the tachometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TRANS TEMP INDICATOR

DESCRIPTION

A transmission over-temperature indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with an optional automatic transmission, this indicator is electronically disabled. The transmission over-temperature indicator is located on the left side of the instrument cluster, to the left of the fuel gauge. The transmission over-temperature indicator consists of a stencil-like cutout of the words “TRANS TEMP” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the “TRANS TEMP” text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The transmission over-temperature indicator is serviced as a unit with the instrument cluster.

OPERATION

The transmission over-temperature indicator gives an indication to the vehicle operator when the transmission fluid temperature is excessive, which may lead to accelerated transmission component wear or failure. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The transmission over-temperature indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the transmission over-temperature indicator for the following reasons:

• **Bulb Test** - Each time the ignition switch is turned to the On position the transmission over-temperature indicator is illuminated for about two seconds as a bulb test.

• **Trans Over-Temp Lamp-On Message** - Each time the cluster receives a trans over-temp lamp-on message from the PCM indicating that the transmission fluid temperature is 135° C (275° F) or higher, the indicator will be illuminated and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a trans over-temp lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the transmission over-temperature indicator is cycled off and then on again by the appropriate trans over-temp messages from the PCM.

• **Actuator Test** - Each time the cluster is put through the actuator test, the transmission over-temperature indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transmission temperature sensor to determine the transmission operating condition. The PCM then sends the proper trans over-temp lamp-on or lamp-off messages to the instrument cluster. If the instrument cluster turns on the transmission over-temperature indicator due to a high transmission oil temperature condition, it may indicate that the transmission and/or the transmission cooling system are being overloaded or that they require service. For further diagnosis of the transmission over-temperature indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transmission temperature sensor, the PCM, the PCI

TRANS TEMP INDICATOR (Continued)

data bus, or the electronic message inputs to the instrument cluster that control the transmission over-temperature indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TURN SIGNAL INDICATOR

DESCRIPTION

Two turn signal indicators, one right and one left, are standard equipment on all instrument clusters. The turn signal indicators are located near the upper edge of the instrument cluster, between the speedometer and the tachometer. Each turn signal indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for “Turn Warning” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents these icons from being clearly visible when they are not illuminated. A green Light Emitting Diode (LED) behind each turn signal indicator cutout in the opaque layer of the overlay causes the icon to appear in green through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The turn signal indicators are serviced as a unit with the instrument cluster.

OPERATION

The turn signal indicators give an indication to the vehicle operator that the turn signal (left or right indicator flashing) or hazard warning (both left and right indicators flashing) have been selected and are operating. These indicators are controlled by transistors on the instrument cluster electronic circuit board based upon the cluster programming, a hard wired multiplex input received by the cluster from the turn signal and hazard warning switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, and electronic messages received from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. Each turn signal indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, each LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the turn signal indicators for the following reasons:

- **Turn Signal-On Input** - Each time the cluster detects a turn signal-on input from the turn signal switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, the requested turn signal lamps and turn signal indicator will be flashed on and off, and an electromechanical relay soldered onto the cluster electronic circuit board will produce a clicking sound to emulate a conventional turn signal flasher. The turn signals and the turn signal indicators continue to flash on and off until the cluster receives a turn signal-off input from the multi-function switch, or until the ignition switch is turned to the Off position, whichever occurs first. The instrument cluster also sends an electronic message to the FCM over the PCI data bus, and the FCM flashes the appropriate exterior turn signal lamps. If the FCM detects an inoperative turn signal circuit, it increases the flash rate for the remaining operative turn signals and sends an electronic message to the instrument cluster. The instrument cluster then increases the flash rate of the turn signal indicator and the clicking rate of the electromechanical relay to provide an indication of the problem to the vehicle operator.
- **Hazard Warning-On Input** - Each time the cluster detects a hazard warning-on input from the hazard warning switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, all of the turn signal lamps and both turn signal indicators will be flashed on and off, and an electromechanical relay soldered onto the cluster electronic circuit board will produce a clicking sound to emulate a conventional hazard warning flasher. The turn signals and the turn signal indicators continue to flash on and off until the cluster receives a hazard warning-off input from the multi-function switch. The instrument cluster also sends an electronic message to the FCM over the PCI data bus, and the FCM flashes all of the exterior turn signal lamps. If the FCM detects an inoperative turn signal circuit, it increases the flash rate for the remaining operative turn signals and sends an electronic message to the instrument cluster. The instrument cluster then increases the flash rate of both turn signal indicators and the clicking rate of the electromechanical relay to provide an indication of the problem to the vehicle operator.
- **Actuator Test** - Each time the cluster is put through the actuator test, the turn signal indicators will be turned on, then off again during the bulb check portion of the test to confirm the functionality of each LED and the cluster control circuitry.

The instrument cluster continually monitors the multi-function switch to determine the proper turn signal and hazard warning system control. The instrument cluster then sends the proper turn signal and hazard warning flasher-on and flasher-off mes-

TURN SIGNAL INDICATOR (Continued)

sages to the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus and flashes the turn signal indicators on and off accordingly. For further diagnosis of the turn signal indicators or the instrument cluster circuitry that controls the indicators, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the turn signal and hazard warning system, the multi-function switch, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the turn signal indicators, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

UPSHIFT INDICATOR

DESCRIPTION

An upshift indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with a manual transmission, this indicator is electronically disabled. The upshift indicator consists of an upward pointed arrow icon, which appears on the right side of the electronic gear selector indicator Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The icon appears in a blue-green color and at the same lighting level as the odometer/trip odometer information when it is illuminated by the instrument cluster electronic circuit board. The upshift indicator is serviced as a unit with the instrument cluster.

OPERATION

The upshift indicator gives an indication to the vehicle operator when the manual transmission should be shifted to the next highest gear in order to achieve the best fuel economy. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles with a diesel engine over the Programmable Communications Interface (PCI) data bus. The upshift indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the upshift indicator for the following reasons:

- **Upshift Lamp-On Message** - Each time the cluster receives an upshift lamp-on message from the PCM or ECM indicating the engine speed and load conditions are right for a transmission upshift to occur, the upshift indicator is illuminated. The indicator remains illuminated until the cluster receives an upshift lamp-off message from the PCM or ECM, or until the ignition switch is turned to the Off position, whichever occurs first. The PCM or ECM will normally send an upshift lamp-off message three to five seconds after a lamp-on message, if an upshift is not performed. The indicator will then remain off until the vehicle stops accelerating and is brought back into the range of indicator operation, or until the transmission is shifted into another gear.
- **Actuator Test** - Each time the cluster is put through the actuator test, the upshift indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine speed and load conditions to determine the proper fuel and ignition requirements. On vehicles with a diesel engine, the ECM continually monitors the engine speed and load conditions to determine the proper fuel requirements. The PCM or ECM then sends the proper upshift indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the upshift indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the upshift indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

VOLTAGE GAUGE

DESCRIPTION

A voltage gauge is standard equipment on all instrument clusters. The voltage gauge is located in the upper left quadrant of the instrument cluster, above the fuel gauge. The voltage gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from “L” (or Low) to “H” (or High) for gasoline engines. On vehicles with a diesel engine, the scale

VOLTAGE GAUGE (Continued)

reads from “8” to “18” volts. An International Control and Display Symbol icon for “Battery Charging Condition” is located on the cluster overlay, directly below the right end of the gauge scale. The voltage gauge graphics are black against a white field except for a single red graduation at each end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The voltage gauge is serviced as a unit with the instrument cluster.

OPERATION

The voltage gauge gives an indication to the vehicle operator of the electrical system voltage. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The voltage gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the left end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **System Voltage Message -** Each time the cluster receives a system voltage message from the PCM or ECM indicating the system voltage is between about 9.5 volts and about 15 volts, the gauge needle is moved to the relative voltage position on the gauge scale.
- **System Voltage Low (Charge Fail) Message -** Each time the cluster receives three consecutive messages from the PCM or ECM indicating the electrical system voltage is less than about 9 volts (charge fail condition), the gauge needle is moved to the graduation on the far left end of the gauge scale and the check gauges indicator is illuminated. The gauge needle remains at the far left end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a single message from the PCM or ECM indicating the electrical system voltage is greater than about 9.5 volts (but less than about 15.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first. On vehicles equipped with the optional diesel engine, the ECM is programmed to restrict the voltage gauge needle to a position above the graduation on the far left end of the gauge scale and suppress the check engine indicator operation until after the engine intake manifold air heater has completed a pre-heat or post-heat cycle.
- **System Voltage High Message -** Each time the cluster receives three consecutive messages from the PCM or ECM indicating the electrical system voltage is greater than about 15.5 volts, the gauge needle is moved to the graduation on the far right end of the gauge scale and the check gauges indicator is illuminated. The gauge needle remains at the right end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 15.0 volts (but greater than about 9.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Communication Error -** If the cluster fails to receive a system voltage message, it will hold the gauge needle at the last indication for about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the far left end of the gauge scale.
- **Actuator Test -** Each time the cluster is put through the actuator test, the voltage gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the system voltage to control the generator output. On vehicles with a diesel engine, the ECM continually monitors the system voltage to control the generator output. The PCM or ECM then sends the proper system voltage messages to the instrument cluster. For further diagnosis of the voltage gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a charge fail or voltage high condition, it may indicate that the charging system requires service. For proper diagnosis of the charging system, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the voltage gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WAIT-TO-START INDICATOR

DESCRIPTION

A wait-to-start indicator is only found in the instrument clusters for vehicles equipped with an optional diesel engine. The wait-to-start indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The wait-to-start indicator consists of stencil-like cutout of the International Control and Display Symbol icon for “Diesel Preheat” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The wait-to-start indicator is serviced as a unit with the instrument cluster.

OPERATION

The wait-to-start indicator gives an indication to the vehicle operator when the air temperature within the diesel engine intake manifold is too cool for efficient and reliable engine starting, and that the intake air heater grids are energized in their preheat operating mode. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Engine Control Module (ECM) over the Programmable Communications Interface (PCI) data bus. The wait-to-start indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the wait-to-start indicator for the following reasons:

- **Wait-To-Start Lamp-On Message** - Each time the cluster receives a wait-to-start lamp-on message from the ECM indicating that the air temperature within the intake manifold is too cool for efficient and reliable engine starting, the wait-to-start indicator will be illuminated. The indicator remains illuminated until the cluster receives a wait-to-start lamp-off message, until the ECM detects that the engine is running or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the wait-to-start indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ECM continually monitors the engine intake air temperature sensor to determine when the intake air heater grids should be energized in their pre-heat operating mode. The ECM then sends the proper wait-to-start lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the wait-to-start indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the engine intake air temperature sensor, the intake air heater grid control circuits, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the wait-to-start indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WASHER FLUID INDICATOR

DESCRIPTION

A washer fluid indicator is standard equipment on all instrument clusters. The washer fluid indicator consists of the words “LOW WASH”, which appear in the lower portion of the odometer/trip odometer Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The “LOW WASH” text appears in an amber color and at the same lighting level as the odometer/trip odometer information when it is illuminated by the instrument cluster electronic circuit board. The washer fluid indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The washer fluid indicator gives an indication to the vehicle operator that the fluid level in the washer reservoir is low. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. The washer fluid indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a bat-

WASHER FLUID INDICATOR (Continued)

tery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the washer fluid indicator for the following reasons:

- **Washer Fluid Indicator Lamp-On Message** - Each time the cluster receives a washer fluid indicator lamp-on message from the FCM indicating that a low washer condition has been detected for sixty consecutive seconds, the washer fluid indicator is illuminated and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a washer fluid indicator lamp-off message for sixty consecutive seconds from the FCM or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the washer fluid indicator is cycled off and then on again by the appropriate washer fluid lamp messages from the FCM.
- **Actuator Test** - Each time the cluster is put through the actuator test, the washer fluid indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The FCM continually monitors the washer fluid level switch in the washer reservoir to determine the level of the washer fluid. The FCM then sends the proper washer fluid indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the washer fluid indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the washer fluid level switch, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the washer fluid indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WATER-IN-FUEL INDICATOR

DESCRIPTION

A water-in-fuel indicator is only found in the instrument clusters for vehicles equipped with an optional diesel engine. The water-in-fuel indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The water-in-fuel indicator consists of stencil-like cutout of the International Control and Display Symbol icon for “Water In Fuel” in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The water-in-fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The water-in-fuel indicator gives an indication to the vehicle operator when there is excessive water in the fuel system. This indicator is controlled by a transistor on the instrument cluster circuit board based upon the cluster programming and electronic messages received by the cluster from the Engine Control Module (ECM) over the Programmable Communications Interface (PCI) data bus. The water-in-fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the water-in-fuel indicator for the following reasons:

WATER-IN-FUEL INDICATOR (Continued)

- **Bulb Test** - Each time the ignition switch is turned to the On position the water-in-fuel indicator is illuminated for about two seconds as a bulb test.
- **Water-In-Fuel Lamp-On Message** - Each time the cluster receives a water-in-fuel lamp-on message from the ECM indicating that there is excessive water in the diesel fuel system, the water-in-fuel indicator will be illuminated. The indicator remains illuminated until the cluster receives a water-in-fuel lamp-off message, or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the water-in-fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ECM continually monitors the water-in-fuel sensor to determine whether there is excessive water in the diesel fuel system. The ECM then sends the proper water-in-fuel lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the water-in-fuel indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the water-in-fuel sensor, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the water-in-fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LAMPS

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LAMPS/LIGHTING - EXTERIOR

TABLE OF CONTENTS

LAMPS/LIGHTING - EXTERIOR

DESCRIPTION

The exterior lighting system for this model include the following components:

- Backup Lamps
- Brake Lamps
- Daytime Running Lamps
- Front Fog Lamps
- Hazard Warning Lamps
- Headlamps
- Park Lamps
- Turn Signal Lamps

Other components of the exterior lighting system for this model include:

- Backup Lamp Switch
- Brake Lamp Switch
- Front Control Module
- Front Fog Lamp Relay
- Hazard Switch
- Multi-Function Switch
- Park Lamp Relay
- Trailer Tow Connectors

Some of the interior and exterior lighting functions are governed by the front control module. The headlamp, dome, and door ajar switchs provide signals to the instrument cluster. The instrument cluster sends a J1850 message to the front control module to enable the necessary components for illumination. Hard wired circuitry connects the exterior lighting system components to the electrical system of the vehicle. Refer to the appropriate wiring information.

OPERATION

DAYTIME RUNNING LAMPS

Power is reduced using pulse-width modulation to the high beams, where by the power is switched on and off rapidly instead of remaining on continuously. The duration and interval of the power pulses is programmed into the Front Control Module (FCM).

HEADLAMP SYSTEM

The instrument cluster monitors both the multiplexed headlamp and multifunction switches. The instrument cluster transmits a J1850 bus message to the front control module (FCM) to activate the headlamps. The headlamp system will default to headlamps ON position when ignition switch is ON and when an open or short circuit failure occurs on the headlamp switch input to the instrument cluster. The system will return to normal operation when the open or short is repaired. A fault will be reported by the Instrument Cluster when a failure occurs on the dimmer or headlamp switch input.

If the exterior lamps are ON, and the headlamp switch is in any position other than OFF, with the ignition switch OFF (LOCK) after 5 minutes, the Instrument Cluster transmits a message via J1850 informing the the FCM. The FCM will then turn off the headlamps, park lamps and fog lamps. This feature (load shed) prevents the vehicle battery from being discharged when the vehicle lights have been left ON.

HEADLAMP TIME DELAY SYSTEM

The headlamp time delay system is activated by turning the headlamps ON (high or low beam) while the engine is running, turning the ignition switch OFF, and then turning the headlamp switch OFF

LAMPS/LIGHTING - EXTERIOR (Continued)

within 45 seconds. The system will not activate if more than 45 seconds elapse between ignition switch OFF and headlamp switch OFF. The FCM will allow the headlamps to remain ON for 60 seconds (configurable) before they automatically turn off (If the key is in the ignition during the headlamp time delay mode, then the headlamps including panel dimming will be ON).

LAMP OUTAGE

If one or more of the following lamps (Low and/or High beams, Brake and/or Turn Signal) are out, then a “lamps out” indicator located in the cluster will illuminate.

OPTICAL HORN/HIGH BEAMS

When the multiplexed multifunction switch is pulled to the first detent (optical horn) signal, the headlamps are ON, the Instrument Cluster shall send a message via J1850 to the FCM to turn on the headlamps drivers to illuminate all four filaments (Low and High beams). When the multifunction switch is pulled to the second detent (high beam) signal and the headlamps are ON, the Instrument Cluster shall send a message via J1850 to the FCM to turn on the headlamps drivers. The High Beams are illuminated and the Low Beams and Fog Lamps (if ON) are extinguished. If the headlamps were in the high beam configuration when power was removed from the headlamps, the headlamps will return to their last state prior to being shut off.

DIAGNOSIS AND TESTING - LAMPS/LIGHTING - EXTERIOR

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION: Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result. Do not use bulbs other than those indicated in the Bulb Application table. Damage to lamp and/or Daytime Running Lamp Module can result. Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When a vehicle experiences problems with the headlamp system, verify the condition of the battery connections, fuses, charging system, headlamp bulbs, wire connectors, relay, multifunction switch, and headlamp switch. Refer to the appropriate wiring information.

Each vehicle is equipped with various lamp assemblies. A good ground is necessary for proper lighting operation. Grounding is provided by the lamp socket when it comes in contact with the metal body, or through a separate ground wire.

When changing lamp bulbs check the socket for loose pin connections and corrosion. Repair as necessary.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

LAMPS/LIGHTING - EXTERIOR (Continued)

HEADLAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
	2. Loose or worn generator drive belt.	2. Adjust or replace generator drive belt.
	3. Charging system output too low.	3. Test and repair charging system, refer to Electrical, Charging
	4. Battery has insufficient charge.	4. Test battery state-of-charge, refer to Electrical, Battery System.
	5. Battery is sulfated or shorted.	5. Load test battery, refer to Electrical, Battery System.
	6. Poor lighting circuit ground.	6. Test for voltage drop across ground circuits, refer to Electrical, Wiring Diagram Information.
HEADLAMP BULBS BURN OUT FREQUENTLY	1. Integrated Control Module (ICM) not controlling voltage.	1. Test and repair Integrated Control Module.
	2. Loose or corroded terminals or splices in circuit.	2. Inspect and repair all connectors and splices. Refer to Electrical, Wiring Information.
HEADLAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low.	1. Test and repair charging system, refer to Electrical, Wiring Information.
	2. Poor lighting circuit ground.	2. Test for voltage drop across ground circuits, refer to Electrical, Wiring Information.
	3. High resistance in headlamp circuit.	3. Test amperage draw of headlamp circuit.
HEADLAMPS FLASH RANDOMLY	1. Poor lighting circuit ground.	1. Test for voltage drop across ground locations, refer to Electrical, Wiring Information.
	2. Variable resistance in headlamp circuit.	2. Test amperage draw of headlamp circuit.
	3. Loose or corroded terminals or splices in circuit.	3. Inspect and repair all connectors and splices, refer to Electrical, Wiring Information.
	4. Faulty headlamp switch.	4. Replace headlamp switch.
	5. Front Control Module Malfunction.	5. Refer to appropriate ICM/FCM diagnostics.

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
HEADLAMPS DO NOT ILLUMINATE	1. No voltage to headlamps.	1. Repair open headlamp circuit, refer to Electrical, Wiring Information.
	2. No ground at headlamps.	2. Repair circuit ground, refer to Electrical, Wiring Information.
	3. Broken connector terminal or wire splice in headlamp circuit.	3. Repair connector terminal or wire splice.
	4. Faulty or burned out bulb.	4. Replace headlamp bulb(s).
	5. Integrated Control Module malfunction.	5. Refer to appropriate Body Control Module diagnostics.
	6. J1850 Bus Communication	6. Verify messages being transmitted by Instrument Cluster and received by FCM.
	7. Front Control Module Malfunction.	7. Refer to appropriate ICM/FCM diagnostics.
HEADLAMPS ON WITH IGNITION IN RUN, WITH HEADLAMP SWITCH OFF	1. Faulty headlamp switch.	1. Replace headlamp switch (review Instrument Cluster logged faults).
	2. Diagnostic tool indicates (4.7 - 5.0V) on headlamp switch input to Instrument Cluster.	2. Inspect and repair terminals, connectors and open circuits.
	3. J1850 Bus Communication.	3. Verify messages being transmitted by Instrument Cluster and received by FCM.
	4. Front Control Module Malfunction.	4. Refer to appropriate ICM/FCM diagnostics.

FOG LAMP DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE IDLING OR IGNITION TURNED OFF.	1. Loose or corroded battery cables.	1. Clean and secure battery cable clamps and posts.
	2. Loose or worn generator drive belt.	2. Adjust or replace generator drive belt.
	3. Charging system output too low.	3. Test and repair charging system. Refer to Electrical, Charging,
	4. Battery has insufficient charge.	4. Test battery state-of-charge. Refer to Electrical, Battery System.
	5. Battery is sulfated or shorted.	5. Load test battery. Refer to Electrical, Battery System.
	6. Poor lighting circuit ground.	6. Test for voltage drop across ground locations. Refer to Electrical, Wiring Information.
FOG LAMP BULBS BURN OUT FREQUENTLY	1. Charging system output too high.	1. Test and repair charging system. Refer to Electrical, Charging.
	2. Loose or corroded terminals or splices in circuit.	2. Inspect and repair all connectors and splices. Refer to Electrical, Wiring Information.

LAMPS/LIGHTING - EXTERIOR (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
FOG LAMPS ARE DIM WITH ENGINE RUNNING ABOVE IDLE	1. Charging system output too low.	1. Test and repair charging system. Refer to Electrical, Charging.
	2. Poor lighting circuit ground.	2. Test for voltage drop across ground locations. Refer to Electrical, Wiring Information.
	3. High resistance in fog lamp circuit.	3. Test amperage draw of fog lamp circuit.
FOG LAMPS FLASH RANDOMLY	1. Poor lighting circuit ground.	1. Test for voltage drop across ground locations. Refer to Electrical, Wiring Information.
	2. Variable resistance in fog lamp circuit.	2. Test amperage draw of fog lamp circuit.
	3. Faulty fog lamp switch (part of headlamp switch).	3. Replace headlamp switch.
	4. Loose or corroded terminals or splices in circuit.	4. Inspect and repair all connectors and splices. Refer to Electrical, Wiring Information.
	5. Is relay engaging properly?	5. Verify function of fog lamp relay in IPM.
	6. J1850 Bus Communication.	6. Verify J1850 message (fog lamp info) transmitted from Instrument Cluster and received by FCM.
FOG LAMPS DO NOT ILLUMINATE	1. Blown fuse for fog lamp.	1. Replace fuse. Refer to Electrical, Wiring Information.
	2. No ground at fog lamps.	2. Repair circuit ground. Refer to Electrical, Wiring Information.
	3. Faulty fog lamp switch (part of headlamp switch).	3. Replace headlamp switch.
	4. Broken connector terminal or wire splice in fog lamp circuit.	4. Repair connector terminal or wire splice.
	5. Faulty or burned out bulb.	5. Replace bulb.
	6. Is relay engaging?	6. Verify function of fog lamp relay in IPM.
	7. J1850 Bus Communication.	7. Verify J1850 message (fog lamp info) transmitted from Instrument Cluster and received by FCM.

DAYTIME RUNNING LAMP (CANADA ONLY) DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
DAYTIME RUNNING LAMPS DO NOT OPERATE	1. Parking brake engaged.	1. Disengage parking brake.
	2. Parking brake circuit shorted to ground.	2. Check cluster telltale, refer to the appropriate wiring information.
	3. Headlamp circuit shorted to ground.	3. Refer to the appropriate wiring information.
	4. FCM, Instrument Cluster not programed with Canadian country code.	4. Check country code.

LAMPS/LIGHTING - EXTERIOR (Continued)

STANDARD PROCEDURE

SAFETY PRECAUTIONS

WARNING: EYE PROTECTION SHOULD BE USED WHEN SERVICING GLASS COMPONENTS. PERSONAL INJURY CAN RESULT.

CAUTION: Do not touch the glass of halogen bulbs with fingers or other possibly oily surface, reduced bulb life will result.Do not use bulbs with higher candle power than indicated in the Bulb Application table . Damage to lamp and/or Daytime Running Lamp Module can result.Do not use fuses, circuit breakers or relays having greater amperage value than indicated on the fuse panel or in the Owners Manual.

When it is necessary to remove components to service another, it should not be necessary to apply excessive force or bend a component to remove it. Before damaging a trim component, verify hidden fasteners or captured edges are not holding the component in place.

SPECIFICATIONS

EXTERIOR LAMPS

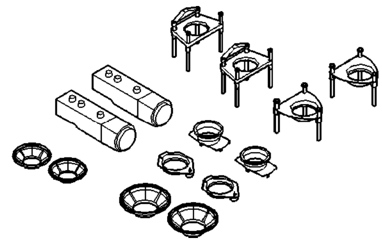
CAUTION: Do not use bulbs that have a higher candle power than the bulb listed in the Bulb Application Table. Damage to lamp can result. Do not touch halogen bulbs with fingers or other oily surfaces. Bulb life will be reduced.

The following Bulb Application Table lists the lamp title on the left side of the column and trade number or part number on the right.

BULB APPLICATION TABLE

LAMP	BULB
Back-up	3157
Center High Mounted Stop lamp	912
Fog lamp	9006LL
Front Park/Turn Signal	4157NAK
Head lamp	9007
License Plate	7F69
Tail, Brake, Turn Signal	3157
Side Marker, Tail Gate, Cab Clearance	168

SPECIAL TOOLS - HEADLAMP ALIGNMENT



Headlamp Aiming Kit C-4466–A

BACKUP LAMP

REMOVAL

(1) Remove and isolate the negitive battery cable.

(2) Remove the taillamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - REMOVAL).

(3) Remove the bulb back plate from the tail lamp unit.

(4) Separate the bulb from the socket.

INSTALLATION

(1) Install the bulb into the socket.

(2) Install the bulb back plate to the tail lamp unit.

(3) Install the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - INSTALLATION).

(4) Reconnect the negative battery cable.

BACKUP LAMP SWITCH

DESCRIPTION

Vehicles equipped with a manual transmission have a normally open, spring-loaded plunger type back-up lamp switch (Fig. 1). The backup lamp switch is located in a threaded hole on the side of the manual transmission housing. The backup lamp switch has a threaded body and a hex formation near the plunger end of the switch, and an integral connector at the opposite end of the switch. When installed, only the connector and the hex formation are visible on the outside of the transmission housing. Vehicles with an optional electronic automatic transmission have a Transmission Range Sensor (TRS) that is used to perform several functions, including that of the backup lamp switch. The TRS is described in further detail elsewhere in this service information. The backup lamp switch cannot be adjusted or repaired and, if faulty or damaged, the entire switch unit must be replaced.

BACKUP LAMP SWITCH (Continued)

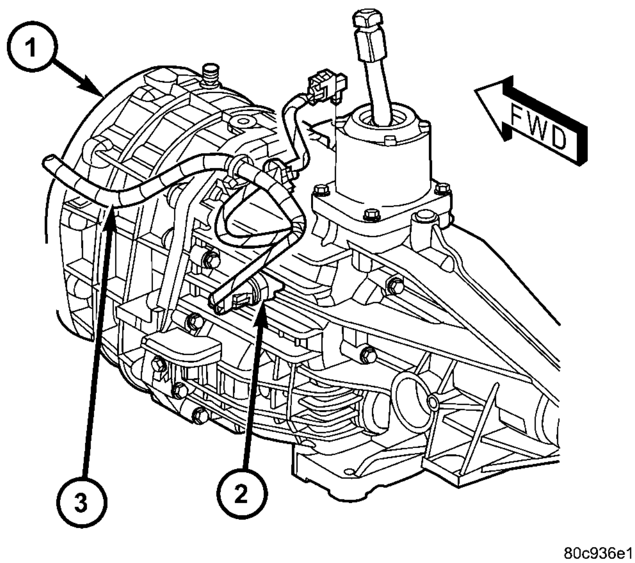


Fig. 1 Backup Lamp Switch - Typical

1 - MANUAL TRANSMISSION
2 - BACKUP LAMP SWITCH
3 - ENGINE WIRE HARNESS

OPERATION

The backup lamp switch controls the flow of battery voltage to the backup lamp bulbs through an output on the back-up lamp feed circuit. The switch plunger is mechanically actuated by the gearshift mechanism within the transmission, which will depress the switch plunger and close the switch contacts whenever the reverse gear has been selected. The switch receives battery voltage through a fuse in the Integrated Power Module (IPM) on a fused ignition switch output (run) circuit whenever the ignition switch is in the On position. A take out of the engine wire harness connects the backup lamp switch to the vehicle electrical system. The backup lamp switch and circuits can be tested using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - BACKUP LAMP SWITCH

(1) Disconnect and isolate the battery negative cable.
(2) Raise and support the vehicle.
(3) Locate and disconnect the engine wire harness connector for the backup lamp switch.
(4) Check for continuity between the two terminal pins in the backup lamp switch connector.
(a) With the gear selector lever in the Reverse position, there should be continuity.
(b) With the gear selector lever in any position other than Reverse, there should be no continuity.

BRAKE LAMP

REMOVAL

(1) Disconnect and isolate the negative battery cable.
(2) Remove the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - REMOVAL).
(3) Remove the bulb back plate from the tail lamp unit.
(4) Remove the bulb from the back plate.

INSTALLATION

(1) Install the bulb into the back plate.
(2) Install the bulb back plate to the tail lamp unit.
(3) Install the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - INSTALLATION).
(4) Connect the negative battery cable.

BRAKE LAMP SWITCH

DESCRIPTION

The plunger type brake lamp switch is mounted on a bracket attached to the base of the steering column, under the instrument panel.

CAUTION: The switch can only be adjusted during initial installation. If the switch is not adjusted properly a new switch must be installed.

OPERATION

The brake lamp switch is hard wired to the Center High Mount Stop Lamp (CHMSL) and also monitored by the Instrument Cluster for use by the brake lamp, speed control brake sensor circuits and electronic brake distribution (EBD). The brake lamp circuit is open until the plunger is depressed. The speed control and brake sensor circuits are closed until the plunger is depressed. When the brake lamp switch transitions, the CHMSL transitions and instrument cluster transmits a brake applied/released message on the bus. The Integrated Power Module (IPM) will then transition the brake lamps.

When the brake light switch is activated, the Powertrain Control Module (PCM) receives an input indicating that the brakes are being applied. After receiving this input, the PCM maintains idle speed to a scheduled rpm through control of the Idle Air Control (IAC) motor. The brake switch input is also used to disable vent and vacuum solenoid output signals to the speed control servo.

BRAKE LAMP SWITCH (Continued)

Vehicles equipped with the speed control option use a dual function brake lamp switch. The PCM monitors the state of the dual function brake lamp switch.

The brake switch is equipped with three sets of contacts, one normally open and the other two normally closed (brakes disengaged). The PCM sends a 12 volt signal to one of the normally closed contacts in the brake switch, which is returned to the PCM as a brake switch state signal. With the contacts closed, the 12 volt signal is pulled to ground causing the signal to go low. The low voltage signal, monitored by the PCM, indicates that the brakes are not applied. When the brakes are applied, the contacts open, causing the PCM's output brake signal to go high, disengaging the speed control, cutting off PCM power to the speed control solenoids.

The second set of normally closed contacts supplies 12 volts from the PCM any time speed control is turned on. Through the brake switch, voltage is routed to the speed control servo solenoids. The speed control solenoids (vacuum, vent and dump) are provided this voltage any time the speed control is ON and the brakes are disengaged.

When the driver applies the brakes, the contacts open and voltage is interrupted to the solenoids. The normally open contacts are fed battery voltage. When the brakes are applied, battery voltage is supplied to the brake lamps.

The brake lamp switch can only be adjusted once. That is at the initial installation of the switch. If the switch is not adjusted properly or has been removed, a new switch must be installed and adjusted.

DIAGNOSIS AND TESTING - BRAKE LAMP SWITCH

The brake lamp switch can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals (Fig. 2).

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2: brake lamp circuit
- Terminals 3 and 4: RWAL/ABS module and Powertrain Control Module (PCM) circuit
- Terminals 5 and 6: speed control circuit

SWITCH CONTINUITY TEST

NOTE: Disconnect switch harness before testing switch continuity.

With switch plunger extended, attach test leads to pins 1 and 2. Replace switch if meter indicates no continuity.

With switch plunger retracted, attach test leads to pins 3 and 4. Replace switch if meter indicates no continuity.

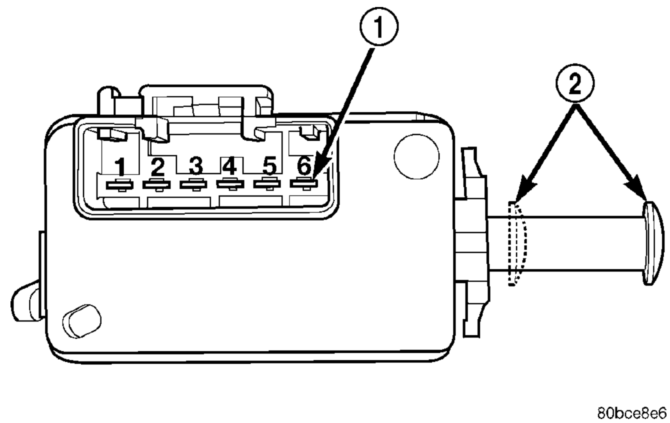


Fig. 2 Brake Lamp Switch Terminal Identification

1 - TERMINAL PINS
2 - PLUNGER TEST POSITIONS

With switch plunger retracted, attach test leads to pins 5 and 6. Replace switch if meter indicates no continuity.

REMOVAL

(1) Disconnect the switch harness (Fig. 3).

(2) Press and hold the brake pedal in applied position.

(3) Rotate the switch counterclockwise about 30° to align the switch lock tab with the notch in bracket.

(4) Pull the switch rearward out of the mounting bracket and release the brake pedal.

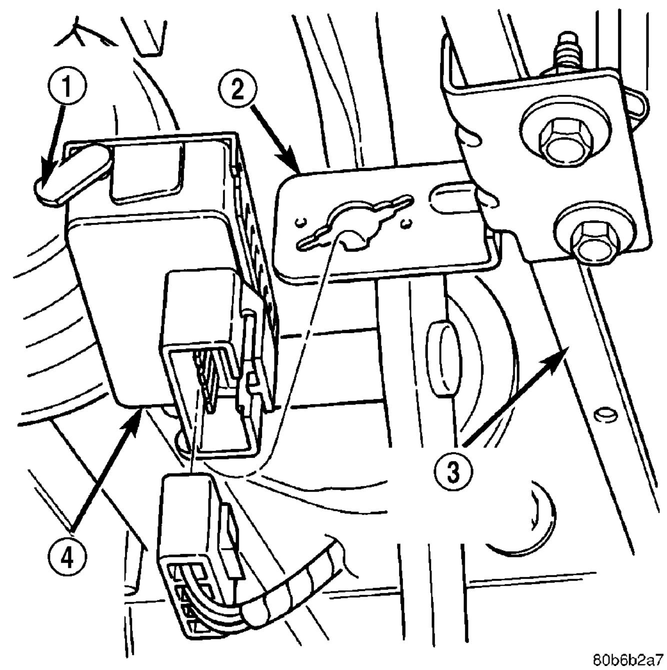


Fig. 3 Brake Lamp Switch & Bracket

1 - RELEASE LEVER
2 - BRACKET
3 - BRAKE PEDAL SUPPORT
4 - BRAKE LAMP SWITCH

BRAKE LAMP SWITCH (Continued)

INSTALLATION

(1) Press and hold the brake pedal down.

(2) Align the tab on the **new** switch with the notch in the switch bracket. Insert the switch in the bracket and turn it clockwise about 30° to lock it in place.

(3) Connect the harness wires to the switch.

(4) Release the brake pedal.

(5) Move the release lever on the switch parallel with the connector to engage the switch plunger. The switch is now adjusted and **can not** be adjusted again.

CENTER HIGH MOUNTED STOP LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the CHMSL from the roof panel. Refer to (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/CENTER HIGH MOUNTED STOP LAMP UN - REMOVAL).

(3) Turn the bulb socket 1/4 turn counterclockwise.

(4) Separate the socket from the lamp.

(5) Remove the bulb.

INSTALLATION

(1) Position the bulb in the socket and press into place.

(2) Position the socket in the lamp.

(3) Turn the bulb socket 1/4 turn clockwise.

(4) Install the CHMSL. Refer to (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ CENTER HIGH MOUNTED STOP LAMP UN - INSTALLATION).

(5) Connect the battery negative cable.

CENTER HIGH MOUNTED STOP LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove screws holding CHMSL to roof panel (Fig. 4).

(3) Separate CHMSL from roof.

(4) Disengage wire connector from body wire harness.

(5) Separate CHMSL from vehicle.

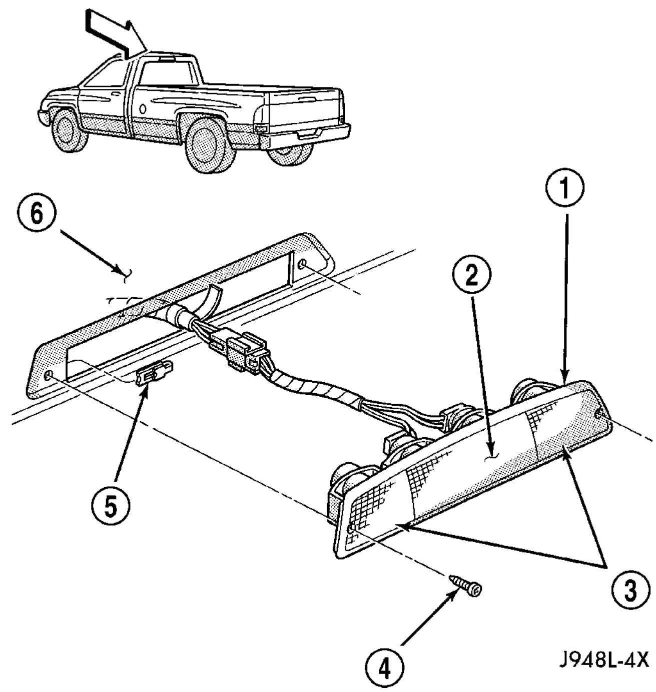


Fig. 4 CENTER HIGH MOUNT STOP LAMP — TYPICAL

1 - CHMSL CARGO LAMP HOUSING
2 - CHMSL
3 - CARGO LAMPS
4 - SCREW
5 - CLIP
6 - CAB

INSTALLATION

(1) Position lamp at cab roof and connect wire connector.

(2) Install screws holding CHMSL to roof panel. Tighten securely.

(3) Connect the battery negative cable.

CAB CLEARANCE LAMP

REMOVAL

(1) Remove both retaining screws and separate the lamp from the roof.

(2) Quarter turn counter clockwise to separate bulb socket from lamp.

INSTALLATION

(1) Quarter twist the bulb socket clockwise into the lamp housing.

(2) Position the lamp assembly onto the roof and install retaining screws. (Fig. 5)

CAB CLEARANCE LAMP (Continued)

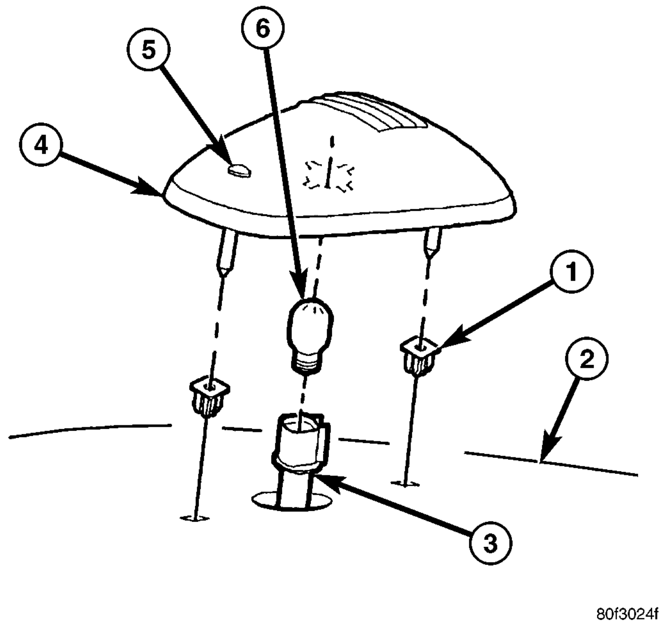


Fig. 5 CLEARANCE LAMP

1 - NUT
2 - CAB ROOF
3 - BULB SOCKET
4 - CLEARANCE LAMP
5 - SCREW
6 - BULB

FOG LAMP

REMOVAL

NOTE: The fog lamps are serviced from the rearward side of the front bumper.

(1) Disconnect and isolate the battery negative cable.
(2) Disengage fog lamp harness connector.
(3) Remove the bolts attaching the fog lamp to the bumper (Fig. 6).
(4) Separate fog lamp from bumper.

INSTALLATION

(1) Position fog lamp in bumper.
(2) Install the bolts attaching the fog lamp to the bumper.
(3) Connect fog lamp harness connector.
(4) Connect the battery negative cable.
(5) Check for proper operation and beam alignment.

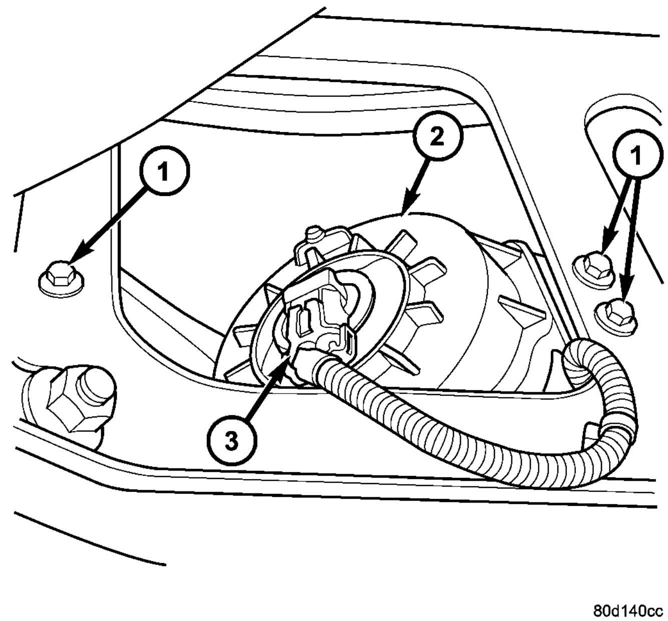


Fig. 6 Fog Lamp

1 - SCREW
2 - FOG LAMP UNIT
3 - CONNECTOR

FOG LAMP RELAY

DESCRIPTION

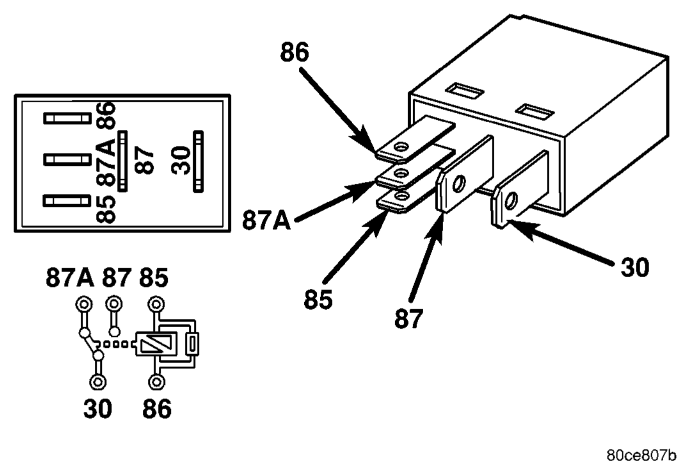


Fig. 7 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

The front fog lamp relay is located in the Power Distribution Center (PDC) in the engine compartment of the vehicle. The front fog lamp relay is a conventional International Standards Organization

FOG LAMP RELAY (Continued)

(ISO) micro relay (Fig. 7). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The front fog lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

The front fog lamp relay is an electromechanical switch that uses a low current input from the Front Control Module (FCM) to control a high current output to the front fog lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The front fog lamp relay terminals are connected to the vehicle electrical system through a connector receptacle in the Power Distribution Center (PDC). The inputs and outputs of the front fog lamp relay include:

- **Common Feed Terminal** - The common feed terminal (30) receives battery voltage at all times from a fuse in the PDC through a fused B(+) circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Front Control Module (FCM) through a front fog lamp relay control circuit. The FCM controls front fog lamp operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery voltage at all times from a fuse in the PDC through a fused B(+) circuit.
- **Normally Open Terminal** - The normally open terminal (87) is connected to the front fog lamps through a front fog lamp relay output circuit and provides battery voltage to the front fog lamps whenever the relay is energized.
- **Normally Closed Terminal** - The normally closed terminal (87A) is not connected in this application.

The front fog lamp relay can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - FRONT FOG LAMP RELAY

The front fog lamp relay (Fig. 8) is located in the Power Distribution Center in the engine compartment. Refer to the appropriate wiring information.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

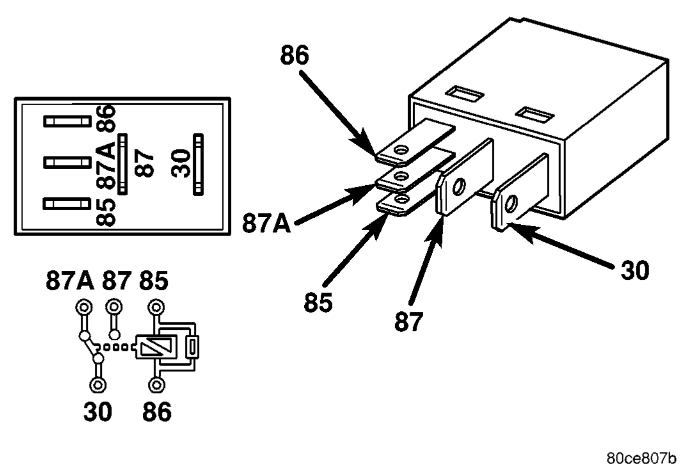


Fig. 8 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

(1) Remove the front fog lamp relay from the PDC. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/FRONT FOG LAMP RELAY - REMOVAL).

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

FOG LAMP RELAY (Continued)

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 8 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover for the Power Distribution Center (PDC).

(3) Remove the front fog lamp relay by grasping it firmly and pulling it straight out from the receptacle in the PDC.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the front fog lamp relay to the proper receptacle in the Power Distribution Center (PDC).

(2) Align the front fog lamp relay terminals with the terminal cavities in the PDC.

(3) Press firmly and evenly on the top of the front fog lamp relay until the terminals are fully seated in the PDC.

(4) Reconnect the battery negative cable.

HAZARD SWITCH

DESCRIPTION

The hazard switch is activated by a push button located in the multifunction switch on the top of the steering column between the steering wheel and instrument cluster.

The hazard warning system allows the vehicle operator to provide other vehicle operators in the near proximity an optical indication that the vehicle is disabled or an obstacle to traffic flow. The hazard warning system has battery voltage at all times, regardless of ignition position.

OPERATION

The instrument cluster monitors the multiplexed multifunction switch operation. When the hazard warning switch is activated, the instrument cluster will send a J1850 bus message to the Front Control Module (FCM), then activate the two turn signal indicators and audible click in the instrument cluster.

The FCM will then activate the necessary relays in the Power Distribution Center (PDC) to begin flashing both the front and rear turn signal indicator lamps.

HEADLAMP

REMOVAL

(1) Disconnect and isolate the negitive battery cable.

(2) Remove the headlamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).

(3) Seperate the socket from the headlamp unit.

INSTALLATION

CAUTION: Do Not Touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Install the socket into the headlamp unit.

(2) Install the headlamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).

(3) Connect the negitive battery cable.

HEADLAMP SWITCH

DESCRIPTION

The multiplexed headlamp switch is located on the instrument panel. The headlamp switch controls the parking lamps, fog lamps and the headlamps. A separate switch in the module controls the interior lamps and instrument cluster illumination. This switch also contains a rheostat for controlling the illumination level of the cluster lamps.

OPERATION

The multiplexed headlamp switch has an off, parking lamp, fog lamp and a headlamp on position. High beams are controlled by the multiplexed multifunction switch on the steering column. The fog lamps are illuminated by pulling back on the headlamp switch knob when in the parking lamp or headlamp ON position.The headlamp switch cannot be repaired. It must be replaced.

The Instrument Cluster monitors the headlamp and multifunction switch operation. When the headlamp switch is rotated to the parking lamp or On position the Instrument Cluster sends a J1850 message to the Front Control Module, which is mated to the power distribution center to become the Integrated Control Module, to illuminate the appropriate bulbs. When the multifunction switch is activated to the optical horn or high beam position the Instrument Cluster illuminates the high beam indicator and sends a J1850 message to the Front Control Module to illuminate the appropriate bulbs.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the left instrument panel bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Disconnect the harness connector.

(4) Remove the screws that secure the headlamp switch to the instrument panel bezel (Fig. 9).

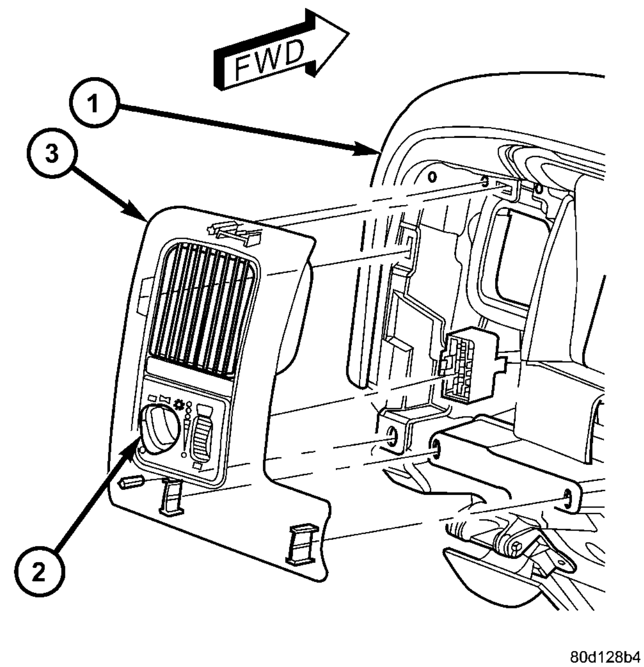


Fig. 9 Headlamp Switch Removal

1 - DASH BOARD
2 - HEADLAMP SWITCH
3 - INSTRUMENT PANEL BEZAL

(5) Remove the headlamp switch from the instrument panel bezel.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the headlamp switch to the left instrument panel bezal and secure with screws.Tighten the screws to 2.2 N·m (20 in. lbs.).

(2) Reconnect the instrument panel wire harness connector for the headlamp switch.

(3) Position the left instrument panel bezal on to the instrument panel.

HEADLAMP SWITCH (Continued)

(4) Install the cluster bezel onto the instrument panel (Fig. 9).

(5) Connect the battery negative cable.

HEADLAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the push pins attaching the seal to the fender.

(3) Remove the bolts attaching the headlamp unit to the fender (Fig. 10).

(4) Remove the bulb sockets from the headlamp unit

(5) Separate headlamp unit from vehicle.

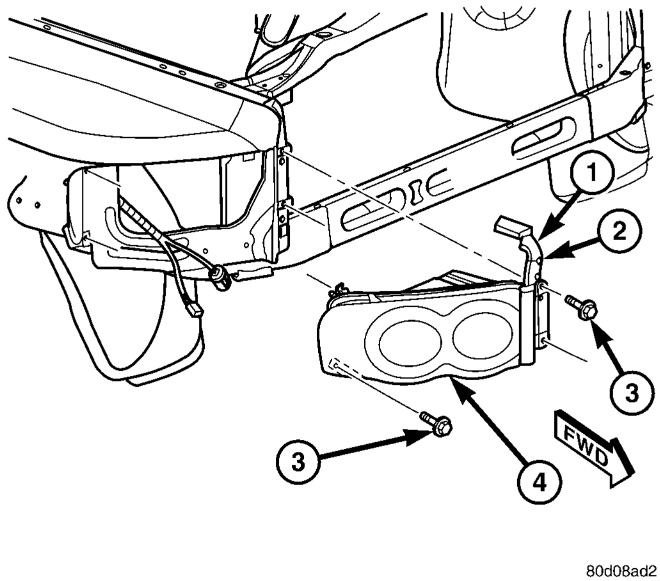


Fig. 10 HEADLAMP — TYPICAL

1 - SEAL
2 - PUSH PIN
3 - SCREW
4 - HEADLAMP UNIT

INSTALLATION

CAUTION: Do not touch the bulb glass with fingers or other oily surfaces. Reduced bulb life will result.

(1) Install the bulb sockets for the front park/turn signal and headlamp.

(2) Position headlamp unit in inner fender panel.

(3) Install the bolts attaching headlamp unit to the fender (Fig. 10).

(4) Align the seal and install the push pins.

(5) Connect the battery negative cable.

ADJUSTMENTS

Headlamps can be aligned using the screen method provided in this section. Alignment Tool C-4466-A or equivalent can also be used. Refer to instructions provided with the tool for proper procedures.

LAMP ALIGNMENT SCREEN PREPARATION

(1) Position vehicle on a level surface perpendicular to a flat wall 7.62 meters (25 ft) away from front of headlamp lens (Fig. 11).

(2) If necessary, tape a line on the floor 7.62 meters (25 ft) away from and parallel to the wall.

(3) Up 1.27 meters (5 feet) from the floor, tape a line on the wall at the centerline of the vehicle. Sight along the centerline of the vehicle (from rear of vehicle forward) to verify accuracy of the line placement.

(4) Rock vehicle side-to-side three times to allow suspension to stabilize.

(5) Jounce front suspension three times by pushing downward on front bumper and releasing.

(6) Measure the distance from the center of headlamp lens to the floor. Transfer measurement to the alignment screen (with tape). Use this line for up/down adjustment reference.

(7) Measure distance from the centerline of the vehicle to the center of each headlamp being aligned. Transfer measurements to screen (with tape) to each side of vehicle centerline. Use these lines for left/right adjustment reference.

VEHICLE PREPARATION FOR HEADLAMP ALIGNMENT

(1) Verify headlamp dimmer switch and high beam indicator operation.

(2) Correct defective components that could hinder proper headlamp alignment.

(3) Verify proper tire inflation.

(4) Clean headlamp lenses.

(5) Verify that luggage area is not heavily loaded.

(6) Fuel tank should be FULL. Add 2.94 kg (6.5 lbs.) of weight over the fuel tank for each estimated gallon of missing fuel.

HEADLAMP ALIGNMENT

A properly aimed low beam headlamp will project top edge of high intensity pattern on screen from 50 mm (2 in.) above to 50 mm (2 in.) below headlamp centerline. The side-to-side outboard edge of high intensity pattern should be from 50 mm (2 in.) left to 50 mm (2 in.) right of headlamp centerline (Fig. 11). **The preferred headlamp alignment is 1″ down for the up/down adjustment and 0 for the left/right adjustment.** The high beam pattern should be correct when the low beams are aligned properly.

To adjust low beam headlamp, rotate alignment screws to achieve the specified aim.

HEADLAMP UNIT (Continued)

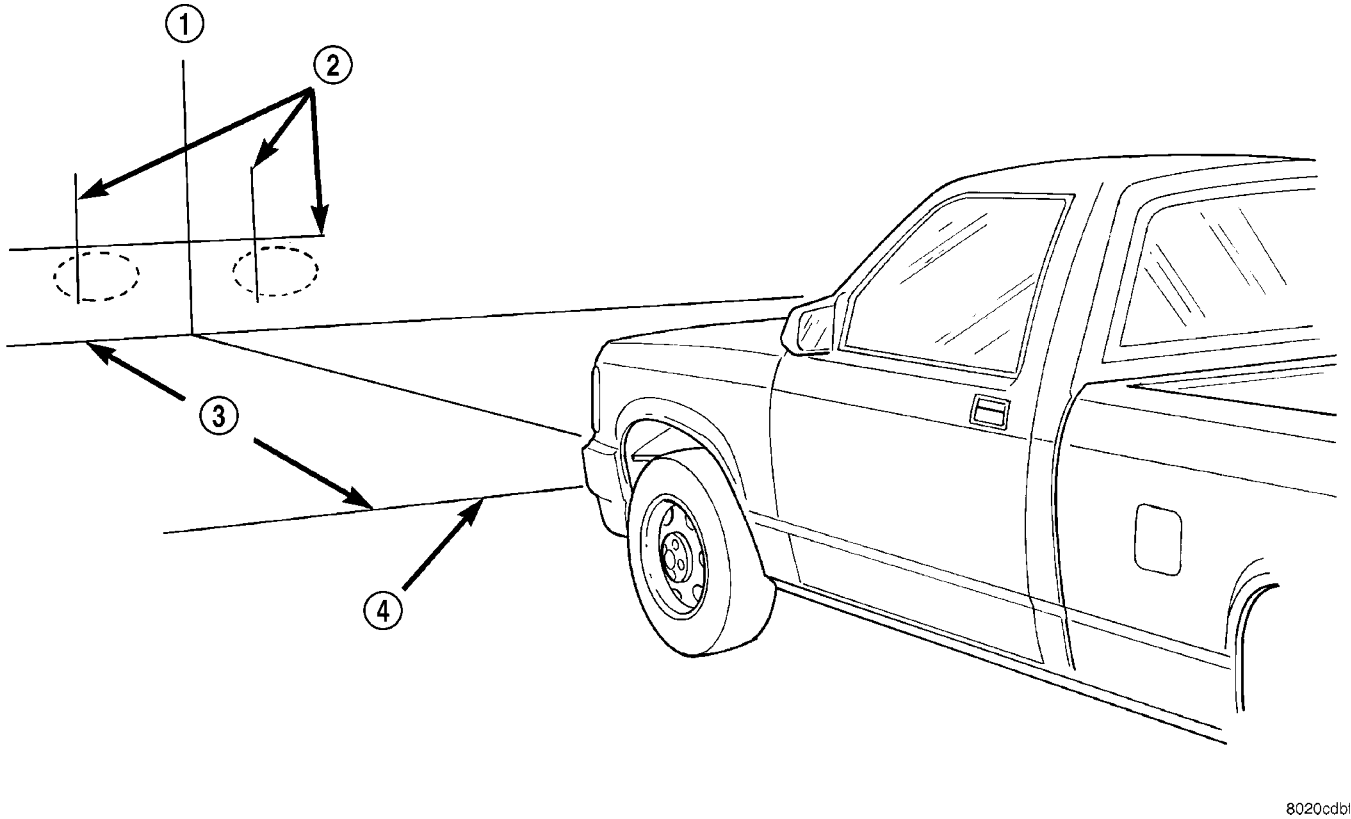


Fig. 11 Headlamp Alignment Screen—Typical

1 - CENTER OF VEHICLE
2 - CENTER OF HEADLAMP
3 - 7.62 METERS (25 FT.)
4 - FRONT OF HEADLAMP

LICENSE PLATE LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Grasp license plate bulb socket and 1/4 turn left to release from the license plate lamp unit.

(3) Pull bulb from license plate lamp socket.

INSTALLATION

(1) Install the bulb in the socket.

(2) Install the socket in to the license plate lamp unit and 1/4 turn to lock.

(3) Connect the battery negative cable.

LICENSE PLATE LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the harness connector.

(3) Remove the retaining clip. (Fig. 12).

(4) Separate license plate lamp from vehicle.

INSTALLATION

(1) Position license plate lamp on the bumper.

(2) Install the clip.

(3) Reconnect the harness connector.

(4) Connect the battery negative cable.

MARKER LAMP UNIT

REMOVAL

REMOVAL

(1) Grasp the lens assembly firmly and pushing rearward, remove the lens assembly from the fender.

(2) Quarter turn the bulb socket counterclockwise and remove it from lens assembly.

REMOVAL

(1) Remove the lens mounting screws.

(2) Quarter twist counterclockwise the tailgate marker lamp bulb sockets and remove lamp housing.

MARKER LAMP UNIT (Continued)

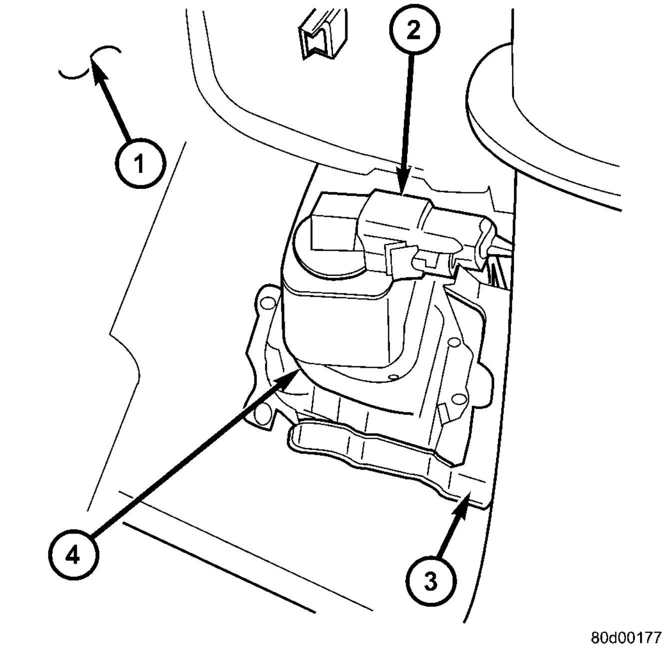


Fig. 12 License Plate Lamp Panel

1 - REAR BUMPER
2 - WIRING CONNECTOR
3 - CLIP
4 - LICENSE PLATE LAMP UNIT

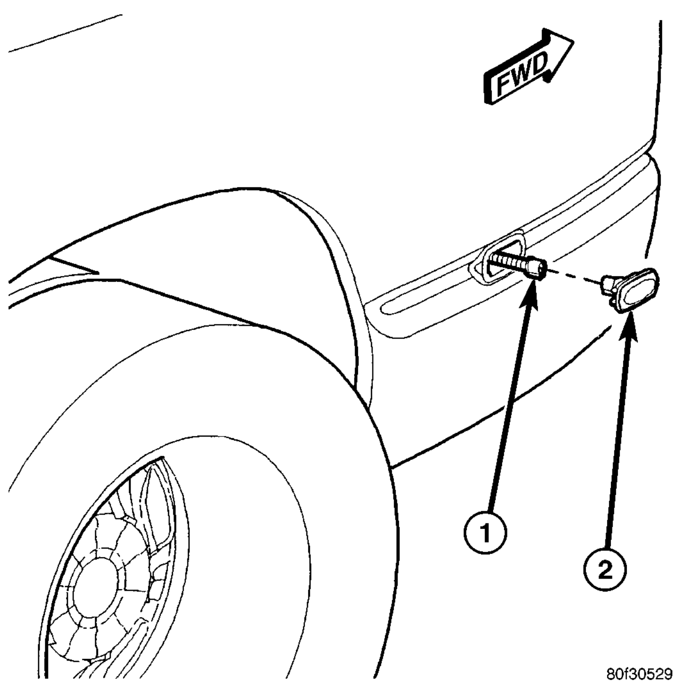


Fig. 13 FENDER EXTENSION AND MARKER LAMP ASSEMBLY

1 - WIRING HARNESS
2 - MARKER LAMP

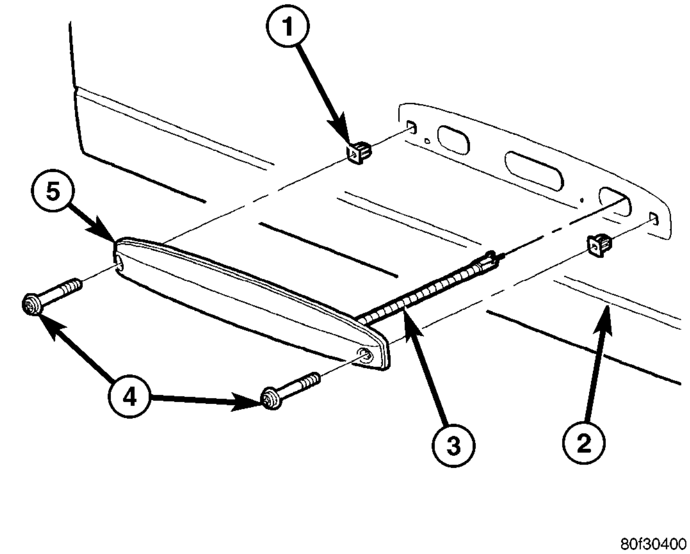


Fig. 14 Tailgate Marker Lamp Housing

1 - Nut
2 - Tailgate
3 - Bulb Harness
4 - Screw
5 - Lens

INSTALLATION

INSTALLATION

(1) Quarter twist the bulb socket into the lamp assembly

(2) Position the lamp assembly against the fender, using firm pressure insert the lens into the fender. (Fig. 13)

INSTALLATION

(1) Position the tailgate marker bulb harness to the lens and quarter twist each bulb assembly clockwise to seat bulb sockets.

(2) Position the tailgate marker lens to the tailgate and install the retaining screws. (Fig. 14)

MULTI-FUNCTION SWITCH

DESCRIPTION - TURN SIGNAL SYSTEM

The multi-function switch is a resistive MUX switch that is monitored by the Instrument Cluster. The turn signals are actuated with the lever on Multi-Function Switch. The signals are automatically turned off by a canceling cam (two lobes molded to the back of the clock spring mechanism). The cam comes in contact with the cancel actuator on the turn signal (multi-function) switch assembly. Either cam

MULTI-FUNCTION SWITCH (Continued)

lobe, pushing on the cancel actuator, returns the switch to the OFF position.

OPERATION - TURN SIGNAL SYSTEM

The Instrument Cluster monitors the multiplexed multifunction switch. In a turning event the Instrument Cluster senses a change in the turn signal lever and illuminates the appropriate turn signal indicator. At the same time, the Instrument Cluster will send a J1850 message on the PCI bus to the Front Control Module (FCM). The FCM will respond by activating the appropriate relay in the Power Distribution Center.

A chime will sound after the turn is completed if vehicle has traveled a distance of approximately 1.0 mile and a speed of 15 mph, with the turn signal ON.

DIAGNOSIS AND TESTING - MULTI-FUNCTION SWITCH

To test the turn signal, headlamp beam select and optical horn portion of the multi-function switch:

(1) Remove the multi-function switch, refer to Electrical, Lamps/Lighting - Exterior, Multi-Function Switch, Removal, and Installation.

(2) Using an ohmmeter check the resistance readings between multi-function switch pins. Refer to Wiring Diagrams for proper pin numbers and the MULTI-FUNCTION SWITCH TESTS table.

MULTI-FUNCTION SWITCH TESTS

EXTERIOR LIGHTING FUNCTIONS		
SWITCH POSITION	CONNECTOR PINS	RESISTANCE (OHMS)
Off	1 - 2	Open
Headlamp High Beams On	1 - 2	518 - 575
Hazard	3 - 2	115 - 128
Optical Horn (Flash-to-Pass) On	1 - 2	1257 - 1397
Off	3 - 2	2643 - 2937
Turn Signal Left	3 - 2	345 - 384
Turn Signal Right	3 - 2	786 - 873
FRONT WIPER FUNCTIONS		
SWITCH POSITION	CONNECTOR PINS	RESISTANCE (OHMS) ±10%
Front Wiper Off	2 - 4	6910 - 7678
Delay 1	2 - 4	2128 - 2365
Delay 2	2 - 4	1089 - 1210
Delay 3	2 - 4	627 - 697
Delay 4	2 - 4	388 - 431
Delay 5	2 - 4	234 - 261
Front Wiper Low	2 - 4	125 - 140
Front Wiper High	2 - 4	50 - 56
Wash	1 - 2	2584 - 2871

REMOVAL

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO THE ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY

(1) Disconnect and isolate battery negative cable.

(2) Remove the steering wheel and the upper and lower steering column shrouds. Refer to Steering, Column, Shroud, Removal.

(3) Disconnect the wire connector from the back of the multi-function switch.

(4) Remove the screws retaining the multi-function switch to the steering column adapter collar (Fig. 15).

(5) Remove the multi-function switch.

MULTI-FUNCTION SWITCH (Continued)

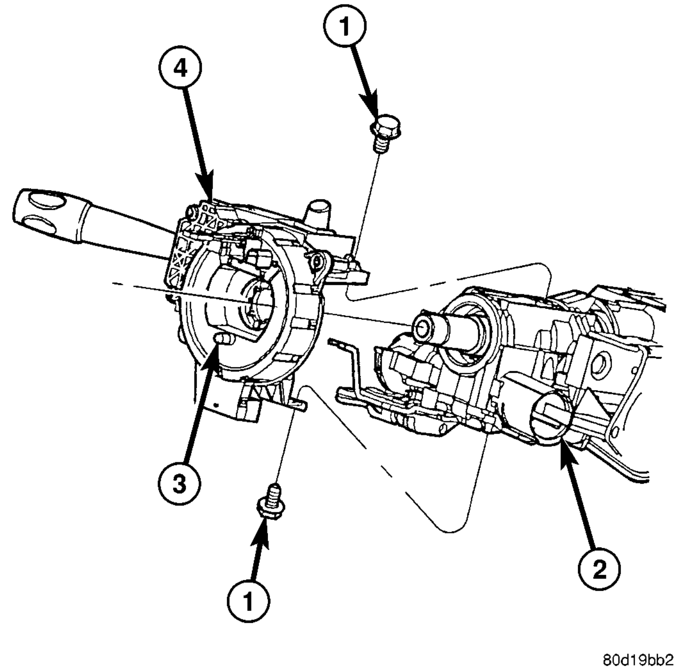


Fig. 15 MULTIFUNCTION SWITCH

1 - SCREW
2 - COLUMN
3 - CLOCK SPRING
4 - MULTI - FUNCTION SWITCH

(6) Remove the screws retaining the clock spring to the multifunction switch.

INSTALLATION

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO THE ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

(1) Install the clock spring on the multifunction switch.

(2) Position the switch on to the steering column.

(3) Install the retaining screws (Fig. 15).

(4) Connect the wire harness connector.

(5) Install the upper, lower steering column shrouds and the steering wheel. Refer to Steering, Column, Shroud, Installation.

(6) Connect the battery negative cable.

PARK LAMP RELAY

DESCRIPTION

The park lamp relay is located in the Power Distribution Center (PDC) of the vehicle. The park lamp

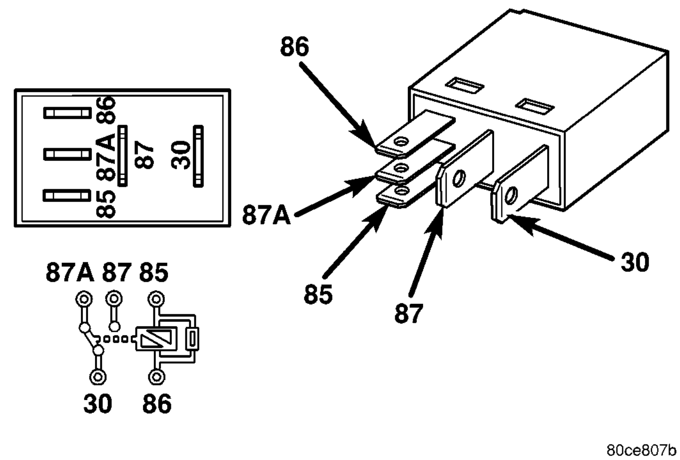


Fig. 16 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

relay is a conventional International Standards Organization (ISO) micro relay (Fig. 16). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

The park lamp relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

The park lamp relay is an electromechanical switch that uses a low current input from the Front Control Module (FCM) to control a high current output to the park lamps. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The park lamp relay terminals are connected to the vehicle electrical system through a connector in the Junction Block (JB). The inputs and outputs of the headlamp low beam relay include:

• **Common Feed Terminal -** The common feed terminal (30) is connected to the park lamps through

PARK LAMP RELAY (Continued)

the park lamp relay output circuit and provides ground to the park lamps when the relay is de-energized, and battery current to the park lamps whenever the relay is energized.

- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Front Control Module (FCM) through a park lamp relay control circuit. The FCM controls park lamp operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the PDC through a fused B(+) circuit.
- **Normally Open Terminal** - The normally open terminal (87) receives battery current at all times from a fuse in the Power Distribution Center (PDC) through a fused B(+) circuit.
- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to ground at all times.

The park lamp relay can be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - PARK LAMP RELAY

The park lamp relay (Fig. 17) is located in the Power Distribution Center (PDC). Refer to the appropriate wiring information.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the park lamp relay from the PDC.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 8 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

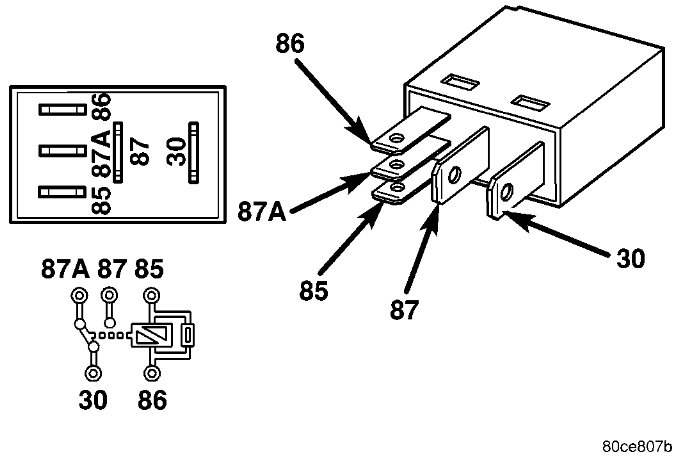


Fig. 17 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the Power Distribution Center (PDC) cover.

(3) Remove the park lamp relay by grasping it firmly and pulling it straight out from the receptacle in the PDC.

PARK LAMP RELAY (Continued)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, FRONT IMPACT SENSORS, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the park lamp relay to the proper receptacle in the Power Distribution Center (PDC).
(2) Align the park lamp relay terminals with the terminal cavities in the PDC.
(3) Press firmly and evenly on the top of the park lamp relay until the terminals are fully seated in the PDC.
(4) Install the PDC cover.
(5) Reconnect the battery negative cable.

PARK/TURN SIGNAL LAMP

REMOVAL

(1) Disconnect and isolate the negative battery cable.
(2) Remove the headlamp unit.(Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL).
(3) Seperate the socket from the headlamp unit.
(4) Release the bulb socket locking tabs and seperate the bulb from the socket (Fig. 18).

INSTALLATION

(1) Install the bulb into the socket.
(2) Install the socket into the headlamp unit.
(3) Install the headlamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION).
(4) Connect the negative battery cable.

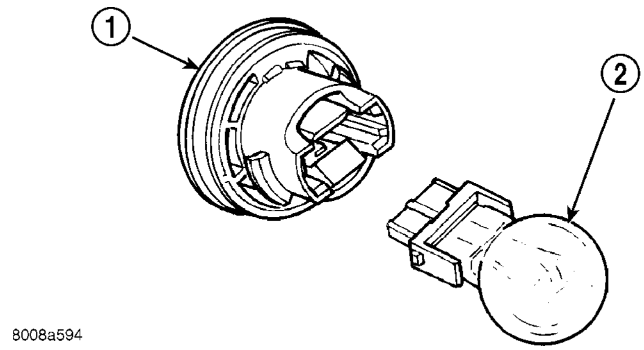


Fig. 18 Pull Bulb From Socket

1 - SOCKET
2 - BULB

TAIL LAMP

REMOVAL

(1) Disconnect and isolate the negative battery cable.
(2) Remove the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - REMOVAL).
(3) Remove the bulb back plate from the tail lamp unit.
(4) Release the bulb locking tabs and remove the bulb from the back plate (Fig. 18).

INSTALLATION

(1) Install the bulb into the back plate.
(2) Install the bulb back plate to the tail lamp unit.
(3) Install the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - INSTALLATION).
(4) Connect the negative battery cable.

TAIL LAMP UNIT

REMOVAL

(1) Lower the tail gate.
(2) Remove the screws
(3) Disengage the taillamp unit from the body panel.
(4) Disconnect the electrical connector (Fig. 19).

INSTALLATION

(1) Connect the wiring harness connector.
(2) Position the taillamp unit into the body panel.
(3) Install the screws (Fig. 19).

TAIL LAMP UNIT (Continued)

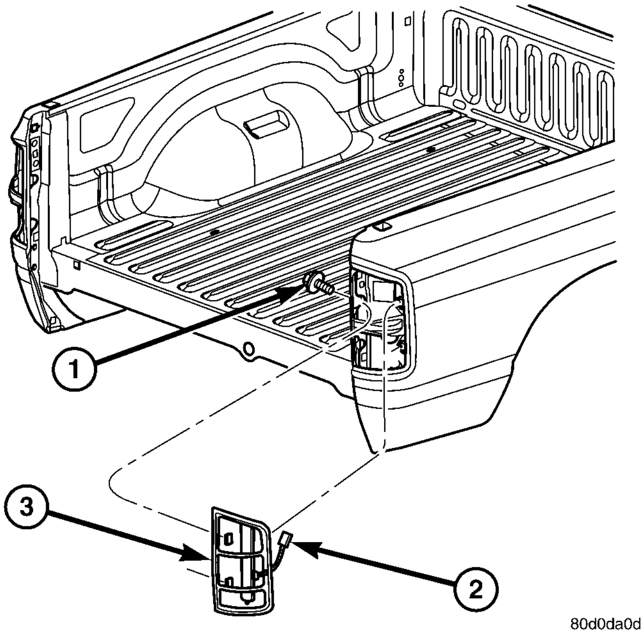


Fig. 19 TAIL LAMP UNIT

1 - SCREW
2 - ELECTRICAL CONNECTOR
3 - TAILLAMP UNIT

TRAILER TOW WIRING

DESCRIPTION

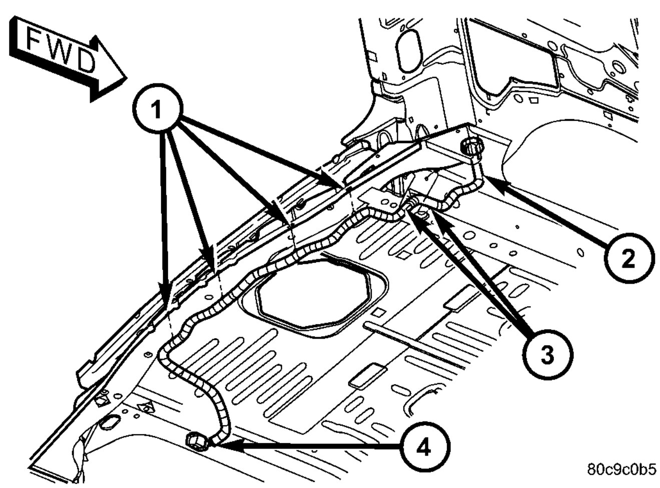


Fig. 20 Trailer Tow Wiring

1 - RETAINER CLIP (4)
2 - REAR BODY HARNESS (TRAILER TOW TAKE OUT)
3 - RETAINER CLIP (2)
4 - WIRE HARNESS CONNECTOR

Vehicles equipped with an optional factory-installed trailer towing package have a rear body wire harness that includes an integral trailer tow wiring take out that connects to a heavy duty, sealed, 7-pin trailer tow connector located in the rear bumper (Fig. 20). This harness includes an adapter harness that adapts the 7-pin trailer tow connector to a standard, light-duty, 4-pin trailer tow connector. Refer to the appropriate wiring information.

TURN LAMP

REMOVAL

(1) Disconnect and isolate the negative battery cable.
(2) Remove the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - REMOVAL).
(3) Remove the bulb back plate from the tail lamp unit.
(4) Separate the bulb from the lamp bar.

INSTALLATION

(1) Install the bulb into the back plate.
(2) Install the bulb back plate to the tail lamp unit.
(3) Install the tail lamp unit (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - INSTALLATION).
(4) Connect the negative battery cable.

UNDERHOOD LAMP

REMOVAL

(1) Disconnect and isolate the battery negative cable.
(2) Insert a small flat blade in the access slot between the lamp base and lamp lens.
(3) Pry the lamp lens upward and remove the lamp lens (Fig. 21).
(4) Depress the bulb terminal inward (Fig. 22) to release the bulb.

INSTALLATION

(1) Engage the replacement bulb wire loop to the terminal closest to the lamp base wire connector (Fig. 22).
(2) Depress the opposite terminal inward and engage the remaining bulb wire loop.
(3) Position the lamp lens on the lamp base and press into place (Fig. 21).
(4) Connect the battery negative cable.

UNDERHOOD LAMP UNIT

REMOVAL

(1) Disconnect and isolate the battery negative cable.

UNDERHOOD LAMP UNIT (Continued)

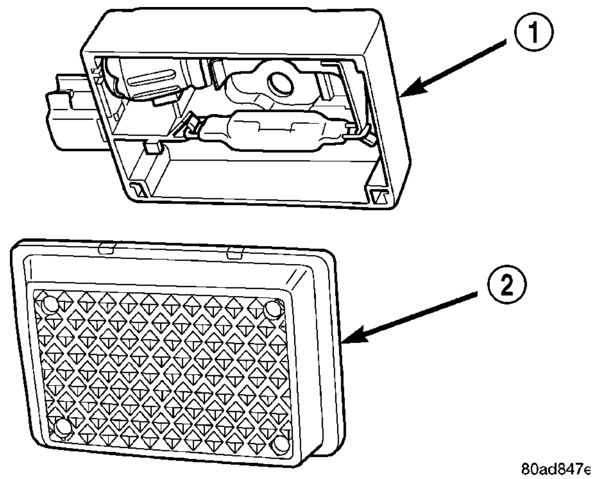


Fig. 21 Underhood Lamp Lens

1 - LAMP
2 - LAMP LENS

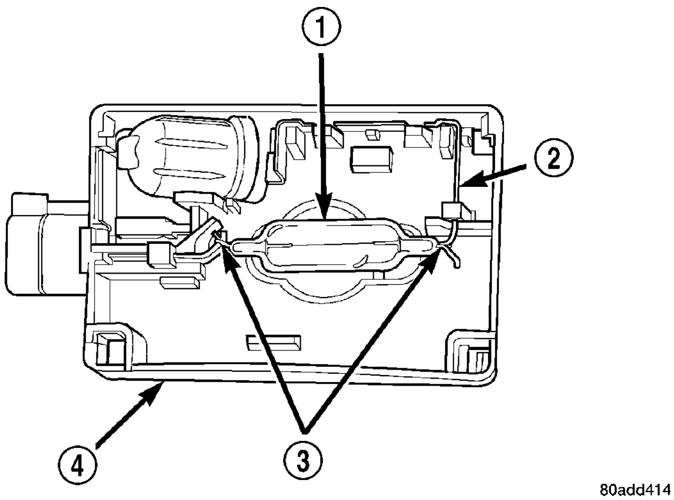


Fig. 22 Underhood Lamp Bulb

1 - BULB
2 - DEPRESS TERMINAL INWARD
3 - BULB WIRE LOOP
4 - LAMP BASE

(2) Disconnect the wire harness connector from the lamp.

(3) Remove lamp lens.

(4) Remove bulb.

(5) Remove screw attaching underhood lamp to the inner hood panel (Fig. 23).

(6) Separate underhood lamp from vehicle.

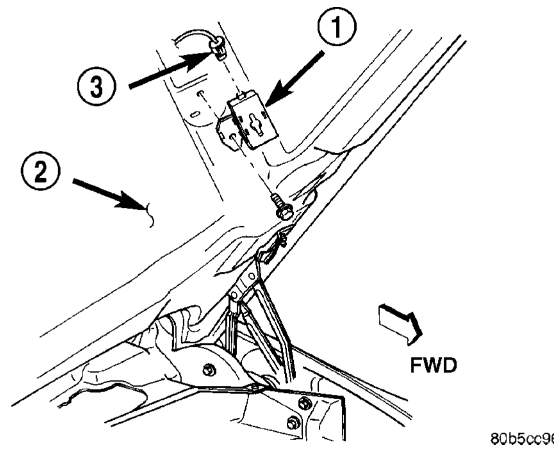


Fig. 23 Underhood Lamp

1 - UNDER HOOD LAMP
2 - HOOD
3 - CONNECTOR

INSTALLATION

(1) Install bulb.

(2) Install lamp lens.

(3) Position the underhood lamp on the hood inner panel.

(4) Install the attaching screw through the lamp and into the hood panel (Fig. 23). Tighten the screw securely.

(5) Fold lamp housing over and firmly press onto base to snap into place.

(6) Connect the wire harness connector to the lamp.

(7) Connect the battery negative cable.

LAMPS/LIGHTING - INTERIOR

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DOME LAMP

DESCRIPTION

The dome lamp is controlled by the instrument cluster which provides power at all times, regardless of the ignition switch position. The ground circuit for the lamp is switched through the integral dome lamp switch or through the door ajar switches via the instrument cluster.

The dome lamp lens and bulb are available for service replacement. If either of the lamp switch or bulb holders is faulty or damaged, the dome lamp assembly must be replaced.

For service of the dome lamp bulb, refer to the appropriate wiring information.

OPERATION

The dome lamp is activated by the door ajar switches via the instrument cluster. When all of the doors are closed, the lamp can be activated by depressing the lens. When any door is open, depressing the lamp lense to activate the lamp switch will not turn the lamps off.

The instrument cluster monitors the door ajar switches. When a door is open the instrument cluster grounds the low side drivers to turn on the lamp. Upon closing all doors, the instrument cluster initiates a 30 second timer. If any of the doors are opened during the “time out” cycle, the instrument cluster will reset the timer until all doors are closed. The instrument cluster will faid to off when the doors are closed and the ignition is turned ON, the time out expires or the power locks are activated.

REMOVAL

(1) Using a small flat blade, pry the left side (driver’s side) of the dome lamp lens downward from dome lamp.

(2) Allow the lens to hang down (Fig. 1), this will disengage the right side of the lamp (passenger’s side) from the headliner.

(3) Pull the right side of the lamp down and slide the lamp to the right (Fig. 2).

(4) Separate the lamp from the headliner.

(5) Disengage dome lamp wire connector from body wire harness.

(6) Separate dome lamp from vehicle.

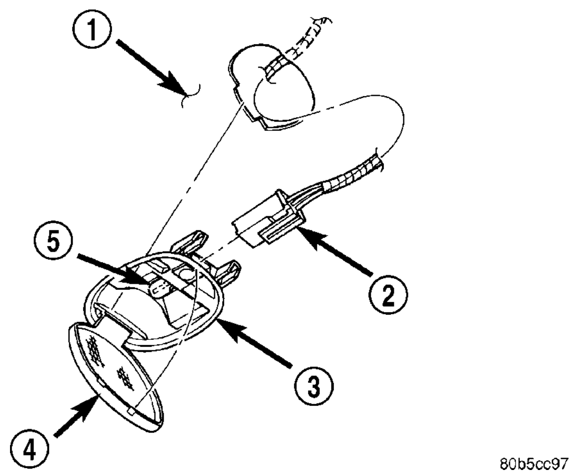

Fig. 1 Dome Lamp Lens

1 - HEADLINER
2 - CONNECTOR
3 - DOME LAMP
4 - LENS
5 - BULB

INSTALLATION

(1) Position dome lamp at headliner.

(2) Connect dome lamp wire connector to body wire harness.

(3) Position the left side of the lamp in the headliner opening and slide lamp to the left (Fig. 1).

(4) Push the right side of the lamp in the headliner opening and push the lamp lens up into the lamp to secure (Fig. 1).

DOME LAMP (Continued)

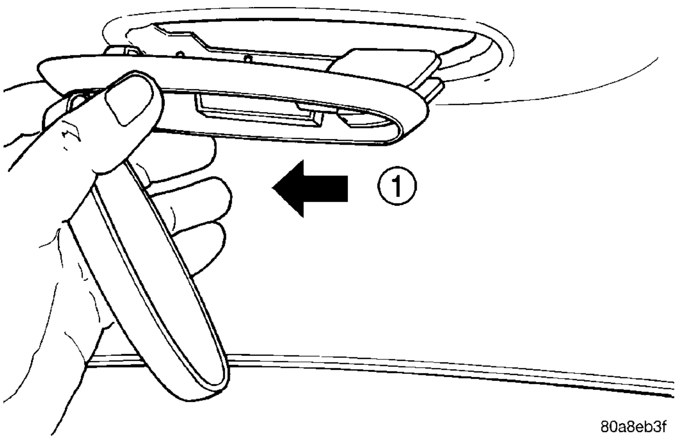

Fig. 2 Dome Lamp

1 - SLIDE LAMP

DOOR AJAR SWITCH

DESCRIPTION

The door ajar switches are integral to the door latches on each door. The switches close a path to ground for the Instrument Cluster when a door is opened.

The door ajar switches cannot be repaired and, if faulty or damaged, the door latch unit must be replaced. Refer to the Body section under Doors for the removal and installation procedure.

OPERATION

The door ajar switches close a path to ground for the Instrument Cluster when a door is opened. The passenger front door is connected in a parallel-series circuit between ground and the Instrument Cluster, while the driver side front door ajar switch is connected in series between ground and the Instrument Cluster to provide a unique input. The Instrument Cluster reads the switch status, then sends the proper switch status messages to other electronic modules over the Programmable Communications Interface (PCI) data bus network. The door ajar switches can be diagnosed using conventional diagnostic tools and methods. Refer to the Body section under Doors for the Removal and Installation procedures.

GLOVE BOX LAMP/SWITCH

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the glove box from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/ GLOVE BOX - REMOVAL) for the procedures.

(3) Reach through the glove box opening and behind the glove box lamp and switch mounting bracket to access the instrument panel wire harness connector on the glove box lamp and switch (Fig. 3).

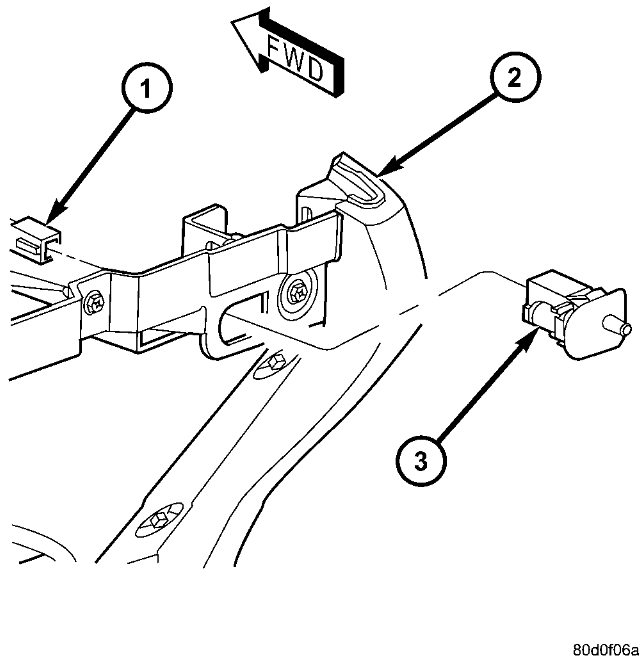

Fig. 3 Glove Box Lamp and Switch Remove/Install

1 - WIRE HARNESS CONNECTOR
2 - DASH BOARD
3 - GLOVE BOX SWITCH/LIGHT

(4) Disconnect the instrument panel wire harness connector from the connector receptacle on the back of the glove box lamp and switch unit.

(5) Reach through the glove box opening and behind the glove box lamp and switch mounting bracket to depress the retaining tabs on the top and bottom of the glove box lamp and switch housing.

(6) While holding the retaining tabs depressed, push the glove box lamp and switch unit out through the hole in the mounting bracket on the instrument panel glove box opening upper reinforcement.

(7) Remove the glove box lamp and switch unit from the instrument panel.

INSTALLATION

(1) Reach through the glove box opening and behind the glove box lamp and switch mounting bracket to feed the instrument panel wire harness connectors out through the hole in the glove box lamp and switch housing mounting bracket.

(2) Position the glove box lamp and switch unit to the instrument panel.

(3) Reconnect the instrument panel wire harness connector to the connector receptacle on the back of the glove box lamp and switch unit.

GLOVE BOX LAMP/SWITCH (Continued)

(4) Push the glove box lamp and switch unit into the hole in the mounting bracket on the instrument panel glove box opening upper reinforcement.

(5) Install the glove box onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION) for the procedures.

(6) Close the glove box.

(7) Reconnect the battery negative cable.

READING LAMP

DESCRIPTION

The overhead console in this vehicle is equipped with two individual reading and courtesy lamps. The lamp lenses are the only visible components of these lamps. Each lamp has its own switch, bulb, reflector and lens within the overhead console.

The overhead console reading and courtesy lamps are controlled by the instrument cluster which provides power at all times, regardless of the ignition switch position. The ground circuit for the lamps is switched through the integral reading and courtesy lamp switches or through the door ajar switches. Each lamp is designed and aimed to provide illumination that will be directed only to that side of the vehicle on which the lamp is located.

The reading and courtesy lamp lenses and bulbs are available for service replacement. The reading and courtesy lamp switches, bulb holders and wiring are only available as part of the overhead console wire harness. If either of the lamp switches or bulb holders is faulty or damaged, the entire overhead console wire harness assembly must be replaced.

For service of the reading and courtesy lamp bulbs, refer to the appropriate wiring information.

OPERATION

All reading and courtesy lamps located in the overhead console are activated by the door ajar switches via the instrument cluster. When all of the doors are closed, these lamps can be individually activated by depressing the corresponding lens. When any door is open, depressing the lamp lenses to activate the lamp switches will not turn the lamps off.

The instrument cluster monitors the door ajar switches. When a door is open the instrument cluster grounds the low side drivers to turn on the lamps. Upon closing all doors, the instrument cluster initiates a 30 second timer. If any of the doors are opened during the “time out” cycle, the instrument cluster will reset the timer until all doors are closed. The instrument cluster will faid to off when the doors are closed and the ignition is turned ON, the time out expires or the power locks are activated.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Insert a long, narrow, flat-bladed tool between the curved (outboard) edge of the reading and courtesy lamp lens and the overhead console housing (Fig. 4).

(3) Gently pry inward and downward against the lens until the latch tab in the center of the outboard edge of the reading and courtesy lamp lens is disengaged from the overhead console housing.

(4) Pull firmly on the lens toward the outboard side of the vehicle to disengage the two pivot tabs on the inboard edge of the reading and courtesy lamp lens are disengaged from the overhead console housing.

(5) Remove the reading and courtesy lamp lens from the overhead console housing.

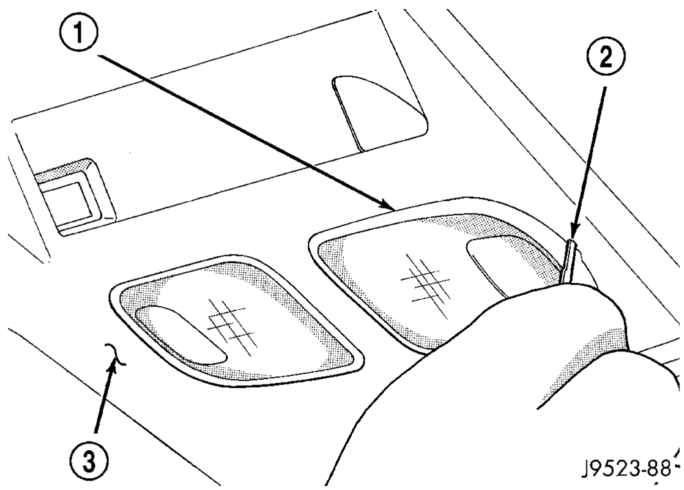

Fig. 4 Overhead Console Reading Lamp Bulb Removal

1 - LENS
2 - FLAT BLADE
3 - CONSOLE

INSTALLATION

(1) Position the reading and courtesy lamp lens onto the overhead console housing.

(2) Align the two pivot tabs on the inboard edge of the reading and courtesy lamp lens with the two pivot holes in the overhead console housing.

(3) Push firmly on the lens toward the inboard side of the vehicle to insert the two pivot tabs on the inboard edge of the reading and courtesy lamp lens into the two pivot holes in the overhead console housing.

(4) Pivot the lens back up into position and press upward firmly until the latch tab in the center of the outboard edge of the reading and courtesy lamp lens snaps back into the overhead console housing.

(5) Reconnect the battery negative cable.

MESSAGE SYSTEMS

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OVERHEAD CONSOLE

DESCRIPTION

Two different overhead consoles are available on DR models. The Electronic Vehicle Information Center (EVIC) (Fig. 1) or Compass Mini-Trip Computer (CMTC). All consoles are equipped with two reading/ courtesy lamps. The overhead console is mounted with screws and two snap clips to a molded plastic retainer bracket located above the headliner.

COMPASS DISPLAY

All the available overhead consoles on this model include Compass information. While in the compass/ temperature mode, the compass will display the direction in which the vehicle is pointed using the eight major compass headings (Examples: north is N, northeast is NE). The self-calibrating compass unit requires no adjusting in normal use. The only calibration that may prove necessary is to drive the vehicle at 5 to 8 kilometers-per-hour (3 to 5 miles-per-hour), on level ground in a square shaped pattern. This will reorient the compass unit to its vehicle.

The compass unit also will compensate for magnetism the body of the vehicle may acquire during normal use. However, avoid placing anything magnetic directly on the roof of the vehicle. Magnetic mounts for an antenna, a repair order hat, or a funeral procession flag can exceed the compensating ability of the compass unit if placed on the roof panel. Magnetic bit drivers used on the fasteners that hold the

OVERHEAD CONSOLE (Continued)

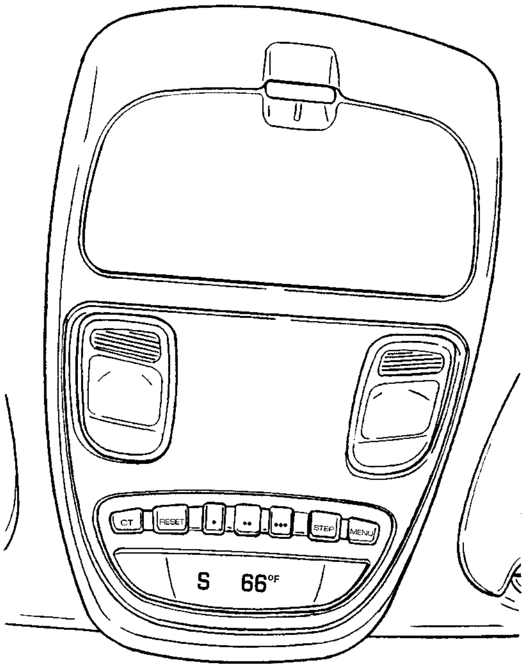

Fig. 1 DR OVERHEAD CONSOLE – EVIC

overhead console assembly to the roof header can also affect compass operation. If the vehicle roof should become magnetized, the demagnetizing and calibration procedures found in this section may be required to restore proper compass operation.

TEMPERATURE DISPLAY

All the available overhead consoles on this model include Temperature information. The temperature displays the outside ambient temperature in whole degrees. The temperature display can be toggled from Fahrenheit to Celsius by selecting the desired U.S./Metric option from the customer programmable features. The displayed temperature is not an instant reading of conditions, but an average temperature. It may take the temperature display several minutes to respond to a major temperature change, such as driving out of a heated garage into winter temperatures.

When the ignition switch is turned to the Off position, the last displayed temperature reading stays in the electronic control modules, (CMTC, EVIC) memory. When the ignition switch is turned to the On position again, the electronic module will display the memory temperature for one minute; then update the display to the current average temperature reading within five minutes.

The temperature function is supported by an ambient temperature sensor. This sensor is mounted outside the passenger compartment near the front and center of the vehicle, and is hard wired to the Front Control Module (FCM). The FCM sends temperature status messages to the module over the J1850 PCI data bus circuit. For more information on the ambient temperature sensor, refer to Ambient Temperature Sensor later in this section.

Following are general descriptions of the major components used in the overhead console. Refer to Wiring Diagrams for complete circuit schematics.

OPERATION

Refer to the vehicle Owner's Manual for specific operation of each overhead console and its systems.

DIAGNOSIS AND TESTING - OVERHEAD CONSOLE

If the problem with the overhead console is an inaccurate or scrambled display, refer to **SELF-DIAGNOSTIC TEST** later in this text. If the problem with the overhead console is incorrect Vacuum Fluorescent Display (VFD) dimming levels, use a DRB III® scan tool and the proper Diagnostic Procedures manual to test for the correct dimming message inputs being received from the Body Control Module (BCM) or Front Control Module (FCM) over the J1850 Programmable Communications Interface (PCI) data bus circuit. If the problem is a no-display condition, use the following procedure. For complete circuit diagrams, refer to **Overhead Console** in the Wiring Diagrams section of the service manual.

(1) Remove the overhead console from the headliner (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(2) Check for battery voltage at the overhead console electrical connector. Refer to Wiring for connector information. If OK, go to Step 3. If not OK, Check for battery voltage at the appropriate B(+) fuse in the integrated power module, repair the open fused B(+) circuit as required.

(3) Turn the ignition switch to the On position. Check the fused ignition switch output circuit(s) at the overhead console electrical connector. If OK, go to Step 4. If not OK, repair the open or shorted circuit as required.

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the overhead console electrical connector and a good ground. There should be continuity. If OK, refer to **SELF-DIAGNOSTIC TEST** below for further diagnosis of the electronics module and the J1850 PCI data bus circuit. If not OK, repair the open ground circuit as required.

SELF-DIAGNOSTIC TEST

A self-diagnostic test is built-in to the module to determine that the electronics module is operating properly, and that all the J1850 PCI data bus messages are being received for proper operation. To perform the self-diagnostic test proceed as follows:

OVERHEAD CONSOLE (Continued)

(1) With the ignition switch in the Off position, simultaneously depress and hold the **STEP and RESET buttons**.

(2) Turn the ignition switch to the On position.

(3) Following completion of the test, the electronics module will display one of the following messages:

a. **Pass Self Test (EVIC only), PASS (CMTC) -** The electronics module is working properly.

b. **Failed Self Test (EVIC only), FAIL (CMTC) -** The electronics module has an internal failure. The electronics module is faulty and must be replaced.

c. **Failed J1850 Communication (EVIC only), BUS (CMTC) -** The electronics module is not receiving proper message input through the J1850 PCI data bus circuit. This can result from one or more faulty electronic modules in the vehicle, or from a faulty PCI data bus. The use of a DRB III® scan tool and the proper Diagnostic Procedures manual are required for further diagnosis.

NOTE: If the compass functions, but accuracy is suspect, it may be necessary to perform a variation adjustment. This procedure allows the compass unit to accommodate variations in the earth's magnetic field strength, based on geographic location. Refer to Compass Variation Adjustment in the Standard Procedures section of this group.

NOTE: If the compass reading displays dashes, and only "CAL" appears in the display, demagnetizing may be necessary to remove excessive residual magnetic fields from the vehicle. Refer to Compass Demagnetizing in the Standard Procedures section of this group.

STANDARD PROCEDURE

STANDARD PROCEDURE - READING/ COURTESY LAMP REPLACEMENT

(1) Open hood, disconnect and isolate the negative battery cable.

(2) Remove the reading/courtesy lamp lens. Using a trim stick, gently pry the forward edge of the reading/courtesy lamp lens outward.

(3) Remove the reading/courtesy lamp socket from the overhead console. Rotate the reading/courtesy lamp socket one quarter turn counter clockwise.

(4) Remove the lamp and socket assembly.

(5) Reverse the above procedure to install.

STANDARD PROCEDURE - MODULE LENS REPLACEMENT

(1) Remove the overhead console (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(2) Remove the electronics module from the overhead console. Refer to the procedure later in this section.

(3) Unsnap the lens from the module and replace lens as necessary.

STANDARD PROCEDURE - MODULE LAMP REPLACEMENT

(1) Remove the overhead console (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(2) Using a flat blade screwdriver twist out socket/ lamp (Fig. 2).

(3) Replace lamp(s) as necessary.

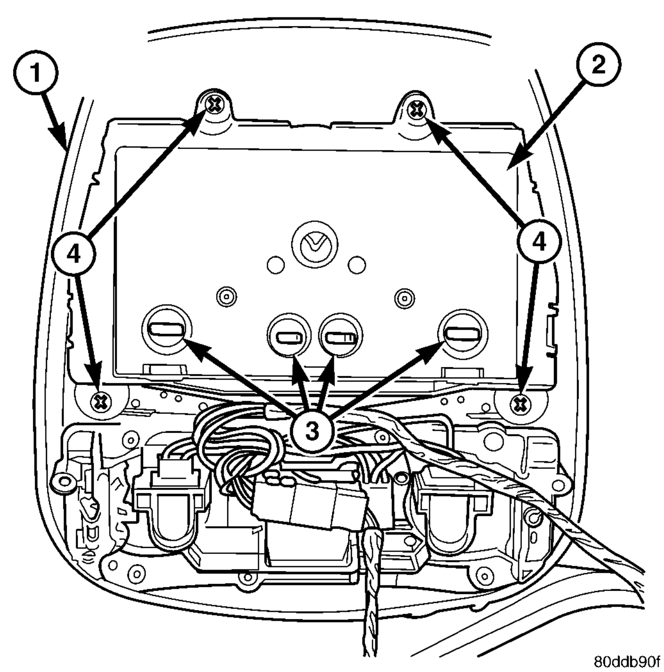

Fig. 2 Top of Overhead Console

1 - OVERHEAD CONSOLE HOUSING
2 - EVIC/CMTC MODULE
3 - ILLUMINATION LAMPS
4 - MODULE RETAINING SCREWS

STANDARD PROCEDURE - COMPASS CALIBRATION

CAUTION: Do not place any external magnets, such as magnetic roof mount antennas, in the vicinity of the compass. Do not use magnetic tools when servicing the overhead console.

OVERHEAD CONSOLE (Continued)

The electronic compass unit features a self-calibrating design, which simplifies the calibration procedure. This feature automatically updates the compass calibration while the vehicle is being driven. This allows the compass unit to compensate for small changes in the residual magnetism that the vehicle may acquire during normal use. If the compass readings appear to be erratic or out of calibration, perform the following calibration procedure. Also, new service replacement Electronic Modules (EVIC, CMTC) must have their compass calibrated using this procedure. Do not attempt to calibrate the compass near large metal objects such as other vehicles, large buildings, or bridges; or, near overhead or underground power lines.

NOTE: Whenever the compass is calibrated manually, the variance number must also be reset. Refer to Compass Variation Adjustment in this group.

To calibrate the compass manually proceed as follows:

(1) Turn the ignition switch to the On position. If the compass/temperature data is not currently being displayed, momentarily depress and release the C/T push button to reach the compass/temperature display.

(2) Depress the RESET push button and hold the button down until “CAL” appears in the display. This takes about ten seconds, and appears about five seconds after “VAR = XX” is displayed.

(3) Release the RESET push button.

(4) Drive the vehicle on a level surface, away from large metal objects and power lines, through three or more complete turns at between five and eight kilometers-per-hour (three and five miles-per-hour) in not less than 48 seconds. The “CAL” message will disappear from the display to indicate that the compass is now calibrated.

NOTE: If the “CAL” message remains in the display, either there is excessive magnetism near the compass, or the unit is faulty. Repeat the calibration procedure one more time.

NOTE: If the wrong direction is still indicated in the compass display, the area selected for calibration may be too close to a strong magnetic field. Repeat the calibration procedure in another location.

STANDARD PROCEDURE - COMPASS DEMAGNETIZING

A degaussing tool (Special Tool 6029) is used to demagnetize, or degauss, the overhead console forward mounting screw and the roof panel above the overhead console. Equivalent units must be rated as continuous duty for 110/115 volts and 60 Hz. They must also have a field strength of over 350 gauss at 7 millimeters (0.25 inch) beyond the tip of the probe.

To demagnetize the roof panel and the overhead console forward mounting screw, proceed as follows:

(1) Be certain that the ignition switch is in the Off position, before you begin the demagnetizing procedure.

(2) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(3) Slowly approach the head of the overhead console mounting screw with the degaussing tool connected.

(4) Contact the head of the screw with the plastic coated tip of the degaussing tool for about two seconds.

(5) With the degaussing tool still energized, slowly back it away from the screw. When the tip of the tool is at least 61 centimeters (2 feet) from the screw head, disconnect the tool.

(6) Place a piece of paper approximately 22 by 28 centimeters (8.5 by 11 inches), oriented on the vehicle lengthwise from front to rear, on the center line of the roof at the windshield header (Fig. 3). The purpose of the paper is to protect the roof panel from scratches, and to define the area to be demagnetized.

(7) Connect the degaussing tool to an electrical outlet, while keeping the tool at least 61 centimeters (2 feet) away from the compass unit.

(8) Slowly approach the center line of the roof panel at the windshield header, with the degaussing tool connected.

(9) Contact the roof panel with the plastic coated tip of the degaussing tool. Be sure that the template is in place to avoid scratching the roof panel. Using a slow, back-and-forth sweeping motion, and allowing 13 millimeters (0.50 inch) between passes, move the tool at least 11 centimeters (4 inches) to each side of the roof center line, and 28 centimeters (11 inches) back from the windshield header.

(10) With the degaussing tool still energized, slowly back it away from the roof panel. When the tip of the tool is at least 61 centimeters (2 feet) from the roof panel, disconnect the tool.

(11) Calibrate the compass and adjust the compass variance (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - STANDARD PROCEDURE).

STANDARD PROCEDURE - COMPASS VARIATION ADJUSTMENT

Compass variance, also known as magnetic declination, is the difference in angle between magnetic north and true geographic north. In some geographic locations, the difference between magnetic and geo-

OVERHEAD CONSOLE (Continued)

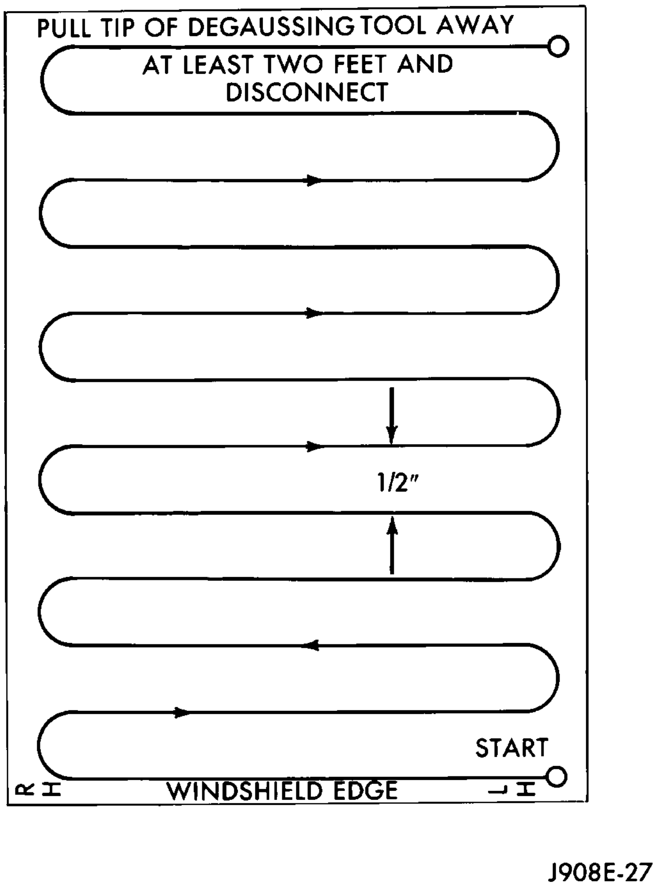

Fig. 3 Roof Demagnetizing Pattern

graphic north is great enough to cause the compass to give false readings. If this problem occurs, the compass variance setting may need to be changed.

To set the compass variance:

(1) Using the Variance Settings map, find your geographic location and note the zone number (Fig. 4).

(2) Turn the ignition switch to the On position. If the compass/temperature data is not currently being displayed, momentarily depress and release the C/T push button to reach the compass/temperature display.

(3) Depress the **RESET** push button and hold the button down until "VAR = XX" appears in the display. This takes about five seconds.

(4) Release the **RESET** push button. "VAR =XX " will remain in the display. "XX" equals the current variance zone setting.

(5) Depress and release the **STEP** push button to step through the zone numbers, until the zone number for your geographic location appears in the display.

(6) Depress and release the **RESET** push button to enter the displayed zone number into the EVIC/CMTC module memory.

(7) Confirm that the correct directions are now indicated by the compass.

REMOVAL

OVERHEAD CONSOLE REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Remove the overhead console retaining screws, located in the sunglass storage bin.

(3) Using your fingertips, grasp the sides of the overhead console and pull straight down evenly to disengage the two snap clips at the front of the unit.

(4) Lower the overhead console far enough to access the wire harness connectors.

(5) Disconnect the EVIC, CMTC electronic module and the reading/courtesy lamps electrical connectors.

(6) Remove the overhead console from the vehicle.

INSTALLATION

(1) Position the overhead console in the vehicle.

(2) Connect the EVIC, CMTC electronic module and the reading/courtesy lamps electrical connectors.

(3) Grasp the sides of the overhead console and push straight up evenly to engage the two snap clips at the rear of the unit.

(4) Install the overhead console retaining screw, located in the front of console. Torque the screw to 1.2 N·m (10 in. lbs.).

(5) Connect the negative battery cable.

OVERHEAD CONSOLE (Continued)

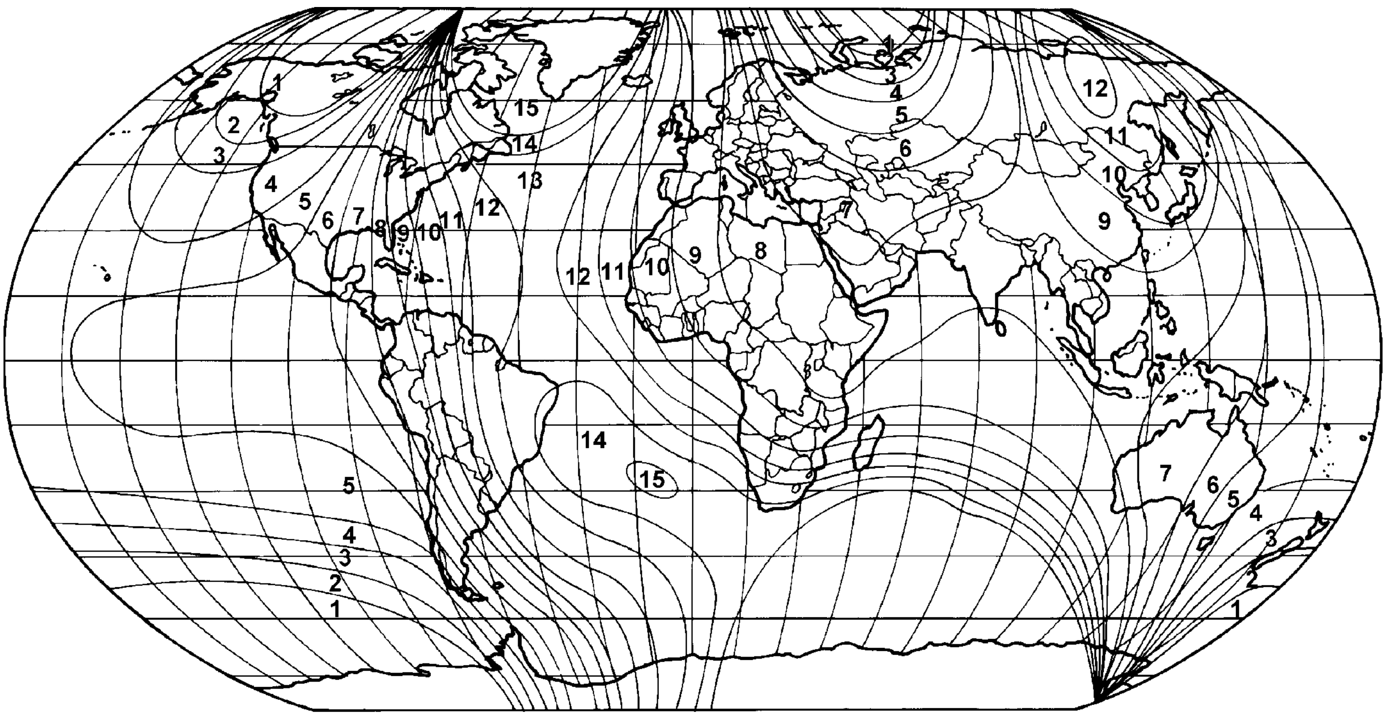

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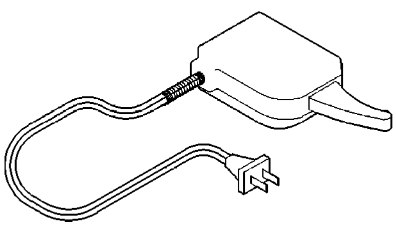
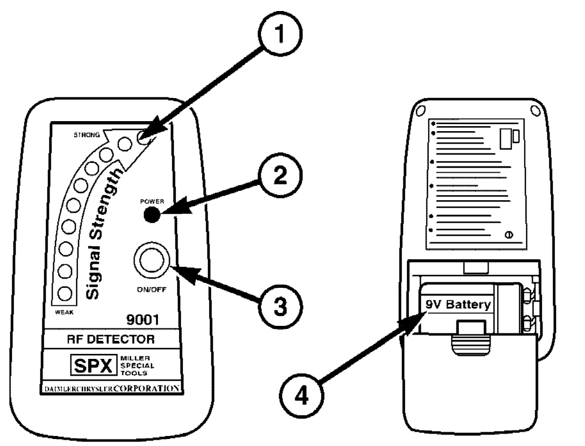
Fig. 4 Variance Settings

SPECIAL TOOLS

OVERHEAD CONSOLE



DEGAUSSING TOOL #6029



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RADIO FREQUENCY DETECTOR #9001

COMPASS/MINI-TRIP COMPUTER

DESCRIPTION

The Compass Mini-Trip Computer (CMTC) is a module located in the overhead console. The CMTC is equipped with a mini-trip feature. The CMTC consists of a electronic control module with a vacuum fluorescent display (VFD) and function switches. The CMTC consists of a electronic module that displays compass, trip computer, and temperature features. Actuating the STEP push button will cause the CMTC to change mode of operation when the ignition is ON. Example:

- Average miles per gallon (ECO)
- Distance to empty (DTE)
- Trip odometer (ODO)
- Elapsed time (ET)
- Off

Actuating the C/T push button will cause the CMTC to change to Compass/Temperature display.

COMPASS/MINI-TRIP COMPUTER (Continued)

OPERATION

The Compass Mini-Trip Computer module in the overhead console has buttons used to select various functions. The CMTC selector buttons will not operate until the ignition is in the RUN position.

When the ignition switch is first turned to the RUN position the CMTC display;

- Returns to the last mode setting selected before the ignition was last switched OFF.

DIAGNOSIS AND TESTING - COMPASS MINI-TRIP COMPUTER

Compass Mini-Trip Computer (CMTC) data is obtained from other electronic modules (CCN, FCM and JTEC) on the J1850 Data Bus circuit. The CMTC will display dashes (- -) for any of the screens it did not receive the bus messages. The label corresponding to the missing information will be lit. If no compass mini-trip computer data is displayed, check the J1850 Data Bus circuit communications and the other modules.

Refer to Overhead Console Diagnosis and Testing for instructions on performing a CMTC module Self-Diagnostic Test. The DRB III® is recommended for checking the J1850 Data Bus circuit and the other modules. Perform the CMTC self diagnosis before replacing the CMTC module.

REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Remove the overhead console from the headliner.(Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

(3) Remove the screws holding Compass Mini-Trip Computer module in the overhead console (Fig. 5).

(4) Disconnect the CMTC module electrical connector. Depress the retaining tab and pull straight apart.

(5) Remove CMTC module from console assembly.

INSTALLATION

(1) Position the compass mini-trip computer module in the overhead console.

(2) Install the screws holding the compass mini-trip computer module in the overhead console.

(3) Connect the module electrical connector.

(4) Install the overhead console on the headliner(Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

(5) Connect the negative battery cable.

(6) Check CMTC module function.

NOTE: If a new module has been installed, the compass will have to be calibrated and the variance set. Refer to Compass Variation Adjustment and Compass Calibration in the Standard Procedures section of this group for the procedures.

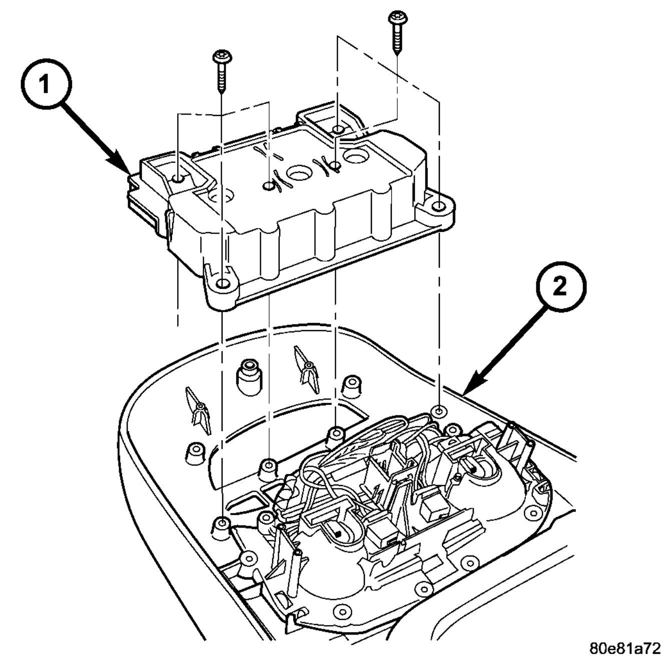

Fig. 5 OVERHEAD CONSOLE MODULE REMOVAL

1 - COMPASS MINI-TRIP COMPUTER MODULE
2 - OVERHEAD CONSOLE

ELECTRONIC VEHICLE INFO CENTER

DESCRIPTION

The Electronic Vehicle Information Center (EVIC) is a module located in the overhead console on some models. The EVIC module features a large Vacuum Fluorescent Display (VFD) screen for displaying information, and back-lit push button switches labeled C/T (compass/temperature), RESET, STEP, and MENU.

The EVIC module contains a central processing unit and interfaces with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) J1850 data bus circuit. The PCI data bus circuit allows the sharing of sensor information. This helps to reduce wire harness complexity, reduce internal controller hardware, and reduce component sensor current loads. At the same time, this system provides increased reliability, enhanced diagnostics, and allows the addition of many new feature capabilities.

The EVIC “Menu” push button provides the vehicle operator with a user interface, which allows the selection of several optional customer programmable electronic features to suit individual preferences.

ELECTRONIC VEHICLE INFO CENTER (Continued)

Refer to **ELECTRONIC VEHICLE INFORMATION CENTER PROGRAMMING** in the Standard Procedures section of this group for more information on the customer programmable feature options.

If the vehicle is equipped with the optional universal transmitter transceiver, the EVIC will also display messages and an icon indicating when the universal transmitter transceiver is being trained, which of the three transmitter buttons is transmitting, and when the transceiver is cleared.

Data input for all EVIC functions, including VFD dimming level, is received through the J1850 PCI data bus circuit. The EVIC module uses its internal programming and all of its data inputs to calculate and display the requested data. If the data displayed is incorrect, perform the self-diagnostic tests as described in this group. If these tests prove inconclusive, the use of a DRB III® scan tool and the proper Diagnostic Procedures manual are recommended for further testing of the EVIC module and the J1850 PCI data bus circuit.

The EVIC module cannot be repaired, and is available for service only as a unit. If any part is faulty or damaged, the complete EVIC module must be replaced.

OPERATION

The Electronic Vehicle Information Center is wired to both constant 12v and ignition switched sources of battery current so that some of its features remain operational at any time, while others may only operate with the ignition switch in the On position. When the ignition switch is turned to the On position, the EVIC module display will return to the last function being displayed before the ignition was turned to the Off position.

The compass/temperature display is the normal EVIC display. With the ignition switch in the On position, momentarily depressing and releasing the C/T (compass/temperature) push button switch will cause the EVIC to return to the compass/temperature display mode from any other mode. While in the compass/temperature display mode, momentarily depressing and releasing the Step push button will step through the available trip computer display options.

The EVIC trip computer features several functions that can be reset. The functions that can be reset are: average fuel economy, trip odometer and elapsed time. With the ignition switch in the On position and with one of the functions of the trip computer that can be reset currently displayed, depressing the Reset push button twice within three seconds will perform a global reset, and all of the trip computer information that can be reset will be reset to zero. With the ignition switch in the On position and the function that is to be reset currently displayed, momentarily depressing and releasing the Reset push button once will perform a local reset, and only the value of the displayed function will be reset to zero. A global or local reset will only occur if the function currently displayed is a function that can be reset. The distance to service function can also be reset using the local reset method, but it will reset back to the Service Interval distance that is set in the EVIC programmable features mode. Refer to **ELECTRONIC VEHICLE INFORMATION CENTER PROGRAMMING** in the Standard Procedures section of this group for more information on setting the Service Interval.

For more information on the features, control functions and setting procedures for the EVIC module, see the owner's manual in the vehicle glove box.

DIAGNOSIS AND TESTING - ELECTRONIC VEHICLE INFORMATION CENTER

Electronic Vehicle Information Center (EVIC) data is obtained from other electronic modules (CCN, FCM, JTEC) on the J1850 Data Bus circuit. The EVIC will display dashes (- -) for any of the screens it did not receive the bus messages. The label corresponding to the missing information will be lit. If no EVIC data is displayed, check the J1850 Data Bus circuit communications and the other modules. If the brightness level is improper check the J1850 Data Bus circuit.

Refer to Overhead Console Diagnosis and Testing for instructions on performing a EVIC module Self-Diagnostic Test. The DRB III® is recommended for checking the J1850 Data Bus circuit and other modules. Perform the EVIC self diagnosis before replacing the EVIC module.

STANDARD PROCEDURE - ELECTRONIC VEHICLE INFORMATION CENTER PROGRAMMING

EVIC PROGRAMMING MODE

Some vehicles are equipped with a Electronic Vehicle Information Center (EVIC) equipped overhead console. The Electronic Vehicle Information Center (EVIC) provides the vehicle operator with a user interface, which allows the selection of several optional customer programmable electronic features to suit individual preferences. The EVIC must be placed into its programming mode in order to view or change the programmable features. To enter the EVIC programming mode and to view or change the selected programmable features options, proceed as follows:

(1) Turn the ignition switch to the On position.

ELECTRONIC VEHICLE INFO CENTER (Continued)

(2) Momentarily depress and release the Menu push button to step through the programmable features list. Each programmable feature and its currently selected option will appear on the EVIC display in the sequence shown in the Programmable Features list that follows.

(3) Momentarily depress and release the Step push button to step through the available options for the programmable feature being displayed.

(4) The option that last appears in the display with a programmable feature before exiting the programming mode, becomes the newly selected programmable feature option.

(5) The EVIC exits the programming mode and returns to its normal operating mode when the C/T push button is depressed or when the end of the programmable features menu list is reached, whichever occurs first.

PROGRAMMABLE FEATURES

- **LANGUAGE? -** The options include English, Francaise, Deutsch, Italiana, or Espanol. The default is English. All EVIC display nomenclature, including the trip computer functions, warning messages and the programmable features appear in the selected language.
- **DISPLAY U.S. OR METRIC? -** The options include U.S. and M. The default is U.S. This feature toggles the trip computer temperature, fuel economy and odometer display readings between U.S. and metric units of measure.
- **SERVICE INTV. = -** The options include from 3200 to 12000 kilometers in 800 kilometer increments (2000 to 6000 miles in 500 mile increments). The default is 12000 kilometers (6000 miles). The selected distance becomes the interval at which the Perform Service warning message will be displayed by the EVIC. If a new distance is selected, a second programmable feature appears, **RESET SERVICE DISTANCE? -** The options include No and Yes. The default is Yes. When Yes is selected, the accumulated distance since the last previous Perform Service warning message will be reset to zero because the service interval has been changed. When No is selected, the distance until the next Perform Service warning message is reduced by the accumulated distance since the last previous message.
- **AUTO DOOR LOCKS? -** The options include Yes and No. The default is Yes. When Yes is selected, all doors lock automatically when vehicle speed reaches 25 kilometers-per-hour (15 miles-per-hour). If YES is selected, a second programmable feature appears, **AUTO UNLOCK ON EXIT? -** The options again include Yes and No. The default is No. When Yes is selected, following each Auto Door Lock event all doors will automatically unlock when the driver door is opened, if the vehicle is stopped and the transmission gear selector is in Park or Neutral. The Auto Door Unlock event will only occur once following each Auto Door Lock event.
- **REMOTE UNLOCK -** The options include Driver Door 1st and All Doors. The default is Driver Door 1st. When Diver Door 1st is selected, only the driver door unlocks when the Unlock button of the Remote Keyless Entry (RKE) transmitter is depressed once. The Unlock button of the RKE transmitter must be depressed twice to unlock all doors. When All Doors is selected, all doors unlock when the Unlock button of the RKE transmitter is depressed once.
- **SOUND HORN ON LOCK? -** The options include On and Off. The default is No. When Yes is selected, a short horn chirp will provide an audible confirmation when the RKE receiver recognizes a valid Lock signal from an RKE transmitter. When No is selected, no horn chirp will occur with the RKE Lock event. This feature may be selected independent of the **FLASH LIGHTS WITH LOCKS?** programmable feature.
- **FLASH LIGHTS WITH LOCKS? -** The options include Yes and No. The default is Yes. When Yes is selected, a single flash of the hazard warning lamps will provide an optical confirmation when the RKE receiver recognizes a valid Lock signal from an RKE transmitter, and two flashes of the same lamps will occur when the RKE receiver recognizes a valid Unlock signal from an RKE transmitter. When No is selected, no lamp flash will occur with the RKE Lock or Unlock event. This feature may be selected independent of the **SOUND HORN ON LOCK?** programmable feature.
- **HEADLAMP DELAY = -** The options include Off, 30 Sec, 60 Sec, and 90 Sec. The default is 90 Sec. When a time interval is selected, the headlamps will remain on for that length of time when the headlamps are turned off after the ignition is turned off, or if the Auto mode is selected on vehicles with the Auto Headlamps option. When Off is selected, the headlamp delay feature is disabled.
- **TRAIN REMOTE -** When this feature is selected the driver can choose to train up to four remote keyless entry transmitters. The options include Yes and No. The default is No. When Yes is selected and the MENU button is pressed the EVIC will display "PRESS REMOTE LOCK & UNLOCK THEN PRESS UNLOCK", followed by a chime to indicate the training sequence can commence. You have approximately 30 seconds to train up to four transmitters, after each transmitter is trained a chime will sound indicating that the training was successful. If remote link to memory is "YES" , the first transmitter trained will be associated with

ELECTRONIC VEHICLE INFO CENTER (Continued)

memory setting 1 and the second transmitter trained will be associated with memory setting 2. Additional transmitters will not be associated with a memory setting. When you have finished training the transmitters, press the menu button again and the EVIC will display "TRAIN DONE "X" TRAINED. If no transmitters are trained within approximately 30 seconds the EVIC will display "TRAIN TIMEOUT".

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the overhead console from the headliner.(Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL).

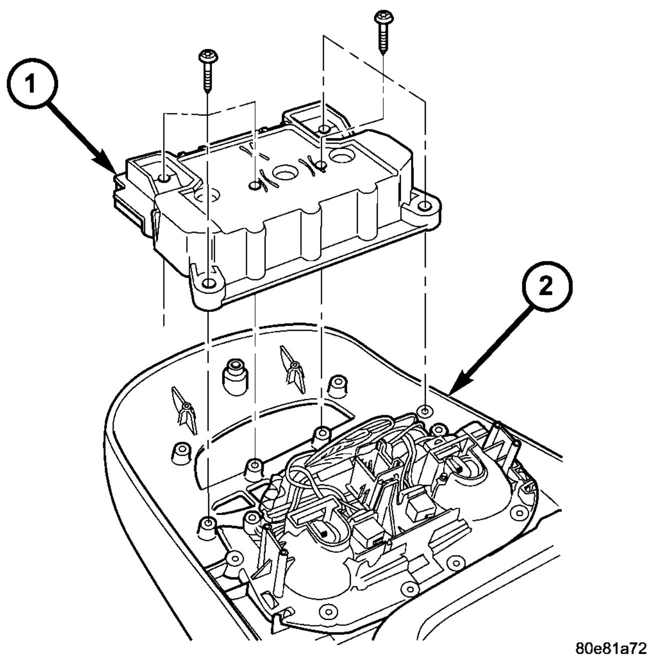

Fig. 6 OVERHEAD CONSOLE MODULE REMOVAL

1 - ELECTRONIC VEHICLE INFORMATION MODULE
2 - OVERHEAD CONSOLE

(3) Disconnect the EVIC module electrical connector. Depress the retaining tab and pull straight apart.

(4) Remove the screws holding the EVIC module in the overhead console (Fig. 6).

(5) Remove EVIC module from console assembly.

INSTALLATION

(1) Position the EVIC module in the overhead console.

(2) Install the screws holding the EVIC module in the overhead console.

(3) Connect the EVIC module electrical connector.

(4) Install the overhead console on the headliner(Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION).

(5) Connect the battery negative cable.

(6) Check EVIC module function.

NOTE: If a new EVIC module has been installed, the compass will have to be calibrated and the variance set. Refer to Compass Variation Adjustment and Compass Calibration in the Standard Procedures section of this group for the procedures.

AMBIENT TEMP SENSOR

DESCRIPTION

Ambient air temperature is monitored by the overhead console. The ambient temperature messages are received from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) J1850 data bus circuit. The FCM receives a hard wired input from the ambient temperature sensor (Fig. 7). The ambient temperature sensor is a variable resistor mounted to the underside of the hood, in the engine compartment.

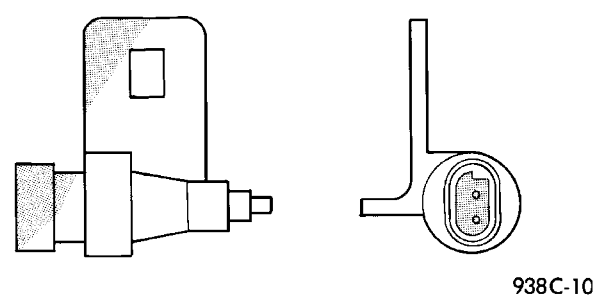

Fig. 7 Ambient Temperature Sensor - Typical

For more information on the front control module, refer to **Front Control Module** in the Electronic Control Modules section of this manual. For complete circuit diagrams, refer to **Wiring**. The ambient temperature sensor cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The ambient temperature sensor is a variable resistor that operates on a five-volt reference signal sent to it by the Front Control Module. The resistance in the sensor changes as temperature changes, changing the temperature sensor signal circuit voltage to the Front Control Module. Based upon the resistance in the sensor, the Front Control Module senses a specific voltage on the temperature sensor signal circuit, which it is programmed to correspond to a specific temperature. The Front Control Module

AMBIENT TEMP SENSOR (Continued)

then sends the proper ambient temperature messages to the EVIC, CMTC over the PCI J1850 data bus.

The temperature function is supported by the ambient temperature sensor, a wiring circuit, the Front Control Module, the Programmable Communications Interface (PCI) data bus, and a portion of the Electronics module. If any portion of the ambient temperature sensor circuit fails, the Front Control Module will self-diagnose the circuit.

For complete circuit diagrams, refer to **Wiring**.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AMBIENT TEMPERATURE SENSOR

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector.

(2) Measure the resistance of the ambient temperature sensor. At 24° C (75° F), the sensor resistance should be approximately 10.3 kilohms. At 30° C (86° F), the sensor resistance should be approximately 7.57 kilohms. The sensor resistance should decrease as the temperature rises. If OK, refer to **Diagnosis and Testing - Ambient Temperature Sensor Circuit** in this group. If not OK, replace the faulty ambient temperature sensor.

NOTE: The ambient temperature sensor is a very sensitive device. When testing, be certain the temperature sensor has had time to stabilize (room temperature) before attempting to read the sensor resistance. Failure to let the ambient temperature sensor temperature stabilize could result in a misleading test.

DIAGNOSIS AND TESTING - AMBIENT TEMPERATURE SENSOR CIRCUIT

(1) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Disconnect the ambient temperature sensor wire harness connector and the Front Control Module wire harness connector.

(2) Connect a jumper wire between the two terminals of the ambient temperature sensor wire harness connector.

(3) Check for continuity between the sensor return circuit and the ambient temperature sensor signal circuit cavities of the Front Control Module wire harness connector. There should be continuity. If OK, go to Step 4. If not OK, repair the open sensor return or signal circuit as required.

(4) Remove the jumper wire from the ambient temperature sensor wire harness connector. Check for continuity between the sensor return circuit cavity of the Front Control Module wire harness connector and a good ground. There should be no continuity. If OK, go to Step 5. If not OK, repair the shorted sensor return circuit as required.

(5) Check for continuity between the ambient temperature sensor signal circuit cavity of the Front Control Module wire harness connector and a good ground. There should be no continuity. If OK, refer to **Diagnosis and Testing - Overhead Console** in this group. If not OK, repair the shorted ambient temperature sensor signal circuit as required.

REMOVAL

(1) Open the hood.

(2) Disconnect and isolate the battery negative cable.

(3) Working on the underside of the hood, remove screw holding sensor to hood panel.

(4) Disconnect the sensor electrical connector and remove sensor from vehicle.

INSTALLATION

(1) Connect the sensor electrical connector.

(2) Working on the underside of the hood, install screw holding sensor to hood panel.

(3) Connect the battery negative cable.

(4) Close the hood.

UNIVERSAL TRANSMITTER

DESCRIPTION

Some DR models are equipped with a universal transmitter transceiver. The universal transmitter is integral to the Electronic Vehicle Information Center (EVIC) and the Compass Mini-Trip Computer (CMTC), which is located in the overhead console. The only visible component of the universal transmitter are the three transmitter push buttons centered between the modules push buttons located just rearward of the display screen in the overhead console. The three universal transmitter push buttons are identified with one, two or three light indicators so that they be easily identified.

Each of the three universal transmitter push buttons control an independent radio transmitter channel. Each of these three channels can be trained to transmit a different radio frequency signal for the remote operation of garage door openers, motorized gate openers, home or office lighting, security systems or just about any other device that can be equipped with a radio receiver in the 286 to 399 MegaHertz (MHz) frequency range for remote opera-

UNIVERSAL TRANSMITTER (Continued)

tion. The universal transmitter is capable of operating systems using either rolling code or non-rolling code technology.

The electronics module displays messages and a small house-shaped icon with one, two or three dots corresponding to the three transmitter buttons to indicate the status of the universal transmitter. The EVIC messages are:

- **Clearing Channels** - Indicates that all of the transmitter codes stored in the universal transmitter have been successfully cleared.
- **Channel “X” Training** - Indicates that the universal transmitter is in its transmitter learning mode.
- **Channel “X” Trained** - Indicates that the universal transmitter has successfully acquired a new transmitter code.
- **Channel “X” Transmitting** - Indicates that a trained universal transmitter button has been depressed and that the universal transmitter is transmitting.

The universal transmitter cannot be repaired, and is available for service only as a unit with the EVIC or CMTC modules. If any part of the universal transmitter is faulty or damaged, the complete EVIC or CMTC module must be replaced.

OPERATION

The universal transmitter operates on a non-switched source of battery current so the unit will remain functional, regardless of the ignition switch position. For more information on the features, programming procedures and operation of the universal transmitter, see the owner’s manual in the vehicle glove box.

DIAGNOSIS AND TESTING - UNIVERSAL TRANSMITTER

If the Universal Transmitter is inoperative, but the Electronic Vehicle Information Center (EVIC) is operating normally, see the owner’s manual in the vehicle glove box for instructions on training the Transmitter. Retrain the Transmitter with a known good transmitter as instructed in the owner’s manual and test the Transmitter operation again. If the unit is still inoperative, test the universal transmitter with Radio Frequency Detector special tool. If both the Transmitter and the EVIC module are inoperative, refer to **Electronic Vehicle Information Center Diagnosis and Testing** in this group for further diagnosis. For complete circuit diagrams, refer to **Wiring Diagrams**. (Fig. 8) as described below:

(1) Turn the Radio Frequency (RF) Detector ON. A “chirp” will sound and the green power LED will light. If the green LED does not light, replace the battery.

(2) Hold the RF detector within one inch of the TRAINED universal transmitter and press any of the transmitters buttons.

(3) The red signal detection LEDs will light and the tool will beep if a radio signal is detected. Repeat this test three times.

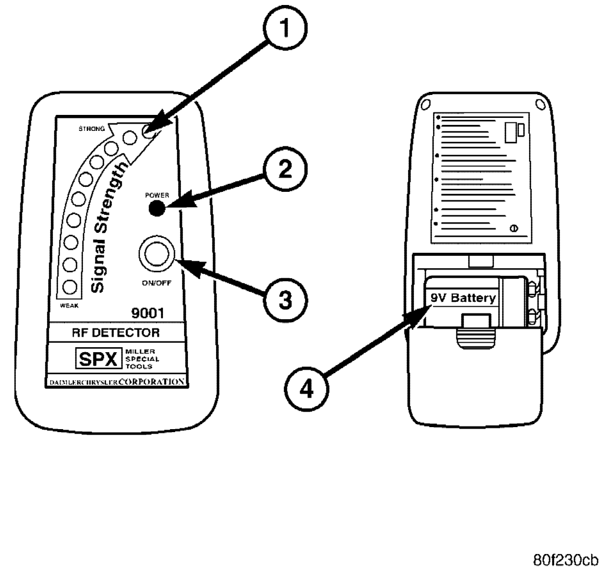

Fig. 8 RADIO FREQUENCY DETECTOR

1 - SIGNAL DETECTION LED’S
2 - POWER LED
3 - ON/OFF SWITCH
4 - 9V BATTERY

STANDARD PROCEDURE

STANDARD PROCEDURE - ERASING TRANSMITTER CODES

To erase the universal transmitter codes, simply hold down the two outside buttons until the display confirms the operation.

NOTE: Individual channels cannot be erased. Erasing the transmitter codes will erase ALL programmed codes.

STANDARD PROCEDURE - SETTING TRANSMITTER CODES

(1) Turn off the engine.

(2) Erase the codes by pressing the two outside buttons. Release the buttons when the display confirms the operation (about 20 seconds).

(3) Choose one of the three buttons to train. Place the hand-held transmitter within one inch of the uni-

UNIVERSAL TRANSMITTER (Continued)

versal transmitter and push the buttons on both transmitters.

(4) Release both buttons. Your universal transmitter is now “trained”. To train the other buttons, repeat Step 3 and Step 4. Be sure to keep your hand-held transmitter in case you need to retrain the universal transmitter.

REMOVAL

(1) For universal transmitter removal and installation procedure, (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE/COMPASS/MINI-TRIP COMPUTER - REMOVAL and INSTALLATION).

POWER SYSTEMS

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POWER LOCKS

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POWER LOCKS

DESCRIPTION

POWER LOCKS

A power operated door lock system is available factory-installed equipment on this model. The power lock system allows all of the doors to be locked or unlocked electrically by operating a switch on either front door trim panel. The power lock system receives non-switched battery current through a fuse in the Integrated Power Module (IPM), so that the power locks remain operational, regardless of the ignition switch position.

The instrument cluster locks the doors automatically when the vehicle is driven beyond the speed of 25.7 Km/h (15 mph), all doors are closed and the accelerator pedal is depressed. The rolling door lock feature can be disabled if desired.

This vehicle also offers several customer programmable features, which allows the selection of several optional electronic features to suit individual preferences.

The power lock system for this vehicle can also be operated remotely using the available Remote Key-

POWER LOCKS (Continued)

less Entry (RKE) system radio frequency transmitters, if equipped.

Certain functions and features of the power lock system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network. For proper diagnosis of these electronic modules or of the PCI data bus network, the use of a DRB III® scan tool and the appropriate diagnostic information are required.

CENTRAL LOCKING/UNLOCKING

The instrument cluster will lock all doors when a cylinder lock switch is activated in the “lock” position. When the instrument cluster receives an unlock command from one of the cylinder lock switches, it will unlock only that door. If the instrument cluster receives a second command within a 5 second period, it will unlock all the remaining doors. The illuminated entry will activate during door unlock.

ENHANCED ACCIDENT RESPONSE

Upon detection of an airbag deployment by way of the PCI bus, the instrument cluster will:

- Immediately disable the power door lock output.
- Unlock all doors by activating the door unlock output for approximately 300 milliseconds.
- After actuating the door unlock output, allow the door lock motors to be activated if the door lock input has been inactive (not erratic) for 2 seconds since the reception of the airbag deployment message.

REMOTE KEYLESS ENTRY

A Radio Frequency (RF) type Remote Keyless Entry (RKE) system is an available factory-installed option on this model. The RKE system allows the use of a remote battery-powered radio transmitter to signal the instrument cluster to actuate the power lock system. The RKE receiver operates on non-switched battery current through a fuse in the Integrated Power Module (IPM), so that the system remains operational, regardless of the ignition switch position.

The RKE transmitters are also equipped with a Panic button. If the Panic button on the RKE transmitter is depressed, the horn will sound and the exterior lights will flash on the vehicle for about three minutes, or until the Panic button is depressed a second time. A vehicle speed of about 25.7 kilometers-per-hour (15 miles-per-hour) will also cancel the panic event.

The RKE system can also perform other functions on this vehicle. If the vehicle is equipped with the optional Vehicle Theft Security System (VTSS), the RKE transmitter will arm the VTSS when the Lock button is depressed, and disarm the VTSS when the Unlock button is depressed.

The RKE system includes two transmitters when the vehicle is shipped from the factory, but the system can retain the vehicle access codes of up to a total of four transmitters. The transmitter codes are retained in the RKE module memory, even if the battery is disconnected. If an RKE transmitter is faulty or lost, new transmitter vehicle access codes can be programmed into the system using a DRB III® scan tool.

This vehicle also offers several customer programmable features, which allows the selection of several optional electronic features to suit individual preferences. Customer programmable feature options affecting the RKE system include:

- **Remote Unlock Sequence** - Allows the option of having only the driver side front door unlock when the RKE transmitter Unlock button is depressed the first time. The remaining doors unlock when the button is depressed a second time within 5 seconds of the first unlock press. Another option is having all doors unlock upon the first depression of the RKE transmitter Unlock button.
- **Sound Horn on Lock** - Allows the option of having the horn sound a short chirp as an audible verification that the RKE system received a valid Lock request from the RKE transmitter, or having no audible verification.
- **Flash Lights with Lock and Unlock** - Allows the option of having the park lamps flash as an optical verification that the RKE system received a valid Lock request or Unlock request from the RKE transmitter, or having no optical verification.
- **Programming Additional Transmitters** - Allows up to a total of four transmitter vehicle access codes to be stored in the receiver memory.

Certain functions and features of the RKE system rely upon resources shared with other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus network. The PCI data bus network allows the sharing of sensor information. This helps to reduce wire harness complexity, internal controller hardware, and component sensor current loads. For diagnosis of these electronic modules or of the PCI data bus network, the use of a DRB III® scan tool and the appropriate diagnostic information are required.

OPERATION

POWER LOCKS

The instrument cluster locks or unlocks the doors when an actuation input signal from a door lock switch or Remote Keyless Entry Module (RKE) is received. The instrument cluster turns on the output

POWER LOCKS (Continued)

drivers and provides a voltage level to the door lock motor for a specified time. All passenger doors can be locked or unlocked using a mechanical button mounted on the door trim panel. The front passenger doors can be locked or unlocked by using the key cylinder.

AUTOMATIC DOOR LOCKS

When the automatic door locks are ENABLED the door locks will lock when the vehicle is moving at about 25.7 Km/h (15 mph), all doors are closed and the accelerator pedal is depressed. This feature can be switched ON or OFF as desired. When the system is DISABLED the door locks will operate normally, but will not lock automatically when the vehicle is rolling. Once the automatic door locks have been actuated, they will not try to lock the doors again until a door is opened.

DOOR LOCK INHIBIT

If the key is in the ignition, in any position, and either front door is ajar, the doors can not be locked, but the unlock function still operates. Pressing the RKE lock/unlock button under these conditions will result in a normal lock/unlock activation.

After the key is removed from the ignition switch, or the doors are closed, the power door locks will operate normally.

DOOR LOCK CIRCUIT PROTECTION

If the door lock switch is actuated continuously for more than five seconds the instrument cluster will turn the output driver OFF (the instrument cluster would consider the switch stuck). Each lock motor is protected with a Positive Temperature Coefficient device that prevents motor burn out.

REMOTE KEYLESS ENTRY

- **LOCK**: Pressing the LOCK button locks all doors, sounds horn (chirp) once if enabled, flashes the park lamps once if enabled, and arms the Vehicle Theft Security System (VTSS), if enabled. The chirp verifies that the RKE module has sent a message to the instrument cluster for door lock operation. If a door has not been closed before pressing the LOCK button, the vehicle may not be secured and the VTSS (if equipped) will not arm until the door is closed.
- **UNLOCK**: Pressing the UNLOCK button once will unlock the driver's door first if enabled, flashes the park lamps twice if enabled, activates the illuminated entry system, and disarms the Vehicle Theft Security System (VTSS), if equipped. Pressing the UNLOCK button twice within five seconds will unlock all doors, if driver's door first is enabled.
- **PANIC**: Pressing the PANIC button sounds the horns at half second intervals, flashes the exterior lamps, and turns ON the interior lamps. The panic alarm will remain on for three minutes, or until the PANIC button is actuated again or the vehicle speed exceeds 25.7 Km/h (15 mph) will cancel the panic event.

The Remote Keyless Entry Module is capable of retaining the transmitter Vehicle Access Code(s) in its memory even after vehicle power has been interrupted.

DIAGNOSIS AND TESTING - POWER LOCKS

The most reliable, efficient, and accurate means to diagnose the power lock system requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the power lock motors are being sent the proper hard wired outputs by the relays for them to perform their power lock system functions.

Following are tests that will help to diagnose the hard wired components and circuits of the power lock system. However, these tests may not prove conclusive in the diagnosis of this system. In order to obtain conclusive testing of the power lock system, the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to, or receive outputs from the power lock system components must be checked.

The instrument cluster will set Diagnostic Trouble Codes (DTC) for the power lock system.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

PRELIMINARY DIAGNOSIS

As a preliminary diagnosis for the power lock system, note the system operation while you actuate both the Lock and Unlock functions with the power lock switches and with the Remote Keyless Entry (RKE) transmitter. Then, proceed as follows:

- If the entire power lock system fails to function with either the power lock switches or the RKE transmitter, check the fused B(+) fuse in the Integrated Power Module (IPM).
- If the power lock system functions with both power lock switches, but not with the RKE transmitter, proceed to diagnosis of the Remote Keyless Entry (RKE) system. (Refer to 8 - ELECTRICAL/POWER LOCKS/KEYLESS ENTRY TRANSMITTER - DIAG-

POWER LOCKS (Continued)

NOSIS AND TESTING) or (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - DIAGNOSIS AND TESTING).

- If the power lock system functions with the RKE transmitter, but not with one or both power lock switches, proceed to diagnosis of the door lock switches. (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK SWITCH - DIAGNOSIS AND TESTING).
- If the driver side power lock switch operates only the driver side front door power lock motor, but all other power lock motors operate with the passenger side power lock switch or the RKE transmitter, use a DRBIII® scan tool and the appropriate diagnostic information to diagnose the Programmable Communications Interface (PCI) data bus.
- If only one power lock motor fails to operate with both power lock switches and the RKE transmitter, proceed to diagnosis of the power lock motor. (Refer to 8 - ELECTRICAL/POWER LOCKS/POWER LOCK MOTOR - DIAGNOSIS AND TESTING).

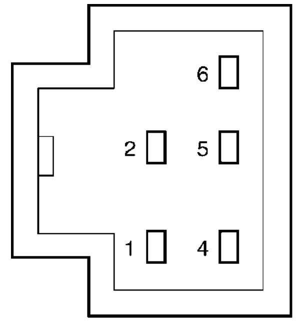
POWER LOCK SWITCH

DIAGNOSIS AND TESTING - POWER LOCK SWITCH

The Light-Emitting Diode (LED) illumination lamp of the power lock switch receives battery current through a fuse in the Integrated Power Module (IPM) on a fused ignition switch output (run) circuit. The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING). If the power lock switch operates, but the LED is inoperative, check for battery current at the switch with the ignition switch in the On position. If OK, replace the faulty switch. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pinout information and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect and isolate the battery negative cable. Remove the power lock switch from the door trim panel. Disconnect the door wire harness connector for the power lock switch from the switch connector receptacle.

(2) Test the power lock switch resistance. See the Power Lock Switch Test chart to determine if the resistance is correct for the switch in each switch position (Fig. 1). If not OK, replace the faulty power lock switch as required.



POWER LOCK SWITCH TEST TABLE

SWITCH POSITION	RESISTANCE BETWEEN PINS 1 & 5
NEUTRAL	10 KILOHMS ±1%
LOCK	820 OHMS ±5%
UNLOCK	330 OHMS ±5%

80c07179

Fig. 1 Power Lock Switch Connector Receptacle

REMOVAL

The power lock switch on the driver side front door trim panel is integral to the driver door module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL).

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Remove the switch from the trim panel bezel.

INSTALLATION

(1) Insert switch to trim panel bezel.

(2) Install door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

DOOR LOCK MOTOR

DESCRIPTION

The lock mechanisms are actuated by a reversible electric motor mounted within each door. The power lock motors are integral to the door latch units.

The power lock motors cannot be adjusted or repaired and, if faulty or damaged, the door latch unit must be replaced.

OPERATION

The door lock motors are controlled by the instrument cluster. A positive and negative battery connection to the two motor terminals will cause the motor to move in one direction. Reversing the current will cause the motor to move in the opposite direction.

DIAGNOSIS AND TESTING - DOOR LOCK MOTOR

The most reliable, efficient, and accurate means to diagnose the power lock system requires the use of a DRBIII® scan tool and the proper Diagnostic Procedures manual. The DRBIII® scan tool can provide confirmation that the PCI data bus is functional, that all of the electronic modules are sending and receiving the proper messages on the PCI data bus, and that the power lock motors are being sent the proper hard wired outputs by the door modules for them to perform their power lock system functions.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

DRIVER DOOR MODULE

DESCRIPTION

A Driver Door Module (DDM) is used on all models equipped with power locks, power windows, and power mirrors. The DDM houses the following switches:

- **Power Lock Switch** - The DDM includes a two-way, momentary, resistor multiplexed switch to control the power lock system.
- **Power Mirror Selector Switch** - A three-position rocker switch in the DDM selects the right or left power mirror for adjustment, or turns the power mirror system Off.
- **Power Mirror Adjustment Switches** - Four momentary, arrowhead shaped, directional switches allow the driver to adjust the selected power mirror in the Up, Down, Right, or Left directions.
- **Power Window Lockout Switch** - A two-way, latching, push-button switch in the DDM allows the vehicle operator to lock out the power window switches on each passenger door so that the passenger door power windows may be operated only from the master switches in the DDM.
- **Power Window Switches** - The DDM houses a two-way, momentary power window switch for the driver side front door. This switch also has a second detent in the Down direction and internal circuitry to provide an Auto-Down feature for the driver side front door power window. In addition to the power window switch for its own door, the DDM houses individual master switches for each passenger door power window.

The DDM also incorporates several green Light-Emitting Diodes (LEDs) that illuminate the power lock and power window switch paddles, and the power mirror switch directional buttons to improve switch visibility in dark ambient lighting conditions. The DDM cannot be adjusted or repaired and, if faulty or damaged, the entire DDM unit must be replaced.

OPERATION

The Driver Door Module (DDM) combines a power lock switch, a driver power window switch with an Auto-down feature, master switches for each passenger door power window, a power window lockout switch, a power mirror selector switch, and four power mirror adjustment switches in a single unit. The switches in the DDM can be diagnosed using conventional diagnostic tools and methods.

Power Lock Switch

The DDM power lock switch circuitry is connected in series between ground and the driver door switch mux input of the instrument cluster. Each power lock switch position (Lock, Unlock, and Neutral) provides a different resistance value to the instrument cluster input, which allows the instrument cluster to sense the switch position. Based upon the power lock switch input, the instrument cluster controls the battery and ground feed outputs to the individual power lock motors to lock or unlock the door latches. The Light-Emitting Diode (LED) in the DDM power lock switch is connected to battery current through the power window circuit breaker in the Integrated Power Module (IPM) on a fused ignition switch output (run-acc) circuit so that the switch will be illuminated whenever the ignition switch is in the On or Accessory positions.

Power Window Switches

The DDM power window switch circuitry is connected to battery current through a circuit breaker in

DRIVER DOOR MODULE (Continued)

the Integrated Power Module (IPM) on a fused ignition switch output (run-acc) circuit so that the power windows will operate whenever the ignition switch is in the On or Accessory positions. Each two-way, momentary master passenger power window switch in the DDM provides battery current and ground to the individual power window switches on each passenger door so that the power window switch controls the battery current and ground feeds to its respective power window motor. The DDM switch for the driver side front door power window is labeled “Auto” and includes an auto-down feature. When this switch is depressed to a second momentary detent position and released, the driver door power window is automatically operated through an internal circuit and relay to its fully lowered position. The Auto-down event is cancelled if the switch paddle is depressed a second time in either the Up or Down direction. When the two position window lockout switch in the DDM is depressed and latched in the lockout position, the battery current feed to each of the individual passenger power window switches is interrupted so that the passenger door power windows can only be operated from the master switches in the DDM. The window lockout switch also controls the battery current feed for the LED in each passenger power window switch so that the switch will not be illuminated when it is locked out.

Power Mirror Switches

The DDM power mirror switch circuitry is connected to battery current through a fuse in the IPM on a fused B(+) circuit so that the power mirrors remain operational regardless of the ignition switch position. A rocker type selector switch has three positions, one to select the right mirror, one to select the left mirror, and a neutral Off position. After the right or left mirror is selected, one of four directional buttons is depressed to move the selected mirror Up, Down, Right or Left. The DDM power mirror switch circuitry controls the battery current and ground feeds to each of the four (two in each mirror head) power mirror motors. The Light-Emitting Diode (LED) in the DDM power mirror switch is connected to battery current through the power window circuit breaker in the IPM on a fused ignition switch output (run-acc) circuit so that the switch directional buttons will be illuminated whenever the ignition switch is in the On or Accessory positions.

DIAGNOSIS AND TESTING - DRIVER DOOR MODULE

The Light-Emitting Diode (LED) illumination lamps for all of the Driver Door Module (DDM) power window, power lock, and power mirror switches receive battery current through the power window circuit breaker in the Integrated Power Module (IPM). If all of the LEDs are inoperative in the DDM, be certain to diagnose the power window system before replacing the switch unit. (Refer to 8 - ELECTRICAL/POWER WINDOWS - DIAGNOSIS AND TESTING). If only one LED in the DDM is inoperative, replace the faulty DDM. If the driver side front door power window operates in a normal manner, but the Auto-Down feature is inoperative, replace the faulty DDM. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Disconnect and isolate the battery negative cable. Remove the DDM from the door trim panel. Disconnect the door wire harness connectors for the DDM from the DDM connector receptacles.

(2) Test the DDM switch continuity. See the Driver Door Module Switch Tests chart to determine if the continuity is correct for the suspect switches in each switch position (Fig. 2) and/or (Fig. 3). If not OK, replace the faulty DDM as required.

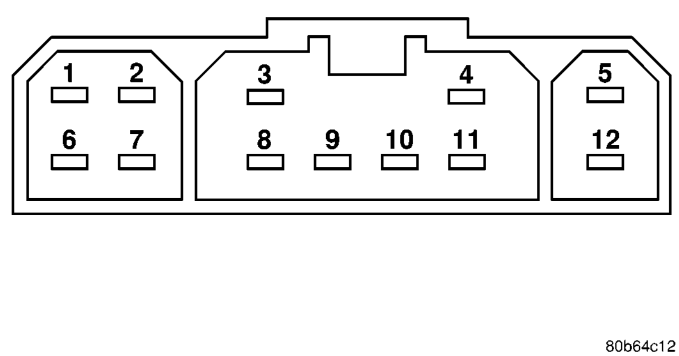


Fig. 2 Driver Door Module Connector C1 Receptacle

DRIVER DOOR MODULE (Continued)

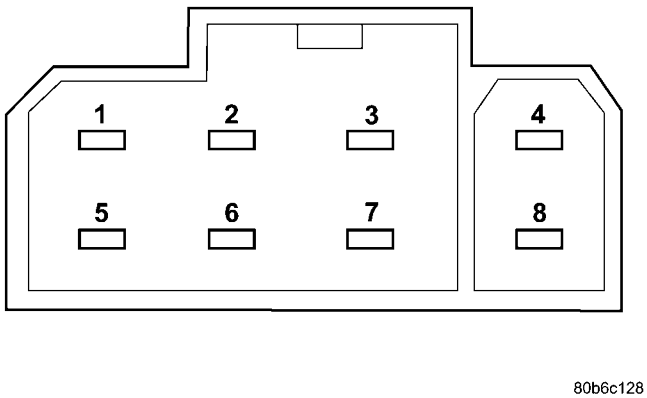


Fig. 3 Driver Door Module Connector C2 Receptacle

DRIVER DOOR MODULE SWITCH TESTS	
POWER LOCK SWITCH	
SWITCH POSITION	RESISTANCE BETWEEN CONNECTOR C-1 PINS 7 & 11
NEUTRAL	10 KILOHMS ± 1%
LOCK	820 OHMS ± 5%
UNLOCK	330 OHMS ± 5%
POWER MIRROR SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN PINS OF CONNECTOR C-2
LEFT MIRROR SELECTED	
UP	PINS 1 & 3
DOWN	PINS 2 & 3
RIGHT	PINS 2 & 3
LEFT	PINS 3 & 6
RIGHT MIRROR SELECTED	
UP	PINS 3 & 7
DOWN	PINS 2 & 3
RIGHT	PINS 2 & 3
LEFT	PINS 3 & 4
POWER WINDOW SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN PINS OF CONNECTOR C-1
NEUTRAL	PINS 1 & 8, PINS 2 & 8, PINS 3 & 8, PINS 4 & 8, PINS 5 & 8, PINS 6 & 8, PINS 8 & 10, PINS 8 & 12
LEFT FRONT UP	PINS 5 & 9

DRIVER DOOR MODULE SWITCH TESTS	
LEFT FRONT DOWN	PINS 9 & 12
RIGHT FRONT UP	PINS 3 & 9
RIGHT FRONT DOWN	PINS 6 & 9
LEFT REAR UP	PINS 4 & 9
LEFT REAR DOWN	PINS 9 & 10
RIGHT REAR UP	PINS 2 & 9
RIGHT REAR DOWN	PINS 1 & 9
POWER WINDOW LOCKOUT SWITCH	
SWITCH POSITION	CONTINUITY BETWEEN
OFF (SWITCH BUTTON RAISED - NOT DEPRESSED)	PIN 9 OF CONNECTOR C-1 & PIN 8 OF CONNECTOR C-2

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Remove the driver door module from the trim panel bezel.

INSTALLATION

(1) Install driver door module to trim panel bezel.

(2) Install door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

REMOTE KEYLESS ENTRY MODULE

DESCRIPTION

When an RKE lock message is sent to the instrument cluster, the instrument cluster actuates the door locks, the interior lighting is turned off, the horn chirps (if this feature is enabled), the park lamps flash (if this feature is enabled) and, if the vehicle is so equipped, the Vehicle Theft Security System (VTSS) is armed. When an RKE unlock message is sent to the instrument cluster, the instrument cluster actuates the driver side front door (or all doors if this feature is enabled) unlock, the interior lighting is turned on and, if the vehicle is so equipped, the VTSS is disarmed.

When an RKE panic message is sent to the instrument cluster, the instrument cluster actuates the driver side front door (or all doors if this feature is enabled) unlock, the interior lighting is turned on and, if the vehicle is so equipped, the VTSS is disarmed. The panic message will also cause the exterior lamps (including the headlights) to flash, and

REMOTE KEYLESS ENTRY MODULE (Continued)

the horn to sound for about three minutes, or until a second panic message is sent to the instrument cluster. A vehicle speed of about 25.7 kilometers-per-hour (15 miles-per-hour) will also cancel the panic event.

Refer to the owner's manual for more information on the features, use and operation of the RKE system.

OPERATION

Whenever the vehicle battery power is interrupted, the Remote Keyless Module (RKE) Module will retain all vehicle access codes in its memory. When replacing or adding a key fob transmitter (maximum of 4) a DRB III® scan tool is required to program the RKE Module to accept the new Vehicle Access Code if a customer owned transmitter is not available.

If a functioning transmitter is available, (Refer to 8 - ELECTRICAL/POWER LOCKS/KEYLESS ENTRY TRANSMITTER - STANDARD PROCEDURE)

DIAGNOSIS AND TESTING - REMOTE KEYLESS ENTRY MODULE

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds. Refer to the proper Body Diagnostic Procedures Manual for testing the Remote Keyless Entry system using a DRB III® scan tool.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Remove remote keyless entry module from instrument cluster (Fig. 4).

INSTALLATION

(1) Install remote keyless entry module to instrument cluster.

(2) Install instrument cluster (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(3) Connect the battery negative cable.

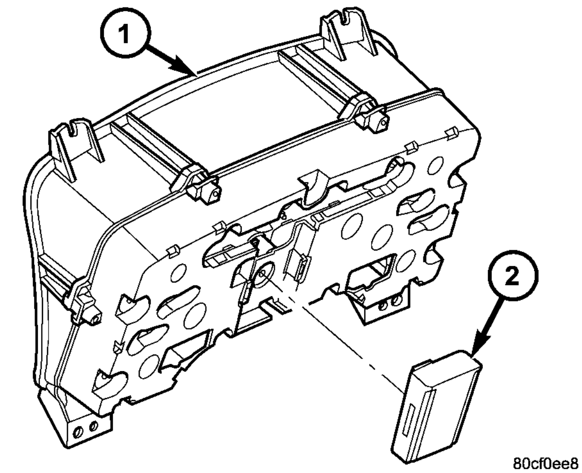


Fig. 4 REMOTE KEYLESS ENTRY MODULE

1 - INSTRUMENT CLUSTER
2 - REMOTE KEYLESS ENTRY MODULE

REMOTE KEYLESS ENTRY TRANSMITTER

DIAGNOSIS AND TESTING - REMOTE KEYLESS ENTRY TRANSMITTER

Using special tool 9001, first test to ensure that the transmitter is functioning. Typical testing distance is 2.5 centimeters (1 inch) for Asian transmitters and 30.5 centimeters (12 inches) for all others. To test, position the transmitter as shown (Fig. 5). Press any transmitter button, then test each button individually. The tool will beep if a radio signal strength that lights five or more LED's is detected. Repeat this test three times. If transmitter fails any of the test refer to the Diagnostic Procedures manual.

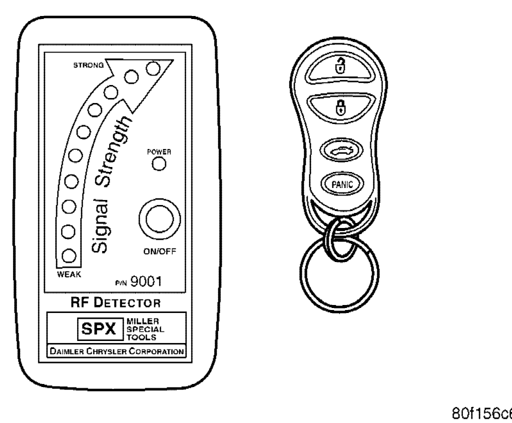


Fig. 5 TRANSMITTER DIAGNOSIS

REMOTE KEYLESS ENTRY TRANSMITTER (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - RKE TRANSMITTER BATTERIES

NOTE: Do not disturb the metal terminal near the batteries. Avoid touching the new batteries. Skin oils may cause battery deterioration. If batteries are touched, clean with rubbing alcohol.

The Remote Keyless Entry (RKE) transmitter case snaps open and shut for battery access. To replace the RKE transmitter batteries:

(1) Using a thin coin, gently pry at the notch in the center seam of the RKE transmitter case halves near the key ring until the two halves unsnap. Be careful not to damage the rubber gasket when separating the case halves.

(2) Lift the back half of the transmitter case off of the RKE transmitter.

(3) Remove the two batteries from the RKE transmitter.

(4) Replace the two batteries with new 3V lithium 2016 cell. Install the batteries with the positive terminal up. Reference the “+ SIDE UP” on the inside of the bottom half of the transmitter case.

(5) Align the two RKE transmitter case halves with each other, and squeeze them firmly and evenly together until they snap back into place. Test transmitter operation.

STANDARD PROCEDURE - RKE TRANSMITTER CUSTOMER PREFERENCES

AUTOMATIC (ROLLING) LOCKS

The rolling locks feature can be toggled ON/OFF by using the DRB III® only.

HORN CHIRP DISABLING / ENABLING

The horn chirp can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter that is already programmed to the vehicle.

To DISABLE (cancel) the horn chirp feature:

(1) Enter the vehicle and close all doors.

(2) Fasten the seat belt (this will cancel the seat belt chime).

(3) Turn the ignition to the ON position.

(4) Press and hold the LOCK button for 4 seconds. Within 6 seconds with the LOCK button still depressed, press the UNLOCK button. When a single chime is heard, release both buttons.

(5) Turn the ignition OFF.

(6) Turn the ignition ON or wait 60 seconds.

(7) Test the horn chirp feature by pressing the LOCK button.

If a chime is not heard, program mode was canceled before the feature could be disabled. If necessary, repeat the procedure.

To ENABLE the horn chirp feature, repeat the above procedure.

OPTICAL CHIRP (FLASH) DISABLING / ENABLING

The optical chirp can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter that is already programmed to the vehicle.

To DISABLE (cancel) the optical chirp feature:

(1) Enter the vehicle and close all doors.

(2) Fasten the seat belt (this will cancel the seat belt chime).

(3) Turn the ignition to the ON position.

(4) Press and hold the LOCK button for 4 seconds. Within 6 seconds with the LOCK button still depressed, press the PANIC button. When a single chime is heard, release both buttons.

(5) Turn the ignition OFF.

(6) Turn the ignition ON or wait 60 seconds.

(7) Test the optical chirp feature by pressing the LOCK button.

If a chime is not heard, program mode was canceled before the feature could be disabled. If necessary, repeat the procedure.

To ENABLE the optical chirp feature, repeat the above procedure.

UNLOCK SEQUENCE

The unlock sequence can be toggled using a DRB III® or by using the Remote Keyless Entry (RKE) transmitter that is already programmed to the vehicle.

To toggle between Driver door first and Unlock all doors function:

(1) Enter the vehicle and close all doors.

(2) Fasten the seat belt (this will cancel the seat belt chime).

(3) Turn the ignition to the ON position.

(4) Press and hold the UNLOCK button for 4 seconds. Within 6 seconds with the UNLOCK button still depressed, press the LOCK button. When a single chime is heard, release both buttons.

(5) Turn the ignition OFF.

(6) Turn the ignition ON or wait 60 seconds.

If a chime is not heard, program mode was canceled before the feature could be disabled. If necessary, repeat the procedure.

To toggle this feature, repeat the above procedure.

STANDARD PROCEDURE - RKE TRANSMITTER PROGRAMING

New Remote Keyless Entry (RKE) transmitters can be programed using the DRB III® scan tool and the proper Diagnostic Procedures manual. The DRB III® scan tool can provide confirmation that the PCI data bus is functional, and that all of the electronic modules are sending and receiving the proper messages on the PCI data bus.

The following procedure can be used as long as one programmed transmitter is available:

NOTE: When entering program mode using that programmed fob, ALL currently programmed fobs will be erased and they will have to be reprogrammed for the vehicle. If program mode is entered and no action is performed, the previously programmed fobs will continue to function.

(1) Enter the vehicle and close all doors.

(2) Fasten the seat belt (this will cancel the seat belt chime). Turn the ignition to the RUN position.

(3) Press and hold the UNLOCK button on a programmed transmitter for 4 to 10 seconds. Within the 4 to 10 seconds with the UNLOCK button still depressed, press the PANIC button for one second. When a single chime is heard, release both buttons.The chime indicates the system is in program mode.

(4) Press and release both the LOCK and UNLOCK buttons simultaneously on a fob to be programmed. A single chime will be heard, this indicates the fob has been recognized.

(5) Press and release any button on the same fob. A single chime will be heard, this indicates the fob has been programmed.

(6) Repeat steps 4 and 5 for up to a total of 4 fobs.

(7) Turn the ignition OFF.

(8) Turn the ignition ON or wait 60 seconds.

The vehicle will remain in program mode for up to 60 seconds from when the original chime (step 3) was heard. After 60 seconds, all programmed transmitters will function normally.

SPECIFICATIONS - REMOTE KEYLESS ENTRY TRANSMITTER

RANGE

Normal operation range is up to a distance of 3 to 7 meters (10 to 23 ft.) of the vehicle. Range may be better or worse depending on the environment around the vehicle.

POWER MIRRORS

TABLE OF CONTENTS

POWER MIRRORS

DESCRIPTION

AUTOMATIC DAY/NIGHT MIRROR

The automatic day/night mirror system is able to automatically change the reflectance of the inside rear view mirror in order to reduce the glare of headlamps approaching the vehicle from the rear. The automatic day/night rear view mirror receives battery current through a fuse in the Integrated Power Module (IPM) only when the ignition switch is in the On position.

OUTSIDE REAR VIEW MIRROR

The power operated outside rear view mirrors allow the driver to adjust both outside mirrors electrically from the driver side front seat position by operating a switch on the driver side front door trim panel. The power mirrors receive a non-switched battery feed through a fuse in the Integrated Power Module (IPM) so that the system will remain operational, regardless of the ignition switch position.

OPERATION

AUTOMATIC DAY/NIGHT MIRROR

A switch located on the bottom of the automatic day/night mirror housing allows the vehicle operator to select whether the automatic dimming feature is operational. When the automatic day/night mirror is turned on, the mirror switch is lighted by an integral Light-Emitting Diode (LED). The mirror will automatically disable its self-dimming feature whenever the vehicle is being driven in reverse.

Refer to the owner's manual for more information on the features, use and operation of the automatic day/night mirror system.

OUTSIDE REAR VIEW MIRROR

The heated mirrors include an electric heating grid behind the mirror glass in each outside mirror, which can clear the mirror glass of ice, snow, or fog. (Refer to 8 - ELECTRICAL/HEATED MIRRORS - DESCRIPTION) for more information.

DIAGNOSIS AND TESTING - POWER MIRRORS

WIRING VOLTAGE TEST

The following wiring test determines whether or not voltage is continuous through the body harness to switch.

(1) Remove the power mirror switch (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL).

(2) Disconnect wire harness connector from back of power mirror switch.

(3) Connect the clip end of a 12 volt test light to Pin 5 in the mirror switch harness connector. Touch the test light probe to Pin 3.

If the test light illuminates, the wiring circuit between the battery and switch is OK.

If the lamp does not illuminate, first check fuse in the Integrated Power Module (IPM). If fuse is OK, then check for a broken wire.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

POWER MIRRORS (Continued)

POWER MIRROR MOTOR TEST

If the power mirror switch is receiving proper current and ground and mirrors do not operate, proceed with power mirror motor test. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Remove the power mirror switch (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL).

(2) Disconnect wire harness connector to power mirror switch (Fig. 1).

(3) Using two jumper wires:

- Connect one to a 12 volt source
- Connect the other to a good body ground
- Refer to the Mirror Motor Test Chart for proper wire connections at the switch connector

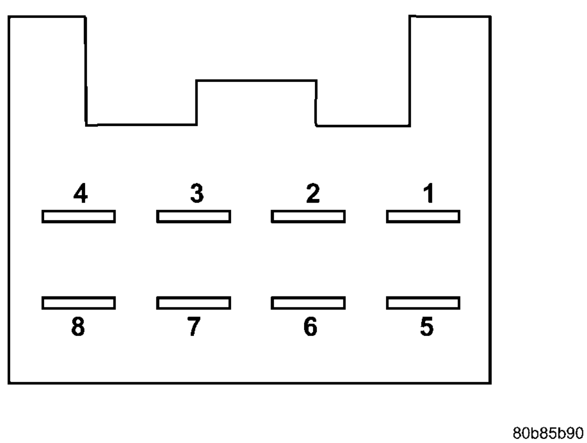


Fig. 1 POWER MIRROR SWITCH CONNECTOR

MIRROR MOTOR TEST CHART

12 VOLTS	GROUND	MIRROR REACTION	
SWITCH CONNECTOR		RIGHT	LEFT
PIN 1	PIN 2	-	UP
PIN 6	PIN 2	-	LEFT
PIN 2	PIN 1	-	DOWN
PIN 2	PIN 6	-	RIGHT
PIN 7	PIN 2	UP	-
PIN 4	PIN 2	LEFT	-
PIN 2	PIN 7	DOWN	-
PIN 2	PIN 4	RIGHT	-

(4) If results shown in table are not obtained, check for open or shorted circuit. Replace mirror assembly as necessary.

AUTOMATIC DAY / NIGHT MIRROR

DESCRIPTION

The automatic day/night mirror uses a thin layer of electrochromic material between two pieces of conductive glass to make up the face of the mirror. When the mirror switch is in the On position, two photocell sensors are used by the mirror circuitry to monitor external light levels and adjust the reflectance of the mirror.

OPERATION

The ambient photocell sensor is located on the forward-facing (windshield side) of the rear view mirror housing, and detects the ambient light levels outside of the vehicle. The headlamp photocell sensor is located inside the rear view mirror housing behind the mirror glass and faces rearward, to detect the level of the light being received at the rear window side of the mirror. When the circuitry of the automatic day/night mirror detects that the difference between the two light levels is too great (the light level received at the rear of the mirror is much higher than that at the front of the mirror), it begins to darken the mirror.

The automatic day/night mirror circuitry also monitors the transmission using an input from the backup lamp circuit. The mirror circuitry is programmed to automatically disable its self-dimming feature whenever it senses that the transmission backup lamp circuit is energized.

The automatic day/night mirror is a completely self-contained unit and cannot be repaired. If faulty or damaged, the entire mirror assembly must be replaced.

DIAGNOSIS AND TESTING - AUTOMATIC DAY / NIGHT MIRROR

For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Check the fuse in the Integrated Power Module (IPM). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the IPM. If OK, go to Step 3. If not OK, repair the open circuit to the ignition switch as required.

AUTOMATIC DAY / NIGHT MIRROR (Continued)

(3) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Unplug the wire harness connector from the automatic day/night mirror (Fig. 2). Connect the battery negative cable. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (run/start) circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit to the IPM as required.

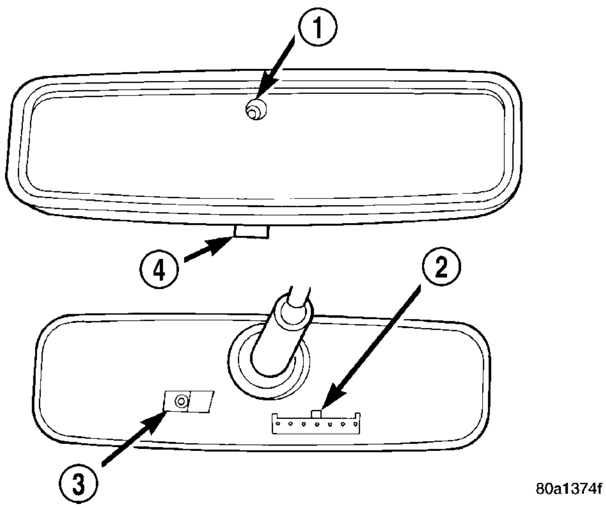


Fig. 2 Automatic Day/Night Mirror

1 - REAR FACING SENSOR
2 - CONNECTOR
3 - FORWARD FACING SENSOR
4 - SWITCH

(4) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the automatic day/night mirror wire harness connector and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the circuit to ground as required.

(5) Connect the battery negative cable. Turn the ignition switch to the On position. Set the parking brake. Place the transmission gear selector lever in the Reverse position. Check for battery voltage at the backup lamp switch output circuit cavity of the automatic day/night mirror wire harness connector. If OK, go to Step 6. If not OK, repair the open circuit as required.

(6) Turn the ignition switch to the Off position. Disconnect the battery negative cable. Plug in the automatic day/night mirror wire harness connector. Connect the battery negative cable. Turn the ignition switch to the On position. Place the transmission gear selector lever in the Neutral position. Place the mirror switch in the On (the LED in the mirror switch is lighted) position. Cover the forward facing ambient photocell sensor to keep out any ambient light.

NOTE: The ambient photocell sensor must be covered completely, so that no light reaches the sensor. Use a finger pressed tightly against the sensor, or cover the sensor completely with electrical tape.

(7) Shine a light into the rearward facing headlamp photocell sensor. The mirror glass should darken. If OK, go to Step 8. If not OK, replace the faulty automatic day/night mirror unit.

(8) With the mirror glass darkened, place the transmission gear selector lever in the Reverse position. The mirror should return to its normal reflectance. If not OK, replace the faulty automatic day/night mirror unit.

REMOVAL

For removal procedures, (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - REMOVAL).

POWER MIRROR SWITCH

DIAGNOSIS AND TESTING - POWER MIRROR SWITCH

The power mirror switch is included with the Driver Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING).

REMOVAL

The power mirror switch is included with the Driver Door Module. (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL).

SIDEVIEW MIRROR

REMOVAL

(Refer to 23 - BODY/EXTERIOR/SIDE VIEW MIRROR - REMOVAL).

POWER SEATS

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POWER SEATS

DESCRIPTION

The power seat system option allows the driver or passenger to electrically adjust the seat position for optimum control and comfort using the power seat switches located on the outboard seat cushion side shield. The power seat system allows the seating position to be adjusted forward, rearward, front up, front down, rear up, or rear down. The power seat system receives battery current through a fuse in the Integrated Power Module, regardless of the ignition switch position. The power seat system includes the following components:

- Driver Power Seat Switch
- Passenger Power Seat Switch
- Driver Power Seat Track
- Passenger Power Seat Track
- Power Lumbar Adjuster(s)

Some models equipped with the power seat option also feature a power operated lumbar support in the seat back. The power lumbar support allows the user to inflate or deflate a bladder located in the lower seat back to achieve optimum comfort and support in the lower lumbar region of the spinal column. The power lumbar support shares the battery feed circuit of the power seat system.

Following are general descriptions of the major components in the power seat system. Refer to **Heated Seat System** for information on the individually controlled heated front seats. Refer to the owner's manual in the vehicle glove box for more information on the features, use and operation of the power seat system.

OPERATION

The power seat system allows the driver and/or front passenger seating positions to be adjusted electrically and independently using the separate power seat switches found on the outboard seat cushion side shield of each front seat. See the owner's manual in the vehicle glove box for more information on the features, use and operation of the power seat system.

DIAGNOSIS AND TESTING - POWER SEAT SYSTEM

Before any testing of the power seat system is attempted, the battery should be fully-charged and all wire harness connections and pins checked to ensure proper continuity and grounds. For circuit descriptions and diagrams, refer to Wiring Diagrams.

With the dome lamp on, apply the power seat switch in the direction of the failure. If the dome lamp dims, the seat may be jamming. Check under and behind the seat for binding or obstructions. If the dome lamp does not dim, proceed with testing of the individual components and circuits.

DRIVER SEAT SWITCH

DESCRIPTION

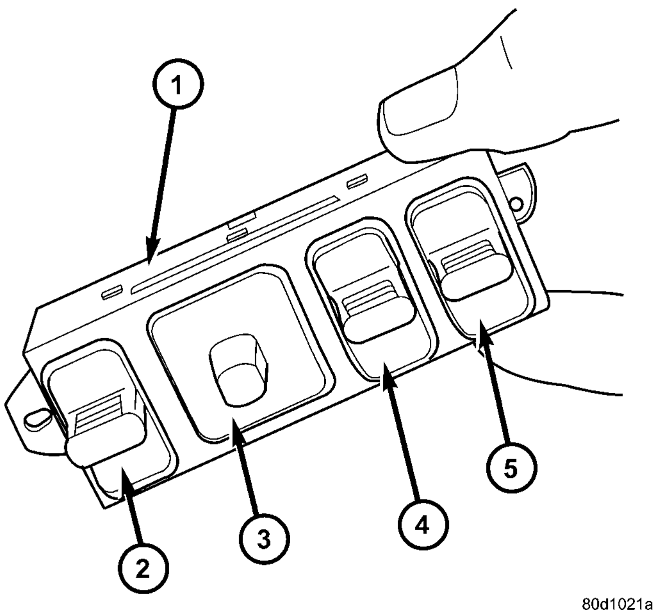

Fig. 1 DR Power Seat Switch

1 - POWER SEAT SWITCH ASSEMBLY
2 - FRONT SEAT CUSHION ADJUSTMENT BUTTON
3 - COMPLETE SEAT ADJUSTMENT BUTTON
4 - REAR SEAT CUSHION ADJUSTMENT BUTTON
5 - LUMBAR ADJUSTMENT BUTTON

The power seat on this model can be adjusted in eight different directions, up, down, front up, front down, rear up, rear down, rearward and forward. The power seat switch (Fig. 1) on this model has an additional switch knob for adjusting the power lumbar support. The power seat switch is located on the outboard side of the seat cushion on the seat cushion side shield. Refer to the owner's manual in the vehicle glove box for more information on the power seat switch functions and the seat adjusting procedures.

The individual switches in the power seat switch assembly cannot be repaired. If one switch is damaged or faulty, the entire power seat switch assembly must be replaced.

OPERATION

When a power switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the power seat track or recliner adjuster motor. The selected adjuster motor operates to move the seat track or recliner through its drive unit in the selected direction until the switch is released, or until the travel limit of the adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor are reversed through the switch contacts. This causes the adjuster motor to run in the opposite direction.

No power seat switch should be held applied in any direction after the adjuster has reached its travel limit. The power seat adjuster motors each contain a self-resetting circuit breaker to protect them from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

DIAGNOSIS AND TESTING - DRIVER SEAT SWITCH

For circuit descriptions and diagrams, refer to Wiring.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power seat switch from the power seat.

(3) Use an ohmmeter to test the continuity of the power seat switches in each position. See the Power Seat Switch Continuity chart (Fig. 2). If OK, refer to Power Seat Track Diagnosis and Testing in this group. If not OK, replace the faulty power seat switch.

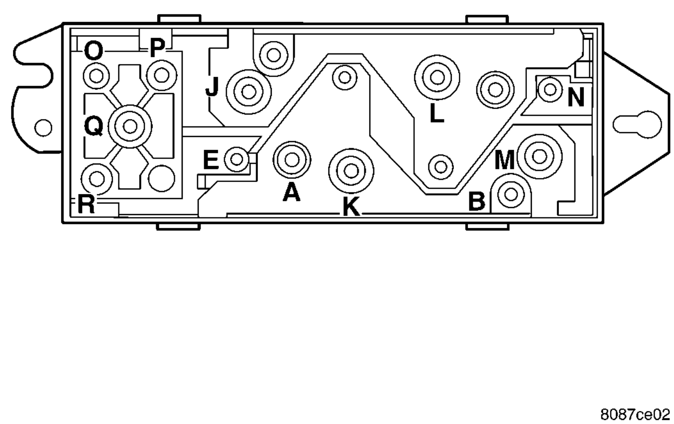

Fig. 2 Testing Driver Power Seat Switch

DRIVER POWER SEAT SWITCH TEST TABLE	
DRIVER SWITCH POSITION	CONTINUITY BETWEEN
OFF	B-N, B-J, B-M B-E, B-L, B-K
VERTICAL UP	A-E, A-M, B-N, B-E
VERTICAL DOWN	A-J, A-N, B-M, B-E

DRIVER SEAT SWITCH (Continued)

DRIVER POWER SEAT SWITCH TEST TABLE	
DRIVER SWITCH POSITION	CONTINUITY BETWEEN
HORIZONTAL FORWARD	A-L, B-K
HORIZONTAL REARWARD	A-K, B-L
FRONT TILT UP	A-M, B-N
FRONT TILT DOWN	A-N, B-M
REAR TILT UP	A-E, B-J
REAR TILT DOWN	A-J, B-E
LUMBAR OFF	O-P, O-R, P-R
LUMPAR UP (INFLATE)	O-P, Q-R
LUMBAR DOWN (DEFLATE)	O-R, P-Q

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the seat cushion side shield from the seat. Refer to the Body section of the service manual for the procedure.

(3) Pull the switch bezel or side shield unit out from the seat far enough to access the switch wire harness connector. Gently pry the locking tabs of the switch away from the wire harness connector and carefully unplug the connector from the power seat switch module.

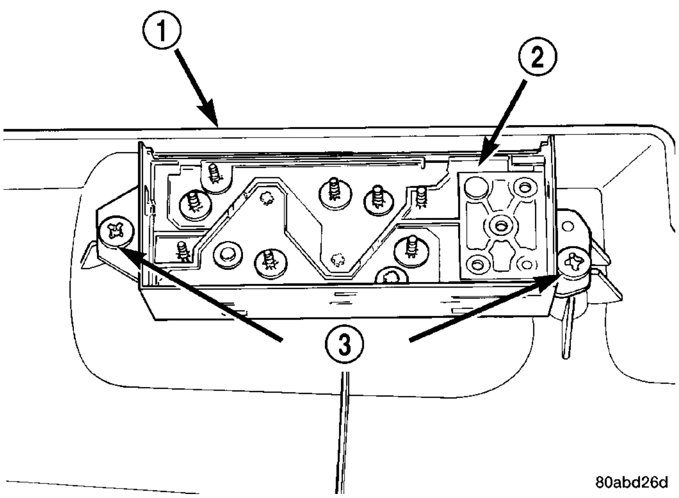

Fig. 3 Power Seat Switch Remove/Install

1 - SEAT SIDE SHIELD
2 - POWER SEAT SWITCH
3 - SCREWS

(4) Remove the screws that secure the power seat switch (Fig. 3).

INSTALLATION

(1) Position the power seat switch on the seat cushion side shield and install the screws that secure the power seat switch to seat cushion side shield.

(2) Connect the electrical connector.

(3) Install the seat cushion side shield on the seat. Refer to the Body section of the service manual for the procedure.

(4) If equipped, install the screw that secures the recliner lever to the recliner mechanism release shaft on the outboard side of the front seat.

(5) Connect the battery negative cable.

PASSENGER SEAT SWITCH

DESCRIPTION

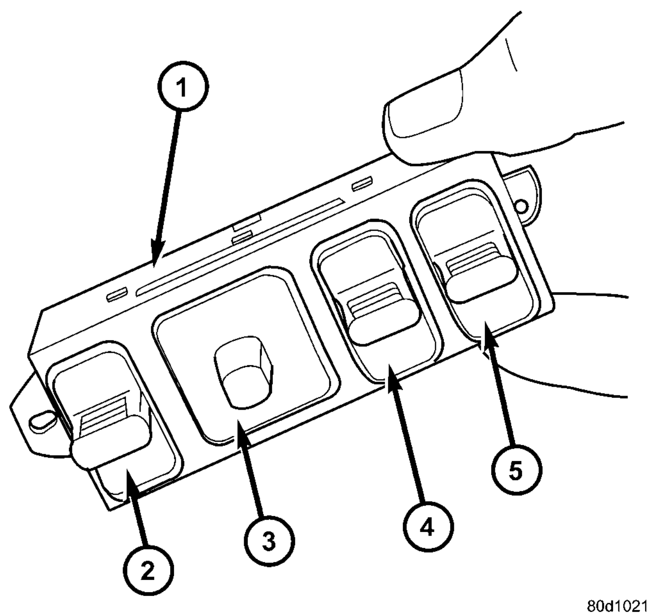

Fig. 4 DR Power Seat Switch

1 - POWER SEAT SWITCH ASSEMBLY
2 - FRONT SEAT CUSHION ADJUSTMENT BUTTON
3 - COMPLETE SEAT ADJUSTMENT BUTTON
4 - REAR SEAT CUSHION ADJUSTMENT BUTTON
5 - LUMBAR ADJUSTMENT BUTTON

The power seat on this model can be adjusted in eight different directions, up, down, front up, front down, rear up, rear down, rearward and forward. The power seat switch (Fig. 4) on this model has an additional switch knob for adjusting the power lumbar support. The power seat switch is located on the outboard side of the seat cushion on the seat cushion side shield. Refer to the owner's manual in the vehicle glove box for more information on the power seat switch functions and the seat adjusting procedures.

PASSENGER SEAT SWITCH (Continued)

The individual switches in the power seat switch assembly cannot be repaired. If one switch is damaged or faulty, the entire power seat switch assembly must be replaced.

OPERATION

When a power switch control knob or knobs are actuated, a battery feed and a ground path are applied through the switch contacts to the power seat track or recliner adjuster motor. The selected adjuster motor operates to move the seat track or recliner through its drive unit in the selected direction until the switch is released, or until the travel limit of the adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor are reversed through the switch contacts. This causes the adjuster motor to run in the opposite direction.

No power seat switch should be held applied in any direction after the adjuster has reached its travel limit. The power seat adjuster motors each contain a self-resetting circuit breaker to protect them from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

DIAGNOSIS AND TESTING - PASSENGER SEAT SWITCH

For circuit descriptions and diagrams, refer to Wiring.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the power seat switch from the power seat.

(3) Use an ohmmeter to test the continuity of the power seat switches in each position. See the Power Seat Switch Continuity chart (Fig. 5). If OK, refer to Power Seat Track Diagnosis and Testing in this group. If not OK, replace the faulty power seat switch.

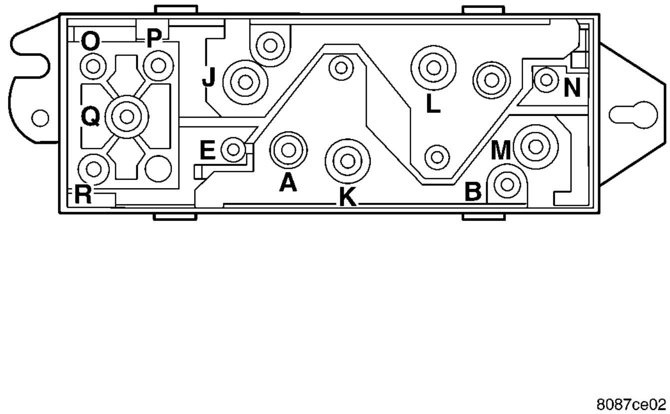

Fig. 5 Testing Passenger Power Seat Switch

PASSENGER SEAT SWITCH TEST TABLE	
PASSENGER SWITCH POSITION	CONTINUITY BETWEEN
OFF	B-N, B-J, B-M B-E, B-L, B-K
VERTICAL UP	A-E, A-M, B-N, B-E
VERTICAL DOWN	A-J, A-N, B-M, B-E
HORIZONTAL FORWARD	A-L, B-K
HORIZONTAL REARWARD	A-K, B-L
FRONT TILT UP	A-M, B-N
FRONT TILT DOWN	A-N, B-M
REAR TILT UP	A-E, B-J
REAR TILT DOWN	A-J, B-E
LUMBAR OFF	O-P, O-R, P-R
LUMPAR UP (INFLATE)	O-P, Q-R
LUMBAR DOWN (DEFLATE)	O-R, P-Q

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the seat cushion side shield from the seat. Refer to the Body section of the service manual for the procedure.

(3) Pull the switch bezel or side shield unit out from the seat far enough to access the switch wire harness connector. Gently pry the locking tabs of the switch away from the wire harness connector and carefully unplug the connector from the power seat switch module.

PASSENGER SEAT SWITCH (Continued)

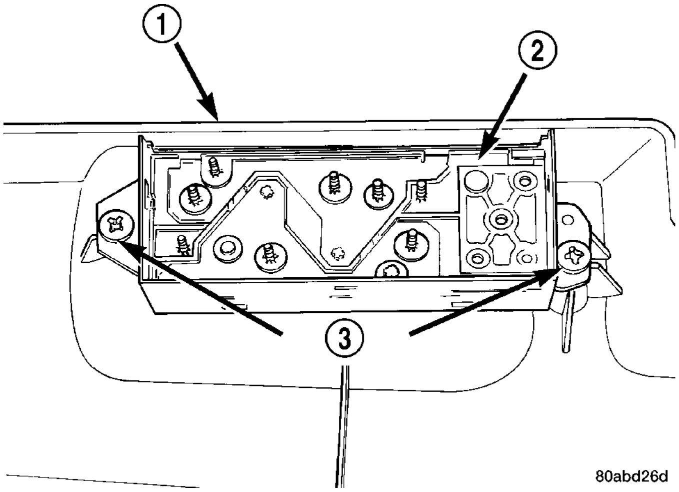

Fig. 6 Power Seat Switch Remove/Install

1 - SEAT SIDE SHIELD
2 - POWER SEAT SWITCH
3 - SCREWS

(4) Remove the screws that secure the power seat switch (Fig. 6).

INSTALLATION

(1) Position the power seat switch on the seat cushion side shield and install the screws that secure the power seat switch to seat cushion side shield.

(2) Connect the electrical connector.

(3) Install the seat cushion side shield on the seat. Refer to the Body section of the service manual for the procedure.

(4) If equipped, install the screw that secures the recliner lever to the recliner mechanism release shaft on the outboard side of the front seat.

(5) Connect the battery negative cable.

POWER SEAT TRACK

DESCRIPTION

The eight-way power seat option includes a power seat track assembly located under each front seat (Fig. 7). The power seat track assembly replaces the standard manually operated seat tracks. The lower half of the power seat track is secured at the front with two bolts to the floor panel seat cross member, and at the rear with two bolts to the floor panel. Four nuts secure the bottom of the seat cushion frame to the upper half of the power seat track unit.

The power seat track assembly cannot be repaired, and is serviced only as a complete assembly. If any component in this assembly is faulty or damaged, the entire power seat track must be replaced.

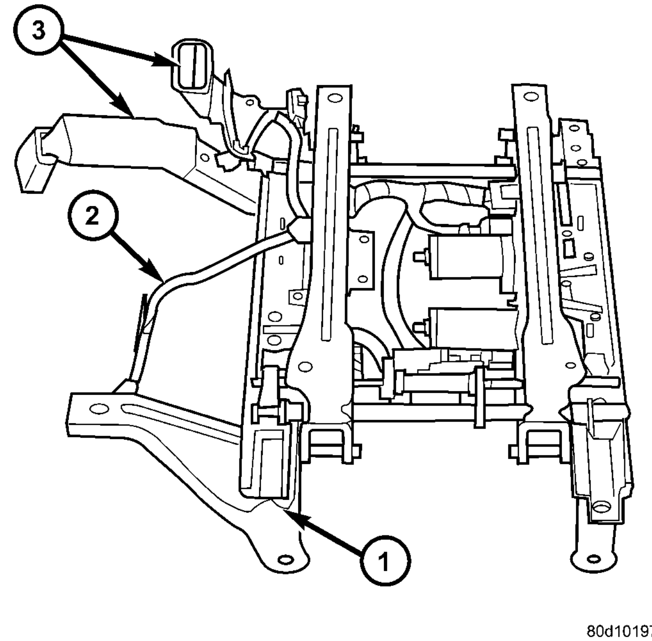

Fig. 7 DR Driver Power Seat Track

1 - POWER SEAT TRACK ASSEMBLY
2 - SEAT TRACK WIRE HARNESS
3 - SEAT BELT BUCKLE ASSEMBLIES

OPERATION

The power seat track unit includes three reversible electric motors that are secured to the upper half of the track unit. Each motor moves the seat adjuster through a combination of worm-drive gearboxes and screw-type drive units.

The front and rear of the seat are operated by two separate vertical adjustment motors. These motors can be operated independently of each other, tilting the entire seat assembly forward or rearward; or, they can be operated in unison by selecting the proper power seat switch functions, which will raise or lower the entire seat assembly. The third motor is the horizontal adjustment motor, which moves the seat track in the forward and rearward directions.

DIAGNOSIS AND TESTING - POWER SEAT TRACK

For complete power seat circuit descriptions and diagrams, refer to Wiring Diagrams.

Operate the power seat switch to move all three seat motors in each direction. The seat should move in each of the selected directions. If the power seat track fails to operate in only one direction, move the seat track a short distance in the opposite direction and test again to be certain that the track is not at its travel limit. If the power seat track still fails to operate in only one direction, refer to Diagnosis and Testing of the Power Seat Switch in this section. If

POWER SEAT TRACK (Continued)

the power seat track fails to operate in more than one direction, proceed as follows:

(1) Check the power seat fuse in the power distribution center. If OK, go to Step 2. If not OK, replace the faulty fuse.

(2) Remove the power seat switch from the seat. Check for battery voltage at the fused B(+) circuit cavity of the power seat switch wire harness connector. If OK, go to Step 3. If not OK, repair the open circuit to the power distribution center as required.

(3) Check for continuity between the ground circuit cavity of the power seat switch wire harness connector and a good ground. There should be continuity. If OK, go to Step 4. If not OK, repair the open circuit to ground as required.

(4) Test the power seat switch as described in this group. If the switch tests OK, check the wire harness between the power seat switch and the motor for shorts or opens. If the circuits check OK, replace the faulty power seat track (adjuster) assembly. If the circuits are not OK, repair the wire harness as required.

REMOVAL

(1) Remove the appropriate seat from the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REMOVAL).

(2) Remove the power seat switch from the seat. Refer to the procedure in this section of the service manual.

(3) Remove four seat track mounting nuts from cushion pan.

(4) Disconnect the power seat electrical and remove the seat track from the seat cushion.

(5) Remove the necessary components that must be transferred to the replacement seat track (seat belt buckles, wire harness, etc.).

INSTALLATION

(1) Install the necessary components that must be transferred to the replacement seat track (seat belt buckles, wire harness, etc.).

(2) Position the seat track and install the retaining nuts on the seat cushion pan studs. Torque the bolts to 25 N·m.

(3) Route and connect the power seat electrical on the seat track and cushion pan.

(4) Install the power seat switch on the seat. Refer to the procedure in this section of the service manual.

(5) Install the seat in the vehicle (Refer to 23 - BODY/SEATS/SEAT - INSTALLATION).

(6) Connect the negative battery cable.

LUMBAR CONTROL SWITCH

DESCRIPTION

The power lumbar seat option includes an electrically operated lumbar support mechanism. A single two-way momentary power lumbar switch is integral with the power seat switches. The power lumbar switch is secured to the back of the seat cushion side shield with screws, and the switch paddle protrudes through a hole to the outside of the shield. The switch paddle is located in a shallow depression molded into the outer surface of the seat cushion side shield that helps to shroud it from unintentional actuation when entering or leaving the vehicle.

The power lumbar switches cannot be adjusted or repaired and, if faulty or damaged, the seat switch assembly must be replaced.

OPERATION

When the power lumbar switch paddle is actuated, a battery feed and a ground path are applied through the switch contacts to the power lumbar adjuster motor. The motor operates to move the lumbar adjuster through its drive unit in the selected direction until the switch is released, or until the travel limit of the adjuster is reached. When the switch is moved in the opposite direction, the battery feed and ground path to the motor are reversed through the switch contacts. This causes the motor to run in the opposite direction.

The power lumbar switch should not be held applied in either direction after the adjuster has reached its travel limit. The power lumbar adjuster motor contains a self-resetting circuit breaker to protect it from overload. However, consecutive or frequent resetting of the circuit breaker must not be allowed to continue, or the motor may be damaged.

REMOVAL

The power lumbar switch is integral with the other power seat switches. Refer to the appropriate driver or passenger power front seat switch removal and/or installation procedure.

LUMBAR MOTOR

DESCRIPTION

The power lumbar seat option includes an electrically operated lumbar support mechanism. The only visible evidence of this option is the separate power lumbar switch control paddle that is located on the outboard seat cushion side shield, next to the other power seat switch control knobs. The power lumbar adjuster and motor are concealed beneath the seat back trim cover and padding, where they are secured

LUMBAR MOTOR (Continued)

to a molded plastic back panel and to the seat back frame.

The power lumbar adjuster cannot be repaired, and is serviced only as a unit with the seat back frame. If the power lumbar adjuster or the seat back frame are damaged or faulty, the entire seat back frame unit must be replaced (Refer to 23 - BODY/SEATS/ SEAT BACK - REMOVAL).

OPERATION

The power lumbar adjuster mechanism includes a reversible electric motor that is secured to the inboard side of the seat back panel and is connected to a worm-drive gearbox. The motor and gearbox operate the lumbar adjuster mechanism in the center of the seat back by extending and retracting a cable that actuates a lever. The action of this lever compresses or relaxes a grid of flexible slats. The more this grid is compressed, the more the slats bow outward against the center of the seat back padding, providing additional lumbar support.

DIAGNOSIS AND TESTING - LUMBAR MOTOR

Actuate the power lumbar switch to move the power lumbar adjuster in each direction. The power lumbar adjuster should move in both directions. It should be noted that the power lumber adjuster normally operates very quietly and exhibits little visible movement. If the power lumbar adjuster fails to operate in only one direction, move the adjuster a short distance in the opposite direction and test again to be certain that the adjuster is not at its travel limit. If the power lumbar adjuster fails to operate in only one direction, Test the appropriate power seat switch as described in this group. If the power lumbar adjuster fails to operate in either direction, perform the following tests. For complete circuit diagrams, refer to **Wiring**.

(1) Check the power seat circuit breaker. If OK, go to Step 2. If not OK, replace the faulty power seat circuit breaker.

(2) Check for battery voltage at the power seat circuit breaker. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the fuse in the Integrated Power Module as required.

(3) Remove the outboard seat cushion side shield from the seat. Disconnect the seat wire harness connector from the power lumbar switch connector receptacle. Check for battery voltage at the fused B(+) circuit cavity of the power seat wire harness connector for the power lumbar switch. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the power seat as required.

(4) Check for continuity between the ground circuit cavity of the power seat wire harness connector for the power lumbar switch and a good ground. There should be continuity. If OK, go to Step 5. If not OK, repair the open ground circuit to ground as required.

(5) Test the power lumbar switch. . If the switch tests OK, test the circuits of the power seat wire harness between the power lumbar adjuster motor and the power lumbar switch for shorts or opens. If the circuits check OK, replace the faulty seat back frame assembly. If the circuits are not OK, repair the power seat wire harness as required.

POWER WINDOWS

TABLE OF CONTENTS

POWER WINDOWS

DESCRIPTION

The power window system allows each of the door windows to be raised and lowered electrically by actuating a switch on each door panel. A master switch on the drivers door allows the driver to raise or lower each of the passenger door windows and to lock out the individual switches on the passenger doors from operation. The power window system receives battery feed through a fuse in the Integrated Power Module (IPM) and a circuit breaker located in the instrument panel wiring harness near the park brake pedal, only when the ignition switch is in the RUN or ACCESSORY position.

OPERATION

WINDOW SWITCH

The power window switches control the battery and ground feeds to the power window motors. The passenger door power window switches receive their battery and ground feeds through the circuitry of the drivers window switch. When the power window lock-out switch is in the Lock position, the battery feed for the passenger door window switches is interrupted.

WINDOW MOTOR

Window motors use permanent type magnets. The B+ and ground applied at the motor terminal pins will cause the motor to rotate in one direction. Reversing current through the motor terminals will cause the motor to rotate in the opposite direction.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

DIAGNOSIS AND TESTING - POWER WINDOWS

WIRING VOLTAGE TEST

The following wiring test determines whether or not voltage is continuous through the body harness to the front switch.

(1) Remove the Driver Door Module (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - REMOVAL).

(2) Disconnect wire connector from back of power window switch.

(3) Switch ignition to the ON position.

(4) Connect the clip end of a 12 volt test light to Pin 14 of the window switch harness connector. Touch the test light probe to Pin 10.

- If the test light illuminates, the wiring circuit between the battery and switch is OK.
- If the lamp does not illuminate, first check the fuse in the Integrated Power Module (IPM). Check the circuit breaker located near the park brake pedal. If fuse and circuit breaker are OK, then check for a broken wire.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

POWER WINDOW MOTOR TEST

If the power window motor is receiving proper current and ground and does not operate, proceed with motor test. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

(1) Remove front door trim panel as necessary to gain access to power window motor wire connector

POWER WINDOWS (Continued)

(Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(2) Disconnect power window motor wire connector from door harness.

(3) Using two jumper wires, connect one to a battery (+) source and the other to a good ground (-).

(4) Connect the Negative (-) jumper probe to one of the motor connector terminals.

(5) Momentarily touch the Positive (+) jumper probe to the other motor connector terminal.

When positive probe is connected the motor should rotate in one direction to either move window up or down. If window is all the way up or down the motor will grunt and the inner door panel will flex when actuated in that one direction.

(6) Reverse jumper probes at the motor connector terminals and window should now move in opposite direction. If window does not move or grunt, replace the motor.

If window moved completely up or down, reverse the jumper probes and cycle window to the opposite position to verify full operation.

If motor grunts and does not move, verify that regulator is not binding.

WINDOW MOTOR

REMOVAL

The window motor is serviced with the window regulator (Refer to 23 - BODY/DOOR - FRONT/WINDOW REGULATOR - REMOVAL) or (Refer to 23 - BODY/DOORS - REAR/WINDOW REGULATOR - REMOVAL).

WINDOW SWITCH

DIAGNOSIS AND TESTING - WINDOW SWITCH

The Light-Emitting Diode (LED) illumination lamps for all of the power window and lock switch and bezel unit switch paddles receive battery current through the power window circuit breaker in the junction block. If all of the LEDs are inoperative in both the power window and lock switch units and the power windows are inoperative, (Refer to 8 - ELECTRICAL/POWER WINDOWS - DIAGNOSIS AND TESTING). If the power windows operate, but any or all of the LEDs are inoperative, the power window and lock switch units with the inoperative LED(s) is faulty and must be replaced. For complete circuit diagrams, refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pinout information and location views for the various wire harness connectors, splices and grounds.

(1) Check the fuse in the Integrated Power Module (IPM) and the circuit breaker located near the park brake pedal. If OK, go to Step 2. If not OK, replace the faulty fuse or circuit breaker.

(2) Turn the ignition switch to the On position. Check for battery voltage at the fuse in the Integrated Power Module (IPM). If OK, turn the ignition switch to the Off position and go to Step 3. If not OK, check circuit breaker and repair the circuit to the ignition switch as required.

(3) Disconnect and isolate the battery negative cable. Remove the power window switch unit from the door trim panel (passenger doors). The drivers door switch is included with the Driver Door Module (Refer to 8 - ELECTRICAL/POWER LOCKS/DOOR MODULE - DIAGNOSIS AND TESTING) for service procedures. Unplug the wire harness connector from the switch unit.

(4) Test the power window switch continuity. See the Power Window Switch Continuity charts to determine if the continuity is correct in the Off, Up and Down switch positions (Fig. 1). If OK, (Refer to 8 - ELECTRICAL/POWER WINDOWS - DIAGNOSIS AND TESTING). If not OK, replace the faulty switch.

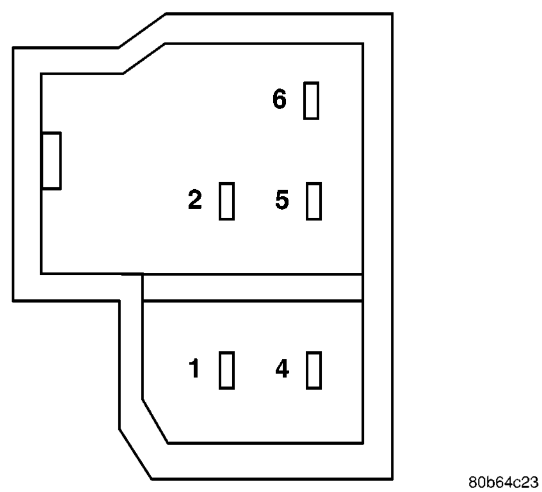

Fig. 1 PASSENGER DOOR SWITCH

POWER WINDOW SWITCH CONTINUITY CHART

SWITCH POSITION	CONTINUITY BETWEEN
NEUTRAL	PIN 2 AND 5, PIN 4 AND 1
UP (FRONT PASSENGER)	PIN 6 AND 5
UP (REAR PASSENGER)	PIN 6 AND 1
DOWN (FRONT PASSENGER)	PIN 6 AND 1
DOWN (REAR PASSENGER)	PIN 6 AND 5

WINDOW SWITCH (Continued)

REMOVAL

FRONT PASSENGER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL).

(3) Remove the switch from the trim panel bezel.

REAR PASSENGER

(1) Disconnect and isolate the battery negative cable.

(2) Remove the door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL).

(3) Gently pry switch from door trim panel.

INSTALLATION

FRONT PASSENGER

(1) Insert switch to trim panel bezel.

(2) Install door trim panel (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

REAR PASSENGER

(1) Install switch to door trim panel

(2) Install door trim panel (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION).

(3) Connect battery negative cable.

RESTRAINTS

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RESTRAINTS

DESCRIPTION

An occupant restraint system is standard factory-installed safety equipment on this model. Available occupant restraints for this model include both active and passive types. Active restraints are those which require the vehicle occupants to take some action to employ, such as fastening a seat belt; while passive restraints require no action by the vehicle occupants to be employed (Fig. 1).

ACTIVE RESTRAINTS

The active restraints for this model include:

• **Front Seat Belts** - Both outboard front seating positions are equipped with three-point seat belt systems employing a lower B-pillar mounted inertia latch-type emergency locking retractor, height-adjustable upper B-pillar mounted turning loops, a fixed lower seat belt anchor secured to the lower B-pillar (standard cab) or floor panel adjacent to the B-pillar (quad cab), and a traveling end-release seat belt buckle secured to the inboard seat track. The driver side retractor for standard cab models includes an electrically actuated seat belt tension reducer. The passenger side front seat retractor for all models is also switchable from an emergency locking retractor to an automatic locking retractor. The front seat belt buckle for the driver side of all models includes an integral seat belt switch that detects whether its seat belt has been fastened. The center front seating position for standard cab models is also equipped with a three-point seat belt employing a floor panel mounted inertia latch-type retractor, a routing bracket and bezel near the top of the cab back panel, and two fixed end-release buckles secured to the center seat cushion frame. The center front seating position for quad cab models is equipped with a fixed lap belt and an end-release buckle secured to the center seat cushion frame.

• **Rear Seat Belts** - All three rear seating positions are equipped with three-point seat belt systems. The outboard seating position belts employ a lower C-pillar mounted inertia latch-type emergency locking retractor, a fixed position upper C-pillar mounted turning loop, and a fixed lower seat belt anchor secured to the lower C-pillar. The rear seat center seating position belt has a rear floor panel mounted inertia latch-type emergency locking retractor and a routing bracket and bezel on the top of the cab back panel. The end-release buckle units for the right outboard seating position and the center seating position lower anchor are integral to the center retractor mounting bracket on the rear floor panel. The end-release buckle units for the center and left outboard seating positions are individually secured to the rear floor panel on models with the standard equipment rear bench seat, or secured with the rear seat mounting hardware on models with the optional 60/40 split rear bench seat.

• **Child Restraint Anchors** - All standard cab models are equipped with two, fixed-position, child seat upper tether anchors that are integral to the upper cab back panel reinforcement and concealed behind individual trim cover and bezel units that are integral to the cab back trim panel. All quad cab models are equipped with three child seat upper tether anchor straps that are secured to the upper cab back panel reinforcement, behind the upright rear seat back. Two lower anchors are also provided for the front outboard seating position of standard cab models, and for each rear outboard seating position on quad cab models. These lower anchors are accessed from the front of the seat where the seat back meets the seat cushion. The child seat tether and lower anchors for the front seat are deleted on quad cab models.

PASSIVE RESTRAINTS

The passive restraints available for this model include the following:

• **Dual Front Airbags** - Next Generation driver and front passenger airbags are available for this model. This airbag system is a passive, inflatable, Supplemental Restraint System (SRS) and vehicles with this equipment can be readily identified by the "SRS - AIRBAG" logo molded into the driver airbag trim cover in the center of the steering wheel and also into the passenger airbag door on the instrument panel above the glove box (Fig. 2). Vehicles with the airbag system can also be identified by the airbag indicator, which will illuminate in the instru-

RESTRAINTS (Continued)

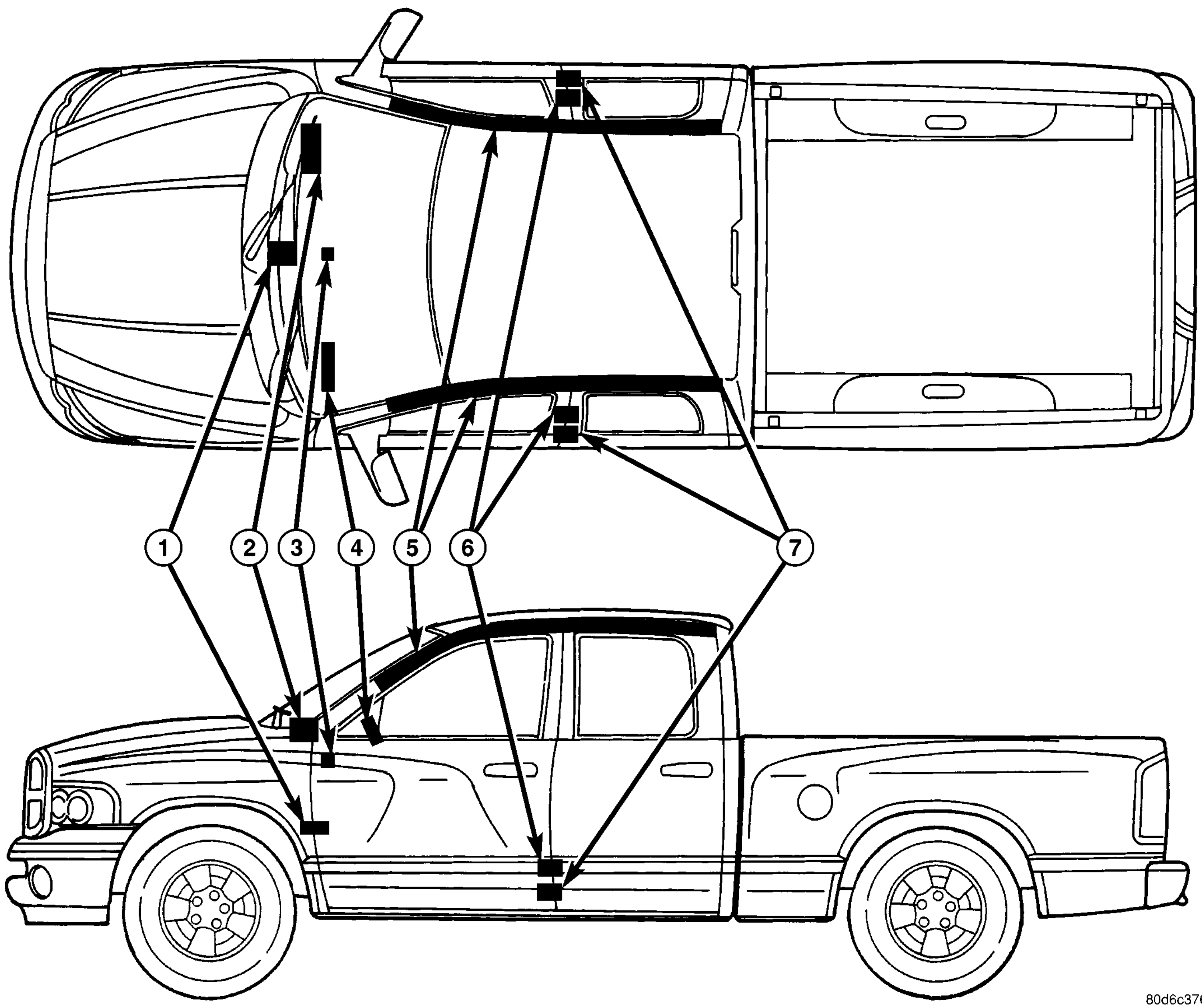

Fig. 1 Supplemental Restraint System

1 - AIRBAG CONTROL MODULE
2 - PASSENGER AIRBAG
3 - PASSENGER AIRBAG ON/OFF SWITCH (STD CAB ONLY)
4 - DRIVER AIRBAG
5 - SIDE CURTAIN AIRBAG
6 - SIDE IMPACT AIRBAG CONTROL MODULE
7 - SEAT BELT TENSIONER

ment cluster for about six seconds as a bulb test each time the ignition switch is turned to the On position. A pyrotechnic-type seat belt tensioner is integral to the front outboard seat belt retractors mounted on each lower B-pillar of all models equipped with dual front airbags.

• **Side Curtain Airbags** - Optional side curtain airbags are available for this model when it is also equipped with dual front airbags. This airbag system is a passive, inflatable, Supplemental Restraint System (SRS) and vehicles with this equipment can be readily identified by a molded identification trim button with the “SRS - AIRBAG” logo located on the headliner above each B-pillar (Fig. 2).

The supplemental restraint system includes the following major components, which are described in further detail elsewhere in this service information:

• **Airbag Control Module** - The Airbag Control Module (ACM) is located on a mount on the floor panel transmission tunnel, below the center of the instrument panel.

• **Airbag Indicator** - The airbag indicator is integral to the ElectroMechanical Instrument Cluster (EMIC), which is located on the instrument panel in front of the driver.

RESTRAINTS (Continued)

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Fig. 2 SRS Logo

- **Clockspring** - The clockspring is located near the top of the steering column, directly beneath the steering wheel.
- **Driver Airbag** - The driver airbag is located in the center of the steering wheel, beneath the driver airbag trim cover.
- **Driver Knee Blocker** - The driver knee blocker is a structural unit secured to the back side of and integral to the instrument panel steering column opening cover.
- **Passenger Airbag** - The passenger airbag is located on the instrument panel, beneath the passenger airbag door on the instrument panel above the glove box on the passenger side of the vehicle.
- **Passenger Airbag On/Off Switch** - Standard cab models without a rear seat are equipped with a passenger airbag on/off switch, which is located on the right side of the instrument panel center bezel.
- **Passenger Knee Blocker** - The passenger knee blocker is a structural reinforcement that is integral to and concealed within the glove box door.
- **Seat Belt Tensioner** - The seat belt tensioner is integral to the front outboard seat belt retractor units on vehicles equipped with dual front airbags.
- **Side Impact Airbag Control Module** - Two Side Impact Airbag Control Modules (SIACM) are used on vehicles with the optional side curtain airbags, one left side and one right side. One SIACM is located behind the B-pillar trim above the outboard front seat belt retractor within each B-pillar.
- **Side Curtain Airbag** - In vehicles equipped with this option, a side curtain airbag is located on each inside roof side rail above the headliner, and extends from the A-pillar to the B-pillar on standard cab models, and from the A-pillar to the C-pillar on quad cab models.

The ACM, both SIACMs, and the EMIC each contain a central processing unit and programming that allow them to communicate with each other using the Programmable Communications Interface (PCI) data bus network. This method of communication is used by the ACM for control of the airbag indicator on all models equipped with dual front airbags. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION).

Hard wired circuitry connects the supplemental restraint system components to each other through the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system, and to the supplemental restraint system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATION

ACTIVE RESTRAINTS

The primary passenger restraints in this or any other vehicle are the standard equipment factory-installed seat belts and child restraint anchors. Seat belts and child restraint anchors are referred to as an active restraint because the vehicle occupants are required to physically fasten and properly adjust these restraints in order to benefit from them. See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed active restraints.

PASSIVE RESTRAINTS

The passive restraints are referred to as a supplemental restraint system because they were designed and are intended to enhance the protection for the occupants of the vehicle **only** when used in conjunction with the seat belts. They are referred to as passive restraints because the vehicle occupants are not required to do anything to make them operate; however, the vehicle occupants must be wearing their seat belts in order to obtain the maximum safety benefit from the factory-installed supplemental restraint system.

The supplemental restraint system electrical circuits are continuously monitored and controlled by a microprocessor and software contained within the Airbag Control Module (ACM) and, on vehicles equipped with the side curtain airbags, both Side

RESTRAINTS (Continued)

Impact Airbag Control Modules (SIACM). An airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) illuminates for about six seconds as a bulb test each time the ignition switch is turned to the On or Start positions. Following the bulb test, the airbag indicator is turned on or off by the ACM to indicate the status of the supplemental restraint system. If the airbag indicator comes on at any time other than during the bulb test, it indicates that there is a problem in the supplemental restraint system electrical circuits. Such a problem may cause airbags not to deploy when required, or to deploy when not required.

Deployment of the supplemental restraints depends upon the angle and severity of an impact. Deployment is not based upon vehicle speed; rather, deployment is based upon the rate of deceleration as measured by the forces of gravity (G force) upon the impact sensors. When an impact is severe enough, the microprocessor in the ACM or the SIACM signals the inflator of the appropriate airbag units to deploy their airbag cushions. The outboard front seat belt tensioners are provided with a deployment signal by the ACM in conjunction with the driver and passenger airbags. During a frontal vehicle impact, the knee blockers work in concert with properly fastened and adjusted seat belts to restrain both the driver and the front seat passenger in the proper position for an airbag deployment. The knee blockers also absorb and distribute the crash energy from the driver and the front seat passenger to the structure of the instrument panel. The seat belt tensioner removes the slack from the outboard front seat belts to provide further assurance that the driver and front seat passenger are properly positioned and restrained for an airbag deployment.

Typically, the vehicle occupants recall more about the events preceding and following a collision than they do of an airbag deployment itself. This is because the airbag deployment and deflation occur so rapidly. In a typical 48 kilometer-per-hour (30 mile-per-hour) barrier impact, from the moment of impact until the airbags are fully inflated takes about 40 milliseconds. Within one to two seconds from the moment of impact, the airbags are almost entirely deflated. The times cited for these events are approximations, which apply only to a barrier impact at the given speed. Actual times will vary somewhat, depending upon the vehicle speed, impact angle, severity of the impact, and the type of collision.

When the ACM monitors a problem in any of the dual front airbag system circuits or components, including the seat belt tensioners, it stores a fault code or Diagnostic Trouble Code (DTC) in its memory circuit and sends an electronic message to the EMIC to turn on the airbag indicator. When the SIACM monitors a problem in any of the side curtain airbag system circuits or component, it stores a fault code or DTC in its memory circuit and sends an electronic message to the ACM, and the ACM sends an electronic message to the EMIC to turn on the airbag indicator. Proper testing of the supplemental restraint system components, the Programmable Communications Interface (PCI) data bus, the electronic message inputs to and outputs from the EMIC, the SIACM, or the ACM, as well as the retrieval or erasure of a DTC from the ACM, SIACM, or EMIC requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

See the owner's manual in the vehicle glove box for more information on the features, use and operation of all of the factory-installed passive restraints.

WARNING

WARNINGS - RESTRAINT SYSTEM

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

RESTRAINTS (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: AN AIRBAG INFLATOR UNIT MAY CONTAIN SODIUM AZIDE AND POTASSIUM NITRATE. THESE MATERIALS ARE POISONOUS AND EXTREMELY FLAMMABLE. CONTACT WITH ACID, WATER, OR HEAVY METALS MAY PRODUCE HARMFUL AND IRRITATING GASES (SODIUM HYDROXIDE IS FORMED IN THE PRESENCE OF MOISTURE) OR COMBUSTIBLE COMPOUNDS. AN AIRBAG INFLATOR UNIT MAY ALSO CONTAIN A GAS CANISTER PRESSURIZED TO OVER 2500 PSI. DO NOT ATTEMPT TO DISMANTLE AN AIRBAG UNIT OR TAMPER WITH ITS INFLATOR. DO NOT PUNCTURE, INCINERATE, OR BRING INTO CONTACT WITH ELECTRICITY. DO NOT STORE AT TEMPERATURES EXCEEDING 93° C (200° F).

WARNING: WHEN HANDLING A SEAT BELT TENSIONER RETRACTOR, PROPER CARE SHOULD BE EXERCISED TO KEEP FINGERS OUT FROM UNDER THE RETRACTOR COVER AND AWAY FROM THE SEAT BELT WEBBING WHERE IT EXITS FROM THE RETRACTOR COVER.

WARNING: REPLACE ALL RESTRAINT SYSTEM COMPONENTS ONLY WITH PARTS SPECIFIED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG. SUBSTITUTE PARTS MAY APPEAR INTERCHANGEABLE, BUT INTERNAL DIFFERENCES MAY RESULT IN INFERIOR OCCUPANT PROTECTION.

WARNING: THE FASTENERS, SCREWS, AND BOLTS ORIGINALLY USED FOR THE RESTRAINT SYSTEM COMPONENTS HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE RESTRAINT SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANY TIME A NEW FASTENER IS NEEDED, REPLACE IT WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR SPECIFIED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

WARNING: WHEN A STEERING COLUMN HAS AN AIRBAG UNIT ATTACHED, NEVER PLACE THE COLUMN ON THE FLOOR OR ANY OTHER SURFACE WITH THE STEERING WHEEL OR AIRBAG UNIT FACE DOWN.

DIAGNOSIS AND TESTING - SUPPLEMENTAL RESTRAINT SYSTEM

Proper diagnosis and testing of the supplemental restraint system components, the Programmable Communications Interface (PCI) data bus, the data bus electronic message inputs to and outputs from the ElectroMechanical Instrument Cluster (EMIC), the Airbag Control Module (ACM), or the Side Impact Airbag Control Module (SIACM) as well as the retrieval or erasure of a Diagnostic Trouble Code (DTC) from the ACM or SIACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

STANDARD PROCEDURE

STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS

At no time should any source of electricity be permitted near the inflator on the back of a non-deployed airbag or seat belt tensioner. When carrying a non-deployed airbag, the trim cover or airbag cushion side of the unit should be pointed away from the body to minimize injury in the event of an accidental deployment. If the airbag unit is placed on a bench or any other surface, the trim cover or airbag cushion side of the unit should be face up to minimize move-

RESTRAINTS (Continued)

ment in the event of an accidental deployment. When handling a non-deployed seat belt tensioner, take proper care to keep fingers out from under the retractor cover and away from the seat belt webbing where it exits from the retractor cover. In addition, the supplemental restraint system should be disarmed whenever any steering wheel, steering column, seat belt tensioner, driver airbag, passenger airbag, side curtain airbag, or instrument panel components require diagnosis or service. Failure to observe this warning could result in accidental airbag deployment and possible personal injury.

All damaged, faulty or non-deployed airbags and seat belt tensioners which are replaced on vehicles are to be handled and disposed of properly. If an airbag or seat belt tensioner unit is faulty or damaged and non-deployed, refer to the Hazardous Substance Control System for proper disposal. Dispose of all non-deployed and deployed airbags and seat belt tensioners in a manner consistent with state, provincial, local and federal regulations.

SUPPLEMENTAL RESTRAINT STORAGE

Airbags and seat belt tensioners must be stored in their original, special container until they are used for service. Also, they must be stored in a clean, dry environment; away from sources of extreme heat, sparks, and high electrical energy. Always place or store any airbag on a surface with its trim cover or airbag cushion side facing up, to minimize movement in case of an accidental deployment.

STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT

Any vehicle which is to be returned to use following a supplemental restraint deployment, must have the deployed restraints replaced. In addition, if the driver airbag has been deployed, the clockspring must be replaced. If the passenger airbag is deployed, the passenger airbag door must be replaced. The seat belt tensioners are deployed by the same signal that deploys the driver and passenger airbags and must also be replaced if either front airbag has been deployed. If a side curtain airbag has been deployed, the complete airbag unit, the headliner, as well as the upper A, B, and C-pillar trim must be replaced. These components are not intended for reuse and will be damaged or weakened as a result of a supplemental restraint deployment, which may or may not be obvious during a visual inspection.

It is also critical that the mounting surfaces and/or mounting brackets for the Airbag Control Module (ACM) and Side Impact Airbag Control Module (SIACM) be closely inspected and restored to their original conditions following any vehicle impact damage. Because the ACM and SIACM each contain impact sensors that are used by the supplemental restraint system to monitor or confirm the direction and severity of a vehicle impact, improper orientation or insecure fastening of these components may cause airbags not to deploy when required, or to deploy when not required. All other vehicle components should be closely inspected following any supplemental restraint deployment, but are to be replaced only as required by the extent of the visible damage incurred.

CLEANUP PROCEDURE

Following a supplemental restraint deployment, the vehicle interior will contain a powdery residue. This residue consists primarily of harmless particulate by-products of the small pyrotechnic charge that initiates the propellant used to deploy a supplemental restraint. However, this residue may also contain traces of sodium hydroxide powder, a chemical by-product of the propellant material that is used to generate the inert gas that inflates the airbag. Since sodium hydroxide powder can irritate the skin, eyes, nose, or throat, be certain to wear safety glasses, rubber gloves, and a long-sleeved shirt during cleanup (Fig. 3).

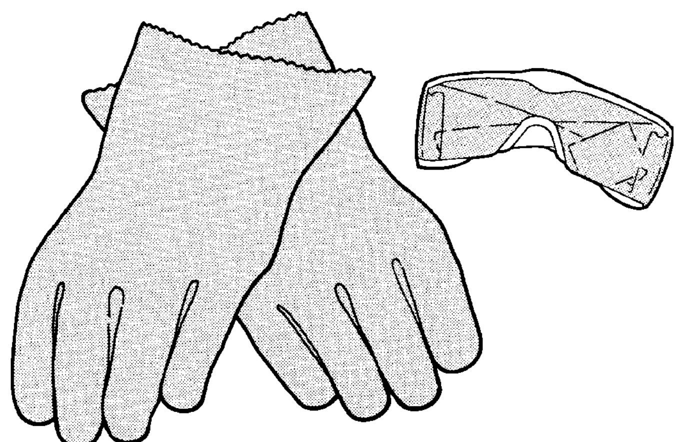

Fig. 3 Wear Safety Glasses and Rubber Gloves - Typical

WARNING: IF YOU EXPERIENCE SKIN IRRITATION DURING CLEANUP, RUN COOL WATER OVER THE AFFECTED AREA. ALSO, IF YOU EXPERIENCE IRRITATION OF THE NOSE OR THROAT, EXIT THE VEHICLE FOR FRESH AIR UNTIL THE IRRITATION CEASES. IF IRRITATION CONTINUES, SEE A PHYSICIAN.

(1) Begin the cleanup by using a vacuum cleaner to remove any residual powder from the vehicle interior. Clean from outside the vehicle and work your

RESTRAINTS (Continued)

way inside, so that you avoid kneeling or sitting on a non-cleaned area.

(2) Be certain to vacuum the heater and air conditioning outlets as well (Fig. 4). Run the heater and air conditioner blower on the lowest speed setting and vacuum any powder expelled from the outlets.

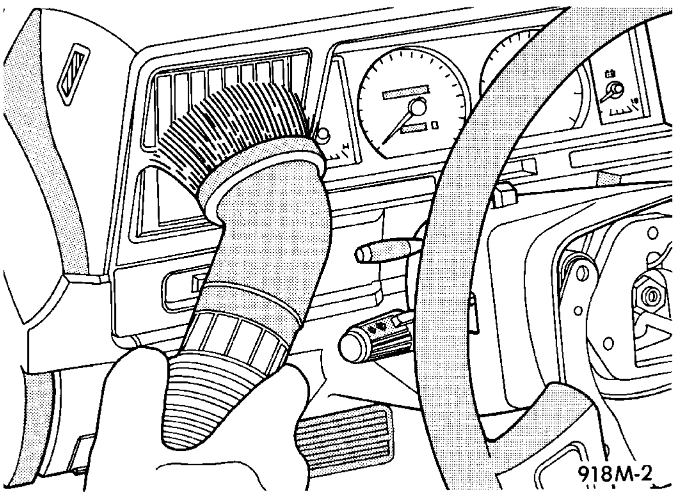

Fig. 4 Vacuum Heater and A/C Outlets - Typical

CAUTION: All damaged, faulty, or non-deployed supplemental restraints which are replaced on vehicles are to be handled and disposed of properly. If an airbag unit or seat belt tensioner unit is faulty or damaged and non-deployed, refer to the Hazardous Substance Control System for proper disposal. Be certain to dispose of all non-deployed and deployed supplemental restraints in a manner consistent with state, provincial, local and federal regulations.

(3) Next, remove the deployed supplemental restraints from the vehicle. Refer to the appropriate service removal procedures.

(4) You may need to vacuum the interior of the vehicle a second time to recover all of the powder.

STANDARD PROCEDURE - VERIFICATION TEST

The following procedure should be performed using a DRBIII® scan tool to verify proper supplemental restraint system operation following the service or replacement of any supplemental restraint system component.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) During the following test, the battery negative cable remains disconnected and isolated, as it was during the supplemental restraint system component removal and installation procedures.

(2) Be certain that the DRBIII® scan tool contains the latest version of the proper DRBIII® software. Connect the DRBIII® to the 16-way Data Link Connector (DLC). The DLC is located on the driver side lower edge of the instrument panel, outboard of the steering column (Fig. 5).

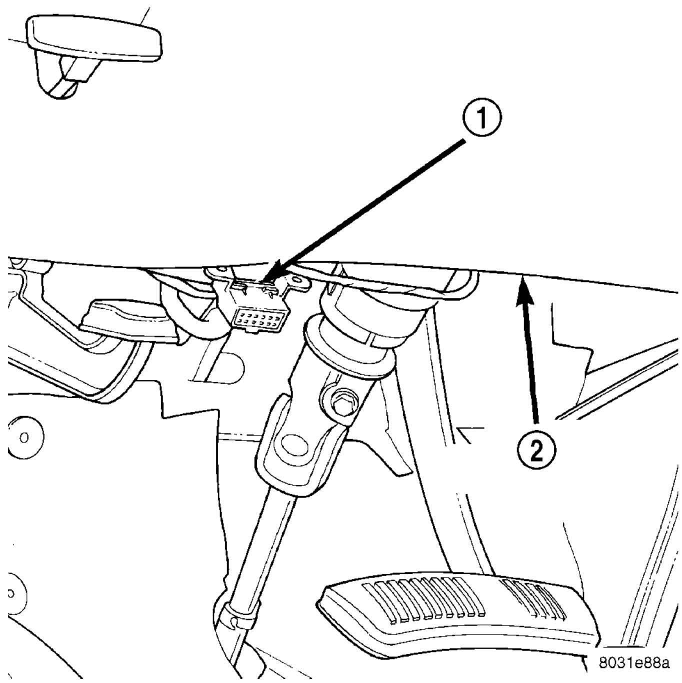

Fig. 5 16-Way Data Link Connector - Typical

1 - 16–WAY DATA LINK CONNECTOR
2 - BOTTOM OF INSTRUMENT PANEL

(3) Turn the ignition switch to the On position and exit the vehicle with the DRBIII® scan tool.

(4) Check to be certain that nobody is in the vehicle, then reconnect the battery negative cable.

(5) Using the DRBIII®, read and record the active (current) Diagnostic Trouble Code (DTC) data.

(6) Next, use the DRBIII® to read and record any stored (historical) DTC data.

(7) If any DTC is found in Step 5 or Step 6, refer to the appropriate diagnostic information.

(8) Use the DRBIII® to erase the stored DTC data. If any problems remain, the stored DTC data will not erase. Refer to the appropriate diagnostic information to diagnose any stored DTC that will not erase.

RESTRAINTS (Continued)

If the stored DTC information is successfully erased, go to Step 9.

(9) Turn the ignition switch to the Off position for about fifteen seconds, and then back to the On position. Observe the airbag indicator in the instrument cluster. It should illuminate for six to eight seconds, and then go out. This indicates that the supplemental restraint system is functioning normally and that the repairs are complete. If the airbag indicator fails to light, or lights and stays on, there is still an active supplemental restraint system fault or malfunction. Refer to the appropriate diagnostic information to diagnose the problem.

ACM COVER

REMOVAL

The Airbag Control Module (ACM) cover is used only on models with an automatic transmission. Models with a manual transmission require that the floor console be removed to access the ACM for service. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Using a trim stick or another suitable wide flat-bladed tool, gently pry each side of the ACM cover away from the instrument panel at each side of the center bracket on the floor panel transmission tunnel far enough to disengage the two snap clip retainers from the instrument panel receptacles (Fig. 6).

(3) Remove the ACM cover from the instrument panel.

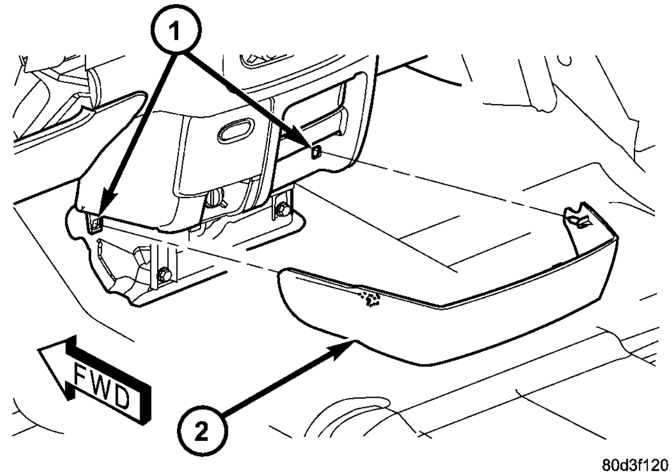

Fig. 6 ACM Cover Remove/Install

1 - INSTRUMENT PANEL RECEPTACLE (2)
2 - ACM COVER

INSTALLATION

The Airbag Control Module (ACM) cover is used only on models with an automatic transmission. Models with a manual transmission require that the floor console be reinstalled following ACM service. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the ACM cover to the instrument panel (Fig. 6).

(2) Align the snap clip retainer on each side of the ACM cover with the instrument panel receptacle at each side of the center bracket on the floor panel transmission tunnel.

(3) Using hand pressure, press firmly and evenly on the outside of the ACM cover over each snap clip retainer location until each retainer is fully engaged in its instrument panel receptacle.

(4) Reconnect the battery negative cable.

AIRBAG CONTROL MODULE

DESCRIPTION

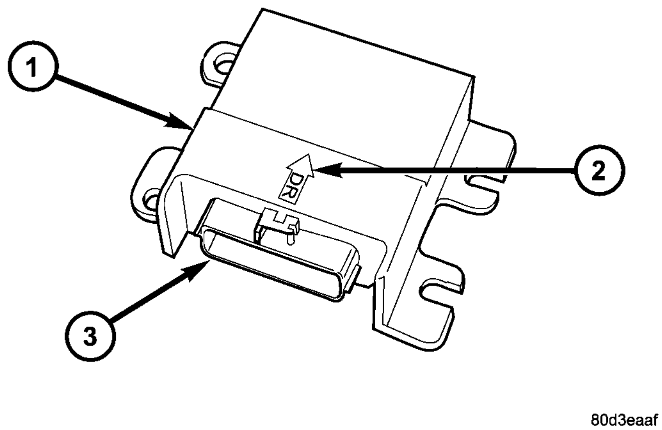

Fig. 7 Airbag Control Module

1 - AIRBAG CONTROL MODULE
2 - ORIENTATION ARROW
3 - CONNECTOR RECEPTACLE

The Airbag Control Module (ACM) is secured with four screws to the top mounting surface of a stamped steel bracket welded onto the top of the floor panel transmission tunnel forward of the instrument panel center support bracket and below the instrument panel center stack in the passenger compartment of the vehicle (Fig. 7). Concealed within a hollow in the center of the die cast aluminum ACM housing is the electronic circuitry of the ACM which includes a microprocessor, an electronic impact sensor, an electromechanical safing sensor, and an energy storage capacitor. A stamped metal cover plate is secured to the bottom of the ACM housing with four screws to enclose and protect the internal electronic circuitry and components.

The ACM housing has integral mounting flanges on each side. Two of the mounting flanges, one on each side, have an integral locating pin on their lower surface. The left flanges have round mounting holes, while the flanges on the right side have slotted mounting holes. An arrow cast into the top of the ACM housing near the rear provides a visual verification of the proper orientation of the unit, and should always be pointed toward the front of the vehicle. A molded plastic electrical connector receptacle containing twenty-three terminal pins exits the rearward facing side of the ACM housing. These terminal pins connect the ACM to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness.

The impact sensor and safing sensor internal to the ACM are calibrated for the specific vehicle, and are only serviced as a unit with the ACM. The ACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

OPERATION

The microprocessor in the Airbag Control Module (ACM) contains the front supplemental restraint system logic circuits and controls all of the front supplemental restraint system components. The ACM uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used for control of the airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) and for supplemental restraint system diagnosis and testing through the 16-way data link connector located on the driver side lower edge of the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER/AIRBAG INDICATOR - OPERATION).

The ACM microprocessor continuously monitors all of the front supplemental restraint system electrical circuits to determine the system readiness. If the ACM detects a monitored system fault, it sets an active and stored Diagnostic Trouble Code (DTC) and sends electronic messages to the EMIC over the PCI data bus to turn on the airbag indicator. An active fault only remains for the duration of the fault, or in some cases, the duration of the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the ACM. For some DTCs, if a fault does not recur for a number of ignition cycles, the ACM will automatically erase the stored DTC. For other internal faults, the stored DTC is latched forever.

In standard cab models, the ACM also monitors a resistor multiplexed input from the passenger airbag on/off switch and provides a control output for the Off indicator in the switch through a passenger airbag indicator driver circuit. If the passenger airbag on/off switch is set to the Off position, the ACM turns on the passenger airbag on/off switch Off indicator and will internally disable the passenger airbag from being deployed if an impact is detected that is sufficient for an airbag deployment. The ACM also turns on the on/off switch Off indicator for about seven seconds each time the ignition switch is turned to the On position as a bulb test. Following the bulb test, the ACM controls the status of the Off indicator based upon the resistance of the input from the on/off switch. The ACM will also set and/or store a DTC for faults it detects in the passenger airbag on/off switch circuits, and will turn on the airbag indicator in the EMIC if a fault has been detected.

AIRBAG CONTROL MODULE (Continued)

On models equipped with optional side curtain airbags, the ACM communicates with both the left and right Side Impact Airbag Control Modules (SIACM) over the PCI data bus. The SIACM notifies the ACM when it has detected a monitored system fault and stored a DTC in memory for its respective side curtain airbag system, and the ACM sets a DTC and controls the airbag indicator operation accordingly.

The ACM receives battery current through two circuits; a fused ignition switch output (run) circuit through a fuse in the Integrated Power Module (IPM), and a fused ignition switch output (run-start) circuit through a second fuse in the IPM. The ACM receives ground through a ground circuit and take out of the instrument panel wire harness. This take out has a single eyelet terminal connector that is secured by a ground screw to the instrument panel support structure. These connections allow the ACM to be operational whenever the ignition switch is in the Start or On positions. The ACM also contains an energy-storage capacitor. When the ignition switch is in the Start or On positions, this capacitor is continually being charged with enough electrical energy to deploy the front supplemental restraint components for up to one second following a battery disconnect or failure. The purpose of the capacitor is to provide backup supplemental restraint system protection in case there is a loss of battery current supply to the ACM during an impact.

Two sensors are contained within the ACM; an electronic impact sensor, and a safing sensor. The electronic impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. The safing sensor is an electromechanical sensor within the ACM that provides an additional logic input to the ACM microprocessor. The safing sensor is a normally open switch that is used to verify the need for a front supplemental restraint deployment by detecting impact energy of a lesser magnitude than that of the electronic impact sensor, and must be closed in order for the front airbags or seat belt tensioners to deploy. A pre-programmed decision algorithm in the ACM microprocessor determines when the deceleration rate as signaled by the impact sensor and the safing sensor indicate an impact that is severe enough to require front supplemental restraint system protection and, based upon the status of the passenger airbag on/off switch input and the severity of the monitored impact, determines what combination of seat belt tensioner and front airbag deployment is required for each front seating position. When the programmed conditions are met, the ACM sends the proper electrical signals to deploy the seat belt tensioners and dual front airbags.

The hard wired inputs and outputs for the ACM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the ACM, the PCI data bus network, or the electronic message inputs to and outputs from the ACM. The most reliable, efficient, and accurate means to diagnose the ACM, the PCI data bus network, and the electronic message inputs to and outputs from the ACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: THE AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE FRONT SUPPLEMENTAL RESTRAINTS. NEVER STRIKE OR DROP THE AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF AN AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER FRONT SUPPLEMENTAL RESTRAINT DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) On models with a manual transmission, remove the floor console from the top of the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL).

(3) On models with an automatic transmission, remove the ACM cover from the instrument panel.

AIRBAG CONTROL MODULE (Continued)

(Refer to 8 - ELECTRICAL/RESTRAINTS/ACM COVER - REMOVAL).

(4) Reach through the rearward facing opening below the instrument panel center stack support bracket on the top of the floor panel transmission tunnel to access and disconnect the instrument panel wire harness connector for the Airbag Control Module (ACM) from the ACM connector receptacle located on the rearward facing side of the module (Fig. 8). To disconnect the instrument panel wire harness connector from the ACM:

(a) Slide the red Connector Position Assurance (CPA) lock on the top of the connector toward the side of the connector.

(b) Depress the connector latch tab and pull the connector straight away from the ACM connector receptacle.

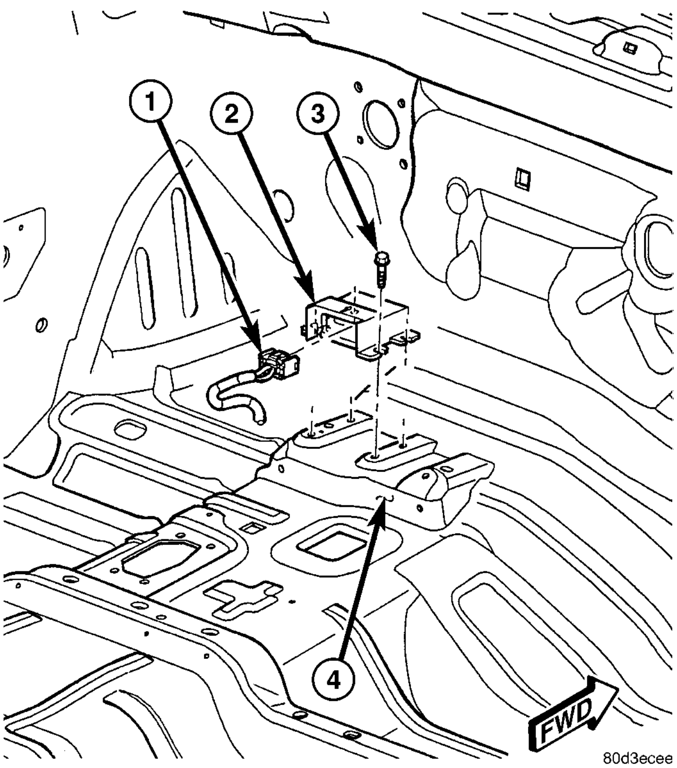

Fig. 8 Airbag Control Module Remove/Install

1 - WIRE HARNESS CONNECTOR
2 - AIRBAG CONTROL MODULE
3 - SCREW (4)
4 - FLOOR PANEL TRANSMISSION TUNNEL

(5) From the right side of the floor panel transmission tunnel, loosen each of the two screws that secure the right side of the ACM to the bracket on the floor panel transmission tunnel about 7 millimeters (0.25 inch).

(6) From the left side of the floor panel transmission tunnel, remove the two screws that secure the left side of the ACM to the bracket on the floor panel transmission tunnel.

(7) Still working from the left side of the floor panel transmission tunnel, lift the ACM upward far enough to disengage the locating pins on the bottom of the ACM mounting flanges from the locating holes in the mounting bracket, then slide the ACM toward the left far enough to disengage the slotted holes in the right ACM mounting flanges from under the heads of the two previously loosened right mounting screws.

(8) Remove the ACM from the left side of the floor panel transmission tunnel.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

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(1) Position the Airbag Control Module (ACM) to the left side of the floor panel transmission tunnel near the ACM bracket (Fig. 8). When the ACM is correctly positioned, the arrow on the ACM housing will be pointed forward in the vehicle.

(2) From the left side of the floor panel transmission tunnel, slide the ACM toward the right far enough to engage the slotted holes in the right ACM mounting flanges under the heads of the two previously loosened right mounting screws, then engage

AIRBAG CONTROL MODULE (Continued)

the locating pins on the bottom of the ACM mounting flanges into the locating holes in the bracket.

(3) Still working from the left side of the floor panel transmission tunnel, install and tighten the two screws that secure the left ACM mounting flanges to the bracket that is welded onto the floor panel transmission tunnel. Tighten the screws to 14 N·m (10 ft. lbs.).

(4) From the right side of the floor panel transmission tunnel, tighten each of the two screws that secure the right side of the ACM to the bracket on the floor panel transmission tunnel. Tighten the screws to 14 N·m (10 ft. lbs.).

(5) Reach through the rearward facing opening below the instrument panel center stack support bracket on the top of the floor panel transmission tunnel to access and reconnect the instrument panel wire harness connector for the ACM to the ACM connector receptacle located on the rearward facing side of the module. Be certain that the latch and the red Connector Position Assurance (CPA) lock on the connector are each fully engaged.

(6) On models with an automatic transmission, reinstall the ACM cover onto the instrument panel. (Refer to 8 - ELECTRICAL/RESTRAINTS/ACM COVER - INSTALLATION).

(7) On models with a manual transmission, reinstall the floor console onto the top of the floor panel transmission tunnel. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION).

(8) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

AUTOMATIC LOCKING RETRACTOR

DESCRIPTION

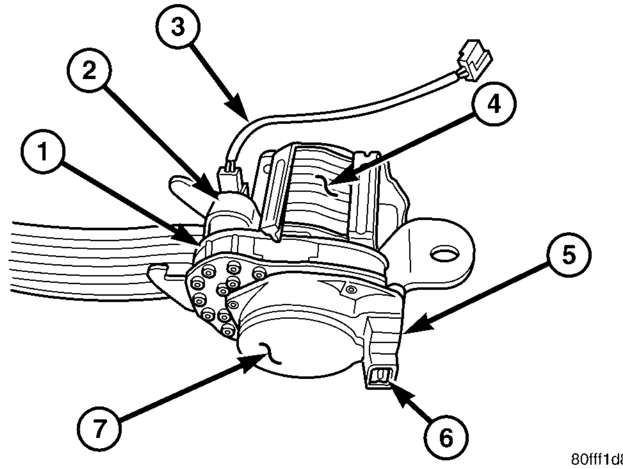


Fig. 9 Automatic Locking Retractor

1 - TENSIONER HOUSING OR CHAMBER
2 - GAS GENERATOR
3 - TENSIONER PIGTAIL WIRE
4 - SPOOL
5 - TENSION REDUCER (DRIVER SIDE ON STANDARD CAB ONLY)
6 - REDUCER CONNECTOR RECEPTACLE
7 - RETRACTOR LOCKING MECHANISM COVER

The seat belt retractors used in all seating positions include an inertia-type, emergency locking mechanism as standard equipment (Fig. 9). However, the retractor locking mechanism for the passenger side front seating position is mechanically switchable from an emergency locking retractor to an automatic locking retractor. The primary function of this feature is to securely accommodate a child seat in the passenger side front seating position of the vehicle without the need for a self-cinching seat belt tip half latch plate unit or another supplemental device that would be required to prevent the seat belt webbing from unwinding freely from the retractor spool of an inertia-type emergency locking retractor mechanism.

The automatic locking mechanism is integral to the passenger side front seat belt and retractor unit and is concealed beneath a molded plastic cover located on the same side of the retractor spool as the seat belt tensioner housing. The retractor is secured to the inner B-pillar on the right side of the vehicle and is concealed beneath the molded plastic inner B-pillar trim. The automatic locking mechanism cannot be adjusted or repaired and, if faulty or damaged, the entire passenger side front seat belt and retractor unit must be replaced.

AUTOMATIC LOCKING RETRACTOR (Continued)

OPERATION

The automatic locking mode of the retractor is engaged and the retractor is switched from operating as a standard inertia-type emergency locking retractor by first buckling the combination lap and shoulder belt buckle. Then grasp the shoulder belt and pull all of the webbing out of the retractor. Once all of the belt webbing is extracted from the spool, the retractor will automatically become engaged in the pre-locked automatic locking mode and will make an audible clicking or ratcheting sound as the shoulder belt is allowed to retract to confirm that the automatic locking mode is now engaged. Once the automatic locking mode is engaged, the retractor will remain locked and the belt will remain tight around whatever it is restraining.

The retractor is returned to standard emergency locking mode by unbuckling the combination lap and shoulder belt buckle and allowing the belt webbing to be almost fully retracted onto the retractor spool. The emergency locking mode is confirmed by the absence of the audible clicking or ratcheting sound as the belt webbing retracts. This mode will allow the belt to unwind from and wind onto the retractor spool freely unless and until a predetermined inertia load is sensed, or until the retractor is again switched to the automatic locking mode.

CHILD RESTRAINT ANCHOR

DESCRIPTION

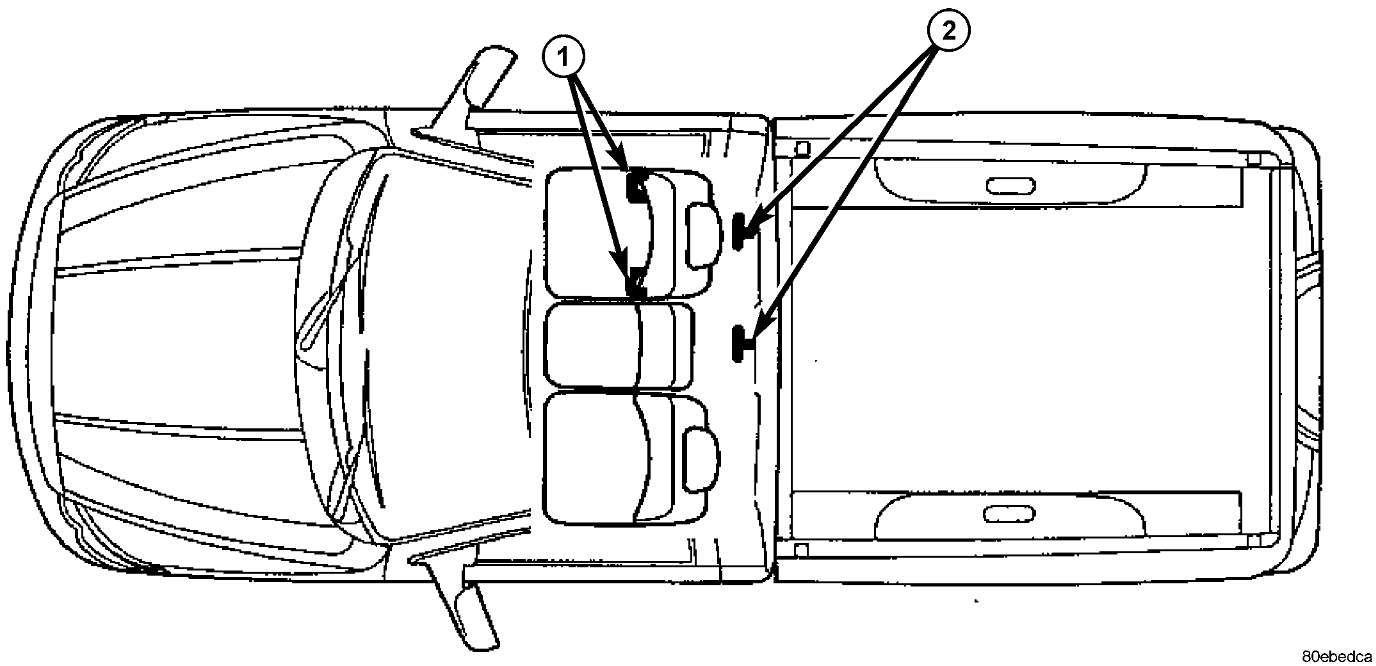


Fig. 10 Child Restraint Anchor Location - Standard Cab

1 - LOWER ANCHOR (PROVIDED FOR OUTBOARD SEATING POSITION ONLY)

2 - TETHER ANCHOR (PROVIDED FOR CENTER AND OUTBOARD SEATING POSITIONS)

CHILD RESTRAINT ANCHOR (Continued)

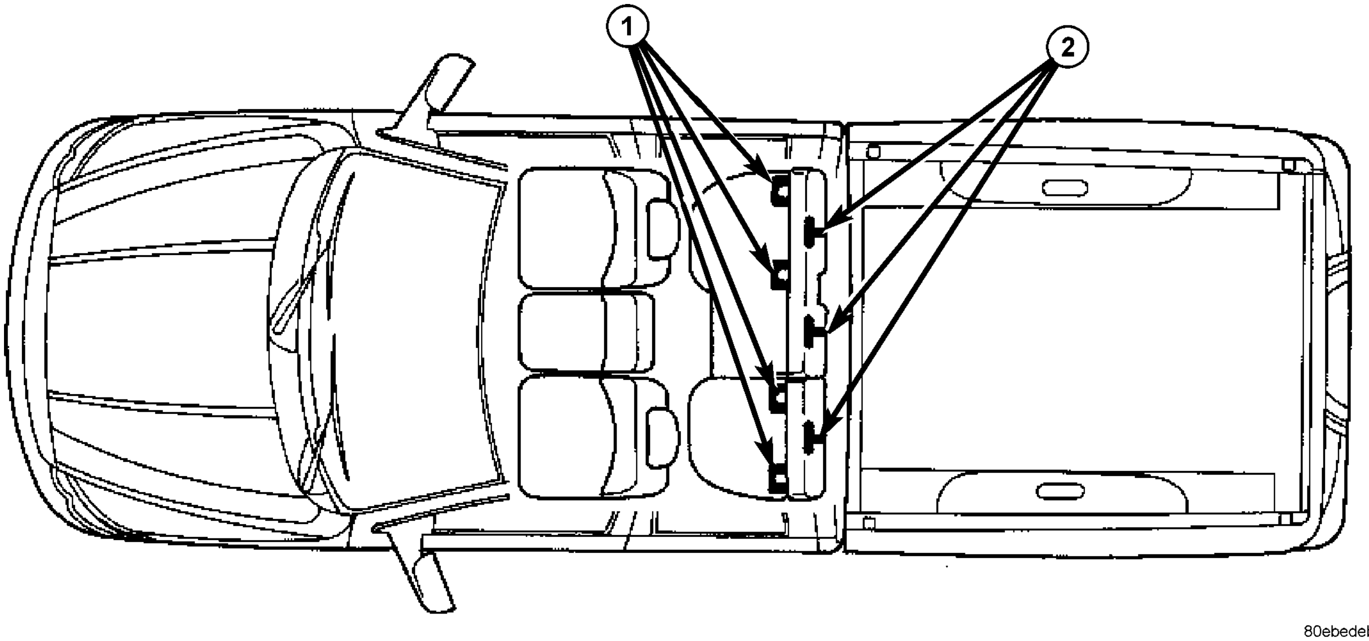


Fig. 11 Child Restraint Anchor Location - Quad Cab

1 - LOWER ANCHOR (PROVIDED FOR REAR OUTBOARD SEATING POSITIONS ONLY)
2 - TETHER ANCHOR (PROVIDED FOR REAR CENTER AND OUTBOARD SEATING POSITIONS)

This model is equipped with a Lower Anchors and Tether for CHildren, or LATCH child restraint anchorage system (Fig. 10) or (Fig. 11). The LATCH system provides for the installation of suitable child restraints in certain seating positions without using the standard equipment seat belt provided for that seating position. Standard cab models are equipped with a fixed-position child restraint upper tether anchor for the front center and outboard seating positions, and child restraint lower anchors for the front outboard seating position. Quad cab models are equipped with a fixed-position child restraint upper tether anchor strap for the rear center and both rear outboard seating positions, and child restraint lower anchors for both rear outboard seating positions. All front seat child restraint anchors are deleted on quad cab models.

The two upper tether anchors for standard cab models are integral to the upper cab back panel reinforcement and are concealed behind individual trim cover and bezel units that are integral to the cab back trim panel (Fig. 12). These upper tether anchors cannot be adjusted or repaired and, if faulty or damaged, they must be replaced as a unit with the upper cab back panel reinforcement. The upper tether anchor trim covers and bezels are serviced as a unit with the cab back trim panel.

The three upper tether anchor straps for quad cab models are secured to the upper cab back panel reinforcement with screws (Fig. 13). These anchor straps are concealed behind the upright rear seat back. The

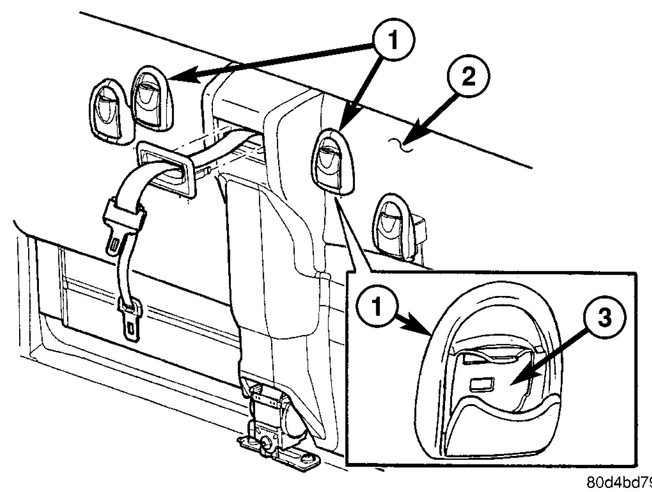


Fig. 12 Child Tether Anchor - Standard Cab

1 - COVER & BEZEL (2)
2 - CAB BACK TRIM PANEL
3 - ANCHOR (2)

upper tether anchor straps are available for individual service replacement.

The lower anchors for all models are integral to their respective front or rear seat cushion frame (Fig. 14) or (Fig. 15). Round markers with an imprinted child seat icon on the standard cab front seat back trim cover helps identify the anchor locations for that application because they may be otherwise difficult to see with the seat back in the upright position. These lower anchors are each constructed from round steel

CHILD RESTRAINT ANCHOR (Continued)

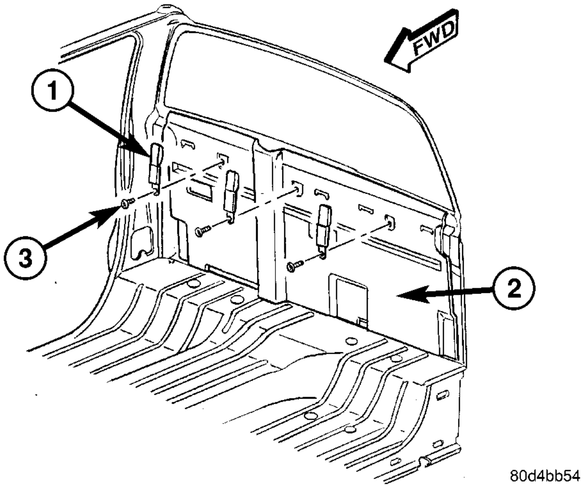


Fig. 13 Child Tether Strap - Quad Cab

1 - TETHER STRAP (3)
2 - CAB BACK PANEL
3 - SCREW (3)

bar stock that is formed into a U-shape, then securely welded at each end to the seat cushion frame. They are each accessed from the front of their respective seats, at each side where the seat back meets the seat cushion. These lower anchors cannot be adjusted or repaired and, if faulty or damaged, they must be replaced as a unit with the seat cushion frame. On quad cab models, if the lower anchors have been bent or broken as a result of a vehicle collision, the latch for the affected rear seat cushion frame unit must also be replaced.

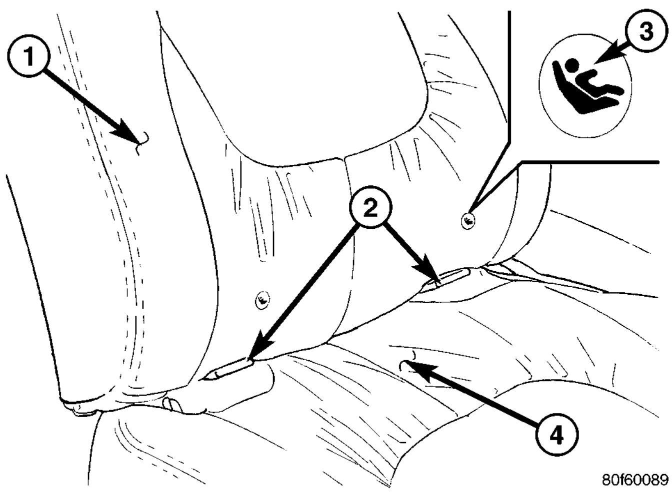


Fig. 14 Child Restraint Lower Anchor - Standard Cab Front Seat

1 - FRONT SEAT BACK
2 - LOWER ANCHOR (2) - PASSENGER SIDE OUTBOARD SEATING POSITION ONLY
3 - LOWER ANCHOR MARKER (2)
4 - FRONT SEAT CUSHION

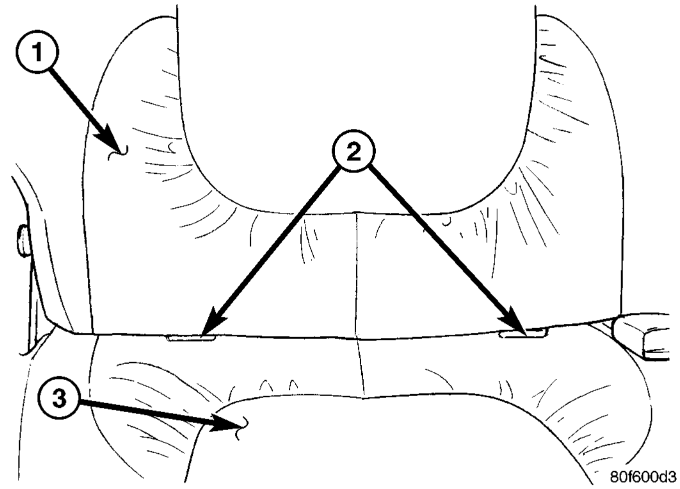


Fig. 15 Child Restraint Lower Anchor - Quad Cab Rear Seat

1 - REAR SEAT BACK
2 - LOWER ANCHOR (2 PER OUTBOARD REAR SEATING POSITION)
3 - REAR SEAT CUSHION

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

OPERATION

See the owner's manual in the vehicle glove box for more information on the proper use of all of the factory-installed child restraint anchors.

REMOVAL

The following procedure applies only to the rear seat upper child tether straps used on quad cab models. The child restraint anchors used in other models and locations are integral to other components and cannot be serviced separately.

CHILD RESTRAINT ANCHOR (Continued)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Remove the rear seat from the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL).

(2) Remove the screw that secures the child tether strap to the upper cab back panel reinforcement (Fig. 16).

(3) Remove the child tether strap from the upper cab back panel reinforcement.

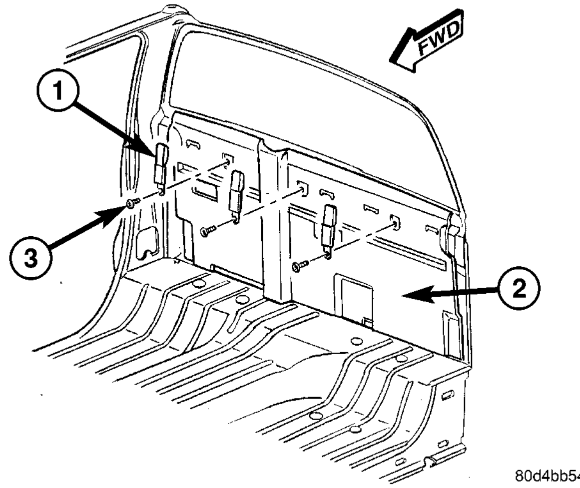


Fig. 16 Child Tether Strap - Quad Cab

1 - TETHER STRAP (3)
2 - CAB BACK PANEL
3 - SCREW (3)

INSTALLATION

The following procedure applies only to the rear seat upper child tether straps used on quad cab models. The child restraint anchors used in other models and locations are integral to other components and cannot be serviced separately.

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the child tether strap onto the upper cab back panel reinforcement (Fig. 16).

(2) Install and tighten the screw that secures the child tether strap to the upper cab back panel reinforcement. Tighten the screw to 14 N·m (10 ft. lbs.).

(3) Reinstall the rear seat into the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION).

CLOCKSPRING

DESCRIPTION

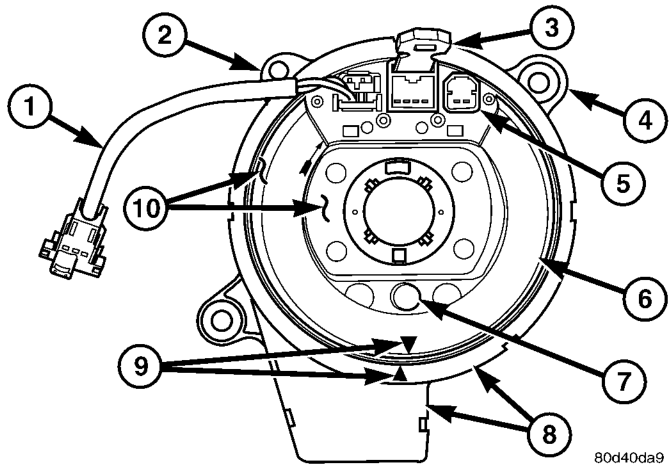


Fig. 17 Clockspring

1 - PIGTAIL WIRE
2 - LOCATING TAB
3 - LOCKING PIN
4 - MOUNTING TAB (2)
5 - UPPER CONNECTOR RECEPTACLE (2)
6 - LABEL
7 - ENGAGEMENT DOWEL & BOOT
8 - CASE
9 - CENTERING ARROWS
10 - ROTOR

The clockspring assembly is secured with two screws onto the multi-function switch mounting housing near the top of the steering column behind the steering wheel (Fig. 17). The clockspring consists of a flat, round molded plastic case with a stubby tail that hangs below the steering column (Fig. 18). The tail contains two connector receptacles that face toward the instrument panel. Within the plastic case is a spool-like molded plastic rotor with a large exposed hub. The upper surface of the rotor hub has a large center hole, two large flats, an engagement dowel with a yellow rubber boot, a short pigtail wire with connector, and two connector receptacles that face toward the steering wheel.

The lower surface of the rotor hub has a molded plastic turn signal cancel cam with two lobes that is keyed to the rotor and is secured there with four integral snap features. Within the plastic case and wound around the rotor spool is a long ribbon-like tape that consists of several thin copper wire leads sandwiched between two thin plastic membranes. The outer end of the tape terminates at the connector receptacles that face the instrument panel, while the inner end of the tape terminates at the pigtail wire and connector receptacles on the hub of the clockspring rotor that face the steering wheel.

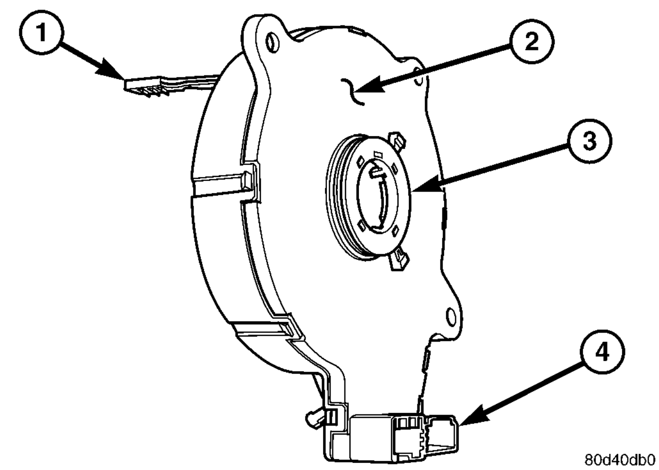


Fig. 18 Turn Signal Cancel Cam

1 - LOCKING PIN
2 - CLOCKSPRING CASE
3 - CANCEL CAM
4 - LOWER CONNECTOR RECEPTACLE (2)

Service replacement clocksprings are shipped pre-centered and with a molded plastic locking pin that snaps into a receptacle on the rotor and is engaged between two tabs on the upper surface of the rotor case. The locking pin secures the centered clockspring rotor to the clockspring case during shipment, but the locking pin must be removed from the clockspring after it is installed on the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

The clockspring cannot be repaired. If the clockspring is faulty, damaged, or if the driver airbag has been deployed, the clockspring must be replaced.

OPERATION

The clockspring is a mechanical electrical circuit component that is used to provide continuous electrical continuity between the fixed instrument panel wire harness and the electrical components mounted on or in the rotating steering wheel. On this model the rotating electrical components include the driver airbag, the horn switch, the speed control switches, and the remote radio switches, if the vehicle is so equipped. The clockspring case is positioned and secured to the multi-function switch mounting housing near the top of the steering column. The connector receptacles on the tail of the fixed clockspring case connect the clockspring to the vehicle electrical system through two take outs with connectors from the instrument panel wire harness.

The clockspring rotor is movable and is keyed by an engagement dowel that is molded onto the rotor hub between two fins that are cast into the lower surface of the steering wheel armature. A yellow rub-

CLOCKSPRING (Continued)

ber boot is installed over the engagement dowel to eliminate contact noise between the dowel and the steering wheel. The two lobes on the turn signal cancel cam on the lower surface of the clockspring rotor hub contact a turn signal cancel actuator of the multi-function switch to provide automatic turn signal cancellation. The yellow sleeved pigtail wires on the upper surface of the clockspring rotor connect the clockspring to the driver airbag, while a steering wheel wire harness connects the two connector receptacles on the upper surface of the clockspring rotor to the horn switch feed pigtail wire connector and, if the vehicle is so equipped, to the optional speed control and remote radio switches on the steering wheel.

Like the clockspring in a timepiece, the clockspring tape has travel limits and can be damaged by being wound too tightly during full stop-to-stop steering wheel rotation. To prevent this from occurring, the clockspring is centered when it is installed on the steering column. Centering the clockspring indexes the clockspring tape to the movable steering components so that the tape can operate within its designed travel limits. However, if the clockspring is removed from the steering column or if the steering shaft is disconnected from the steering gear, the clockspring spool can change position relative to the movable steering components. The clockspring must be re-centered following completion of this service or the tape may be damaged.

Service replacement clocksprings are shipped pre-centered and with a plastic locking pin installed. This locking pin should not be disengaged until the clockspring has been installed on the steering column. If the locking pin is removed or damaged before the clockspring is installed on a steering column, the clockspring centering procedure must be performed. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

STANDARD PROCEDURE - CLOCKSPRING CENTERING

The clockspring is designed to wind and unwind when the steering wheel is rotated, but is only designed to rotate the same number of turns (about five complete rotations) as the steering wheel can be turned from stop to stop. Centering the clockspring indexes the clockspring tape to other steering components so that it can operate within its designed travel limits. The rotor of a centered clockspring can be rotated two and one-half turns in either direction from the centered position, without damaging the clockspring tape.

However, if the clockspring is removed for service or if the steering column is disconnected from the steering gear, the clockspring tape can change position relative to the other steering components. The clockspring must then be re-centered following completion of such service or the clockspring tape may be damaged. Service replacement clocksprings are shipped pre-centered, with a plastic locking pin installed (Fig. 19). This locking pin should not be removed until the clockspring has been installed on the steering column. If the locking pin is removed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

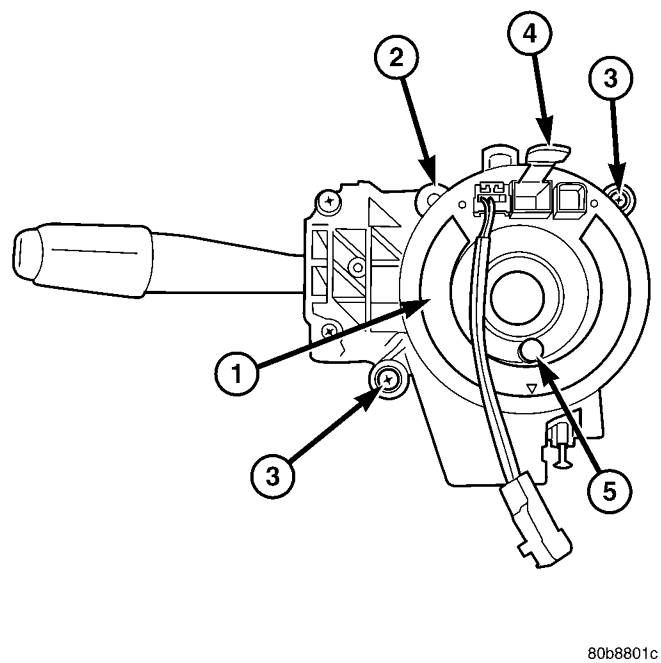


Fig. 19 Clockspring and Multi-Function Switch

1 - CLOCKSPRING
2 - LOCATING PIN
3 - SCREW (2)
4 - LOCKING PIN
5 - ENGAGEMENT DOWEL BOOT

CLOCKSPRING (Continued)

NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Place the front wheels in the straight-ahead position.

(2) Remove the clockspring from the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

(3) Rotate the clockspring rotor clockwise to the end of its travel. **Do not apply excessive torque.**

(4) From the end of the clockwise travel, rotate the rotor about two and one-half turns counterclockwise. The engagement dowel and yellow rubber boot should end up at the bottom, and the arrows on the clockspring rotor and case should be in alignment. The clockspring is now centered.

(5) The front wheels should still be in the straight-ahead position. Reinstall the clockspring onto the steering column. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - INSTALLATION).

REMOVAL

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: Before starting this procedure, be certain to turn the steering wheel until the front wheels are in the straight-ahead position.

(1) Place the front wheels in the straight ahead position.

(2) Remove the driver airbag from the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Disconnect the steering wheel wire harness connectors from the upper clockspring connector receptacles.

CAUTION: Be certain that the screws that secure the steering wheel puller to the steering wheel are fully engaged in the steering wheel armature without passing through the steering wheel and damaging the clockspring.

(4) Remove the steering wheel from the steering column. (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - REMOVAL).

(5) Remove the steering column opening cover from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).

(6) If the vehicle is so equipped, grasp the steering column tilt knob firmly and pull it straight rearward to remove it from the tilt adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk.

(7) From below the steering column, remove the two outboard screws that secure the upper shroud to the lower shroud.

(8) Using hand pressure, push gently inward on both sides of the upper shroud near the parting line between the upper and lower shrouds to release the snap features that secure it to the lower shroud.

(9) Remove the upper shroud from the lower shroud.

(10) From below the steering column, remove the one center screw that secures the lower shroud to the steering column lock housing.

(11) Remove the lower shroud from the steering column.

(12) Disconnect the two instrument panel wire harness connectors for the clockspring from the two connector receptacles below the steering column on the back of the clockspring housing.

(13) Remove the two screws that secure the clockspring to the multi-function switch mounting housing (Fig. 20).

(14) Remove the clockspring from the multi-function switch mounting housing. The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

(15) If the removed clockspring is to be reused, be certain to secure the clockspring rotor to the clockspring case to maintain clockspring centering until it is reinstalled on the steering column. If clockspring centering is not maintained, the clockspring must be centered again before it is reinstalled. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING).

CLOCKSPRING (Continued)

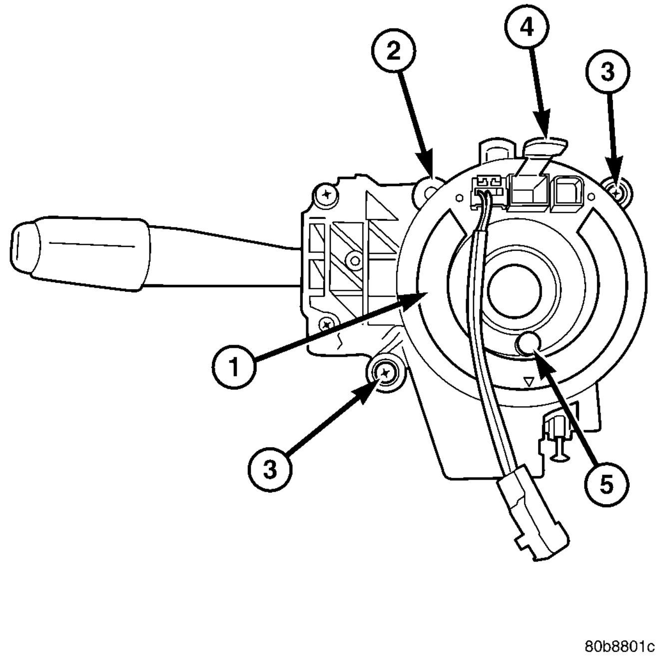


Fig. 20 Clockspring and Multi-Function Switch

1 - CLOCKSPRING
2 - LOCATING PIN
3 - SCREW (2)
4 - LOCKING PIN
5 - ENGAGEMENT DOWEL BOOT

INSTALLATION

The clockspring cannot be repaired. It must be replaced if faulty or damaged, or if the driver airbag has been deployed.

If the clockspring is not properly centered in relation to the steering wheel, steering shaft and steering gear, it may be damaged. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - STANDARD PROCEDURE - CLOCKSPRING CENTERING). Service replacement clocksprings are shipped pre-centered, with a plastic locking pin installed. This locking pin should not be removed until the clockspring has been installed on the steering column. If the locking pin is removed before the clockspring is installed on a steering column, the clockspring centering procedure must be performed.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: Before starting this procedure, be certain that the front wheels are still in the straight-ahead position.

(1) Carefully slide the centered clockspring down over the steering column upper shaft until the hole in the locating tab at the eleven o'clock position on the clockspring case is engaged over the locating pin on the multi-function switch mounting housing (Fig. 20).

(2) Install and tighten the two screws that secure the clockspring to the multi-function switch mounting housing. Tighten the screws to 2 N·m (20 in. lbs.).

(3) Reconnect the two instrument panel wire harness connectors for the clockspring to the two connector receptacles below the steering column on the back of the clockspring housing.

(4) Position the lower shroud onto the steering column.

(5) From below the steering column, install and tighten the one center screw that secures the lower shroud to the steering column lock housing. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Position the upper shroud onto the steering column. If the vehicle is equipped with an automatic transmission, be certain to engage the gearshift lever gap hider into the openings in the right side of the upper and lower shrouds.

(7) Align the snap features on the upper shroud with the receptacles on the lower shroud and apply hand pressure to snap them together.

(8) From below the steering column, install and tighten the two screws that secure the upper shroud to the lower shroud. Tighten the screws to 2 N·m (20 in. lbs.).

(9) If the vehicle is equipped with the optional tilt steering column, align the steering column tilt knob with the tilt adjuster mechanism lever located on the left side of the column just below the multi-function switch control stalk and, using hand pressure, push the knob firmly onto the lever.

(10) Reinstall the steering column opening cover onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(11) If a new clockspring has been installed, remove the locking pin that is securing the clockspring rotor to the clockspring case to maintain clockspring centering.

CLOCKSPRING (Continued)

NOTE: When reinstalling the steering wheel, be certain to index the yellow rubber booted engagement dowel on the upper surface of the clockspring rotor between the two fins cast into the lower surface of the steering wheel armature hub.

(12) Reinstall the steering wheel onto the steering column. (Refer to 19 - STEERING/COLUMN/STEERING WHEEL - INSTALLATION).

(13) Reconnect the steering wheel wire harness connectors to the upper clockspring connector receptacles. Be certain that the steering wheel wire harness is routed between the steering wheel back trim cover and the steering wheel armature.

(14) Reinstall the driver airbag onto the steering wheel. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

DRIVER AIRBAG

DESCRIPTION

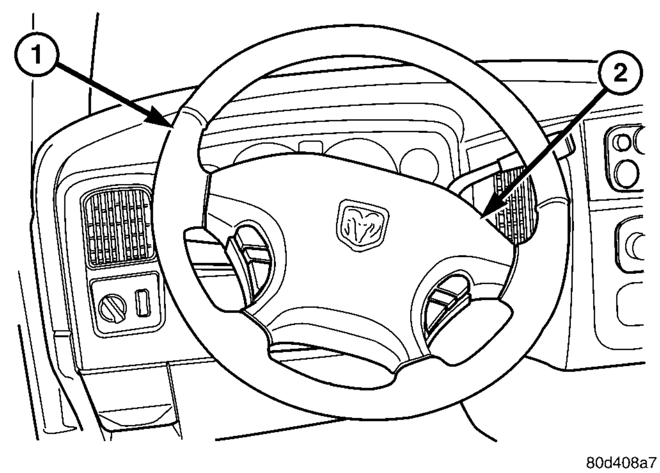


Fig. 21 Driver Airbag Trim Cover

1 - STEERING WHEEL
2 - TRIM COVER

The color-keyed, injection molded, thermoplastic driver airbag protective trim cover is the most visible part of the driver airbag (Fig. 21). The driver airbag is located in the center of the steering wheel, where it is secured with two screws to the armature of the four-spoke steering wheel. All models have a Dodge Ram logo embossed in the center of the trim cover. Concealed beneath the driver airbag trim cover are the horn switch, the folded airbag cushion, the airbag cushion retainer, the airbag housing, the airbag inflator, and the retainers that secure the inflator to the airbag housing.

The airbag cushion, housing, and inflator are secured within an integral receptacle molded into the back of the trim cover. The stamped metal airbag housing is secured by integral tabs that engage slotted locking blocks at the top and bottom of the trim cover receptacle, an integral metal hook inserted through a window in the vertical wall of the trim cover receptacle at each side, and by three aluminum blind rivets. This combination of fasteners locks the trim cover securely in place on the airbag housing.

The resistive membrane-type horn switch is secured with heat stakes to the inside surface of the driver airbag trim cover, between the trim cover and the folded airbag cushion. The horn switch ground pigtail wire has an eyelet terminal connector that is captured beneath a flanged nut on the upper right inflator mounting stud on the back of the housing (Fig. 22). The horn switch feed pigtail wire has a black, molded plastic insulator that is secured by an integral retainer in a locator hole near the upper left corner of the airbag housing and is connected to the vehicle electrical system through a dedicated take out of the steering wheel wire harness. Both horn switch wires are routed through integral routing slots in the upper locking block of the trim cover receptacle.

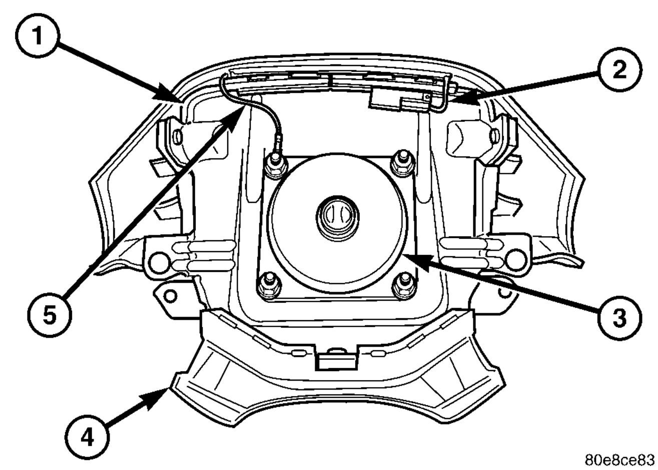


Fig. 22 Driver Airbag Housing

1 - HOUSING
2 - HORN SWITCH FEED WIRE
3 - INFLATOR
4 - TRIM COVER RECEPTACLE
5 - HORN SWITCH GROUND WIRE

The airbag used in this model is a Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. A 71.1 centimeter (28 inch) diameter, radial deploying fabric cushion with internal tethers is used. The airbag inflator is a non-azide, pyrotechnic-type unit and is secured by four flanged hex nuts to four studs on the airbag cushion retainer ring to the back of the stamped metal airbag housing. A connector receptacle on the driver airbag

DRIVER AIRBAG (Continued)

inflator connects the inflator initiator to the vehicle electrical system through a yellow-jacketed, two-wire pigtail harness of the clockspring.

The driver airbag cannot be repaired, and must be replaced if deployed or in any way damaged.

OPERATION

The driver airbag is deployed by electrical signals generated by the Airbag Control Module (ACM) through the driver airbag squib circuit to the initiator in the airbag inflator. When the ACM sends the proper electrical signal to the initiator the electrical energy generates enough heat to initiate a small pyrotechnic charge which, in turn ignites chemical pellets within the inflator. Once ignited, these chemical pellets burn rapidly and produce a large quantity of inert gas. The inflator is sealed to the back of the airbag housing and a diffuser in the inflator directs all of the inert gas into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the driver airbag trim cover will split at predetermined breakout lines, then fold back out of the way along with the horn switch unit. Following an airbag deployment, the airbag cushion quickly deflates by venting the inert gas towards the instrument panel through vent holes within the fabric used to construct the back (steering wheel side) panel of the airbag cushion.

Some of the chemicals used to create the inert gas may be considered hazardous while in their solid state before they are burned, but they are securely sealed within the airbag inflator. Typically, all potentially hazardous chemicals are burned during an airbag deployment event. The inert gas that is produced when the chemicals are burned is harmless. However, a small amount of residue from the burned chemicals may cause some temporary discomfort if it contacts the skin, eyes, or breathing passages. If skin or eye irritation is noted, rinse the affected area with plenty of cool, clean water. If breathing passages are irritated, move to another area where there is plenty of clean, fresh air to breath. If the irritation is not alleviated by these actions, contact a physician.

REMOVAL

The following procedure is for replacement of a faulty or damaged driver airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the driver airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG CUSHION AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) From the underside of the steering wheel, remove the two screws that secure the two trim covers or speed control switches to each side of the driver airbag trim cover.

(3) From the top of the steering wheel, remove the two trim covers or speed control switches from the pockets on each side of the driver airbag trim cover to access the driver airbag mounting screws.

(4) Remove the two screws that secure the driver airbag to the steering wheel armature (Fig. 23).

(5) Pull the driver airbag away from the steering wheel far enough to access the two electrical connections at the back of the airbag housing.

(6) Disconnect the steering wheel wire harness horn switch feed take out connector from the horn switch feed pigtail wire connector insulator located on the back of the driver airbag housing.

DRIVER AIRBAG (Continued)

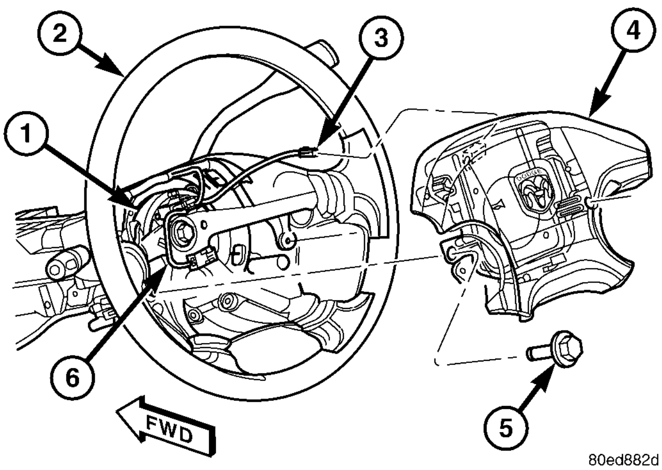


Fig. 23 Driver Airbag Remove/Install

1 - CLOCKSPRING
2 - STEERING WHEEL
3 - HORN SWITCH FEED TAKE OUT
4 - DRIVER AIRBAG
5 - SCREW (2)
6 - CLOCKSPRING PIGTAIL WIRE

CAUTION: Do not pull on the clockspring pigtail wires or pry on the connector insulator to disengage the connector from the driver airbag inflator connector receptacle. Improper removal of these pigtail wires and their connector insulators can result in damage to the airbag circuits or connector insulators.

(7) The clockspring driver airbag pigtail wire connector is secured by integral latches to the airbag inflator connector receptacle, which is located on the back of the driver airbag housing. Depress the latches on each side of the connector insulator and pull the insulator straight out from the airbag inflator to disconnect it from the connector receptacle.

(8) Remove the driver airbag from the steering wheel.

(9) If the driver airbag has been deployed, the clockspring must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

INSTALLATION

The following procedure is for replacement of a faulty or damaged driver airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the driver airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE DRIVER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE DRIVER AIRBAG CUSHION AND THE DRIVER AIRBAG TRIM COVER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

WARNING: THE DRIVER AIRBAG TRIM COVER MUST NEVER BE PAINTED. REPLACEMENT AIRBAGS ARE SERVICED WITH TRIM COVERS IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE TRIM COVER RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Position the driver airbag close enough to the steering wheel to reconnect the two electrical connections at the back of the airbag housing.

(2) When installing the driver airbag, reconnect the clockspring driver airbag pigtail wire connector to the airbag inflator connector receptacle by pressing straight in on the connector (Fig. 23). You can be certain that the connector is fully engaged in its receptacle by listening carefully for a distinct, audible click as the connector latches snap into place.

(3) Reconnect the steering wheel wire harness horn switch feed take out connector to the horn switch feed pigtail wire connector insulator located on the back of the driver airbag housing.

(4) Carefully position the driver airbag in the steering wheel. Be certain that the clockspring pigtail wire and the steering wheel wire harness in the

DRIVER AIRBAG (Continued)

steering wheel hub area are not pinched between the driver airbag and the steering wheel armature.

(5) Install and tighten the two screws that secure the driver airbag to the steering wheel armature. Tighten the screws to 14 N·m (120 in. lbs.).

(6) From the top of the steering wheel, position the two trim covers or speed control switches into the pockets on each side of the driver airbag trim cover.

(7) From the underside of the steering wheel, install and tighten the two screws that secure the two trim covers or speed control switches to each side of the driver airbag trim cover. Tighten the screws to 2 N·m (15 in. lbs.).

(8) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

FRONT CENTER SEAT BELT & RETRACTOR

REMOVAL

A front center seat belt and retractor is used only on standard cab models. Quad cab models have a lap belt in the front center seating position. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT CENTER SEAT BELT BUCKLE - REMOVAL).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Reach between the center of the front seat cushion and front seat back to access and unbuckle the front center seat belt lower anchor latch plate from the unique black, keyed lower anchor buckle. Use an ignition key or a small screwdriver to depress the small white release button on the anchor buckle.

(2) Move the front seat to its most forward position for easiest access to the front center seat belt and retractor unit.

(3) Using a trim stick or another suitable wide flat-bladed tool, gently pry at each side of the front center seat belt bezel on the cab back trim panel to release the snap features that secure the bezel to the panel (Fig. 24).

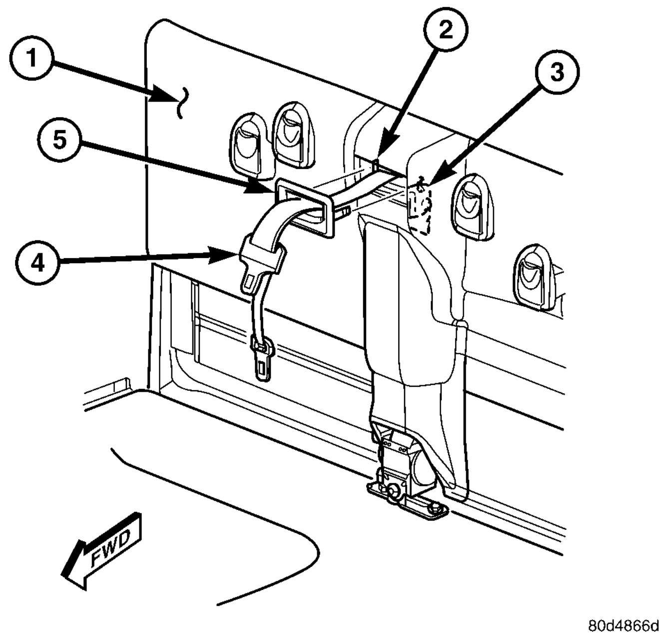


Fig. 24 Front Center Seat Belt Bezel

1 - TRIM PANEL
2 - BODY BRACKET
3 - SEAT BELT BRACKET
4 - SEAT BELT
5 - BEZEL

(4) Remove the bezel from the webbing of the front center seat belt.

(5) Remove the trim from the cab back panel. (Refer to 23 - BODY/INTERIOR/REAR CAB BACK PANEL TRIM - REMOVAL).

(6) Remove the two screws that secure the belt bracket of the front center seat belt to the body bracket on the upper cab back panel reinforcement (Fig. 25).

(7) Remove the belt bracket of the front center seat belt from the body bracket on the upper cab back panel reinforcement.

(8) Remove the two screws that secure the front center seat belt retractor bracket to the floor panel near the base of the cab back panel.

FRONT CENTER SEAT BELT & RETRACTOR (Continued)

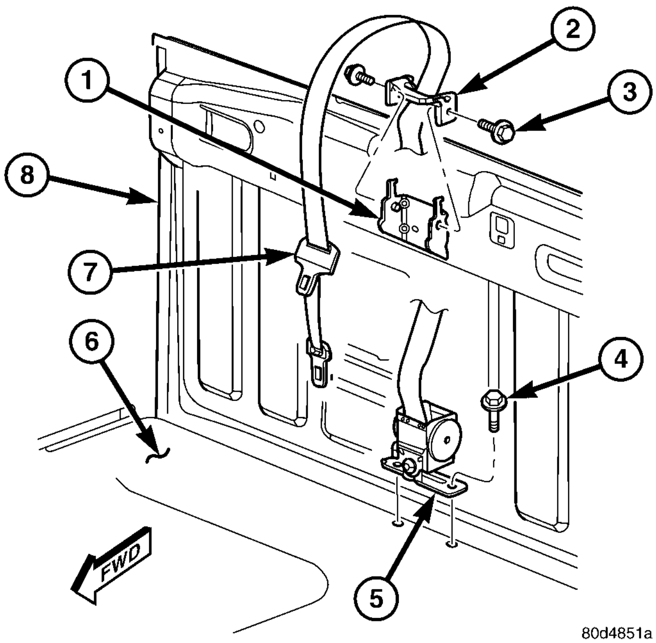


Fig. 25 Front Center Seat Belt & Retractor Remove/Install

1 - BODY BRACKET
2 - BELT BRACKET
3 - SCREW (2)
4 - SCREW (2)
5 - RETRACTOR
6 - FLOOR PANEL
7 - SEAT BELT
8 - CAB BACK PANEL

(9) Remove the front center seat belt and retractor unit from the floor panel.

INSTALLATION

A front center seat belt and retractor is used only on standard cab models. Quad cab models have a lap belt in the front center seating position. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT CENTER SEAT BELT BUCKLE - INSTALLATION).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the front center seat belt and retractor unit to the floor panel at the base of the cab back panel to the right of center (Fig. 25).

(2) Install and tighten the two screws that secure the front center seat belt retractor bracket to the floor panel near the base of the cab back panel. Tighten the screws to 40 N·m (29 ft. lbs.).

(3) Position the belt bracket of the front center seat belt to the body bracket on the upper cab back panel reinforcement.

(4) Install and tighten the two screws that secure the belt bracket of the front center seat belt to the body bracket on the upper cab back panel reinforcement. Tighten the screws to 20 N·m (15 ft. lbs.).

(5) Reinstall the trim onto the cab back panel. (Refer to 23 - BODY/INTERIOR/REAR CAB BACK PANEL TRIM - INSTALLATION).

(6) Route the webbing of the front center seat belt through the bezel and position the bezel to the belt opening near the top of the cab back trim panel (Fig. 24).

(7) Using hand pressure, press firmly and evenly on each side of the front center seat belt bezel until it snaps into place on the cab back trim panel.

(8) Move the front seat back to its rearward position.

(9) Reach between the center of the front seat cushion and front seat back to access and buckle the front center seat belt lower anchor latch plate to the unique black, keyed lower anchor buckle.

FRONT CENTER SEAT BELT

REMOVAL

A fixed position front center seat belt buckle is located on the left side of the front center seat section (20 percent) used on all models. Standard cab models also have a unique fixed position black, keyed front center seat belt lower anchor buckle for the three-point center seat belt lower anchor located on the right side of the front center seat section. The following procedure also applies to the fixed position front center seat lap belt located on the right side of the front center seat section of all quad cab models. The three-point front center seat belt and retractor unit is only used on standard cab models. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT CENTER SEAT BELT & RETRACTOR - REMOVAL).

FRONT CENTER SEAT BELT (Continued)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Move the adjacent right or left front outboard seat section (40 percent) to its most forward position for easiest access to the front center seat belt buckle, lap belt lower anchor, or unique black, keyed front center seat belt lower anchor buckle (Fig. 26).

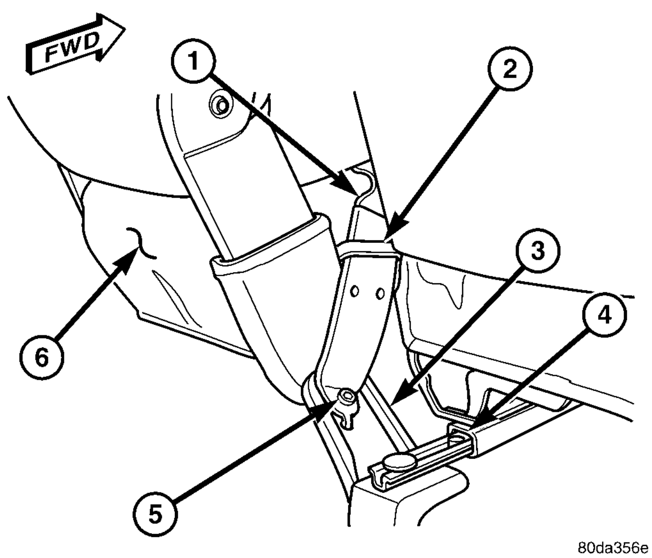


Fig. 26 Front Center Seat Belt Remove/Install

1 - FRONT CENTER SEAT BELT
2 - ELASTIC STRAP
3 - CENTER SEAT SUPPORT BRACKET
4 - INBOARD FRONT SEAT TRACK
5 - SCREW
6 - CENTER SEAT SECTION

(2) From behind the front seat, remove the screw that secures the front center seat belt buckle, lap belt lower anchor, or unique black, keyed front center seat belt lower anchor buckle to the center seat support bracket.

(3) From the front of the front seat, reach between the center seat cushion and the adjacent right or left front outboard seat cushion to access and remove the front center seat belt buckle, lap belt unit, or unique black, keyed front center seat belt lower anchor buckle through the elastic strap on the side of the center seat cushion.

(4) Remove the front center seat belt buckle, lap belt unit, or unique black, keyed front center seat belt lower anchor buckle from the front seat.

INSTALLATION

A fixed position front center seat belt buckle is located on the left side of the front center seat section (20 percent) used on all models. Standard cab models also have a unique fixed position black, keyed front center seat belt lower anchor buckle for the three-point center seat belt lower anchor located on the right side of the front center seat section. The following procedure also applies to the fixed position front center seat lap belt located on the right side of the front center seat section of all quad cab models. The three-point front center seat belt and retractor unit is only used on standard cab models. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT CENTER SEAT BELT & RETRACTOR - INSTALLATION).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) From the front of the front seat, position the front center seat belt buckle, lap belt unit, or unique black, keyed front center seat belt lower anchor

FRONT CENTER SEAT BELT (Continued)

buckle between the center seat cushion and the adjacent right or left front outboard seat cushion.

(2) From the front of the front seat, reach between the center seat cushion and the adjacent right or left front outboard seat cushion to route the front center seat belt buckle, lap belt unit lower anchor, or unique black, keyed front center seat belt lower anchor buckle through the elastic strap on the side of the center seat cushion (Fig. 26).

(3) From behind the front seat, position the front center seat belt buckle, lap belt lower anchor, or unique black, keyed front center seat belt lower anchor buckle to the center seat support bracket.

(4) Install and tighten the screw that secures the front center seat belt buckle, lap belt lower anchor, or unique black, keyed front center seat belt lower anchor buckle to the center seat support bracket. Tighten the screw to 40 N·m (29 ft. lbs.).

(5) Move the adjacent right or left front outboard seat section (40 percent) back to its rearward position.

FRONT OUTBOARD SEAT BELT & RETRACTOR

REMOVAL

REMOVAL - STANDARD CAB

The following procedure is for replacement of a faulty or damaged front outboard seat belt and retractor unit, which includes a seat belt tensioner for this model.(Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TENSIONER - DESCRIPTION). The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

The seat belt retractor on the driver's side of standard cab models only also includes a tension reducer. (Refer to 8 - ELECTRICAL/RESTRAINTS/TENSION REDUCER - DESCRIPTION). The seat belt retractor on the passenger's side of all models includes a switchable automatic locking mechanism. (Refer to 8 - ELECTRICAL/RESTRAINTS/AUTOMATIC LOCKING RETRACTOR - DESCRIPTION).

If the seat belt or retractor is faulty or damaged, but the seat belt tensioner is not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the seat belt tensioner has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the front outboard seat belt and retractor from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Move the front seat to its most forward position for easiest access to the lower seat belt anchor and the B-pillar trim.

(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

FRONT OUTBOARD SEAT BELT & RETRACTOR (Continued)

(3) Remove the screw that secures the lower seat belt anchor to the lower inner B-pillar (Fig. 27).

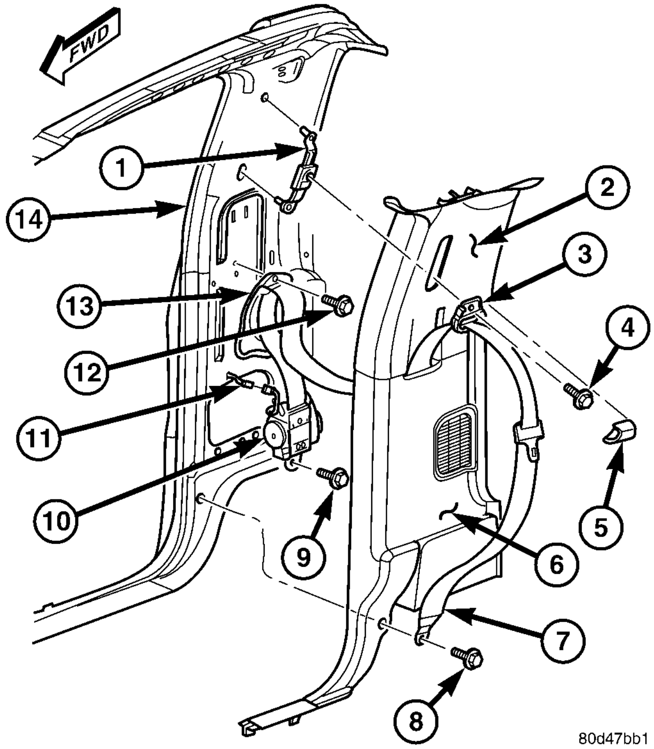


Fig. 27 Front Outboard Seat Belt & Retractor Remove/Install - Standard Cab

1 - ADJUSTER
2 - UPPER TRIM PANEL
3 - TURNING LOOP
4 - SCREW
5 - TRIM COVER
6 - LOWER TRIM PANEL
7 - LOWER ANCHOR
8 - SCREW
9 - SCREW
10 - RETRACTOR
11 - WIRE HARNESS CONNECTOR
12 - SCREW
13 - WEB GUIDE
14 - B-PILLAR

(4) Remove the lower seat belt anchor from the lower inner B-pillar.

(5) Unsnap and remove the trim cover from the front outboard seat belt turning loop to access the screw that secures the turning loop to the height adjuster on the upper inner B-pillar. Discard the removed turning loop trim cover as it is not intended for reuse.

(6) Remove the screw that secures the seat belt turning loop to the height adjuster.

(7) Remove the seat belt turning loop from the height adjuster.

(8) Remove the upper and lower trim from the inner B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(9) Remove the screw that secures the seat belt web guide to the inner B-pillar near the belt line.

(10) Remove the seat belt web guide from the inner B-pillar.

(11) On the driver side only, disconnect the body wire harness take out and white connector from the connector receptacle for the seat belt tension reducer located near the bottom of the retractor.

(12) Disengage the seat belt tensioner pigtail wire retainer from the hole in the inner B-pillar sheet metal.

(13) Disconnect the yellow seat belt tensioner pigtail wire connector from the body wire harness take out and connector for the tensioner.

(14) Remove the screw that secures the lower retractor bracket to the lower inner B-pillar below the retractor mounting hole.

(15) Disengage the hooks on the upper retractor bracket from the slots in the lower inner B-pillar above the retractor mounting hole.

(16) Remove the front outboard seat belt and retractor from the retractor mounting hole in the lower inner B-pillar.

REMOVAL - QUAD CAB

The following procedure is for replacement of a faulty or damaged front outboard seat belt and retractor unit, which includes a seat belt tensioner for this model. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TENSIONER - DESCRIPTION). The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

The seat belt retractor on the passenger's side of all models includes a switchable automatic locking mechanism. (Refer to 8 - ELECTRICAL/RESTRAINTS/AUTOMATIC LOCKING RETRACTOR - DESCRIPTION).

If the seat belt or retractor is faulty or damaged, but the seat belt tensioner is not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the seat belt tensioner has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the front outboard seat belt and retractor from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

FRONT OUTBOARD SEAT BELT & RETRACTOR (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Move the front seat to its most forward position for easiest access to the lower seat belt anchor and the B-pillar trim.

(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(3) Remove the screw that secures the lower seat belt anchor to the floor panel near the base of the inner B-pillar (Fig. 28).

(4) Remove the lower seat belt anchor from the floor panel near the base of the inner B-pillar.

(5) Unsnap and remove the trim cover from the front outboard seat belt turning loop to access the screw that secures the turning loop to the height adjuster on the upper inner B-pillar. Discard the removed turning loop trim cover as it is not intended for reuse.

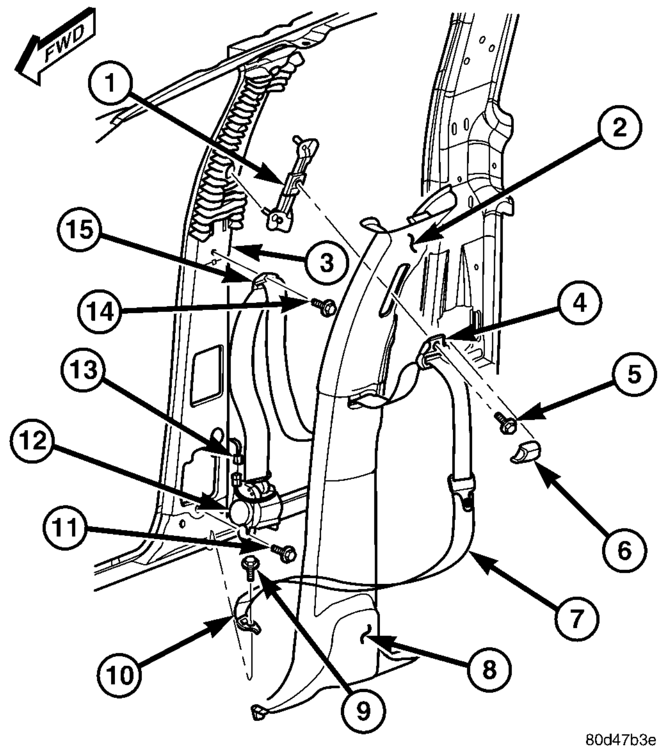


Fig. 28 Front Outboard Seat Belt & Retractor Remove/Install - Quad Cab

1 - ADJUSTER
2 - UPPER TRIM PANEL
3 - B-PILLAR
4 - TURNING LOOP
5 - SCREW
6 - TRIM COVER
7 - SEAT BELT
8 - LOWER TRIM PANEL
9 - SCREW
10 - LOWER ANCHOR
11 - SCREW
12 - RETRACTOR
13 - WIRE HARNESS CONNECTOR
14 - SCREW
15 - WEB GUIDE

(6) Remove the screw that secures the seat belt turning loop to the height adjuster.

(7) Remove the seat belt turning loop from the height adjuster.

(8) Remove the upper and lower trim from the inner B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL).

(9) Remove the screw that secures the seat belt web guide to the inner B-pillar near the belt line.

(10) Remove the seat belt web guide from the inner B-pillar.

FRONT OUTBOARD SEAT BELT & RETRACTOR (Continued)

(11) Disengage the seat belt tensioner pigtail wire retainer from the hole in the inner B-pillar sheet metal.

(12) Disconnect the yellow seat belt tensioner pigtail wire connector from the body wire harness take out and connector for the tensioner.

(13) Remove the screw that secures the lower retractor bracket to the lower inner B-pillar below the retractor mounting hole.

(14) Disengage the hooks on the upper retractor bracket from the slots in the lower inner B-pillar above the retractor mounting hole.

(15) Remove the front outboard seat belt and retractor from the retractor mounting hole in the lower inner B-pillar.

INSTALLATION

INSTALLATION - STANDARD CAB

The following procedure is for replacement of a faulty or damaged front outboard seat belt and retractor unit, which includes a seat belt tensioner for this model. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TENSIONER - DESCRIPTION). The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

The seat belt retractor on the driver's side of standard cab models only also includes a tension reducer. (Refer to 8 - ELECTRICAL/RESTRAINTS/TENSION REDUCER - DESCRIPTION). The seat belt retractor on the passenger's side of all models includes a switchable automatic locking mechanism. (Refer to 8 - ELECTRICAL/RESTRAINTS/AUTOMATIC LOCKING RETRACTOR - DESCRIPTION).

If the seat belt or retractor is faulty or damaged, but the seat belt tensioner is not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the seat belt tensioner has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the front outboard seat belt and retractor from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the front outboard seat belt and retractor to the retractor mounting hole in the lower inner B-pillar (Fig. 27).

(2) Engage the hooks on the upper retractor bracket into the slots in the lower inner B-pillar above the retractor mounting hole.

(3) Install and tighten the screw that secures the lower retractor bracket to the lower inner B-pillar below the retractor mounting hole. Tighten the screw to 40 N·m (29 ft. lbs.).

(4) Reconnect the yellow seat belt tensioner pigtail wire connector to the body wire harness take out and connector for the tensioner.

(5) Engage the seat belt tensioner pigtail wire retainer into the hole in the inner B-pillar sheet metal.

(6) On the driver side only, reconnect the body wire harness take out and white connector to the

FRONT OUTBOARD SEAT BELT & RETRACTOR (Continued)

seat belt tension reducer connector receptacle near the bottom of the retractor.

(7) Position the seat belt web guide to its mounting location on the inner B-pillar near the belt line.

(8) Install and tighten the screw that secures the seat belt web guide to the inner B-pillar. Tighten the screw to 2 N·m (20 in. lbs.).

(9) Reinstall the upper and lower trim onto the inner B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(10) Position the seat belt turning loop onto the height adjuster on the upper inner B-pillar.

(11) Install and tighten the screw that secures the seat belt turning loop to the height adjuster. Tighten the screw to 40 N·m (29 ft. lbs.).

(12) Engage the lower snap features of the new trim cover over the front outboard seat belt turning loop and, using hand pressure, press firmly and evenly on the top of the trim cover until it snaps into place.

(13) Position the lower seat belt anchor to the lower inner B-pillar.

(14) Install and tighten the screw that secures the lower seat belt anchor to the B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(15) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

(16) Move the front seat back to its rearward position.

INSTALLATION - QUAD CAB

The following procedure is for replacement of a faulty or damaged front outboard seat belt and retractor unit, which includes a seat belt tensioner for this model. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TENSIONER - DESCRIPTION). The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

The seat belt retractor on the passenger's side of all models includes a switchable automatic locking mechanism. (Refer to 8 - ELECTRICAL/RESTRAINTS/AUTOMATIC LOCKING RETRACTOR - DESCRIPTION).

If the seat belt or retractor is faulty or damaged, but the seat belt tensioner is not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the seat belt tensioner has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the front outboard seat belt and retractor from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the front outboard seat belt and retractor to the retractor mounting hole in the lower inner B-pillar (Fig. 28).

FRONT OUTBOARD SEAT BELT & RETRACTOR (Continued)

(2) Engage the hooks on the upper retractor bracket into the slots in the lower inner B-pillar above the retractor mounting hole.

(3) Install and tighten the screw that secures the lower retractor bracket to the lower inner B-pillar below the retractor mounting hole. Tighten the screw to 40 N·m (29 ft. lbs.).

(4) Reconnect the yellow seat belt tensioner pigtail wire connector to the body wire harness take out and connector for the tensioner.

(5) Engage the seat belt tensioner pigtail wire retainer into the hole in the inner B-pillar sheet metal.

(6) Position the seat belt web guide to its mounting location on the inner B-pillar near the belt line.

(7) Install and tighten the screw that secures the seat belt web guide to the inner B-pillar. Tighten the screw to 2 N·m (20 in. lbs.).

(8) Reinstall the upper and lower trim onto the inner B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION) and (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION).

(9) Position the seat belt turning loop onto the height adjuster on the upper inner B-pillar.

(10) Install and tighten the screw that secures the seat belt turning loop to the height adjuster. Tighten the screw to 40 N·m (29 ft. lbs.).

(11) Engage the lower snap features of the new trim cover over the front outboard seat belt turning loop and, using hand pressure, press firmly and evenly on the top of the trim cover until it snaps into place.

(12) Position the lower seat belt anchor to the floor panel near the base of the inner B-pillar.

(13) Install and tighten the screw that secures the lower seat belt anchor to the floor panel near the base of the inner B-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(14) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

(15) Move the front seat back to its rearward position.

FRONT OUTBOARD SEAT BELT BUCKLE

REMOVAL

A traveling front outboard seat belt buckle is located on the inboard side of each front outboard seat section (40 percent) used on all models. The seat belt buckle on the driver's side front seat for all models also includes a seat belt switch. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT SWITCH - DESCRIPTION).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Move the right or left front outboard seat section (40 percent) to its most rearward position and tilt the seat back forward for easiest access to the front outboard seat belt buckle lower anchor.

(2) For easiest access to the front outboard seat belt buckle lower anchor on standard cab models, also move the outboard seat section (40 percent) opposite the side from which the buckle is to be removed to its most forward position and tilt the seat back forward.

(3) On standard cab models only, remove the stowage tray from the rear floor panel behind the seat. (Refer to 23 - BODY/INTERIOR/REAR FLOOR STOWAGE TRAY - REMOVAL).

(4) From behind the front seat on the driver side only, disconnect the seat belt switch pigtail wire connector from the seat wire harness take out and connector for the switch located below the inboard edge of the driver side inboard seat track just forward of the buckle lower anchor (Fig. 29).

(5) From behind the front seat, remove the screw that secures the front outboard seat belt buckle lower anchor to the bracket on the inboard seat track.

(6) From the front of the front seat, reach between the center seat cushion and the adjacent right or left front outboard seat cushion to access and remove the front outboard seat belt buckle from the seat.

FRONT OUTBOARD SEAT BELT BUCKLE (Continued)

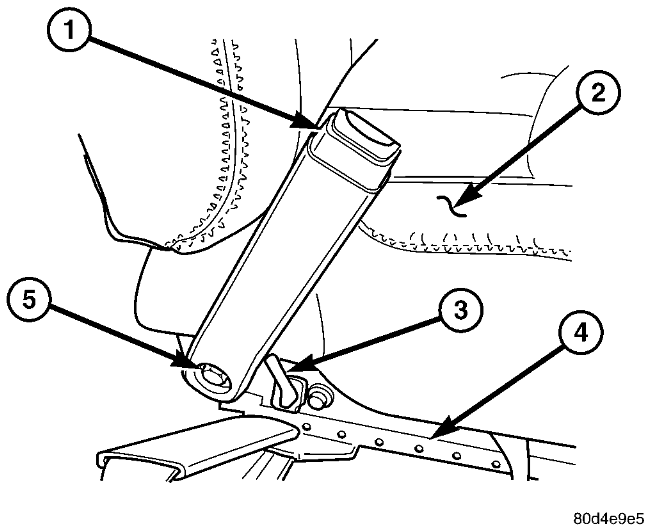


Fig. 29 Front Outboard Seat Belt Buckle Remove/Install

1 - DRIVER SIDE FRONT OUTBOARD SEAT BELT BUCKLE
2 - SEAT CUSHION
3 - PIGTAIL WIRE
4 - INBOARD SEAT TRACK
5 - SCREW

INSTALLATION

A traveling front outboard seat belt buckle is located on the inboard side of each front outboard seat section (40 percent) used on all models. The seat belt buckle on the driver's side front seat for all models also includes a seat belt switch. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT SWITCH - DESCRIPTION).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) From the front of the front seat, reach between the center seat cushion and the adjacent right or left front outboard seat cushion to position the front outboard seat belt buckle to the seat (Fig. 29).

(2) From behind the front seat, install and tighten the screw that secures the front outboard seat belt buckle lower anchor to the bracket on the inboard seat track. Tighten the screw to 25 N·m (18 ft. lbs.).

(3) From behind the front seat on the driver side only, reconnect the seat belt switch pigtail wire connector to the seat wire harness take out and connector for the switch located below the inboard edge of the driver side inboard seat track just forward of the buckle lower anchor.

(4) On standard cab models only, reinstall the stowage tray onto the rear floor panel behind the seat. (Refer to 23 - BODY/INTERIOR/REAR FLOOR STOWAGE TRAY - INSTALLATION).

(5) On standard cab models, move the outboard seat section (40 percent) opposite the side from which the buckle was replaced to its most rearward position and tilt the seat back to its upright position.

PASSENGER AIRBAG

DESCRIPTION

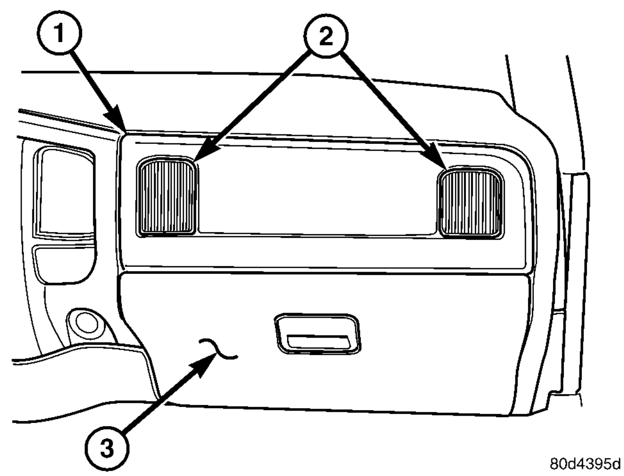


Fig. 30 Passenger Airbag Door

1 - PASSENGER AIRBAG DOOR
2 - PANEL OUTLET (2)
3 - GLOVE BOX DOOR

The rearward facing surface of the injection molded, thermoplastic passenger airbag door is the most visible part of the passenger airbag (Fig. 30). The passenger airbag door is located above the glove box opening on the instrument panel in front of the front seat passenger seating position. The upper and outboard edges of the airbag door are secured with

PASSENGER AIRBAG (Continued)

seven integral snap features to the instrument panel base trim, while two screws secure the integral inboard mounting flange to the base trim, and four screws secure the lower mounting flange to the upper glove box opening reinforcement integral to the instrument panel structural support. The passenger airbag door includes two air conditioning panel outlets and their housings. Each of the panel outlet housings feature four snap features that secure them to the back of the airbag door and two mounting tabs that are also secured with one screw each to the upper glove box opening reinforcement.

Located behind the passenger airbag door within the instrument panel is the passenger airbag unit (Fig. 31). The passenger airbag housing fits into a molded receptacle on the back of the airbag door, where six stamped hook formations on the upper and lower edges of the airbag housing are engaged in six small window openings on the upper and lower flanges of the receptacle to secure the airbag door to the airbag housing. The inboard airbag door fasteners and mounting flange are concealed beneath the instrument panel center bezel, while the lower fasteners and mounting flange are concealed beneath the instrument panel lower surround. The passenger airbag unit is secured by four screws through four brackets (two front and two rear) that are integral to the base of the airbag housing to the instrument panel structural support.

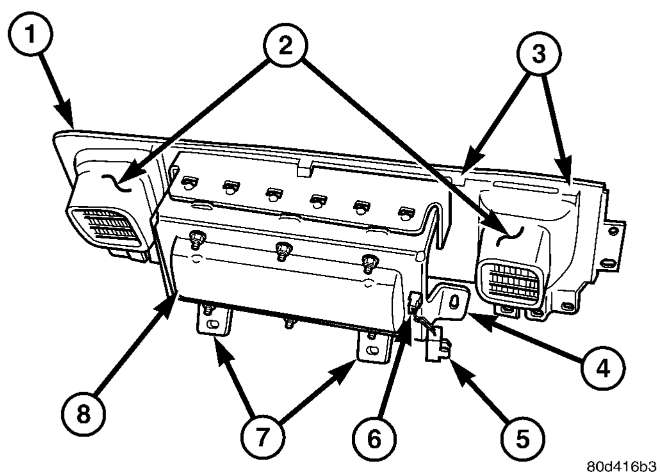


Fig. 31 Passenger Airbag Unit

1 - DOOR
2 - PANEL OUTLET HOUSING (2)
3 - SNAP FEATURE (7)
4 - REAR BRACKET (2)
5 - PIGTAIL WIRE CONNECTOR
6 - INFLATOR
7 - FRONT BRACKET (2)
8 - HOUSING

The passenger airbag unit used in this model is a Next Generation-type that complies with revised federal airbag standards to deploy with less force than those used in some prior models. The passenger airbag unit consists of a stamped and welded metal housing, the airbag cushion, the airbag inflator, and a stamped metal airbag and inflator retainer plate that is secured to the airbag housing with six studs and nuts. The airbag housing contains the airbag inflator and the folded airbag cushion. An approximately 80 centimeter (31.5 inch) wide by 90 centimeter (35.5 inch) high rectangular fabric cushion is used. The airbag inflator is a non-azide, pyrotechnic-type unit that is secured to and sealed within the airbag housing. The inflator initiator is connected to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness.

The passenger airbag includes the airbag door and the two panel outlet housings. This unit cannot be repaired, and must be replaced if deployed, faulty, or in any way damaged.

OPERATION

The passenger airbag is deployed by an electrical signal generated by the Airbag Control Module (ACM) through the passenger airbag squib circuits to the initiator in the airbag inflator. The hybrid-type inflator assembly includes a small canister of highly compressed inert gas. When the ACM sends the proper electrical signal to the airbag inflator, the initiator converts the electrical energy into chemical energy. This chemical energy produces the pressure necessary to rupture a burst disk in the inert gas canister.

The inflator is sealed to the airbag cushion so that all of the released inert gas is directed into the airbag cushion, causing the cushion to inflate. As the cushion inflates, the passenger airbag door will split at predetermined tear seam lines concealed on the inside surface of the door, then the door will pivot up over the top of the instrument panel and out of the way. Following a passenger airbag deployment, the airbag cushion quickly deflates by venting the inert gas through vent holes within the fabric used to construct the back (instrument panel side) of the airbag cushion.

REMOVAL

The following procedure is for replacement of a faulty or damaged passenger airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/ RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the passenger airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment

PASSENGER AIRBAG (Continued)

before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the lower surround from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/LOWER SURROUND - REMOVAL).

(3) Remove the two screws that secure the mounting tabs of the two panel outlet housings to the upper glove box opening reinforcement (Fig. 32).

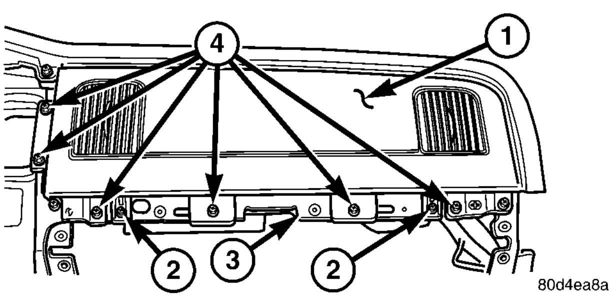


Fig. 32 Passenger Airbag Door Screws

1 - PASSENGER AIRBAG DOOR
2 - PANEL OUTLET SCREW (2)
3 - GLOVE BOX OPENING UPPER REINFORCEMENT
4 - DOOR SCREW (6)

(4) Remove the six screws that secure the inboard and lower flanges of the passenger airbag door to the instrument panel.

(5) Reach through and above the glove box opening to access and remove the two screws that secure the passenger airbag rear brackets to the upper glove box opening reinforcement (Fig. 33).

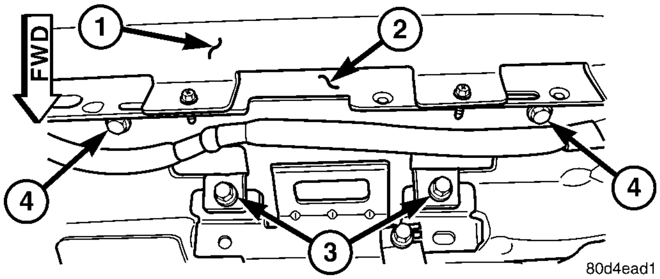


Fig. 33 Passenger Airbag Remove/Install

1 - PASSENGER AIRBAG DOOR
2 - UPPER GLOVE BOX OPENING REINFORCEMENT
3 - FRONT BRACKET SCREW (2)
4 - REAR BRACKET SCREW (2)

(6) Reach through and above the glove box opening to access and remove the two screws that secure the passenger airbag front brackets to the instrument panel structural support.

(7) Using a trim stick or another suitable wide flat-bladed tool, gently pry the upper and outboard edges of the passenger airbag door away from the instrument panel far enough to disengage the seven snap features on the door from the receptacles in the instrument panel base trim (Fig. 34).

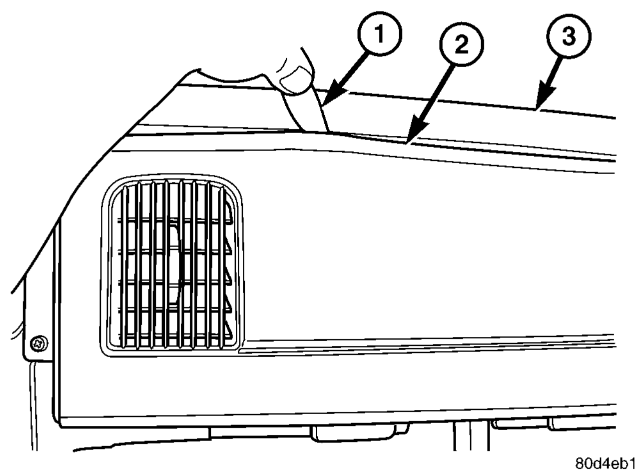


Fig. 34 Passenger Airbag Door Disengage

1 - TRIM STICK
2 - PASSENGER AIRBAG DOOR
3 - INSTRUMENT PANEL

(8) Pull the passenger airbag housing and door unit straight back from the instrument panel far enough to access the instrument panel wire harness

PASSENGER AIRBAG (Continued)

take out and connector for the airbag inflator located on the inboard side of the housing.

(9) Disconnect the instrument panel wire harness connector for the passenger airbag from the connector receptacle on the airbag inflator.

(10) Remove the passenger airbag and airbag door from the instrument panel as a unit.

INSTALLATION

The following procedure is for replacement of a faulty or damaged passenger airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the passenger airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE PASSENGER AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE PASSENGER AIRBAG CUSHION AND THE PASSENGER AIRBAG DOOR. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

WARNING: THE PASSENGER AIRBAG DOOR MUST NEVER BE PAINTED. REPLACEMENT PASSENGER AIRBAG UNITS ARE SERVICED WITH DOORS IN THE ORIGINAL COLORS. PAINT MAY CHANGE THE WAY IN WHICH THE MATERIAL OF THE AIRBAG DOOR RESPONDS TO AN AIRBAG DEPLOYMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Carefully position the passenger airbag and airbag door to the instrument panel as a unit.

(2) Reconnect the instrument panel wire harness connector for the passenger airbag to the connector receptacle on the airbag inflator. Be certain that the connector latches are fully engaged.

(3) Position the passenger airbag housing and door unit into the instrument panel.

(4) Using hand pressure, press firmly and evenly over each of the seven snap features on the upper and outboard edges of the passenger airbag door until they snap into their receptacles in the instrument panel base trim.

(5) Reach through and above the glove box opening to install and tighten the two screws that secure the passenger airbag front brackets to the instrument panel structural support (Fig. 33). Tighten the screws to 6 N·m (55 in. lbs.).

(6) Reach through and above the glove box opening to install and tighten the two screws that secure the passenger airbag rear brackets to the upper glove box opening reinforcement. Tighten the screws to 6 N·m (55 in. lbs.).

(7) Install and tighten the six screws that secure the inboard and lower flanges of the passenger airbag door to the instrument panel (Fig. 32). Tighten the screws to 2 N·m (20 in. lbs.).

(8) Install and tighten the two screws that secure the mounting tabs of the two panel outlet housings to the upper glove box opening reinforcement. Tighten the screws to 2 N·m (20 in. lbs.).

(9) Reinstall the lower surround onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/LOWER SURROUND - INSTALLATION).

(10) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

PASSENGER AIRBAG ON/OFF SWITCH

DESCRIPTION

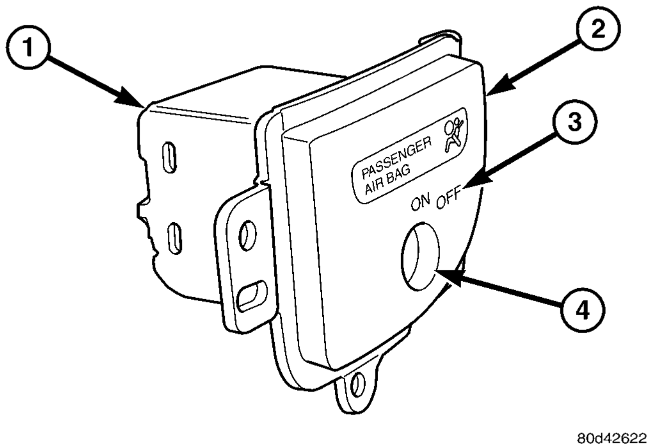


Fig. 35 Passenger Airbag On/Off Switch

1 - SWITCH
2 - FACE PLATE
3 - OFF INDICATOR
4 - KEY CYLINDER ACTUATOR

The passenger airbag on/off switch is standard equipment on all standard cab versions of this model when they are equipped with the dual front airbag system (Fig. 35). This switch is a two-position, resistor multiplexed switch with a single integral red Light-Emitting Diode (LED), and a non-coded key cylinder-type actuator. The switch is located in the lower right corner of instrument panel center bezel, near the center of instrument panel to make the Off indicator visible to all front seat occupants. When the switch is in its installed position, the only components visible through the dedicated opening of the cluster bezel are the switch face plate and nomenclature, and the key cylinder actuator. The ″Off″ position of the switch is illuminated when this switch position is selected, while the “On” position of the switch is designated by text imprinted upon the face plate of the switch, but is not illuminated. The remainder of the switch is concealed behind the switch face plate and the instrument panel center bezel.

The passenger airbag on/off switch housing is constructed of molded plastic and has three integral mounting tabs. These mounting tabs are used to secure the switch to the back of the molded plastic switch face plate with three small screws. The molded plastic face plate also has three integral mounting tabs that are used to secure the switch and face plate unit to the instrument panel center bezel with three additional screws. A molded plastic connector receptacle on the back of the switch housing connects the switch to the vehicle electrical system through a dedicated take out and connector of the instrument panel wire harness. The molded plastic harness connector insulator is keyed and latched to ensure proper and secure switch electrical connections. The passenger airbag on/off switch cannot be adjusted or repaired and, if faulty or damaged, the switch must be replaced.

OPERATION

The passenger airbag on/off switch allows the customer to turn the passenger airbag function On or Off to accommodate certain uses of the right front seating position where airbag protection may not be desired. See the owner’s manual in the vehicle glove box for specific recommendations on when to enable or disable the passenger airbag. The Off indicator of the switch will be illuminated whenever the switch is turned to the Off position and the ignition switch is in the On position.

The ignition key is the only key or object that should ever be inserted into the key cylinder actuator of the switch. The on/off switch requires only a partial key insertion to fully depress a spring-loaded locking plunger. The spring-loaded locking plunger prevents the user from leaving the key in the switch. The key will be automatically ejected when force is not applied. To actuate the passenger airbag on/off switch, insert the ignition key into the switch key actuator far enough to fully depress the plunger, then rotate the actuator to the desired switch position. When the switch key actuator is rotated to its clockwise stop (the key actuator slot will be aligned with the Off indicator), the Off indicator is illuminated and the passenger airbag is disabled. When the switch is rotated to its counterclockwise stop (the key actuator slot will be in a vertical position), the Off indicator will be extinguished and the passenger airbag is enabled.

The passenger airbag on/off switch connects one of two internal resistors in series between the passenger airbag mux switch sense and passenger airbag mux switch return circuits of the Airbag Control Module (ACM). The ACM continually monitors the resistance in these circuits to determine the switch position that has been selected. When the switch is in the Off position, the ACM provides a ground input to the switch through the passenger airbag indicator driver circuit, which energizes the Light-Emitting Diode (LED) that illuminates the Off indicator of the switch.

The ACM will also illuminate the Off indicator of the switch for about seven seconds each time the ignition switch is turned to the On position as a bulb test. The ACM will store a Diagnostic Trouble Code (DTC) for any fault it detects in the passenger airbag

PASSENGER AIRBAG ON/OFF SWITCH (Continued)

on/off switch or Off indicator circuits, and will illuminate the airbag indicator in the instrument cluster if a fault is detected. For proper diagnosis of the passenger airbag on/off switch or the ACM, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the center bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(3) From the back of the center bezel, remove the three screws that secure the passenger airbag on/off switch and face plate unit to the back of the bezel (Fig. 36).

(4) Remove the passenger airbag on/off switch and face plate from the center bezel as a unit.

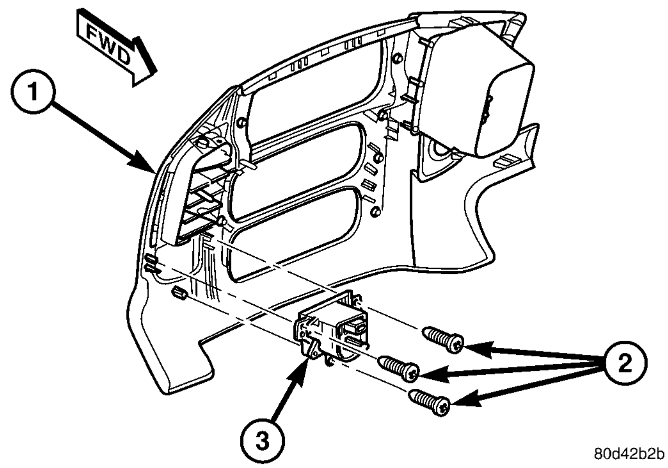


Fig. 36 Passenger Airbag On/Off Switch Remove/Install

1 - CENTER BEZEL
2 - SCREW (3)
3 - SWITCH & PLATE UNIT

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the passenger airbag on/off switch and face plate unit to the back of the center bezel (Fig. 36).

(2) Install and tighten the three screws that secure the passenger airbag on/off switch face plate to the back of the center bezel. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reinstall the center bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(4) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

REAR CENTER SEAT BELT & RETRACTOR

REMOVAL

The rear center seat belt retractor is secured with a single screw to a mounting bracket that includes the unique black, keyed center seat belt lower anchor buckle and the right outboard occupant buckle, but can be removed from the mounting bracket and is serviced separately from the two buckles. The center anchor buckle and the right outboard occupant buckle are serviced as a unit with their mounting bracket. (Refer to 8 - ELECTRICAL/RESTRAINTS/

REAR CENTER SEAT BELT & RETRACTOR (Continued)

REAR SEAT BELT BUCKLE - REMOVAL - CENTER ANCHOR & RIGHT OUTBOARD).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Reach between the rear seat cushion and the rear seat back to access and unbuckle the center seat belt lower anchor latch plate from the unique black, keyed lower anchor buckle. Use an ignition key or a small screwdriver to depress the small white release button on the anchor buckle.

(2) Remove the rear seat from the vehicle. On models with the optional 60/40 split rear bench, only the 60 percent section (right side) of the rear seat must be removed. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL).

(3) Lift upward on the forward edge of the rear center seat belt bezel at the top of the cab back panel to release the snap features that secure the bezel to the belt bracket (Fig. 37).

(4) Remove the bezel from the webbing of the rear center seat belt.

(5) Lift the rear center seat belt cover off of the belt bracket at the top of the cab back panel and remove the cover from the webbing of the rear center seat belt.

(6) Remove the two screws that secure the belt bracket of the rear center seat belt to the body bracket on the upper cab back panel reinforcement.

(7) Remove the belt bracket of the rear center seat belt from the body bracket.

(8) Remove the screw that secures the rear center seat belt retractor to the center anchor/right outboard occupant buckle and mounting bracket unit on the rear floor panel near the cab back panel (Fig. 38).

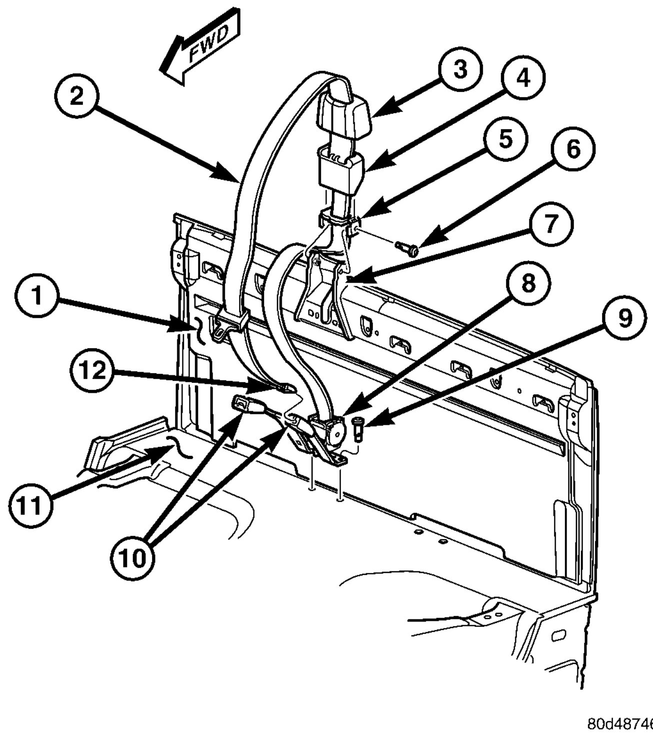


Fig. 37 Rear Center Seat Belt & Retractor Remove/Install

1 - CAB BACK PANEL
2 - CENTER SEAT BELT
3 - BEZEL
4 - COVER
5 - BELT BRACKET
6 - SCREW (2)
7 - BODY BRACKET
8 - RETRACTOR
9 - SCREW (2)
10 - CENTER ANCHOR/RIGHT OUTBOARD OCCUPANT BUCKLE & BRACKET UNIT
11 - REAR FLOOR PANEL
12 - LOWER ANCHOR LATCH PLATE

(9) Remove the rear center seat belt retractor from the center anchor/right outboard occupant buckle and mounting bracket unit.

(10) Remove the rear center seat belt and retractor unit from the vehicle.

INSTALLATION

The rear center seat belt retractor is secured with a single screw to a mounting bracket that includes the unique black, keyed center seat belt lower anchor buckle and the right outboard occupant buckle, but can be removed from the mounting bracket and is serviced separately from the two buckles. The center anchor buckle and the right outboard occupant buckle are serviced as a unit with their mounting bracket. (Refer to 8 - ELECTRICAL/RESTRAINTS/REAR SEAT BELT BUCKLE - INSTALLATION - CENTER ANCHOR & RIGHT OUTBOARD).

REAR CENTER SEAT BELT & RETRACTOR (Continued)

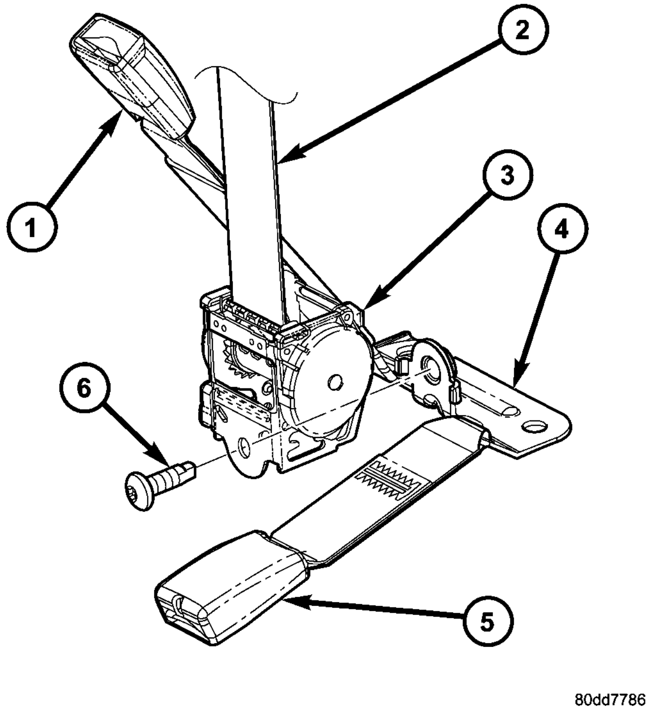


Fig. 38 Rear Center Retractor & Mounting Bracket

1 - RIGHT OUTBOARD OCCUPANT BUCKLE
2 - REAR CENTER SEAT BELT
3 - REAR CENTER SEAT BELT RETRACTOR
4 - MOUNTING BRACKET
5 - CENTER ANCHOR BUCKLE
6 - SCREW (1)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the rear center seat belt and retractor unit onto the center anchor/right outboard occupant buckle and mounting bracket unit on the rear floor panel near the base of the cab back panel (Fig. 38).

(2) Install and tighten the screw that secures the rear center seat belt retractor bracket to the center anchor/right outboard occupant buckle and mounting bracket unit. Tighten the screw to 40 N·m (29 ft. lbs.).

(3) Position the belt bracket of the rear center seat belt onto the body bracket on the upper cab back panel reinforcement (Fig. 37).

(4) Install and tighten the two screws that secure the belt bracket of the rear center seat belt to the body bracket. Tighten the screws to 20 N·m (15 ft. lbs.).

(5) Lift the webbing of the rear center seat belt and slide the cover over the belt bracket at the top of the cab back panel until it is fully seated.

(6) Route the rear center seat belt bezel over the webbing of the rear center seat belt.

(7) Position the rear center seat belt bezel over the cover and belt bracket at the top of the cab back panel and engage the rearward snap features of the bezel with the belt bracket. Using hand pressure, press firmly and evenly downward on the front of the bezel until it snaps into place over the cover and belt bracket.

(8) Reinstall the rear seat into the vehicle. On models with the optional 60/40 split rear bench, only the 60 percent section (right side) of the rear seat must be reinstalled. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION).

(9) Reach between the rear seat cushion and the rear seat back to buckle the rear center seat belt lower anchor latch plate to the unique black, keyed lower anchor buckle.

REAR OUTBOARD SEAT BELT & RETRACTOR

REMOVAL

The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

REAR OUTBOARD SEAT BELT & RETRACTOR (Continued)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Remove the rear seat from the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL).

(2) Remove the screw that secures the lower seat belt anchor to the base of the inner C-pillar (Fig. 39).

(3) Remove the lower seat belt anchor from the base of the inner C-pillar.

(4) Unsnap and remove the trim cover from the rear outboard seat belt turning loop to access the screw that secures the turning loop to the upper inner C-pillar. Discard the removed turning loop trim cover as it is not intended for reuse.

(5) Remove the screw that secures the seat belt turning loop to the C-pillar.

(6) Remove the seat belt turning loop from the upper inner C-pillar.

(7) Remove the upper and lower trim from the inner C-pillar. (Refer to 23 - BODY/INTERIOR/C-PILLAR UPPER TRIM - REMOVAL) and (Refer to 23 - BODY/INTERIOR/C-PILLAR LOWER TRIM - REMOVAL).

(8) Remove the screw that secures the seat belt web guide to the inner C-pillar near the belt line.

(9) Remove the seat belt web guide from the inner C-pillar.

(10) Remove the screw that secures the lower retractor bracket to the lower inner C-pillar below the retractor mounting hole.

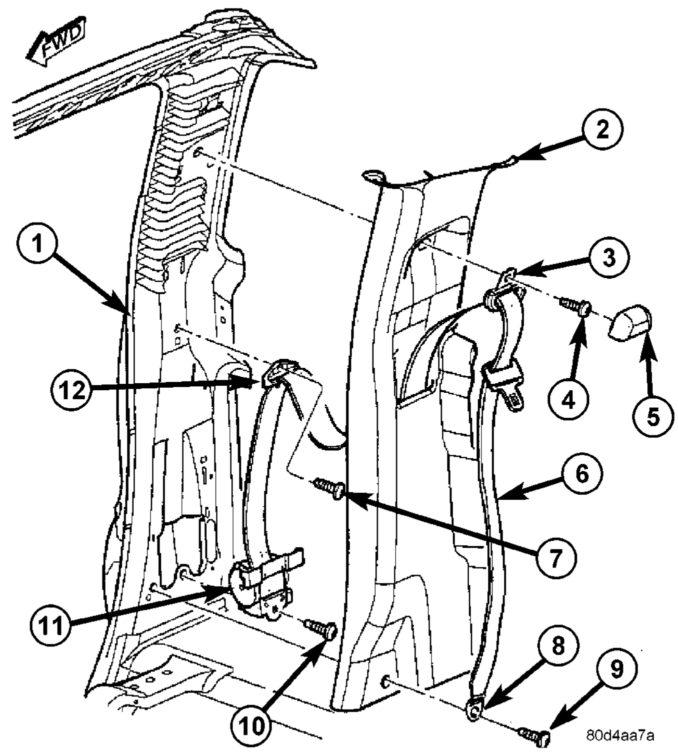


Fig. 39 Rear Outboard Seat Belt & Retractor Remove/Install

1 - C-PILLAR
2 - TRIM PANEL
3 - TURNING LOOP
4 - SCREW
5 - TRIM COVER
6 - SEAT BELT
7 - SCREW
8 - LOWER ANCHOR
9 - SCREW
10 - SCREW
11 - RETRACTOR
12 - WEB GUIDE

(11) Disengage the hook on the upper retractor bracket from the slot in the lower inner C-pillar above the retractor mounting hole.

(12) Remove the rear outboard seat belt and retractor from the retractor mounting hole in the lower inner C-pillar.

INSTALLATION

The only component of this seat belt and retractor unit that is available for individual service replacement is the plastic web stop button that prevents the latch plate from falling to the floor while in the stored position. Refer to the instructions supplied with the service kit for the proper web stop button replacement procedures.

REAR OUTBOARD SEAT BELT & RETRACTOR (Continued)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the rear outboard seat belt and retractor to the retractor mounting hole in the lower inner C-pillar (Fig. 39).

(2) Engage the hook on the upper retractor bracket into the slot in the lower inner C-pillar above the retractor mounting hole.

(3) Install and tighten the screw that secures the lower retractor bracket to the lower inner C-pillar below the retractor mounting hole. Tighten the screw to 40 N·m (29 ft. lbs.).

(4) Position the seat belt web guide to the inner C-pillar near the belt line.

(5) Install and tighten the screw that secures the seat belt web guide to the inner C-pillar. Tighten the screw to 2 N·m (20 in. lbs.).

(6) Reinstall the upper and lower trim onto the inner C-pillar. (Refer to 23 - BODY/INTERIOR/C-PILLAR UPPER TRIM - INSTALLATION) and (Refer to 23 - BODY/INTERIOR/C-PILLAR LOWER TRIM - INSTALLATION).

(7) Position the seat belt turning loop onto the upper inner C-pillar.

(8) Install and tighten the screw that secures the seat belt turning loop to the C-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(9) Engage the lower snap features of the new trim cover over the rear outboard seat belt turning loop and, using hand pressure, press firmly and evenly on the top of the trim cover until it snaps into place.

(10) Position the lower seat belt anchor to the base of the inner C-pillar.

(11) Install and tighten the screw that secures the lower seat belt anchor to the base of the inner C-pillar. Tighten the screw to 40 N·m (29 ft. lbs.).

(12) Reinstall the rear seat into the vehicle. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION).

REAR SEAT BELT BUCKLE

REMOVAL

REMOVAL - CENTER & LEFT OUTBOARD

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Lift up the rear seat cushion into its stowed position against the rear seat back.

(2) Remove the screw that secures either the center or the left outboard occupant buckle unit to the rear floor panel near the base of the cab back panel (Fig. 40). On models with the optional 60/40 split rear bench, the screw that secures the buckle unit also secures one of the rear seat mounting brackets to the rear floor panel.

(3) Remove the center or the left outboard occupant buckle unit from the rear floor panel or from the rear seat mounting bracket.

REMOVAL - CENTER ANCHOR & RIGHT OUTBOARD

The unique black, keyed center seat belt lower anchor buckle and the right outboard occupant buckle are serviced as a unit with their mounting bracket. The rear center seat belt retractor is also secured to the mounting bracket with these two buckles, but can be removed from the mounting bracket and is serviced separately from the two buck-

REAR SEAT BELT BUCKLE (Continued)

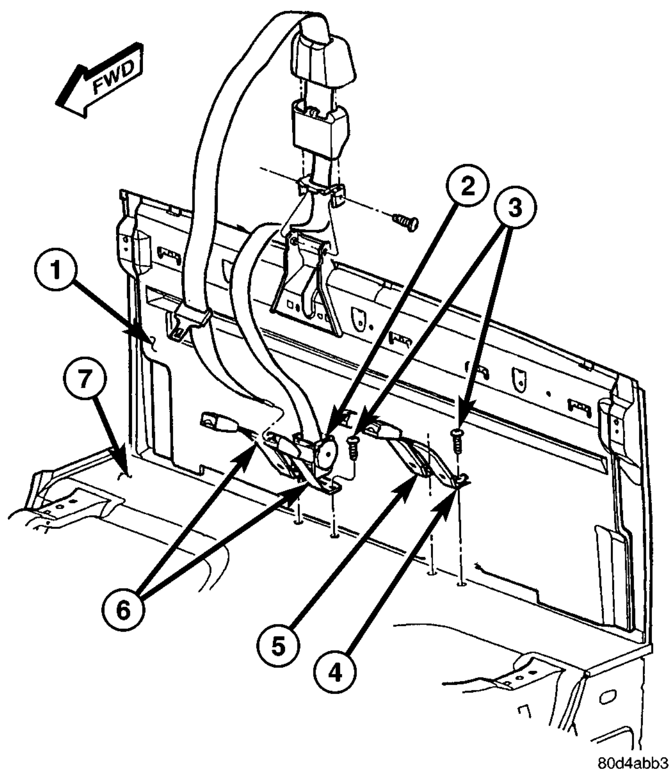


Fig. 40 Rear Seat Belt Buckle Remove/Install

1 - CAB BACK PANEL
2 - CENTER SEAT BELT RETRACTOR
3 - SCREW (4)
4 - LEFT OUTBOARD OCCUPANT BUCKLE UNIT
5 - CENTER OCCUPANT BUCKLE UNIT
6 - CENTER ANCHOR/RIGHT OUTBOARD OCCUPANT BUCKLE & BRACKET UNIT
7 - REAR FLOOR PANEL

les. (Refer to 8 - ELECTRICAL/RESTRAINTS/REAR CENTER SEAT BELT & RETRACTOR - REMOVAL).

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Reach between the rear seat cushion and the rear seat back to access and unbuckle the rear center seat belt lower anchor latch plate from the unique black, keyed lower anchor buckle. Use an ignition key or a small screwdriver to depress the small white release button on the anchor buckle.

(2) Remove the rear seat from the vehicle. On models with the optional 60/40 split rear bench, only the 60 percent section (right side) of the rear seat must be removed. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL).

(3) Remove the screw that secures the rear center seat belt retractor to the center anchor/right outboard occupant buckle and mounting bracket unit on the rear floor panel near the cab back panel (Fig. 41).

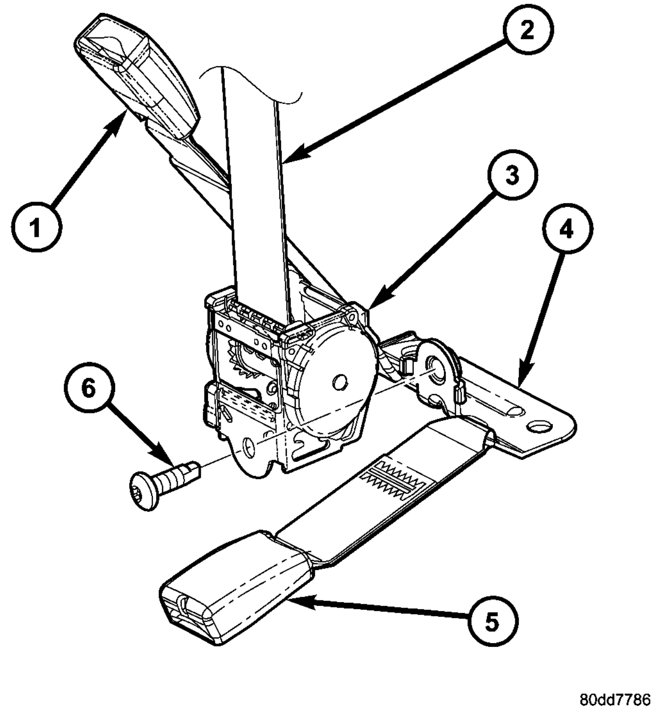


Fig. 41 Rear Center Retractor & Mounting Bracket

1 - RIGHT OUTBOARD OCCUPANT BUCKLE
2 - REAR CENTER SEAT BELT
3 - REAR CENTER SEAT BELT RETRACTOR
4 - MOUNTING BRACKET
5 - CENTER ANCHOR BUCKLE
6 - SCREW (1)

(4) Remove the rear center seat belt retractor from the center anchor/right outboard occupant buckle and mounting bracket unit.

(5) Remove the two screws that secure the center anchor/right outboard occupant buckle and mounting bracket unit to the rear floor panel near the base of the cab back panel (Fig. 42).

REAR SEAT BELT BUCKLE (Continued)

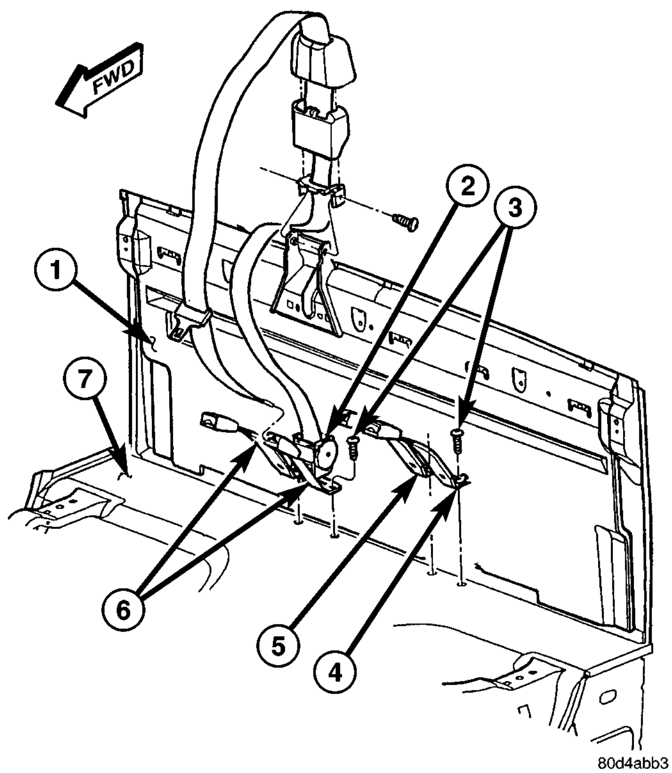


Fig. 42 Rear Seat Belt Buckle Remove/Install

1 - CAB BACK PANEL
2 - CENTER SEAT BELT RETRACTOR
3 - SCREW (4)
4 - LEFT OUTBOARD OCCUPANT BUCKLE UNIT
5 - CENTER OCCUPANT BUCKLE UNIT
6 - CENTER ANCHOR/RIGHT OUTBOARD OCCUPANT BUCKLE & BRACKET UNIT
7 - REAR FLOOR PANEL

(6) Remove the center anchor/right outboard occupant buckle and mounting bracket unit from the rear floor panel.

INSTALLATION

INSTALLATION - CENTER & LEFT OUTBOARD

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the center or the left outboard occupant buckle unit onto the rear floor panel or onto the rear seat mounting bracket near the base of the cab back panel (Fig. 40). On models with the optional 60/40 split rear bench, the screw that secures the buckle unit also secures one of the rear seat mounting brackets to the rear floor panel.

(2) Install and tighten the screw that secures the center or the left outboard occupant buckle unit to the rear floor panel. Tighten the screw to 40 N·m (29 ft. lbs.).

(3) Lower the rear seat cushion back to its normal seating position.

INSTALLATION - CENTER ANCHOR & RIGHT OUTBOARD

The unique black, keyed center seat belt lower anchor buckle and the right outboard occupant buckle are serviced as a unit with their mounting bracket. The rear center seat belt retractor is also secured to the mounting bracket with these two buckles, but can be removed from the mounting bracket and is serviced separately from the two buckles. (Refer to 8 - ELECTRICAL/RESTRAINTS/REAR CENTER SEAT BELT & RETRACTOR - INSTALLATION).

REAR SEAT BELT BUCKLE (Continued)

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the center anchor/right outboard occupant buckle and mounting bracket unit onto the rear floor panel near the base of the cab back panel (Fig. 42).

(2) Install and tighten the two screws that secure the center anchor/right outboard occupant buckle and mounting bracket unit to the rear floor panel. Tighten the screws to 40 N·m (29 ft. lbs.).

(3) Position the rear center seat belt retractor onto the center anchor/right outboard occupant buckle and mounting bracket unit (Fig. 41).

(4) Install and tighten the screw that secures the rear center seat belt retractor to the center anchor/right outboard occupant buckle and mounting bracket unit. Tighten the screw to 40 N·m (29 ft. lbs.).

(5) Reinstall the rear seat into the vehicle. On models with the optional 60/40 split rear bench, only the 60 percent section (right side) of the rear seat must be reinstalled. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION).

(6) Reach between the rear seat cushion and the rear seat back to access and buckle the rear center seat belt lower anchor latch plate to the unique black, keyed lower anchor buckle.

SEAT BELT SWITCH

DESCRIPTION

The seat belt switch is a small, normally open, single pole, single throw, leaf contact, momentary switch. Only one seat belt switch is installed in the vehicle, and it is integral to the buckle of the driver side front seat belt buckle-half, located on the

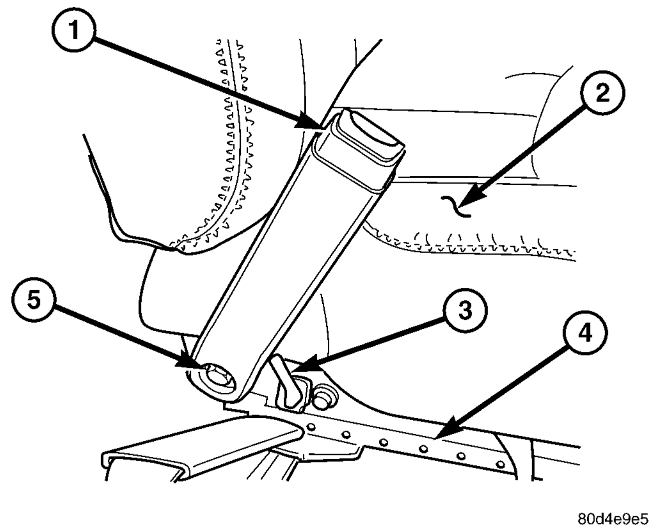


Fig. 43 Seat Belt Switch

1 - DRIVER SIDE FRONT OUTBOARD SEAT BELT BUCKLE
2 - SEAT CUSHION
3 - PIGTAIL WIRE
4 - INBOARD SEAT TRACK
5 - SCREW

inboard side of the driver side front seat track (Fig. 43). The seat belt switch is connected to the vehicle electrical system through a two-wire pigtail wire and connector on the seat belt buckle-half, which is connected to a wire harness connector and take out of the seat wire harness routed beneath the driver side front seat cushion in the passenger compartment.

The seat belt switch cannot be adjusted or repaired and, if faulty or damaged, the entire driver side front seat belt buckle-half unit must be replaced.

OPERATION

The seat belt switch is designed to control a path to ground for the seat belt switch sense input of the ElectroMechanical Instrument Cluster (EMIC). When the driver side front seat belt tip-half is inserted into the seat belt buckle, the switch closes the path to ground; and, when the driver side front seat belt tip-half is removed from the seat belt buckle, the switch opens the ground path. The switch is actuated by the latch mechanism within the seat belt buckle.

The seat belt switch is connected in series between ground and the seat belt switch sense input of the instrument cluster. The seat belt switch receives ground at all times through its pigtail wire connection to the seat wire harness from a take out of the body wire harness. An eyelet terminal connector on the body wire harness ground take out is secured beneath a ground screw on the left cowl side inner panel, beneath the instrument panel. The seat belt switch may de diagnosed using conventional diagnostic tools and methods.

SEAT BELT SWITCH (Continued)

DIAGNOSIS AND TESTING - SEAT BELT SWITCH

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Disconnect the seat belt switch pigtail wire connector from the seat wire harness connector for the seat belt switch on the inboard side of the driver side front seat forward of the seat belt buckle-half anchor. Check for continuity between the seat belt switch sense circuit and the ground circuit cavities of the seat belt switch pigtail wire connector. There should be continuity with the seat belt buckled, and no continuity with the seat belt unbuckled. If OK, go to Step 2. If not OK, replace the faulty front seat belt buckle-half assembly.

(2) Check for continuity between the ground circuit cavity in the seat wire harness connector for the seat belt switch and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open ground circuit to ground (G301) as required.

(3) Remove the instrument cluster from the instrument panel. Check for continuity between the seat belt switch sense circuit cavity of the seat wire harness connector for the seat belt switch and a good ground. There should be no continuity. If OK, go to Step 4. If not OK, repair the shorted seat belt switch sense circuit between the seat belt switch and the instrument cluster as required.

(4) Check for continuity between the seat belt switch sense circuit cavities of the seat wire harness connector for the seat belt switch and the instrument panel wire harness connector (Connector C2) for the instrument cluster. There should be continuity. If OK, test and replace the faulty instrument cluster as required. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If not OK, repair the open seat belt switch sense circuit between the seat belt switch and the instrument cluster as required.

SEAT BELT TENSIONER

DESCRIPTION

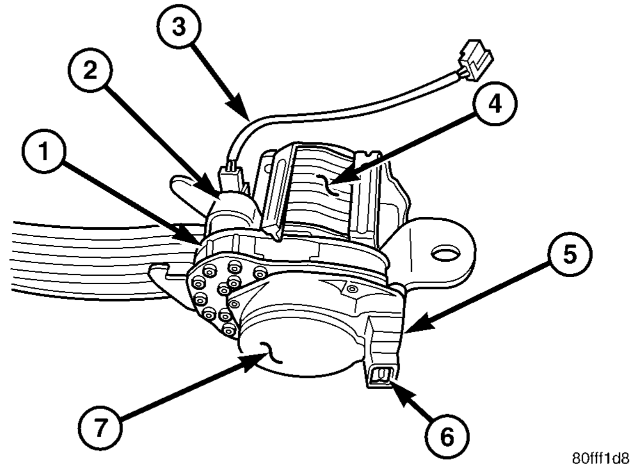


Fig. 44 Seat Belt Tensioner

1 - TENSIONER HOUSING OR CHAMBER
2 - GAS GENERATOR
3 - TENSIONER PIGTAIL WIRE
4 - SPOOL
5 - TENSION REDUCER (DRIVER SIDE ON STANDARD CAB ONLY)
6 - REDUCER CONNECTOR RECEPTACLE
7 - RETRACTOR LOCKING MECHANISM COVER

Front outboard seating position seat belt tensioners supplement the driver and passenger airbags for all versions of this model (Fig. 44). The seat belt tensioner is integral to the front outboard seat belt and retractor unit, which is secured to the inner B-pillar on the right and left sides of the vehicle. The retractor is concealed beneath the molded plastic inner B-pillar trim. The seat belt tensioner consists primarily of a die cast aluminum tensioner housing or chamber, a mechanical clutch unit, a tape-like metal strip, a pair of cutters, a pyrotechnically activated gas generator, and a short pigtail wire. All of these components are located on one side of the retractor spool on the outside of the retractor housing. The seat belt tensioner is controlled by the Airbag Control Module (ACM) and is connected to the vehicle electrical system through a dedicated take out of the body wire harness by a keyed and latching molded plastic connector insulator to ensure a secure connection.

SEAT BELT TENSIONER (Continued)

The seat belt tensioner cannot be repaired and, if faulty or damaged, the entire outboard front seat belt and retractor unit must be replaced. If the front airbags have been deployed, the seat belt tensioners have also been deployed. The seat belt tensioner is not intended for reuse and must be replaced following a deployment. A locked retractor that will not allow the seat belt webbing to be retracted or extracted is a sure indication that the seat belt tensioner has been deployed and requires replacement. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT OUTBOARD SEAT BELT & RETRACTOR - REMOVAL).

OPERATION

The seat belt tensioners are deployed by a signal generated by the Airbag Control Module (ACM) through the driver and passenger seat belt tensioner line 1 and line 2 (or squib) circuits. When the ACM sends the proper electrical signal to the tensioners, the electrical energy generates enough heat to initiate a small pyrotechnic gas generator. The gas generator is installed at the top of the tensioner housing which contains a long metal tape that is routed through two chambers within the housing. Each end of the tape is wound around the outer sleeve of a mechanical clutch mechanism secured to one end of the torsion bar upon which the retractor spool is secured. As the gas expands, it is directed against the metal tape within the two chambers of the housing causing the tape to unwind from the clutch sleeve. As the clutch rotates it engages the torsion bar, which drives the seat belt retractor spool causing the slack to be removed from the seat belt.

Once a seat belt tensioning sequence has been completed, the forward momentum of the occupant results in deformation of the torsion bar. As the torsion bar deforms it allows the seat belt webbing to unwind from the retractor spool, which causes the metal tape to be wound back onto the clutch sleeve until it is pulled tight against two cutter blades within the housing, which immediately cut the metal tape.

Removing excess slack from the seat belt not only keeps the occupant properly positioned for an airbag deployment following a frontal impact of the vehicle, but also helps to reduce injuries that the occupant might experience in these situations as a result of a harmful contact with the steering wheel, steering column, instrument panel and/or windshield. The torsion bar is designed to deform in order to control the loading being applied to the occupant by the seat belt during a frontal impact, further reducing the potential for occupant injuries.

The ACM monitors the condition of the seat belt tensioners through circuit resistance. The ACM will illuminate the airbag indicator in the ElectroMechanical Instrument Cluster (EMIC) and store a Diagnostic Trouble Code (DTC) for any fault that is detected. For proper diagnosis of the seat belt tensioners, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SEAT BELT TENSION REDUCER

DESCRIPTION

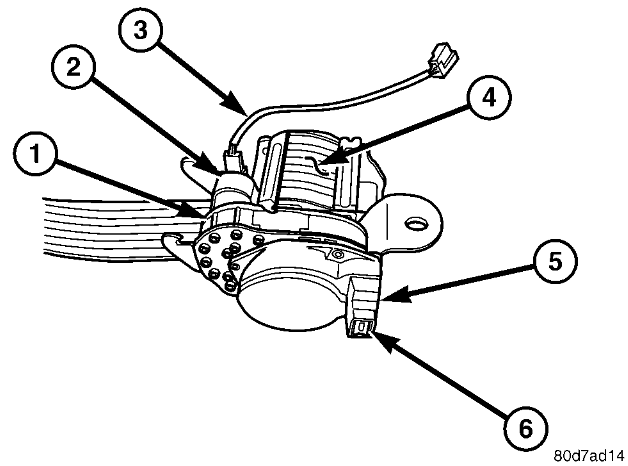


Fig. 45 Seat Belt Tension Reducer

1 - TENSIONER HOUSING OR CHAMBER
2 - GAS GENERATOR
3 - TENSIONER PIGTAIL WIRE
4 - SPOOL
5 - TENSION REDUCER (DRIVER SIDE ON STANDARD CAB ONLY)
6 - REDUCER CONNECTOR RECEPTACLE

A seat belt tension reducer is standard equipment for the driver side front outboard seat belt on standard cab versions of this model (Fig. 45). The tension reducer is integral to the driver side front outboard seat belt and retractor unit, which is secured to the inner B-pillar on the left side of the vehicle. The retractor is concealed beneath the molded plastic inner B-pillar trim. The seat belt tension reducer consists primarily of a 12-volt Direct Current (DC) solenoid and an integral connector receptacle that is located on the forward facing end housing of the retractor. The seat belt tension reducer is controlled by a battery current output of the ignition switch and a ground path provided by the seat belt switch, and is connected to the vehicle electrical system through a dedicated take out of the body wire harness by a keyed and latching molded plastic connector insulator to ensure a secure connection.

The seat belt tension reducer cannot be repaired and, if faulty or damaged, the entire driver side front

SEAT BELT TENSION REDUCER (Continued)

outboard seat belt and retractor unit must be replaced. (Refer to 8 - ELECTRICAL/RESTRAINTS/ FRONT OUTBOARD SEAT BELT & RETRACTOR - REMOVAL).

OPERATION

The seat belt tension reducer is controlled by a ground signal received from the seat belt switch on the seat belt switch sense circuit and a battery current signal received from the ignition switch on the fused ignition switch output (run-accessory) circuit. When the seat belt switch is closed (the driver side front seat belt is fastened) and the ignition switch is in the On or Accessory positions, the seat belt tension reducer solenoid is energized. When the solenoid is energized, it actuates a mechanism within the driver side front outboard seat belt retractor to reduce the normal recoil spring tension exerted by the retractor spool, which is designed to reel in the seat belt webbing onto the spool. When the driver side seat belt is unbuckled or if the ignition switch is turned to any position except On or Accessory, the tension reducer solenoid is de-energized and the normal recoil spring tension of the retractor is restored.

The action of the seat belt tension reducer results in improved seat belt comfort for the driver. Reducing the seat belt retractor recoil spring tension is desirable on standard cab models of this vehicle and not on the quad cab model due to the different mounting position required for the seat belt turning loop on the B-pillar relative to the driver's seat position on the standard cab model. The seat belt tension reducer may be diagnosed using conventional diagnostic tools and methods.

DIAGNOSIS AND TESTING - SEAT BELT TENSION REDUCER

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the seat belt tension reducer from the tension reducer connector receptacle on the driver side front outboard seat belt and retractor unit. Using an ohmmeter, measure the resistance between the seat belt switch sense circuit terminal pin and the fused ignition switch output (run-accessory) circuit terminal pin in the tension reducer connector receptacle on the retractor. Resistance through the tension reducer solenoid coil should be 53 ohms at 20° C (68° F). If OK, go to Step 2. If not OK, replace the faulty driver side front outboard seat belt and retractor unit.

(2) Check for continuity between the seat belt switch sense circuit cavity of the body wire harness connector for the seat belt tension reducer and a good ground. There should be continuity with the driver side front seat belt buckled, and no continuity with the driver side front seat belt unbuckled. If OK, go to Step 3. If not OK, repair the shorted or open seat belt switch sense circuit between the tension reducer and the seat belt switch as required.

(3) Reconnect the battery negative cable. Check for battery current at the fused ignition switch output (run-accessory) circuit of the body wire harness connector for the seat belt tension reducer. There should be battery current with the ignition switch in the On or Accessory positions, and no battery current with the ignition switch in any other position. If not OK, repair the shorted or open fused ignition switch output (run-accessory) circuit between the tension reducer and the ignition switch as required.

SEAT BELT TURNING LOOP ADJUSTER

REMOVAL

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Unsnap and remove the trim cover from the front outboard seat belt turning loop to access the screw that secures the turning loop to the height adjuster on the upper inner B-pillar. Discard the removed turning loop trim cover as it is not intended for reuse.

(2) Remove the screw that secures the seat belt turning loop to the height adjuster.

(3) Remove the front seat belt turning loop from the height adjuster.

(4) Remove the upper trim from the inner B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL).

(5) Loosen the two screws that secure the seat belt turning loop height adjuster far enough to remove the adjuster from the upper B-pillar (Fig. 46).

(6) Disengage the tab near the lower end of the seat belt turning loop height adjuster from the slot in the sheet metal and remove the adjuster from the inner B-pillar.

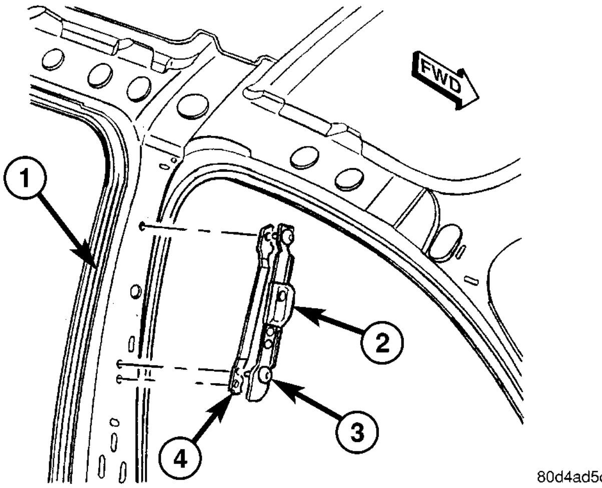


Fig. 46 Seat Belt Turning Loop Adjuster Remove/ Install

1 - B-PILLAR
2 - ADJUSTER
3 - SCREW (2)
4 - GRAB HANDLE BRACKET (QUAD CAB ONLY)

INSTALLATION

WARNING: DURING AND FOLLOWING ANY SEAT BELT OR CHILD RESTRAINT ANCHOR SERVICE, CAREFULLY INSPECT ALL SEAT BELTS, BUCKLES, MOUNTING HARDWARE, RETRACTORS, TETHER STRAPS, AND ANCHORS FOR PROPER INSTALLATION, OPERATION, OR DAMAGE. REPLACE ANY BELT THAT IS CUT, FRAYED, OR TORN. STRAIGHTEN ANY BELT THAT IS TWISTED. TIGHTEN ANY LOOSE FASTENERS. REPLACE ANY BELT THAT HAS A DAMAGED OR INOPERATIVE BUCKLE OR RETRACTOR. REPLACE ANY BELT THAT HAS A BENT OR DAMAGED LATCH PLATE OR ANCHOR PLATE. REPLACE ANY CHILD RESTRAINT ANCHOR OR THE UNIT TO WHICH THE ANCHOR IS INTEGRAL THAT HAS BEEN BENT OR DAMAGED. NEVER ATTEMPT TO REPAIR A SEAT BELT OR CHILD RESTRAINT COMPONENT. ALWAYS REPLACE DAMAGED OR FAULTY SEAT BELT AND CHILD RESTRAINT COMPONENTS WITH THE CORRECT, NEW AND UNUSED REPLACEMENT PARTS LISTED IN THE DAIMLERCHRYSLER MOPAR PARTS CATALOG.

(1) Position the front seat belt turning loop adjuster to the inner B-pillar (Fig. 46).

(2) Engage the tab near the lower end of the seat belt turning loop height adjuster into the slot in the sheet metal of the inner B-pillar.

(3) Hand tighten the lower of the two screws that secure the seat belt turning loop height adjuster to the upper B-pillar far enough to keep the tab on the lower end of the adjuster engaged in the B-pillar slot.

(4) Install the upper screw that secures the seat belt turning loop height adjuster to the upper B-pillar, then tighten both the upper and lower screws to 40 N·m (29 ft. lbs.).

(5) Reinstall the upper trim onto the inside of the B-pillar. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION).

SEAT BELT TURNING LOOP ADJUSTER (Continued)

(6) Position the seat belt turning loop onto the height adjuster on the upper inner B-pillar.

(7) Install and tighten the screw that secures the seat belt turning loop to the height adjuster. Tighten the screw to 40 N·m (29 ft. lbs.).

(8) Engage the lower snap features of the new trim cover over the front outboard seat belt turning loop and, using hand pressure, press firmly and evenly on the top of the trim cover until it snaps into place.

SIDE CURTAIN AIRBAG

DESCRIPTION

Fig. 47 SRS Logo

Optional side curtain airbags are available for this model when it is also equipped with dual front airbags. These airbags are passive, inflatable, Supplemental Restraint System (SRS) components, and vehicles with this equipment can be readily identified by a molded identification trim button with the “SRS - AIRBAG” logo located on the headliner above each A-pillar, and above each B-pillar on quad cab models (Fig. 47). This system is designed to reduce injuries to the vehicle occupants in the event of a side impact collision.

Vehicles equipped with side curtain airbags have two individually controlled curtain airbag units. These airbag units are concealed and mounted above the headliner where they are each secured to one of the roof side rails (Fig. 48). Each folded airbag cushion is contained within a long extruded plastic channel that extends along the roof rail from the A-pillar at the front of the vehicle to just behind the B-pillar on standard cab models, and to just behind the C-pillar on quad cab models. A tether extends down the A-pillar from the front of the airbag cushion, where it is retained to the pillar with plastic push-in routing clips and it is secured to the base of the A-pillar near the belt line with a screw.

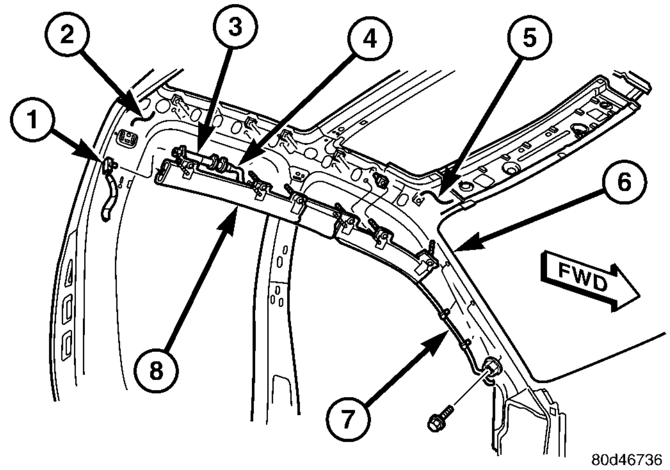


Fig. 48 Side Curtain Airbag

1 - WIRE HARNESS CONNECTOR
2 - B-PILLAR (STD CAB) OR C-PILLAR (QUAD CAB)
3 - INFLATOR
4 - MANIFOLD
5 - ROOF SIDE RAIL
6 - A-PILLAR
7 - TETHER
8 - CHANNEL

The hybrid-type inflator for each airbag is secured to the roof rail at the rear of the airbag unit behind the B-pillar (standard cab) or C-pillar (quad cab), and is connected to the airbag cushion by a long tubular manifold. The inflator bracket and the airbag cushion channel are located with plastic push-in fasteners to the roof rail, then secured with screws to spring nuts located in the roof rail. A two-wire take out of the body wire harness with a keyed and latched connector insulator connects directly to an integral receptacle on the inflator initiator.

The side curtain airbag unit cannot be adjusted or repaired and must be replaced if deployed, faulty, or in any way damaged. Once a side curtain airbag has been deployed, the complete airbag unit, the headliner, the upper A, B, and C-pillar trim, and all other visibly damaged components must be replaced.

OPERATION

Each side curtain airbag is deployed individually by an electrical signal generated by the left or right Side Impact Airbag Control Module (SIACM) to which it is connected through left or right curtain airbag line 1 and line 2 (or squib) circuits. The hybrid-type inflator assembly for each airbag contains a small canister of highly compressed inert gas. When the SIACM sends the proper electrical signal to the airbag inflator, the electrical energy creates enough heat to ignite chemical pellets within the inflator. Once ignited, these chemicals burn rapidly and produce the pressure necessary to rupture a containment disk in the inert gas canister. The inflator

SIDE CURTAIN AIRBAG (Continued)

and inert gas canister are sealed and connected to a tubular manifold so that all of the released gas is directed into the folded curtain airbag cushion, causing the cushion to inflate.

As the airbag cushion inflates it will drop down from the roof rail between the edge of the headliner and the side glass/body pillars to form a curtain-like cushion to protect the vehicle occupants during a side impact collision. The front tether keeps the front portion of the bag taut, thus ensuring that the bag will deploy in the proper position. Following the airbag deployment, the airbag cushion quickly deflates by venting the inert gas through the loose weave of the cushion fabric, and the deflated cushion hangs down loosely from the roof rail.

REMOVAL

The following procedure is for replacement of a faulty or damaged side curtain airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the side curtain airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE SIDE CURTAIN AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE SIDE CURTAIN AIRBAG CUSHION AND THE HEADLINER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(2) Remove the headliner from the vehicle. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL).

(3) Remove the screw that secures the side curtain airbag tether retainer to the base of the A-pillar near the belt line (Fig. 49).

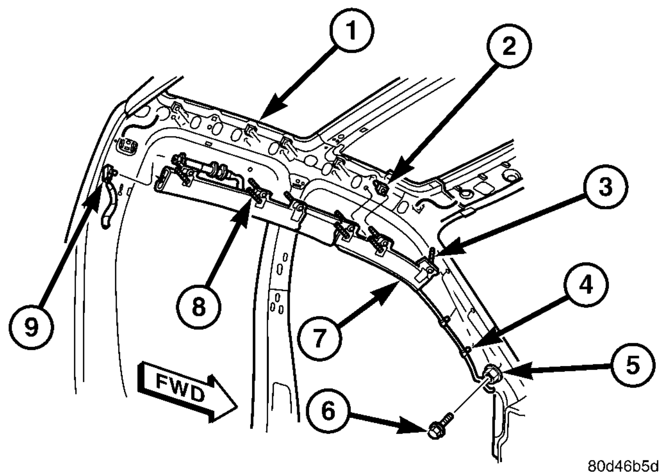


Fig. 49 Side Curtain Airbag Remove/Install - Typical

1 - ROOF SIDE RAIL
2 - SPRING NUT (4 - STD CAB/6 - QUAD CAB)
3 - SCREW (4 - STD CAB/6 - QUAD CAB)
4 - CLIP (2)
5 - RIVET NUT
6 - SCREW
7 - SIDE CURTAIN AIRBAG
8 - RETAINER (3 - STD CAB/5 - QUAD CAB)
9 - WIRE HARNESS CONNECTOR

(4) Disengage the two side curtain airbag tether plastic retainer clips from the A-pillar.

(5) Disconnect the body wire harness connector for the side curtain airbag from the connector receptacle at the back of the airbag inflator.

(6) Remove the four screws (standard cab) or six screws (quad cab) that secure the side curtain airbag inflator and manifold tube brackets to the nuts in the roof rail.

(7) Grasp the extruded plastic side curtain airbag channel firmly and pull it straight away from the roof rail far enough to disengage all three (standard cab) or five (quad cab) plastic push-in fasteners that secure it.

SIDE CURTAIN AIRBAG (Continued)

(8) Remove the side curtain airbag from the vehicle as a unit.

INSTALLATION

The following procedure is for replacement of a faulty or damaged side curtain airbag. If the airbag is faulty or damaged, but not deployed, review the recommended procedures for handling non-deployed supplemental restraints. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - HANDLING NON-DEPLOYED SUPPLEMENTAL RESTRAINTS). If the side curtain airbag has been deployed, review the recommended procedures for service after a supplemental restraint deployment before removing the airbag from the vehicle. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - SERVICE AFTER A SUPPLEMENTAL RESTRAINT DEPLOYMENT).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: WHEN REMOVING A DEPLOYED AIRBAG, RUBBER GLOVES, EYE PROTECTION, AND A LONG-SLEEVED SHIRT SHOULD BE WORN. THERE MAY BE DEPOSITS ON THE AIRBAG UNIT AND OTHER INTERIOR SURFACES. IN LARGE DOSES, THESE DEPOSITS MAY CAUSE IRRITATION TO THE SKIN AND EYES.

WARNING: USE EXTREME CARE TO PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE SIDE CURTAIN AIRBAG, OR BECOMING ENTRAPPED BETWEEN THE SIDE CURTAIN AIRBAG CUSHION AND THE HEADLINER. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OCCUPANT INJURIES UPON AIRBAG DEPLOYMENT.

(1) Position the side curtain airbag into the vehicle as a unit.

(2) Align all three (standard cab) or five (quad cab) plastic push-in fasteners that secure the extruded plastic side curtain airbag channel with their holes in the roof side rail and push them straight into the roof rail until they are fully seated (Fig. 49).

(3) Working from the rear of the vehicle to the front, install and tighten the four screws (standard cab) or six screws (quad cab) that secure the side curtain airbag inflator and manifold tube brackets to the nuts in the roof rail. Tighten the screws to 5 N·m (40 in. lbs.).

(4) Reconnect the body wire harness connector for the side curtain airbag to the connector receptacle at the back of the airbag inflator. Be certain the connector is fully engaged and latched.

(5) Engage the two side curtain airbag tether plastic retainer clips into the A-pillar.

(6) Install and tighten the screw that secures the side curtain airbag tether retainer to the base of the A-pillar near the belt line. Tighten the screw to 6 N·m (55 in. lbs.).

(7) Reinstall the headliner into the vehicle. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION).

(8) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

SIDE IMPACT AIRBAG CONTROL MODULE

DESCRIPTION

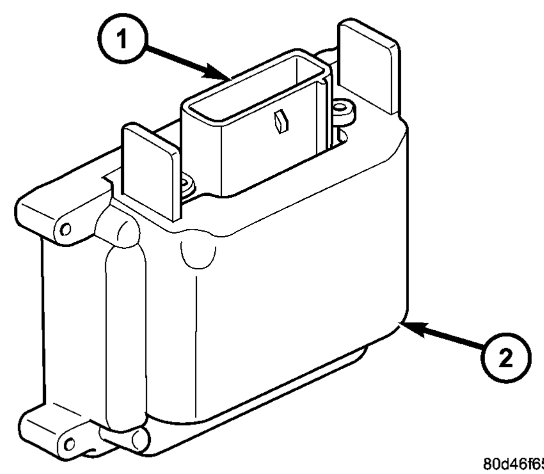


Fig. 50 Side Impact Airbag Control Module

1 - CONNECTOR RECEPTACLE
2 - SIACM

On vehicles equipped with the optional side curtain airbags, a Side Impact Airbag Control Module

SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

(SIACM) and its mounting bracket are secured with four screws to the inside of each B-pillar behind (standard cab) or above (quad cab) the front outboard seat belt retractor, and concealed behind the B-pillar trim (Fig. 50). Concealed within a hollow in the center of the die cast aluminum SIACM housing is the electronic circuitry of the SIACM which includes a microprocessor and an electronic impact sensor.

The SIACM housing is secured to a die cast (standard cab) or stamped steel (quad cab) mounting bracket, which is unique for the right or left side application of this component. The SIACM should never be removed from its mounting bracket. The housing also receives a case ground through this mounting bracket when it is secured to the vehicle. A molded plastic electrical connector receptacle that exits the top of the SIACM housing connects the unit to the vehicle electrical system through a dedicated take out and connector of the body wire harness. Both the SIACM housing and its electrical connection are sealed to protect the internal electronic circuitry and components against moisture intrusion.

The impact sensor internal to the SIACM is calibrated for the specific vehicle, and is only serviced as a unit with the SIACM. The SIACM cannot be repaired or adjusted and, if damaged or faulty, it must be replaced.

OPERATION

The microprocessor in the Side Impact Airbag Control Module (SIACM) contains the side curtain airbag system logic circuits and controls all of the features of only the side curtain airbag mounted on the same side of the vehicle as the SIACM. The SIACM uses On-Board Diagnostics (OBD) and can communicate with other electronic modules in the vehicle as well as with the DRBIII® scan tool using the Programmable Communications Interface (PCI) data bus network. This method of communication is used by the SIACM to communicate with the Airbag Control Module (ACM) and for supplemental restraint system diagnosis and testing through the 16-way data link connector located on the driver side lower edge of the instrument panel. The ACM communicates with both the left and right SIACM over the PCI data bus.

The SIACM microprocessor continuously monitors all of the side curtain airbag electrical circuits to determine the system readiness. If the SIACM detects a monitored system fault, it sets an active and stored Diagnostic Trouble Code (DTC) and sends electronic messages to the ACM over the PCI data bus. The ACM will respond by sending an electronic message to the EMIC to turn on the airbag indicator, and by storing a DTC that will indicate whether the left or the right SIACM has stored the DTC that initiated the airbag indicator illumination. An active fault only remains for the current ignition switch cycle, while a stored fault causes a DTC to be stored in memory by the SIACM. For some DTCs, if a fault does not recur for a number of ignition cycles, the SIACM will automatically erase the stored DTC. For other internal faults, the stored DTC is latched forever.

The SIACM receives battery current on a fused ignition switch output (run-start) circuit through a fuse in the Integrated Power Module (IPM). The SIACM has a case ground through its mounting bracket and also receives a power ground through a ground circuit and take out of the body wire harness. This take out has a single eyelet terminal connector that is secured by a ground screw to the body sheet metal. These connections allow the SIACM to be operational whenever the ignition switch is in the Start or On positions. An electronic impact sensor is contained within the SIACM. The electronic impact sensor is an accelerometer that senses the rate of vehicle deceleration, which provides verification of the direction and severity of an impact. A pre-programmed decision algorithm in the SIACM microprocessor determines when the deceleration rate as signaled by the impact sensor indicates a side impact that is severe enough to require side curtain airbag protection. When the programmed conditions are met, the SIACM sends the proper electrical signals to deploy the side curtain airbag.

The hard wired inputs and outputs for the SIACM may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods will not prove conclusive in the diagnosis of the SIACM, the PCI data bus network, or the electronic message inputs to and outputs from the SIACM. The most reliable, efficient, and accurate means to diagnose the SIACM, the PCI data bus network, and the electronic message inputs to and outputs from the SIACM requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

REMOVAL

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(1) Adjust the front seat to its most forward position for easiest access to the lower B-pillar trim.

(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(3) Remove the front outboard seat belt and retractor from the inside of the B-pillar. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT OUTBOARD SEAT BELT & RETRACTOR - REMOVAL - STANDARD CAB).

(4) Remove the four screws that secure the Side Impact Airbag Control Module (SIACM) mounting bracket to the inside of the B-pillar (Fig. 51).

(5) Reach through the retractor mounting hole in the inner B-pillar to access and disengage the two plastic push-in fasteners that secure the SIACM to the inside of the B-pillar.

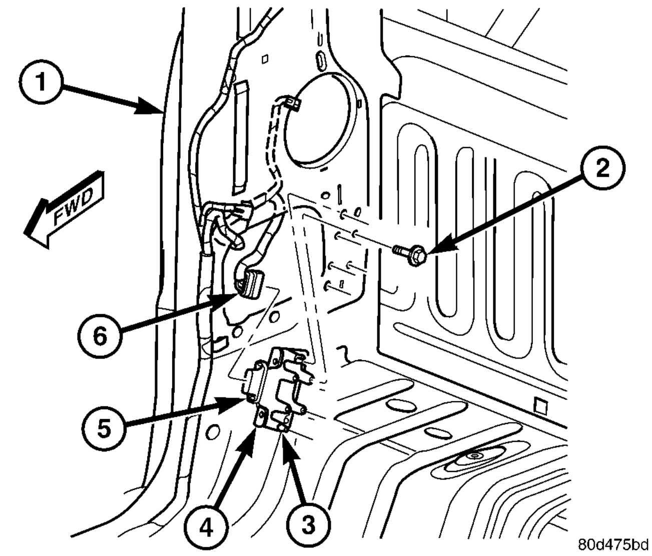


Fig. 51 Side Impact Airbag Control Module Remove/Install - Std Cab

1 - B-PILLAR
2 - SCREW (4)
3 - FASTENER (2)
4 - BRACKET
5 - SIACM
6 - WIRE HARNESS CONNECTOR

(6) Pull the SIACM and mounting bracket out through the retractor mounting hole far enough to access and disconnect the body wire harness connector for the SIACM from the module connector receptacle.

(7) Remove the SIACM and its mounting bracket from the B-pillar as a unit.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(1) Adjust the front seat to its most forward position for easiest access to the lower B-pillar trim.

(2) Disconnect and isolate the battery negative cable. Wait two minutes for the system capacitor to discharge before further service.

(3) Remove the front outboard seat belt and retractor from the inside of the B-pillar. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT OUTBOARD SEAT BELT & RETRACTOR - REMOVAL - QUAD CAB).

(4) Remove the four screws that secure the Side Impact Airbag Control Module (SIACM) mounting bracket to the inside of the B-pillar (Fig. 52).

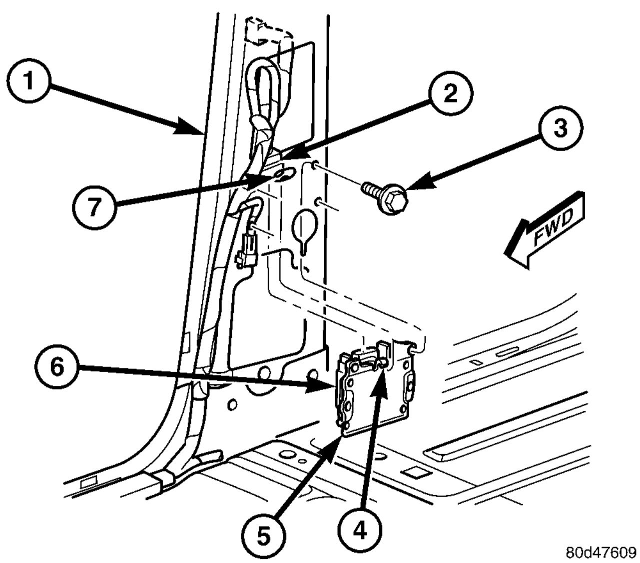


Fig. 52 Side Impact Airbag Control Module Remove/Install - Quad Cab

1 - B-PILLAR
2 - WIRE HARNESS CONNECTOR
3 - SCREW (4)
4 - HOOK
5 - BRACKET
6 - SIACM
7 - SLOT

(5) Reach through the retractor mounting hole in the inner B-pillar to access the SIACM and lift it upward far enough to disengage the hook on the mounting bracket from the slot on the inner B-pillar.

(6) Pull the SIACM and mounting bracket out through the retractor mounting hole far enough to access and disconnect the body wire harness connector for the SIACM from the module connector receptacle.

(7) Remove the SIACM and its mounting bracket from the B-pillar as a unit.

INSTALLATION

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(1) Position the Side Impact Airbag Control Module (SIACM) and its mounting bracket to the B-pillar as a unit (Fig. 51).

(2) Reconnect the body wire harness connector for the SIACM to the module connector receptacle.

(3) Reach through the retractor mounting hole in the inner B-pillar to position and engage the two

SIDE IMPACT AIRBAG CONTROL MODULE (Continued)

plastic push-in fasteners that secure the SIACM to the inside of the B-pillar.

(4) Loosely install the four screws that secure the SIACM mounting bracket to the base of the B-pillar.

(5) Tighten the four screws that secure the SIACM mounting bracket to the B-pillar in the following sequence: upper left, lower right, lower left, upper right. Tighten the screws to 12 N·m (105 in. lbs.).

(6) Reinstall the front outboard seat belt and retractor to the inside of the B-pillar. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT OUTBOARD SEAT BELT & RETRACTOR - INSTALLATION - STANDARD CAB).

(7) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: THE SIDE IMPACT AIRBAG CONTROL MODULE CONTAINS THE IMPACT SENSOR, WHICH ENABLES THE SYSTEM TO DEPLOY THE SIDE CURTAIN AIRBAGS. NEVER STRIKE OR DROP THE SIDE IMPACT AIRBAG CONTROL MODULE, AS IT CAN DAMAGE THE IMPACT SENSOR OR AFFECT ITS CALIBRATION. IF A SIDE IMPACT AIRBAG CONTROL MODULE IS ACCIDENTALLY DROPPED DURING SERVICE, THE MODULE MUST BE SCRAPPED AND REPLACED WITH A NEW UNIT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ACCIDENTAL, INCOMPLETE, OR IMPROPER SIDE CURTAIN AIRBAG DEPLOYMENT AND POSSIBLE OCCUPANT INJURIES.

(1) Position the Side Impact Airbag Control Module (SIACM) and its mounting bracket to the B-pillar as a unit (Fig. 52).

(2) Reconnect the body wire harness connector for the SIACM to the module connector receptacle.

(3) Reach through the retractor mounting hole in the inner B-pillar to position and engage the hook on the SIACM mounting bracket in the slot of the inner B-pillar.

(4) Loosely install the four screws that secure the SIACM mounting bracket to the inner B-pillar.

(5) Tighten the four screws that secure the SIACM mounting bracket to the B-pillar in the following sequence: upper left, lower right, lower left, upper right. Tighten the screws to 12 N·m (105 in. lbs.).

(6) Reinstall the front outboard seat belt and retractor to the inside of the B-pillar. (Refer to 8 - ELECTRICAL/RESTRAINTS/FRONT OUTBOARD SEAT BELT & RETRACTOR - INSTALLATION - QUAD CAB).

(7) Do not reconnect the battery negative cable at this time. The supplemental restraint system verification test procedure should be performed following service of any supplemental restraint system component. (Refer to 8 - ELECTRICAL/RESTRAINTS - STANDARD PROCEDURE - VERIFICATION TEST).

SPEED CONTROL

TABLE OF CONTENTS

SPEED CONTROL

DESCRIPTION

All 3.7L/4.7L/5.9L/8.0LGas Engines and/or Diesel With Automatic Trans.

The speed control system is operated by the use of a cable and a vacuum controlled servo. Electronic control of the speed control system is integrated into the Powertrain Control Module (PCM). The controls consist of two steering wheel mounted switches. The switches are labeled: ON/OFF, RES/ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

5.7L Gas

The speed control system is fully electronically controlled by the Powertrain Control Module (PCM). **A cable and a vacuum controlled servo are not used. This is a servo-less system.** The controls consist of two steering wheel mounted switches. The switches are labeled: ON/OFF, RES/ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

5.9L Diesel With Manual Trans.

The speed control system is fully electronically controlled by the Engine Control Module (ECM). **A cable and a vacuum controlled servo are not used if the vehicle is equipped with a manual transmission and a diesel engine. This is a servo-less system.** The controls consist of two steering wheel mounted switches. The switches are labeled: ON/OFF, RES/ACCEL, SET, COAST, and CANCEL.

The system is designed to operate at speeds above 30 mph (50 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

SPEED CONTROL (Continued)

OPERATION

When speed control is selected by depressing the ON switch, the PCM (the ECM with a diesel engine) allows a set speed to be stored in its RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.
- Depressing the clutch pedal (if equipped).

NOTE: Depressing the OFF switch or turning off the ignition switch will erase the set speed stored in the PCM (the ECM with a diesel engine).

For added safety, the speed control system is programmed to disengage for any of the following conditions:

- An indication of Park or Neutral
- A rapid increase rpm (indicates that the clutch has been disengaged)
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The speed signal increases at a rate of 10 mph per second (indicates that the coefficient of friction between the road surface and tires is extremely low)
- The speed signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)

Once the speed control has been disengaged, depressing the RES/ACCEL switch (when speed is greater than 30 mph) restores the vehicle to the target speed that was stored in the PCM (the ECM with a diesel engine).

While the speed control is engaged, the driver can increase the vehicle speed by depressing the RES/ACCEL switch. The new target speed is stored in the PCM (the ECM with a diesel engine) when the RES/ACCEL is released. The PCM also has a ″tap-up″ feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the RES/ACCEL switch.

A “tap down” feature is used to decelerate without disengaging the speed control system. To decelerate from an existing recorded target speed, momentarily depress the COAST switch. For each switch activation, speed will be lowered approximately 1 mph.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - VACUUM SUPPLY TEST

3.7L / 4.7L / 5.9L / 8.0L Gas Powered Engines

3.7L/4.7L/5.9L/8.0L gas powered engines: actual engine vacuum, a vacuum reservoir, a one-way check valve and vacuum lines are used to supply vacuum to the speed control servo.

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum is less than ten inches of mercury, determine source of leak. Check vacuum line to engine for leaks. Also check actual engine intake manifold vacuum. If manifold vacuum does not meet this requirement, check for poor engine performance and repair as necessary.

(4) If vacuum line to engine is not leaking, check for leak at vacuum reservoir. To locate and gain access to reservoir, refer to Vacuum Reservoir Removal/Installation in this group. Disconnect vacuum line at reservoir and connect a hand-operated vacuum pump to reservoir fitting. Apply vacuum. Reservoir vacuum should not bleed off. If vacuum is being lost, replace reservoir.

(5) Verify operation of one-way check valve and check it for leaks.

(a) Locate one-way check valve. The valve is located in vacuum line between vacuum reservoir and engine vacuum source. Disconnect vacuum hoses (lines) at each end of valve.

(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(c) Connect a hand-operated vacuum pump to vacuum source end of check valve. Apply vacuum. Vacuum should flow through valve. If vacuum is not flowing, replace one-way check valve. Seal the fitting at opposite end of valve with a finger and apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

5.7 Gas

Vacuum is not used for any part of the speed control system if equipped with a 5.7L V-8 engine.

5.9L Diesel Engine With Manual Trans.

Vacuum is not used for any part of the speed control system if equipped with a diesel engine and a manual transmission.

SPEED CONTROL (Continued)

5.9L Diesel Engines With Automatic Trans.

If equipped with a diesel powered engine and an automatic transmission, an electric vacuum pump and vacuum lines are used to supply vacuum to the speed control servo. A vacuum reservoir is not used.

DIAGNOSIS AND TESTING - ROAD TEST

Perform a vehicle road test to verify reports of speed control system malfunction. The road test should include attention to the speedometer. Speedometer operation should be smooth and without flutter at all speeds.

Flutter in the speedometer indicates a problem which might cause surging in the speed control system. The cause of any speedometer problems should be corrected before proceeding. Refer to Instrument Cluster for speedometer diagnosis.

If a road test verifies a system problem and the speedometer operates properly, check for:

- A Diagnostic Trouble Code (DTC). If a DTC exists, conduct tests per the Powertrain Diagnostic Procedures service manual.
- A misadjusted brake (stop) lamp switch. This could also cause an intermittent problem.
- Loose, damaged or corroded electrical connections at the servo (if used). Corrosion should be removed from electrical terminals and a light coating of Mopar MultiPurpose Grease, or equivalent, applied.
- Leaking vacuum reservoir (if used).
- Loose or leaking vacuum hoses or connections (if used).
- Defective one-way vacuum check valve (if used).
- Secure attachment of both ends of the speed control servo cable (if used).
- Smooth operation of throttle linkage (if used) and throttle body air valve.
- Failed speed control servo (if used). Do the servo vacuum test.

CAUTION: When test probing for voltage or continuity at electrical connectors, care must be taken not to damage connector, terminals or seals. If these components are damaged, intermittent or complete system failure may occur.

SPECIFICATIONS

TORQUE - SPEED CONTROL

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Servo Mounting Bracket-to-Servo Nuts	7	-	60
Servo Mounting Bracket-to-Battery Tray Screws	4	-	30
Speed Control Switch Mounting Screws	1.7	-	15
Vacuum Reservoir Mounting Nuts	3	-	20

CABLE

DESCRIPTION

The speed control servo cable is connected between the speed control vacuum servo diaphragm and the throttle body control linkage. This cable is used with 3.7L/4.7L/5.9L/8.0L gas powered engines only. It is also used if equipped with a 5.9L diesel engine equipped with an automatic transmission.

A speed control servo cable **is not used** if equipped with either a 5.9L diesel engine equipped with a manual transmission, or any 5.7L engine/transmission combinations.

OPERATION

This cable causes the throttle control linkage to open or close the throttle valve in response to movement of the vacuum servo diaphragm.

REMOVAL

3.7L / 4.7L GAS

(1) Disconnect negative battery cable at battery.

(2) Remove air intake tube at top of throttle body.

The accelerator cable must be partially removed to gain access to speed control cable.

CABLE (Continued)

(3) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 1) from throttle body bellcrank.

(4) Using a pick or small screwdriver, press release tab (Fig. 2) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 2) towards right side of vehicle to remove throttle cable from throttle body bracket.

(5) Using finger pressure only, disconnect servo cable connector (Fig. 3) at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle. **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(6) Slide speed control cable plastic mount towards right of vehicle to remove cable from throttle body bracket (Fig. 4).

(7) Remove servo cable from servo. Refer to Servo Removal/Installation.

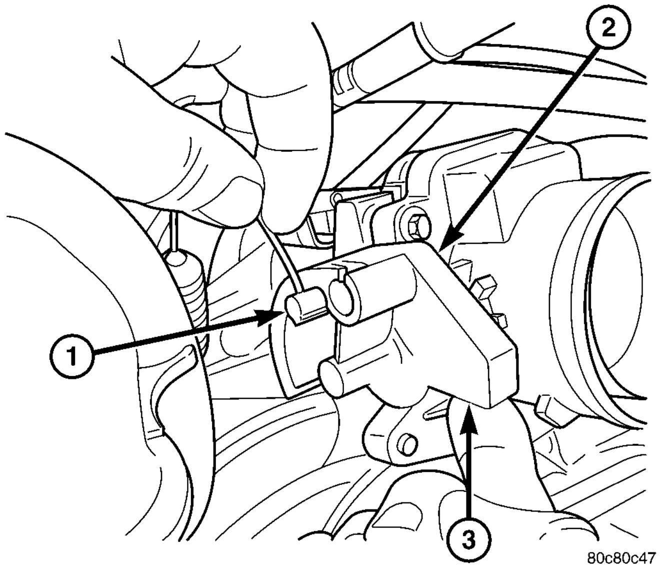


Fig. 1 THROTTLE CABLE PIN - 3.7L / 4.7L

1 - THROTTLE CABLE PIN
2 - THROTTLE BODY BELLCRANK
3 - PUSH UP HERE

5.9L Gas

(1) Disconnect negative battery cable at battery.

(2) Remove air intake tube at top of throttle body.

(3) Using finger pressure only, remove speed control cable connector at bellcrank by pushing connector rearward off the bellcrank pin (Fig. 5). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(4) Squeeze 2 tabs on sides of speed control cable at throttle body mounting bracket (locking plate) and push out of bracket.

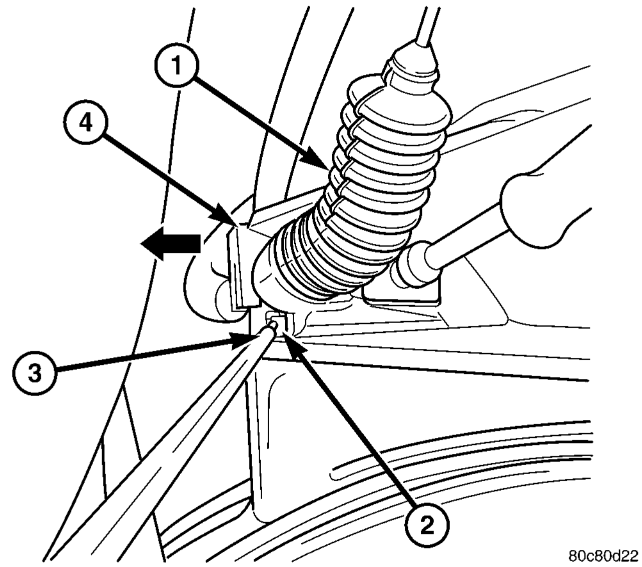


Fig. 2 THROTTLE CABLE RELEASE TAB - 3.7L / 4.7L

1 - THROTTLE CABLE
2 - RELEASE TAB
3 - PICK OR SCREWDRIVER
4 - PLASTIC CABLE MOUNT

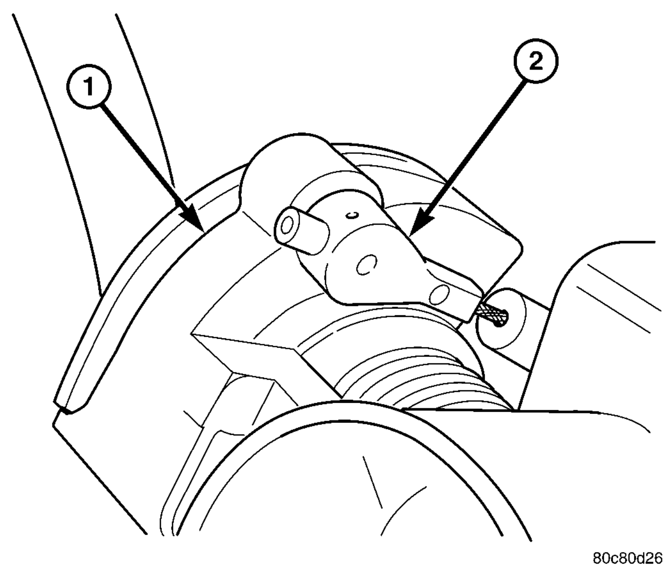


Fig. 3 SPEED CONTROL CABLE AT BELLCRANK - 3.7L / 4.7L

1 - THROTTLE BODY BELLCRANK
2 - SPEED CONTROL CABLE CONNECTOR

(5) Remove servo cable from servo. Refer to Speed Control Servo Removal/Installation in this group.

CABLE (Continued)

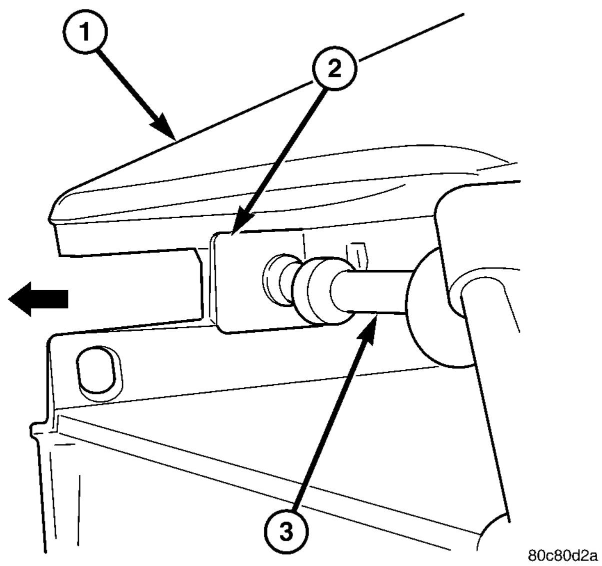


Fig. 4 SPEED CONTROL CABLE AT BRACKET - 3.7L / 4.7L

1 - THROTTLE CABLE BRACKET
2 - PLASTIC CABLE MOUNT
3 - SPEED CONTROL CABLE

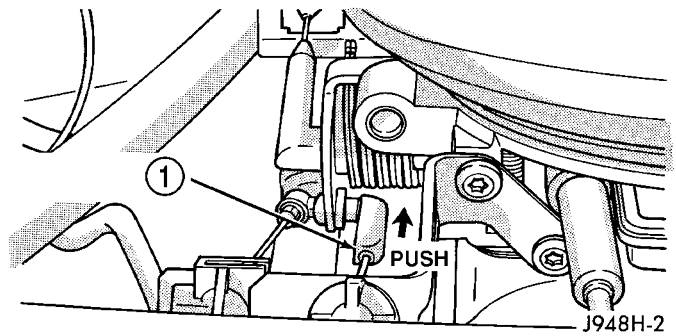


Fig. 5 SERVO CABLE AT THROTTLE BODY - 5.9L GAS

1 - VEHICLE SPEED CONTROL CABLE

8.0L Gas

(1) Disconnect negative battery cable at battery.

(2) Using finger pressure only, remove speed control cable connector at bellcrank by pushing connector off the bellcrank pin (Fig. 6). **DO NOT try to pull connector off perpendicular to the bellcrank pin. Connector will be broken.**

(3) Squeeze 2 tabs on sides of speed control cable at throttle body mounting bracket (locking plate) and push out of bracket.

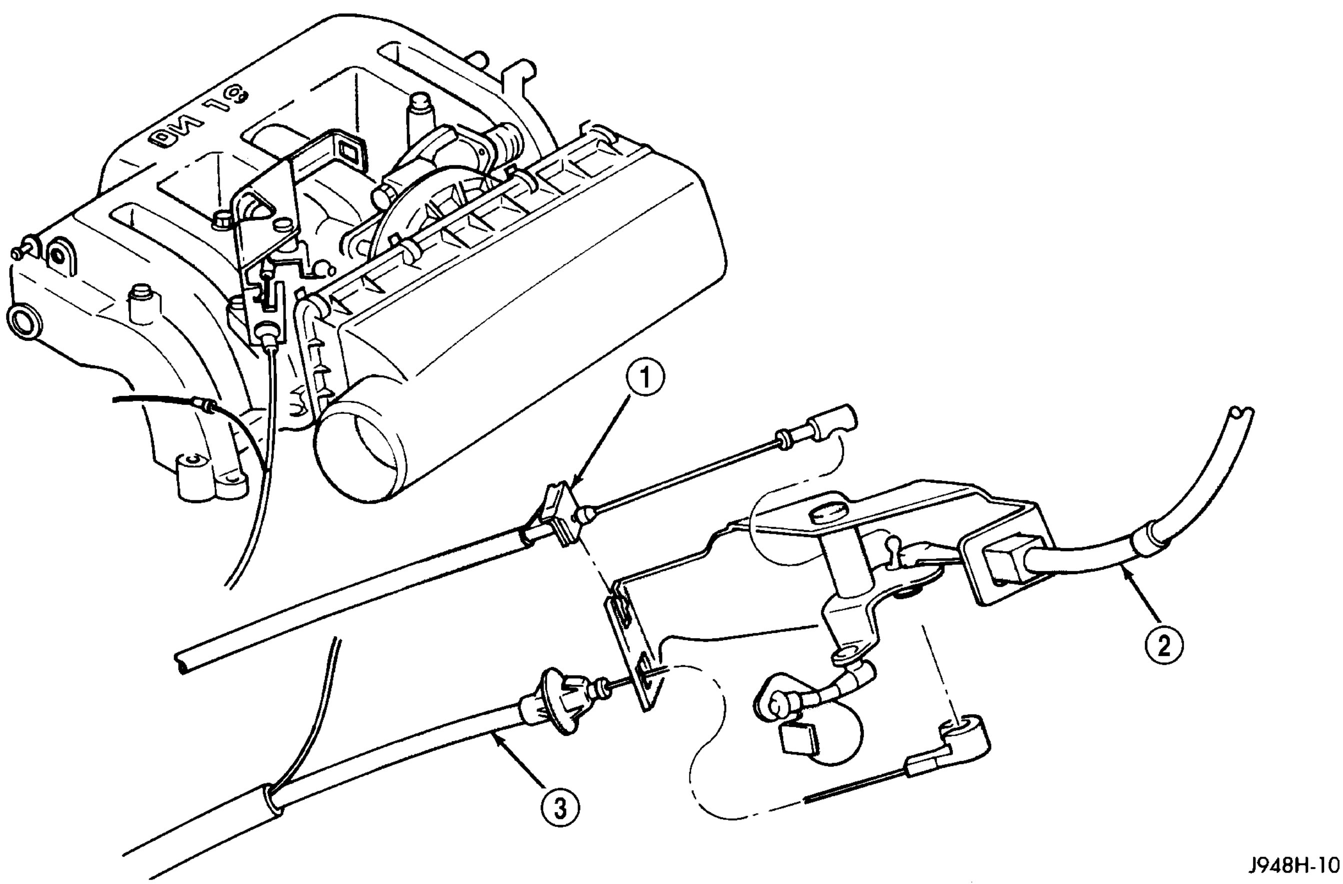


Fig. 6 SERVO CABLE AT THROTTLE BODY — 8.0L V-10 ENGINE

1 - THROTTLE CABLE
2 - THROTTLE VALVE CABLE
3 - SPEED CONTROL SERVO CABLE

CABLE (Continued)

(4) Remove servo cable from servo. Refer to Speed Control Servo Removal/Installation in this group.

5.9L Diesel — Auto. Trans.

(1) Disconnect both negative battery cables at both batteries.

(2) Remove cable/lever/linkage cover. Refer to Speed Control Servo Removal/Installation.

(3) Remove (disconnect) servo cable from servo. Refer to Speed Control Servo Removal/Installation.

(4) Using finger pressure only, disconnect end of servo cable from throttle lever pin by pulling forward on connector while holding lever rearward (Fig. 7). **DO NOT try to pull connector off perpendicular to lever pin. Connector will be broken.**

(5) Squeeze 2 pinch tabs (Fig. 7) on sides of speed control cable at mounting bracket and push cable rearward out of bracket.

(6) Remove cable from vehicle.

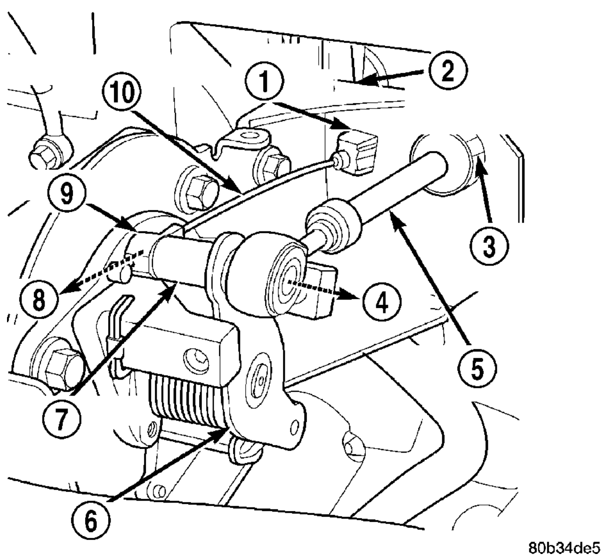


Fig. 7 SERVO CABLE AT THROTTLE LEVER — 5.9L DIESEL

1 - PINCH (2) TABS
2 - CABLE MOUNTING BRACKET
3 - PINCH TABS (2)
4 - OFF
5 - THROTTLE CABLE
6 - THROTTLE LEVER
7 - THROTTLE LEVER PIN
8 - OFF
9 - CONNECTOR
10 - SPEED CONTROL CABLE

INSTALLATION

3.7L / 4.7L Gas

(1) Install end of cable to speed control servo. Refer to Servo Removal/Installation.

(2) Slide speed control cable plastic mount into throttle body bracket.

(3) Install speed control cable connector onto throttle body bellcrank pin (push rearward to snap into location).

(4) Slide throttle (accelerator) cable plastic mount into throttle body bracket. Continue sliding until cable release tab is aligned to hole in throttle body mounting bracket.

(5) While holding throttle to wide open position, place throttle cable pin into throttle body bellcrank.

(6) Install air intake tube to top of throttle body.

(7) Connect negative battery cable at battery.

(8) Before starting engine, operate accelerator pedal to check for any binding.

5.9L / 8.0L Gas

(1) Install end of cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Install cable into throttle body mounting bracket. Cable snaps into bracket.

(3) Install speed control cable connector at throttle body bellcrank pin. Connector snaps onto pin.

(4) Install air intake tube to top of throttle body (except 8.0L).

(5) Connect negative battery cable to battery.

(6) Before starting engine, operate accelerator pedal to check for any binding.

5.9L Diesel — Auto. Trans.

(1) Install (connect) end of speed control servo cable to speed control servo. Refer to Speed Control Servo Removal/Installation.

(2) Install cable through mounting hole on mounting bracket. Cable snaps into bracket.

(3) Connect servo cable to throttle lever by pushing cable connector rearward onto lever pin while holding lever forward.

(4) Connect negative battery cables to both batteries.

(5) Before starting engine, operate accelerator pedal to check for any binding.

(6) Install cable/lever cover.

SERVO

DESCRIPTION

A speed control servo is not used with any 5.7L V-8 engine, or with the 5.9L diesel engine when equipped with a manual transmission.

The speed control servo is attached to the bottom of the battery tray.

The servo unit consists of a solenoid valve body, and a vacuum chamber. The solenoid valve body contains three solenoids:

- Vacuum
- Vent
- Dump

SERVO (Continued)

The vacuum chamber contains a diaphragm with a cable attached to control the throttle linkage.

OPERATION

A speed control servo is not used with any 5.7L V-8 engine, or with the 5.9L diesel engine when equipped with a manual transmission.

The Powertrain Control Module (PCM) controls the solenoid valve body. The solenoid valve body controls the application and release of vacuum to the diaphragm of the vacuum servo. The servo unit cannot be repaired and is serviced only as a complete assembly.

Power is supplied to the servo's by the PCM through the brake switch. The PCM controls the ground path for the vacuum and vent solenoids.

The dump solenoid is energized anytime it receives power. If power to the dump solenoid is interrupted, the solenoid dumps vacuum in the servo. This provides a safety backup to the vent and vacuum solenoids.

The vacuum and vent solenoids must be grounded at the PCM to operate. When the PCM grounds the vacuum servo solenoid, the solenoid allows vacuum to enter the servo and pull open the throttle plate using the cable. When the PCM breaks the ground, the solenoid closes and no more vacuum is allowed to enter the servo. The PCM also operates the vent solenoid via ground. The vent solenoid opens and closes a passage to bleed or hold vacuum in the servo as required.

The PCM duty cycles the vacuum and vent solenoids to maintain the set speed, or to accelerate and decelerate the vehicle. To increase throttle opening, the PCM grounds the vacuum and vent solenoids. To decrease throttle opening, the PCM removes the grounds from the vacuum and vent solenoids. When the brake is released, if vehicle speed exceeds 30 mph to resume, 35 mph to set, and the RES/ACCEL switch has been depressed, ground for the vent and vacuum circuits is restored.

REMOVAL

The speed control servo assembly is attached to the bottom of the battery tray (Fig. 8).

(1) Disconnect negative battery cable at battery (both cables at both batteries if diesel).

(2) To gain access to servo, remove plastic wheelhouse splash shield over left-front wheel.

(3) Disconnect vacuum line at servo (Fig. 8).

(4) Disconnect electrical connector at servo (Fig. 8).

(5) Remove 3 servo mounting screws (Fig. 8). Depending on engine application, different sets of mounting lugs (Fig. 8) are used to support servo to battery tray. While removing, note proper lugs.

(6) Disconnect servo cable at throttle body. Refer to Servo Cable Removal/Installation.

(7) Remove 2 mounting nuts holding servo cable sleeve to bracket (Fig. 9).

(8) Pull speed control cable sleeve and servo away from servo mounting bracket to expose cable retaining clip (Fig. 9) and remove clip. Note: The servo mounting bracket displayed in (Fig. 9) is a typical bracket and may/may not be applicable to this model vehicle.

(9) Remove servo from mounting bracket. While removing, note orientation of servo to bracket.

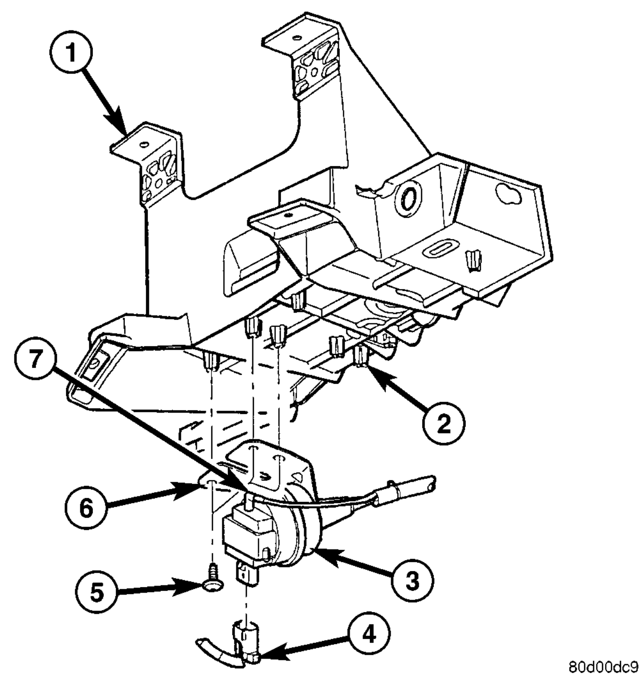


Fig. 8 SPEED CONTROL SERVO LOCATION

1 - BATTERY TRAY
2 - MOUNTING LUGS
3 - SERVO
4 - ELEC. CONNEC.
5 - MOUNTING SCREWS (3)
6 - MOUNTING BRACKET
7 - VACUUM LINE

INSTALLATION

(1) Position servo to mounting bracket (Fig. 9).

(2) Align hole in cable connector with hole in servo pin. Install cable-to-servo retaining clip (Fig. 9).

(3) Insert servo mounting studs through holes in servo mounting bracket.

(4) Install 2 servo-to-mounting bracket nuts and tighten. Refer to torque specifications.

(5) Position servo assembly to correct mounting lugs on battery tray (Fig. 8) and install 3 screws. Tighten 3 screws. Refer to torque specifications.

(6) Connect vacuum line at servo.

(7) Connect electrical connector at servo.

SERVO (Continued)

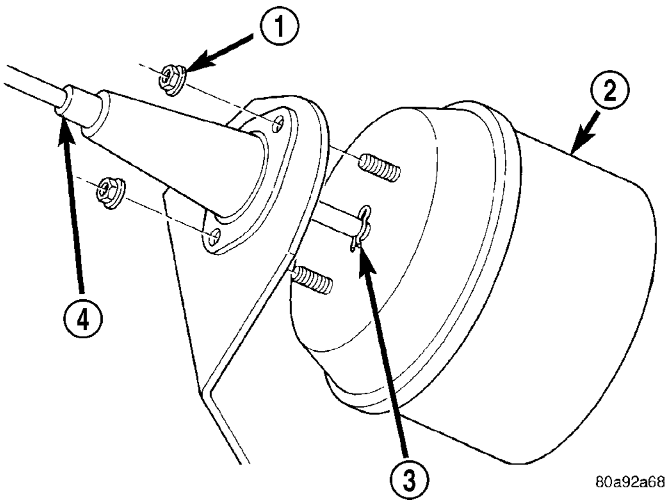


Fig. 9 SERVO CABLE CLIP REMOVE/INSTALL — TYPICAL

1 - SERVO MOUNTING NUTS (2)
2 - SERVO
3 - CABLE RETAINING CLIP
4 - SERVO CABLE AND SLEEVE

(8) Connect servo cable to throttle body. Refer to servo Cable Removal/Installation.

(9) Install left-front wheel-well liner.

(10) Connect negative battery cable to battery (connect both cables if diesel).

(11) Before starting engine, operate accelerator pedal to check for any binding.

SWITCH

DESCRIPTION

Two separate switch pods operate the speed control system. The steering-wheel-mounted switches use multiplexed circuits to provide inputs to the PCM (to the ECM for diesel) for ON, OFF, RESUME, ACCELERATE, SET, DECEL and CANCEL modes. Refer to the owner's manual for more information on speed control switch functions and setting procedures.

The individual switches cannot be repaired. If one switch fails, the entire switch module must be replaced.

Depending on engine control computer (JTEC having a 3– plug connector or NGC having a 4– plug connector), 2 types of switches are used. Both types of switches are internally and externally different. The switch used with the NGC system has an attached pigtail lead. The switch used with the JTEC system does not have an attached pigtail lead.

OPERATION

When speed control is selected by depressing the ON, OFF switch, the PCM (ECM for diesel) allows a set speed to be stored in its RAM for speed control. To store a set speed, depress the SET switch while the vehicle is moving at a speed between approximately 35 and 85 mph. In order for the speed control to engage, the brakes cannot be applied, nor can the gear selector be indicating the transmission is in Park or Neutral.

The speed control can be disengaged manually by:

- Stepping on the brake pedal
- Depressing the OFF switch
- Depressing the CANCEL switch.

The speed control can be disengaged also by any of the following conditions:

- An indication of Park or Neutral
- The VSS signal increases at a rate of 10 mph per second (indicates that the co-efficient of friction between the road surface and tires is extremely low)
- Depressing the clutch pedal.
- Excessive engine rpm (indicates that the transmission may be in a low gear)
- The VSS signal decreases at a rate of 10 mph per second (indicates that the vehicle may have decelerated at an extremely high rate)
- If the actual speed is not within 20 mph of the set speed

The previous disengagement conditions are programmed for added safety.

Once the speed control has been disengaged, depressing the ACCEL switch restores the vehicle to the target speed that was stored in the PCM's RAM (ECM for diesel).

NOTE: Depressing the OFF switch will erase the set speed stored in the PCM's RAM.

If, while the speed control is engaged, the driver wishes to increase vehicle speed, the PCM (ECM for diesel) is programmed for an acceleration feature. With the ACCEL switch held closed, the vehicle accelerates slowly to the desired speed. The new target speed is stored in the PCM's RAM when the ACCEL switch is released. The PCM also has a ″tap-up″ feature in which vehicle speed increases at a rate of approximately 2 mph for each momentary switch activation of the ACCEL switch.

The PCM also provides a means to decelerate without disengaging speed control. To decelerate from an existing recorded target speed, depress and hold the COAST switch until the desired speed is reached. Then release the switch. The ON, OFF switch operates two components: the PCM's ON, OFF input, and the battery voltage to the brake switch.

SWITCH (Continued)

REMOVAL

Depending on engine control computer (JTEC having a 3–plug connector or 5.7L V-8 NGC having a 4–plug connector), 2 types of switches are used. Both types of switches are internally and externally different. The switches used with the NGC system have attached pigtail leads (Fig. 11). The switch used with the JTEC system does not have an attached pigtail lead.

(1) Remove switch mounting screw (Fig. 10). or (Fig. 11)

(2) Pull switch from steering wheel.

(3) Unplug electrical connector from switch (Fig. 10), or, switch pigtail wire harness from steering wheel wire harness (Fig. 11) and remove switch.

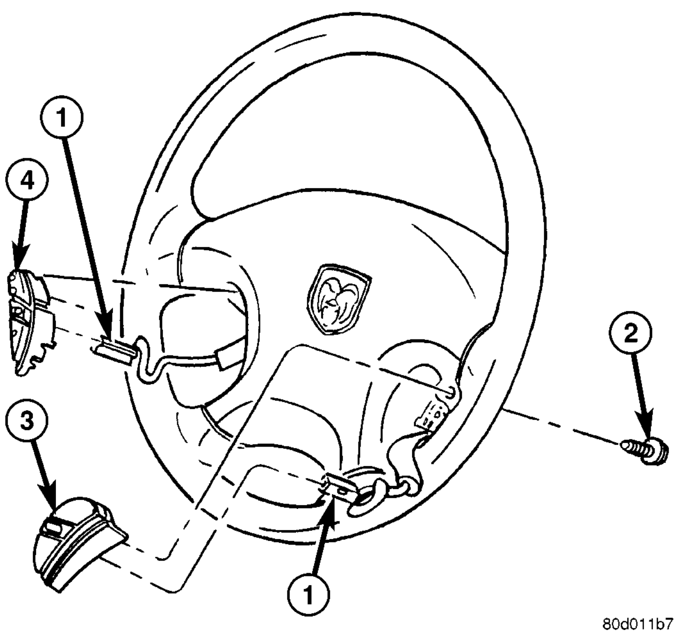


Fig. 10 SPEED CONTROL SWITCHES (EXCEPT 5.7L V-8 ENGINE)

1 - ELECTRICAL CONNECTORS
2 - MOUNTING SCREWS
3 - RIGHT SWITCH
4 - LEFT SWITCH

INSTALLATION

(1) Plug electrical connector into switch (Fig. 10), or connect pigtail wire harness to steering wheel wire harness (Fig. 11). Be sure wires are not pinched.

(2) Position switch to steering wheel.

(3) Install switch mounting screw and tighten. Refer to torque specifications.

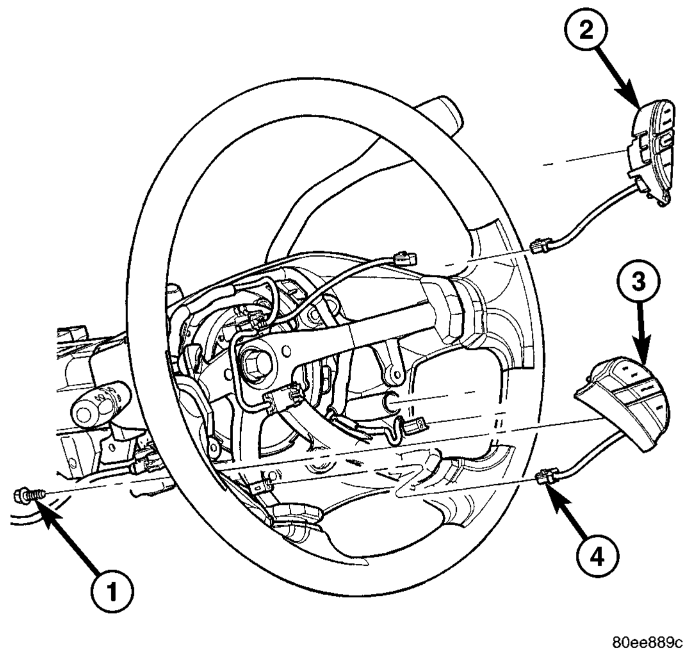


Fig. 11 SPEED CONTROL SWITCHES (WITH 5.7L V-8 ENGINE)

1 - MOUNTING SCREWS
2 - RIGHT SWITCH
3 - LEFT SWITCH
4 - PIGTAIL LEADS

VACUUM RESERVOIR

DESCRIPTION

The vacuum reservoir is a plastic storage tank connected to an engine vacuum source by vacuum lines. A vacuum reservoir is not used with diesel engines or the 5.7L gas powered engine.

OPERATION

The vacuum reservoir is used to supply the vacuum needed to maintain proper speed control operation when engine vacuum drops, such as in climbing a grade while driving. A one-way check valve is used in the vacuum line between the reservoir and the vacuum source. This check valve is used to trap engine vacuum in the reservoir. On certain vehicle applications, this reservoir is shared with the heating/air-conditioning system. The vacuum reservoir cannot be repaired and must be replaced if faulty.

DIAGNOSIS AND TESTING - VACUUM RESERVOIR

(1) Disconnect vacuum hose at speed control servo and install a vacuum gauge into the disconnected hose.

VACUUM RESERVOIR (Continued)

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum is less than ten inches of mercury, determine source of leak. Check vacuum line to engine for leaks. Also check actual engine intake manifold vacuum. If manifold vacuum does not meet this requirement, check for poor engine performance and repair as necessary.

(4) If vacuum line to engine is not leaking, check for leak at vacuum reservoir. To locate and gain access to reservoir, refer to Vacuum Reservoir Removal/Installation in this group. Disconnect vacuum line at reservoir and connect a hand-operated vacuum pump to reservoir fitting. Apply vacuum. Reservoir vacuum should not bleed off. If vacuum is being lost, replace reservoir.

(5) Verify operation of one-way check valve and check it for leaks. **Certain models may be equipped with 2 check-valves.**

(a) Locate one-way check valve. The valve is located in vacuum line between vacuum reservoir and engine vacuum source. Disconnect vacuum hoses (lines) at each end of valve.

(b) Connect a hand-operated vacuum pump to reservoir end of check valve. Apply vacuum. Vacuum should not bleed off. If vacuum is being lost, replace one-way check valve.

(c) Connect a hand-operated vacuum pump to vacuum source end of check valve. Apply vacuum. Vacuum should flow through valve. If vacuum is not flowing, replace one-way check valve. Seal the fitting at opposite end of valve with a finger and apply vacuum. If vacuum will not hold, diaphragm within check valve has ruptured. Replace valve.

REMOVAL

The vacuum reservoir is located in the engine compartment under the fresh air cowl grill panel (Fig. 12).

(1) Remove wiper blades and arms. Refer to Wiper Arm Removal / Installation in the Wipers / Washers section.

(2) Remove fresh air cowl grill. Refer to Cowl Grill Removal / Installation.

(3) Disconnect vacuum line at reservoir (Fig. 13).

(4) Remove 2 reservoir mounting nuts (Fig. 13).

(5) Remove reservoir from cowl.

INSTALLATION

(1) Position reservoir onto 2 weld studs (Fig. 13).

(2) Install 2 mounting nuts and tighten. Refer to torque specifications.

(3) Connect vacuum line to reservoir fitting.

(4) Install cowl grill. Refer to Cowl Grill Removal / Installation.

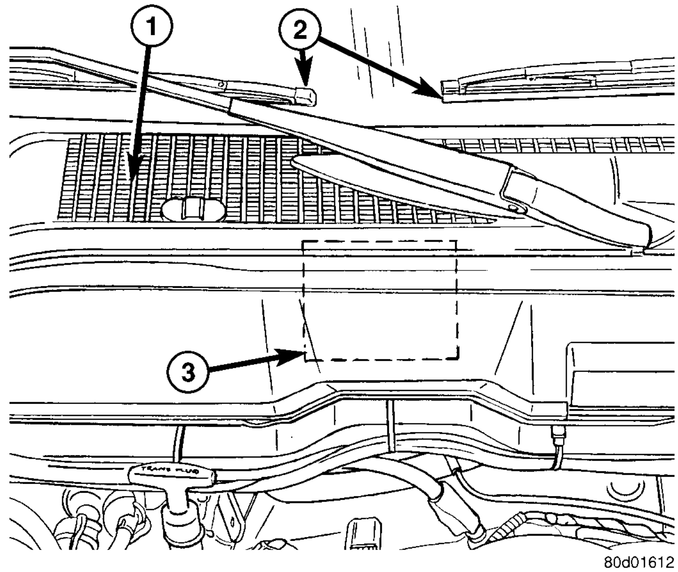


Fig. 12 VACUUM RESERVOIR LOCATION

1 - COWL GRILL
2 - WIPER ARMS / BLADES
3 - VACUUM RESERVOIR

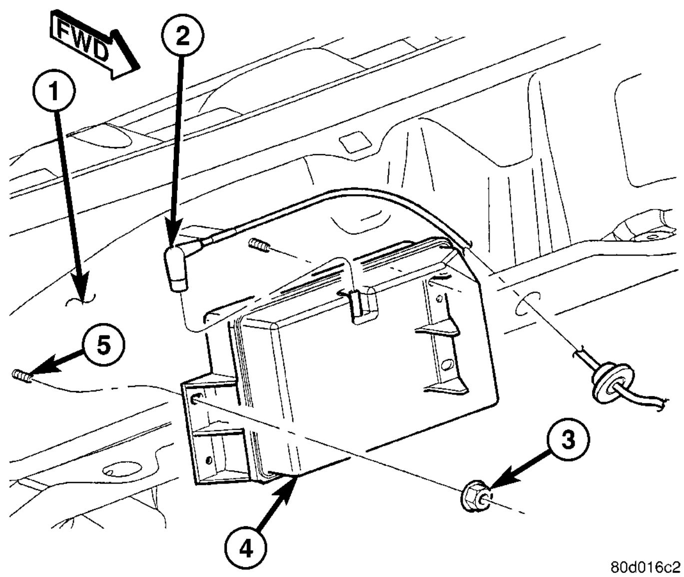


Fig. 13 VACUUM RESERVOIR REMOVAL / INSTALLATION

1 - COWL (BELOW WIPER ARMS)
2 - VACUUM LINE CONNECTION
3 - MOUNTING NUTS (2)
4 - VACUUM RESERVOIR
5 - WELDED STUDS

(5) Install wiper arms / blades. Refer to Wiper Arm Removal / Installation.

VEHICLE THEFT SECURITY

TABLE OF CONTENTS

VEHICLE THEFT SECURITY

DESCRIPTION

DESCRIPTION

The Vehicle Theft/Security System (VTSS) is designed to protect against whole vehicle theft. The system monitors the vehicle doors and ignition for unauthorized operation.

The VTSS activates:

- Sounding of the horn
- Flashing of the park lamps
- Flashing of the head lamps

The Remote Keyless Entry (RKE) has 1 mode of operation, **CUSTOMER USAGE** mode. The customer usage mode provides full functionality of the module and is the mode in which the RKE module should be operating when used by the customer.

SENTRY KEY IMMOBILIZER SYSTEM (SKIS)

The Sentry Key Immobilizer System (SKIS) is designed to provide passive protection against unauthorized vehicle use by preventing the engine from operating while the system is armed. The primary components of this system are the Sentry Key Immobilizer Module (SKIM), the Sentry Key transponder, the Vehicle Theft/Security System (VTSS) indicator LED, and the Powertrain Control Module (PCM).

The SKIM is installed on the steering column near the ignition lock cylinder. The transponder is located under the molded rubber cap on the head of the ignition key. The VTSS indicator LED is located in the instrument cluster.

The SKIS includes two valid Sentry Key transponders from the factory. This is so the customer can self program new keys if one is lost. If the customer wishes, additional non-coded blank Sentry Keys are available. These blank keys can be cut to match a valid ignition key, but the engine will not start unless the key transponder is also programmed to the vehicle. The SKIS will recognize no more than eight valid Sentry Key transponders at any one time.

The SKIS performs a self-test each time the ignition switch is turned to the ON position, and will store Diagnostic Trouble Codes (DTC's) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC can be retrieved using a DRBIII® scan tool as described in the proper Body Diagnostic Procedures Manual.

DESCRIPTION

The Sentry Key Immobilizer Module (SKIM) contains a Radio Frequency (RF) transceiver and a central processing unit, which includes the Sentry Key Immobilizer System (SKIS) program logic. The SKIS programming enables the SKIM to program and retain in memory the codes of at least two, but no more than eight electronically coded Sentry Key transponders. The SKIS programming also enables the SKIM to communicate over the Programmable Communication Interface (PCI) bus network with the Powertrain Control Module (PCM), and/or the DRBIII® scan tool.

VEHICLE THEFT SECURITY (Continued)

OPERATION

OPERATION

When in the **Customer Usage** mode of operation, the system is armed when the vehicle is locked using the:

- Power Door Lock Switches
- Remote Keyless Entry (RKE) Transmitter
- Key Cylinder Switches

After the vehicle is locked and the last door is closed, the VTSS indicator in the instrument cluster will flash quickly for 16 seconds, indicating that the arming is in process. After 16 seconds, the LED will continue to flash at a slower rate indicating that the system is armed.

VTSS disarming occurs upon normal vehicle entry by unlocking either door via the key cylinder or RKE transmitter, or by starting the vehicle with a valid Sentry Key. This disarming will also halt the alarm once it has been activated.

A tamper alert exists to notify the driver that the system has been activated. This alert consists of 3 horn pulses and the security telltail flashing for 30 seconds when the vehicle is disarmed. The tamper alert will not occur if disarmed while alarming.

The VTSS will not arm by mechanically locking the vehicle doors. This will manually override the system.

OPERATION

The SKIS includes two valid Sentry Key transponders from the factory. These two Sentry Keys can be used to program additional non-coded blank Sentry Keys. These blank keys can be cut to match a valid ignition key, but the engine will not start unless the key transponder is also programmed to the vehicle. The SKIS will recognize no more than eight valid Sentry Key transponders at any one time.

The SKIS performs a self-test each time the ignition switch is turned to the ON position, and will store Diagnostic Trouble Codes (DTC's) if a system malfunction is detected. The SKIS can be diagnosed, and any stored DTC can be retrieved using a DRBIII® scan tool as described in the proper Powertrain Diagnostic Procedures manual.

OPERATION

The SKIM transmits and receives RF signals through a tuned antenna enclosed within a molded plastic ring formation that is integral to the SKIM housing. When the SKIM is properly installed on the steering column, the antenna ring is oriented around the circumference of the ignition lock cylinder housing. This antenna ring must be located within eight millimeters (0.31 inches) of the Sentry Key in order to ensure proper RF communication between the SKIM and the Sentry Key transponder.

For added system security, each SKIM is programmed with a unique “Secret Key” code and a security code. The SKIM keeps the “Secret Key” code in memory. The SKIM also sends the “Secret Key” code to each of the programmed Sentry Key transponders. The security code is used by the assembly plant to access the SKIS for initialization, or by the dealer technician to access the system for service. The SKIM also stores in its memory the Vehicle Identification Number (VIN), which it learns through a PCI bus message from the PCM during initialization.

The SKIM and the PCM both use software that includes a rolling code algorithm strategy, which helps to reduce the possibility of unauthorized SKIS disarming. The rolling code algorithm ensures security by preventing an override of the SKIS through the unauthorized substitution of the SKIM or the PCM. However, the use of this strategy also means that replacement of either the SKIM or the PCM units will require a system initialization procedure to restore system operation.

When the ignition switch is turned to the ON or START positions, the SKIM transmits an RF signal to excite the Sentry Key transponder. The SKIM then listens for a return RF signal from the transponder of the Sentry Key that is inserted in the ignition lock cylinder. If the SKIM receives an RF signal with valid “Secret Key” and transponder identification codes, the SKIM sends a “valid key” message to the PCM over the PCI bus. If the SKIM receives an invalid RF signal or no response, it sends “invalid key” messages to the PCM. The PCM will enable or disable engine operation based upon the status of the SKIM messages.

The SKIM also sends messages to the Instrument Cluster which controls the VTSS indicator. The SKIM sends messages to the Instrument Cluster to turn the indicator on for about three seconds when the ignition switch is turned to the ON position as a “bulb” test. After completion of the “bulb” test, the SKIM sends bus messages to keep the indicator off for a duration of about one second. Then the SKIM sends messages to turn the indicator on or off based upon the results of the SKIS self-tests. If the VTSS indicator comes on and stays on after the “bulb test”, it indicates that the SKIM has detected a system malfunction and/or that the SKIS has become inoperative.

If the SKIM detects an invalid key when the ignition switch is turned to the ON position, it sends messages to flash the VTSS indicator. The SKIM can also send messages to flash the indicator to serve as an indication to the customer that the SKIS has been

VEHICLE THEFT SECURITY (Continued)

placed in its "Customer Learn" programming mode. See Sentry Key Immobilizer System Transponder Programming in this section for more information on the "Customer Learn" programming mode.

For diagnosis or initialization of the SKIM and the PCM, a DRBIII® scan tool and the proper Powertrain Diagnostic Procedures manual are required. The SKIM cannot be repaired and, if faulty or damaged, the unit must be replaced.

DIAGNOSIS AND TESTING

VEHICLE THEFT SECURITY SYSTEM

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, REFER TO RESTRAINT SYSTEMS BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

NOTE: The most reliable, efficient, and accurate means to diagnose the Vehicle Theft Security System (VTSS) and Sentry Key Immobilizer System (SKIS) involves the use of a DRBIII® scan tool and the proper Powertrain Diagnostic Procedures manual.

The Vehicle Theft Security System (VTSS), Sentry Key Immobilizer System (SKIS) and the Programmable Communication Interface (PCI) bus network should be diagnosed using a DRBIII® scan tool. The DRBIII® will allow confirmation that the PCI bus is functional, that the Sentry Key Immobilizer Module (SKIM) is placing the proper messages on the PCI bus, and that the Powertrain Control Module (PCM) and the Instrument Cluster are receiving the PCI bus messages. Refer to the proper Powertrain or Body Diagnostic Procedures manual.

Visually inspect the related wiring harness connectors. Look for broken, bent, pushed out or corroded terminals. If any of the conditions are present, repair as necessary. Refer to Wiring Diagrams for complete circuit descriptions and diagrams. Refer to (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/SENTRY KEY IMMOBILIZER MODULE - REMOVAL) for SKIM replacement.

STANDARD PROCEDURE

CONFIGURING A NEW MODULE / SWITCH OPERATING MODES

To configure a new module or to switch operating modes, a DRBIII® scan tool must be used.

(1) Hook up the DRBIII® scan tool to the Data Link Connector (DLC).

(2) With the key in the ignition, turn the key to the RUN position.

(3) After the DRBIII® scan tool initialization, perform the following:

- (a) Select "Theft Alarm."
- (b) Select "VTSS."
- (c) Select "Miscellaneous."

(4) Once in the "Miscellaneous" screen:

- (a) If you wish to configure a new module, select "Configure Module."
- (b) If you wish to put the module into customer usage mode, select "Enable VTSS."
- (c) If you wish to put the module into dealer lot mode, select "Dealer Lot."

SENTRY KEY IMMOBILIZER SYSTEM INITIALIZATION

The Sentry Key Immobilizer System (SKIS) initialization should be performed following a Sentry Key Immobilizer Module (SKIM) replacement.

It can be summarized by the following:

(1) Obtain the vehicles unique PIN number assigned to it's original SKIM from the vehicle owner, the vehicle's invoice or from Chrysler's Customer Center.

(2) With the DRBIII® scan tool, select "Theft Alarm," "SKIM," Miscellaneous." Select "SKIM Module Replaced" function and the DRBIII® will prompt you through the following steps.

(3) Enter secured access mode using the unique four digit PIN number.

(4) Program the vehicle's VIN number into the SKIM's memory.

(5) Program the country code into the SKIM's memory (U.S.).

(6) Transfer the vehicle's unique Secret Key data from the PCM. This process will require the SKIM to be in **secured access mode**. The PIN number must be entered into the DRBIII® before the SKIM will enter **secured access mode**. Once **secured access mode** is active, the SKIM will remain in that mode for 60 seconds.

(7) Program all customer keys into the SKIM's memory. This required that the SKIM be in **secured access mode** The SKIM will immediately exit **secured access mode** after each key is programmed.

VEHICLE THEFT SECURITY (Continued)

NOTE: If a PCM is replaced, the unique "Secret Key" data must be transferred from the SKIM to the PCM. This procedure requires the SKIM to be placed in SECURED ACCESS MODE using the four digit PIN code.

SENTRY KEY IMMOBILIZER SYSTEM TRANSPONDER PROGRAMMING

Two programmed Sentry Key transponders are included with the Sentry Key Immobilizer System (SKIS) when it is shipped from the factory. The Sentry Key Immobilizer Module (SKIM) can be programmed to recognize up to six additional transponders, for a total of eight Sentry Keys. The following "Customer Learn" programming procedure for the programming of additional transponders requires access to at least two of the valid Sentry Keys. If two valid Sentry Keys are not available, Sentry Key programming will require the use of a DRBIII® scan tool.

CUSTOMER LEARN PROGRAMMING

(1) Obtain the additional Sentry Key transponder blank(s) that are to be programmed for the vehicle. Cut the additional Sentry Key transponder blanks to match the ignition lock cylinder mechanical key codes.

(2) Insert one of the two valid Sentry Key transponders into the ignition switch and turn the ignition switch to the ON position.

(3) After the ignition switch has been in the ON position for about three seconds, but no more than fifteen seconds, cycle the ignition switch back to the OFF position. Replace the first valid Sentry Key in the ignition lock cylinder with the second valid Sentry Key and turn the ignition switch back to the ON position. Both operations must be performed within 15 seconds.

(4) In approximately ten seconds the VTSS indicator LED will start to flash to indicate that the system has entered the "Customer Learn" programming mode.

(5) Within approximately sixty seconds of entering the "Customer Learn" programming mode, turn the ignition switch to the OFF position, replace the valid Sentry Key with a blank Sentry Key transponder, and turn the ignition switch back to the ON position.

(6) In approximately ten seconds, the VTSS indicator LED will stop flashing and stay on solid for approximately three seconds and then turn OFF to indicate that the blank Sentry Key transponder has been successfully programmed. The SKIS will immediately return to normal system operation following exit from the "Customer Learn" programming mode.

(7) Repeat this process for each additional Sentry Key transponder blank to be programmed.

If any of the above steps is not completed in the proper sequence, or within the allotted time, the SKIS will automatically exit the "Customer Learn" programming mode. The SKIS will also automatically exit the "Customer Learn" programming mode if it sees a non-blank Sentry Key transponder when it should see a blank, if it has already programmed eight valid Sentry Keys, or if the ignition switch is turned to the OFF position for more than about fifty seconds.

NOTE: While in Customer Learn mode (LED flashing), the engine will not START and RUN.

PROGRAMMING BLANK SENTRY KEY TRANSPONDERS WITH A DRBIII® SCAN TOOL

When programming a blank Sentry Key transponder, the key blank must first be cut to match the ignition lock cylinder. It will also be necessary to enter the vehicle's four digit PIN code into the DRBIII® scan tool to enter the Sentry Key Immobilizer Module's (SKIM's) secured access mode.

NOTE: Once a Sentry Key is programmed to a particular vehicle, it cannot be transferred to another vehicle.

Insert the blank key into the ignition and turn it to the RUN position. Using the DRBIII® scan tool, select "Theft Alarm," then "SKIM," then "Miscellaneous." Select "Program New Key." Enter the four digit PIN code using the DRBIII®. When programming is completed, the SKIM will exit secured access mode and the DRBIII® will display the status of the key. One of five different status messages may be displayed as follows:

- "Programming Successful" is displayed if SKIM Sentry Key programming succeeds.
- "Learned Key in Ignition" is displayed if the key in the ignition has already been programmed into that vehicle's SKIM.
- "8 Keys Already Learned (At The Maximum) Programming Not Done" is displayed if eight keys have already been programmed into the SKIM. In this case, if a new key needs to be added due to a lost or defective key, the "Erase All Keys" function (requires entering secured access mode) has to be performed. Then the customer's seven keys plus the new key MUST be reprogrammed into the SKIM.
- "Programming Not Attempted" is displayed after an "Erase All Keys" function is executed.
- "Programming Key Failed" is displayed if further diagnosis is required.

VEHICLE THEFT SECURITY (Continued)

- To learn additional keys, turn the ignition OFF, remove the learned key, and insert the next new blank key. Turn ignition to the RUN position and re-enter the secured access mode function and repeat the “Program New Key” procedure outlined above.

SENTRY KEY IMMOBILIZER SYSTEM INDICATOR LAMP

DESCRIPTION

The Sentry Key Immobilizer System (SKIS) uses the Vehicle Theft Security System (VTSS) indicator in the instrument cluster to give an indication when the SKIS is faulty or when the vehicle has been immobilized due to the use of an invalid key. The indicator is controlled by the instrument cluster based upon messages received from the Sentry Key Immobilizer Module (SKIM).

OPERATION

The SKIM sends PCI Bus messages to the instrument cluster, to turn on the ’Security” indicator for about 3 seconds when the ignition is turned to the ON position, as a “Bulb” test. After completion of the “Bulb” test, the SKIM sends a PCI bus messages to keep the LED off for 1 second. Then the SKIM sends messages to the instrument cluster to turn the LED off based upon the results if the SKIS self - test. If the indicator illuminates and remains illuminated after the “bulb test”, it indicates that the SKIM has detected a system malfunction and/or the system has become inoperative. If the SKIM detects a invalid key when the ignition switch is turned on, it sends a message to the instrument cluster to flash the “Security” indicator.

The SKIM can also send messages to the cluster to flash the LED and generate a chime. These functions serve as an indication to the customer that the SKIM is in the **Customer Learn** programming mode. See Sentry Key Immobilizer System Transponder Programming in this group for more information on the “Customer Learn” programming Mode.

If the VTSS indicator remains on after the “Bulb” test, the system should be diagnosed using the DRBIII® scan tool and the proper Powertrain Diagnostic Procedures manual.

WIPERS/WASHERS

TABLE OF CONTENTS

WIPERS/WASHERS

DESCRIPTION

An electrically operated intermittent wiper and washer system is standard factory-installed safety equipment on this model (Fig. 1). The wiper and washer system includes the following major components, which are described in further detail elsewhere in this service information:

- **Check Valve** - The washer system check valve is integral to the wye fitting located in the washer plumbing between the cowl plenum washer hose and the washer nozzles, and is concealed beneath the cowl plenum cover/grille panel at the base of the windshield.
- **Front Control Module** - The Front Control Module (FCM) is integral to the Integrated Power Module (IPM). The IPM is located in the engine compartment, near the battery. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - DESCRIPTION).

WIPERS/WASHERS (Continued)

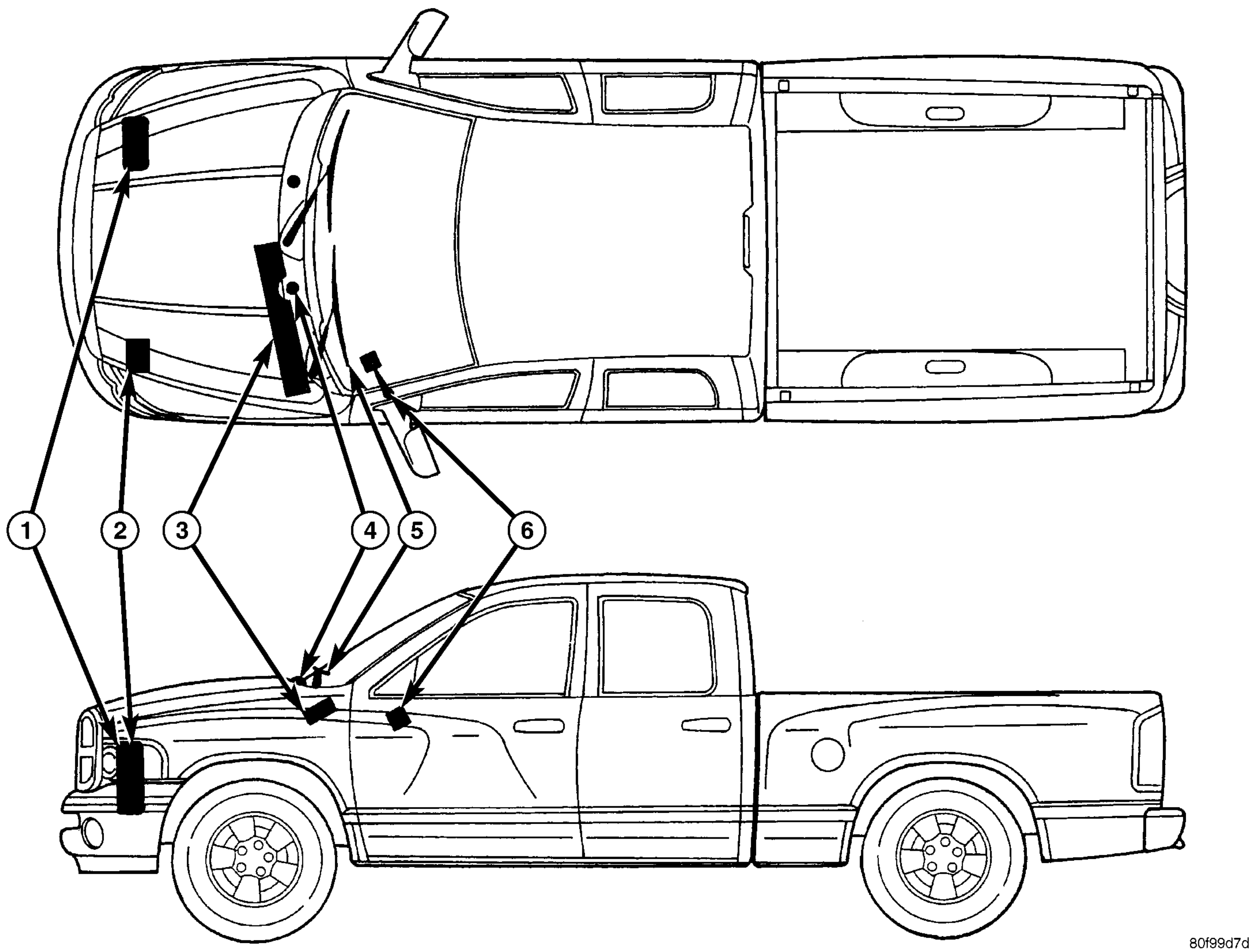


Fig. 1 Wiper & Washer System

1 - WASHER RESERVOIR, PUMP/MOTOR, FLUID LEVEL SWITCH (EXCEPT V-10 & DIESEL ENGINE)
2 - WASHER RESERVOIR, PUMP/MOTOR, FLUID LEVEL SWITCH (V-10 & DIESEL ENGINE ONLY)
3 - WIPER MODULE
4 - WASHER NOZZLE (2)
5 - WIPER ARM & BLADE (2)
6 - MULTI-FUNCTION (WIPER, WASHER, & LIGHTING) SWITCH

- **Instrument Cluster -** In this model, the instrument cluster is also sometimes referred to as the Cab Control Node (CCN). The instrument cluster is located in the instrument panel above the steering column opening, directly in front of the driver. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DESCRIPTION).
- **Multi-Function Switch** - The multi-function switch is located on the top of the steering column, just below the steering wheel. The multi-function switch includes a control stalk that extends through an opening on the left side of the steering column shrouds and a control knob on the end of the stalk is dedicated to providing all of the driver controls for the wiper and washer systems. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DESCRIPTION).
- **Washer Fluid Level Switch -** The washer fluid level switch is located in a dedicated hole on the outboard side of the washer reservoir in the engine compartment.
- **Washer Nozzle -** Two fluidic washer nozzles are secured with integral snap features to dedicated openings in the cowl plenum cover/grille panel located near the base of the windshield.
- **Washer Plumbing** - The plumbing for the washer system consists of rubber hoses and molded plastic fittings. The plumbing is routed along the right side of the engine compartment from the washer reservoir, and through a trough near the right end of the cowl plenum cover/grille panel into the cowl plenum to the washer nozzle fittings.

WIPERS/WASHERS (Continued)

- **Washer Pump/Motor** - The electric washer pump/motor unit is located in a dedicated hole on the rearward facing surface of the washer reservoir in the engine compartment.
- **Washer Reservoir** - On all models except those with an optional V-10 or diesel engine, the washer reservoir is secured by integral mounting tabs and a snap feature to slots in the right side of the cooling module shroud in the engine compartment. On models with an optional V-10 or diesel engine, the washer reservoir is secured by screws to the back of the upright left vertical member of the radiator support in the engine compartment. The washer reservoir filler neck is accessed from the engine compartment.
- **Wiper Arm** - The two wiper arms are secured with integral latches to the serrated ends of the two wiper pivot shafts, which extend through the cowl plenum cover/grille panel located near the base of the windshield.
- **Wiper Blade** - The two wiper blades are secured to the two wiper arms with an integral latch, and are parked on the glass near the bottom of the windshield when the wiper system is not in operation.
- **Wiper High/Low Relay** - The wiper high/low relay is an International Standards Organization (ISO) micro relay located in the Integrated Power Module (IPM) in the engine compartment near the battery.
- **Wiper Module** - The wiper pivot shafts are the only visible components of the wiper module. The remainder of the module is concealed within the cowl plenum area beneath the cowl plenum cover/grille panel. The wiper module includes the wiper module bracket, four rubber-isolated wiper module mounts, the wiper motor, the wiper motor crank arm, the two wiper drive links, and the two wiper pivots.
- **Wiper On/Off Relay** - The wiper on/off relay is an International Standards Organization (ISO) micro relay located in the Integrated Power Module (IPM) in the engine compartment near the battery.

Hard wired circuitry connects the wiper and washer system components to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the wiper and washer system components through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

OPERATING MODES

The components of the wiper and washer system are designed to work in concert to provide the following operating modes:

- **Continuous Wipe Mode** - The control knob on the control stalk of the multi-function switch has two continuous wipe positions, Low and High. When selected, these switch positions will cause the two-speed wiper motor to operate in a continuous low or high speed cycle.
- **Intermittent Wipe Mode** - The control knob on the control stalk of the multi-function switch has five minor detent intermittent wipe positions. When selected, these switch positions will cause the wiper system to operate with one of five delay intervals between complete wipe cycles. The intermittent wipe delay intervals are speed sensitive and will be doubled when the vehicle speed is about sixteen kilometers-per-hour (ten miles-per-hour) or less.
- **Pulse Wipe Mode** - When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for less than about one-half second, the wiper system will operate the wipers for one complete low speed cycle, then will park the wiper blades near the base of the windshield.
- **Washer Mode** - When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for more than about one-half second with the wiper system turned Off, the washer pump/motor and the wipers will operate for as long as the washer switch is held closed up to about thirty seconds, then the wipe-after-wash mode is invoked when the control knob is released. When the Wash position is selected with the wiper system operating in a continuous wipe mode, washer fluid will be dispensed onto the windshield glass through the washer nozzles for as long as the washer switch is held closed up to about thirty seconds. When the Wash position is selected with the wiper system operating in an intermittent wipe mode, washer fluid is still dispensed until the control knob is released; however, the wipers will operate in a low speed continuous cycle from the time the washer switch is closed until several wipe cycles after the switch is released, before returning to the selected intermittent wipe interval. If the control knob is held in the depressed Wash position for more than about thirty seconds, washer system operation will be suspended until the control knob is released for about two seconds then cycled back to the Wash position.

WIPERS/WASHERS (Continued)

- **Wipe-After-Wash Mode** - When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for more than about one-half second with the wiper system turned Off, the washer pump/motor and the wipers will operate for as long as the washer switch is held closed up to about thirty seconds, then provide several additional wipe cycles after the control knob is released before parking the wiper blades near the base of the windshield. If the control knob is held in the depressed Wash position for more than about thirty seconds, washer system operation will be suspended until the control knob is released for about two seconds then cycled back to the Wash position.

OPERATION

The wiper and washer system is designed to provide the vehicle operator with a convenient, safe, and reliable means of maintaining visibility through the windshield glass. The various components of this system are designed to convert electrical energy produced by the vehicle electrical system into the mechanical action of the wiper blades to wipe the outside surface of the glass, as well as into the hydraulic action of the washer system to apply washer fluid stored in an on-board reservoir to the area of the glass to be wiped. When combined, these components provide the means to effectively maintain clear visibility for the vehicle operator by removing excess accumulations of rain, snow, bugs, mud, or other minor debris from the outside windshield glass surface that might be encountered while driving the vehicle under numerous types of inclement operating conditions.

The vehicle operator initiates all wiper and washer system functions with the control knob on the end of the control stalk of the multi-function switch that extends from the left side of the steering column, just below the steering wheel. Rotating the control knob on the end of the control stalk, selects the Off, Delay, Low, or High wiper system operating modes. In the Delay mode, the control knob also allows the vehicle operator to select from one of five intermittent wipe Delay intervals. Depressing the control knob towards the steering column actuates the momentary washer system switch, which selects the Wash, Wipe-After-Wash, and Pulse Wipe Modes depending upon when and how long the switch is held closed. The multi-function switch provides hard wired resistor multiplexed inputs to the instrument cluster for all of the wiper and washer system functions. The instrument cluster then sends electronic messages to the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus requesting the appropriate wiper and washer system operating modes.

Wiper and washer system operation are completely controlled by the instrument cluster and FCM logic circuits, and that logic will only allow these systems to operate when the ignition switch is in the Accessory or On positions. Battery current is directed from a B(+) fuse in the Integrated Power Module (IPM) to the wiper on/off relay and the wiper high/low relay in the IPM through a fused B(+) circuit. The FCM uses low side drivers to control wiper system operation by energizing or de-energizing the wiper high/low and wiper on/off relays. The FCM uses a high side driver to control the operation of the washer pump motor unit. The multi-function switch circuitry receives a clean ground output from the instrument cluster on a multi-function switch return circuit, then provides resistor multiplexed inputs to the instrument cluster on an intermittent wipe mux circuit to indicate the selected wiper system mode and on a wash/beam select mux circuit to indicate the selected washer system mode.

The hard wired circuits and components of the wiper and washer system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the FCM, or the electronic message inputs to or outputs from the instrument cluster or FCM that control the wiper and washer system operating modes. The most reliable, efficient, and accurate means to diagnose the instrument cluster or the FCM inputs and outputs related to the various wiper and washer system operating modes requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

OPERATING MODES

Following are paragraphs that briefly describe the operation of each of the wiper and washer system operating modes.

CONTINUOUS WIPE MODE

When the Low position of the control knob on the control stalk of the multi-function switch is selected the instrument cluster sends an electronic wiper switch low message to the FCM, then the FCM energizes the wiper on/off relay. This directs battery current through the normally open contacts of the energized wiper on/off relay and the normally closed contacts of the de-energized wiper high/low relay to the low speed brush of the wiper motor, causing the wipers to cycle at low speed.

When the High position of the control knob is selected the instrument cluster sends an electronic wiper switch high message to the FCM, then the FCM energizes both the wiper on/off relay and the wiper high/low relay. This directs battery current

WIPERS/WASHERS (Continued)

through the normally open contacts of the energized wiper on/off relay and the normally open contacts of the energized wiper high/low relay to the high speed brush of the wiper motor, causing the wipers to cycle at high speed.

When the Off position of the multi-function switch control knob is selected, the instrument cluster sends an electronic wiper switch off message to the FCM. If the wiper motor was operating at high speed, the FCM immediately de-energizes the wiper high/low relay causing the wiper motor to return to low speed operation. Then one of two events will occur. The event that occurs depends upon the position of the wiper blades on the windshield at the moment that the control knob Off position is selected.

If the wiper blades are in the down position on the windshield when the Off position is selected, the park switch that is integral to the wiper motor is closed to ground and provides a hard wired park switch sense input to the FCM. The FCM then de-energizes the wiper on/off relay and the wiper motor ceases to operate. If the wiper blades are not in the down position on the windshield at the moment the Off position is selected, the park switch is an open circuit and the FCM keeps the wiper on/off relay energized, which causes the wiper motor to continue running at low speed until the wiper blades are in the down position on the windshield and the park switch input to the FCM is again closed to ground.

INTERMITTENT WIPE MODE

When the control knob on the control stalk of the multi-function switch is moved to one of the Delay interval positions the instrument cluster sends an electronic wiper switch delay message to the FCM, then the FCM electronic intermittent wipe logic circuit responds by calculating the correct length of time between wiper sweeps based upon the selected delay interval input. The FCM monitors the changing state of the wiper motor park switch through a hard wired park switch sense input. This input allows the FCM to determine the proper intervals at which to energize and de-energize the wiper on/off relay to operate the wiper motor intermittently for one low speed cycle at a time.

The FCM logic is also programmed to provide vehicle speed sensitivity to the selected intermittent wipe delay intervals. In order to provide this feature the FCM monitors electronic vehicle speed messages from the Powertrain Control Module (PCM) and doubles the selected delay interval whenever the vehicle speed is about sixteen kilometers-per-hour (ten miles-per-hour) or less.

PULSE WIPE MODE

When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for less than about one-half second, the instrument cluster sends an electronic washer switch message to the FCM, then the FCM the energizes the wiper on/off relay for one complete wipe cycle. The FCM de-energizes the relay when the state of the park switch sense changes to ground, parking the wiper blades near the base of the windshield.

WASH MODE

When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for more than about one-half second, the instrument cluster sends an electronic washer switch message to the FCM, then the FCM directs battery current to the washer pump/motor unit. This will cause the washer pump/motor unit to be energized for as long as the Wash switch is held closed up to about thirty seconds, and to de-energize when the front Wash switch is released.

When the control knob is depressed to the momentary Wash position while the wiper system is operating in one of the Delay interval positions, the washer pump/motor operation is the same. However, the FCM also energizes the wiper on/off relay to override the selected delay interval and operate the wiper motor in a continuous low speed mode for as long as the control knob is held depressed, then de-energizes the relay and reverts to the selected delay mode interval several wipe cycles after the control knob is released. If the control knob is held depressed for more than about thirty seconds, the FCM will suspend washer pump/motor operation until the knob is released for about two seconds, then cycled back to the Wash position.

WIPE-AFTER-WASH MODE

When the control knob on the control stalk of the multi-function switch is depressed to the momentary Wash position for more than about one-half second while the wiper system is not operating, the instrument cluster sends an electronic washer switch message to the FCM, then the FCM the directs battery current to the washer pump/motor unit and energizes the wiper on/off relay. This will cause the washer pump/motor unit to be energized and operate the wiper motor in a continuous low speed mode for as long as the Wash switch is held closed up to about thirty seconds. When the control knob is released, the FCM de-energizes the washer pump/motor unit, but allows the wiper motor to operate for several additional wipe cycles before it de-energizes the wiper on/off relay and parks the wiper blades near the base of the windshield.

WIPERS/WASHERS (Continued)

If the control knob is held depressed for more than about thirty seconds, the FCM will suspend washer pump/motor operation until the knob is released for about two seconds, then cycled back to the Wash position; however, the wipers will continue to operate for as long as the Wash switch is held closed. The FCM monitors the changing state of the wiper motor park switch through a hard wired wiper park switch sense circuit input. This input allows the FCM to count the number of wipe cycles that occur after the Wash switch is released, and to determine the proper interval at which to de-energize the wiper on/off relay to complete the wipe-after-wash mode cycle.

DIAGNOSIS AND TESTING - WIPER & WASHER SYSTEM

If the wiper motor operates, but the wipers do not move on the windshield, replace the faulty wiper module. If the washer pump/motor operates, but no washer fluid is dispensed on the glass; or, if the wipers operate, but chatter, lift, or do not clear the glass, clean and inspect the wiper and washer system components as required. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - CLEANING) and (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - INSPECTION). For diagnosis and testing of the multi-function switch (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/MULTI-FUNCTION SWITCH - DIAGNOSIS AND TESTING). Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

The hard wired circuits and components of the wiper and washer system may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the Front Control Module (FCM), or the electronic message inputs to or outputs from the instrument cluster and the FCM that control the various wiper and washer system operating modes. The most reliable, efficient, and accurate means to diagnose the instrument cluster, the FCM, or the electronic message inputs and outputs related to the various wiper and washer system operating modes requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CLEANING - WIPER & WASHER SYSTEM

WIPER SYSTEM

The squeegees of wiper blades exposed to the elements for a long time tend to lose their wiping effectiveness. Periodic cleaning of the squeegees is suggested to remove any deposits of salt or road film. The wiper blades, arms, and windshield glass should only be cleaned using a sponge or soft cloth and windshield washer fluid, a mild detergent, or a non-abrasive cleaner. If the wiper blades continue to leave streaks, smears, hazing, or beading on the glass after thorough cleaning of the squeegees and the glass, the entire wiper blade assembly must be replaced.

CAUTION: Protect the rubber squeegees of the wiper blades from any petroleum-based cleaners, solvents, or contaminants. These products can rapidly deteriorate the rubber squeegees.

WASHER SYSTEM

If the washer system is contaminated with foreign material, drain the washer reservoir by removing the washer pump/motor from the reservoir. Clean foreign material from the inside of the washer pump/motor inlet filter screen and the washer reservoir using clean washer fluid, a mild detergent, or a non-abrasive cleaner. Flush foreign material from the washer system plumbing by first disconnecting the washer hoses from the washer nozzles, then running the washer pump/motor to run clean washer fluid or water through the system. Plugged or restricted washer nozzles should be carefully back-flushed using compressed air. If the washer nozzle obstruction cannot be cleared, replace the washer nozzle.

CAUTION: Never introduce petroleum-based cleaners, solvents, or contaminants into the washer system. These products can rapidly deteriorate the rubber seals and hoses of the washer system, as well as the rubber squeegees of the wiper blades.

WIPERS/WASHERS (Continued)

CAUTION: Never use compressed air to flush the washer system plumbing. Compressed air pressures are too great for the washer system plumbing components and will result in further system damage. Never use sharp instruments to clear a plugged washer nozzle or damage to the nozzle orifice and improper nozzle spray patterns will result.

INSPECTION - WIPER & WASHER SYSTEM

WIPER SYSTEM

The wiper blades and wiper arms should be inspected periodically, not just when wiper performance problems are experienced. This inspection should include the following points:

(1) Inspect the wiper arms for any indications of damage, or contamination. If the wiper arms are contaminated with any foreign material, clean them as required. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - CLEANING). If a wiper arm is damaged or corrosion is evident, replace the wiper arm with a new unit. Do not attempt to repair a wiper arm that is damaged or corroded.

(2) Carefully lift the wiper blade off of the glass. Note the action of the wiper arm hinge. The wiper arm should pivot freely at the hinge, but with no lateral looseness evident. If there is any binding evident in the wiper arm hinge, or there is evident lateral play in the wiper arm hinge, replace the wiper arm.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(3) Once proper hinge action of the wiper arm is confirmed, check the hinge for proper spring tension. Remove the wiper blade from the wiper arm. Either place a small postal scale between the blade end of the wiper arm and the glass, or carefully lift the blade end of the arm away from the glass using a small fish scale. Compare the scale readings between the right and left wiper arms. Replace a wiper arm if it has comparatively lower spring tension, as evidenced by a lower scale reading.

(4) Inspect the wiper blades and squeegees for any indications of damage, contamination, or rubber deterioration (Fig. 2). If the wiper blades or squeegees are contaminated with any foreign material, clean them and the glass as required. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - CLEANING). After cleaning the wiper blade and the glass, if the wiper blade still fails to clear the glass without smearing, streaking, chattering, hazing, or beading, replace the wiper blade. Also, if a wiper blade is damaged or the squeegee rubber is damaged or deteriorated, replace the wiper blade with a new unit. Do not attempt to repair a wiper blade that is damaged.

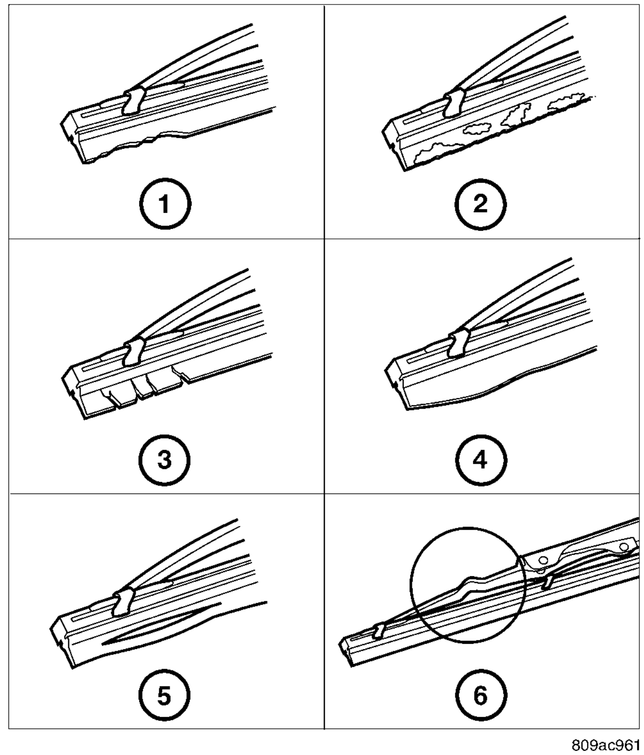


Fig. 2 Wiper Blade Inspection

1 - WORN OR UNEVEN EDGES
2 - ROAD FILM OR FOREIGN MATERIAL DEPOSITS
3 - HARD, BRITTLE, OR CRACKED
4 - DEFORMED OR FATIGUED
5 - SPLIT
6 - DAMAGED SUPPORT COMPONENTS

WASHER SYSTEM

The washer system components should be inspected periodically, not just when washer performance problems are experienced. This inspection should include the following points:

(1) Check for ice or other foreign material in the washer reservoir. If contaminated, clean and flush the washer system. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - CLEANING).

(2) Inspect the washer plumbing for pinched, leaking, deteriorated, or incorrectly routed hoses and damaged or disconnected hose fittings. Replace damaged or deteriorated hoses and hose fittings. Leaking washer hoses can sometimes be repaired by cutting the hose at the leak and splicing it back together using an in-line connector fitting. Similarly, sections of deteriorated hose can be cut out and replaced by splicing in new sections of hose using in-line connector fittings. Whenever routing a washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts. Also, sharp bends that might pinch the washer hose must be avoided.

CHECK VALVE

DESCRIPTION

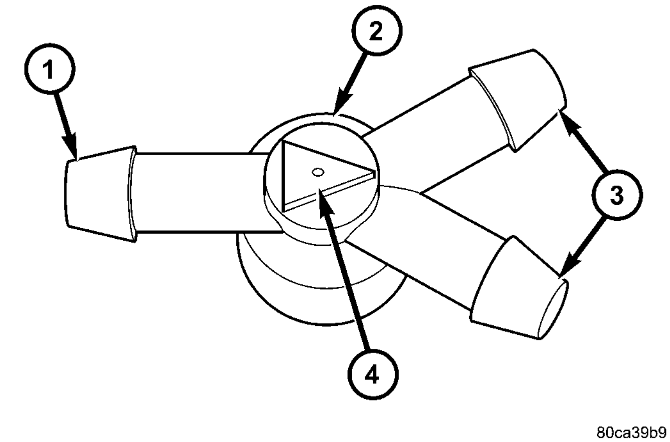


Fig. 3 Check Valve

1 - INLET NIPPLE
2 - CHECK VALVE
3 - OUTLET NIPPLE (2)
4 - FLOW DIRECTION ARROW

A single washer system check valve is standard equipment on this model, and is installed in the washer system plumbing (Fig. 3). The check valve is integral to the washer nozzle plumbing wye fitting located in the cowl plenum area beneath the cowl plenum cover/grille panel near the base of the windshield. The check valve consists of a molded plastic body with a raised arrowhead molded into its center section that indicates the direction of the flow through the valve, and three barbed hose nipples formed in a wye configuration on the outside circumference of the center section of the valve body. The check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The check valve provides more than one function in this application. It serves as a wye connector fitting between the engine compartment and washer nozzle sections of the washer supply hose. It prevents washer fluid from draining out of the washer supply hoses back to the washer reservoir. This drain-back would result in a lengthy delay from when the washer switch is actuated until washer fluid was dispensed through the washer nozzles, because the washer pump would have to refill the washer plumbing from the reservoir to the nozzles. Such a drain-back condition could also result in water, dirt, or other outside contaminants being siphoned into the washer system through the washer nozzle orifice. This water could subsequently freeze and plug the nozzle, while other contaminants could interfere with proper nozzle operation and cause improper nozzle spray patterns. In addition, the check valve prevents washer fluid from siphoning through the washer nozzles after the washer system is turned Off.

When the washer pump pressurizes and pumps washer fluid from the reservoir through the washer plumbing, the fluid pressure unseats a diaphragm from over a sump well within the valve by overriding the spring pressure applied to it by a piston (Fig. 4). With the diaphragm unseated, washer fluid is allowed to flow toward the two washer nozzles. When the washer pump stops operating, the spring pressure on the piston seats the diaphragm over the sump well in the valve and fluid flow in either direction within the washer plumbing is prevented. The check valve cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

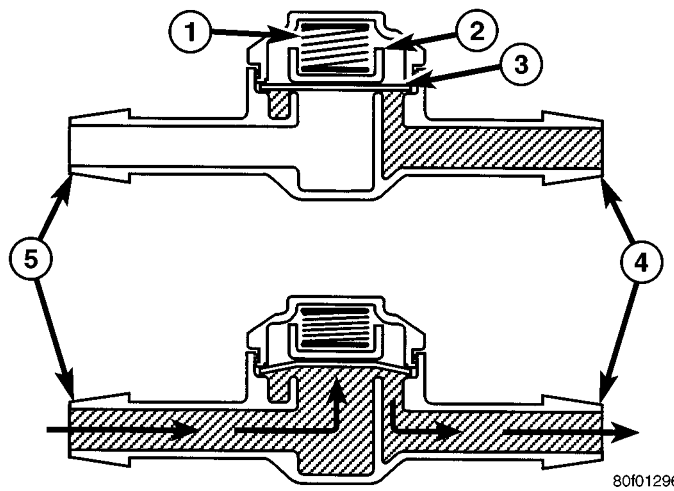


Fig. 4 Check Valve

1 - SPRING
2 - PISTON
3 - DIAPHRAGM
4 - TO WASHER NOZZLE
5 - FROM WASHER PUMP

REMOVAL

(1) Remove both wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARM - REMOVAL).

(2) Unlatch and open the hood.

(3) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(4) From the underside of the cowl plenum cover/grille panel, disconnect the cowl plenum and washer nozzle hoses from the three barbed nipples of the check valve (Fig. 5).

(5) Remove the check valve from the underside of the cowl plenum cover/grille panel.

CHECK VALVE (Continued)

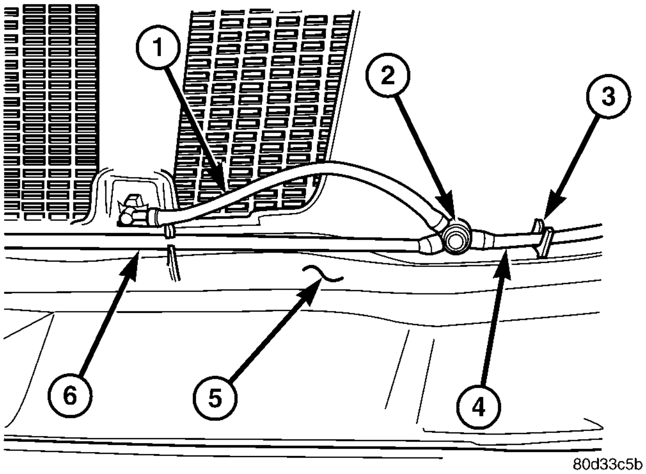


Fig. 5 Check Valve Remove/Install

1 - WASHER NOZZLE HOSE (RIGHT)
2 - CHECK VALVE
3 - ROUTING CLIP
4 - COWL PLENUM WASHER HOSE
5 - COWL PLENUM COVER/GRILLE PANEL (UNDERSIDE)
6 - WASHER NOZZLE HOSE (LEFT)

INSTALLATION

(1) Position the check valve to the underside of the cowl plenum cover/grille panel (Fig. 5). Be certain that the flow direction arrow molded into the check valve body is oriented towards the washer nozzles.

(2) From the underside of the cowl plenum cover/ grille panel, reconnect the cowl plenum and washer nozzle hoses to the three barbed nipples of the check valve.

(3) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(4) Close and latch the hood.

(5) Reinstall both wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/ WIPER ARM - INSTALLATION).

WASHER FLUID LEVEL SWITCH

DESCRIPTION

The washer fluid level switch is a single pole, single throw reed-type switch mounted on the outboard side of the of the washer reservoir in the engine compartment (Fig. 6). Only the molded plastic switch mounting flange and the integral connector receptacle are visible when the switch is installed in the reservoir. A short nipple formation extends from the inner surface of the switch mounting flange, and a barb on the nipple near the switch mounting flange is pressed through a rubber grommet seal installed in the mounting hole of the reservoir.

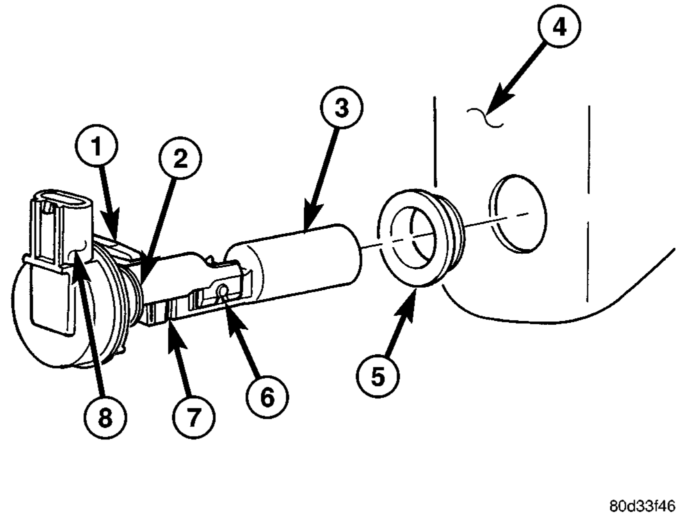


Fig. 6 Washer Fluid Level Switch

1 - MOUNTING FLANGE
2 - BARBED NIPPLE
3 - FLOAT
4 - RESERVOIR
5 - GROMMET SEAL
6 - PIVOT
7 - MAGNET
8 - CONNECTOR RECEPTACLE

A small, molded plastic float has two pivot pins near its center that are snapped into two receptacles near the ends of two stanchions that extend toward the float from the switch nipple formation. A small magnet is secured within the end of the float nearest the switch nipple formation, and a reed switch is concealed within the nipple. A diagnostic resistor is connected between the two switch terminals within the switch mounting flange. The washer fluid level switch cannot be adjusted or repaired. If faulty or damaged, the switch must be replaced.

OPERATION

The washer fluid level switch uses a pivoting, oblong float to monitor the level of the washer fluid in the washer reservoir. The float contains a small magnet. When the float pivots, the proximity of this magnet to a stationary reed switch within the nipple formation of the switch changes. When the fluid level in the washer reservoir is at or above the float level, the float moves to a vertical position, the influence of the float magnetic field is removed from the reed switch, and the normally open reed switch contacts open. When the fluid level in the washer reservoir falls below the level of the pivoting float, the float moves to a horizontal position, the influence of the float magnetic field is applied to the reed switch, and the contacts of the normally open reed switch close.

WASHER FLUID LEVEL SWITCH (Continued)

The washer fluid level switch is connected to the vehicle electrical system through a dedicated take out and connector of the right (except V-10 and diesel engines) or left (V-10 and diesel engines only) headlamp and dash wire harness. The switch is connected in series between a clean ground output of the Front Control Module (FCM) on a sensor return circuit and the washer fluid switch sense input to the FCM. When the switch closes, the FMC senses the ground on the washer fluid switch sense circuit. The FMC is programmed to respond to this input by sending an electronic washer fluid indicator lamp-on message to the instrument cluster over the Programmable Communications Interface (PCI) data bus. The instrument cluster responds to this message by illuminating the washer fluid indicator and by sounding an audible chime tone warning.

The washer fluid level switch may be diagnosed and tested using conventional diagnostic tools and procedures. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the Front Control Module (FCM), or the electronic message inputs to or outputs from the instrument cluster and the FCM that control the operation of the washer fluid visual and/or audible indicators. The most reliable, efficient, and accurate means to diagnose the washer fluid level indicator, the instrument cluster, the FCM, or the electronic message inputs and outputs related to the washer fluid indicator requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

The washer fluid level switch can be removed from the washer reservoir without removing the reservoir from the vehicle.

(1) Unlatch and open the hood.

(2) Disconnect and isolate the battery negative cable.

(3) Disconnect the washer hose from the barbed outlet nipple of the washer pump/motor unit and allow the washer fluid to drain into a clean container for reuse.

(4) Disconnect the right (except V-10 and diesel engine) or left (V-10 and diesel engine only) headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle (Fig. 7) or (Fig. 8).

NOTE: The pivoting float of the washer fluid level switch must be in a horizontal position within the reservoir in order to be removed. With the reservoir empty and in an upright position, the pivoting float will orient itself to the horizontal position when the switch connector receptacle is pointed straight upwards.

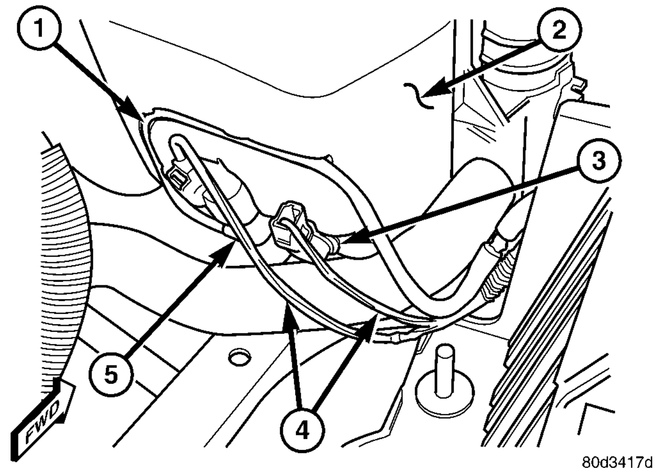


Fig. 7 Washer Fluid Level Switch Remove/Install - Except V-10 & Diesel Engine

1 - WASHER HOSE
2 - WASHER RESERVOIR
3 - WASHER FLUID LEVEL SWITCH
4 - WIRE HARNESS
5 - WASHER PUMP/MOTOR

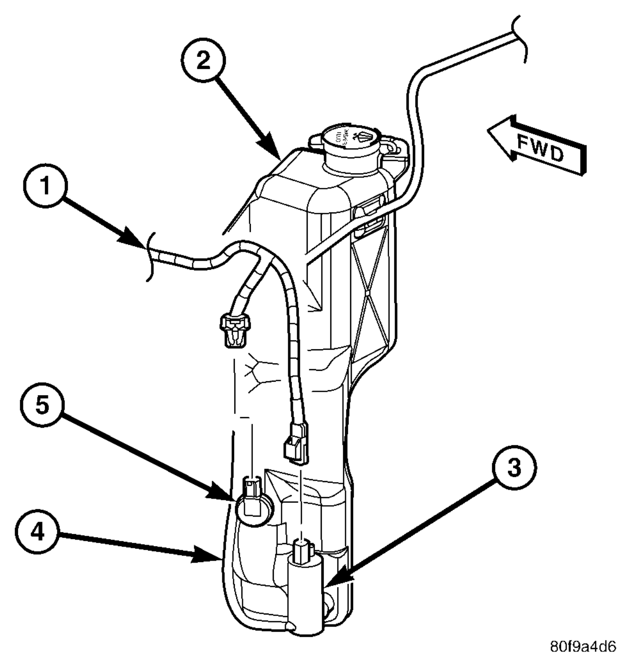


Fig. 8 Washer Fluid Level Switch Remove/Install - V-10 & Diesel Engine

1 - WIRE HARNESS
2 - WASHER RESERVOIR
3 - WASHER PUMP/MOTOR
4 - WASHER HOSE
5 - WASHER FLUID LEVEL SWITCH

(5) Using a trim stick or another suitable wide flat-bladed tool, gently pry the barbed nipple of the washer fluid level switch out of the rubber grommet seal on the reservoir sump. Care must be taken not to damage the reservoir.

WASHER FLUID LEVEL SWITCH (Continued)

(6) Remove the washer fluid level switch from the washer reservoir.

(7) Remove the rubber grommet seal from the washer fluid level switch mounting hole in the washer reservoir and discard.

INSTALLATION

(1) Install a new rubber grommet seal into the washer fluid level switch mounting hole in the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Insert the float of the washer fluid level switch through the rubber grommet seal and into the washer reservoir. The connector receptacle of the washer fluid level switch should be pointed upward.

(3) Using hand pressure, press firmly and evenly on the washer fluid level switch mounting flange until the barbed nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.

(4) Reconnect the right (except V-10 and diesel engine) or left (V-10 and diesel engine only) headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle (Fig. 7) or (Fig. 8).

(5) Reconnect the removed washer hose to the barbed outlet nipple of the washer pump/motor unit.

(6) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(7) Reconnect the battery negative cable.

(8) Close and latch the hood.

WASHER HOSES/TUBES

DESCRIPTION

The washer plumbing consists of a small diameter rubber reservoir washer hose that is routed from the barbed outlet nipple of the electric washer pump/motor unit on the washer reservoir through a trough molded into the back of the reservoir above the washer pump and to the engine compartment washer hose (Fig. 9). On models equipped with an optional V-10 or diesel engine, the reservoir washer hose is routed through routing clips on the top of the radiator fan shroud from the washer reservoir on the left side of the radiator to the engine compartment washer hose on the right side of the radiator. The engine compartment washer hose is contained within the right headlamp and dash wire harness, which is routed through the engine compartment along the top of the right front fender wheel house to the dash panel.

The engine compartment washer hose is connected to the washer reservoir washer hose and to the cowl plenum washer hose with molded plastic in-line fittings that have a barbed nipple on each end. The cowl plenum washer hose is routed from the engine compartment into the cowl plenum area through a trough formation located near the right end of the cowl plenum cover/grille panel. The cowl plenum washer hose is connected to the washer system check valve/wye fitting on the underside of the cowl plenum cover/grille panel. The cowl plenum washer hose and the two washer nozzle hoses are routed through integral routing clips on the underside of the cowl plenum cover/grille panel. The cowl plenum washer hose is connected to one nipple on the wye fitting and the two washer nozzle hoses are connected to the other two wye fitting nipples. The washer nozzle hoses are then routed along the underside of the cowl plenum cover/grille panel to the two washer nozzles.

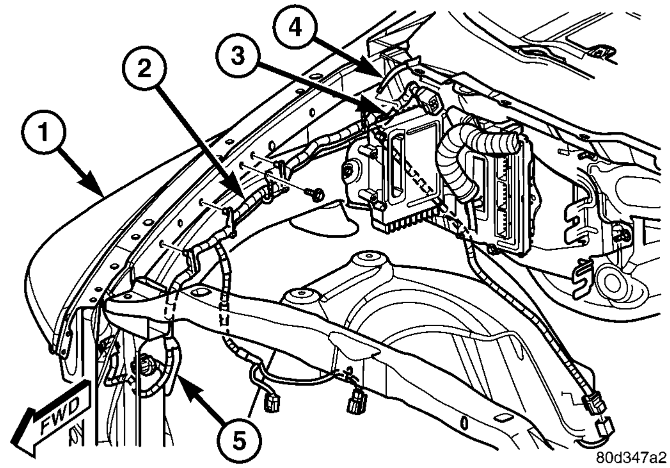


Fig. 9 Engine Compartment Washer Hose

1 - RIGHT FENDER
2 - RIGHT HEADLAMP & DASH WIRE HARNESS
3 - ENGINE COMPARTMENT WASHER HOSE (TO COWL PLENUM)
4 - COWL PLENUM WASHER HOSE
5 - ENGINE COMPARTMENT WASHER HOSE (TO WASHER RESERVOIR)

Washer hose is available for service only as roll stock, which must then be cut to length. The molded plastic washer hose fittings cannot be repaired. If these fittings are faulty or damaged, they must be replaced.

OPERATION

Washer fluid in the washer reservoir is pressurized and fed by the washer pump/motor through the washer system plumbing and fittings to the two washer nozzles. Whenever routing the washer hose or a wire harness containing a washer hose, it must be routed away from hot, sharp, or moving parts; and, sharp bends that might pinch the hose must be avoided.

WASHER NOZZLE

DESCRIPTION

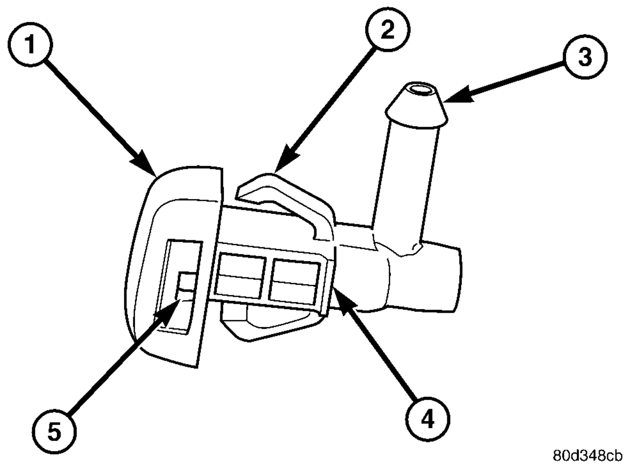


Fig. 10 Washer Nozzle

1 - HOOD
2 - LATCH (2)
3 - NIPPLE
4 - ANTI-ROTATION TAB
5 - ORIFICE

The two washer nozzles have integral snap features and an anti-rotation tab that secure them in dedicated holes in the cowl plenum cover/grille panel located near the base of the windshield (Fig. 10). The domed upper surface of the washer nozzle is visible on the top of the plenum cover/grille panel, and the nozzle orifice is oriented towards the windshield glass. The washer plumbing fittings for the washer nozzles are concealed beneath the cowl plenum cover/grille panel. These fluidic washer nozzles are constructed of molded plastic. The cowl plenum cover/grille panel must be removed from the vehicle to access the nozzles for service. The washer nozzles cannot be adjusted or repaired. If faulty or damaged, they must be replaced.

OPERATION

The two washer nozzles are designed to dispense washer fluid into the wiper pattern area on the outside of the windshield glass. Pressurized washer fluid is fed to each nozzle from the washer reservoir by the washer pump/motor unit through a single hose, which is attached to a barbed nipple on each washer nozzle below the cowl plenum cover/grille panel. A fluidic matrix within the washer nozzle causes the pressurized washer fluid to be emitted from the nozzle orifice as an oscillating stream to more effectively cover a larger area of the glass to be cleaned.

REMOVAL

(1) Remove both wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARM - REMOVAL).

(2) Unlatch and open the hood.

(3) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(4) From the underside of the cowl plenum cover/grille panel, disconnect the washer nozzle hose from the barbed nipple of the washer nozzle (Fig. 11).

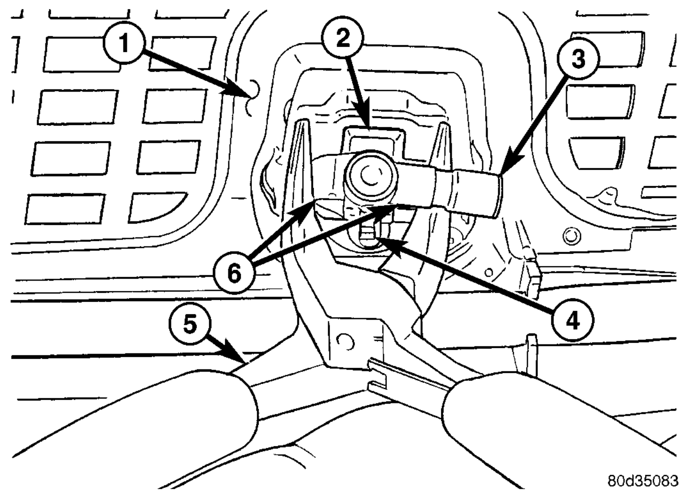


Fig. 11 Washer Nozzle Remove/Install

1 - COWL PLENUM COVER/GRILLE PANEL (UNDERSIDE)
2 - ANTI-ROTATION TAB (LARGE)
3 - NIPPLE
4 - ANTI-ROTATION TAB (SMALL)
5 - PLIERS
6 - LATCH (2)

(5) From the underside of the cowl plenum cover/grille panel, release the integral snap features of the washer nozzle and push the nozzle out through the mounting hole toward the top side of the cowl plenum cover/grille panel.

(6) Remove the washer nozzle from the top of the cowl plenum cover/grille panel.

INSTALLATION

(1) From the top of the cowl plenum cover/grille panel, position the nipple end of the washer nozzle through the mounting hole and engage the anti-rotation tab of the nipple into the anti-rotation notch in the mounting hole.

(2) Using hand pressure, push firmly and evenly on the top of the washer nozzle until the integral snap features lock into place on the underside of the cowl plenum cover/grille panel.

(3) From the underside of the cowl plenum cover/grille panel, reconnect the washer hose to the barbed nipple of the washer nozzle (Fig. 11).

WASHER NOZZLE (Continued)

(4) Reinstall the washer hose for the washer nozzle into its routing clips on the underside of the cowl plenum cover/grille panel.

(5) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(6) Close and latch the hood.

(7) Reinstall both wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARM - INSTALLATION).

WASHER PUMP/MOTOR

DESCRIPTION

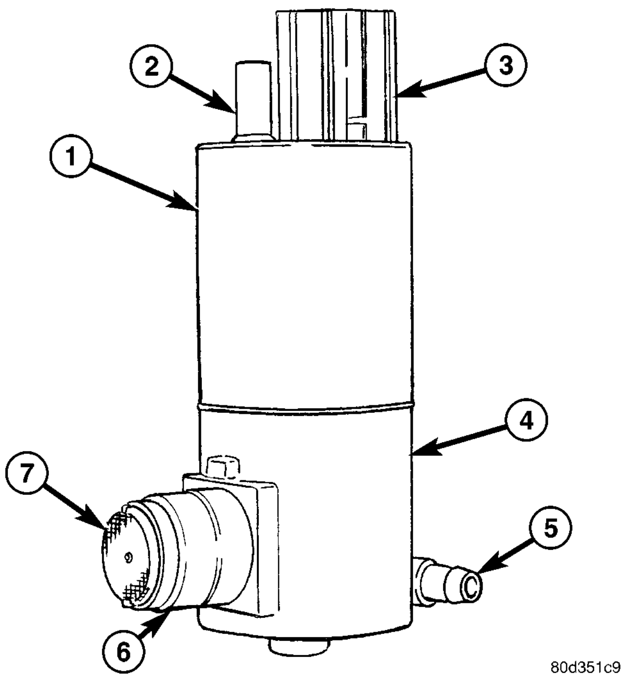


Fig. 12 Washer Pump/Motor

1 - MOTOR
2 - SNAP POST
3 - CONNECTOR RECEPTACLE
4 - PUMP
5 - OUTLET NIPPLE
6 - INLET NIPPLE
7 - FILTER SCREEN

The washer pump/motor unit (Fig. 12) is located on the rearward facing surface of the washer reservoir, in the right (except V-10 or diesel engine) or left (V-10 and diesel engine only) front corner of the engine compartment. A small permanently lubricated and sealed electric motor is coupled to the rotor-type washer pump. A seal flange with a barbed inlet nipple on the pump housing passes through a rubber grommet seal installed in a dedicated mounting hole of the washer reservoir. When the pump is installed in the reservoir a barbed outlet nipple on the pump housing connects the unit to the washer system through a short washer reservoir hose.

The washer pump/motor unit is retained on the reservoir by the interference fit between the barbed pump inlet nipple and the grommet seal, which is a light press fit. The top of the washer pump is also secured to the washer reservoir by the use of a snap post on the motor housing and a snap post receptacle molded into the reservoir that allows for mounting of the washer pump without the use of fasteners. An integral connector receptacle on the top of the motor housing connects the unit to the vehicle electrical system. The washer pump/motor unit cannot be repaired. If faulty or damaged, the entire washer pump/motor unit must be replaced.

OPERATION

The washer pump/motor unit features a small Direct Current (DC) electric motor. The motor is connected to the vehicle electrical system through a single take out and two-cavity connector of the right (except V-10 or diesel engine) or left (V-10 or diesel engine only) headlamp and dash wire harness. The motor is grounded at all times through another take out of the right (except V-10 or diesel engine) or left (V-10 or diesel engine only) headlamp and dash wire harness. On models without the V-10 or diesel engine a single eyelet terminal connector is secured by a nut to a ground stud located on the right front fender inner shield in the engine compartment. On models with a V-10 or diesel engine an eyelet terminal connector is secured by a ground screw to the left front fender inner shield in the engine compartment. The motor receives battery current on a washer pump/motor control circuit.

The washer pump/motor control circuit is energized through a high side driver within the Front Control Module (FCM) whenever the FCM receives an electronic message requesting washer system operation from the instrument cluster over the Programmable Communications Interface (PCI) data bus. The instrument cluster monitors a resistor multiplexed hard wired input from the momentary washer switch contacts within the multi-function switch on the steering column to determine when it should issue the electronic message requesting washer system operation.

Washer fluid is gravity-fed from the washer reservoir to the inlet side of the washer pump. When the pump motor is energized, the motor spins the rotor within the washer pump. The spinning pump rotor pressurizes the washer fluid and forces it through the pump outlet nipple, the washer plumbing, and the washer nozzles onto the windshield glass.

The washer pump/motor unit may be diagnosed using conventional diagnostic tools and methods.

WASHER PUMP/MOTOR (Continued)

However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the Front Control Module (FCM), or the electronic message inputs to or outputs from the instrument cluster and the FCM that control the operation of the washer pump/motor unit. The most reliable, efficient, and accurate means to diagnose the washer pump/motor unit, the instrument cluster, the FCM, or the electronic message inputs and outputs related to the washer pump/motor unit operation requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

The washer pump/motor unit can be removed from the washer reservoir without removing the reservoir from the vehicle.

(1) Unlatch and open the hood.

(2) Disconnect and isolate the battery negative cable.

(3) Disconnect the washer hose from the barbed outlet nipple of the washer pump/motor unit and allow the washer fluid to drain into a clean container for reuse.

(4) Disconnect the right (except V-10 or diesel engine) or left (V-10 or diesel engine only) headlamp and dash wire harness connector for the washer pump/motor unit from the motor connector receptacle (Fig. 13).

(5) Firmly grasp the top of the washer pump/motor housing.

(6) Pull lightly outward on the top of the washer pump/motor housing away from the washer reservoir far enough to disengage the snap post on the top of the motor from the receptacle in the reservoir.

(7) Pull the washer pump/motor unit straight out from the washer reservoir far enough to disengage the barbed pump inlet nipple from the rubber grommet seal in the reservoir.

(8) Disconnect the reservoir washer hose from the washer pump/motor unit outlet nipple.

(9) Remove washer pump/motor unit from the back of the washer reservoir.

(10) Remove the rubber grommet seal from the washer reservoir and discard.

INSTALLATION

(1) Install a new rubber grommet seal into the washer pump mounting hole in the washer reservoir. Always use a new rubber grommet seal on the reservoir.

(2) Position the barbed inlet nipple of the washer pump to the rubber grommet seal in the washer reservoir (Fig. 13).

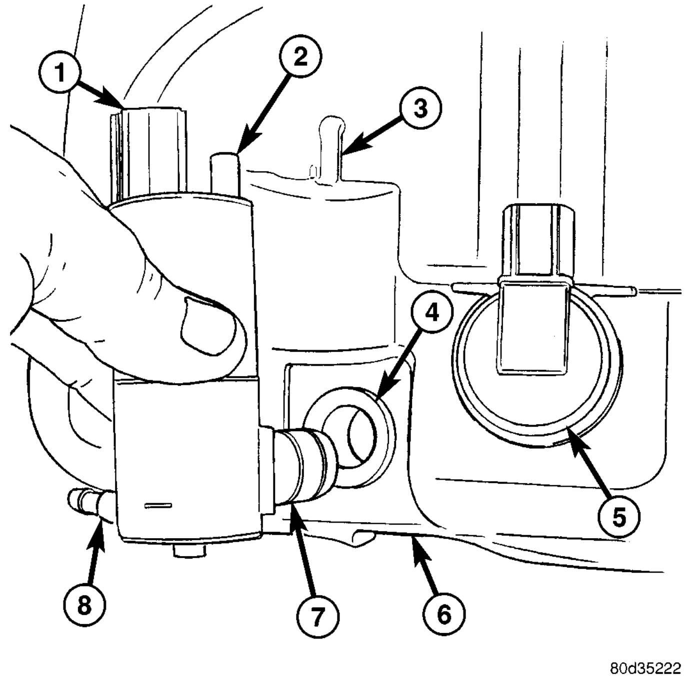


Fig. 13 Washer Pump/Motor Remove/Install

1 - CONNECTOR RECEPTACLE
2 - SNAP POST
3 - SNAP POST RECEPTACLE
4 - GROMMET SEAL
5 - WASHER FLUID LEVEL SWITCH
6 - WASHER RESERVOIR
7 - INLET NIPPLE
8 - OUTLET NIPPLE

(3) Using hand pressure, press on the washer pump/motor unit firmly and evenly until the barbed inlet nipple is fully seated in the rubber grommet seal in the washer reservoir mounting hole.

(4) Align the washer pump/motor snap post on the top of the motor housing with the snap post receptacle in the washer reservoir.

(5) Using hand pressure, press firmly and evenly on the top of washer pump/motor unit until the snap post snaps into the washer reservoir receptacle.

(6) Reconnect the washer reservoir hose to the barbed outlet nipple of the washer pump.

(7) Reconnect the right (except V-10 or diesel engine) or left (V-10 or diesel engine only) headlamp and dash wire harness connector for the washer pump/motor unit to the motor connector receptacle.

(8) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(9) Reconnect the battery negative cable.

(10) Close and latch the hood.

WASHER RESERVOIR

DESCRIPTION

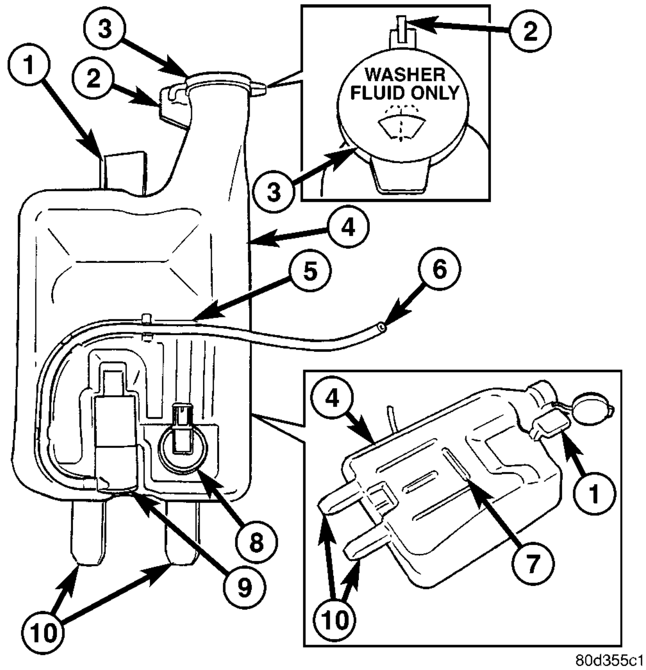


Fig. 14 Washer Reservoir - except V-10 & Diesel Engine

1 - TOP TAB
2 - HOOK FEATURE
3 - CAP
4 - RESERVOIR
5 - TROUGH
6 - HOSE
7 - LOCK FEATURE
8 - WASHER FLUID LEVEL SWITCH
9 - WASHER PUMP/MOTOR
10 - BOTTOM TAB (2)

Except on models equipped with an optional V-10 or diesel engine, the molded plastic washer fluid reservoir is mounted on the right rearward facing surface of the cooling module radiator shroud in the engine compartment (Fig. 14). On models with the V-10 or diesel engine, the molded plastic washer fluid reservoir is mounted on the rearward facing surface of the left vertical member of the radiator support in the engine compartment. The reservoir is a molded unit constructed of a translucent plastic that allows the washer fluid level to be inspected without removing the washer reservoir cap. The most visible component of the washer reservoir is the filler cap unit, which is secured to and hinges on a hook feature that is integral to the filler neck near the top of the reservoir. The bright yellow plastic filler cap snaps over the filler neck opening and seals the reservoir opening with an integral rubber gasket. The filler cap is labeled with an International Control and Display Symbol icon for “Windshield Washer” and the text “Washer Fluid Only” that are molded into it and highlighted in black against the yellow plastic cap for visibility.

There are dedicated holes near the bottom of the rearward facing side of the reservoir provided for the mounting of the washer pump/motor unit and the washer fluid level switch. A snap post receptacle molded into the reservoir allows for mounting of the washer pump without the use of fasteners. The reservoir also features an integral hose routing trough on its rearward facing side. Except on models with a V-10 or diesel engine, the washer reservoir is secured to the cooling module radiator shroud with three integral tabs, two at the bottom and one at the top. The two bottom tabs are inserted into two slots near the bottom of the shroud, while the upper tab slides into an integral channel-like slot near the top of the shroud. A molded lock feature on the forward facing surface of the reservoir engages a molded depression on the rearward facing surface of the radiator shroud when the reservoir is fully seated on the shroud, locking the unit securely in place. On models with a V-10 or diesel engine, the washer reservoir is secured with two screws through integral mounting tabs to the left vertical member of the radiator support. On many models, a molded plastic coolant recovery container or a coolant pressure container must be detached from the top of the cooling module and moved aside to access the washer fluid reservoir for service. This may be accomplished without opening or draining the engine cooling system.

OPERATION

The washer fluid reservoir provides a secure, on-vehicle storage location for a large reserve of washer fluid for operation of the washer system. The washer reservoir filler neck provides a clearly marked and readily accessible point from which to add washer fluid to the reservoir. The washer/pump motor unit is located in a sump area near the bottom of the reservoir to be certain that washer fluid will be available to the pump as the fluid level in the reservoir becomes depleted. The washer pump/motor unit is mounted in the lowest position in the sump. The washer fluid level switch is mounted just above the sump area of the reservoir so that there will be adequate warning to the vehicle operator that the washer fluid level is low, well before the washer system will no longer operate.

WASHER RESERVOIR (Continued)

REMOVAL

REMOVAL - EXCEPT V-10 OR DIESEL ENGINE

(1) Unlatch and open the hood.

(2) Disconnect and isolate the battery negative cable.

(3) Remove the fasteners securing the coolant recovery container or the coolant pressure container to the top of the cooling module and move the container aside. It is not necessary to open or drain the engine cooling system. (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY CONTAINER - REMOVAL) or (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESSURE CONTAINER - REMOVAL).

(4) Disconnect the reservoir washer hose from the barbed nipple of the inline fitting at the engine compartment washer hose in the right headlamp and dash wire harness and allow the washer fluid to drain from the reservoir into a clean container for reuse (Fig. 15).

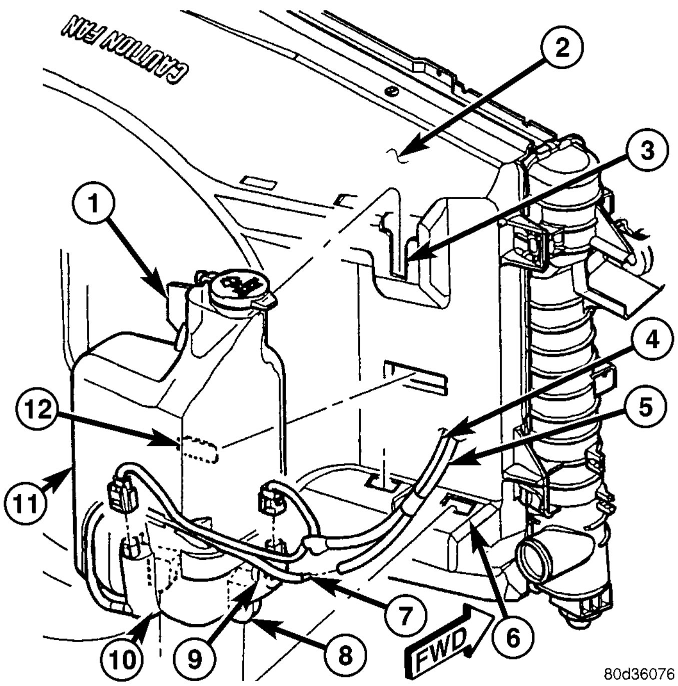


Fig. 15 Washer Reservoir Remove/Install

1 - TOP TAB
2 - RADIATOR SHROUD
3 - TOP SLOT
4 - RIGHT HEADLAMP & DASH WIRE HARNESS
5 - ENGINE COMPARTMENT WASHER HOSE
6 - BOTTOM SLOT (2)
7 - RESERVOIR WASHER HOSE
8 - BOTTOM TAB (2)
9 - WASHER FLUID LEVEL SWITCH
10 - WASHER PUMP/MOTOR
11 - WASHER RESERVOIR
12 - LOCK FEATURE

(5) Disconnect the right headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle.

(6) Disconnect the right headlamp and dash wire harness connector for the washer pump/motor unit from the motor connector receptacle.

(7) Grasp the bottom of the washer reservoir firmly with both hands and pull the unit sharply upward to disengage the locking feature on the washer reservoir from the depression in the radiator shroud.

(8) Continue lifting the washer reservoir upward far enough to disengage the three mounting tabs (one at the top and two at the bottom) from the channel-like slot at the top and the two slots at the bottom of the radiator shroud.

(9) Remove the washer reservoir from the right side of the engine compartment.

REMOVAL - V-10 OR DIESEL ENGINE

(1) Unlatch and open the hood.

(2) Disconnect and isolate the battery negative cable.

(3) Disengage the reservoir washer hose from the integral routing clips on the top of the radiator fan shroud (Fig. 16).

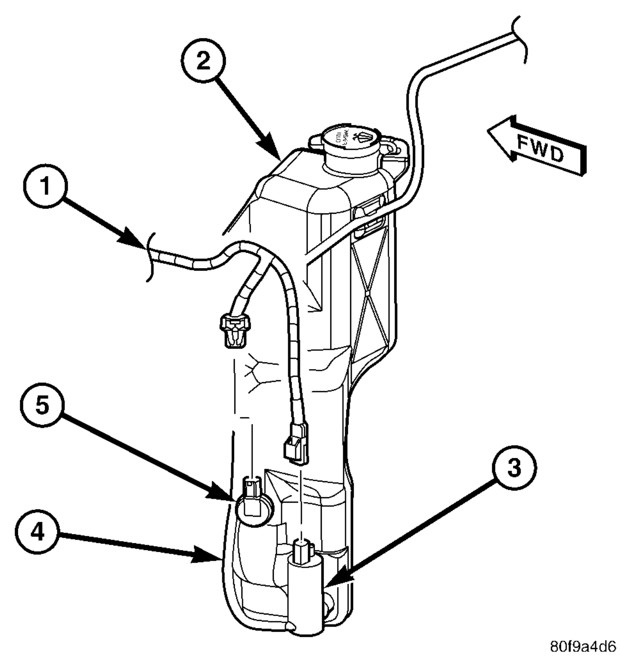


Fig. 16 Washer Reservoir Connections - V-10 & Diesel Engine

1 - WIRE HARNESS
2 - WASHER RESERVOIR
3 - WASHER PUMP/MOTOR
4 - WASHER HOSE
5 - WASHER FLUID LEVEL SWITCH

WASHER RESERVOIR (Continued)

(4) Disconnect the reservoir washer hose from the barbed nipple of the inline fitting at the engine compartment washer hose in the right headlamp and dash wire harness and allow the washer fluid to drain from the reservoir into a clean container for reuse.

(5) Disconnect the left headlamp and dash wire harness connector for the washer fluid level switch from the switch connector receptacle.

(6) Disconnect the left headlamp and dash wire harness connector for the washer pump/motor unit from the motor connector receptacle.

(7) Remove the two screws that secure the washer reservoir to the left vertical member of the radiator support (Fig. 17).

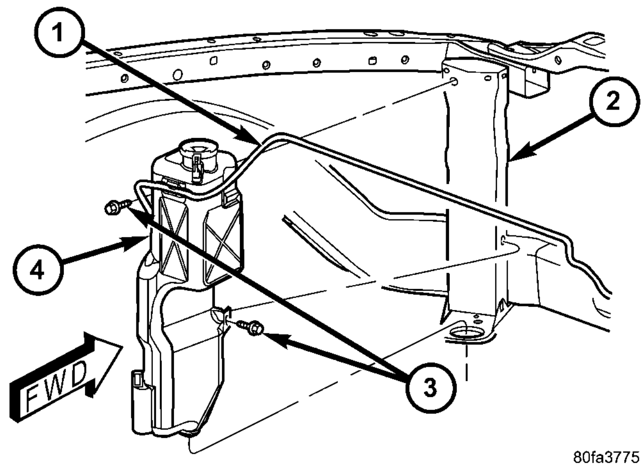


Fig. 17 Washer Reservoir Remove/Install - V-10 & Diesel Engine

1 - RESERVOIR WASHER HOSE
2 - RADIATOR SUPPORT
3 - SCREW (2)
4 - WASHER RESERVOIR

(8) Remove the washer reservoir from the left side of the engine compartment.

INSTALLATION

INSTALLATION - EXCEPT V-10 OR DIESEL ENGINE

(1) Position the washer reservoir into the right side of the engine compartment.

(2) Align and insert the three mounting tabs (one at the top and two at the bottom) into the two slots at the bottom and the channel-like slot at the top of the radiator shroud (Fig. 15).

(3) Place both hands on the top of the washer reservoir and push the unit downward far enough for the locking feature on the washer reservoir to snap into the depression in the radiator shroud.

(4) Reconnect the right headlamp and dash wire harness connector for the washer pump/motor unit to the motor connector receptacle.

(5) Reconnect the right headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle.

(6) Reconnect the reservoir washer hose to the barbed nipple of the inline fitting at the engine compartment washer hose in the right headlamp and dash wire harness.

(7) Reposition the coolant recovery container or the coolant pressure container to the top of the cooling module and reinstall the fasteners that secure it there. (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY CONTAINER - INSTALLATION) or (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESSURE CONTAINER - INSTALLATION).

(8) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(9) Reconnect the battery negative cable.

(10) Close and latch the hood.

INSTALLATION - V-10 OR DIESEL ENGINE

(1) Position the washer reservoir into the left side of the engine compartment (Fig. 17).

(2) Install and tighten the two screws that secure the washer reservoir to the left vertical member of the radiator support. Tighten the screws to 10 N·m (85 in. lbs.).

(3) Reconnect the left headlamp and dash wire harness connector for the washer pump/motor unit to the motor connector receptacle (Fig. 16).

(4) Reconnect the left headlamp and dash wire harness connector for the washer fluid level switch to the switch connector receptacle.

(5) Reconnect the reservoir washer hose to the barbed nipple of the inline fitting at the engine compartment washer hose in the right headlamp and dash wire harness.

(6) Engage the reservoir washer hose into the integral routing clips on the top of the radiator fan shroud.

(7) Refill the washer reservoir with the washer fluid drained from the reservoir during the removal procedure.

(8) Reconnect the battery negative cable.

(9) Close and latch the hood.

WIPER ARM

DESCRIPTION

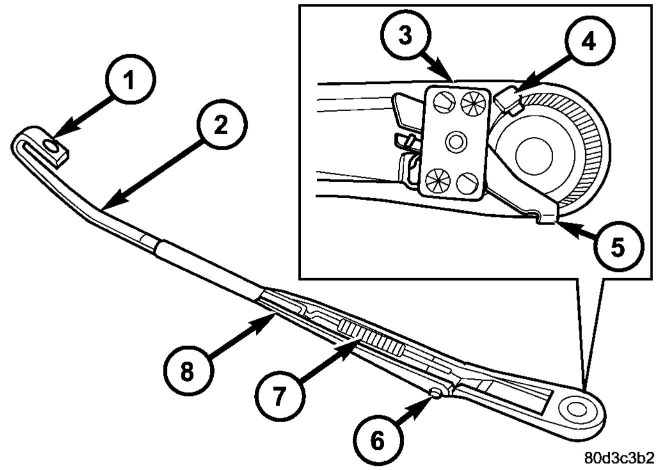


Fig. 18 Wiper Arm

1 - HOOK
2 - STRAP
3 - PIVOT END
4 - KEY
5 - LATCH
6 - HINGE PIN
7 - TENSION SPRING
8 - CHANNEL

The wiper arms are the rigid members located between the wiper pivots that protrude from the cowl plenum cover/grille panel near the base of the windshield and the wiper blades on the windshield glass (Fig. 18). These wiper arms feature an over-center hinge that allows easy access to the windshield glass for cleaning. The wiper arm has a die cast metal pivot end with a large internally serrated socket formation at one end. A key within the socket formation indexes the wiper arm to a keyway in the pivot shaft of the wiper module to provide wiper alignment, and a spring-loaded latch on the underside of the wiper arm pivot end locks the unit to the pivot shaft when it is fully installed. The right and left wiper arms for this model are not interchangeable, as the right wiper arm is slightly longer than the left one.

The wide end of a tapered, stamped steel channel hinges on and is secured with a hinge pin to the blade end of the wiper arm pivot end. One end of a long, rigid, stamped steel strap, with a small hole near its pivot end, is riveted and crimped within the narrow end of the stamped steel channel. The tip of the wiper blade end of this strap is bent back under itself to form a small hook. Concealed within the stamped steel channel, one end of a long spring is engaged with a wire hook on the underside of the die cast pivot end, while the other end of the spring is hooked through the small hole in the steel strap. The entire wiper arm has a satin black finish applied to all of its visible surfaces.

A wiper arm cannot be adjusted or repaired. If damaged or faulty, the entire wiper arm unit must be replaced.

OPERATION

The wiper arms are designed to mechanically transmit the motion from the wiper pivots to the wiper blades. The wiper arm must be properly indexed to the wiper pivot in order to maintain the proper wiper blade travel on the glass. The serrated and keyed socket formation in the wiper arm pivot end interlocks with the serrations and keyway on the outer circumference of the wiper pivot shaft, providing positive engagement and alignment of this connection. The latch positively locks the wiper arm to the wiper pivot shaft when the arm is fully installed. The spring-loaded wiper arm hinge controls the down-force applied through the tip of the wiper arm to the wiper blade on the glass. The hook formation on the tip of the wiper arm provides a cradle for securing and latching the wiper blade pivot block to the wiper arm.

REMOVAL

(1) Lift the wiper arm to its over-center position to hold the wiper blade off of the glass and relieve the spring tension on the wiper arm to wiper pivot shaft connection.

(2) Pull the latch on the pivot end of the wiper arm outward (Fig. 19).

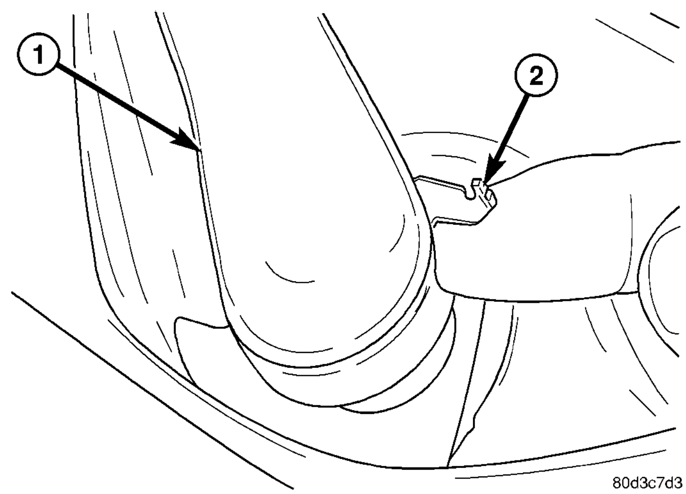


Fig. 19 Wiper Arm Remove/Install

1 - WIPER ARM PIVOT END
2 - LATCH

(3) Remove the wiper arm pivot end from the wiper pivot shaft.

WIPER ARM (Continued)

INSTALLATION

The right and left wiper arms are not interchangeable. The right wiper arm is slightly longer than the left. Be certain that each wiper arm is installed on the proper wiper pivot.

(1) Place the wiper arm hinge in its over-center position prior to attempting installation.

(2) The wiper arms are indexed to the wiper pivot shafts with integral keys in the wiper arm pivot ends and keyways in the wiper pivot shafts. Align the key of the wiper arm to the keyway on the wiper pivot shaft.

(3) Once the wiper blade is aligned, push the pivot of the wiper arm down firmly and evenly over the wiper pivot shaft until it is fully engaged. When the wiper arm is fully engaged on the wiper pivot, the spring-loaded latch (Fig. 19) will snap back into place against the wiper arm pivot end.

(4) Gently lower the wiper arm until the wiper blade is in position on the windshield glass.

WIPER BLADE

DESCRIPTION

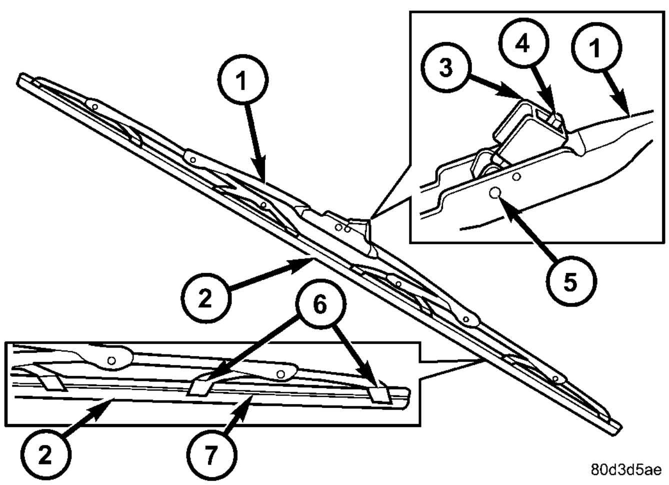


Fig. 20 Wiper Blade

1 - SUPERSTRUCTURE
2 - ELEMENT
3 - PIVOT BLOCK
4 - RELEASE TAB
5 - PIVOT PIN
6 - CLAWS
7 - FLEXOR

Each wiper blade is secured by an integral latching pivot block to the hook formation on the tip of each wiper arm, and rests on the glass near the base of the windshield when the wipers are not in operation (Fig. 20). The wiper blade consists of the following components:

- **Superstructure** - The superstructure includes several stamped steel bridges and links with claw formations that grip the wiper blade element. Also included in this unit is the latching, molded plastic pivot block that secures the superstructure to the wiper arm. All of the metal components of the wiper blade have a satin black finish applied.
- **Element** - The wiper element or squeegee is the resilient rubber member of the wiper blade that contacts the glass.
- **Flexor** - The flexor is a rigid metal component running along the length of each side of the wiper element where it is gripped by the claws of the superstructure.

All models have two 60.00 centimeter (23.62 inch) long wiper blades with non-replaceable rubber elements (squeegees). The wiper blades cannot be adjusted or repaired. If faulty, worn, or damaged the entire wiper blade unit must be replaced.

OPERATION

The wiper blades are moved back and forth across the glass by the wiper arms when the wipers are being operated. The wiper blade superstructure is the flexible frame that grips the wiper blade element and evenly distributes the force of the spring-loaded wiper arm along the length of the element. The combination of the wiper arm force and the flexibility of the superstructure makes the element conform to and maintain proper contact with the glass, even as the blade is moved over the varied curvature that may be encountered across the glass surface. The wiper element flexor provides the claws of the blade superstructure with a rigid, yet flexible component on the element which can be gripped. The rubber element is designed to be stiff enough to maintain an even cleaning edge as it is drawn across the glass, yet resilient enough to conform to the glass surface and flip from one cleaning edge to the other each time the wiper blade changes directions.

REMOVAL

NOTE: The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Lift the wiper arm to raise the wiper blade and element off of the glass, until the wiper arm hinge is in its over-center position.

(2) To remove the wiper blade from the wiper arm, depress the pivot block latch release tab under the tip of the arm and slide the blade away from the tip towards the pivot end of the arm far enough to disengage the pivot block from the hook formation on the end of the arm (Fig. 21).

WIPER BLADE (Continued)

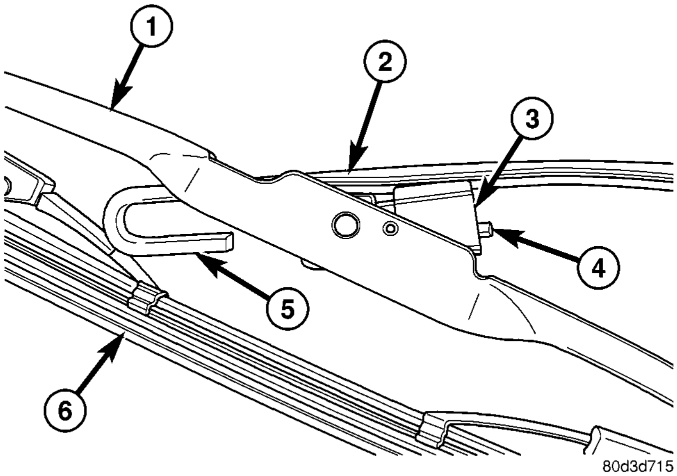


Fig. 21 Wiper Blade Remove/Install

1 - SUPERSTRUCTURE
2 - WIPER ARM
3 - PIVOT BLOCK
4 - RELEASE TAB
5 - HOOK
6 - ELEMENT

(3) Extract the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure just ahead of the wiper blade pivot block/latch unit.

CAUTION: Do not allow the wiper arm to spring back against the glass without the wiper blade in place or the glass may be damaged.

(4) Gently lower the tip of the wiper arm onto the glass.

INSTALLATION

NOTE: The notched end of the wiper element flexor should always be oriented towards the end of the wiper blade that is nearest to the wiper pivot.

(1) Lift the wiper arm off of the windshield glass, until the wiper arm hinge is in its over-center position.

(2) Position the wiper blade near the hook formation on the tip of the arm with the notched end of the wiper element flexor oriented towards the end of the wiper arm that is nearest to the wiper pivot.

(3) Insert the hook formation on the tip of the wiper arm through the opening in the wiper blade superstructure ahead of the wiper blade pivot block/latch unit far enough to engage the pivot block into the hook (Fig. 21).

(4) Slide the wiper blade pivot block/latch up into the hook formation on the tip of the wiper arm until the latch release tab snaps into its locked position. Latch engagement will be accompanied by an audible click.

(5) Gently lower the wiper blade onto the glass.

WIPER HIGH/LOW RELAY

DESCRIPTION

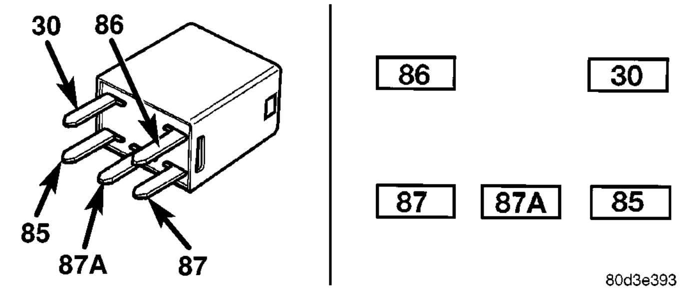


Fig. 22 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

The wiper high/low relay is located in the Integrated Power Module (IPM) in the engine compartment near the battery. The wiper high/low relay is a conventional International Standards Organization (ISO) micro relay (Fig. 22). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The wiper high/low relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

The wiper high/low relay is an electromechanical switch that uses a low current input from the Front Control Module (FCM) to control a high current output to the wiper motor. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

WIPER HIGH/LOW RELAY (Continued)

The wiper high/low relay terminals are connected to the vehicle electrical system through a connector receptacle in the Integrated Power Module (IPM). The inputs and outputs of the wiper high/low relay include:

- **Common Feed Terminal** - The common feed terminal (30) is connected to the output of the wiper on/off relay at all times through the wiper on/off relay output circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Front Control Module (FCM) through a wiper high/low relay control circuit. The FCM controls wiper motor operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current when the ignition switch is in the On or Accessory positions from a fuse in the Integrated Power Module (IPM) through a fused ignition switch output (run-acc) circuit.
- **Normally Open Terminal** - The normally open terminal (87) is connected to the high speed brush of the wiper motor through a wiper high/low relay high speed output circuit, and is connected to the high speed brush whenever the relay is energized.
- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to the low speed brush of the wiper motor through a wiper high/low relay low speed output circuit, and is connected to the low speed brush whenever the relay is de-energized.

The wiper high/low relay can be diagnosed using conventional diagnostic tools and methods. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the Front Control Module (FCM), or the electronic message inputs to or outputs from the instrument cluster and the FCM that control the operation of the wiper high/low relay. The most reliable, efficient, and accurate means to diagnose the wiper high/low relay, the instrument cluster, the FCM, or the electronic message inputs and outputs related to the wiper high/low relay operation requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - WIPER HIGH/LOW RELAY

The wiper high/low relay (Fig. 23) is located in the Integrated Power Module (IPM) in the engine compartment near the battery. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

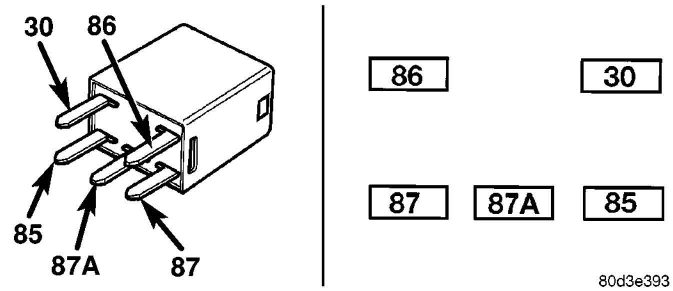


Fig. 23 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

(1) Remove the wiper high/low relay from the IPM. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER HIGH/LOW RELAY - REMOVAL).

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 8 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Integrated Power Module (IPM) (Fig. 24).

(3) Remove the wiper high/low relay by grasping it firmly and pulling it straight out from the receptacle in the IPM.

INSTALLATION

(1) Position the wiper high/low relay to the proper receptacle in the Integrated Power Module (IPM) (Fig. 24).

(2) Align the wiper high/low relay terminals with the terminal cavities in the IPM receptacle.

(3) Push firmly and evenly on the top of the wiper high/low relay until the terminals are fully seated in the terminal cavities in the IPM receptacle.

(4) Reinstall the cover onto the IPM.

(5) Reconnect the battery negative cable.

WIPER HIGH/LOW RELAY (Continued)

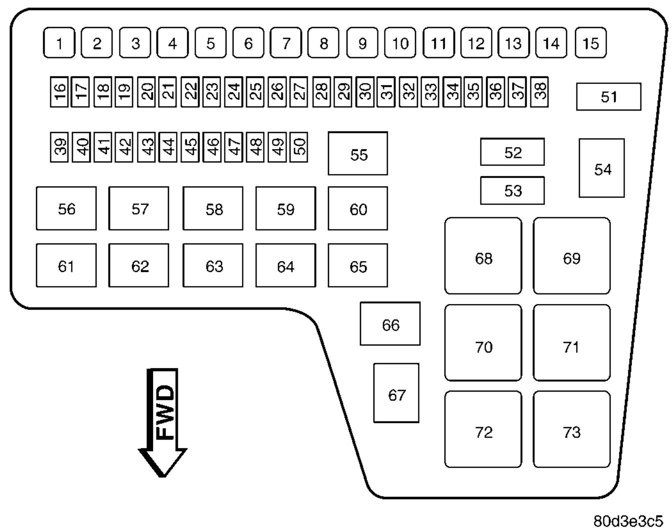


Fig. 24 Integrated Power Module

1 - 15 - CARTRIDGE FUSE
16 - 53 - BLADE FUSE
54 - HEATED MIRROR RELAY
55 - WIPER ON/OFF RELAY
56 - A/C CONDENSER FAN RELAY
57 - ENGINE CONTROL RELAY
58 - FUEL PUMP RELAY
59 - TRANSMISSION RELAY
60 - WIPER HIGH/LOW RELAY
61 - SPARE
62 - FOG LAMP RELAY
63 - ADJUSTABLE PEDAL RELAY
64 - A/C CLUTCH RELAY
65 - SPARE
66 - O2 RELAY
67 - SPARE
68 - SPARE
69 - SPARE
70 - SPARE
71 - SPARE
72 - STARTER RELAY
73 - PARK LAMP RELAY

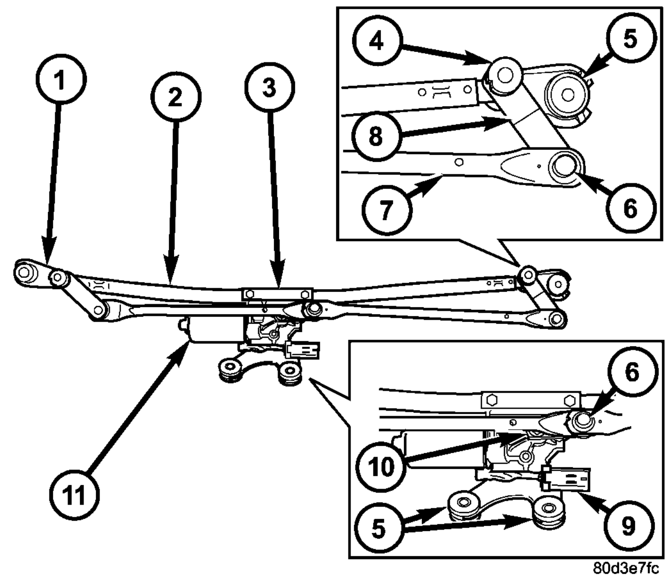


Fig. 25 Wiper Module

1 - PIVOT BRACKET (2)
2 - TUBE
3 - CLAMP
4 - PIVOT SHAFT (2)
5 - INSULATOR (4)
6 - LINKAGE BUSHING (4)
7 - DRIVE LINK (2)
8 - PIVOT CRANK ARM (2)
9 - PIGTAIL WIRE CONNECTOR
10 - MOTOR CRANK ARM
11 - WIPER MOTOR

WIPER MODULE

DESCRIPTION

The wiper motor bracket is secured with two screws below the wiper motor through two rubber insulators to the bottom of the cowl plenum panel beneath the cowl plenum cover/grille panel (Fig. 25). Two screws secure the top of the wiper module bracket to the cowl plenum panel through rubber insulators located on the outboard end of each pivot bracket. The ends of the wiper pivot shafts that protrude through dedicated openings in the cowl plenum cover/grille panel to drive the wiper arms and blades are the only visible components of the wiper module. The wiper module consists of the following major components:

- **Bracket -** The wiper module bracket consists of a long tubular steel main member that has a die cast pivot bracket formation near each end where the two wiper pivots are secured. A stamped steel clamp secures the center of the tubular member to the die cast bracket integral to the wiper motor with two screws.
- **Crank Arm -** The wiper motor crank arm is a stamped steel unit with a slotted hole on the driven end that is secured to the wiper motor output shaft with a nut, and has a ball stud secured to the drive end.
- **Linkage -** Two stamped steel drive links connect the wiper motor crank arm to the wiper pivot lever arms. The left side drive link has a plastic socket-type bushing on each end. The right side drive link has a plastic socket-type bushing on one end, and a plastic sleeve-type bushing on the other end. The socket-type bushing on one end of each drive link is snap-fit over the ball stud on the lever arm of its respective pivot. The right side drive link sleeve-type bushing end is then fit over the motor crank arm ball stud, and the other socket-type bushing of the left side drive link is snap-fit over the exposed end of the wiper motor crank arm ball stud.

WIPER MODULE (Continued)

- **Motor** - The wiper motor features an integral die cast bracket to which the wiper module bracket is secured with a stamped steel clamp and two screws near the top and which has two rubber insulated mounting ears at the bottom. This die casting also serves as the wiper motor transmission housing from which the wiper motor output shaft exits. A nut secures the wiper motor crank arm to the motor output shaft. The two-speed permanent magnet wiper motor features an integral transmission, an internal park switch, and an internal automatic resetting circuit breaker.
- **Pivots** - The two front wiper pivots are secured within the die cast pivot brackets on the outboard ends of the wiper module main member. The lever arms that extend from the center of the pivot shafts each have a ball stud on their end. The upper end of each pivot shaft where the wiper arms will be fastened each has a serrated driver with a keyway. The lower ends of the pivot shafts are installed through lubricated bushings in the pivot brackets and are secured with snap rings.

The wiper module cannot be adjusted or repaired. If any component of the module is faulty or damaged, the entire wiper module unit must be replaced.

OPERATION

The wiper module operation is controlled by the battery current inputs received by the wiper motor through the wiper on/off and wiper high/low relays. The wiper motor speed is controlled by current flow to either the low speed or the high speed set of brushes. The park switch is a single pole, single throw, momentary switch within the wiper motor that is mechanically actuated by the wiper motor transmission components. The park switch alternately opens and closes the wiper park switch sense circuit to ground, depending upon the position of the wipers on the glass. This feature allows the motor to complete its current wipe cycle after the wiper system has been turned Off, and to park the wiper blades in the lowest portion of the wipe pattern. The automatic resetting circuit breaker protects the motor from overloads. The wiper motor crank arm, the two wiper linkage members, and the two wiper pivots mechanically convert the rotary output of the wiper motor to the back and forth wiping motion of the wiper arms and blades on the glass.

REMOVAL

(1) Remove both wiper arms from the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARM - REMOVAL).

(2) Unlatch and open the hood.

(3) Disconnect and isolate the battery negative cable.

(4) Remove the cowl plenum cover/grille panel from over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(5) Disconnect the left headlamp and dash wire harness connector for the wiper motor from the motor pigtail wire connector (Fig. 26).

(6) Remove the two screws that secure the wiper module to the top of the cowl plenum panel at the pivot brackets.

(7) Remove the two screws that secure the wiper module to the bottom of the cowl plenum panel.

(8) Remove the wiper module from the cowl plenum panel as a unit.

INSTALLATION

(1) Position the wiper module into the cowl plenum as a unit (Fig. 26).

(2) Install the two screws that secure the wiper module to the top of the cowl plenum panel at the pivot brackets. Tighten the screw on the driver side, followed by the screw on the passenger side. Tighten the screws to 7 N·m (60 in. lbs.).

(3) Install and tighten the screws that secure the wiper module to the bottom of the cowl plenum panel. Tighten the screw on the passenger side, followed by the screw on the driver side. Tighten the screws to 7 N·m (60 in. lbs.).

(4) Reconnect the left headlamp and dash wire harness connector for the wiper motor to the motor pigtail wire connector.

(5) Reinstall the cowl plenum cover/grille panel over the cowl plenum. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(6) Reconnect the battery negative cable.

(7) Close and latch the hood.

(8) Reinstall both wiper arms onto the wiper pivots. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION).

WIPER MODULE (Continued)

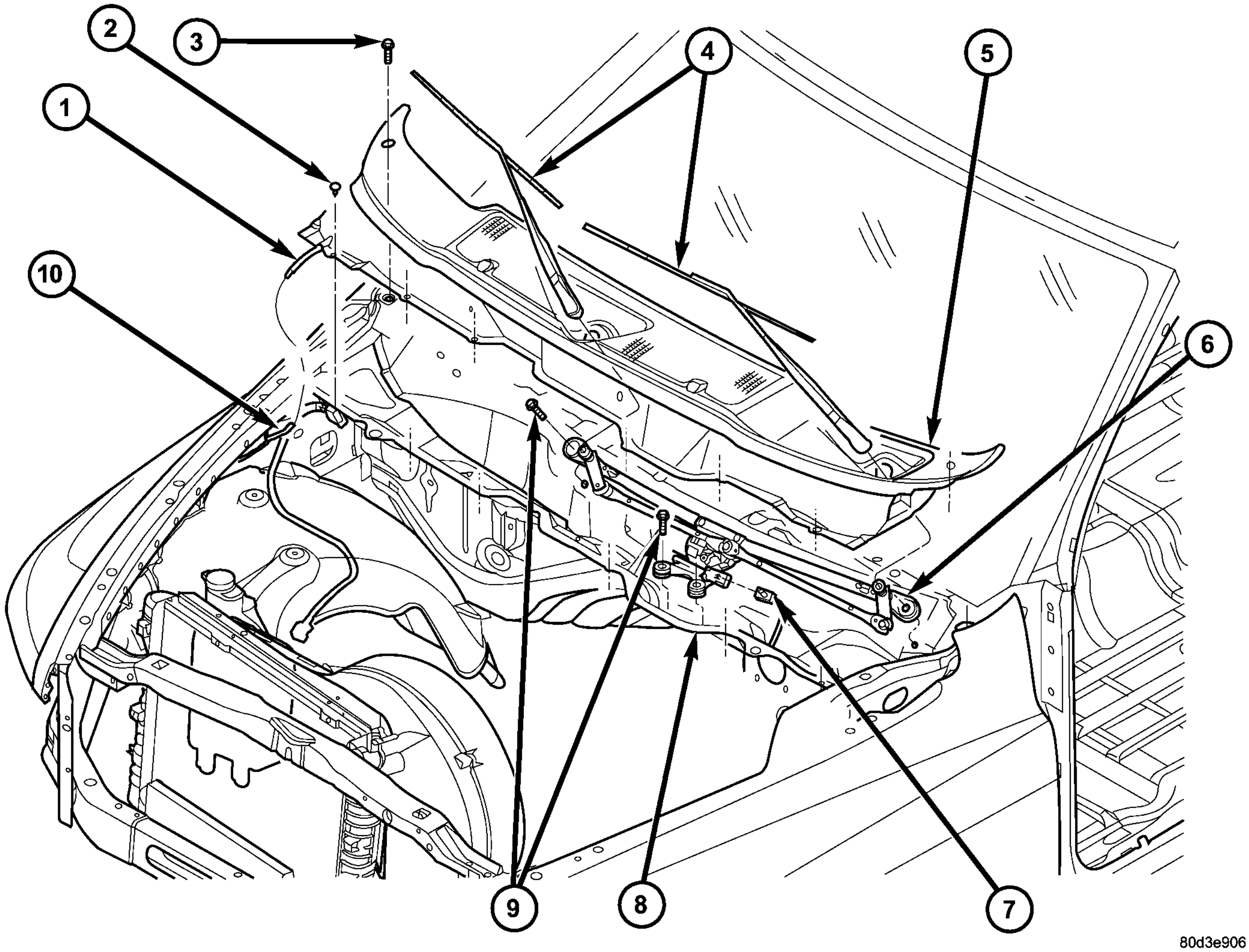


Fig. 26 Wiper Module Remove/Install

1 - COWL PLENUM WASHER HOSE
2 - PLASTIC FASTENER (6)
3 - SCREW (2)
4 - WIPER ARM & BLADE (2)
5 - COWL PLENUM COVER/GRILLE PANEL
6 - WIPER MODULE
7 - WIRE HARNESS CONNECTOR
8 - PLENUM PANEL
9 - SCREW (4)
10 - ENGINE COMPARTMENT WASHER HOSE

WIPER ON/OFF RELAY

DESCRIPTION

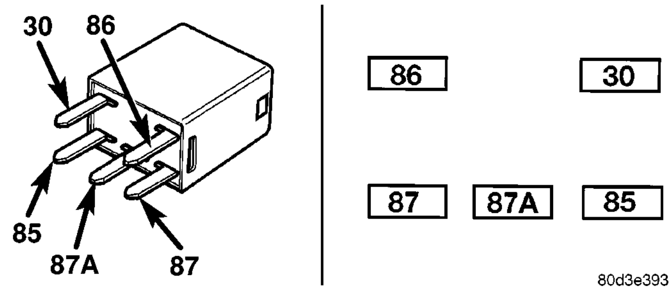


Fig. 27 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

The wiper on/off relay is located in the Integrated Power Module (IPM) in the engine compartment near the battery. The wiper on/off relay is a conventional International Standards Organization (ISO) micro relay (Fig. 27). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

The wiper on/off relay cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

The wiper on/off relay is an electromechanical switch that uses a low current input from the Front Control Module (FCM) to control a high current output to the wiper motor. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

The wiper on/off relay terminals are connected to the vehicle electrical system through a connector receptacle in the Integrated Power Module (IPM). The inputs and outputs of the wiper on/off relay include:

- **Common Feed Terminal** - The common feed terminal (30) is connected to the common feed terminal of the wiper high/low relay at all times through the wiper on/off relay output circuit.
- **Coil Ground Terminal** - The coil ground terminal (85) is connected to a control output of the Front Control Module (FCM) through a wiper on/off relay control circuit. The FCM controls wiper motor operation by controlling a ground path through this circuit.
- **Coil Battery Terminal** - The coil battery terminal (86) receives battery current at all times from a fuse in the IPM through a fused ignition switch output (run-acc) circuit.
- **Normally Open Terminal** - The normally open terminal (87) receives battery current at all times from a fuse in the IPM through a fused ignition switch output (run-acc) circuit, and provides battery current to the wiper on/off relay output circuit whenever the relay is energized.
- **Normally Closed Terminal** - The normally closed terminal (87A) is connected to ground at all times through a take out of the left headlamp and dash wire harness with an eyelet terminal connector that is secured by a screw to the front end sheet metal, and is connected to the wiper on/off relay output circuit whenever the relay is de-energized.

The wiper on/off relay may be diagnosed using conventional diagnostic tools and methods. However, conventional diagnostic methods may not prove conclusive in the diagnosis of the instrument cluster, the Front Control Module (FCM), or the electronic message inputs to or outputs from the instrument cluster and the FCM that control the operation of the wiper on/off relay. The most reliable, efficient, and accurate means to diagnose the wiper on/off relay, the instrument cluster, the FCM, or the electronic message inputs and outputs related to the wiper on/off relay operation requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

WIPER ON/OFF RELAY (Continued)

DIAGNOSIS AND TESTING - WIPER ON/OFF RELAY

The wiper on/off relay (Fig. 28) is located in the Integrated Power Module (IPM) in the engine compartment near the battery. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

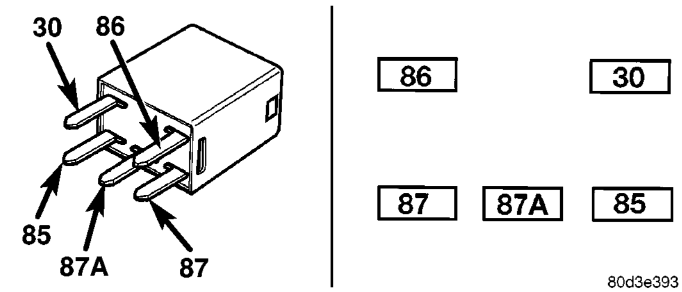


Fig. 28 ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

(1) Remove the wiper on/off relay from the IPM. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/ WIPER ON/OFF RELAY - REMOVAL).

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 75 ± 8 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRBIII® scan tool to perform further testing. Refer to the appropriate diagnostic information.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Integrated Power Module (IPM) (Fig. 29).

(3) Remove the wiper on/off relay by grasping it firmly and pulling it straight out from the receptacle in the IPM.

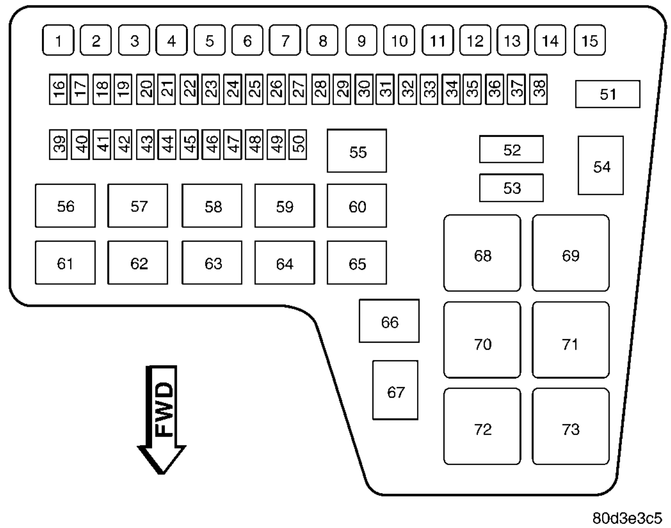


Fig. 29 Integrated Power Module

1 - 15 - CARTRIDGE FUSE
16 - 53 - BLADE FUSE
54 - HEATED MIRROR RELAY
55 - WIPER ON/OFF RELAY
56 - A/C CONDENSER FAN RELAY
57 - ENGINE CONTROL RELAY
58 - FUEL PUMP RELAY
59 - TRANSMISSION RELAY
60 - WIPER HIGH/LOW RELAY
61 - SPARE
62 - FOG LAMP RELAY
63 - ADJUSTABLE PEDAL RELAY
64 - A/C CLUTCH RELAY
65 - SPARE
66 - O2 RELAY
67 - SPARE
68 - SPARE
69 - SPARE
70 - SPARE
71 - SPARE
72 - STARTER RELAY
73 - PARK LAMP RELAY

INSTALLATION

(1) Position the wiper on/off relay to the proper receptacle in the Integrated Power Module (IPM) (Fig. 29).

(2) Align the wiper on/off relay terminals with the terminal cavities in the IPM receptacle.

(3) Push firmly and evenly on the top of the wiper on/off relay until the terminals are fully seated in the terminal cavities in the IPM receptacle.

(4) Reinstall the cover onto the IPM.

(5) Reconnect the battery negative cable.

WIRING

TABLE OF CONTENTS

8W-01 WIRING DIAGRAM INFORMATION

TABLE OF CONTENTS

WIRING DIAGRAM INFORMATION

DESCRIPTION

DESCRIPTION - HOW TO USE WIRING DIAGRAMS

DaimlerChrysler Corporation wiring diagrams are designed to provide information regarding the vehicles wiring content. In order to effectively use the wiring diagrams to diagnose and repair DaimlerChrysler Corporation vehicles, it is important to understand all of their features and characteristics.

Diagrams are arranged such that the power (B+) side of the circuit is placed near the top of the page, and the ground (B-) side of the circuit is placed near the bottom of the page (Fig. 1).

All switches, components, and modules are shown in the at rest position with the doors closed and the key removed from the ignition (Fig. 2).

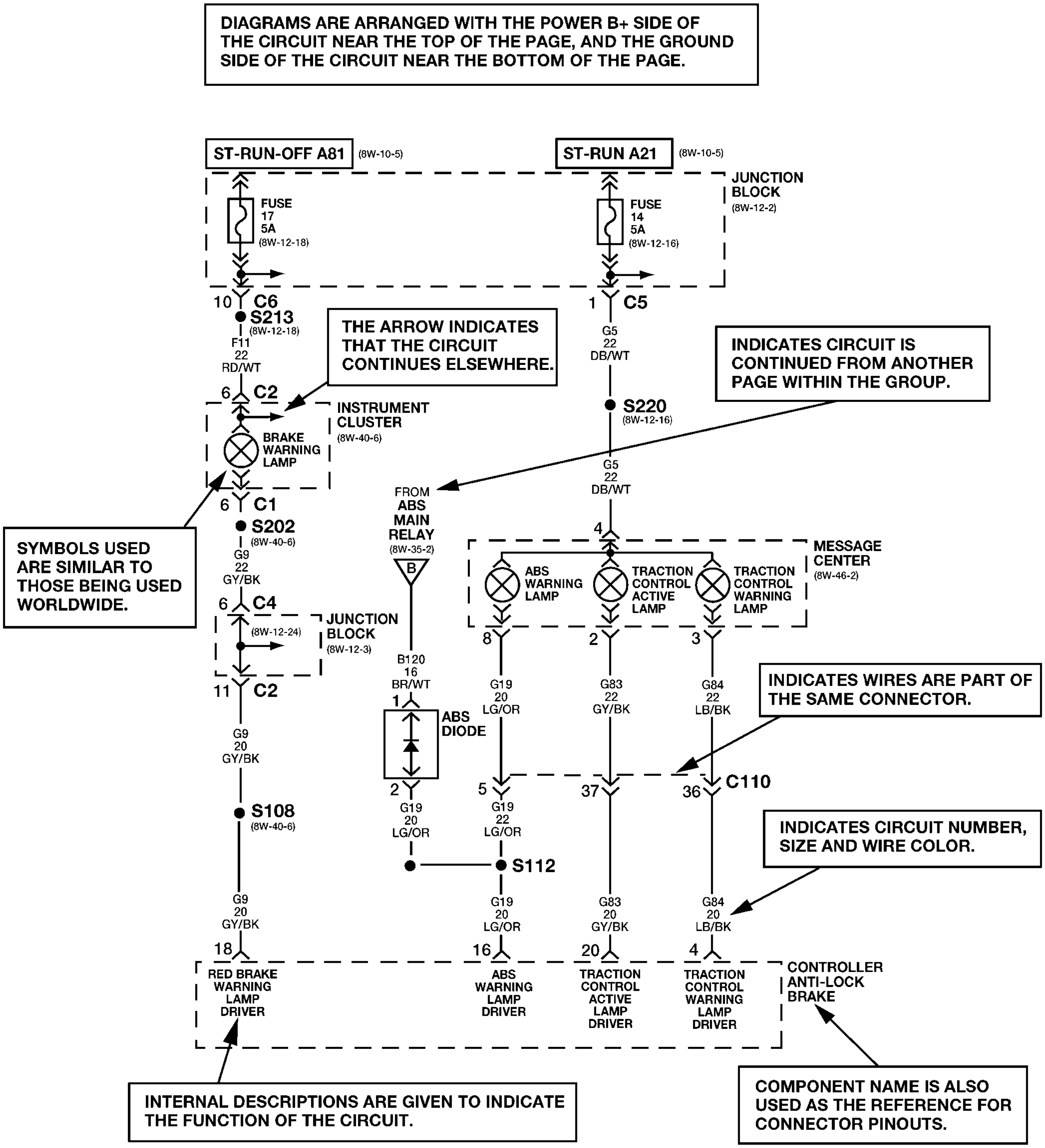
Components are shown two ways. A solid line around a component indicates that the component is complete. A dashed line around the component indicates that the component is being shown is not complete. Incomplete components have a reference number to indicate the page where the component is shown complete.

It is important to realize that no attempt is made on the diagrams to represent components and wiring as they appear on the vehicle. For example, a short piece of wire is treated the same as a long one. In addition, switches and other components are shown as simply as possible, with regard to function only.

SYMBOLS

International symbols are used throughout the wiring diagrams. These symbols are consistent with those being used around the world (Fig. 3).

WIRING DIAGRAM INFORMATION (Continued)

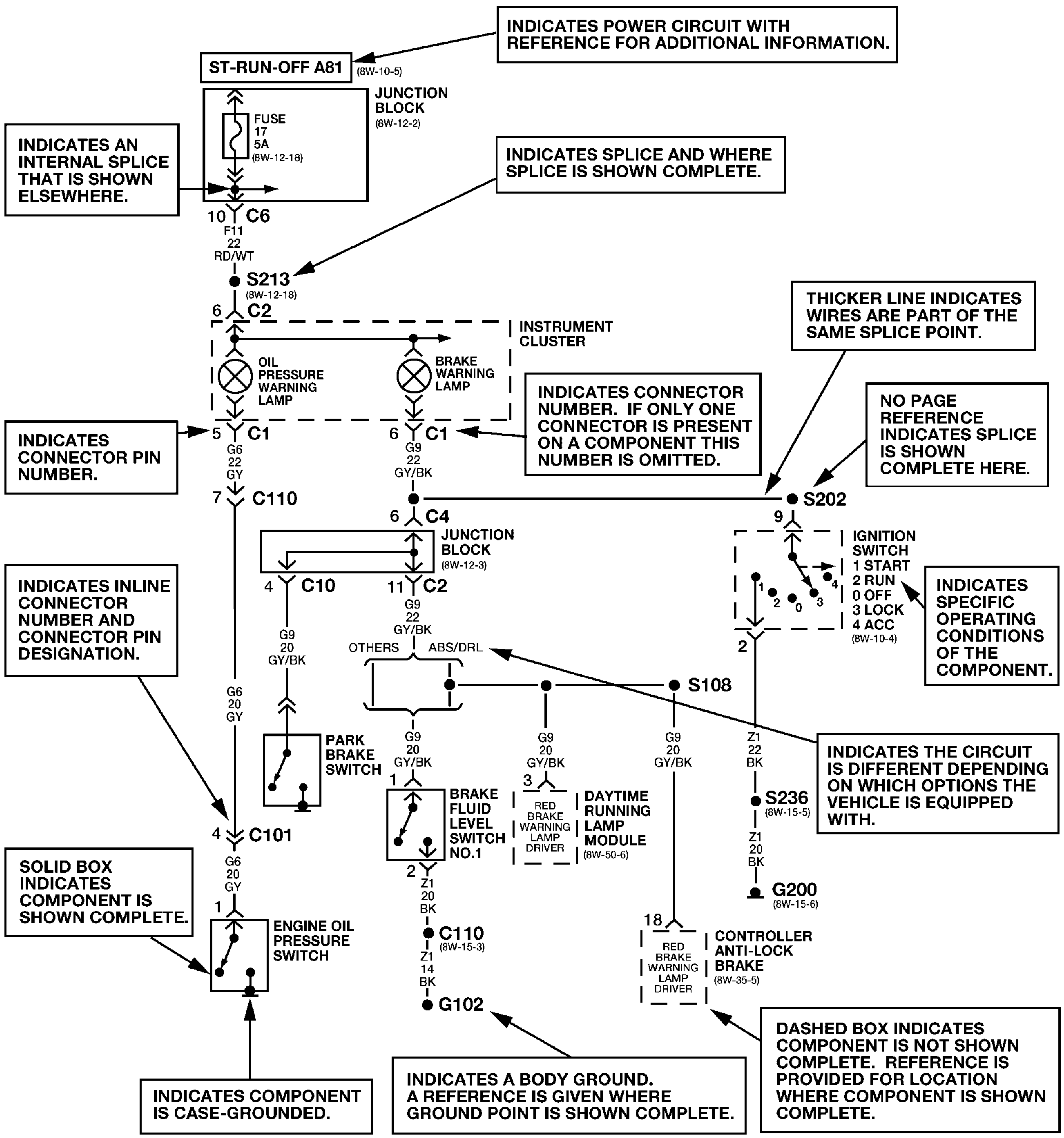


The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

80c06d01

Fig. 1 WIRING DIAGRAM EXAMPLE 1

WIRING DIAGRAM INFORMATION (Continued)



The System shown here is an EXAMPLE ONLY. It does not represent the actual circuit shown in the WIRING DIAGRAM SECTION.

80c06d02

Fig. 2 WIRING DIAGRAM EXAMPLE 2

WIRING DIAGRAM INFORMATION (Continued)

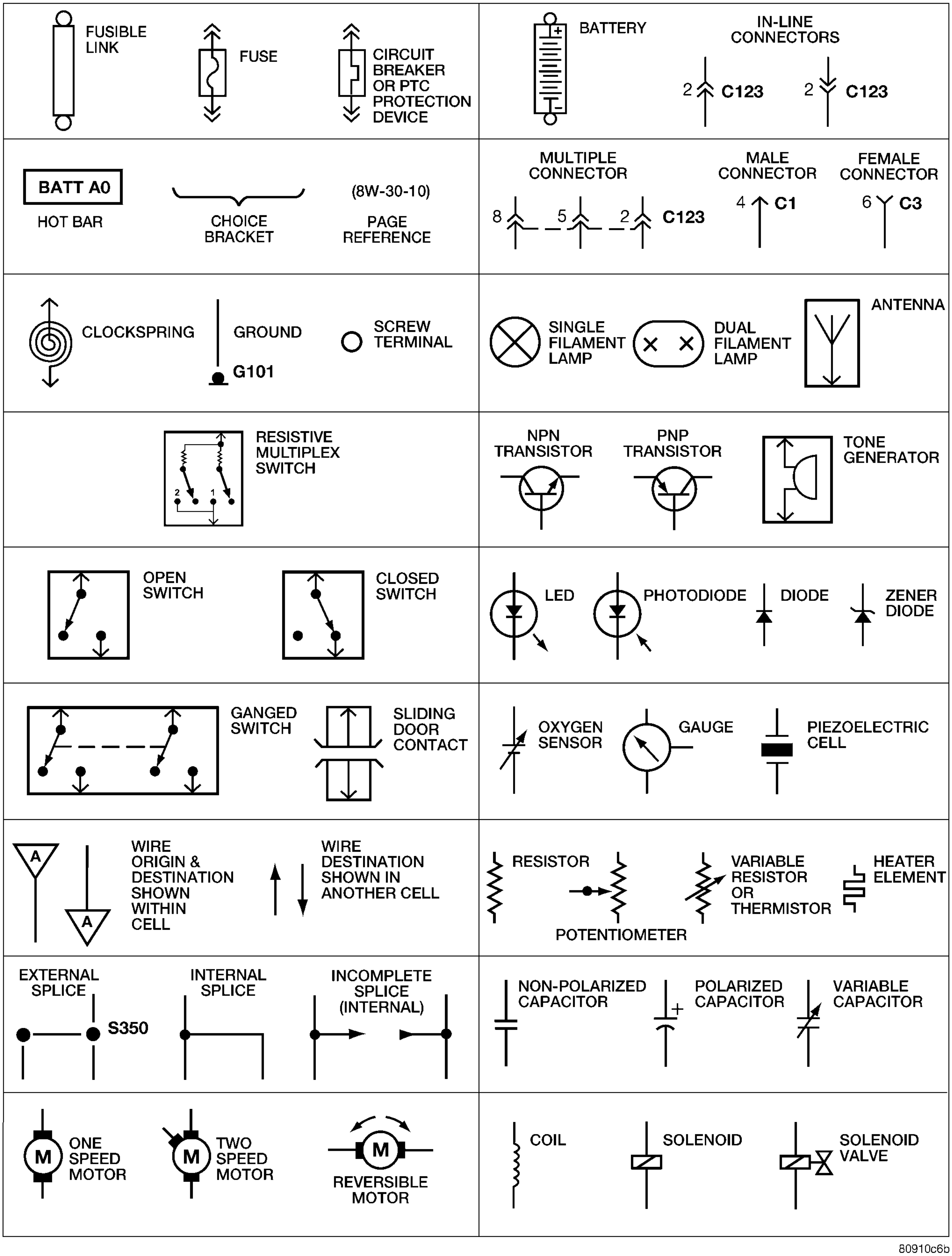


Fig. 3 WIRING DIAGRAM SYMBOLS

WIRING DIAGRAM INFORMATION (Continued)

TERMINOLOGY

This is a list of terms and definitions used in the wiring diagrams.

LHD . . . . Left Hand Drive Vehicles
RHD . . . . Right Hand Drive Vehicles
ATX . . Automatic Transmissions-Front Wheel Drive
MTX . . . Manual Transmissions-Front Wheel Drive
AT . . . . Automatic Transmissions-Rear Wheel Drive
MT . . . . . Manual Transmissions-Rear Wheel Drive
SOHC . . . . Single Over Head Cam Engine
DOHC . . . . Double Over Head Cam Engine
Built-Up-Export . . . . Vehicles Built For Sale In Markets Other Than North America
Except Built-Up-Export . . . . Vehicles Built For Sale In North America

DESCRIPTION - CIRCUIT INFORMATION

Each wire shown in the diagrams contains a code which identifies the main circuit, part of the main circuit, gage of wire, and color (Fig. 4).

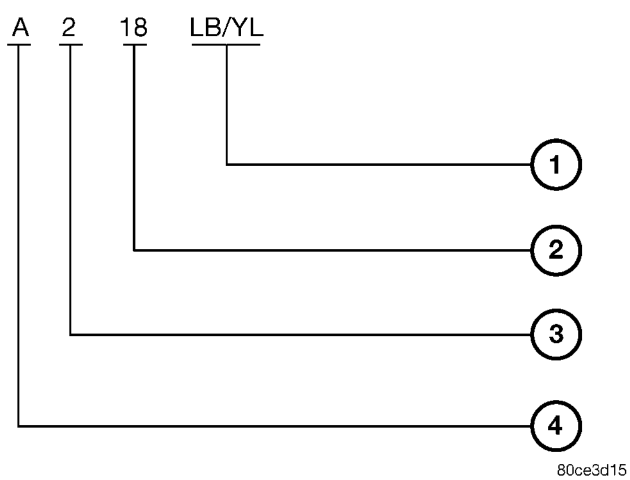


Fig. 4 WIRE CODE IDENTIFICATION

1 - COLOR OF WIRE (LIGHT BLUE WITH YELLOW TRACER
2 - GAGE OF WIRE (18 GAGE)
3 - PART OF MAIN CIRCUIT (VARIES DEPENDING ON EQUIPMENT)
4 - MAIN CIRCUIT IDENTIFICATION

WIRE COLOR CODE CHART

COLOR CODE	COLOR
BL	BLUE
BK	BLACK
BR	BROWN
DB	DARK BLUE
DG	DARK GREEN
GY	GRAY
LB	LIGHT BLUE
LG	LIGHT GREEN
OR	ORANGE
PK	PINK
RD	RED
TN	TAN
VT	VIOLET
WT	WHITE
YL	YELLOW
*	WITH TRACER

WIRING DIAGRAM INFORMATION (Continued)

DESCRIPTION - CIRCUIT FUNCTIONS

All circuits in the diagrams use an alpha/numeric code to identify the wire and it's function. To identify which circuit code applies to a system, refer to the Circuit Identification Code Chart. This chart shows the main circuits only and does not show the secondary codes that may apply to some models.

CIRCUIT IDENTIFICATION CODE CHART

CIRCUIT	FUNCTION
A	BATTERY FEED
B	BRAKE CONTROLS
C	CLIMATE CONTROLS
D	DIAGNOSTIC CIRCUITS
E	DIMMING ILLUMINATION CIRCUITS
F	FUSED CIRCUITS
G	MONITORING CIRCUITS (GAUGES)
H	OPEN
I	NOT USED
J	OPEN
K	POWERTRAIN CONTROL MODULE
L	EXTERIOR LIGHTING
M	INTERIOR LIGHTING
N	NOT USED
O	NOT USED
P	POWER OPTION (BATTERY FEED)
Q	POWER OPTIONS (IGNITION FEED)
R	PASSIVE RESTRAINT
S	SUSPENSION/STEERING
T	TRANSMISSION/TRANSAXLE/ TRANSFER CASE
U	OPEN
V	SPEED CONTROL, WIPER/ WASHER
W	OPEN
X	AUDIO SYSTEMS
Y	OPEN
Z	GROUNDS

DESCRIPTION - SECTION IDENTIFICATION AND INFORMATION

The wiring diagrams are grouped into individual sections. If a component is most likely found in a particular group, it will be shown complete (all wires, connectors, and pins) within that group. For example, the Auto Shutdown Relay is most likely to be found in Group 30, so it is shown there complete. It can, however, be shown partially in another group if it contains some associated wiring.

Splice diagrams in Section 8W-70 show the entire splice and provide references to other sections the splices serves. Section 8W-70 only contains splice diagrams that are not shown in their entirety somewhere else in the wiring diagrams.

Section 8W-80 shows each connector and the circuits involved with that connector. The connectors are identified using the name/number on the diagram pages.

WIRING SECTION CHART

GROUP	TOPIC
8W-01 thru 8W-09	General information and Diagram Overview
8W-10 thru 8W-19	Main Sources of Power and Vehicle Grounding
8W-20 thru 8W-29	Starting and Charging
8W-30 thru 8W-39	Powertrain/Drivetrain Systems
8W-40 thru 8W-49	Body Electrical items and A/C
8W-50 thru 8W-59	Exterior Lighting, Wipers and Trailer Tow
8W-60 thru 8W-69	Power Accessories
8W-70	Splice Information
8W-80	Connector Pin Outs
8W-91	Connector, Ground and Splice Locations

WIRING DIAGRAM INFORMATION (Continued)

DESCRIPTION - CONNECTOR, GROUND AND SPLICE INFORMATION

CAUTION: Not all connectors are serviced. Some connectors are serviced only with a harness. A typical example might be the Supplemental Restraint System connectors. Always check parts availability before attempting a repair.

IDENTIFICATION

In-line connectors are identified by a number, as follows:

- In-line connectors located in the engine compartment are C100 series numbers
- In-line connectors located in the Instrument Panel area are C200 series numbers.
- In-line connectors located in the body are C300 series numbers.
- Jumper harness connectors are C400 series numbers.
- Grounds and ground connectors are identified with a “G” and follow the same series numbering as the in-line connectors.
- Splices are identified with an “S” and follow the same series numbering as the in-line connectors.
- Component connectors are identified by the component name instead of a number. Multiple connectors on a component use a C1, C2, etc. identifier.

LOCATIONS

Section 8W-91 contains connector/ground/splice location illustrations. The illustrations contain the connector name (or number)/ground number/splice number and component identification. Connector/ground/splice location charts in section 8W-91 reference the figure numbers of the illustrations.

The abbreviation T/O is used in the component location section to indicate a point in which the wiring harness branches out to a component. The abbreviation N/S means Not Shown in the illustrations

WARNING

WARNINGS - GENERAL

WARNINGS provide information to prevent personal injury and vehicle damage. Below is a list of general warnings that should be followed any time a vehicle is being serviced.

WARNING: ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.

WARNING: USE SAFETY STANDS ANYTIME A PROCEDURE REQUIRES BEING UNDER A VEHICLE.

WARNING: BE SURE THAT THE IGNITION SWITCH ALWAYS IS IN THE OFF POSITION, UNLESS THE PROCEDURE REQUIRES IT TO BE ON.

WARNING: SET THE PARKING BRAKE WHEN WORKING ON ANY VEHICLE. AN AUTOMATIC TRANSMISSION SHOULD BE IN PARK. A MANUAL TRANSMISSION SHOULD BE IN NEUTRAL.

WARNING: OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA.

WARNING: KEEP AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE FAN AND BELTS.

WARNING: TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD(S), TAIL PIPE, CATALYTIC CONVERTER AND MUFFLER.

WARNING: DO NOT ALLOW FLAME OR SPARKS NEAR THE BATTERY. GASES ARE ALWAYS PRESENT IN AND AROUND THE BATTERY.

WARNING: ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY AND AVOID LOOSE CLOTHING.

DIAGNOSIS AND TESTING - WIRING HARNESS

TROUBLESHOOTING TOOLS

When diagnosing a problem in an electrical circuit there are several common tools necessary. These tools are listed and explained below.

- Jumper Wire - This is a test wire used to connect two points of a circuit. It can be used to bypass an open in a circuit.

WARNING: NEVER USE A JUMPER WIRE ACROSS A LOAD, SUCH AS A MOTOR, CONNECTED BETWEEN A BATTERY FEED AND GROUND.

- Voltmeter - Used to check for voltage on a circuit. Always connect the black lead to a known good ground and the red lead to the positive side of the circuit.

CAUTION: Most of the electrical components used in today’s vehicles are Solid State. When checking voltages in these circuits, use a meter with a 10 - megohm or greater impedance rating.

WIRING DIAGRAM INFORMATION (Continued)

• Ohmmeter - Used to check the resistance between two points of a circuit. Low or no resistance in a circuit means good continuity.

CAUTION: Most of the electrical components used in today's vehicles are Solid State. When checking resistance in these circuits use a meter with a 10 - megohm or greater impedance rating. In addition, make sure the power is disconnected from the circuit. Circuits that are powered up by the vehicle's electrical system can cause damage to the equipment and provide false readings.

• Probing Tools - These tools are used for probing terminals in connectors (Fig. 5). Select the proper size tool from Special Tool Package 6807, and insert it into the terminal being tested. Use the other end of the tool to insert the meter probe.

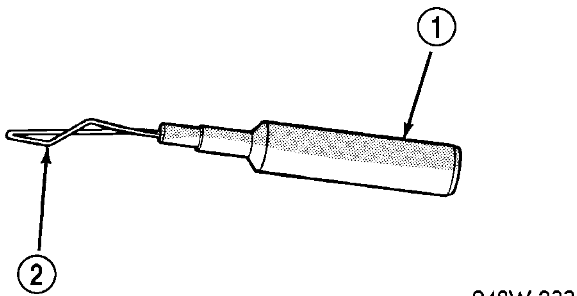


Fig. 5 PROBING TOOL

1 - SPECIAL TOOL 6801
2 - PROBING END

INTERMITTENT AND POOR CONNECTIONS

Most intermittent electrical problems are caused by faulty electrical connections or wiring. It is also possible for a sticking component or relay to cause a problem. Before condemning a component or wiring assembly, check the following items.

- Connectors are fully seated
- Spread terminals, or terminal push out
- Terminals in the wiring assembly are fully seated into the connector/component and locked into position
- Dirt or corrosion on the terminals. Any amount of corrosion or dirt could cause an intermittent problem
- Damaged connector/component casing exposing the item to dirt or moisture
- Wire insulation that has rubbed through causing a short to ground
- Some or all of the wiring strands broken inside of the insulation
- Wiring broken inside of the insulation

TROUBLESHOOTING WIRING PROBLEMS

When troubleshooting wiring problems there are six steps which can aid in the procedure. The steps are listed and explained below. Always check for non-factory items added to the vehicle before doing any diagnosis. If the vehicle is equipped with these items, disconnect them to verify these add-on items are not the cause of the problem.

(1) Verify the problem.

(2) Verify any related symptoms. Do this by performing operational checks on components that are in the same circuit. Refer to the wiring diagrams.

(3) Analyze the symptoms. Use the wiring diagrams to determine what the circuit is doing, where the problem most likely is occurring and where the diagnosis will continue.

(4) Isolate the problem area.

(5) Repair the problem area.

(6) Verify the proper operation. For this step, check for proper operation of all items on the repaired circuit. Refer to the wiring diagrams.

STANDARD PROCEDURE

STANDARD PROCEDURE - ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES

All ESD sensitive components are solid state and a symbol (Fig. 6) is used to indicate this. When handling any component with this symbol, comply with the following procedures to reduce the possibility of electrostatic charge build up on the body and inadvertent discharge into the component. If it is not known whether the part is ESD sensitive, assume that it is.

(1) Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across a seat, sitting down from a standing position, or walking a distance.

(2) Avoid touching electrical terminals of the part, unless instructed to do so by a written procedure.

(3) When using a voltmeter, be sure to connect the ground lead first.

(4) Do not remove the part form it's protective packing until it is time to install the part.

(5) Before removing the part from it's pakage, ground the pakage to a known good ground on the vehicle.

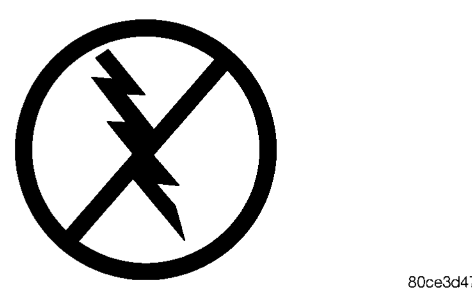


Fig. 6 ELECTROSTATIC DISCHARGE SYMBOL

WIRING DIAGRAM INFORMATION (Continued)

STANDARD PROCEDURE - TESTING OF VOLTAGE POTENTIAL

(1) Connect the ground lead of a voltmeter to a known good ground (Fig. 7).

(2) Connect the other lead of the voltmeter to the selected test point. The vehicle ignition may need to be turned ON to check voltage. Refer to the appropriate test procedure.

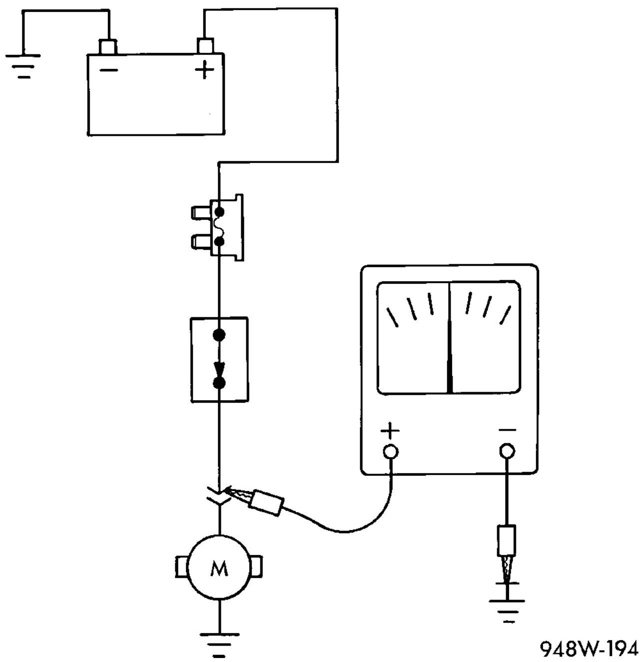


Fig. 7 TESTING FOR VOLTAGE POTENTIAL

STANDARD PROCEDURE - TESTING FOR CONTINUITY

(1) Remove the fuse for the circuit being checked or, disconnect the battery.

(2) Connect one lead of the ohmmeter to one side of the circuit being tested (Fig. 8).

(3) Connect the other lead to the other end of the circuit being tested. Low or no resistance means good continuity.

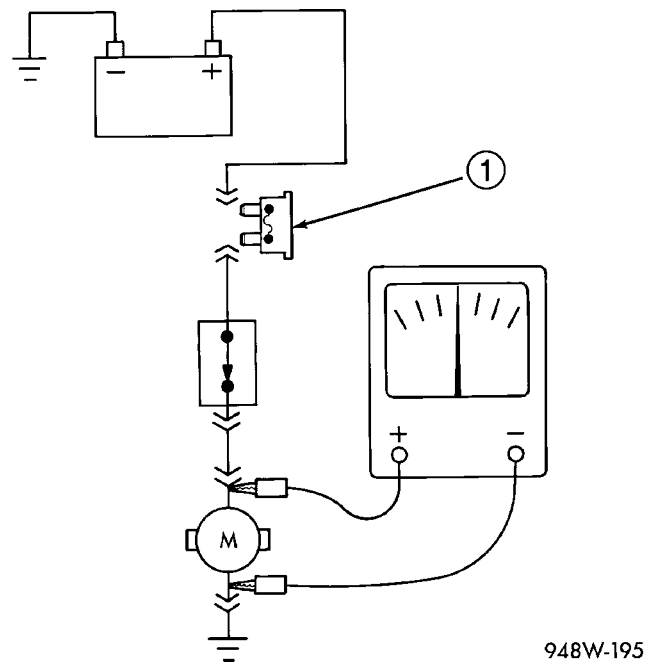


Fig. 8 TESTING FOR CONTINUITY

1 - FUSE REMOVED FROM CIRCUIT

STANDARD PROCEDURE - TESTING FOR A SHORT TO GROUND

(1) Remove the fuse and disconnect all items involved with the fuse.

(2) Connect a test light or a voltmeter across the terminals of the fuse.

(3) Starting at the fuse block, wiggle the wiring harness about six to eight inches apart and watch the voltmeter/test lamp.

(4) If the voltmeter registers voltage or the test lamp glows, there is a short to ground in that general area of the wiring harness.

WIRING DIAGRAM INFORMATION (Continued)

STANDARD PROCEDURE - TESTING FOR A SHORT TO GROUND ON FUSES POWERING SEVERAL LOADS

(1) Refer to the wiring diagrams and disconnect or isolate all items on the suspected fused circuits.

(2) Replace the blown fuse.

(3) Supply power to the fuse by turning ON the ignition switch or re-connecting the battery.

(4) Start connecting or energizing the items in the fuse circuit one at a time. When the fuse blows the circuit with the short to ground has been isolated.

STANDARD PROCEDURE - TESTING FOR A VOLTAGE DROP

(1) Connect the positive lead of the voltmeter to the side of the circuit closest to the battery (Fig. 9).

(2) Connect the other lead of the voltmeter to the other side of the switch, component or circuit.

(3) Operate the item.

(4) The voltmeter will show the difference in voltage between the two points.

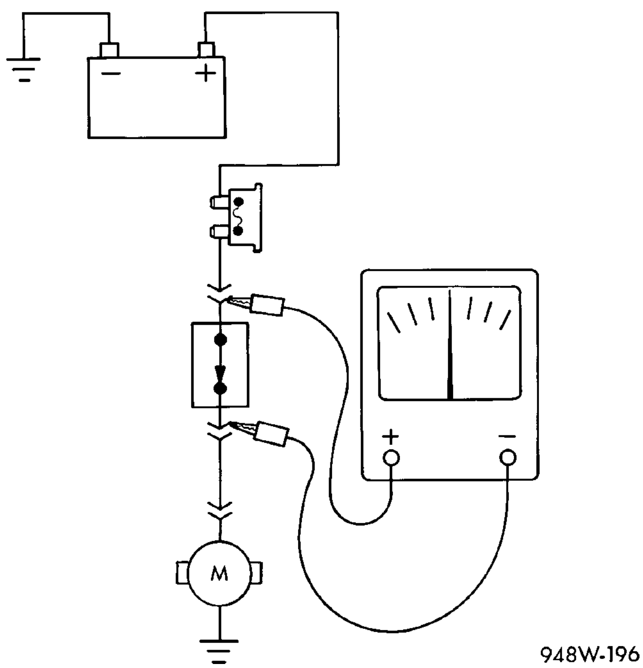
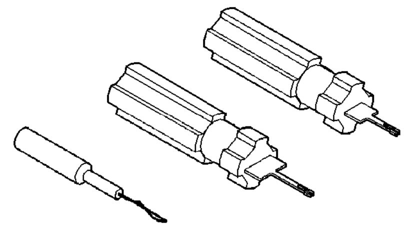


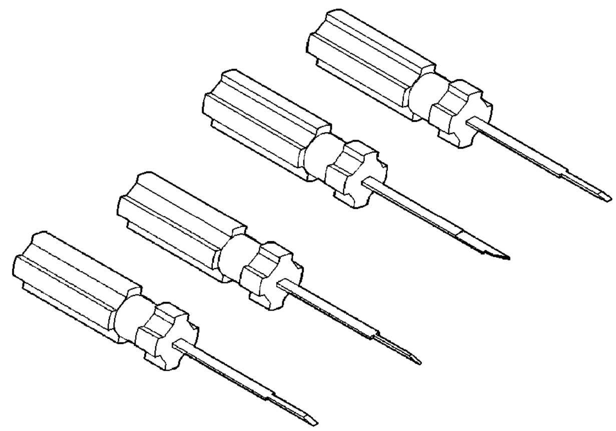
Fig. 9 TESTING FOR VOLTAGE DROP

SPECIAL TOOLS

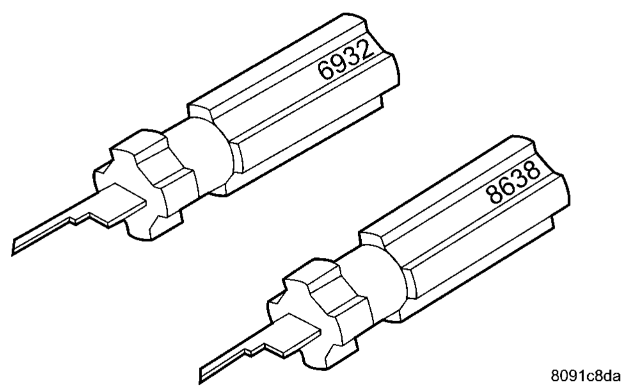
WIRING/TERMINAL



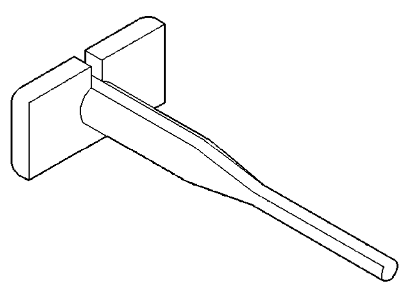
PROBING TOOL PACKAGE 6807



TERMINAL PICK TOOL SET 6680



TERMINAL REMOVING TOOLS 6932 AND 8638



TERMINAL REMOVING TOOL 6934

CONNECTOR

REMOVAL

(1) Disconnect battery.

(2) Release Connector Lock (Fig. 10).

(3) Disconnect the connector being repaired from its mating half/component.

(4) Remove the dress cover (if applicable) (Fig. 10).

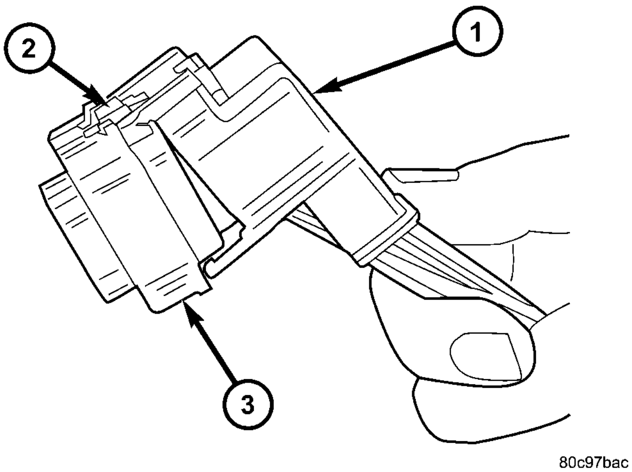


Fig. 10 REMOVAL OF DRESS COVER

1 - DRESS COVER
2 - CONNECTOR LOCK
3 - CONNECTOR

(5) Release the Secondary Terminal Lock, if required (Fig. 11).

(6) Position the connector locking finger away from the terminal using the proper special tool. Pull on the wire to remove the terminal from the connector (Fig. 12).

INSTALLATION

(1) Insert the removed terminal in the same cavity on the repair connector.

(2) Repeat steps for each terminal in the connector, being sure that all wires are inserted into the proper cavities. For additional connector pin-out identification, refer to the wiring diagrams.

(3) When the connector is re-assembled, the secondary terminal lock must be placed in the locked position to prevent terminal push out.

(4) Replace dress cover (if applicable).

(5) Connect connector to its mating half/component.

(6) Connect battery and test all affected systems.

CONNECTOR (Continued)

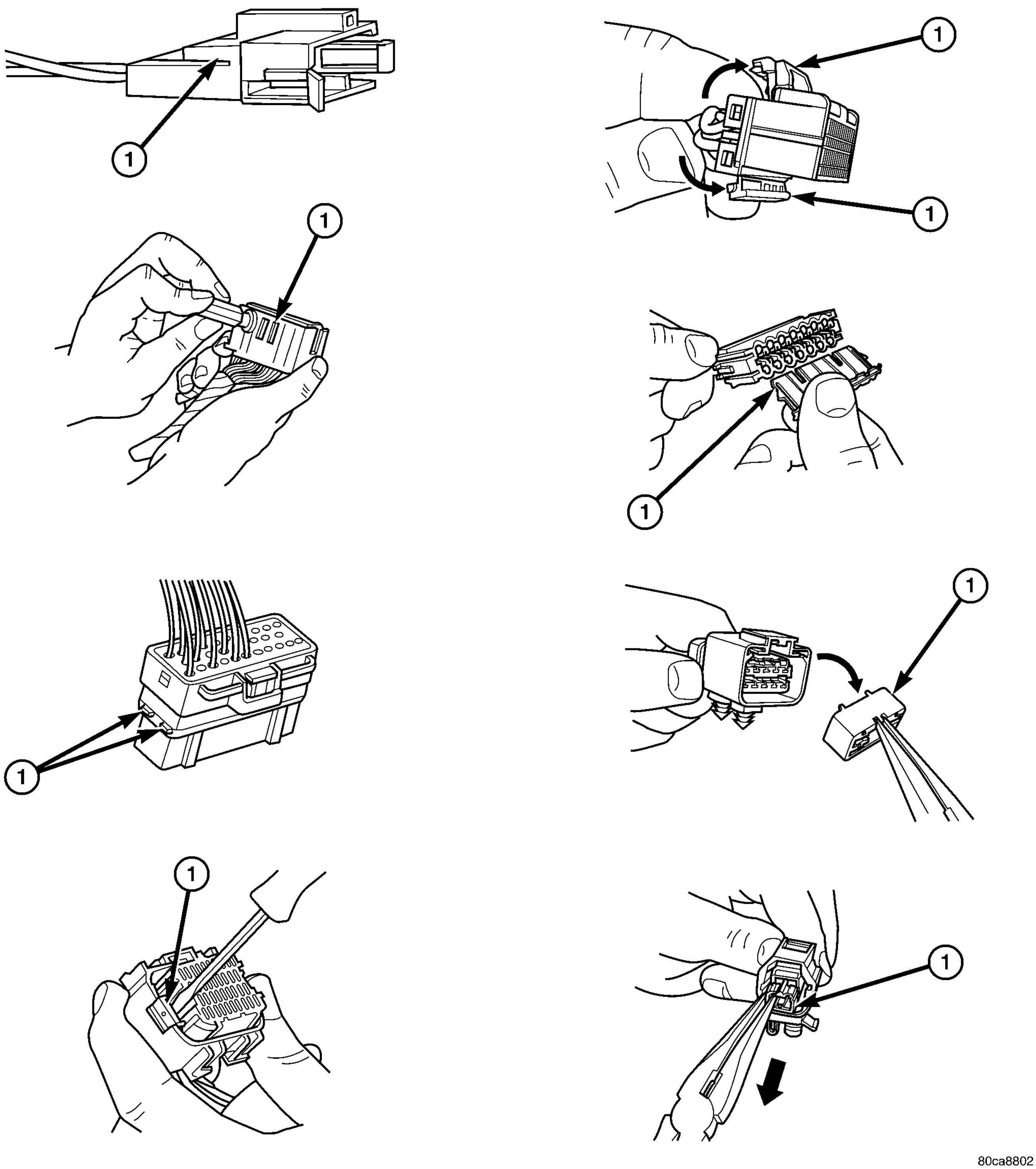


Fig. 11 EXAMPLES OF CONNECTOR SECONDARY TERMINAL LOCKS

1 - Secondary Terminal Lock

CONNECTOR (Continued)

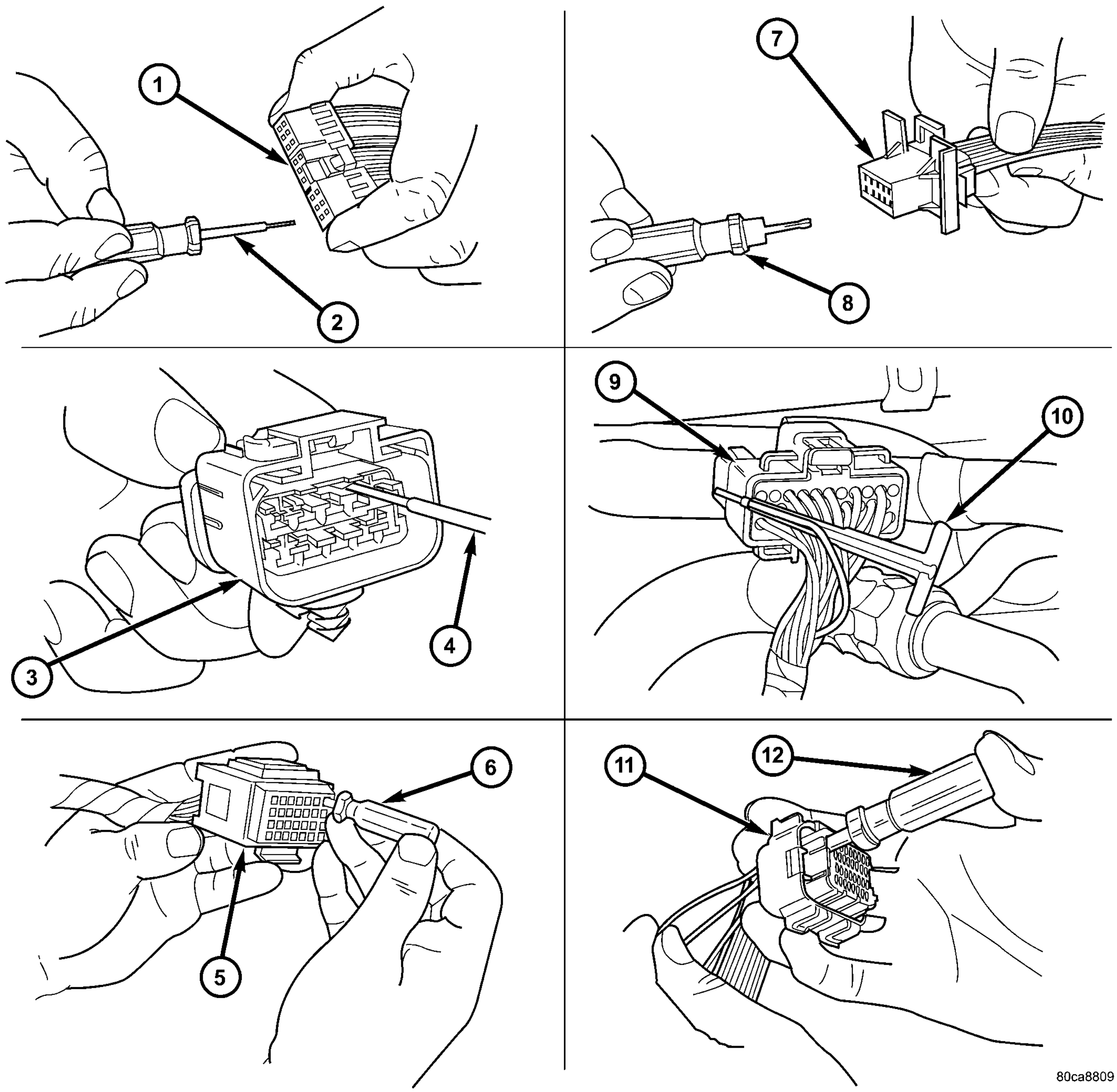


Fig. 12 TERMINAL REMOVAL

1 - TYPICAL CONNECTOR
2 - PICK FROM SPECIAL TOOL KIT 6680
3 - APEX CONNECTOR
4 - PICK FROM SPECIAL TOOL KIT 6680
5 - AUGAT CONNECTOR
6 - SPECIAL TOOL 6932
7 - MOLEX CONNECTOR
8 - SPECIAL TOOL 6742
9 - THOMAS AND BETTS CONNECTOR
10 - SPECIAL TOOL 6934
11 - TYCO CONNECTOR
12 - SPECIAL TOOL 8638

DIODE

REMOVAL

(1) Disconnect the battery.

(2) Locate the diode in the harness, and remove the protective covering.

(3) Remove the diode from the harness, pay attention to the current flow direction (Fig. 13).

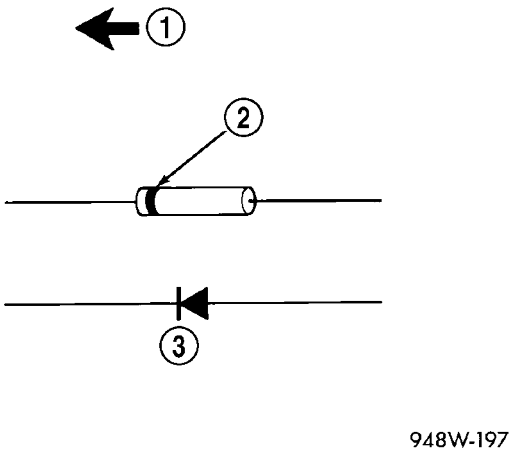


Fig. 13 DIODE IDENTIFICATION

1 - CURRENT FLOW
2 - BAND AROUND DIODE INDICATES CURRENT FLOW
3 - DIODE AS SHOWN IN THE DIAGRAMS

INSTALLATION

(1) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(2) Install the new diode in the harness, making sure current flow is correct. If necessary, refer to the appropriate wiring diagram for current flow (Fig. 13).

(3) Solder the connection together using rosin core type solder only. **Do not use acid core solder.**

(4) Tape the diode to the harness using electrical tape. Make sure the diode is completely sealed from the elements.

(5) Re-connect the battery and test affected systems.

TERMINAL

REMOVAL

(1) Follow steps for removing terminals described in the connector removal section.

(2) Cut the wire 6 inches from the back of the connector.

INSTALLATION

(1) Select a wire from the terminal repair kit that best matches the color and gage of the wire being repaired.

(2) Cut the repair wire to the proper length and remove one–half (1/2) inch of insulation.

(3) Splice the repair wire to the wire harness (see wire splicing procedure).

(4) Insert the repaired wire into the connector.

(5) Install the connector locking wedge, if required, and reconnect the connector to its mating half/component.

(6) Re-tape the wire harness starting at 1–1/2 inches behind the connector and 2 inches past the repair.

(7) Connect battery and test all affected systems.

WIRE

STANDARD PROCEDURE - WIRE SPLICING

When splicing a wire, it is important that the correct gage be used as shown in the wiring diagrams.

(1) Remove one-half (1/2) inch of insulation from each wire that needs to be spliced.

(2) Place a piece of adhesive lined heat shrink tubing on one side of the wire. Make sure the tubing will be long enough to cover and seal the entire repair area.

(3) Place the strands of wire overlapping each other inside of the splice clip (Fig. 14).

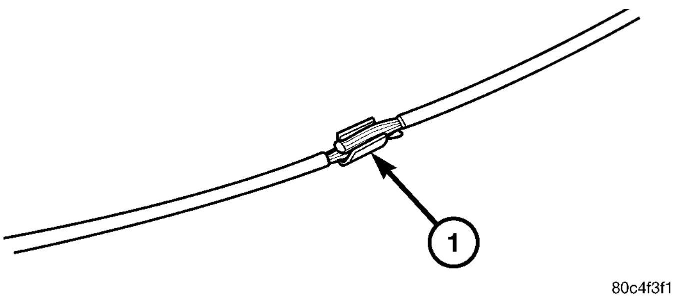


Fig. 14 SPLICE BAND

1 - SPLICE BAND

(4) Using crimping tool, Mopar p/n 05019912AA, crimp the splice clip and wires together (Fig. 15).

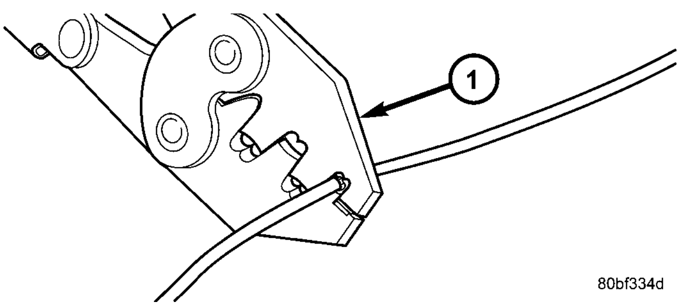


Fig. 15 CRIMPING TOOL

1 - CRIMPING TOOL

(5) Solder the connection together using rosin core type solder only (Fig. 16).

CAUTION: DO NOT USE ACID CORE SOLDER.

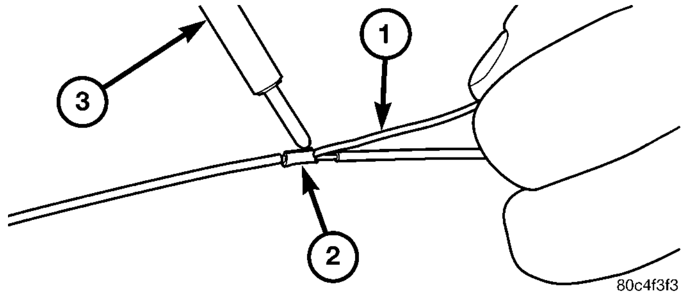


Fig. 16 SOLDER SPLICE

1 - SOLDER
2 - SPLICE BAND
3 - SOLDERING IRON

(6) Center the heat shrink tubing over the joint and heat using a heat gun. Heat the joint until the tubing is tightly sealed and sealant comes out of both ends of the tubing (Fig. 17).

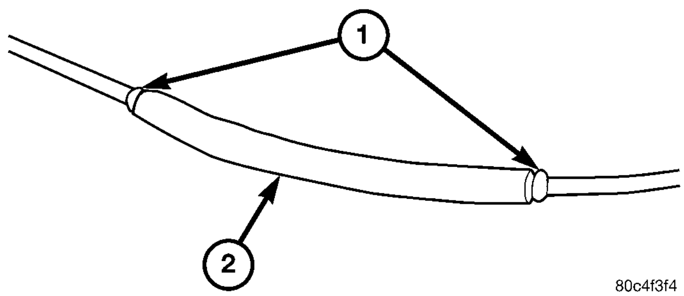


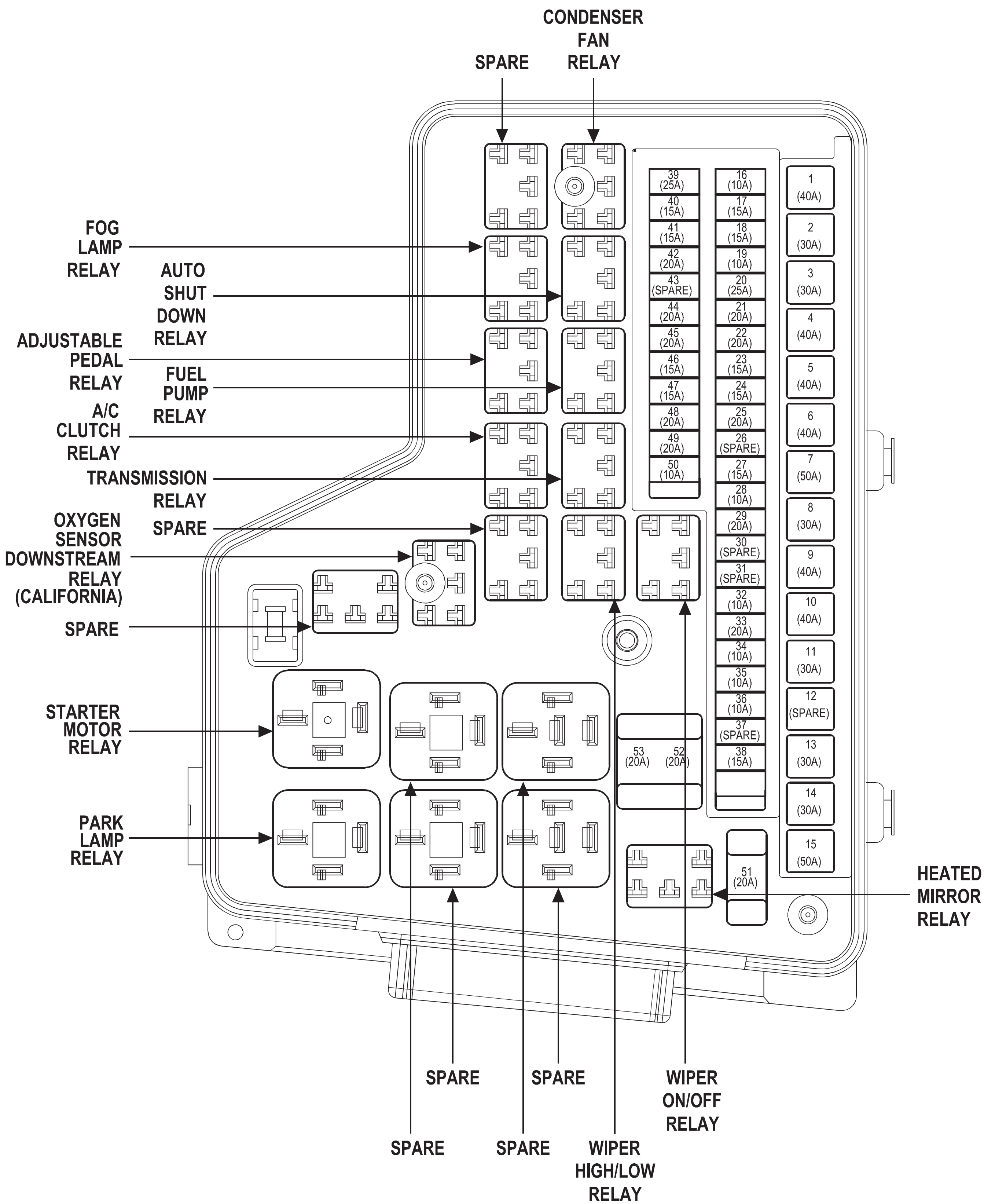
Fig. 17 HEAT SHRINK TUBE

1 - SEALANT
2 - HEAT SHRINK TUBE

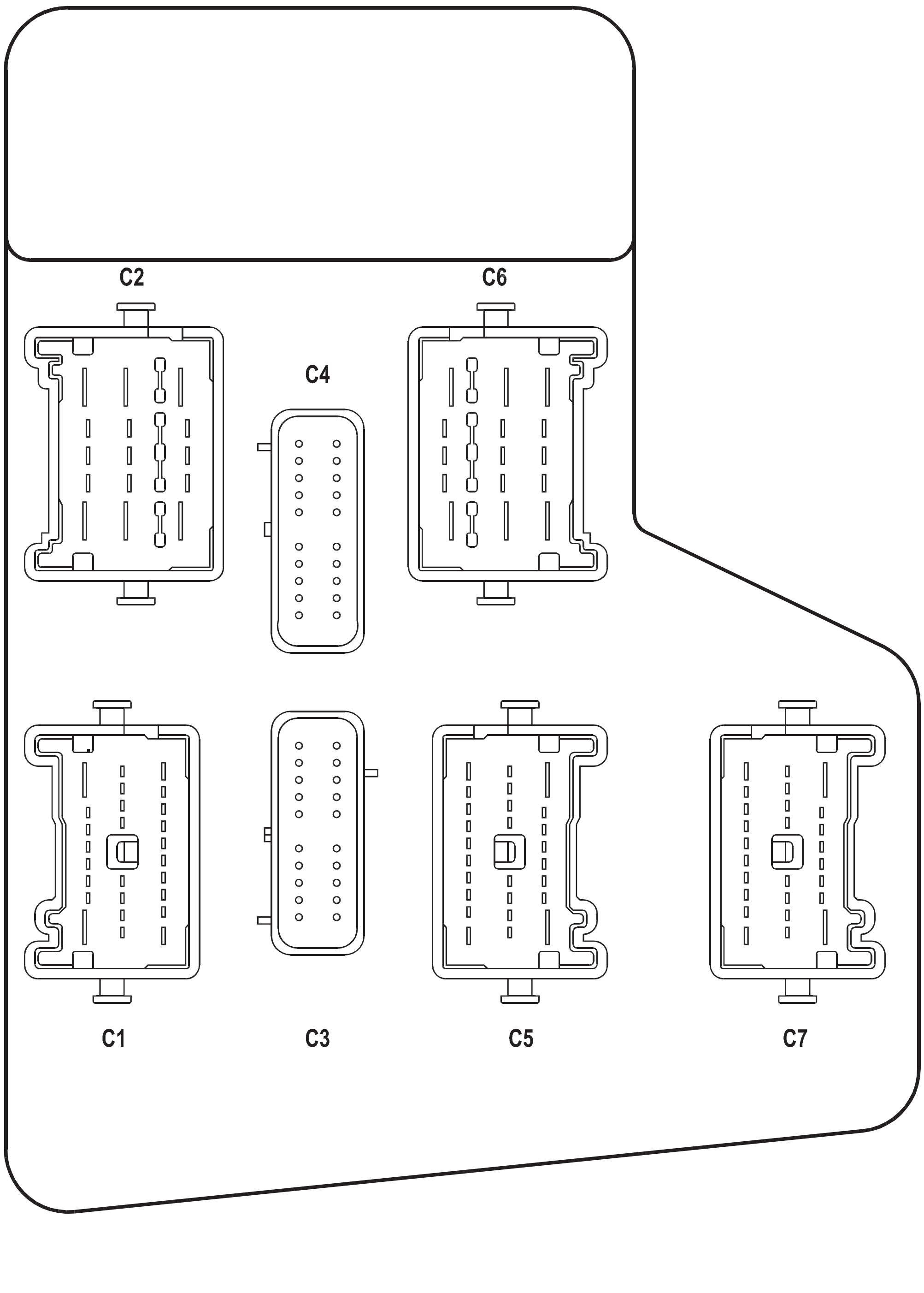
8W-02 COMPONENT INDEX

8W-10 POWER DISTRIBUTION

INTEGRATED POWER MODULE



INTEGRATED POWER MODULE
(REAR VIEW)



FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	40	Y133 14RD/OR	FUSED B(+)
2	30	INTERNAL	FUSED B(+)
3	30	A22 16BK/OR	FUSED B(+)
4	40	A2 10PK/BK	FUSED B(+)
5	40	INTERNAL	FUSED B(+)
6	40	A10 12RD/DG	FUSED B(+)
7	50	F37 12RD/LB	FUSED B(+)
8	30	INTERNAL	FUSED B(+)
9	40	A30 10RD/WT	FUSED B(+)
10	40	Y131 14RD/WT	FUSED B(+)
11	30	INTERNAL	FUSED B(+)
12	40	A112 12RD/TN □	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	30	A17 16 RD/BK □□	FUSED IGNITION SWITCH OUTPUT (RUN-START)
13	30	INTERNAL	FUSED B(+)
14	30	INTERNAL	FUSED B(+)
15	50	INTERNAL	FUSED B(+)
16	10	INTERNAL	FUSED B(+)
17	15	F32 18RD/YL	FUSED B(+)
18	15	E1 20TN	FUSED B(+)
19	20	A14 20RD/WT	FUSED B(+)
20	25	A1 16RD	FUSED B(+)
21	20	F75 18VT	FUSED B(+)
22	20	F35 18RD	FUSED B(+)
23	-	-	-
24	15	A108 18TN/RD	FUSED B(+)
25	20	A12 18RD/TN	FUSED B(+)
26	25A	INTERNAL	FUSED B(+)
27	15	INTERNAL	FUSED B(+)
28	10	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
29	20	F30 18RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
30	-	-	-
31	-	-	-
32	10	L7 18BK/YL	FUSED PARK LAMP RELAY OUTPUT
33	20	L76 18BK/OR	FUSED PARK LAMP RELAY OUTPUT

□ DIESEL
□□ GAS

FUSES

FUSE NO.	AMPS	FUSED CIRCUIT	FUNCTION
34	10	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
35	10	A20 20RD/DB	FUSED IGNITION SWITCH OUTPUT (RUN)
36	10	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
37	-	-	-
38	15	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
39	25	INTERNAL	FUSED B(+)
40	15	INTERNAL	FUSED B(+)
41	15	INTERNAL	FUSED B(+)
42	20	Y148 18YL/RD	FUSED B(+)
43	25	A34 16LB/RD	FUSED B(+)
44	20	INTERNAL	FUSED B(+)
45	20	INTERNAL	FUSED B(+)
46	15	INTERNAL	FUSED B(+)
47	15	INTERNAL	FUSED B(+)
48	20	F235 18RD	FUSED B(+)
49	20	INTERNAL	FUSED AUTO SHUT DOWN RELAY OUTPUT
50	10	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
51	20	M1 18PK	FUSED B(+)
52	20	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
53	20	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)

POSITIVE TEMPERATURE COEFFICIENTS (PTC)

PTC NO.	AMPS	FUSED CIRCUIT	FUNCTION
1	7.5	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
2	4.5	Y105 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
3	13	-	-
4	13	-	-
5	7.5	INTERNAL	FUSED B(+)

A/C COMPRESSOR CLUTCH RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
86	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
85	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
87	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
87A	-	-

ADJUSTABLE PEDAL RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	ADJUSTABLE PEDAL RELAY CONTROL
87A	Y153 18DB/RD	ADJUSTABLE PEDAL RELAY OUTPUT
87	-	-

AUTO SHUT DOWN RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	K51 18DB/YL	AUTO SHUT DOWN RELAY CONTROL
87	INTERNAL	AUTO SHUT DOWN RELAY OUTPUT
87A	-	-

CONDENSER FAN RELAY

CAVITY	CIRCUIT	FUNCTION
30	A17 16RD/BK	FUSED B(+)
85	A17 16RD/BK	FUSED B(+)
86	Y145 18DB/YL	CONDENSER FAN RELAY CONTROL
87	C23 16DG	CONDENSER FAN RELAY OUTPUT
87A	-	-

HEATED MIRROR RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN)
86	C16 20LB/YL	HEATED MIRROR RELAY CONTROL
87	F121 16TN/BK	HEATED MIRROR RELAY OUTPUT
87A	-	-

FOG LAMP RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	FOG LAMP RELAY CONTROL
87	L39 18LB	FOG LAMP RELAY OUTPUT
87A	-	-

FUEL PUMP RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
86	K31 18BR	FUEL PUMP RELAY CONTROL
87	A64 16DG/WT	FUEL PUMP RELAY OUTPUT
87A	-	-

HORN RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	HORN RELAY CONTROL
87	X2 18DG/RD	HORN RELAY OUTPUT
87A	-	-

OXYGEN SENSOR DOWNSTREAM RELAY (CALIFORNIA)

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED AUTO SHUT DOWN RELAY OUTPUT
85	INTERNAL	FUSED AUTO SHUT DOWN RELAY OUTPUT
86	K127 18DB/OR	OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
87	A42 18DG	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
87A	-	-

PARK LAMP RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	PARK LAMP RELAY CONTROL
87	INTERNAL	PARK LAMP RLAY OUTPUT
87A	-	-

STARTER MOTOR RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	A41 16YL	FUSED IGNITION SWITCH OUTPUT (START)
86	T24 18BR/YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
87	T40 14BR	STARTER MOTOR RELAY OUTPUT
87A	-	-

TRAILER TOW LEFT TURN RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	TRAILER TOW LEFT TURN RELAY CONTROL
87	Y141 18DG/WT	TRAILER TOW LEFT TURN RELAY OUTPUT
87A	-	-

TRAILER TOW RIGHT TURN RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	INTERNAL	FUSED B(+)
86	INTERNAL	TRAILER TOW RIGHT TURN RELAY CONTROL
87	Y140 18WT/PK	TRAILER TOW RIGHT TURN RELAY OUTPUT
87A	-	-

TRANSMISSION CONTROL RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	FUSED B(+)
85	K30 18PK	TRANSMISSION CONTROL RELAY CONTROL
86	K173 18LG □□□	GROUND
87	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
87A	-	-
86	K173 18LG △△△	GENERATOR SOURCE

WIPER HIGH/ LOW RELAY

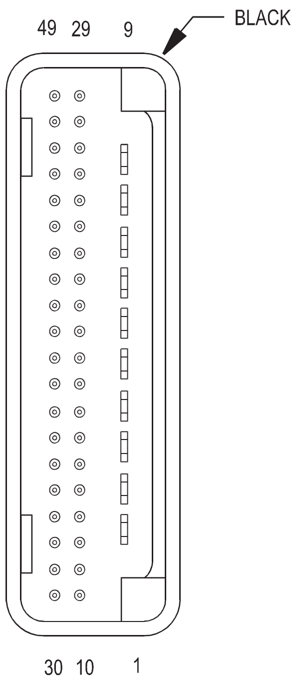
CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	WIPER CONTROL
85	INTERNAL	WIPER SPEED RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	V4 16RD/YL	WIPER RELAY HIGH SPEED OUTPUT
87A	V3 16BR/WT	WIPER RELAY LOW SPEED OUTPUT

WIPER ON/ OFF RELAY

CAVITY	CIRCUIT	FUNCTION
30	INTERNAL	WIPER CONTROL
85	INTERNAL	WIPER ON/OFF RELAY CONTROL
86	INTERNAL	FUSED B(+)
87	INTERNAL	FUSED B(+)
87A	Z316 12BK/OR	GROUND

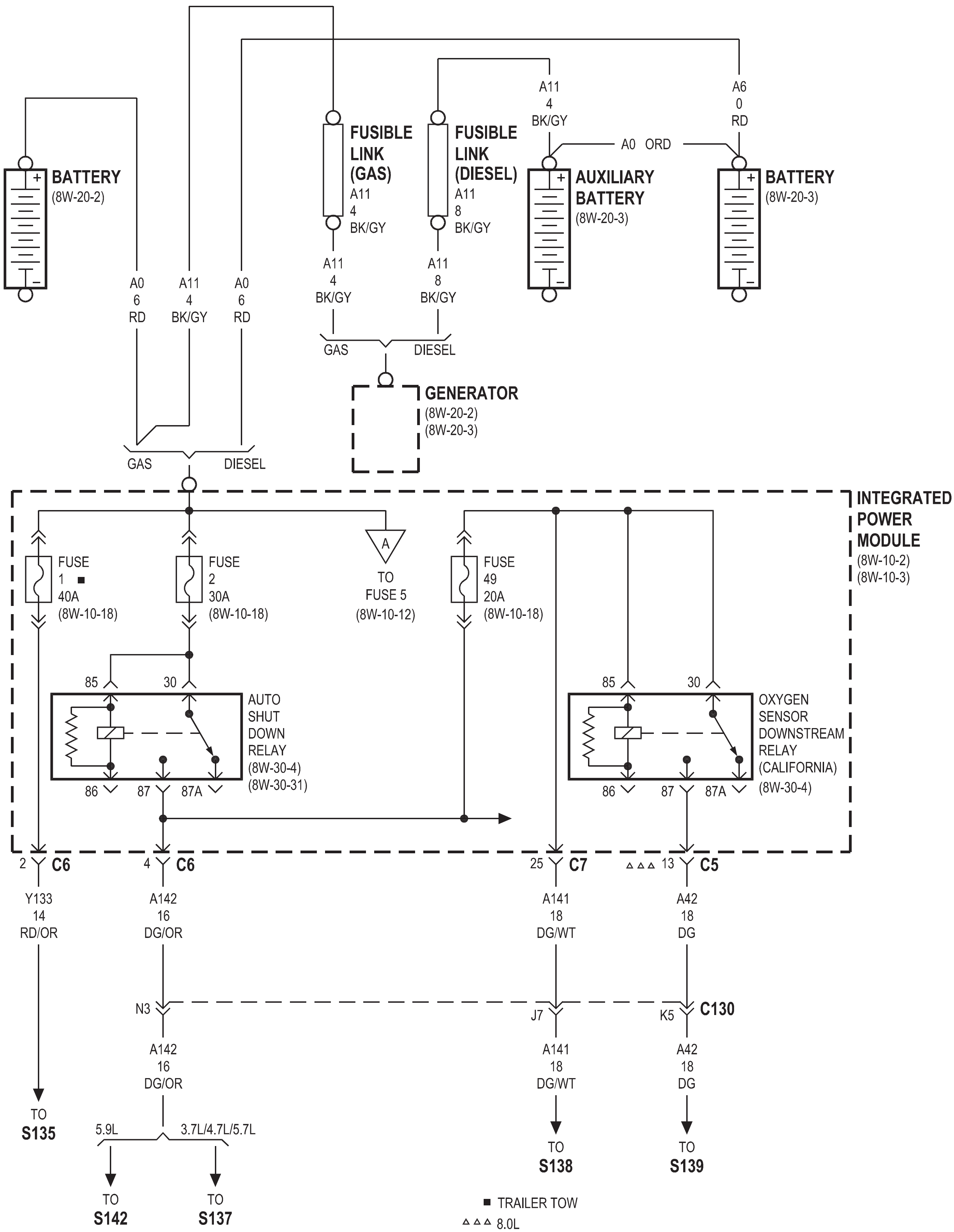
□□□ 3.7L/4.7L

△△△ 5.9L

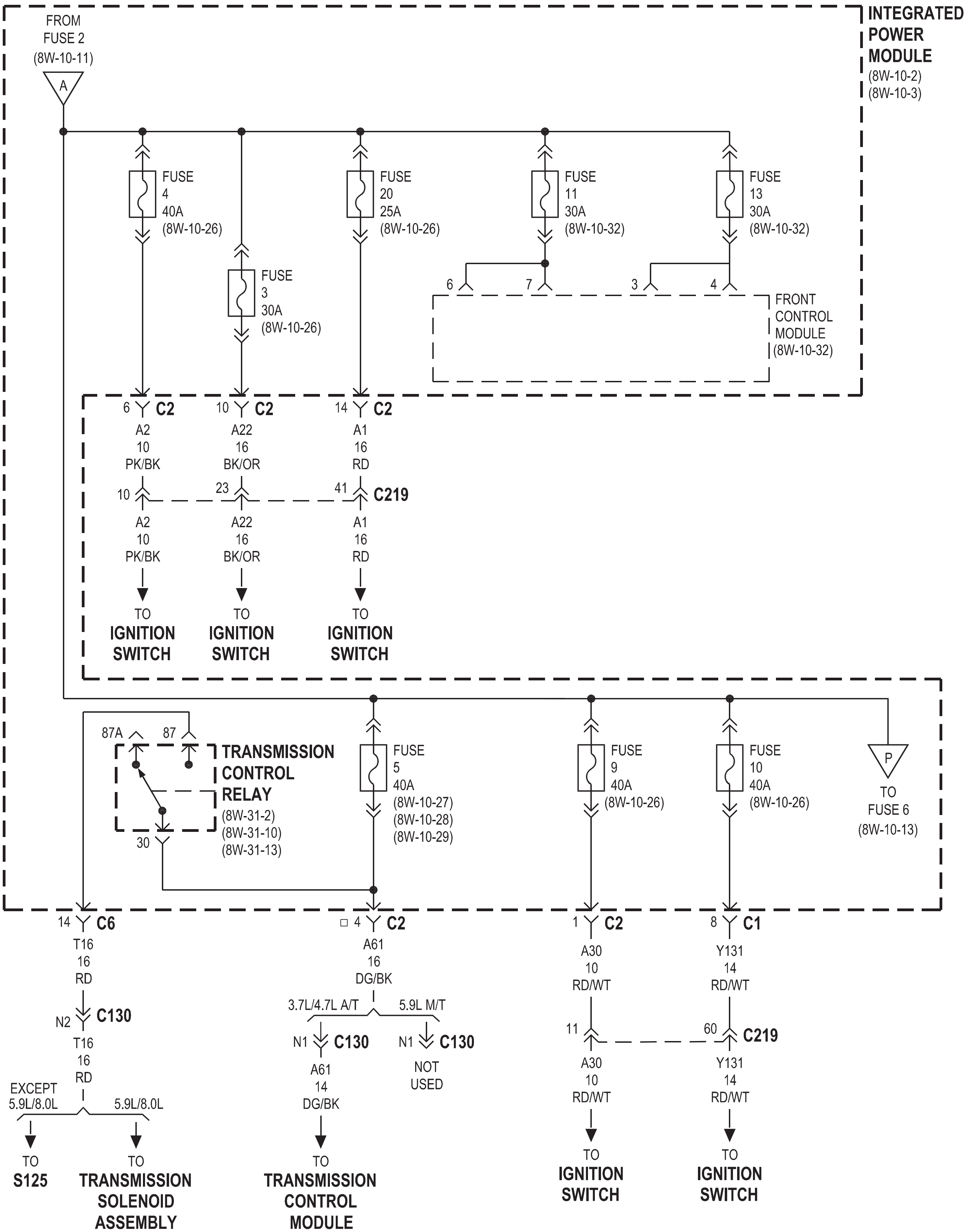


INTEGRATED POWER MODULE FCM

CAV	CIRCUIT	FUNCTION
1	Y169	RIGHT LOW BEAM DRIVER
2	Y170	LEFT HIGH BEAM DRIVER
3	INTERNAL	FUSED B(+)
4	INTERNAL	FUSED B(+)
5	V10	WASHER PUMP MOTOR SENSE
6	INTERNAL	FUSED B(+)
7	INTERNAL	FUSED B(+)
8	Y168	RIGHT HIGH BEAM DRIVER
9	Y171	LEFT LOW BEAM DRIVER
10	INTERNAL	B(+)
11	-	-
12	Z21	GROUND
13	-	-
14	INTERNAL	TRAILER TOW LEFT TURN RELAY CONTROL
15	INTERNAL	PARK LAMP RELAY CONTROL
16	-	-
17	INTERNAL	WIPER ON/OFF RELAY CONTROL
18	INTERNAL	FOG LAMP RELAY CONTROL
19	L62	RIGHT REAR TURN LAMP DRIVER
20	-	-
21	-	-
22	L1	BACKUP LAMP FEED
23	-	-
24	-	-
25	-	-
26	-	-
27	Z2	GROUND
28	G29	WASHER FLUID SWITCH SENSE
29	G31	AMBIENT TEMPERATURE SENSOR SIGNAL
30	Z12	GROUND
31	Z21	GROUND
32	INTERNAL	HORN RELAY CONTROL
33	-	-
34	INTERNAL	TRAILER TOW RIGHT TURN RELAY CONTROL
35	INTERNAL	ADJUSTABLE PEDAL RELAY CONTROL
36	-	-
37	INTERNAL	WIPER HIGH/LOW RELAY CONTROL
38	D25	PCI BUS
39	-	-
40	-	-
41	L22	RIGHT STOP LAMP DRIVER
42	L61	LEFT FRONT TURN LAMP DRIVER
43	L24	LEFT STOP LAMP DRIVER
44	L63	LEFT REAR TURN LAMP DRIVER
45	L60	RIGHT FRONT TURN LAMP DRIVER
46	Y137	SENSOR GROUND
47	Z12	GROUND
48	INTERNAL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
49	V5	WIPER PARK SWITCH SENSE



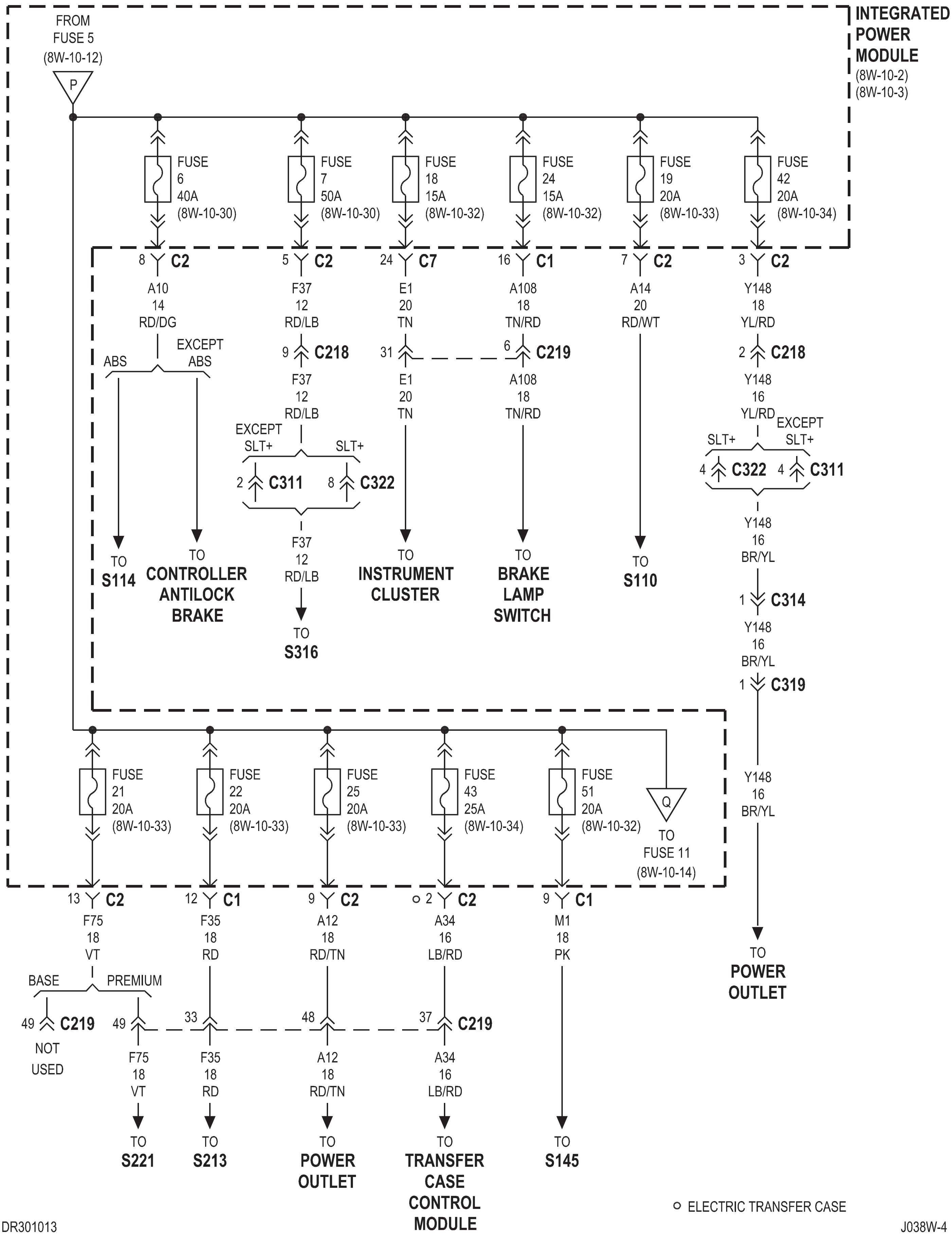
BATTERY
(8W-20-2)
FUSIBLE LINK (GAS)
A11
4
BK/GY
FUSIBLE LINK (DIESEL)
A11
8
BK/GY
A11
4
BK/GY
A0 ORD
A6
0
RD
AUXILIARY BATTERY
(8W-20-3)
BATTERY
(8W-20-3)
A0
6
RD
A11
4
BK/GY
A0
6
RD
GAS
DIESEL
GENERATOR
(8W-20-2)
(8W-20-3)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
1 ■
40A
(8W-10-18)
FUSE
2
30A
(8W-10-18)
A
TO FUSE 5
(8W-10-12)
FUSE
49
20A
(8W-10-18)
85
30
86
87
87A
AUTO SHUT DOWN RELAY
(8W-30-4)
(8W-30-31)
OXYGEN SENSOR DOWNSTREAM RELAY (CALIFORNIA)
(8W-30-4)
2 C6
4 C6
25 C7
△△△ 13 C5
Y133
14
RD/OR
A142
16
DG/OR
A141
18
DG/WT
A42
18
DG
N3
J7
K5
C130
TO S135
5.9L
3.7L/4.7L/5.7L
TO S142
TO S137
TO S138
TO S139
■ TRAILER TOW
△△△ 8.0L

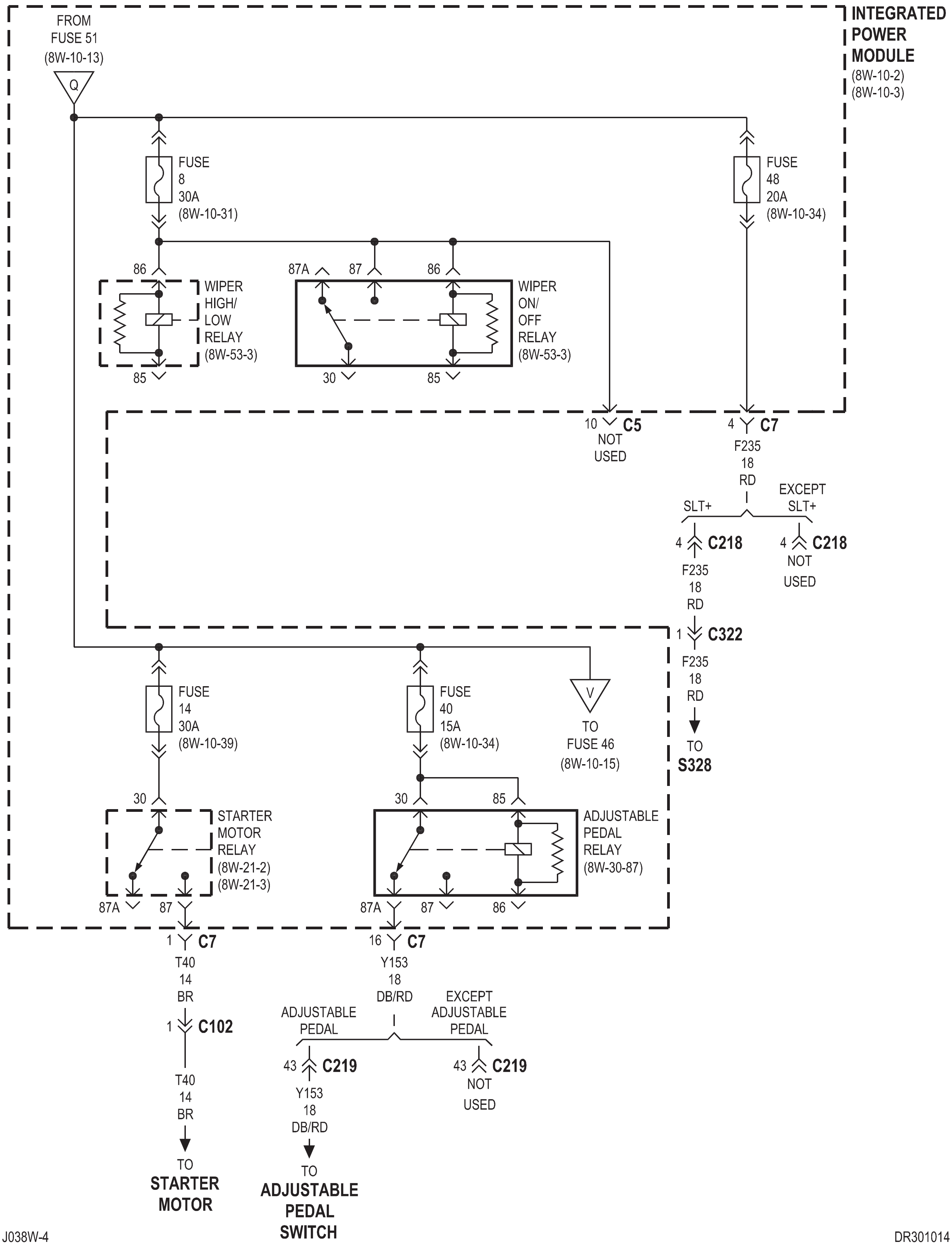


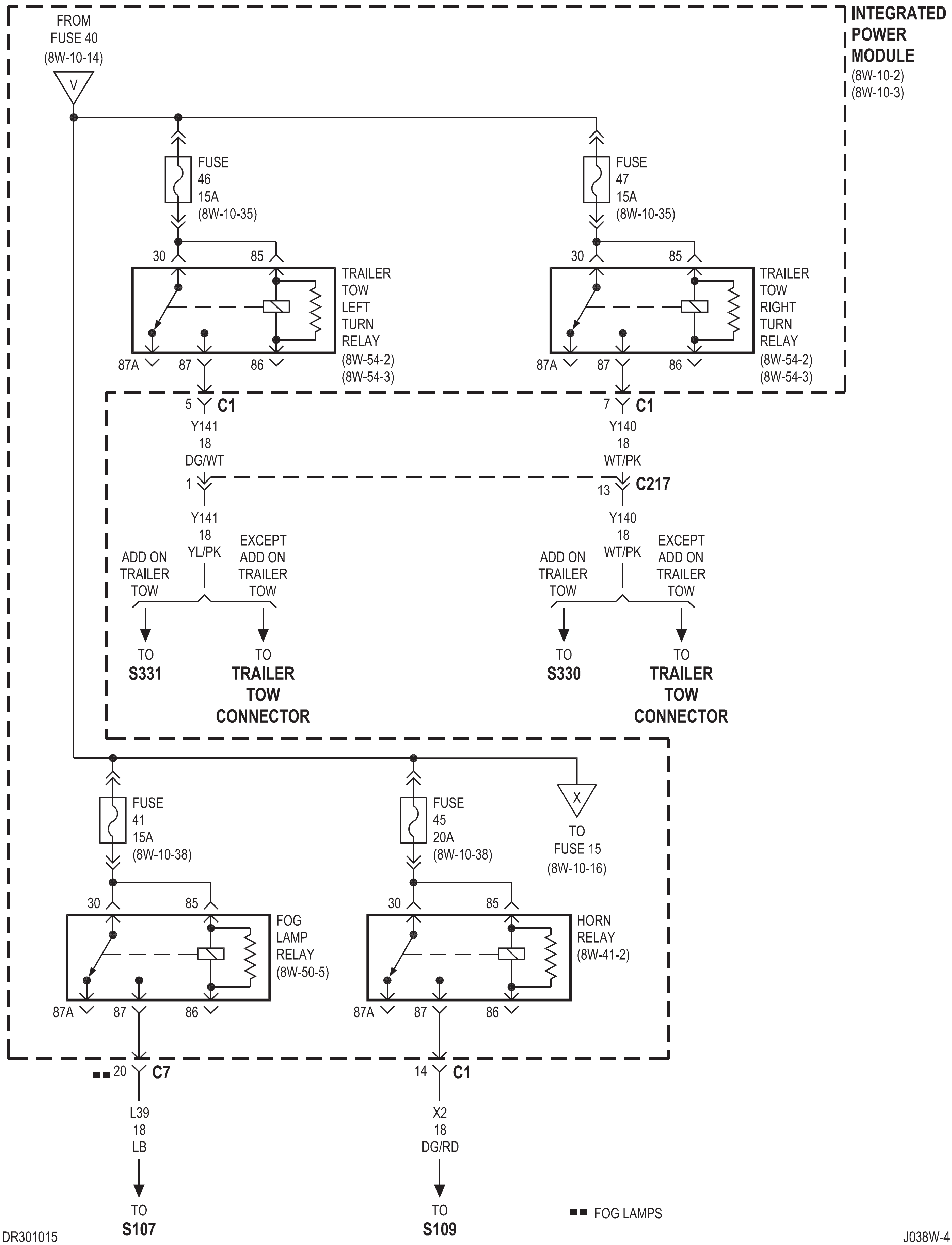
J038W-4

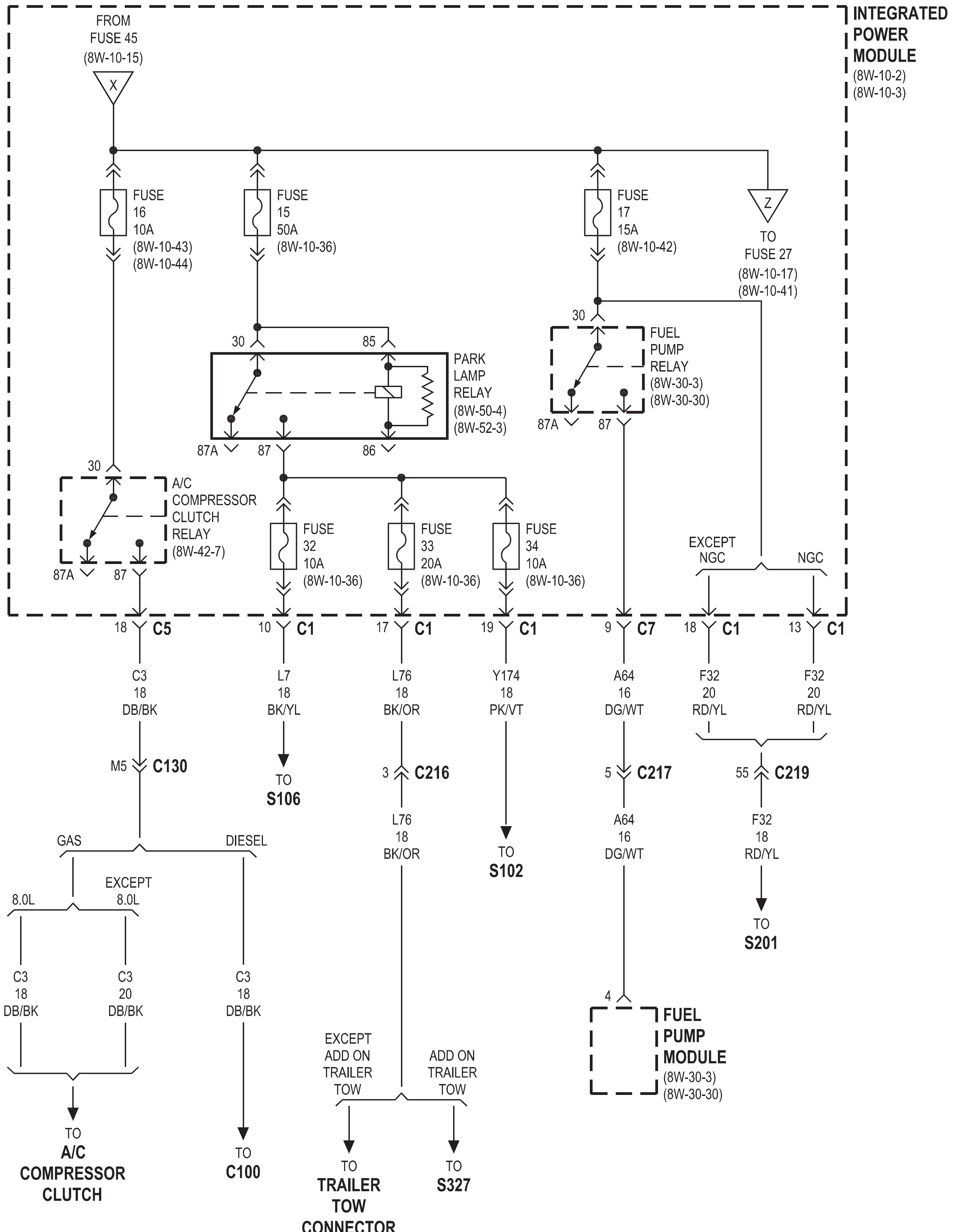
□ EXCEPT DIESEL/8.0L

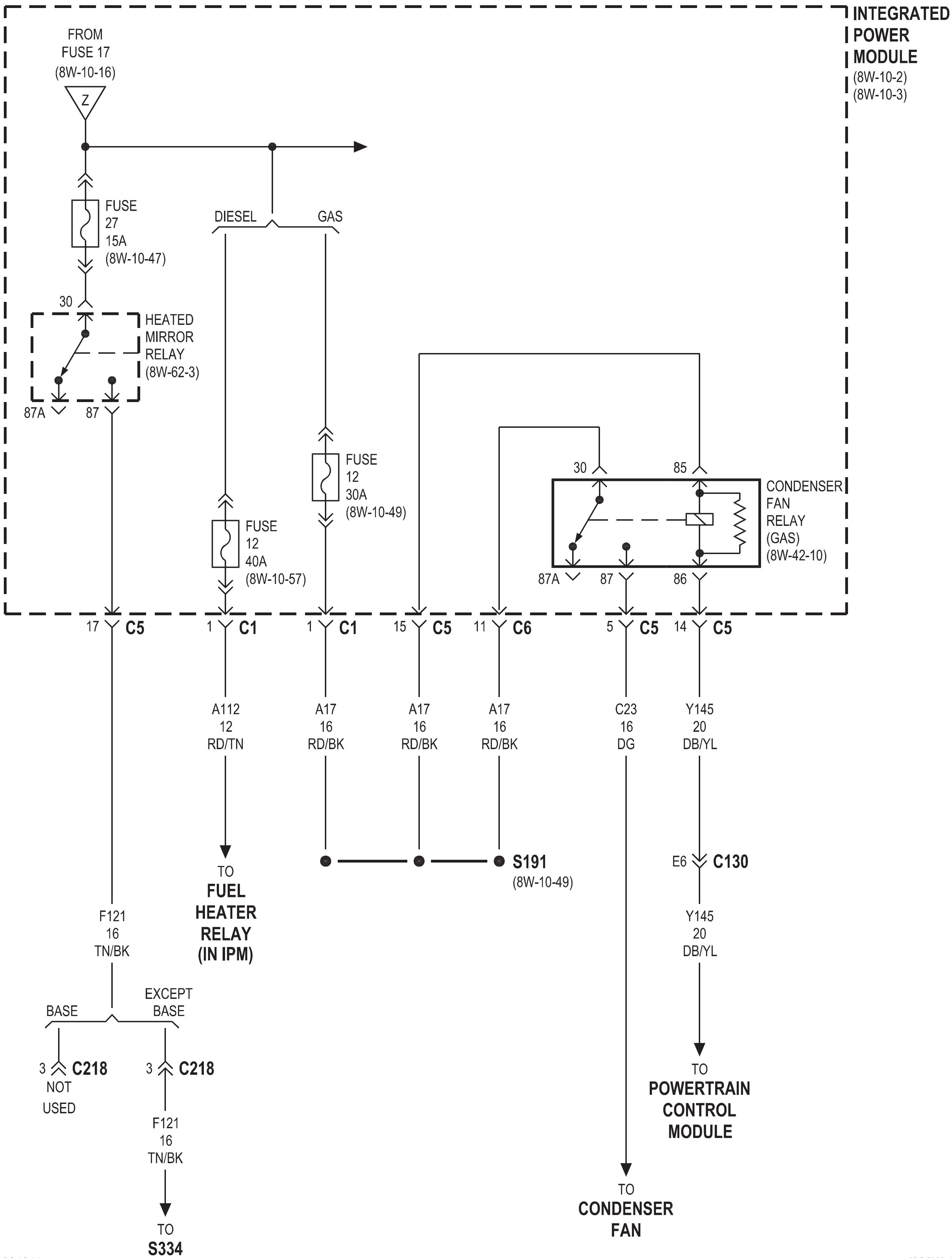
DR301012

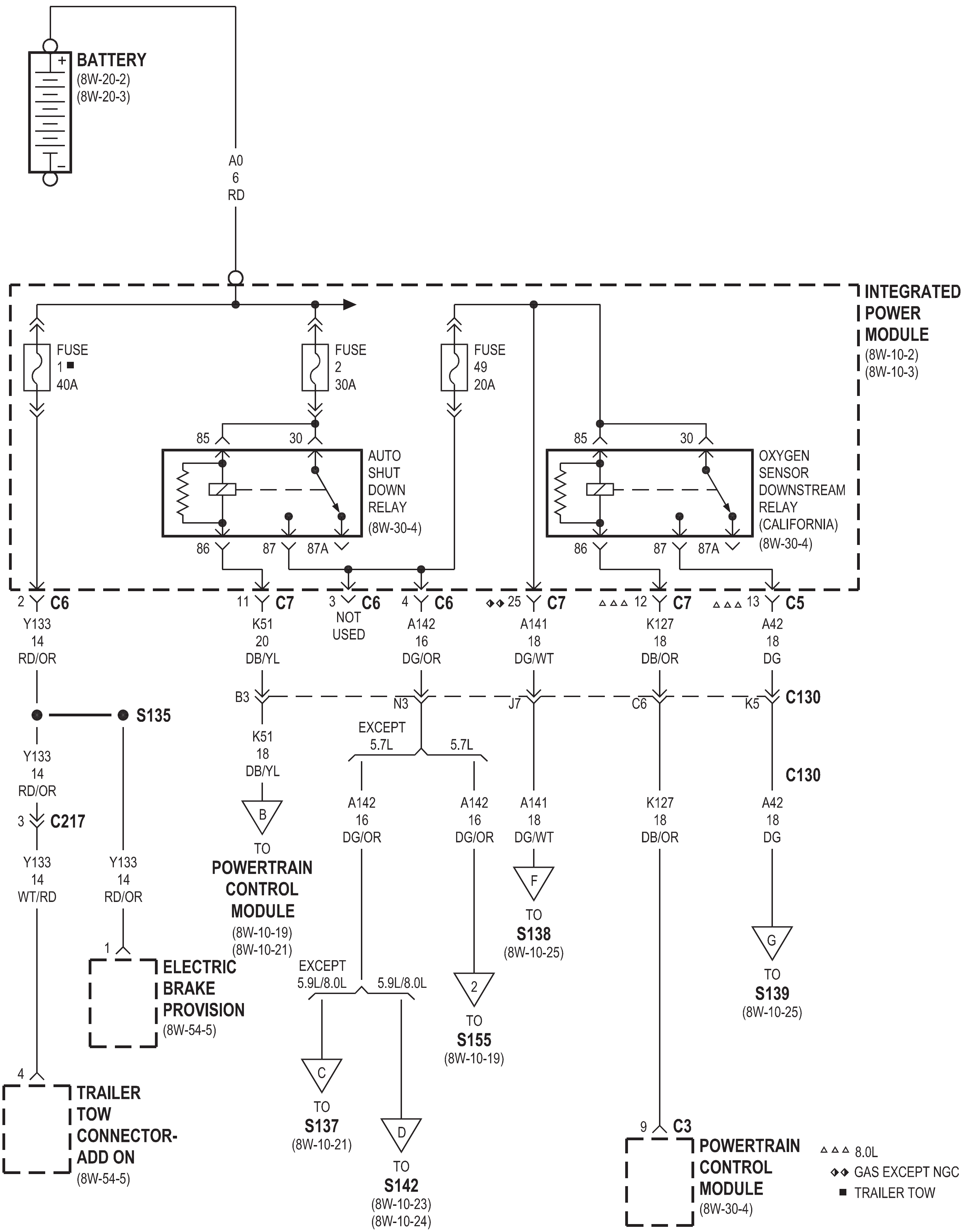

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FROM FUSE 5 (8W-10-12)
P
FUSE 6 40A (8W-10-30)
FUSE 7 50A (8W-10-30)
FUSE 18 15A (8W-10-32)
FUSE 24 15A (8W-10-32)
FUSE 19 20A (8W-10-33)
FUSE 42 20A (8W-10-34)
8 C2
A10 14 RD/DG
ABS
EXCEPT ABS
TO S114
TO CONTROLLER ANTILOCK BRAKE
5 C2
F37 12 RD/LB
9 C218
F37 12 RD/LB
EXCEPT SLT+
SLT+
2 C311
8 C322
F37 12 RD/LB
TO S316
24 C7
E1 20 TN
31
E1 20 TN
TO INSTRUMENT CLUSTER
16 C1
A108 18 TN/RD
6 C219
A108 18 TN/RD
TO BRAKE LAMP SWITCH
7 C2
A14 20 RD/WT
TO S110
3 C2
Y148 18 YL/RD
2 C218
Y148 16 YL/RD
SLT+
EXCEPT SLT+
4 C322
4 C311
Y148 16 BR/YL
1 C314
Y148 16 BR/YL
1 C319
Y148 16 BR/YL
TO POWER OUTLET
FUSE 21 20A (8W-10-33)
FUSE 22 20A (8W-10-33)
FUSE 25 20A (8W-10-33)
FUSE 43 25A (8W-10-34)
FUSE 51 20A (8W-10-32)
Q
TO FUSE 11 (8W-10-14)
13 C2
F75 18 VT
BASE
PREMIUM
49 C219
NOT USED
49
F75 18 VT
TO S221
12 C1
F35 18 RD
33
F35 18 RD
TO S213
9 C2
A12 18 RD/TN
48
A12 18 RD/TN
TO POWER OUTLET
○ 2 C2
A34 16 LB/RD
37 C219
A34 16 LB/RD
TO TRANSFER CASE CONTROL MODULE
9 C1
M1 18 PK
TO S145
○ ELECTRIC TRANSFER CASE


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FROM FUSE 51 (8W-10-13)
Q
FUSE 8 30A (8W-10-31)
FUSE 48 20A (8W-10-34)
86
WIPER HIGH/ LOW RELAY (8W-53-3)
85
87A
87
86
WIPER ON/ OFF RELAY (8W-53-3)
30
85
10 C5 NOT USED
4 C7
F235 18 RD
SLT+
EXCEPT SLT+
4 C218
4 C218 NOT USED
F235 18 RD
1 C322
F235 18 RD
TO S328
FUSE 14 30A (8W-10-39)
FUSE 40 15A (8W-10-34)
V
TO FUSE 46 (8W-10-15)
30
STARTER MOTOR RELAY (8W-21-2) (8W-21-3)
87A
87
30
85
ADJUSTABLE PEDAL RELAY (8W-30-87)
87A
87
86
1 C7
T40 14 BR
1 C102
T40 14 BR
TO STARTER MOTOR
16 C7
Y153 18 DB/RD
ADJUSTABLE PEDAL
EXCEPT ADJUSTABLE PEDAL
43 C219
43 C219 NOT USED
Y153 18 DB/RD
TO ADJUSTABLE PEDAL SWITCH

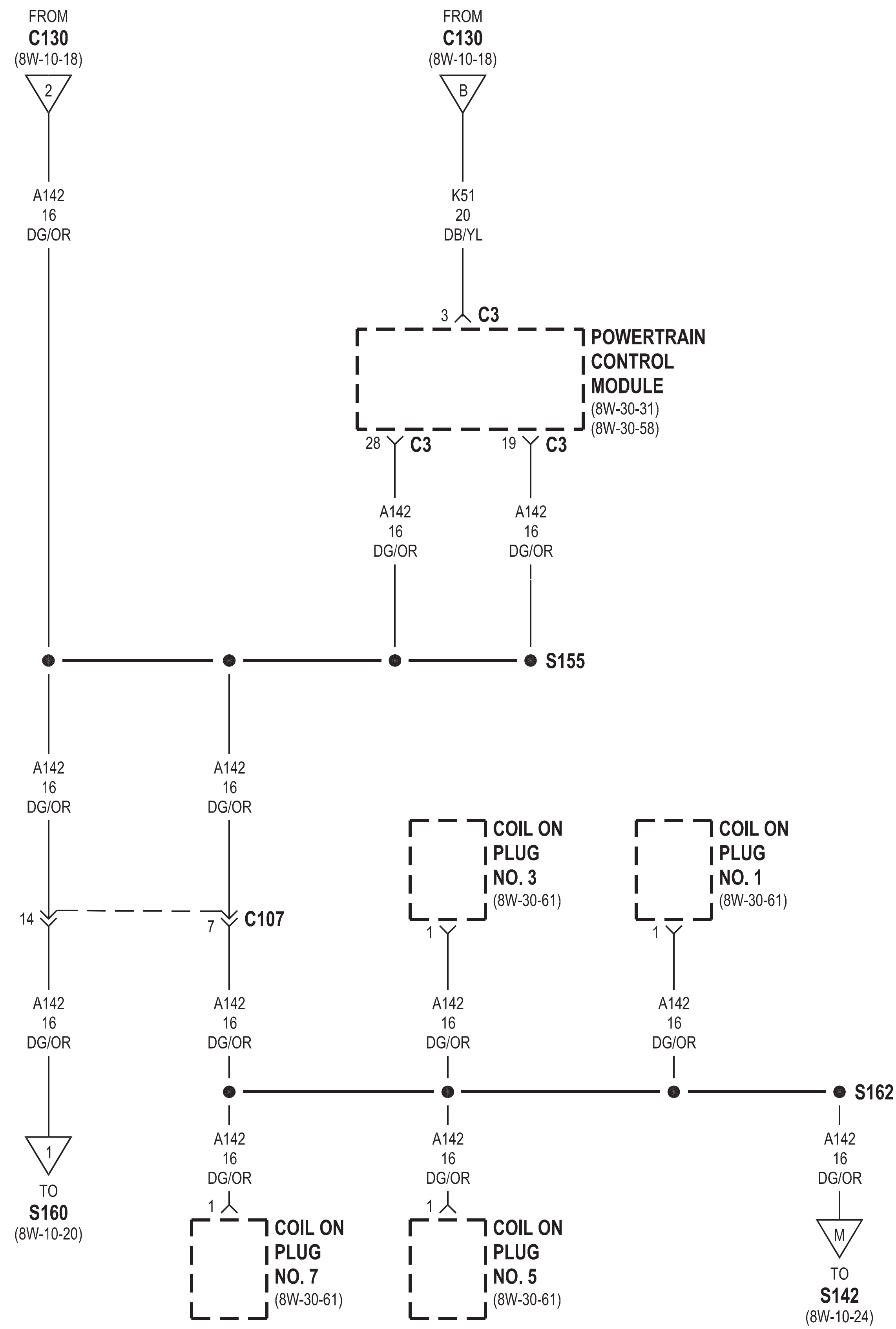

INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FROM
FUSE 40
(8W-10-14)
V
FUSE
46
15A
(8W-10-35)
FUSE
47
15A
(8W-10-35)
30
85
TRAILER
TOW
LEFT
TURN
RELAY
(8W-54-2)
(8W-54-3)
87A
87
86
TRAILER
TOW
RIGHT
TURN
RELAY
(8W-54-2)
(8W-54-3)
5 C1
Y141
18
DG/WT
7 C1
Y140
18
WT/PK
1
13 C217
Y141
18
YL/PK
ADD ON
TRAILER
TOW
EXCEPT
ADD ON
TRAILER
TOW
TO
S331
TO
TRAILER
TOW
CONNECTOR
Y140
18
WT/PK
TO
S330
FUSE
41
15A
(8W-10-38)
FUSE
45
20A
(8W-10-38)
X
TO
FUSE 15
(8W-10-16)
FOG
LAMP
RELAY
(8W-50-5)
HORN
RELAY
(8W-41-2)
20 C7
14 C1
L39
18
LB
X2
18
DG/RD
TO
S107
TO
S109
FOG LAMPS


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FROM FUSE 45
(8W-10-15)
X
FUSE 16 10A
(8W-10-43)
(8W-10-44)
FUSE 15 50A
(8W-10-36)
FUSE 17 15A
(8W-10-42)
Z
TO FUSE 27
(8W-10-17)
(8W-10-41)
PARK LAMP RELAY
(8W-50-4)
(8W-52-3)
30
85
87A
87
86
FUEL PUMP RELAY
(8W-30-3)
(8W-30-30)
A/C COMPRESSOR CLUTCH RELAY
(8W-42-7)
FUSE 32 10A
(8W-10-36)
FUSE 33 20A
(8W-10-36)
FUSE 34 10A
(8W-10-36)
EXCEPT NGC
NGC
18 C5
10 C1
17 C1
19 C1
9 C7
18 C1
13 C1
C3 18 DB/BK
L7 18 BK/YL
L76 18 BK/OR
Y174 18 PK/VT
A64 16 DG/WT
F32 20 RD/YL
F32 20 RD/YL
M5 C130
TO S106
3 C216
TO S102
5 C217
55 C219
L76 18 BK/OR
A64 16 DG/WT
F32 18 RD/YL
TO S201
GAS
DIESEL
8.0L
EXCEPT 8.0L
C3 18 DB/BK
C3 20 DB/BK
C3 18 DB/BK
4
FUEL PUMP MODULE
(8W-30-3)
(8W-30-30)
EXCEPT ADD ON TRAILER TOW
ADD ON TRAILER TOW
TO A/C COMPRESSOR CLUTCH
TO C100
TO TRAILER TOW CONNECTOR
TO S327

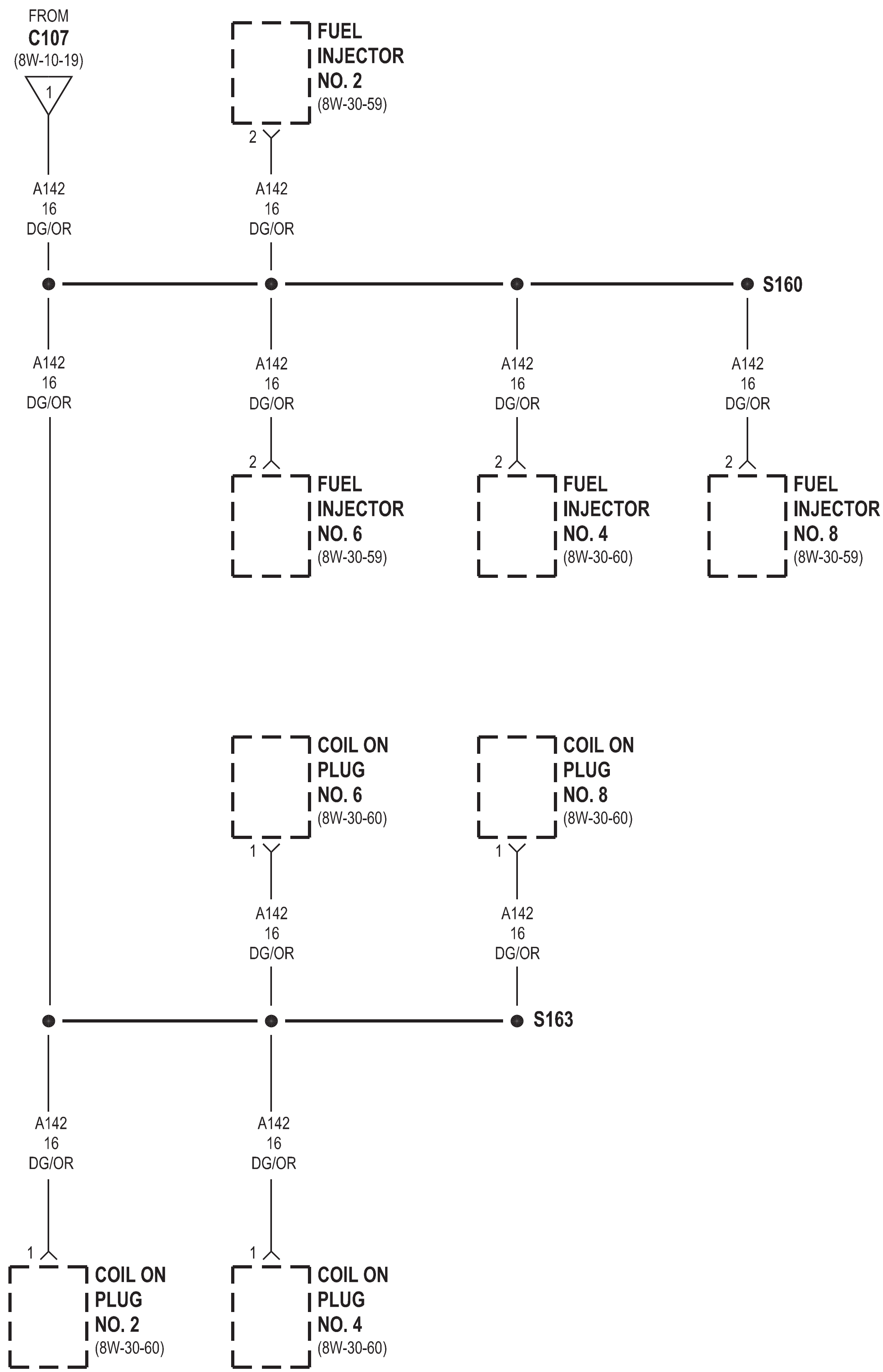

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FROM FUSE 17
(8W-10-16)
Z
FUSE 27 15A
(8W-10-47)
30
HEATED MIRROR RELAY
(8W-62-3)
87A
87
DIESEL
GAS
FUSE 12 40A
(8W-10-57)
FUSE 12 30A
(8W-10-49)
30
85
CONDENSER FAN RELAY (GAS)
(8W-42-10)
87A
87
86
17 C5
1 C1
1 C1
15 C5
11 C6
5 C5
14 C5
A112 12 RD/TN
A17 16 RD/BK
A17 16 RD/BK
A17 16 RD/BK
C23 16 DG
Y145 20 DB/YL
TO FUEL HEATER RELAY (IN IPM)
S191
(8W-10-49)
E6 C130
Y145 20 DB/YL
F121 16 TN/BK
BASE
EXCEPT BASE
3 C218
NOT USED
3 C218
F121 16 TN/BK
TO S334
TO POWERTRAIN CONTROL MODULE
TO CONDENSER FAN

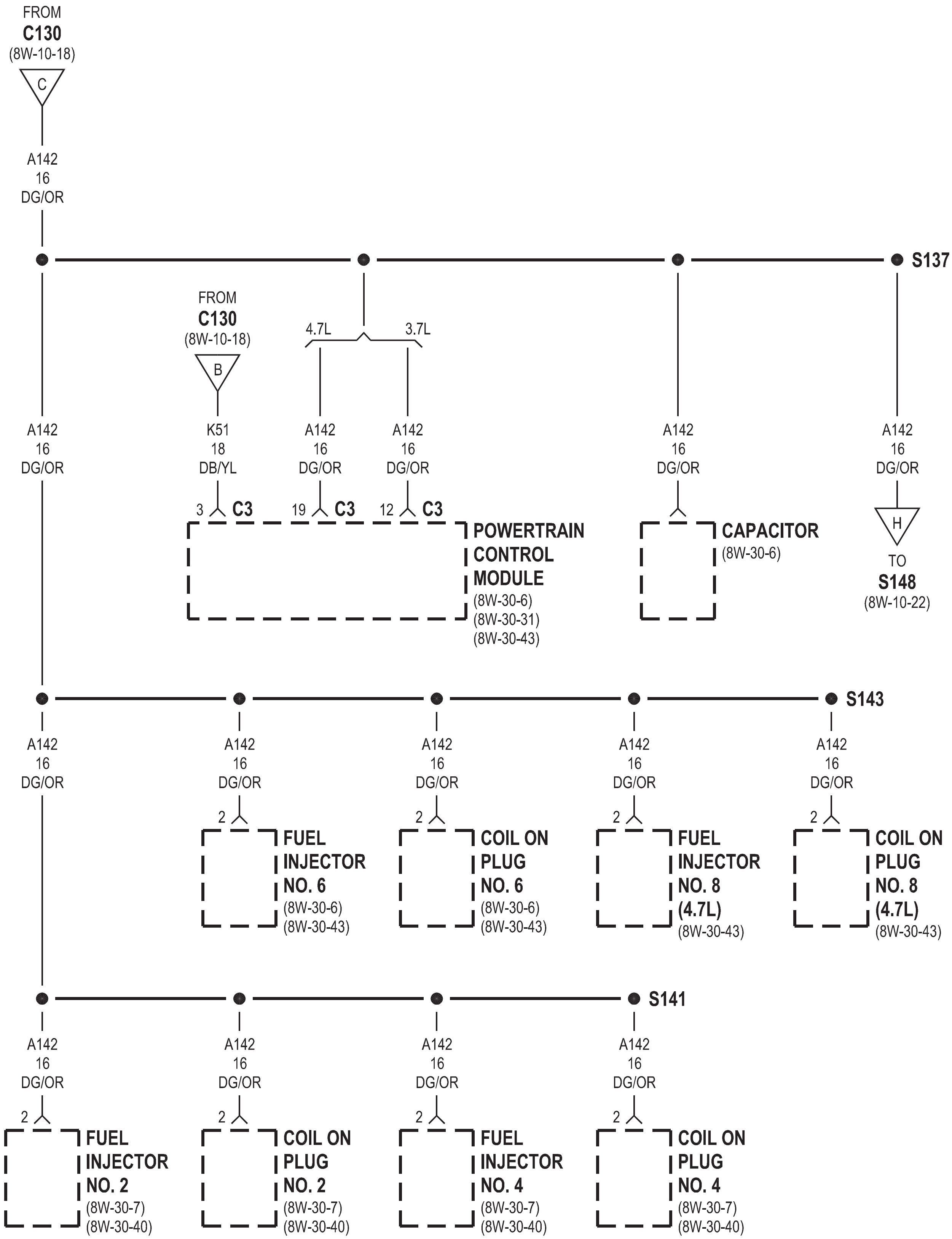

BATTERY
(8W-20-2)
(8W-20-3)
A0
6
RD
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
1 ■
40A
FUSE
2
30A
FUSE
49
20A
85
30
AUTO
SHUT
DOWN
RELAY
(8W-30-4)
86
87
87A
OXYGEN
SENSOR
DOWNSTREAM
RELAY
(CALIFORNIA)
(8W-30-4)
2 C6
Y133
14
RD/OR
11 C7
K51
20
DB/YL
3 C6
NOT
USED
4 C6
A142
16
DG/OR
25 C7
A141
18
DG/WT
12 C7
K127
18
DB/OR
13 C5
A42
18
DG
B3
N3
J7
C6
K5
C130
S135
EXCEPT
5.7L
5.7L
3 C217
Y133
14
WT/RD
K51
18
DB/YL
B
TO
POWERTRAIN
CONTROL
MODULE
(8W-10-19)
(8W-10-21)
F
TO
S138
(8W-10-25)
G
TO
S139
(8W-10-25)
1
ELECTRIC
BRAKE
PROVISION
(8W-54-5)
EXCEPT
5.9L/8.0L
5.9L/8.0L
2
TO
S155
(8W-10-19)
4
TRAILER
TOW
CONNECTOR-
ADD ON
(8W-54-5)
C
TO
S137
(8W-10-21)
D
TO
S142
(8W-10-23)
(8W-10-24)
9 C3
POWERTRAIN
CONTROL
MODULE
(8W-30-4)
8.0L
GAS EXCEPT NGC
TRAILER TOW

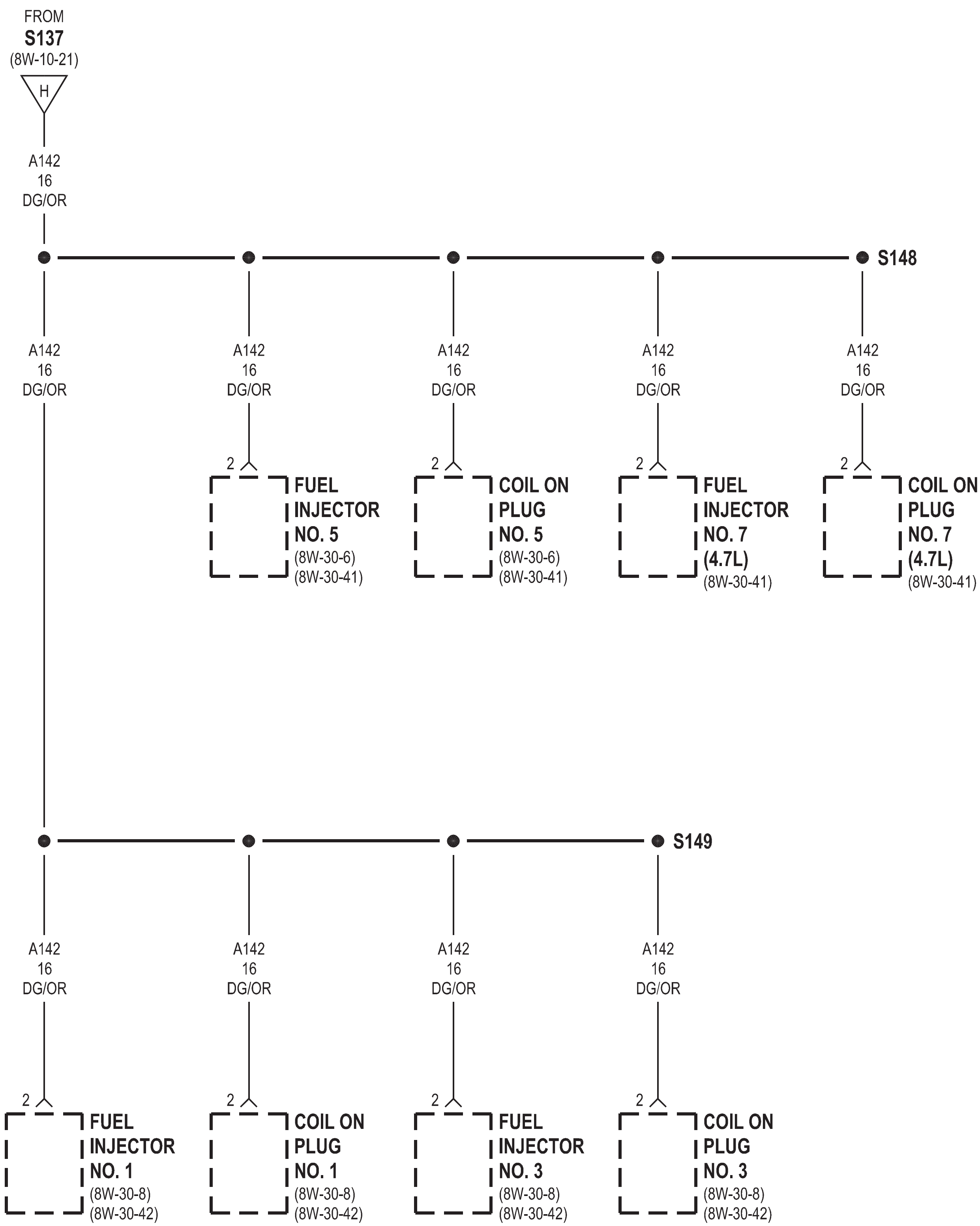
5.7L


FROM
C130
(8W-10-18)
2
FROM
C130
(8W-10-18)
B
A142
16
DG/OR
K51
20
DB/YL
3 C3
POWERTRAIN
CONTROL
MODULE
(8W-30-31)
(8W-30-58)
28 C3
19 C3
A142
16
DG/OR
S155
C107
14
7
COIL ON
PLUG
NO. 3
(8W-30-61)
COIL ON
PLUG
NO. 1
(8W-30-61)
S162
1
TO
S160
(8W-10-20)
COIL ON
PLUG
NO. 7
(8W-30-61)
COIL ON
PLUG
NO. 5
(8W-30-61)
M
TO
S142
(8W-10-24)

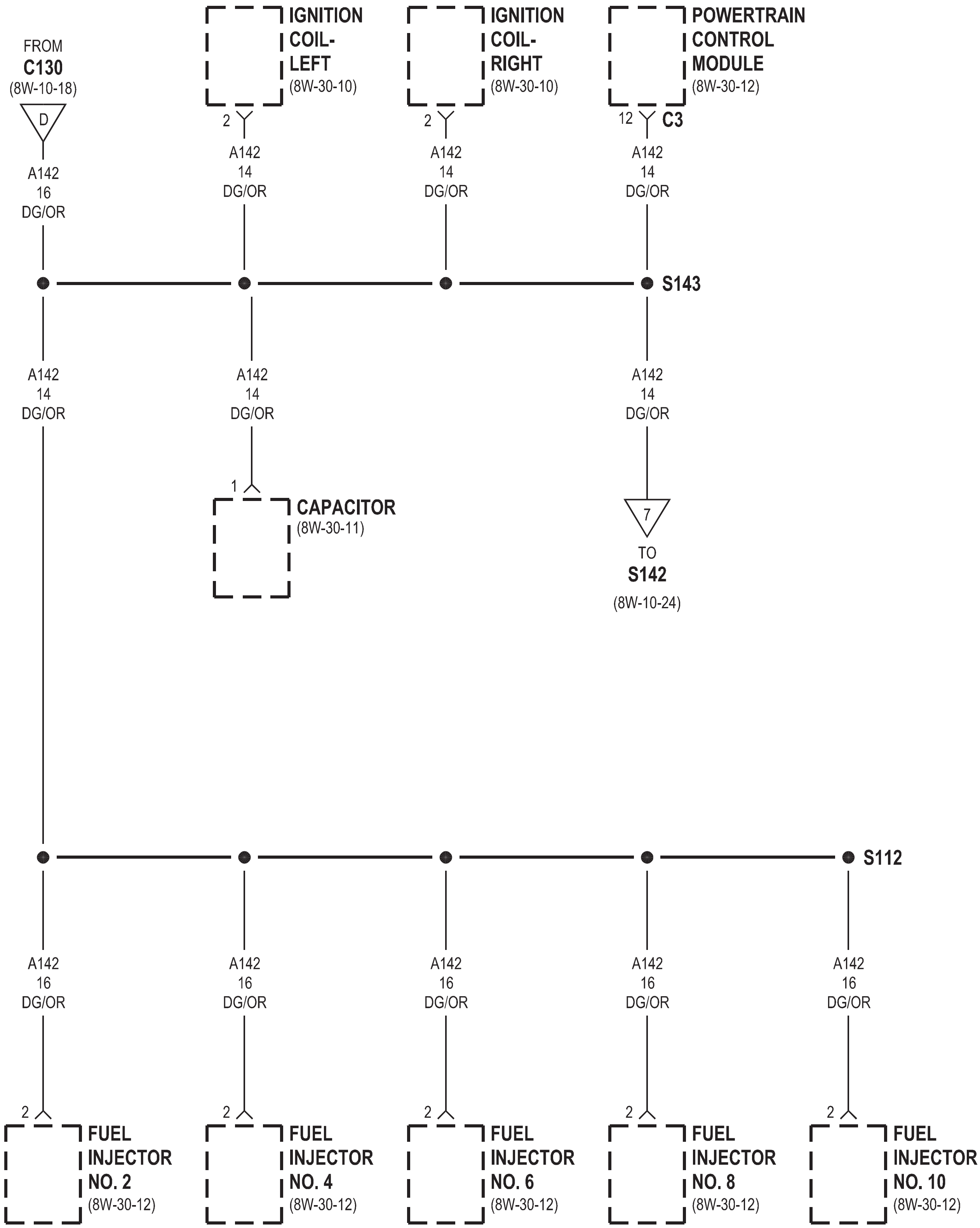
5.7L


FROM
C107
(8W-10-19)
1
FUEL INJECTOR NO. 2
(8W-30-59)
2
A142
16
DG/OR
S160
FUEL INJECTOR NO. 6
(8W-30-59)
FUEL INJECTOR NO. 4
(8W-30-60)
FUEL INJECTOR NO. 8
(8W-30-59)
COIL ON PLUG NO. 6
(8W-30-60)
COIL ON PLUG NO. 8
(8W-30-60)
1
S163
COIL ON PLUG NO. 2
(8W-30-60)
COIL ON PLUG NO. 4
(8W-30-60)

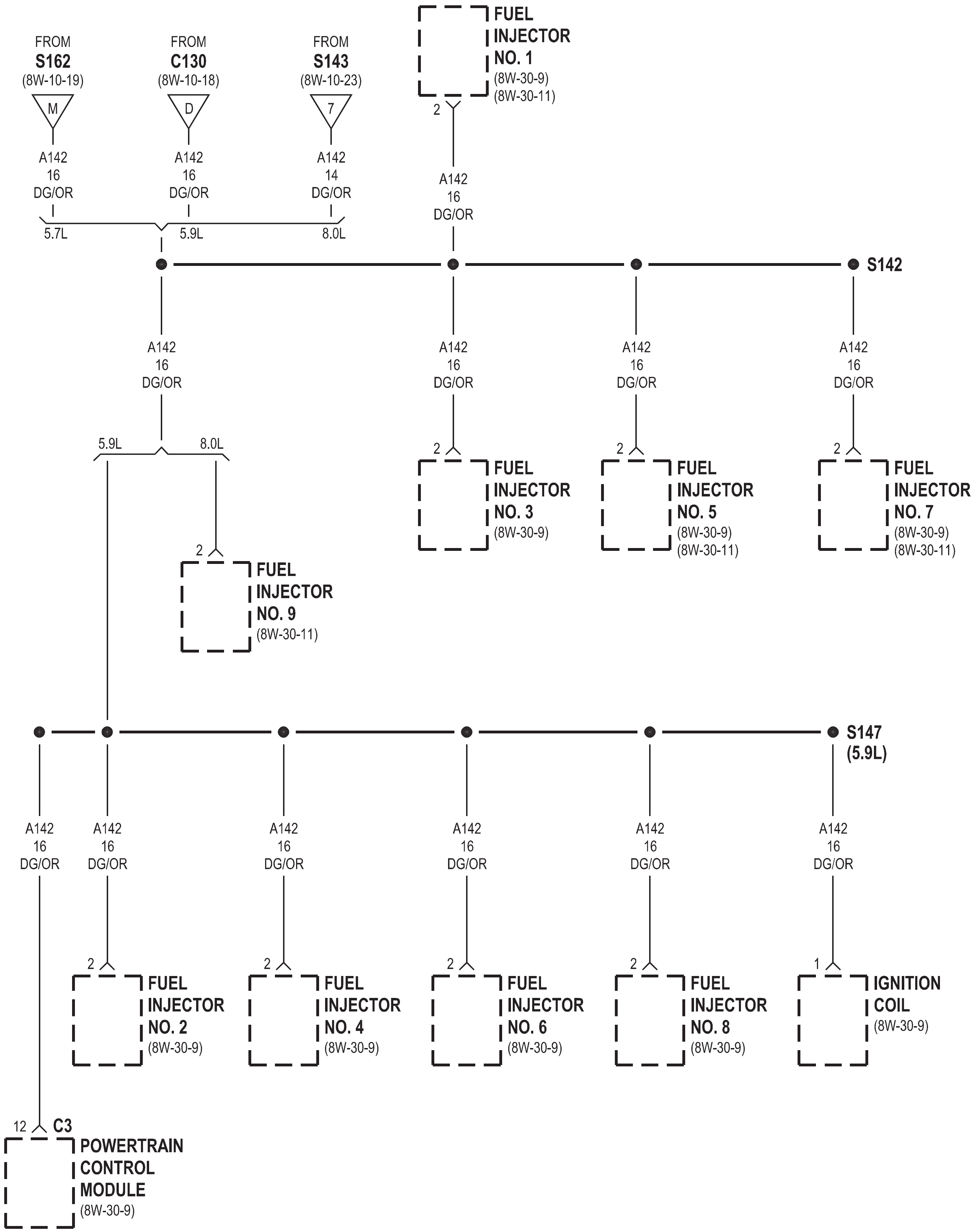

FROM
C130
(8W-10-18)
C
A142
16
DG/OR
S137
FROM
C130
(8W-10-18)
B
4.7L
3.7L
K51
18
DB/YL
3 C3
19 C3
12 C3
POWERTRAIN
CONTROL
MODULE
(8W-30-6)
(8W-30-31)
(8W-30-43)
CAPACITOR
(8W-30-6)
H
TO
S148
(8W-10-22)
S143
2
FUEL
INJECTOR
NO. 6
(8W-30-6)
(8W-30-43)
COIL ON
PLUG
NO. 6
(8W-30-6)
(8W-30-43)
FUEL
INJECTOR
NO. 8
(4.7L)
(8W-30-43)
COIL ON
PLUG
NO. 8
(4.7L)
(8W-30-43)
S141
FUEL
INJECTOR
NO. 2
(8W-30-7)
(8W-30-40)
COIL ON
PLUG
NO. 2
(8W-30-7)
(8W-30-40)
FUEL
INJECTOR
NO. 4
(8W-30-7)
(8W-30-40)
COIL ON
PLUG
NO. 4
(8W-30-7)
(8W-30-40)


FROM
S137
(8W-10-21)
H
A142
16
DG/OR
S148
A142
16
DG/OR
2
FUEL INJECTOR NO. 5
(8W-30-6)
(8W-30-41)
COIL ON PLUG NO. 5
(8W-30-6)
(8W-30-41)
FUEL INJECTOR NO. 7 (4.7L)
(8W-30-41)
COIL ON PLUG NO. 7 (4.7L)
(8W-30-41)
S149
FUEL INJECTOR NO. 1
(8W-30-8)
(8W-30-42)
COIL ON PLUG NO. 1
(8W-30-8)
(8W-30-42)
FUEL INJECTOR NO. 3
(8W-30-8)
(8W-30-42)
COIL ON PLUG NO. 3
(8W-30-8)
(8W-30-42)

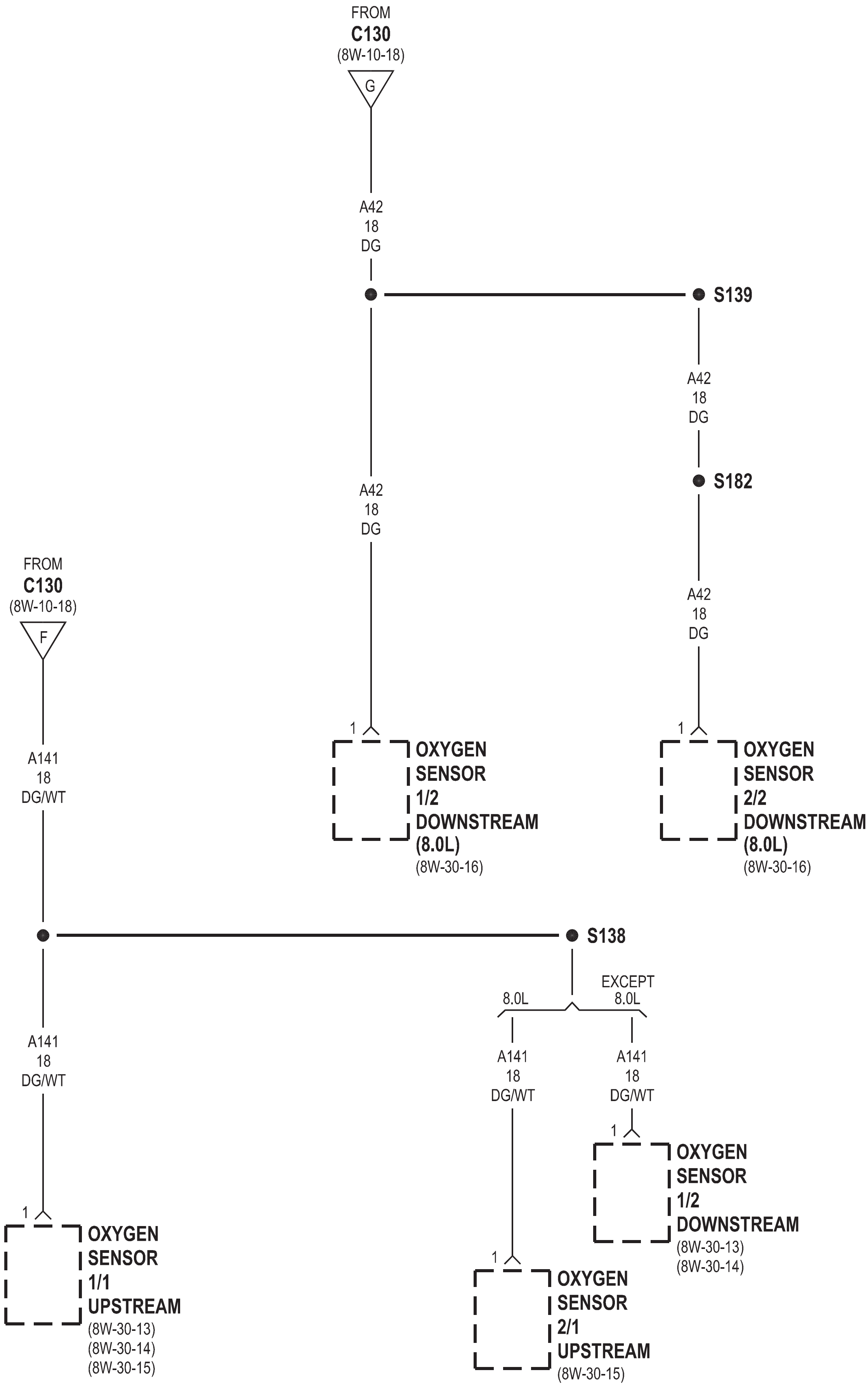
8.0L

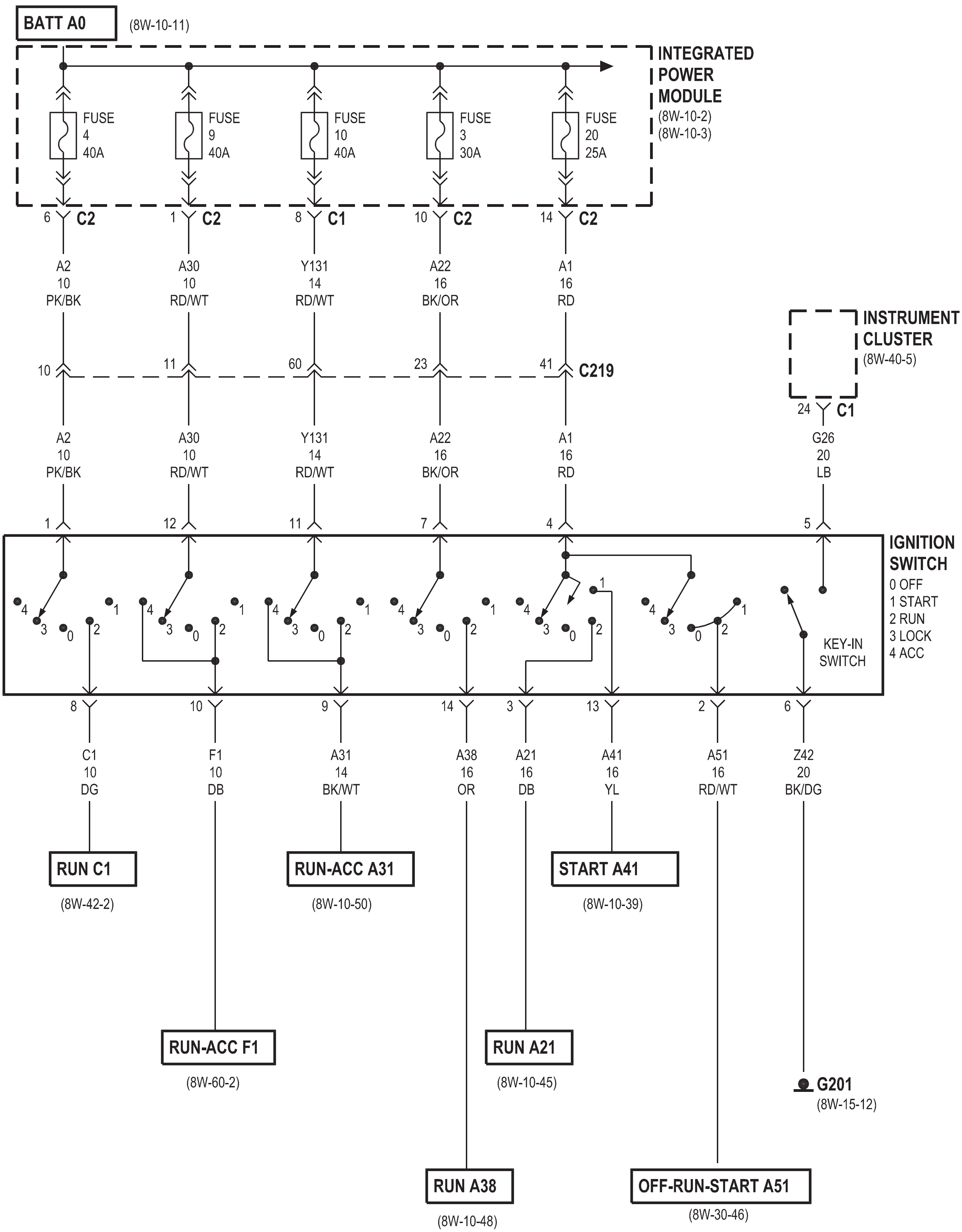

FROM
C130
(8W-10-18)
D
A142
16
DG/OR
IGNITION COIL-LEFT
(8W-30-10)
2
A142
14
DG/OR
IGNITION COIL-RIGHT
(8W-30-10)
2
A142
14
DG/OR
POWERTRAIN CONTROL MODULE
(8W-30-12)
12 C3
A142
14
DG/OR
S143
A142
14
DG/OR
A142
14
DG/OR
1
CAPACITOR
(8W-30-11)
A142
14
DG/OR
7
TO
S142
(8W-10-24)
S112
A142
16
DG/OR
2
FUEL INJECTOR NO. 2
(8W-30-12)
FUEL INJECTOR NO. 4
(8W-30-12)
FUEL INJECTOR NO. 6
(8W-30-12)
FUEL INJECTOR NO. 8
(8W-30-12)
FUEL INJECTOR NO. 10
(8W-30-12)

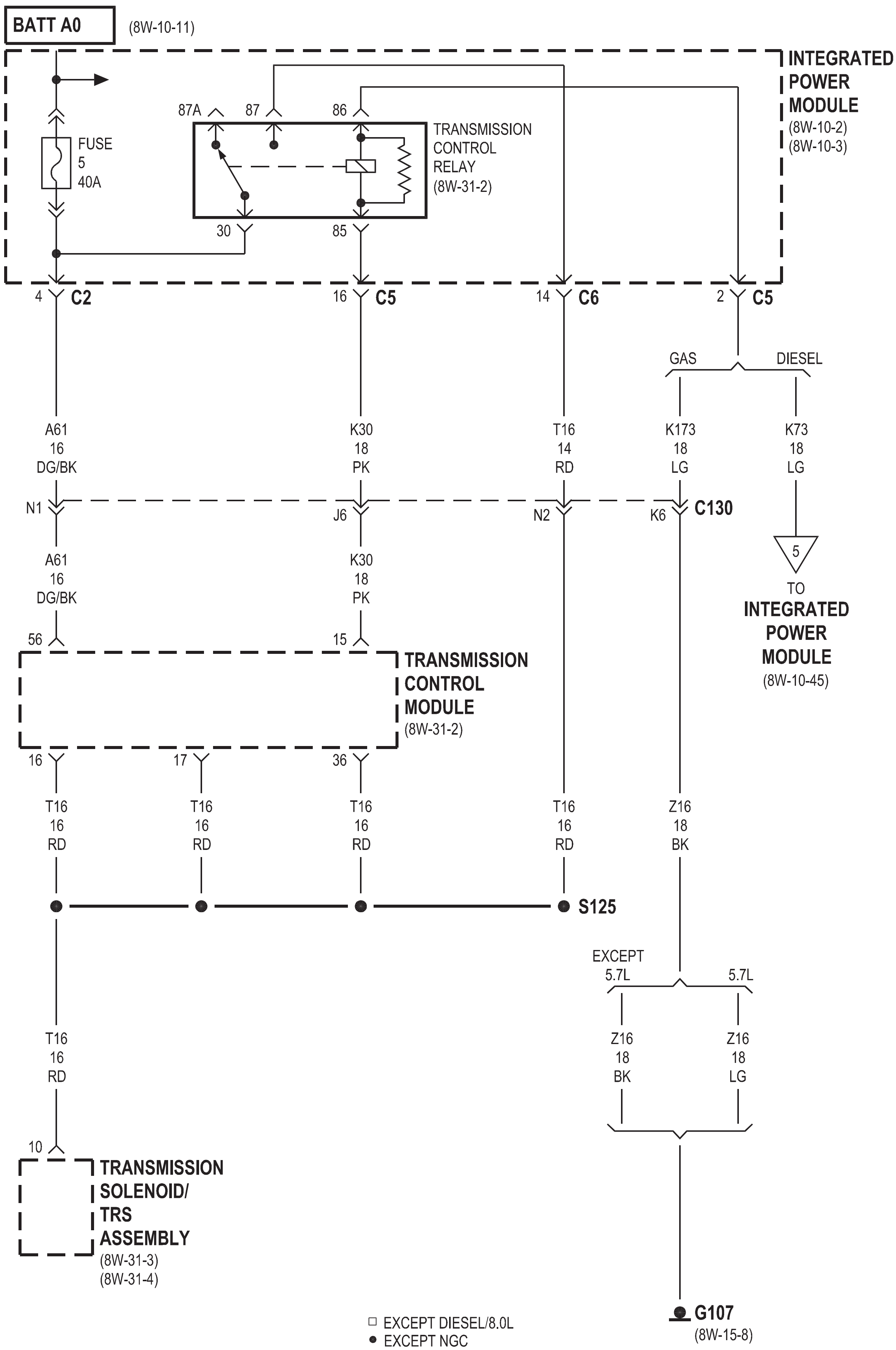
5.7L/5.9L/8.0L

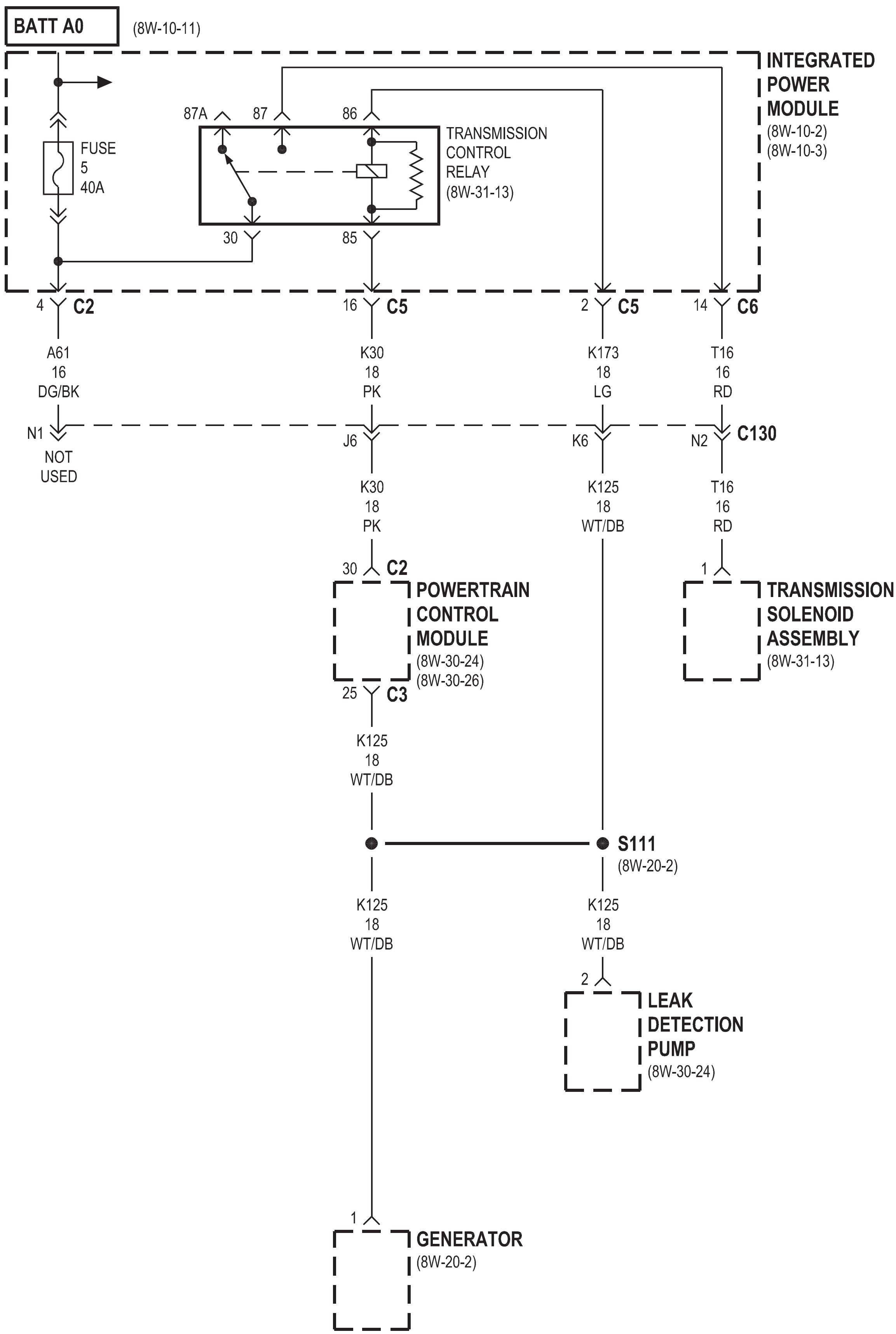

FUEL
INJECTOR
NO. 1
(8W-30-9)
(8W-30-11)
FROM
S162
(8W-10-19)
M
FROM
C130
(8W-10-18)
D
FROM
S143
(8W-10-23)
7
A142
16
DG/OR
A142
14
DG/OR
5.7L
5.9L
8.0L
S142
FUEL
INJECTOR
NO. 3
(8W-30-9)
FUEL
INJECTOR
NO. 5
(8W-30-9)
(8W-30-11)
FUEL
INJECTOR
NO. 7
(8W-30-9)
(8W-30-11)
FUEL
INJECTOR
NO. 9
(8W-30-11)
S147
(5.9L)
FUEL
INJECTOR
NO. 2
(8W-30-9)
FUEL
INJECTOR
NO. 4
(8W-30-9)
FUEL
INJECTOR
NO. 6
(8W-30-9)
FUEL
INJECTOR
NO. 8
(8W-30-9)
IGNITION
COIL
(8W-30-9)
C3
POWERTRAIN
CONTROL
MODULE
(8W-30-9)

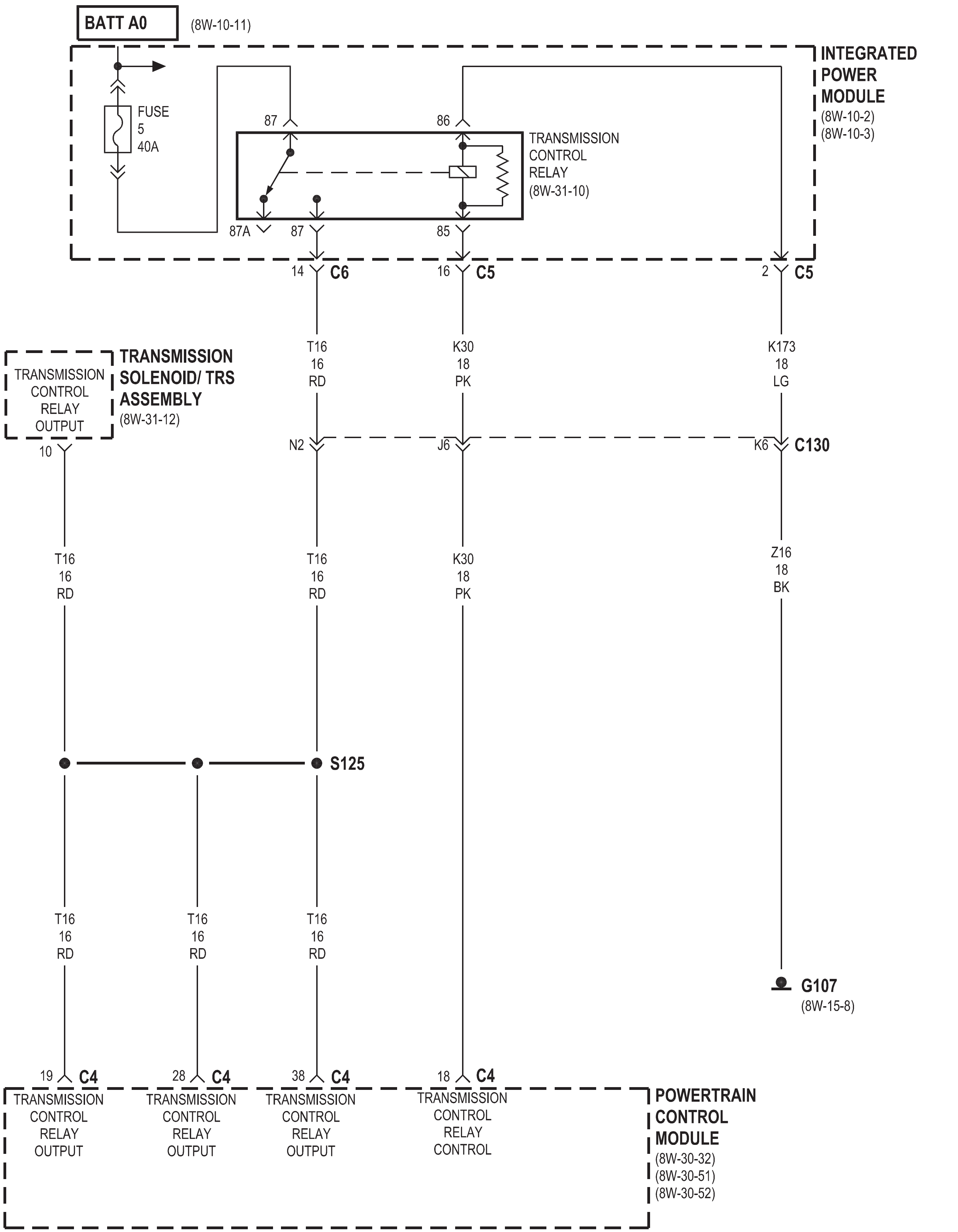
JTEC

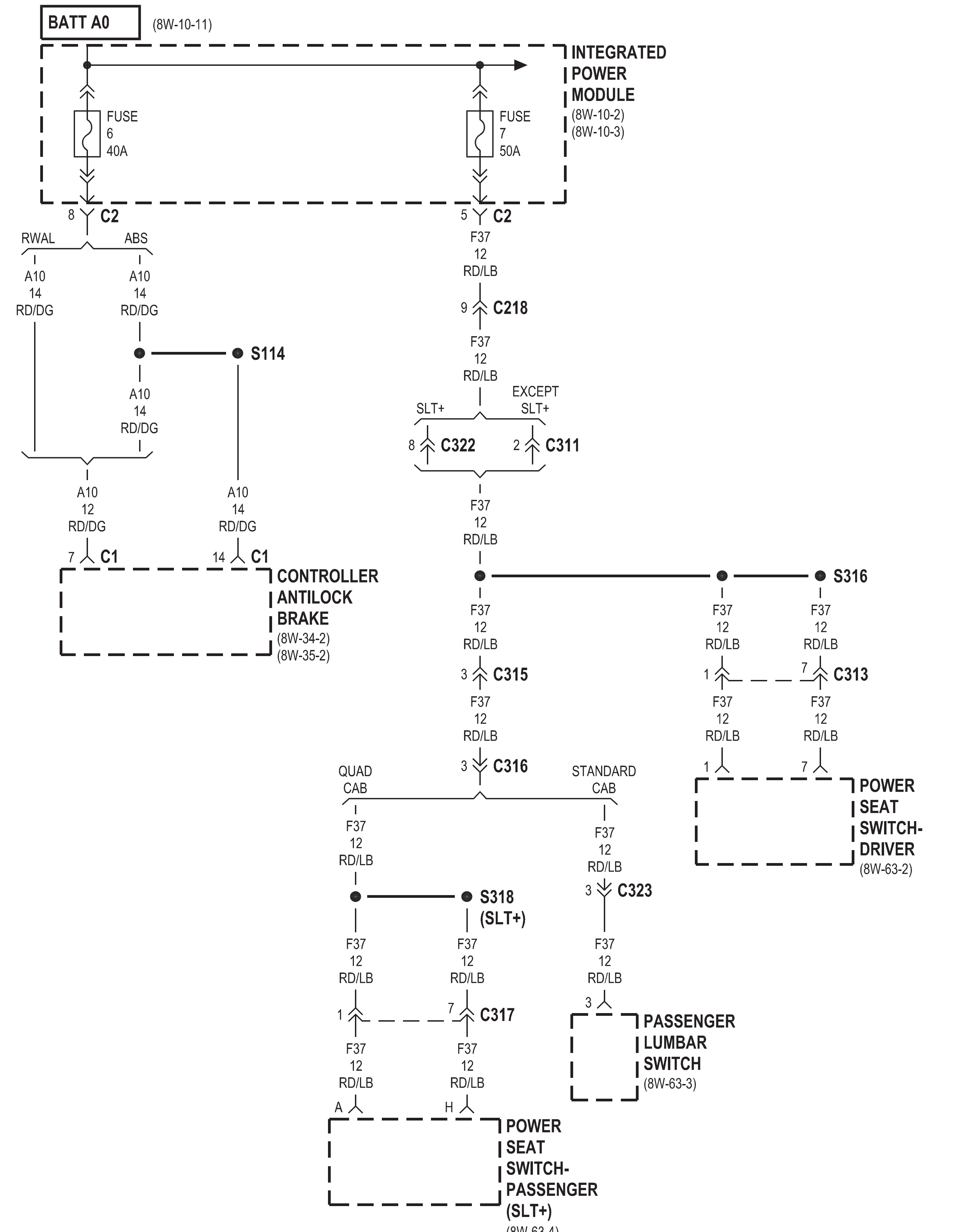

FROM
C130
(8W-10-18)
G
A42
18
DG
S139
A42
18
DG
S182
A42
18
DG
A42
18
DG
1
OXYGEN SENSOR 1/2 DOWNSTREAM (8.0L)
(8W-30-16)
1
OXYGEN SENSOR 2/2 DOWNSTREAM (8.0L)
(8W-30-16)
FROM
C130
(8W-10-18)
F
A141
18
DG/WT
S138
8.0L
EXCEPT 8.0L
A141
18
DG/WT
A141
18
DG/WT
A141
18
DG/WT
1
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-13)
(8W-30-14)
1
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
(8W-30-14)
(8W-30-15)
1
OXYGEN SENSOR 2/1 UPSTREAM
(8W-30-15)


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 4 40A
FUSE 9 40A
FUSE 10 40A
FUSE 3 30A
FUSE 20 25A
6 C2
1 C2
8 C1
10 C2
14 C2
A2 10 PK/BK
A30 10 RD/WT
Y131 14 RD/WT
A22 16 BK/OR
A1 16 RD
10
11
60
23
41
C219
INSTRUMENT CLUSTER
(8W-40-5)
24 C1
G26 20 LB
1
12
11
7
4
5
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
KEY-IN SWITCH
8
10
9
14
3
13
2
6
C1 10 DG
F1 10 DB
A31 14 BK/WT
A38 16 OR
A21 16 DB
A41 16 YL
A51 16 RD/WT
Z42 20 BK/DG
RUN C1
(8W-42-2)
RUN-ACC A31
(8W-10-50)
START A41
(8W-10-39)
RUN-ACC F1
(8W-60-2)
RUN A21
(8W-10-45)
G201
(8W-15-12)
RUN A38
(8W-10-48)
OFF-RUN-START A51
(8W-30-46)

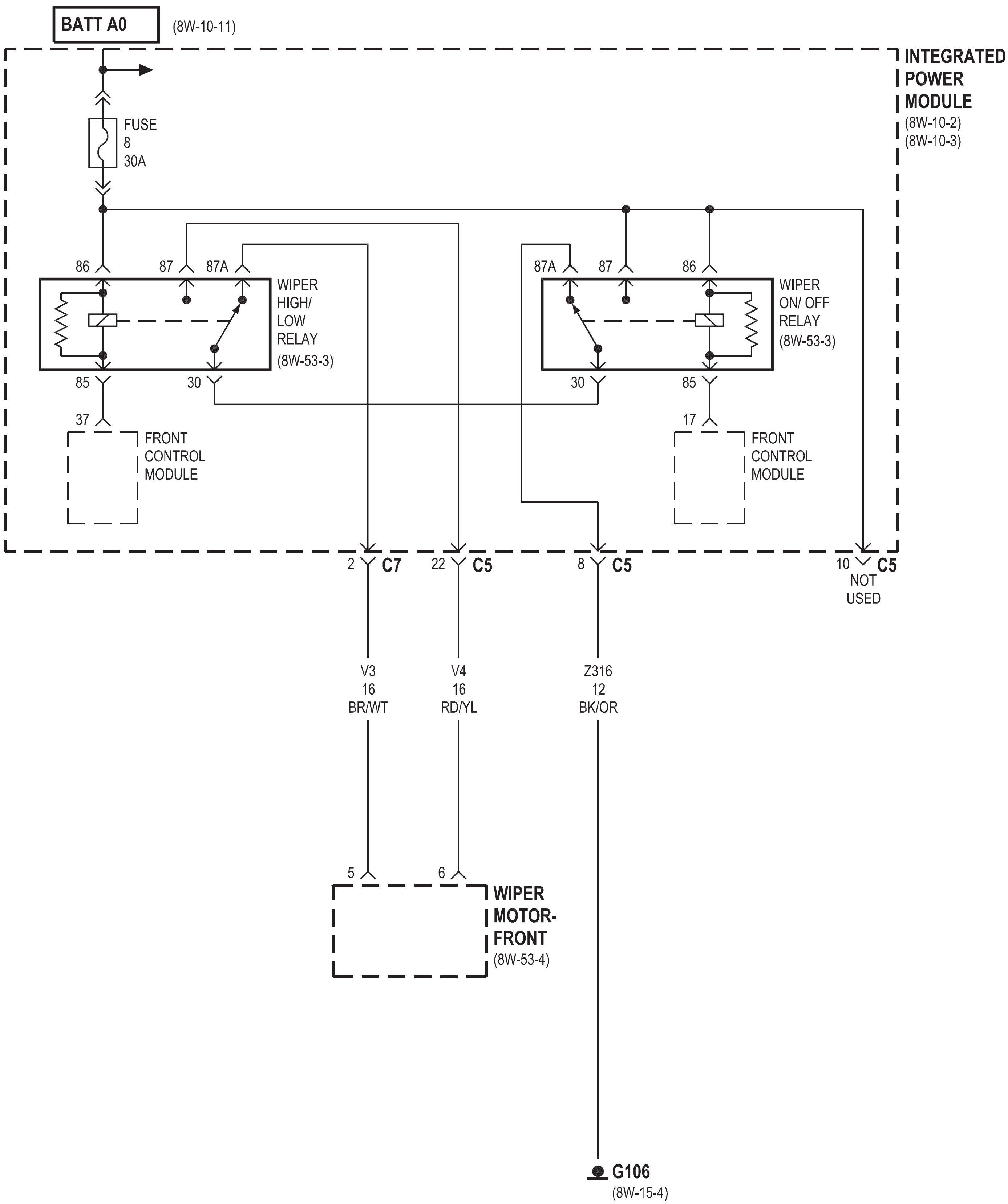

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
87A
87
86
TRANSMISSION
CONTROL
RELAY
(8W-31-2)
30
85
4 C2
16 C5
14 C6
2 C5
GAS
DIESEL
A61
16
DG/BK
K30
18
PK
T16
14
RD
K173
18
LG
K73
18
LG
N1
J6
N2
K6
C130
5
TO
INTEGRATED
POWER
MODULE
(8W-10-45)
56
15
TRANSMISSION
CONTROL
MODULE
(8W-31-2)
16
17
36
T16
16
RD
Z16
18
BK
S125
EXCEPT
5.7L
5.7L
Z16
18
LG
10
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
(8W-31-4)
G107
(8W-15-8)
□ EXCEPT DIESEL/8.0L
● EXCEPT NGC

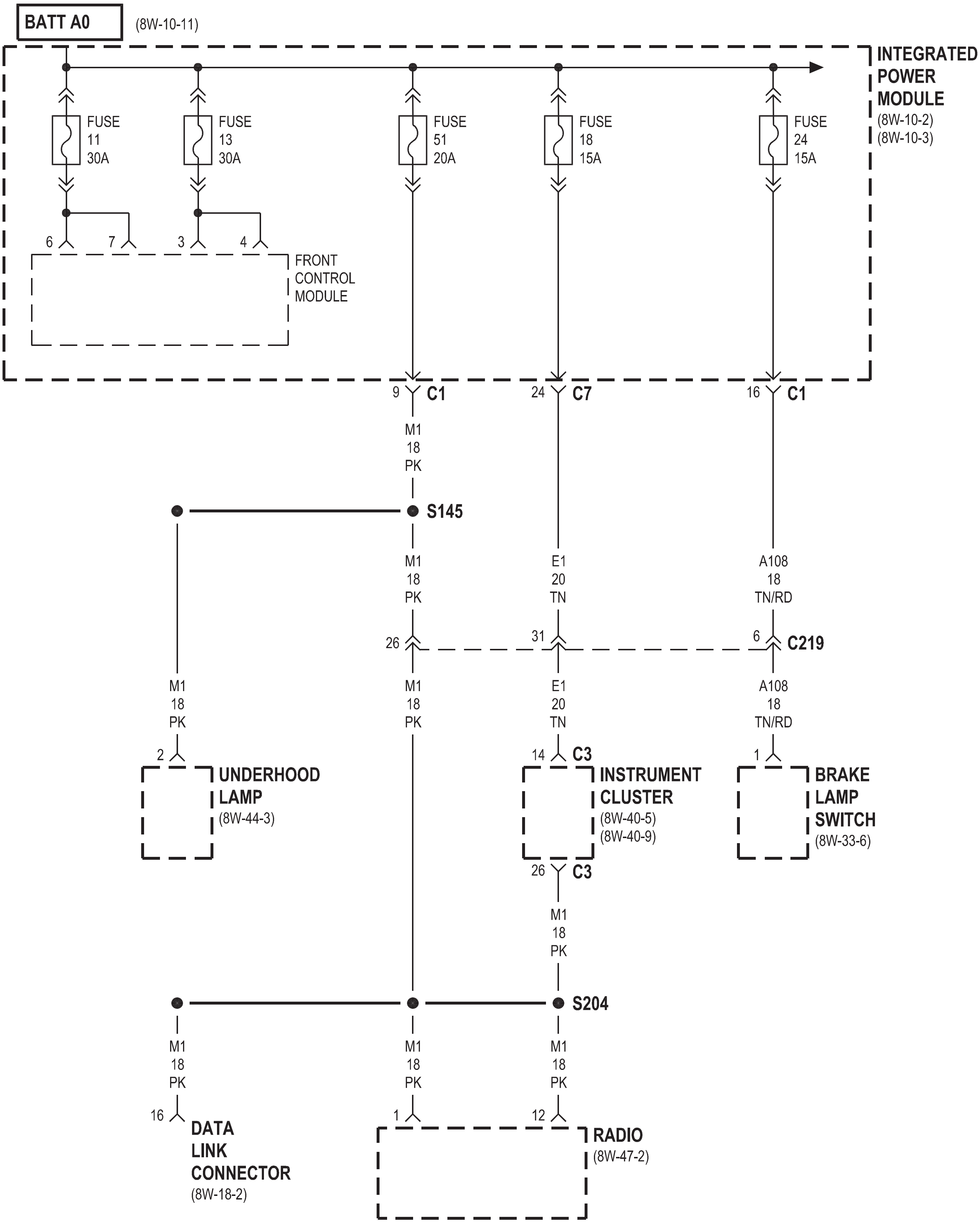

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
87A
87
86
TRANSMISSION
CONTROL
RELAY
(8W-31-13)
30
85
4
C2
16
C5
2
C5
14
C6
A61
16
DG/BK
K30
18
PK
K173
18
LG
T16
16
RD
N1
NOT
USED
J6
K6
N2
C130
K30
18
PK
K125
18
WT/DB
T16
16
RD
30
C2
POWERTRAIN
CONTROL
MODULE
(8W-30-24)
(8W-30-26)
25
C3
1
TRANSMISSION
SOLENOID
ASSEMBLY
(8W-31-13)
K125
18
WT/DB
S111
(8W-20-2)
K125
18
WT/DB
K125
18
WT/DB
2
LEAK
DETECTION
PUMP
(8W-30-24)
1
GENERATOR
(8W-20-2)

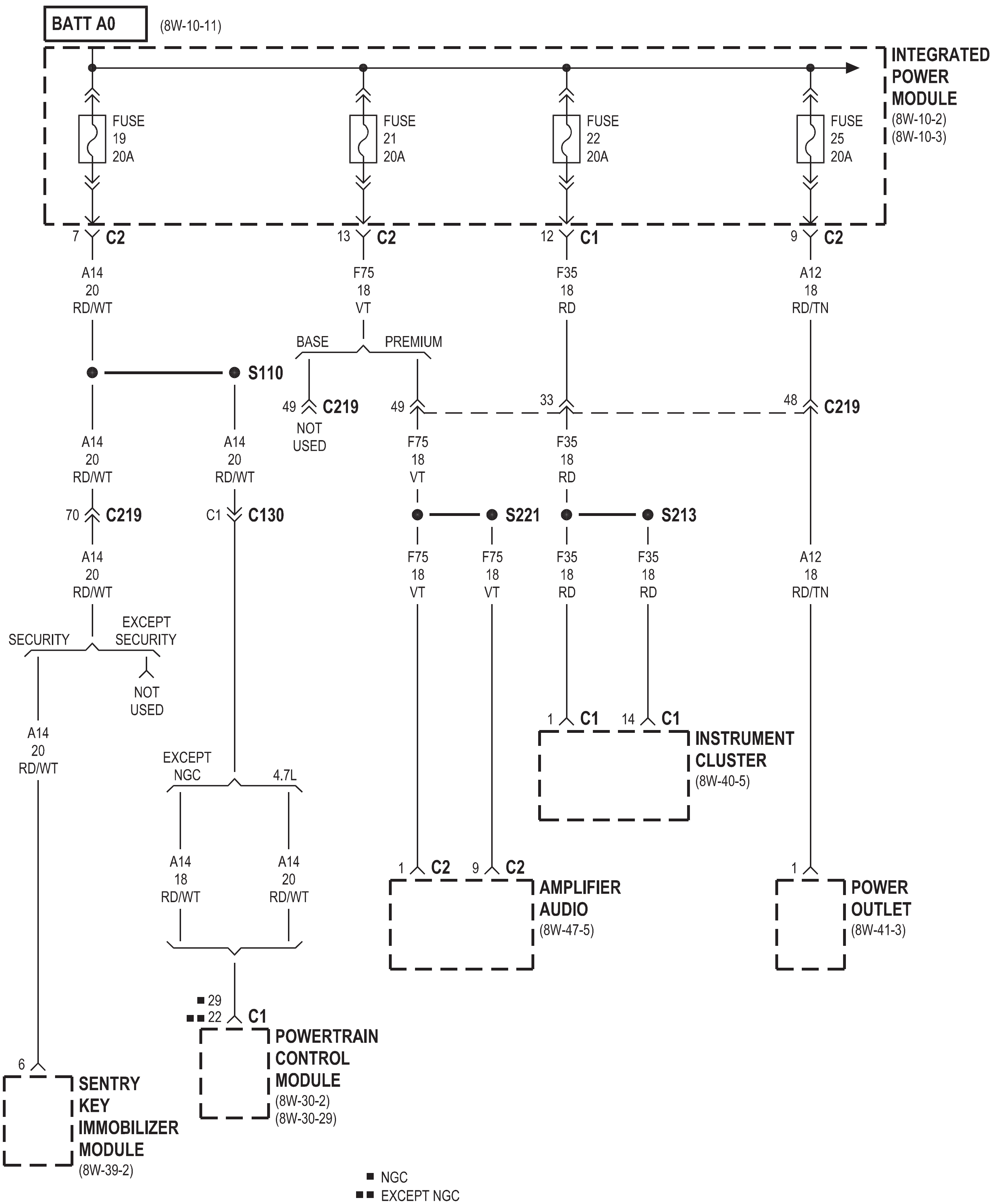

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
87
86
TRANSMISSION CONTROL RELAY
(8W-31-10)
87A
87
85
14
C6
16
C5
2
C5
T16
16
RD
K30
18
PK
K173
18
LG
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-12)
10
N2
J6
K6
C130
T16
16
RD
T16
16
RD
K30
18
PK
Z16
18
BK
S125
T16
16
RD
T16
16
RD
T16
16
RD
G107
(8W-15-8)
19
C4
28
C4
38
C4
18
C4
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-32)
(8W-30-51)
(8W-30-52)



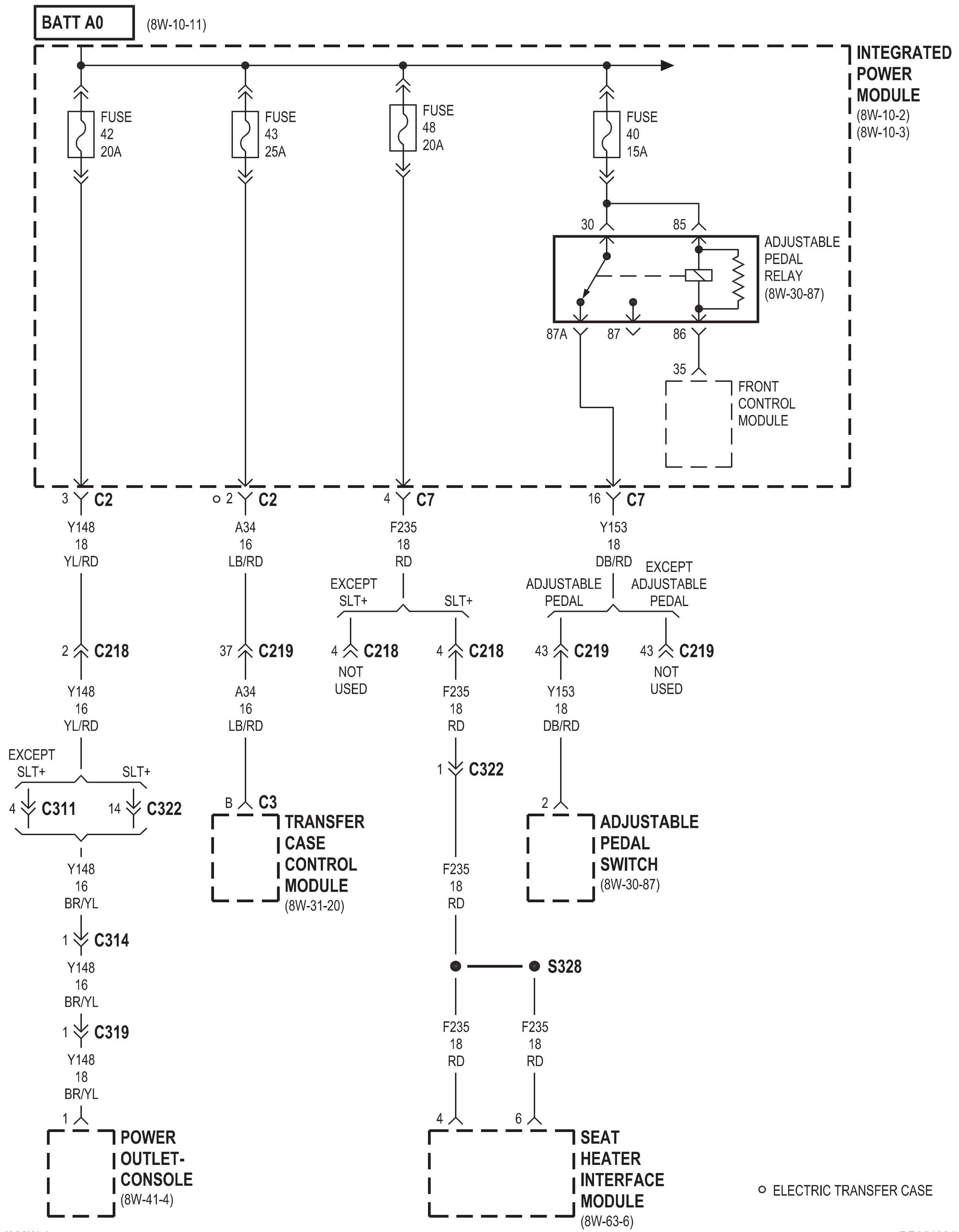
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 6 40A
FUSE 7 50A
8 C2
5 C2
RWAL
ABS
A10 14 RD/DG
S114
A10 12 RD/DG
7 C1
14 C1
CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
F37 12 RD/LB
9 C218
SLT+
EXCEPT SLT+
8 C322
2 C311
S316
3 C315
1 C313 7
3 C316
QUAD CAB
STANDARD CAB
S318 (SLT+)
3 C323
1 C317 7
A
H
POWER SEAT SWITCH-PASSENGER (SLT+)
(8W-63-4)
PASSENGER LUMBAR SWITCH
(8W-63-3)
POWER SEAT SWITCH-DRIVER
(8W-63-2)

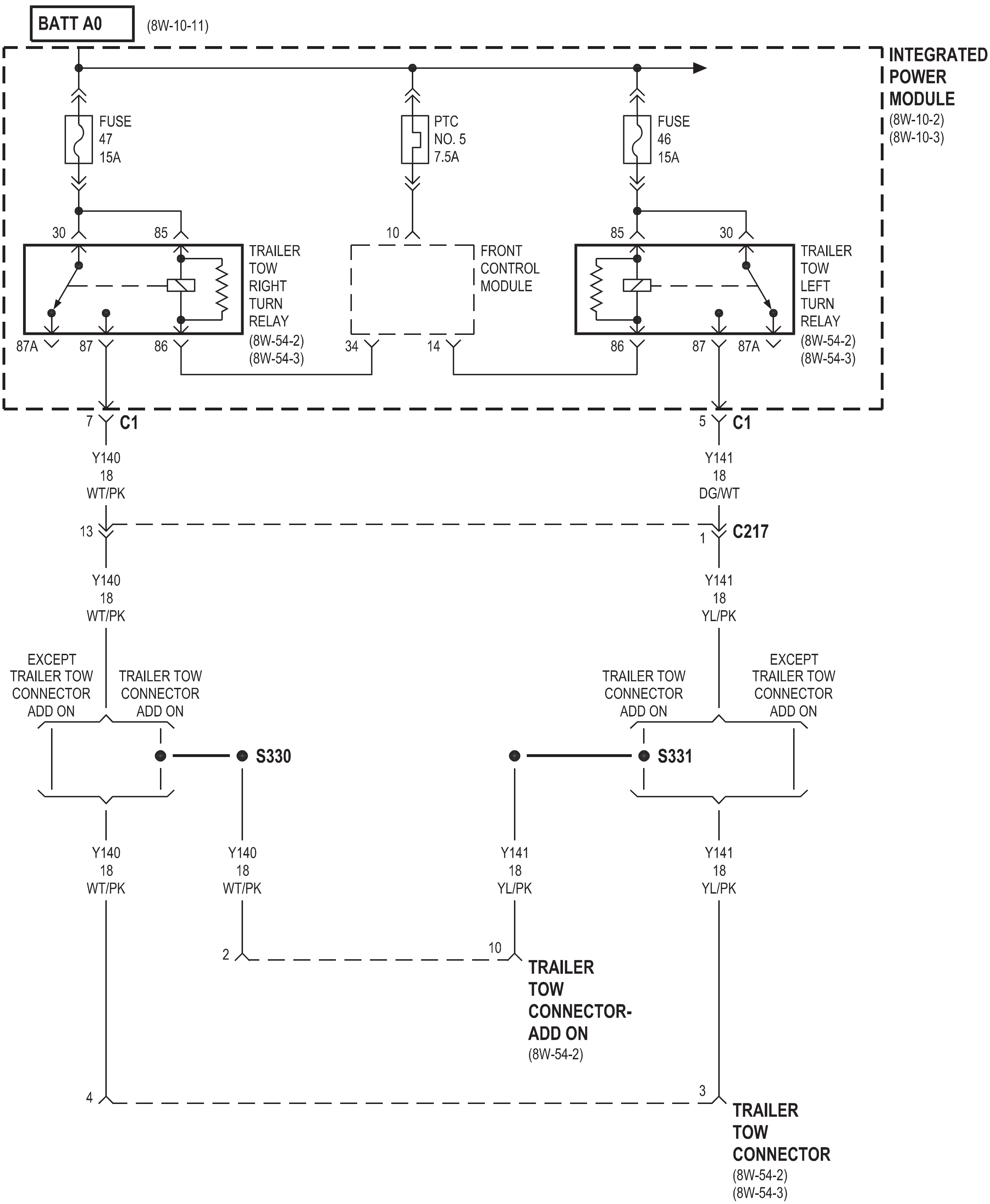

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
8
30A
86
87
87A
WIPER
HIGH/
LOW
RELAY
(8W-53-3)
85
30
37
FRONT
CONTROL
MODULE
87A
87
86
WIPER
ON/ OFF
RELAY
(8W-53-3)
30
85
17
FRONT
CONTROL
MODULE
2 C7
22 C5
8 C5
10 C5
NOT
USED
V3
16
BR/WT
V4
16
RD/YL
Z316
12
BK/OR
5
6
WIPER
MOTOR-
FRONT
(8W-53-4)
G106
(8W-15-4)

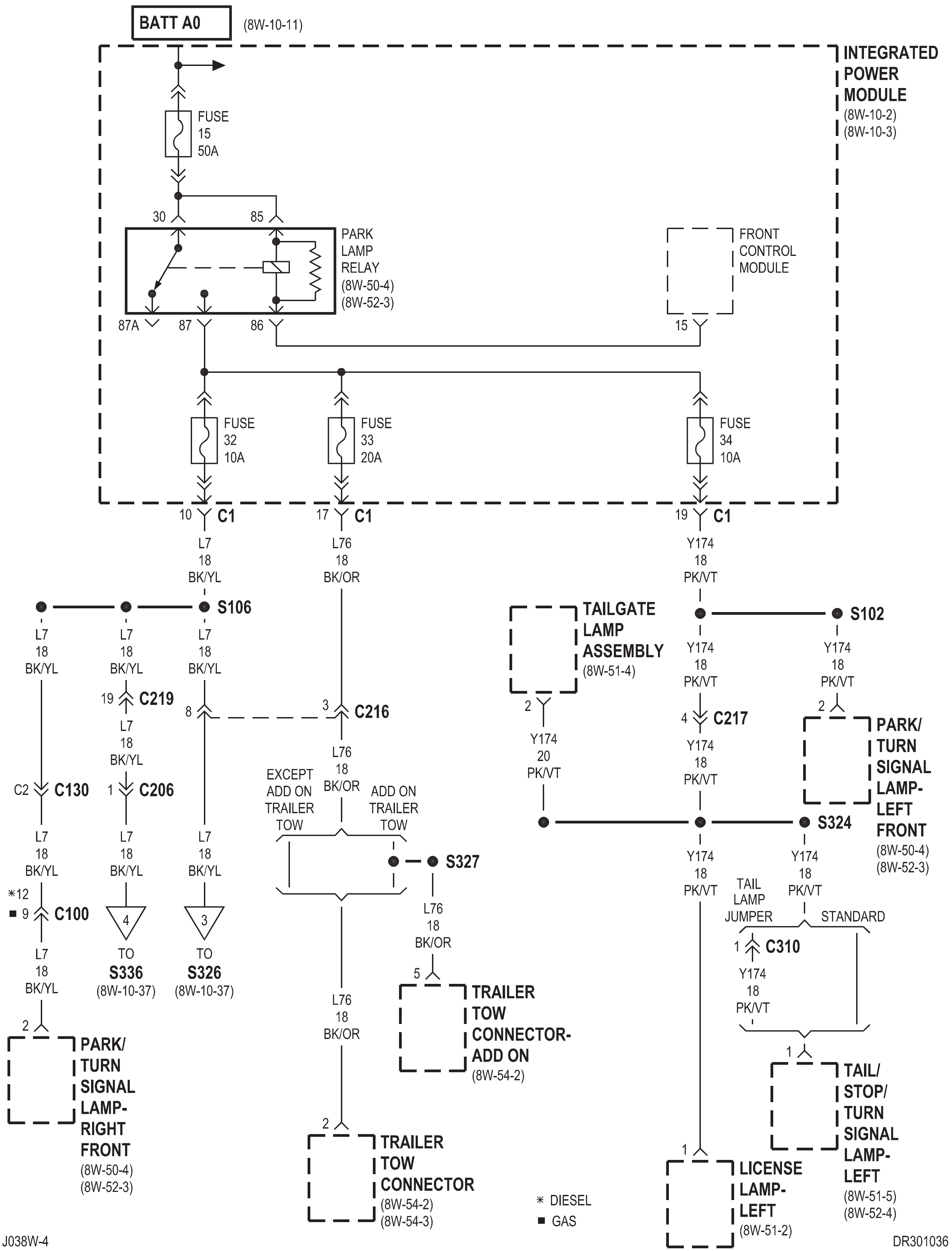

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 11 30A
FUSE 13 30A
FUSE 51 20A
FUSE 18 15A
FUSE 24 15A
6
7
3
4
FRONT CONTROL MODULE
9 C1
24 C7
16 C1
M1 18 PK
S145
E1 20 TN
A108 18 TN/RD
26
31
6 C219
2
UNDERHOOD LAMP
(8W-44-3)
14 C3
INSTRUMENT CLUSTER
(8W-40-5)
(8W-40-9)
26 C3
1
BRAKE LAMP SWITCH
(8W-33-6)
S204
16
DATA LINK CONNECTOR
(8W-18-2)
1
12
RADIO
(8W-47-2)

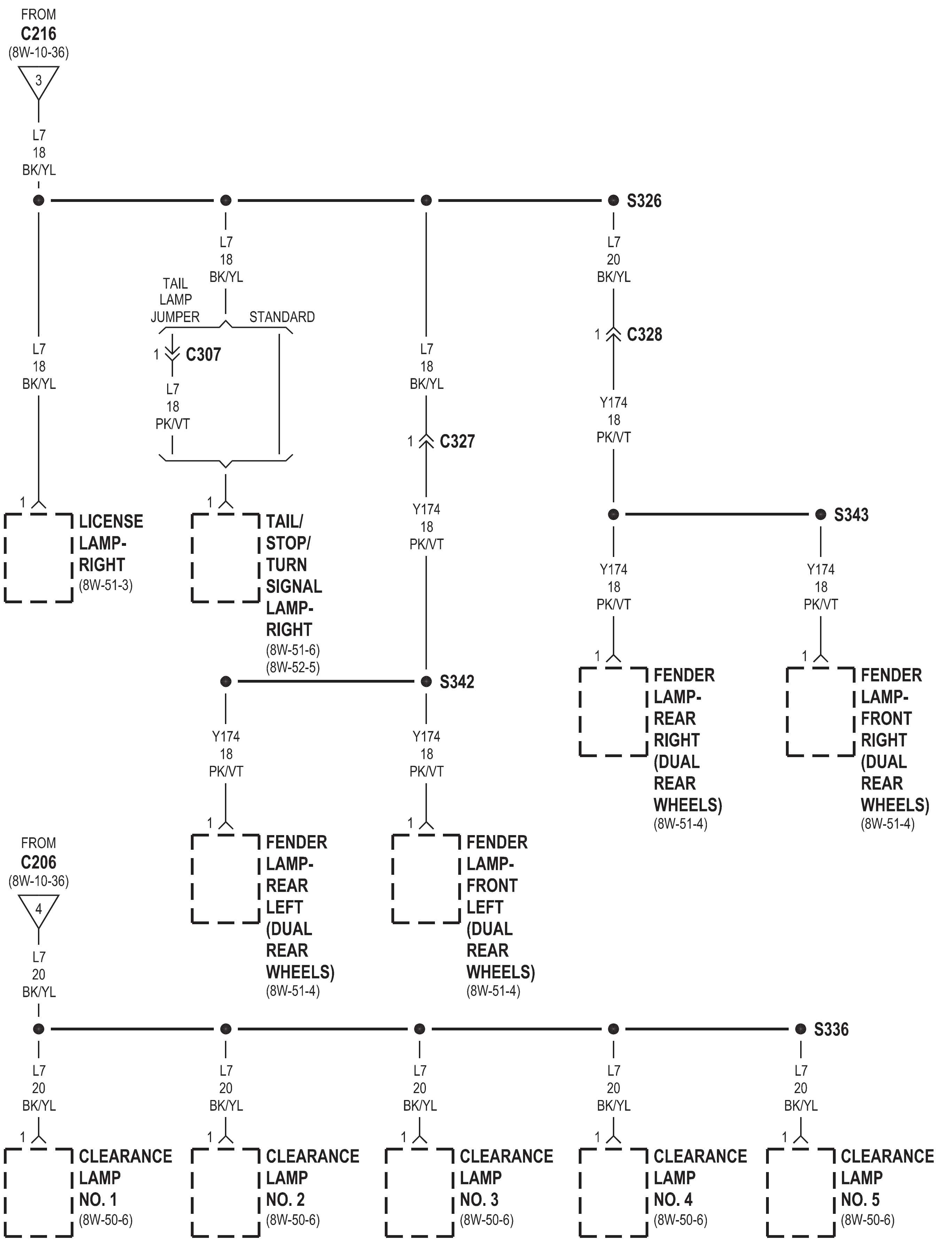


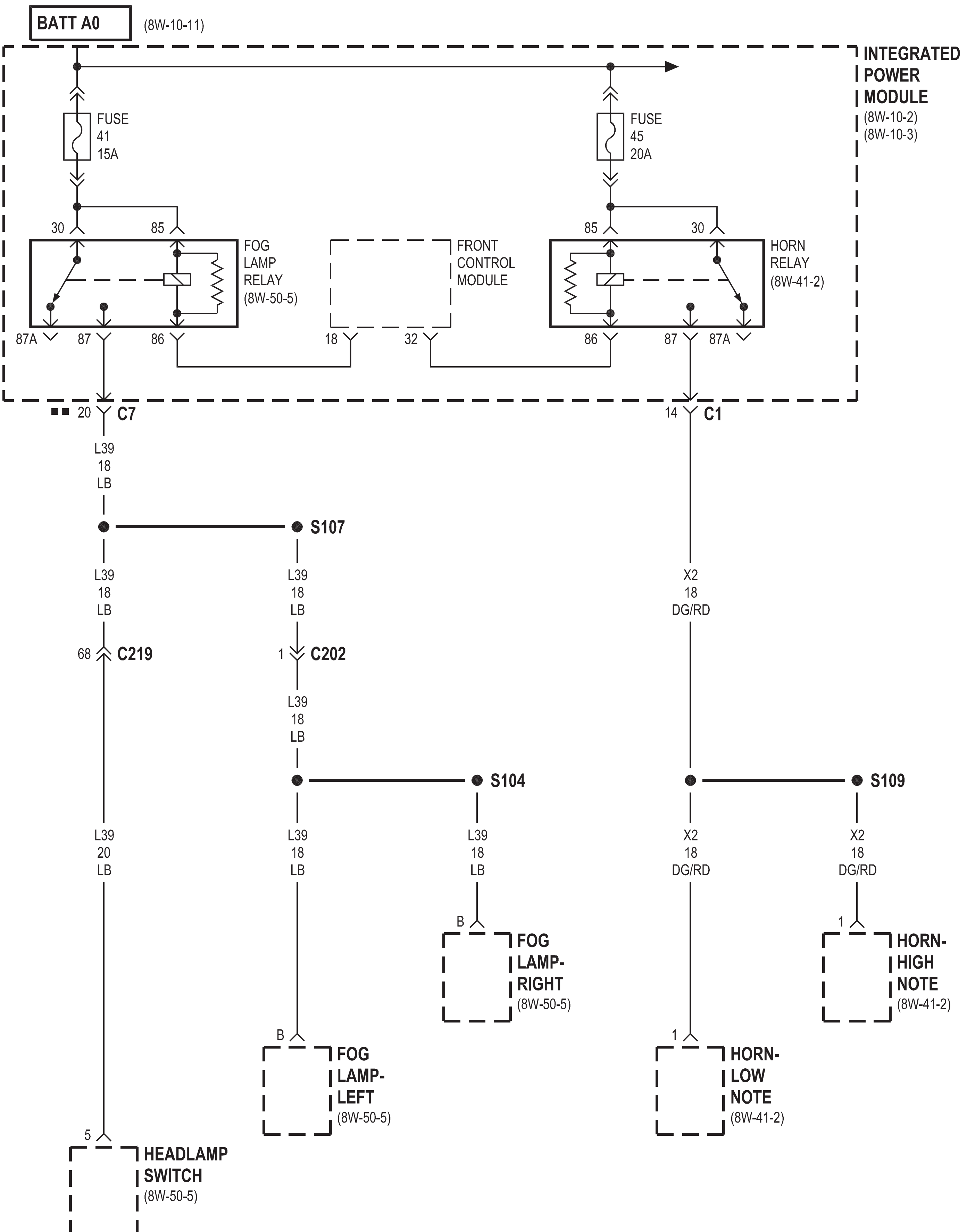
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 19 20A
FUSE 21 20A
FUSE 22 20A
FUSE 25 20A
7 C2
13 C2
12 C1
9 C2
A14 20 RD/WT
F75 18 VT
F35 18 RD
A12 18 RD/TN
BASE
PREMIUM
S110
49 C219
NOT USED
49
33
48 C219
A14 20 RD/WT
A14 20 RD/WT
F75 18 VT
F35 18 RD
70 C219
C1 C130
S221
S213
A14 20 RD/WT
F75 18 VT
F75 18 VT
F35 18 RD
F35 18 RD
A12 18 RD/TN
SECURITY
EXCEPT SECURITY
NOT USED
A14 20 RD/WT
1 C1
14 C1
INSTRUMENT CLUSTER
(8W-40-5)
EXCEPT NGC
4.7L
A14 18 RD/WT
A14 20 RD/WT
1 C2
9 C2
AMPLIFIER AUDIO
(8W-47-5)
1
POWER OUTLET
(8W-41-3)
■ 29
■■ 22
C1
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-29)
6
SENTRY KEY IMMOBILIZER MODULE
(8W-39-2)
■ NGC
■■ EXCEPT NGC

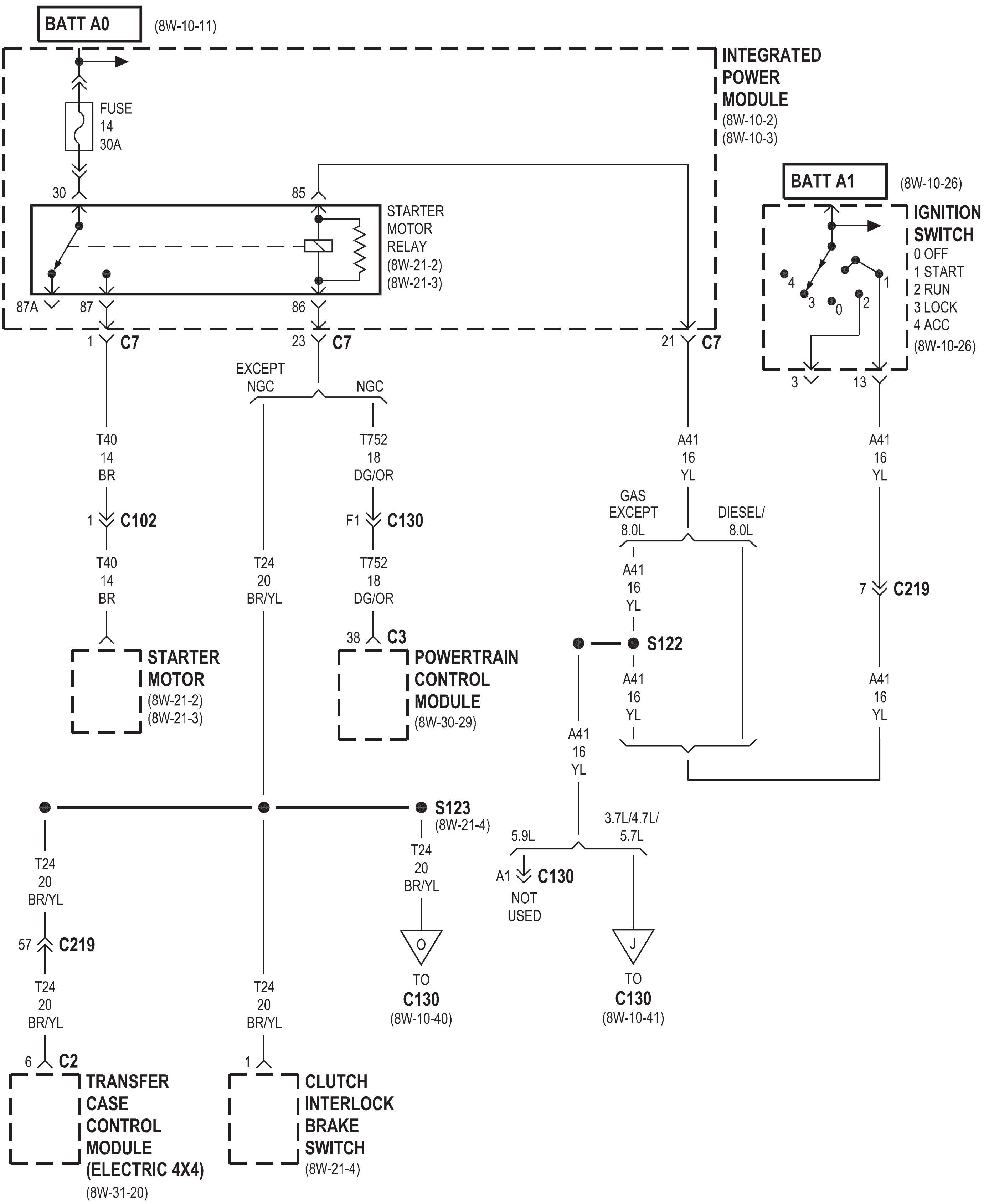

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 42 20A
FUSE 43 25A
FUSE 48 20A
FUSE 40 15A
30
85
ADJUSTABLE PEDAL RELAY
(8W-30-87)
87A
87
86
35
FRONT CONTROL MODULE
3 C2
2 C2
4 C7
16 C7
Y148 18 YL/RD
A34 16 LB/RD
F235 18 RD
Y153 18 DB/RD
EXCEPT SLT+
SLT+
ADJUSTABLE PEDAL
EXCEPT ADJUSTABLE PEDAL
2 C218
37 C219
4 C218
NOT USED
4 C218
43 C219
43 C219
NOT USED
Y148 16 YL/RD
A34 16 LB/RD
F235 18 RD
Y153 18 DB/RD
EXCEPT SLT+
SLT+
4 C311
14 C322
1 C322
B C3
TRANSFER CASE CONTROL MODULE
(8W-31-20)
2
ADJUSTABLE PEDAL SWITCH
(8W-30-87)
Y148 16 BR/YL
F235 18 RD
1 C314
S328
Y148 16 BR/YL
1 C319
F235 18 RD
F235 18 RD
Y148 18 BR/YL
1
POWER OUTLET-CONSOLE
(8W-41-4)
4
6
SEAT HEATER INTERFACE MODULE
(8W-63-6)
ELECTRIC TRANSFER CASE


BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
47
15A
PTC
NO. 5
7.5A
FUSE
46
15A
30
85
10
85
30
TRAILER
TOW
RIGHT
TURN
RELAY
(8W-54-2)
(8W-54-3)
FRONT
CONTROL
MODULE
TRAILER
TOW
LEFT
TURN
RELAY
(8W-54-2)
(8W-54-3)
87A
87
86
34
14
86
87
87A
7
C1
5
C1
Y140
18
WT/PK
Y141
18
DG/WT
13
1
C217
Y140
18
WT/PK
Y141
18
YL/PK
EXCEPT
TRAILER TOW
CONNECTOR
ADD ON
TRAILER TOW
CONNECTOR
ADD ON
TRAILER TOW
CONNECTOR
ADD ON
EXCEPT
TRAILER TOW
CONNECTOR
ADD ON
S330
S331
Y140
18
WT/PK
Y140
18
WT/PK
Y141
18
YL/PK
Y141
18
YL/PK
2
10
TRAILER
TOW
CONNECTOR-
ADD ON
(8W-54-2)
4
3
TRAILER
TOW
CONNECTOR
(8W-54-2)
(8W-54-3)

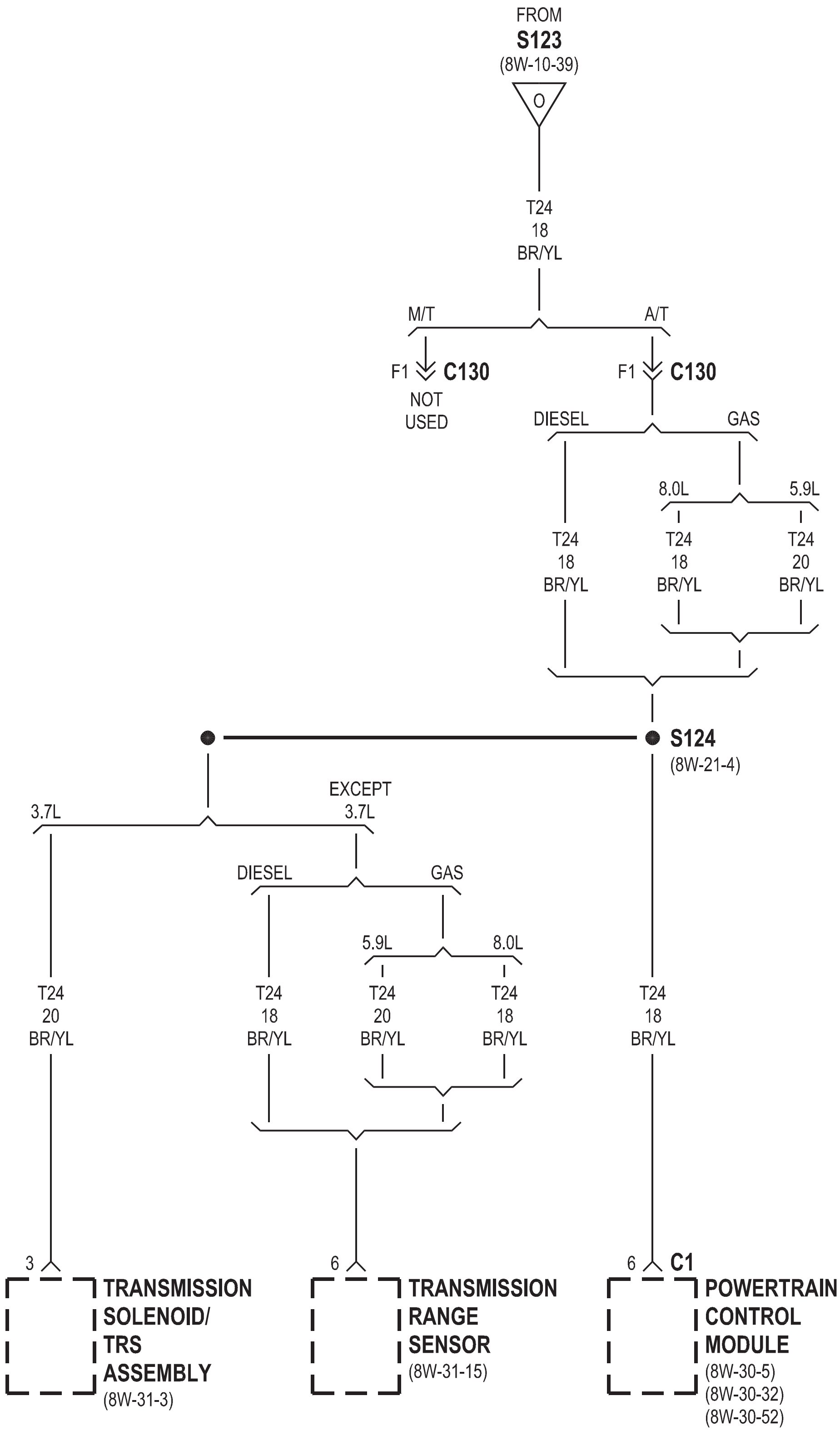

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 15 50A
30
85
PARK LAMP RELAY
(8W-50-4)
(8W-52-3)
87A
87
86
FRONT CONTROL MODULE
15
FUSE 32 10A
FUSE 33 20A
FUSE 34 10A
10 C1
17 C1
19 C1
L7 18 BK/YL
L76 18 BK/OR
Y174 18 PK/VT
S106
S102
TAILGATE LAMP ASSEMBLY
(8W-51-4)
19 C219
8
3 C216
2
4 C217
PARK/ TURN SIGNAL LAMP- LEFT FRONT
(8W-50-4)
(8W-52-3)
Y174 20 PK/VT
C2 C130
1 C206
EXCEPT ADD ON TRAILER TOW
ADD ON TRAILER TOW
S327
S324
*12
■ 9 C100
TO S336
(8W-10-37)
TO S326
(8W-10-37)
TAIL LAMP JUMPER
STANDARD
1 C310
5
TRAILER TOW CONNECTOR- ADD ON
(8W-54-2)
PARK/ TURN SIGNAL LAMP- RIGHT FRONT
(8W-50-4)
(8W-52-3)
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
(8W-51-5)
(8W-52-4)
TRAILER TOW CONNECTOR
(8W-54-2)
(8W-54-3)
* DIESEL
■ GAS
LICENSE LAMP- LEFT
(8W-51-2)

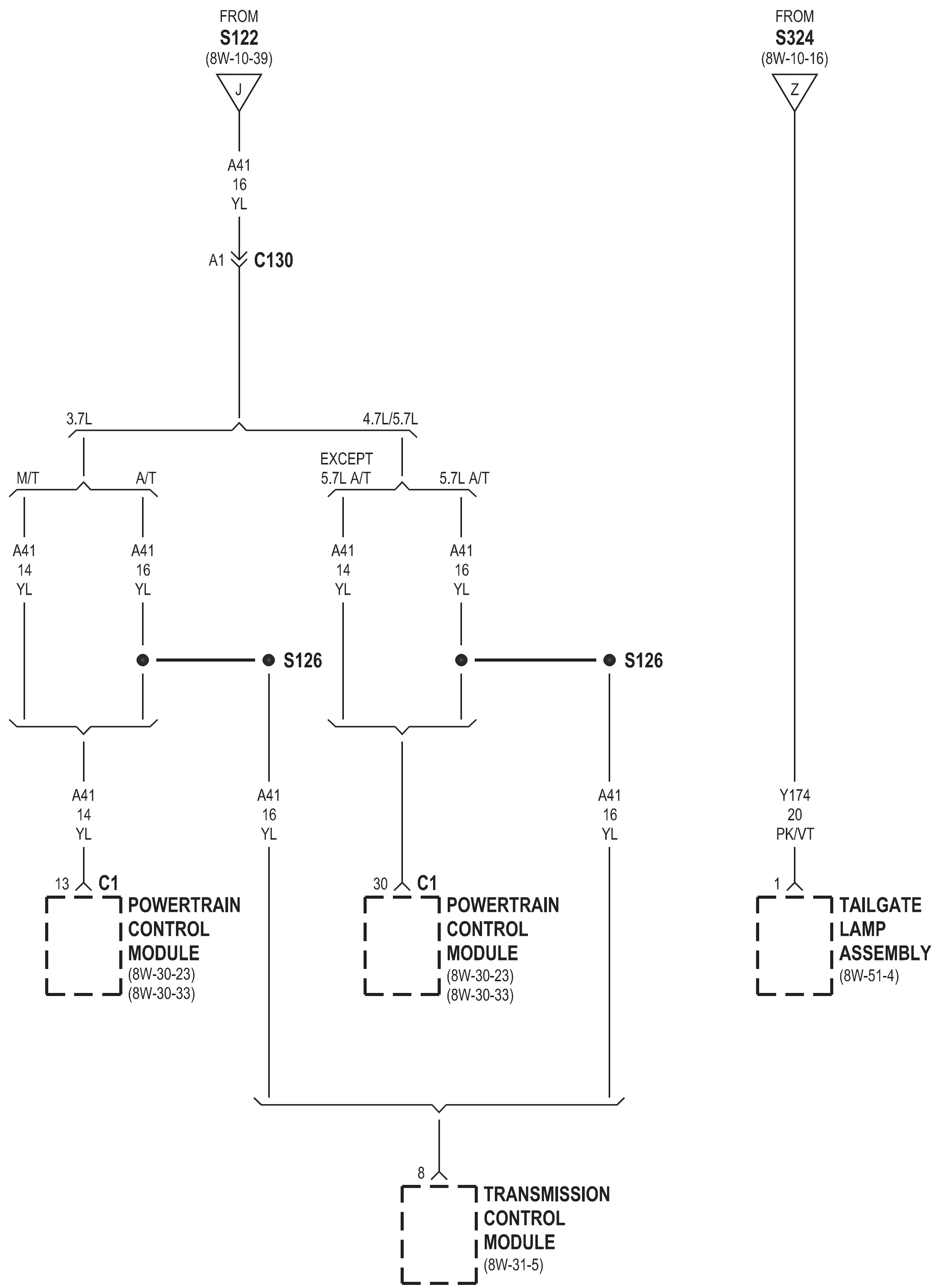

FROM
C216
(8W-10-36)
3
L7
18
BK/YL
S326
L7
20
BK/YL
1 C328
Y174
18
PK/VT
S343
TAIL
LAMP
JUMPER
STANDARD
1 C307
L7
18
PK/VT
1 C327
LICENSE
LAMP-
RIGHT
(8W-51-3)
TAIL/
STOP/
TURN
SIGNAL
LAMP-
RIGHT
(8W-51-6)
(8W-52-5)
S342
FENDER
LAMP-
REAR
RIGHT
(DUAL
REAR
WHEELS)
(8W-51-4)
FENDER
LAMP-
FRONT
RIGHT
(DUAL
REAR
WHEELS)
(8W-51-4)
FENDER
LAMP-
REAR
LEFT
(DUAL
REAR
WHEELS)
(8W-51-4)
FENDER
LAMP-
FRONT
LEFT
(DUAL
REAR
WHEELS)
(8W-51-4)
FROM
C206
(8W-10-36)
4
S336
CLEARANCE
LAMP
NO. 1
(8W-50-6)
CLEARANCE
LAMP
NO. 2
(8W-50-6)
CLEARANCE
LAMP
NO. 3
(8W-50-6)
CLEARANCE
LAMP
NO. 4
(8W-50-6)
CLEARANCE
LAMP
NO. 5
(8W-50-6)

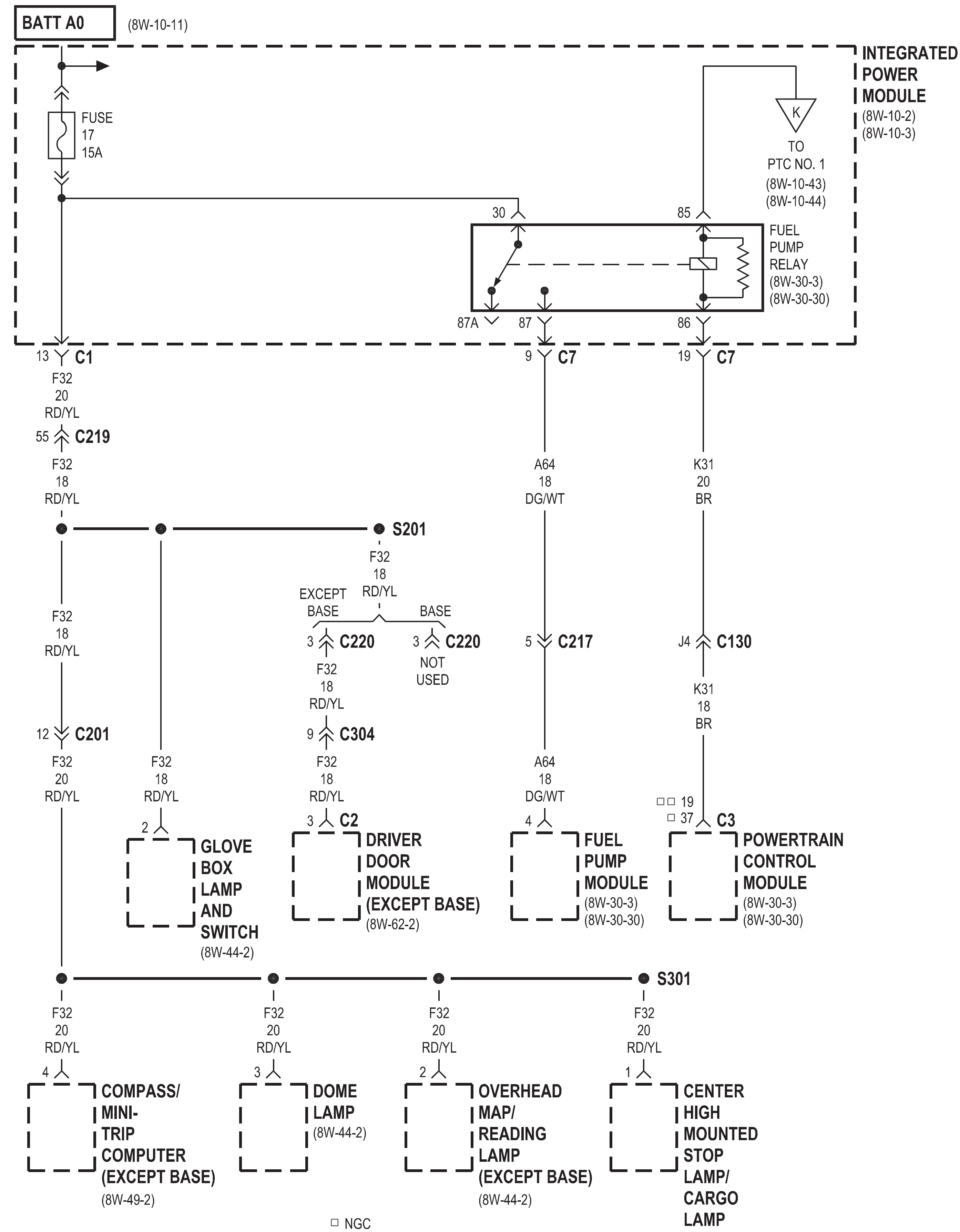

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 41 15A
FUSE 45 20A
30
85
FOG LAMP RELAY
(8W-50-5)
FRONT CONTROL MODULE
HORN RELAY
(8W-41-2)
87A
87
86
18
32
20
C7
14
C1
L39
18
LB
S107
X2
18
DG/RD
68
C219
1
C202
S104
S109
L39
20
LB
B
FOG LAMP- RIGHT
(8W-50-5)
FOG LAMP- LEFT
(8W-50-5)
HORN- HIGH NOTE
(8W-41-2)
HORN- LOW NOTE
(8W-41-2)
5
HEADLAMP SWITCH
(8W-50-5)
■■ FOG LAMPS



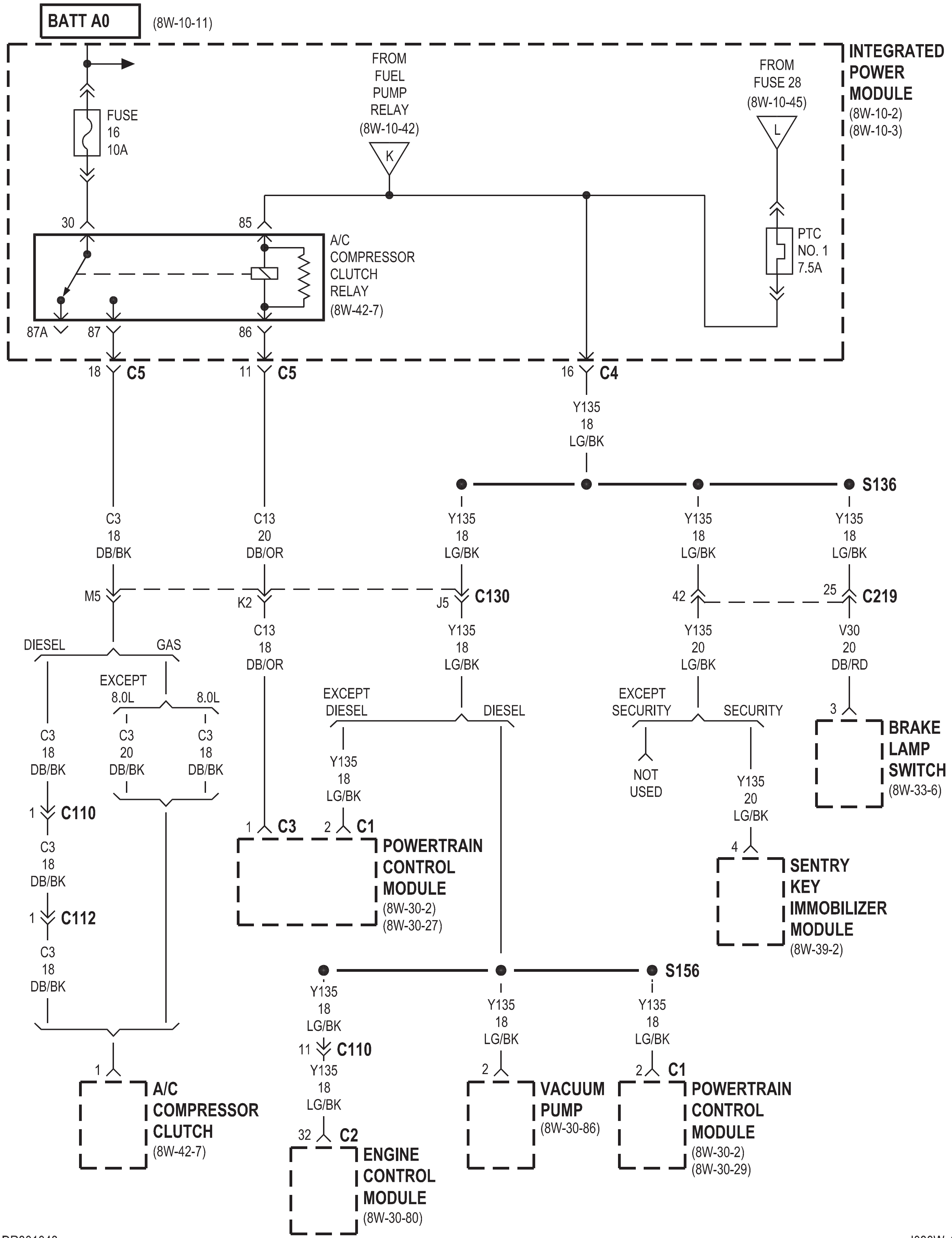
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 14 30A
30
85
STARTER MOTOR RELAY
(8W-21-2)
(8W-21-3)
87A
87
86
BATT A1
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
4 3 0 2 1
3
13
1 C7
23 C7
21 C7
EXCEPT NGC
NGC
T40 14 BR
T752 18 DG/OR
A41 16 YL
A41 16 YL
1 C102
F1 C130
GAS EXCEPT 8.0L
DIESEL/ 8.0L
T40 14 BR
T24 20 BR/YL
T752 18 DG/OR
A41 16 YL
7 C219
38 C3
S122
STARTER MOTOR
(8W-21-2)
(8W-21-3)
POWERTRAIN CONTROL MODULE
(8W-30-29)
A41 16 YL
A41 16 YL
A41 16 YL
S123
(8W-21-4)
T24 20 BR/YL
5.9L
3.7L/4.7L/ 5.7L
T24 20 BR/YL
A1 C130
NOT USED
57 C219
O
J
T24 20 BR/YL
T24 20 BR/YL
TO C130
(8W-10-40)
TO C130
(8W-10-41)
6 C2
1
TRANSFER CASE CONTROL MODULE (ELECTRIC 4X4)
(8W-31-20)
CLUTCH INTERLOCK BRAKE SWITCH
(8W-21-4)


FROM
S123
(8W-10-39)
O
T24
18
BR/YL
M/T
A/T
F1
C130
NOT
USED
F1
C130
DIESEL
GAS
8.0L
5.9L
T24
18
BR/YL
T24
18
BR/YL
T24
20
BR/YL
S124
(8W-21-4)
3.7L
EXCEPT
3.7L
DIESEL
GAS
5.9L
8.0L
T24
20
BR/YL
T24
18
BR/YL
T24
20
BR/YL
T24
18
BR/YL
T24
18
BR/YL
3
6
6
C1
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
TRANSMISSION
RANGE
SENSOR
(8W-31-15)
POWERTRAIN
CONTROL
MODULE
(8W-30-5)
(8W-30-32)
(8W-30-52)

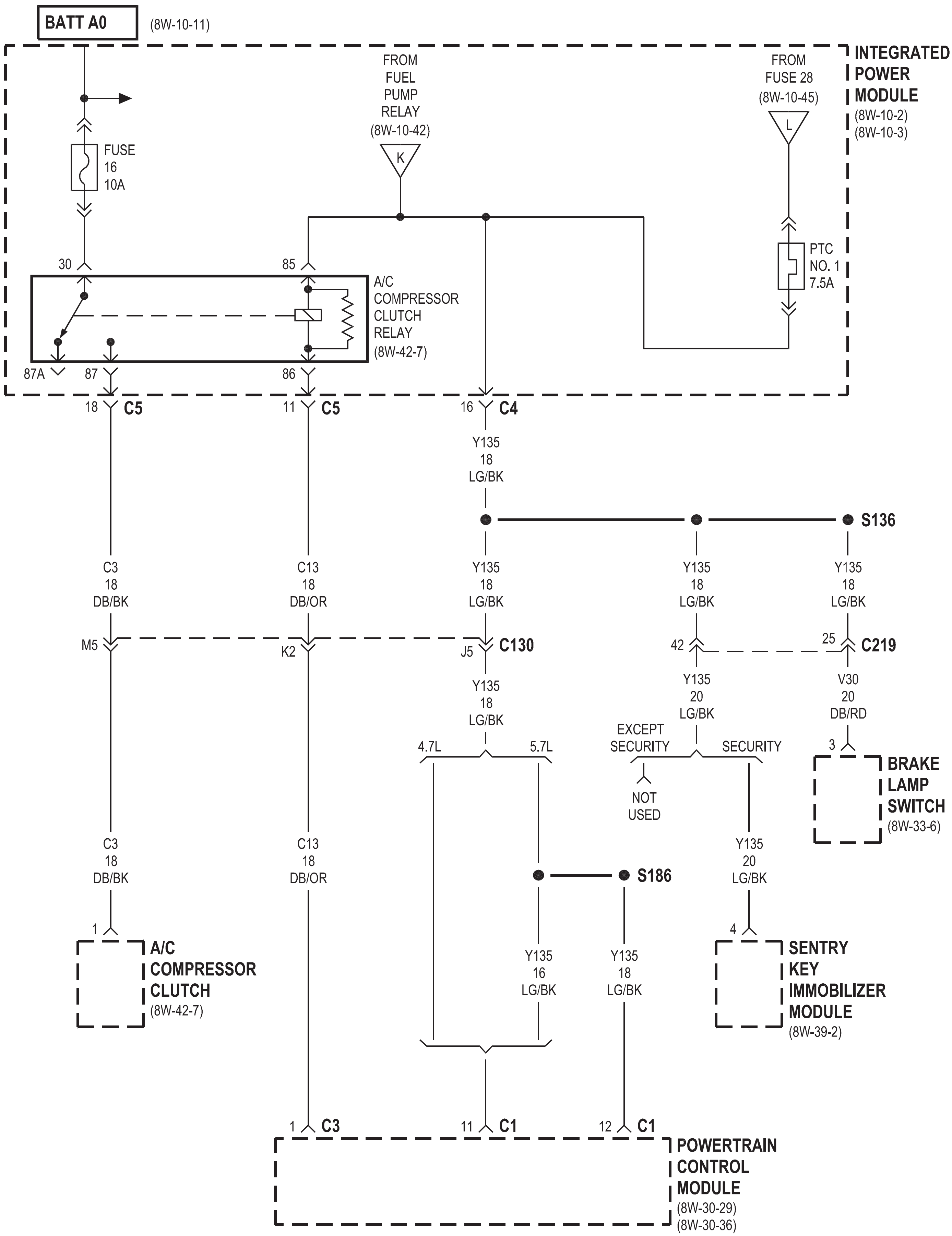

FROM
S122
(8W-10-39)
J
FROM
S324
(8W-10-16)
Z
A41
16
YL
A1
C130
3.7L
4.7L/5.7L
M/T
A/T
EXCEPT
5.7L A/T
5.7L A/T
A41
14
YL
A41
16
YL
A41
14
YL
A41
16
YL
S126
S126
A41
14
YL
A41
16
YL
A41
16
YL
Y174
20
PK/VT
13
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-23)
(8W-30-33)
30
C1
POWERTRAIN
CONTROL
MODULE
(8W-30-23)
(8W-30-33)
1
TAILGATE
LAMP
ASSEMBLY
(8W-51-4)
8
TRANSMISSION
CONTROL
MODULE
(8W-31-5)

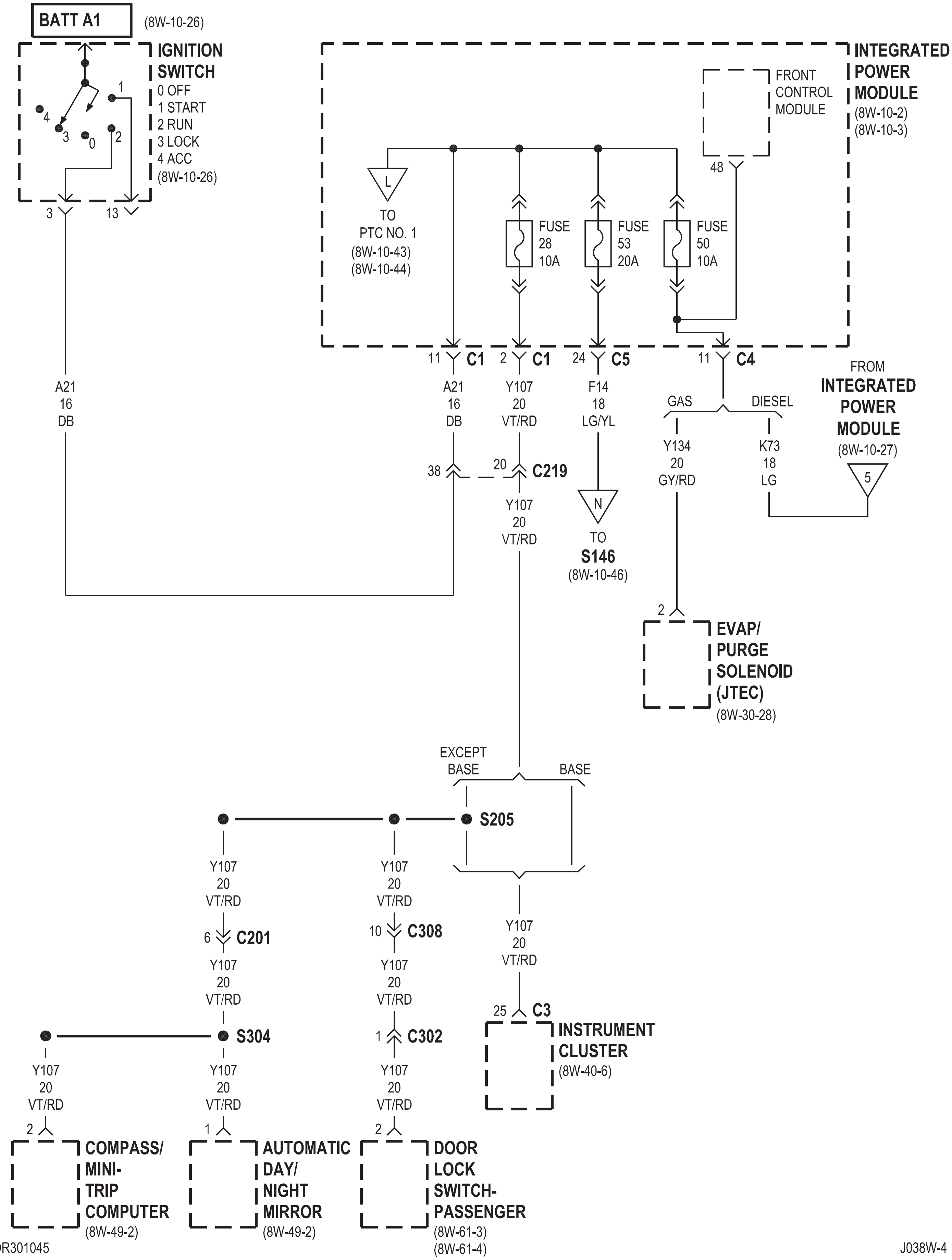


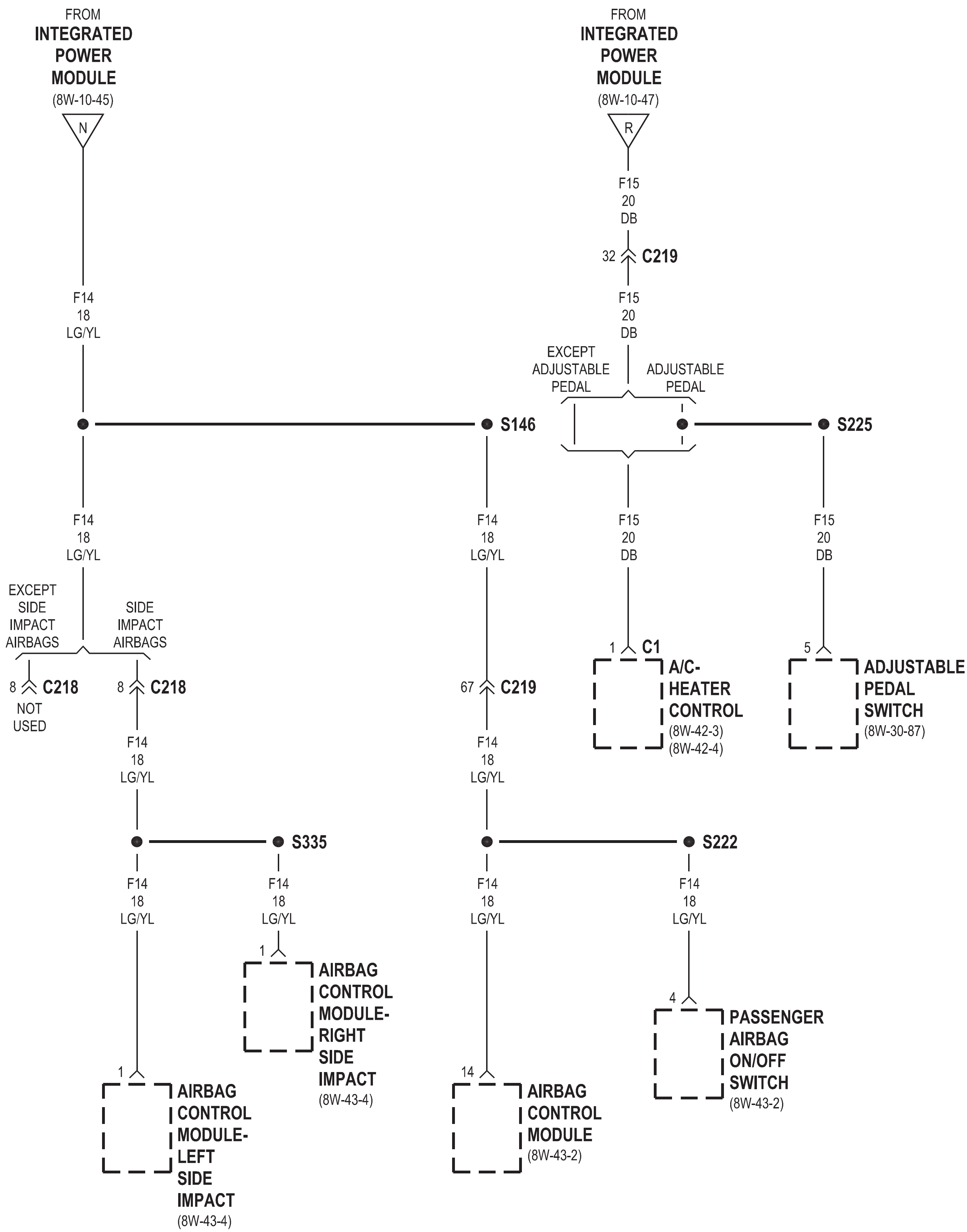
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 17 15A
K
TO PTC NO. 1
(8W-10-43)
(8W-10-44)
30
85
FUEL PUMP RELAY
(8W-30-3)
(8W-30-30)
87A
87
86
13 C1
9 C7
19 C7
F32 20 RD/YL
55 C219
F32 18 RD/YL
A64 18 DG/WT
K31 20 BR
S201
F32 18 RD/YL
EXCEPT BASE
BASE
F32 18 RD/YL
3 C220
3 C220
NOT USED
5 C217
J4 C130
F32 18 RD/YL
K31 18 BR
12 C201
9 C304
F32 20 RD/YL
F32 18 RD/YL
F32 18 RD/YL
A64 18 DG/WT
□□ 19
□ 37
2
GLOVE BOX LAMP AND SWITCH
(8W-44-2)
3 C2
DRIVER DOOR MODULE (EXCEPT BASE)
(8W-62-2)
4
FUEL PUMP MODULE
(8W-30-3)
(8W-30-30)
C3
POWERTRAIN CONTROL MODULE
(8W-30-3)
(8W-30-30)
S301
F32 20 RD/YL
F32 20 RD/YL
F32 20 RD/YL
F32 20 RD/YL
4
COMPASS/ MINI-TRIP COMPUTER (EXCEPT BASE)
(8W-49-2)
3
DOME LAMP
(8W-44-2)
2
OVERHEAD MAP/ READING LAMP (EXCEPT BASE)
(8W-44-2)
1
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP
(8W-44-2)
□ NGC
□□ EXCEPT NGC

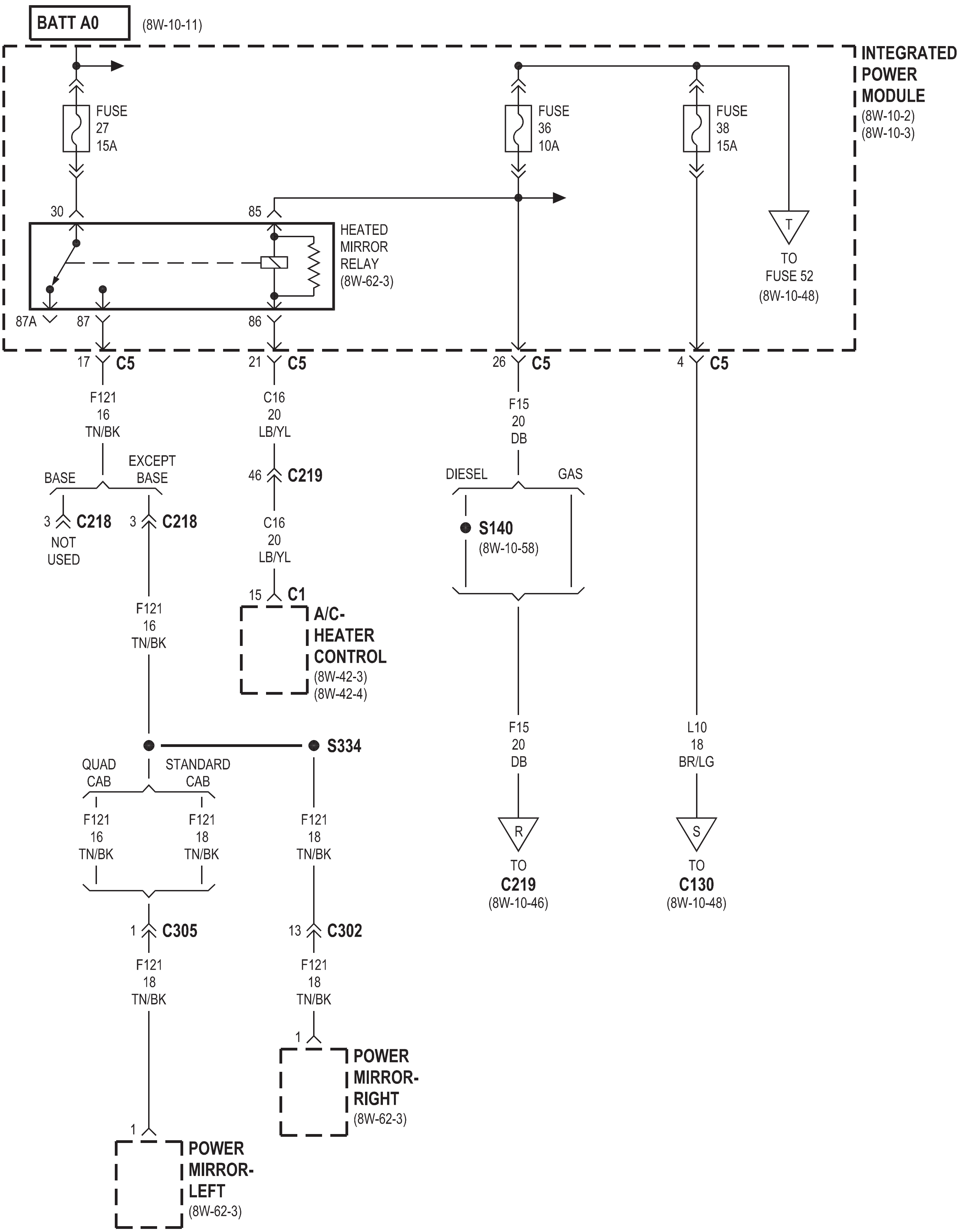

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 16 10A
FROM FUEL PUMP RELAY (8W-10-42)
K
FROM FUSE 28 (8W-10-45)
L
PTC NO. 1 7.5A
30
85
A/C COMPRESSOR CLUTCH RELAY (8W-42-7)
87A
87
86
18 C5
11 C5
16 C4
Y135 18 LG/BK
S136
C3 18 DB/BK
C13 20 DB/OR
Y135 18 LG/BK
Y135 18 LG/BK
Y135 18 LG/BK
M5
K2
J5
C130
42
25
C219
DIESEL
GAS
C13 18 DB/OR
Y135 18 LG/BK
Y135 20 LG/BK
V30 20 DB/RD
EXCEPT 8.0L
8.0L
EXCEPT DIESEL
DIESEL
EXCEPT SECURITY
SECURITY
3
BRAKE LAMP SWITCH
(8W-33-6)
C3 18 DB/BK
C3 20 DB/BK
C3 18 DB/BK
Y135 18 LG/BK
NOT USED
Y135 20 LG/BK
1 C110
1 C3
2 C1
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-27)
4
SENTRY KEY IMMOBILIZER MODULE
(8W-39-2)
C3 18 DB/BK
1 C112
C3 18 DB/BK
S156
Y135 18 LG/BK
Y135 18 LG/BK
Y135 18 LG/BK
11 C110
Y135 18 LG/BK
1
A/C COMPRESSOR CLUTCH
(8W-42-7)
2
VACUUM PUMP
(8W-30-86)
2 C1
POWERTRAIN CONTROL MODULE
(8W-30-2)
(8W-30-29)
32 C2
ENGINE CONTROL MODULE
(8W-30-80)

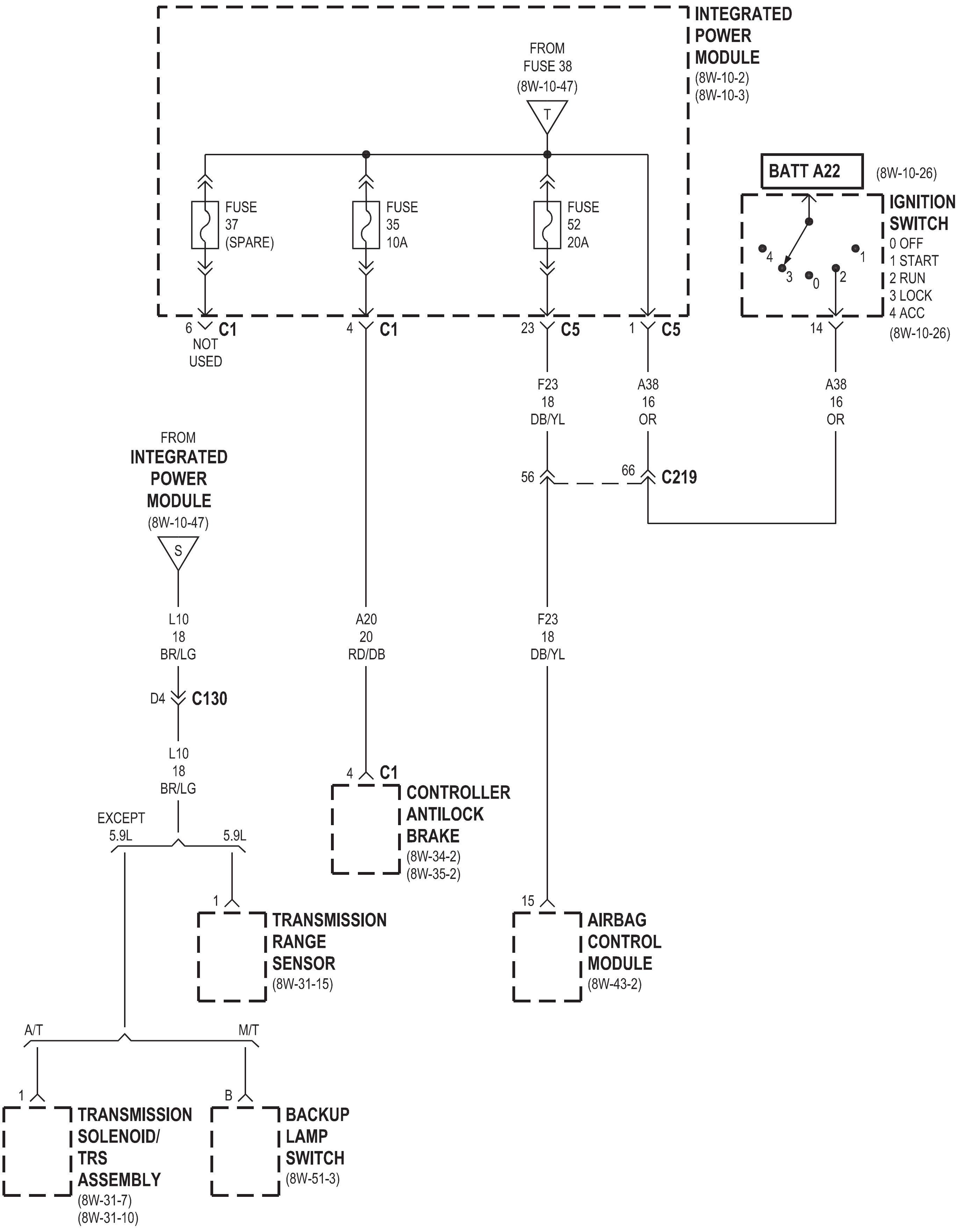
NGC

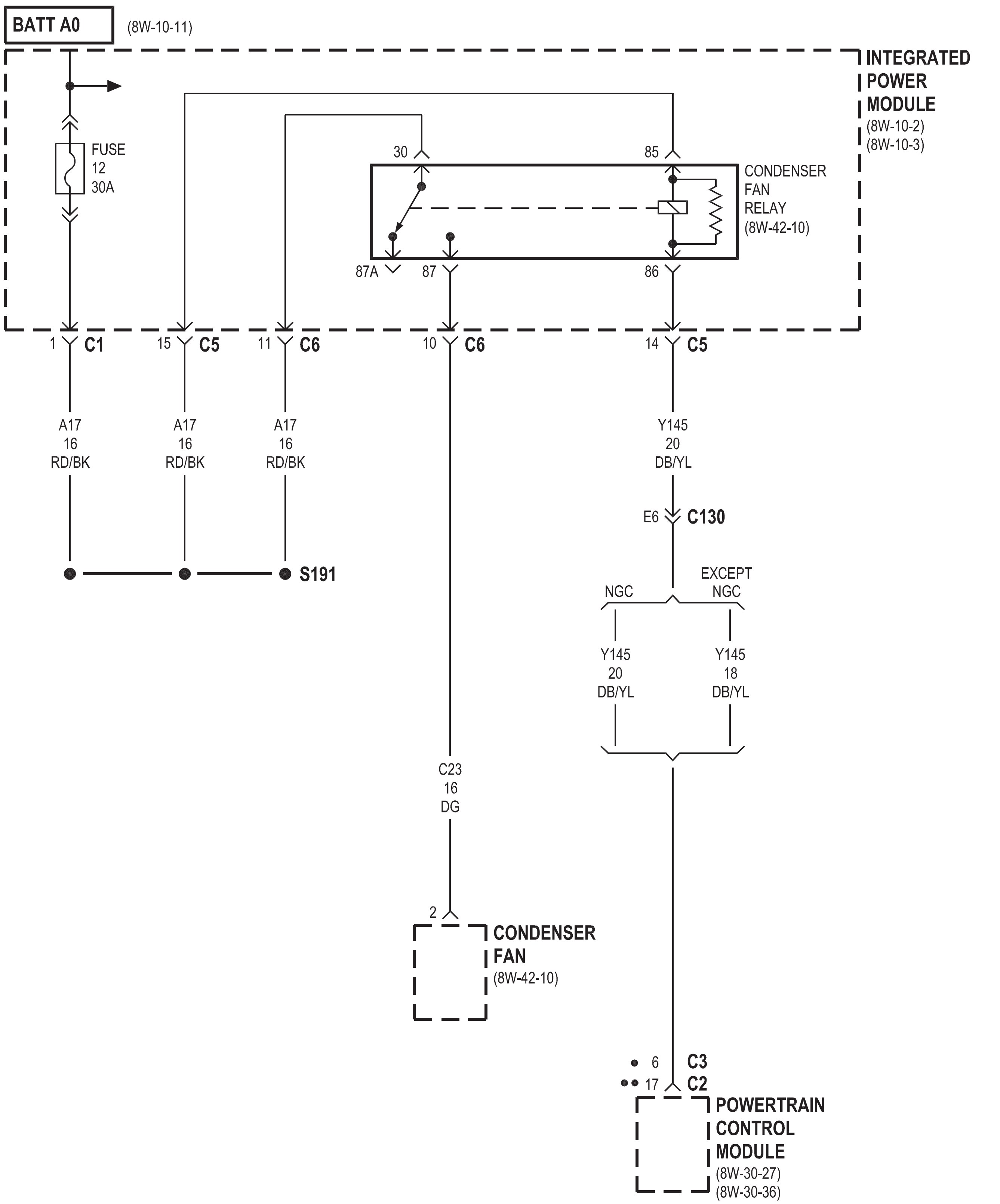

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 16 10A
FROM FUEL PUMP RELAY (8W-10-42)
K
FROM FUSE 28 (8W-10-45)
L
PTC NO. 1 7.5A
30
85
A/C COMPRESSOR CLUTCH RELAY (8W-42-7)
87A
87
86
18 C5
11 C5
16 C4
Y135 18 LG/BK
S136
C3 18 DB/BK
C13 18 DB/OR
Y135 18 LG/BK
Y135 18 LG/BK
Y135 18 LG/BK
M5
K2
J5
C130
42
25
C219
Y135 18 LG/BK
Y135 20 LG/BK
V30 20 DB/RD
4.7L
5.7L
EXCEPT SECURITY
SECURITY
NOT USED
3
BRAKE LAMP SWITCH
(8W-33-6)
C3 18 DB/BK
C13 18 DB/OR
S186
Y135 20 LG/BK
1
A/C COMPRESSOR CLUTCH
(8W-42-7)
Y135 16 LG/BK
Y135 18 LG/BK
4
SENTRY KEY IMMOBILIZER MODULE
(8W-39-2)
1 C3
11 C1
12 C1
POWERTRAIN CONTROL MODULE
(8W-30-29)
(8W-30-36)

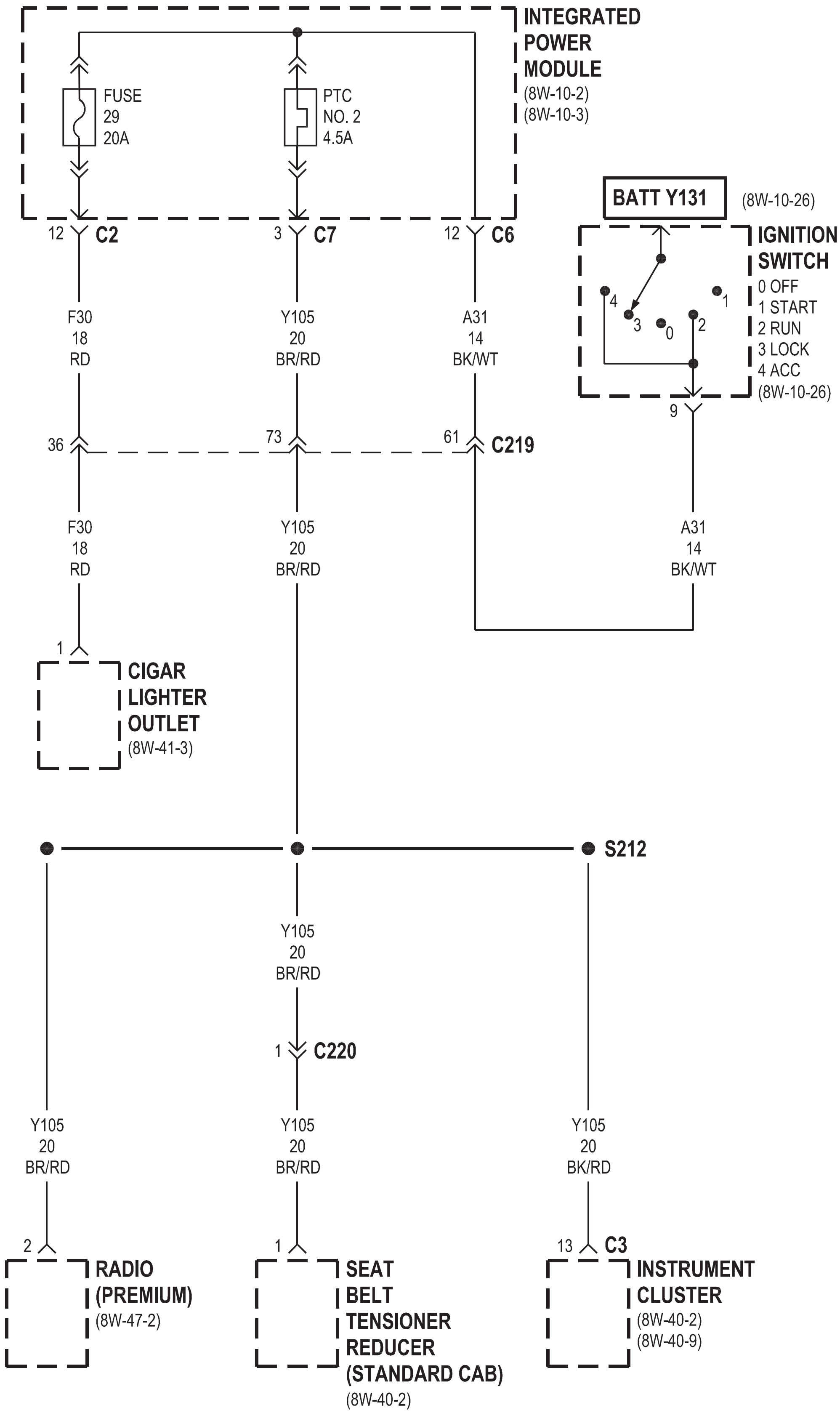

BATT A1
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
TO PTC NO. 1
(8W-10-43)
(8W-10-44)
FUSE 28 10A
FUSE 53 20A
FUSE 50 10A
C1
C1
C5
C4
A21 16 DB
Y107 20 VT/RD
F14 18 LG/YL
GAS
DIESEL
Y134 20 GY/RD
K73 18 LG
FROM INTEGRATED POWER MODULE
(8W-10-27)
C219
TO S146
(8W-10-46)
EVAP/ PURGE SOLENOID (JTEC)
(8W-30-28)
EXCEPT BASE
BASE
S205
C201
C308
C302
S304
C3
INSTRUMENT CLUSTER
(8W-40-6)
COMPASS/ MINI- TRIP COMPUTER
(8W-49-2)
AUTOMATIC DAY/ NIGHT MIRROR
(8W-49-2)
DOOR LOCK SWITCH- PASSENGER
(8W-61-3)
(8W-61-4)

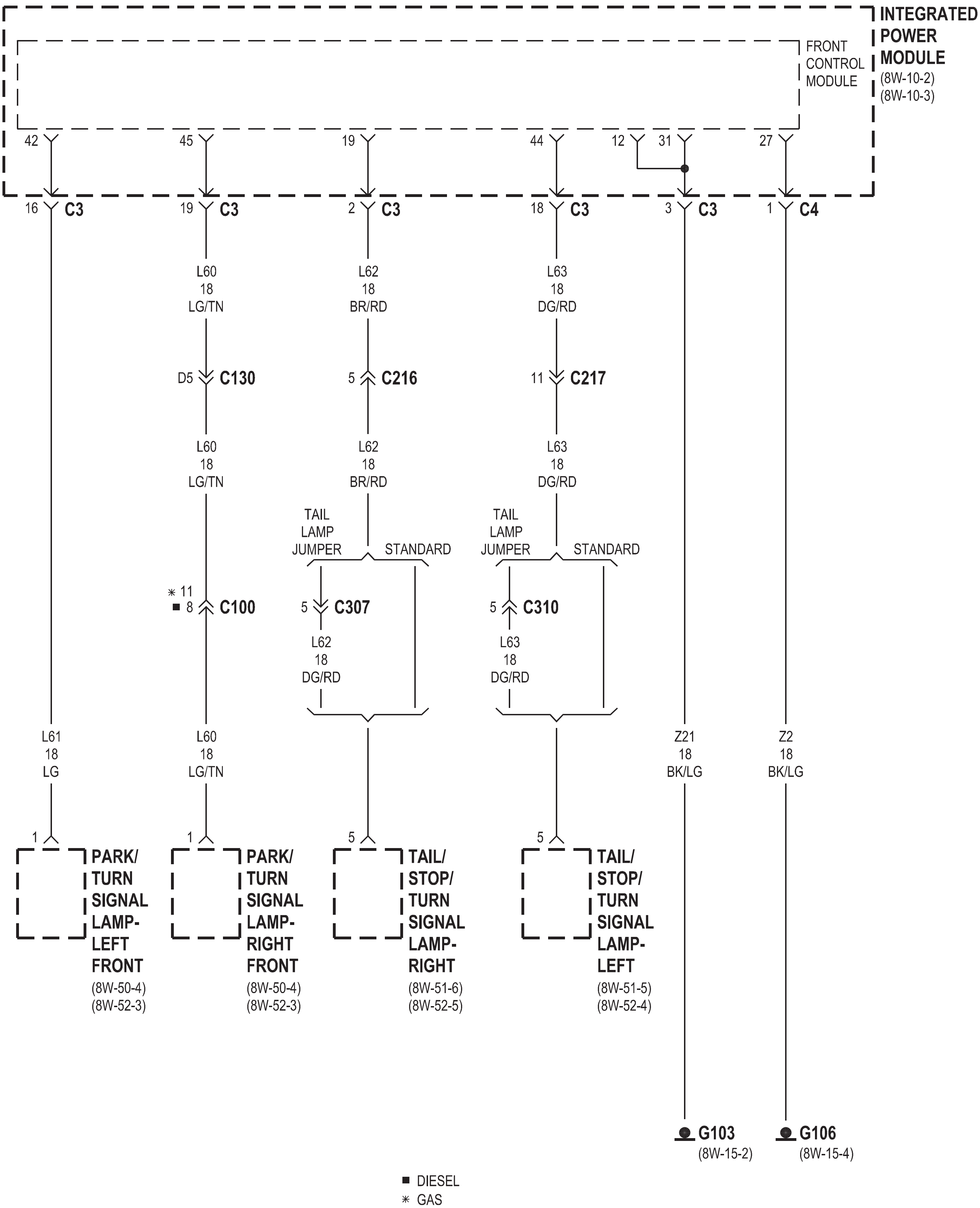

FROM
INTEGRATED
POWER
MODULE
(8W-10-45)
N
F14
18
LG/YL
FROM
INTEGRATED
POWER
MODULE
(8W-10-47)
R
F15
20
DB
32
C219
EXCEPT
ADJUSTABLE
PEDAL
ADJUSTABLE
PEDAL
S146
S225
EXCEPT
SIDE
IMPACT
AIRBAGS
SIDE
IMPACT
AIRBAGS
8
C218
NOT
USED
67
C219
1
C1
A/C-
HEATER
CONTROL
(8W-42-3)
(8W-42-4)
5
ADJUSTABLE
PEDAL
SWITCH
(8W-30-87)
S335
S222
AIRBAG
CONTROL
MODULE-
RIGHT
SIDE
IMPACT
(8W-43-4)
4
PASSENGER
AIRBAG
ON/OFF
SWITCH
(8W-43-2)
AIRBAG
CONTROL
MODULE-
LEFT
SIDE
IMPACT
(8W-43-4)
14
AIRBAG
CONTROL
MODULE
(8W-43-2)

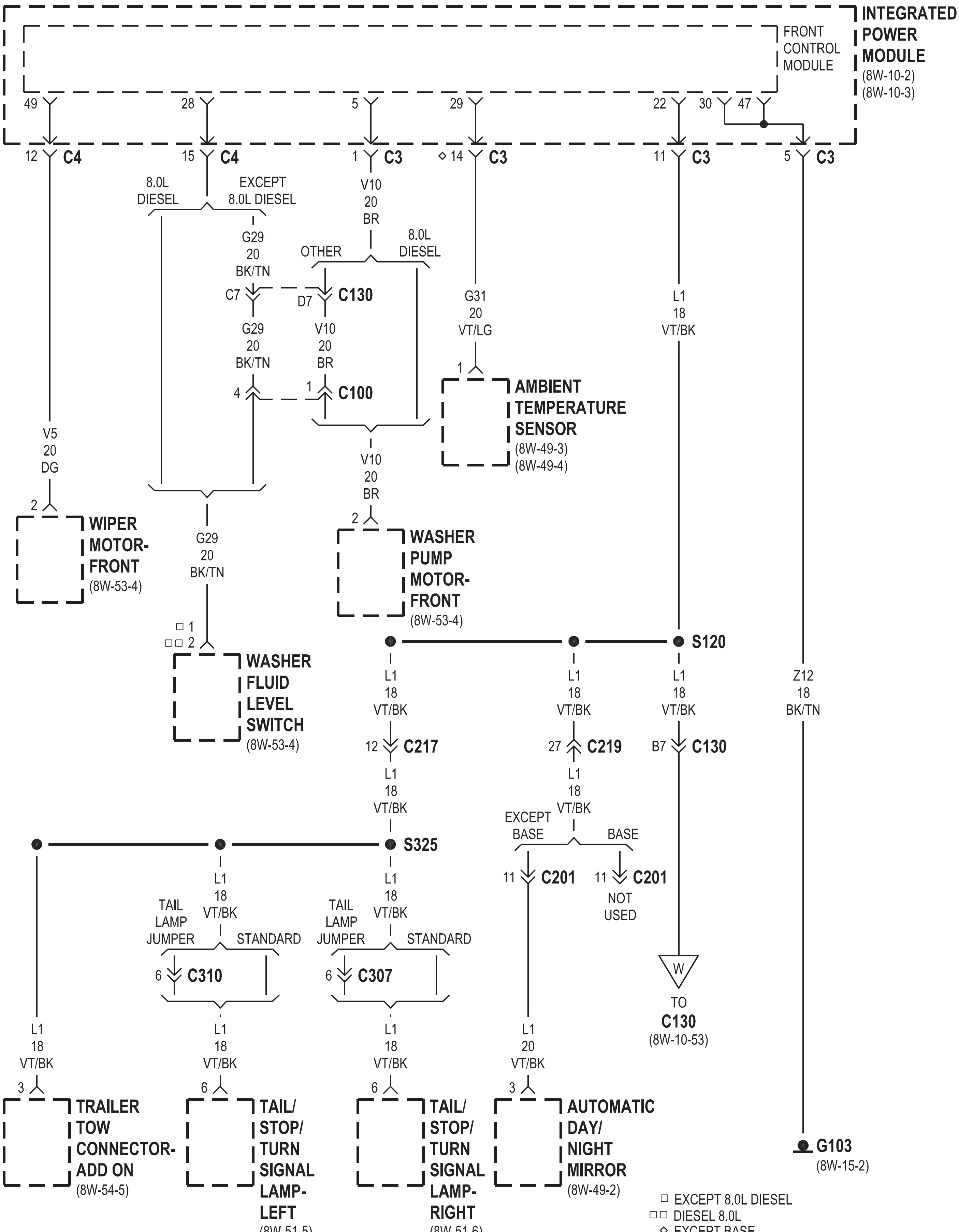

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 27 15A
FUSE 36 10A
FUSE 38 15A
30
85
HEATED MIRROR RELAY
(8W-62-3)
87A
87
86
T
TO FUSE 52
(8W-10-48)
17 C5
21 C5
26 C5
4 C5
F121 16 TN/BK
C16 20 LB/YL
F15 20 DB
BASE
EXCEPT BASE
3 C218
NOT USED
3 C218
46 C219
C16 20 LB/YL
15 C1
A/C-HEATER CONTROL
(8W-42-3)
(8W-42-4)
DIESEL
GAS
S140
(8W-10-58)
F121 16 TN/BK
S334
QUAD CAB
STANDARD CAB
F121 16 TN/BK
F121 18 TN/BK
F121 18 TN/BK
F15 20 DB
L10 18 BR/LG
R
TO C219
(8W-10-46)
S
TO C130
(8W-10-48)
1 C305
13 C302
F121 18 TN/BK
F121 18 TN/BK
1
POWER MIRROR-RIGHT
(8W-62-3)
1
POWER MIRROR-LEFT
(8W-62-3)


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FROM FUSE 38
(8W-10-47)
T
FUSE 37 (SPARE)
FUSE 35 10A
FUSE 52 20A
BATT A22
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
6 C1
NOT USED
4 C1
23 C5
1 C5
14
F23 18 DB/YL
A38 16 OR
A38 16 OR
56
66 C219
FROM INTEGRATED POWER MODULE
(8W-10-47)
S
L10 18 BR/LG
A20 20 RD/DB
F23 18 DB/YL
D4 C130
L10 18 BR/LG
4 C1
CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
EXCEPT 5.9L
5.9L
1
TRANSMISSION RANGE SENSOR
(8W-31-15)
15
AIRBAG CONTROL MODULE
(8W-43-2)
A/T
M/T
1
B
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-7)
(8W-31-10)
BACKUP LAMP SWITCH
(8W-51-3)

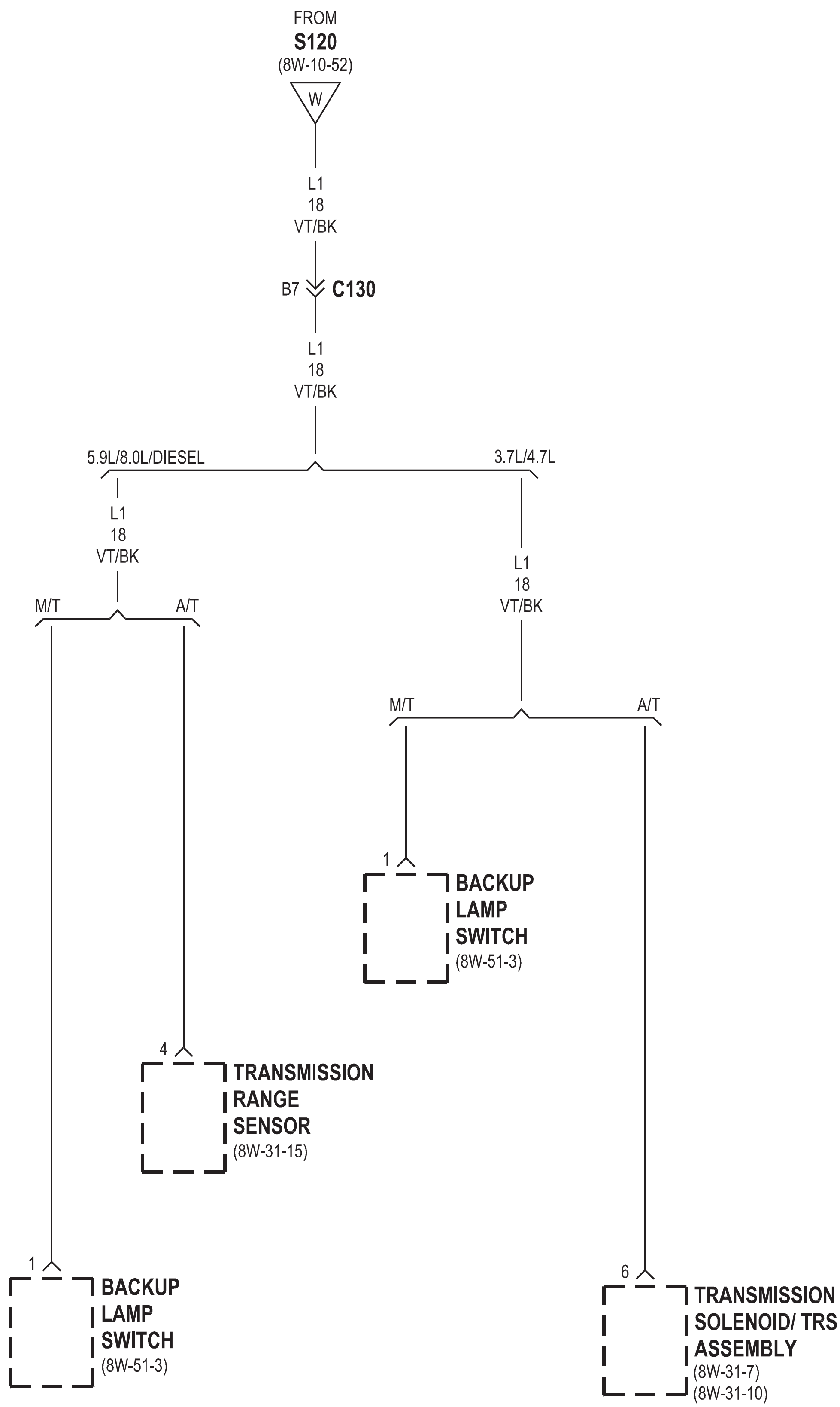

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
12
30A
30
85
CONDENSER
FAN
RELAY
(8W-42-10)
87A
87
86
1 C1
15 C5
11 C6
10 C6
14 C5
A17
16
RD/BK
A17
16
RD/BK
A17
16
RD/BK
Y145
20
DB/YL
E6 C130
S191
NGC
EXCEPT
NGC
Y145
20
DB/YL
Y145
18
DB/YL
C23
16
DG
2
CONDENSER
FAN
(8W-42-10)
6 C3
17 C2
POWERTRAIN
CONTROL
MODULE
(8W-30-27)
(8W-30-36)
NGC
EXCEPT NGC

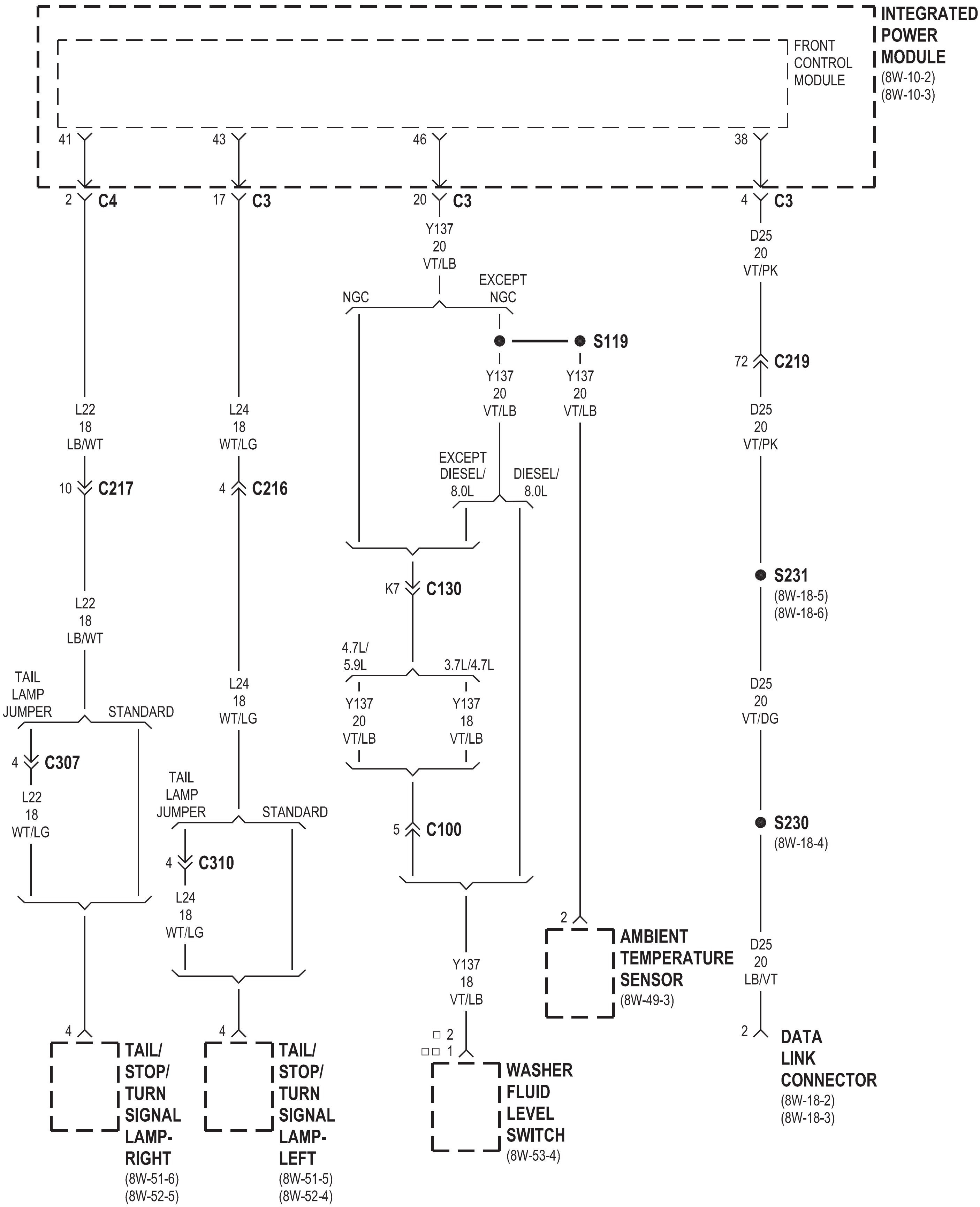

INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
29
20A
PTC
NO. 2
4.5A
12 C2
3 C7
12 C6
BATT Y131
(8W-10-26)
IGNITION
SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
F30
18
RD
Y105
20
BR/RD
A31
14
BK/WT
9
36
73
61
C219
CIGAR
LIGHTER
OUTLET
(8W-41-3)
S212
1 C220
2
RADIO
(PREMIUM)
(8W-47-2)
1
SEAT
BELT
TENSIONER
REDUCER
(STANDARD CAB)
(8W-40-2)
Y105
20
BK/RD
13 C3
INSTRUMENT
CLUSTER
(8W-40-2)
(8W-40-9)


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
42
45
19
44
12
31
27
16 C3
19 C3
2 C3
18 C3
3 C3
1 C4
L60
18
LG/TN
L62
18
BR/RD
L63
18
DG/RD
D5 C130
5 C216
11 C217
TAIL LAMP JUMPER
STANDARD
⁎ 11
■ 8 C100
5 C307
5 C310
L62
18
DG/RD
L63
18
DG/RD
L61
18
LG
Z21
18
BK/LG
Z2
18
BK/LG
PARK/ TURN SIGNAL LAMP- LEFT FRONT
(8W-50-4)
(8W-52-3)
PARK/ TURN SIGNAL LAMP- RIGHT FRONT
(8W-50-4)
(8W-52-3)
TAIL/ STOP/ TURN SIGNAL LAMP- RIGHT
(8W-51-6)
(8W-52-5)
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
(8W-51-5)
(8W-52-4)
G103
(8W-15-2)
G106
(8W-15-4)
■ DIESEL
⁎ GAS

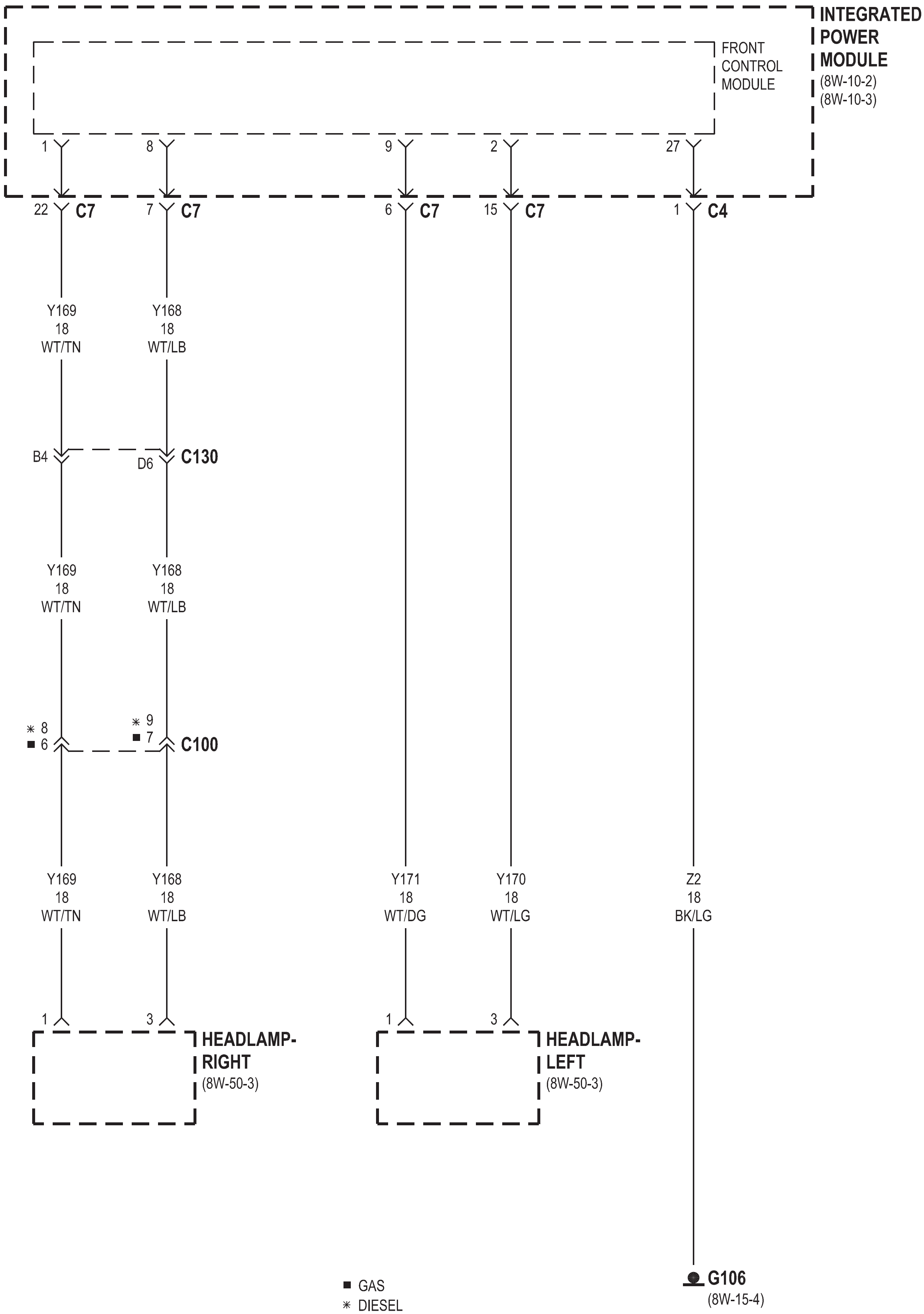


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
49
28
5
29
22
30
47
12 C4
15 C4
1 C3
◇ 14 C3
11 C3
5 C3
8.0L DIESEL
EXCEPT 8.0L DIESEL
V10 20 BR
G29 20 BK/TN
OTHER
8.0L DIESEL
C7
D7 C130
G29 20 BK/TN
V10 20 BR
4
1 C100
G31 20 VT/LG
L1 18 VT/BK
1
AMBIENT TEMPERATURE SENSOR
(8W-49-3)
(8W-49-4)
V5 20 DG
V10 20 BR
2
WIPER MOTOR-FRONT
(8W-53-4)
G29 20 BK/TN
2
WASHER PUMP MOTOR-FRONT
(8W-53-4)
□ 1
□□ 2
WASHER FLUID LEVEL SWITCH
(8W-53-4)
S120
L1 18 VT/BK
L1 18 VT/BK
L1 18 VT/BK
Z12 18 BK/TN
12 C217
27 C219
B7 C130
L1 18 VT/BK
L1 18 VT/BK
EXCEPT BASE
BASE
S325
11 C201
11 C201
NOT USED
L1 18 VT/BK
L1 18 VT/BK
TAIL LAMP JUMPER
STANDARD
TAIL LAMP JUMPER
STANDARD
6 C310
6 C307
W
TO C130
(8W-10-53)
L1 18 VT/BK
L1 18 VT/BK
L1 18 VT/BK
L1 20 VT/BK
3
6
6
3
TRAILER TOW CONNECTOR-ADD ON
(8W-54-5)
TAIL/ STOP/ TURN SIGNAL LAMP-LEFT
(8W-51-5)
TAIL/ STOP/ TURN SIGNAL LAMP-RIGHT
(8W-51-6)
AUTOMATIC DAY/ NIGHT MIRROR
(8W-49-2)
G103
(8W-15-2)
□ EXCEPT 8.0L DIESEL
□□ DIESEL 8.0L
◇ EXCEPT BASE


FROM
S120
(8W-10-52)
W
L1
18
VT/BK
B7
C130
L1
18
VT/BK
5.9L/8.0L/DIESEL
3.7L/4.7L
L1
18
VT/BK
M/T
A/T
L1
18
VT/BK
M/T
A/T
1
BACKUP
LAMP
SWITCH
(8W-51-3)
4
TRANSMISSION
RANGE
SENSOR
(8W-31-15)
1
BACKUP
LAMP
SWITCH
(8W-51-3)
6
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-7)
(8W-31-10)



□ EXCEPT 8.0L DIESEL
□□ 8.0L DIESEL



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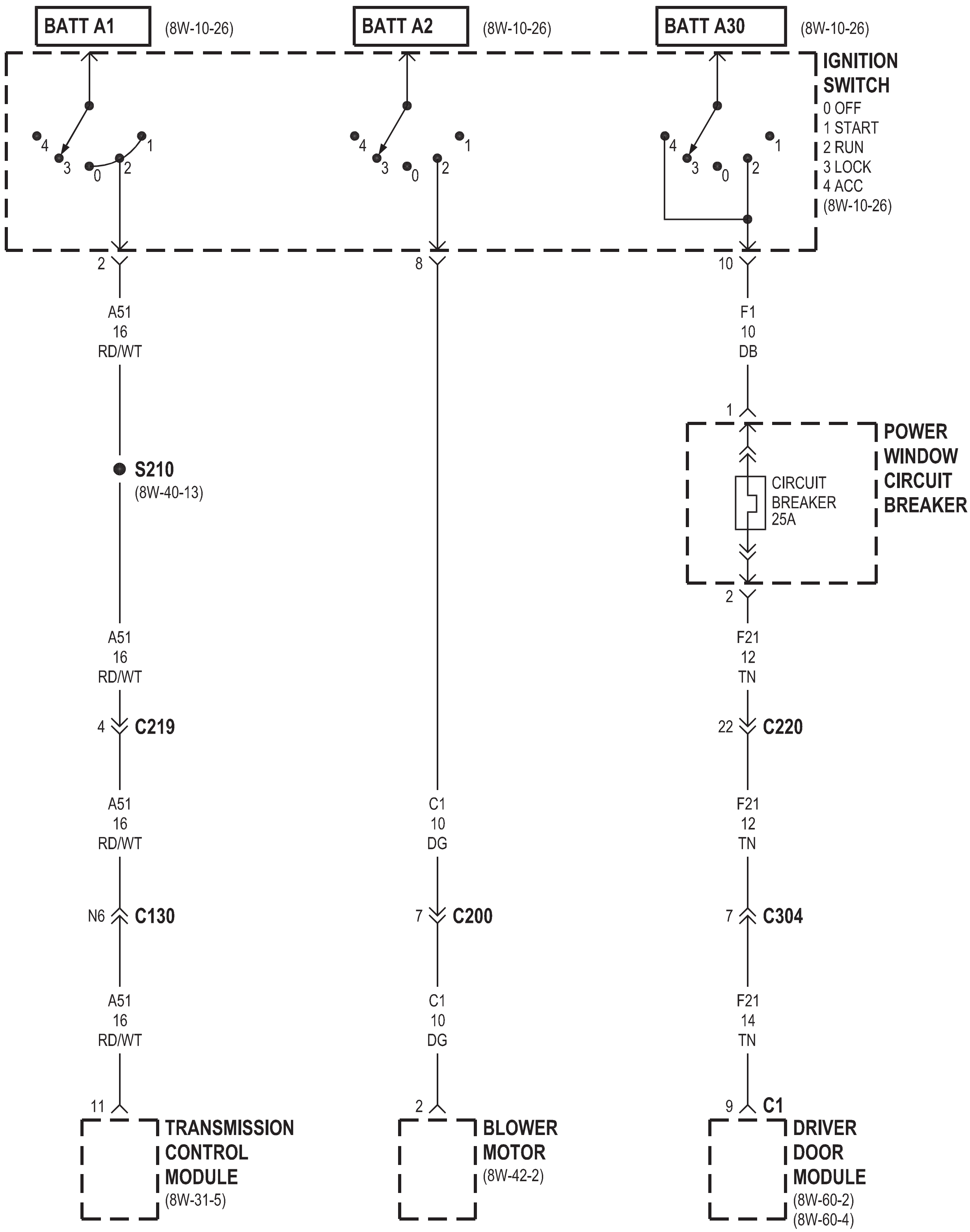
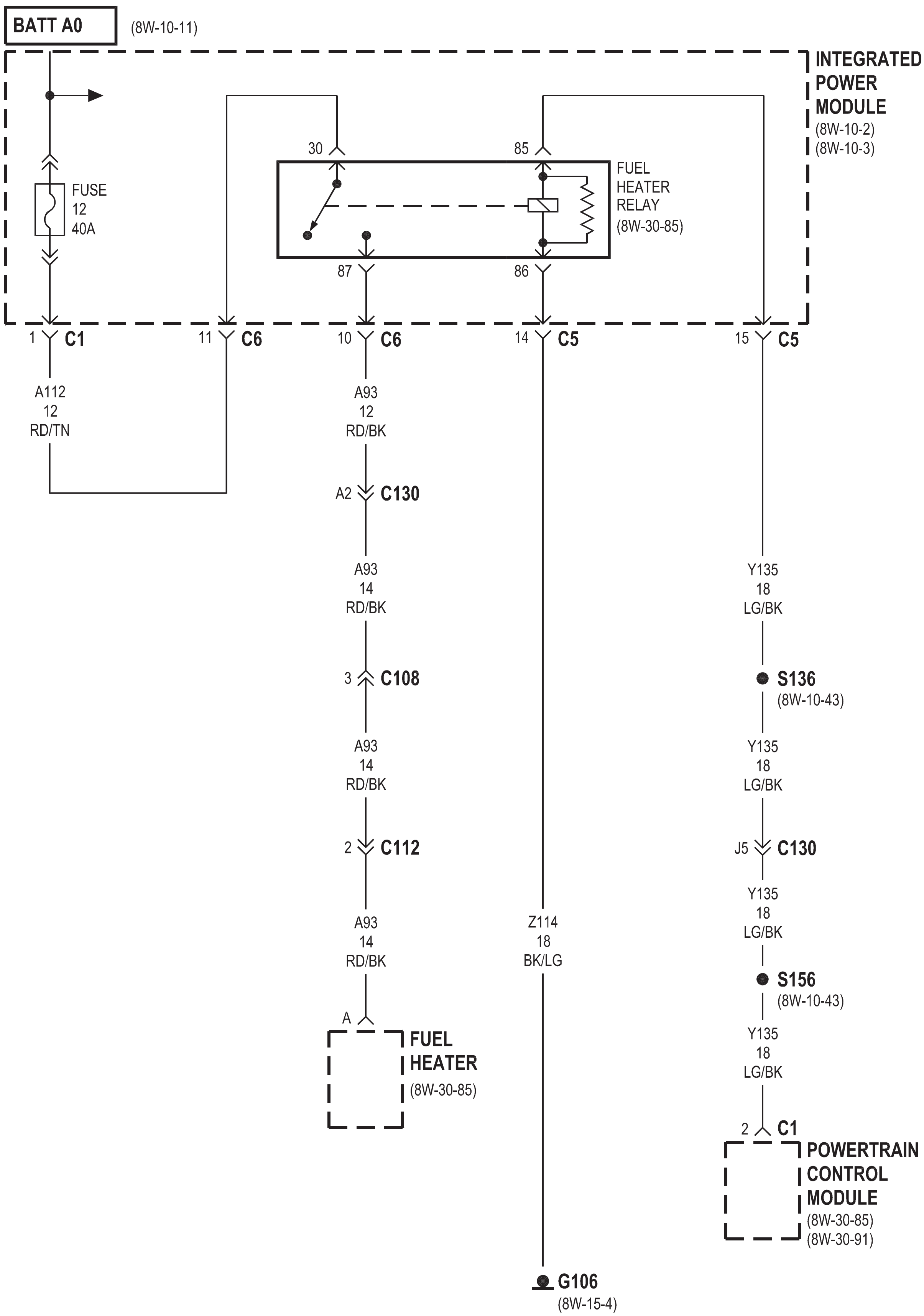
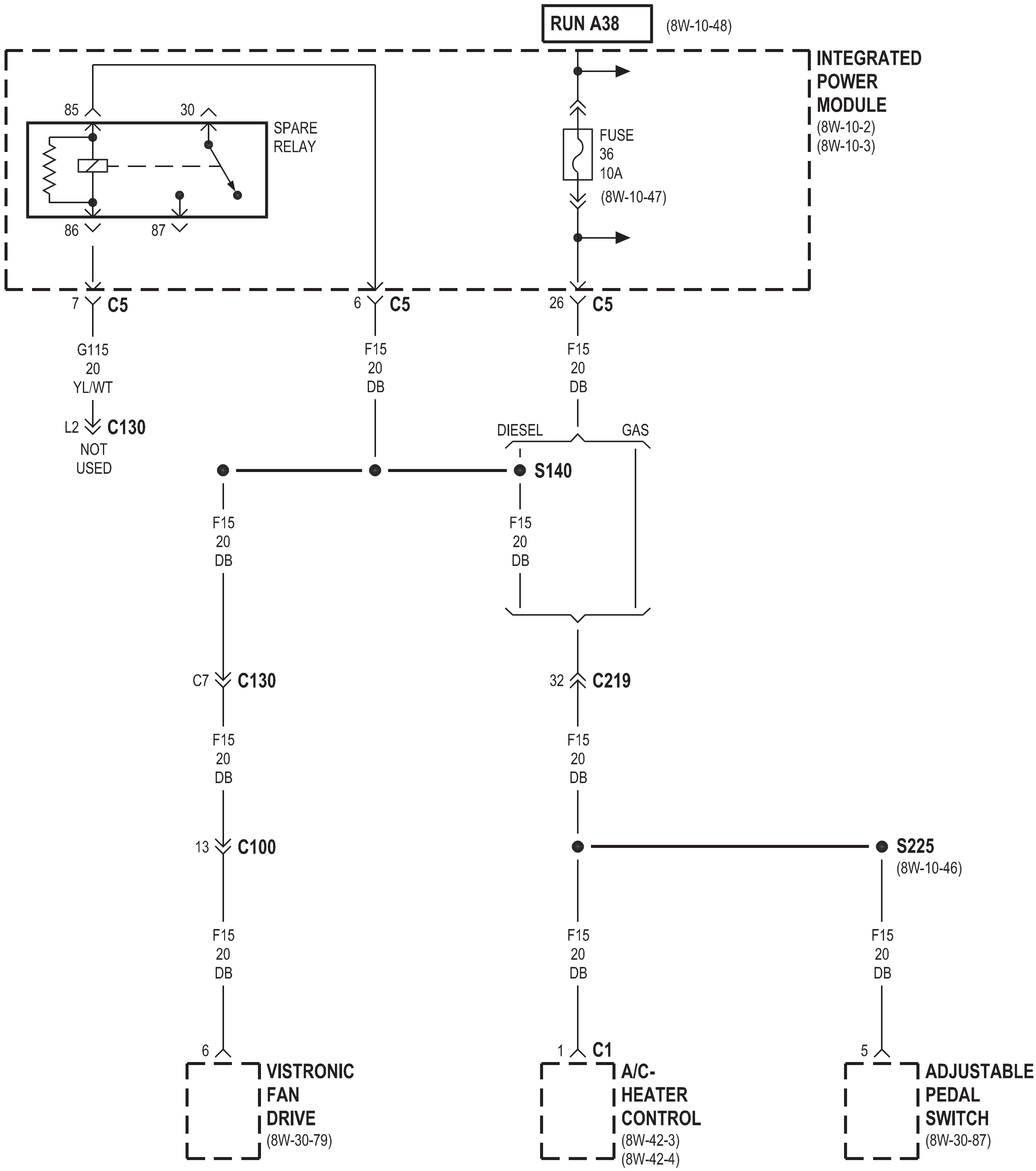
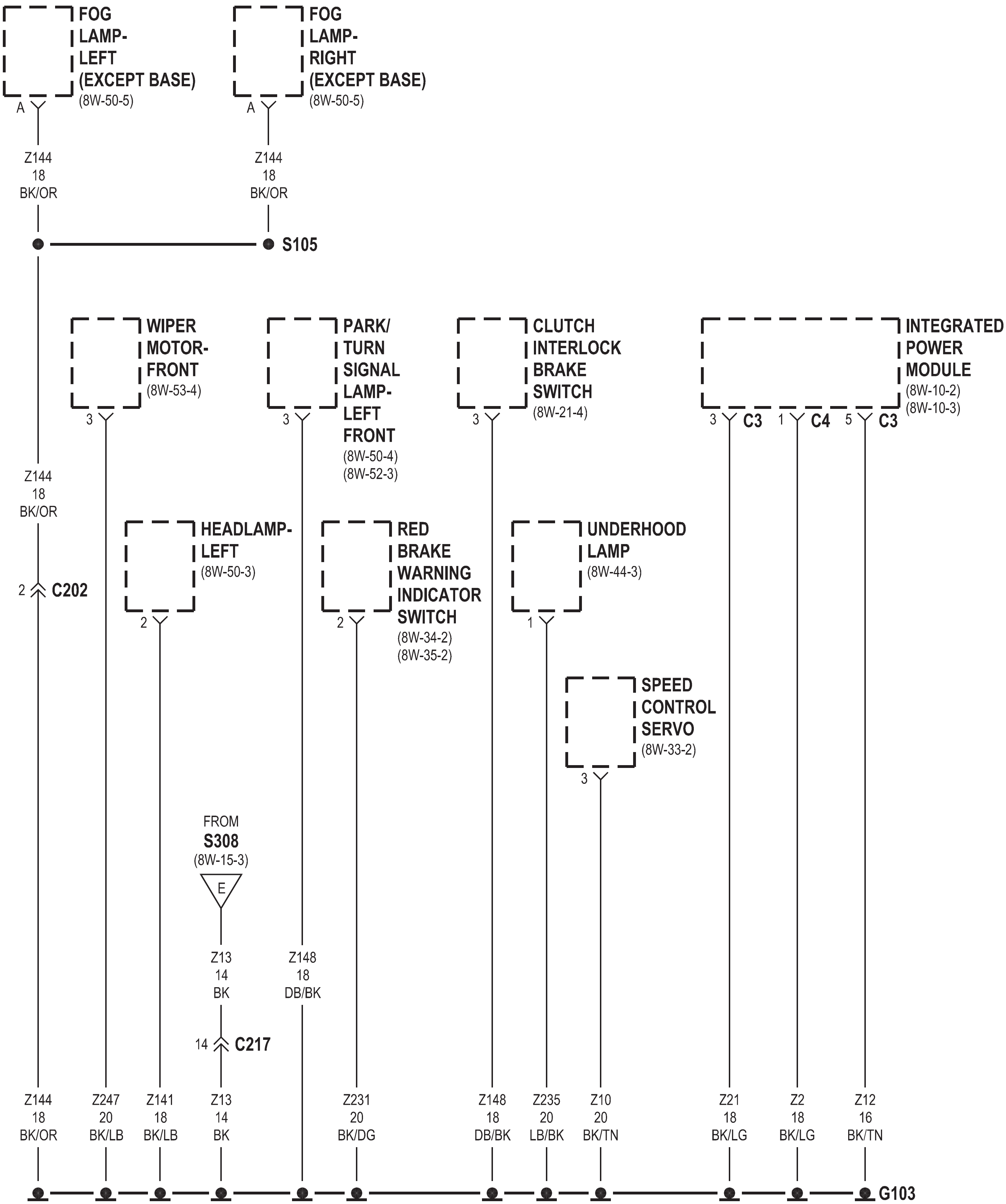
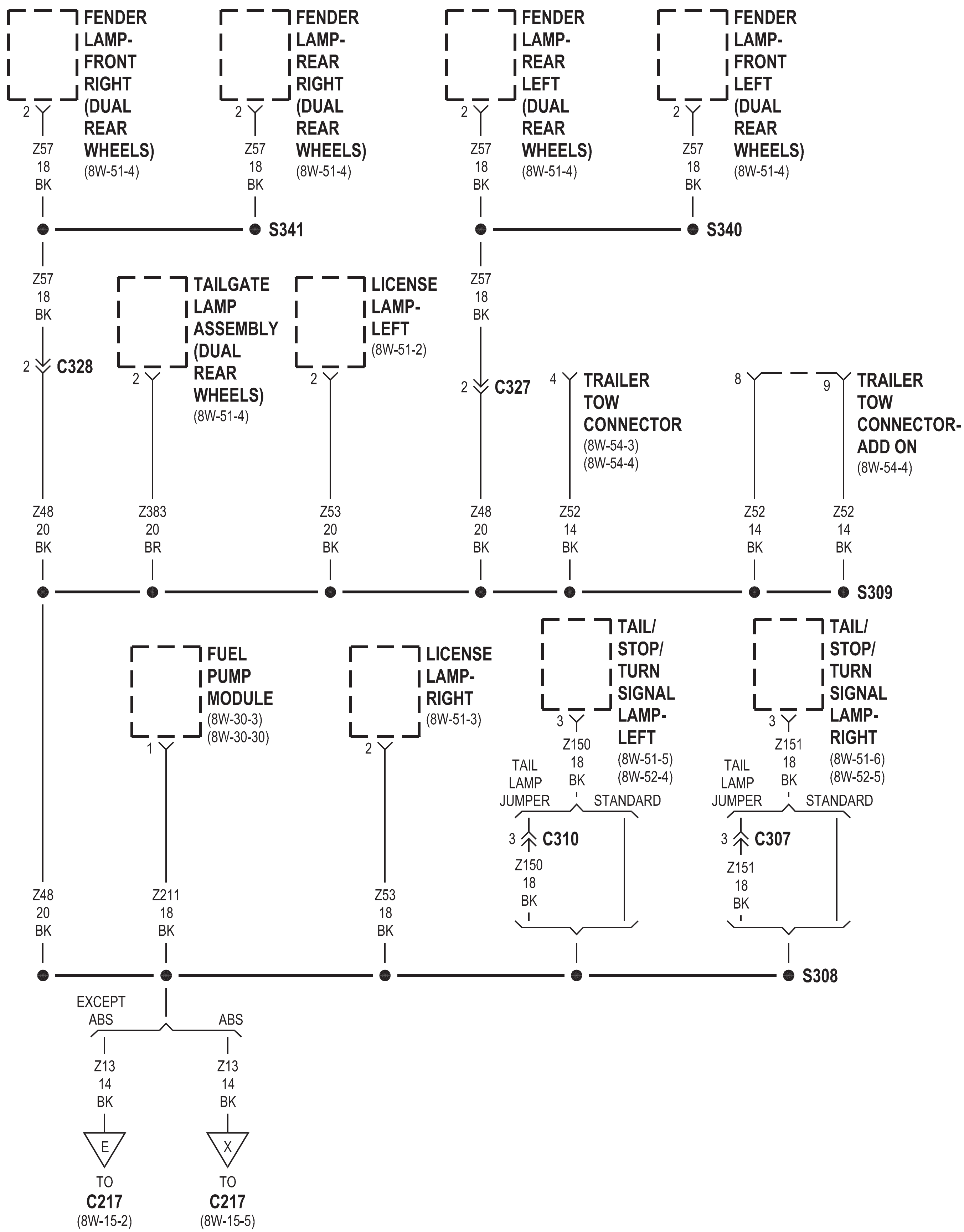

BATT A1
(8W-10-26)
BATT A2
(8W-10-26)
BATT A30
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
A51
16
RD/WT
S210
(8W-40-13)
C219
C130
F1
10
DB
POWER WINDOW CIRCUIT BREAKER
CIRCUIT BREAKER 25A
F21
12
TN
C220
C304
F21
14
TN
C1
10
DG
C200
N6
TRANSMISSION CONTROL MODULE
(8W-31-5)
BLOWER MOTOR
(8W-42-2)
C1
DRIVER DOOR MODULE
(8W-60-2)
(8W-60-4)


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 12 40A
30
85
87
86
FUEL HEATER RELAY
(8W-30-85)
1 C1
11 C6
10 C6
14 C5
15 C5
A112 12 RD/TN
A93 12 RD/BK
A2 C130
A93 14 RD/BK
3 C108
A93 14 RD/BK
2 C112
A93 14 RD/BK
A
FUEL HEATER
(8W-30-85)
Z114 18 BK/LG
G106
(8W-15-4)
Y135 18 LG/BK
S136
(8W-10-43)
Y135 18 LG/BK
J5 C130
Y135 18 LG/BK
S156
(8W-10-43)
Y135 18 LG/BK
2 C1
POWERTRAIN CONTROL MODULE
(8W-30-85)
(8W-30-91)

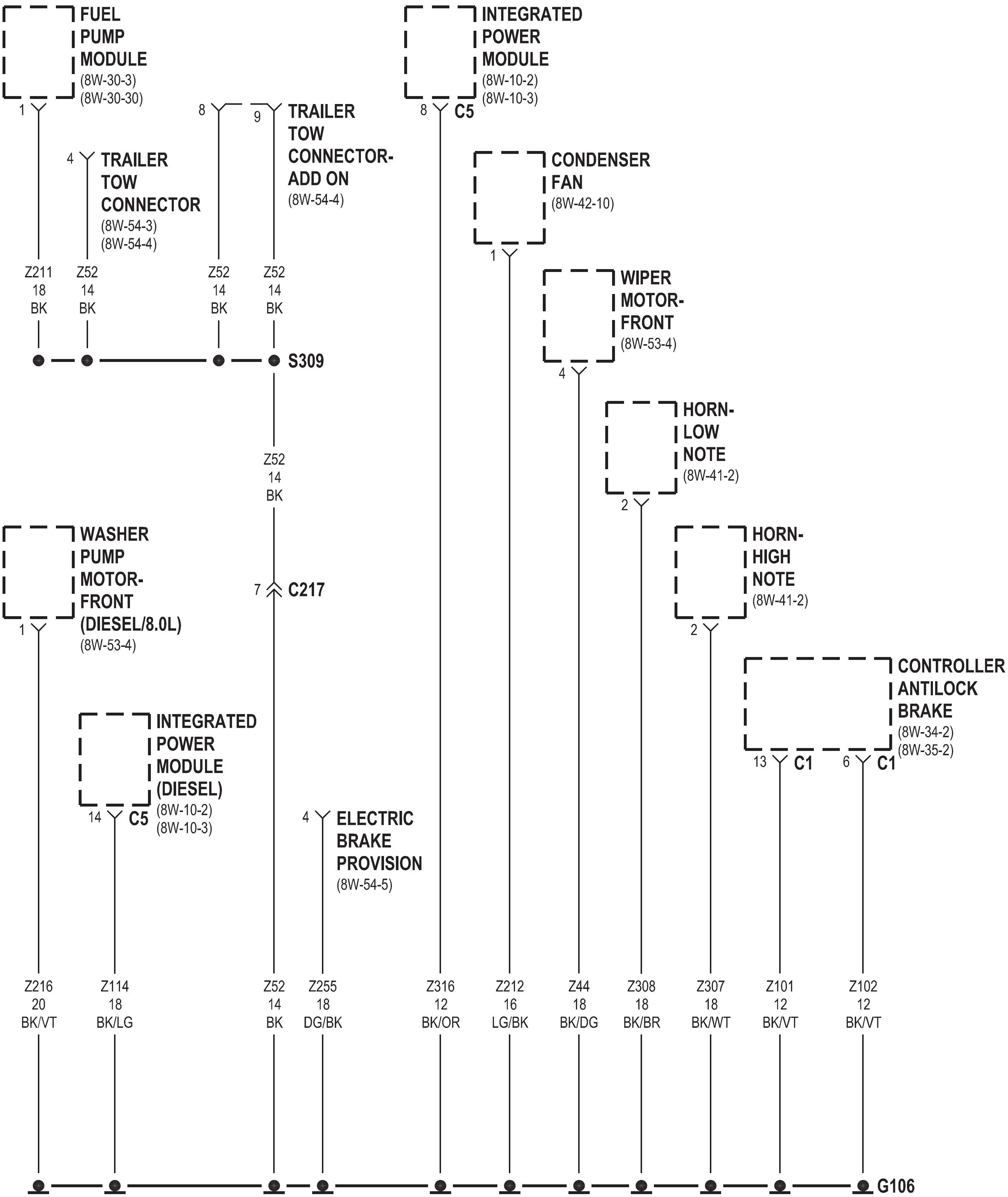

RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
85
30
SPARE RELAY
86
87
FUSE 36 10A
(8W-10-47)
7 C5
6 C5
26 C5
G115 20 YL/WT
L2 C130
NOT USED
F15 20 DB
DIESEL
GAS
S140
C7 C130
32 C219
13 C100
S225
(8W-10-46)
6
VISTRONIC FAN DRIVE
(8W-30-79)
1 C1
A/C-HEATER CONTROL
(8W-42-3)
(8W-42-4)
5
ADJUSTABLE PEDAL SWITCH
(8W-30-87)

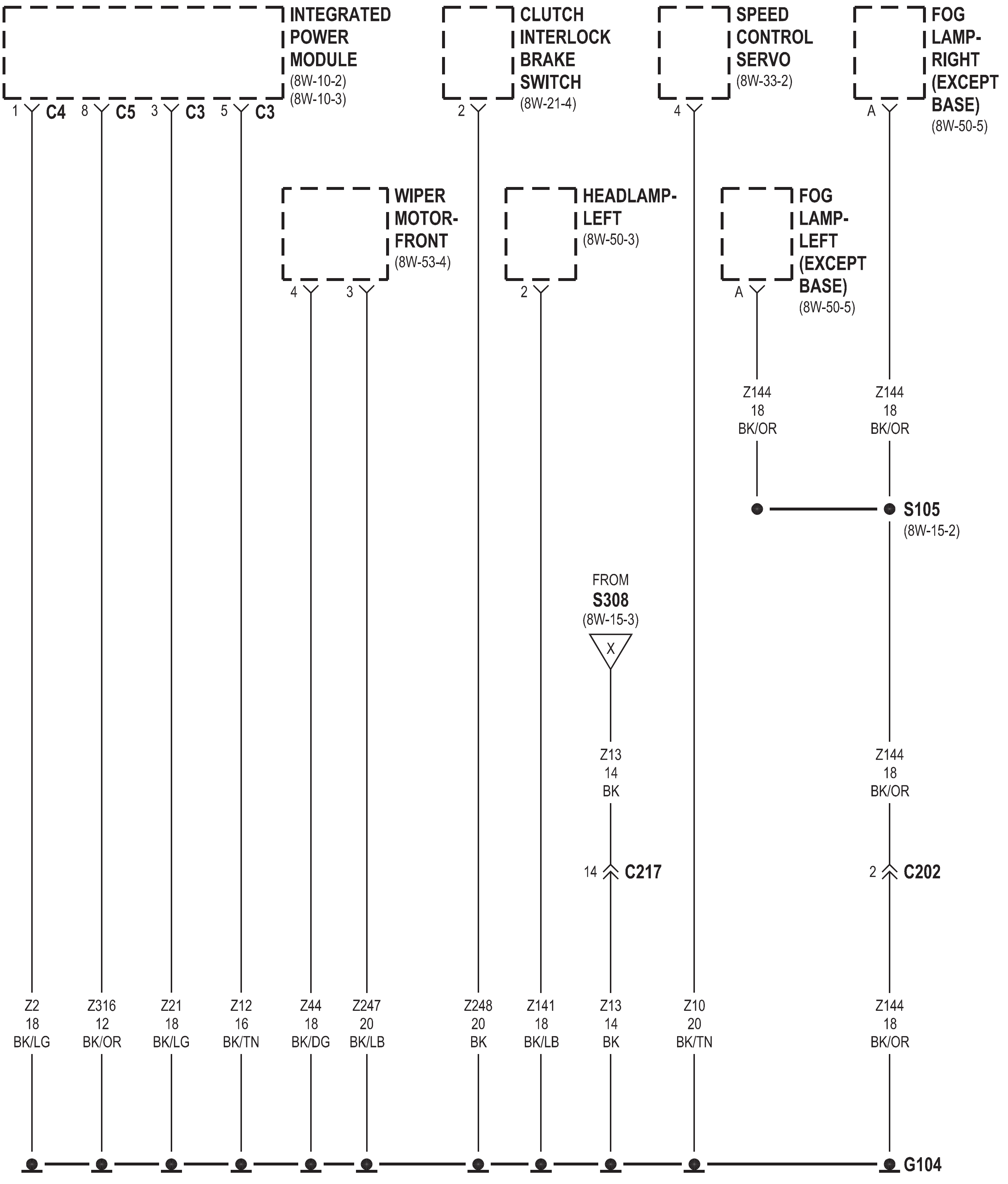
8W-15 GROUND DISTRIBUTION


FOG LAMP- LEFT (EXCEPT BASE)
(8W-50-5)
FOG LAMP- RIGHT (EXCEPT BASE)
(8W-50-5)
A
Z144 18 BK/OR
S105
WIPER MOTOR- FRONT
(8W-53-4)
PARK/ TURN SIGNAL LAMP- LEFT FRONT
(8W-50-4)
(8W-52-3)
CLUTCH INTERLOCK BRAKE SWITCH
(8W-21-4)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
3 C3
1 C4
5 C3
HEADLAMP- LEFT
(8W-50-3)
RED BRAKE WARNING INDICATOR SWITCH
(8W-34-2)
(8W-35-2)
UNDERHOOD LAMP
(8W-44-3)
SPEED CONTROL SERVO
(8W-33-2)
2 C202
FROM
S308
(8W-15-3)
E
Z13 14 BK
Z148 18 DB/BK
14 C217
Z144 18 BK/OR
Z247 20 BK/LB
Z141 18 BK/LB
Z13 14 BK
Z231 20 BK/DG
Z148 18 DB/BK
Z235 20 LB/BK
Z10 20 BK/TN
Z21 18 BK/LG
Z2 18 BK/LG
Z12 16 BK/TN
G103


FENDER LAMP-FRONT RIGHT (DUAL REAR WHEELS) (8W-51-4)
FENDER LAMP-REAR RIGHT (DUAL REAR WHEELS) (8W-51-4)
FENDER LAMP-REAR LEFT (DUAL REAR WHEELS) (8W-51-4)
FENDER LAMP-FRONT LEFT (DUAL REAR WHEELS) (8W-51-4)
Z57 18 BK
S341
S340
C328
C327
TAILGATE LAMP ASSEMBLY (DUAL REAR WHEELS) (8W-51-4)
LICENSE LAMP-LEFT (8W-51-2)
TRAILER TOW CONNECTOR (8W-54-3) (8W-54-4)
TRAILER TOW CONNECTOR-ADD ON (8W-54-4)
Z48 20 BK
Z383 20 BR
Z53 20 BK
Z52 14 BK
S309
FUEL PUMP MODULE (8W-30-3) (8W-30-30)
LICENSE LAMP-RIGHT (8W-51-3)
TAIL/ STOP/ TURN SIGNAL LAMP-LEFT (8W-51-5) (8W-52-4)
TAIL/ STOP/ TURN SIGNAL LAMP-RIGHT (8W-51-6) (8W-52-5)
Z150 18 BK
Z151 18 BK
TAIL LAMP JUMPER
STANDARD
C310
C307
Z211 18 BK
Z53 18 BK
S308
EXCEPT ABS
ABS
Z13 14 BK
E
X
TO C217 (8W-15-2)
TO C217 (8W-15-5)

ABS


FUEL PUMP MODULE
(8W-30-3)
(8W-30-30)
1
4
TRAILER TOW CONNECTOR
(8W-54-3)
(8W-54-4)
8
9
TRAILER TOW CONNECTOR-ADD ON
(8W-54-4)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
8
C5
CONDENSER FAN
(8W-42-10)
1
WIPER MOTOR-FRONT
(8W-53-4)
4
HORN-LOW NOTE
(8W-41-2)
2
HORN-HIGH NOTE
(8W-41-2)
2
CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
13
C1
6
C1
Z211 18 BK
Z52 14 BK
Z52 14 BK
Z52 14 BK
S309
Z52 14 BK
WASHER PUMP MOTOR-FRONT (DIESEL/8.0L)
(8W-53-4)
1
7
C217
INTEGRATED POWER MODULE (DIESEL)
(8W-10-2)
(8W-10-3)
14
C5
4
ELECTRIC BRAKE PROVISION
(8W-54-5)
Z216 20 BK/VT
Z114 18 BK/LG
Z52 14 BK
Z255 18 DG/BK
Z316 12 BK/OR
Z212 16 LG/BK
Z44 18 BK/DG
Z308 18 BK/BR
Z307 18 BK/WT
Z101 12 BK/VT
Z102 12 BK/VT
G106



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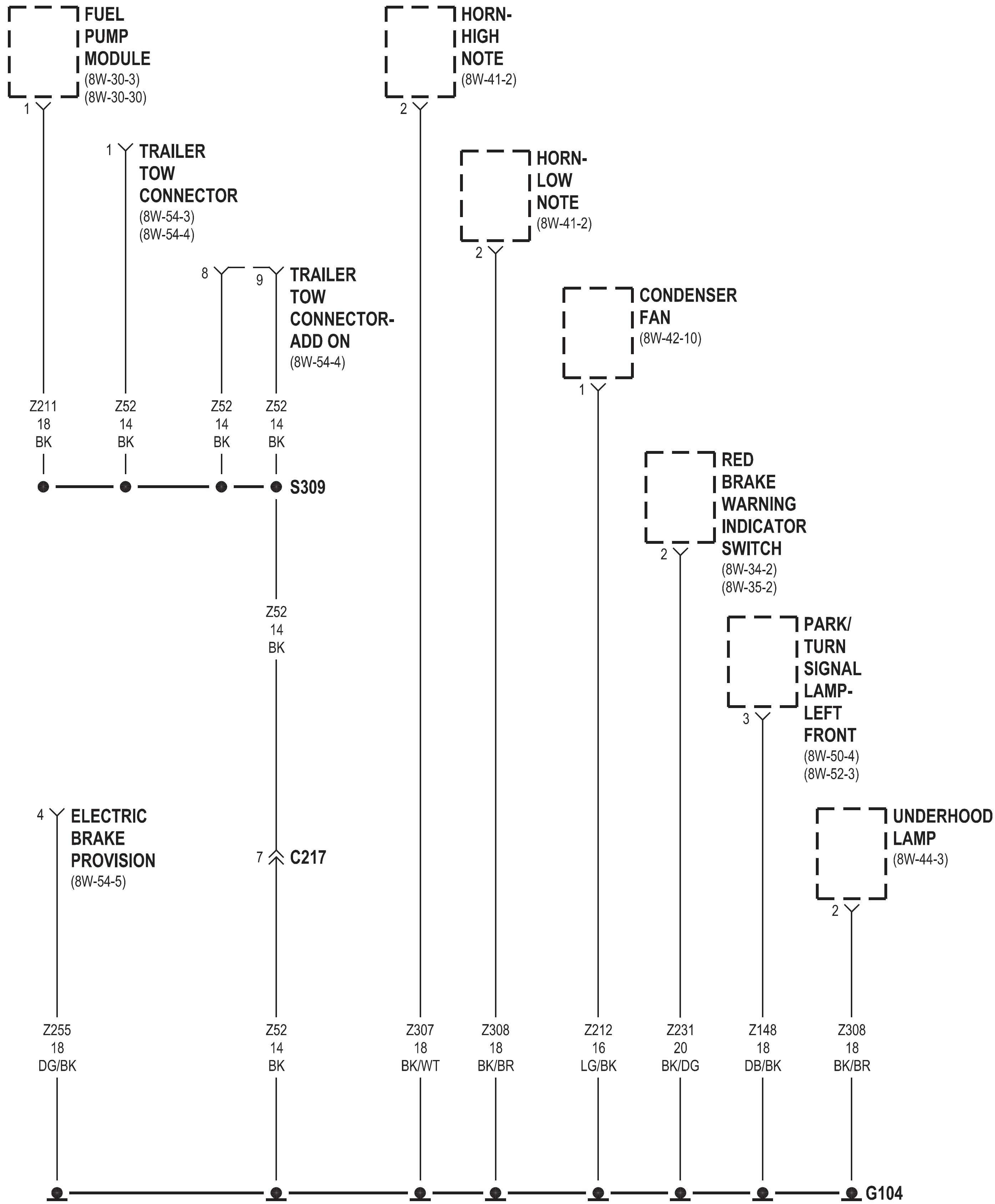
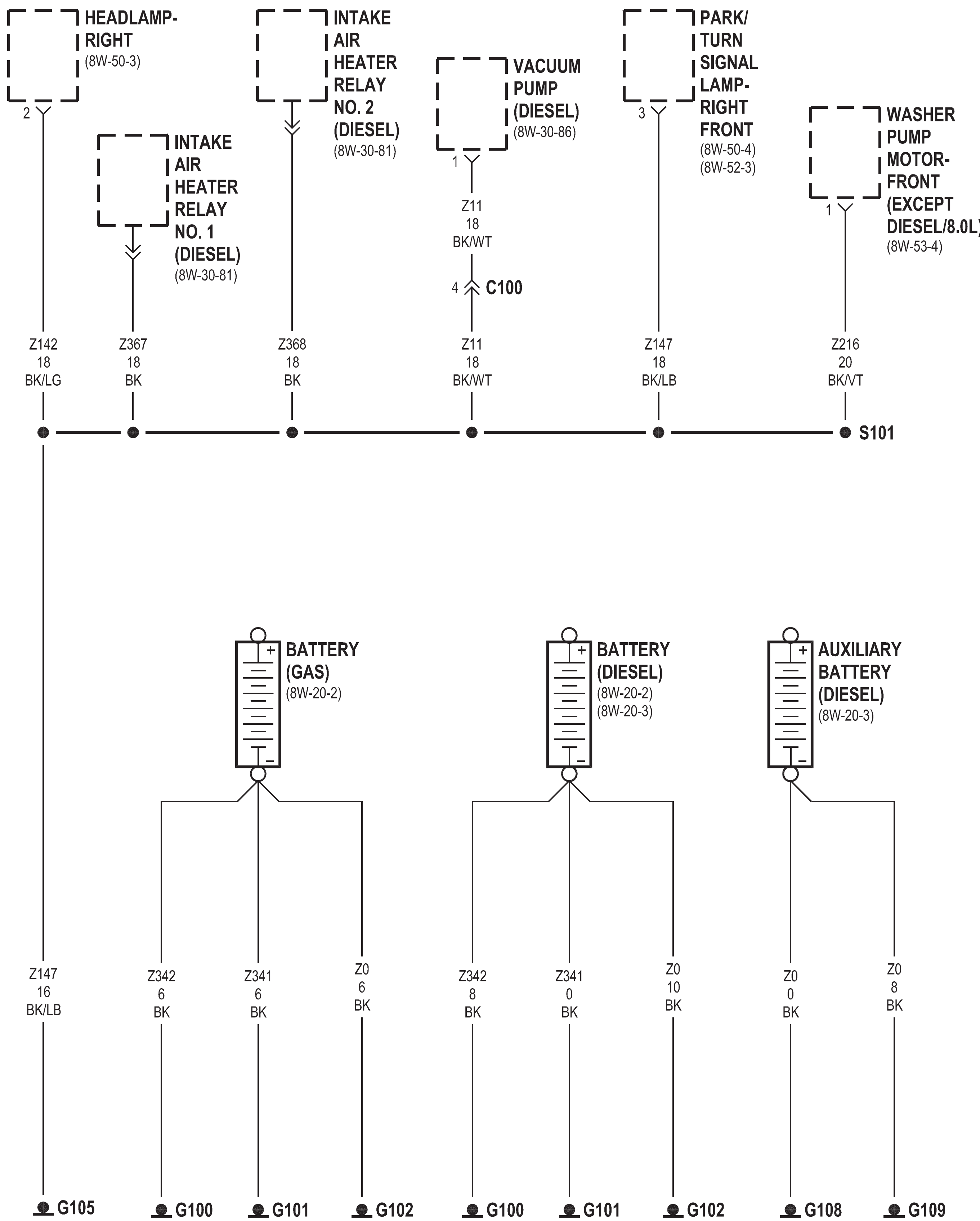
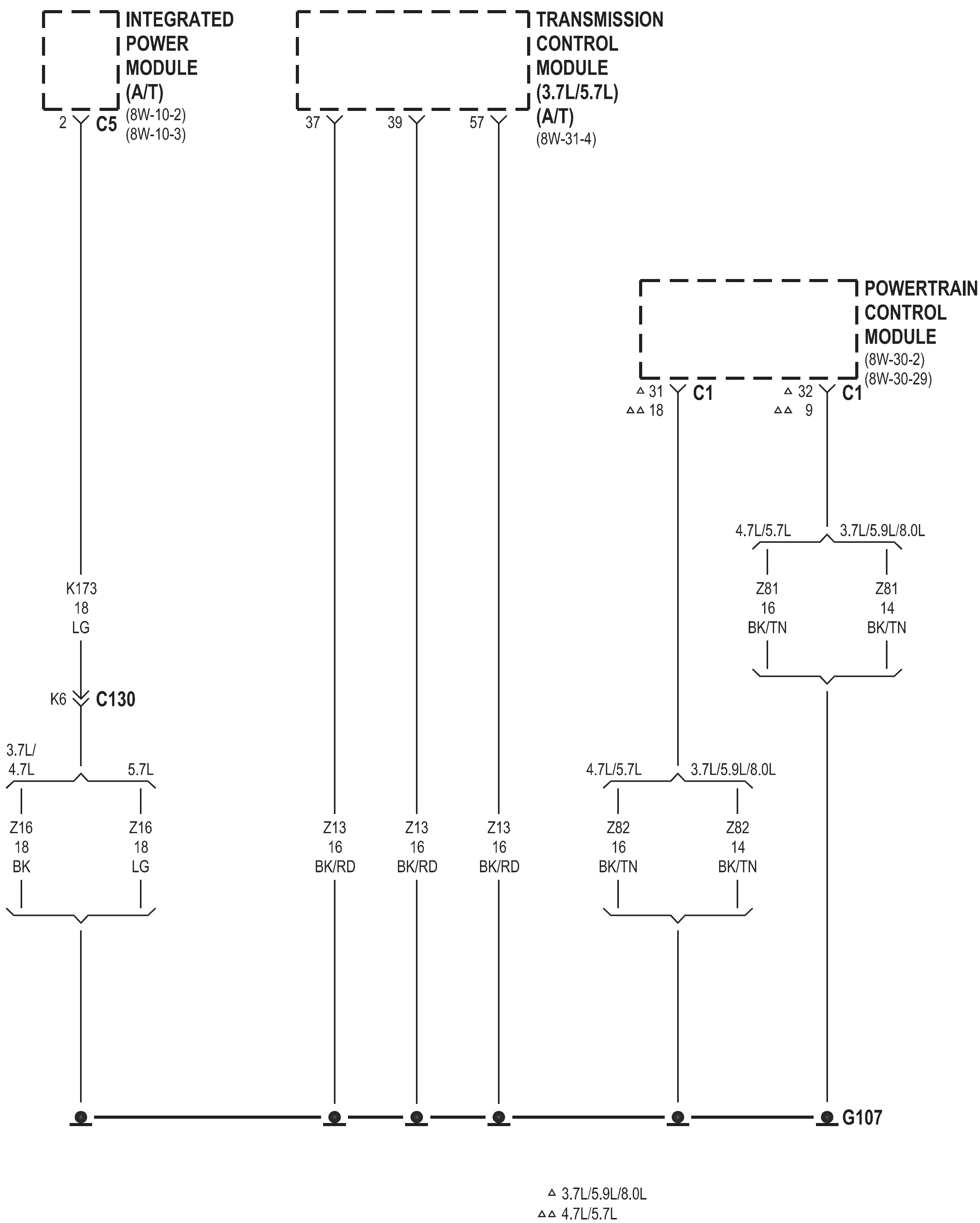
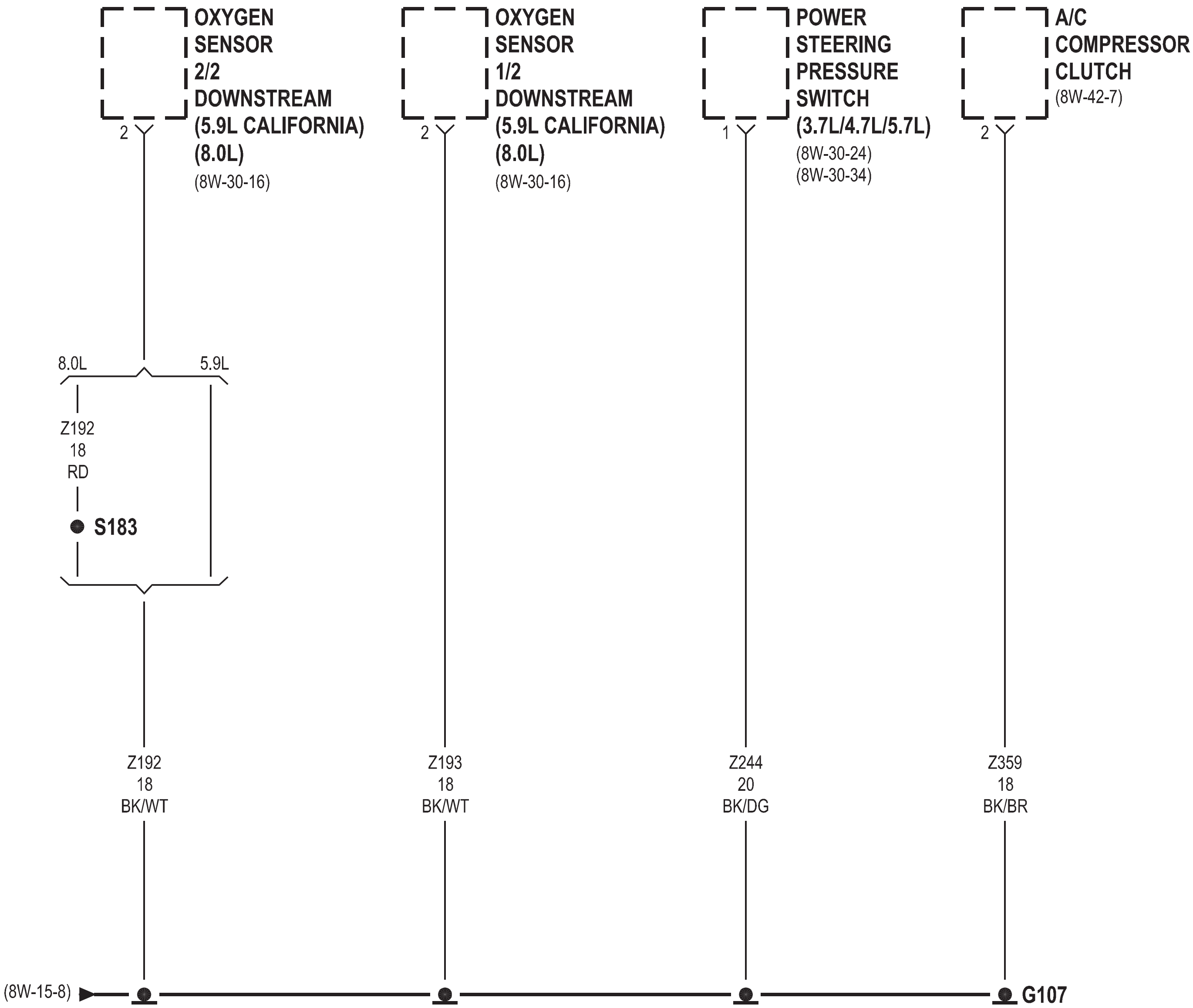
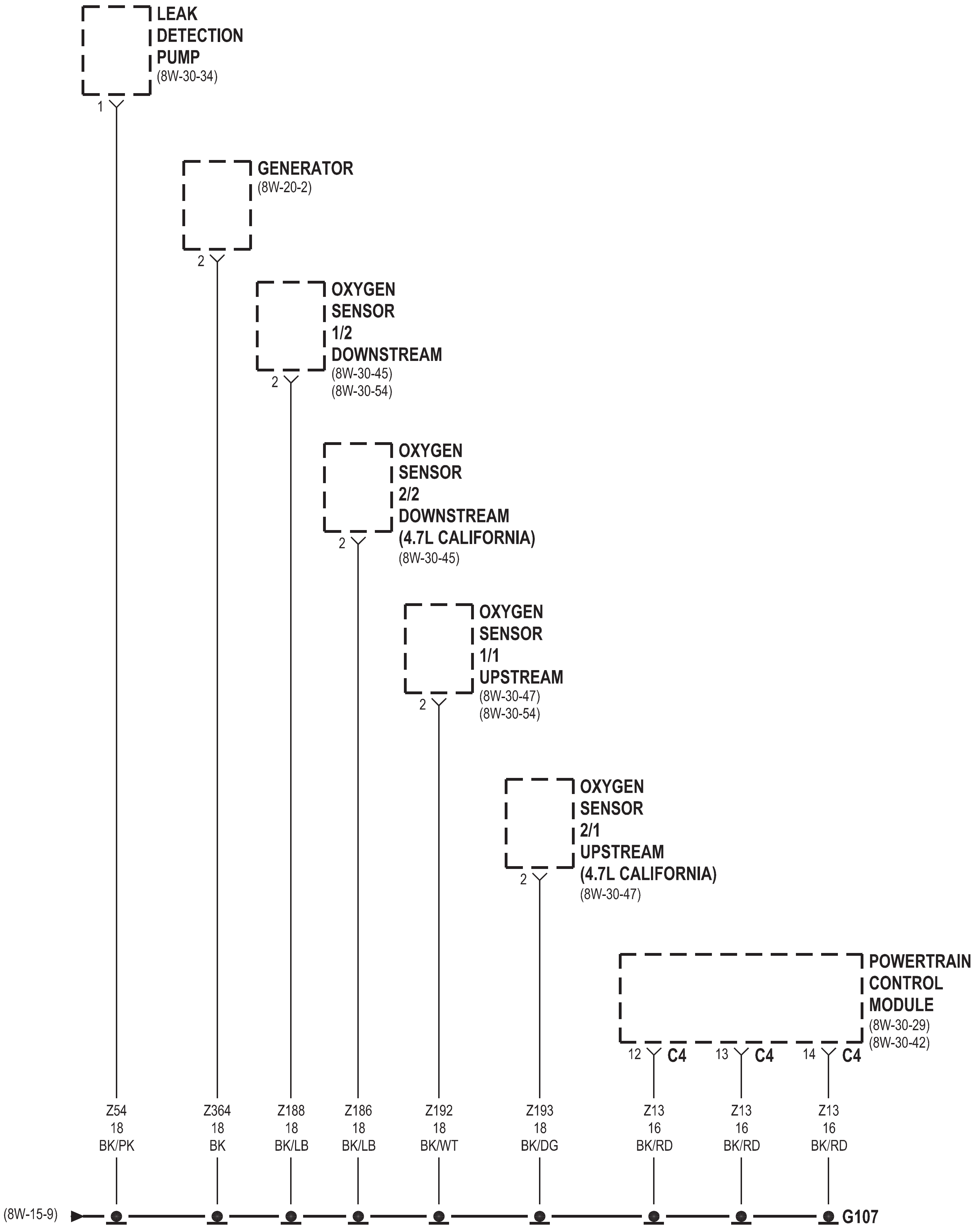
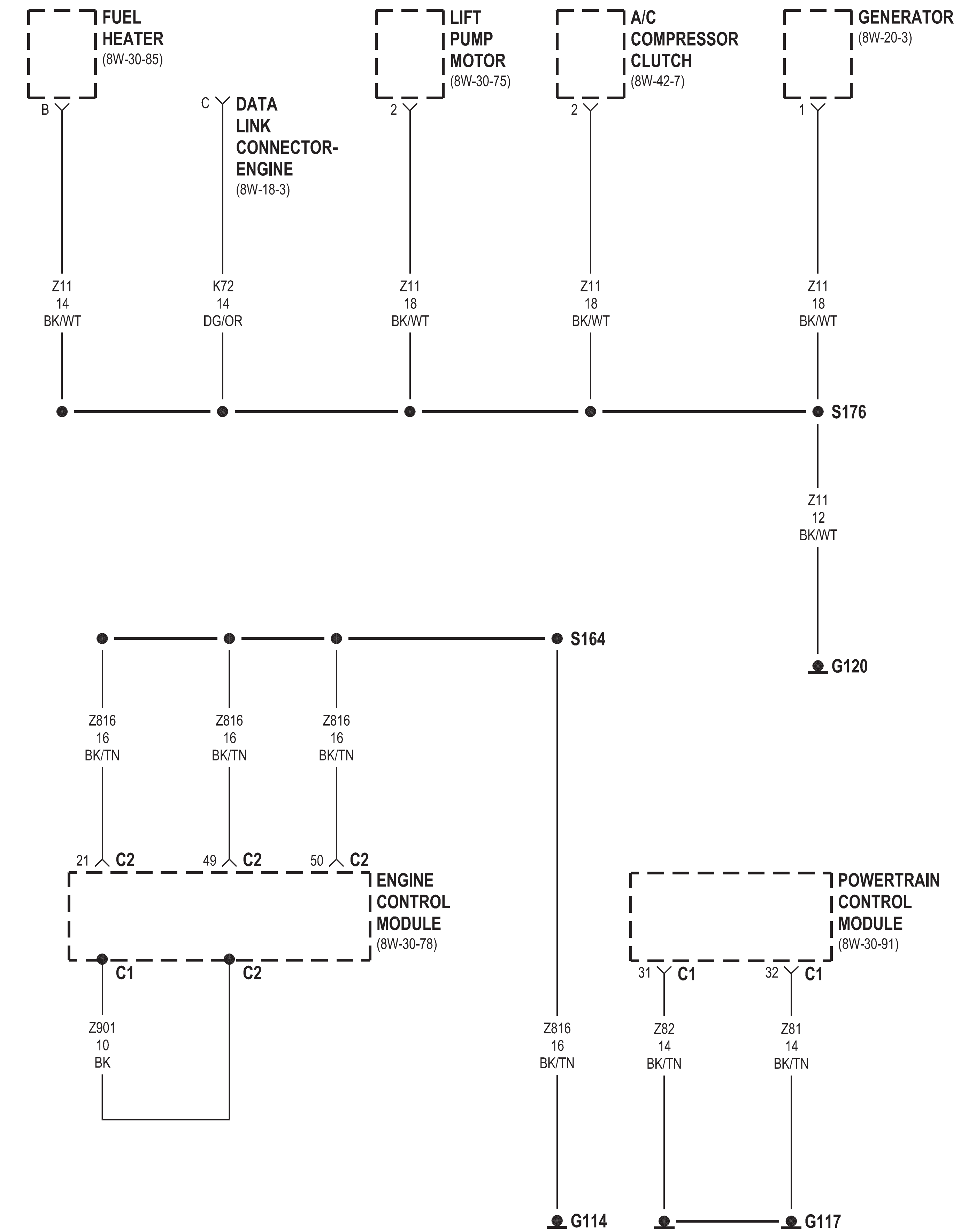

FUEL PUMP MODULE
(8W-30-3)
(8W-30-30)
HORN-HIGH NOTE
(8W-41-2)
TRAILER TOW CONNECTOR
(8W-54-3)
(8W-54-4)
HORN-LOW NOTE
(8W-41-2)
TRAILER TOW CONNECTOR-ADD ON
(8W-54-4)
CONDENSER FAN
(8W-42-10)
Z211 18 BK
Z52 14 BK
Z52 14 BK
Z52 14 BK
S309
RED BRAKE WARNING INDICATOR SWITCH
(8W-34-2)
(8W-35-2)
Z52 14 BK
PARK/ TURN SIGNAL LAMP-LEFT FRONT
(8W-50-4)
(8W-52-3)
ELECTRIC BRAKE PROVISION
(8W-54-5)
C217
UNDERHOOD LAMP
(8W-44-3)
Z255 18 DG/BK
Z52 14 BK
Z307 18 BK/WT
Z308 18 BK/BR
Z212 16 LG/BK
Z231 20 BK/DG
Z148 18 DB/BK
Z308 18 BK/BR
G104

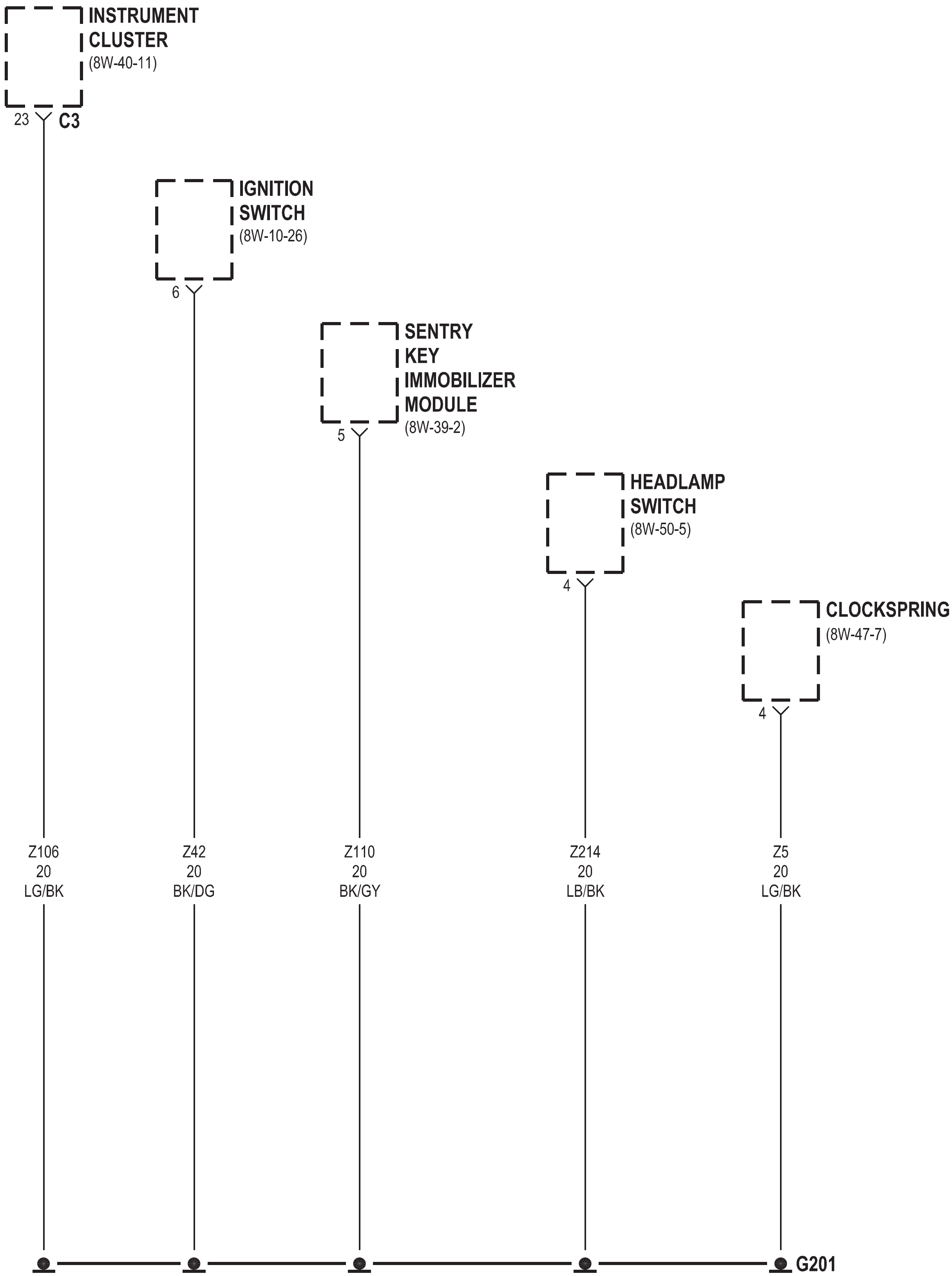

HEADLAMP-
RIGHT
(8W-50-3)
INTAKE
AIR
HEATER
RELAY
NO. 1
(DIESEL)
(8W-30-81)
INTAKE
AIR
HEATER
RELAY
NO. 2
(DIESEL)
(8W-30-81)
VACUUM
PUMP
(DIESEL)
(8W-30-86)
PARK/
TURN
SIGNAL
LAMP-
RIGHT
FRONT
(8W-50-4)
(8W-52-3)
WASHER
PUMP
MOTOR-
FRONT
(EXCEPT
DIESEL/8.0L)
(8W-53-4)
2
3
1
1
Z11
18
BK/WT
4
C100
Z142
18
BK/LG
Z367
18
BK
Z368
18
BK
Z11
18
BK/WT
Z147
18
BK/LB
Z216
20
BK/VT
S101
BATTERY
(GAS)
(8W-20-2)
BATTERY
(DIESEL)
(8W-20-2)
(8W-20-3)
AUXILIARY
BATTERY
(DIESEL)
(8W-20-3)
Z147
16
BK/LB
Z342
6
BK
Z341
6
BK
Z0
6
BK
Z342
8
BK
Z341
0
BK
Z0
10
BK
Z0
0
BK
Z0
8
BK
G105
G100
G101
G102
G100
G101
G102
G108
G109

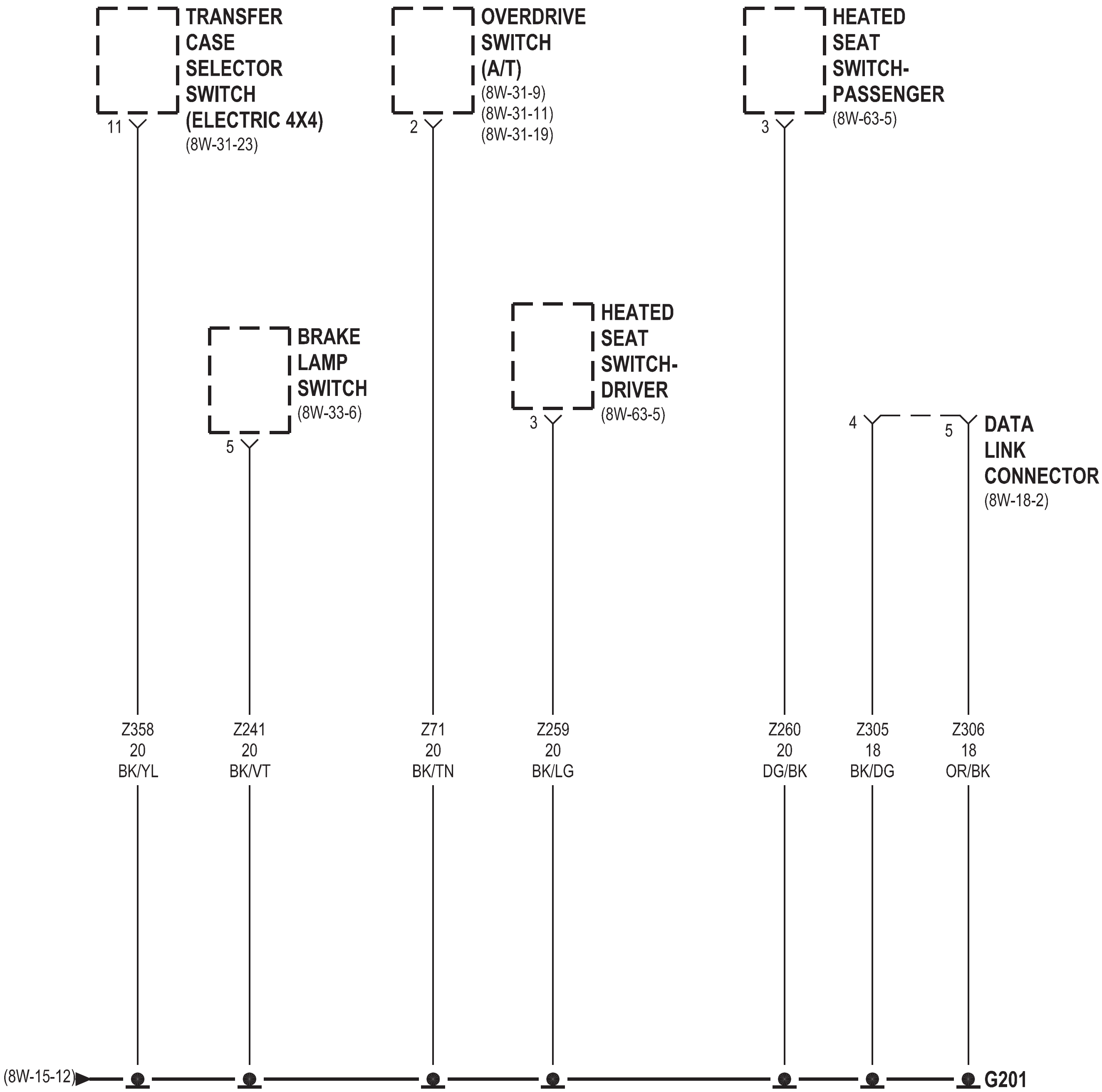

INTEGRATED
POWER
MODULE
(A/T)
(8W-10-2)
(8W-10-3)
2
C5
TRANSMISSION
CONTROL
MODULE
(3.7L/5.7L)
(A/T)
(8W-31-4)
37
39
57
POWERTRAIN
CONTROL
MODULE
(8W-30-2)
(8W-30-29)
△ 31
△△ 18
C1
△ 32
△△ 9
C1
4.7L/5.7L
3.7L/5.9L/8.0L
Z81
16
BK/TN
Z81
14
BK/TN
K173
18
LG
K6
C130
3.7L/
4.7L
5.7L
Z16
18
BK
Z16
18
LG
Z13
16
BK/RD
Z13
16
BK/RD
Z13
16
BK/RD
4.7L/5.7L
3.7L/5.9L/8.0L
Z82
16
BK/TN
Z82
14
BK/TN
G107
△ 3.7L/5.9L/8.0L
△△ 4.7L/5.7L


OXYGEN SENSOR 2/2 DOWNSTREAM (5.9L CALIFORNIA) (8.0L)
(8W-30-16)
2
OXYGEN SENSOR 1/2 DOWNSTREAM (5.9L CALIFORNIA) (8.0L)
(8W-30-16)
2
POWER STEERING PRESSURE SWITCH (3.7L/4.7L/5.7L)
(8W-30-24)
(8W-30-34)
1
A/C COMPRESSOR CLUTCH
(8W-42-7)
2
8.0L
5.9L
Z192 18 RD
S183
Z192 18 BK/WT
Z193 18 BK/WT
Z244 20 BK/DG
Z359 18 BK/BR
(8W-15-8)
G107

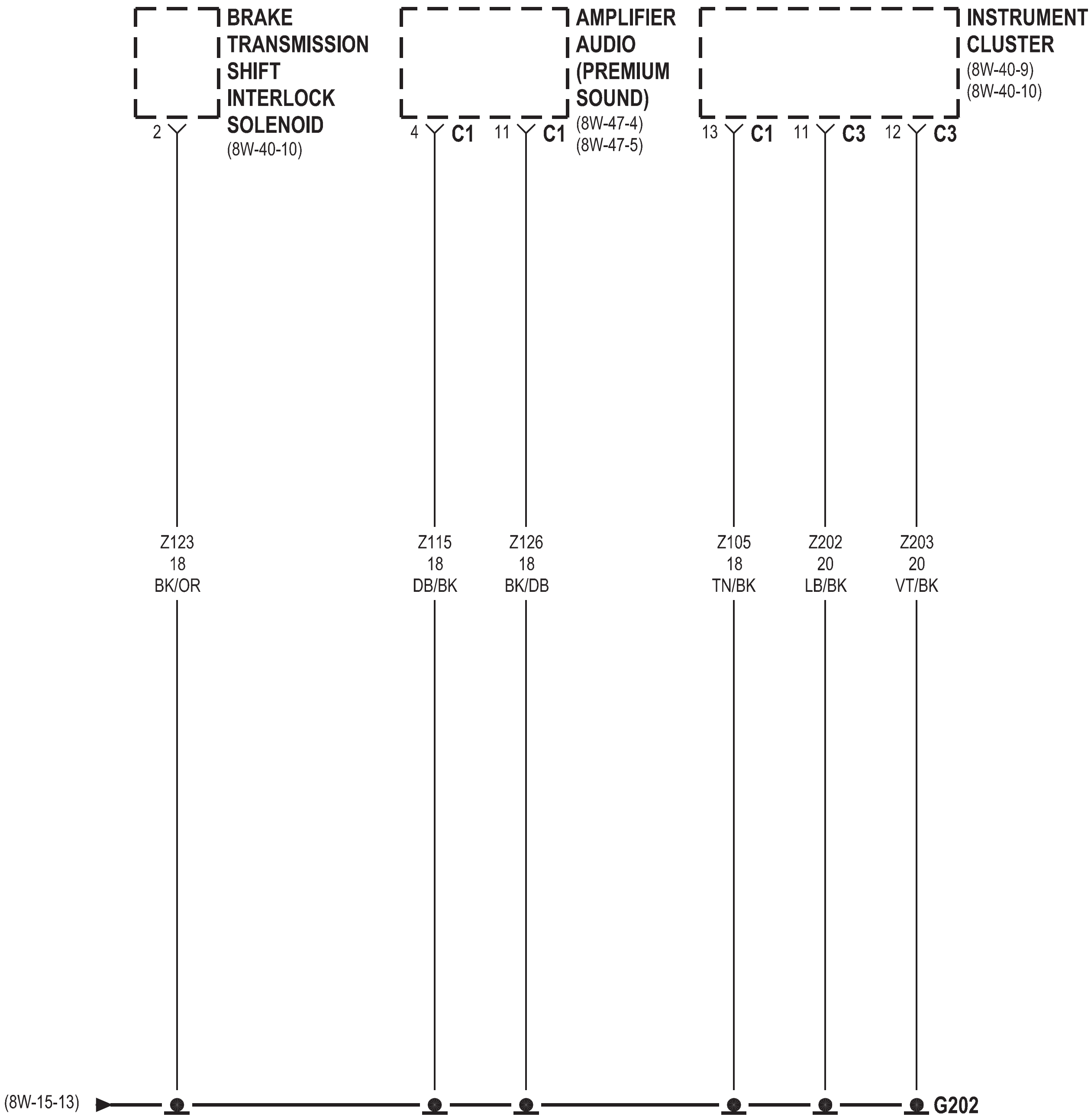

LEAK DETECTION PUMP
(8W-30-34)
GENERATOR
(8W-20-2)
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-45)
(8W-30-54)
OXYGEN SENSOR 2/2 DOWNSTREAM (4.7L CALIFORNIA)
(8W-30-45)
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-47)
(8W-30-54)
OXYGEN SENSOR 2/1 UPSTREAM (4.7L CALIFORNIA)
(8W-30-47)
POWERTRAIN CONTROL MODULE
(8W-30-29)
(8W-30-42)
1
2
2
2
2
2
12 C4
13 C4
14 C4
Z54 18 BK/PK
Z364 18 BK
Z188 18 BK/LB
Z186 18 BK/LB
Z192 18 BK/WT
Z193 18 BK/DG
Z13 16 BK/RD
Z13 16 BK/RD
Z13 16 BK/RD
(8W-15-9)
G107

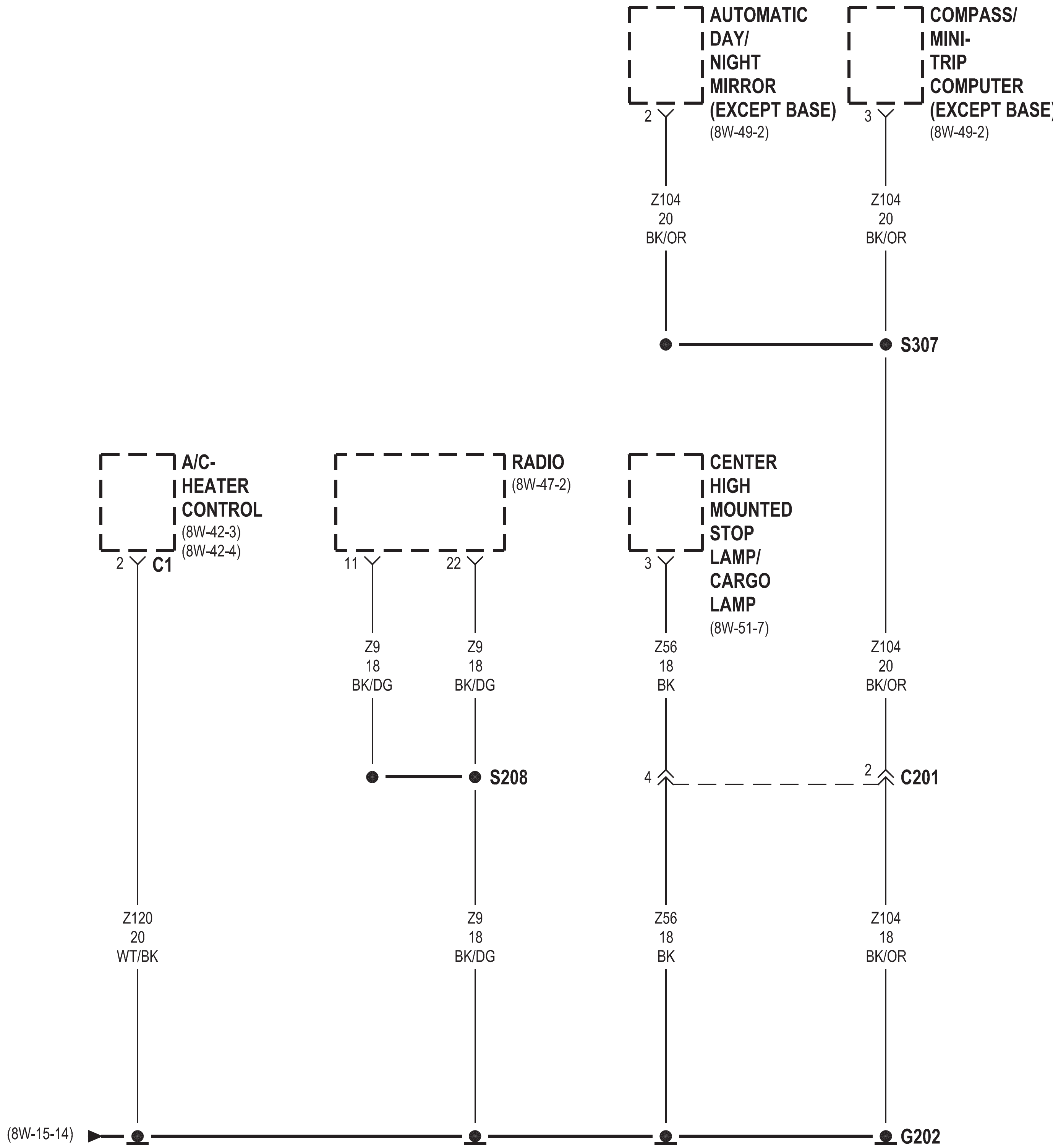

FUEL HEATER
(8W-30-85)
B
C
DATA LINK CONNECTOR-ENGINE
(8W-18-3)
LIFT PUMP MOTOR
(8W-30-75)
2
A/C COMPRESSOR CLUTCH
(8W-42-7)
2
GENERATOR
(8W-20-3)
1
Z11
14
BK/WT
K72
14
DG/OR
Z11
18
BK/WT
Z11
18
BK/WT
Z11
18
BK/WT
S176
Z11
12
BK/WT
G120
S164
Z816
16
BK/TN
Z816
16
BK/TN
Z816
16
BK/TN
21 C2
49 C2
50 C2
ENGINE CONTROL MODULE
(8W-30-78)
C1
C2
Z901
10
BK
Z816
16
BK/TN
POWERTRAIN CONTROL MODULE
(8W-30-91)
31 C1
32 C1
Z82
14
BK/TN
Z81
14
BK/TN
G114
G117

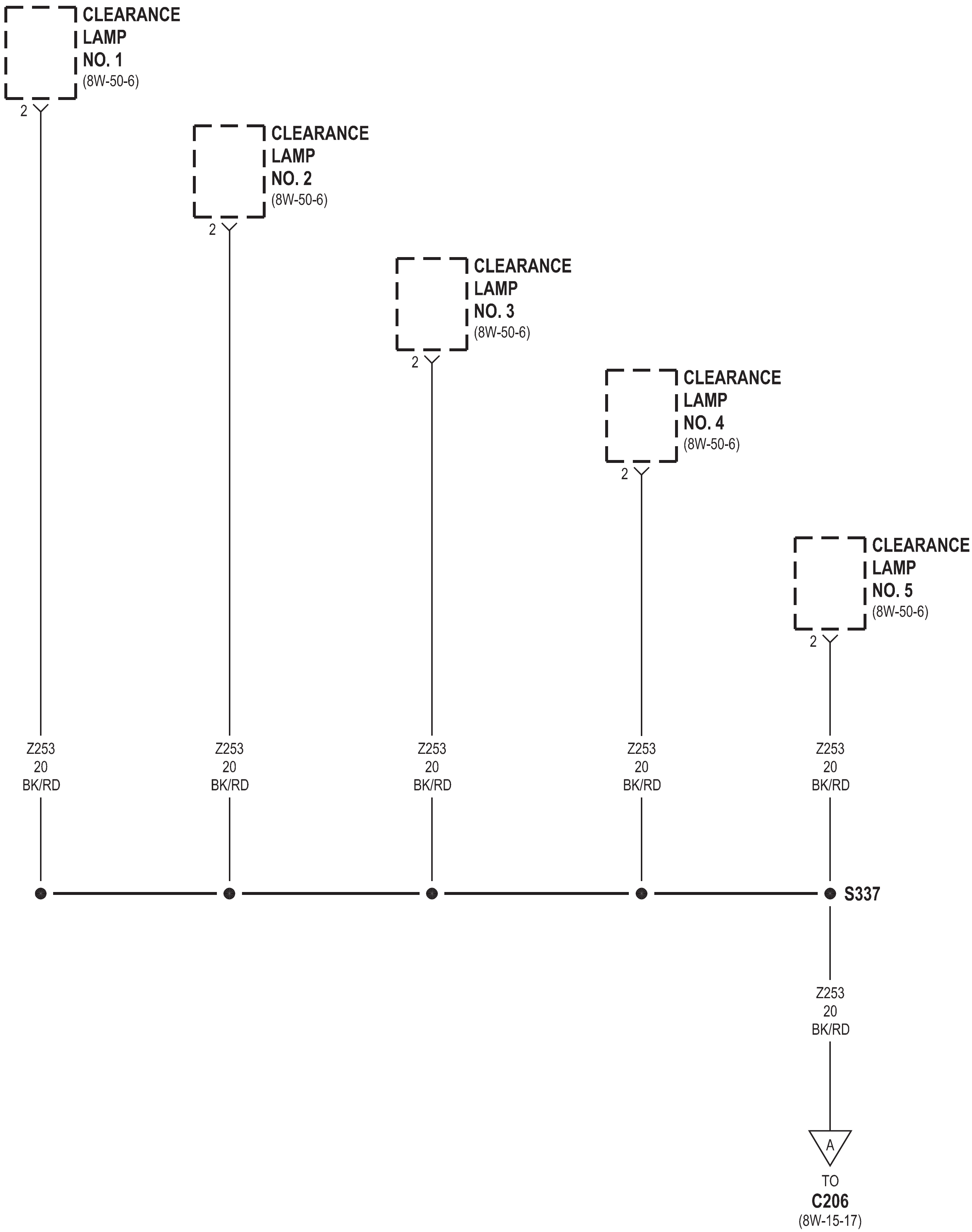

INSTRUMENT
CLUSTER
(8W-40-11)
23
C3
IGNITION
SWITCH
(8W-10-26)
6
SENTRY
KEY
IMMOBILIZER
MODULE
(8W-39-2)
5
HEADLAMP
SWITCH
(8W-50-5)
4
CLOCKSPRING
(8W-47-7)
4
Z106
20
LG/BK
Z42
20
BK/DG
Z110
20
BK/GY
Z214
20
LB/BK
Z5
20
LG/BK
G201

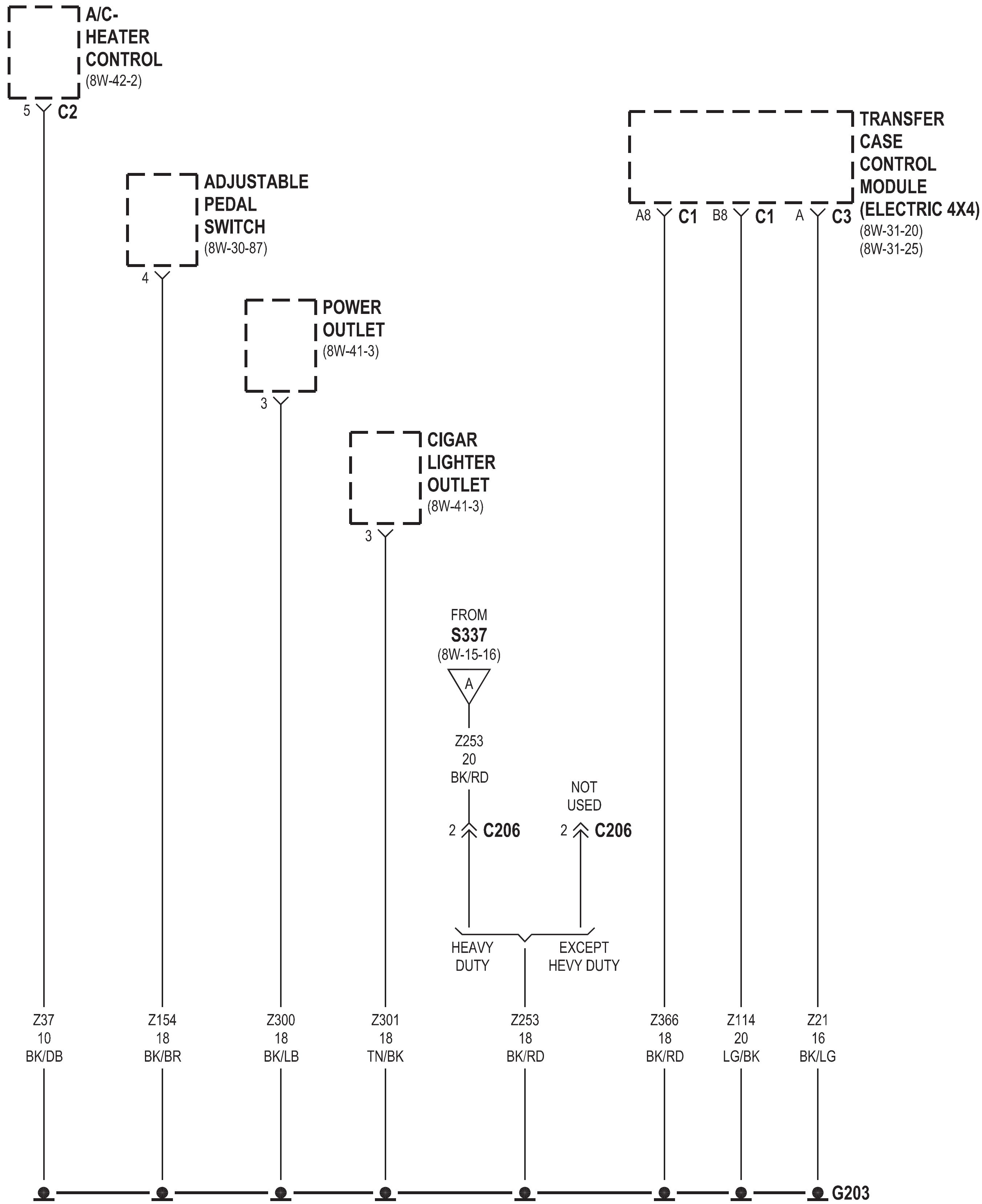


TRANSFER CASE SELECTOR SWITCH (ELECTRIC 4X4)
(8W-31-23)
11
OVERDRIVE SWITCH (A/T)
(8W-31-9)
(8W-31-11)
(8W-31-19)
2
HEATED SEAT SWITCH-PASSENGER
(8W-63-5)
3
BRAKE LAMP SWITCH
(8W-33-6)
5
HEATED SEAT SWITCH-DRIVER
(8W-63-5)
3
4
5
DATA LINK CONNECTOR
(8W-18-2)
Z358 20 BK/YL
Z241 20 BK/VT
Z71 20 BK/TN
Z259 20 BK/LG
Z260 20 DG/BK
Z305 18 BK/DG
Z306 18 OR/BK
(8W-15-12)
G201

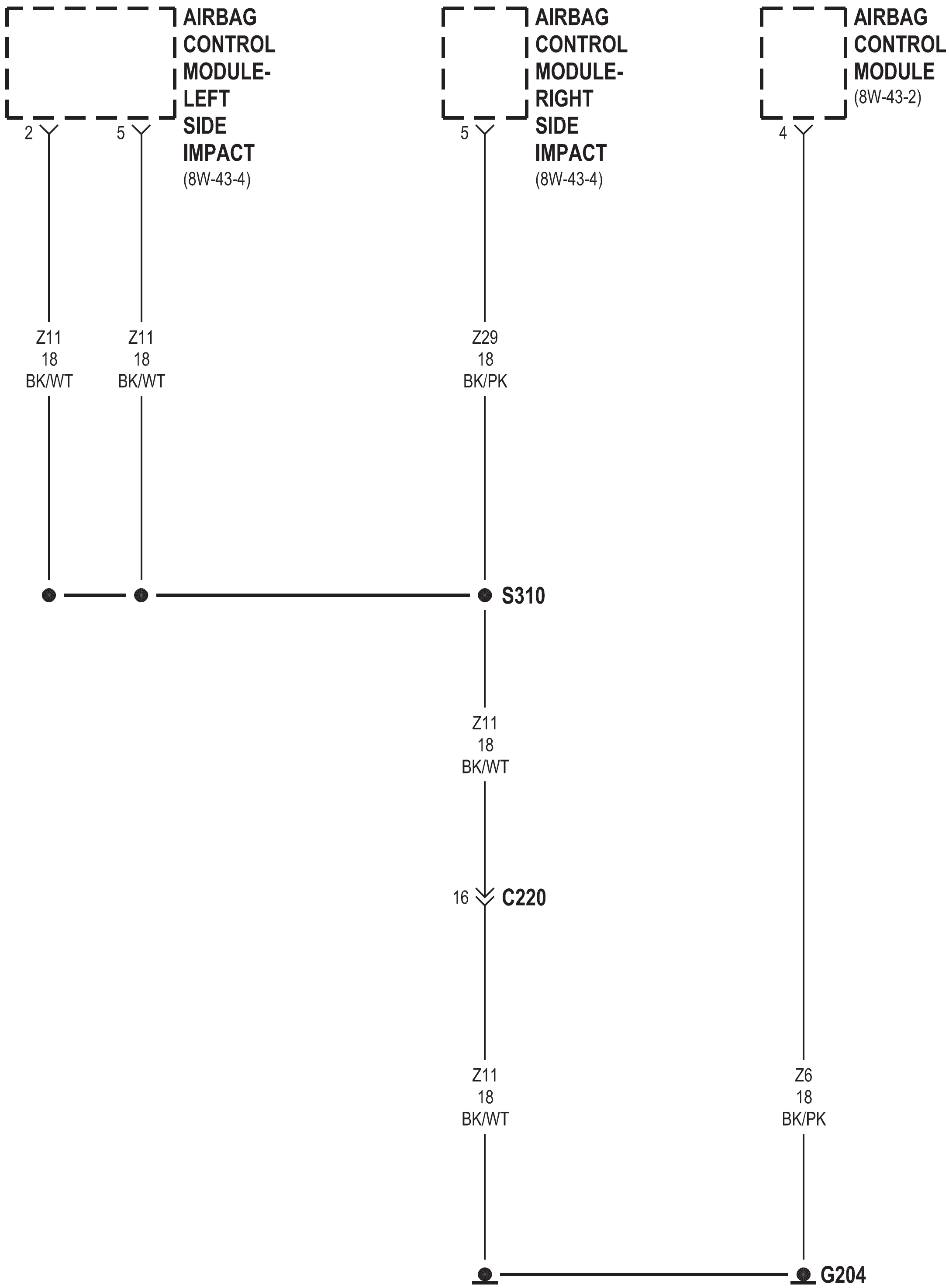

BRAKE
TRANSMISSION
SHIFT
INTERLOCK
SOLENOID
(8W-40-10)
AMPLIFIER
AUDIO
(PREMIUM
SOUND)
(8W-47-4)
(8W-47-5)
INSTRUMENT
CLUSTER
(8W-40-9)
(8W-40-10)
2
4 C1
11 C1
13 C1
11 C3
12 C3
Z123
18
BK/OR
Z115
18
DB/BK
Z126
18
BK/DB
Z105
18
TN/BK
Z202
20
LB/BK
Z203
20
VT/BK
(8W-15-13)
G202

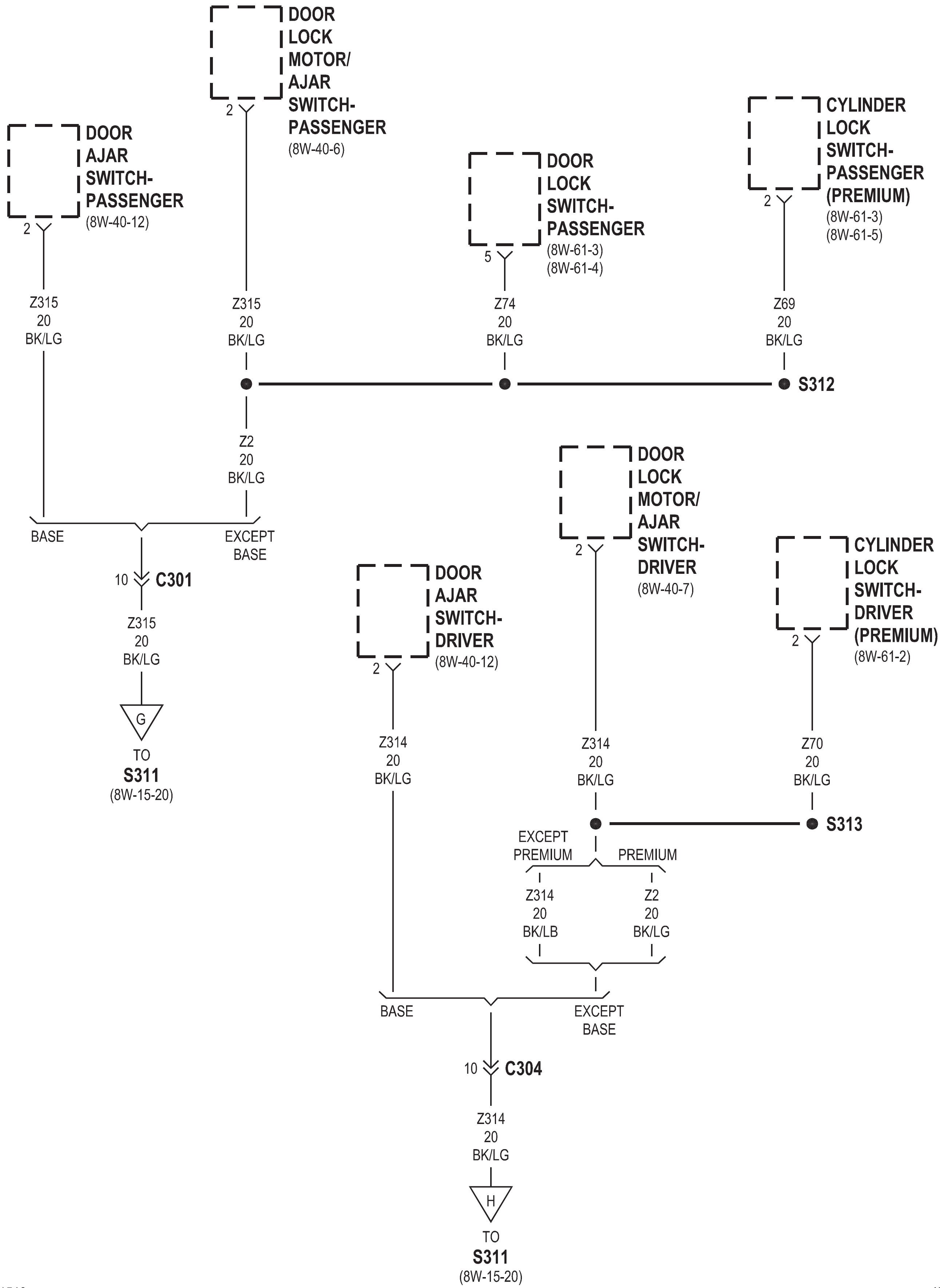

AUTOMATIC DAY/ NIGHT MIRROR (EXCEPT BASE)
(8W-49-2)
COMPASS/ MINI- TRIP COMPUTER (EXCEPT BASE)
(8W-49-2)
2
3
Z104 20 BK/OR
Z104 20 BK/OR
S307
A/C- HEATER CONTROL
(8W-42-3)
(8W-42-4)
2 C1
RADIO
(8W-47-2)
11
22
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP
(8W-51-7)
3
Z9 18 BK/DG
Z9 18 BK/DG
Z56 18 BK
Z104 20 BK/OR
S208
4
2 C201
Z120 20 WT/BK
Z9 18 BK/DG
Z56 18 BK
Z104 18 BK/OR
(8W-15-14)
G202

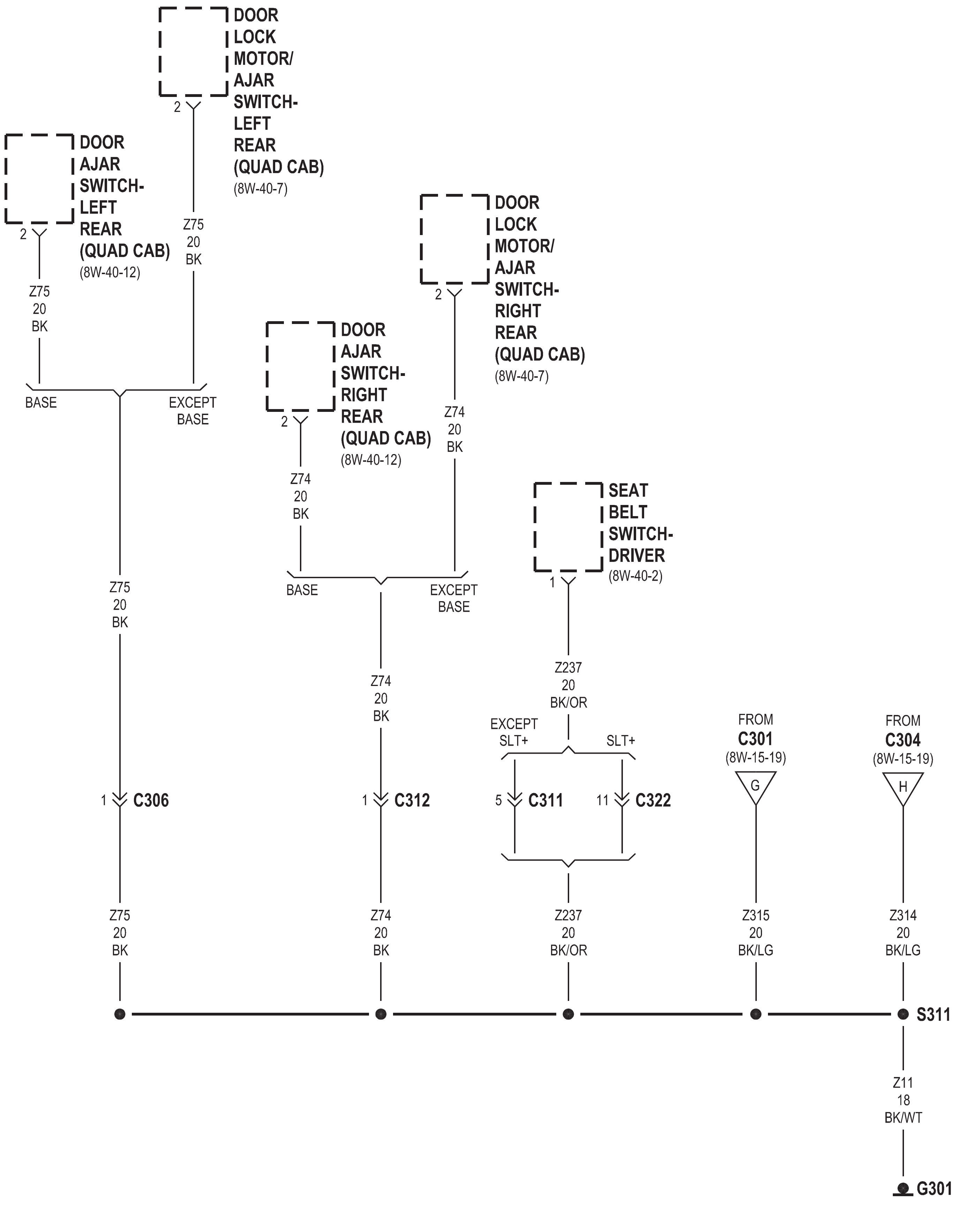

CLEARANCE
LAMP
NO. 1
(8W-50-6)
2
CLEARANCE
LAMP
NO. 2
(8W-50-6)
2
CLEARANCE
LAMP
NO. 3
(8W-50-6)
2
CLEARANCE
LAMP
NO. 4
(8W-50-6)
2
CLEARANCE
LAMP
NO. 5
(8W-50-6)
2
Z253
20
BK/RD
Z253
20
BK/RD
Z253
20
BK/RD
Z253
20
BK/RD
Z253
20
BK/RD
S337
Z253
20
BK/RD
A
TO
C206
(8W-15-17)


A/C-
HEATER
CONTROL
(8W-42-2)
5 C2
ADJUSTABLE
PEDAL
SWITCH
(8W-30-87)
4
POWER
OUTLET
(8W-41-3)
3
CIGAR
LIGHTER
OUTLET
(8W-41-3)
3
TRANSFER
CASE
CONTROL
MODULE
(ELECTRIC 4X4)
(8W-31-20)
(8W-31-25)
A8 C1
B8 C1
A C3
FROM
S337
(8W-15-16)
A
Z253
20
BK/RD
NOT
USED
2 C206
2 C206
HEAVY
DUTY
EXCEPT
HEVY DUTY
Z37
10
BK/DB
Z154
18
BK/BR
Z300
18
BK/LB
Z301
18
TN/BK
Z253
18
BK/RD
Z366
18
BK/RD
Z114
20
LG/BK
Z21
16
BK/LG
G203

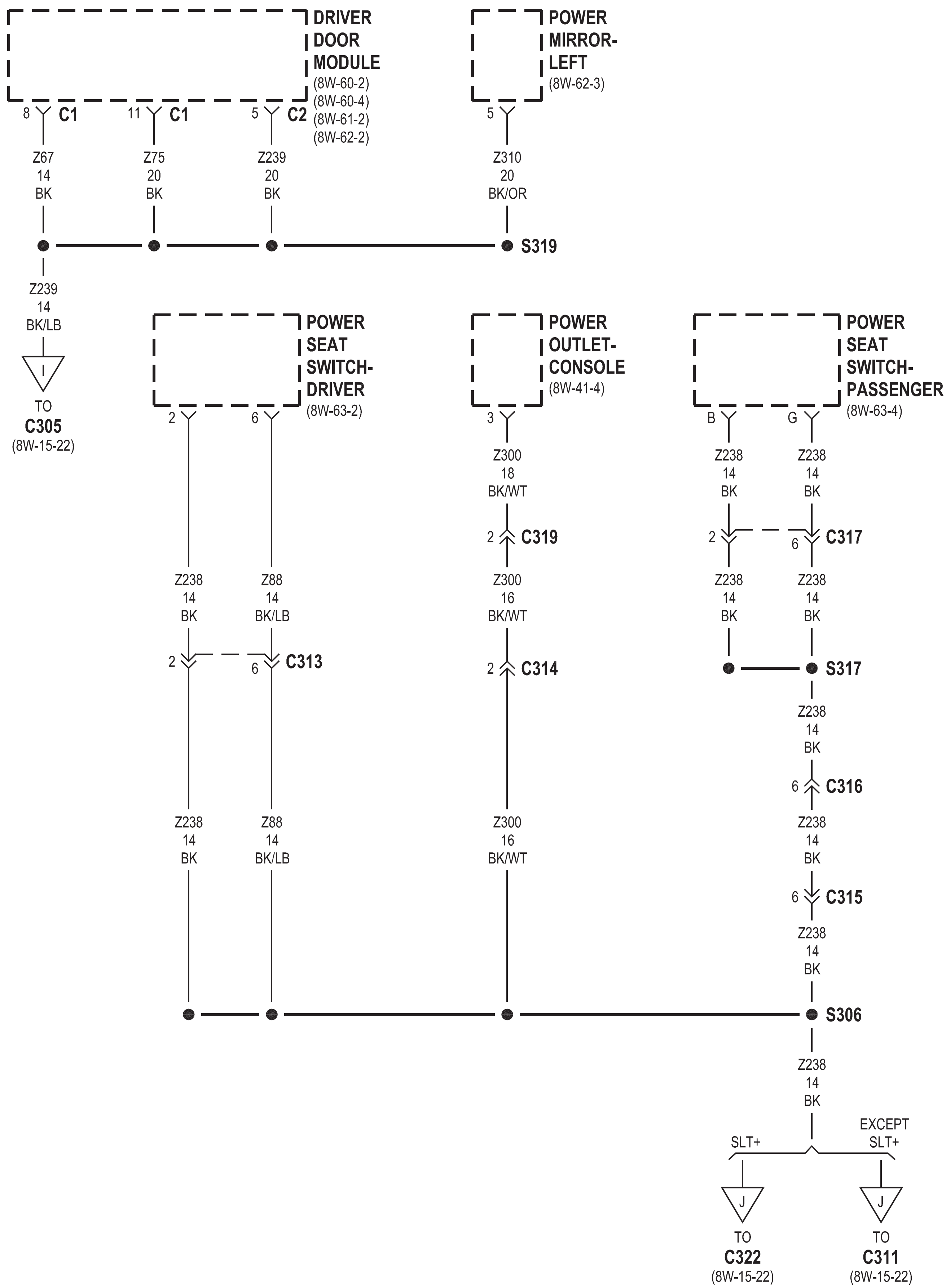
EXCEPT BASE

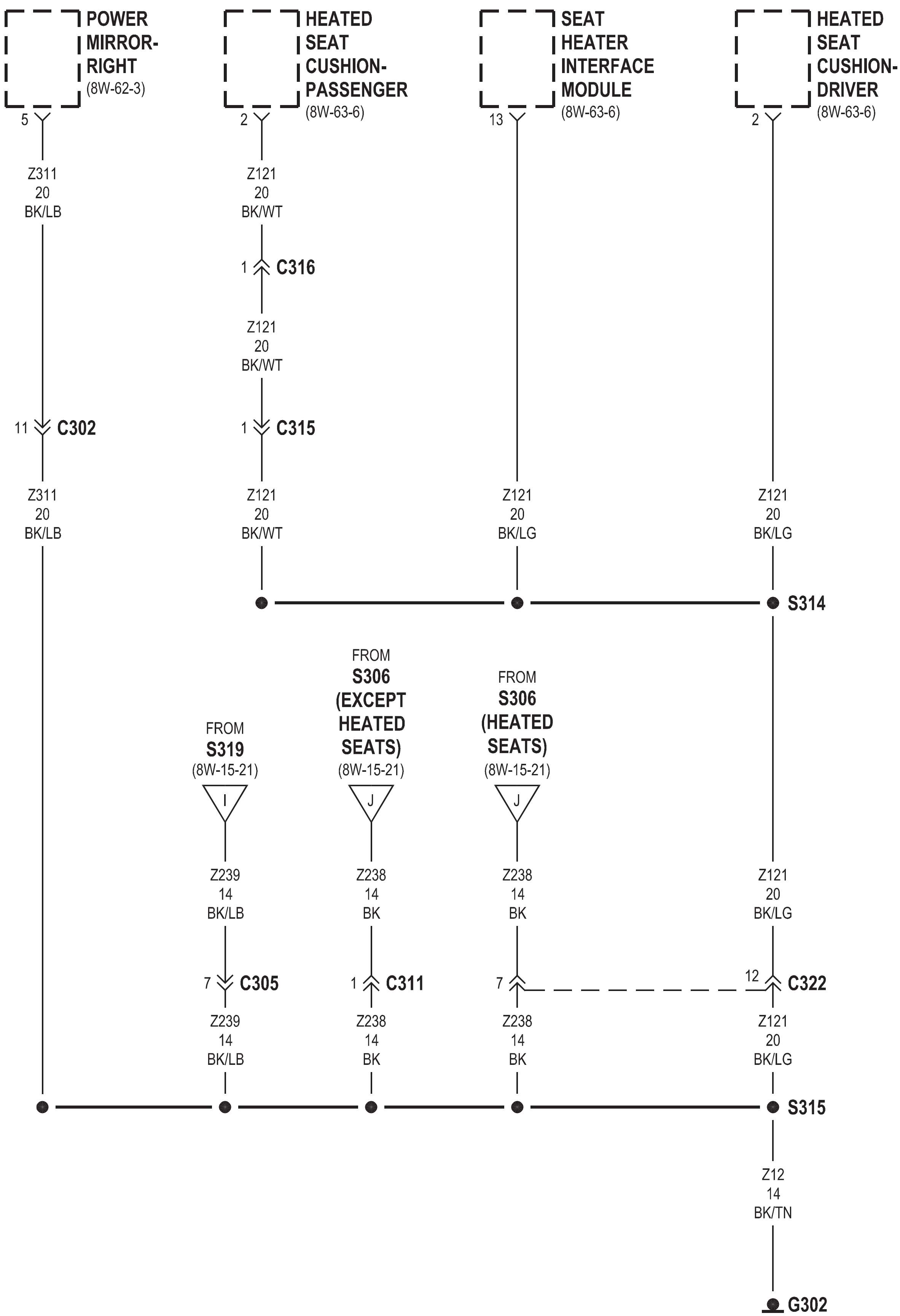

AIRBAG
CONTROL
MODULE-
LEFT
SIDE
IMPACT
(8W-43-4)
AIRBAG
CONTROL
MODULE-
RIGHT
SIDE
IMPACT
(8W-43-4)
AIRBAG
CONTROL
MODULE
(8W-43-2)
2
5
5
4
Z11
18
BK/WT
Z11
18
BK/WT
Z29
18
BK/PK
S310
Z11
18
BK/WT
16
C220
Z11
18
BK/WT
Z6
18
BK/PK
G204


DOOR AJAR SWITCH-PASSENGER
(8W-40-12)
2
Z315
20
BK/LG
DOOR LOCK MOTOR/ AJAR SWITCH-PASSENGER
(8W-40-6)
2
Z315
20
BK/LG
DOOR LOCK SWITCH-PASSENGER
(8W-61-3)
(8W-61-4)
5
Z74
20
BK/LG
CYLINDER LOCK SWITCH-PASSENGER (PREMIUM)
(8W-61-3)
(8W-61-5)
2
Z69
20
BK/LG
S312
Z2
20
BK/LG
BASE
EXCEPT BASE
10
C301
Z315
20
BK/LG
G
TO
S311
(8W-15-20)
DOOR AJAR SWITCH-DRIVER
(8W-40-12)
2
Z314
20
BK/LG
DOOR LOCK MOTOR/ AJAR SWITCH-DRIVER
(8W-40-7)
2
Z314
20
BK/LG
CYLINDER LOCK SWITCH-DRIVER (PREMIUM)
(8W-61-2)
2
Z70
20
BK/LG
S313
EXCEPT PREMIUM
PREMIUM
Z314
20
BK/LB
Z2
20
BK/LG
BASE
EXCEPT BASE
10
C304
Z314
20
BK/LG
H
TO
S311
(8W-15-20)

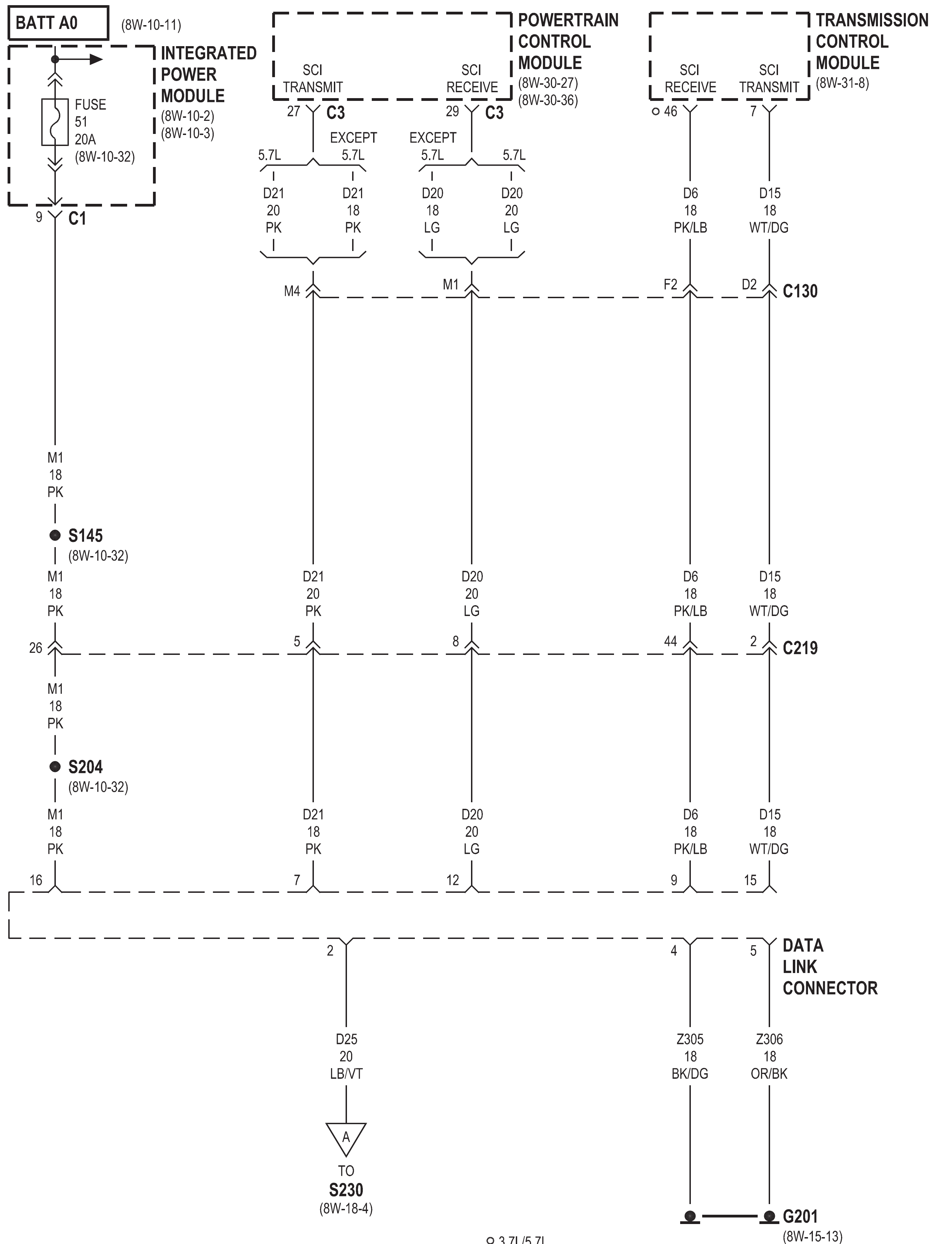

DOOR LOCK MOTOR/ AJAR SWITCH- LEFT REAR (QUAD CAB)
(8W-40-7)
DOOR AJAR SWITCH- LEFT REAR (QUAD CAB)
(8W-40-12)
DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR (QUAD CAB)
(8W-40-7)
DOOR AJAR SWITCH- RIGHT REAR (QUAD CAB)
(8W-40-12)
SEAT BELT SWITCH- DRIVER
(8W-40-2)
2
Z75 20 BK
BASE
EXCEPT BASE
Z74 20 BK
1
Z237 20 BK/OR
EXCEPT SLT+
SLT+
FROM C301 (8W-15-19)
FROM C304 (8W-15-19)
G
H
1 C306
1 C312
5 C311
11 C322
Z315 20 BK/LG
Z314 20 BK/LG
S311
Z11 18 BK/WT
G301

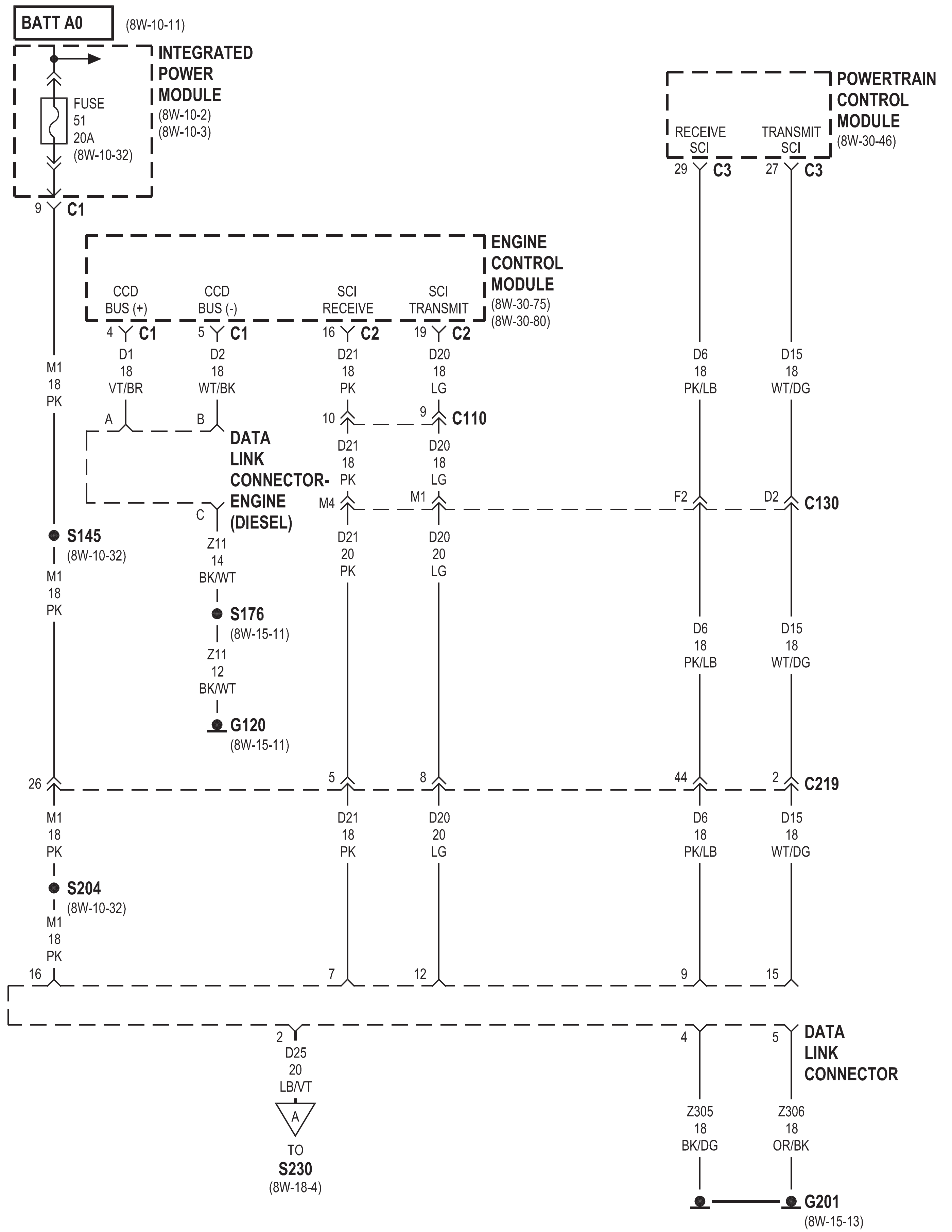
EXCEPT BASE

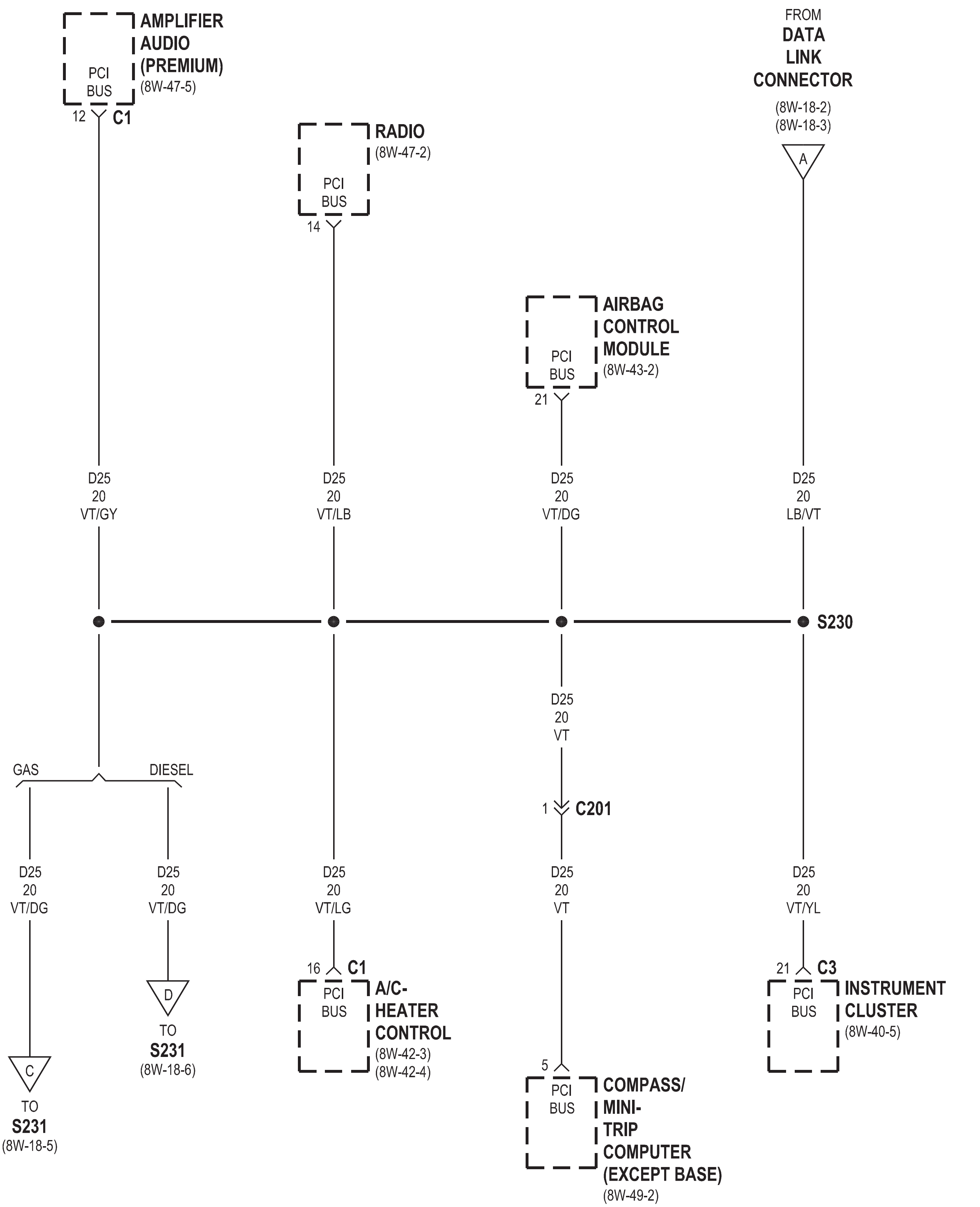

DRIVER DOOR MODULE
(8W-60-2)
(8W-60-4)
(8W-61-2)
(8W-62-2)
POWER MIRROR-LEFT
(8W-62-3)
8 C1
11 C1
5 C2
5
Z67 14 BK
Z75 20 BK
Z239 20 BK
Z310 20 BK/OR
S319
Z239 14 BK/LB
I
TO C305 (8W-15-22)
POWER SEAT SWITCH-DRIVER
(8W-63-2)
POWER OUTLET-CONSOLE
(8W-41-4)
POWER SEAT SWITCH-PASSENGER
(8W-63-4)
2
6
3
B
G
Z300 18 BK/WT
Z238 14 BK
Z238 14 BK
2 C319
2 6 C317
Z238 14 BK
Z88 14 BK/LB
Z300 16 BK/WT
Z238 14 BK
Z238 14 BK
2 6 C313
2 C314
S317
Z238 14 BK
6 C316
Z238 14 BK
Z88 14 BK/LB
Z300 16 BK/WT
Z238 14 BK
6 C315
Z238 14 BK
S306
Z238 14 BK
SLT+
EXCEPT SLT+
J
J
TO C322 (8W-15-22)
TO C311 (8W-15-22)


POWER MIRROR-RIGHT
(8W-62-3)
HEATED SEAT CUSHION-PASSENGER
(8W-63-6)
SEAT HEATER INTERFACE MODULE
(8W-63-6)
HEATED SEAT CUSHION-DRIVER
(8W-63-6)
5
2
13
2
Z311 20 BK/LB
Z121 20 BK/WT
1 C316
Z121 20 BK/WT
11 C302
1 C315
Z311 20 BK/LB
Z121 20 BK/WT
Z121 20 BK/LG
Z121 20 BK/LG
S314
FROM S319 (8W-15-21)
FROM S306 (EXCEPT HEATED SEATS) (8W-15-21)
FROM S306 (HEATED SEATS) (8W-15-21)
I
J
J
Z239 14 BK/LB
Z238 14 BK
Z238 14 BK
Z121 20 BK/LG
7 C305
1 C311
7
12 C322
Z239 14 BK/LB
Z238 14 BK
Z238 14 BK
Z121 20 BK/LG
S315
Z12 14 BK/TN
G302

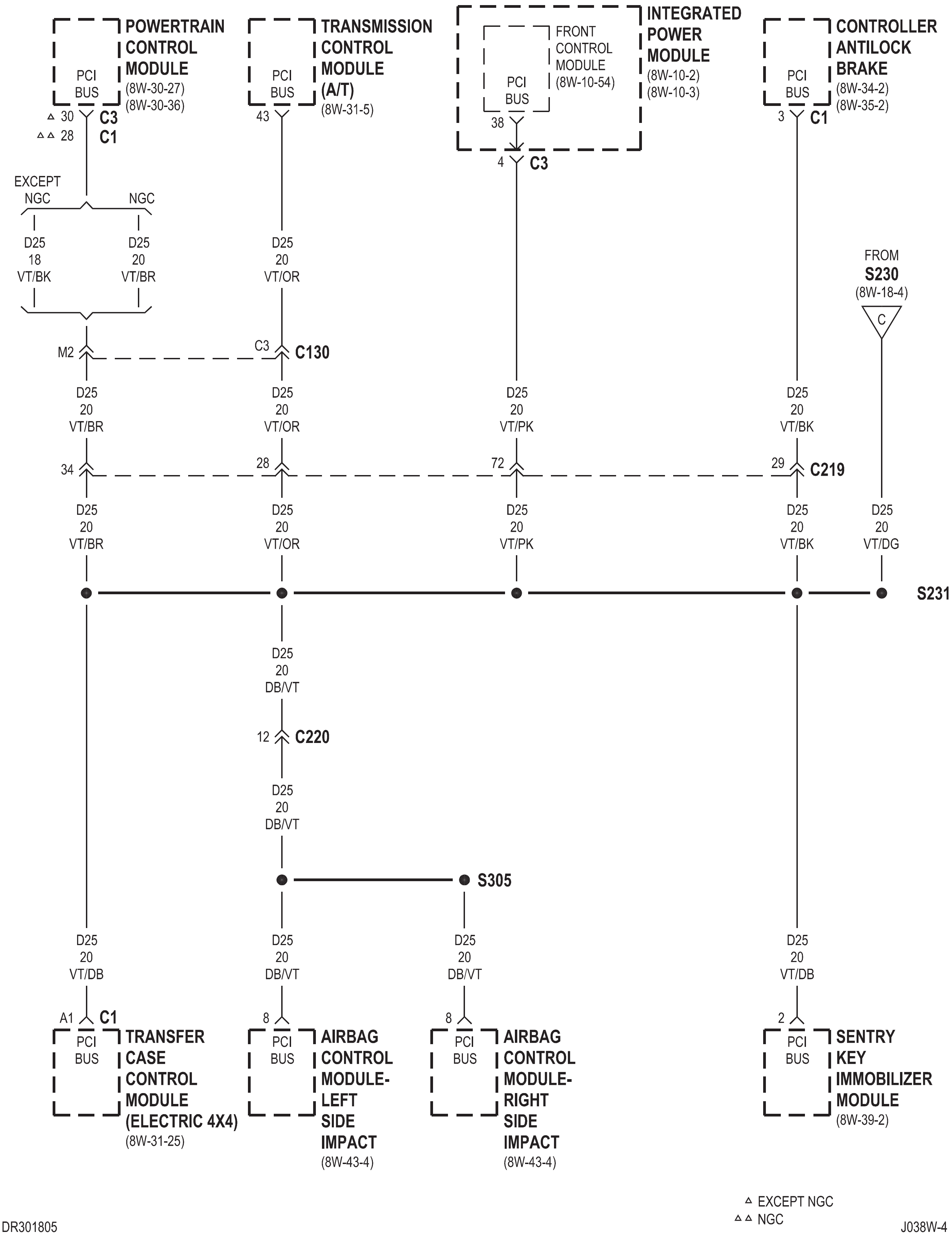
8W-18 BUS COMMUNICATIONS

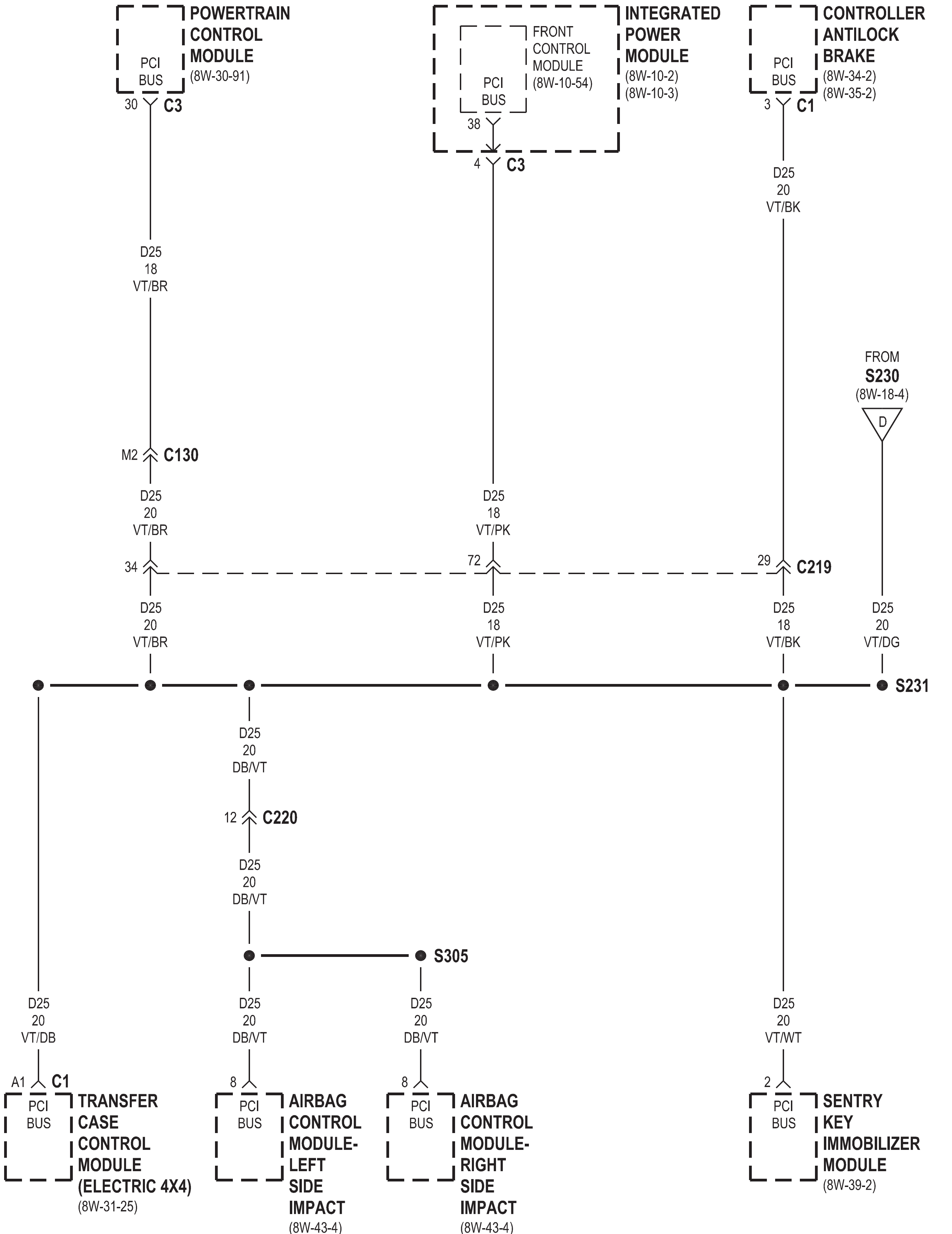

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 51 20A (8W-10-32)
9 C1
POWERTRAIN CONTROL MODULE
(8W-30-27)
(8W-30-36)
SCI TRANSMIT
SCI RECEIVE
27 C3
29 C3
5.7L
EXCEPT 5.7L
D21 20 PK
D21 18 PK
D20 18 LG
D20 20 LG
TRANSMISSION CONTROL MODULE
(8W-31-8)
SCI RECEIVE
SCI TRANSMIT
46
7
D6 18 PK/LB
D15 18 WT/DG
M4
M1
F2
D2
C130
M1 18 PK
S145
(8W-10-32)
D21 20 PK
D20 20 LG
26
5
8
44
2
C219
S204
(8W-10-32)
D21 18 PK
16
7
12
9
15
2
4
5
DATA LINK CONNECTOR
D25 20 LB/VT
Z305 18 BK/DG
Z306 18 OR/BK
A
TO S230
(8W-18-4)
G201
(8W-15-13)
3.7L/5.7L


BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
51
20A
(8W-10-32)
9 C1
POWERTRAIN
CONTROL
MODULE
(8W-30-46)
RECEIVE
SCI
TRANSMIT
SCI
29 C3
27 C3
ENGINE
CONTROL
MODULE
(8W-30-75)
(8W-30-80)
CCD
BUS (+)
CCD
BUS (-)
SCI
RECEIVE
SCI
TRANSMIT
4 C1
5 C1
16 C2
19 C2
M1
18
PK
D1
18
VT/BR
D2
18
WT/BK
D21
18
PK
D20
18
LG
D6
18
PK/LB
D15
18
WT/DG
A
B
10
9 C110
DATA
LINK
CONNECTOR-
ENGINE
(DIESEL)
C
M4
M1
F2
D2 C130
D21
20
PK
D20
20
LG
S145
(8W-10-32)
Z11
14
BK/WT
S176
(8W-15-11)
Z11
12
BK/WT
G120
(8W-15-11)
26
5
8
44
2 C219
D20
20
LG
S204
(8W-10-32)
16
7
12
9
15
2
4
5
DATA
LINK
CONNECTOR
D25
20
LB/VT
A
TO
S230
(8W-18-4)
Z305
18
BK/DG
Z306
18
OR/BK
G201
(8W-15-13)


AMPLIFIER
AUDIO
(PREMIUM)
(8W-47-5)
PCI
BUS
12
C1
RADIO
(8W-47-2)
PCI
BUS
14
FROM
DATA
LINK
CONNECTOR
(8W-18-2)
(8W-18-3)
A
AIRBAG
CONTROL
MODULE
(8W-43-2)
PCI
BUS
21
D25
20
VT/GY
D25
20
VT/LB
D25
20
VT/DG
D25
20
LB/VT
S230
D25
20
VT
GAS
DIESEL
1
C201
D25
20
VT/DG
D25
20
VT/DG
D25
20
VT/LG
D25
20
VT
D25
20
VT/YL
16
C1
PCI
BUS
A/C-
HEATER
CONTROL
(8W-42-3)
(8W-42-4)
21
C3
PCI
BUS
INSTRUMENT
CLUSTER
(8W-40-5)
D
TO
S231
(8W-18-6)
C
TO
S231
(8W-18-5)
5
PCI
BUS
COMPASS/
MINI-
TRIP
COMPUTER
(EXCEPT BASE)
(8W-49-2)

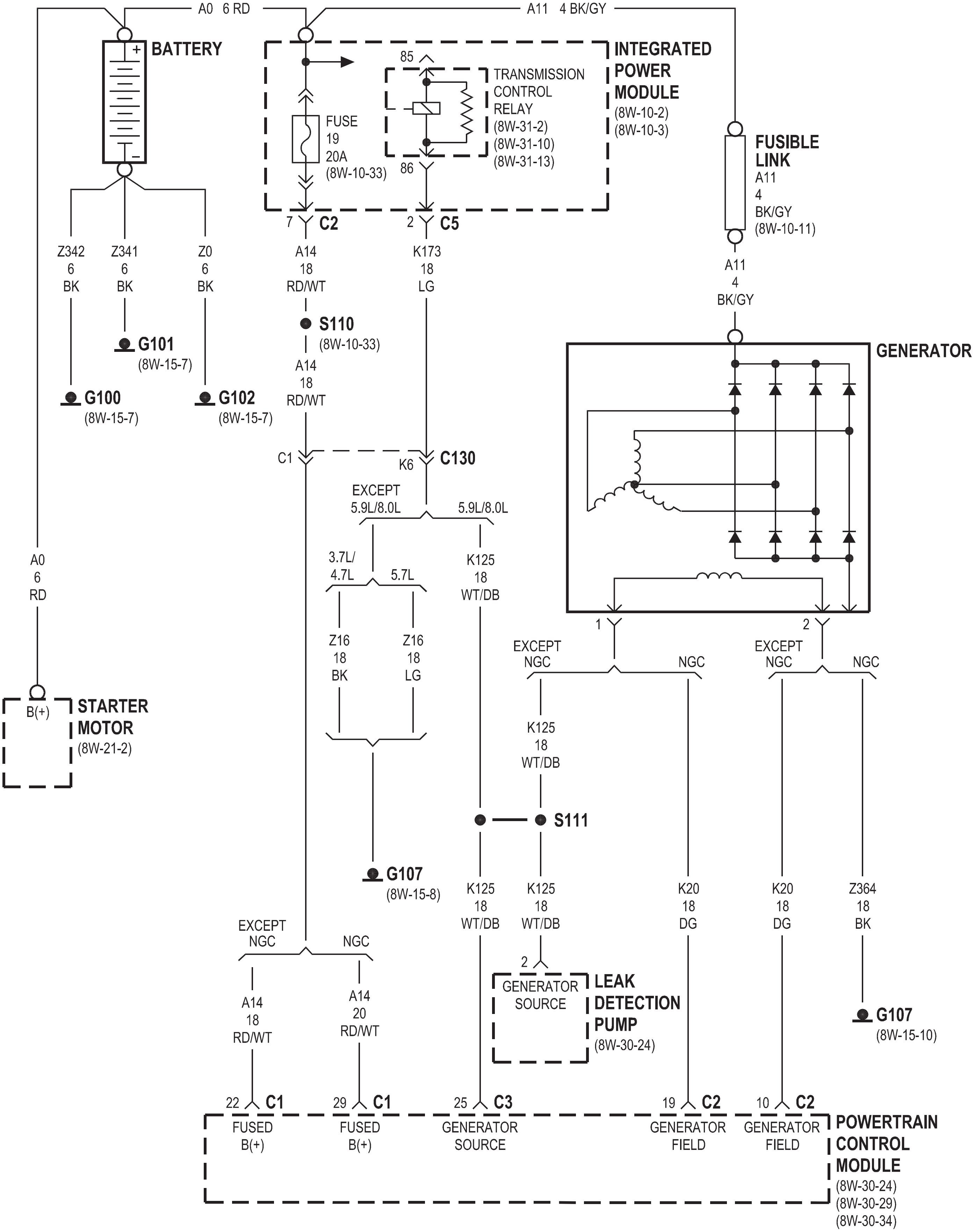
GAS


POWERTRAIN CONTROL MODULE
(8W-30-27)
(8W-30-36)
PCI BUS
▵ 30 C3
▵▵ 28 C1
EXCEPT NGC
NGC
D25 18 VT/BK
D25 20 VT/BR
TRANSMISSION CONTROL MODULE (A/T)
(8W-31-5)
PCI BUS
43
D25 20 VT/OR
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-54)
PCI BUS
38
4 C3
CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
PCI BUS
3 C1
FROM S230
(8W-18-4)
C
M2
C3 C130
D25 20 VT/BR
D25 20 VT/OR
D25 20 VT/PK
D25 20 VT/BK
34
28
72
29 C219
D25 20 VT/DG
S231
D25 20 DB/VT
12 C220
S305
D25 20 VT/DB
D25 20 DB/VT
D25 20 DB/VT
D25 20 VT/DB
A1 C1
PCI BUS
TRANSFER CASE CONTROL MODULE (ELECTRIC 4X4)
(8W-31-25)
8
PCI BUS
AIRBAG CONTROL MODULE-LEFT SIDE IMPACT
(8W-43-4)
8
PCI BUS
AIRBAG CONTROL MODULE-RIGHT SIDE IMPACT
(8W-43-4)
2
PCI BUS
SENTRY KEY IMMOBILIZER MODULE
(8W-39-2)
▵ EXCEPT NGC
▵▵ NGC

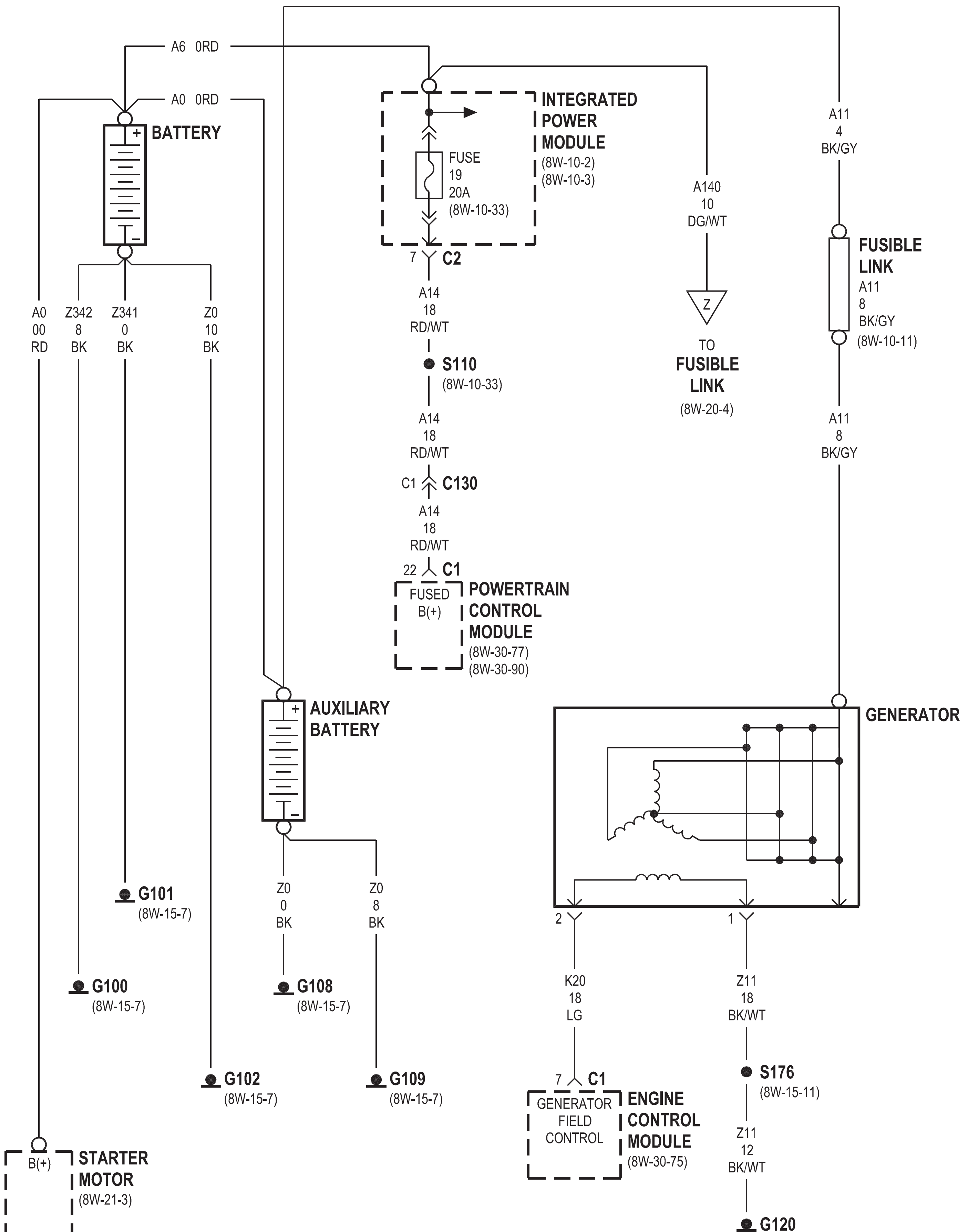

POWERTRAIN CONTROL MODULE
PCI BUS
(8W-30-91)
30 C3
D25 18 VT/BR
M2 C130
D25 20 VT/BR
34
D25 20 VT/BR
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-54)
PCI BUS
38
4 C3
D25 18 VT/PK
72
D25 18 VT/PK
CONTROLLER ANTILOCK BRAKE
PCI BUS
(8W-34-2)
(8W-35-2)
3 C1
D25 20 VT/BK
29 C219
D25 18 VT/BK
FROM S230
(8W-18-4)
D
D25 20 VT/DG
S231
D25 20 DB/VT
12 C220
D25 20 DB/VT
S305
D25 20 VT/DB
A1 C1
PCI BUS
TRANSFER CASE CONTROL MODULE (ELECTRIC 4X4)
(8W-31-25)
D25 20 DB/VT
8
PCI BUS
AIRBAG CONTROL MODULE- LEFT SIDE IMPACT
(8W-43-4)
D25 20 DB/VT
8
PCI BUS
AIRBAG CONTROL MODULE- RIGHT SIDE IMPACT
(8W-43-4)
D25 20 VT/WT
2
PCI BUS
SENTRY KEY IMMOBILIZER MODULE
(8W-39-2)

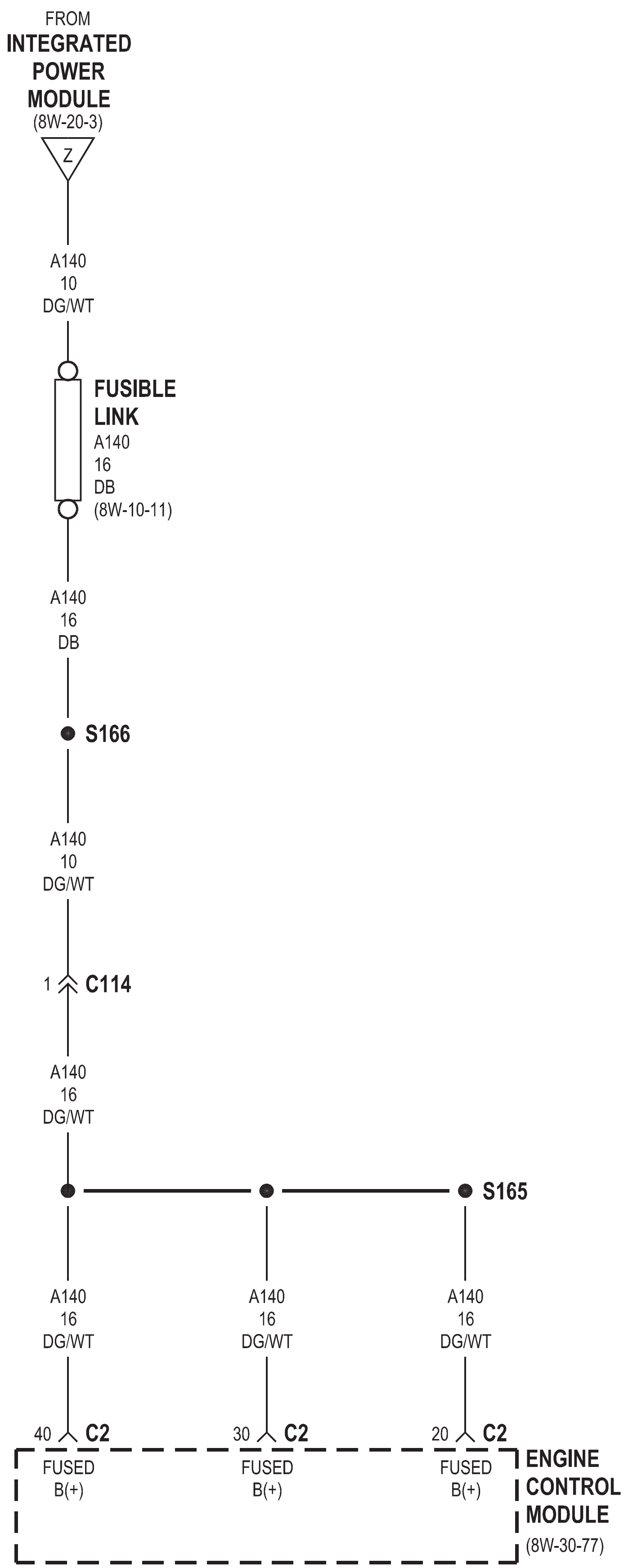
8W-20 CHARGING SYSTEM

GAS

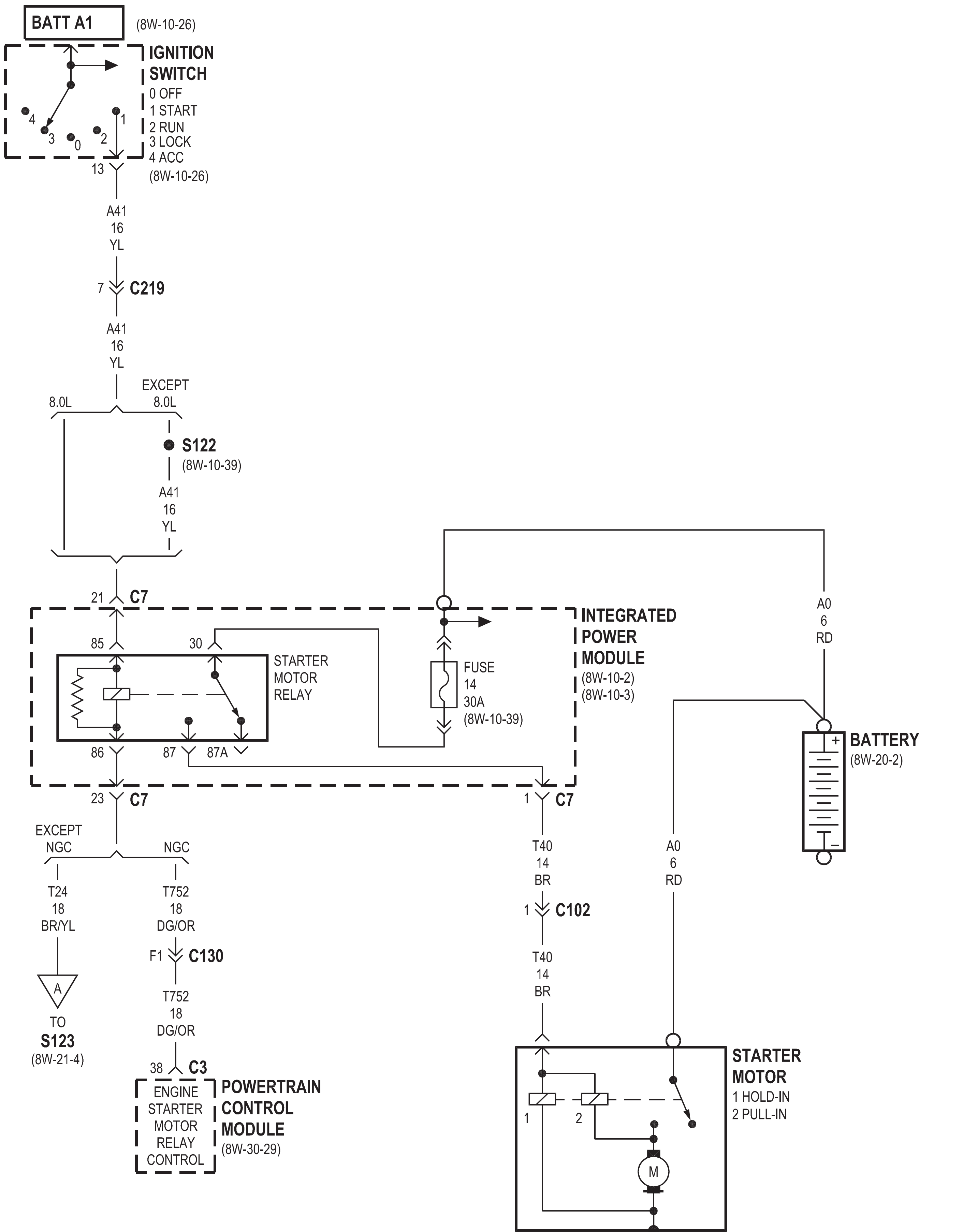

A0 6 RD
A11 4 BK/GY
BATTERY
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
85
TRANSMISSION CONTROL RELAY
(8W-31-2)
(8W-31-10)
(8W-31-13)
86
FUSE 19 20A (8W-10-33)
FUSIBLE LINK
A11 4 BK/GY (8W-10-11)
7 C2
2 C5
Z342 6 BK
Z341 6 BK
Z0 6 BK
A14 18 RD/WT
K173 18 LG
A11 4 BK/GY
G101 (8W-15-7)
S110 (8W-10-33)
G100 (8W-15-7)
G102 (8W-15-7)
GENERATOR
C1
K6
C130
EXCEPT 5.9L/8.0L
5.9L/8.0L
3.7L/ 4.7L
5.7L
K125 18 WT/DB
A0 6 RD
Z16 18 BK
Z16 18 LG
1
2
EXCEPT NGC
NGC
STARTER MOTOR (8W-21-2)
B(+)
S111
G107 (8W-15-8)
K20 18 DG
Z364 18 BK
2
GENERATOR SOURCE
LEAK DETECTION PUMP (8W-30-24)
G107 (8W-15-10)
A14 20 RD/WT
22 C1
29 C1
25 C3
19 C2
10 C2
FUSED B(+)
GENERATOR SOURCE
GENERATOR FIELD
POWERTRAIN CONTROL MODULE
(8W-30-24)
(8W-30-29)
(8W-30-34)

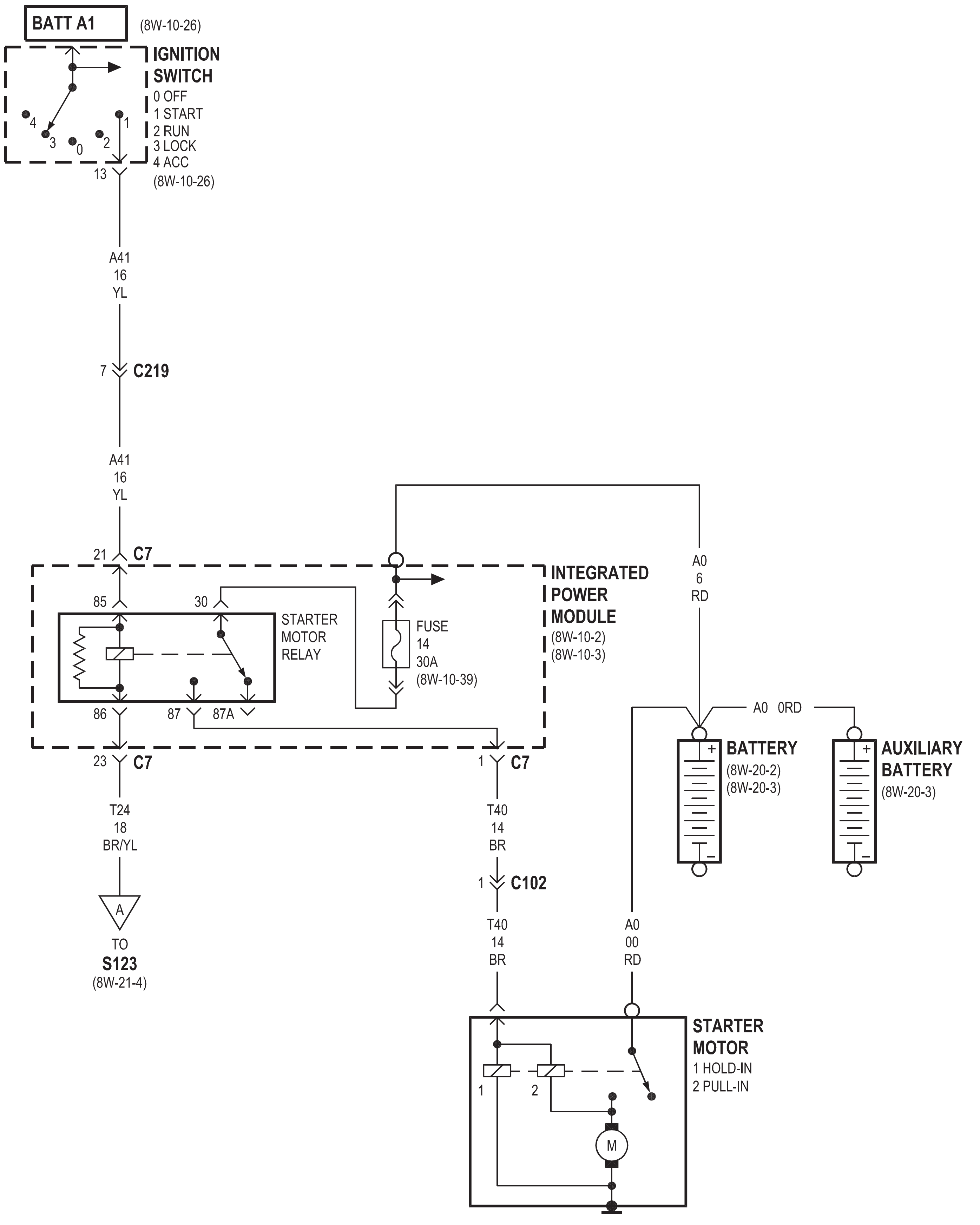
DIESEL

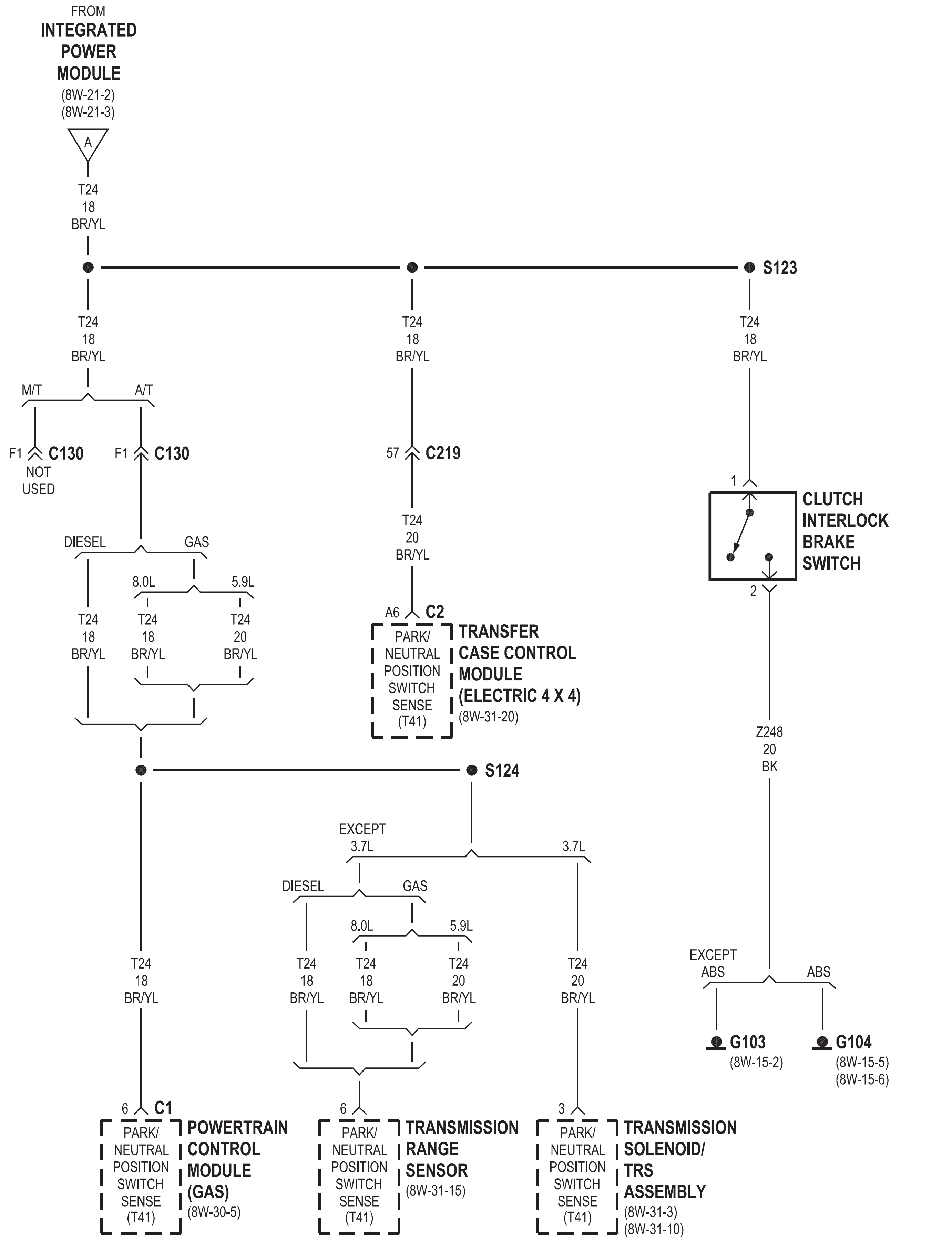

A6 0RD
A0 0RD
BATTERY
A0
00
RD
Z342
8
BK
Z341
0
BK
Z0
10
BK
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
19
20A
(8W-10-33)
7 C2
A14
18
RD/WT
S110
(8W-10-33)
A14
18
RD/WT
C1 C130
A14
18
RD/WT
22 C1
FUSED
B(+)
POWERTRAIN
CONTROL
MODULE
(8W-30-77)
(8W-30-90)
A140
10
DG/WT
Z
TO
FUSIBLE
LINK
(8W-20-4)
A11
4
BK/GY
FUSIBLE
LINK
A11
8
BK/GY
(8W-10-11)
A11
8
BK/GY
GENERATOR
AUXILIARY
BATTERY
Z0
0
BK
Z0
8
BK
G101
(8W-15-7)
G100
(8W-15-7)
G108
(8W-15-7)
G102
(8W-15-7)
G109
(8W-15-7)
2
1
K20
18
LG
Z11
18
BK/WT
7 C1
GENERATOR
FIELD
CONTROL
ENGINE
CONTROL
MODULE
(8W-30-75)
S176
(8W-15-11)
Z11
12
BK/WT
G120
(8W-15-11)
B(+)
STARTER
MOTOR
(8W-21-3)


FROM
INTEGRATED
POWER
MODULE
(8W-20-3)
Z
A140
10
DG/WT
FUSIBLE
LINK
A140
16
DB
(8W-10-11)
A140
16
DB
S166
A140
10
DG/WT
1
C114
A140
16
DG/WT
S165
A140
16
DG/WT
A140
16
DG/WT
A140
16
DG/WT
40
C2
30
C2
20
C2
FUSED
B(+)
FUSED
B(+)
FUSED
B(+)
ENGINE
CONTROL
MODULE
(8W-30-77)

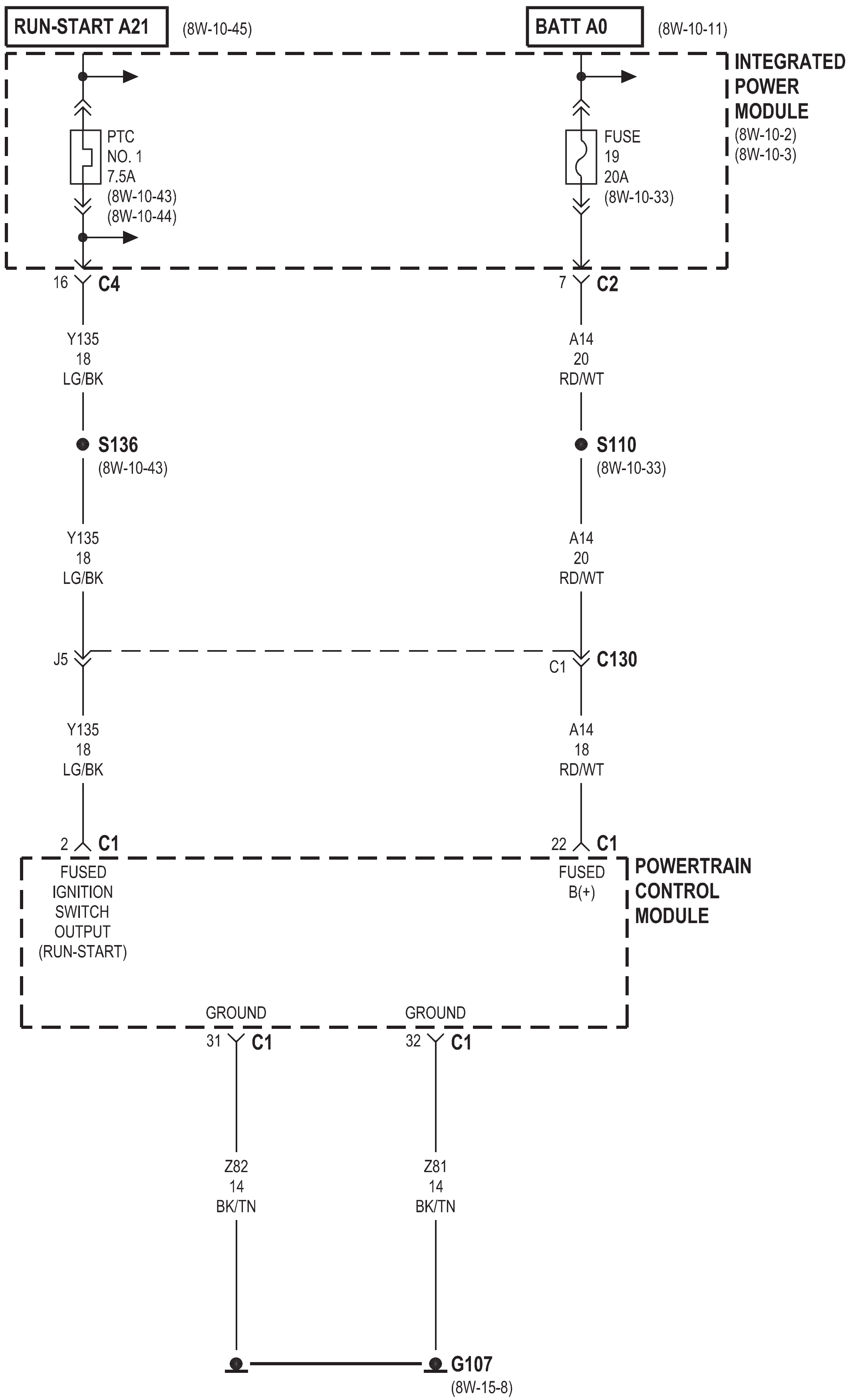
8W-21 STARTING SYSTEM


BATT A1
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
13
A41
16
YL
7
C219
A41
16
YL
8.0L
EXCEPT 8.0L
S122
(8W-10-39)
A41
16
YL
21
C7
85
30
STARTER MOTOR RELAY
86
87
87A
FUSE
14
30A
(8W-10-39)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
A0
6
RD
BATTERY
(8W-20-2)
23
C7
1
C7
EXCEPT NGC
NGC
T24
18
BR/YL
A
TO
S123
(8W-21-4)
T752
18
DG/OR
F1
C130
T752
18
DG/OR
38
C3
ENGINE STARTER MOTOR RELAY CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-29)
T40
14
BR
1
C102
T40
14
BR
A0
6
RD
STARTER MOTOR
1 HOLD-IN
2 PULL-IN
M

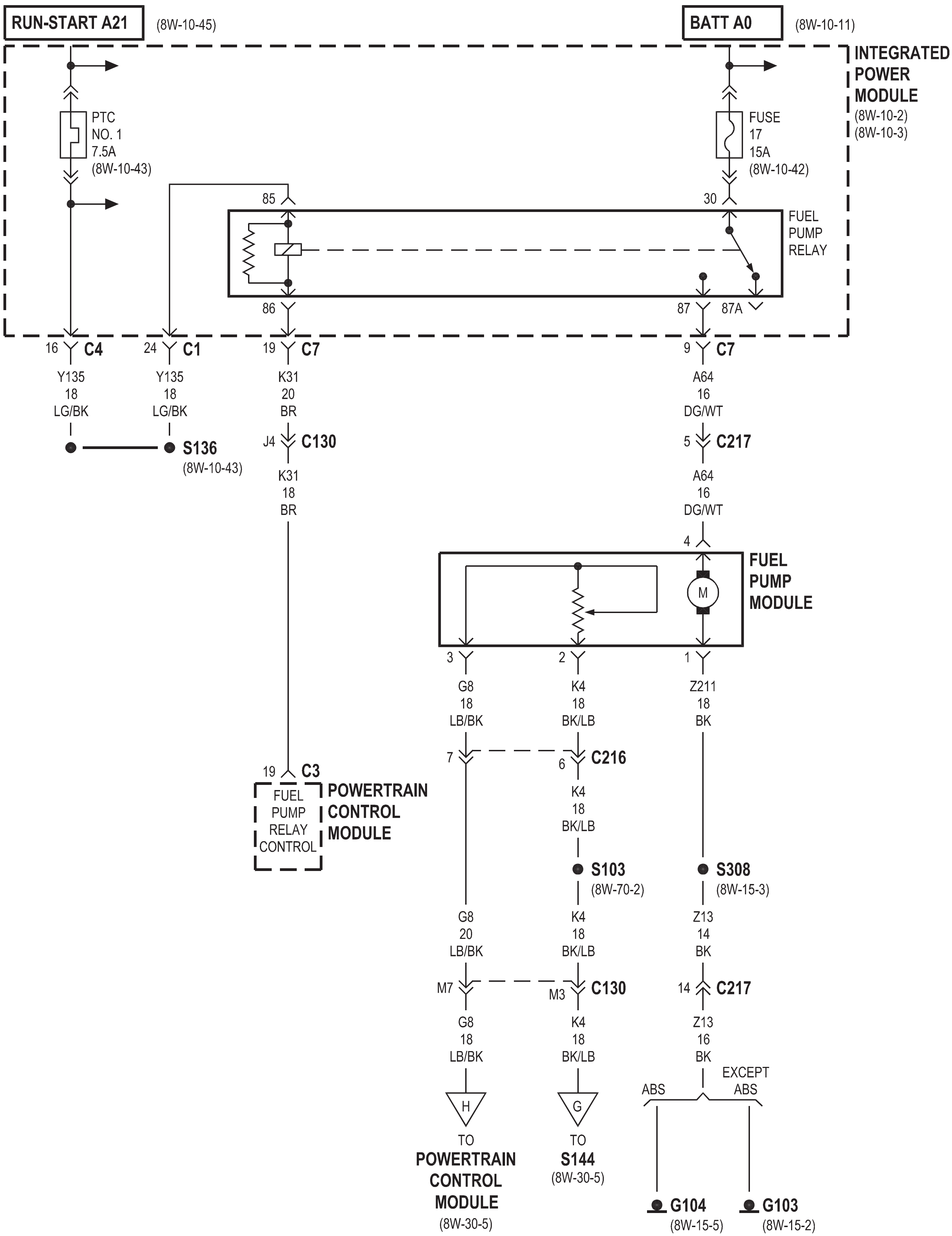

BATT A1
(8W-10-26)
IGNITION
SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
4
3
0
2
1
13
A41
16
YL
7
C219
A41
16
YL
21
C7
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
85
30
STARTER
MOTOR
RELAY
FUSE
14
30A
(8W-10-39)
86
87
87A
23
C7
1
C7
A0
6
RD
A0 0RD
BATTERY
(8W-20-2)
(8W-20-3)
AUXILIARY
BATTERY
(8W-20-3)
T24
18
BR/YL
A
TO
S123
(8W-21-4)
T40
14
BR
1
C102
T40
14
BR
A0
00
RD
STARTER
MOTOR
1 HOLD-IN
2 PULL-IN
1
2
M

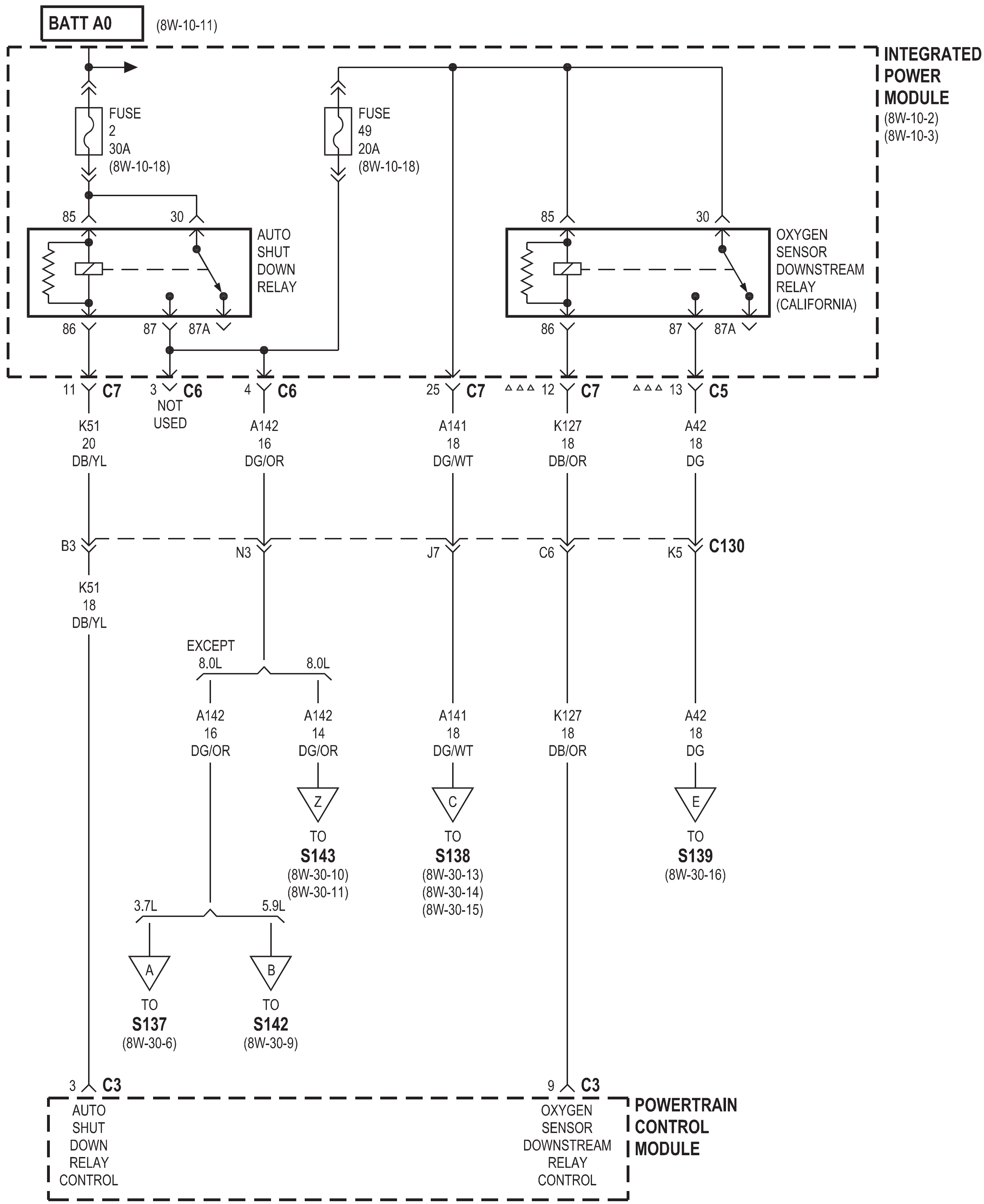

FROM
INTEGRATED
POWER
MODULE
(8W-21-2)
(8W-21-3)
A
T24
18
BR/YL
S123
M/T
A/T
F1
C130
NOT
USED
C219
57
C2
A6
1
2
CLUTCH
INTERLOCK
BRAKE
SWITCH
DIESEL
GAS
8.0L
5.9L
T24
20
BR/YL
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
TRANSFER
CASE CONTROL
MODULE
(ELECTRIC 4 X 4)
(8W-31-20)
Z248
20
BK
S124
EXCEPT
3.7L
EXCEPT
ABS
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
6
C1
3
POWERTRAIN
CONTROL
MODULE
(GAS)
(8W-30-5)
TRANSMISSION
RANGE
SENSOR
(8W-31-15)
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
(8W-31-10)

8W-30 FUEL/IGNITION SYSTEM

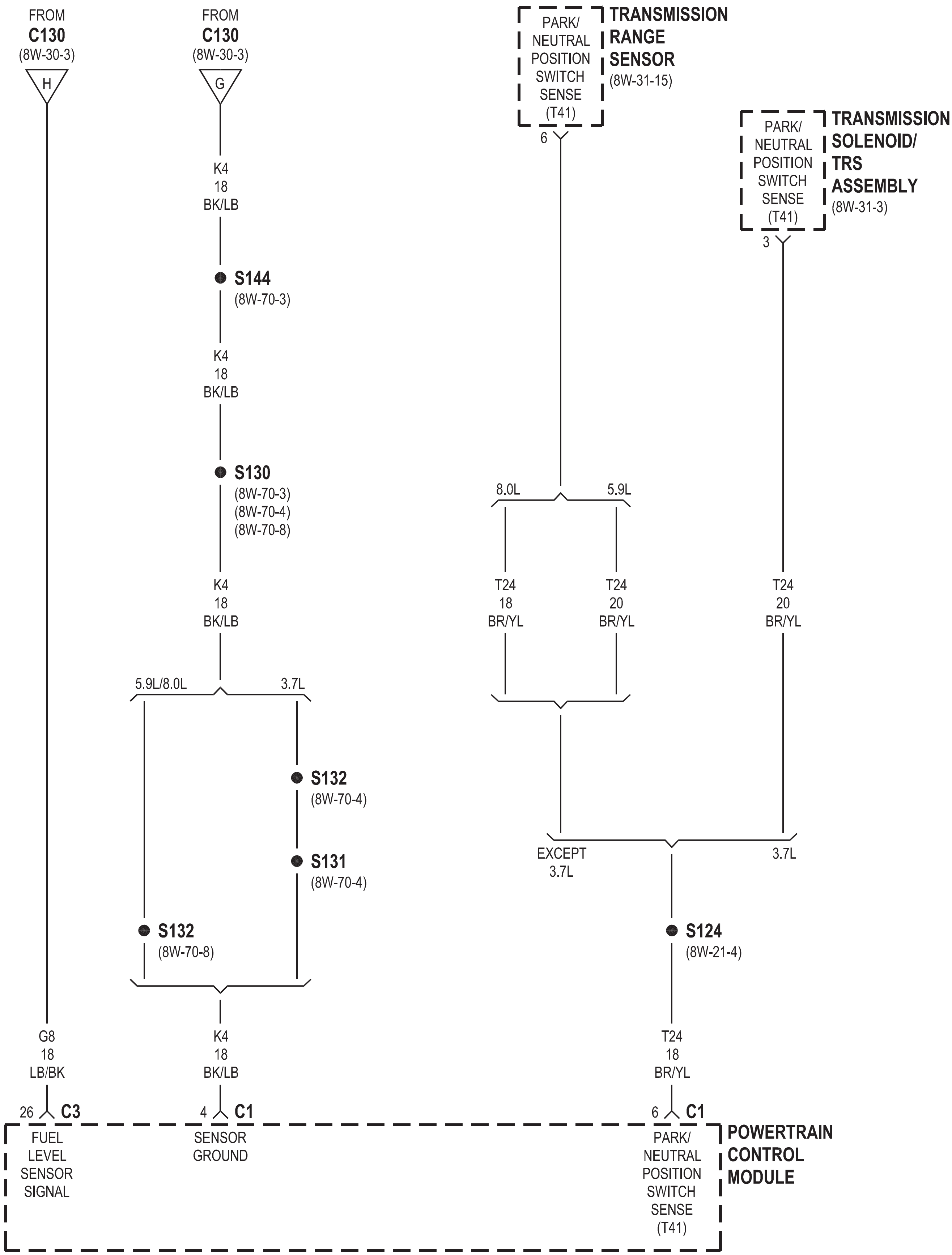

RUN-START A21
(8W-10-45)
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
PTC NO. 1 7.5A
(8W-10-43)
(8W-10-44)
FUSE 19 20A
(8W-10-33)
16 C4
7 C2
Y135 18 LG/BK
A14 20 RD/WT
S136
(8W-10-43)
S110
(8W-10-33)
Y135 18 LG/BK
A14 20 RD/WT
J5
C1 C130
Y135 18 LG/BK
A14 18 RD/WT
2 C1
22 C1
POWERTRAIN CONTROL MODULE
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED B(+)
GROUND
GROUND
31 C1
32 C1
Z82 14 BK/TN
Z81 14 BK/TN
G107
(8W-15-8)

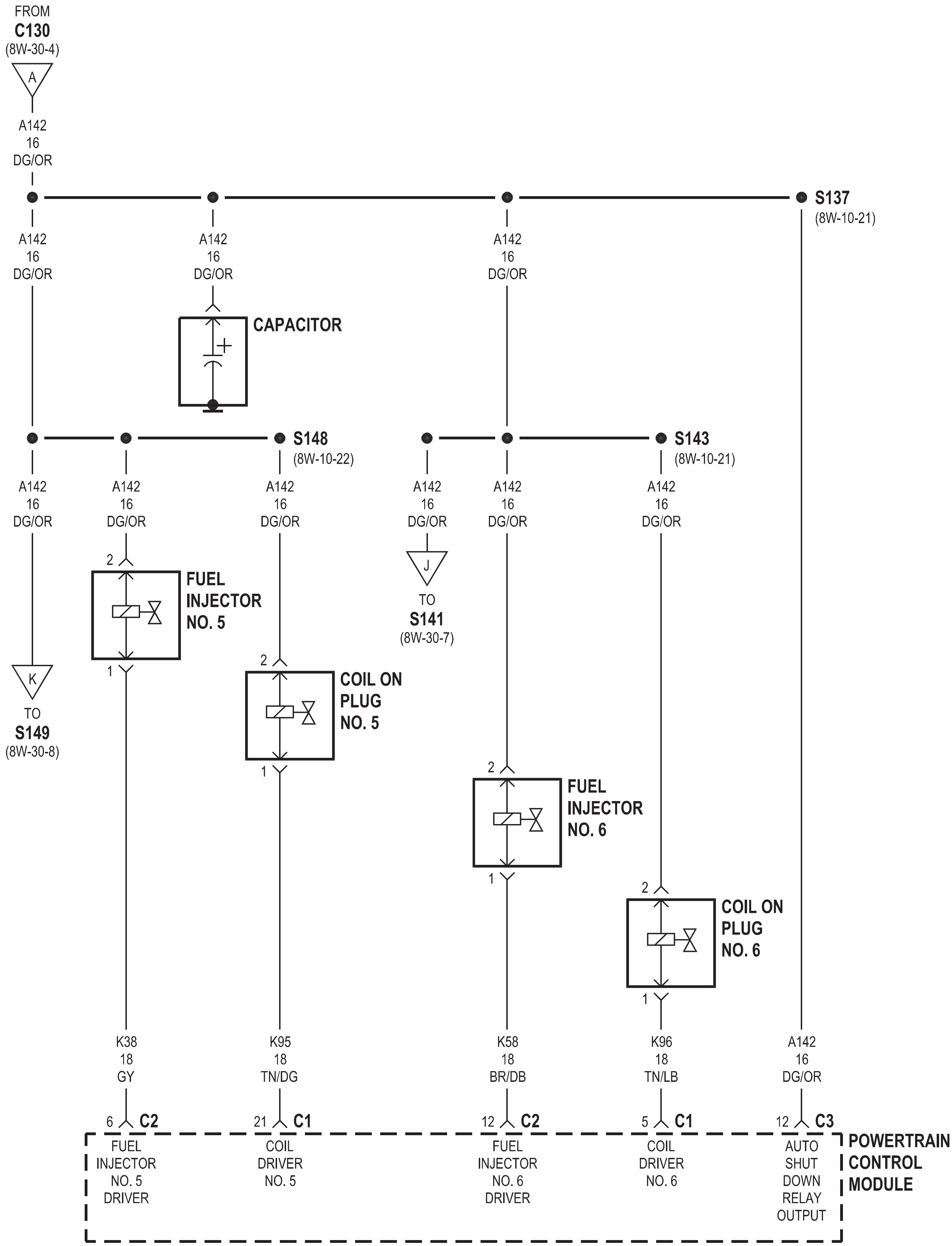
JTEC

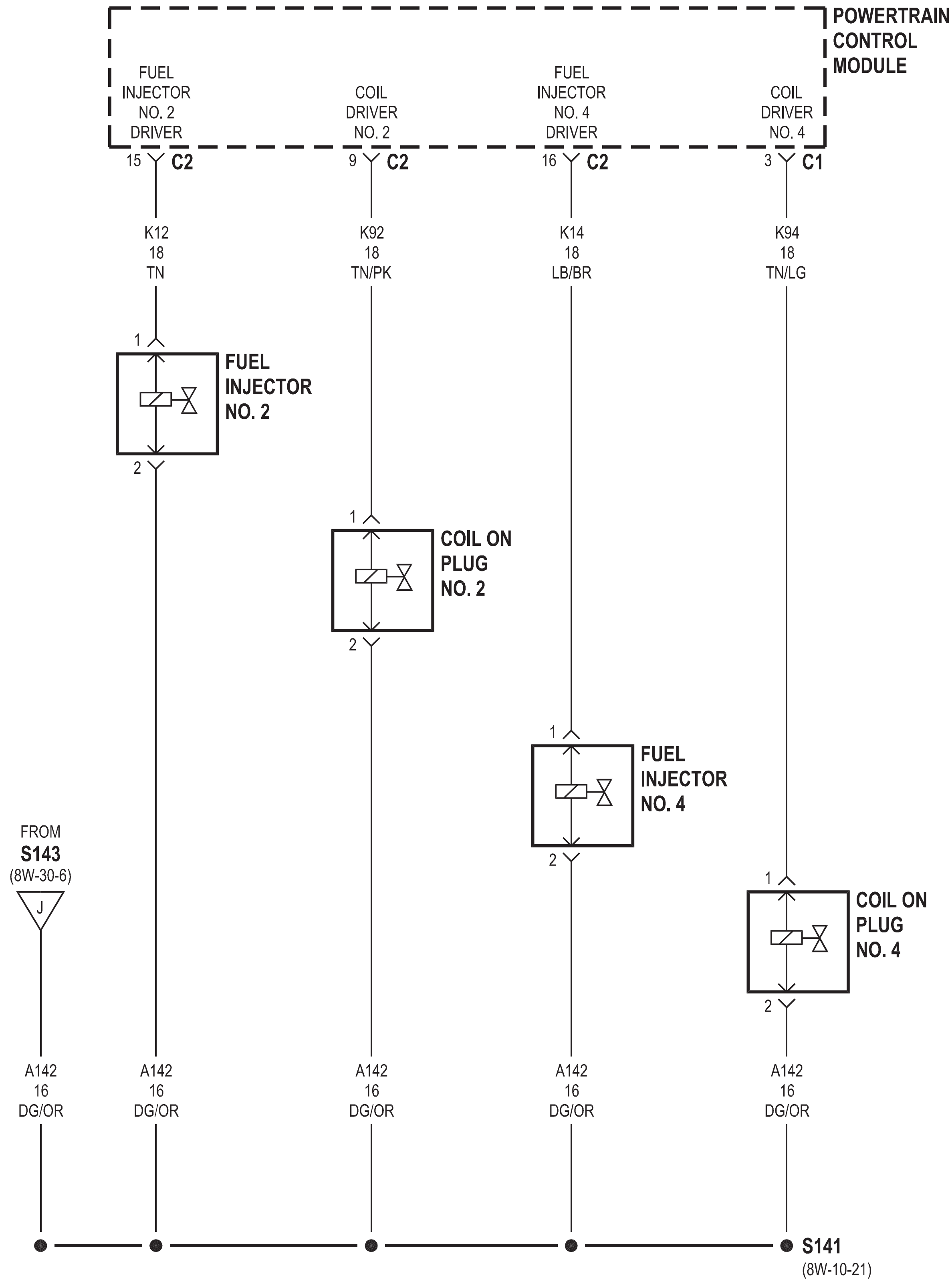

RUN-START A21
(8W-10-45)
BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-43)
FUSE
17
15A
(8W-10-42)
85
30
FUEL
PUMP
RELAY
86
87
87A
16 C4
24 C1
19 C7
9 C7
Y135
18
LG/BK
Y135
18
LG/BK
K31
20
BR
A64
16
DG/WT
S136
(8W-10-43)
J4 C130
5 C217
K31
18
BR
A64
16
DG/WT
4
FUEL
PUMP
MODULE
M
3
2
1
G8
18
LB/BK
K4
18
BK/LB
Z211
18
BK
7
6 C216
19 C3
FUEL
PUMP
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE
K4
18
BK/LB
S103
(8W-70-2)
S308
(8W-15-3)
G8
20
LB/BK
K4
18
BK/LB
Z13
14
BK
M7
M3 C130
14 C217
G8
18
LB/BK
K4
18
BK/LB
Z13
16
BK
EXCEPT
ABS
ABS
H
G
TO
POWERTRAIN
CONTROL
MODULE
(8W-30-5)
TO
S144
(8W-30-5)
G104
(8W-15-5)
G103
(8W-15-2)

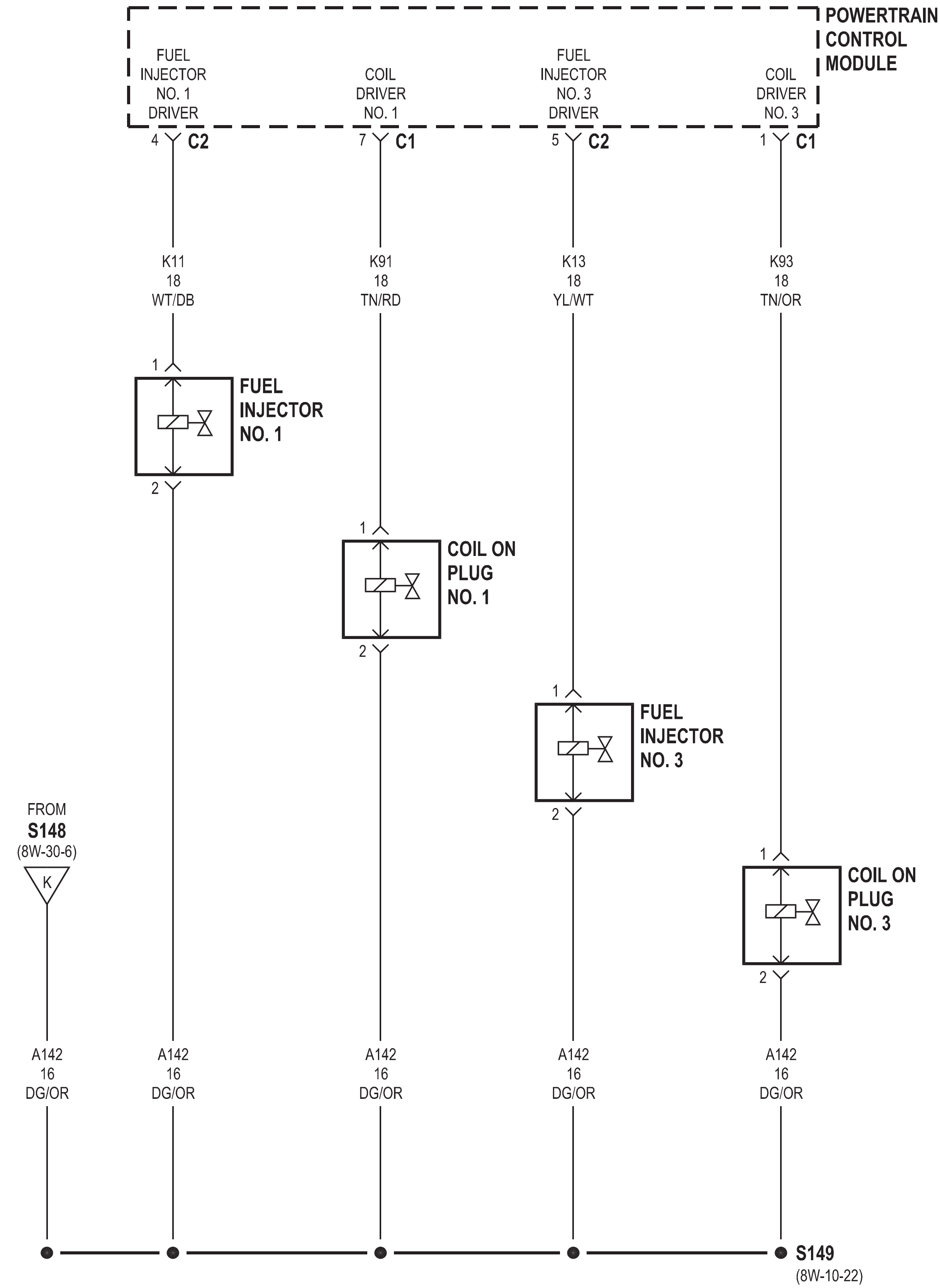

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 2 30A (8W-10-18)
FUSE 49 20A (8W-10-18)
85 30
AUTO SHUT DOWN RELAY
86 87 87A
85 30
OXYGEN SENSOR DOWNSTREAM RELAY (CALIFORNIA)
86 87 87A
11 C7
3 C6 NOT USED
4 C6
25 C7
△△△ 12 C7
△△△ 13 C5
K51 20 DB/YL
A142 16 DG/OR
A141 18 DG/WT
K127 18 DB/OR
A42 18 DG
B3 N3 J7 C6 K5 C130
K51 18 DB/YL
EXCEPT 8.0L
8.0L
A142 16 DG/OR
A142 14 DG/OR
A141 18 DG/WT
K127 18 DB/OR
A42 18 DG
Z TO S143 (8W-30-10) (8W-30-11)
C TO S138 (8W-30-13) (8W-30-14) (8W-30-15)
E TO S139 (8W-30-16)
3.7L
5.9L
A TO S137 (8W-30-6)
B TO S142 (8W-30-9)
3 C3
9 C3
AUTO SHUT DOWN RELAY CONTROL
OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
POWERTRAIN CONTROL MODULE

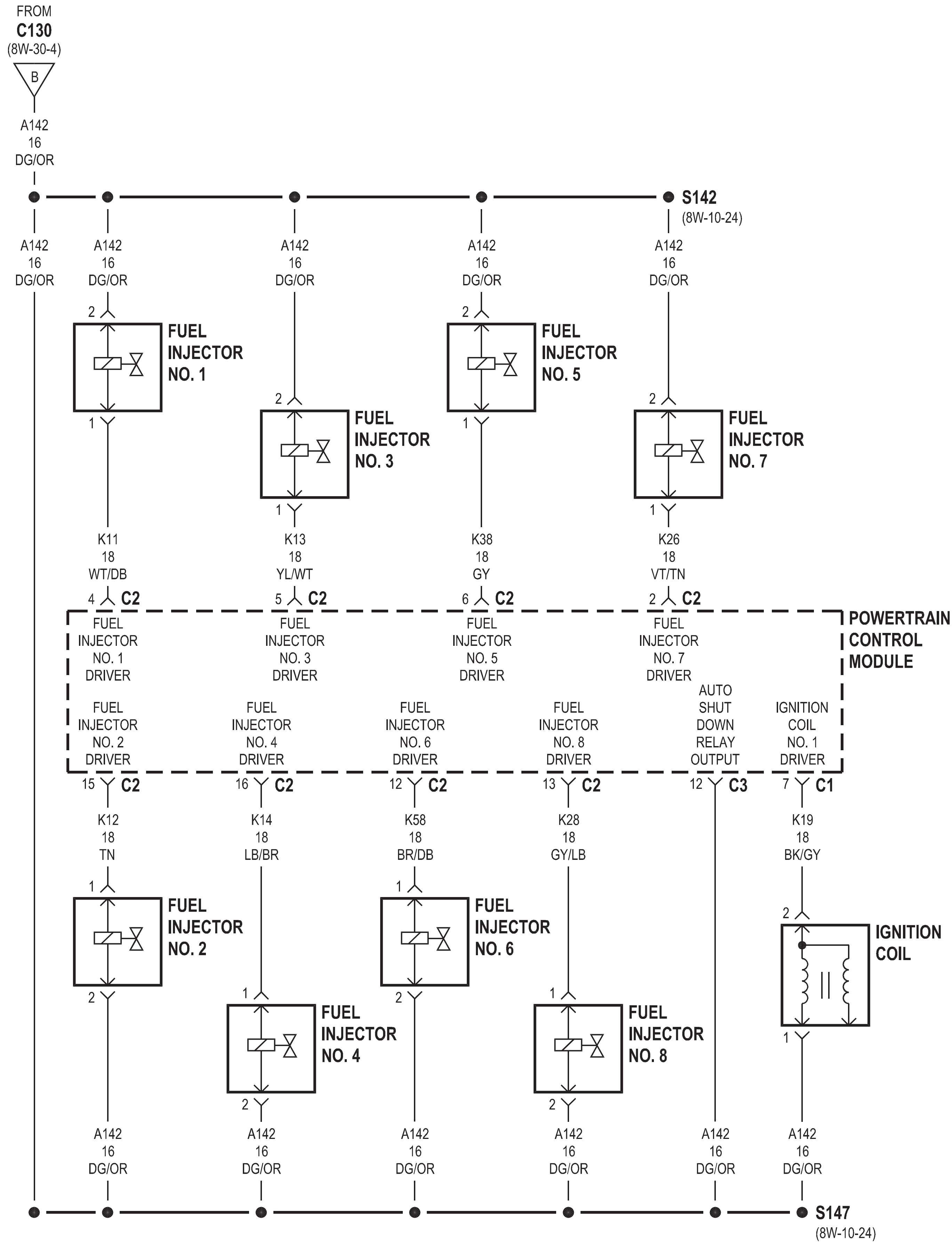
△△△ 8.0L

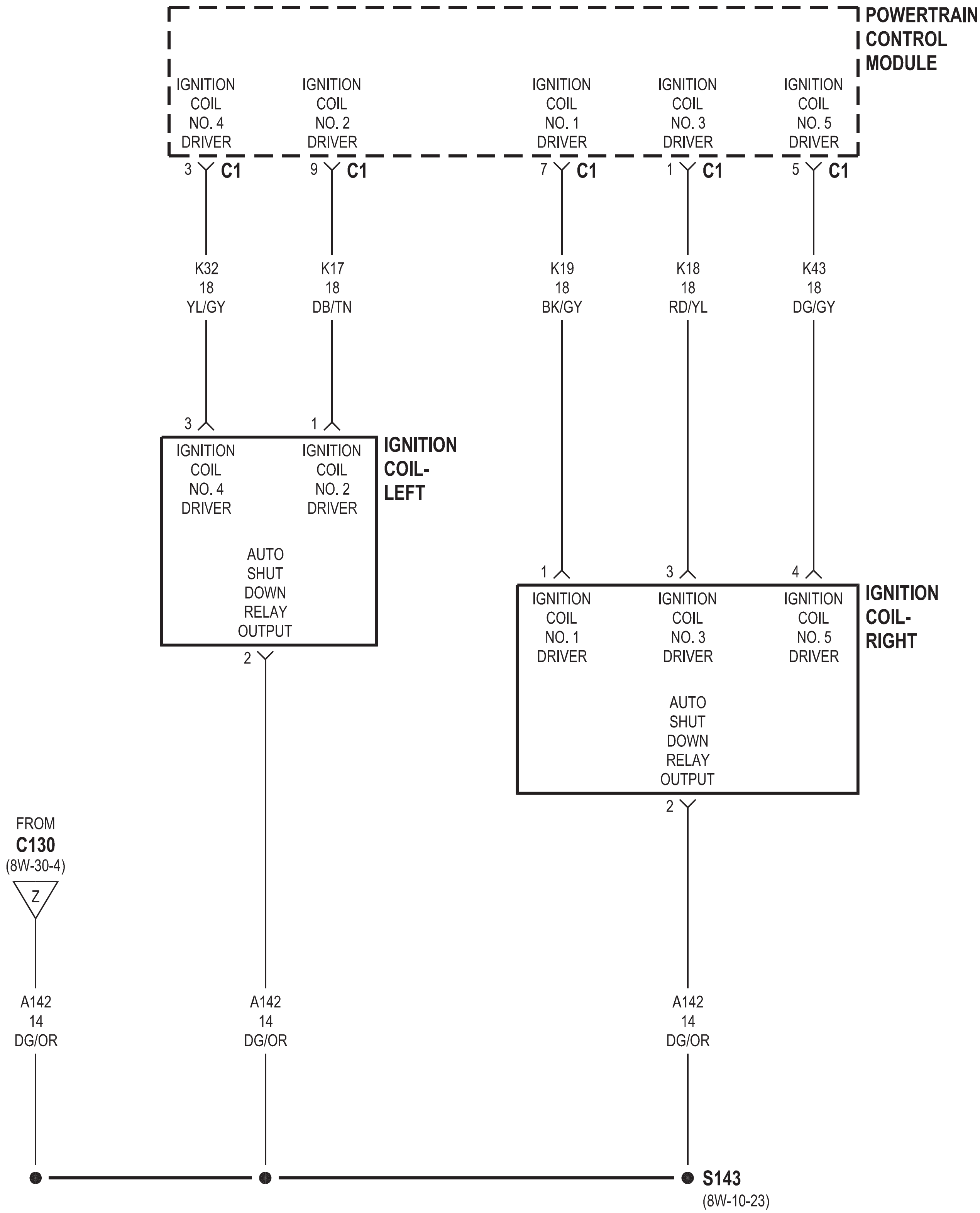

FROM
C130
(8W-30-3)
H
FROM
C130
(8W-30-3)
G
K4
18
BK/LB
S144
(8W-70-3)
K4
18
BK/LB
S130
(8W-70-3)
(8W-70-4)
(8W-70-8)
K4
18
BK/LB
5.9L/8.0L
3.7L
S132
(8W-70-4)
S131
(8W-70-4)
S132
(8W-70-8)
G8
18
LB/BK
K4
18
BK/LB
26 C3
4 C1
FUEL
LEVEL
SENSOR
SIGNAL
SENSOR
GROUND
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
TRANSMISSION
RANGE
SENSOR
(8W-31-15)
6
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
3
8.0L
5.9L
T24
18
BR/YL
T24
20
BR/YL
T24
20
BR/YL
EXCEPT
3.7L
3.7L
S124
(8W-21-4)
T24
18
BR/YL
6 C1
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
POWERTRAIN
CONTROL
MODULE

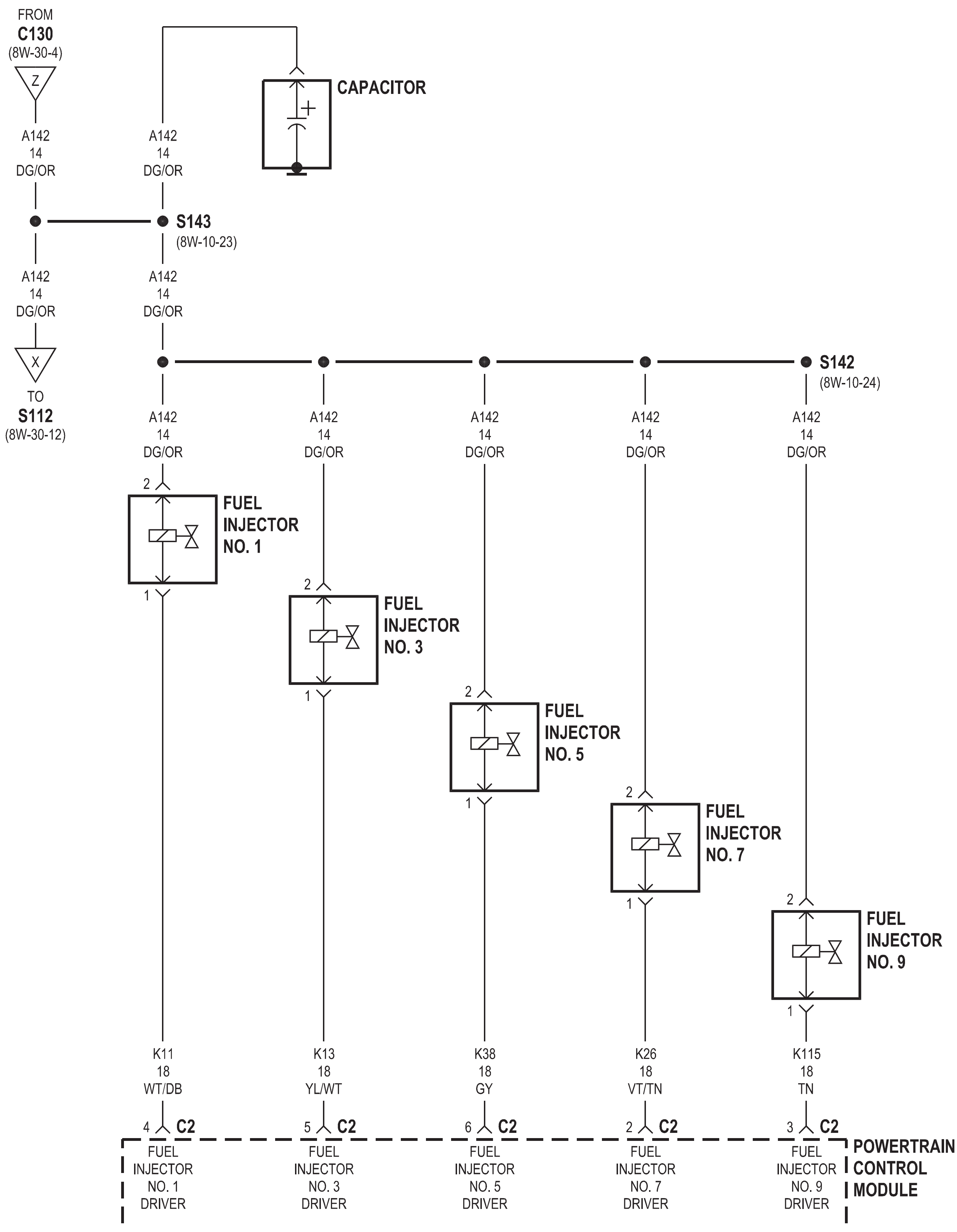

FROM
C130
(8W-30-4)
A
A142
16
DG/OR
S137
(8W-10-21)
CAPACITOR
S148
(8W-10-22)
S143
(8W-10-21)
FUEL
INJECTOR
NO. 5
J
TO
S141
(8W-30-7)
K
TO
S149
(8W-30-8)
COIL ON
PLUG
NO. 5
FUEL
INJECTOR
NO. 6
COIL ON
PLUG
NO. 6
K38
18
GY
K95
18
TN/DG
K58
18
BR/DB
K96
18
TN/LB
A142
16
DG/OR
6 C2
21 C1
12 C2
5 C1
12 C3
FUEL
INJECTOR
NO. 5
DRIVER
COIL
DRIVER
NO. 5
FUEL
INJECTOR
NO. 6
DRIVER
COIL
DRIVER
NO. 6
AUTO
SHUT
DOWN
RELAY
OUTPUT
POWERTRAIN
CONTROL
MODULE

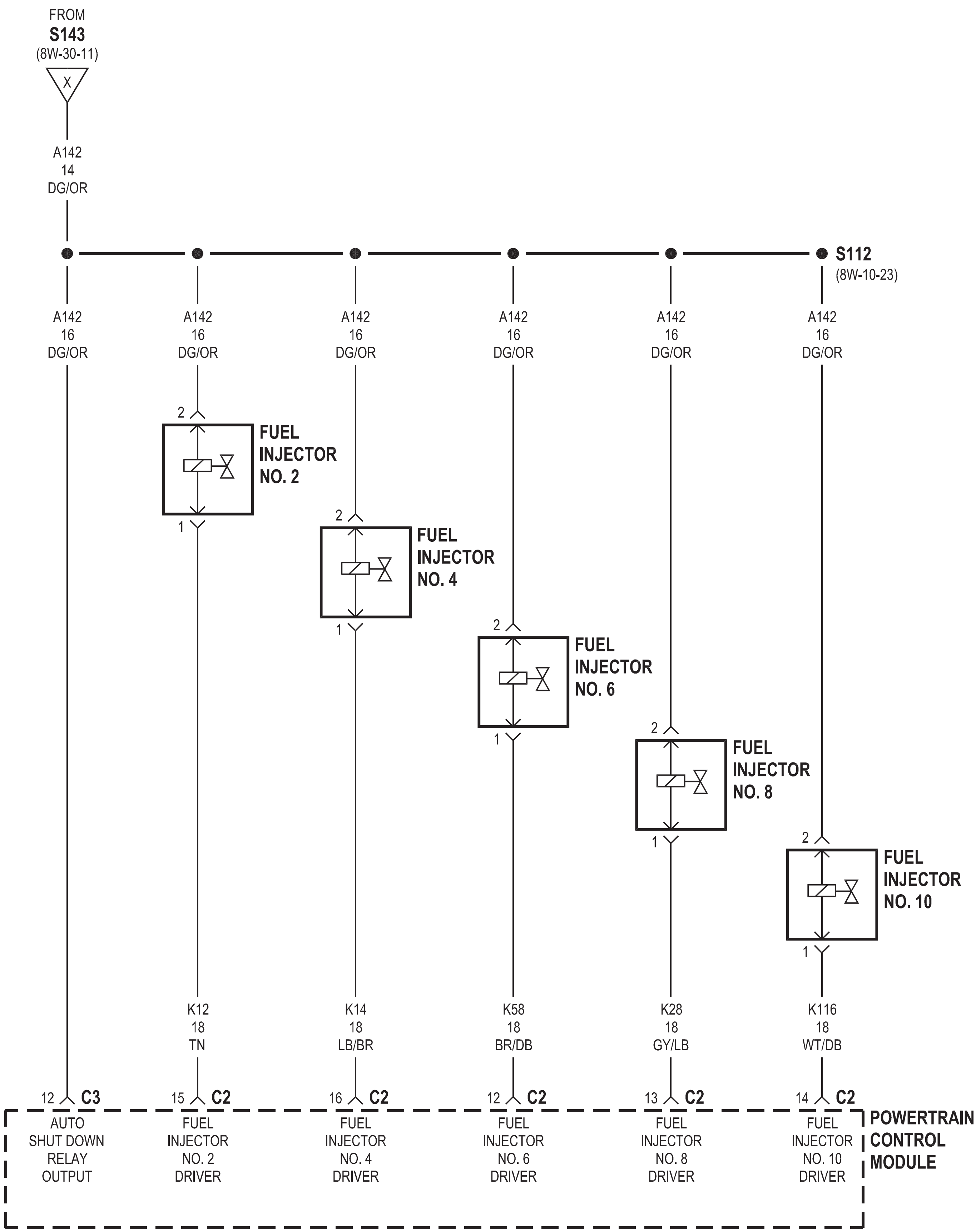

POWERTRAIN CONTROL MODULE
FUEL INJECTOR NO. 2 DRIVER
15 C2
COIL DRIVER NO. 2
9 C2
FUEL INJECTOR NO. 4 DRIVER
16 C2
COIL DRIVER NO. 4
3 C1
K12 18 TN
K92 18 TN/PK
K14 18 LB/BR
K94 18 TN/LG
FUEL INJECTOR NO. 2
COIL ON PLUG NO. 2
FUEL INJECTOR NO. 4
COIL ON PLUG NO. 4
FROM S143 (8W-30-6)
J
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
S141 (8W-10-21)

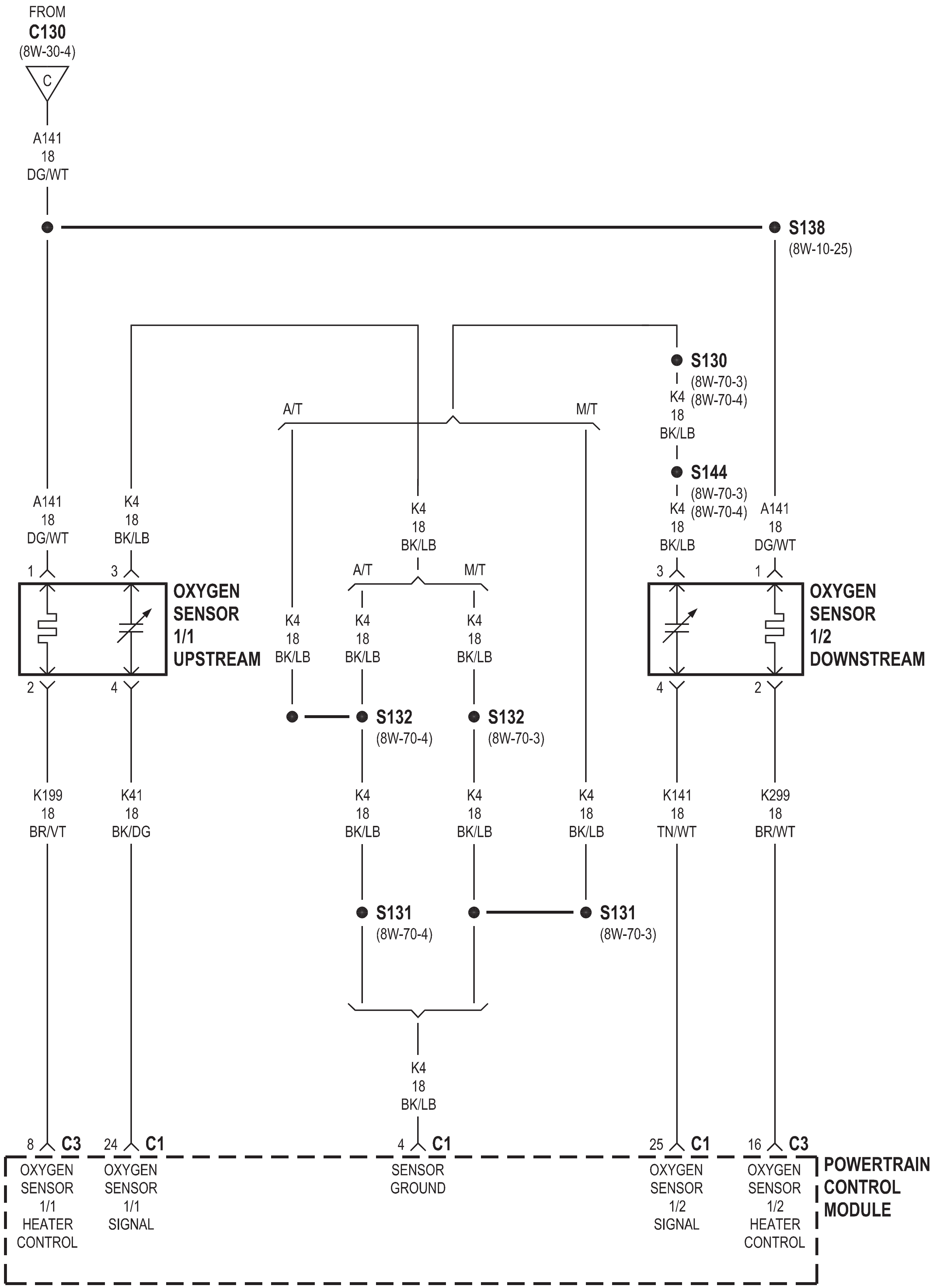

POWERTRAIN CONTROL MODULE
FUEL INJECTOR NO. 1 DRIVER
COIL DRIVER NO. 1
FUEL INJECTOR NO. 3 DRIVER
COIL DRIVER NO. 3
4 C2
7 C1
5 C2
1 C1
K11 18 WT/DB
K91 18 TN/RD
K13 18 YL/WT
K93 18 TN/OR
FUEL INJECTOR NO. 1
COIL ON PLUG NO. 1
FUEL INJECTOR NO. 3
COIL ON PLUG NO. 3
1
2
FROM S148 (8W-30-6)
K
A142 16 DG/OR
S149 (8W-10-22)

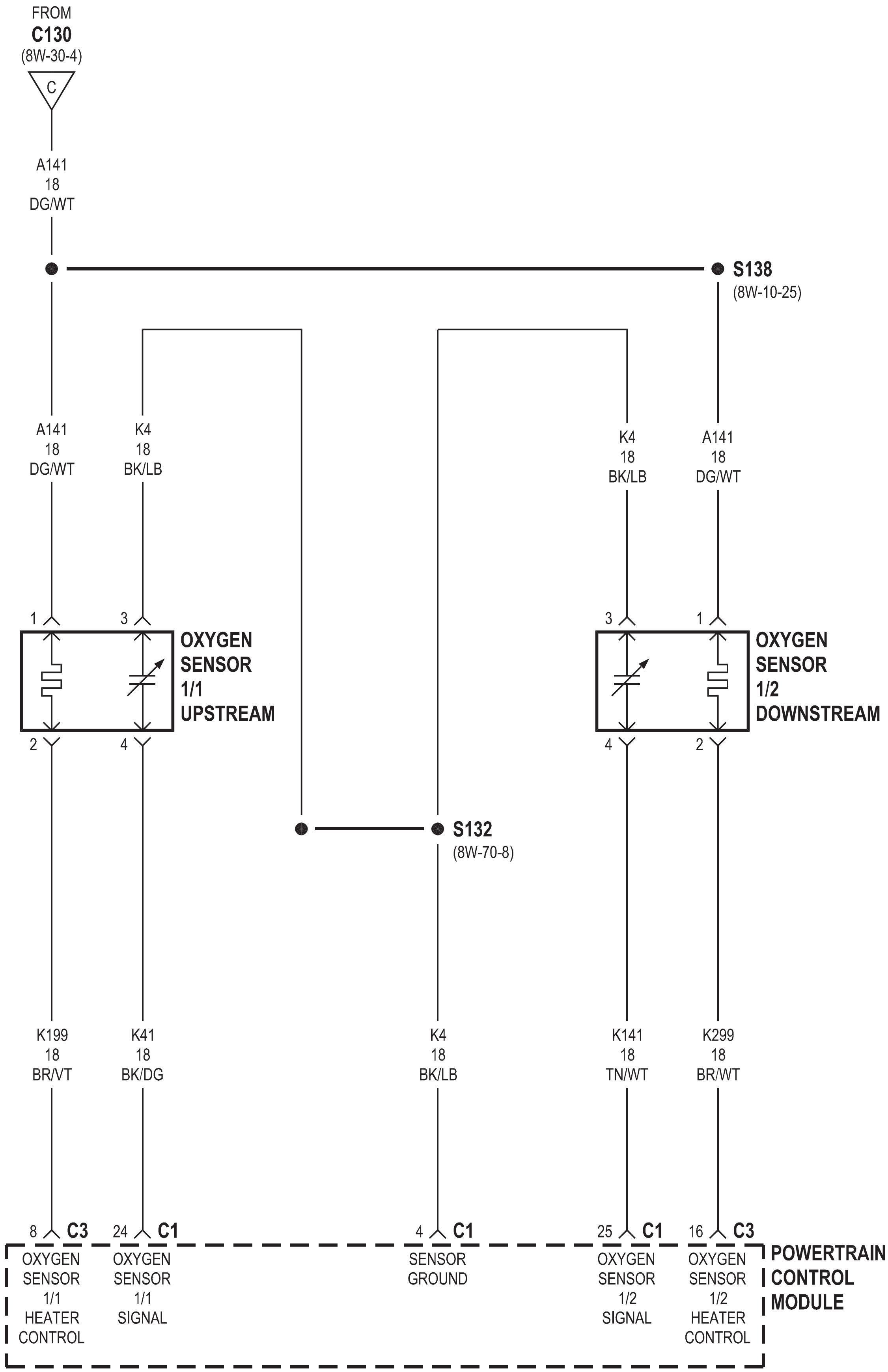

FROM
C130
(8W-30-4)
B
A142
16
DG/OR
S142
(8W-10-24)
FUEL INJECTOR NO. 1
FUEL INJECTOR NO. 3
FUEL INJECTOR NO. 5
FUEL INJECTOR NO. 7
K11 18 WT/DB
K13 18 YL/WT
K38 18 GY
K26 18 VT/TN
4 C2
5 C2
6 C2
2 C2
POWERTRAIN CONTROL MODULE
FUEL INJECTOR NO. 1 DRIVER
FUEL INJECTOR NO. 3 DRIVER
FUEL INJECTOR NO. 5 DRIVER
FUEL INJECTOR NO. 7 DRIVER
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 4 DRIVER
FUEL INJECTOR NO. 6 DRIVER
FUEL INJECTOR NO. 8 DRIVER
AUTO SHUT DOWN RELAY OUTPUT
IGNITION COIL NO. 1 DRIVER
15 C2
16 C2
12 C2
13 C2
12 C3
7 C1
K12 18 TN
K14 18 LB/BR
K58 18 BR/DB
K28 18 GY/LB
K19 18 BK/GY
FUEL INJECTOR NO. 2
FUEL INJECTOR NO. 4
FUEL INJECTOR NO. 6
FUEL INJECTOR NO. 8
IGNITION COIL
S147
(8W-10-24)

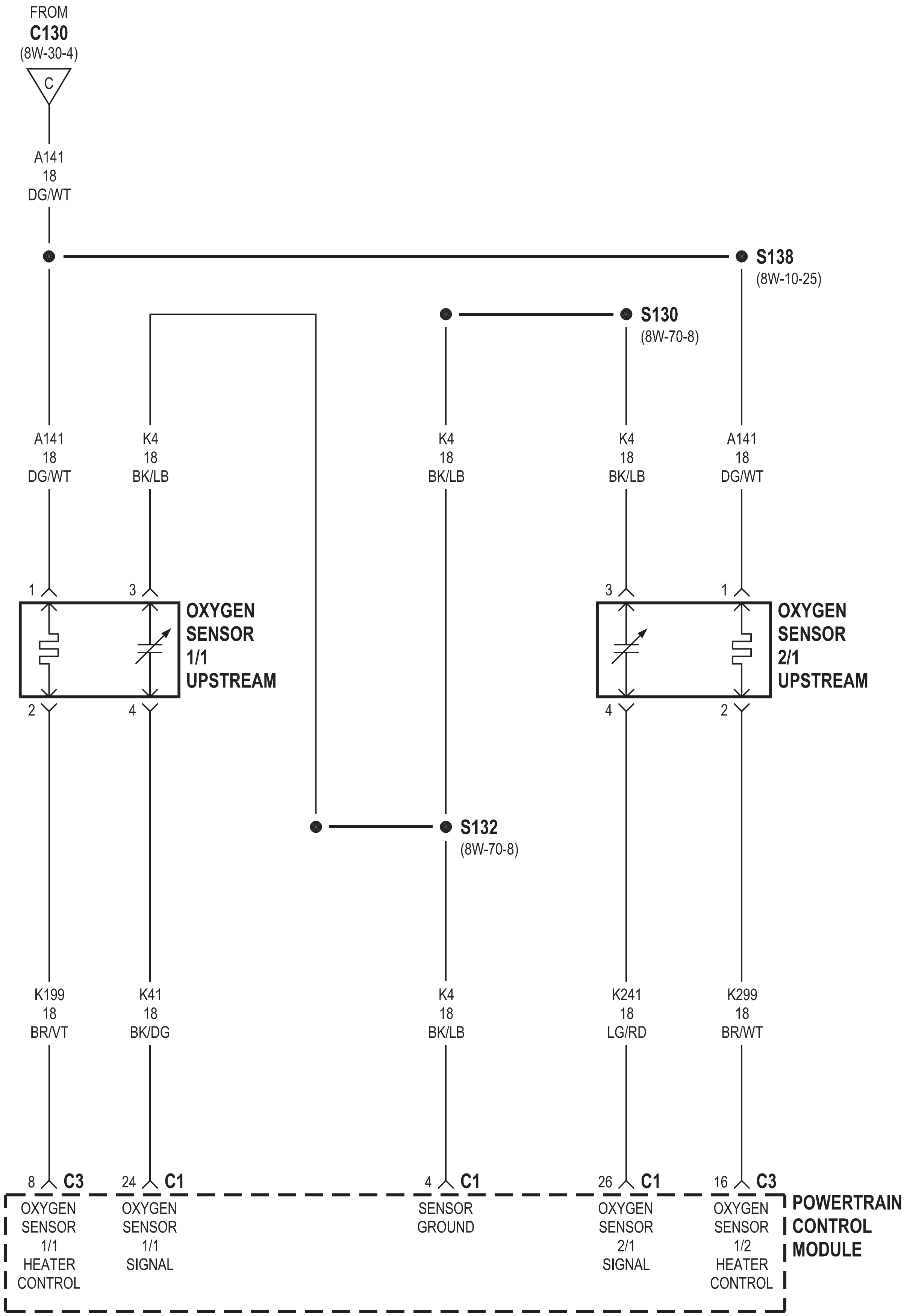

POWERTRAIN CONTROL MODULE
IGNITION COIL NO. 4 DRIVER
IGNITION COIL NO. 2 DRIVER
IGNITION COIL NO. 1 DRIVER
IGNITION COIL NO. 3 DRIVER
IGNITION COIL NO. 5 DRIVER
3 C1
9 C1
7 C1
1 C1
5 C1
K32 18 YL/GY
K17 18 DB/TN
K19 18 BK/GY
K18 18 RD/YL
K43 18 DG/GY
3
1
IGNITION COIL- LEFT
IGNITION COIL NO. 4 DRIVER
IGNITION COIL NO. 2 DRIVER
AUTO SHUT DOWN RELAY OUTPUT
2
1
3
4
IGNITION COIL- RIGHT
IGNITION COIL NO. 1 DRIVER
IGNITION COIL NO. 3 DRIVER
IGNITION COIL NO. 5 DRIVER
AUTO SHUT DOWN RELAY OUTPUT
2
FROM C130 (8W-30-4)
Z
A142 14 DG/OR
A142 14 DG/OR
A142 14 DG/OR
S143 (8W-10-23)

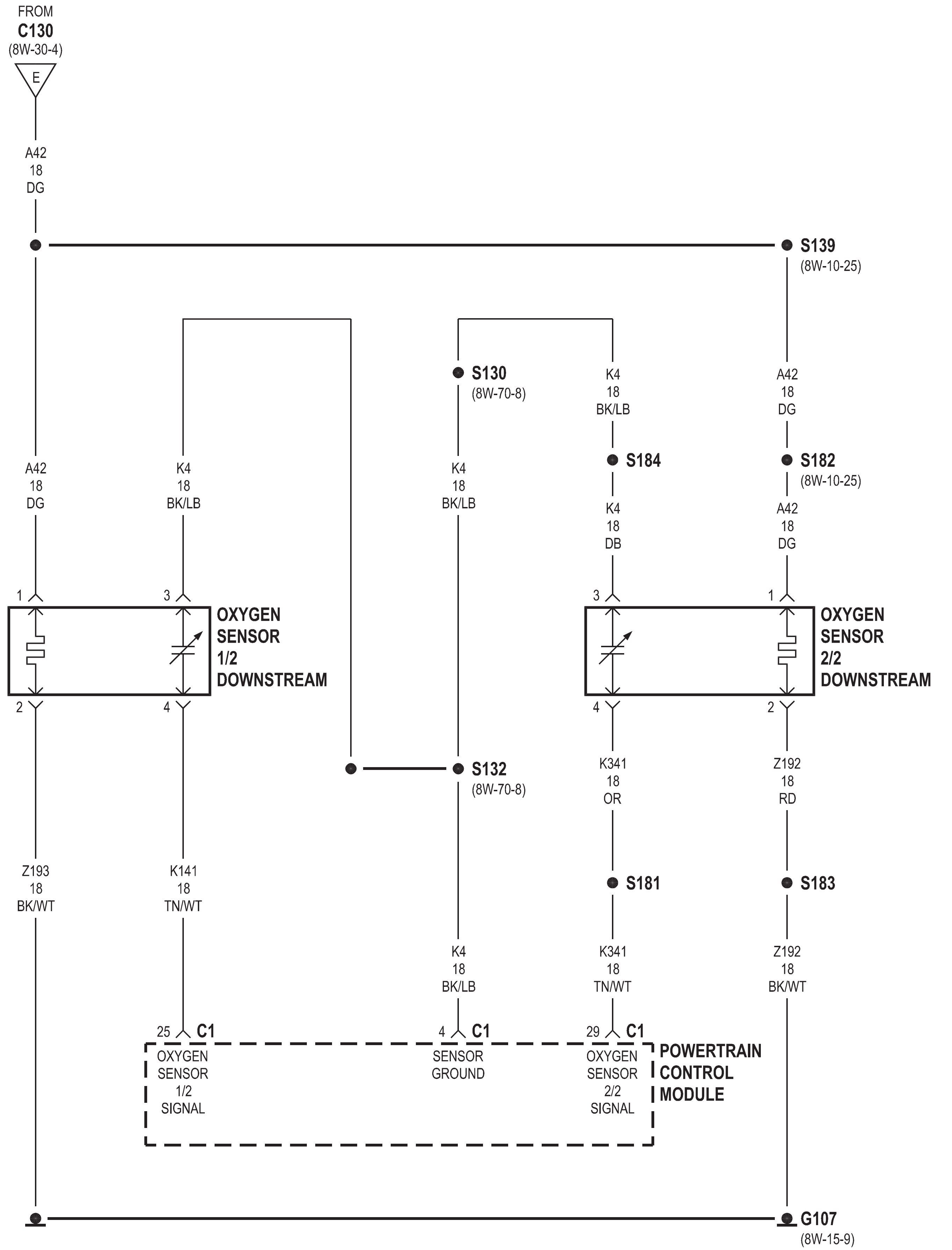

FROM
C130
(8W-30-4)
Z
A142
14
DG/OR
CAPACITOR
S143
(8W-10-23)
X
TO
S112
(8W-30-12)
S142
(8W-10-24)
FUEL INJECTOR NO. 1
FUEL INJECTOR NO. 3
FUEL INJECTOR NO. 5
FUEL INJECTOR NO. 7
FUEL INJECTOR NO. 9
K11
18
WT/DB
K13
18
YL/WT
K38
18
GY
K26
18
VT/TN
K115
18
TN
C2
FUEL INJECTOR NO. 1 DRIVER
FUEL INJECTOR NO. 3 DRIVER
FUEL INJECTOR NO. 5 DRIVER
FUEL INJECTOR NO. 7 DRIVER
FUEL INJECTOR NO. 9 DRIVER
POWERTRAIN CONTROL MODULE

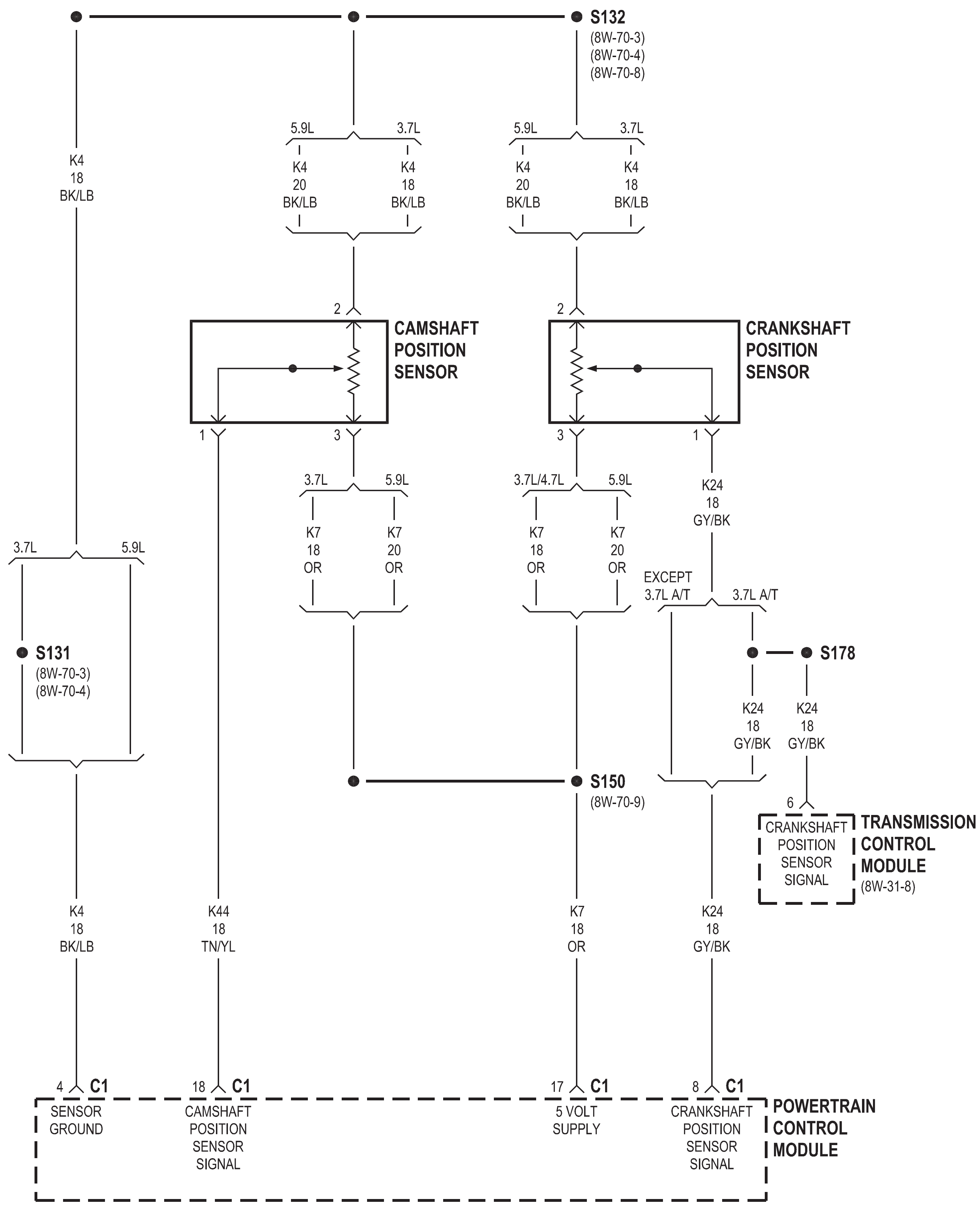

FROM
S143
(8W-30-11)
X
A142
14
DG/OR
S112
(8W-10-23)
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
FUEL INJECTOR NO. 2
FUEL INJECTOR NO. 4
FUEL INJECTOR NO. 6
FUEL INJECTOR NO. 8
FUEL INJECTOR NO. 10
K12
18
TN
K14
18
LB/BR
K58
18
BR/DB
K28
18
GY/LB
K116
18
WT/DB
12 C3
15 C2
16 C2
12 C2
13 C2
14 C2
AUTO SHUT DOWN RELAY OUTPUT
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 4 DRIVER
FUEL INJECTOR NO. 6 DRIVER
FUEL INJECTOR NO. 8 DRIVER
FUEL INJECTOR NO. 10 DRIVER
POWERTRAIN CONTROL MODULE

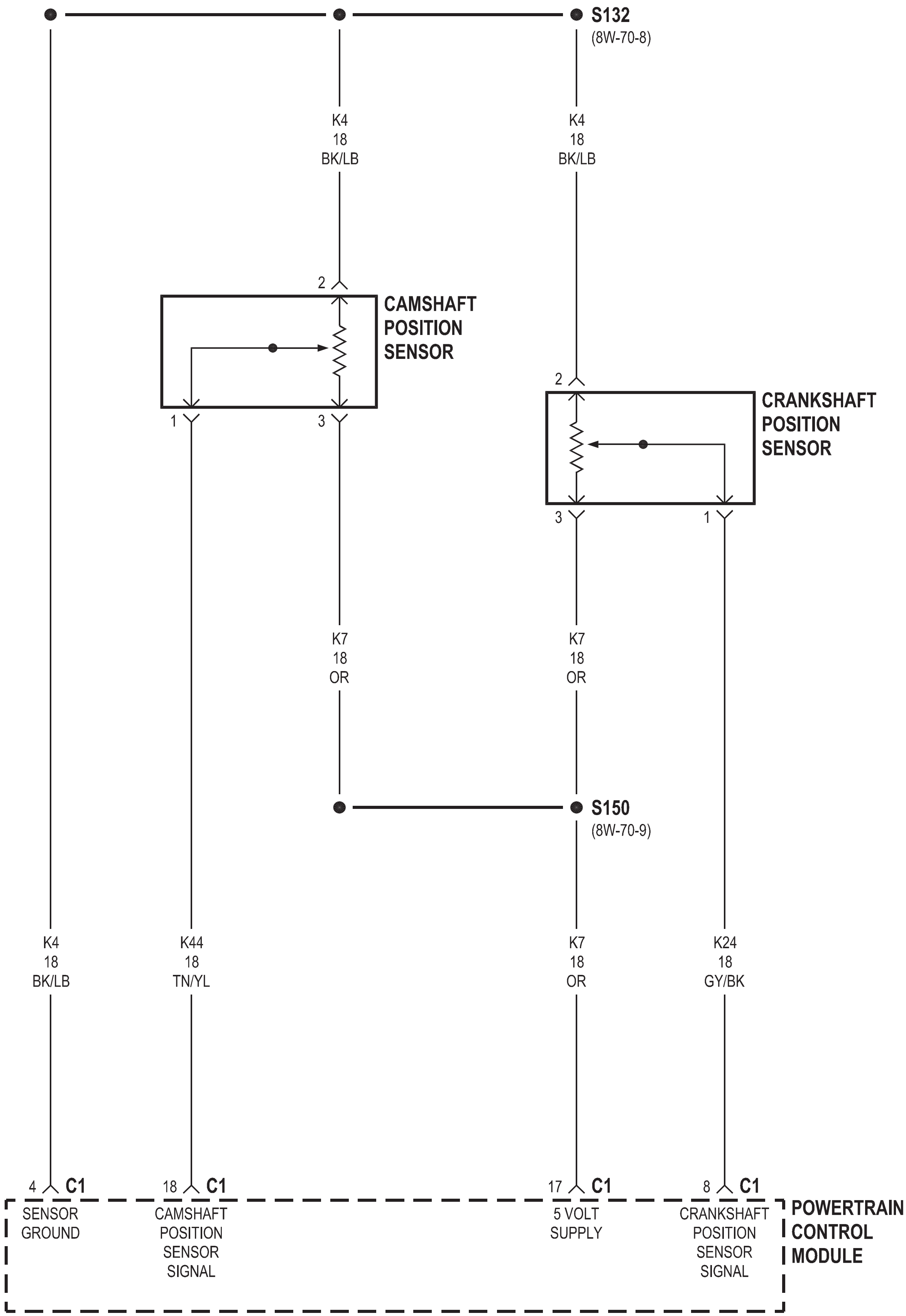

FROM
C130
(8W-30-4)
C
A141
18
DG/WT
S138
(8W-10-25)
S130
(8W-70-3)
(8W-70-4)
K4
18
BK/LB
S144
(8W-70-3)
(8W-70-4)
A/T
M/T
A141
18
DG/WT
K4
18
BK/LB
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
1/2
DOWNSTREAM
S132
(8W-70-4)
S132
(8W-70-3)
K199
18
BR/VT
K41
18
BK/DG
K141
18
TN/WT
K299
18
BR/WT
S131
(8W-70-4)
S131
(8W-70-3)
8 C3
24 C1
4 C1
25 C1
16 C3
OXYGEN
SENSOR
1/1
HEATER
CONTROL
OXYGEN
SENSOR
1/1
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
1/2
SIGNAL
OXYGEN
SENSOR
1/2
HEATER
CONTROL
POWERTRAIN
CONTROL
MODULE

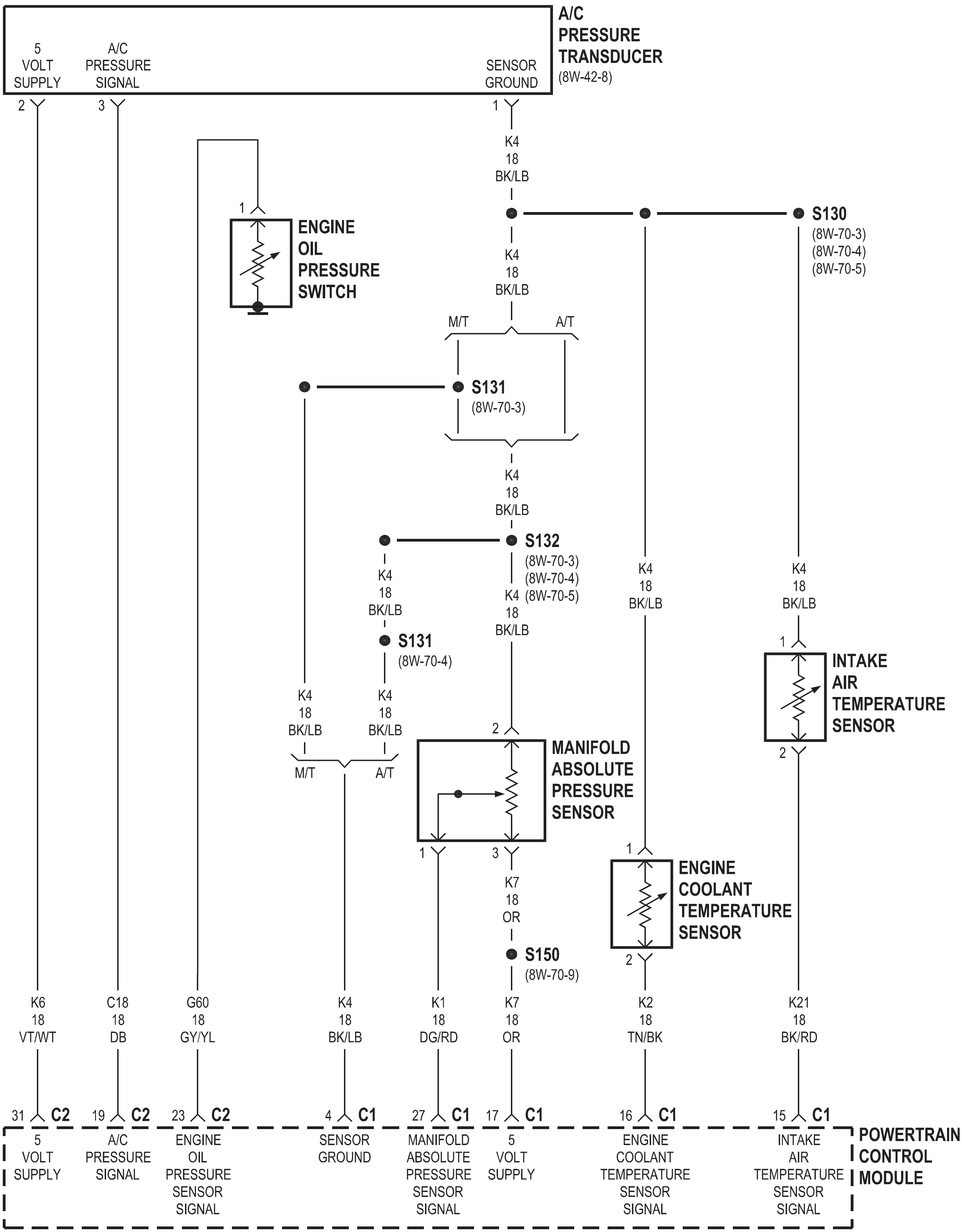

FROM
C130
(8W-30-4)
C
A141
18
DG/WT
S138
(8W-10-25)
A141
18
DG/WT
K4
18
BK/LB
K4
18
BK/LB
A141
18
DG/WT
1
3
OXYGEN
SENSOR
1/1
UPSTREAM
2
4
3
1
OXYGEN
SENSOR
1/2
DOWNSTREAM
4
2
S132
(8W-70-8)
K199
18
BR/WT
K41
18
BK/DG
K4
18
BK/LB
K141
18
TN/WT
K299
18
BR/WT
8 C3
24 C1
4 C1
25 C1
16 C3
OXYGEN
SENSOR
1/1
HEATER
CONTROL
OXYGEN
SENSOR
1/1
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
1/2
SIGNAL
OXYGEN
SENSOR
1/2
HEATER
CONTROL
POWERTRAIN
CONTROL
MODULE

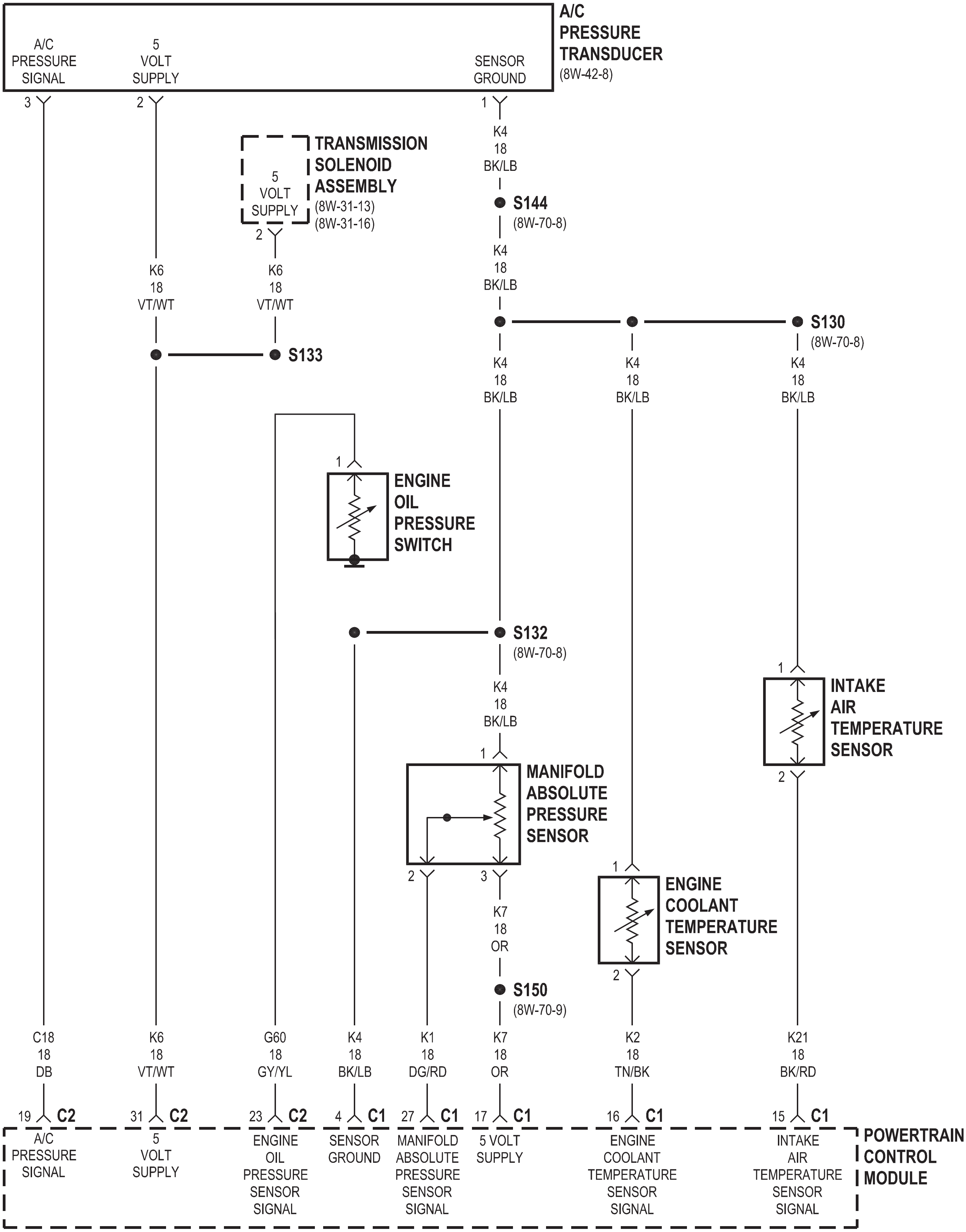

FROM
C130
(8W-30-4)
C
A141
18
DG/WT
S138
(8W-10-25)
S130
(8W-70-8)
A141
18
DG/WT
K4
18
BK/LB
K4
18
BK/LB
K4
18
BK/LB
A141
18
DG/WT
1
3
OXYGEN
SENSOR
1/1
UPSTREAM
3
1
OXYGEN
SENSOR
2/1
UPSTREAM
2
4
4
2
S132
(8W-70-8)
K199
18
BR/VT
K41
18
BK/DG
K4
18
BK/LB
K241
18
LG/RD
K299
18
BR/WT
8 C3
24 C1
4 C1
26 C1
16 C3
OXYGEN
SENSOR
1/1
HEATER
CONTROL
OXYGEN
SENSOR
1/1
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
2/1
SIGNAL
OXYGEN
SENSOR
1/2
HEATER
CONTROL
POWERTRAIN
CONTROL
MODULE

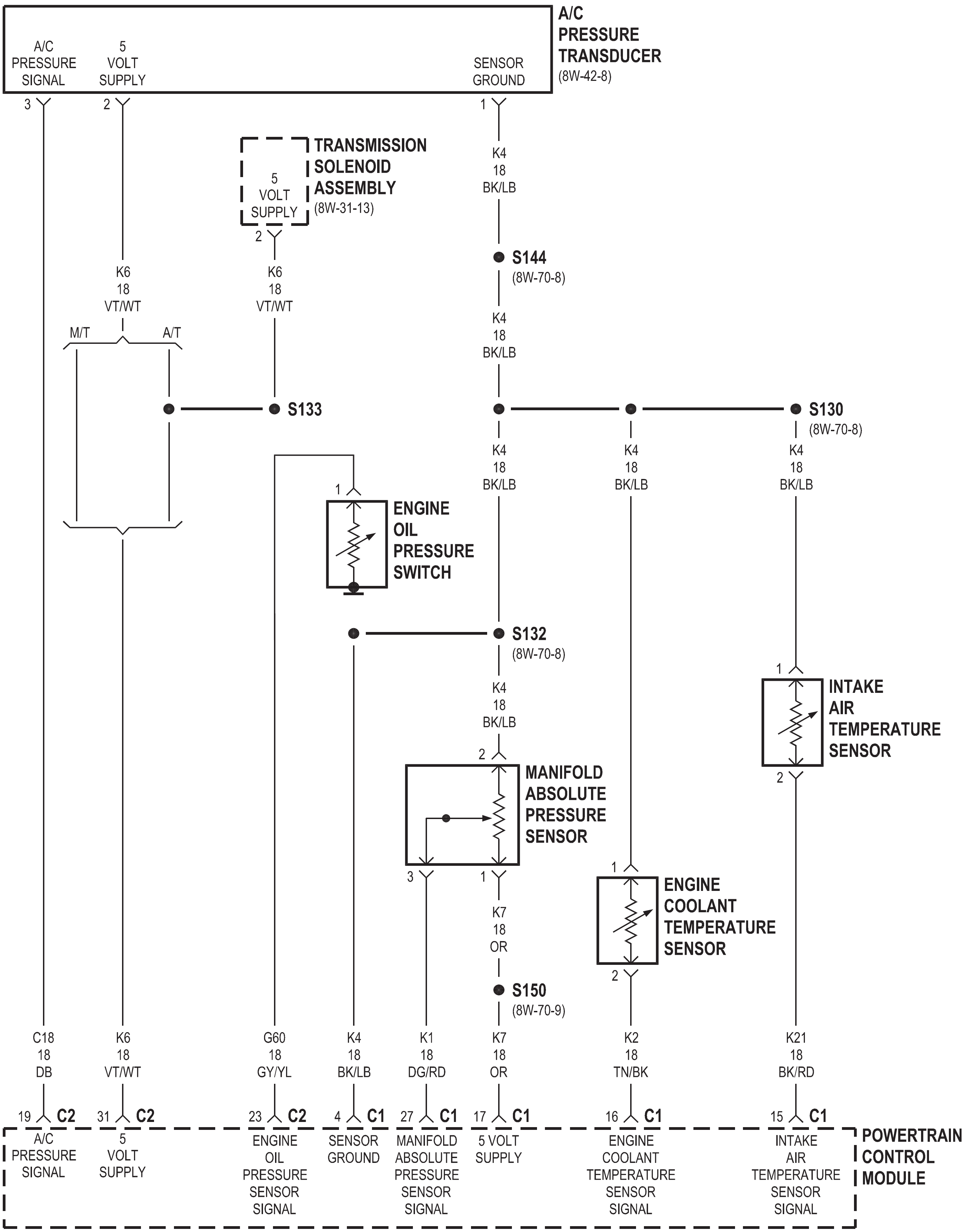

FROM
C130
(8W-30-4)
E
A42
18
DG
S139
(8W-10-25)
S130
(8W-70-8)
K4
18
BK/LB
A42
18
DG
S184
S182
(8W-10-25)
A42
18
DG
K4
18
BK/LB
K4
18
BK/LB
K4
18
DB
A42
18
DG
1
3
OXYGEN
SENSOR
1/2
DOWNSTREAM
2
4
3
1
OXYGEN
SENSOR
2/2
DOWNSTREAM
4
2
S132
(8W-70-8)
K341
18
OR
Z192
18
RD
Z193
18
BK/WT
K141
18
TN/WT
S181
S183
K4
18
BK/LB
K341
18
TN/WT
Z192
18
BK/WT
25
C1
4
C1
29
C1
OXYGEN
SENSOR
1/2
SIGNAL
SENSOR
GROUND
OXYGEN
SENSOR
2/2
SIGNAL
POWERTRAIN
CONTROL
MODULE
G107
(8W-15-9)

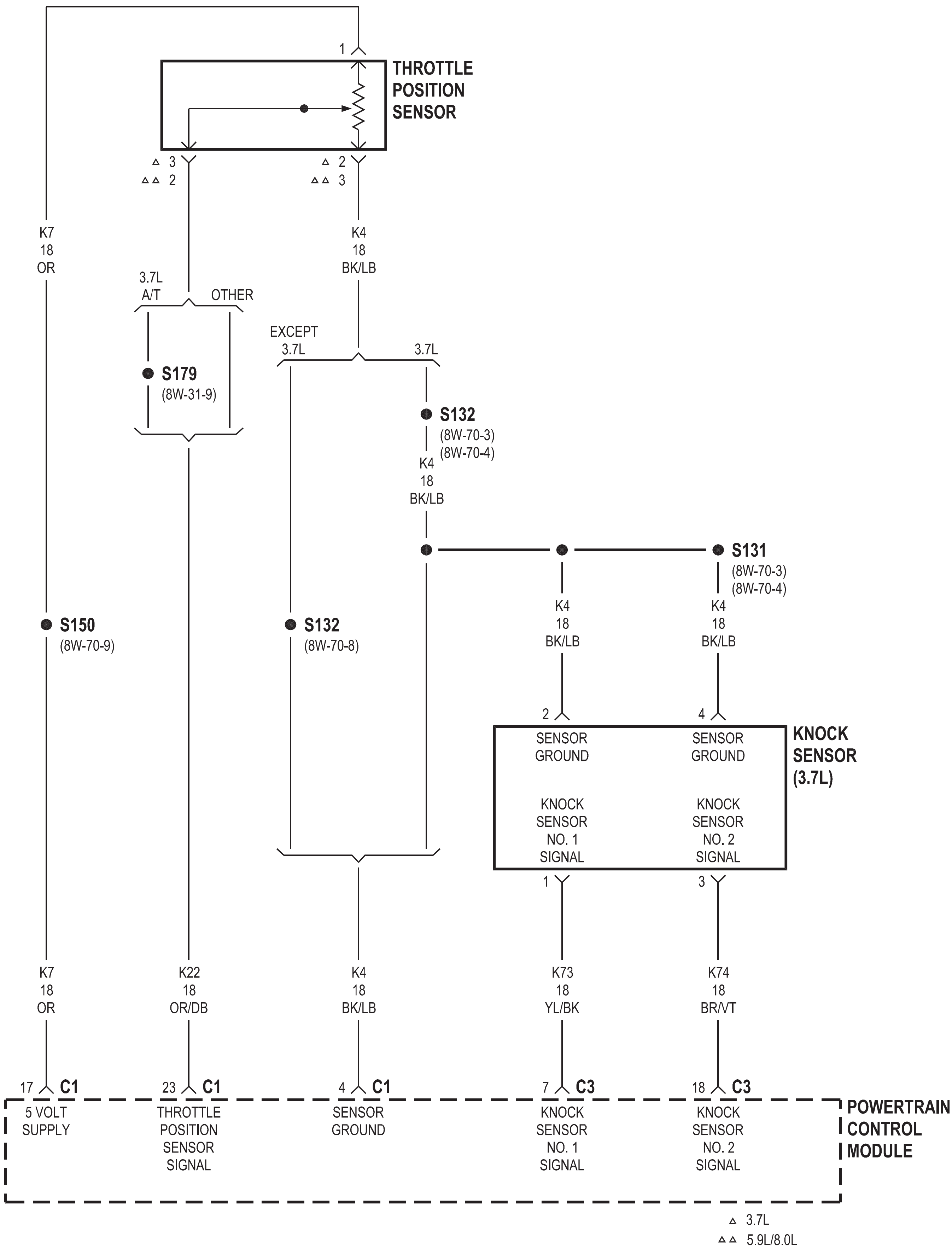

S132
(8W-70-3)
(8W-70-4)
(8W-70-8)
5.9L
3.7L
K4
18
BK/LB
K4
20
BK/LB
2
CAMSHAFT
POSITION
SENSOR
CRANKSHAFT
POSITION
SENSOR
1
3
3.7L/4.7L
K7
18
OR
K7
20
OR
K24
18
GY/BK
EXCEPT
3.7L A/T
3.7L A/T
S131
(8W-70-3)
(8W-70-4)
S178
S150
(8W-70-9)
6
CRANKSHAFT
POSITION
SENSOR
SIGNAL
TRANSMISSION
CONTROL
MODULE
(8W-31-8)
K44
18
TN/YL
4
C1
SENSOR
GROUND
18
CAMSHAFT
POSITION
SENSOR
SIGNAL
17
5 VOLT
SUPPLY
8
POWERTRAIN
CONTROL
MODULE


S132
(8W-70-8)
K4
18
BK/LB
K4
18
BK/LB
2
CAMSHAFT
POSITION
SENSOR
1
3
2
CRANKSHAFT
POSITION
SENSOR
3
1
K7
18
OR
K7
18
OR
S150
(8W-70-9)
K4
18
BK/LB
K44
18
TN/YL
K7
18
OR
K24
18
GY/BK
4 C1
18 C1
17 C1
8 C1
SENSOR
GROUND
CAMSHAFT
POSITION
SENSOR
SIGNAL
5 VOLT
SUPPLY
CRANKSHAFT
POSITION
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE

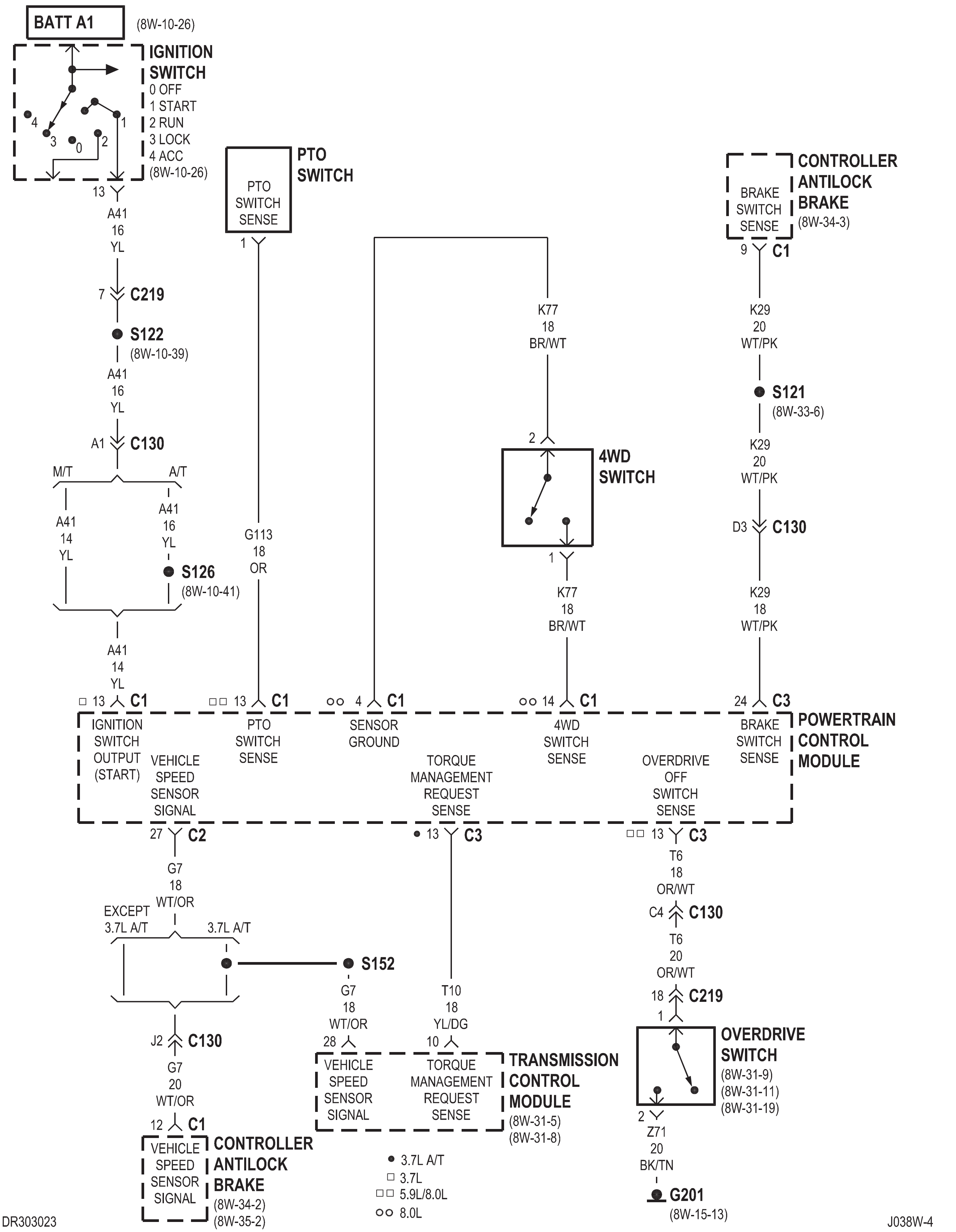

A/C PRESSURE TRANSDUCER
(8W-42-8)
5 VOLT SUPPLY
A/C PRESSURE SIGNAL
SENSOR GROUND
K4 18 BK/LB
ENGINE OIL PRESSURE SWITCH
S130
(8W-70-3)
(8W-70-4)
(8W-70-5)
M/T
A/T
S131
(8W-70-3)
S132
(8W-70-3)
(8W-70-4)
(8W-70-5)
S131
(8W-70-4)
INTAKE AIR TEMPERATURE SENSOR
MANIFOLD ABSOLUTE PRESSURE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
K7 18 OR
S150
(8W-70-9)
K6 18 VT/WT
C18 18 DB
G60 18 GY/YL
K4 18 BK/LB
K1 18 DG/RD
K7 18 OR
K2 18 TN/BK
K21 18 BK/RD
31 C2
19 C2
23 C2
4 C1
27 C1
17 C1
16 C1
15 C1
5 VOLT SUPPLY
A/C PRESSURE SIGNAL
ENGINE OIL PRESSURE SENSOR SIGNAL
SENSOR GROUND
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

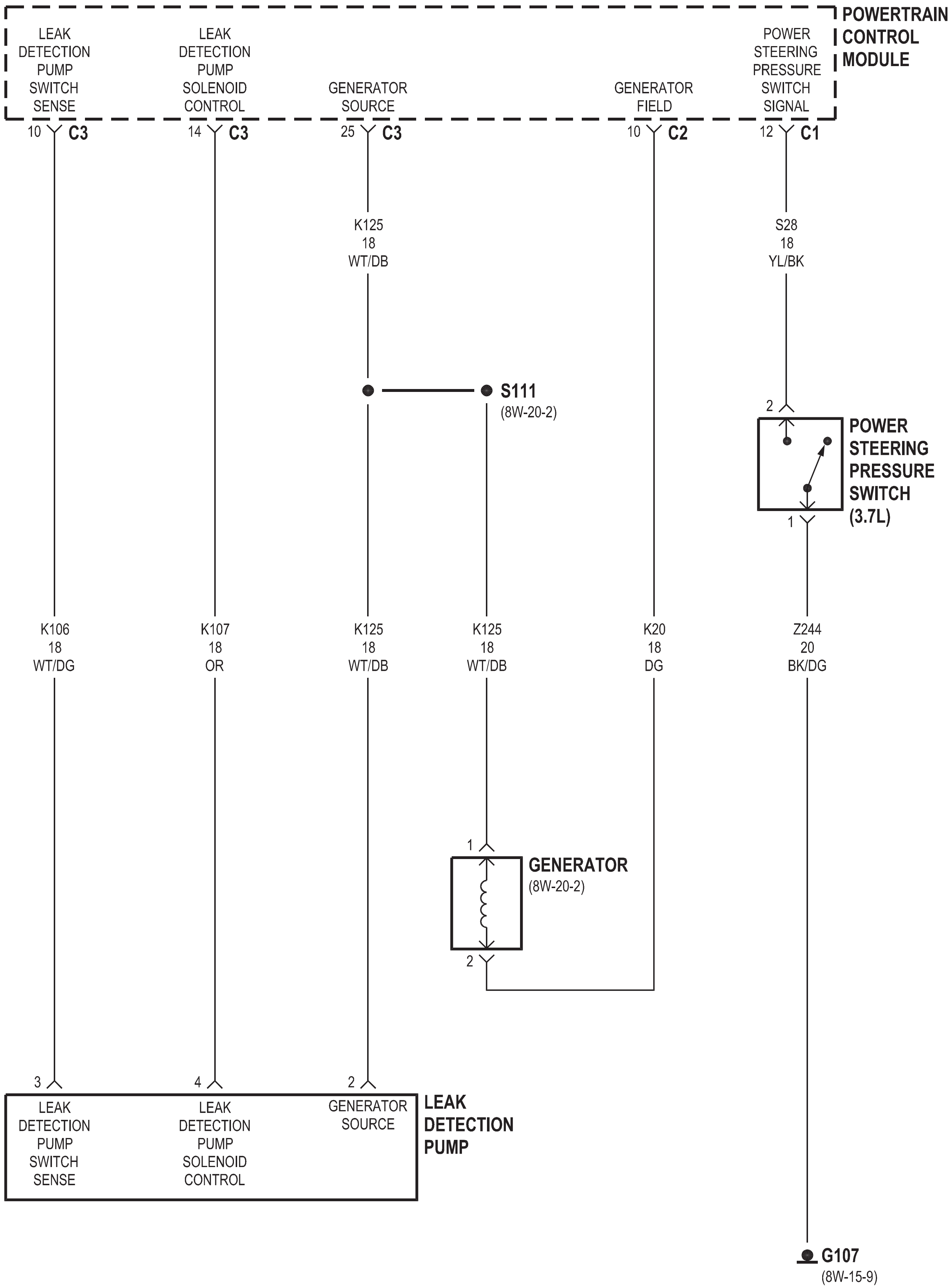

A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
A/C PRESSURE TRANSDUCER
(8W-42-8)
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-13)
(8W-31-16)
5 VOLT SUPPLY
K4 18 BK/LB
S144
(8W-70-8)
K6 18 VT/WT
S133
S130
(8W-70-8)
ENGINE OIL PRESSURE SWITCH
S132
(8W-70-8)
INTAKE AIR TEMPERATURE SENSOR
MANIFOLD ABSOLUTE PRESSURE SENSOR
K7 18 OR
S150
(8W-70-9)
ENGINE COOLANT TEMPERATURE SENSOR
C18 18 DB
K6 18 VT/WT
G60 18 GY/YL
K4 18 BK/LB
K1 18 DG/RD
K7 18 OR
K2 18 TN/BK
K21 18 BK/RD
19 C2
31 C2
23 C2
4 C1
27 C1
17 C1
16 C1
15 C1
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
ENGINE OIL PRESSURE SENSOR SIGNAL
SENSOR GROUND
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

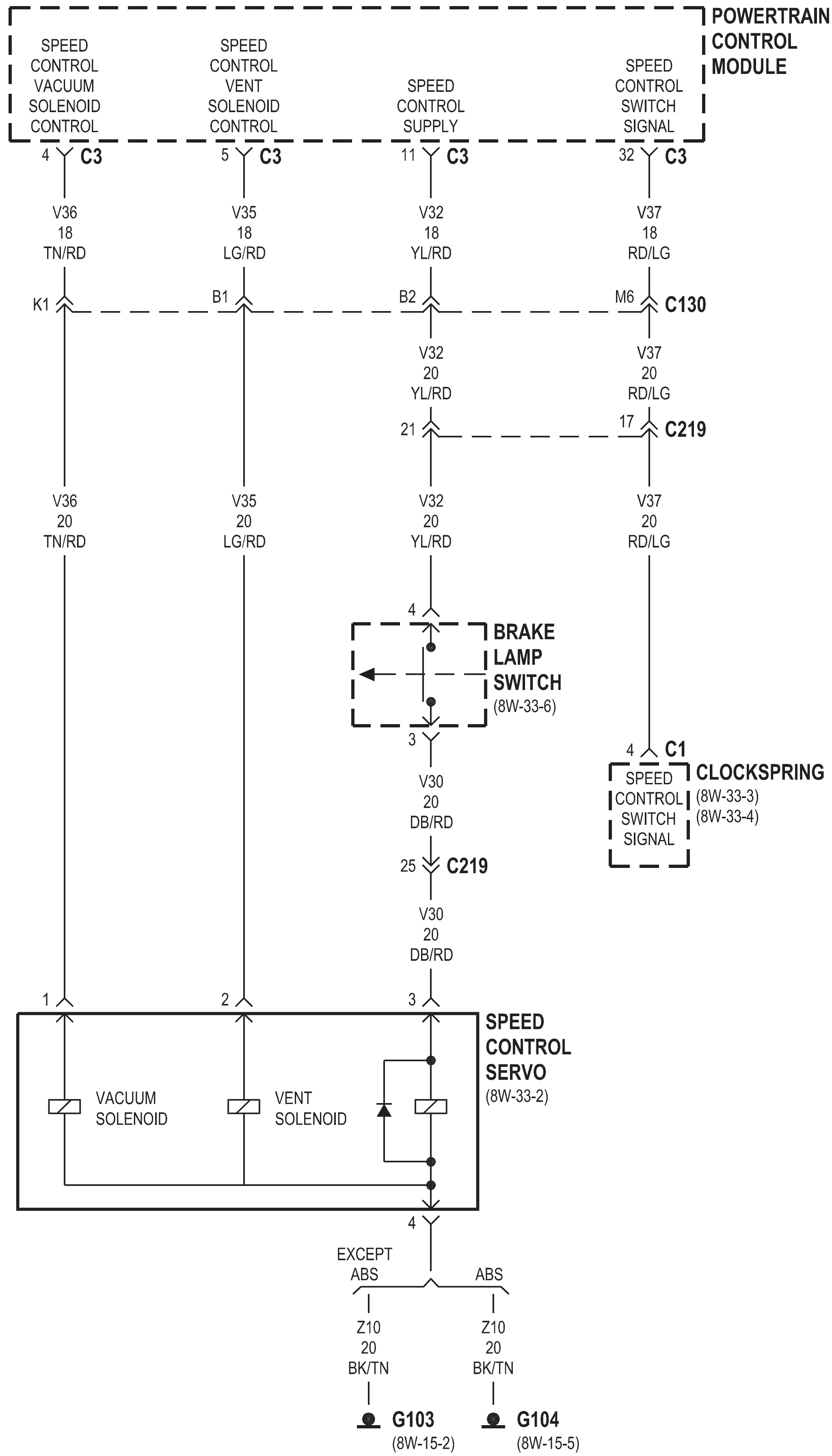

A/C PRESSURE TRANSDUCER
(8W-42-8)
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-13)
5 VOLT SUPPLY
K4 18 BK/LB
S144
(8W-70-8)
K6 18 VT/WT
M/T
A/T
S133
S130
(8W-70-8)
ENGINE OIL PRESSURE SWITCH
S132
(8W-70-8)
INTAKE AIR TEMPERATURE SENSOR
MANIFOLD ABSOLUTE PRESSURE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
K7 18 OR
S150
(8W-70-9)
C18 18 DB
K6 18 VT/WT
G60 18 GY/YL
K4 18 BK/LB
K1 18 DG/RD
K7 18 OR
K2 18 TN/BK
K21 18 BK/RD
19 C2
31 C2
23 C2
4 C1
27 C1
17 C1
16 C1
15 C1
POWERTRAIN CONTROL MODULE
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
ENGINE OIL PRESSURE SENSOR SIGNAL
SENSOR GROUND
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL

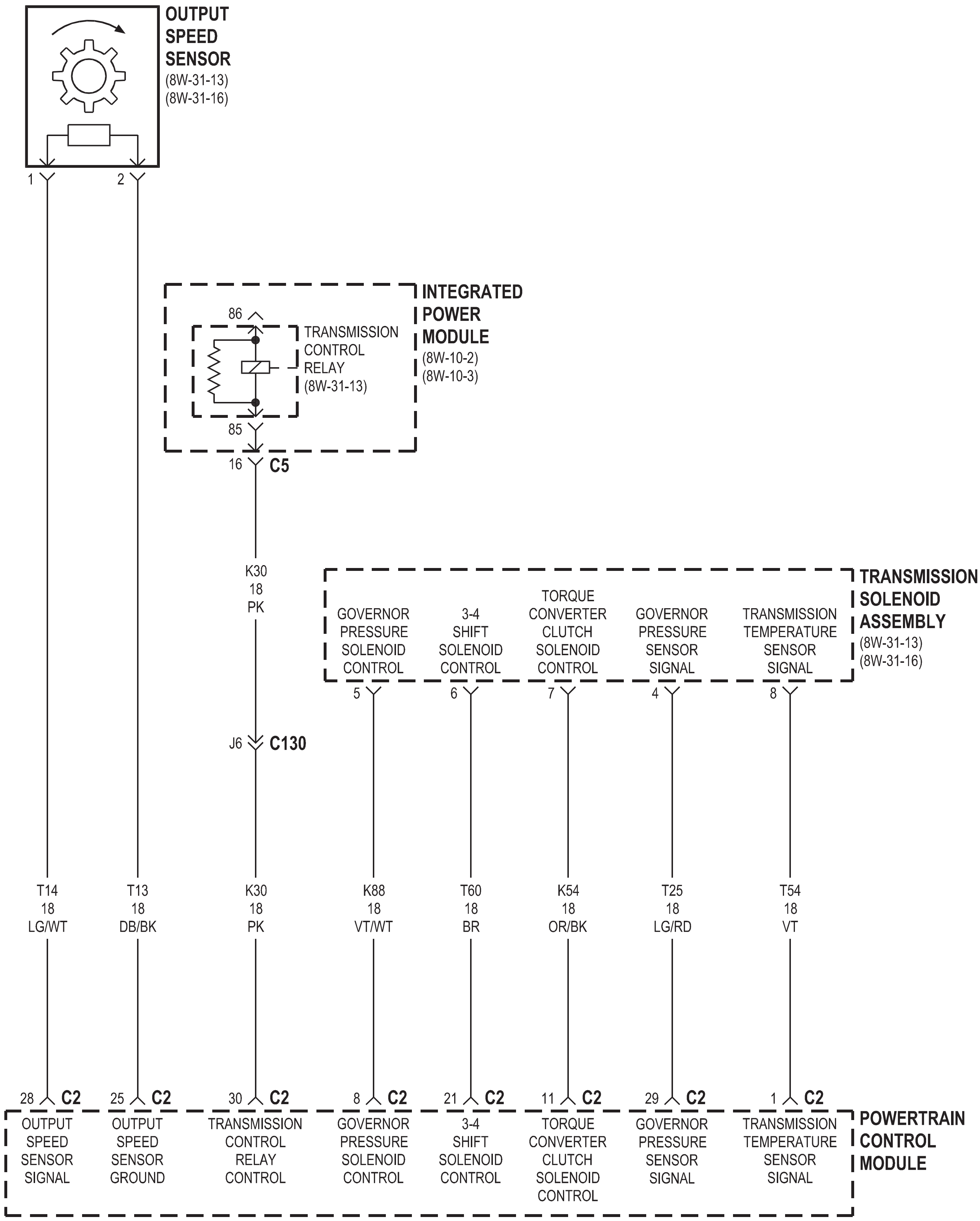

1
THROTTLE
POSITION
SENSOR
△ 3
△△ 2
△ 2
△△ 3
K7
18
OR
K4
18
BK/LB
3.7L
A/T
OTHER
EXCEPT
3.7L
3.7L
S179
(8W-31-9)
S132
(8W-70-3)
(8W-70-4)
K4
18
BK/LB
S131
(8W-70-3)
(8W-70-4)
S150
(8W-70-9)
S132
(8W-70-8)
K4
18
BK/LB
K4
18
BK/LB
2
4
KNOCK
SENSOR
(3.7L)
SENSOR
GROUND
SENSOR
GROUND
KNOCK
SENSOR
NO. 1
SIGNAL
KNOCK
SENSOR
NO. 2
SIGNAL
1
3
K7
18
OR
K22
18
OR/DB
K4
18
BK/LB
K73
18
YL/BK
K74
18
BR/VT
17 C1
23 C1
4 C1
7 C3
18 C3
5 VOLT
SUPPLY
THROTTLE
POSITION
SENSOR
SIGNAL
SENSOR
GROUND
KNOCK
SENSOR
NO. 1
SIGNAL
KNOCK
SENSOR
NO. 2
SIGNAL
POWERTRAIN
CONTROL
MODULE
△ 3.7L
△△ 5.9L/8.0L

JTEC

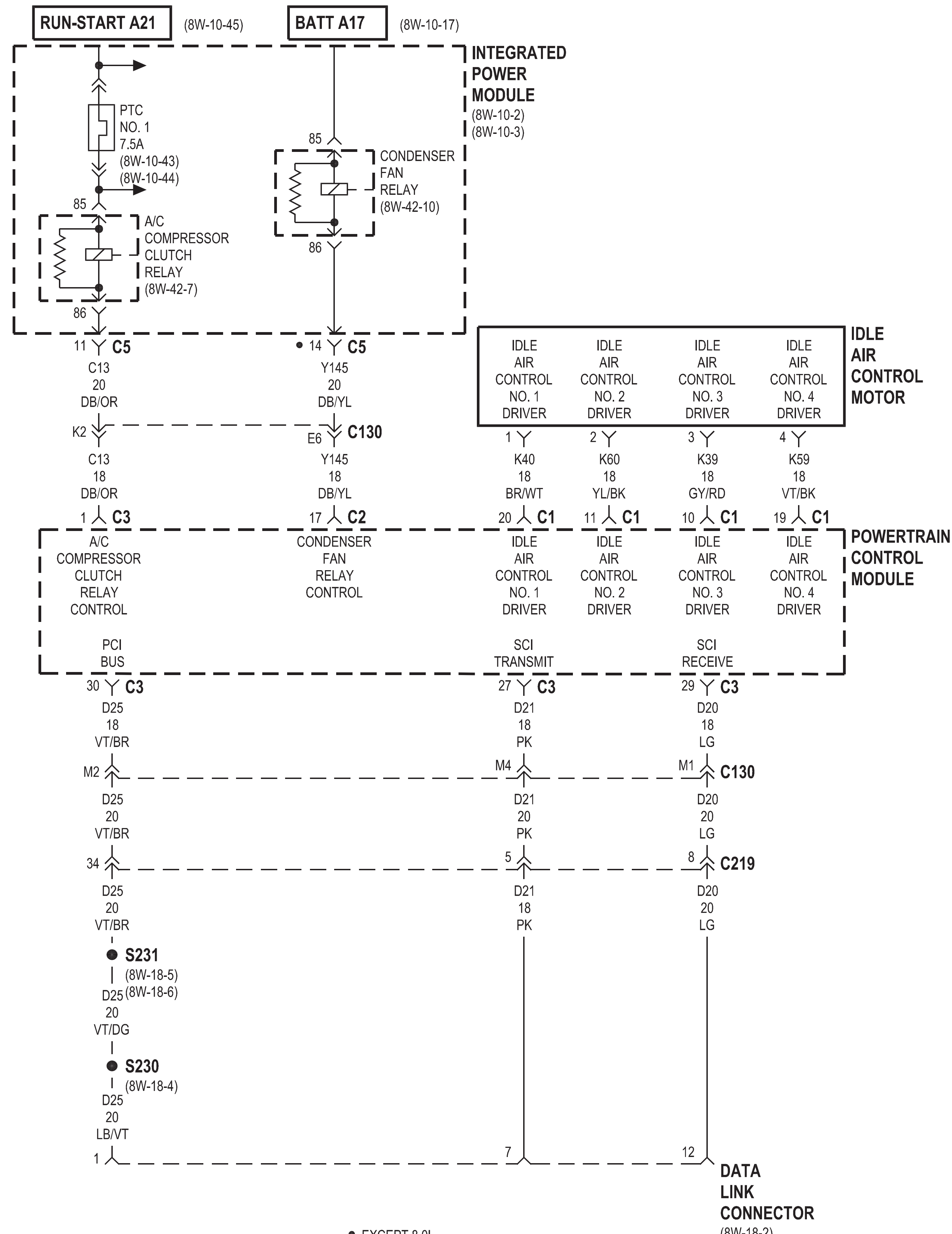

BATT A1
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
4
3
0
2
1
13
A41
16
YL
7
C219
S122
(8W-10-39)
A41
16
YL
A1
C130
M/T
A/T
A41
14
YL
A41
16
YL
S126
(8W-10-41)
A41
14
YL
PTO SWITCH SENSE
PTO SWITCH
1
G113
18
OR
K77
18
BR/WT
2
4WD SWITCH
1
K77
18
BR/WT
CONTROLLER ANTILOCK BRAKE
BRAKE SWITCH SENSE
(8W-34-3)
9
C1
K29
20
WT/PK
S121
(8W-33-6)
K29
20
WT/PK
D3
C130
K29
18
WT/PK
13 C1
13 C1
4 C1
14 C1
24 C3
POWERTRAIN CONTROL MODULE
IGNITION SWITCH OUTPUT (START)
VEHICLE SPEED SENSOR SIGNAL
PTO SWITCH SENSE
SENSOR GROUND
TORQUE MANAGEMENT REQUEST SENSE
4WD SWITCH SENSE
OVERDRIVE OFF SWITCH SENSE
BRAKE SWITCH SENSE
27 C2
13 C3
13 C3
G7
18
WT/OR
EXCEPT 3.7L A/T
3.7L A/T
S152
G7
18
WT/OR
T10
18
YL/DG
T6
18
OR/WT
C4
C130
T6
20
OR/WT
18
C219
1
OVERDRIVE SWITCH
(8W-31-9)
(8W-31-11)
(8W-31-19)
2
Z71
20
BK/TN
G201
(8W-15-13)
J2
C130
G7
20
WT/OR
12 C1
CONTROLLER ANTILOCK BRAKE
VEHICLE SPEED SENSOR SIGNAL
(8W-34-2)
(8W-35-2)
28
10
TRANSMISSION CONTROL MODULE
VEHICLE SPEED SENSOR SIGNAL
TORQUE MANAGEMENT REQUEST SENSE
(8W-31-5)
(8W-31-8)
● 3.7L A/T
□ 3.7L
□□ 5.9L/8.0L
○○ 8.0L
DR303023
J038W-4

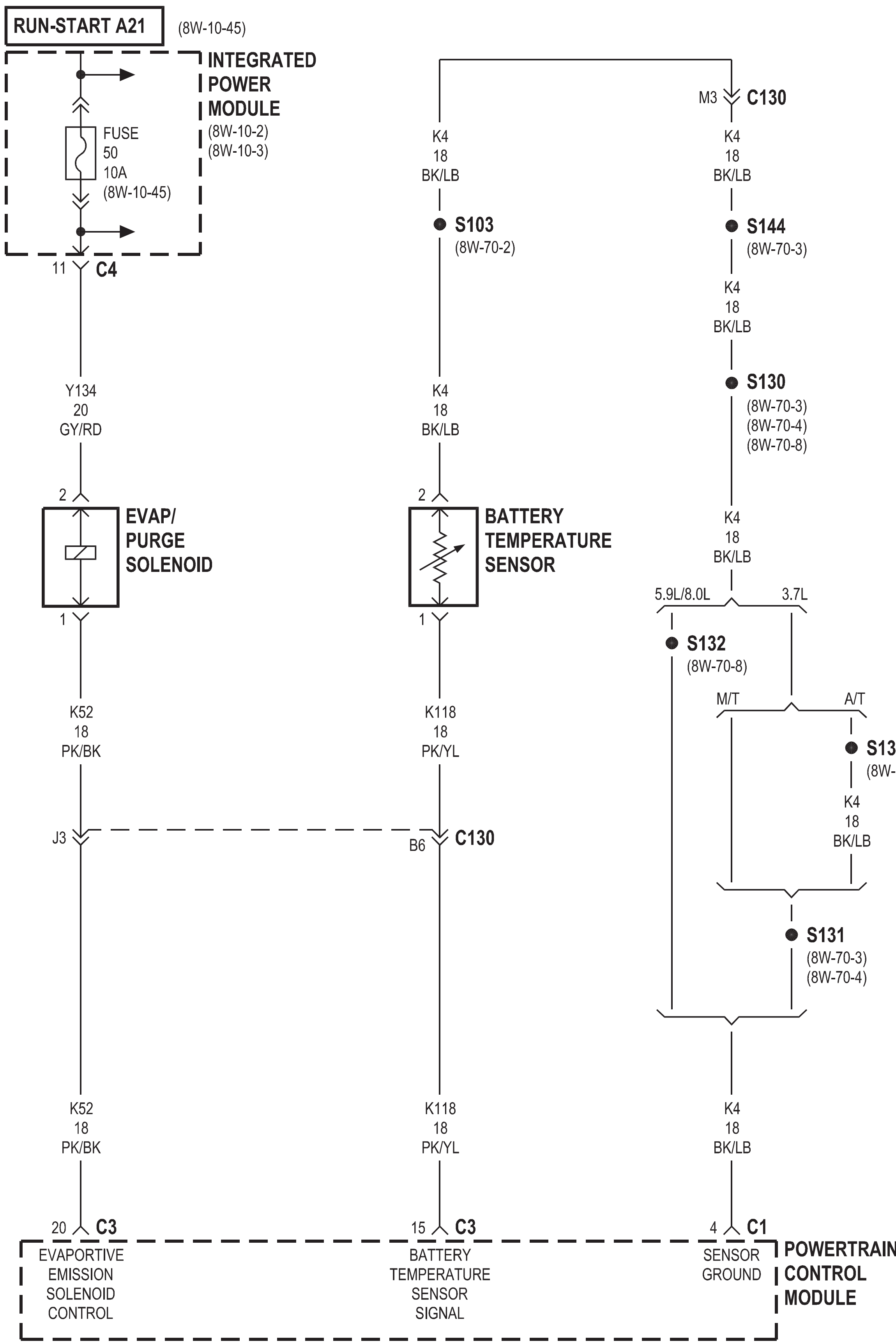

POWERTRAIN CONTROL MODULE
LEAK DETECTION PUMP SWITCH SENSE
LEAK DETECTION PUMP SOLENOID CONTROL
GENERATOR SOURCE
GENERATOR FIELD
POWER STEERING PRESSURE SWITCH SIGNAL
10 C3
14 C3
25 C3
10 C2
12 C1
K125 18 WT/DB
S28 18 YL/BK
S111
(8W-20-2)
2
POWER STEERING PRESSURE SWITCH (3.7L)
1
K106 18 WT/DG
K107 18 OR
K125 18 WT/DB
K125 18 WT/DB
K20 18 DG
Z244 20 BK/DG
1
GENERATOR
(8W-20-2)
2
3
4
2
LEAK DETECTION PUMP
LEAK DETECTION PUMP SWITCH SENSE
LEAK DETECTION PUMP SOLENOID CONTROL
GENERATOR SOURCE
G107
(8W-15-9)


POWERTRAIN CONTROL MODULE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL SUPPLY
SPEED CONTROL SWITCH SIGNAL
4 C3
5 C3
11 C3
32 C3
V36 18 TN/RD
V35 18 LG/RD
V32 18 YL/RD
V37 18 RD/LG
K1
B1
B2
M6 C130
V32 20 YL/RD
V37 20 RD/LG
21
17 C219
V36 20 TN/RD
V35 20 LG/RD
V32 20 YL/RD
V37 20 RD/LG
4
BRAKE LAMP SWITCH
(8W-33-6)
3
V30 20 DB/RD
25 C219
V30 20 DB/RD
4 C1
CLOCKSPRING
(8W-33-3)
(8W-33-4)
SPEED CONTROL SWITCH SIGNAL
1
2
3
SPEED CONTROL SERVO
(8W-33-2)
VACUUM SOLENOID
VENT SOLENOID
4
EXCEPT ABS
ABS
Z10 20 BK/TN
Z10 20 BK/TN
G103
(8W-15-2)
G104
(8W-15-5)

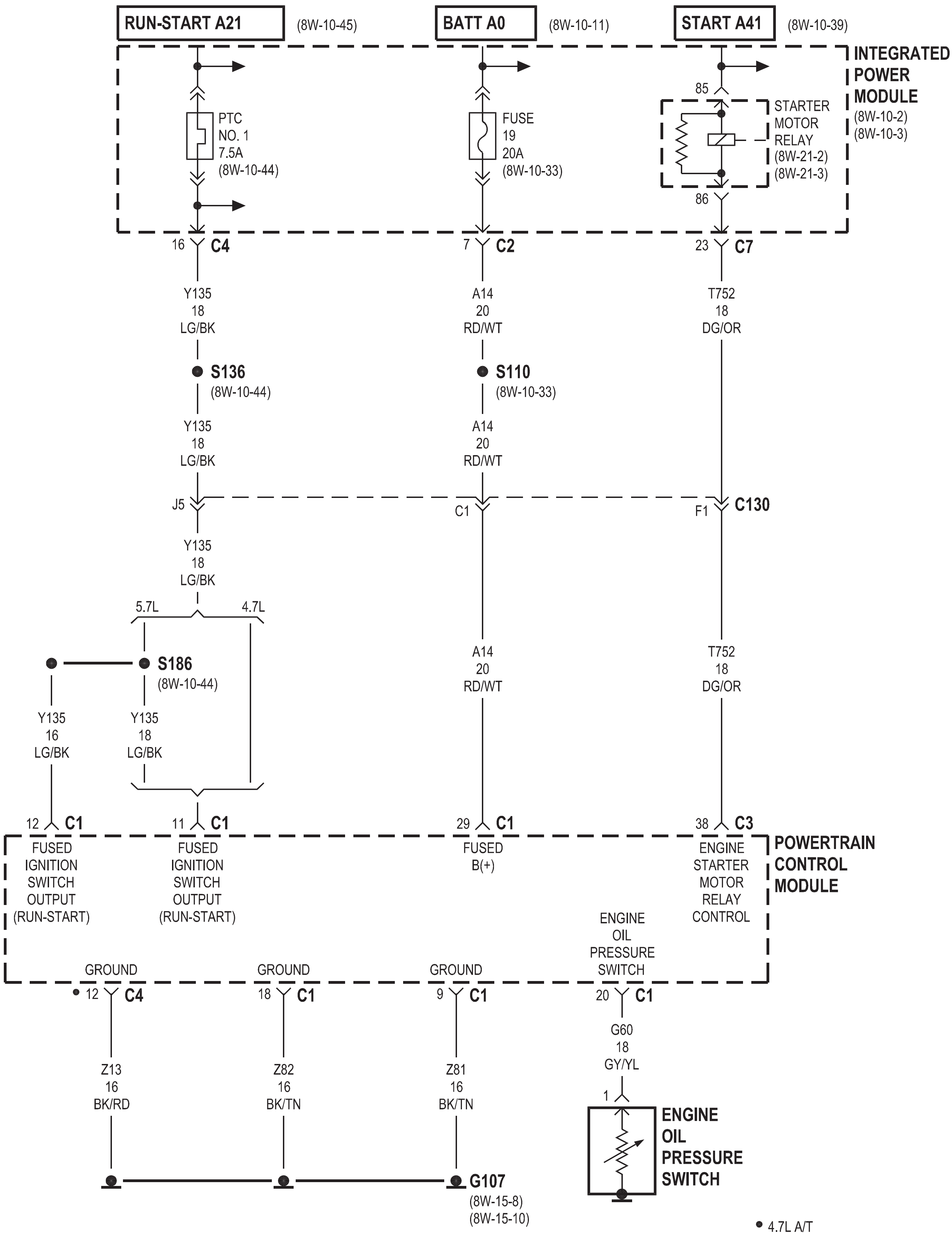

OUTPUT
SPEED
SENSOR
(8W-31-13)
(8W-31-16)
1
2
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
86
TRANSMISSION
CONTROL
RELAY
(8W-31-13)
85
16
C5
K30
18
PK
J6
C130
TRANSMISSION
SOLENOID
ASSEMBLY
(8W-31-13)
(8W-31-16)
GOVERNOR
PRESSURE
SOLENOID
CONTROL
3-4
SHIFT
SOLENOID
CONTROL
TORQUE
CONVERTER
CLUTCH
SOLENOID
CONTROL
GOVERNOR
PRESSURE
SENSOR
SIGNAL
TRANSMISSION
TEMPERATURE
SENSOR
SIGNAL
5
6
7
4
8
T14
18
LG/WT
T13
18
DB/BK
K30
18
PK
K88
18
VT/WT
T60
18
BR
K54
18
OR/BK
T25
18
LG/RD
T54
18
VT
28 C2
25 C2
30 C2
8 C2
21 C2
11 C2
29 C2
1 C2
OUTPUT
SPEED
SENSOR
SIGNAL
OUTPUT
SPEED
SENSOR
GROUND
TRANSMISSION
CONTROL
RELAY
CONTROL
GOVERNOR
PRESSURE
SOLENOID
CONTROL
3-4
SHIFT
SOLENOID
CONTROL
TORQUE
CONVERTER
CLUTCH
SOLENOID
CONTROL
GOVERNOR
PRESSURE
SENSOR
SIGNAL
TRANSMISSION
TEMPERATURE
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE

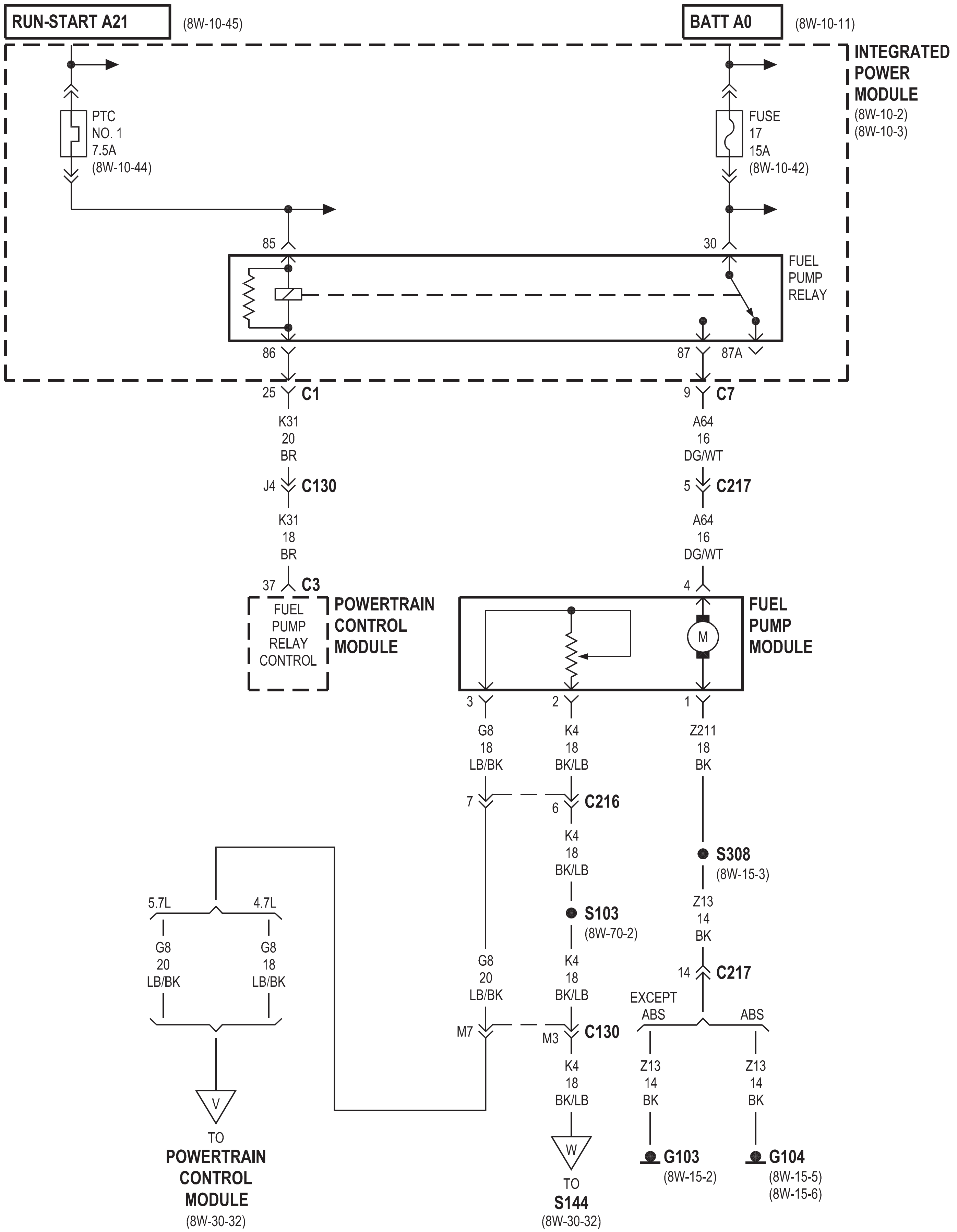
JTEC

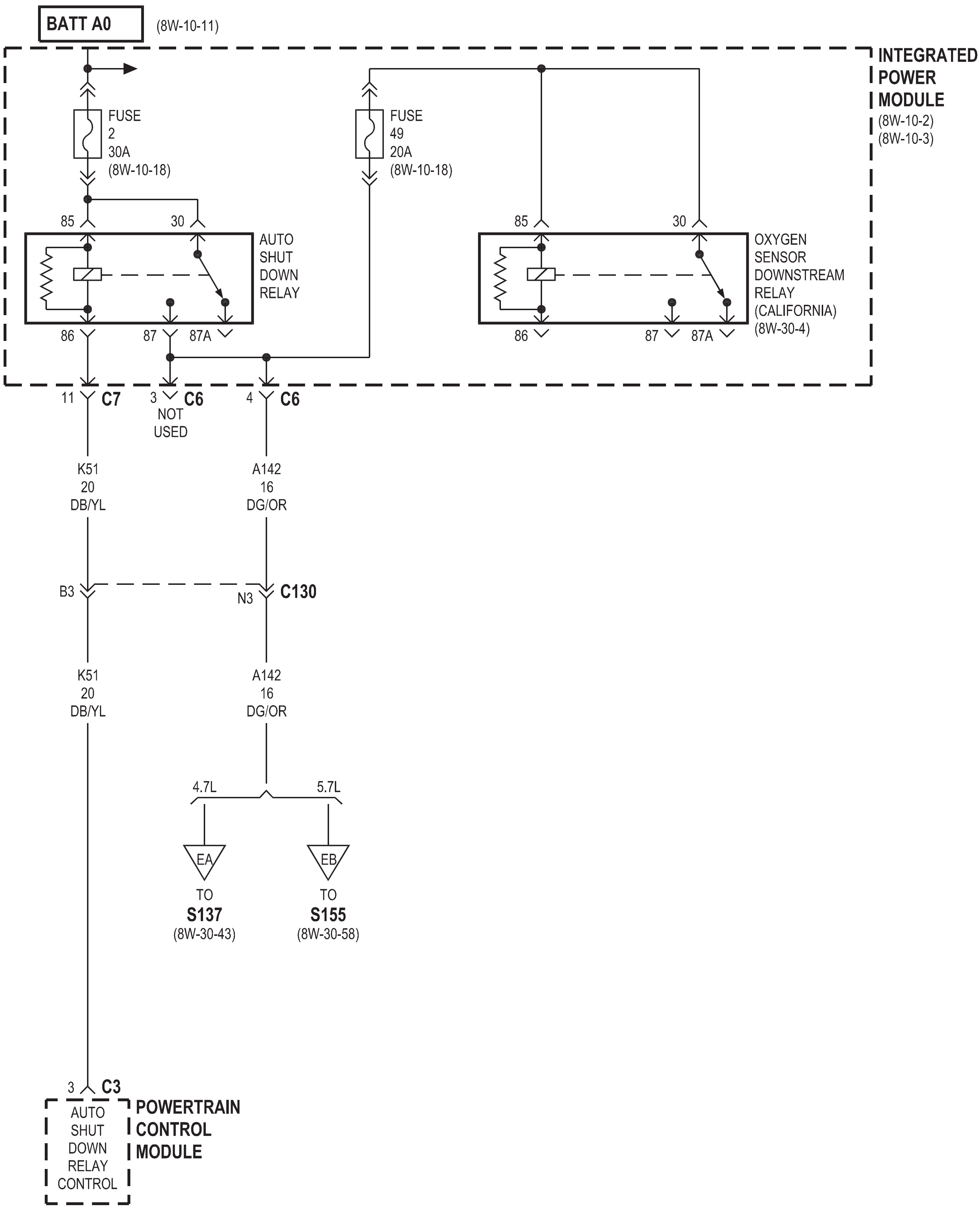

RUN-START A21
(8W-10-45)
BATT A17
(8W-10-17)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-43)
(8W-10-44)
85
A/C
COMPRESSOR
CLUTCH
RELAY
(8W-42-7)
86
85
CONDENSER
FAN
RELAY
(8W-42-10)
86
11 C5
C13
20
DB/OR
● 14 C5
Y145
20
DB/YL
K2
E6 C130
C13
18
DB/OR
Y145
18
DB/YL
IDLE
AIR
CONTROL
NO. 1
DRIVER
IDLE
AIR
CONTROL
NO. 2
DRIVER
IDLE
AIR
CONTROL
NO. 3
DRIVER
IDLE
AIR
CONTROL
NO. 4
DRIVER
IDLE
AIR
CONTROL
MOTOR
1
K40
18
BR/WT
2
K60
18
YL/BK
3
K39
18
GY/RD
4
K59
18
VT/BK
1 C3
17 C2
20 C1
11 C1
10 C1
19 C1
A/C
COMPRESSOR
CLUTCH
RELAY
CONTROL
CONDENSER
FAN
RELAY
CONTROL
IDLE
AIR
CONTROL
NO. 1
DRIVER
IDLE
AIR
CONTROL
NO. 2
DRIVER
IDLE
AIR
CONTROL
NO. 3
DRIVER
IDLE
AIR
CONTROL
NO. 4
DRIVER
POWERTRAIN
CONTROL
MODULE
PCI
BUS
SCI
TRANSMIT
SCI
RECEIVE
30 C3
27 C3
29 C3
D25
18
VT/BR
D21
18
PK
D20
18
LG
M2
M4
M1 C130
D25
20
VT/BR
D21
20
PK
D20
20
LG
34
5
8 C219
D25
20
VT/BR
D21
18
PK
D20
20
LG
S231
(8W-18-5)
(8W-18-6)
D25
20
VT/DG
S230
(8W-18-4)
D25
20
LB/VT
1
7
12
DATA
LINK
CONNECTOR
(8W-18-2)
● EXCEPT 8.0L

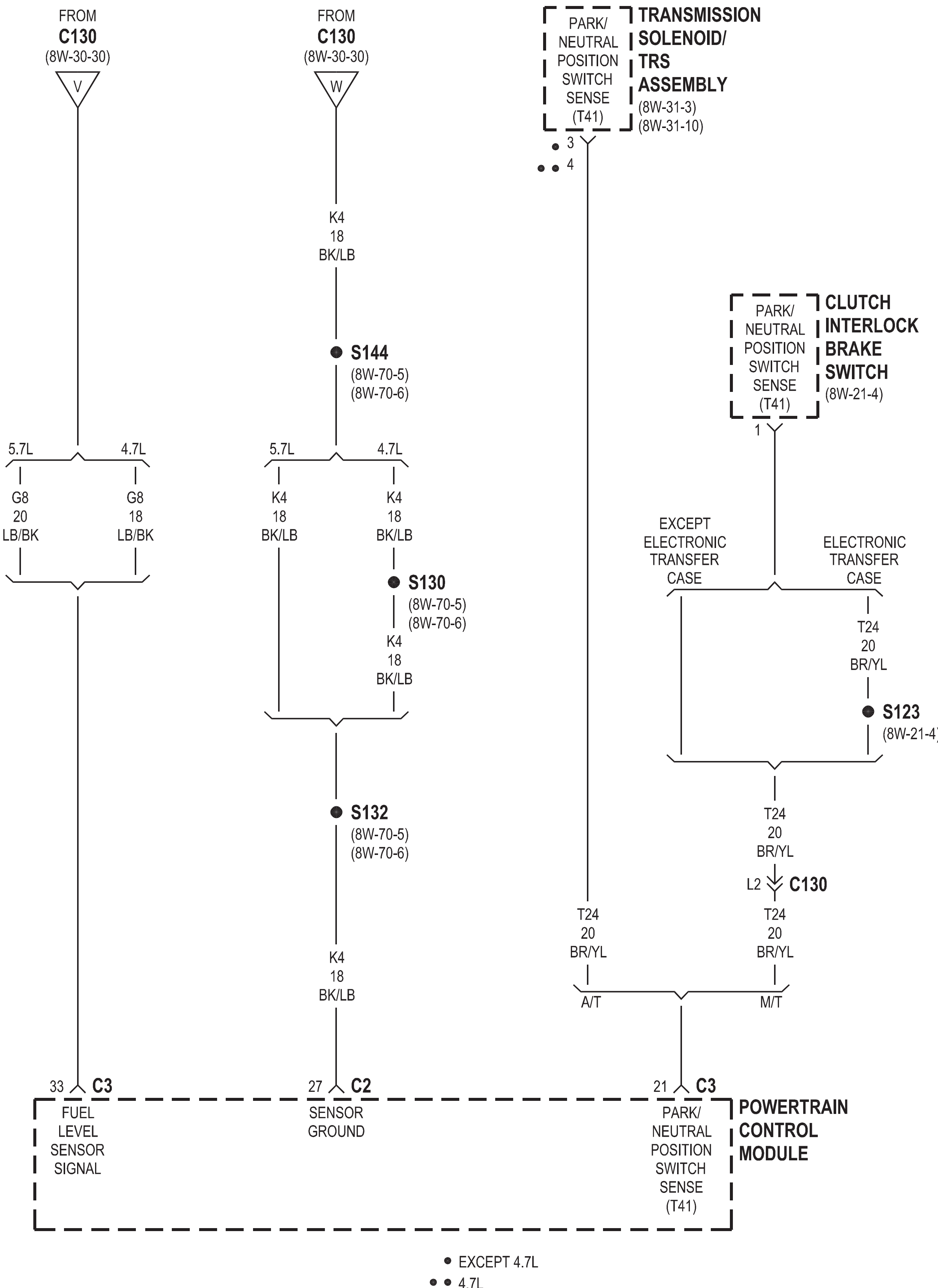

RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 50 10A (8W-10-45)
11 C4
Y134 20 GY/RD
2
EVAP/ PURGE SOLENOID
1
K52 18 PK/BK
J3
K52 18 PK/BK
20 C3
K4 18 BK/LB
S103 (8W-70-2)
K4 18 BK/LB
2
BATTERY TEMPERATURE SENSOR
1
K118 18 PK/YL
B6 C130
K118 18 PK/YL
15 C3
M3 C130
K4 18 BK/LB
S144 (8W-70-3)
K4 18 BK/LB
S130 (8W-70-3) (8W-70-4) (8W-70-8)
K4 18 BK/LB
5.9L/8.0L
3.7L
S132 (8W-70-8)
M/T
A/T
S132 (8W-70-4)
K4 18 BK/LB
S131 (8W-70-3) (8W-70-4)
K4 18 BK/LB
4 C1
EVAPORTIVE EMISSION SOLENOID CONTROL
BATTERY TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
POWERTRAIN CONTROL MODULE

NGC

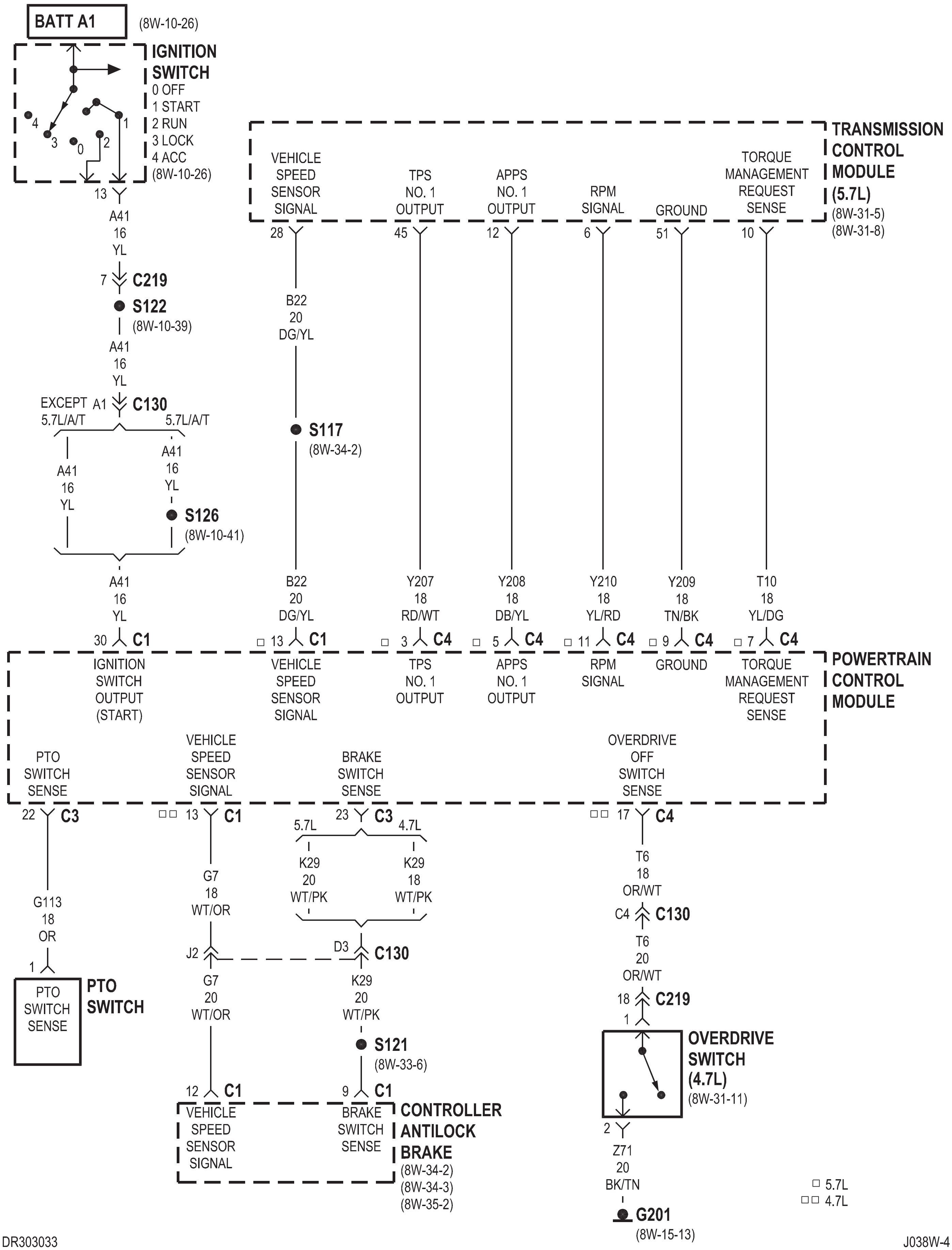

RUN-START A21
(8W-10-45)
BATT A0
(8W-10-11)
START A41
(8W-10-39)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-44)
FUSE
19
20A
(8W-10-33)
85
STARTER
MOTOR
RELAY
(8W-21-2)
(8W-21-3)
86
16
C4
7
C2
23
C7
Y135
18
LG/BK
A14
20
RD/WT
T752
18
DG/OR
S136
(8W-10-44)
S110
(8W-10-33)
Y135
18
LG/BK
A14
20
RD/WT
J5
C1
F1
C130
Y135
18
LG/BK
5.7L
4.7L
S186
(8W-10-44)
A14
20
RD/WT
T752
18
DG/OR
Y135
16
LG/BK
Y135
18
LG/BK
12
C1
11
C1
29
C1
38
C3
POWERTRAIN
CONTROL
MODULE
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
FUSED
B(+)
ENGINE
STARTER
MOTOR
RELAY
CONTROL
ENGINE
OIL
PRESSURE
SWITCH
GROUND
GROUND
GROUND
12
C4
18
C1
9
C1
20
C1
G60
18
GY/YL
Z13
16
BK/RD
Z82
16
BK/TN
Z81
16
BK/TN
1
ENGINE
OIL
PRESSURE
SWITCH
G107
(8W-15-8)
(8W-15-10)
4.7L A/T


RUN-START A21
(8W-10-45)
BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-44)
FUSE
17
15A
(8W-10-42)
85
30
FUEL
PUMP
RELAY
86
87
87A
25
C1
9
C7
K31
20
BR
A64
16
DG/WT
J4
C130
5
C217
K31
18
BR
A64
16
DG/WT
37
C3
4
FUEL
PUMP
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE
M
FUEL
PUMP
MODULE
3
2
1
G8
18
LB/BK
K4
18
BK/LB
Z211
18
BK
7
6
C216
K4
18
BK/LB
S308
(8W-15-3)
S103
(8W-70-2)
Z13
14
BK
5.7L
4.7L
G8
20
LB/BK
G8
18
LB/BK
G8
20
LB/BK
K4
18
BK/LB
14
C217
EXCEPT
ABS
ABS
M7
M3
C130
K4
18
BK/LB
Z13
14
BK
Z13
14
BK
V
TO
POWERTRAIN
CONTROL
MODULE
(8W-30-32)
W
TO
S144
(8W-30-32)
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 2 30A (8W-10-18)
FUSE 49 20A (8W-10-18)
85
30
AUTO SHUT DOWN RELAY
86
87
87A
OXYGEN SENSOR DOWNSTREAM RELAY (CALIFORNIA)
(8W-30-4)
11 C7
3 C6
NOT USED
4 C6
K51 20 DB/YL
A142 16 DG/OR
B3
N3 C130
K51 20 DB/YL
A142 16 DG/OR
4.7L
5.7L
EA
EB
TO S137 (8W-30-43)
TO S155 (8W-30-58)
3 C3
AUTO SHUT DOWN RELAY CONTROL
POWERTRAIN CONTROL MODULE

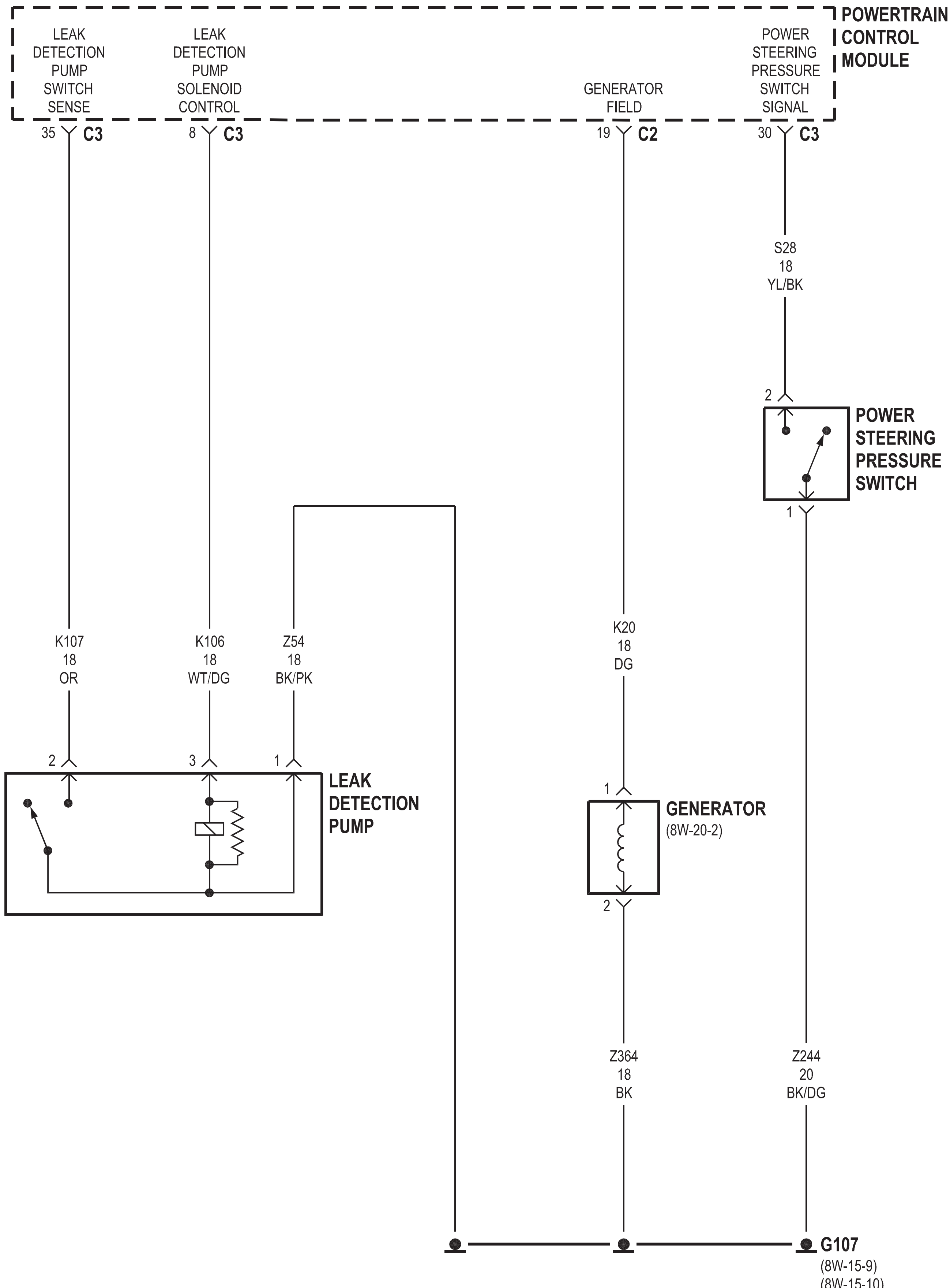

FROM
C130
(8W-30-30)
V
FROM
C130
(8W-30-30)
W
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
(8W-31-10)
3
4
K4
18
BK/LB
S144
(8W-70-5)
(8W-70-6)
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
CLUTCH
INTERLOCK
BRAKE
SWITCH
(8W-21-4)
1
5.7L
4.7L
G8
20
LB/BK
G8
18
LB/BK
5.7L
4.7L
K4
18
BK/LB
K4
18
BK/LB
S130
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
EXCEPT
ELECTRONIC
TRANSFER
CASE
ELECTRONIC
TRANSFER
CASE
T24
20
BR/YL
S123
(8W-21-4)
S132
(8W-70-5)
(8W-70-6)
T24
20
BR/YL
L2
C130
T24
20
BR/YL
T24
20
BR/YL
K4
18
BK/LB
T24
20
BR/YL
A/T
M/T
33
C3
27
C2
21
C3
FUEL
LEVEL
SENSOR
SIGNAL
SENSOR
GROUND
PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
POWERTRAIN
CONTROL
MODULE
• EXCEPT 4.7L
• • 4.7L

NGC

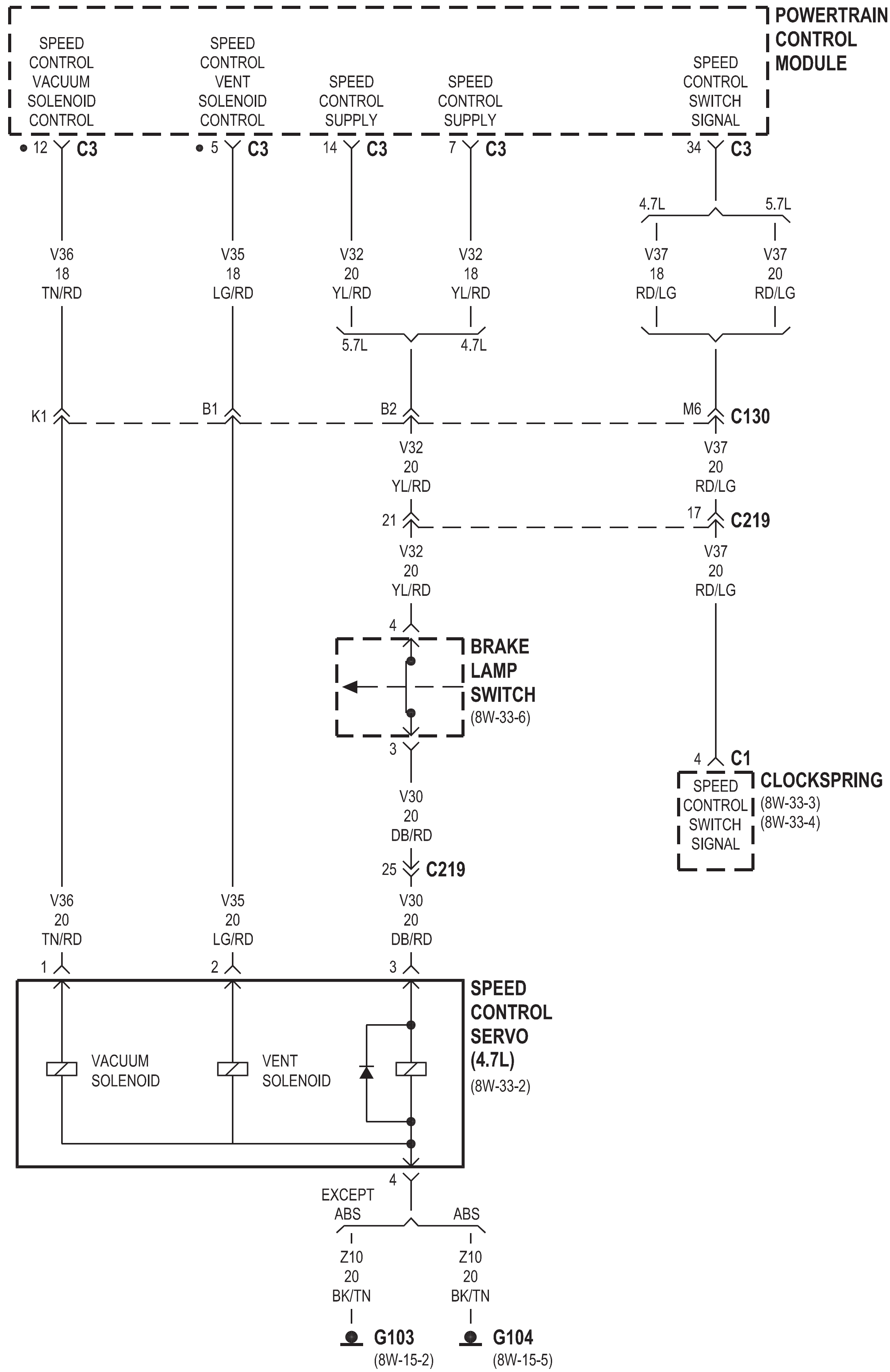


DR303033

J038W-4

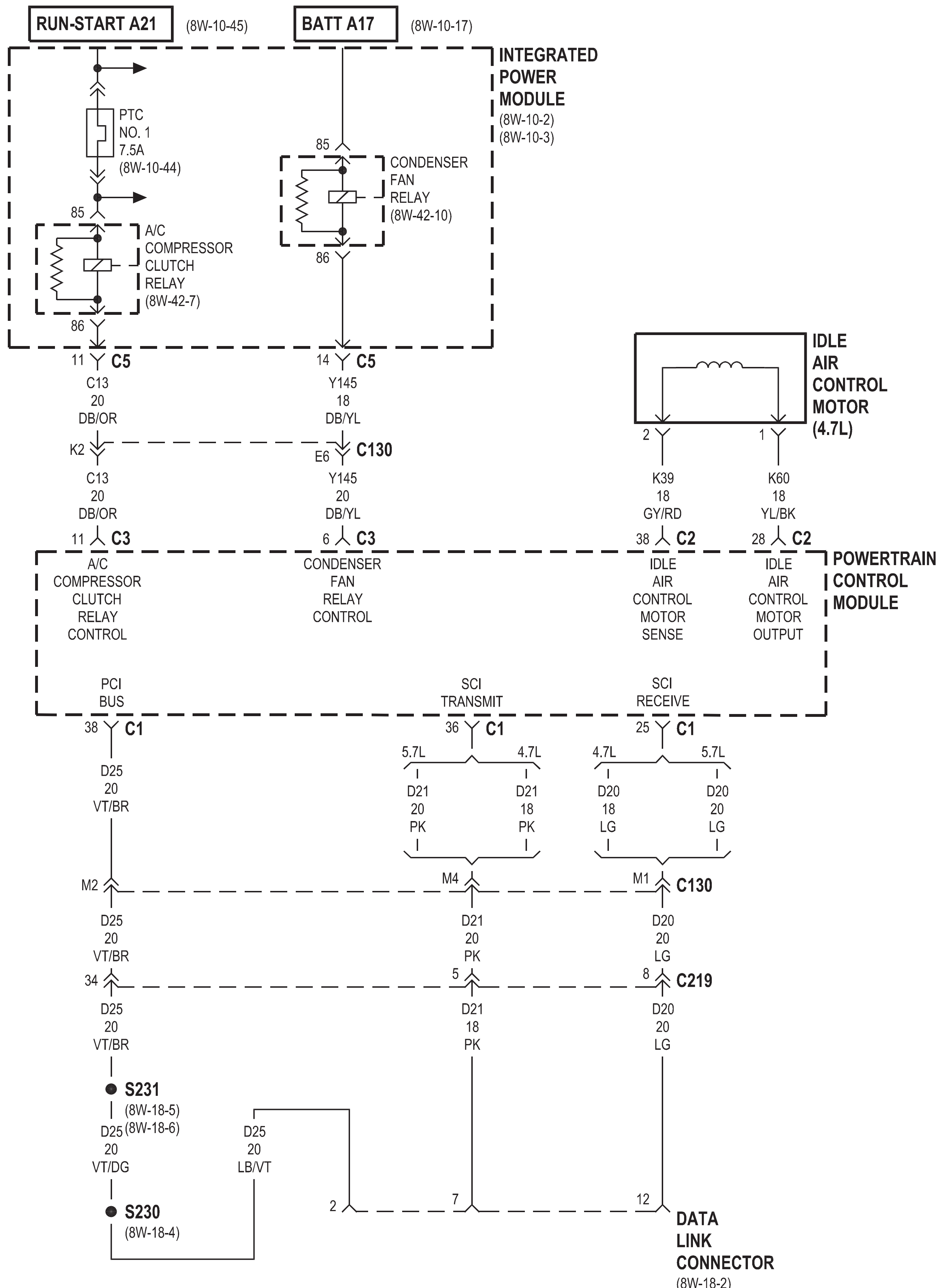

POWERTRAIN CONTROL MODULE
LEAK DETECTION PUMP SWITCH SENSE
LEAK DETECTION PUMP SOLENOID CONTROL
GENERATOR FIELD
POWER STEERING PRESSURE SWITCH SIGNAL
35 C3
8 C3
19 C2
30 C3
S28 18 YL/BK
2
POWER STEERING PRESSURE SWITCH
1
K107 18 OR
K106 18 WT/DG
Z54 18 BK/PK
K20 18 DG
2
3
1
LEAK DETECTION PUMP
1
GENERATOR
(8W-20-2)
2
Z364 18 BK
Z244 20 BK/DG
G107
(8W-15-9)
(8W-15-10)

NGC

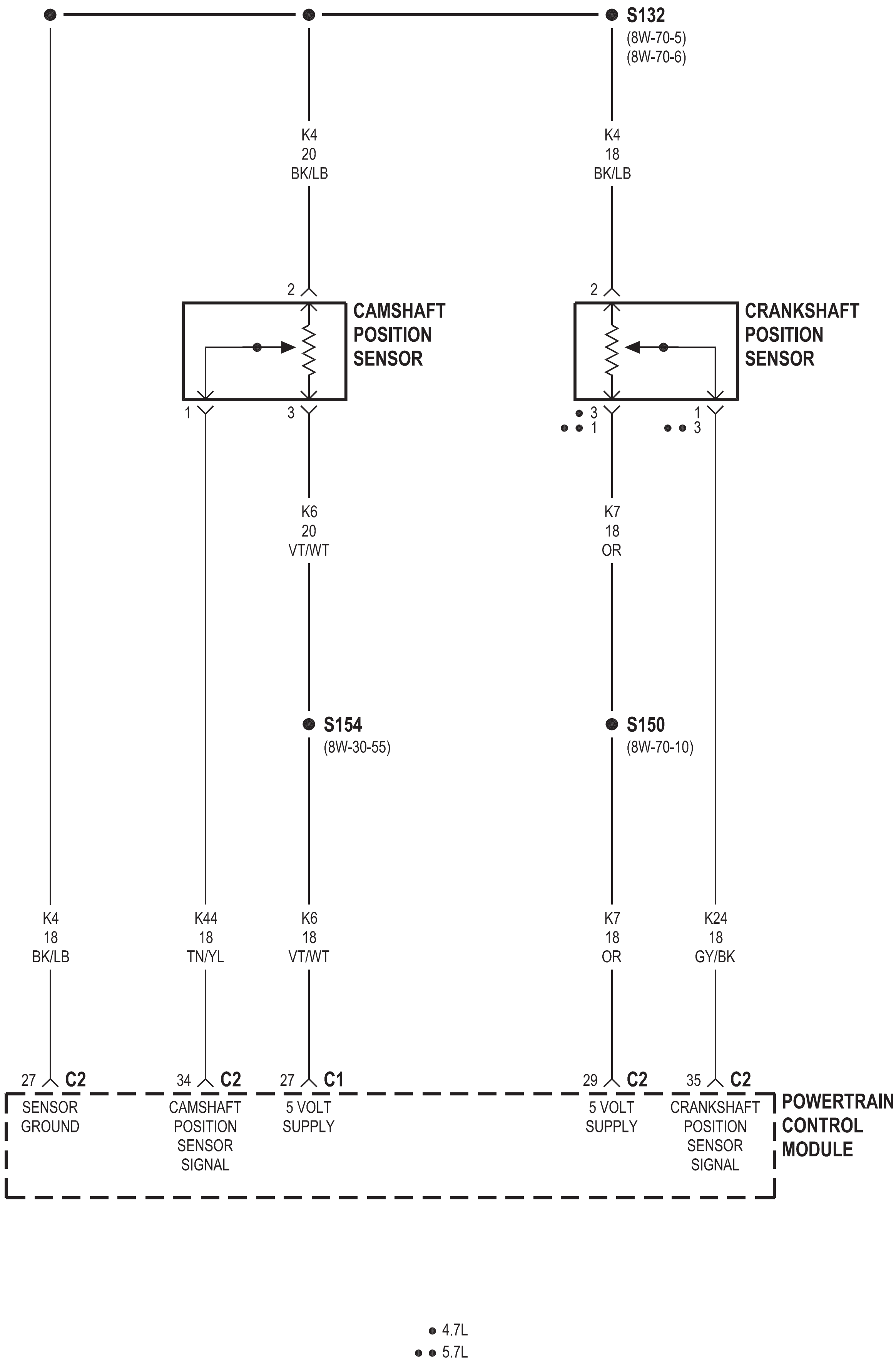

POWERTRAIN CONTROL MODULE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL SUPPLY
SPEED CONTROL SUPPLY
SPEED CONTROL SWITCH SIGNAL
12 C3
5 C3
14 C3
7 C3
34 C3
4.7L
5.7L
V36 18 TN/RD
V35 18 LG/RD
V32 20 YL/RD
V32 18 YL/RD
V37 18 RD/LG
V37 20 RD/LG
5.7L
4.7L
K1
B1
B2
M6
C130
V32 20 YL/RD
V37 20 RD/LG
21
17
C219
V32 20 YL/RD
V37 20 RD/LG
4
BRAKE LAMP SWITCH
(8W-33-6)
3
4 C1
SPEED CONTROL SWITCH SIGNAL
CLOCKSPRING
(8W-33-3)
(8W-33-4)
V30 20 DB/RD
25 C219
V36 20 TN/RD
V35 20 LG/RD
V30 20 DB/RD
1
2
3
VACUUM SOLENOID
VENT SOLENOID
SPEED CONTROL SERVO (4.7L)
(8W-33-2)
4
EXCEPT ABS
ABS
Z10 20 BK/TN
Z10 20 BK/TN
G103
(8W-15-2)
G104
(8W-15-5)

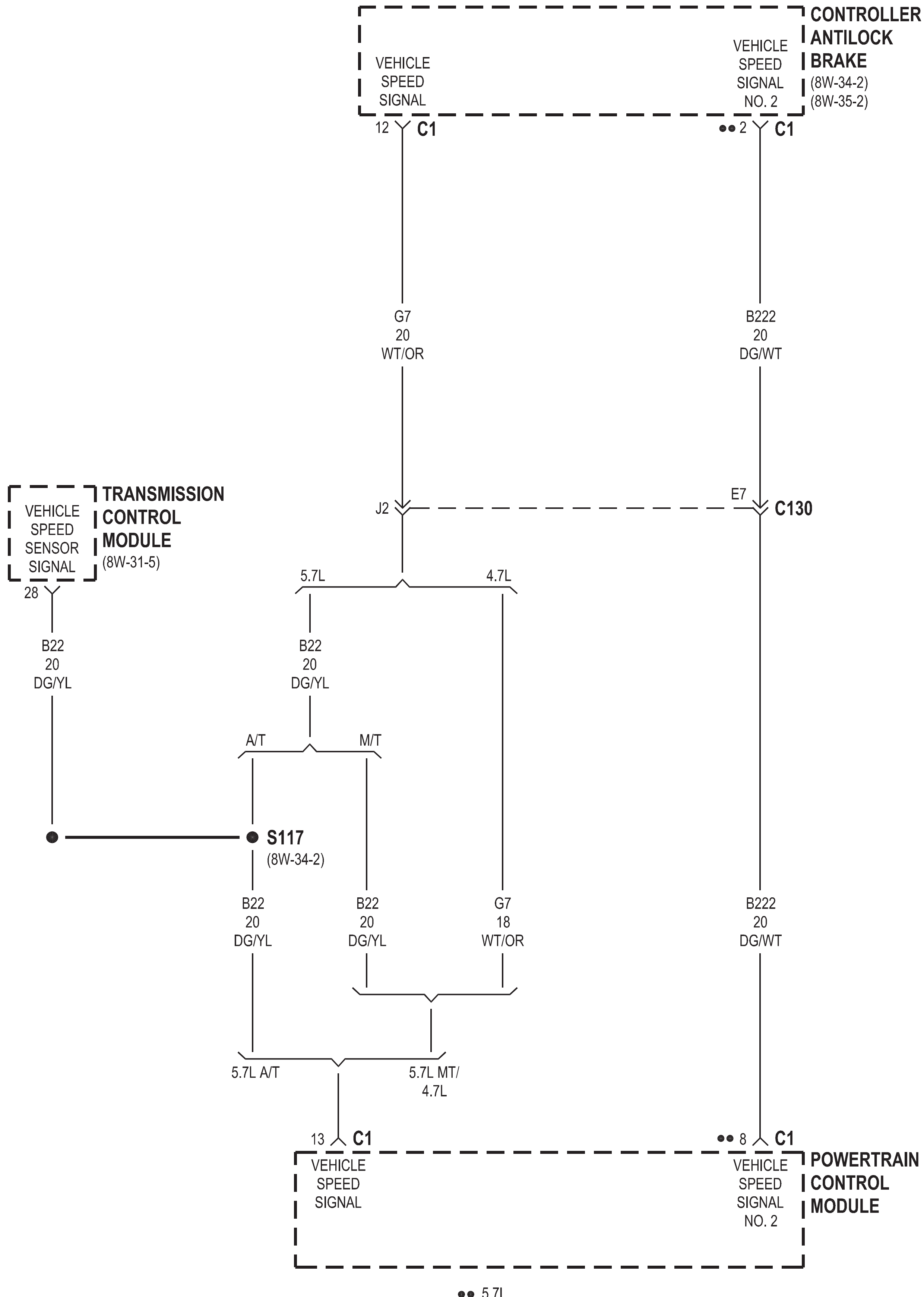
• 4.7L

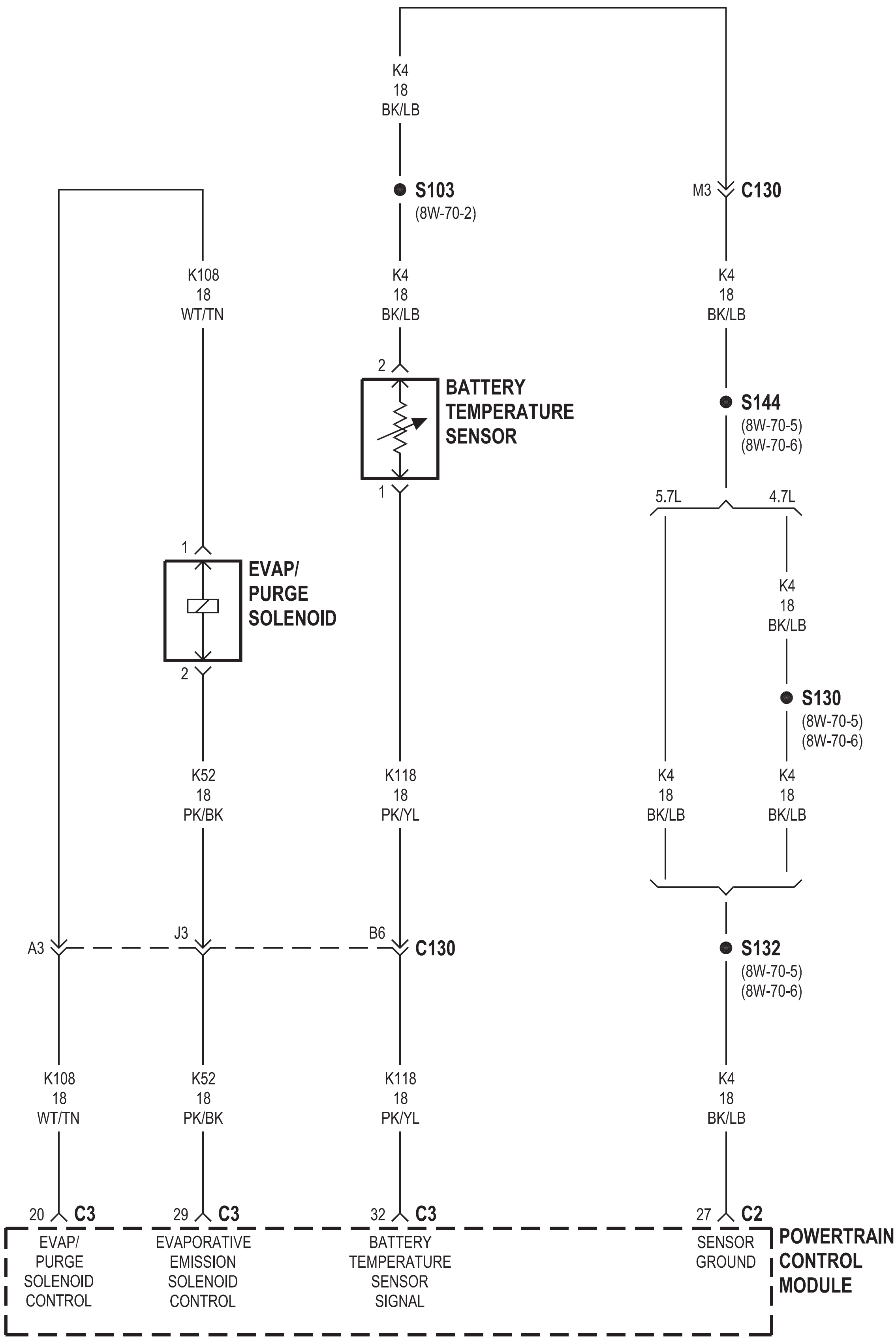
NGC

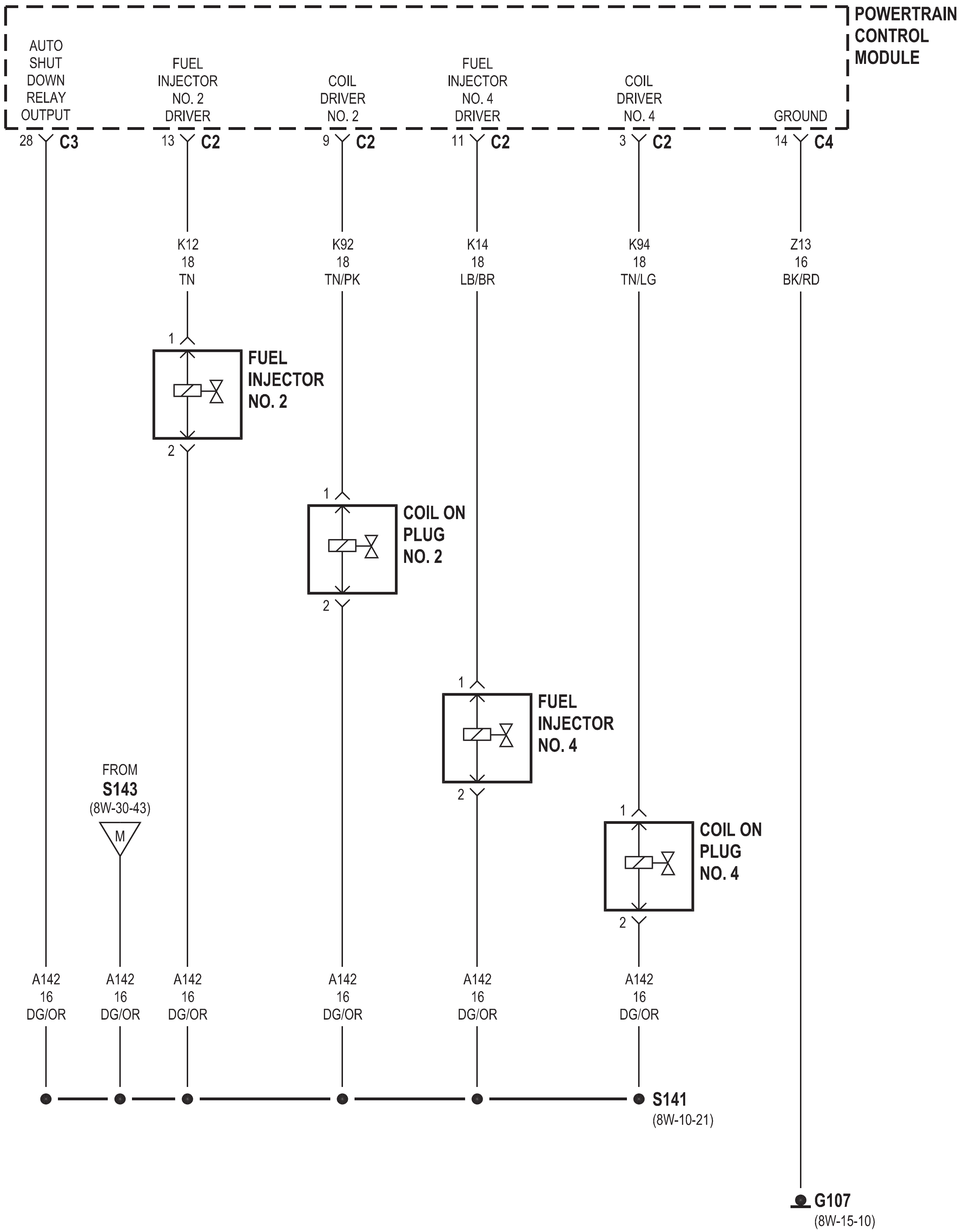


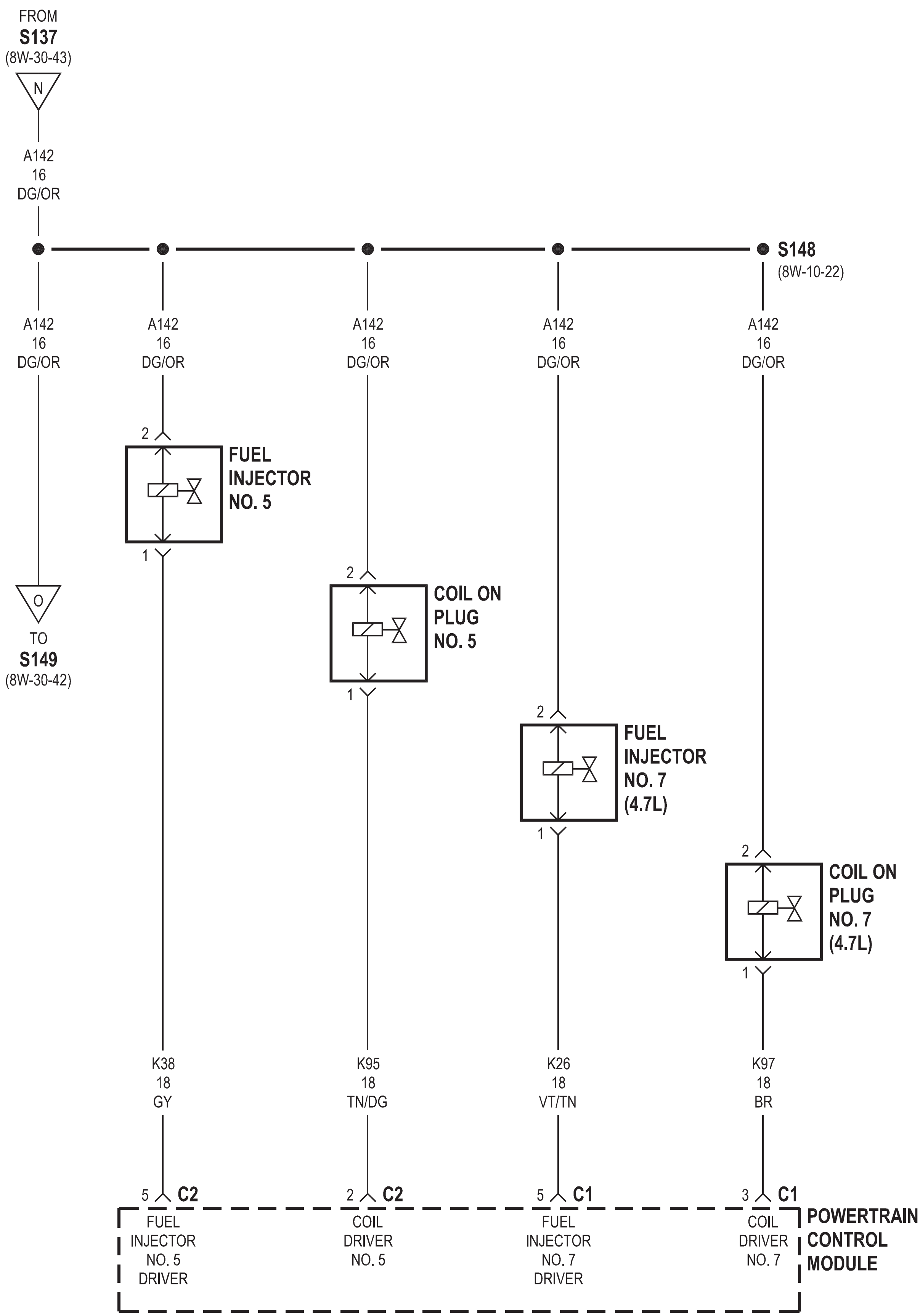
RUN-START A21
(8W-10-45)
BATT A17
(8W-10-17)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-44)
85
CONDENSER
FAN
RELAY
(8W-42-10)
86
85
A/C
COMPRESSOR
CLUTCH
RELAY
(8W-42-7)
86
11 C5
C13
20
DB/OR
14 C5
Y145
18
DB/YL
K2
E6 C130
C13
20
DB/OR
Y145
20
DB/YL
IDLE
AIR
CONTROL
MOTOR
(4.7L)
2
1
K39
18
GY/RD
K60
18
YL/BK
11 C3
6 C3
38 C2
28 C2
POWERTRAIN
CONTROL
MODULE
A/C
COMPRESSOR
CLUTCH
RELAY
CONTROL
CONDENSER
FAN
RELAY
CONTROL
IDLE
AIR
CONTROL
MOTOR
SENSE
IDLE
AIR
CONTROL
MOTOR
OUTPUT
PCI
BUS
SCI
TRANSMIT
SCI
RECEIVE
38 C1
36 C1
25 C1
5.7L
4.7L
4.7L
5.7L
D25
20
VT/BR
D21
20
PK
D21
18
PK
D20
18
LG
D20
20
LG
M2
M4
M1 C130
D25
20
VT/BR
D21
20
PK
D20
20
LG
34
5
8 C219
D25
20
VT/BR
D21
18
PK
D20
20
LG
S231
(8W-18-5)
(8W-18-6)
D25
20
VT/DG
D25
20
LB/VT
S230
(8W-18-4)
2
7
12
DATA
LINK
CONNECTOR
(8W-18-2)

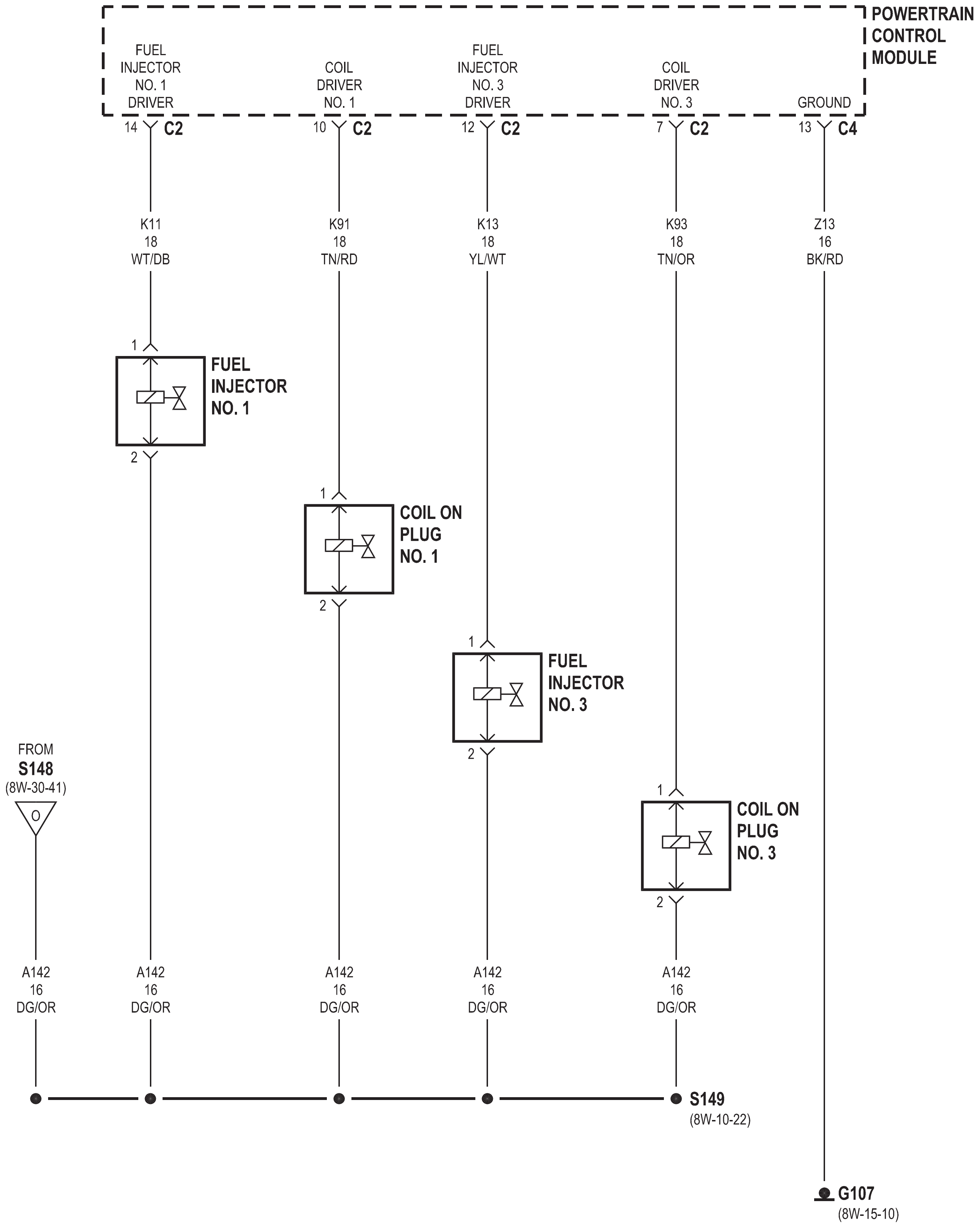

S132
(8W-70-5)
(8W-70-6)
K4
20
BK/LB
K4
18
BK/LB
2
CAMSHAFT
POSITION
SENSOR
2
CRANKSHAFT
POSITION
SENSOR
1
3
3
1
1
3
K6
20
VT/WT
K7
18
OR
S154
(8W-30-55)
S150
(8W-70-10)
K4
18
BK/LB
K44
18
TN/YL
K6
18
VT/WT
K7
18
OR
K24
18
GY/BK
27 C2
34 C2
27 C1
29 C2
35 C2
SENSOR
GROUND
CAMSHAFT
POSITION
SENSOR
SIGNAL
5 VOLT
SUPPLY
5 VOLT
SUPPLY
CRANKSHAFT
POSITION
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE
● 4.7L
●● 5.7L

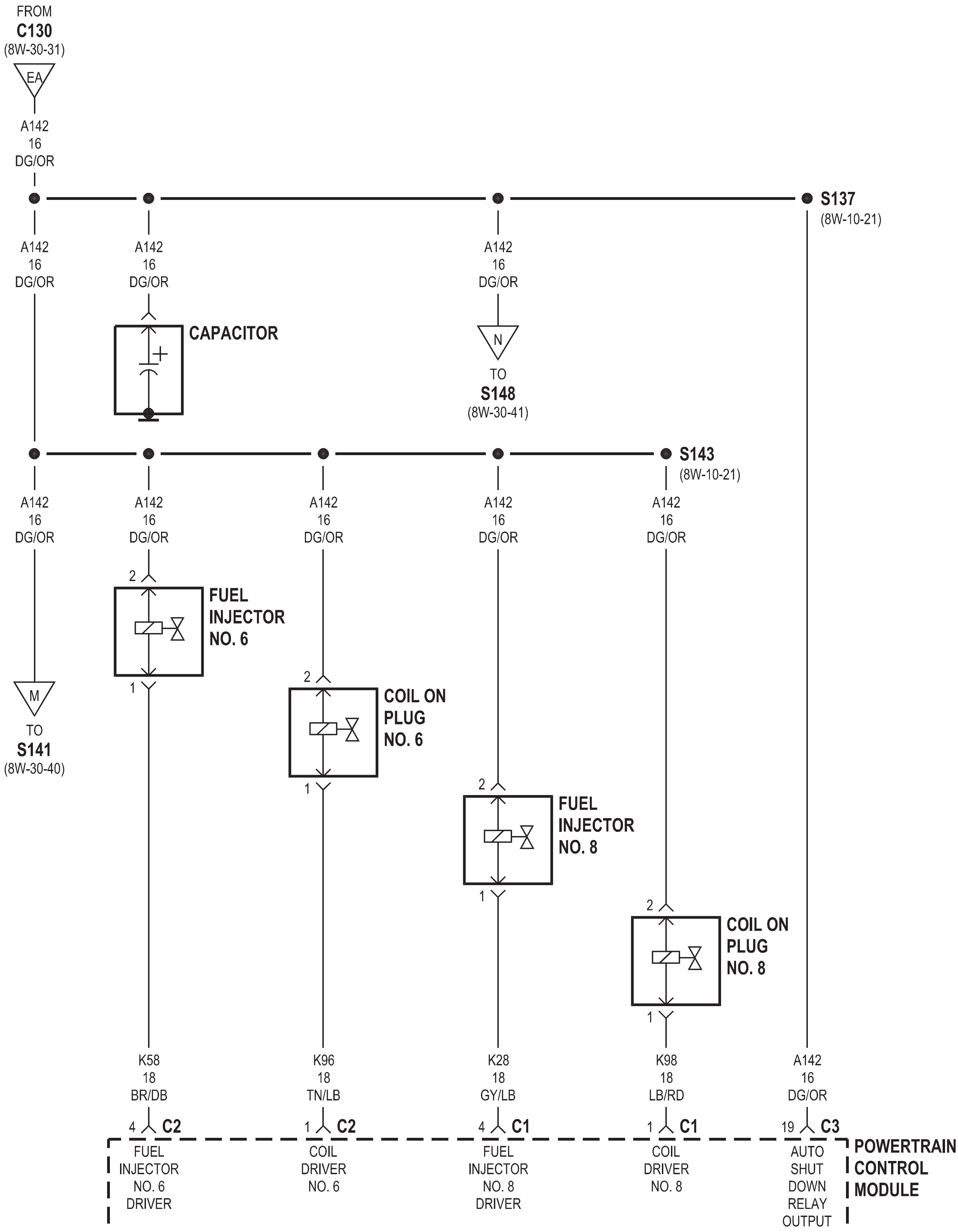

CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-35-2)
VEHICLE SPEED SIGNAL
VEHICLE SPEED SIGNAL NO. 2
12
C1
●● 2
C1
G7
20
WT/OR
B222
20
DG/WT
J2
E7
C130
TRANSMISSION CONTROL MODULE
(8W-31-5)
VEHICLE SPEED SENSOR SIGNAL
28
5.7L
4.7L
B22
20
DG/YL
B22
20
DG/YL
A/T
M/T
S117
(8W-34-2)
B22
20
DG/YL
B22
20
DG/YL
G7
18
WT/OR
B222
20
DG/WT
5.7L A/T
5.7L MT/
4.7L
13
C1
●● 8
C1
VEHICLE SPEED SIGNAL
VEHICLE SPEED SIGNAL NO. 2
POWERTRAIN CONTROL MODULE
●● 5.7L

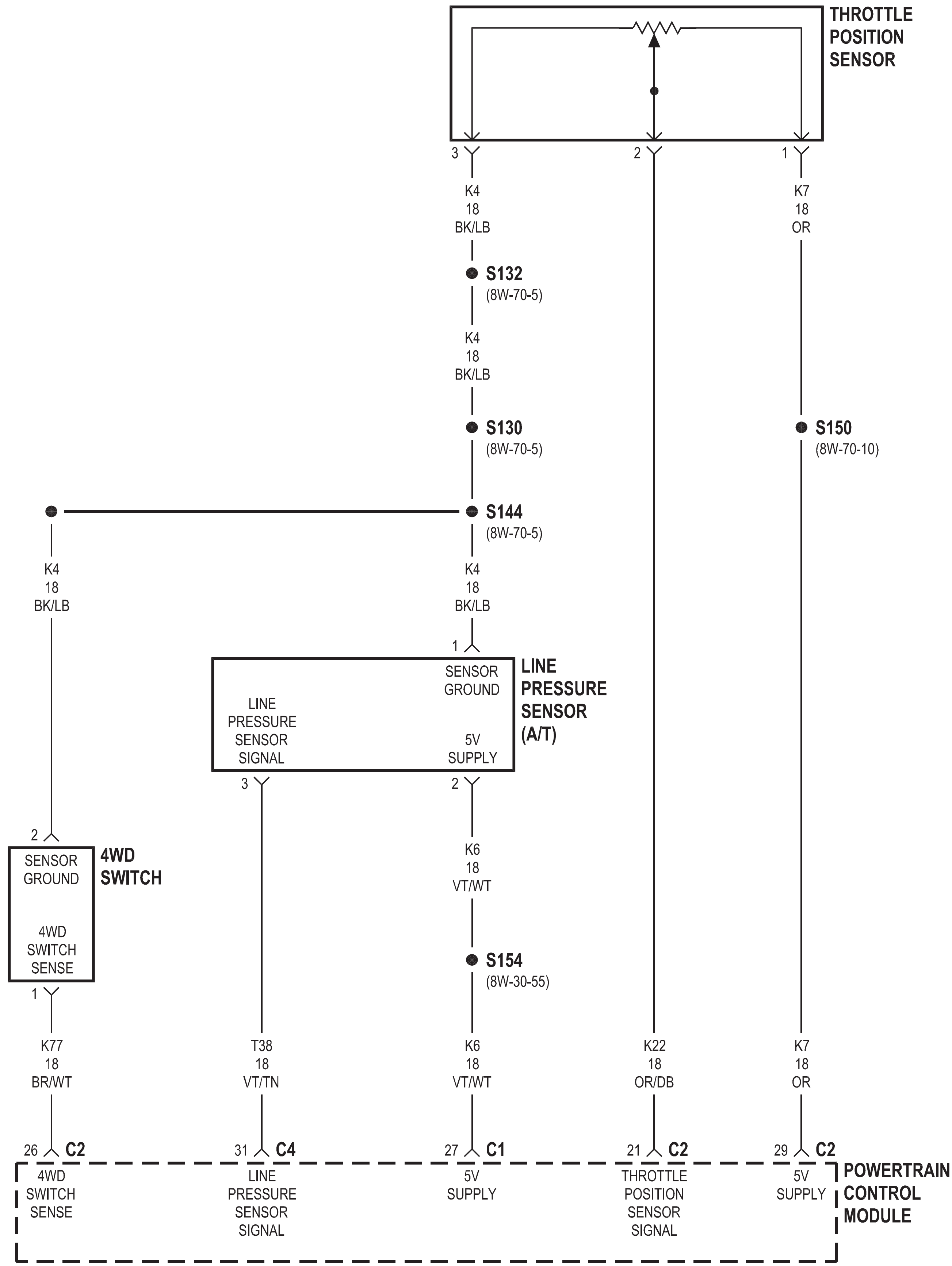

K4
18
BK/LB
S103
(8W-70-2)
M3
C130
K108
18
WT/TN
K4
18
BK/LB
K4
18
BK/LB
2
BATTERY
TEMPERATURE
SENSOR
1
S144
(8W-70-5)
(8W-70-6)
5.7L
4.7L
1
EVAP/
PURGE
SOLENOID
2
K4
18
BK/LB
S130
(8W-70-5)
(8W-70-6)
K52
18
PK/BK
K118
18
PK/YL
K4
18
BK/LB
K4
18
BK/LB
A3
J3
B6
C130
S132
(8W-70-5)
(8W-70-6)
K108
18
WT/TN
K52
18
PK/BK
K118
18
PK/YL
K4
18
BK/LB
20 C3
29 C3
32 C3
27 C2
EVAP/
PURGE
SOLENOID
CONTROL
EVAPORATIVE
EMISSION
SOLENOID
CONTROL
BATTERY
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
POWERTRAIN
CONTROL
MODULE

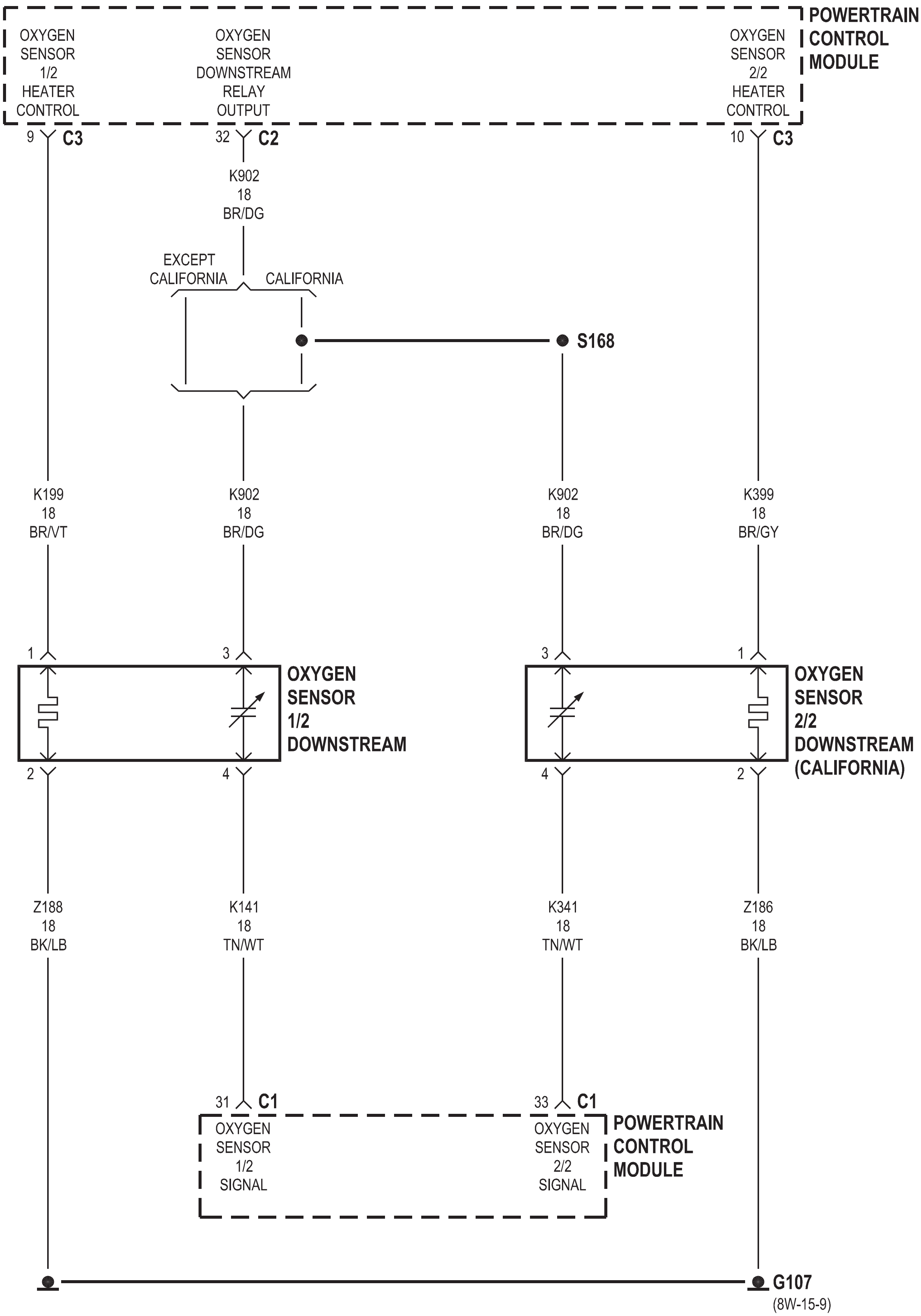

POWERTRAIN CONTROL MODULE
AUTO SHUT DOWN RELAY OUTPUT
FUEL INJECTOR NO. 2 DRIVER
COIL DRIVER NO. 2
FUEL INJECTOR NO. 4 DRIVER
COIL DRIVER NO. 4
GROUND
28 C3
13 C2
9 C2
11 C2
3 C2
14 C4
K12 18 TN
K92 18 TN/PK
K14 18 LB/BR
K94 18 TN/LG
Z13 16 BK/RD
FUEL INJECTOR NO. 2
COIL ON PLUG NO. 2
FUEL INJECTOR NO. 4
COIL ON PLUG NO. 4
1
2
FROM S143 (8W-30-43)
M
A142 16 DG/OR
S141 (8W-10-21)
G107 (8W-15-10)

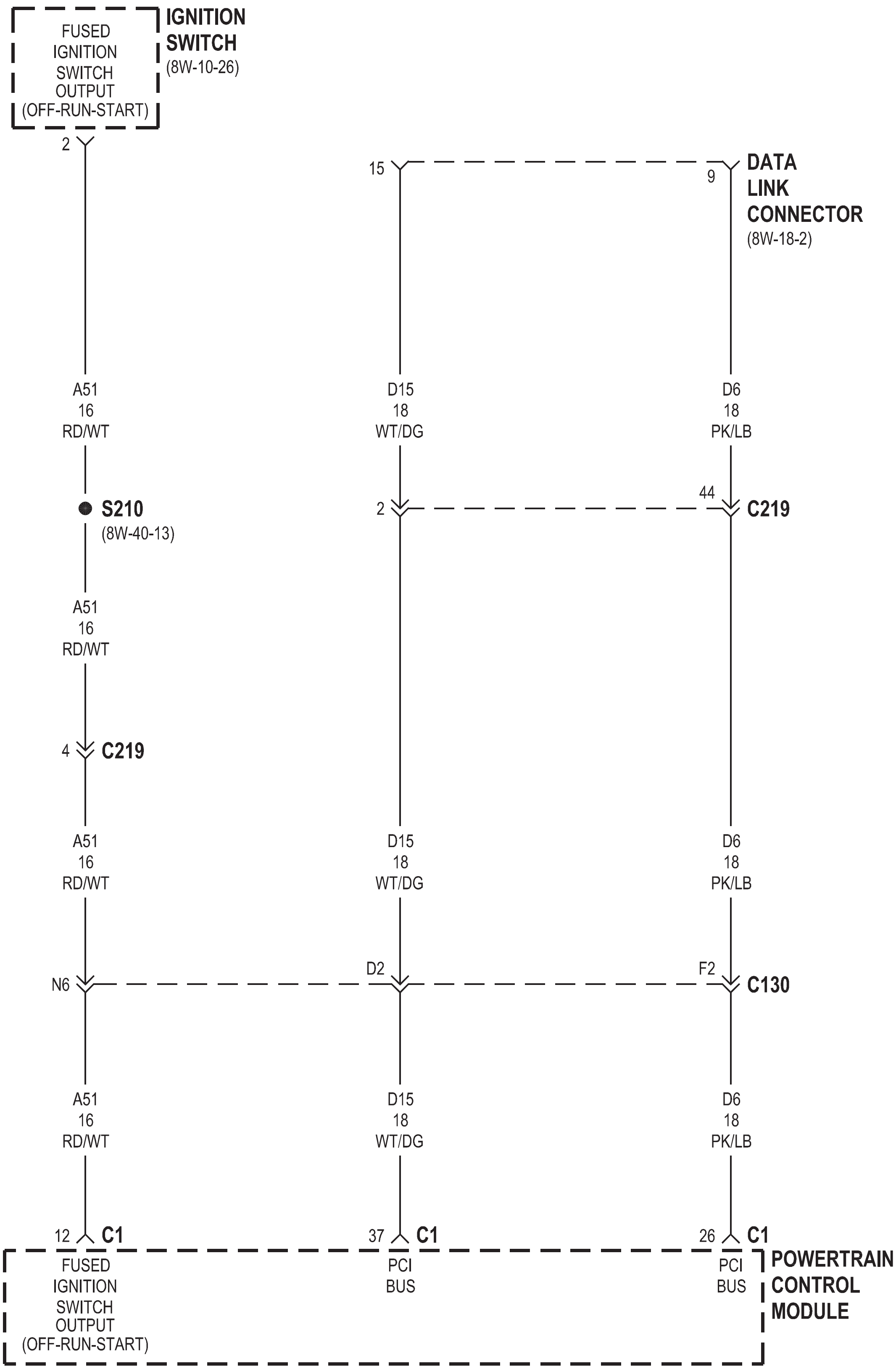

FROM
S137
(8W-30-43)
N
A142
16
DG/OR
S148
(8W-10-22)
A142
16
DG/OR
FUEL
INJECTOR
NO. 5
O
TO
S149
(8W-30-42)
COIL ON
PLUG
NO. 5
FUEL
INJECTOR
NO. 7
(4.7L)
COIL ON
PLUG
NO. 7
(4.7L)
K38
18
GY
K95
18
TN/DG
K26
18
VT/TN
K97
18
BR
5 C2
2 C2
5 C1
3 C1
FUEL
INJECTOR
NO. 5
DRIVER
COIL
DRIVER
NO. 5
FUEL
INJECTOR
NO. 7
DRIVER
COIL
DRIVER
NO. 7
POWERTRAIN
CONTROL
MODULE

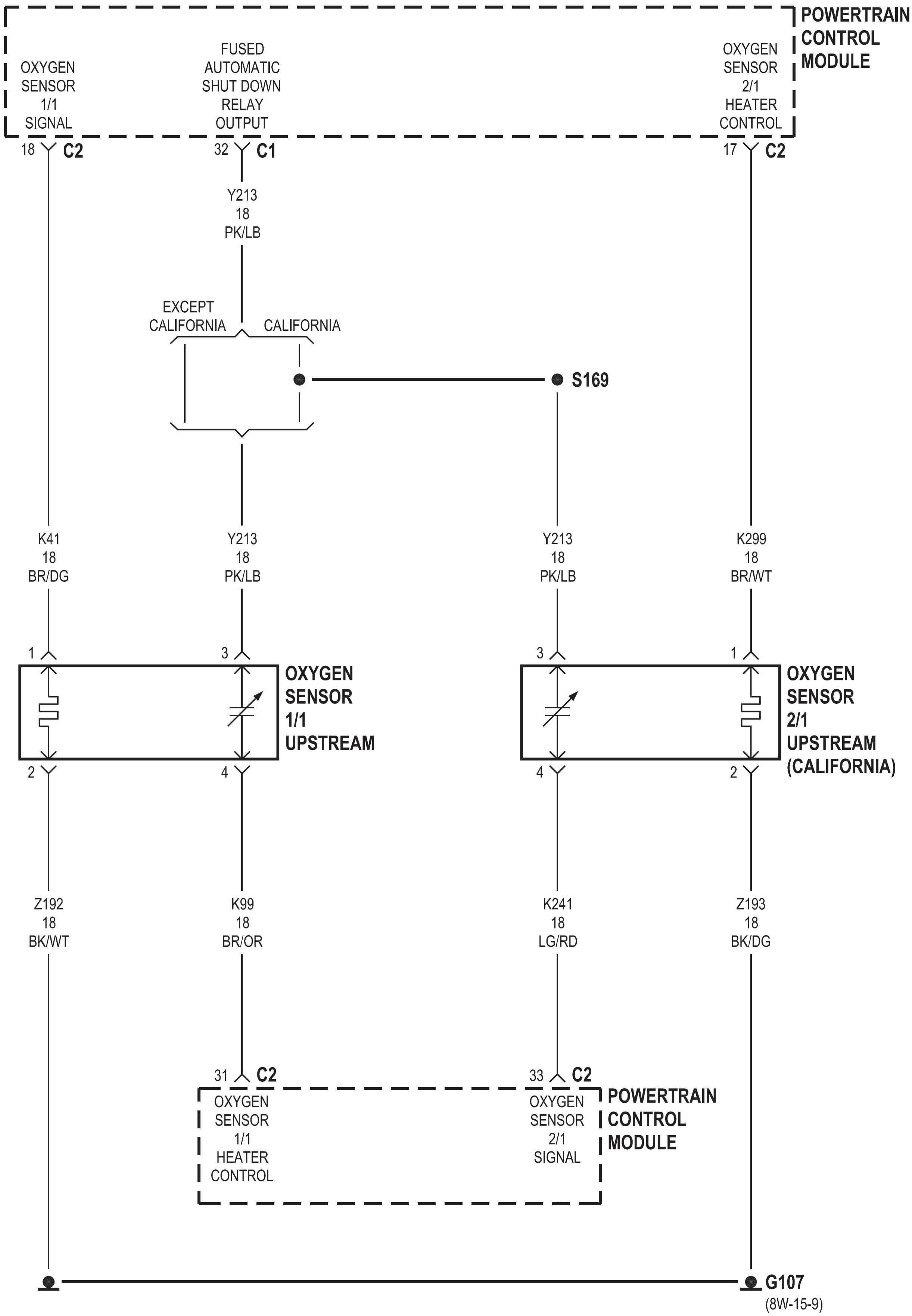

POWERTRAIN CONTROL MODULE
FUEL INJECTOR NO. 1 DRIVER
14 C2
COIL DRIVER NO. 1
10 C2
FUEL INJECTOR NO. 3 DRIVER
12 C2
COIL DRIVER NO. 3
7 C2
GROUND
13 C4
K11 18 WT/DB
K91 18 TN/RD
K13 18 YL/WT
K93 18 TN/OR
Z13 16 BK/RD
FUEL INJECTOR NO. 1
COIL ON PLUG NO. 1
FUEL INJECTOR NO. 3
COIL ON PLUG NO. 3
1
2
FROM S148 (8W-30-41)
O
A142 16 DG/OR
S149 (8W-10-22)
G107 (8W-15-10)

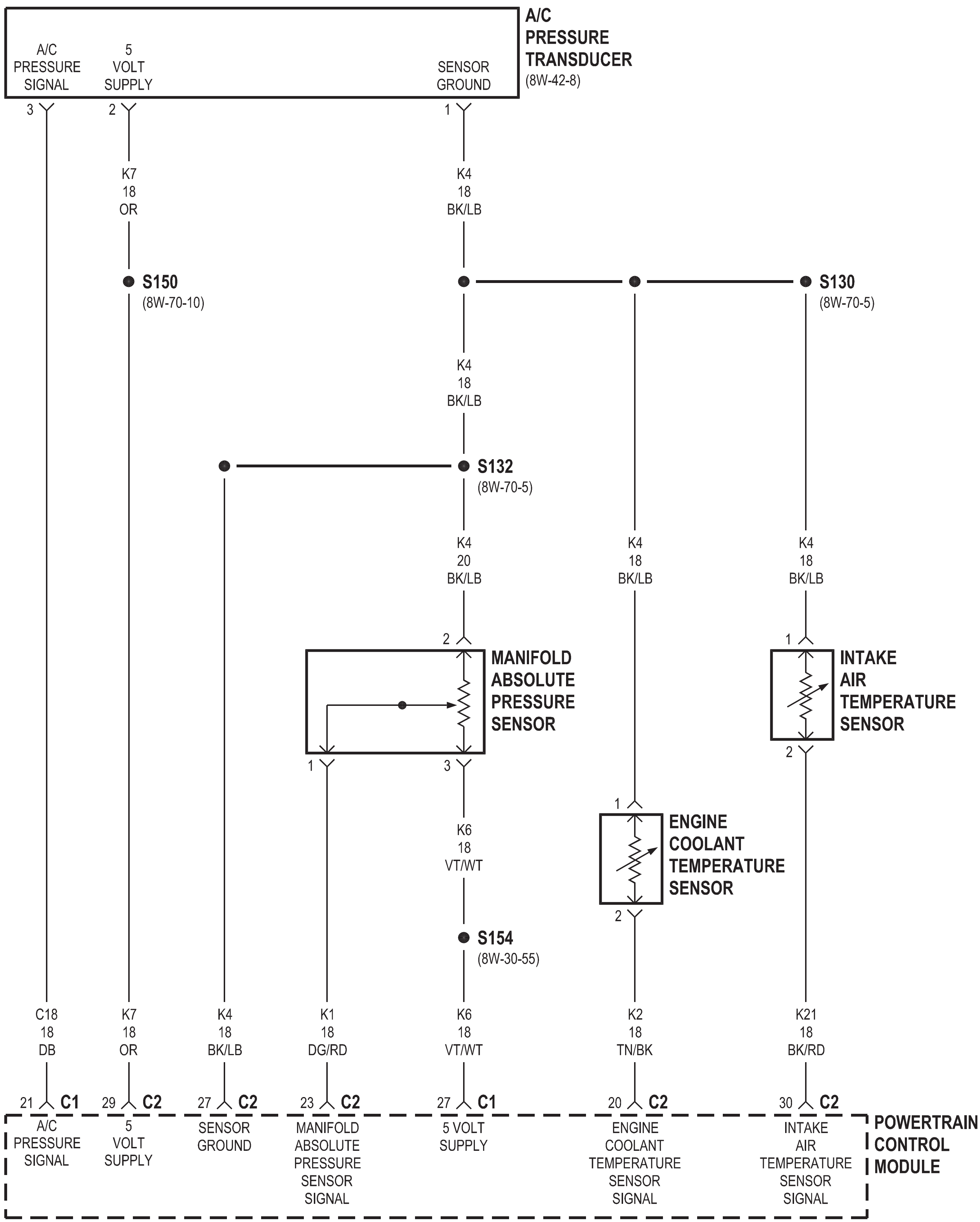

FROM
C130
(8W-30-31)
EA
A142
16
DG/OR
S137
(8W-10-21)
A142
16
DG/OR
CAPACITOR
N
TO
S148
(8W-30-41)
S143
(8W-10-21)
FUEL
INJECTOR
NO. 6
M
TO
S141
(8W-30-40)
COIL ON
PLUG
NO. 6
FUEL
INJECTOR
NO. 8
COIL ON
PLUG
NO. 8
K58
18
BR/DB
K96
18
TN/LB
K28
18
GY/LB
K98
18
LB/RD
A142
16
DG/OR
4 C2
1 C2
4 C1
1 C1
19 C3
FUEL
INJECTOR
NO. 6
DRIVER
COIL
DRIVER
NO. 6
FUEL
INJECTOR
NO. 8
DRIVER
COIL
DRIVER
NO. 8
AUTO
SHUT
DOWN
RELAY
OUTPUT
POWERTRAIN
CONTROL
MODULE

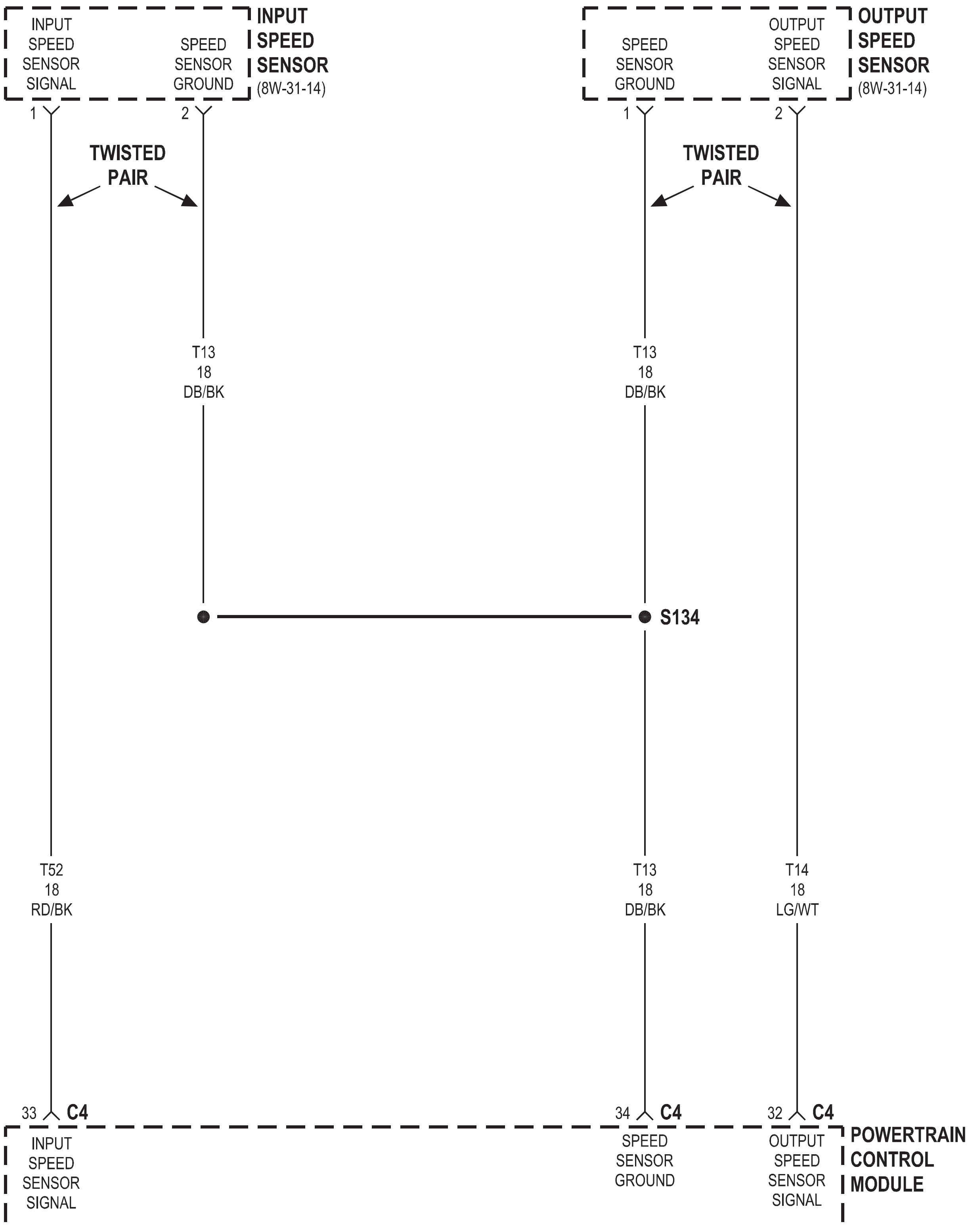

THROTTLE POSITION SENSOR
3
2
1
K4 18 BK/LB
K7 18 OR
S132 (8W-70-5)
K4 18 BK/LB
S130 (8W-70-5)
S150 (8W-70-10)
S144 (8W-70-5)
K4 18 BK/LB
K4 18 BK/LB
1
SENSOR GROUND
LINE PRESSURE SENSOR SIGNAL
5V SUPPLY
LINE PRESSURE SENSOR (A/T)
3
2
2
SENSOR GROUND
4WD SWITCH SENSE
4WD SWITCH
1
K6 18 VT/WT
S154 (8W-30-55)
K77 18 BR/WT
T38 18 VT/TN
K6 18 VT/WT
K22 18 OR/DB
K7 18 OR
26 C2
31 C4
27 C1
21 C2
29 C2
4WD SWITCH SENSE
LINE PRESSURE SENSOR SIGNAL
5V SUPPLY
THROTTLE POSITION SENSOR SIGNAL
5V SUPPLY
POWERTRAIN CONTROL MODULE

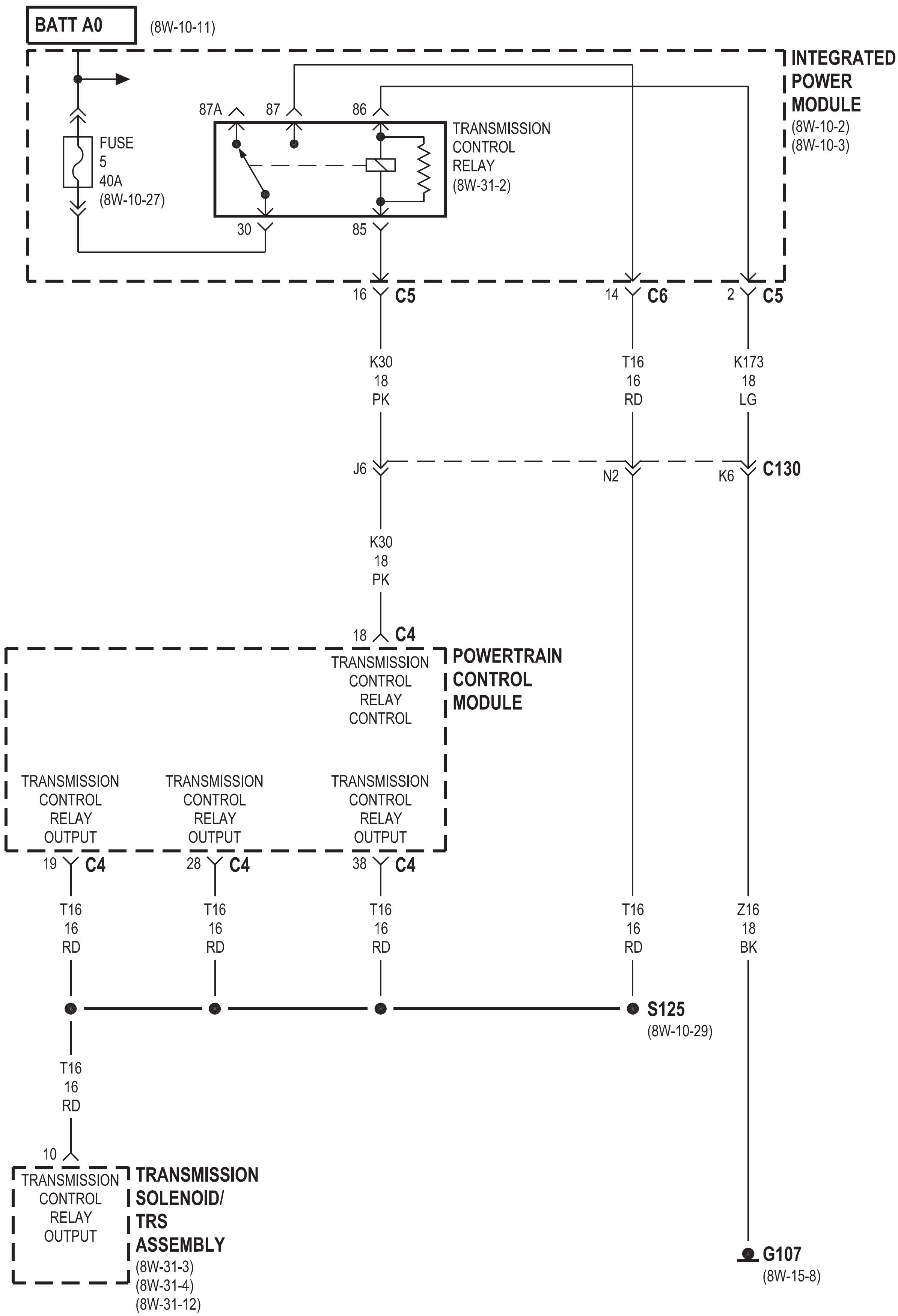

POWERTRAIN CONTROL MODULE
OXYGEN SENSOR 1/2 HEATER CONTROL
OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
OXYGEN SENSOR 2/2 HEATER CONTROL
9 C3
32 C2
10 C3
K902 18 BR/DG
EXCEPT CALIFORNIA
CALIFORNIA
S168
K199 18 BR/VT
K902 18 BR/DG
K902 18 BR/DG
K399 18 BR/GY
1
3
3
1
OXYGEN SENSOR 1/2 DOWNSTREAM
OXYGEN SENSOR 2/2 DOWNSTREAM (CALIFORNIA)
2
4
4
2
Z188 18 BK/LB
K141 18 TN/WT
K341 18 TN/WT
Z186 18 BK/LB
31 C1
33 C1
OXYGEN SENSOR 1/2 SIGNAL
OXYGEN SENSOR 2/2 SIGNAL
POWERTRAIN CONTROL MODULE
G107
(8W-15-9)

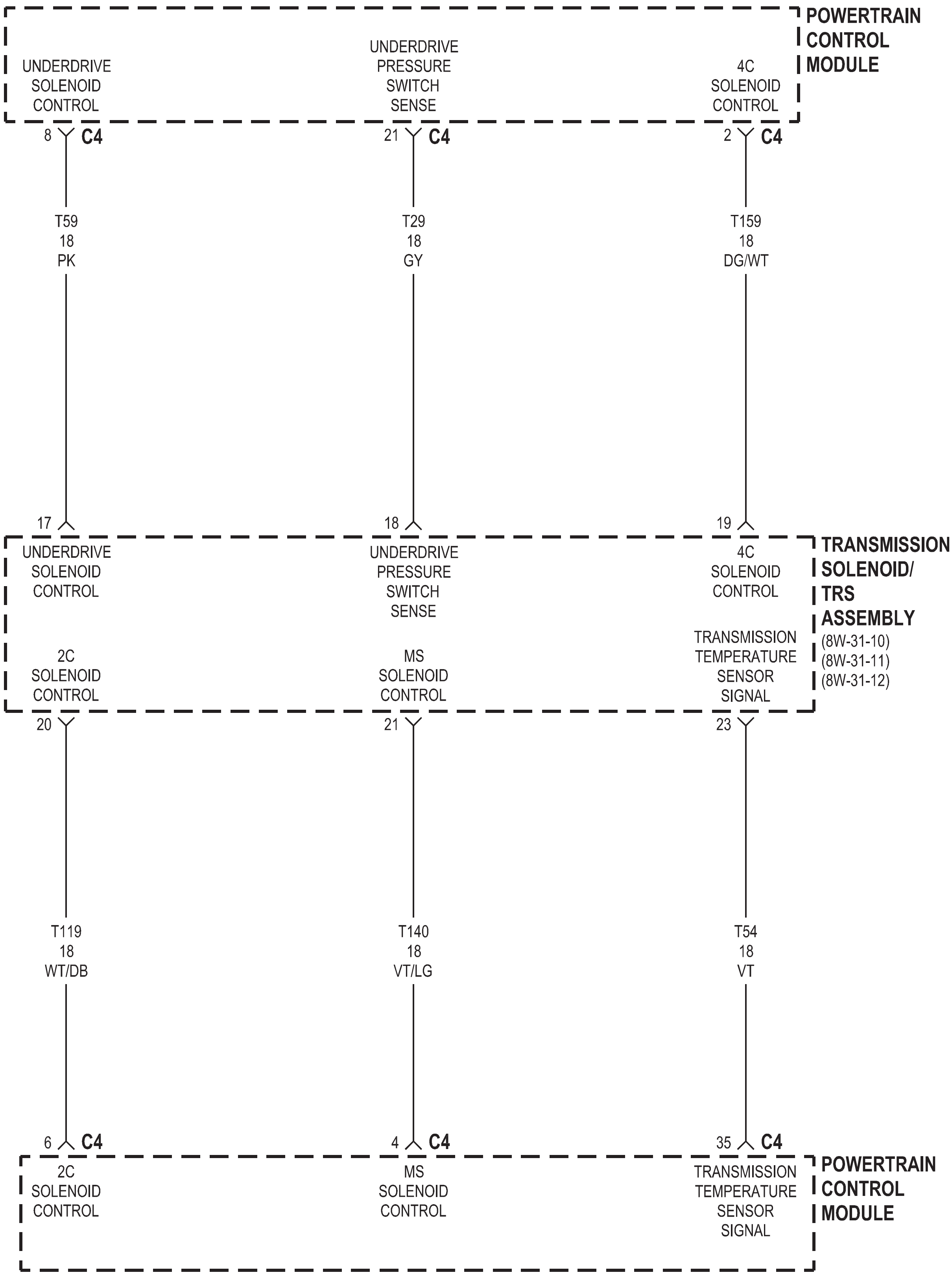

FUSED IGNITION SWITCH OUTPUT (OFF-RUN-START)
IGNITION SWITCH
(8W-10-26)
2
15
9
DATA LINK CONNECTOR
(8W-18-2)
A51 16 RD/WT
D15 18 WT/DG
D6 18 PK/LB
S210
(8W-40-13)
2
44
C219
A51 16 RD/WT
4
C219
A51 16 RD/WT
D15 18 WT/DG
D6 18 PK/LB
N6
D2
F2
C130
A51 16 RD/WT
D15 18 WT/DG
D6 18 PK/LB
12 C1
37 C1
26 C1
FUSED IGNITION SWITCH OUTPUT (OFF-RUN-START)
PCI BUS
PCI BUS
POWERTRAIN CONTROL MODULE

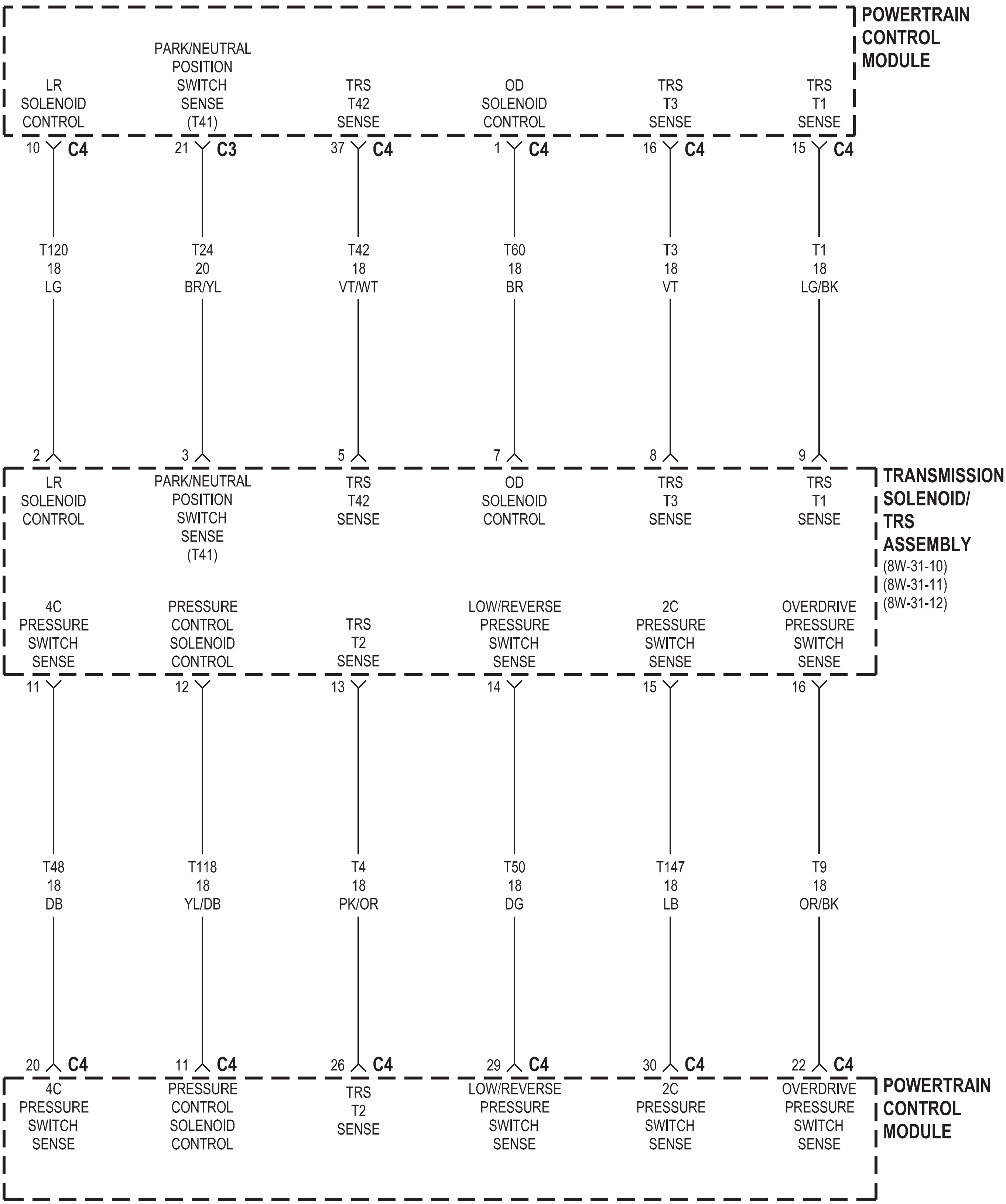

POWERTRAIN CONTROL MODULE
OXYGEN SENSOR 1/1 SIGNAL
FUSED AUTOMATIC SHUT DOWN RELAY OUTPUT
OXYGEN SENSOR 2/1 HEATER CONTROL
18 C2
32 C1
17 C2
Y213 18 PK/LB
EXCEPT CALIFORNIA
CALIFORNIA
S169
K41 18 BR/DG
Y213 18 PK/LB
Y213 18 PK/LB
K299 18 BR/WT
1
3
3
1
OXYGEN SENSOR 1/1 UPSTREAM
OXYGEN SENSOR 2/1 UPSTREAM (CALIFORNIA)
2
4
4
2
Z192 18 BK/WT
K99 18 BR/OR
K241 18 LG/RD
Z193 18 BK/DG
31 C2
33 C2
OXYGEN SENSOR 1/1 HEATER CONTROL
OXYGEN SENSOR 2/1 SIGNAL
POWERTRAIN CONTROL MODULE
G107
(8W-15-9)

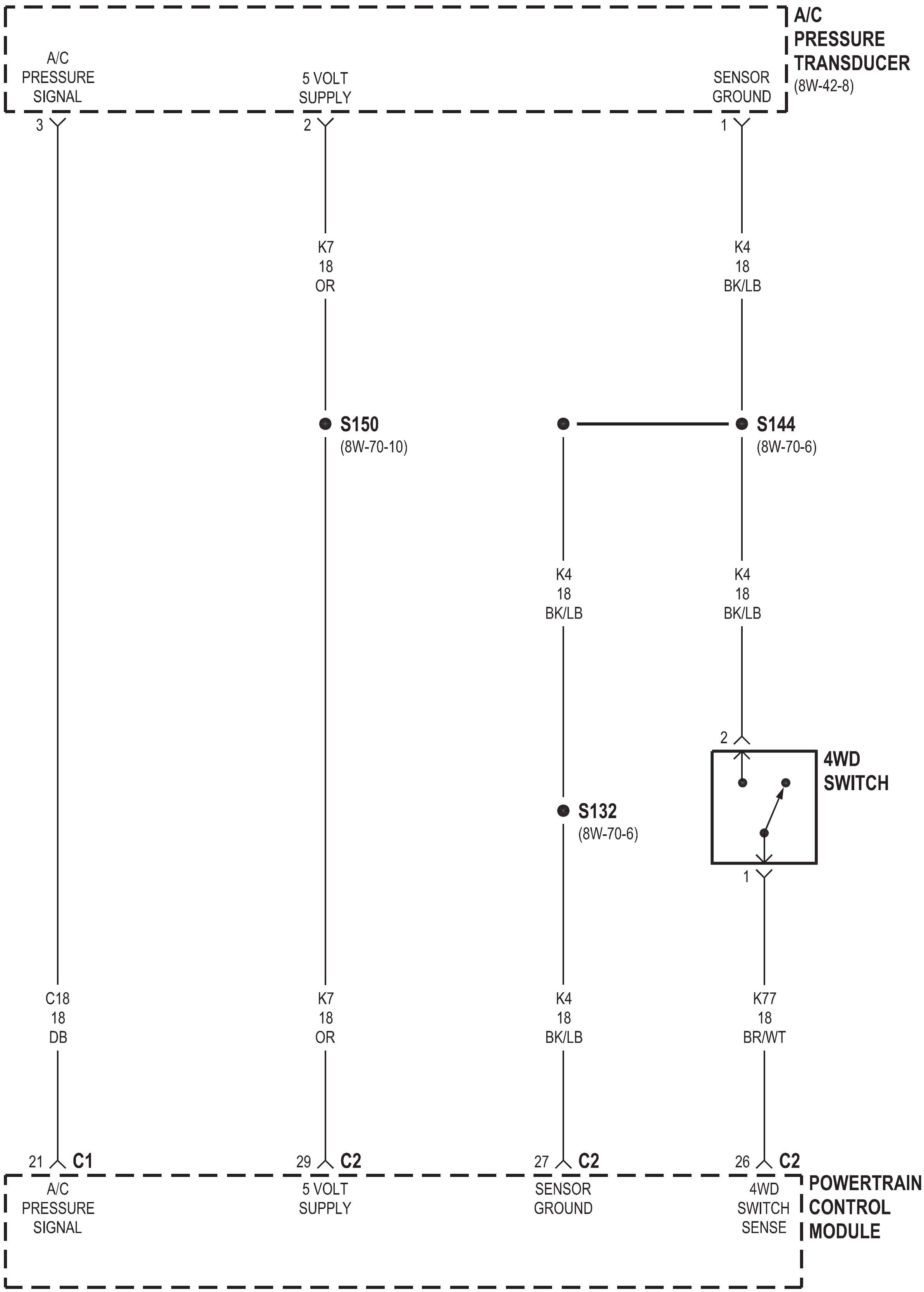

A/C PRESSURE TRANSDUCER
(8W-42-8)
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
3
2
1
K7 18 OR
K4 18 BK/LB
S150
(8W-70-10)
S130
(8W-70-5)
K4 18 BK/LB
S132
(8W-70-5)
K4 20 BK/LB
K4 18 BK/LB
K4 18 BK/LB
MANIFOLD ABSOLUTE PRESSURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
K6 18 VT/WT
S154
(8W-30-55)
C18 18 DB
K7 18 OR
K4 18 BK/LB
K1 18 DG/RD
K6 18 VT/WT
K2 18 TN/BK
K21 18 BK/RD
21 C1
29 C2
27 C2
23 C2
27 C1
20 C2
30 C2
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

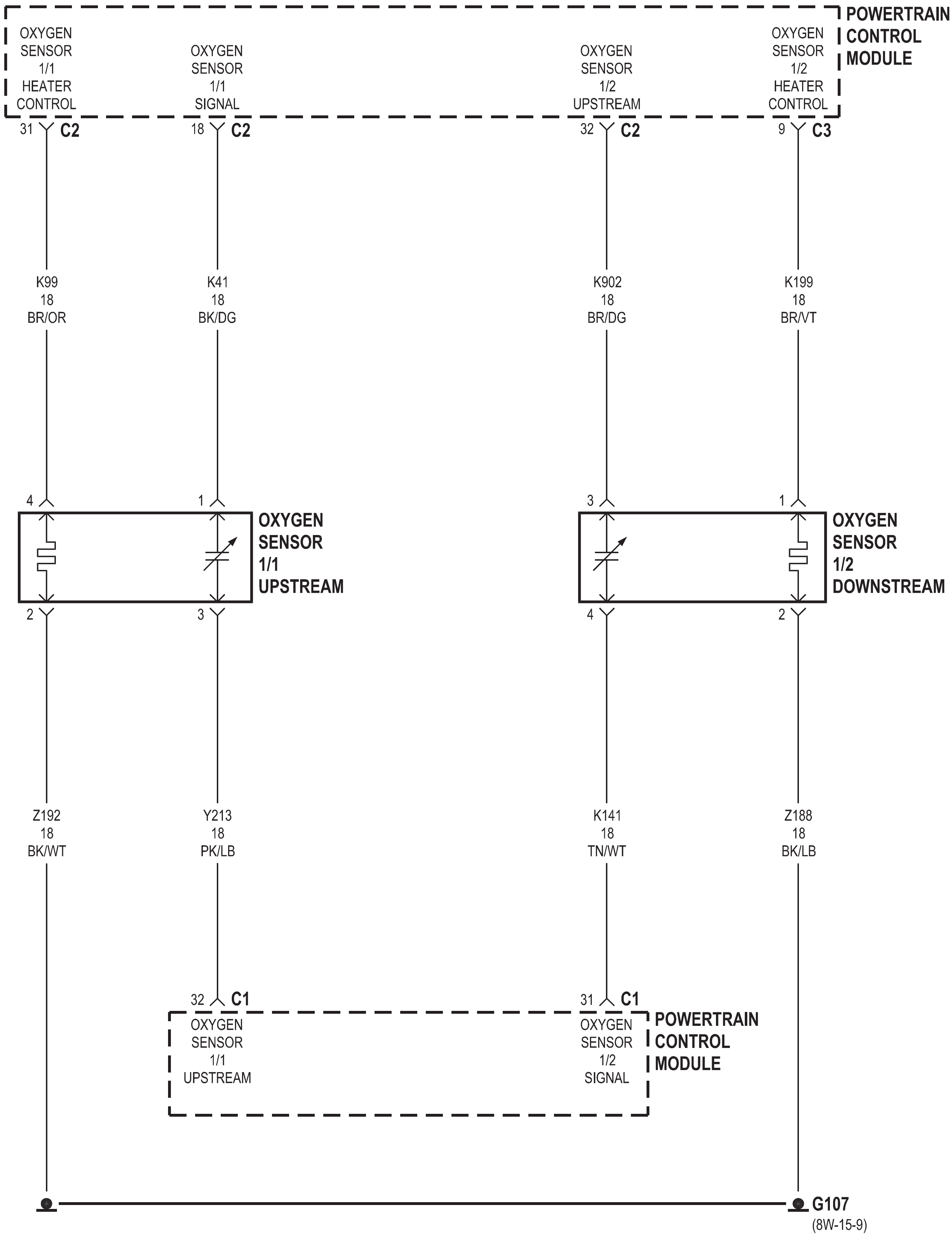

INPUT SPEED SENSOR SIGNAL
SPEED SENSOR GROUND
INPUT SPEED SENSOR
(8W-31-14)
1
2
TWISTED PAIR
SPEED SENSOR GROUND
OUTPUT SPEED SENSOR SIGNAL
OUTPUT SPEED SENSOR
(8W-31-14)
1
2
TWISTED PAIR
T13
18
DB/BK
T13
18
DB/BK
S134
T52
18
RD/BK
T13
18
DB/BK
T14
18
LG/WT
33
C4
34
C4
32
C4
INPUT SPEED SENSOR SIGNAL
SPEED SENSOR GROUND
OUTPUT SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

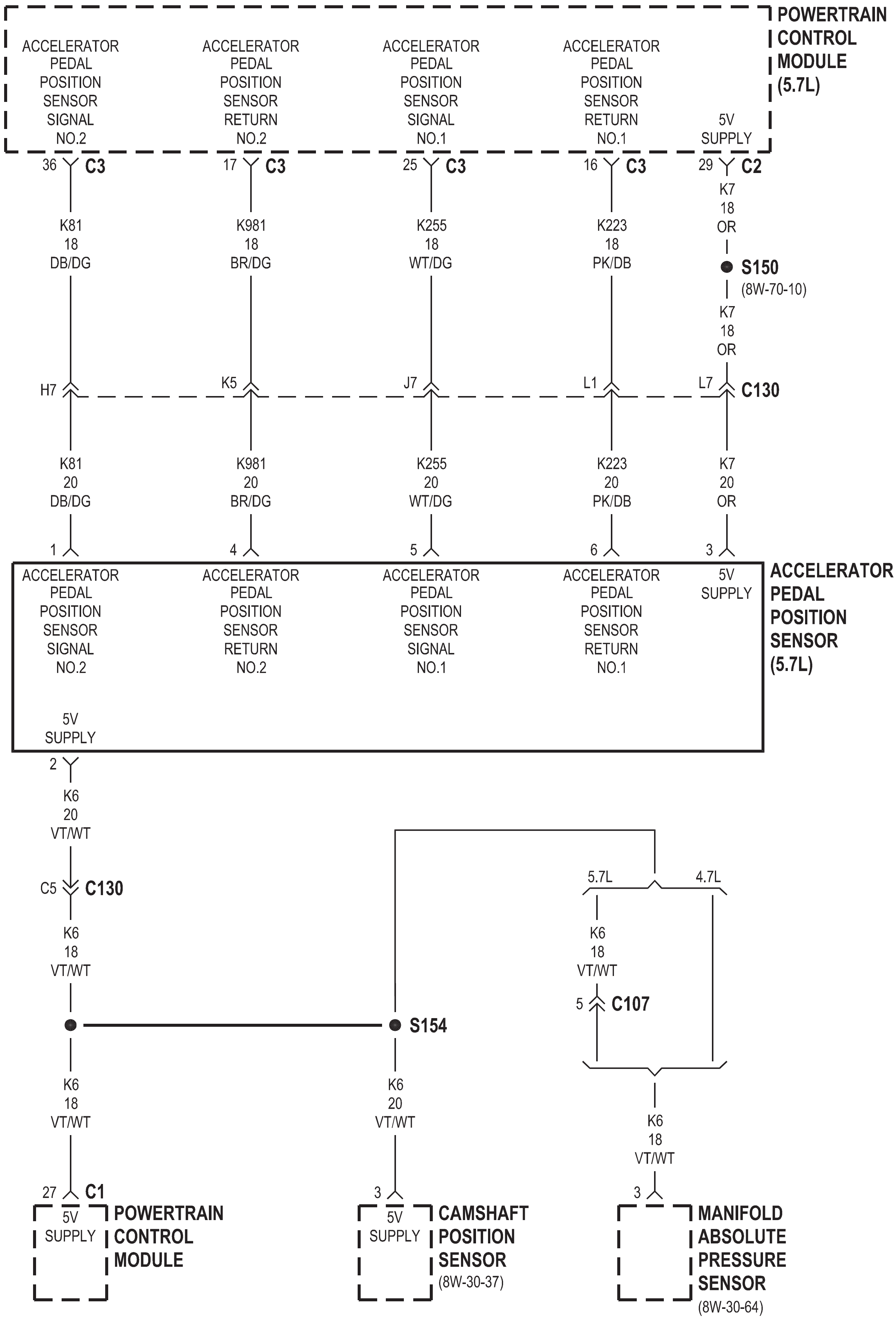

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
(8W-10-27)
87A
87
86
30
85
TRANSMISSION CONTROL RELAY
(8W-31-2)
16
C5
14
C6
2
C5
K30
18
PK
T16
16
RD
K173
18
LG
J6
N2
K6
C130
K30
18
PK
18
C4
TRANSMISSION CONTROL RELAY CONTROL
POWERTRAIN CONTROL MODULE
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
19
C4
28
C4
38
C4
T16
16
RD
T16
16
RD
T16
16
RD
T16
16
RD
Z16
18
BK
S125
(8W-10-29)
T16
16
RD
10
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-3)
(8W-31-4)
(8W-31-12)
G107
(8W-15-8)

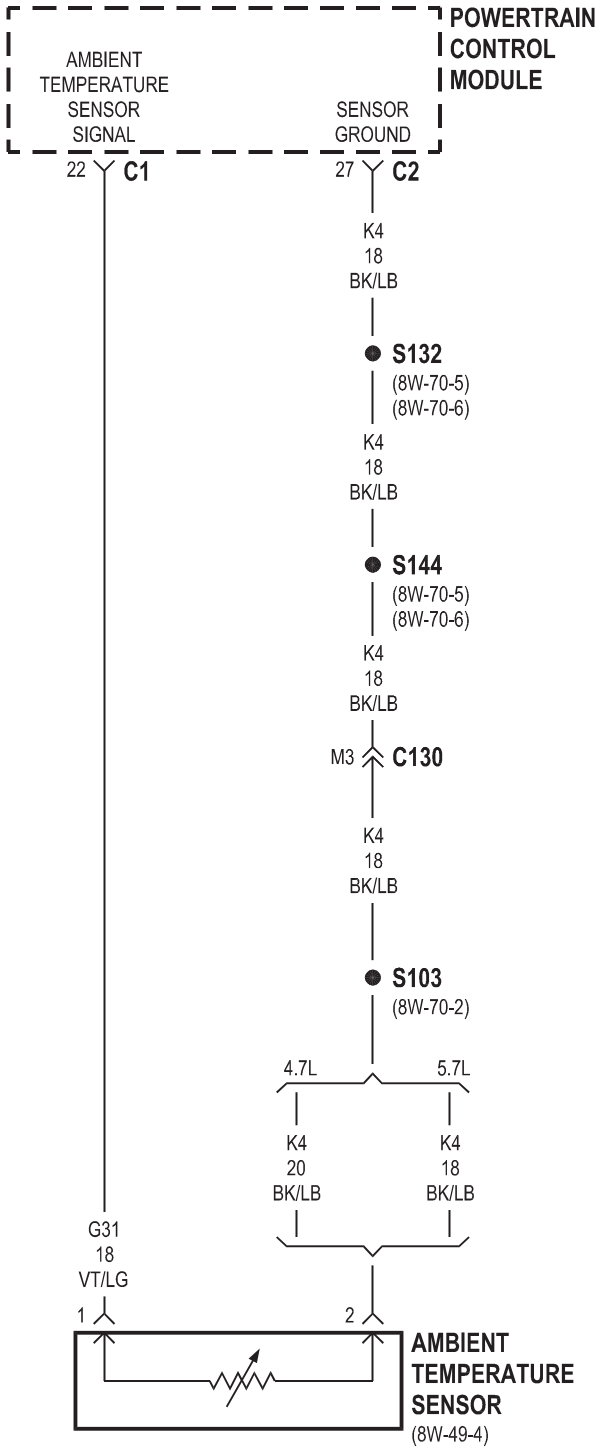

POWERTRAIN CONTROL MODULE
UNDERDRIVE SOLENOID CONTROL
UNDERDRIVE PRESSURE SWITCH SENSE
4C SOLENOID CONTROL
8 C4
21 C4
2 C4
T59 18 PK
T29 18 GY
T159 18 DG/WT
17
18
19
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-10)
(8W-31-11)
(8W-31-12)
UNDERDRIVE SOLENOID CONTROL
UNDERDRIVE PRESSURE SWITCH SENSE
4C SOLENOID CONTROL
2C SOLENOID CONTROL
MS SOLENOID CONTROL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
20
21
23
T119 18 WT/DB
T140 18 VT/LG
T54 18 VT
6 C4
4 C4
35 C4
POWERTRAIN CONTROL MODULE
2C SOLENOID CONTROL
MS SOLENOID CONTROL
TRANSMISSION TEMPERATURE SENSOR SIGNAL

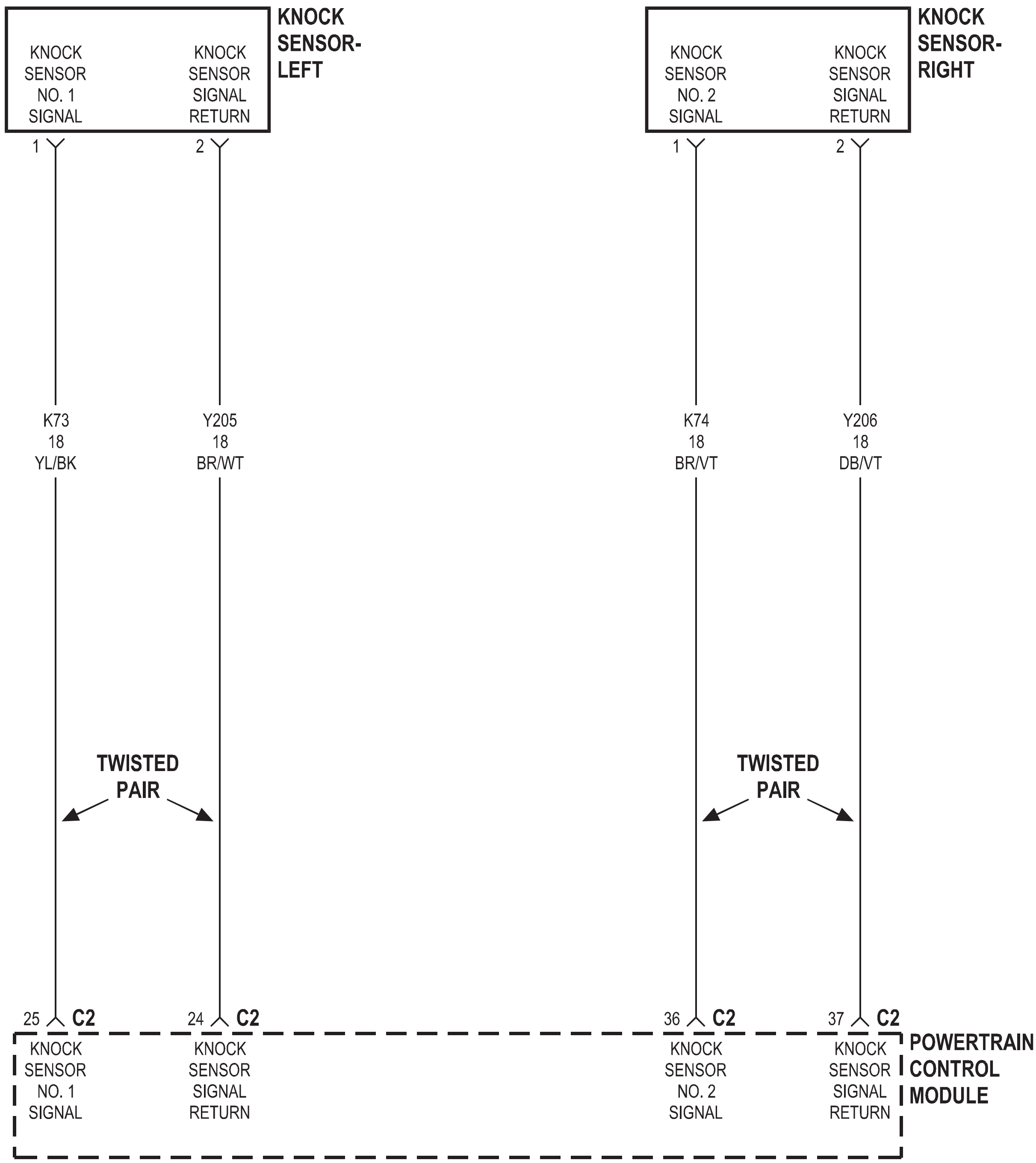

POWERTRAIN CONTROL MODULE
LR SOLENOID CONTROL
PARK/NEUTRAL POSITION SWITCH SENSE (T41)
TRS T42 SENSE
OD SOLENOID CONTROL
TRS T3 SENSE
TRS T1 SENSE
10 C4
21 C3
37 C4
1 C4
16 C4
15 C4
T120 18 LG
T24 20 BR/YL
T42 18 VT/WT
T60 18 BR
T3 18 VT
T1 18 LG/BK
2
3
5
7
8
9
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-10)
(8W-31-11)
(8W-31-12)
LR SOLENOID CONTROL
PARK/NEUTRAL POSITION SWITCH SENSE (T41)
TRS T42 SENSE
OD SOLENOID CONTROL
TRS T3 SENSE
TRS T1 SENSE
4C PRESSURE SWITCH SENSE
PRESSURE CONTROL SOLENOID CONTROL
TRS T2 SENSE
LOW/REVERSE PRESSURE SWITCH SENSE
2C PRESSURE SWITCH SENSE
OVERDRIVE PRESSURE SWITCH SENSE
11
12
13
14
15
16
T48 18 DB
T118 18 YL/DB
T4 18 PK/OR
T50 18 DG
T147 18 LB
T9 18 OR/BK
20 C4
11 C4
26 C4
29 C4
30 C4
22 C4
4C PRESSURE SWITCH SENSE
PRESSURE CONTROL SOLENOID CONTROL
TRS T2 SENSE
LOW/REVERSE PRESSURE SWITCH SENSE
2C PRESSURE SWITCH SENSE
OVERDRIVE PRESSURE SWITCH SENSE
POWERTRAIN CONTROL MODULE


A/C PRESSURE TRANSDUCER
(8W-42-8)
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
3
2
1
K7
18
OR
K4
18
BK/LB
S150
(8W-70-10)
S144
(8W-70-6)
K4
18
BK/LB
K4
18
BK/LB
2
4WD SWITCH
S132
(8W-70-6)
1
C18
18
DB
K7
18
OR
K4
18
BK/LB
K77
18
BR/WT
21 C1
29 C2
27 C2
26 C2
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
4WD SWITCH SENSE
POWERTRAIN CONTROL MODULE

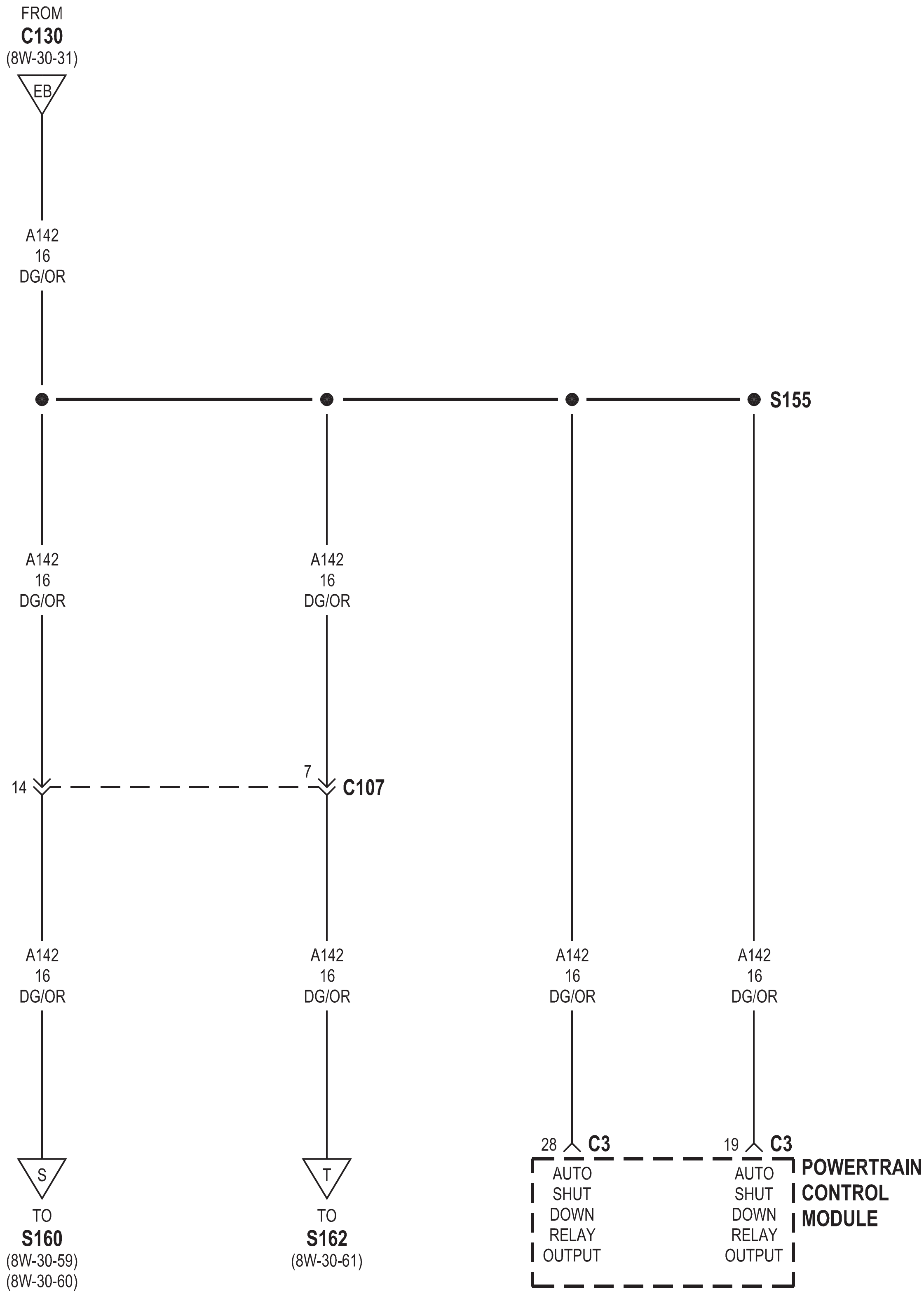

POWERTRAIN
CONTROL
MODULE
OXYGEN
SENSOR
1/1
HEATER
CONTROL
OXYGEN
SENSOR
1/1
SIGNAL
OXYGEN
SENSOR
1/2
UPSTREAM
OXYGEN
SENSOR
1/2
HEATER
CONTROL
31 C2
18 C2
32 C2
9 C3
K99
18
BR/OR
K41
18
BK/DG
K902
18
BR/DG
K199
18
BR/VT
4
1
3
1
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
1/2
DOWNSTREAM
2
3
4
2
Z192
18
BK/WT
Y213
18
PK/LB
K141
18
TN/WT
Z188
18
BK/LB
32 C1
31 C1
OXYGEN
SENSOR
1/1
UPSTREAM
OXYGEN
SENSOR
1/2
SIGNAL
POWERTRAIN
CONTROL
MODULE
G107
(8W-15-9)


POWERTRAIN CONTROL MODULE (5.7L)
ACCELERATOR PEDAL POSITION SENSOR SIGNAL NO.2
ACCELERATOR PEDAL POSITION SENSOR RETURN NO.2
ACCELERATOR PEDAL POSITION SENSOR SIGNAL NO.1
ACCELERATOR PEDAL POSITION SENSOR RETURN NO.1
5V SUPPLY
36 C3
17 C3
25 C3
16 C3
29 C2
K81 18 DB/DG
K981 18 BR/DG
K255 18 WT/DG
K223 18 PK/DB
K7 18 OR
S150
(8W-70-10)
K7 18 OR
H7
K5
J7
L1
L7
C130
K81 20 DB/DG
K981 20 BR/DG
K255 20 WT/DG
K223 20 PK/DB
K7 20 OR
1
4
5
6
3
ACCELERATOR PEDAL POSITION SENSOR (5.7L)
ACCELERATOR PEDAL POSITION SENSOR SIGNAL NO.2
ACCELERATOR PEDAL POSITION SENSOR RETURN NO.2
ACCELERATOR PEDAL POSITION SENSOR SIGNAL NO.1
ACCELERATOR PEDAL POSITION SENSOR RETURN NO.1
5V SUPPLY
5V SUPPLY
2
K6 20 VT/WT
C5 C130
K6 18 VT/WT
5.7L
4.7L
K6 18 VT/WT
5 C107
S154
K6 18 VT/WT
K6 20 VT/WT
K6 18 VT/WT
27 C1
3
3
5V SUPPLY
POWERTRAIN CONTROL MODULE
5V SUPPLY
CAMSHAFT POSITION SENSOR
(8W-30-37)
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-64)

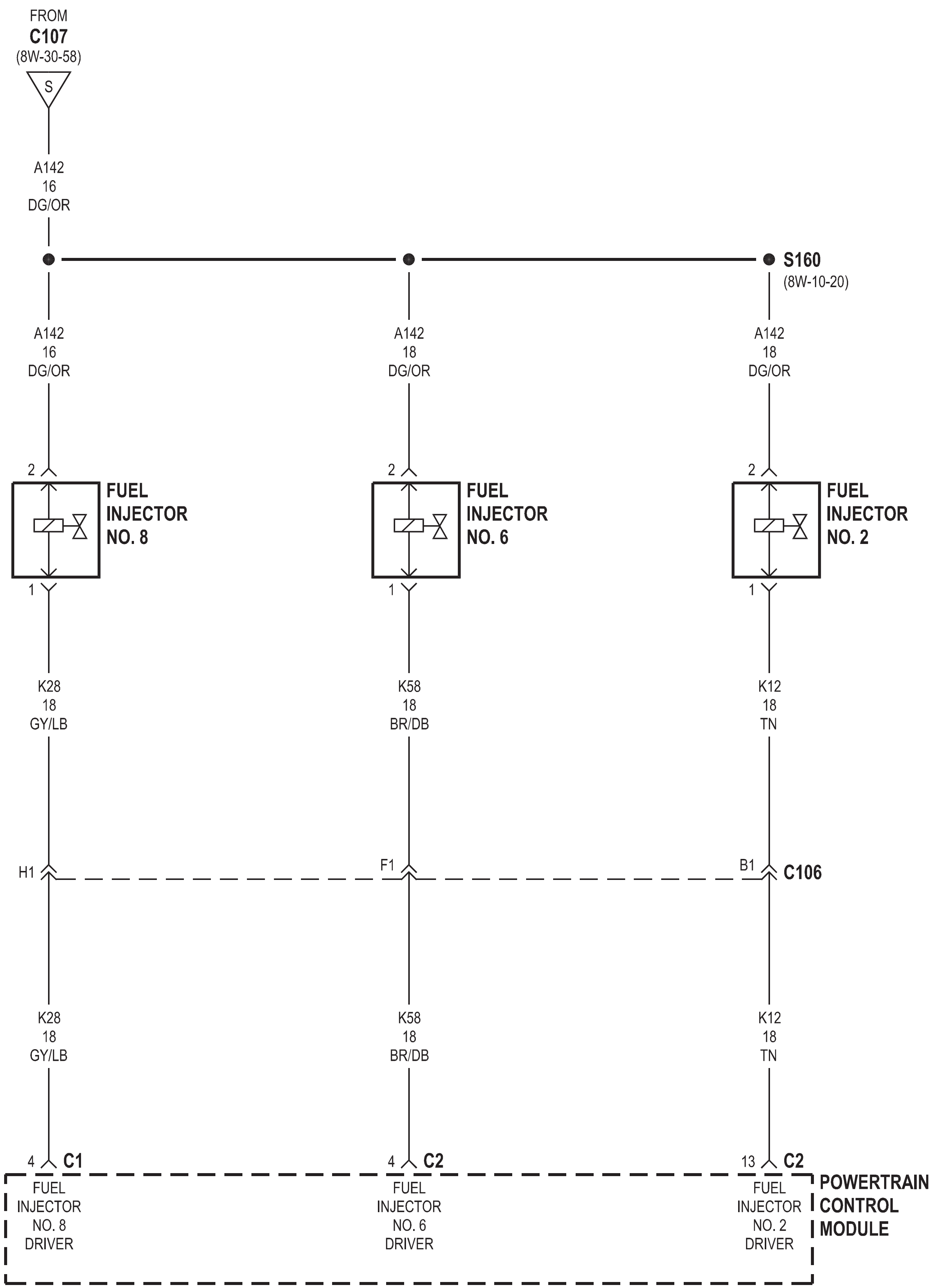

POWERTRAIN
CONTROL
MODULE
AMBIENT
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
22
C1
27
C2
K4
18
BK/LB
S132
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
S144
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
M3
C130
K4
18
BK/LB
S103
(8W-70-2)
4.7L
5.7L
K4
20
BK/LB
K4
18
BK/LB
G31
18
VT/LG
1
2
AMBIENT
TEMPERATURE
SENSOR
(8W-49-4)

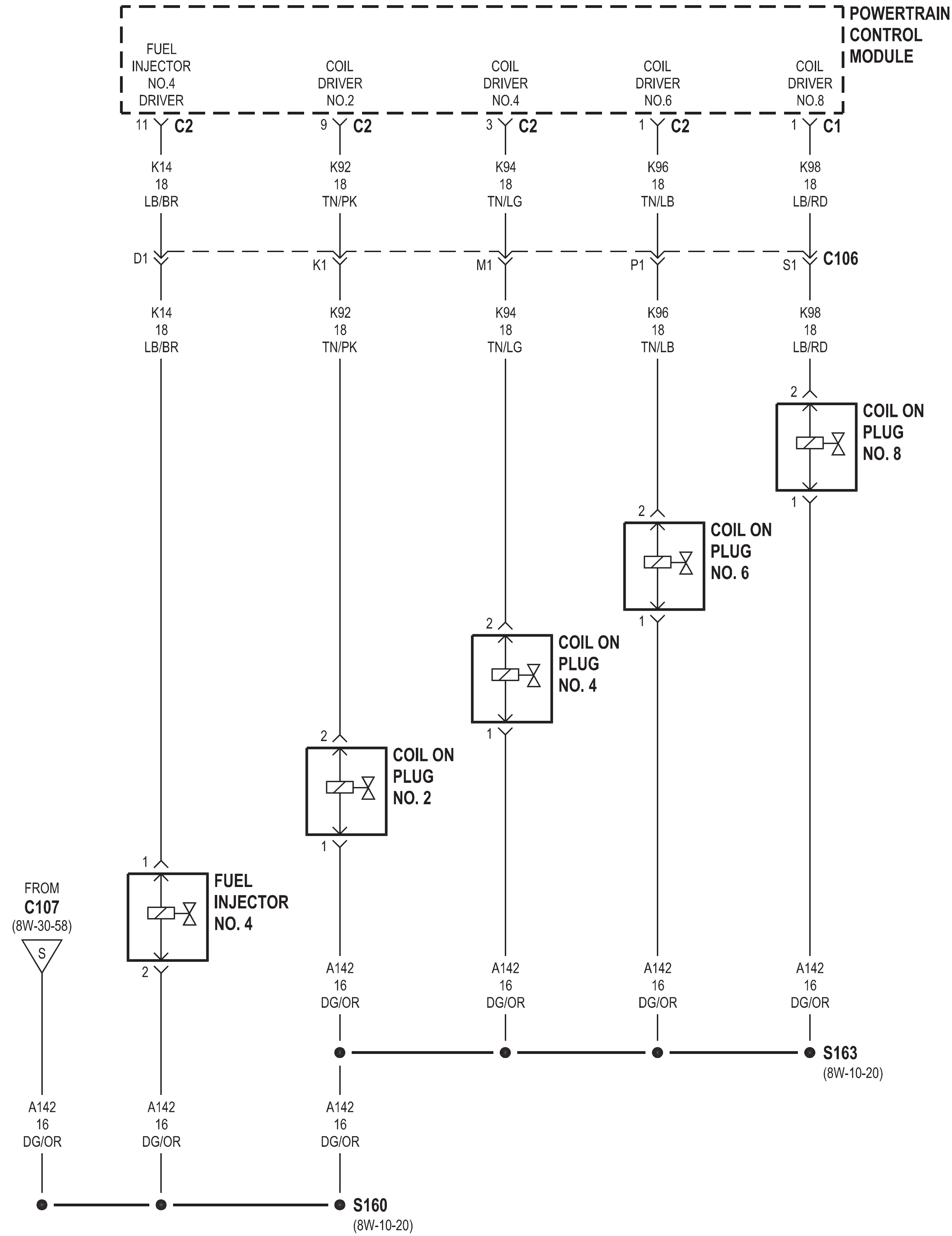


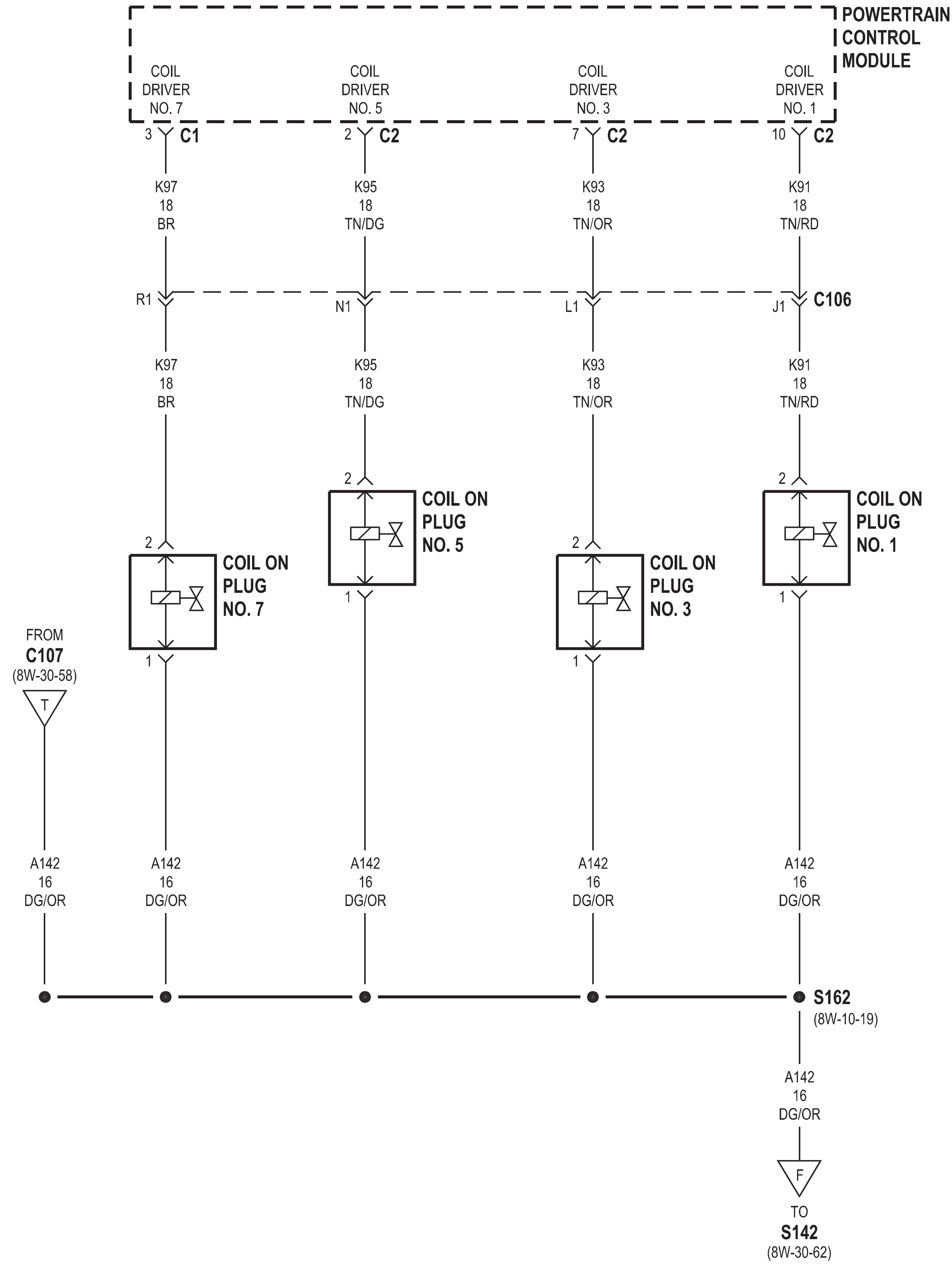
KNOCK SENSOR-LEFT
KNOCK SENSOR NO. 1 SIGNAL
KNOCK SENSOR SIGNAL RETURN
1
2
KNOCK SENSOR-RIGHT
KNOCK SENSOR NO. 2 SIGNAL
KNOCK SENSOR SIGNAL RETURN
1
2
K73 18 YL/BK
Y205 18 BR/WT
K74 18 BR/VT
Y206 18 DB/VT
TWISTED PAIR
TWISTED PAIR
25 C2
24 C2
36 C2
37 C2
POWERTRAIN CONTROL MODULE
KNOCK SENSOR NO. 1 SIGNAL
KNOCK SENSOR SIGNAL RETURN
KNOCK SENSOR NO. 2 SIGNAL
KNOCK SENSOR SIGNAL RETURN

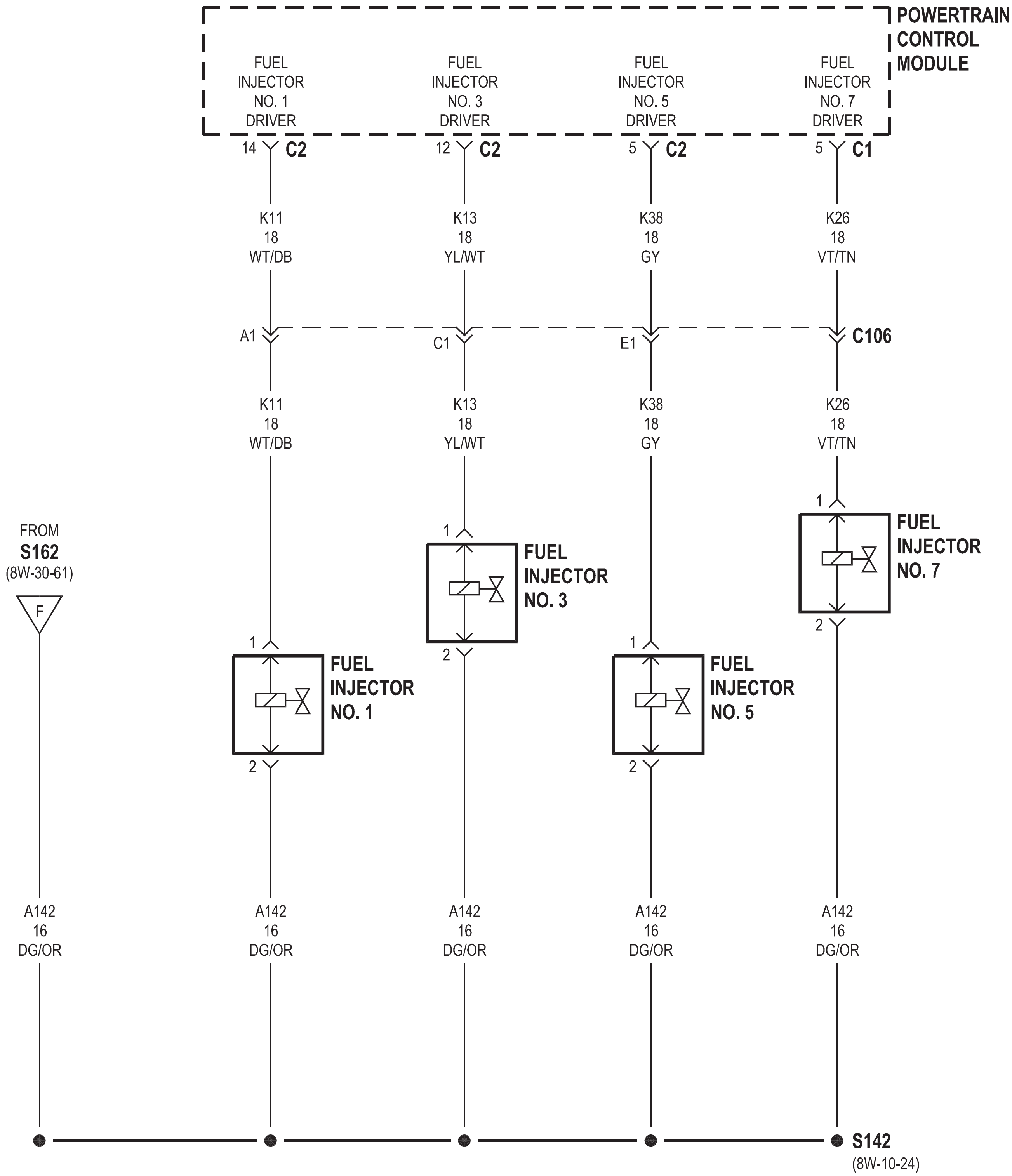


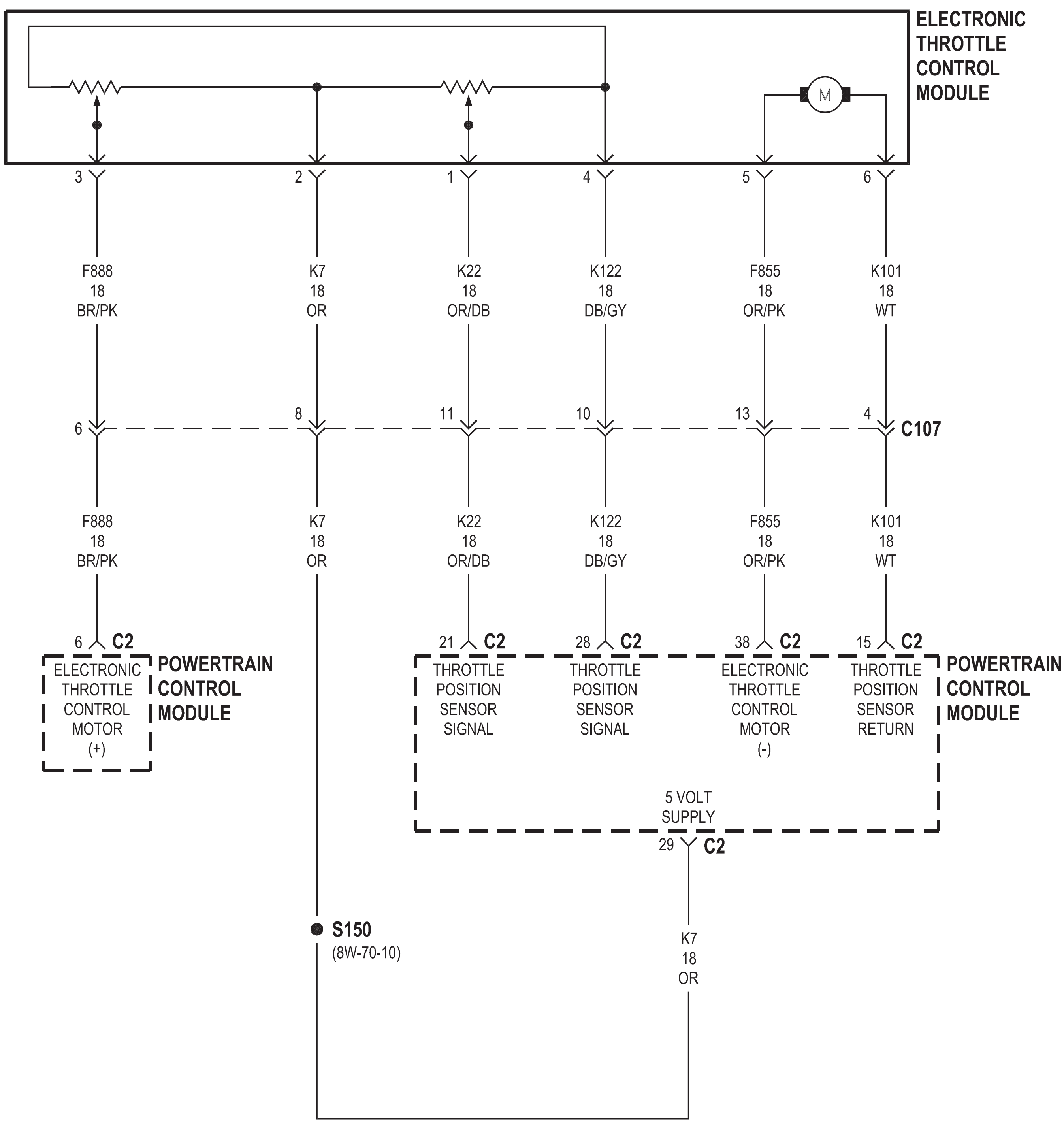
FROM
C130
(8W-30-31)
EB
A142
16
DG/OR
S155
A142
16
DG/OR
A142
16
DG/OR
14
7
C107
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
A142
16
DG/OR
S
TO
S160
(8W-30-59)
(8W-30-60)
T
TO
S162
(8W-30-61)
28
C3
19
C3
AUTO SHUT DOWN RELAY OUTPUT
AUTO SHUT DOWN RELAY OUTPUT
POWERTRAIN CONTROL MODULE

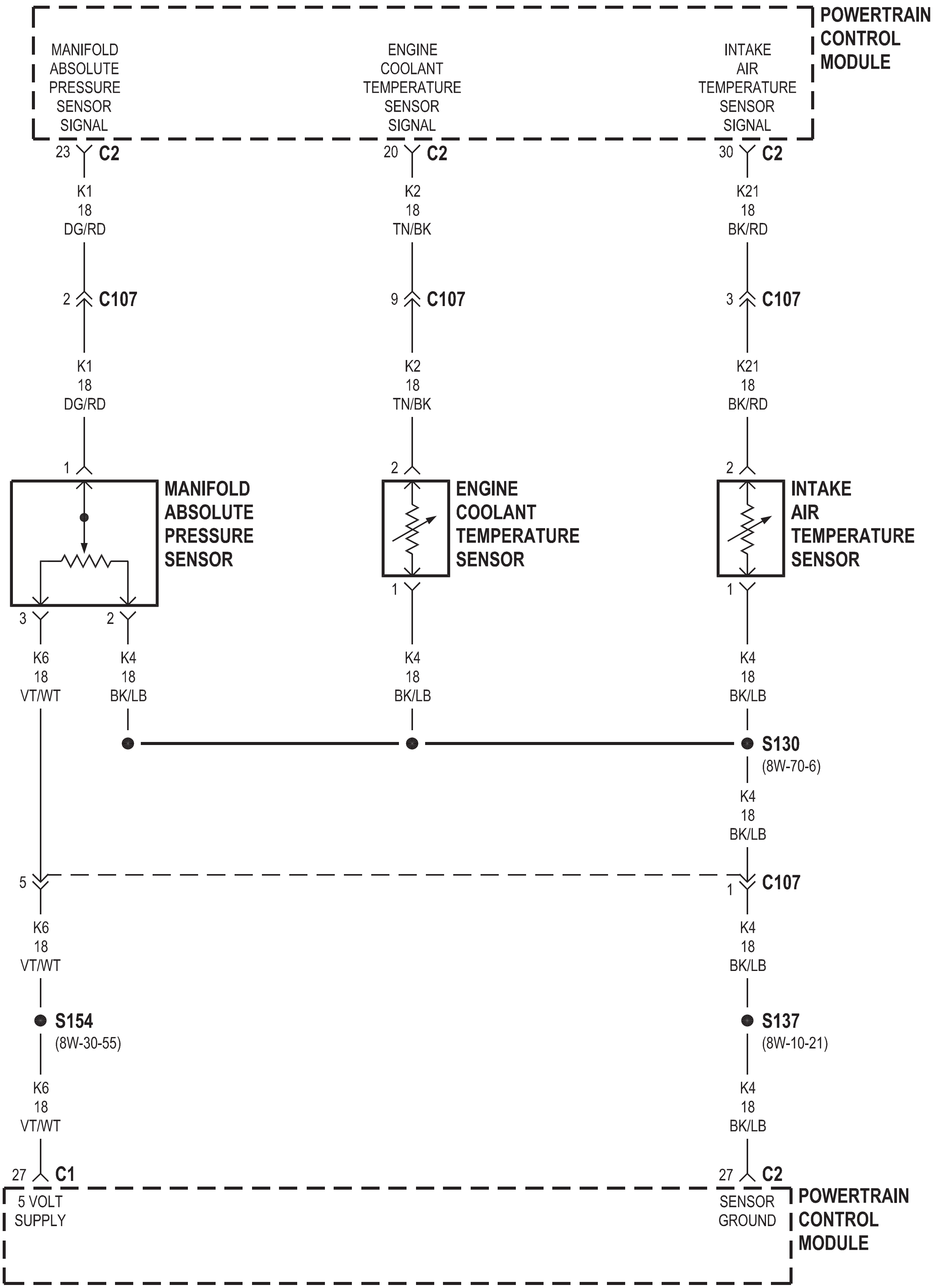

FROM
C107
(8W-30-58)
S
A142
16
DG/OR
S160
(8W-10-20)
A142
16
DG/OR
A142
18
DG/OR
A142
18
DG/OR
2
FUEL INJECTOR NO. 8
FUEL INJECTOR NO. 6
FUEL INJECTOR NO. 2
1
K28
18
GY/LB
K58
18
BR/DB
K12
18
TN
H1
F1
B1
C106
K28
18
GY/LB
K58
18
BR/DB
K12
18
TN
4 C1
4 C2
13 C2
FUEL INJECTOR NO. 8 DRIVER
FUEL INJECTOR NO. 6 DRIVER
FUEL INJECTOR NO. 2 DRIVER
POWERTRAIN CONTROL MODULE

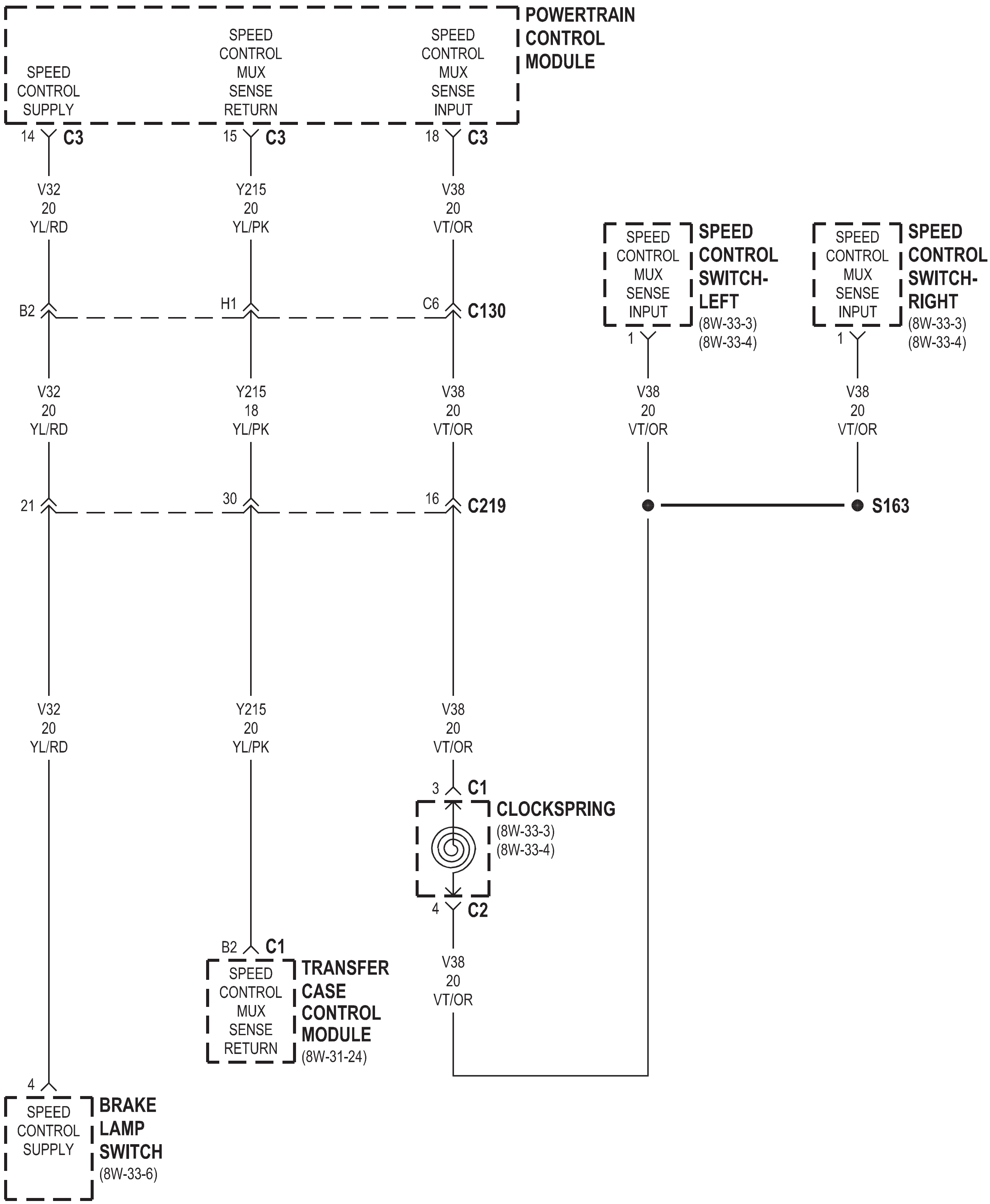

POWERTRAIN CONTROL MODULE
FUEL INJECTOR NO.4 DRIVER
COIL DRIVER NO.2
COIL DRIVER NO.4
COIL DRIVER NO.6
COIL DRIVER NO.8
11 C2
9 C2
3 C2
1 C2
1 C1
K14 18 LB/BR
K92 18 TN/PK
K94 18 TN/LG
K96 18 TN/LB
K98 18 LB/RD
D1
K1
M1
P1
S1
C106
K14 18 LB/BR
K92 18 TN/PK
K94 18 TN/LG
K96 18 TN/LB
K98 18 LB/RD
COIL ON PLUG NO. 8
COIL ON PLUG NO. 6
COIL ON PLUG NO. 4
COIL ON PLUG NO. 2
FUEL INJECTOR NO. 4
FROM C107 (8W-30-58)
S
A142 16 DG/OR
S163 (8W-10-20)
S160 (8W-10-20)

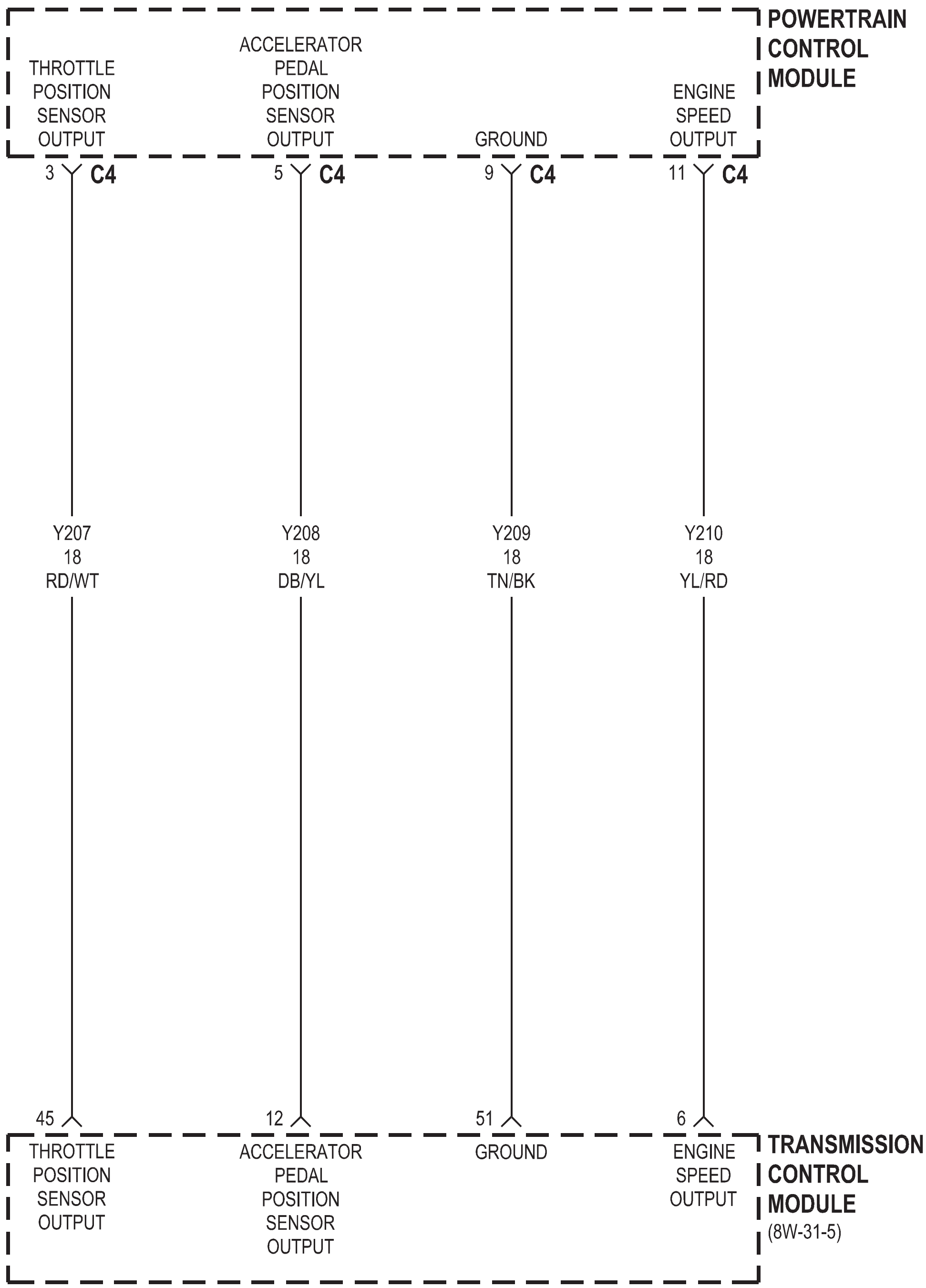

POWERTRAIN
CONTROL
MODULE
COIL DRIVER NO. 7
COIL DRIVER NO. 5
COIL DRIVER NO. 3
COIL DRIVER NO. 1
3 C1
2 C2
7 C2
10 C2
K97 18 BR
K95 18 TN/DG
K93 18 TN/OR
K91 18 TN/RD
R1
N1
L1
J1
C106
K97 18 BR
K95 18 TN/DG
K93 18 TN/OR
K91 18 TN/RD
COIL ON PLUG NO. 7
COIL ON PLUG NO. 5
COIL ON PLUG NO. 3
COIL ON PLUG NO. 1
FROM
C107
(8W-30-58)
T
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
A142 16 DG/OR
S162
(8W-10-19)
A142 16 DG/OR
F
TO
S142
(8W-30-62)

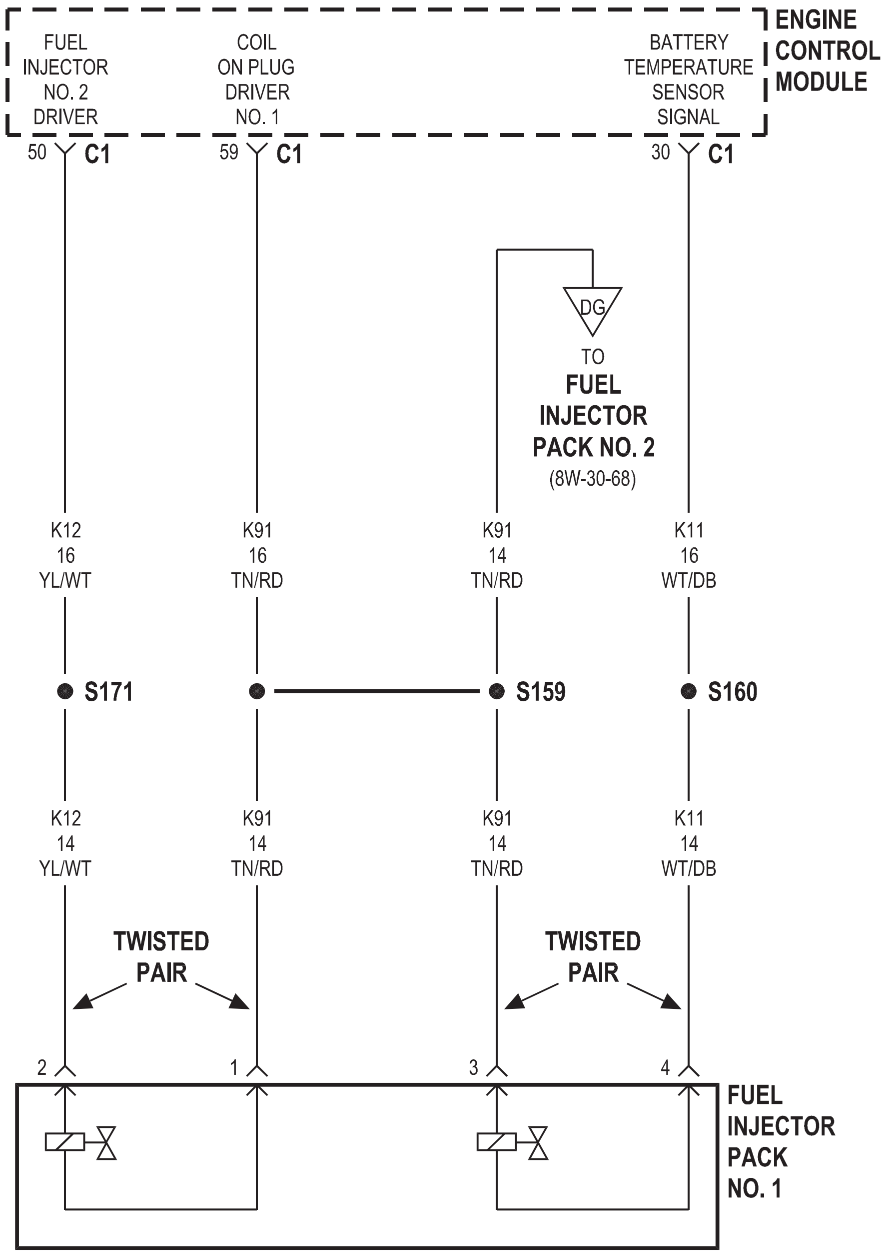

POWERTRAIN
CONTROL
MODULE
FUEL
INJECTOR
NO. 1
DRIVER
FUEL
INJECTOR
NO. 3
DRIVER
FUEL
INJECTOR
NO. 5
DRIVER
FUEL
INJECTOR
NO. 7
DRIVER
14 C2
12 C2
5 C2
5 C1
K11
18
WT/DB
K13
18
YL/WT
K38
18
GY
K26
18
VT/TN
A1
C1
E1
C106
K11
18
WT/DB
K13
18
YL/WT
K38
18
GY
K26
18
VT/TN
FROM
S162
(8W-30-61)
F
FUEL
INJECTOR
NO. 1
FUEL
INJECTOR
NO. 3
FUEL
INJECTOR
NO. 5
FUEL
INJECTOR
NO. 7
1
2
A142
16
DG/OR
S142
(8W-10-24)

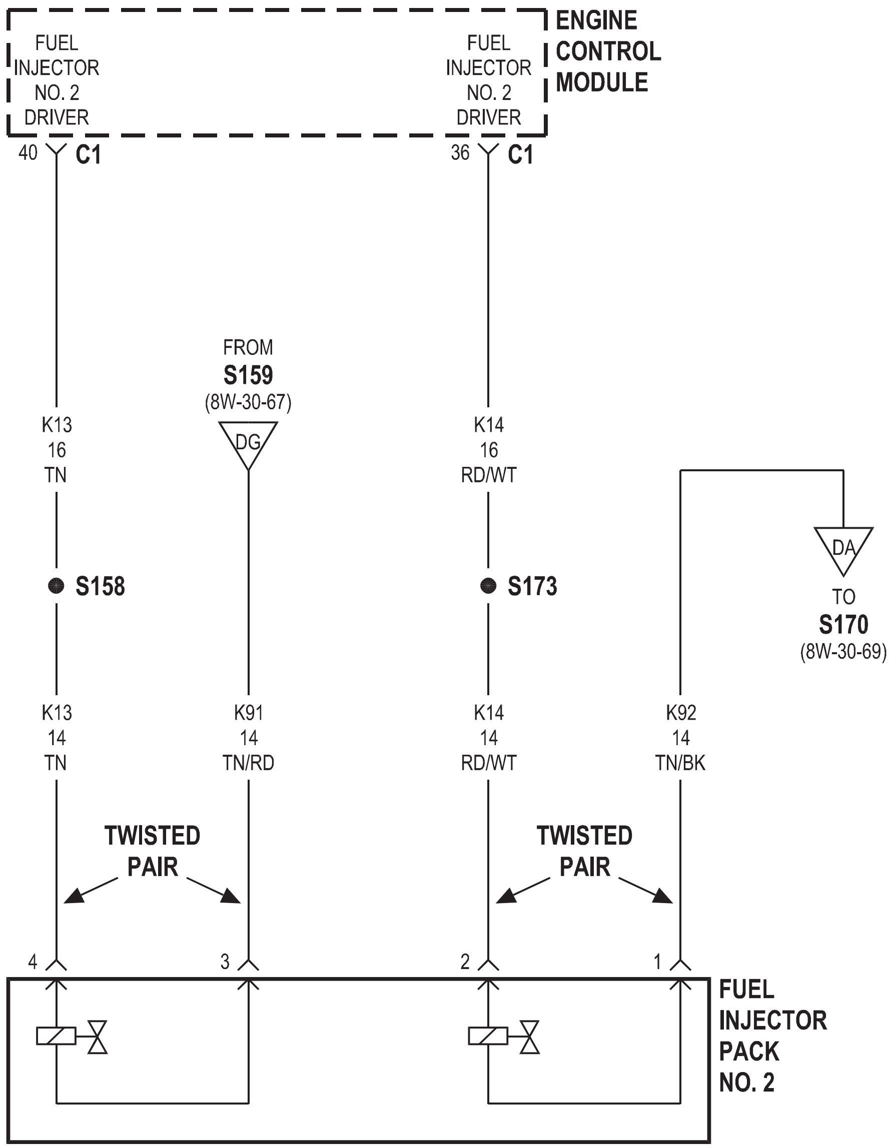

ELECTRONIC THROTTLE CONTROL MODULE
M
3
2
1
4
5
6
F888 18 BR/PK
K7 18 OR
K22 18 OR/DB
K122 18 DB/GY
F855 18 OR/PK
K101 18 WT
6
8
11
10
13
4
C107
F888 18 BR/PK
K7 18 OR
K22 18 OR/DB
K122 18 DB/GY
F855 18 OR/PK
K101 18 WT
6 C2
ELECTRONIC THROTTLE CONTROL MOTOR (+)
POWERTRAIN CONTROL MODULE
21 C2
28 C2
38 C2
15 C2
THROTTLE POSITION SENSOR SIGNAL
THROTTLE POSITION SENSOR SIGNAL
ELECTRONIC THROTTLE CONTROL MOTOR (-)
THROTTLE POSITION SENSOR RETURN
POWERTRAIN CONTROL MODULE
5 VOLT SUPPLY
29 C2
S150
(8W-70-10)
K7 18 OR


POWERTRAIN CONTROL MODULE
MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
INTAKE AIR TEMPERATURE SENSOR SIGNAL
23 C2
20 C2
30 C2
K1 18 DG/RD
K2 18 TN/BK
K21 18 BK/RD
2 C107
9 C107
3 C107
K1 18 DG/RD
K2 18 TN/BK
K21 18 BK/RD
1
2
2
MANIFOLD ABSOLUTE PRESSURE SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
INTAKE AIR TEMPERATURE SENSOR
3
2
1
1
K6 18 VT/WT
K4 18 BK/LB
K4 18 BK/LB
K4 18 BK/LB
S130
(8W-70-6)
K4 18 BK/LB
5
1 C107
K6 18 VT/WT
K4 18 BK/LB
S154
(8W-30-55)
S137
(8W-10-21)
K6 18 VT/WT
K4 18 BK/LB
27 C1
27 C2
5 VOLT SUPPLY
SENSOR GROUND
POWERTRAIN CONTROL MODULE

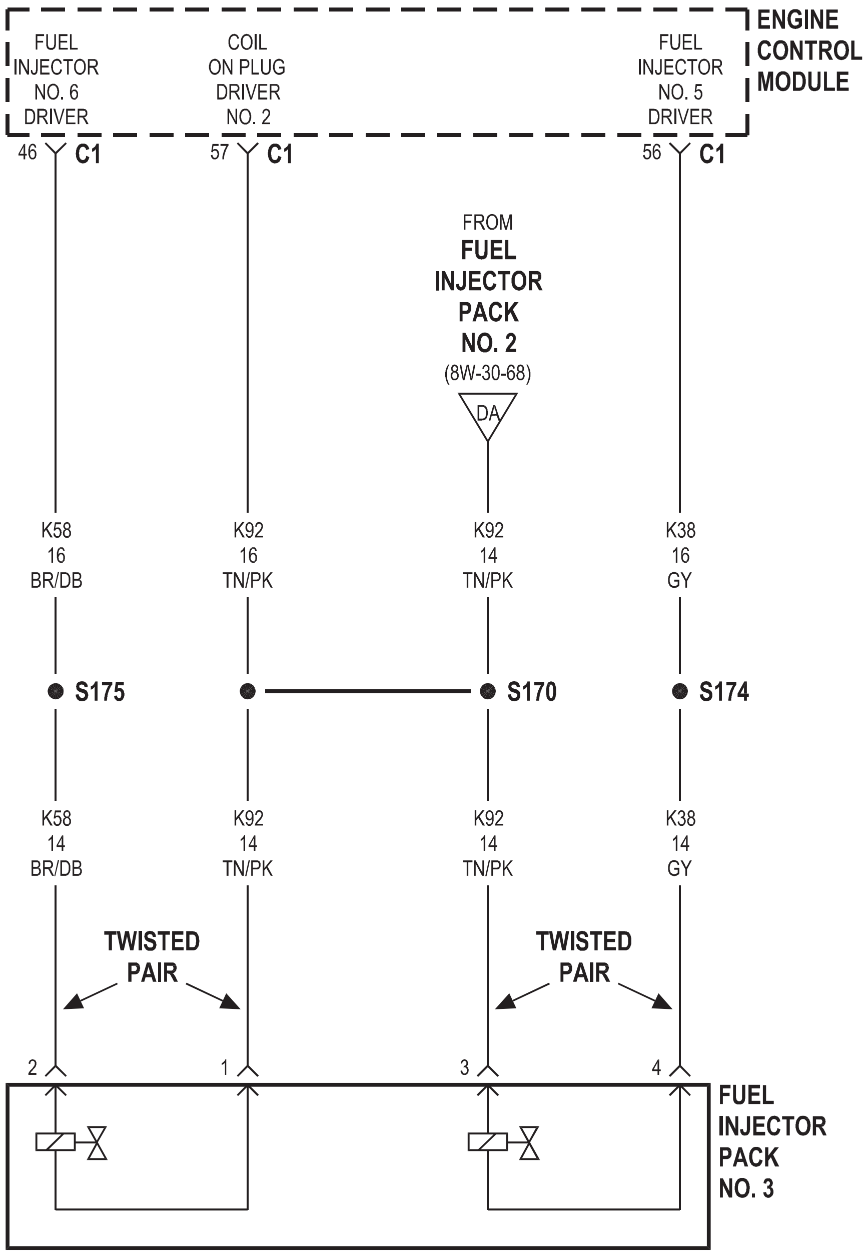

POWERTRAIN CONTROL MODULE
SPEED CONTROL SUPPLY
SPEED CONTROL MUX SENSE RETURN
SPEED CONTROL MUX SENSE INPUT
14 C3
15 C3
18 C3
V32 20 YL/RD
Y215 20 YL/PK
V38 20 VT/OR
B2
H1
C6
C130
V32 20 YL/RD
Y215 18 YL/PK
V38 20 VT/OR
21
30
16
C219
V32 20 YL/RD
Y215 20 YL/PK
V38 20 VT/OR
3 C1
CLOCKSPRING
(8W-33-3)
(8W-33-4)
4 C2
V38 20 VT/OR
B2 C1
SPEED CONTROL MUX SENSE RETURN
TRANSFER CASE CONTROL MODULE
(8W-31-24)
4
SPEED CONTROL SUPPLY
BRAKE LAMP SWITCH
(8W-33-6)
SPEED CONTROL MUX SENSE INPUT
SPEED CONTROL SWITCH-LEFT
(8W-33-3)
(8W-33-4)
1
V38 20 VT/OR
SPEED CONTROL MUX SENSE INPUT
SPEED CONTROL SWITCH-RIGHT
(8W-33-3)
(8W-33-4)
1
V38 20 VT/OR
S163

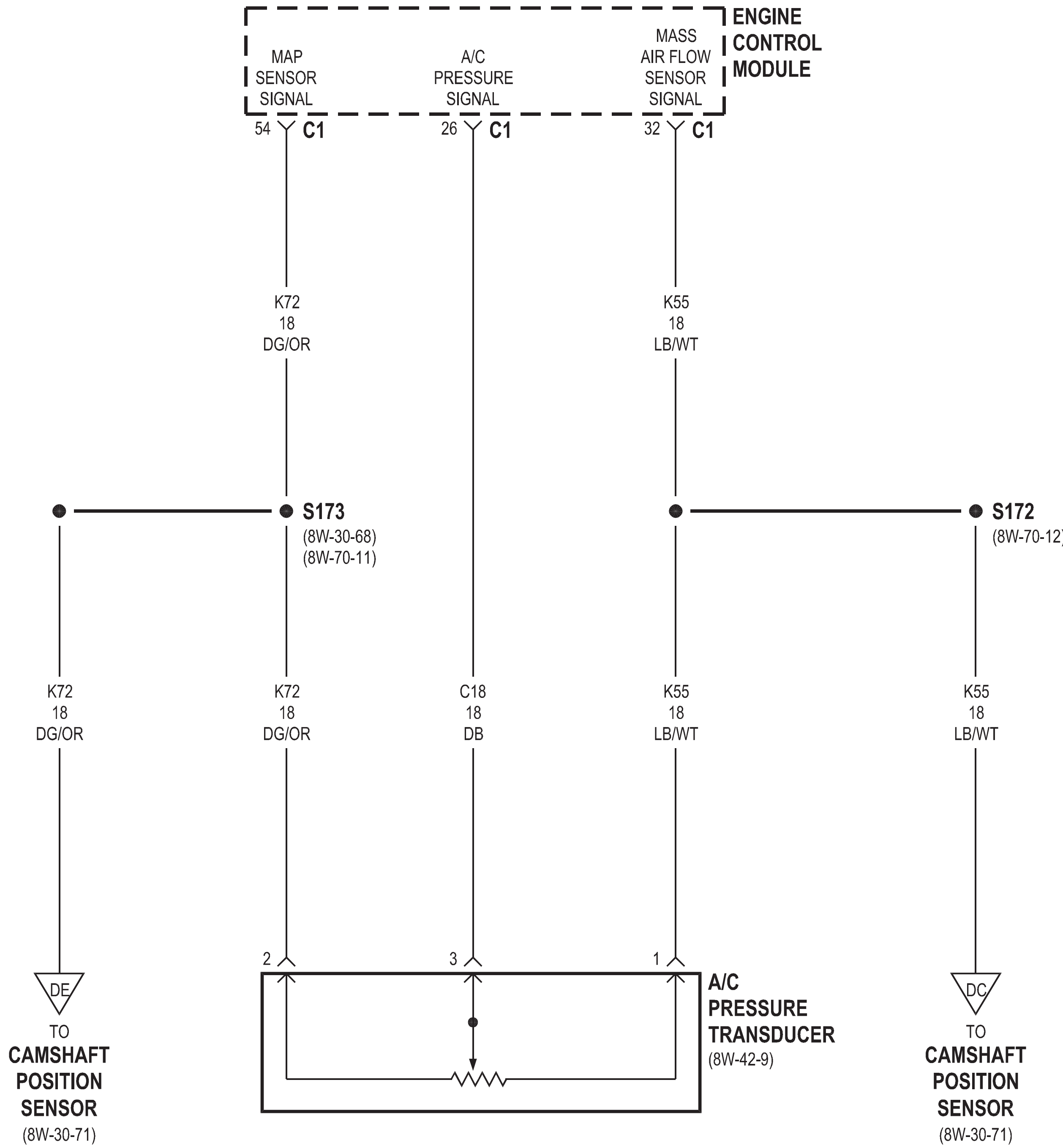

POWERTRAIN CONTROL MODULE
THROTTLE POSITION SENSOR OUTPUT
ACCELERATOR PEDAL POSITION SENSOR OUTPUT
GROUND
ENGINE SPEED OUTPUT
3 C4
5 C4
9 C4
11 C4
Y207 18 RD/WT
Y208 18 DB/YL
Y209 18 TN/BK
Y210 18 YL/RD
45
12
51
6
THROTTLE POSITION SENSOR OUTPUT
ACCELERATOR PEDAL POSITION SENSOR OUTPUT
GROUND
ENGINE SPEED OUTPUT
TRANSMISSION CONTROL MODULE
(8W-31-5)

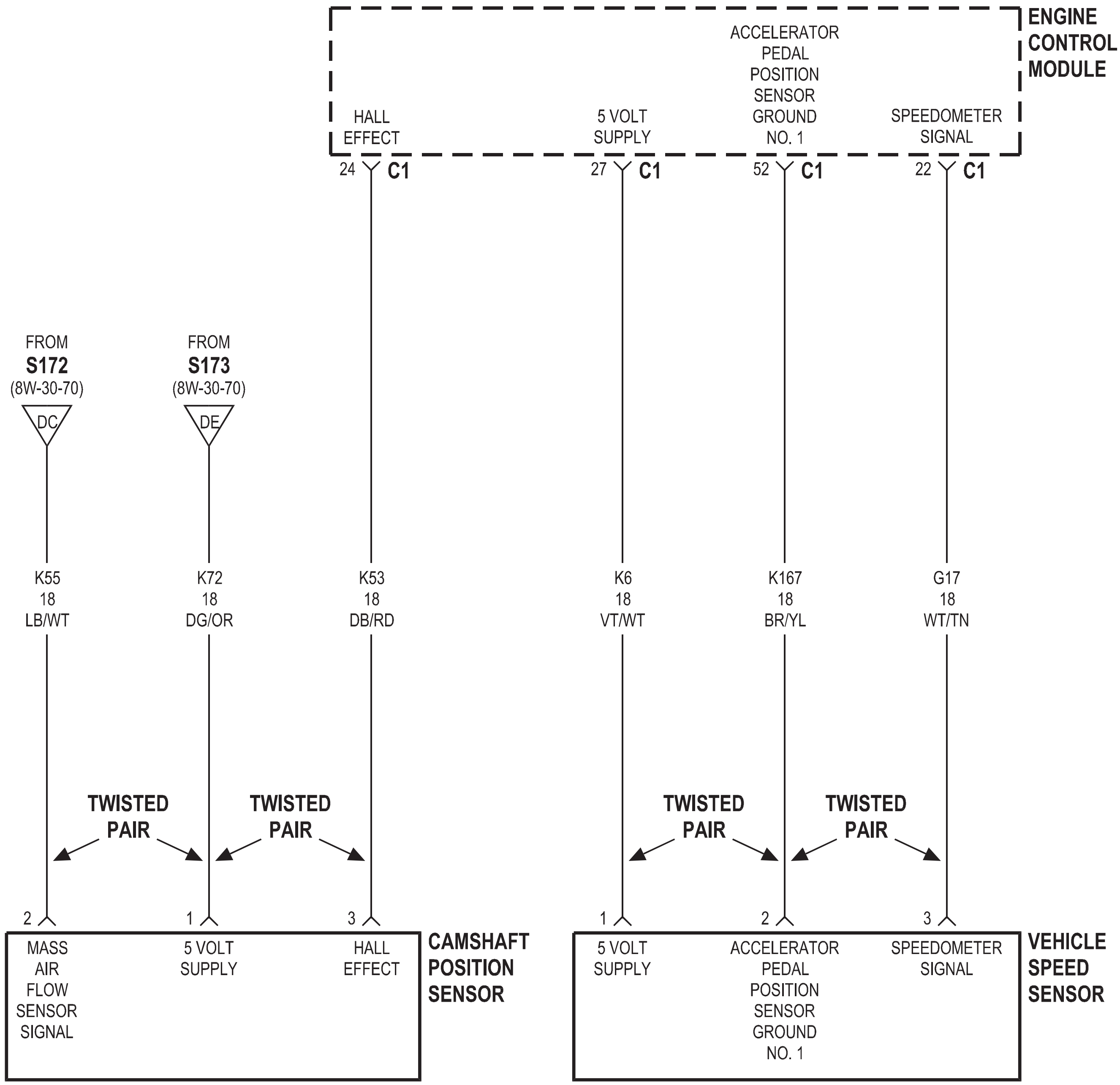

ENGINE CONTROL MODULE
FUEL INJECTOR NO. 2 DRIVER
COIL ON PLUG DRIVER NO. 1
BATTERY TEMPERATURE SENSOR SIGNAL
50 C1
59 C1
30 C1
DG
TO
FUEL INJECTOR PACK NO. 2
(8W-30-68)
K12 16 YL/WT
K91 16 TN/RD
K91 14 TN/RD
K11 16 WT/DB
S171
S159
S160
K12 14 YL/WT
K91 14 TN/RD
K91 14 TN/RD
K11 14 WT/DB
TWISTED PAIR
TWISTED PAIR
2
1
3
4
FUEL INJECTOR PACK NO. 1

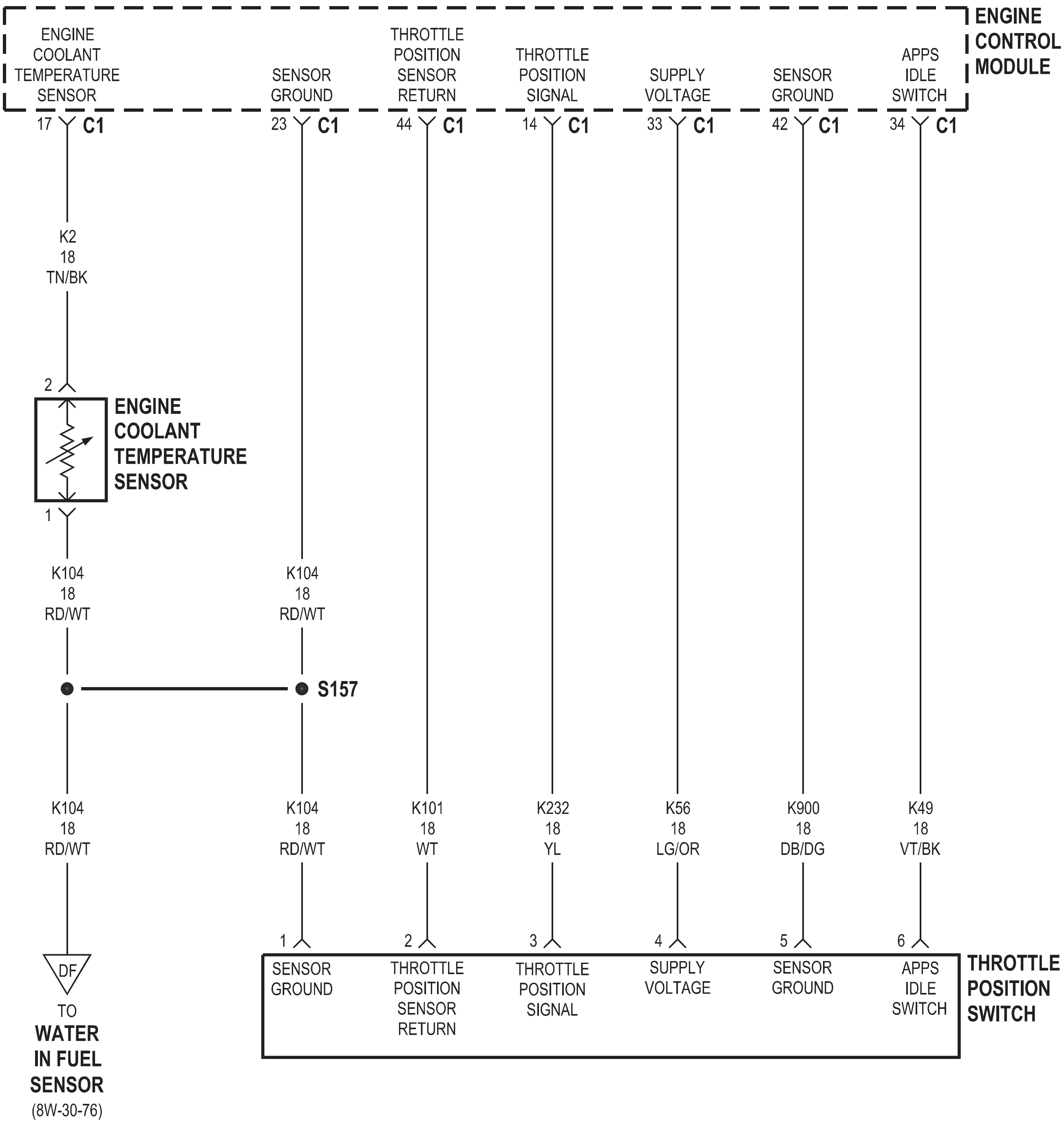


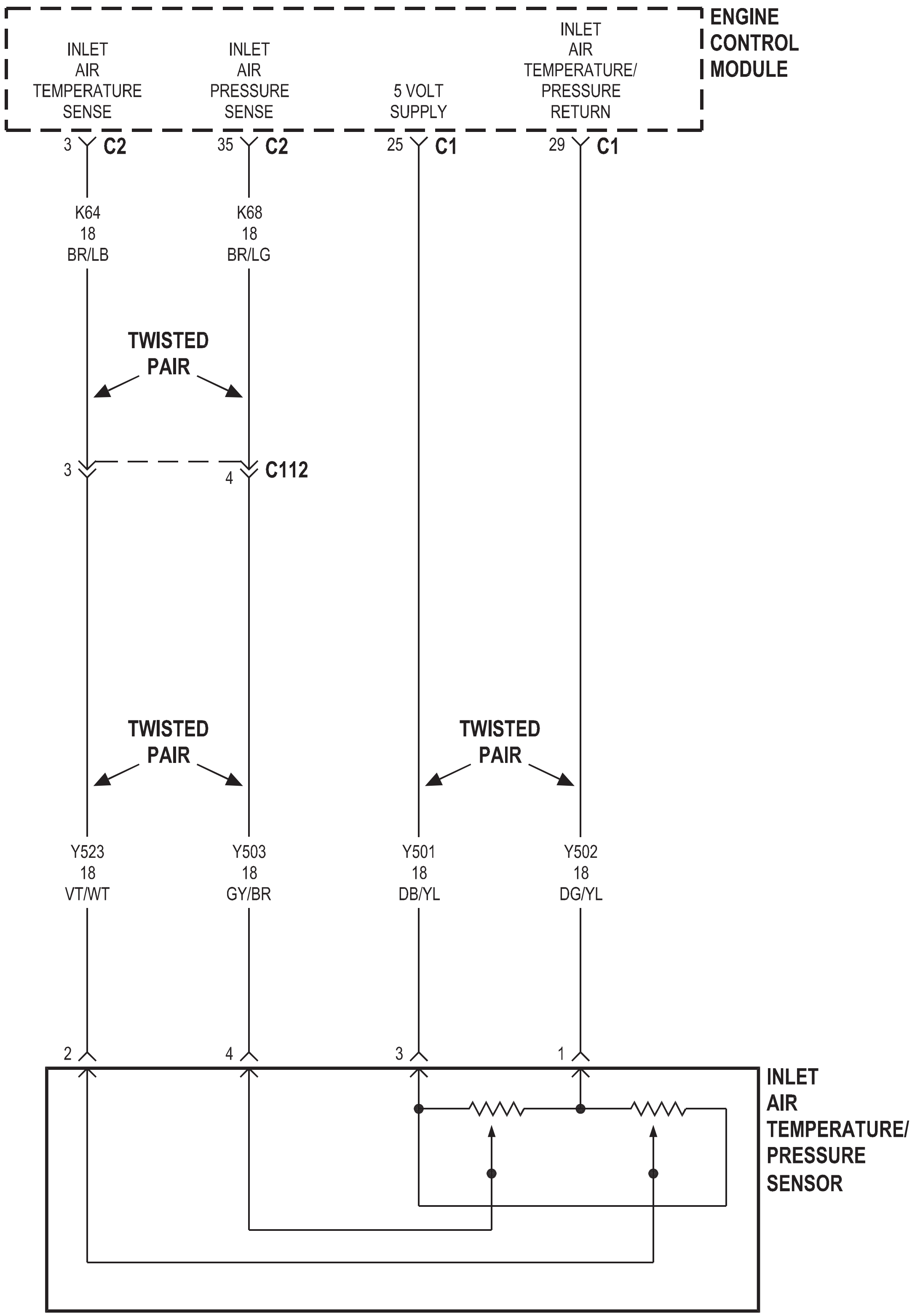
ENGINE CONTROL MODULE
FUEL INJECTOR NO. 2 DRIVER
FUEL INJECTOR NO. 2 DRIVER
40
C1
36
C1
FROM
S159
(8W-30-67)
DG
K13
16
TN
K14
16
RD/WT
S158
S173
DA
TO
S170
(8W-30-69)
K13
14
TN
K91
14
TN/RD
K14
14
RD/WT
K92
14
TN/BK
TWISTED PAIR
TWISTED PAIR
4
3
2
1
FUEL INJECTOR PACK NO. 2

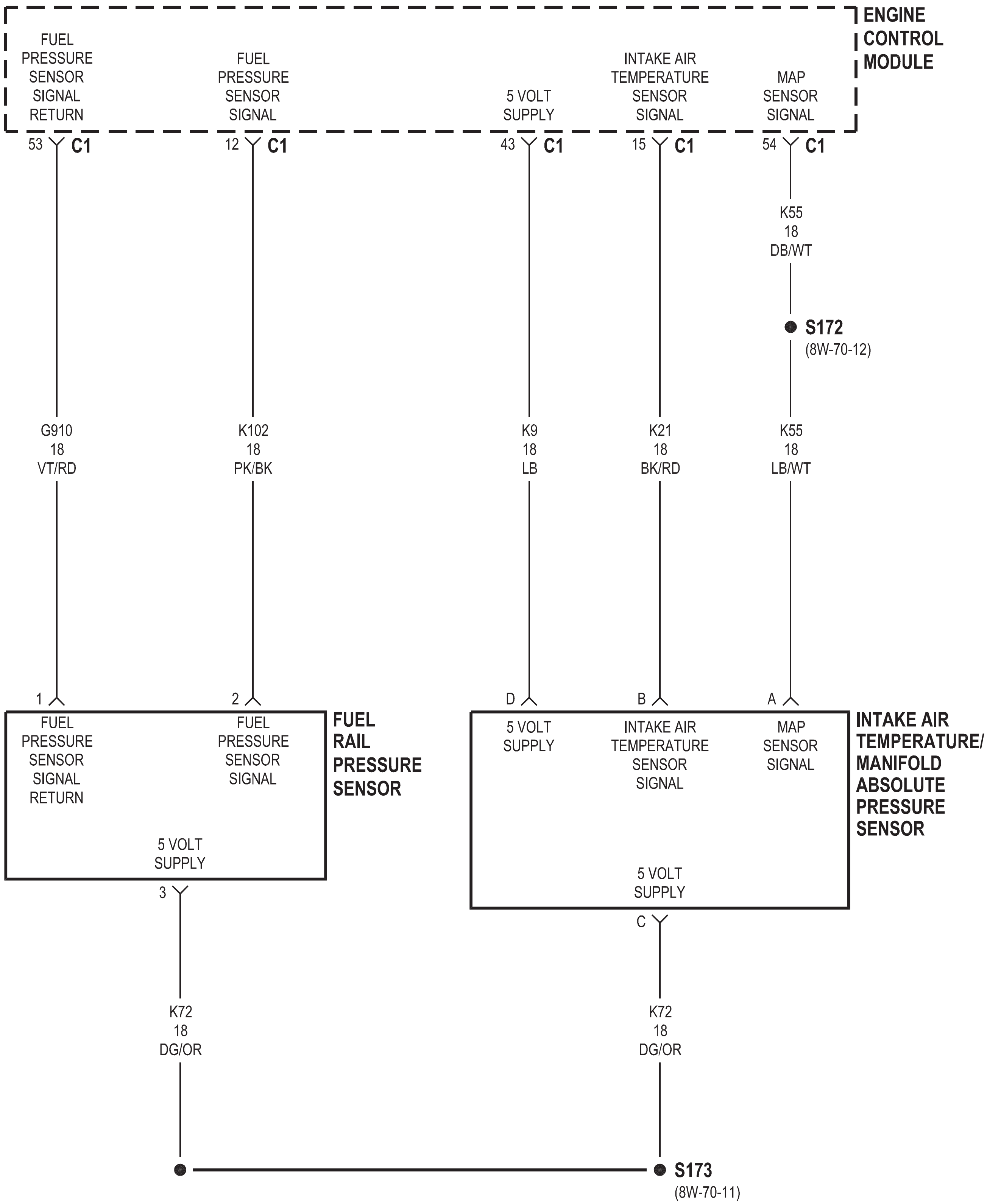

ENGINE CONTROL MODULE
FUEL INJECTOR NO. 6 DRIVER
COIL ON PLUG DRIVER NO. 2
FUEL INJECTOR NO. 5 DRIVER
46 C1
57 C1
56 C1
FROM FUEL INJECTOR PACK NO. 2 (8W-30-68)
DA
K58 16 BR/DB
K92 16 TN/PK
K92 14 TN/PK
K38 16 GY
S175
S170
S174
K58 14 BR/DB
K92 14 TN/PK
K92 14 TN/PK
K38 14 GY
TWISTED PAIR
TWISTED PAIR
2
1
3
4
FUEL INJECTOR PACK NO. 3

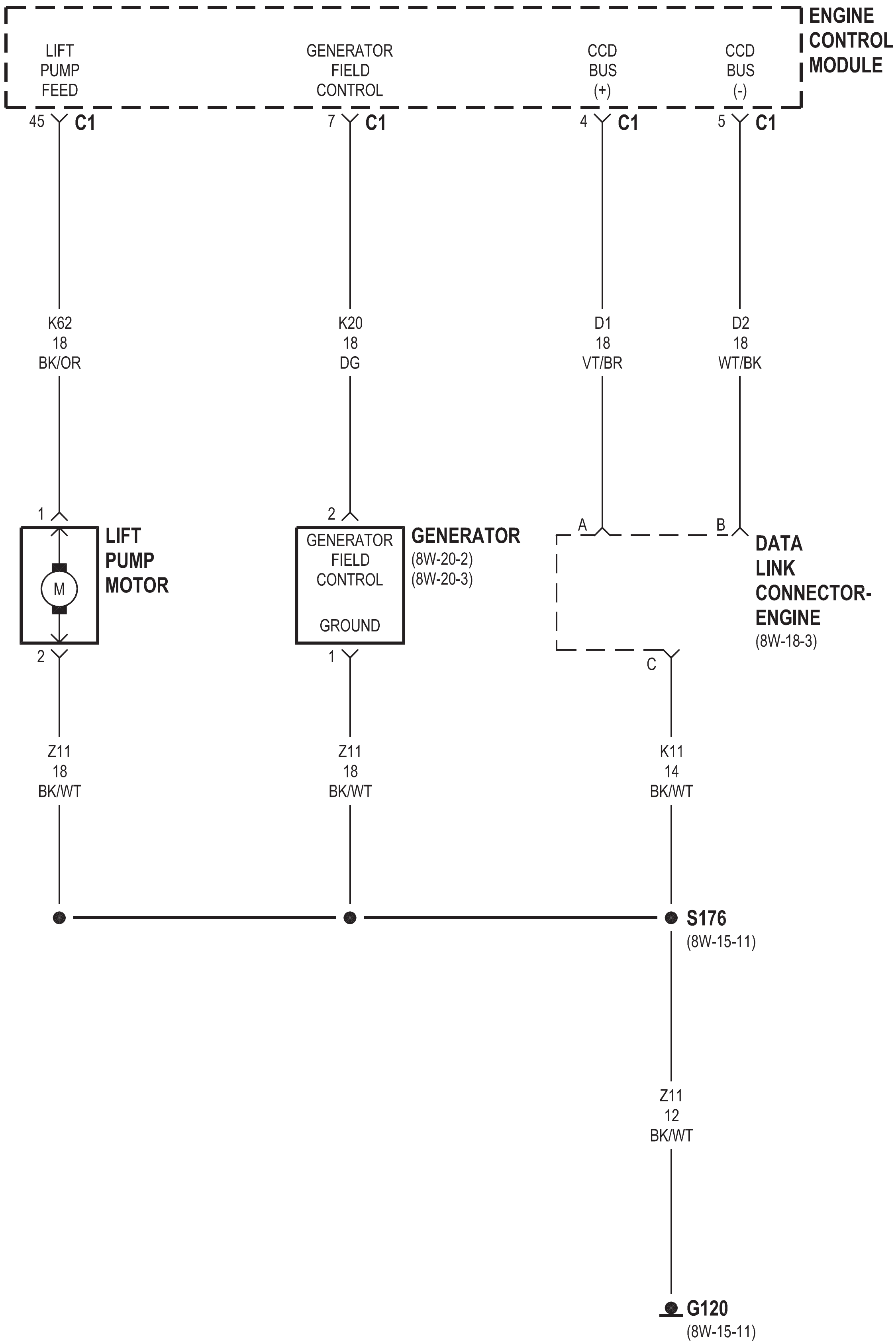

ENGINE CONTROL MODULE
MAP SENSOR SIGNAL
A/C PRESSURE SIGNAL
MASS AIR FLOW SENSOR SIGNAL
54 C1
26 C1
32 C1
K72 18 DG/OR
K55 18 LB/WT
S173
(8W-30-68)
(8W-70-11)
S172
(8W-70-12)
K72 18 DG/OR
K72 18 DG/OR
C18 18 DB
K55 18 LB/WT
K55 18 LB/WT
2
3
1
DE
TO CAMSHAFT POSITION SENSOR
(8W-30-71)
A/C PRESSURE TRANSDUCER
(8W-42-9)
DC
TO CAMSHAFT POSITION SENSOR
(8W-30-71)

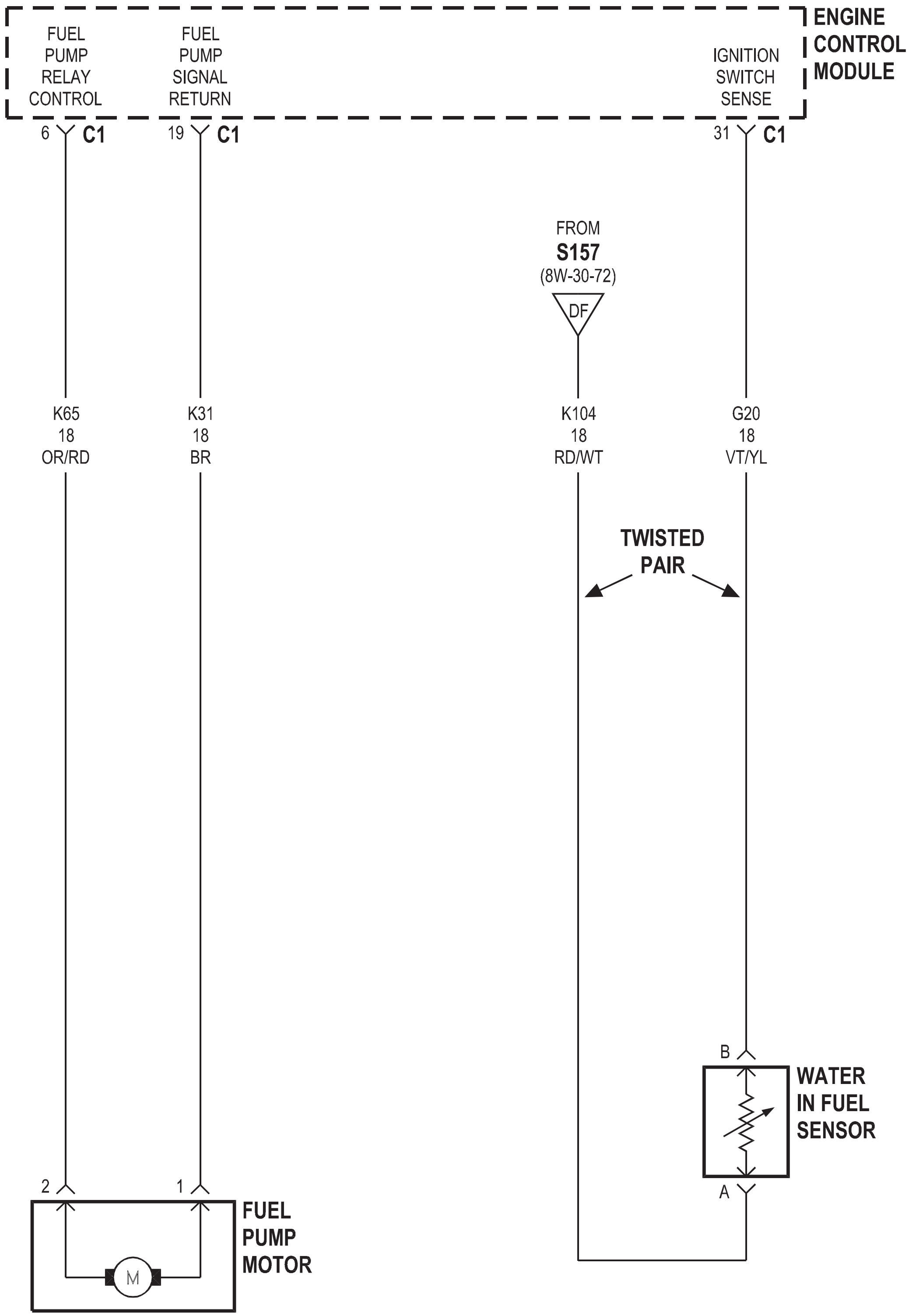

ENGINE CONTROL MODULE
HALL EFFECT
5 VOLT SUPPLY
ACCELERATOR PEDAL POSITION SENSOR GROUND NO. 1
SPEEDOMETER SIGNAL
24 C1
27 C1
52 C1
22 C1
FROM S172 (8W-30-70)
DC
FROM S173 (8W-30-70)
DE
K55 18 LB/WT
K72 18 DG/OR
K53 18 DB/RD
K6 18 VT/WT
K167 18 BR/YL
G17 18 WT/TN
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
TWISTED PAIR
2
1
3
MASS AIR FLOW SENSOR SIGNAL
5 VOLT SUPPLY
HALL EFFECT
CAMSHAFT POSITION SENSOR
1
2
3
5 VOLT SUPPLY
ACCELERATOR PEDAL POSITION SENSOR GROUND NO. 1
SPEEDOMETER SIGNAL
VEHICLE SPEED SENSOR

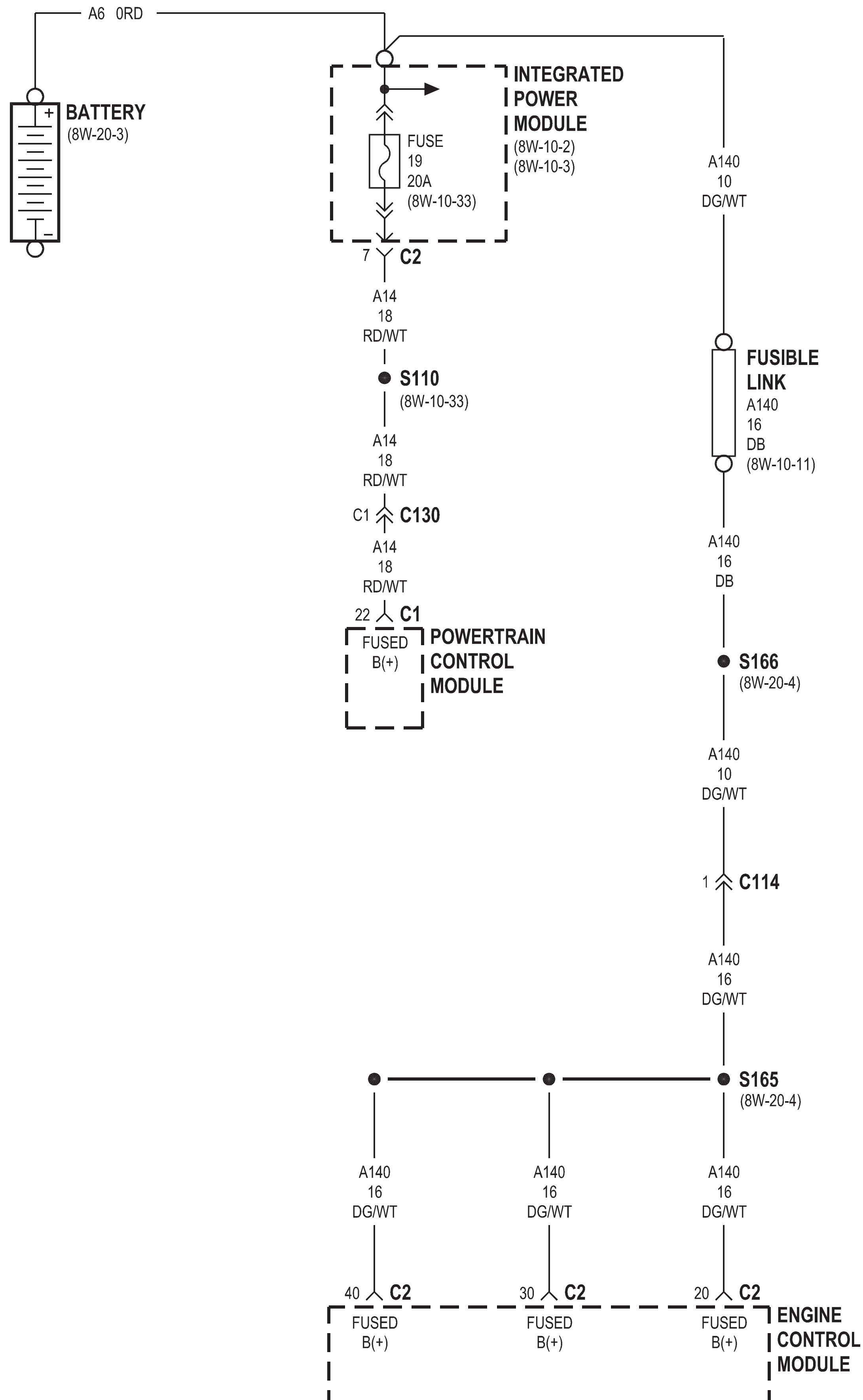

ENGINE CONTROL MODULE
ENGINE COOLANT TEMPERATURE SENSOR
SENSOR GROUND
THROTTLE POSITION SENSOR RETURN
THROTTLE POSITION SIGNAL
SUPPLY VOLTAGE
SENSOR GROUND
APPS IDLE SWITCH
17 C1
23 C1
44 C1
14 C1
33 C1
42 C1
34 C1
K2 18 TN/BK
2
ENGINE COOLANT TEMPERATURE SENSOR
1
K104 18 RD/WT
K104 18 RD/WT
S157
K104 18 RD/WT
K104 18 RD/WT
K101 18 WT
K232 18 YL
K56 18 LG/OR
K900 18 DB/DG
K49 18 VT/BK
DF
TO WATER IN FUEL SENSOR (8W-30-76)
1
2
3
4
5
6
SENSOR GROUND
THROTTLE POSITION SENSOR RETURN
THROTTLE POSITION SIGNAL
SUPPLY VOLTAGE
SENSOR GROUND
APPS IDLE SWITCH
THROTTLE POSITION SWITCH

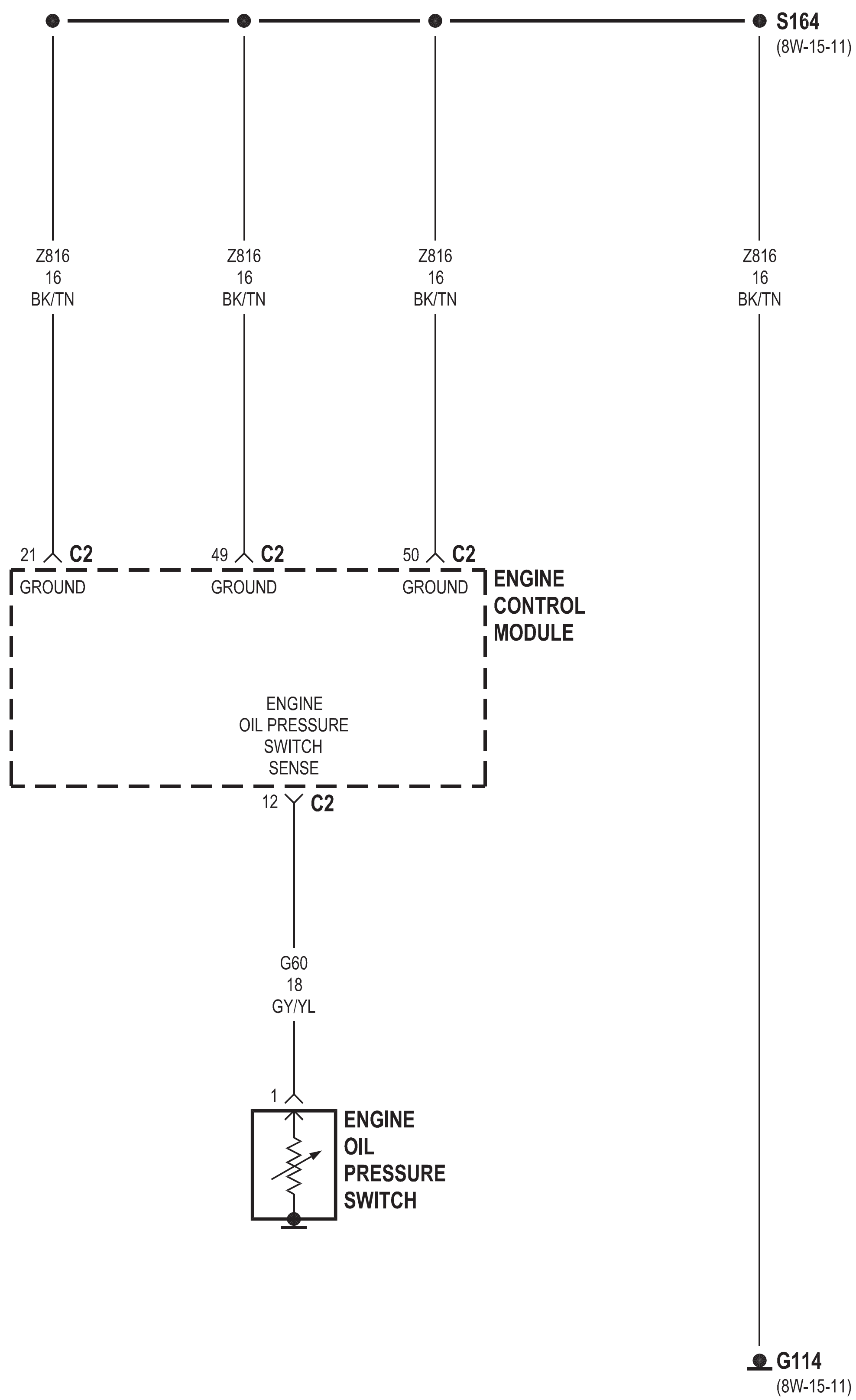

ENGINE CONTROL MODULE
INLET AIR TEMPERATURE SENSE
INLET AIR PRESSURE SENSE
5 VOLT SUPPLY
INLET AIR TEMPERATURE/ PRESSURE RETURN
3 C2
35 C2
25 C1
29 C1
K64 18 BR/LB
K68 18 BR/LG
TWISTED PAIR
3
4 C112
TWISTED PAIR
TWISTED PAIR
Y523 18 VT/WT
Y503 18 GY/BR
Y501 18 DB/YL
Y502 18 DG/YL
2
4
3
1
INLET AIR TEMPERATURE/ PRESSURE SENSOR

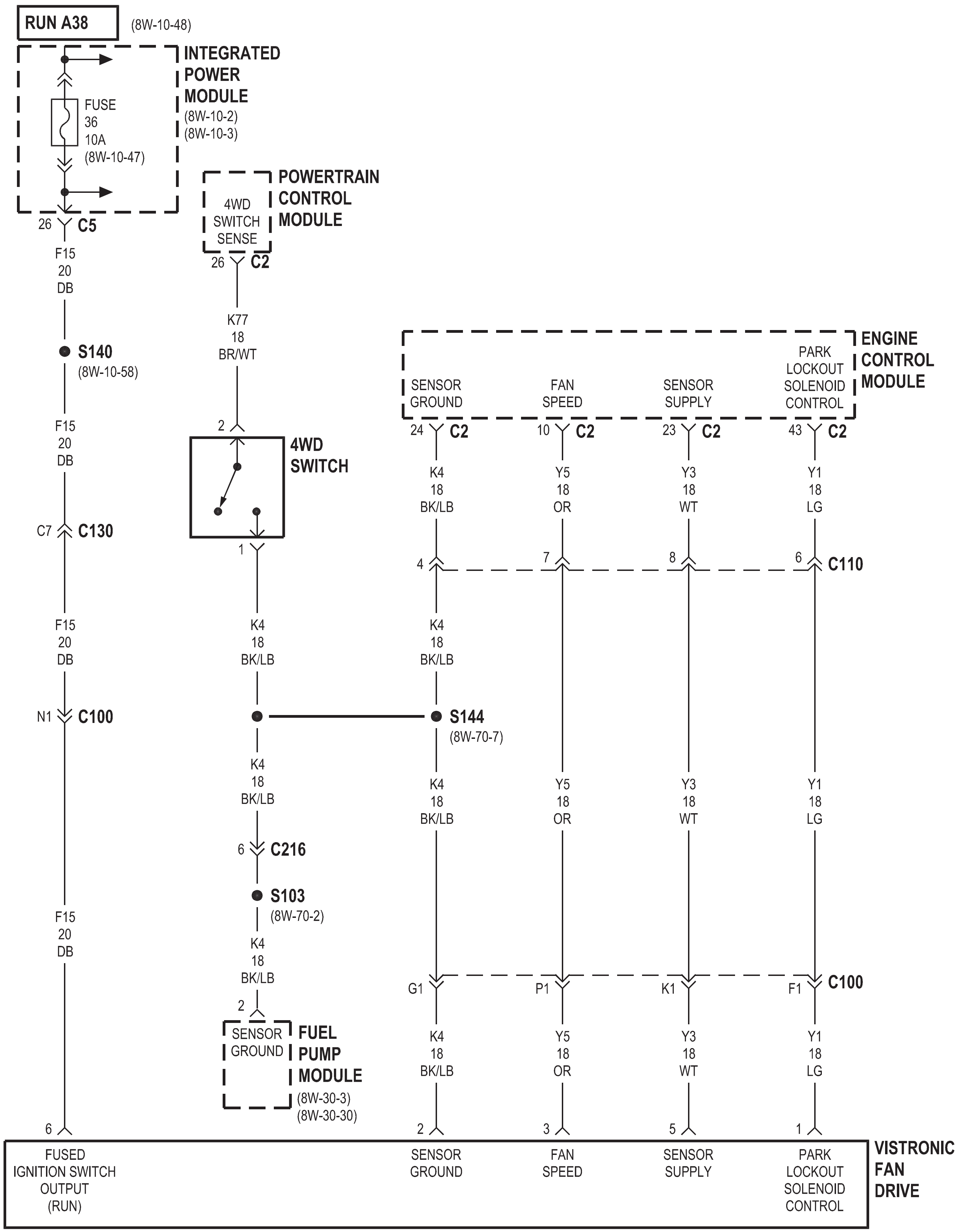

ENGINE CONTROL MODULE
FUEL PRESSURE SENSOR SIGNAL RETURN
FUEL PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
INTAKE AIR TEMPERATURE SENSOR SIGNAL
MAP SENSOR SIGNAL
53 C1
12 C1
43 C1
15 C1
54 C1
K55 18 DB/WT
S172 (8W-70-12)
G910 18 VT/RD
K102 18 PK/BK
K9 18 LB
K21 18 BK/RD
K55 18 LB/WT
1
2
D
B
A
FUEL PRESSURE SENSOR SIGNAL RETURN
FUEL PRESSURE SENSOR SIGNAL
5 VOLT SUPPLY
3
FUEL RAIL PRESSURE SENSOR
5 VOLT SUPPLY
INTAKE AIR TEMPERATURE SENSOR SIGNAL
MAP SENSOR SIGNAL
5 VOLT SUPPLY
C
INTAKE AIR TEMPERATURE/ MANIFOLD ABSOLUTE PRESSURE SENSOR
K72 18 DG/OR
K72 18 DG/OR
S173 (8W-70-11)

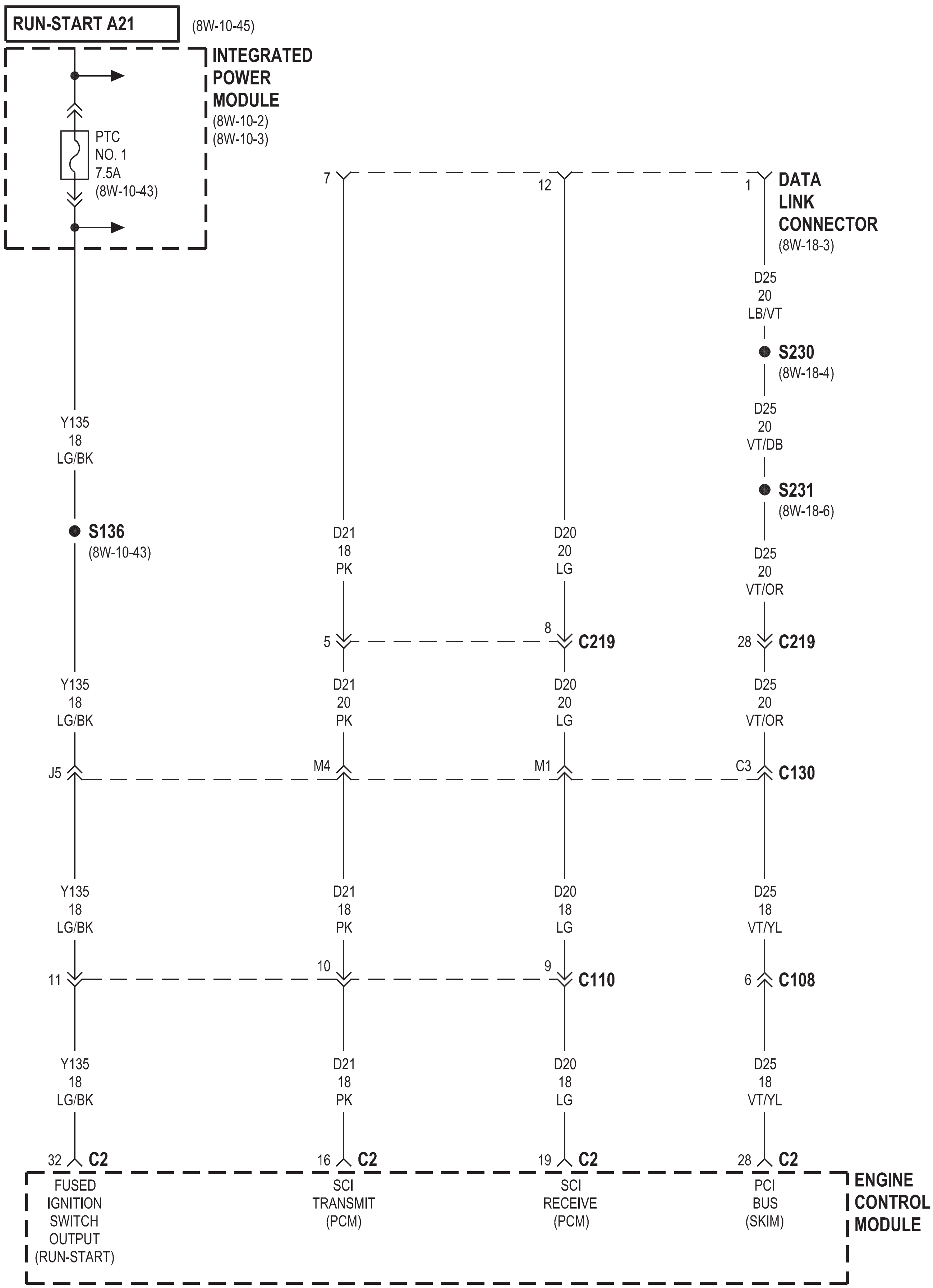

ENGINE CONTROL MODULE
LIFT PUMP FEED
GENERATOR FIELD CONTROL
CCD BUS (+)
CCD BUS (-)
45 C1
7 C1
4 C1
5 C1
K62 18 BK/OR
K20 18 DG
D1 18 VT/BR
D2 18 WT/BK
1
2
A
B
LIFT PUMP MOTOR
M
GENERATOR FIELD CONTROL
GROUND
GENERATOR (8W-20-2) (8W-20-3)
DATA LINK CONNECTOR-ENGINE (8W-18-3)
2
1
C
Z11 18 BK/WT
Z11 18 BK/WT
K11 14 BK/WT
S176 (8W-15-11)
Z11 12 BK/WT
G120 (8W-15-11)

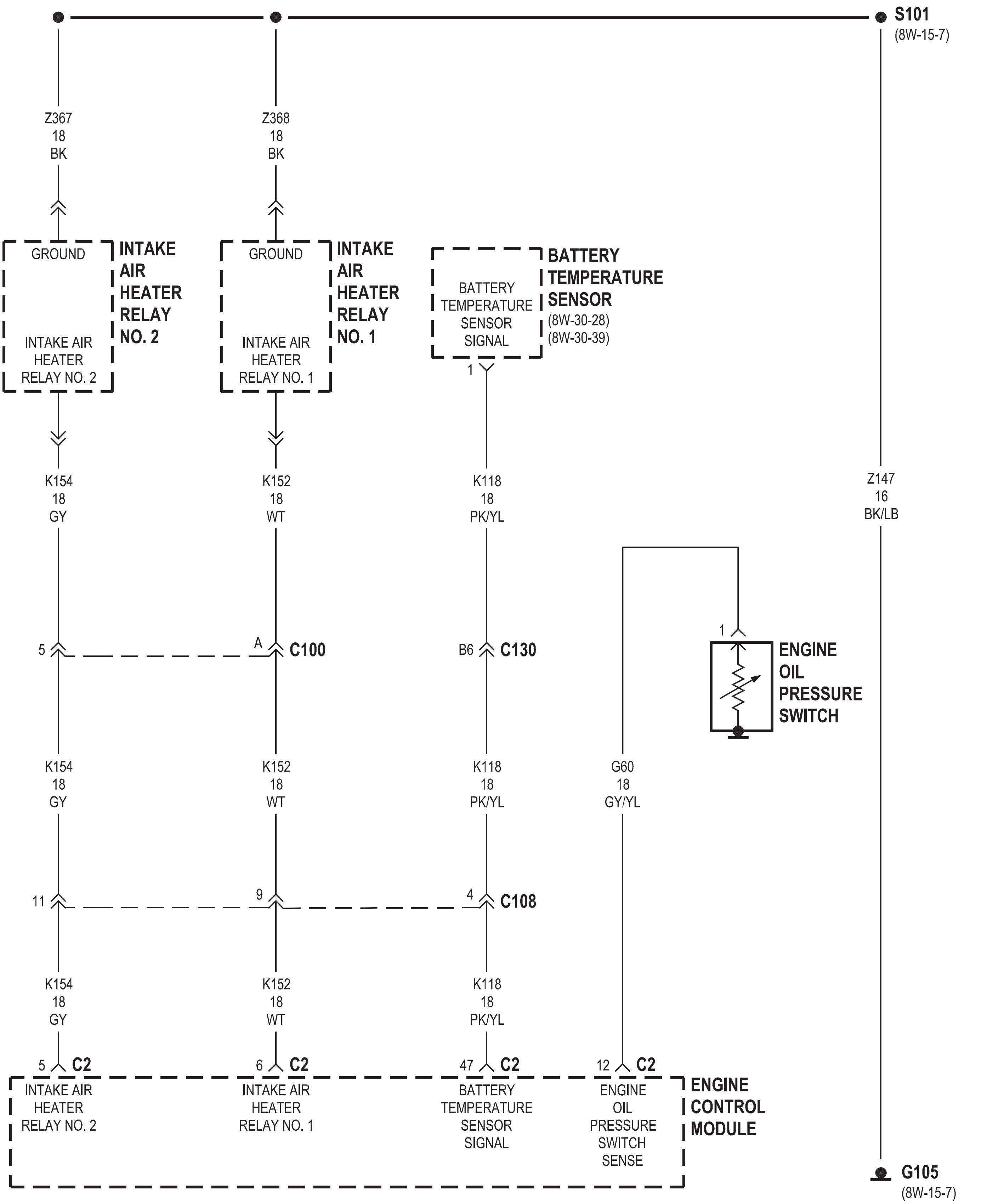

ENGINE CONTROL MODULE
FUEL PUMP RELAY CONTROL
FUEL PUMP SIGNAL RETURN
IGNITION SWITCH SENSE
6 C1
19 C1
31 C1
FROM
S157
(8W-30-72)
DF
K65
18
OR/RD
K31
18
BR
K104
18
RD/WT
G20
18
VT/YL
TWISTED PAIR
B
A
WATER IN FUEL SENSOR
2
1
M
FUEL PUMP MOTOR

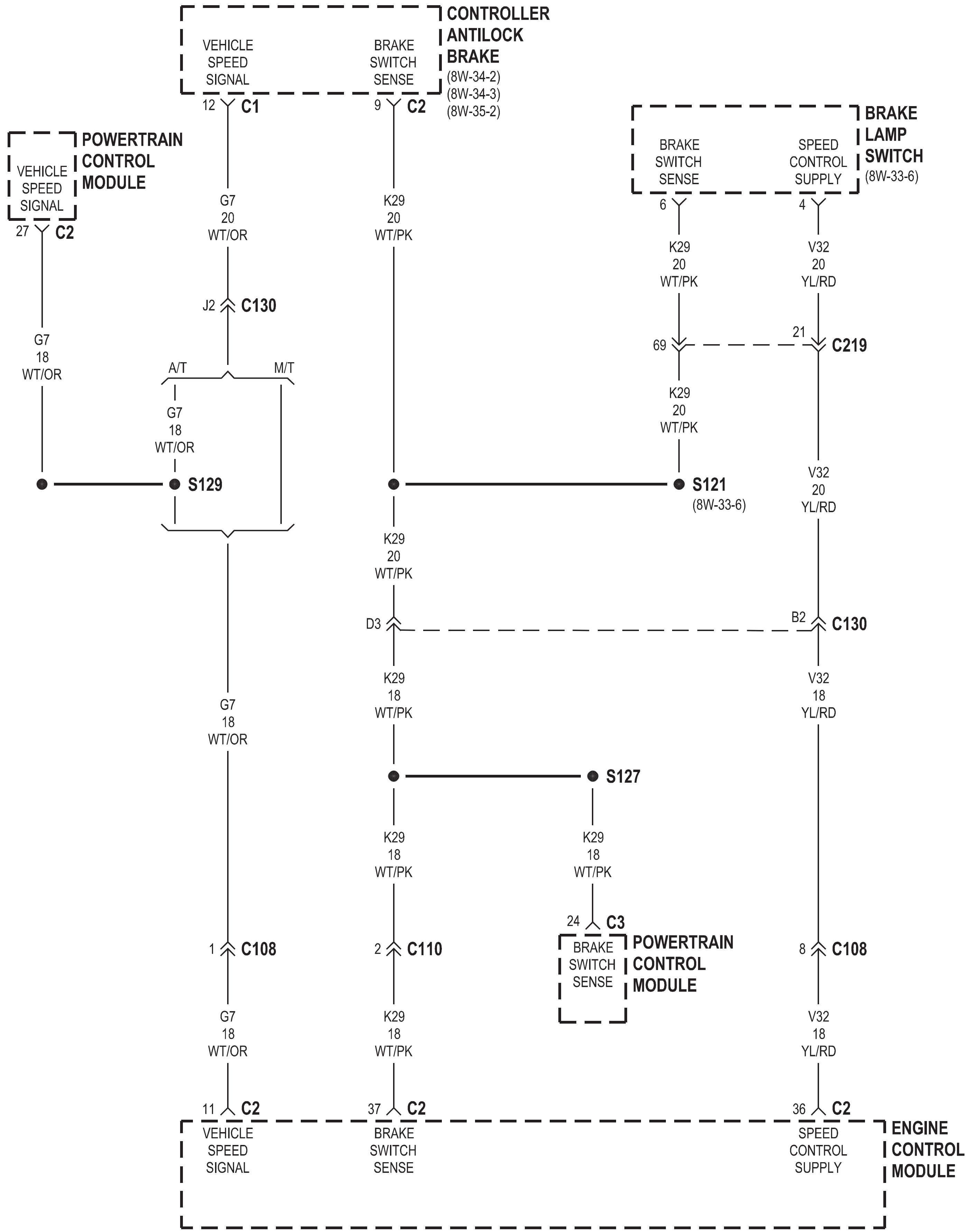

A6 0RD
BATTERY
(8W-20-3)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
19
20A
(8W-10-33)
7 C2
A14
18
RD/WT
S110
(8W-10-33)
A14
18
RD/WT
C1 C130
A14
18
RD/WT
22 C1
FUSED
B(+)
POWERTRAIN
CONTROL
MODULE
A140
10
DG/WT
FUSIBLE
LINK
A140
16
DB
(8W-10-11)
A140
16
DB
S166
(8W-20-4)
A140
10
DG/WT
1 C114
A140
16
DG/WT
S165
(8W-20-4)
A140
16
DG/WT
A140
16
DG/WT
A140
16
DG/WT
40 C2
30 C2
20 C2
FUSED
B(+)
FUSED
B(+)
FUSED
B(+)
ENGINE
CONTROL
MODULE

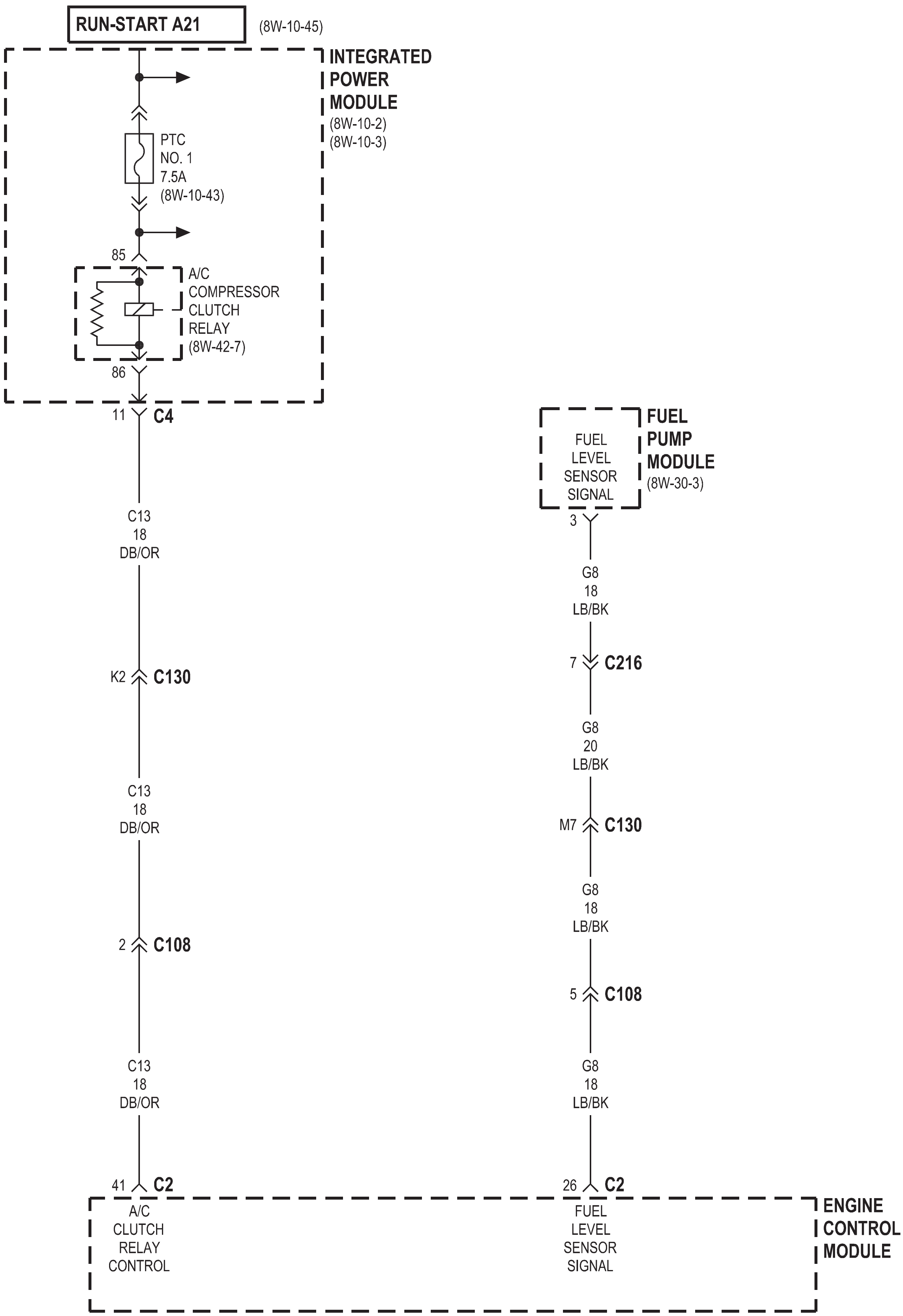

S164
(8W-15-11)
Z816
16
BK/TN
Z816
16
BK/TN
Z816
16
BK/TN
Z816
16
BK/TN
21
C2
49
C2
50
C2
GROUND
GROUND
GROUND
ENGINE
CONTROL
MODULE
ENGINE
OIL PRESSURE
SWITCH
SENSE
12
C2
G60
18
GY/YL
1
ENGINE
OIL
PRESSURE
SWITCH
G114
(8W-15-11)

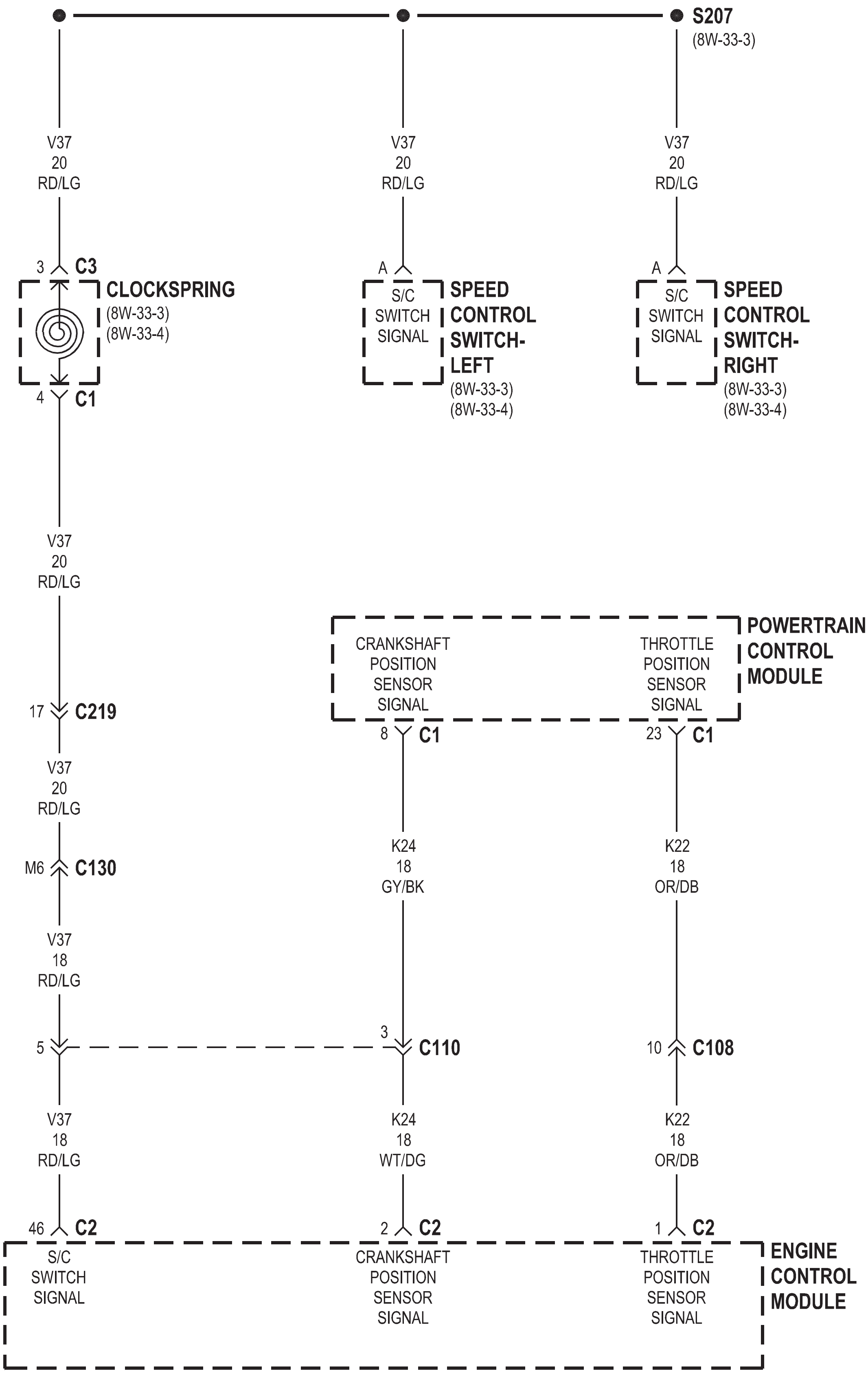

RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 36 10A (8W-10-47)
26 C5
F15 20 DB
S140
(8W-10-58)
C7 C130
N1 C100
POWERTRAIN CONTROL MODULE
4WD SWITCH SENSE
26 C2
K77 18 BR/WT
4WD SWITCH
2
1
K4 18 BK/LB
S144
(8W-70-7)
6 C216
S103
(8W-70-2)
FUEL PUMP MODULE
SENSOR GROUND
(8W-30-3)
(8W-30-30)
ENGINE CONTROL MODULE
SENSOR GROUND
FAN SPEED
SENSOR SUPPLY
PARK LOCKOUT SOLENOID CONTROL
24 C2
10 C2
23 C2
43 C2
Y5 18 OR
Y3 18 WT
Y1 18 LG
4 7 8 6 C110
G1 P1 K1 F1 C100
6 2 3 5 1
VISTRONIC FAN DRIVE
FUSED IGNITION SWITCH OUTPUT (RUN)

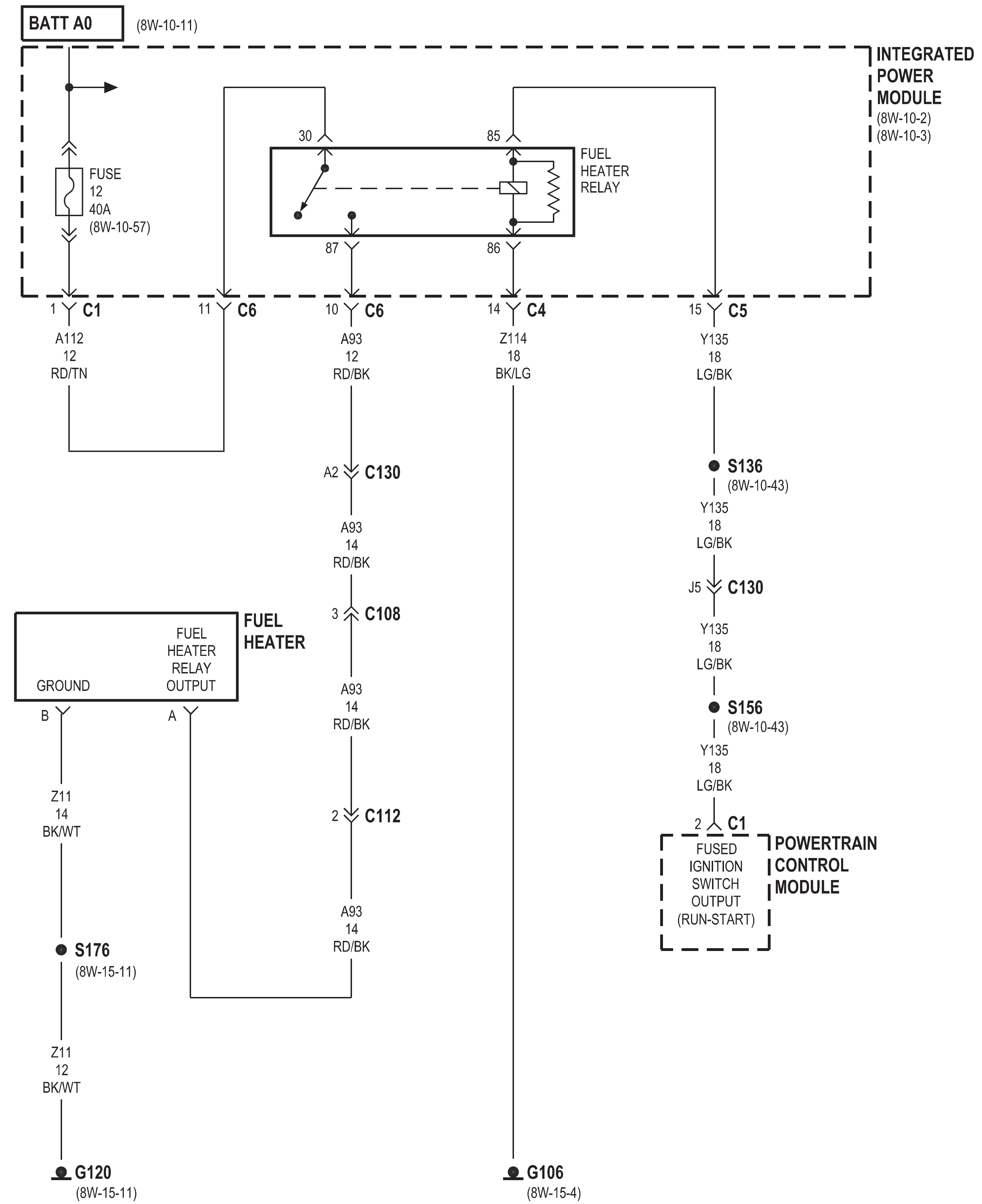

RUN-START A21
(8W-10-45)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-43)
7
12
1
DATA
LINK
CONNECTOR
(8W-18-3)
D25
20
LB/VT
S230
(8W-18-4)
D25
20
VT/DB
S231
(8W-18-6)
Y135
18
LG/BK
S136
(8W-10-43)
D21
18
PK
D20
20
LG
D25
20
VT/OR
5
8
C219
28
C219
Y135
18
LG/BK
D21
20
PK
D20
20
LG
D25
20
VT/OR
J5
M4
M1
C3
C130
Y135
18
LG/BK
D21
18
PK
D20
18
LG
D25
18
VT/YL
11
10
9
C110
6
C108
Y135
18
LG/BK
D21
18
PK
D20
18
LG
D25
18
VT/YL
32
C2
16
C2
19
C2
28
C2
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
SCI
TRANSMIT
(PCM)
SCI
RECEIVE
(PCM)
PCI
BUS
(SKIM)
ENGINE
CONTROL
MODULE

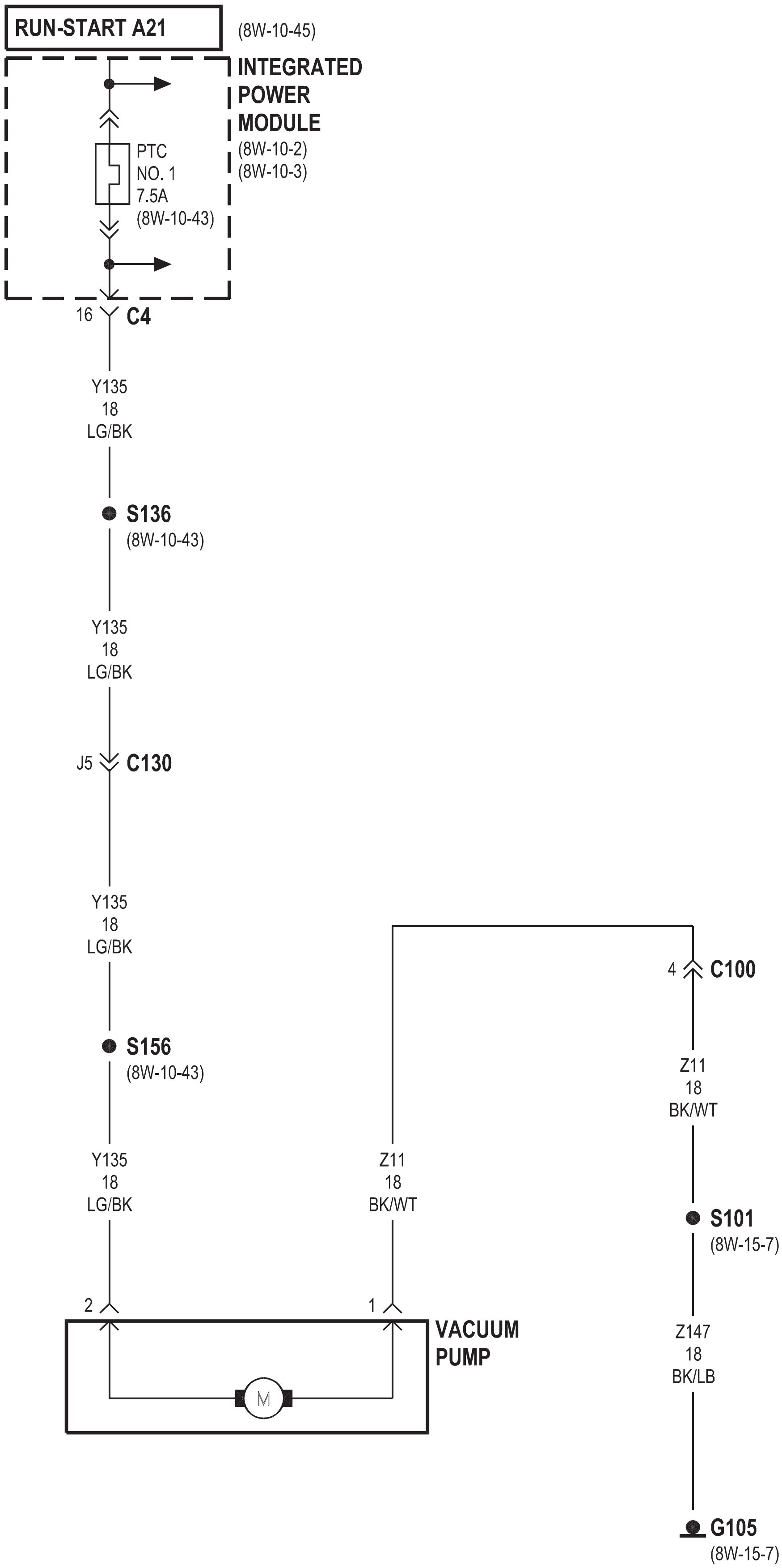

S101
(8W-15-7)
Z367
18
BK
Z368
18
BK
GROUND
INTAKE AIR
HEATER
RELAY NO. 2
INTAKE AIR HEATER RELAY NO. 2
GROUND
INTAKE AIR
HEATER
RELAY NO. 1
INTAKE AIR HEATER RELAY NO. 1
BATTERY
TEMPERATURE
SENSOR
SIGNAL
BATTERY TEMPERATURE SENSOR
(8W-30-28)
(8W-30-39)
1
K154
18
GY
K152
18
WT
K118
18
PK/YL
Z147
16
BK/LB
5
A
C100
B6
C130
1
ENGINE OIL PRESSURE SWITCH
K154
18
GY
K152
18
WT
K118
18
PK/YL
G60
18
GY/YL
11
9
4
C108
K154
18
GY
K152
18
WT
K118
18
PK/YL
5 C2
6 C2
47 C2
12 C2
INTAKE AIR
HEATER
RELAY NO. 2
INTAKE AIR
HEATER
RELAY NO. 1
BATTERY
TEMPERATURE
SENSOR
SIGNAL
ENGINE
OIL
PRESSURE
SWITCH
SENSE
ENGINE CONTROL MODULE
G105
(8W-15-7)

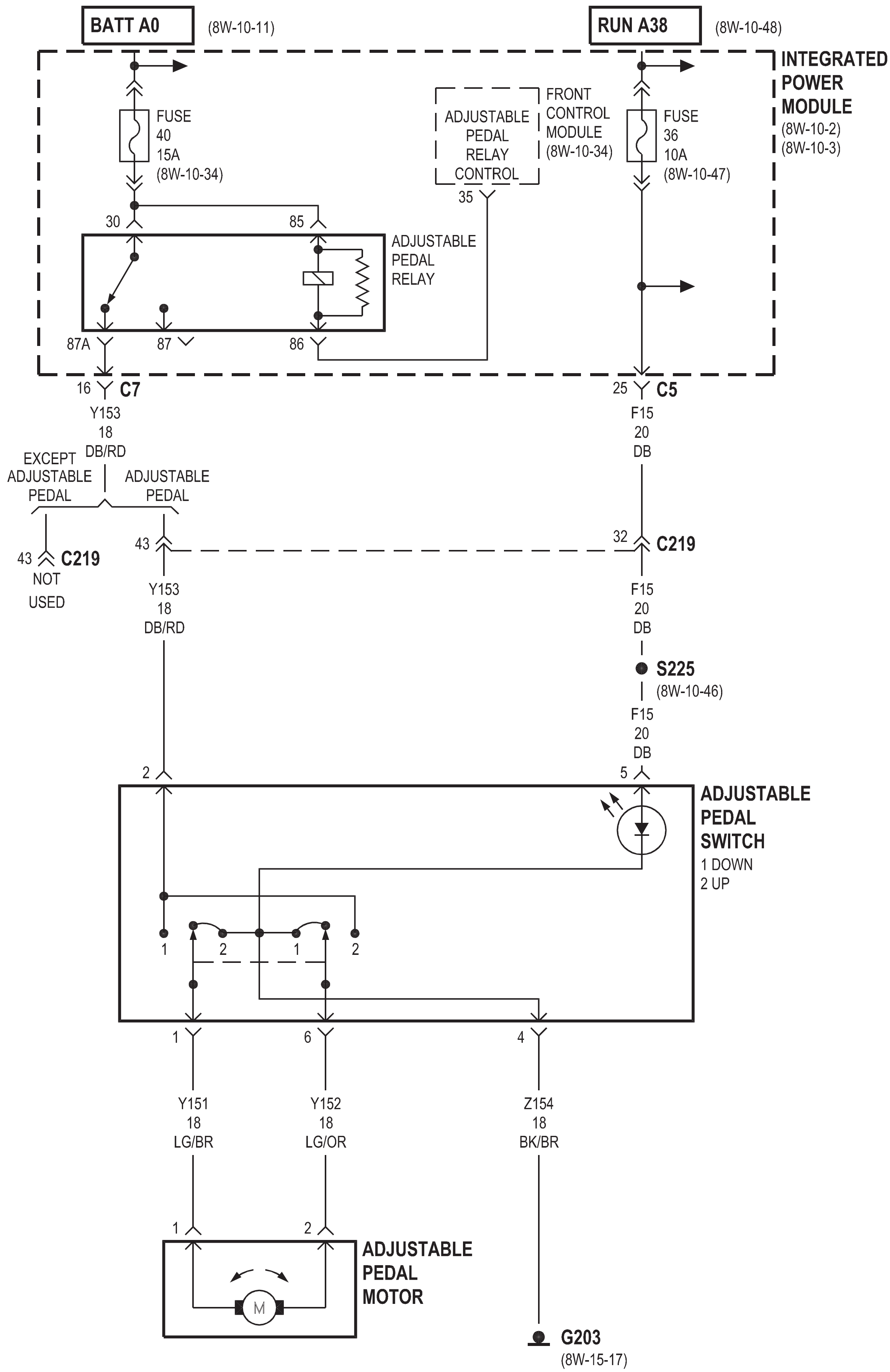

CONTROLLER ANTILOCK BRAKE
(8W-34-2)
(8W-34-3)
(8W-35-2)
VEHICLE SPEED SIGNAL
BRAKE SWITCH SENSE
12 C1
9 C2
POWERTRAIN CONTROL MODULE
VEHICLE SPEED SIGNAL
27 C2
BRAKE LAMP SWITCH
(8W-33-6)
BRAKE SWITCH SENSE
SPEED CONTROL SUPPLY
6
4
G7 20 WT/OR
K29 20 WT/PK
K29 20 WT/PK
V32 20 YL/RD
J2 C130
G7 18 WT/OR
69
21 C219
A/T
M/T
G7 18 WT/OR
K29 20 WT/PK
S129
S121
(8W-33-6)
V32 20 YL/RD
K29 20 WT/PK
D3
B2 C130
G7 18 WT/OR
K29 18 WT/PK
V32 18 YL/RD
S127
K29 18 WT/PK
K29 18 WT/PK
24 C3
POWERTRAIN CONTROL MODULE
BRAKE SWITCH SENSE
1 C108
2 C110
8 C108
G7 18 WT/OR
K29 18 WT/PK
V32 18 YL/RD
11 C2
37 C2
36 C2
ENGINE CONTROL MODULE
VEHICLE SPEED SIGNAL
BRAKE SWITCH SENSE
SPEED CONTROL SUPPLY

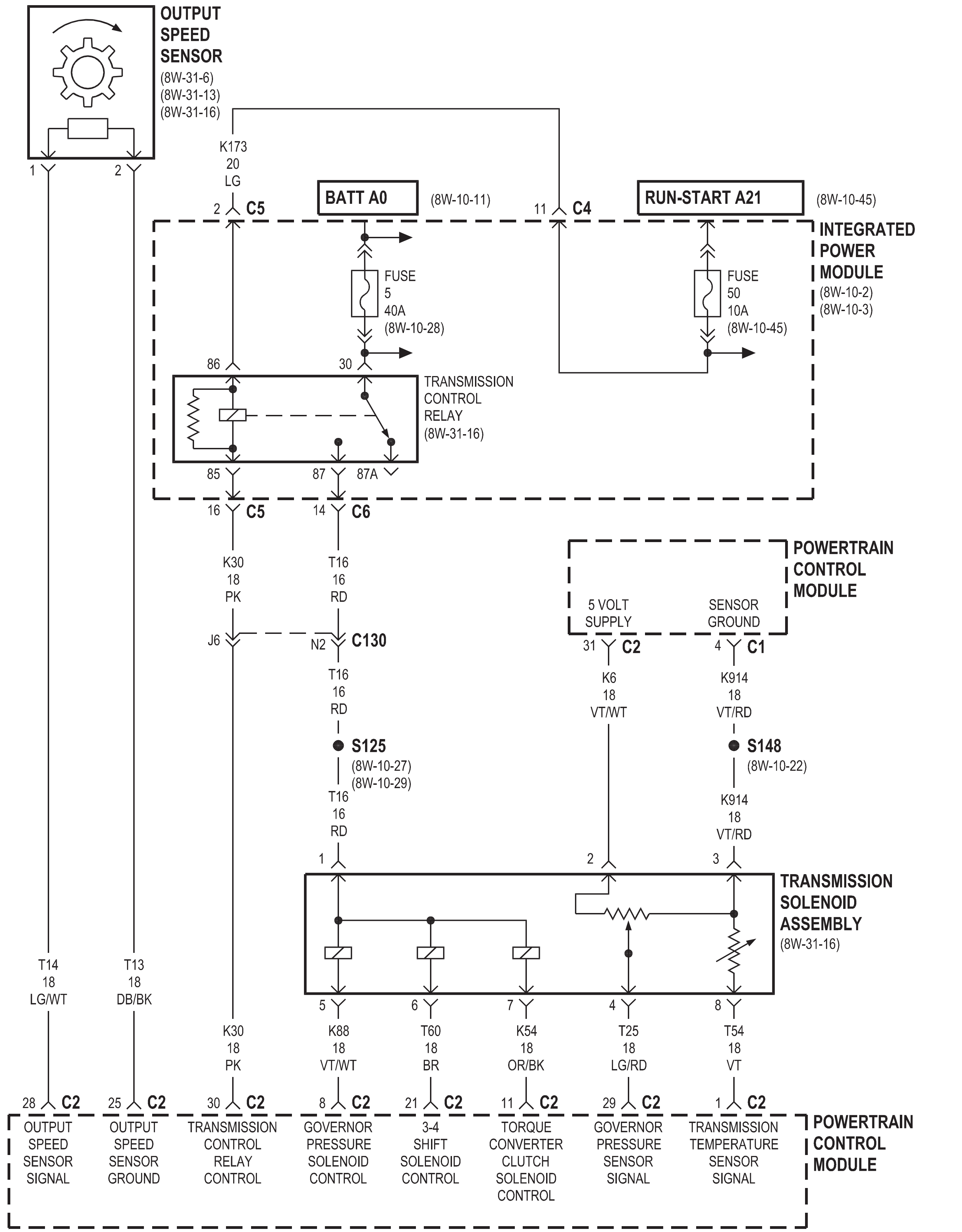

RUN-START A21
(8W-10-45)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-43)
85
A/C
COMPRESSOR
CLUTCH
RELAY
(8W-42-7)
86
11
C4
C13
18
DB/OR
K2
C130
C13
18
DB/OR
2
C108
C13
18
DB/OR
41
C2
A/C
CLUTCH
RELAY
CONTROL
FUEL
LEVEL
SENSOR
SIGNAL
FUEL
PUMP
MODULE
(8W-30-3)
3
G8
18
LB/BK
7
C216
G8
20
LB/BK
M7
C130
G8
18
LB/BK
5
C108
G8
18
LB/BK
26
C2
FUEL
LEVEL
SENSOR
SIGNAL
ENGINE
CONTROL
MODULE

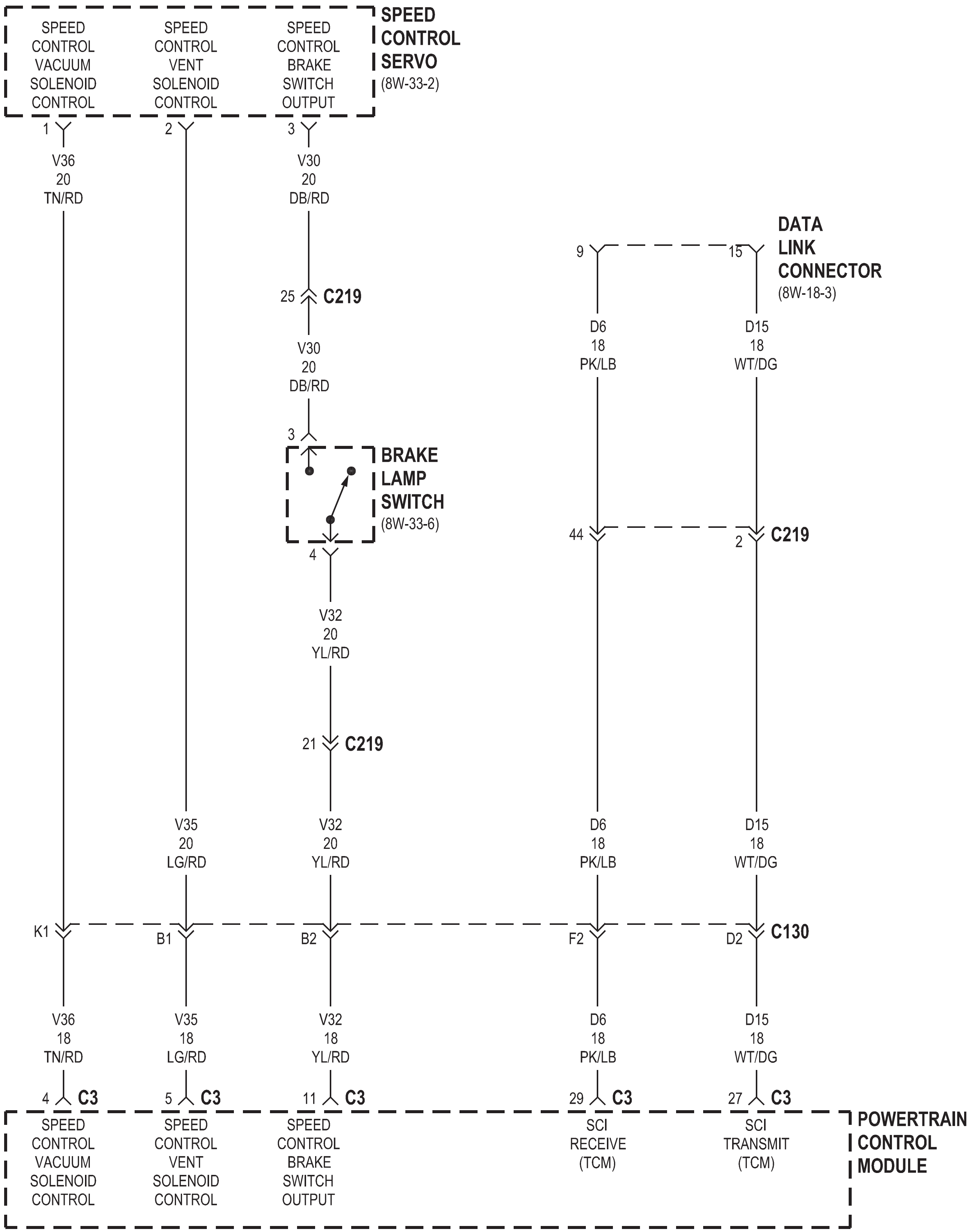

S207
(8W-33-3)
V37
20
RD/LG
V37
20
RD/LG
V37
20
RD/LG
3
C3
CLOCKSPRING
(8W-33-3)
(8W-33-4)
4
C1
A
S/C
SWITCH
SIGNAL
SPEED
CONTROL
SWITCH-
LEFT
(8W-33-3)
(8W-33-4)
A
S/C
SWITCH
SIGNAL
SPEED
CONTROL
SWITCH-
RIGHT
(8W-33-3)
(8W-33-4)
V37
20
RD/LG
17
C219
V37
20
RD/LG
M6
C130
V37
18
RD/LG
5
CRANKSHAFT
POSITION
SENSOR
SIGNAL
THROTTLE
POSITION
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE
8
C1
23
C1
K24
18
GY/BK
K22
18
OR/DB
3
C110
10
C108
V37
18
RD/LG
K24
18
WT/DG
K22
18
OR/DB
46
C2
2
C2
1
C2
S/C
SWITCH
SIGNAL
CRANKSHAFT
POSITION
SENSOR
SIGNAL
THROTTLE
POSITION
SENSOR
SIGNAL
ENGINE
CONTROL
MODULE

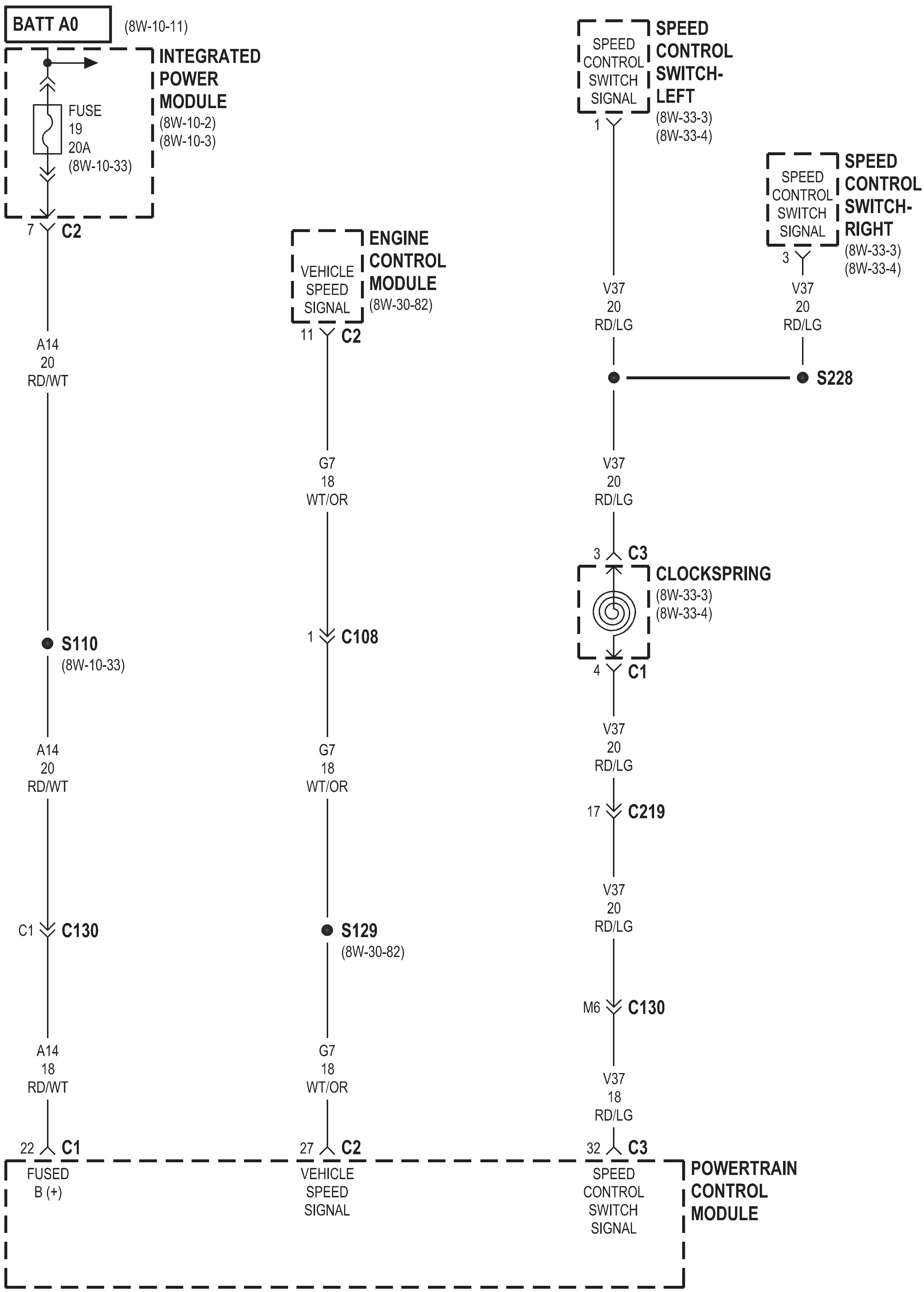

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
12
40A
(8W-10-57)
30
85
FUEL
HEATER
RELAY
87
86
1 C1
11 C6
10 C6
14 C4
15 C5
A112
12
RD/TN
A93
12
RD/BK
Z114
18
BK/LG
Y135
18
LG/BK
A2 C130
S136
(8W-10-43)
A93
14
RD/BK
Y135
18
LG/BK
J5 C130
3 C108
FUEL
HEATER
FUEL
HEATER
RELAY
OUTPUT
GROUND
B
A
Y135
18
LG/BK
S156
(8W-10-43)
A93
14
RD/BK
Y135
18
LG/BK
2 C112
2 C1
Z11
14
BK/WT
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-START)
POWERTRAIN
CONTROL
MODULE
A93
14
RD/BK
S176
(8W-15-11)
Z11
12
BK/WT
G120
(8W-15-11)
G106
(8W-15-4)

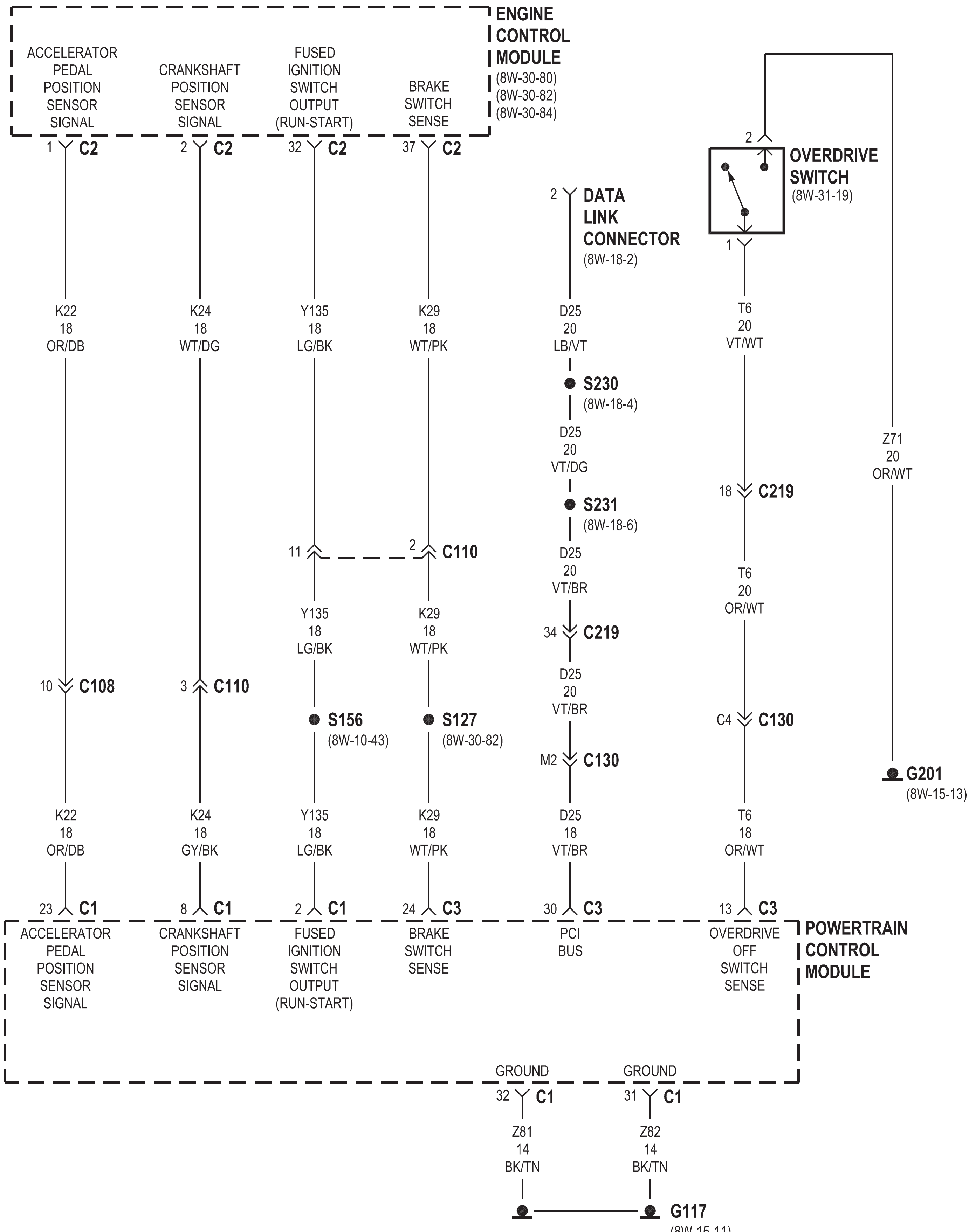

RUN-START A21
(8W-10-45)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
PTC
NO. 1
7.5A
(8W-10-43)
16
C4
Y135
18
LG/BK
S136
(8W-10-43)
Y135
18
LG/BK
J5
C130
Y135
18
LG/BK
S156
(8W-10-43)
Y135
18
LG/BK
Z11
18
BK/WT
4
C100
Z11
18
BK/WT
S101
(8W-15-7)
Z147
18
BK/LB
2
1
VACUUM
PUMP
M
G105
(8W-15-7)


BATT A0
(8W-10-11)
RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 40 15A (8W-10-34)
ADJUSTABLE PEDAL RELAY CONTROL
FRONT CONTROL MODULE (8W-10-34)
35
FUSE 36 10A (8W-10-47)
30
85
ADJUSTABLE PEDAL RELAY
87A
87
86
16 C7
25 C5
Y153 18 DB/RD
F15 20 DB
EXCEPT ADJUSTABLE PEDAL
ADJUSTABLE PEDAL
43 C219
NOT USED
43
32 C219
Y153 18 DB/RD
F15 20 DB
S225
(8W-10-46)
F15 20 DB
2
5
ADJUSTABLE PEDAL SWITCH
1 DOWN
2 UP
1 2 1 2
1
6
4
Y151 18 LG/BR
Y152 18 LG/OR
Z154 18 BK/BR
1
2
M
ADJUSTABLE PEDAL MOTOR
G203
(8W-15-17)

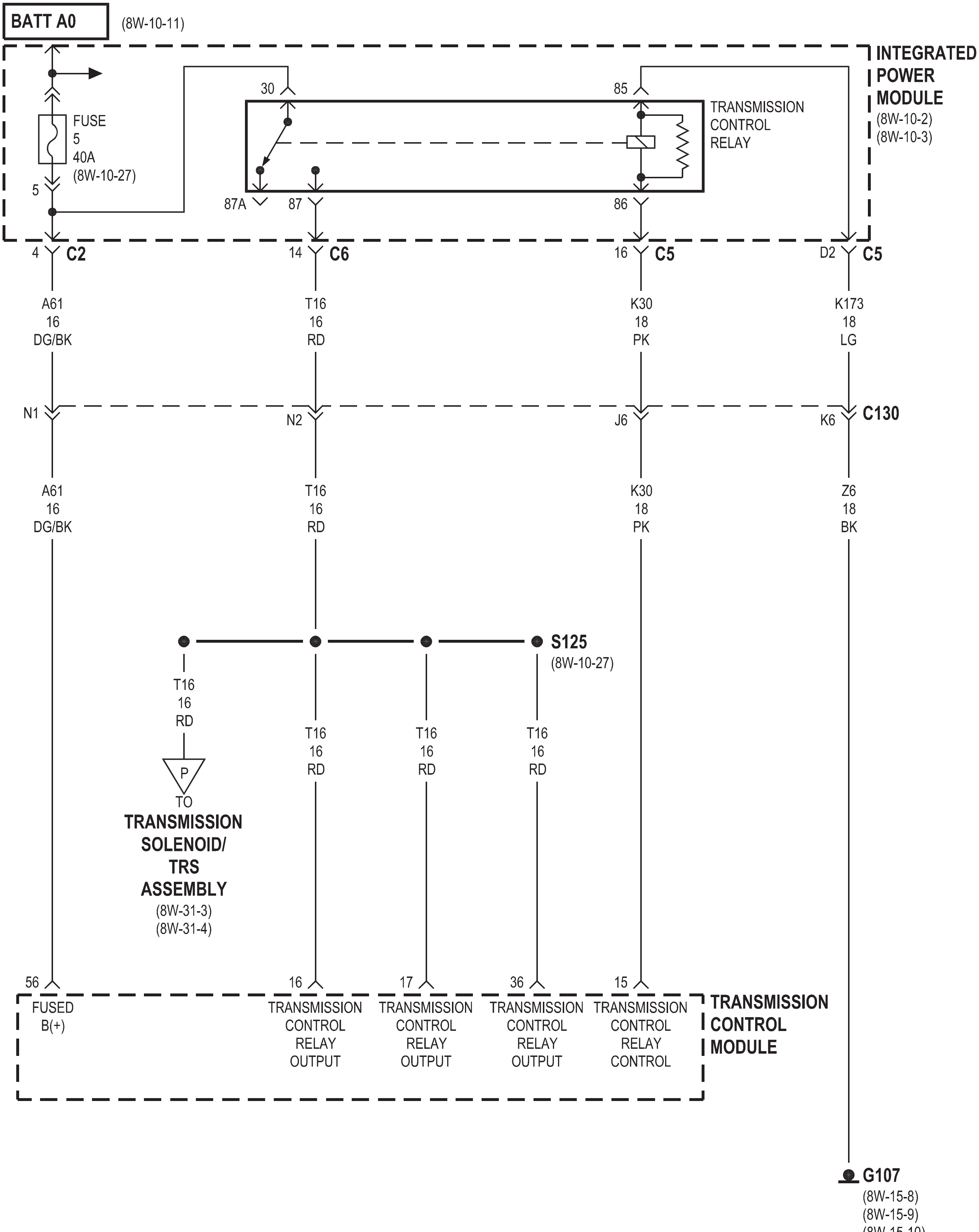

OUTPUT SPEED SENSOR
(8W-31-6)
(8W-31-13)
(8W-31-16)
K173
20
LG
C5
BATT A0
(8W-10-11)
C4
RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
(8W-10-28)
FUSE
50
10A
(8W-10-45)
TRANSMISSION CONTROL RELAY
(8W-31-16)
86
30
85
87
87A
C5
C6
POWERTRAIN CONTROL MODULE
5 VOLT SUPPLY
SENSOR GROUND
K30
18
PK
T16
16
RD
J6
N2
C130
C2
C1
K6
18
VT/WT
K914
18
VT/RD
S125
(8W-10-27)
(8W-10-29)
S148
(8W-10-22)
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-16)
T14
18
LG/WT
T13
18
DB/BK
K88
18
VT/WT
T60
18
BR
K54
18
OR/BK
T25
18
LG/RD
T54
18
VT
OUTPUT SPEED SENSOR SIGNAL
OUTPUT SPEED SENSOR GROUND
TRANSMISSION CONTROL RELAY CONTROL
GOVERNOR PRESSURE SOLENOID CONTROL
3-4 SHIFT SOLENOID CONTROL
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
GOVERNOR PRESSURE SENSOR SIGNAL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE

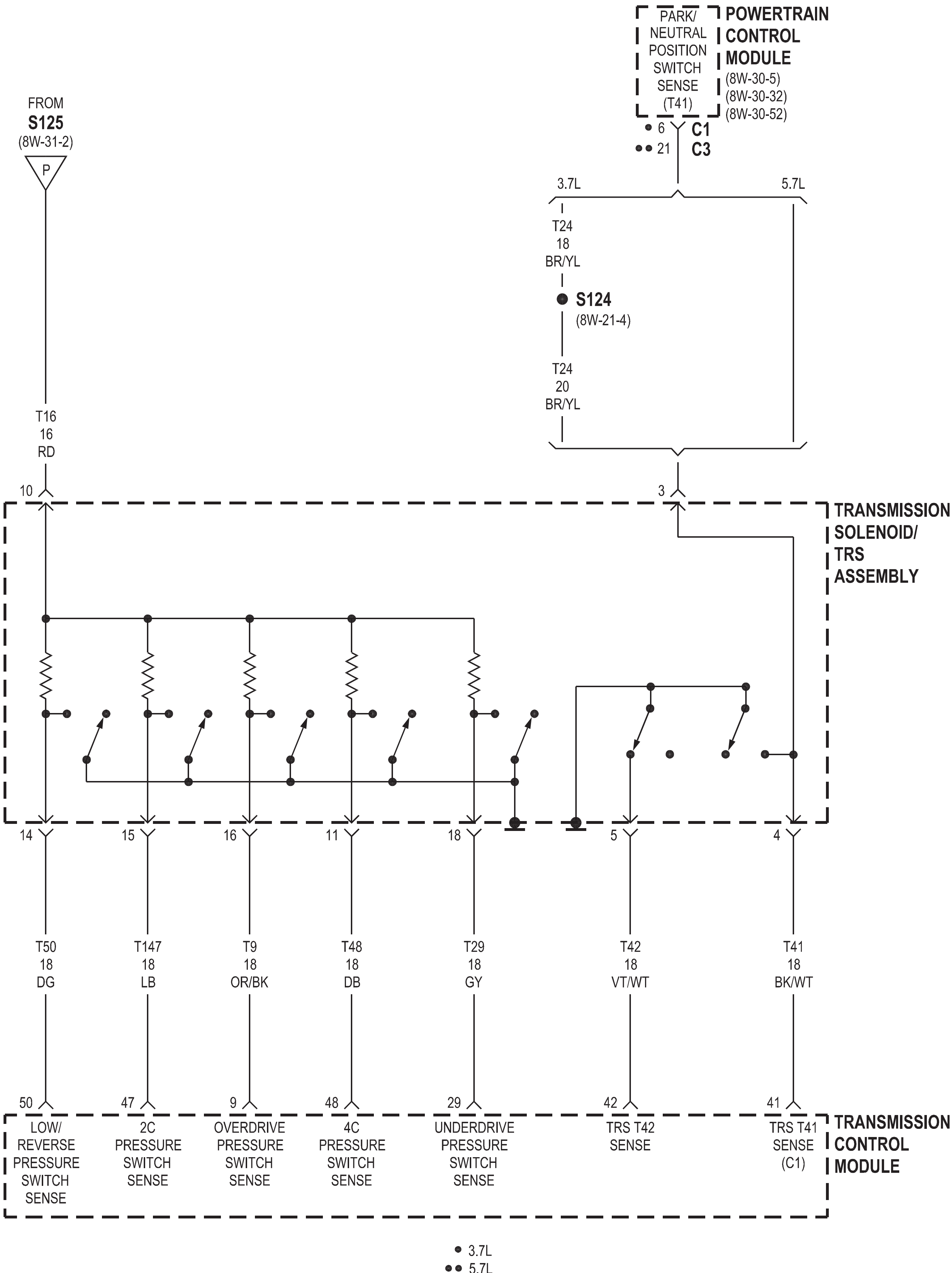

SPEED CONTROL SERVO
(8W-33-2)
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL BRAKE SWITCH OUTPUT
1
2
3
V36 20 TN/RD
V30 20 DB/RD
25 C219
V30 20 DB/RD
3
BRAKE LAMP SWITCH
(8W-33-6)
4
V32 20 YL/RD
21 C219
V35 20 LG/RD
V32 20 YL/RD
DATA LINK CONNECTOR
(8W-18-3)
9
15
D6 18 PK/LB
D15 18 WT/DG
44
2
C219
D6 18 PK/LB
D15 18 WT/DG
K1
B1
B2
F2
D2
C130
V36 18 TN/RD
V35 18 LG/RD
V32 18 YL/RD
D6 18 PK/LB
D15 18 WT/DG
4 C3
5 C3
11 C3
29 C3
27 C3
POWERTRAIN CONTROL MODULE
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL BRAKE SWITCH OUTPUT
SCI RECEIVE (TCM)
SCI TRANSMIT (TCM)

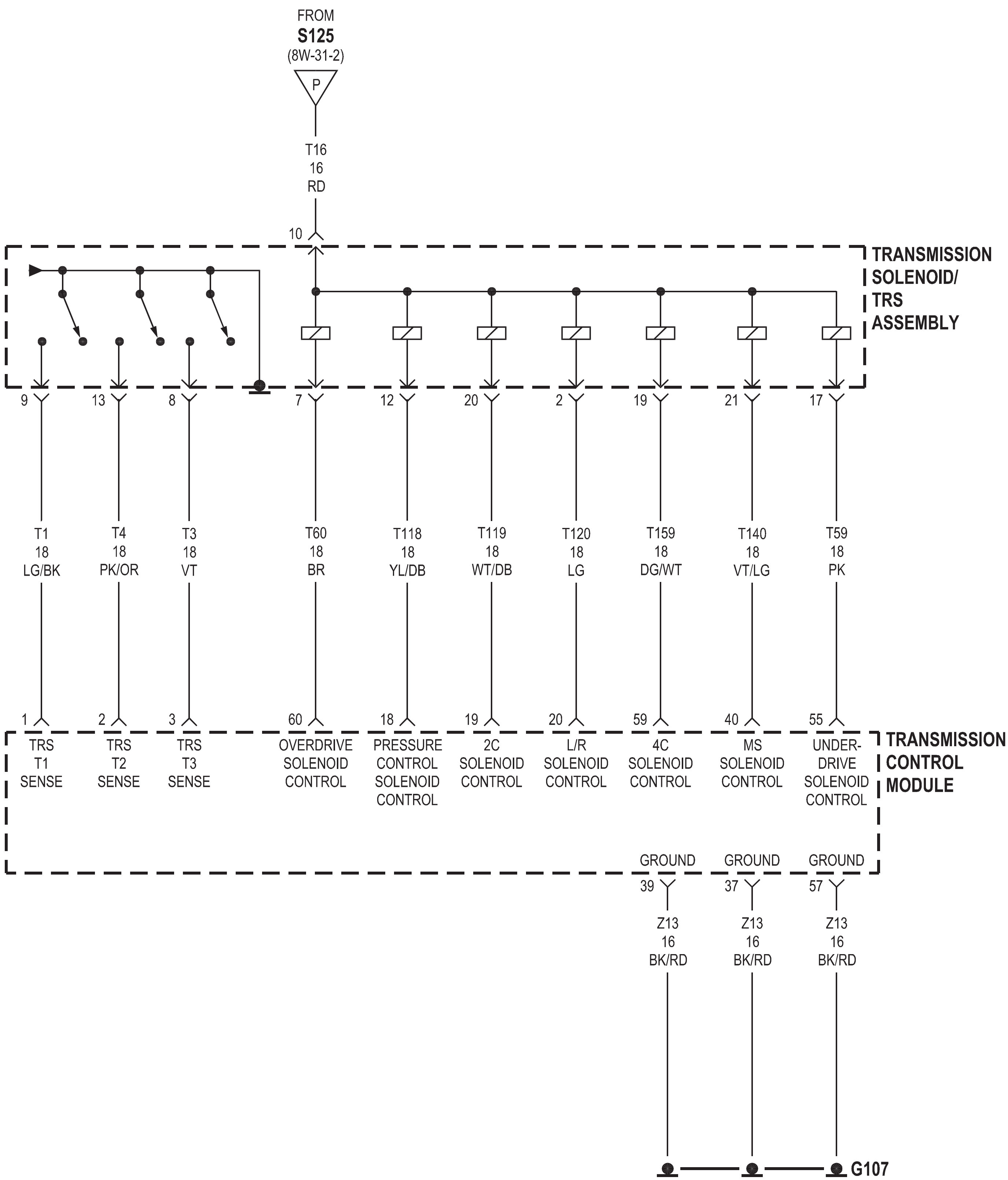

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
19
20A
(8W-10-33)
7 C2
A14
20
RD/WT
S110
(8W-10-33)
A14
20
RD/WT
C1 C130
A14
18
RD/WT
22 C1
FUSED B (+)
ENGINE CONTROL MODULE
(8W-30-82)
VEHICLE SPEED SIGNAL
11 C2
G7
18
WT/OR
1 C108
G7
18
WT/OR
S129
(8W-30-82)
G7
18
WT/OR
27 C2
VEHICLE SPEED SIGNAL
SPEED CONTROL SWITCH-LEFT
(8W-33-3)
(8W-33-4)
SPEED CONTROL SWITCH SIGNAL
1
SPEED CONTROL SWITCH-RIGHT
(8W-33-3)
(8W-33-4)
SPEED CONTROL SWITCH SIGNAL
3
V37
20
RD/LG
V37
20
RD/LG
S228
V37
20
RD/LG
3 C3
CLOCKSPRING
(8W-33-3)
(8W-33-4)
4 C1
V37
20
RD/LG
17 C219
V37
20
RD/LG
M6 C130
V37
18
RD/LG
32 C3
SPEED CONTROL SWITCH SIGNAL
POWERTRAIN CONTROL MODULE

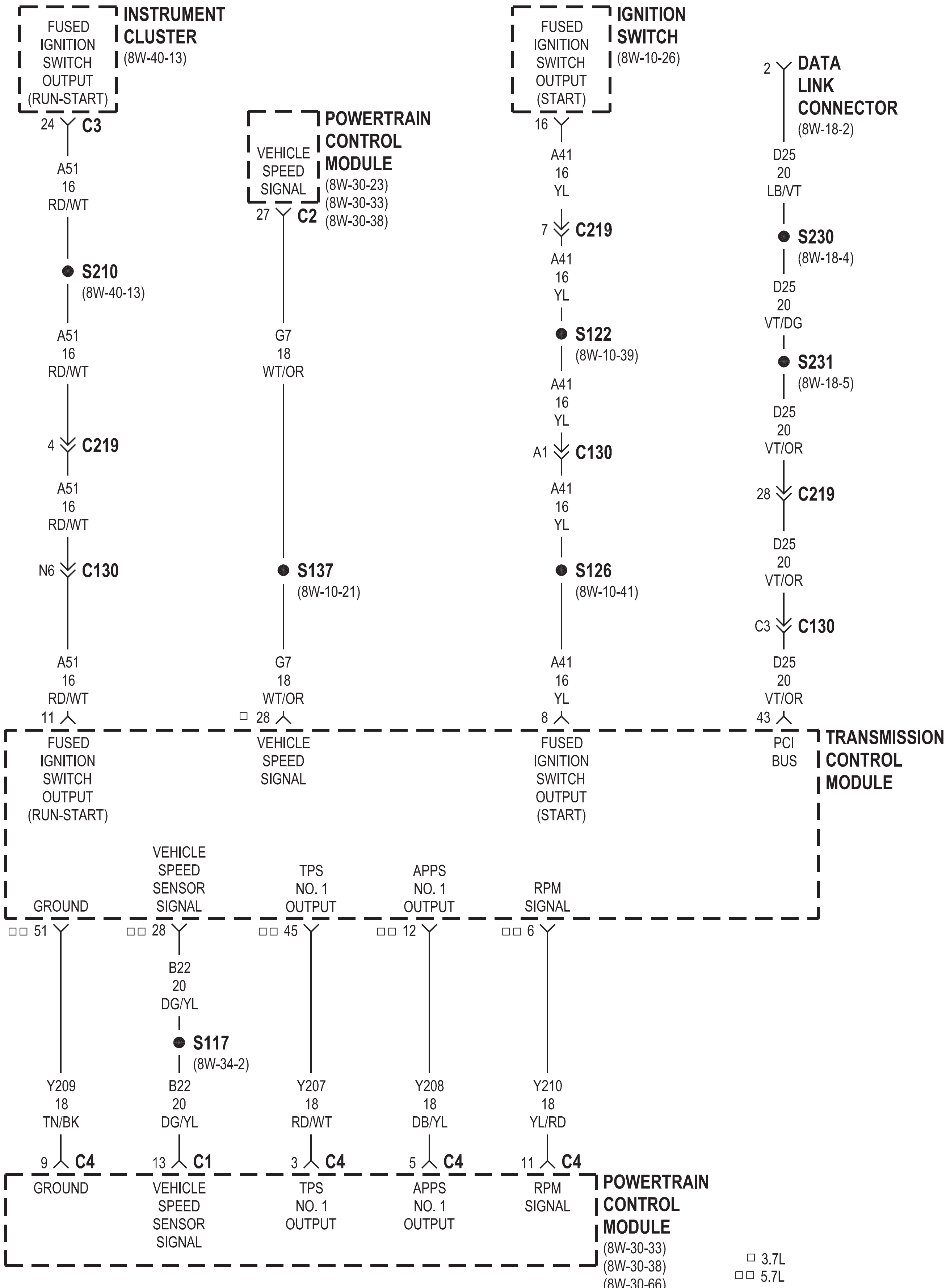

ENGINE CONTROL MODULE
(8W-30-80)
(8W-30-82)
(8W-30-84)
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
CRANKSHAFT POSITION SENSOR SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BRAKE SWITCH SENSE
1 C2
2 C2
32 C2
37 C2
DATA LINK CONNECTOR
(8W-18-2)
2
OVERDRIVE SWITCH
(8W-31-19)
2
1
K22 18 OR/DB
K24 18 WT/DG
Y135 18 LG/BK
K29 18 WT/PK
D25 20 LB/VT
T6 20 VT/WT
S230
(8W-18-4)
D25 20 VT/DG
S231
(8W-18-6)
Z71 20 OR/WT
18 C219
11
2 C110
D25 20 VT/BR
T6 20 OR/WT
Y135 18 LG/BK
K29 18 WT/PK
34 C219
10 C108
3 C110
D25 20 VT/BR
S156
(8W-10-43)
S127
(8W-30-82)
C4 C130
M2 C130
G201
(8W-15-13)
K22 18 OR/DB
K24 18 GY/BK
Y135 18 LG/BK
K29 18 WT/PK
D25 18 VT/BR
T6 18 OR/WT
23 C1
8 C1
2 C1
24 C3
30 C3
13 C3
POWERTRAIN CONTROL MODULE
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
CRANKSHAFT POSITION SENSOR SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BRAKE SWITCH SENSE
PCI BUS
OVERDRIVE OFF SWITCH SENSE
GROUND
GROUND
32 C1
31 C1
Z81 14 BK/TN
Z82 14 BK/TN
G117
(8W-15-11)

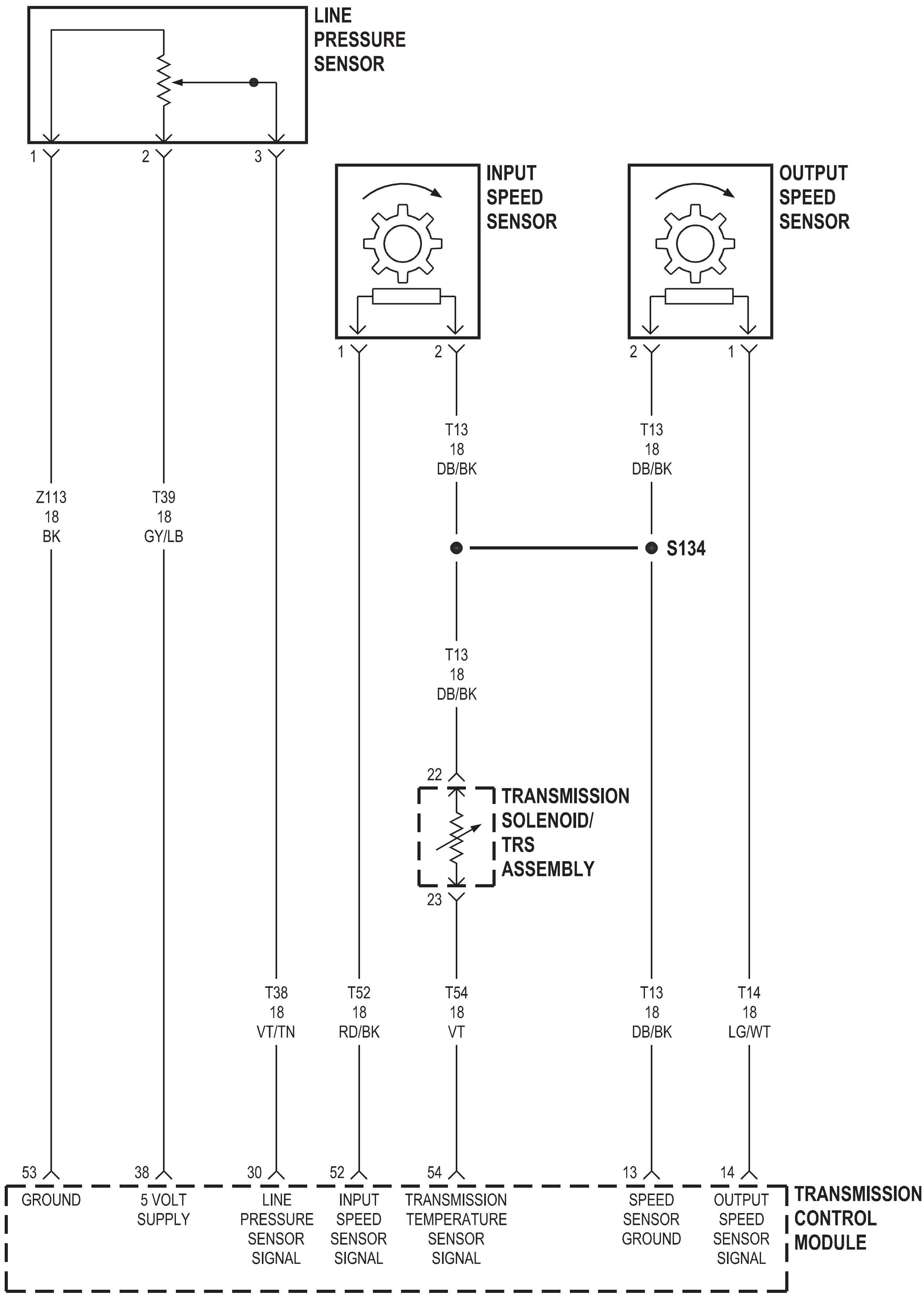
8W-31 TRANSMISSION CONTROL SYSTEM

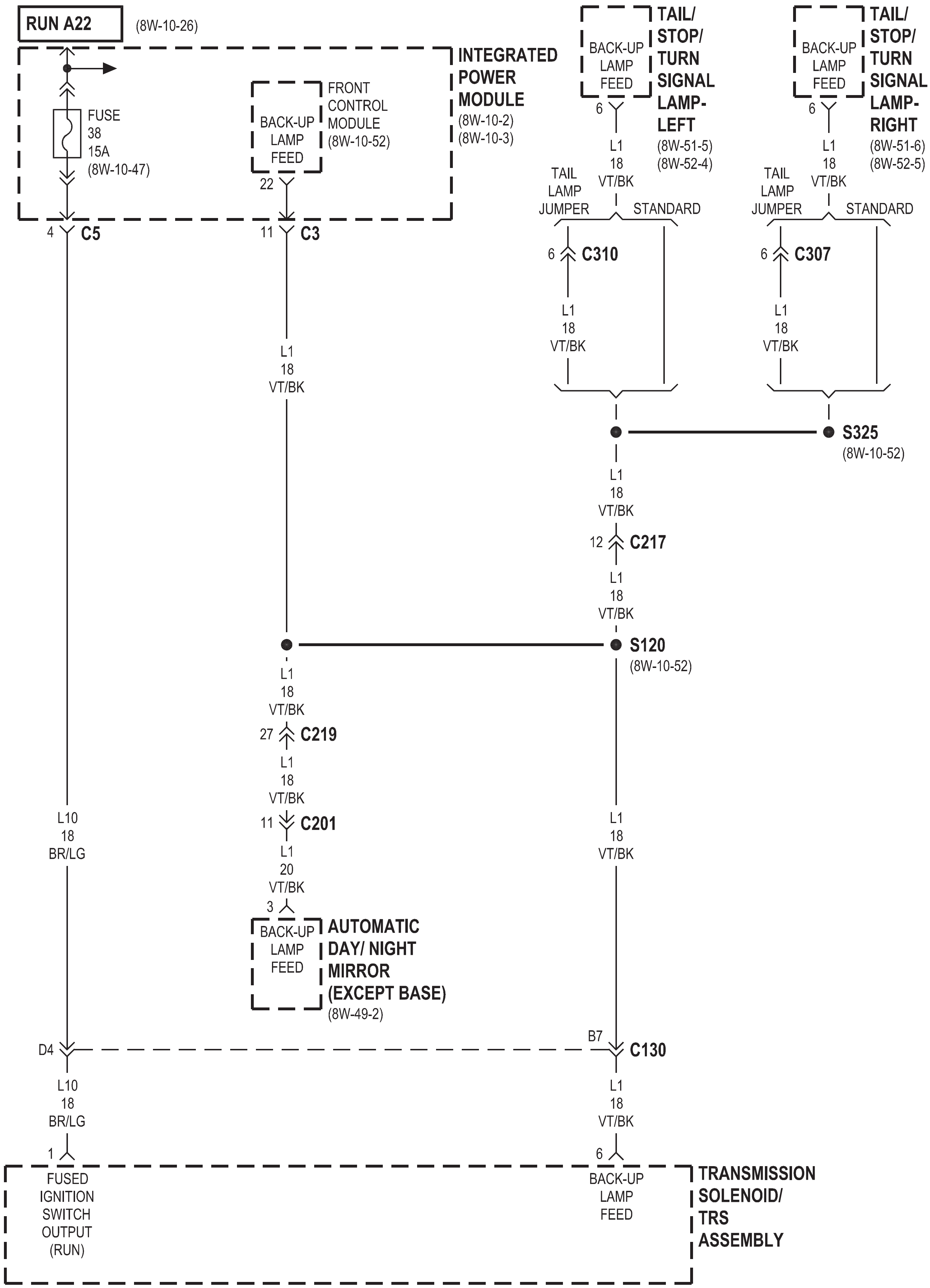

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
(8W-10-27)
5
30
85
87A
87
86
TRANSMISSION
CONTROL
RELAY
4 C2
14 C6
16 C5
D2 C5
A61
16
DG/BK
T16
16
RD
K30
18
PK
K173
18
LG
N1
N2
J6
K6
C130
A61
16
DG/BK
T16
16
RD
K30
18
PK
Z6
18
BK
S125
(8W-10-27)
T16
16
RD
P
TO
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
(8W-31-3)
(8W-31-4)
T16
16
RD
T16
16
RD
T16
16
RD
56
16
17
36
15
FUSED
B(+)
TRANSMISSION
CONTROL
RELAY
OUTPUT
TRANSMISSION
CONTROL
RELAY
OUTPUT
TRANSMISSION
CONTROL
RELAY
OUTPUT
TRANSMISSION
CONTROL
RELAY
CONTROL
TRANSMISSION
CONTROL
MODULE
G107
(8W-15-8)
(8W-15-9)
(8W-15-10)

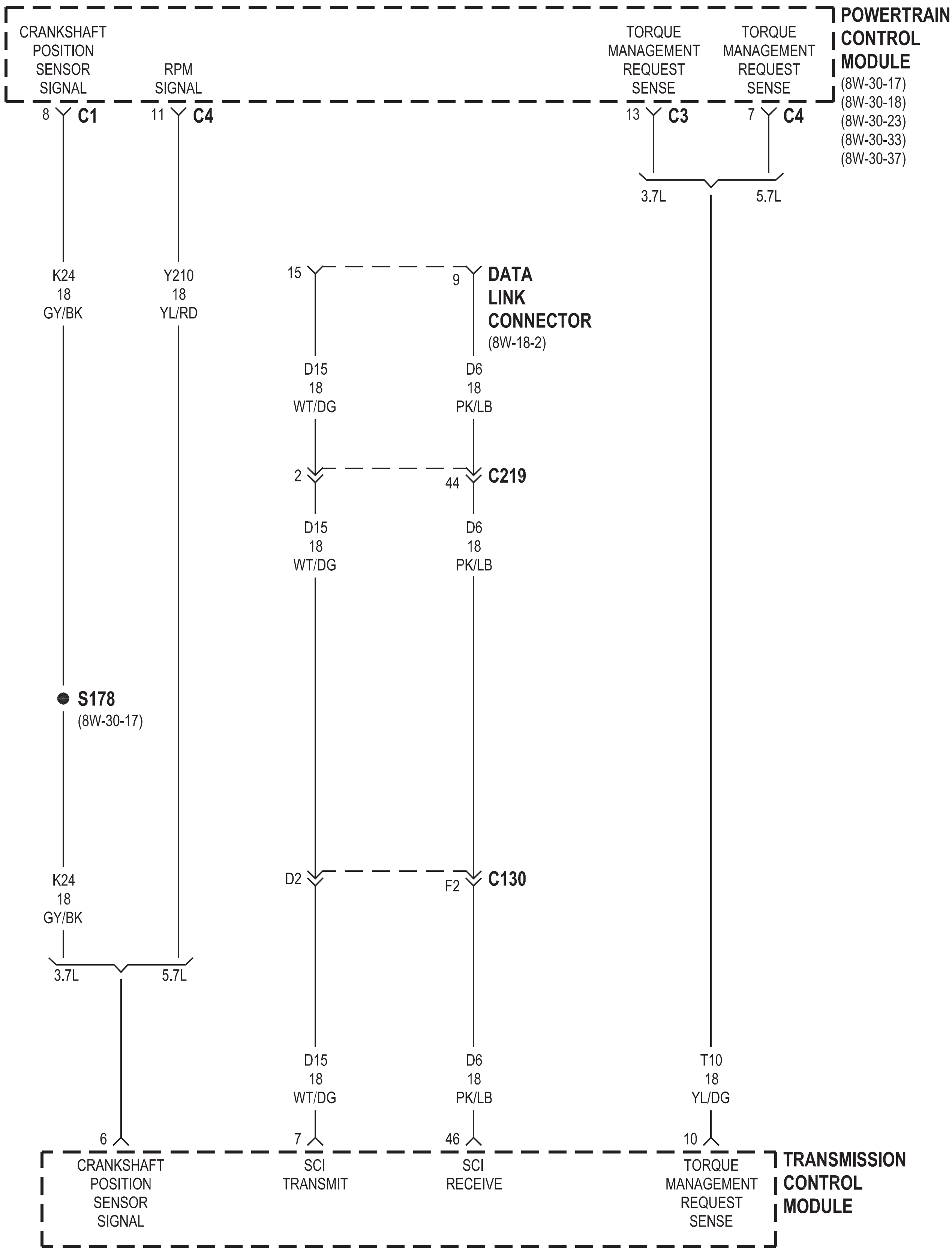

PARK/
NEUTRAL
POSITION
SWITCH
SENSE
(T41)
POWERTRAIN
CONTROL
MODULE
(8W-30-5)
(8W-30-32)
(8W-30-52)
• 6 C1
•• 21 C3
3.7L
5.7L
FROM
S125
(8W-31-2)
P
T24
18
BR/YL
S124
(8W-21-4)
T24
20
BR/YL
T16
16
RD
10
3
TRANSMISSION
SOLENOID/
TRS
ASSEMBLY
14
15
16
11
18
5
4
T50
18
DG
T147
18
LB
T9
18
OR/BK
T48
18
DB
T29
18
GY
T42
18
VT/WT
T41
18
BK/WT
50
47
9
48
29
42
41
LOW/
REVERSE
PRESSURE
SWITCH
SENSE
2C
PRESSURE
SWITCH
SENSE
OVERDRIVE
PRESSURE
SWITCH
SENSE
4C
PRESSURE
SWITCH
SENSE
UNDERDRIVE
PRESSURE
SWITCH
SENSE
TRS T42
SENSE
TRS T41
SENSE
(C1)
TRANSMISSION
CONTROL
MODULE
• 3.7L
•• 5.7L

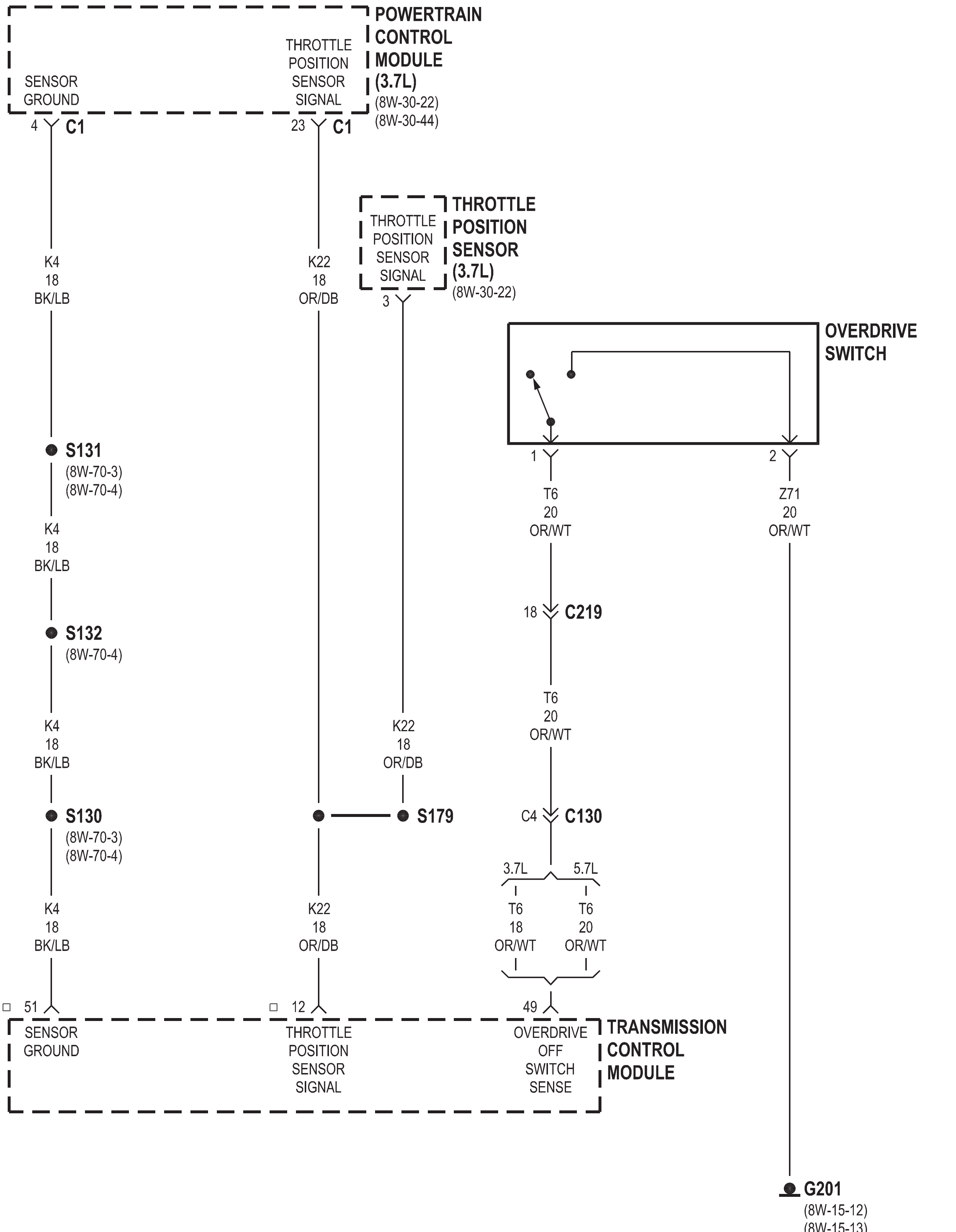

FROM
S125
(8W-31-2)
P
T16
16
RD
10
TRANSMISSION SOLENOID/ TRS ASSEMBLY
9
13
8
7
12
20
2
19
21
17
T1 18 LG/BK
T4 18 PK/OR
T3 18 VT
T60 18 BR
T118 18 YL/DB
T119 18 WT/DB
T120 18 LG
T159 18 DG/WT
T140 18 VT/LG
T59 18 PK
1
2
3
60
18
19
20
59
40
55
TRS T1 SENSE
TRS T2 SENSE
TRS T3 SENSE
OVERDRIVE SOLENOID CONTROL
PRESSURE CONTROL SOLENOID CONTROL
2C SOLENOID CONTROL
L/R SOLENOID CONTROL
4C SOLENOID CONTROL
MS SOLENOID CONTROL
UNDER-DRIVE SOLENOID CONTROL
TRANSMISSION CONTROL MODULE
GROUND
GROUND
GROUND
39
37
57
Z13 16 BK/RD
Z13 16 BK/RD
Z13 16 BK/RD
G107
(8W-15-8)


INSTRUMENT CLUSTER (8W-40-13)
FUSED IGNITION SWITCH OUTPUT (RUN-START)
24 C3
A51 16 RD/WT
S210 (8W-40-13)
A51 16 RD/WT
4 C219
A51 16 RD/WT
N6 C130
A51 16 RD/WT
11
POWERTRAIN CONTROL MODULE (8W-30-23) (8W-30-33) (8W-30-38)
VEHICLE SPEED SIGNAL
27 C2
G7 18 WT/OR
S137 (8W-10-21)
G7 18 WT/OR
□ 28
IGNITION SWITCH (8W-10-26)
FUSED IGNITION SWITCH OUTPUT (START)
16
A41 16 YL
7 C219
A41 16 YL
S122 (8W-10-39)
A41 16 YL
A1 C130
A41 16 YL
S126 (8W-10-41)
A41 16 YL
8
2 DATA LINK CONNECTOR (8W-18-2)
D25 20 LB/VT
S230 (8W-18-4)
D25 20 VT/DG
S231 (8W-18-5)
D25 20 VT/OR
28 C219
D25 20 VT/OR
C3 C130
D25 20 VT/OR
43
TRANSMISSION CONTROL MODULE
FUSED IGNITION SWITCH OUTPUT (RUN-START)
VEHICLE SPEED SIGNAL
FUSED IGNITION SWITCH OUTPUT (START)
PCI BUS
GROUND
VEHICLE SPEED SENSOR SIGNAL
TPS NO. 1 OUTPUT
APPS NO. 1 OUTPUT
RPM SIGNAL
□□ 51
□□ 28
□□ 45
□□ 12
□□ 6
B22 20 DG/YL
S117 (8W-34-2)
Y209 18 TN/BK
B22 20 DG/YL
Y207 18 RD/WT
Y208 18 DB/YL
Y210 18 YL/RD
9 C4
13 C1
3 C4
5 C4
11 C4
GROUND
VEHICLE SPEED SENSOR SIGNAL
TPS NO. 1 OUTPUT
APPS NO. 1 OUTPUT
RPM SIGNAL
POWERTRAIN CONTROL MODULE (8W-30-33) (8W-30-38) (8W-30-66)
□ 3.7L
□□ 5.7L

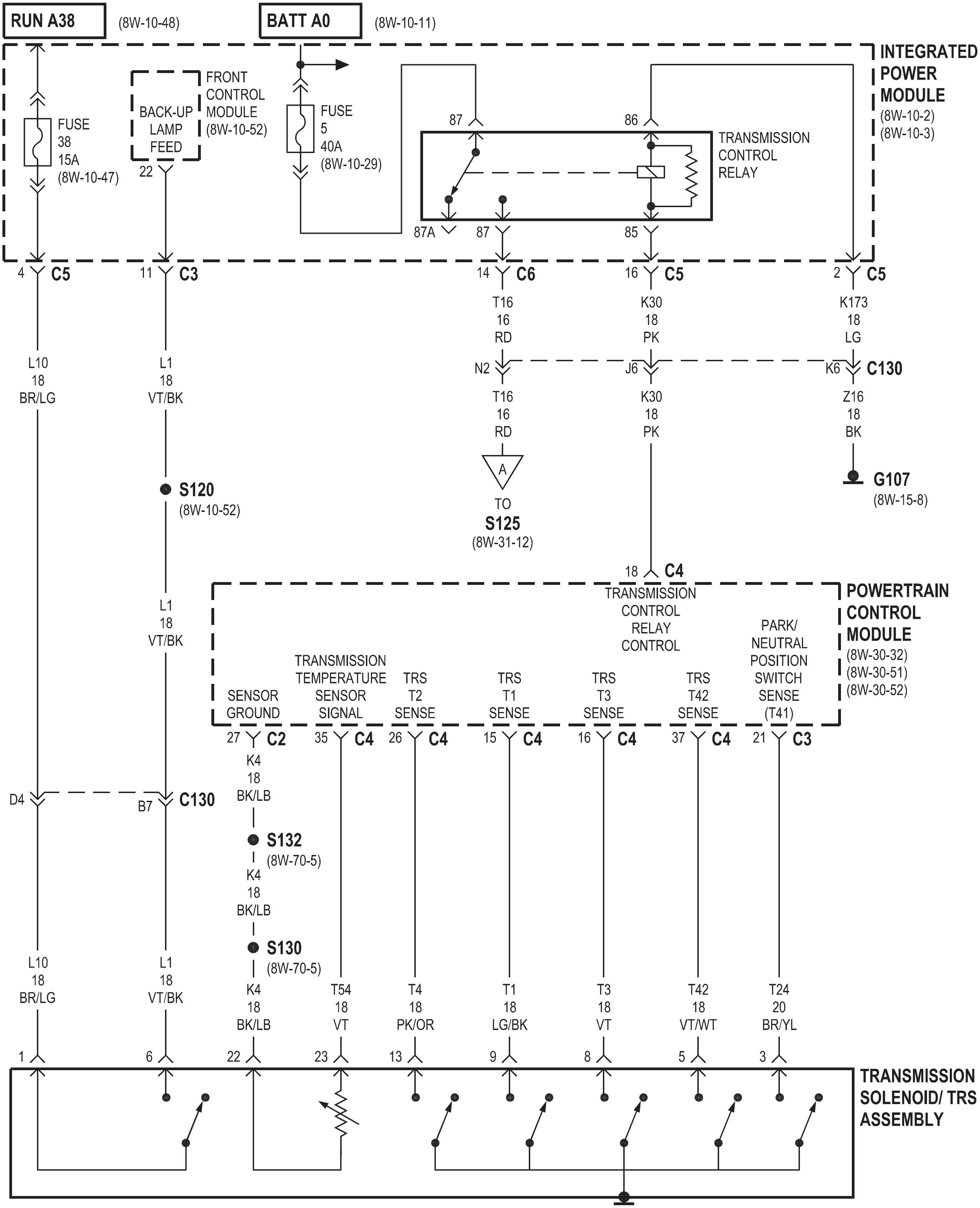

LINE PRESSURE SENSOR
1
2
3
INPUT SPEED SENSOR
1
2
OUTPUT SPEED SENSOR
2
1
T13
18
DB/BK
T13
18
DB/BK
Z113
18
BK
T39
18
GY/LB
S134
T13
18
DB/BK
22
TRANSMISSION SOLENOID/ TRS ASSEMBLY
23
T38
18
VT/TN
T52
18
RD/BK
T54
18
VT
T13
18
DB/BK
T14
18
LG/WT
53
38
30
52
54
13
14
GROUND
5 VOLT SUPPLY
LINE PRESSURE SENSOR SIGNAL
INPUT SPEED SENSOR SIGNAL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
SPEED SENSOR GROUND
OUTPUT SPEED SENSOR SIGNAL
TRANSMISSION CONTROL MODULE


RUN A22
(8W-10-26)
FUSE
38
15A
(8W-10-47)
BACK-UP LAMP FEED
22
FRONT CONTROL MODULE
(8W-10-52)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
4
C5
11
C3
BACK-UP LAMP FEED
6
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
(8W-51-5)
(8W-52-4)
BACK-UP LAMP FEED
6
TAIL/ STOP/ TURN SIGNAL LAMP- RIGHT
(8W-51-6)
(8W-52-5)
L1
18
VT/BK
TAIL LAMP JUMPER
STANDARD
6
C310
6
C307
S325
(8W-10-52)
12
C217
S120
(8W-10-52)
27
C219
11
C201
L1
20
VT/BK
3
BACK-UP LAMP FEED
AUTOMATIC DAY/ NIGHT MIRROR (EXCEPT BASE)
(8W-49-2)
L10
18
BR/LG
D4
B7
C130
1
6
FUSED IGNITION SWITCH OUTPUT (RUN)
BACK-UP LAMP FEED
TRANSMISSION SOLENOID/ TRS ASSEMBLY

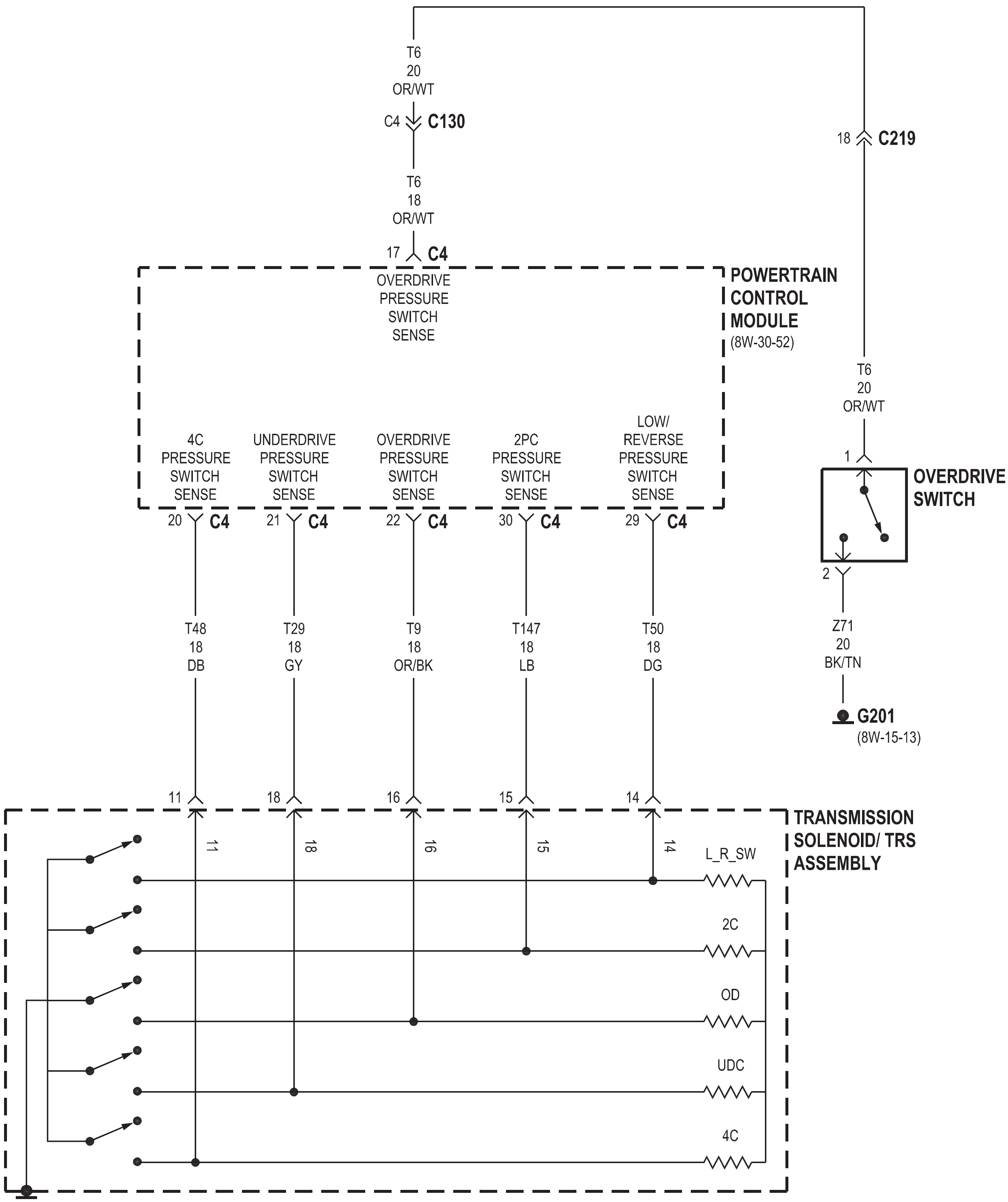

POWERTRAIN CONTROL MODULE
(8W-30-17)
(8W-30-18)
(8W-30-23)
(8W-30-33)
(8W-30-37)
CRANKSHAFT POSITION SENSOR SIGNAL
RPM SIGNAL
TORQUE MANAGEMENT REQUEST SENSE
TORQUE MANAGEMENT REQUEST SENSE
8 C1
11 C4
13 C3
7 C4
3.7L
5.7L
K24
18
GY/BK
Y210
18
YL/RD
15
9
DATA LINK CONNECTOR
(8W-18-2)
D15
18
WT/DG
D6
18
PK/LB
2
44
C219
S178
(8W-30-17)
D2
F2
C130
3.7L
5.7L
T10
18
YL/DG
6
7
46
10
CRANKSHAFT POSITION SENSOR SIGNAL
SCI TRANSMIT
SCI RECEIVE
TORQUE MANAGEMENT REQUEST SENSE
TRANSMISSION CONTROL MODULE

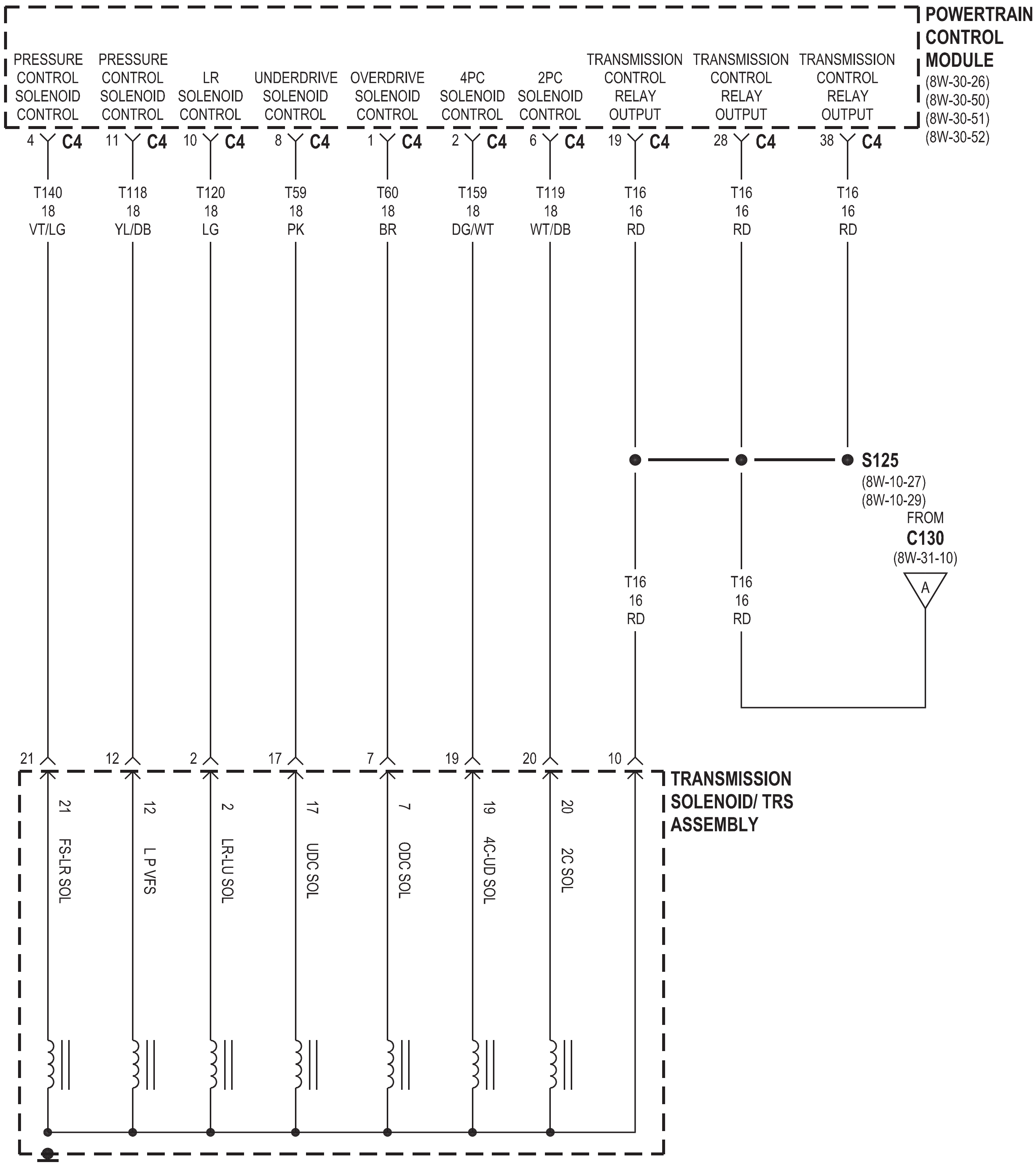

POWERTRAIN CONTROL MODULE (3.7L)
(8W-30-22)
(8W-30-44)
SENSOR GROUND
THROTTLE POSITION SENSOR SIGNAL
4 C1
23 C1
K4 18 BK/LB
K22 18 OR/DB
THROTTLE POSITION SENSOR (3.7L)
(8W-30-22)
THROTTLE POSITION SENSOR SIGNAL
3
OVERDRIVE SWITCH
1
2
T6 20 OR/WT
Z71 20 OR/WT
S131
(8W-70-3)
(8W-70-4)
K4 18 BK/LB
18 C219
S132
(8W-70-4)
T6 20 OR/WT
K4 18 BK/LB
K22 18 OR/DB
S130
(8W-70-3)
(8W-70-4)
S179
C4 C130
3.7L
5.7L
T6 18 OR/WT
T6 20 OR/WT
K4 18 BK/LB
K22 18 OR/DB
51
12
49
TRANSMISSION CONTROL MODULE
SENSOR GROUND
THROTTLE POSITION SENSOR SIGNAL
OVERDRIVE OFF SWITCH SENSE
G201
(8W-15-12)
(8W-15-13)
□ 3.7L

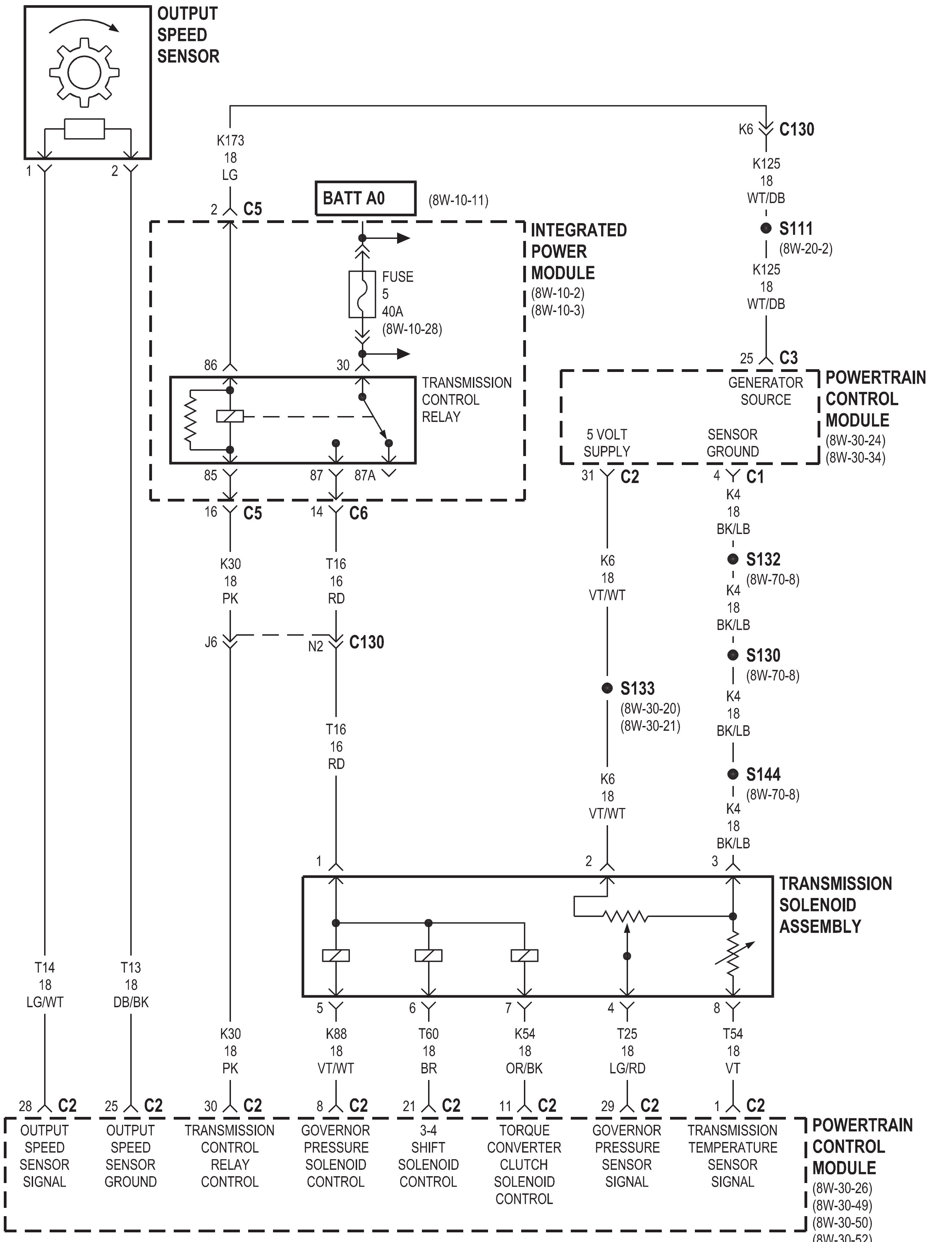
4.7L

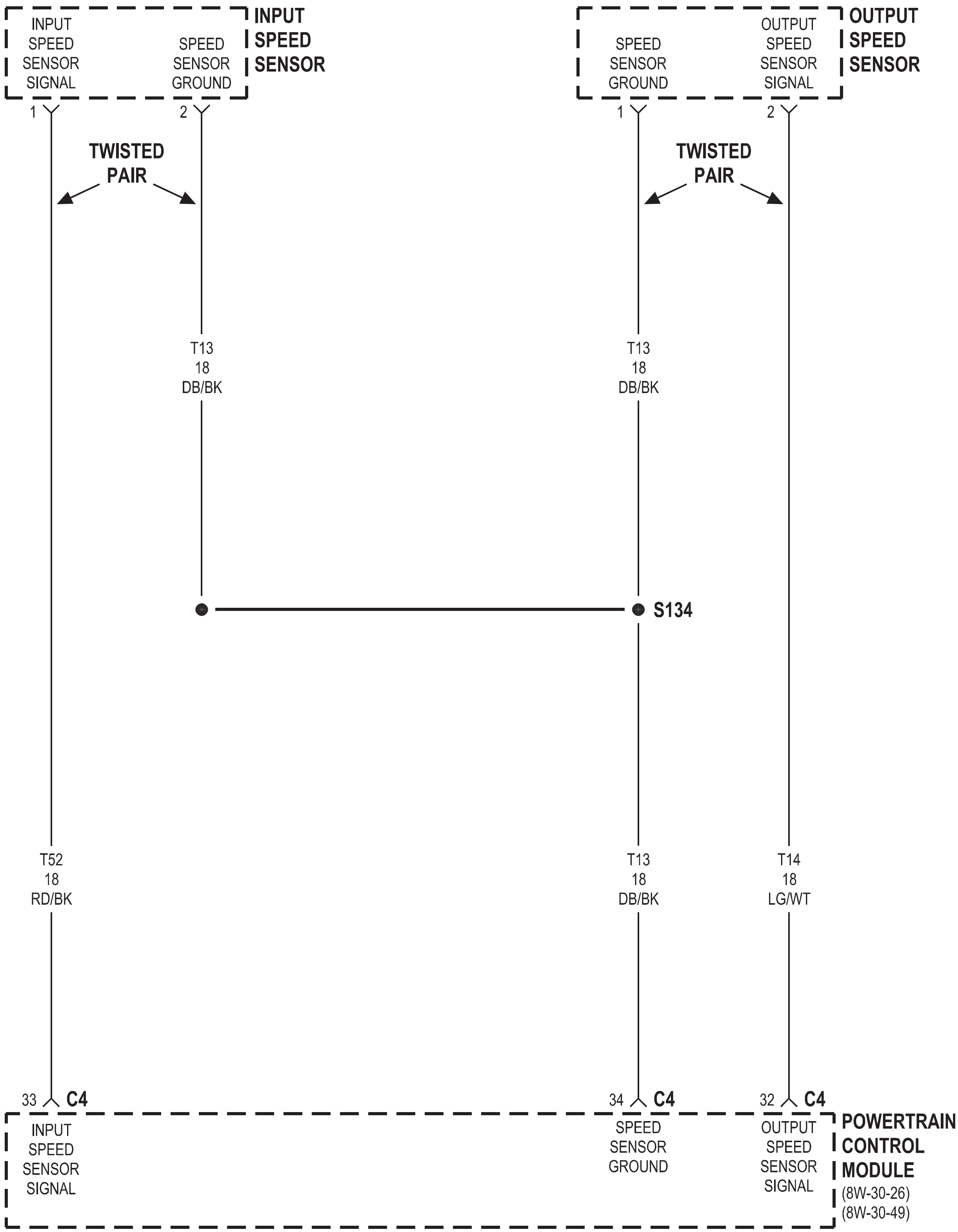


RUN A38
(8W-10-48)
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 38 15A
(8W-10-47)
BACK-UP LAMP FEED
FRONT CONTROL MODULE
(8W-10-52)
22
FUSE 5 40A
(8W-10-29)
87
86
TRANSMISSION CONTROL RELAY
87A
87
85
4 C5
11 C3
14 C6
16 C5
2 C5
T16 16 RD
K30 18 PK
K173 18 LG
N2
J6
K6 C130
T16 16 RD
K30 18 PK
Z16 18 BK
A
TO S125
(8W-31-12)
G107
(8W-15-8)
L10 18 BR/LG
L1 18 VT/BK
S120
(8W-10-52)
L1 18 VT/BK
18 C4
POWERTRAIN CONTROL MODULE
(8W-30-32)
(8W-30-51)
(8W-30-52)
TRANSMISSION CONTROL RELAY CONTROL
PARK/ NEUTRAL POSITION SWITCH SENSE (T41)
SENSOR GROUND
TRANSMISSION TEMPERATURE SENSOR SIGNAL
TRS T2 SENSE
TRS T1 SENSE
TRS T3 SENSE
TRS T42 SENSE
27 C2
35 C4
26 C4
15 C4
16 C4
37 C4
21 C3
K4 18 BK/LB
D4
B7 C130
S132
(8W-70-5)
K4 18 BK/LB
S130
(8W-70-5)
L10 18 BR/LG
L1 18 VT/BK
K4 18 BK/LB
T54 18 VT
T4 18 PK/OR
T1 18 LG/BK
T3 18 VT
T42 18 VT/WT
T24 20 BR/YL
1
6
22
23
13
9
8
5
3
TRANSMISSION SOLENOID/ TRS ASSEMBLY

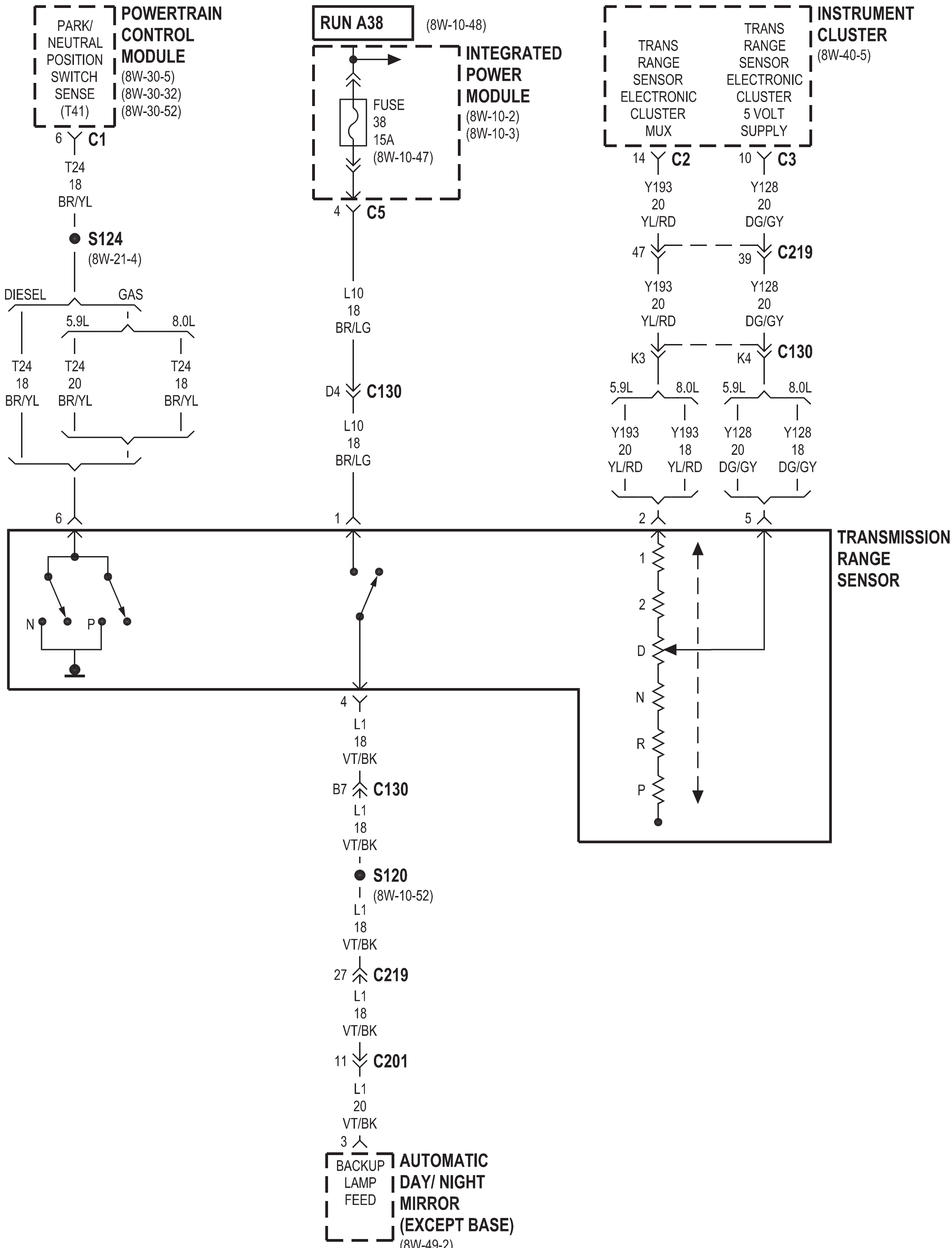

T6
20
OR/WT
C4
C130
18
C219
T6
18
OR/WT
17
C4
OVERDRIVE
PRESSURE
SWITCH
SENSE
POWERTRAIN
CONTROL
MODULE
(8W-30-52)
T6
20
OR/WT
1
OVERDRIVE
SWITCH
2
Z71
20
BK/TN
G201
(8W-15-13)
4C
PRESSURE
SWITCH
SENSE
UNDERDRIVE
PRESSURE
SWITCH
SENSE
OVERDRIVE
PRESSURE
SWITCH
SENSE
2PC
PRESSURE
SWITCH
SENSE
LOW/
REVERSE
PRESSURE
SWITCH
SENSE
20 C4
21 C4
22 C4
30 C4
29 C4
T48
18
DB
T29
18
GY
T9
18
OR/BK
T147
18
LB
T50
18
DG
11
18
16
15
14
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
L_R_SW
2C
OD
UDC
4C

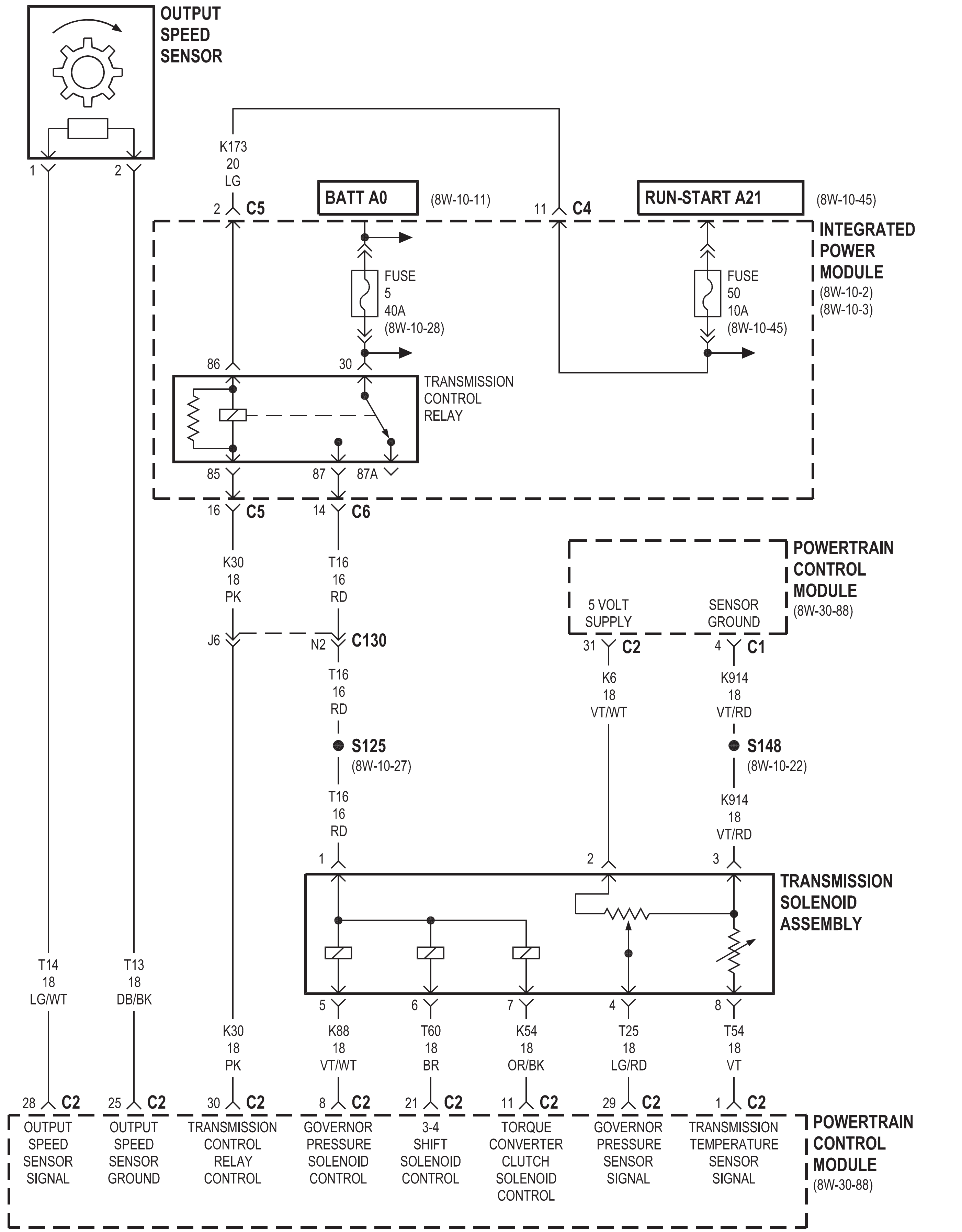

POWERTRAIN CONTROL MODULE
(8W-30-26)
(8W-30-50)
(8W-30-51)
(8W-30-52)
PRESSURE CONTROL SOLENOID CONTROL
PRESSURE CONTROL SOLENOID CONTROL
LR SOLENOID CONTROL
UNDERDRIVE SOLENOID CONTROL
OVERDRIVE SOLENOID CONTROL
4PC SOLENOID CONTROL
2PC SOLENOID CONTROL
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
TRANSMISSION CONTROL RELAY OUTPUT
4 C4
11 C4
10 C4
8 C4
1 C4
2 C4
6 C4
19 C4
28 C4
38 C4
T140 18 VT/LG
T118 18 YL/DB
T120 18 LG
T59 18 PK
T60 18 BR
T159 18 DG/WT
T119 18 WT/DB
T16 16 RD
T16 16 RD
T16 16 RD
S125
(8W-10-27)
(8W-10-29)
FROM
C130
(8W-31-10)
A
T16 16 RD
T16 16 RD
21
12
2
17
7
19
20
10
TRANSMISSION SOLENOID/ TRS ASSEMBLY
21 FS-LR SOL
12 L P VFS
2 LR-LU SOL
17 UDC SOL
7 ODC SOL
19 4C-UD SOL
20 2C SOL

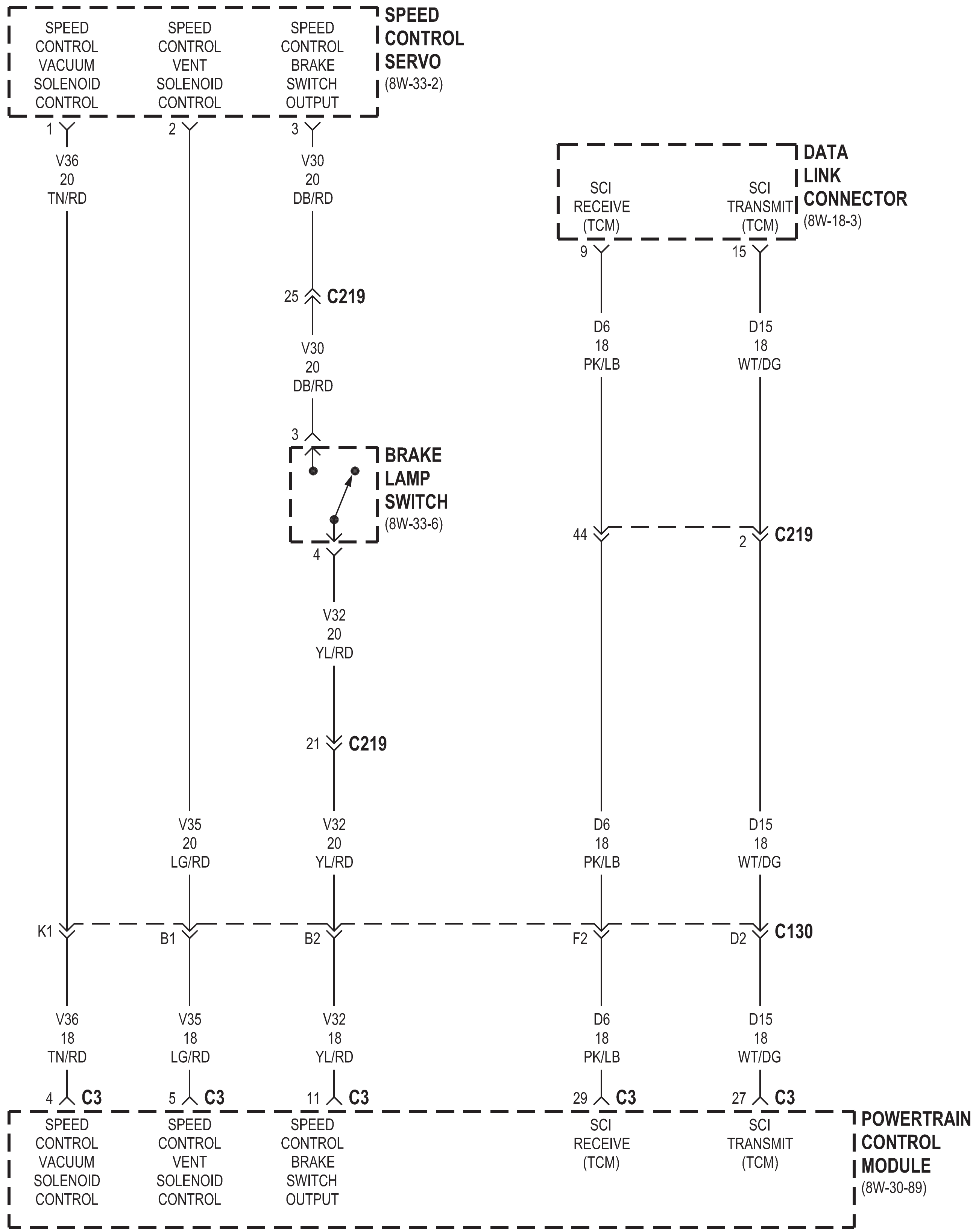

OUTPUT SPEED SENSOR
1
2
K173
18
LG
2
C5
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
(8W-10-28)
86
30
TRANSMISSION CONTROL RELAY
85
87
87A
16
C5
14
C6
K30
18
PK
T16
16
RD
J6
N2
C130
T16
16
RD
K6
C130
K125
18
WT/DB
S111
(8W-20-2)
K125
18
WT/DB
25
C3
GENERATOR SOURCE
POWERTRAIN CONTROL MODULE
(8W-30-24)
(8W-30-34)
5 VOLT SUPPLY
SENSOR GROUND
31
C2
4
C1
K4
18
BK/LB
S132
(8W-70-8)
K4
18
BK/LB
S130
(8W-70-8)
K4
18
BK/LB
S144
(8W-70-8)
K4
18
BK/LB
K6
18
VT/WT
S133
(8W-30-20)
(8W-30-21)
K6
18
VT/WT
1
2
3
TRANSMISSION SOLENOID ASSEMBLY
5
6
7
4
8
T14
18
LG/WT
T13
18
DB/BK
K30
18
PK
K88
18
VT/WT
T60
18
BR
K54
18
OR/BK
T25
18
LG/RD
T54
18
VT
28 C2
25 C2
30 C2
8 C2
21 C2
11 C2
29 C2
1 C2
OUTPUT SPEED SENSOR SIGNAL
OUTPUT SPEED SENSOR GROUND
TRANSMISSION CONTROL RELAY CONTROL
GOVERNOR PRESSURE SOLENOID CONTROL
3-4 SHIFT SOLENOID CONTROL
TORQUE CONVERTER CLUTCH SOLENOID CONTROL
GOVERNOR PRESSURE SENSOR SIGNAL
TRANSMISSION TEMPERATURE SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-26)
(8W-30-49)
(8W-30-50)
(8W-30-52)

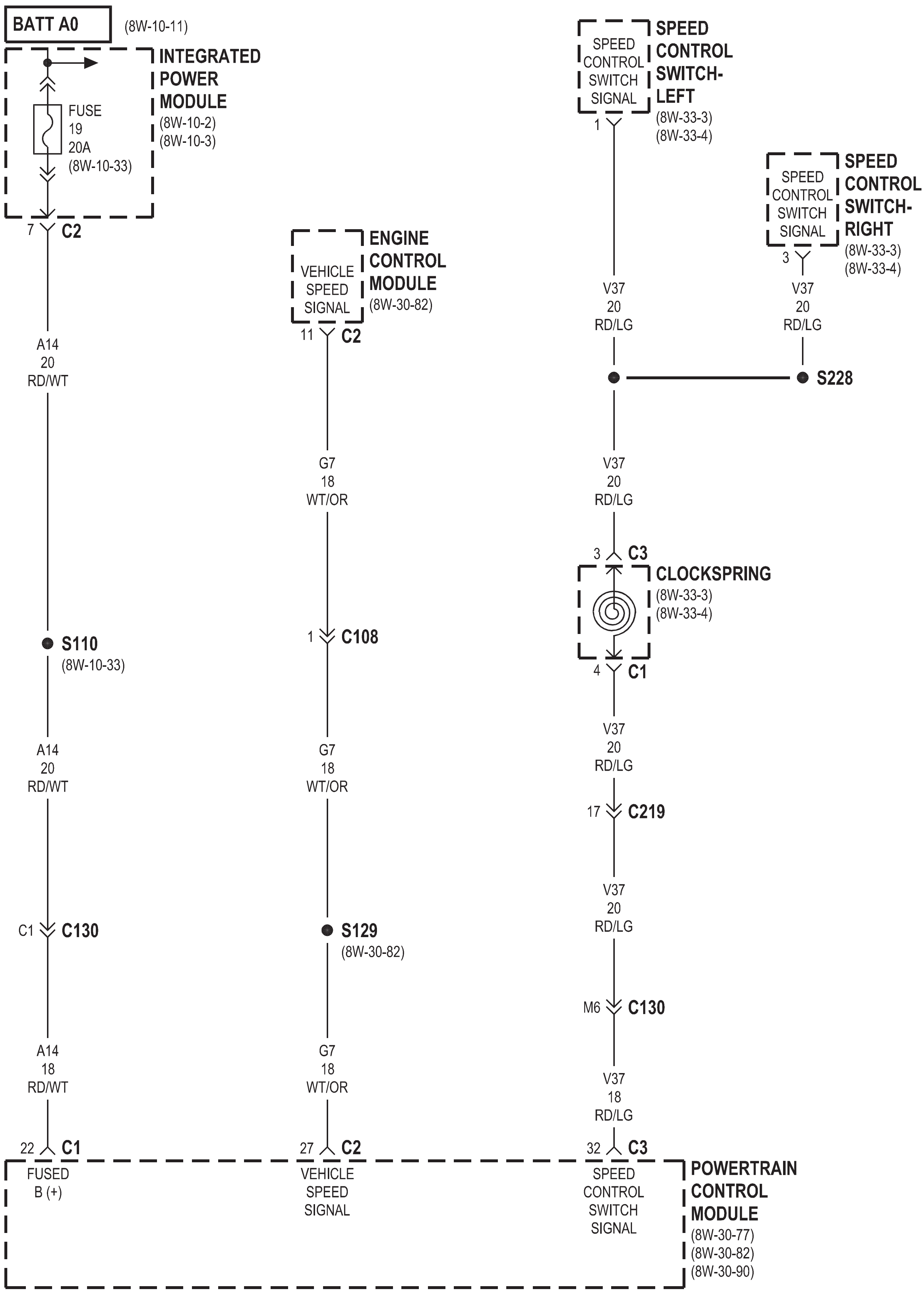

INPUT
SPEED
SENSOR
SIGNAL
SPEED
SENSOR
GROUND
INPUT
SPEED
SENSOR
1
2
TWISTED
PAIR
SPEED
SENSOR
GROUND
OUTPUT
SPEED
SENSOR
SIGNAL
OUTPUT
SPEED
SENSOR
1
2
TWISTED
PAIR
T13
18
DB/BK
T13
18
DB/BK
S134
T52
18
RD/BK
T13
18
DB/BK
T14
18
LG/WT
33
C4
34
C4
32
C4
INPUT
SPEED
SENSOR
SIGNAL
SPEED
SENSOR
GROUND
OUTPUT
SPEED
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE
(8W-30-26)
(8W-30-49)

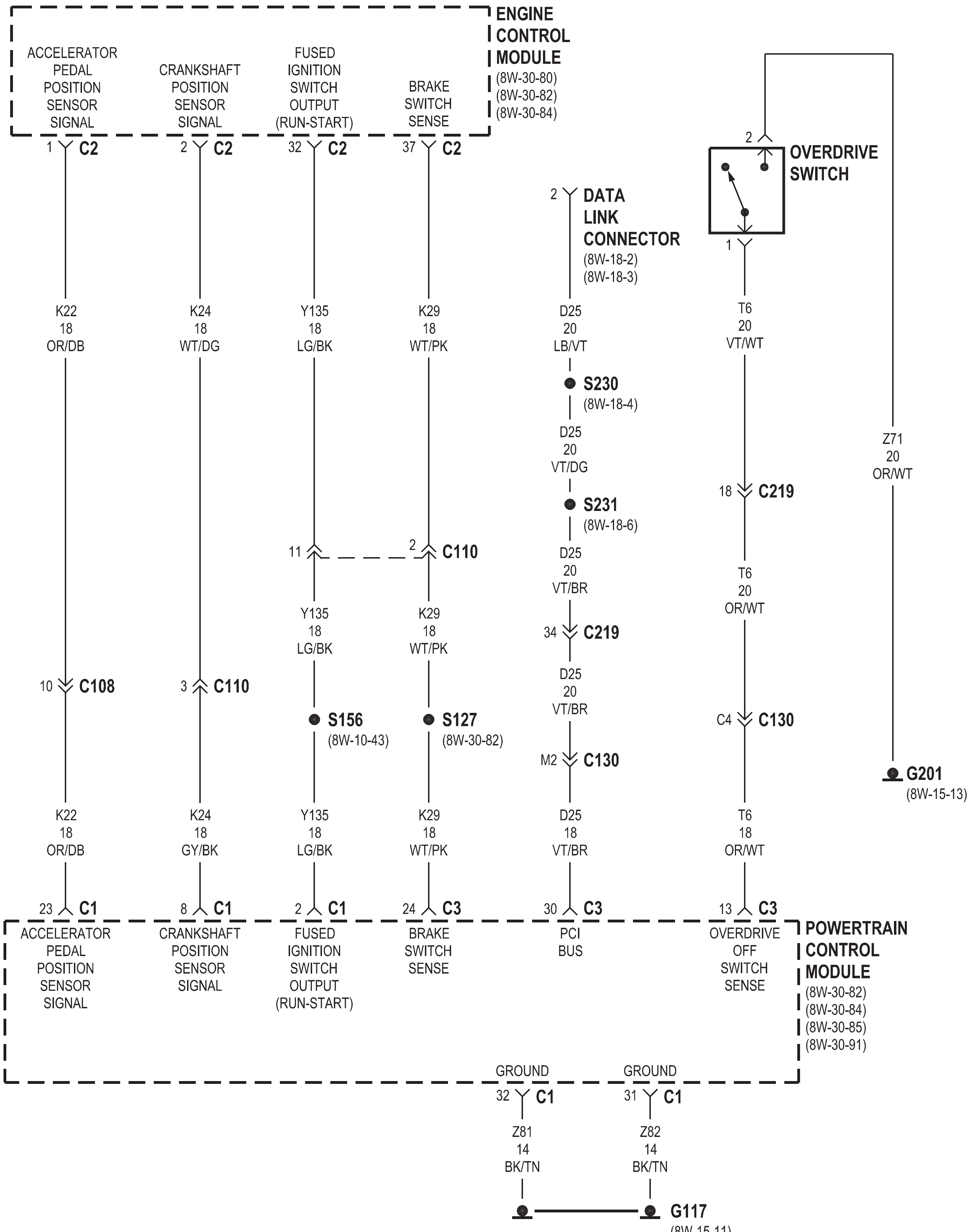
5.9L/8.0L/DIESEL



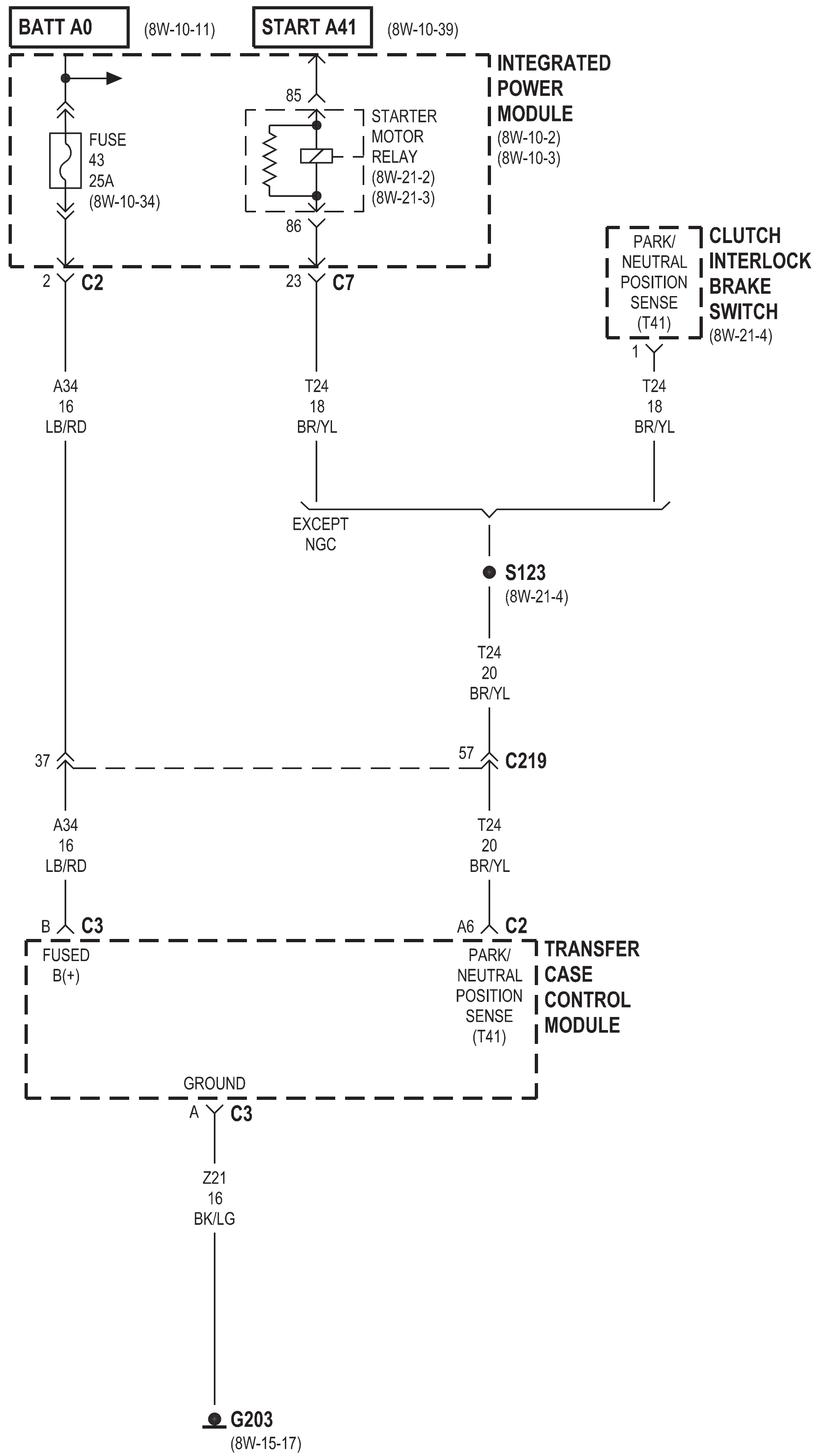

OUTPUT
SPEED
SENSOR
K173
20
LG
BATT A0
(8W-10-11)
C5
C4
RUN-START A21
(8W-10-45)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
5
40A
(8W-10-28)
FUSE
50
10A
(8W-10-45)
TRANSMISSION
CONTROL
RELAY
86
30
85
87
87A
C5
C6
K30
18
PK
T16
16
RD
J6
N2
C130
POWERTRAIN
CONTROL
MODULE
(8W-30-88)
5 VOLT
SUPPLY
SENSOR
GROUND
C2
C1
K6
18
VT/WT
K914
18
VT/RD
S125
(8W-10-27)
S148
(8W-10-22)
TRANSMISSION
SOLENOID
ASSEMBLY
T14
18
LG/WT
T13
18
DB/BK
K88
18
VT/WT
T60
18
BR
K54
18
OR/BK
T25
18
LG/RD
T54
18
VT
OUTPUT
SPEED
SENSOR
SIGNAL
OUTPUT
SPEED
SENSOR
GROUND
TRANSMISSION
CONTROL
RELAY
CONTROL
GOVERNOR
PRESSURE
SOLENOID
CONTROL
3-4
SHIFT
SOLENOID
CONTROL
TORQUE
CONVERTER
CLUTCH
SOLENOID
CONTROL
GOVERNOR
PRESSURE
SENSOR
SIGNAL
TRANSMISSION
TEMPERATURE
SENSOR
SIGNAL
POWERTRAIN
CONTROL
MODULE
(8W-30-88)


SPEED CONTROL SERVO
(8W-33-2)
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL BRAKE SWITCH OUTPUT
1
2
3
V36 20 TN/RD
V30 20 DB/RD
25 C219
V30 20 DB/RD
3
BRAKE LAMP SWITCH
(8W-33-6)
4
V32 20 YL/RD
21 C219
V35 20 LG/RD
V32 20 YL/RD
DATA LINK CONNECTOR
(8W-18-3)
SCI RECEIVE (TCM)
SCI TRANSMIT (TCM)
9
15
D6 18 PK/LB
D15 18 WT/DG
44
2 C219
D6 18 PK/LB
D15 18 WT/DG
K1
B1
B2
F2
D2 C130
V36 18 TN/RD
V35 18 LG/RD
V32 18 YL/RD
D6 18 PK/LB
D15 18 WT/DG
4 C3
5 C3
11 C3
29 C3
27 C3
SPEED CONTROL VACUUM SOLENOID CONTROL
SPEED CONTROL VENT SOLENOID CONTROL
SPEED CONTROL BRAKE SWITCH OUTPUT
SCI RECEIVE (TCM)
SCI TRANSMIT (TCM)
POWERTRAIN CONTROL MODULE
(8W-30-89)

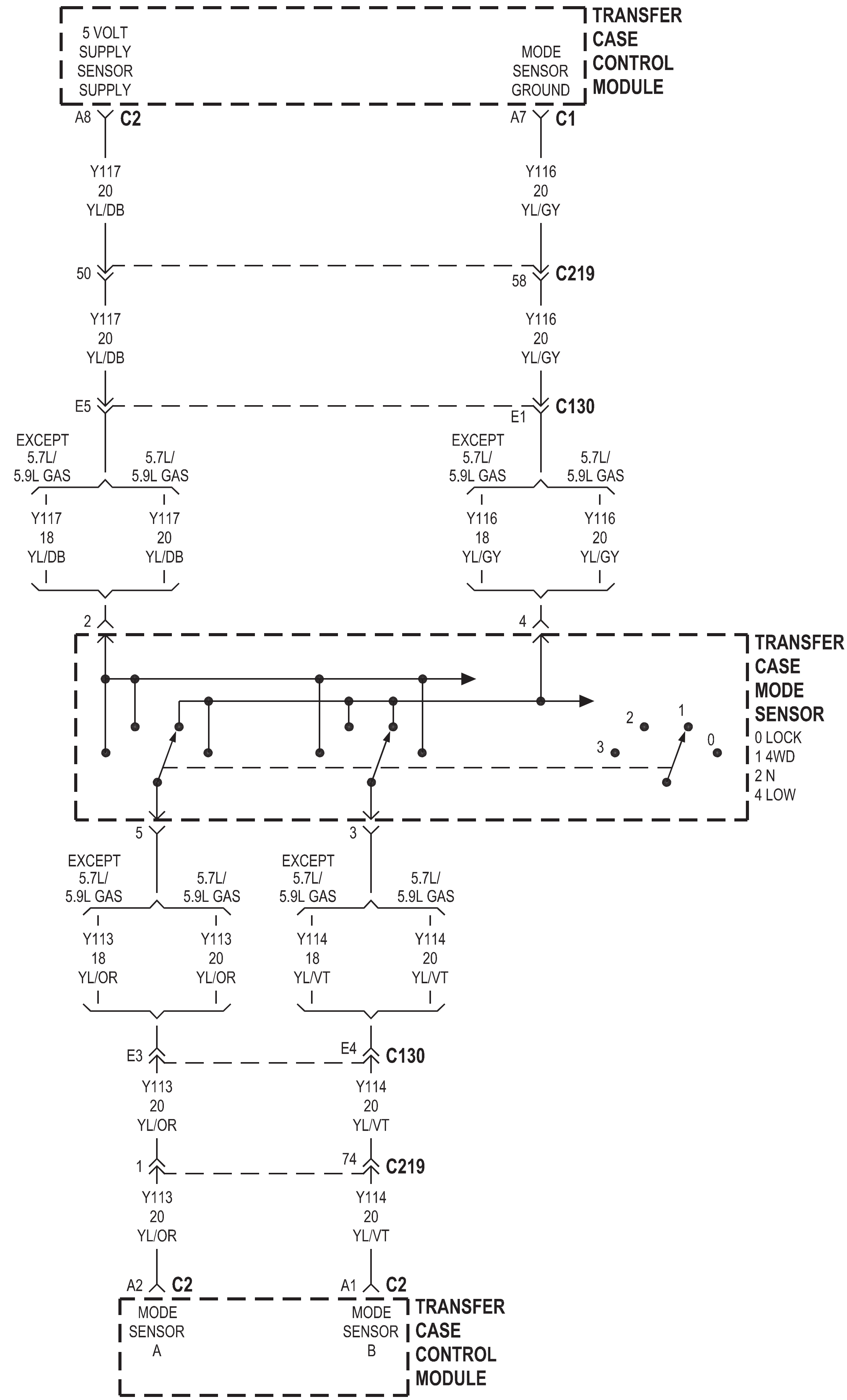

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 19 20A
(8W-10-33)
7 C2
A14 20 RD/WT
S110
(8W-10-33)
A14 20 RD/WT
C1 C130
A14 18 RD/WT
22 C1
FUSED B (+)
ENGINE CONTROL MODULE
(8W-30-82)
VEHICLE SPEED SIGNAL
11 C2
G7 18 WT/OR
1 C108
G7 18 WT/OR
S129
(8W-30-82)
G7 18 WT/OR
27 C2
VEHICLE SPEED SIGNAL
SPEED CONTROL SWITCH-LEFT
SPEED CONTROL SWITCH SIGNAL
(8W-33-3)
(8W-33-4)
1
V37 20 RD/LG
SPEED CONTROL SWITCH-RIGHT
SPEED CONTROL SWITCH SIGNAL
(8W-33-3)
(8W-33-4)
3
V37 20 RD/LG
S228
V37 20 RD/LG
3 C3
CLOCKSPRING
(8W-33-3)
(8W-33-4)
4 C1
V37 20 RD/LG
17 C219
V37 20 RD/LG
M6 C130
V37 18 RD/LG
32 C3
SPEED CONTROL SWITCH SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-77)
(8W-30-82)
(8W-30-90)


ENGINE CONTROL MODULE
(8W-30-80)
(8W-30-82)
(8W-30-84)
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
CRANKSHAFT POSITION SENSOR SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BRAKE SWITCH SENSE
1 C2
2 C2
32 C2
37 C2
OVERDRIVE SWITCH
2
1
DATA LINK CONNECTOR
(8W-18-2)
(8W-18-3)
K22 18 OR/DB
K24 18 WT/DG
Y135 18 LG/BK
K29 18 WT/PK
D25 20 LB/VT
T6 20 VT/WT
S230
(8W-18-4)
D25 20 VT/DG
Z71 20 OR/WT
18 C219
S231
(8W-18-6)
11
2 C110
D25 20 VT/BR
T6 20 OR/WT
Y135 18 LG/BK
K29 18 WT/PK
34 C219
10 C108
3 C110
D25 20 VT/BR
S156
(8W-10-43)
S127
(8W-30-82)
C4 C130
M2 C130
G201
(8W-15-13)
K22 18 OR/DB
K24 18 GY/BK
Y135 18 LG/BK
K29 18 WT/PK
D25 18 VT/BR
T6 18 OR/WT
23 C1
8 C1
2 C1
24 C3
30 C3
13 C3
POWERTRAIN CONTROL MODULE
(8W-30-82)
(8W-30-84)
(8W-30-85)
(8W-30-91)
ACCELERATOR PEDAL POSITION SENSOR SIGNAL
CRANKSHAFT POSITION SENSOR SIGNAL
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BRAKE SWITCH SENSE
PCI BUS
OVERDRIVE OFF SWITCH SENSE
GROUND
GROUND
32 C1
31 C1
Z81 14 BK/TN
Z82 14 BK/TN
G117
(8W-15-11)

ELECTRONIC TRANSFER CASE



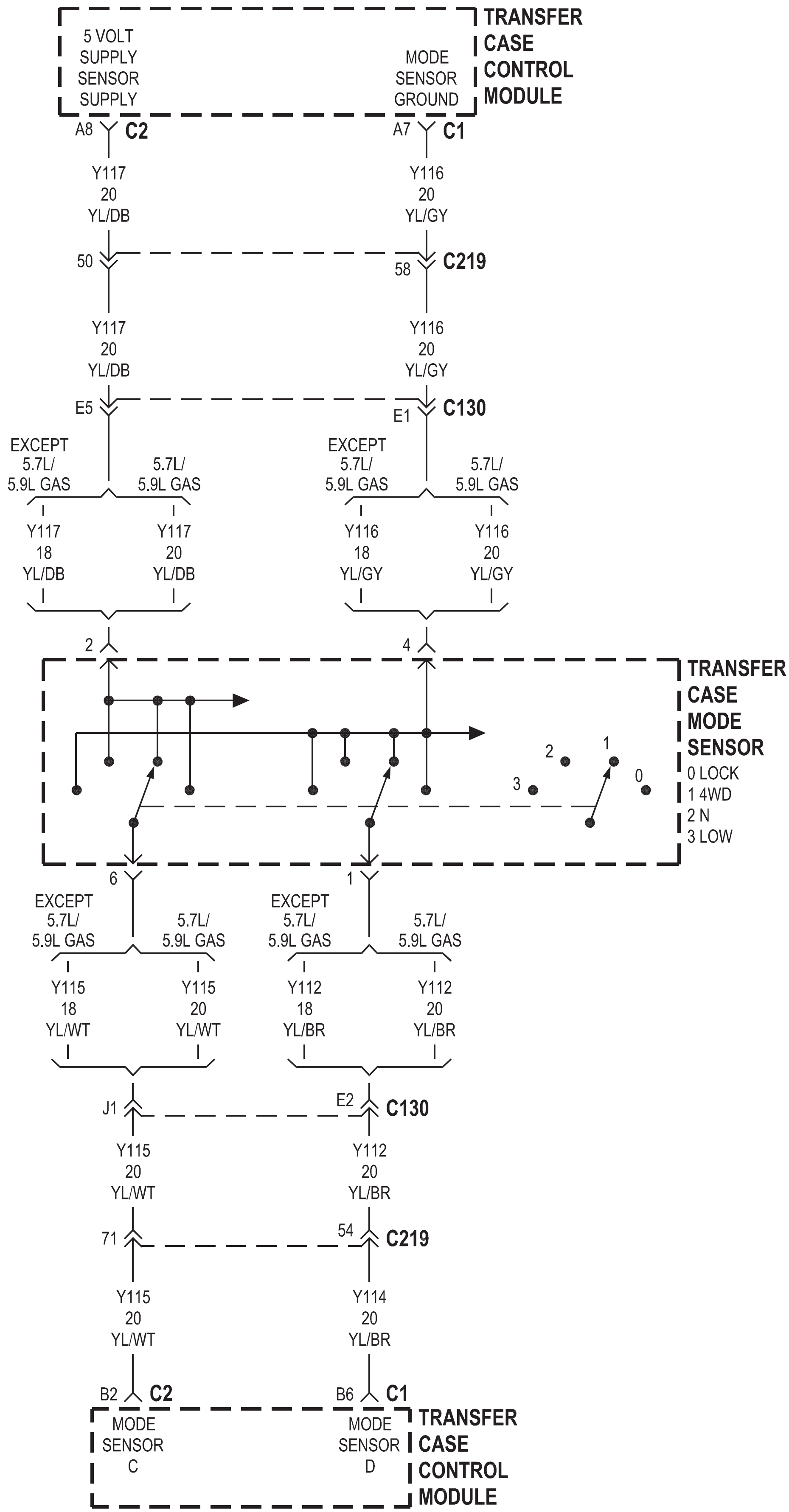
ELECTRONIC TRANSFER CASE EXCEPT 3.7L



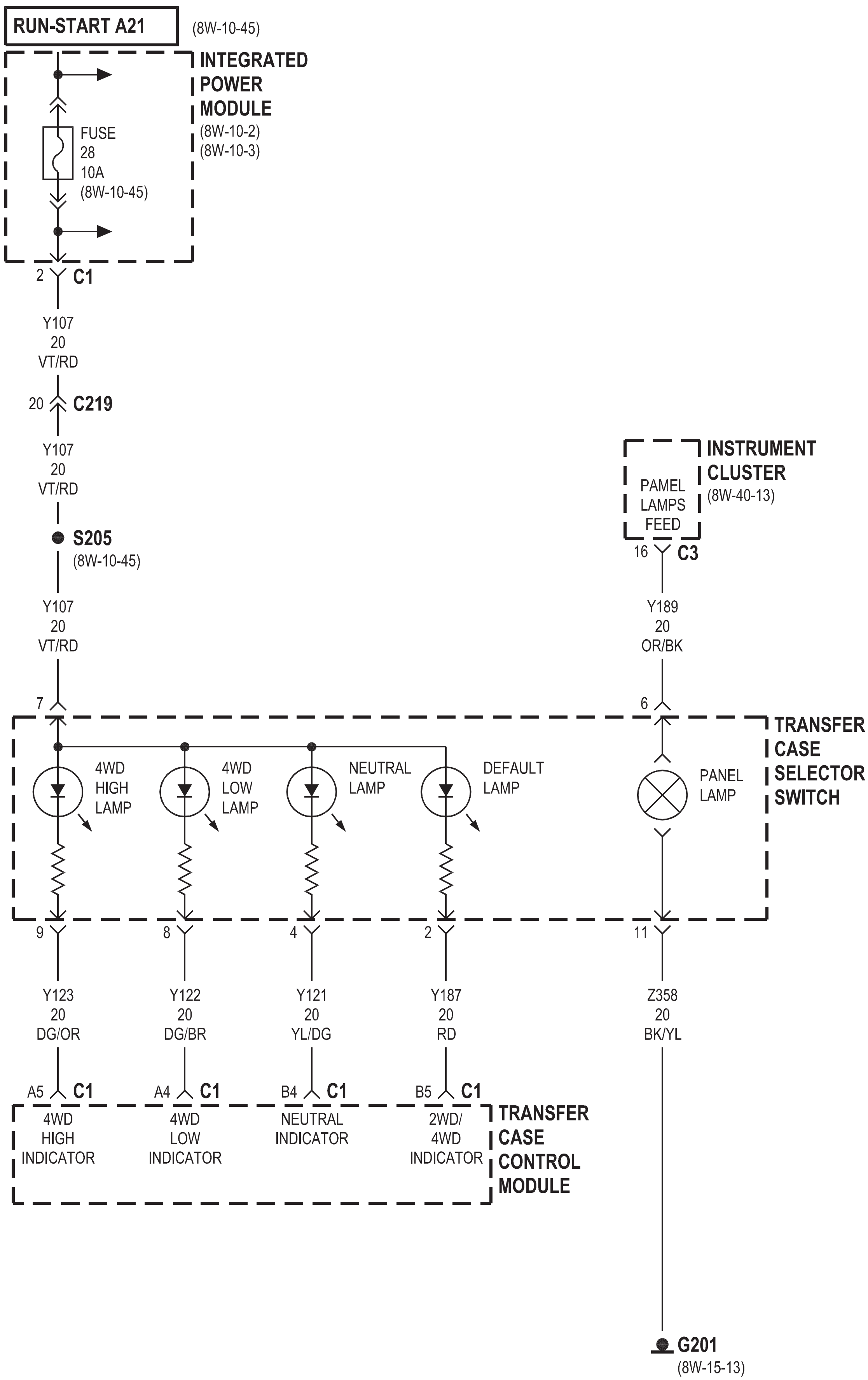
DR303121

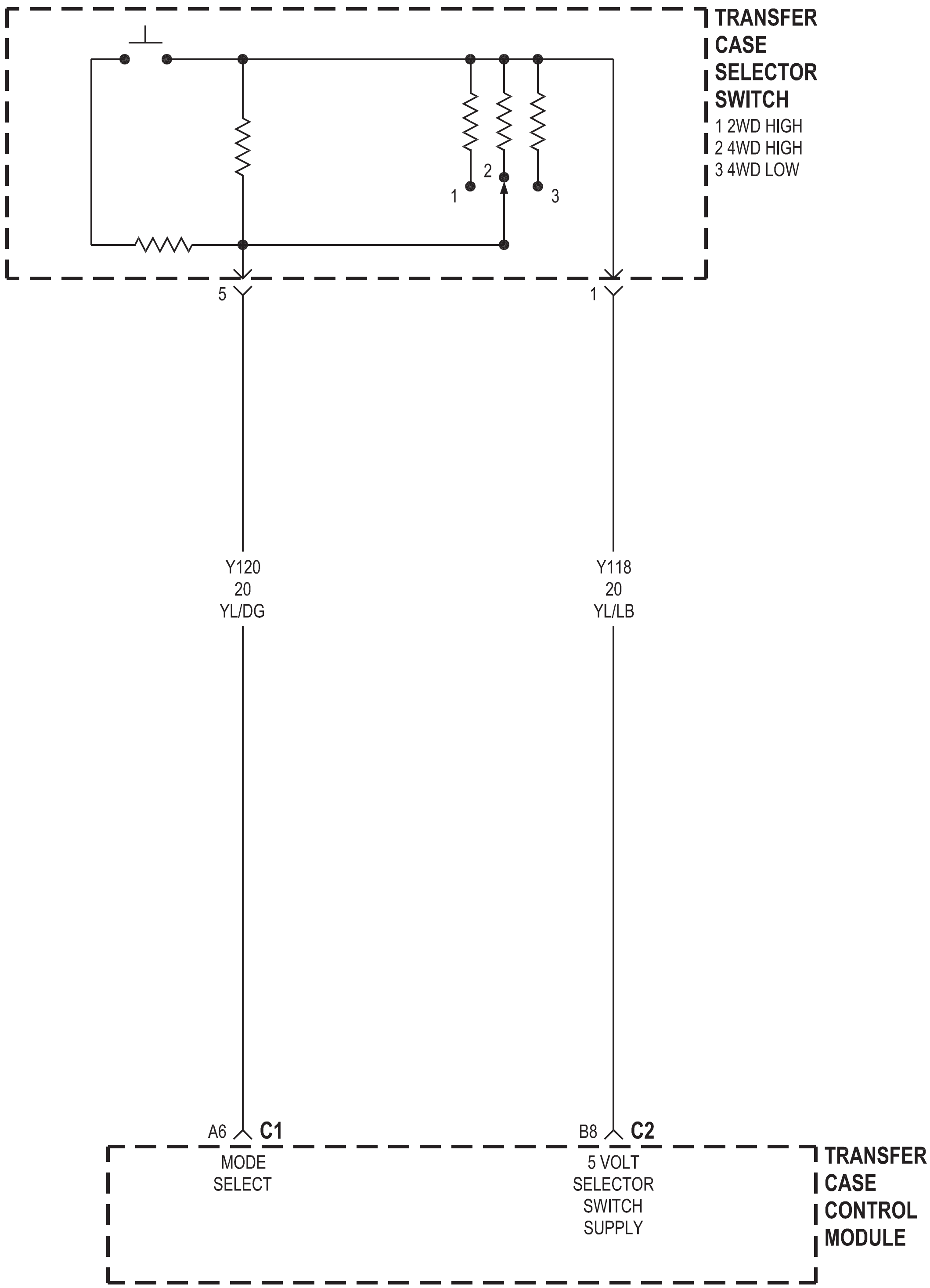
J038W-4

ELECTRONIC TRANSFER CASE EXCEPT 3.7L

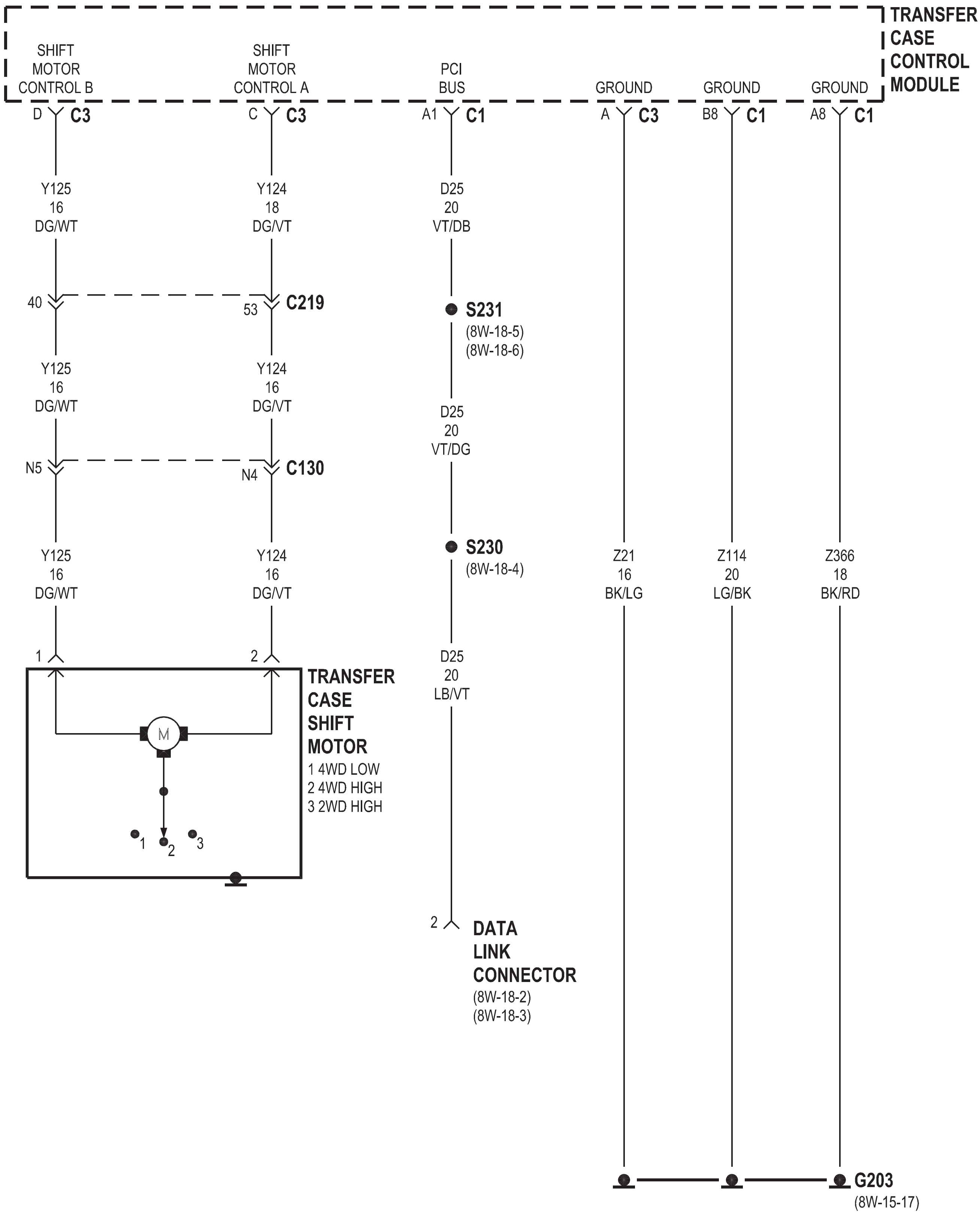


ELECTRONIC TRANSFER CASE

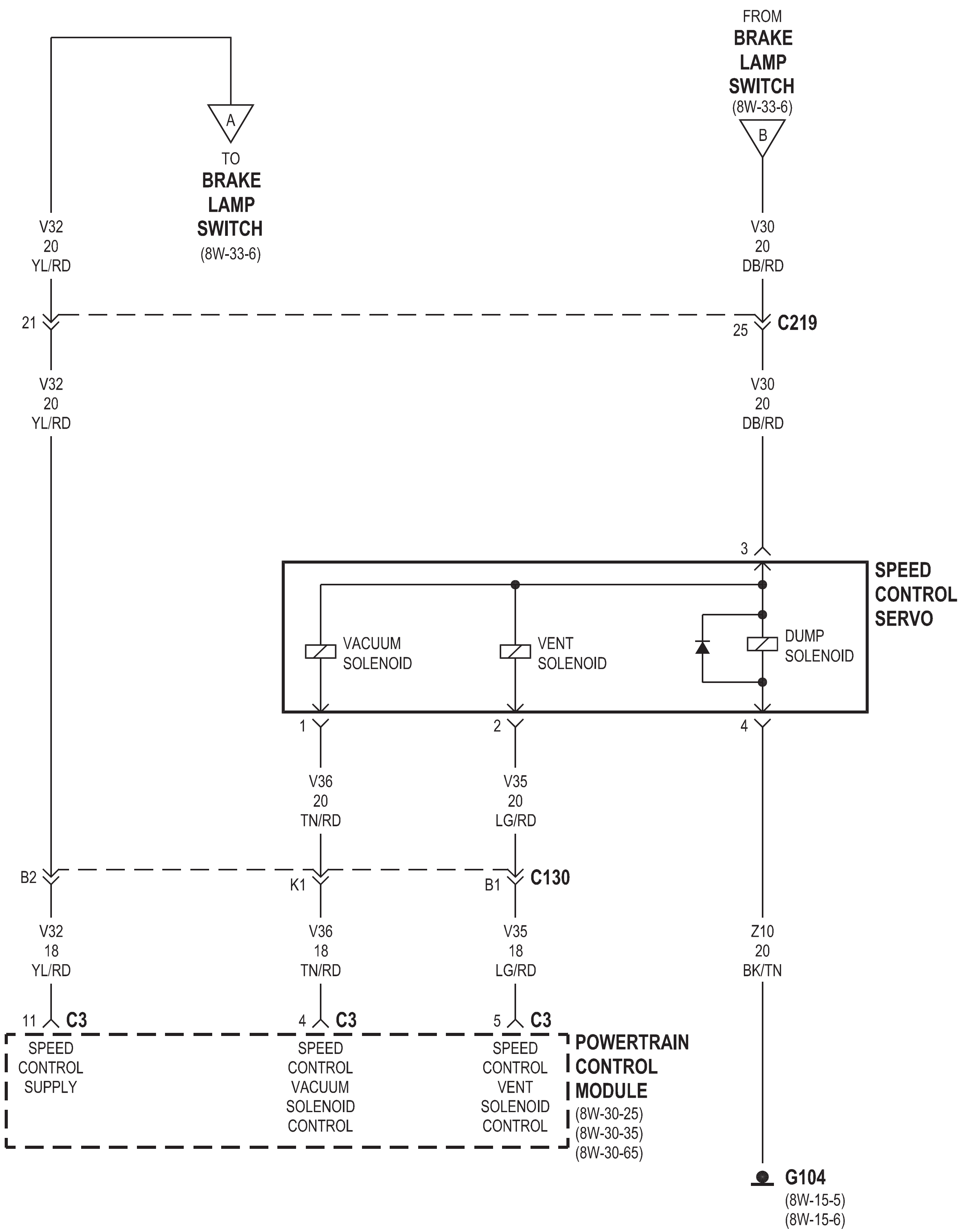


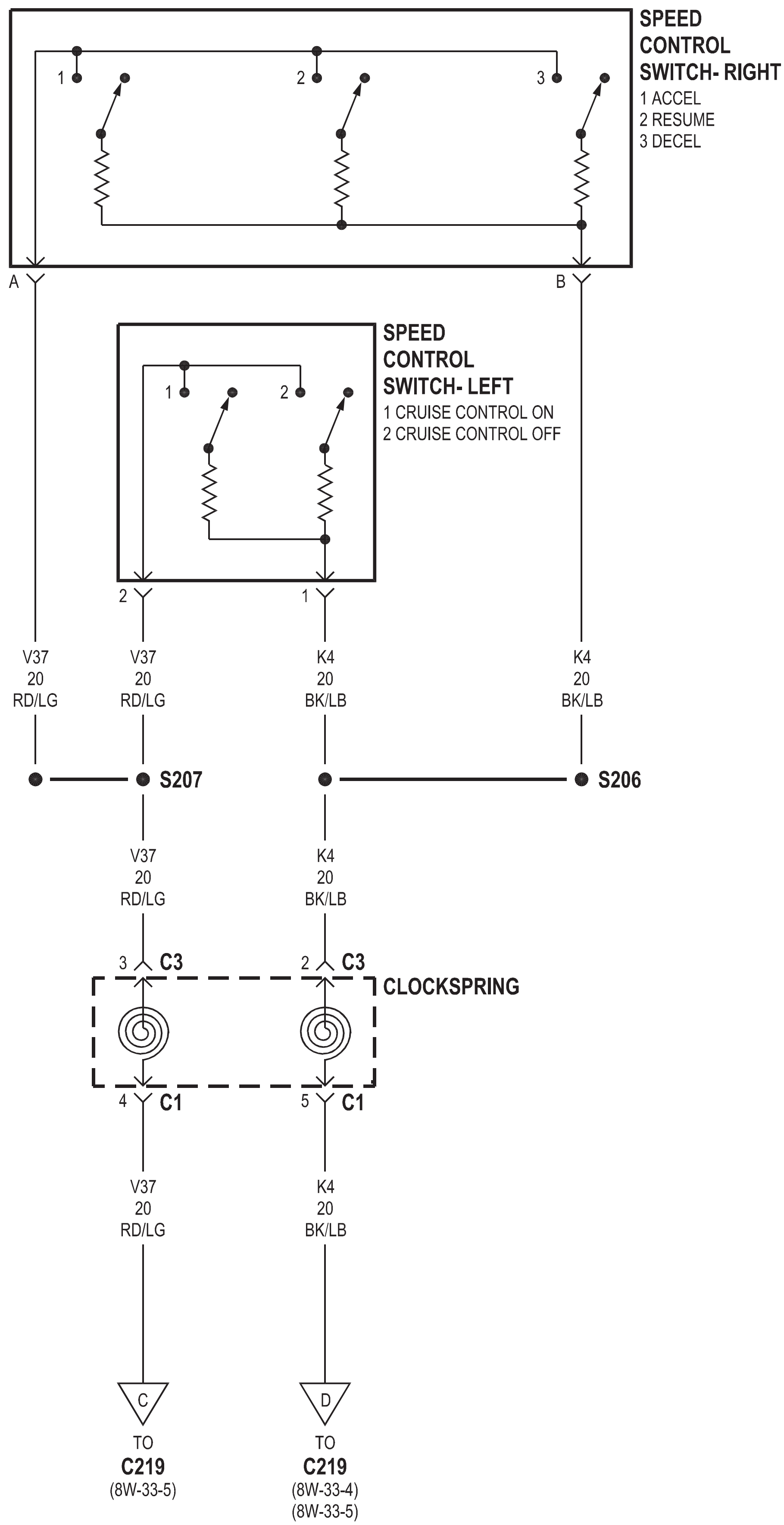

TRANSFER
CASE
SELECTOR
SWITCH
1 2WD HIGH
2 4WD HIGH
3 4WD LOW
1
2
3
5
1
Y120
20
YL/DG
Y118
20
YL/LB
A6
C1
B8
C2
MODE
SELECT
5 VOLT
SELECTOR
SWITCH
SUPPLY
TRANSFER
CASE
CONTROL
MODULE

ELECTRONIC TRANSFER CASE

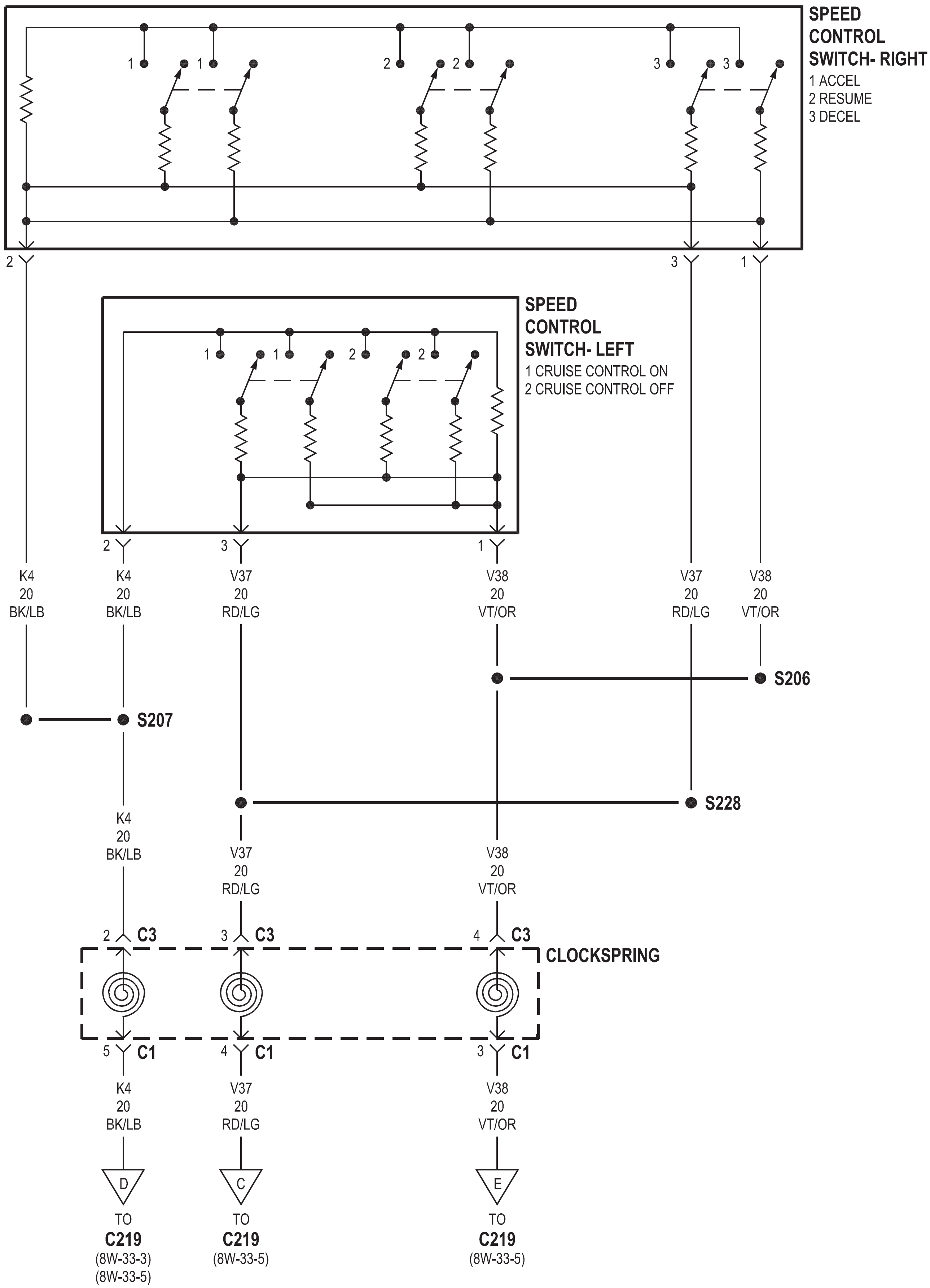


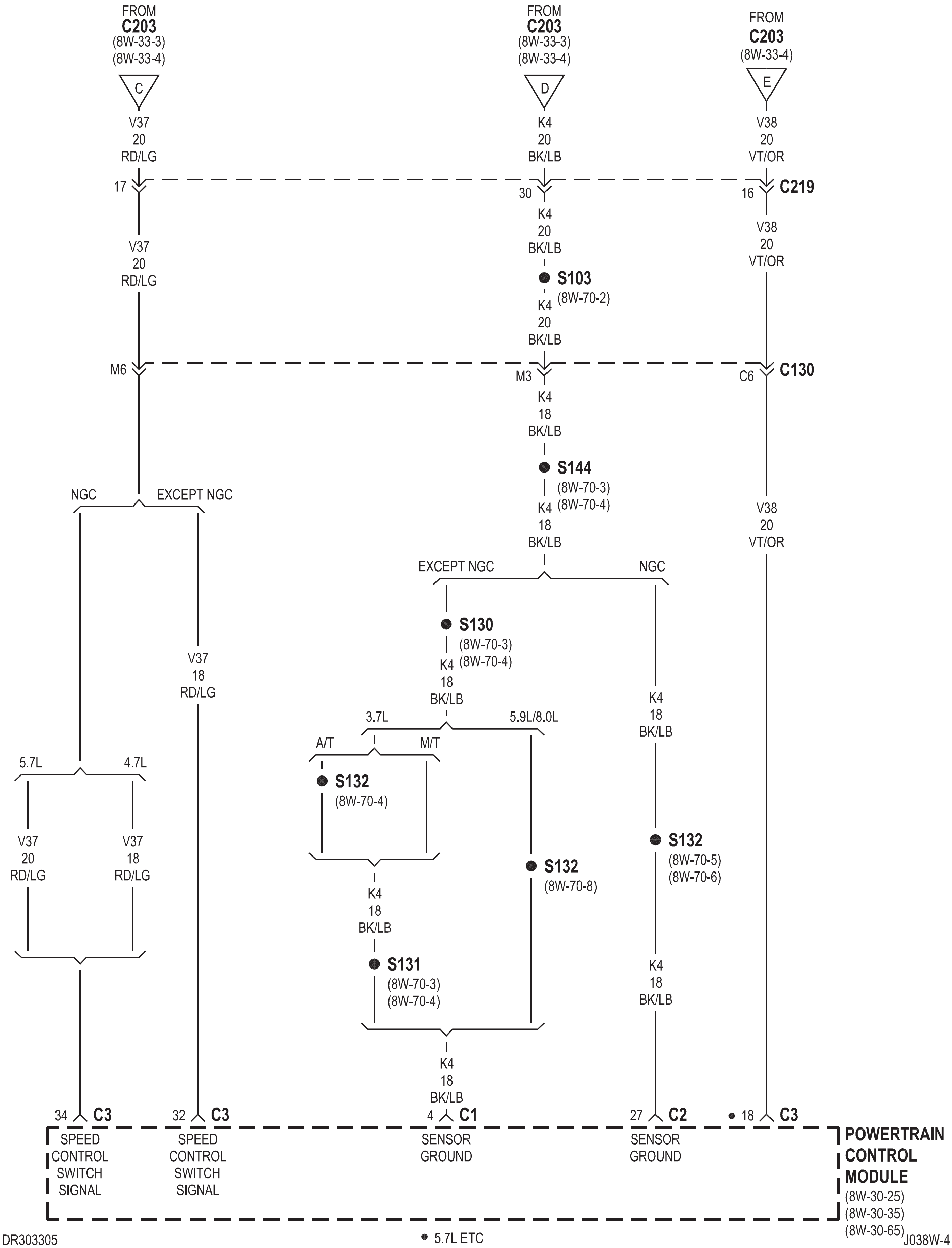
8W-33 VEHICLE SPEED CONTROL

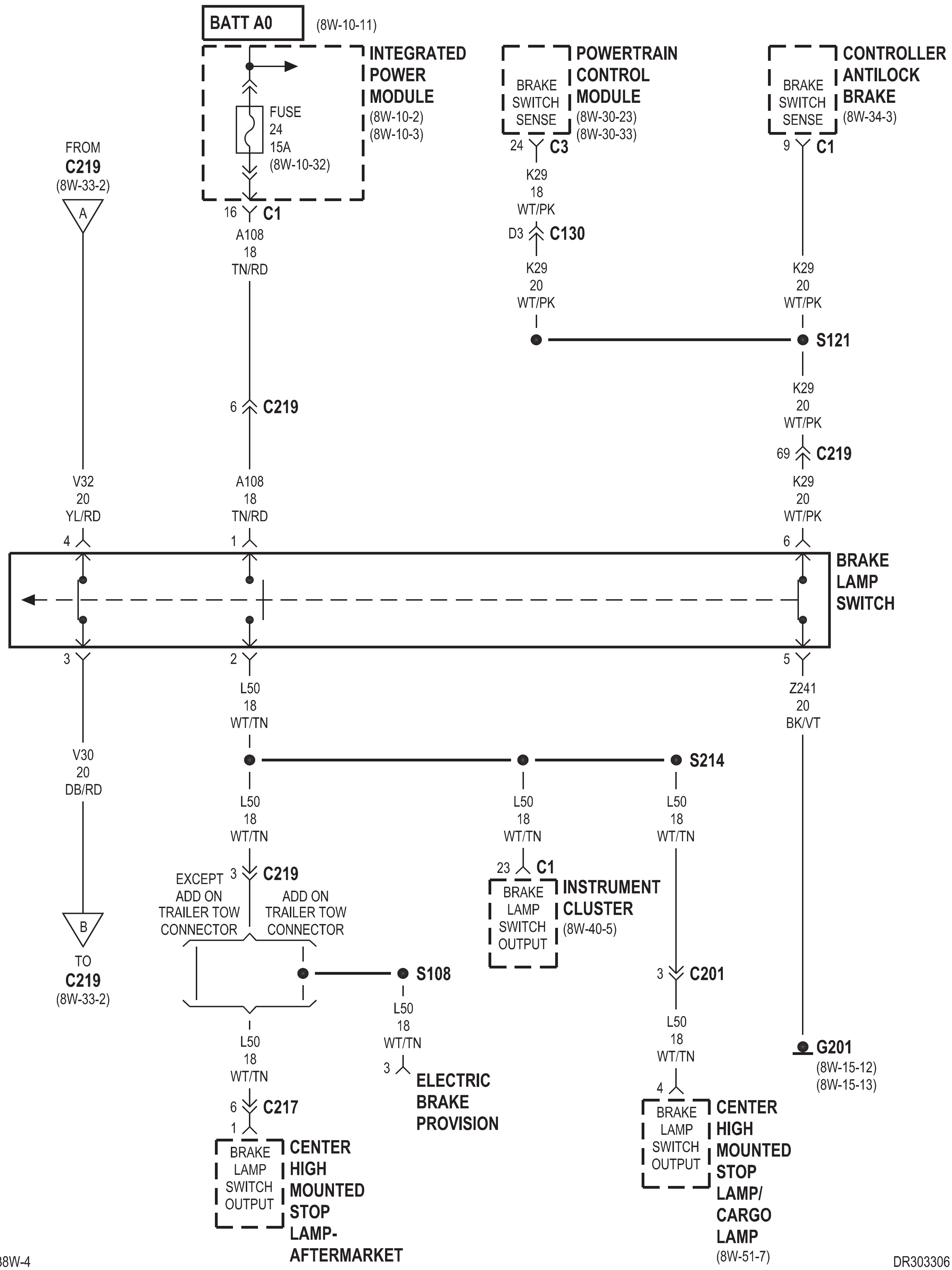

FROM
BRAKE
LAMP
SWITCH
(8W-33-6)
A
B
TO
BRAKE
LAMP
SWITCH
(8W-33-6)
V32
20
YL/RD
V30
20
DB/RD
21
25
C219
V32
20
YL/RD
V30
20
DB/RD
3
SPEED
CONTROL
SERVO
VACUUM
SOLENOID
VENT
SOLENOID
DUMP
SOLENOID
1
2
4
V36
20
TN/RD
V35
20
LG/RD
B2
K1
B1
C130
V32
18
YL/RD
V36
18
TN/RD
V35
18
LG/RD
Z10
20
BK/TN
11
C3
4
C3
5
C3
SPEED
CONTROL
SUPPLY
SPEED
CONTROL
VACUUM
SOLENOID
CONTROL
SPEED
CONTROL
VENT
SOLENOID
CONTROL
POWERTRAIN
CONTROL
MODULE
(8W-30-25)
(8W-30-35)
(8W-30-65)
G104
(8W-15-5)
(8W-15-6)


SPEED CONTROL SWITCH- RIGHT
1 ACCEL
2 RESUME
3 DECEL
1
2
3
A
B
SPEED CONTROL SWITCH- LEFT
1 CRUISE CONTROL ON
2 CRUISE CONTROL OFF
1
2
2
1
V37 20 RD/LG
V37 20 RD/LG
K4 20 BK/LB
K4 20 BK/LB
S207
S206
V37 20 RD/LG
K4 20 BK/LB
3 C3
2 C3
CLOCKSPRING
4 C1
5 C1
V37 20 RD/LG
K4 20 BK/LB
C
D
TO C219 (8W-33-5)
TO C219 (8W-33-4) (8W-33-5)

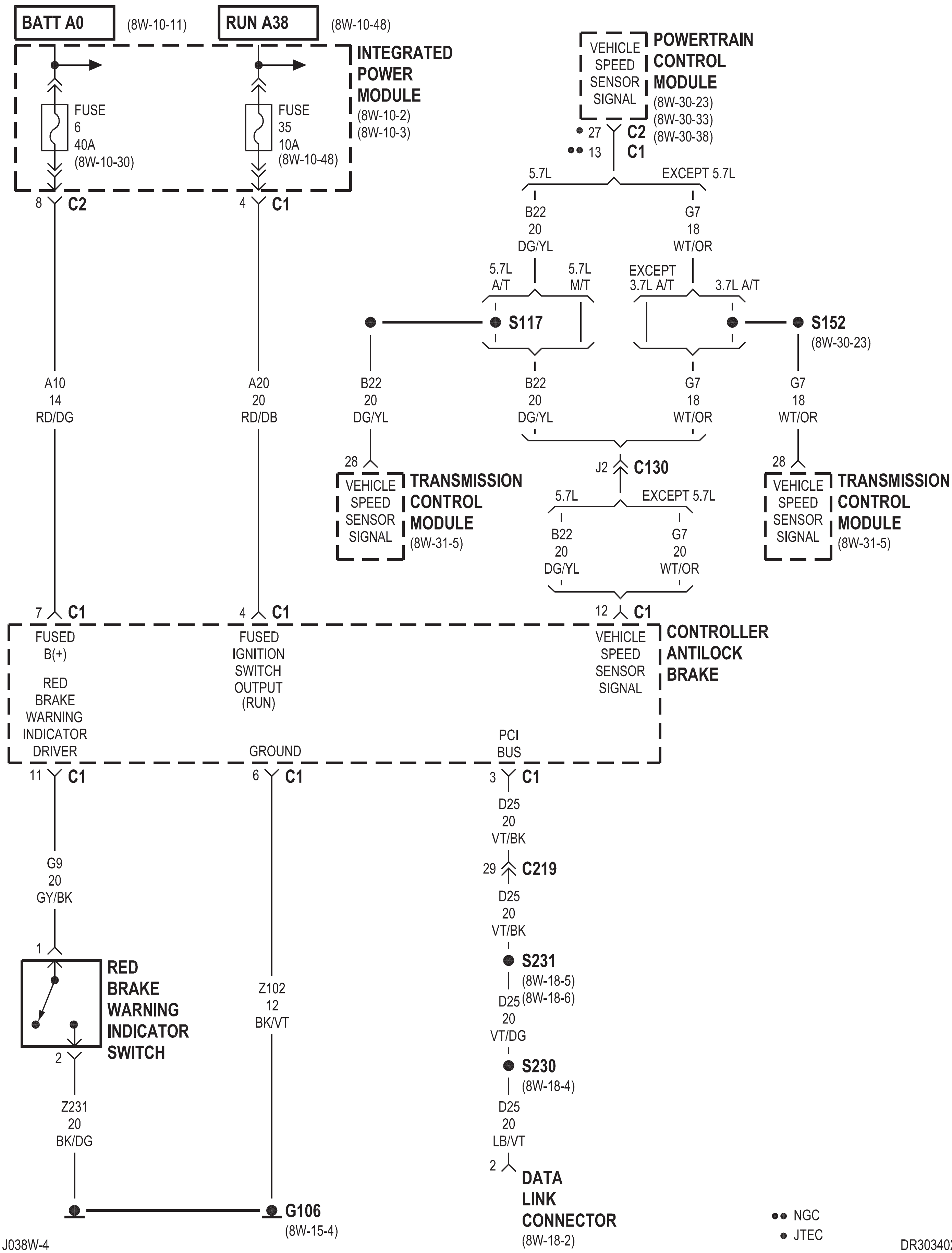
ETC

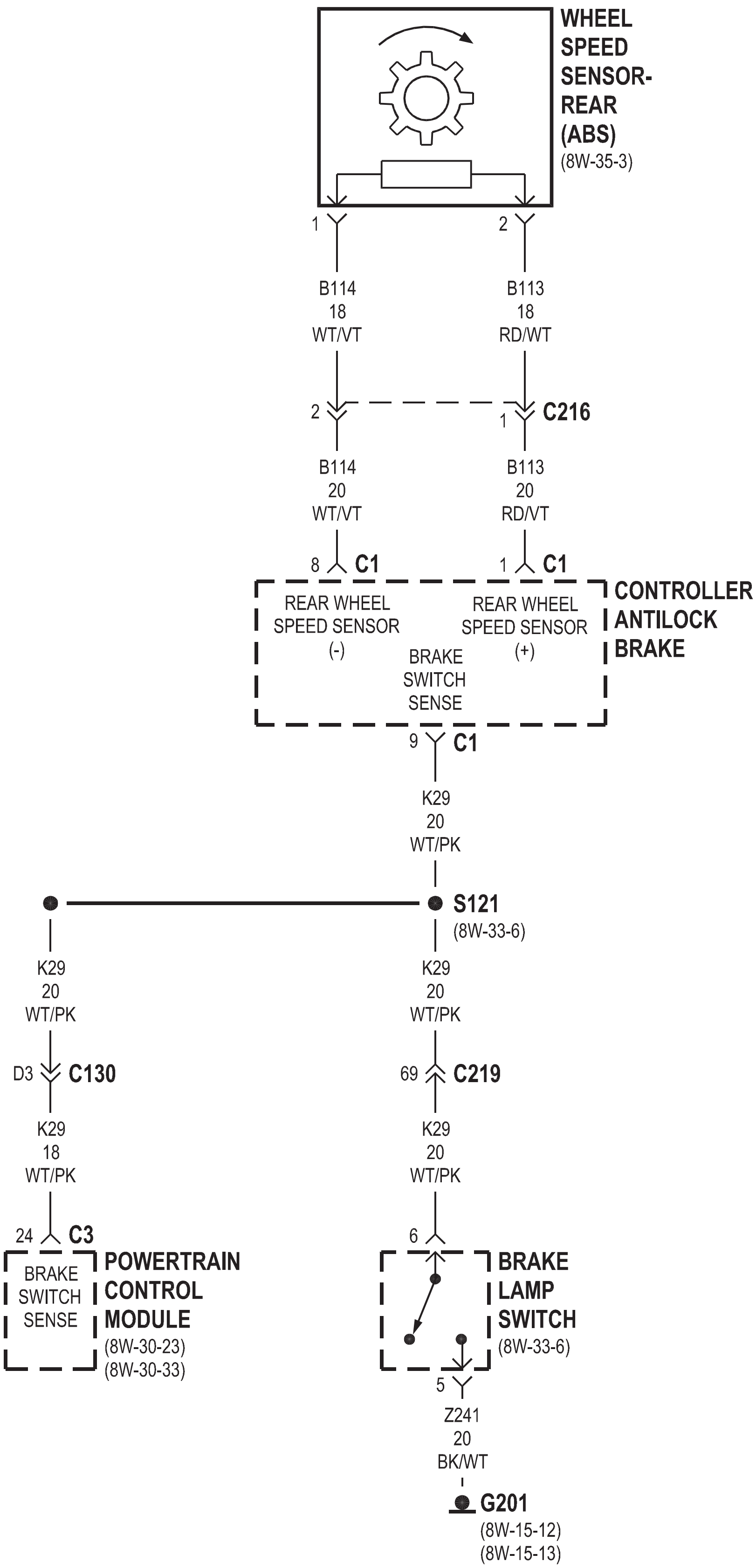

SPEED
CONTROL
SWITCH- RIGHT
1 ACCEL
2 RESUME
3 DECEL
SPEED
CONTROL
SWITCH- LEFT
1 CRUISE CONTROL ON
2 CRUISE CONTROL OFF
K4
20
BK/LB
V37
20
RD/LG
V38
20
VT/OR
S206
S207
S228
C3
CLOCKSPRING
C1
TO
C219
(8W-33-3)
(8W-33-5)
TO
C219
(8W-33-5)
TO
C219
(8W-33-5)


FROM
C203
(8W-33-3)
(8W-33-4)
C
V37
20
RD/LG
FROM
C203
(8W-33-3)
(8W-33-4)
D
K4
20
BK/LB
FROM
C203
(8W-33-4)
E
V38
20
VT/OR
17
30
16
C219
V37
20
RD/LG
K4
20
BK/LB
S103
(8W-70-2)
K4
20
BK/LB
V38
20
VT/OR
M6
M3
C6
C130
K4
18
BK/LB
S144
(8W-70-3)
(8W-70-4)
K4
18
BK/LB
NGC
EXCEPT NGC
V38
20
VT/OR
EXCEPT NGC
NGC
S130
(8W-70-3)
(8W-70-4)
K4
18
BK/LB
V37
18
RD/LG
K4
18
BK/LB
3.7L
5.9L/8.0L
A/T
M/T
5.7L
4.7L
S132
(8W-70-4)
V37
20
RD/LG
V37
18
RD/LG
S132
(8W-70-8)
S132
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
S131
(8W-70-3)
(8W-70-4)
K4
18
BK/LB
K4
18
BK/LB
34 C3
32 C3
4 C1
27 C2
• 18 C3
SPEED CONTROL SWITCH SIGNAL
SPEED CONTROL SWITCH SIGNAL
SENSOR GROUND
SENSOR GROUND
POWERTRAIN CONTROL MODULE
(8W-30-25)
(8W-30-35)
(8W-30-65)
DR303305
• 5.7L ETC
J038W-4

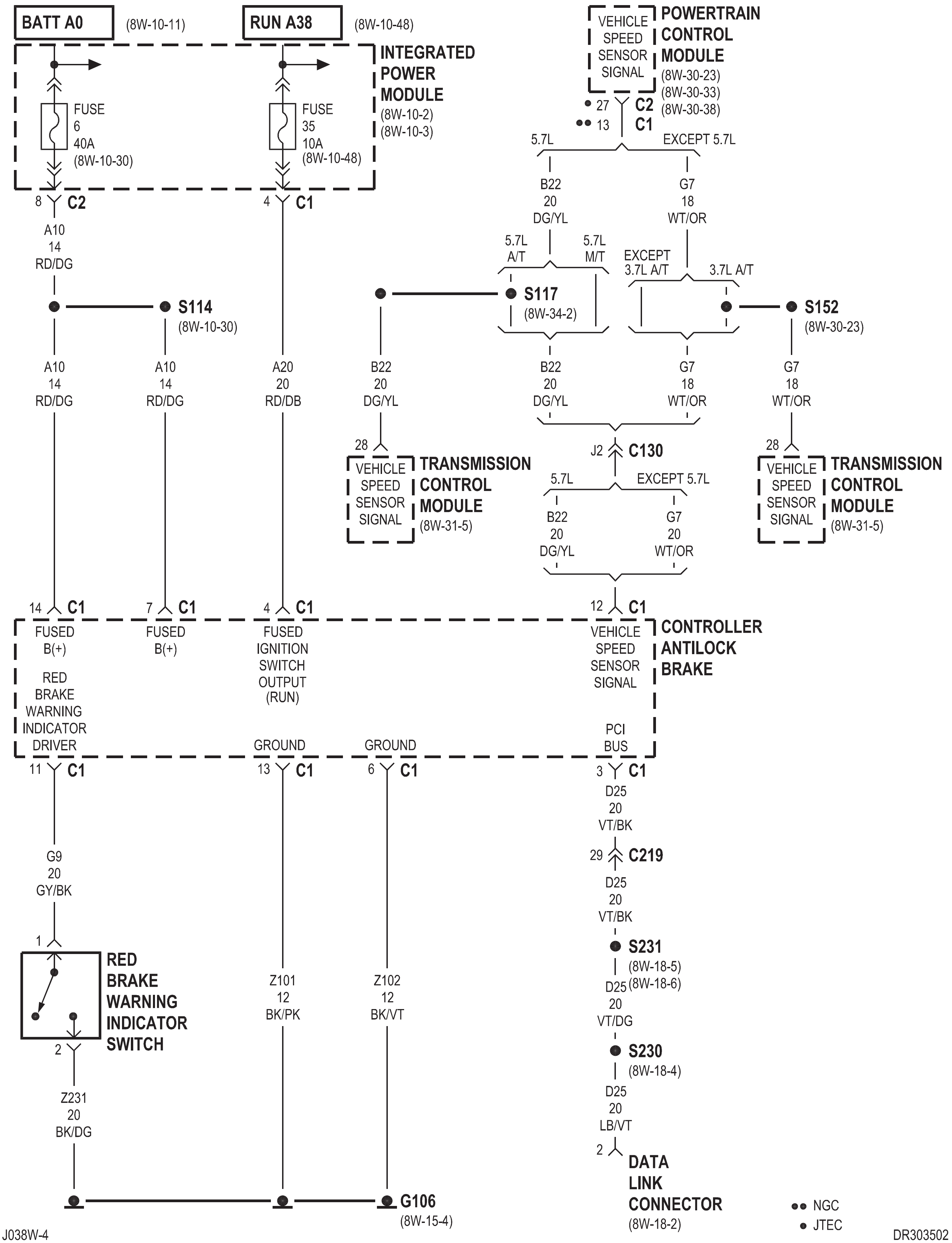

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 24 15A (8W-10-32)
16 C1
A108 18 TN/RD
POWERTRAIN CONTROL MODULE
BRAKE SWITCH SENSE
(8W-30-23)
(8W-30-33)
24 C3
K29 18 WT/PK
D3 C130
K29 20 WT/PK
CONTROLLER ANTILOCK BRAKE
BRAKE SWITCH SENSE
(8W-34-3)
9 C1
K29 20 WT/PK
S121
K29 20 WT/PK
69 C219
K29 20 WT/PK
6
FROM C219 (8W-33-2)
A
V32 20 YL/RD
4
6 C219
A108 18 TN/RD
1
BRAKE LAMP SWITCH
3
2
5
V30 20 DB/RD
B
TO C219 (8W-33-2)
L50 18 WT/TN
S214
L50 18 WT/TN
L50 18 WT/TN
L50 18 WT/TN
3 C219
EXCEPT ADD ON TRAILER TOW CONNECTOR
ADD ON TRAILER TOW CONNECTOR
S108
L50 18 WT/TN
3
ELECTRIC BRAKE PROVISION
L50 18 WT/TN
6 C217
1
BRAKE LAMP SWITCH OUTPUT
CENTER HIGH MOUNTED STOP LAMP-AFTERMARKET
23 C1
BRAKE LAMP SWITCH OUTPUT
INSTRUMENT CLUSTER
(8W-40-5)
3 C201
L50 18 WT/TN
4
BRAKE LAMP SWITCH OUTPUT
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP
(8W-51-7)
Z241 20 BK/VT
G201
(8W-15-12)
(8W-15-13)

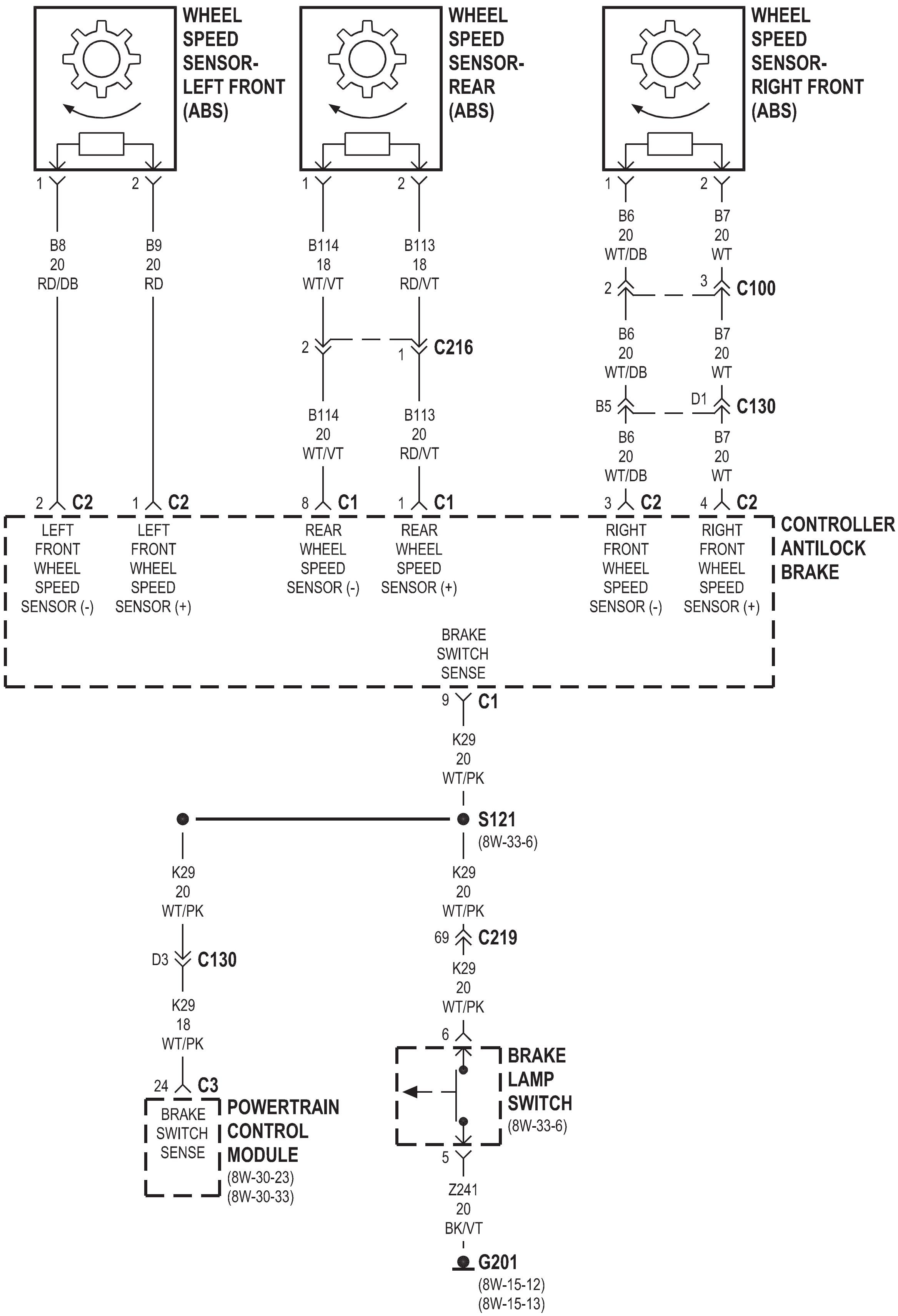
8W-34 REAR WHEEL ANTILOCK BRAKES


BATT A0
(8W-10-11)
RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 6 40A (8W-10-30)
FUSE 35 10A (8W-10-48)
8 C2
4 C1
A10 14 RD/DG
A20 20 RD/DB
VEHICLE SPEED SENSOR SIGNAL
POWERTRAIN CONTROL MODULE
(8W-30-23)
(8W-30-33)
(8W-30-38)
27 C2
13 C1
5.7L
EXCEPT 5.7L
B22 20 DG/YL
G7 18 WT/OR
5.7L A/T
5.7L M/T
EXCEPT 3.7L A/T
3.7L A/T
S117
S152
(8W-30-23)
B22 20 DG/YL
G7 18 WT/OR
28
TRANSMISSION CONTROL MODULE
(8W-31-5)
J2 C130
B22 20 DG/YL
G7 20 WT/OR
7 C1
4 C1
12 C1
FUSED B(+)
RED BRAKE WARNING INDICATOR DRIVER
FUSED IGNITION SWITCH OUTPUT (RUN)
VEHICLE SPEED SENSOR SIGNAL
CONTROLLER ANTILOCK BRAKE
GROUND
PCI BUS
11 C1
6 C1
3 C1
G9 20 GY/BK
1
RED BRAKE WARNING INDICATOR SWITCH
2
Z231 20 BK/DG
Z102 12 BK/VT
D25 20 VT/BK
29 C219
S231
(8W-18-5)
(8W-18-6)
D25 20 VT/DG
S230
(8W-18-4)
D25 20 LB/VT
2
DATA LINK CONNECTOR
(8W-18-2)
G106
(8W-15-4)
NGC
JTEC
J038W-4
DR303402

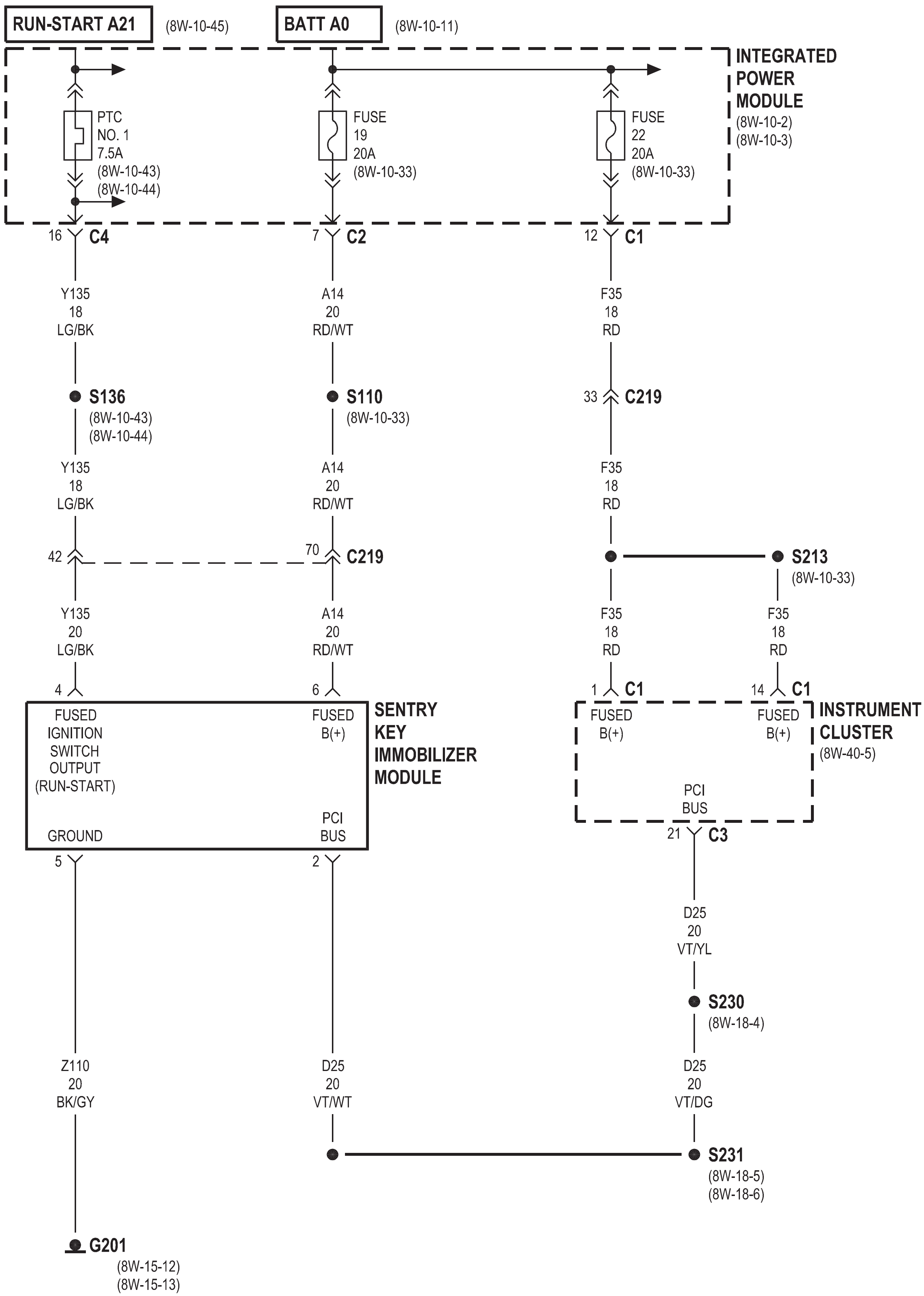

WHEEL SPEED SENSOR-REAR (ABS)
(8W-35-3)
1
2
B114
18
WT/VT
B113
18
RD/WT
2
1
C216
B114
20
WT/VT
B113
20
RD/VT
8
C1
1
C1
CONTROLLER ANTILOCK BRAKE
REAR WHEEL SPEED SENSOR (-)
REAR WHEEL SPEED SENSOR (+)
BRAKE SWITCH SENSE
9
C1
K29
20
WT/PK
S121
(8W-33-6)
K29
20
WT/PK
K29
20
WT/PK
D3
C130
69
C219
K29
18
WT/PK
K29
20
WT/PK
24
C3
BRAKE SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-23)
(8W-30-33)
6
BRAKE LAMP SWITCH
(8W-33-6)
5
Z241
20
BK/WT
G201
(8W-15-12)
(8W-15-13)

8W-35 ALL WHEEL ANTILOCK BRAKES

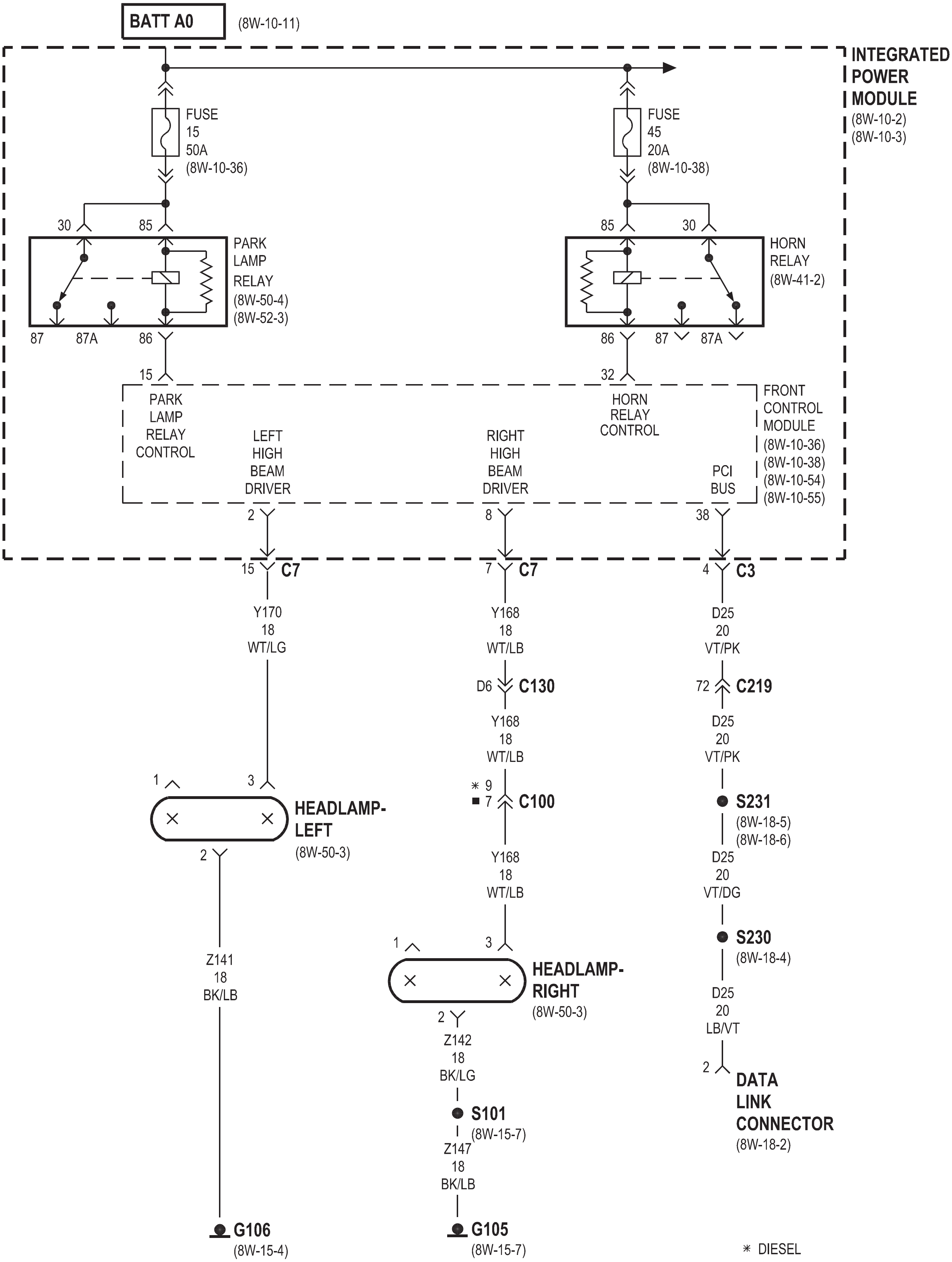

BATT A0
(8W-10-11)
RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 6 40A (8W-10-30)
FUSE 35 10A (8W-10-48)
8 C2
4 C1
A10 14 RD/DG
S114
(8W-10-30)
A10 14 RD/DG
A10 14 RD/DG
A20 20 RD/DB
POWERTRAIN CONTROL MODULE
(8W-30-23)
(8W-30-33)
(8W-30-38)
VEHICLE SPEED SENSOR SIGNAL
27 C2
13 C1
5.7L
EXCEPT 5.7L
B22 20 DG/YL
G7 18 WT/OR
5.7L A/T
5.7L M/T
EXCEPT 3.7L A/T
3.7L A/T
S117
(8W-34-2)
S152
(8W-30-23)
B22 20 DG/YL
B22 20 DG/YL
G7 18 WT/OR
G7 18 WT/OR
28
TRANSMISSION CONTROL MODULE
(8W-31-5)
VEHICLE SPEED SENSOR SIGNAL
J2 C130
5.7L
EXCEPT 5.7L
B22 20 DG/YL
G7 20 WT/OR
14 C1
7 C1
4 C1
12 C1
CONTROLLER ANTILOCK BRAKE
FUSED B(+)
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN)
VEHICLE SPEED SENSOR SIGNAL
RED BRAKE WARNING INDICATOR DRIVER
GROUND
GROUND
PCI BUS
11 C1
13 C1
6 C1
3 C1
G9 20 GY/BK
D25 20 VT/BK
29 C219
D25 20 VT/BK
S231
(8W-18-5)
(8W-18-6)
D25 20 VT/DG
S230
(8W-18-4)
D25 20 LB/VT
1
2
RED BRAKE WARNING INDICATOR SWITCH
Z101 12 BK/PK
Z102 12 BK/VT
Z231 20 BK/DG
G106
(8W-15-4)
DATA LINK CONNECTOR
(8W-18-2)
•• NGC
• JTEC
J038W-4
DR303502

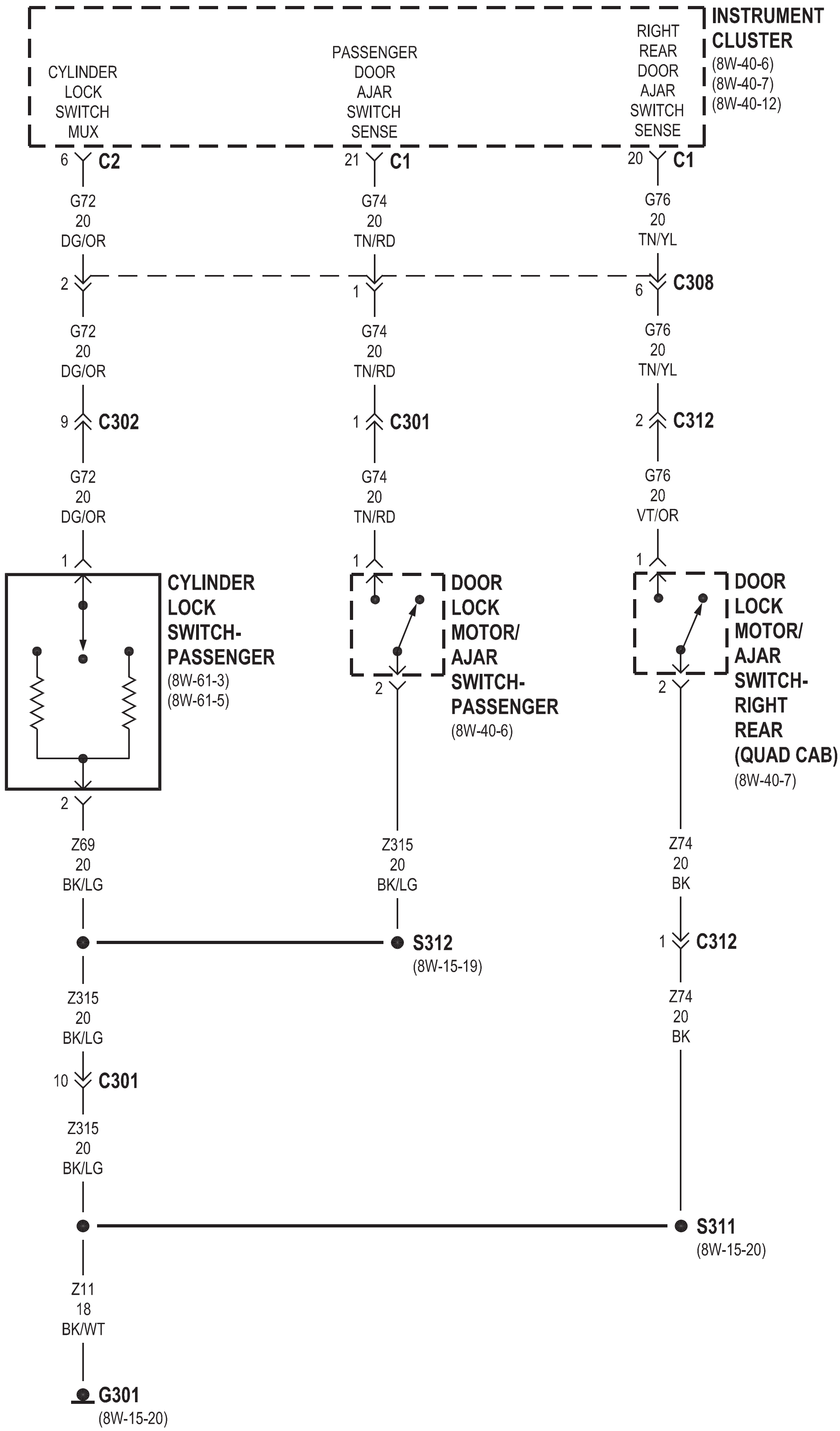

WHEEL SPEED SENSOR- LEFT FRONT (ABS)
WHEEL SPEED SENSOR- REAR (ABS)
WHEEL SPEED SENSOR- RIGHT FRONT (ABS)
1
2
B8 20 RD/DB
B9 20 RD
B114 18 WT/VT
B113 18 RD/VT
C216
B114 20 WT/VT
B113 20 RD/VT
B6 20 WT/DB
B7 20 WT
C100
C130
B5
D1
C2
C1
LEFT FRONT WHEEL SPEED SENSOR (-)
LEFT FRONT WHEEL SPEED SENSOR (+)
REAR WHEEL SPEED SENSOR (-)
REAR WHEEL SPEED SENSOR (+)
RIGHT FRONT WHEEL SPEED SENSOR (-)
RIGHT FRONT WHEEL SPEED SENSOR (+)
CONTROLLER ANTILOCK BRAKE
BRAKE SWITCH SENSE
9 C1
K29 20 WT/PK
S121
(8W-33-6)
69 C219
D3 C130
K29 18 WT/PK
24 C3
BRAKE SWITCH SENSE
POWERTRAIN CONTROL MODULE
(8W-30-23)
(8W-30-33)
BRAKE LAMP SWITCH
(8W-33-6)
Z241 20 BK/VT
G201
(8W-15-12)
(8W-15-13)

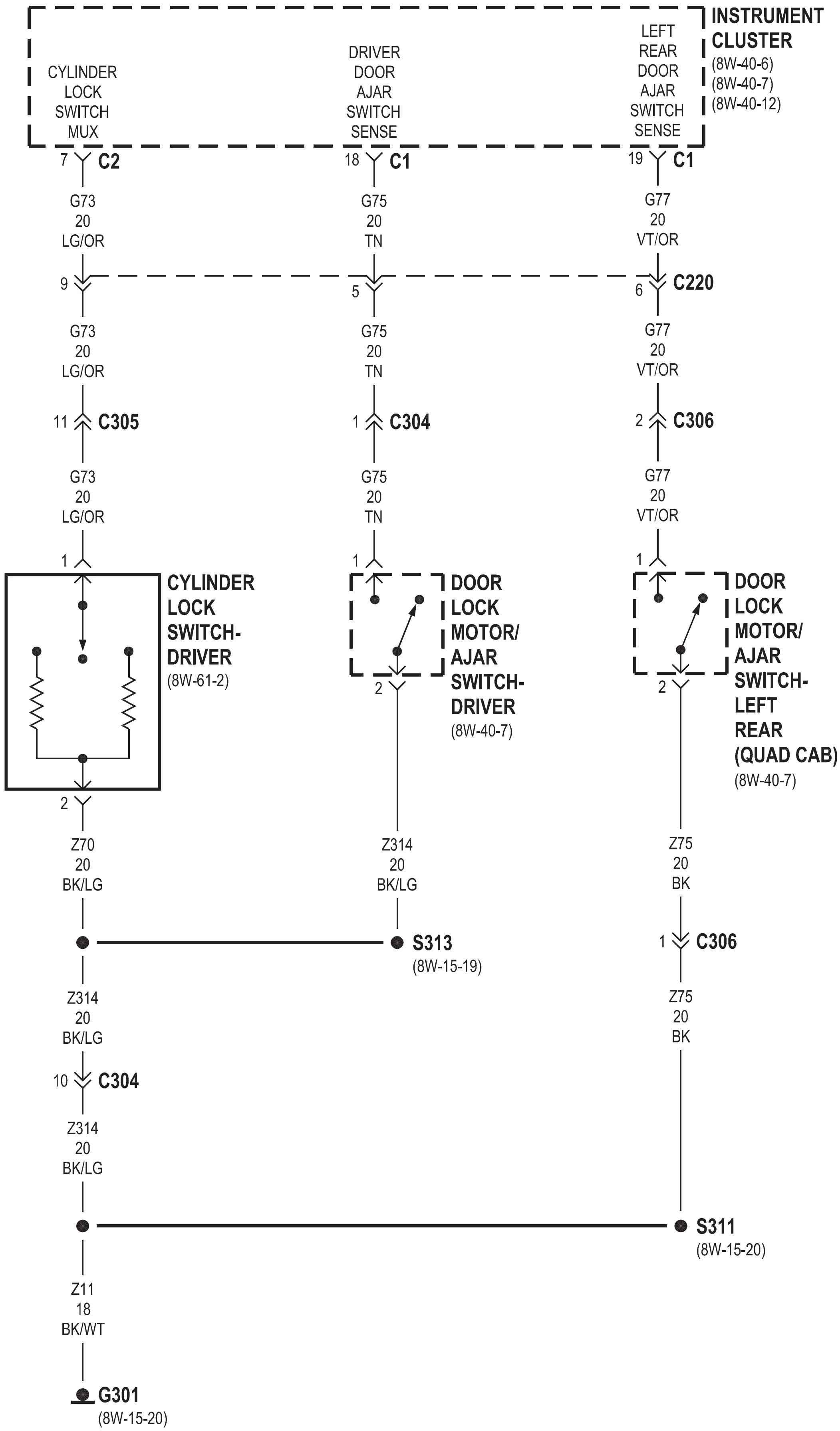
8W-39 VEHICLE THEFT SECURITY SYSTEM



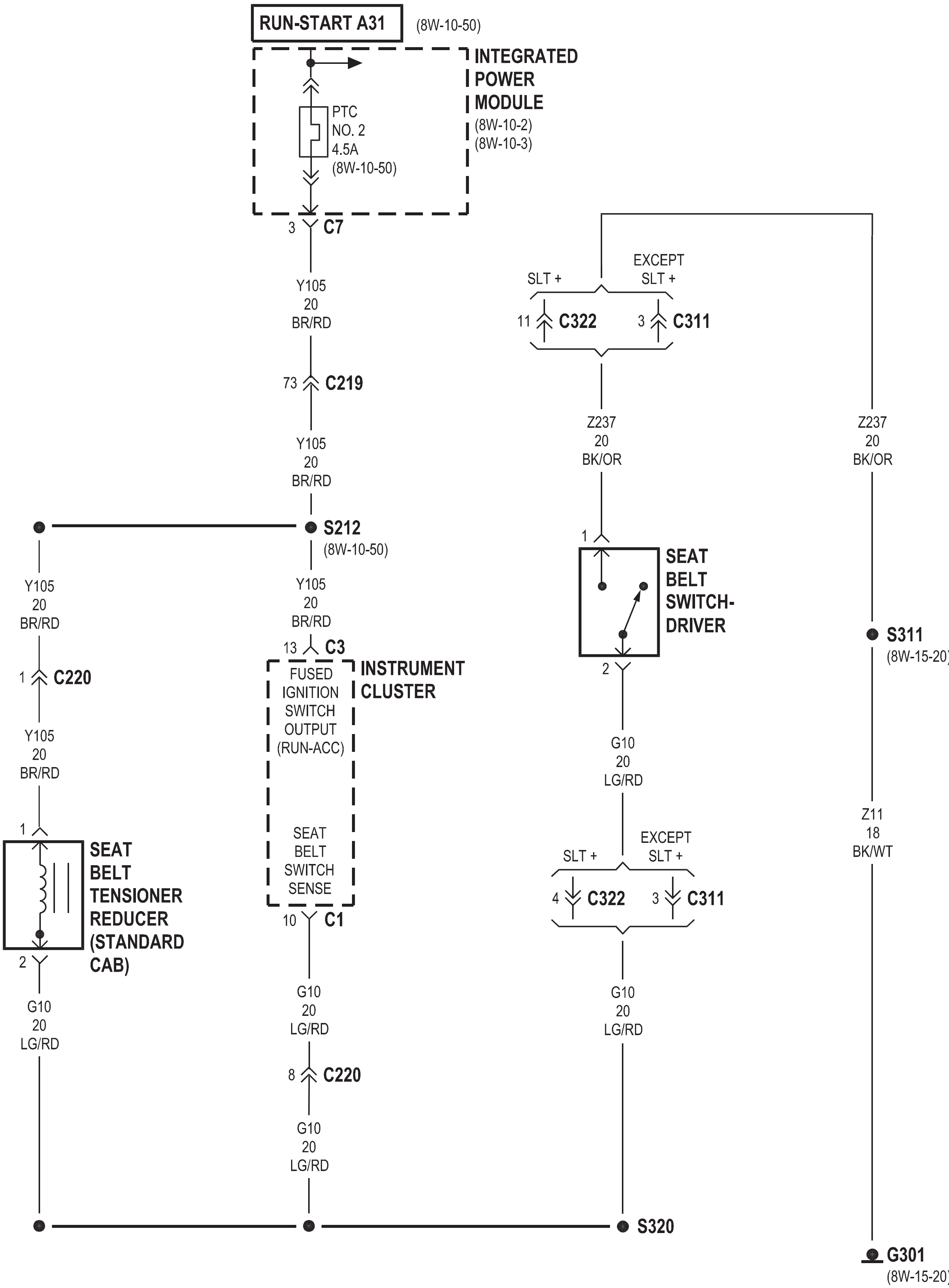
RUN-START A21
(8W-10-45)
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
PTC NO. 1 7.5A
(8W-10-43)
(8W-10-44)
FUSE 19 20A
(8W-10-33)
FUSE 22 20A
(8W-10-33)
16 C4
7 C2
12 C1
Y135 18 LG/BK
A14 20 RD/WT
F35 18 RD
S136
(8W-10-43)
(8W-10-44)
S110
(8W-10-33)
33 C219
Y135 18 LG/BK
A14 20 RD/WT
F35 18 RD
42
70 C219
S213
(8W-10-33)
Y135 20 LG/BK
A14 20 RD/WT
F35 18 RD
F35 18 RD
4
6
1 C1
14 C1
FUSED IGNITION SWITCH OUTPUT (RUN-START)
FUSED B(+)
SENTRY KEY IMMOBILIZER MODULE
FUSED B(+)
FUSED B(+)
INSTRUMENT CLUSTER
(8W-40-5)
PCI BUS
GROUND
PCI BUS
21 C3
5
2
D25 20 VT/YL
S230
(8W-18-4)
Z110 20 BK/GY
D25 20 VT/WT
D25 20 VT/DG
S231
(8W-18-5)
(8W-18-6)
G201
(8W-15-12)
(8W-15-13)

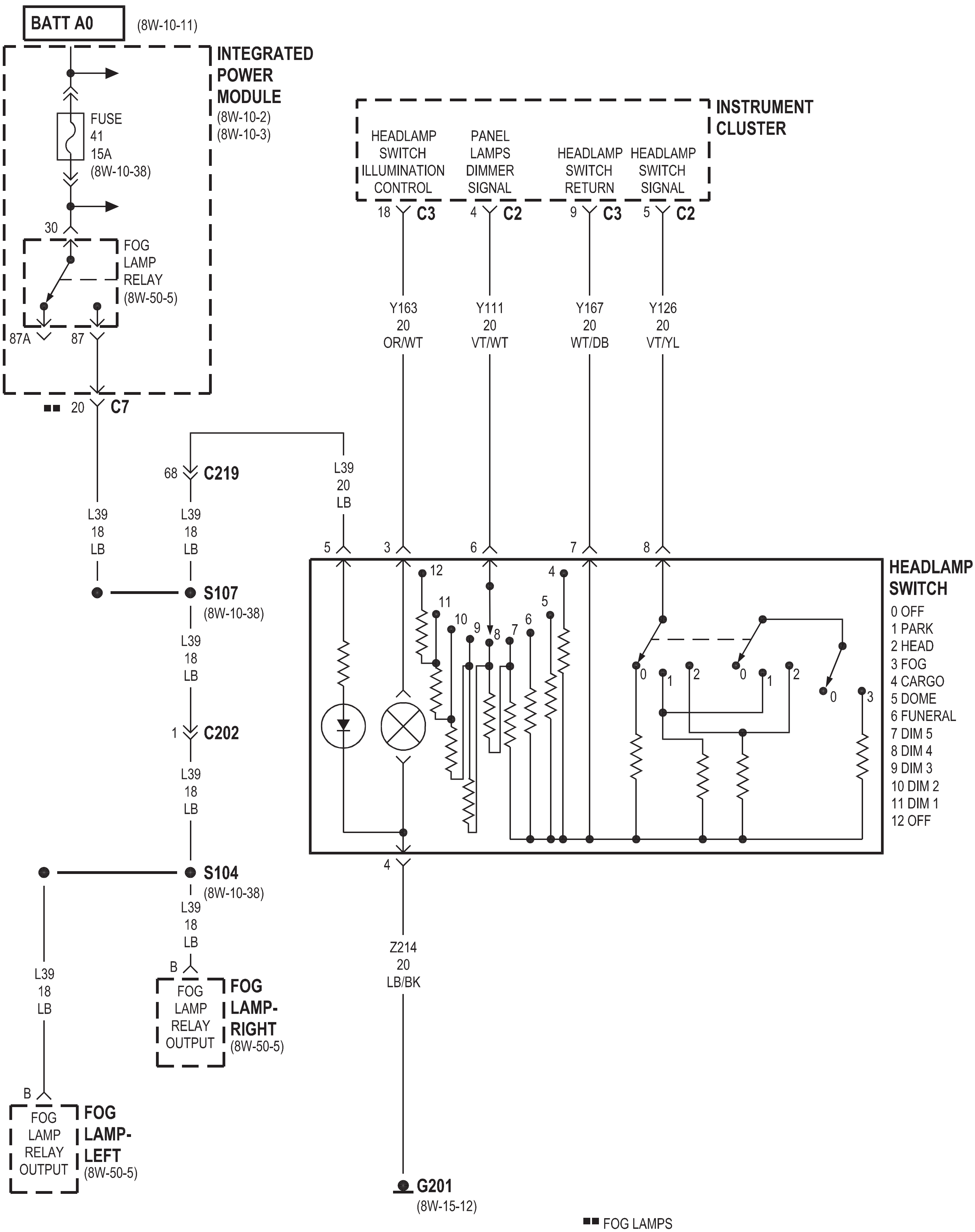

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 15 50A (8W-10-36)
FUSE 45 20A (8W-10-38)
30
85
PARK LAMP RELAY
(8W-50-4)
(8W-52-3)
87
87A
86
85
30
HORN RELAY
(8W-41-2)
86
87
87A
15
PARK LAMP RELAY CONTROL
32
HORN RELAY CONTROL
FRONT CONTROL MODULE
(8W-10-36)
(8W-10-38)
(8W-10-54)
(8W-10-55)
LEFT HIGH BEAM DRIVER
RIGHT HIGH BEAM DRIVER
PCI BUS
2
8
38
15 C7
7 C7
4 C3
Y170 18 WT/LG
Y168 18 WT/LB
D25 20 VT/PK
D6 C130
72 C219
Y168 18 WT/LB
D25 20 VT/PK
✱ 9
■ 7 C100
S231
(8W-18-5)
(8W-18-6)
D25 20 VT/DG
Y168 18 WT/LB
S230
(8W-18-4)
D25 20 LB/VT
1
3
HEADLAMP-LEFT
(8W-50-3)
2
Z141 18 BK/LB
1
3
HEADLAMP-RIGHT
(8W-50-3)
2
Z142 18 BK/LG
S101
(8W-15-7)
Z147 18 BK/LB
2
DATA LINK CONNECTOR
(8W-18-2)
G106
(8W-15-4)
G105
(8W-15-7)
✱ DIESEL
■ GAS


INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-12)
CYLINDER LOCK SWITCH MUX
PASSENGER DOOR AJAR SWITCH SENSE
RIGHT REAR DOOR AJAR SWITCH SENSE
6 C2
21 C1
20 C1
G72 20 DG/OR
G74 20 TN/RD
G76 20 TN/YL
2
1
6 C308
G72 20 DG/OR
G74 20 TN/RD
G76 20 TN/YL
9 C302
1 C301
2 C312
G72 20 DG/OR
G74 20 TN/RD
G76 20 VT/OR
1
1
1
CYLINDER LOCK SWITCH-PASSENGER
(8W-61-3)
(8W-61-5)
DOOR LOCK MOTOR/ AJAR SWITCH-PASSENGER
(8W-40-6)
DOOR LOCK MOTOR/ AJAR SWITCH-RIGHT REAR (QUAD CAB)
(8W-40-7)
2
2
2
Z69 20 BK/LG
Z315 20 BK/LG
Z74 20 BK
S312
(8W-15-19)
1 C312
Z315 20 BK/LG
Z74 20 BK
10 C301
Z315 20 BK/LG
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)


INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-12)
CYLINDER LOCK SWITCH MUX
DRIVER DOOR AJAR SWITCH SENSE
LEFT REAR DOOR AJAR SWITCH SENSE
7 C2
18 C1
19 C1
G73 20 LG/OR
G75 20 TN
G77 20 VT/OR
9
5
6 C220
11 C305
1 C304
2 C306
1
CYLINDER LOCK SWITCH-DRIVER
(8W-61-2)
DOOR LOCK MOTOR/ AJAR SWITCH-DRIVER
(8W-40-7)
DOOR LOCK MOTOR/ AJAR SWITCH-LEFT REAR (QUAD CAB)
(8W-40-7)
2
Z70 20 BK/LG
Z314 20 BK/LG
Z75 20 BK
S313
(8W-15-19)
1 C306
10 C304
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)

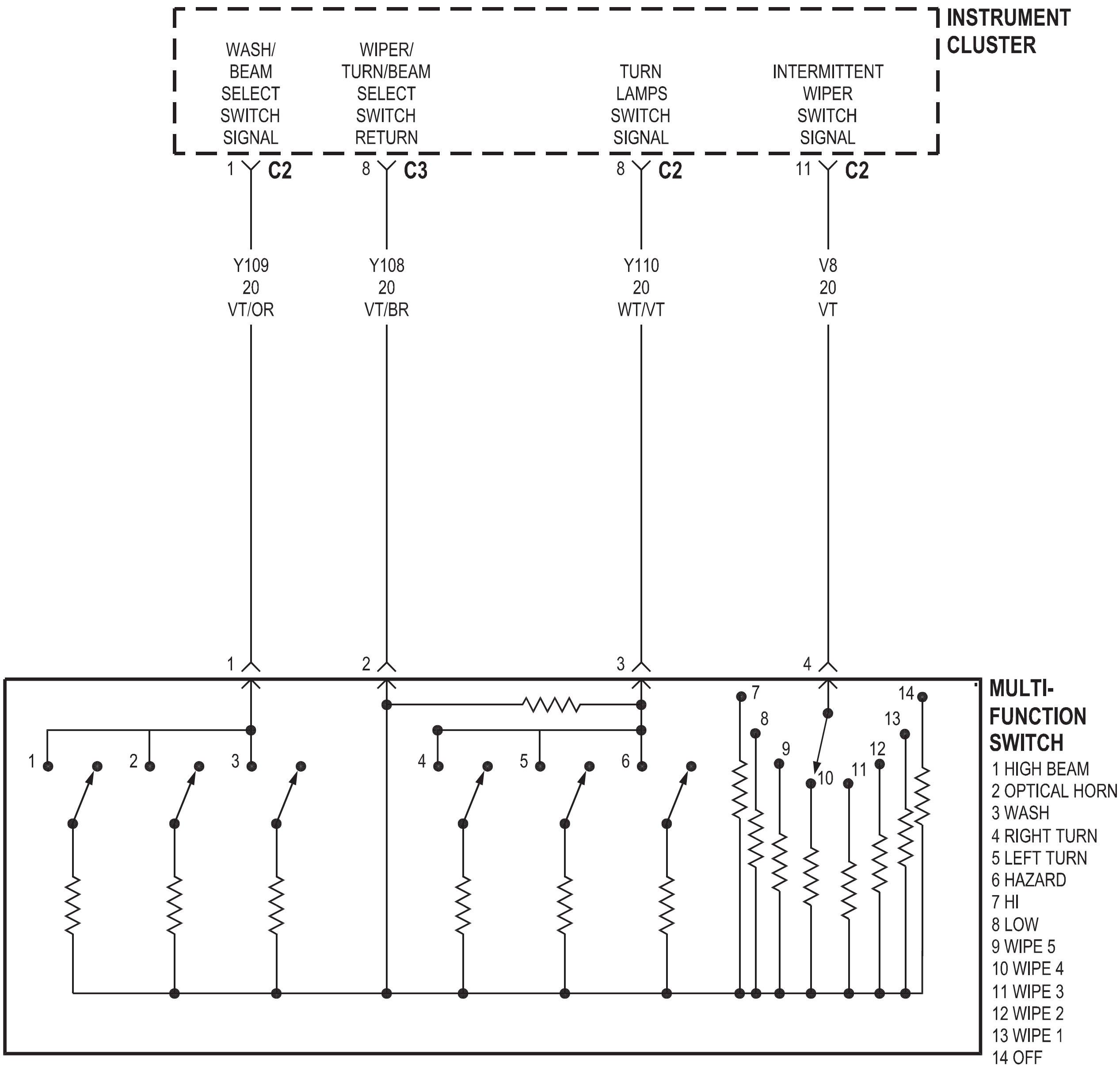
8W-40 INSTRUMENT CLUSTER

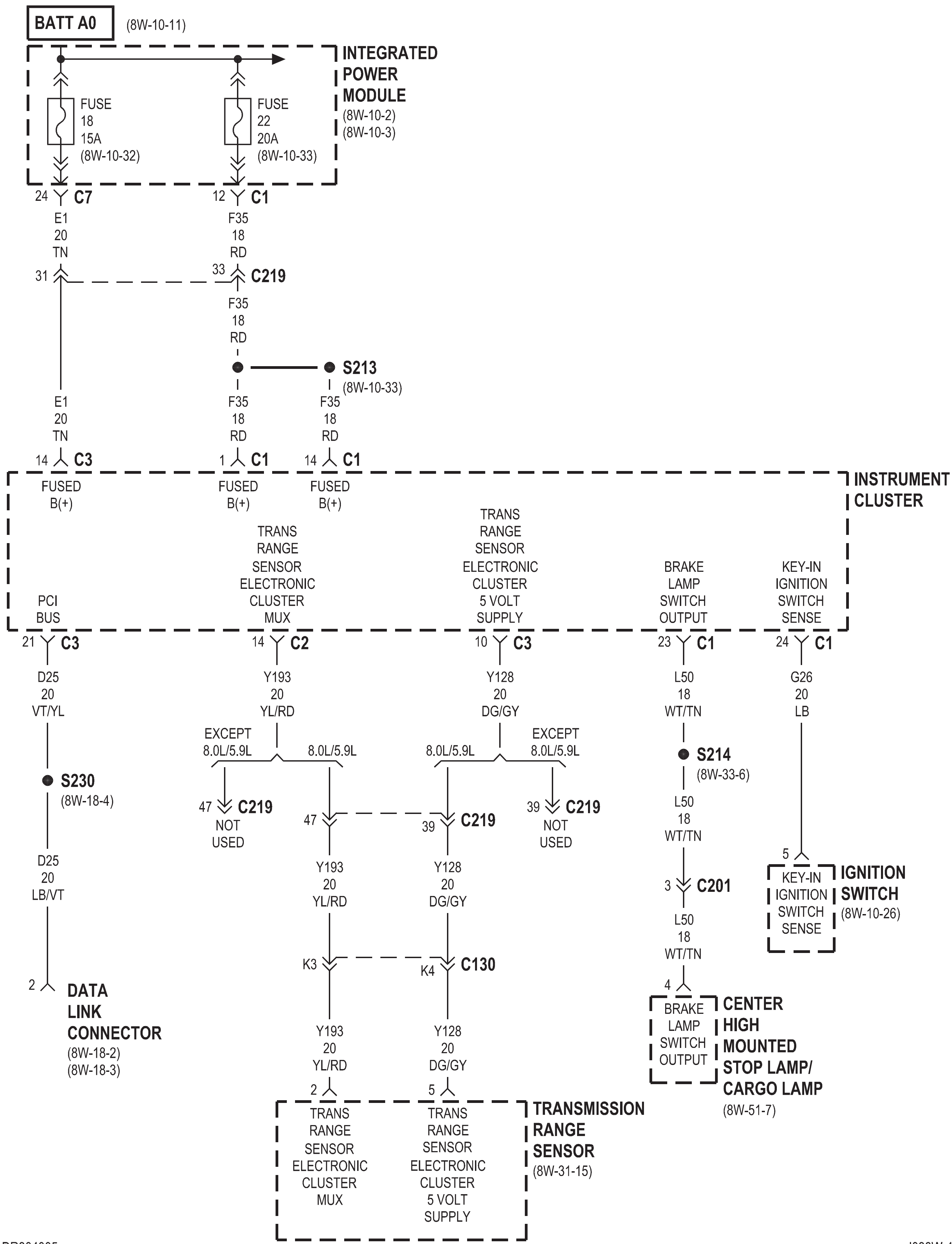

RUN-START A31
(8W-10-50)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
PTC NO. 2 4.5A
(8W-10-50)
3 C7
Y105 20 BR/RD
73 C219
Y105 20 BR/RD
S212
(8W-10-50)
Y105 20 BR/RD
1 C220
Y105 20 BR/RD
1
SEAT BELT TENSIONER REDUCER (STANDARD CAB)
2
G10 20 LG/RD
Y105 20 BR/RD
13 C3
INSTRUMENT CLUSTER
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
SEAT BELT SWITCH SENSE
10 C1
G10 20 LG/RD
8 C220
G10 20 LG/RD
S320
SLT +
EXCEPT SLT +
11 C322
3 C311
Z237 20 BK/OR
1
SEAT BELT SWITCH-DRIVER
2
G10 20 LG/RD
SLT +
EXCEPT SLT +
4 C322
3 C311
G10 20 LG/RD
Z237 20 BK/OR
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)



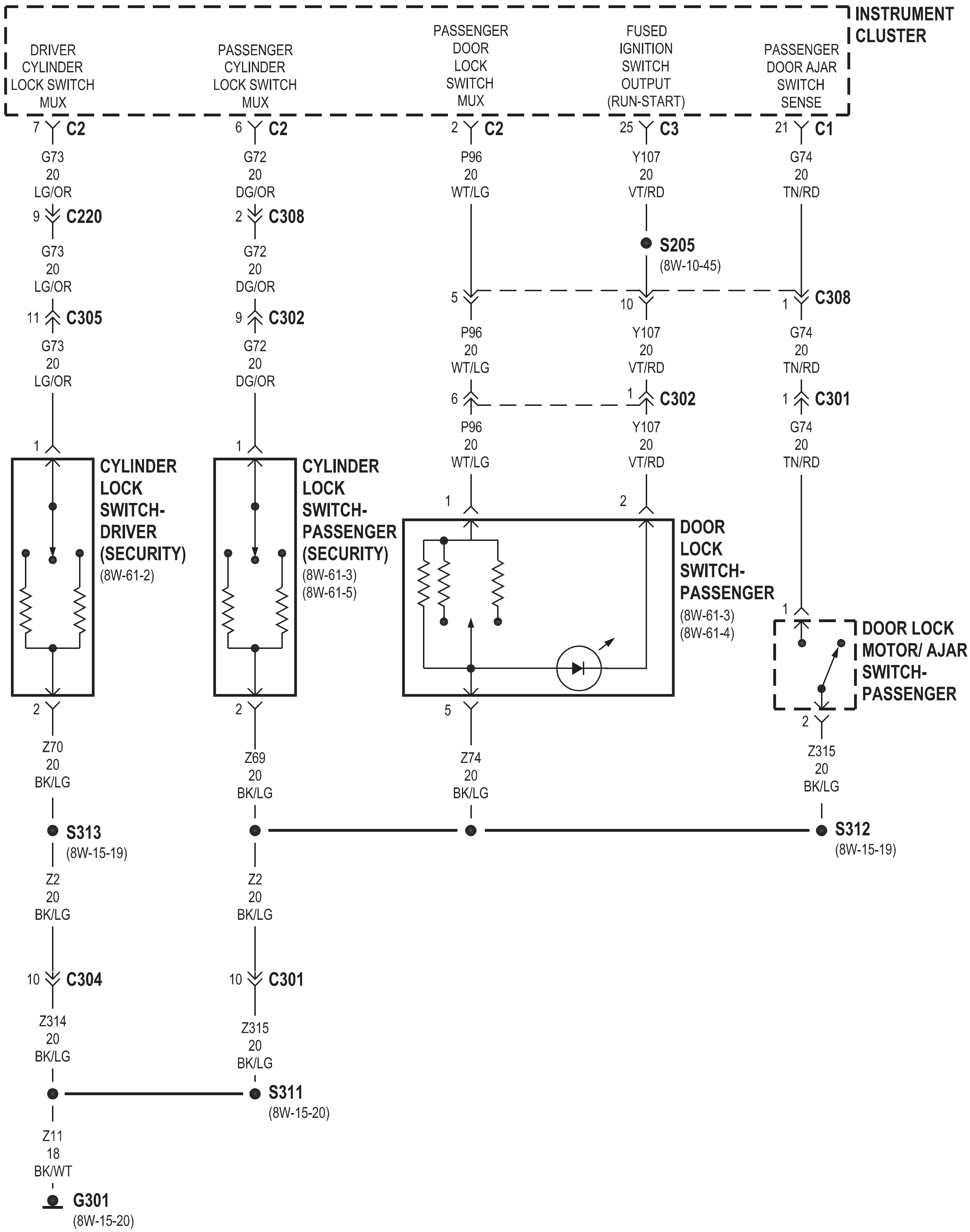
DR304003

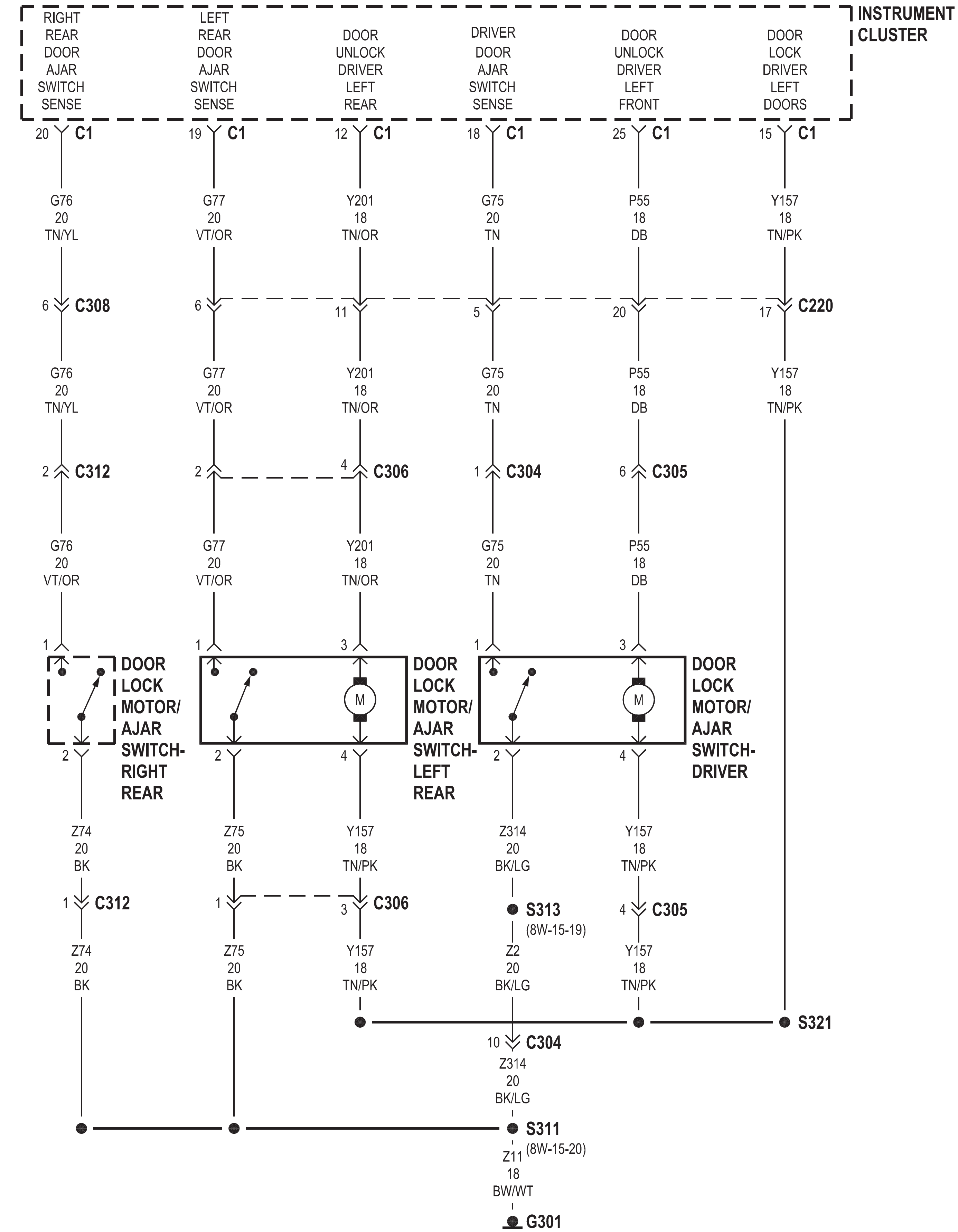
J038W-4

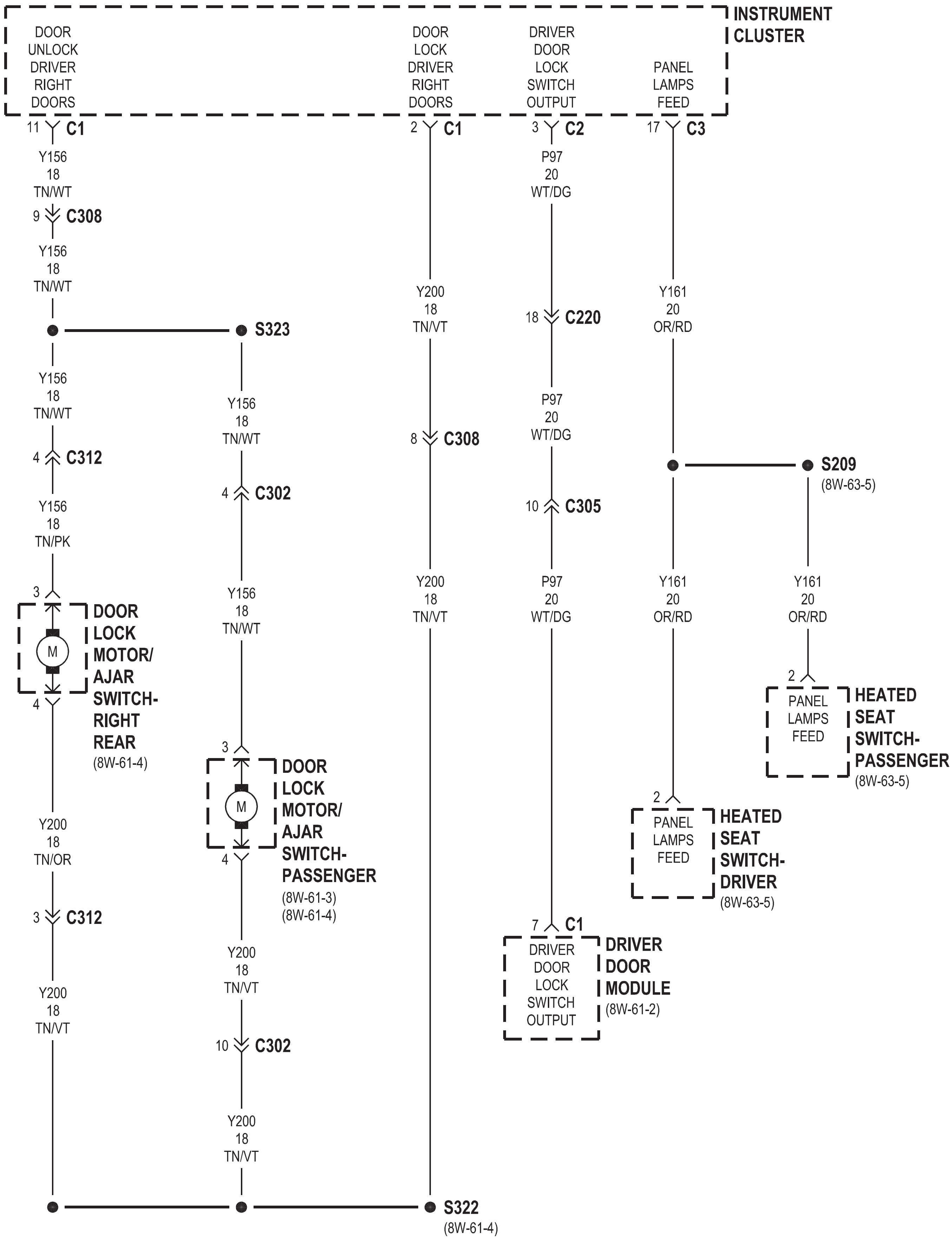

INSTRUMENT CLUSTER
WASH/ BEAM SELECT SWITCH SIGNAL
WIPER/ TURN/BEAM SELECT SWITCH RETURN
TURN LAMPS SWITCH SIGNAL
INTERMITTENT WIPER SWITCH SIGNAL
1 C2
8 C3
8 C2
11 C2
Y109 20 VT/OR
Y108 20 VT/BR
Y110 20 WT/VT
V8 20 VT
1
2
3
4
MULTI-FUNCTION SWITCH
1 HIGH BEAM
2 OPTICAL HORN
3 WASH
4 RIGHT TURN
5 LEFT TURN
6 HAZARD
7 HI
8 LOW
9 WIPE 5
10 WIPE 4
11 WIPE 3
12 WIPE 2
13 WIPE 1
14 OFF

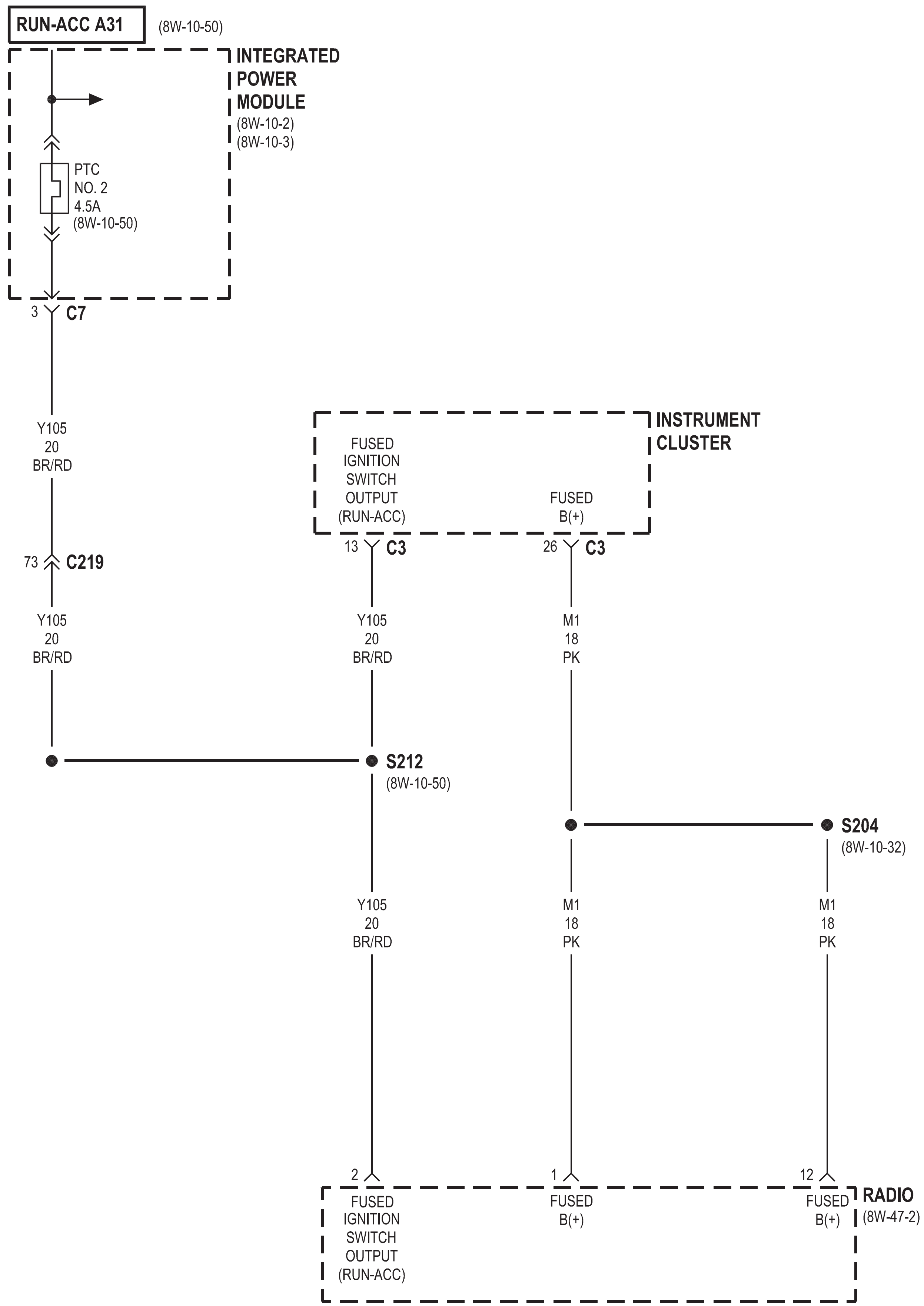


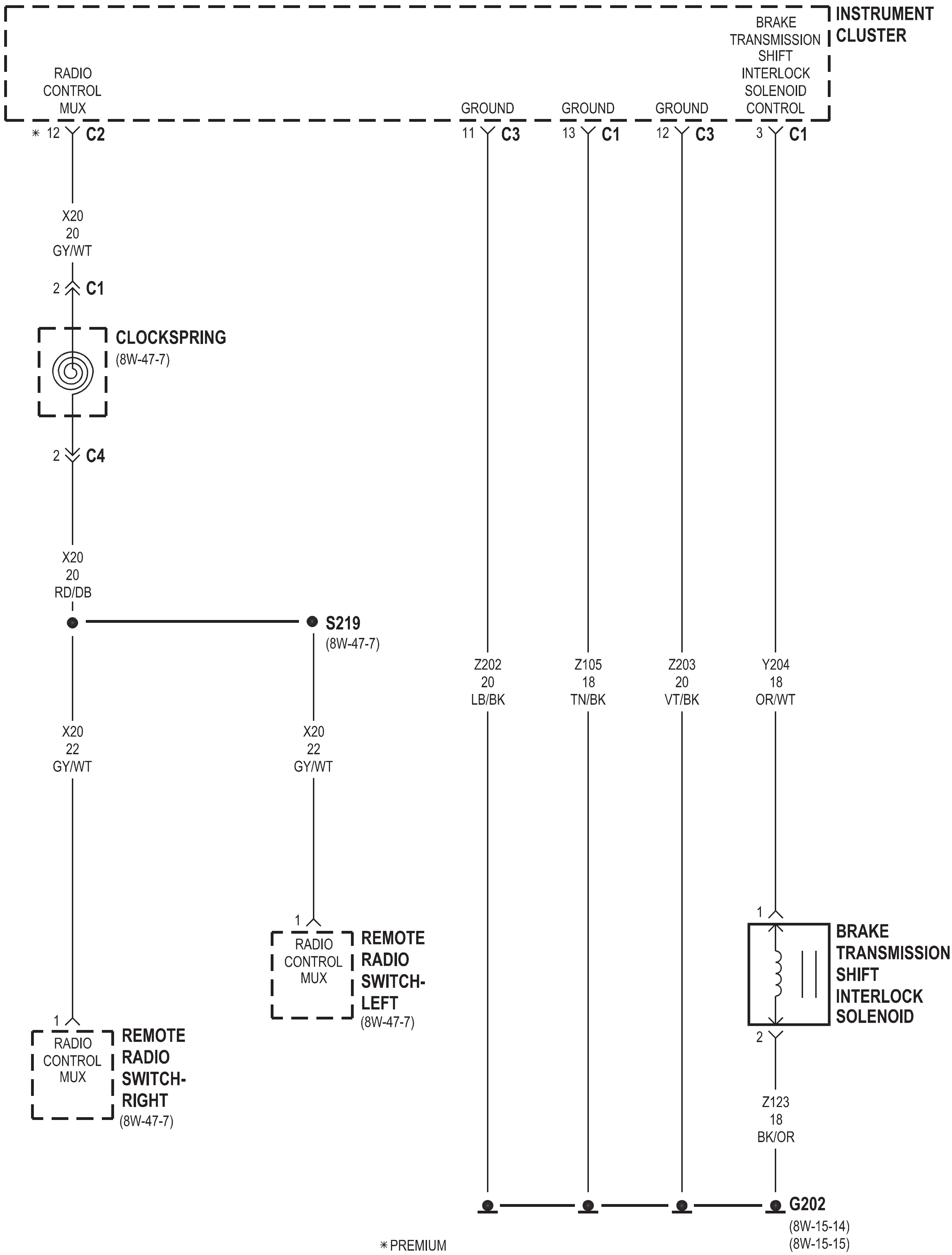
DR304005 J038W-4

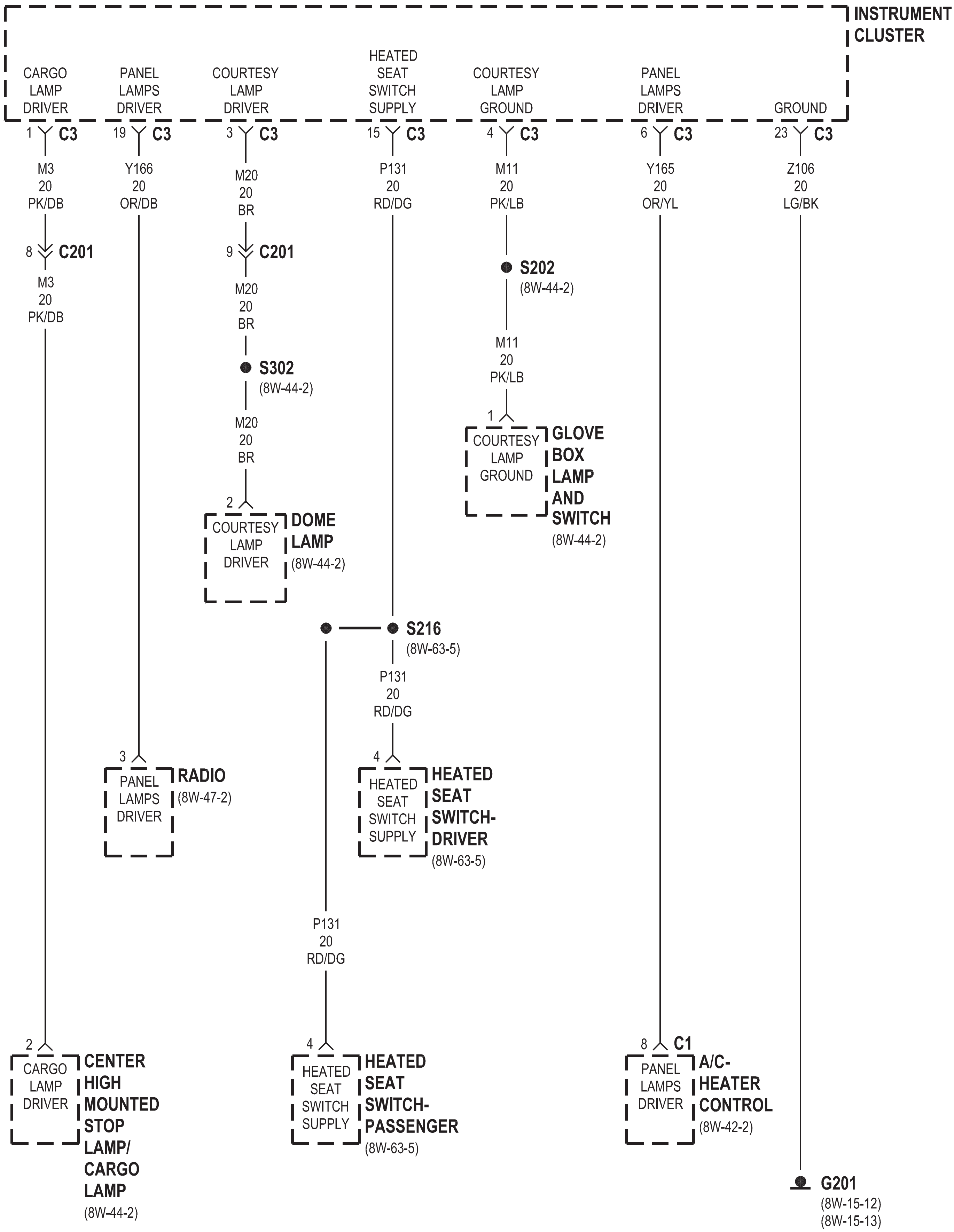

INSTRUMENT CLUSTER
DRIVER CYLINDER LOCK SWITCH MUX
PASSENGER CYLINDER LOCK SWITCH MUX
PASSENGER DOOR LOCK SWITCH MUX
FUSED IGNITION SWITCH OUTPUT (RUN-START)
PASSENGER DOOR AJAR SWITCH SENSE
7 C2
6 C2
2 C2
25 C3
21 C1
G73 20 LG/OR
G72 20 DG/OR
P96 20 WT/LG
Y107 20 VT/RD
G74 20 TN/RD
9 C220
2 C308
S205
(8W-10-45)
5
10
1 C308
11 C305
9 C302
6
1 C302
1 C301
1
2
CYLINDER LOCK SWITCH- DRIVER (SECURITY)
(8W-61-2)
CYLINDER LOCK SWITCH- PASSENGER (SECURITY)
(8W-61-3)
(8W-61-5)
DOOR LOCK SWITCH- PASSENGER
(8W-61-3)
(8W-61-4)
DOOR LOCK MOTOR/ AJAR SWITCH- PASSENGER
Z70 20 BK/LG
Z69 20 BK/LG
Z74 20 BK/LG
Z315 20 BK/LG
S313
(8W-15-19)
S312
(8W-15-19)
Z2 20 BK/LG
10 C304
10 C301
Z314 20 BK/LG
Z315 20 BK/LG
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)

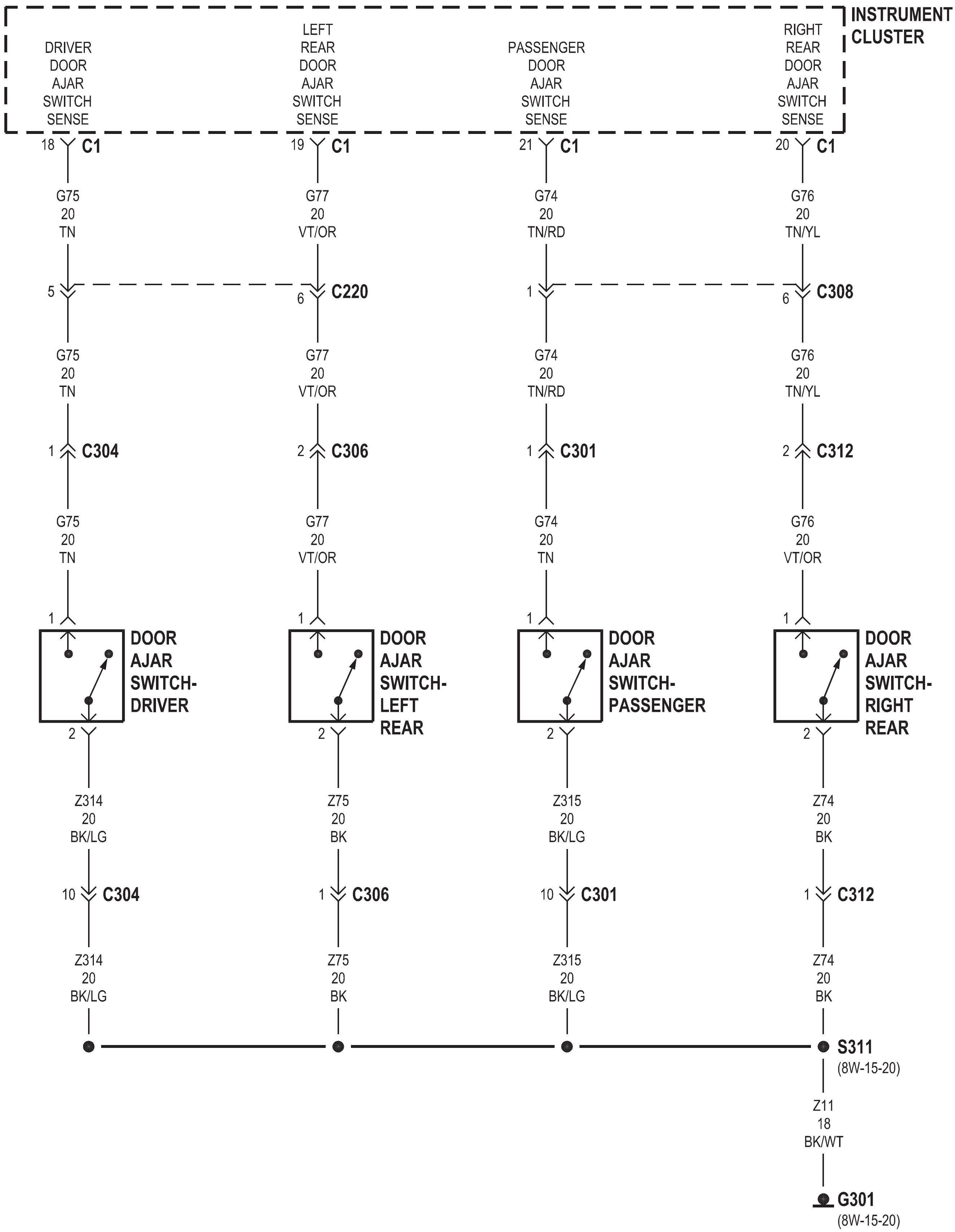

INSTRUMENT CLUSTER
RIGHT REAR DOOR AJAR SWITCH SENSE
LEFT REAR DOOR AJAR SWITCH SENSE
DOOR UNLOCK DRIVER LEFT REAR
DRIVER DOOR AJAR SWITCH SENSE
DOOR UNLOCK DRIVER LEFT FRONT
DOOR LOCK DRIVER LEFT DOORS
20 C1
19 C1
12 C1
18 C1
25 C1
15 C1
G76 20 TN/YL
G77 20 VT/OR
Y201 18 TN/OR
G75 20 TN
P55 18 DB
Y157 18 TN/PK
6 C308
6
11
5
20
17 C220
G76 20 TN/YL
G77 20 VT/OR
Y201 18 TN/OR
G75 20 TN
P55 18 DB
Y157 18 TN/PK
2 C312
2
4 C306
1 C304
6 C305
G76 20 VT/OR
G77 20 VT/OR
Y201 18 TN/OR
G75 20 TN
P55 18 DB
1
1
3
1
3
M
M
DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR
DOOR LOCK MOTOR/ AJAR SWITCH- LEFT REAR
DOOR LOCK MOTOR/ AJAR SWITCH- DRIVER
2
2
4
2
4
Z74 20 BK
Z75 20 BK
Y157 18 TN/PK
Z314 20 BK/LG
Y157 18 TN/PK
1 C312
1
3 C306
S313 (8W-15-19)
4 C305
Z74 20 BK
Z75 20 BK
Y157 18 TN/PK
Z2 20 BK/LG
Y157 18 TN/PK
S321
10 C304
Z314 20 BK/LG
S311 (8W-15-20)
Z11 18 BW/WT
G301 (8W-15-20)

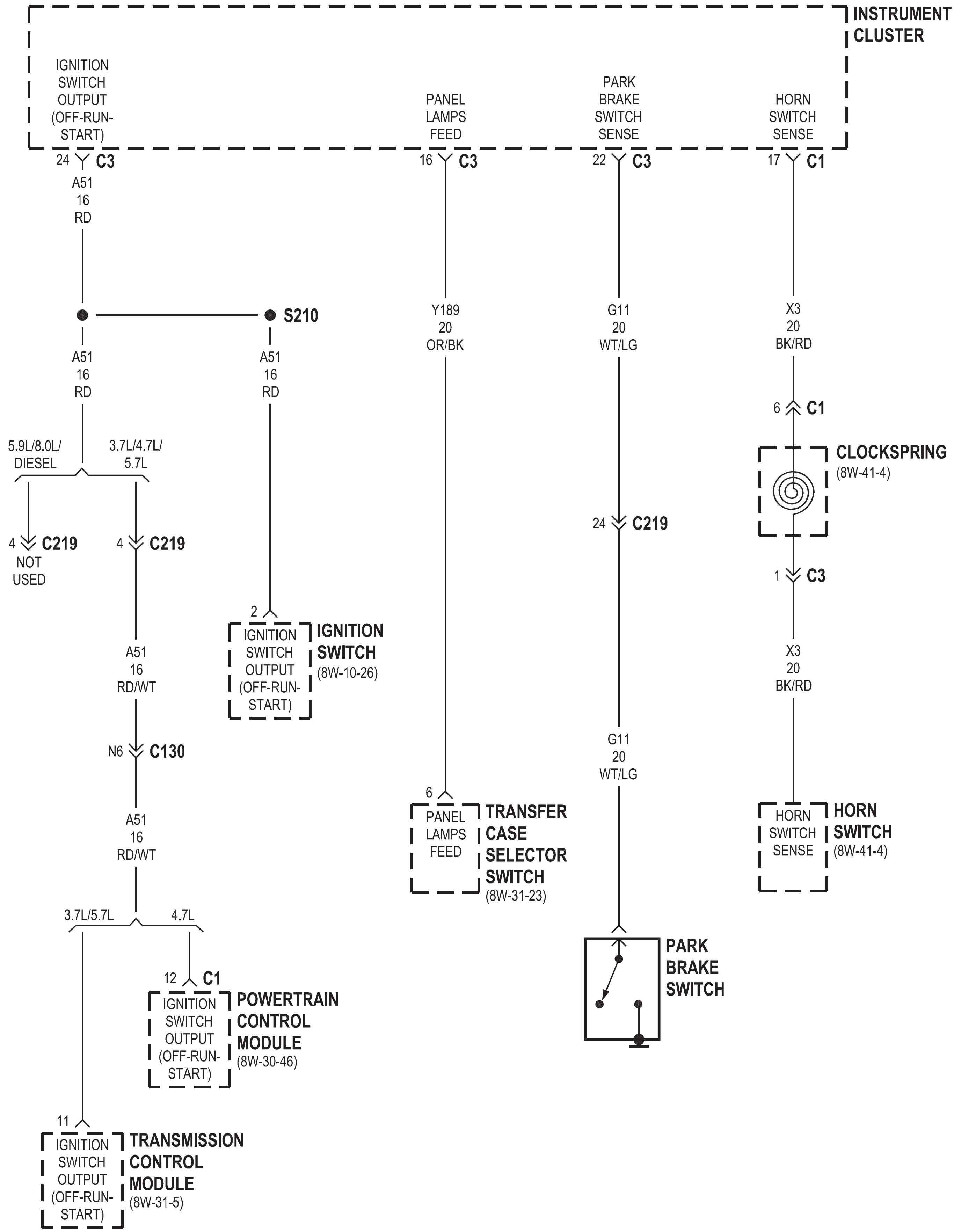

INSTRUMENT CLUSTER
DOOR UNLOCK DRIVER RIGHT DOORS
DOOR LOCK DRIVER RIGHT DOORS
DRIVER DOOR LOCK SWITCH OUTPUT
PANEL LAMPS FEED
11 C1
2 C1
3 C2
17 C3
Y156 18 TN/WT
9 C308
Y156 18 TN/WT
S323
Y156 18 TN/WT
Y156 18 TN/WT
4 C312
4 C302
Y156 18 TN/PK
Y156 18 TN/WT
3
M
4
DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR
(8W-61-4)
3
M
4
DOOR LOCK MOTOR/ AJAR SWITCH- PASSENGER
(8W-61-3)
(8W-61-4)
Y200 18 TN/OR
3 C312
Y200 18 TN/VT
Y200 18 TN/VT
10 C302
Y200 18 TN/VT
Y200 18 TN/VT
8 C308
Y200 18 TN/VT
S322
(8W-61-4)
P97 20 WT/DG
18 C220
P97 20 WT/DG
10 C305
P97 20 WT/DG
7 C1
DRIVER DOOR LOCK SWITCH OUTPUT
DRIVER DOOR MODULE
(8W-61-2)
Y161 20 OR/RD
S209
(8W-63-5)
Y161 20 OR/RD
Y161 20 OR/RD
2
PANEL LAMPS FEED
HEATED SEAT SWITCH- PASSENGER
(8W-63-5)
2
PANEL LAMPS FEED
HEATED SEAT SWITCH- DRIVER
(8W-63-5)


RUN-ACC A31
(8W-10-50)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
PTC NO. 2 4.5A
(8W-10-50)
3 C7
Y105 20 BR/RD
73 C219
Y105 20 BR/RD
INSTRUMENT CLUSTER
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
FUSED B(+)
13 C3
26 C3
Y105 20 BR/RD
M1 18 PK
S212
(8W-10-50)
S204
(8W-10-32)
Y105 20 BR/RD
M1 18 PK
M1 18 PK
2
1
12
RADIO
(8W-47-2)
FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
FUSED B(+)
FUSED B(+)

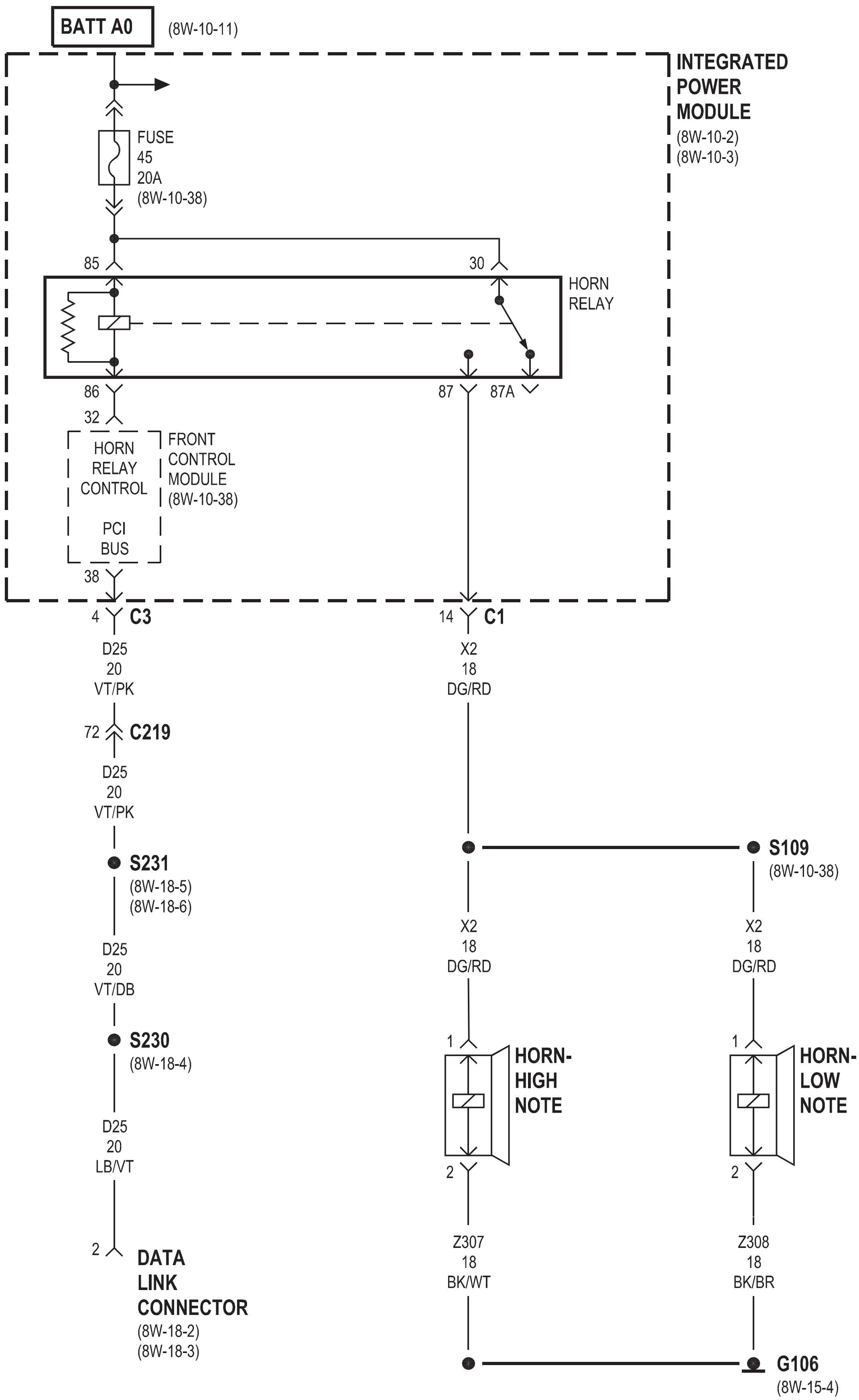

INSTRUMENT CLUSTER
RADIO CONTROL MUX
GROUND
GROUND
GROUND
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID CONTROL
* 12 C2
11 C3
13 C1
12 C3
3 C1
X20 20 GY/WT
2 C1
CLOCKSPRING (8W-47-7)
2 C4
X20 20 RD/DB
S219 (8W-47-7)
Z202 20 LB/BK
Z105 18 TN/BK
Z203 20 VT/BK
Y204 18 OR/WT
X20 22 GY/WT
X20 22 GY/WT
1
RADIO CONTROL MUX
REMOTE RADIO SWITCH-LEFT (8W-47-7)
1
BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID
2
1
RADIO CONTROL MUX
REMOTE RADIO SWITCH-RIGHT (8W-47-7)
Z123 18 BK/OR
G202 (8W-15-14) (8W-15-15)
* PREMIUM

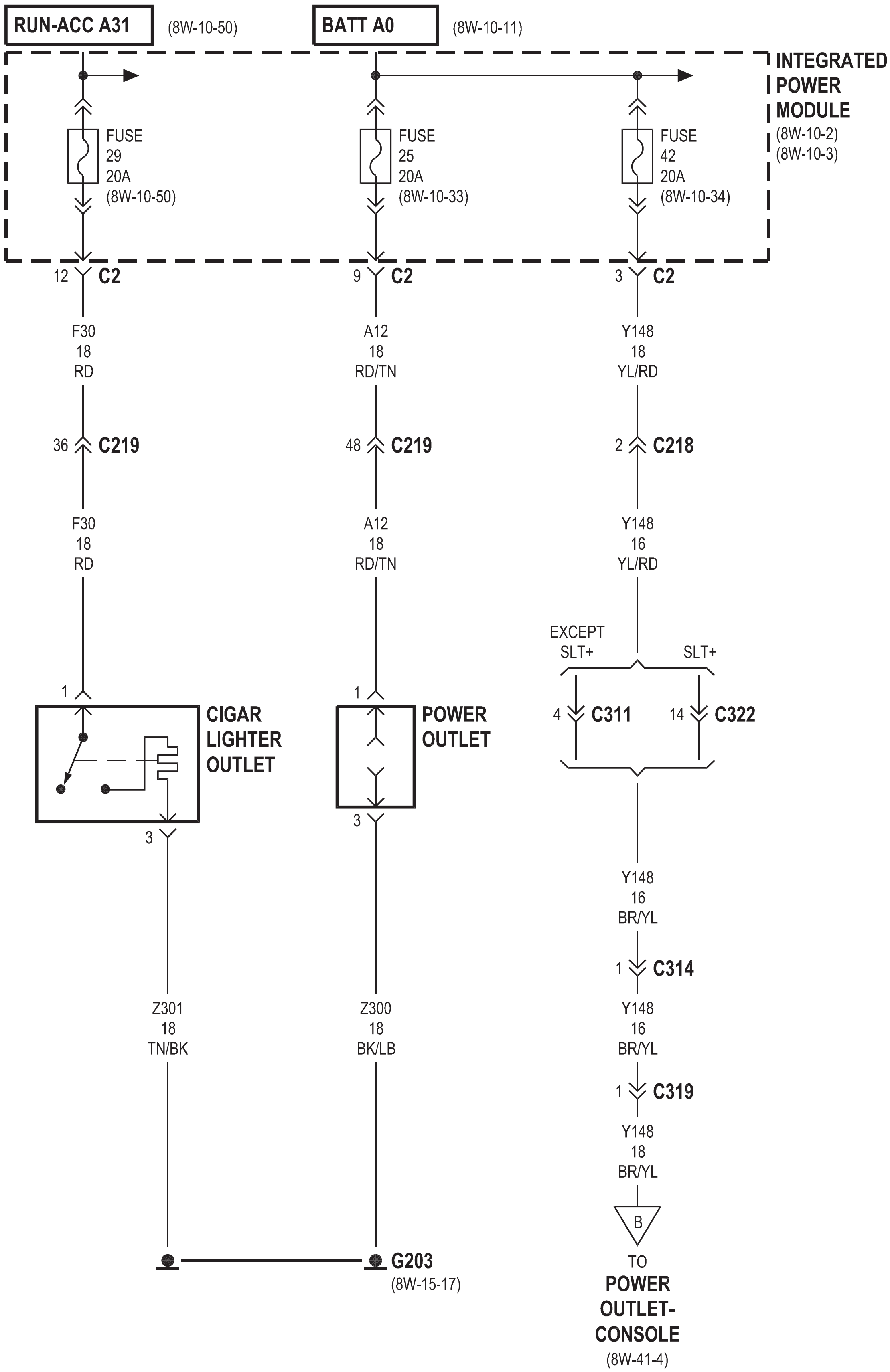

INSTRUMENT CLUSTER
CARGO LAMP DRIVER
PANEL LAMPS DRIVER
COURTESY LAMP DRIVER
HEATED SEAT SWITCH SUPPLY
COURTESY LAMP GROUND
PANEL LAMPS DRIVER
GROUND
1 C3
19 C3
3 C3
15 C3
4 C3
6 C3
23 C3
M3 20 PK/DB
Y166 20 OR/DB
M20 20 BR
P131 20 RD/DG
M11 20 PK/LB
Y165 20 OR/YL
Z106 20 LG/BK
8 C201
9 C201
M3 20 PK/DB
M20 20 BR
S202 (8W-44-2)
S302 (8W-44-2)
M11 20 PK/LB
M20 20 BR
1
COURTESY LAMP GROUND
GLOVE BOX LAMP AND SWITCH (8W-44-2)
2
COURTESY LAMP DRIVER
DOME LAMP (8W-44-2)
S216 (8W-63-5)
P131 20 RD/DG
3
PANEL LAMPS DRIVER
RADIO (8W-47-2)
4
HEATED SEAT SWITCH SUPPLY
HEATED SEAT SWITCH-DRIVER (8W-63-5)
P131 20 RD/DG
2
CARGO LAMP DRIVER
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP (8W-44-2)
4
HEATED SEAT SWITCH SUPPLY
HEATED SEAT SWITCH-PASSENGER (8W-63-5)
8 C1
PANEL LAMPS DRIVER
A/C-HEATER CONTROL (8W-42-2)
G201 (8W-15-12) (8W-15-13)

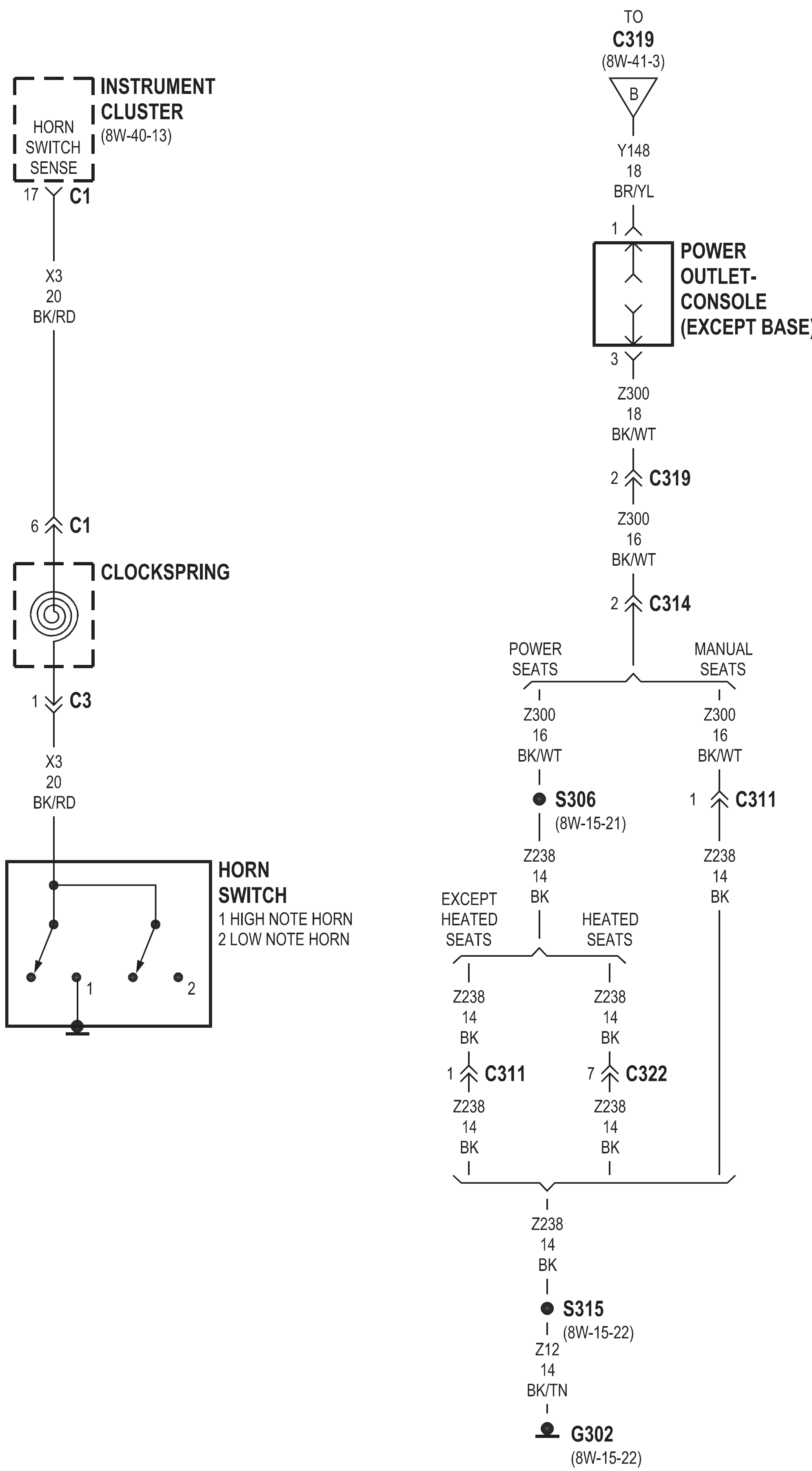

INSTRUMENT CLUSTER
DRIVER DOOR AJAR SWITCH SENSE
LEFT REAR DOOR AJAR SWITCH SENSE
PASSENGER DOOR AJAR SWITCH SENSE
RIGHT REAR DOOR AJAR SWITCH SENSE
18 C1
19 C1
21 C1
20 C1
G75 20 TN
G77 20 VT/OR
G74 20 TN/RD
G76 20 TN/YL
5
6 C220
1
6 C308
G75 20 TN
G77 20 VT/OR
G74 20 TN/RD
G76 20 TN/YL
1 C304
2 C306
1 C301
2 C312
G75 20 TN
G77 20 VT/OR
G74 20 TN
G76 20 VT/OR
1
1
1
1
DOOR AJAR SWITCH-DRIVER
DOOR AJAR SWITCH-LEFT REAR
DOOR AJAR SWITCH-PASSENGER
DOOR AJAR SWITCH-RIGHT REAR
2
2
2
2
Z314 20 BK/LG
Z75 20 BK
Z315 20 BK/LG
Z74 20 BK
10 C304
1 C306
10 C301
1 C312
Z314 20 BK/LG
Z75 20 BK
Z315 20 BK/LG
Z74 20 BK
S311 (8W-15-20)
Z11 18 BK/WT
G301 (8W-15-20)


INSTRUMENT CLUSTER
IGNITION SWITCH OUTPUT (OFF-RUN-START)
PANEL LAMPS FEED
PARK BRAKE SWITCH SENSE
HORN SWITCH SENSE
24 C3
16 C3
22 C3
17 C1
A51 16 RD
S210
A51 16 RD
A51 16 RD
Y189 20 OR/BK
G11 20 WT/LG
X3 20 BK/RD
6 C1
CLOCKSPRING
(8W-41-4)
24 C219
1 C3
X3 20 BK/RD
5.9L/8.0L/ DIESEL
3.7L/4.7L/ 5.7L
4 C219
NOT USED
4 C219
A51 16 RD/WT
N6 C130
A51 16 RD/WT
2
IGNITION SWITCH OUTPUT (OFF-RUN-START)
IGNITION SWITCH
(8W-10-26)
G11 20 WT/LG
6
PANEL LAMPS FEED
TRANSFER CASE SELECTOR SWITCH
(8W-31-23)
HORN SWITCH SENSE
HORN SWITCH
(8W-41-4)
3.7L/5.7L
4.7L
12 C1
IGNITION SWITCH OUTPUT (OFF-RUN-START)
POWERTRAIN CONTROL MODULE
(8W-30-46)
PARK BRAKE SWITCH
11
IGNITION SWITCH OUTPUT (OFF-RUN-START)
TRANSMISSION CONTROL MODULE
(8W-31-5)

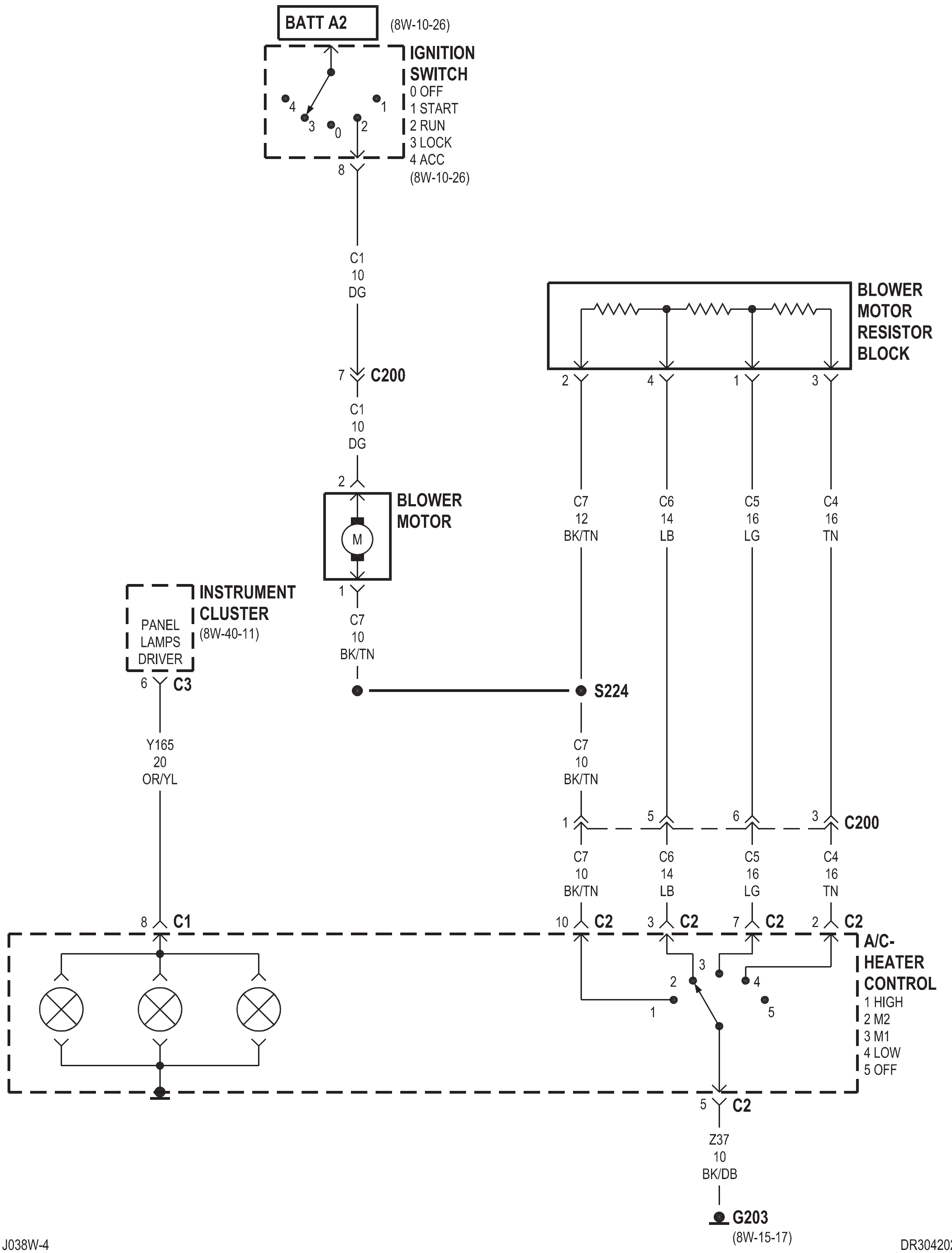
8W-41 HORN/CIGAR LIGHTER/POWER OUTLET

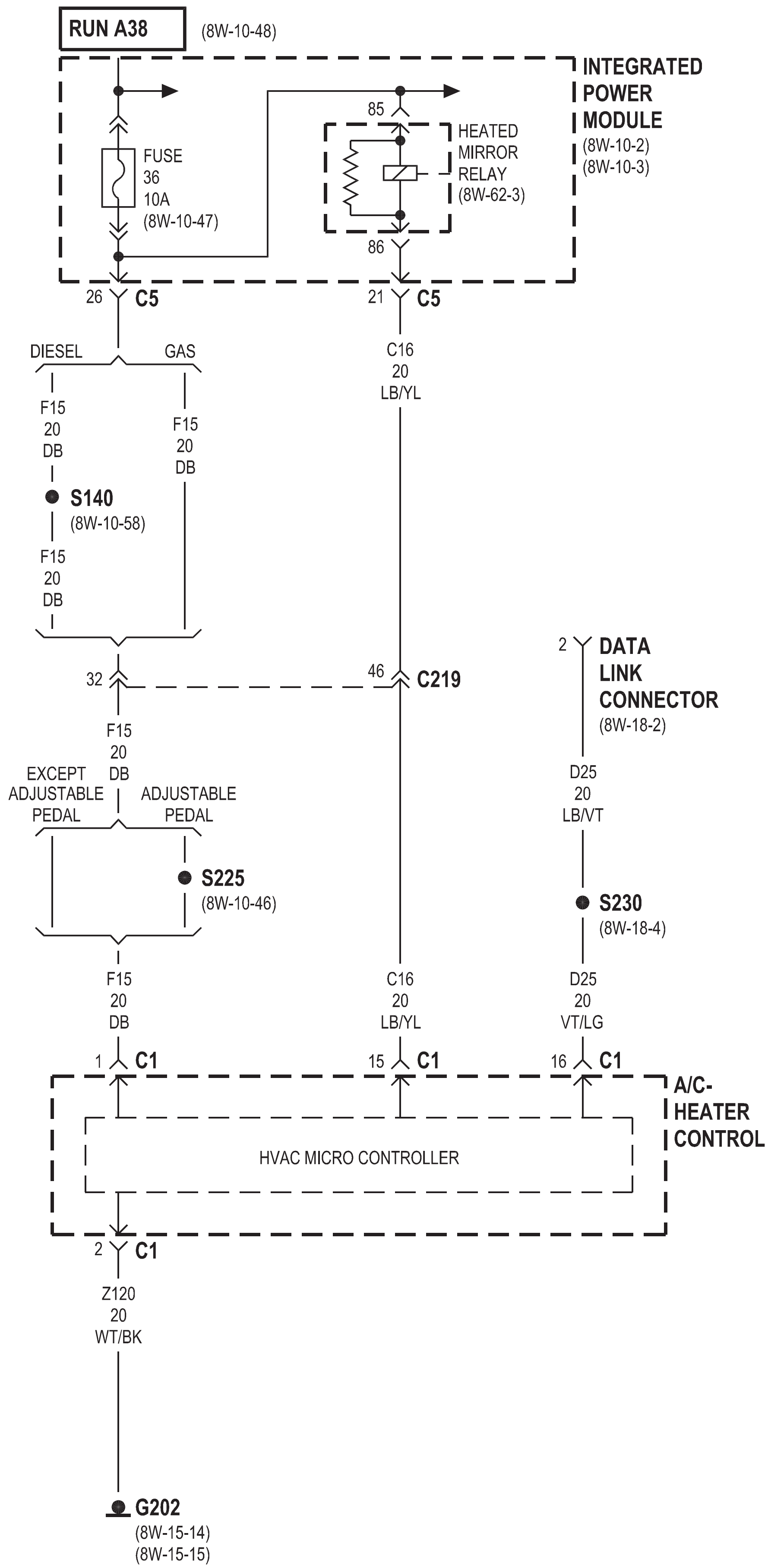

BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
45
20A
(8W-10-38)
85
30
HORN
RELAY
86
87
87A
32
HORN
RELAY
CONTROL
PCI
BUS
FRONT
CONTROL
MODULE
(8W-10-38)
38
4
C3
14
C1
D25
20
VT/PK
X2
18
DG/RD
72
C219
D25
20
VT/PK
S231
(8W-18-5)
(8W-18-6)
S109
(8W-10-38)
D25
20
VT/DB
X2
18
DG/RD
X2
18
DG/RD
S230
(8W-18-4)
1
HORN-
HIGH
NOTE
1
HORN-
LOW
NOTE
D25
20
LB/VT
2
2
2
DATA
LINK
CONNECTOR
(8W-18-2)
(8W-18-3)
Z307
18
BK/WT
Z308
18
BK/BR
G106
(8W-15-4)

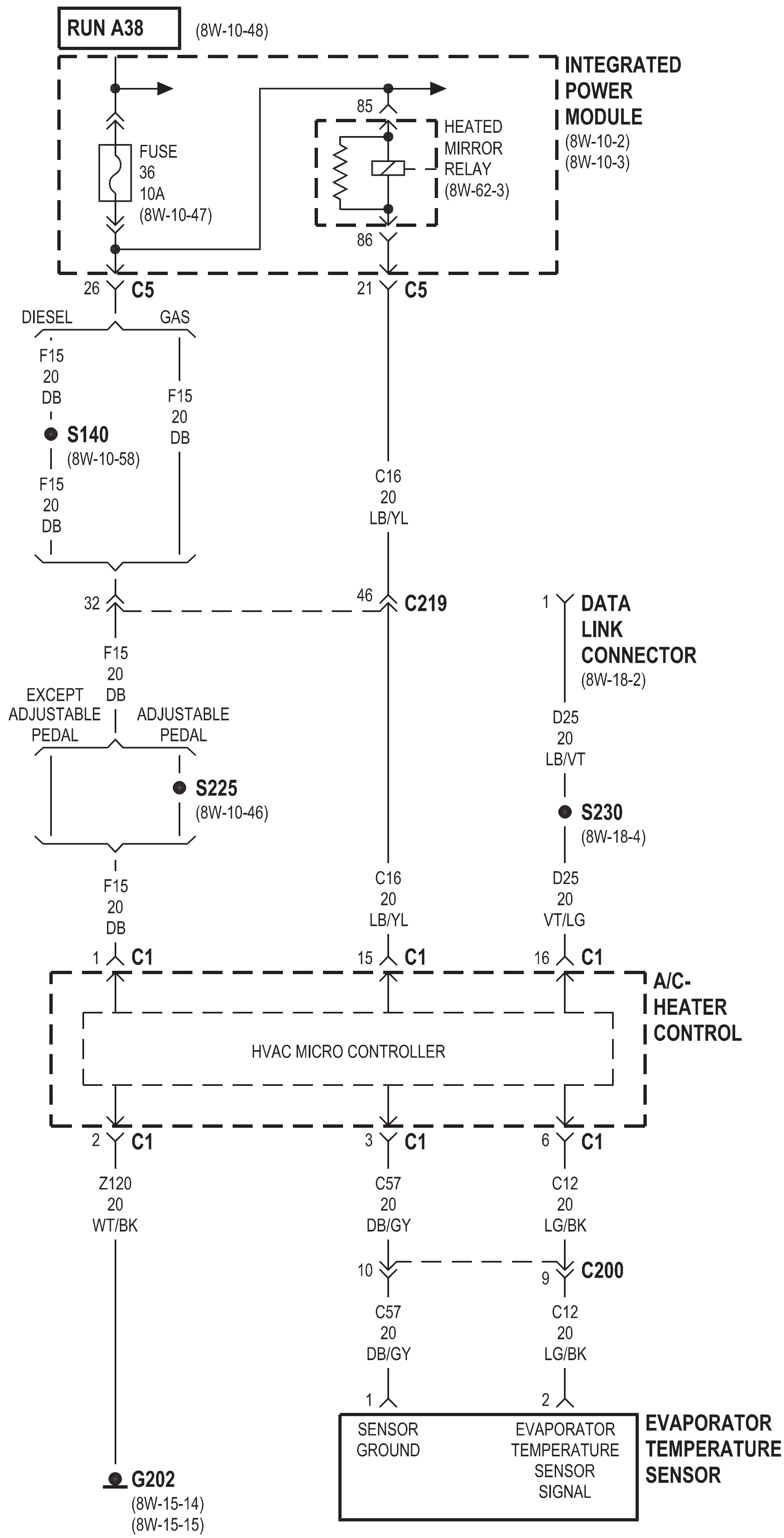

RUN-ACC A31
(8W-10-50)
BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
29
20A
(8W-10-50)
FUSE
25
20A
(8W-10-33)
FUSE
42
20A
(8W-10-34)
12 C2
9 C2
3 C2
F30
18
RD
A12
18
RD/TN
Y148
18
YL/RD
36 C219
48 C219
2 C218
F30
18
RD
A12
18
RD/TN
Y148
16
YL/RD
EXCEPT
SLT+
SLT+
1
CIGAR
LIGHTER
OUTLET
3
1
POWER
OUTLET
3
4 C311
14 C322
Y148
16
BR/YL
1 C314
Y148
16
BR/YL
1 C319
Y148
18
BR/YL
Z301
18
TN/BK
Z300
18
BK/LB
G203
(8W-15-17)
B
TO
POWER
OUTLET-
CONSOLE
(8W-41-4)

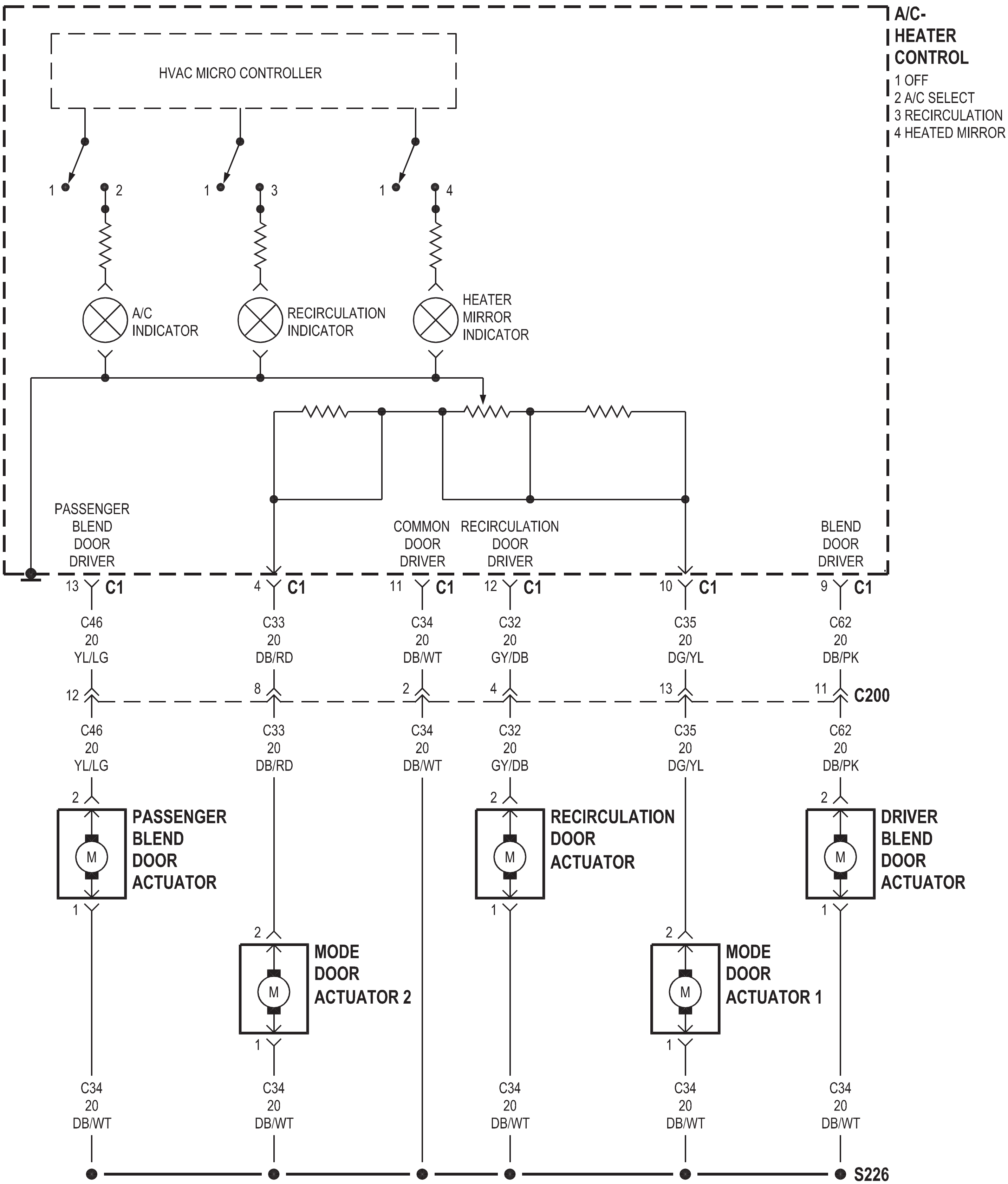

INSTRUMENT CLUSTER
(8W-40-13)
HORN SWITCH SENSE
17 C1
X3
20
BK/RD
6 C1
CLOCKSPRING
1 C3
X3
20
BK/RD
HORN SWITCH
1 HIGH NOTE HORN
2 LOW NOTE HORN
1
2
TO
C319
(8W-41-3)
B
Y148
18
BR/YL
1
POWER OUTLET-CONSOLE (EXCEPT BASE)
3
Z300
18
BK/WT
2 C319
Z300
16
BK/WT
2 C314
POWER SEATS
MANUAL SEATS
Z300
16
BK/WT
S306
(8W-15-21)
1 C311
Z238
14
BK
EXCEPT HEATED SEATS
HEATED SEATS
1 C311
7 C322
S315
(8W-15-22)
Z12
14
BK/TN
G302
(8W-15-22)

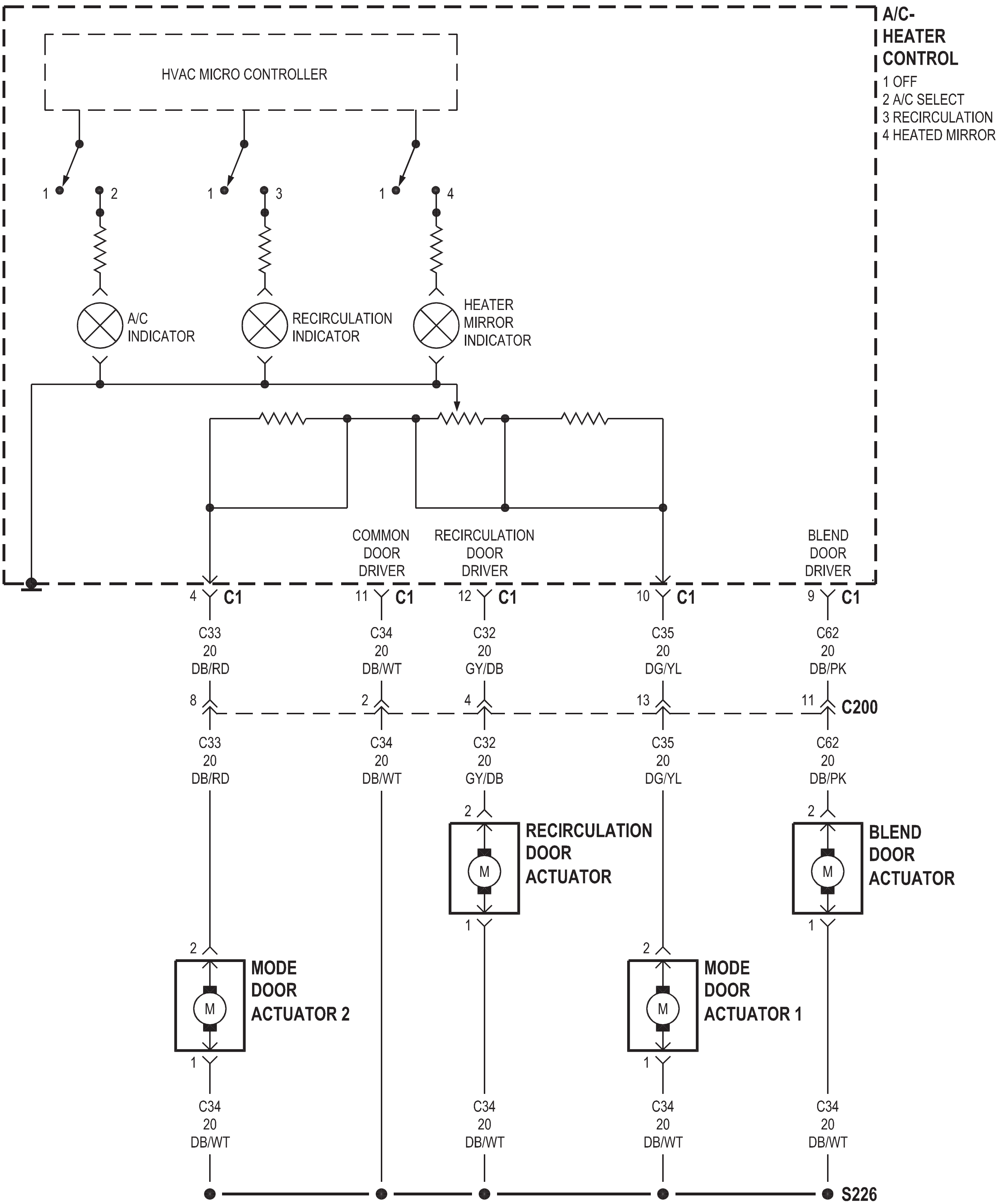
8W-42 AIR CONDITIONING


BATT A2
(8W-10-26)
IGNITION SWITCH
0 OFF
1 START
2 RUN
3 LOCK
4 ACC
(8W-10-26)
C1
10
DG
C200
BLOWER MOTOR RESISTOR BLOCK
BLOWER MOTOR
M
INSTRUMENT CLUSTER
PANEL LAMPS DRIVER
(8W-40-11)
C3
C7
10
BK/TN
S224
C7
12
BK/TN
C6
14
LB
C5
16
LG
C4
16
TN
Y165
20
OR/YL
C1
C2
A/C-HEATER CONTROL
1 HIGH
2 M2
3 M1
4 LOW
5 OFF
Z37
10
BK/DB
G203
(8W-15-17)

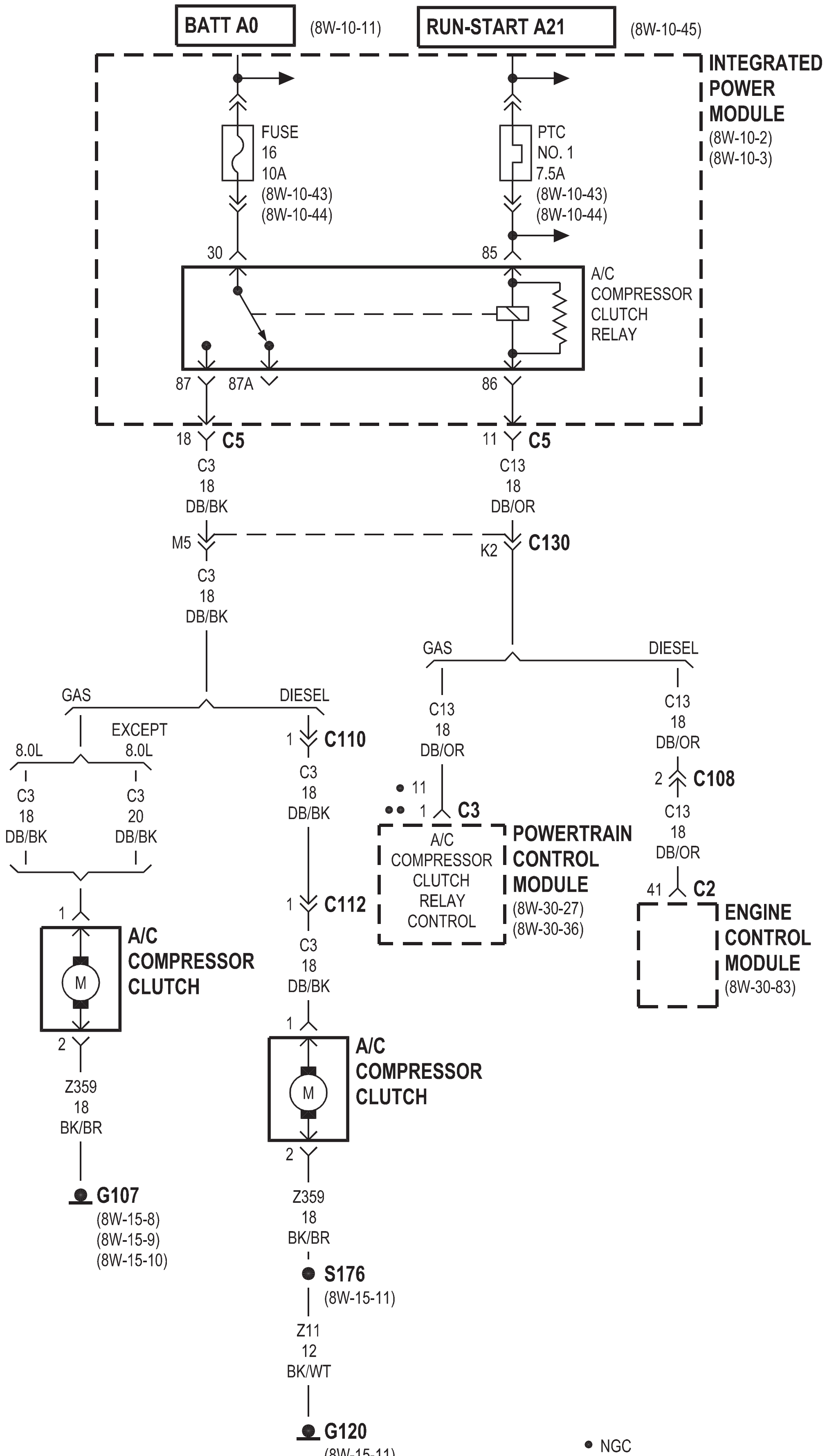

RUN A38
(8W-10-48)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
36
10A
(8W-10-47)
85
HEATED
MIRROR
RELAY
(8W-62-3)
86
26
C5
21
C5
DIESEL
GAS
C16
20
LB/YL
F15
20
DB
F15
20
DB
S140
(8W-10-58)
F15
20
DB
2
DATA
LINK
CONNECTOR
(8W-18-2)
32
46
C219
F15
20
DB
EXCEPT
ADJUSTABLE
PEDAL
ADJUSTABLE
PEDAL
D25
20
LB/VT
S225
(8W-10-46)
S230
(8W-18-4)
F15
20
DB
C16
20
LB/YL
D25
20
VT/LG
1
C1
15
C1
16
C1
A/C-
HEATER
CONTROL
HVAC MICRO CONTROLLER
2
C1
Z120
20
WT/BK
G202
(8W-15-14)
(8W-15-15)


RUN A38
(8W-10-48)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
36
10A
(8W-10-47)
85
HEATED MIRROR RELAY
(8W-62-3)
86
26
C5
21
C5
DIESEL
GAS
F15
20
DB
S140
(8W-10-58)
C16
20
LB/YL
32
46
C219
1
DATA LINK CONNECTOR
(8W-18-2)
EXCEPT ADJUSTABLE PEDAL
ADJUSTABLE PEDAL
S225
(8W-10-46)
D25
20
LB/VT
S230
(8W-18-4)
D25
20
VT/LG
1
C1
15
C1
16
C1
A/C-HEATER CONTROL
HVAC MICRO CONTROLLER
2
C1
3
C1
6
C1
Z120
20
WT/BK
C57
20
DB/GY
C12
20
LG/BK
10
9
C200
1
2
SENSOR GROUND
EVAPORATOR TEMPERATURE SENSOR SIGNAL
EVAPORATOR TEMPERATURE SENSOR
G202
(8W-15-14)
(8W-15-15)

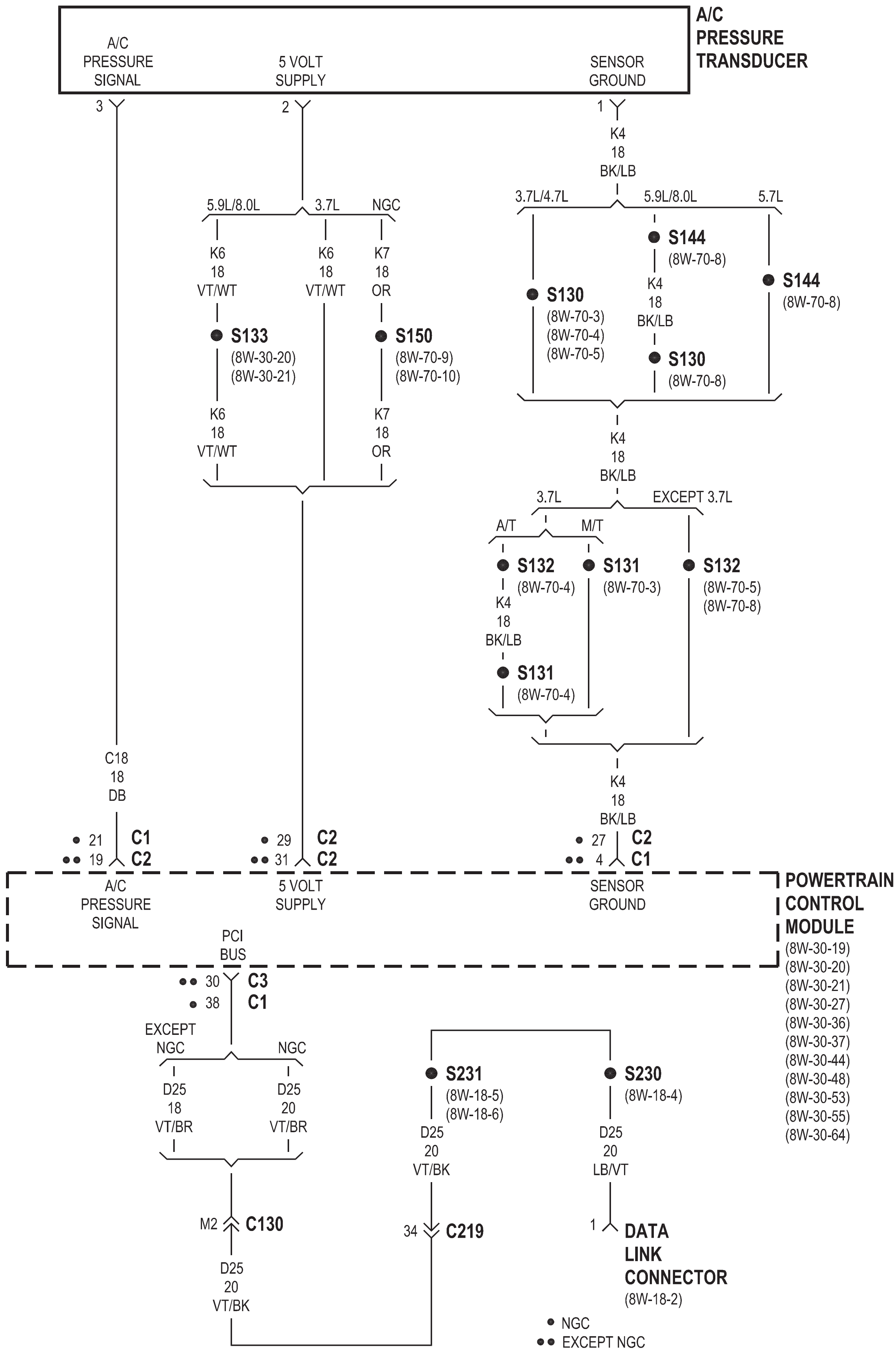

A/C-
HEATER
CONTROL
1 OFF
2 A/C SELECT
3 RECIRCULATION
4 HEATED MIRROR
HVAC MICRO CONTROLLER
A/C
INDICATOR
RECIRCULATION
INDICATOR
HEATER
MIRROR
INDICATOR
PASSENGER
BLEND
DOOR
DRIVER
COMMON
DOOR
DRIVER
RECIRCULATION
DOOR
DRIVER
BLEND
DOOR
DRIVER
C1
C46 20 YL/LG
C33 20 DB/RD
C34 20 DB/WT
C32 20 GY/DB
C35 20 DG/YL
C62 20 DB/PK
C200
PASSENGER
BLEND
DOOR
ACTUATOR
RECIRCULATION
DOOR
ACTUATOR
DRIVER
BLEND
DOOR
ACTUATOR
MODE
DOOR
ACTUATOR 2
MODE
DOOR
ACTUATOR 1
M
S226

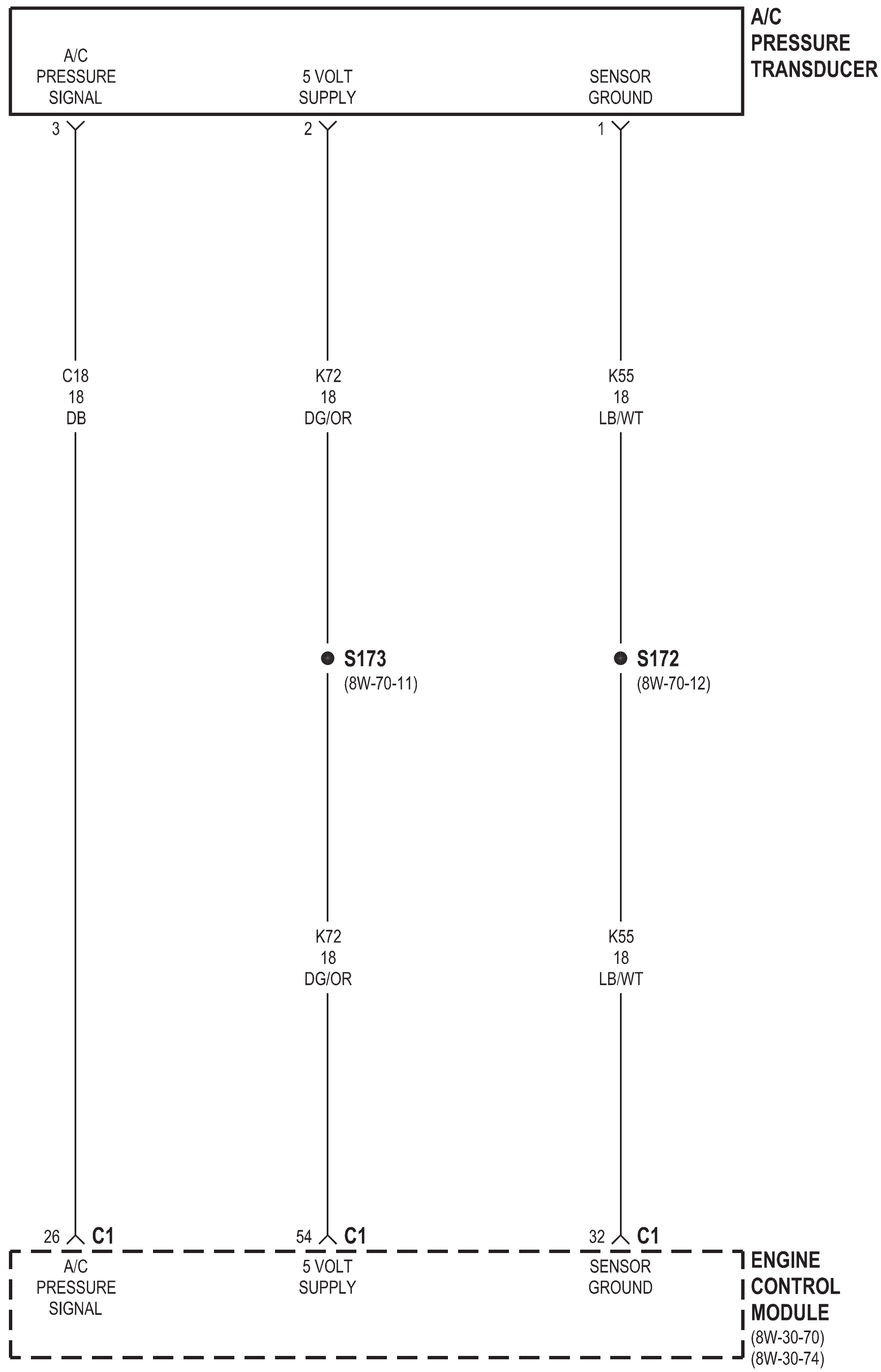

A/C-
HEATER
CONTROL
1 OFF
2 A/C SELECT
3 RECIRCULATION
4 HEATED MIRROR
HVAC MICRO CONTROLLER
A/C
INDICATOR
RECIRCULATION
INDICATOR
HEATER
MIRROR
INDICATOR
COMMON
DOOR
DRIVER
RECIRCULATION
DOOR
DRIVER
BLEND
DOOR
DRIVER
C1
C33
20
DB/RD
C34
20
DB/WT
C32
20
GY/DB
C35
20
DG/YL
C62
20
DB/PK
C200
RECIRCULATION
DOOR
ACTUATOR
BLEND
DOOR
ACTUATOR
MODE
DOOR
ACTUATOR 2
MODE
DOOR
ACTUATOR 1
S226

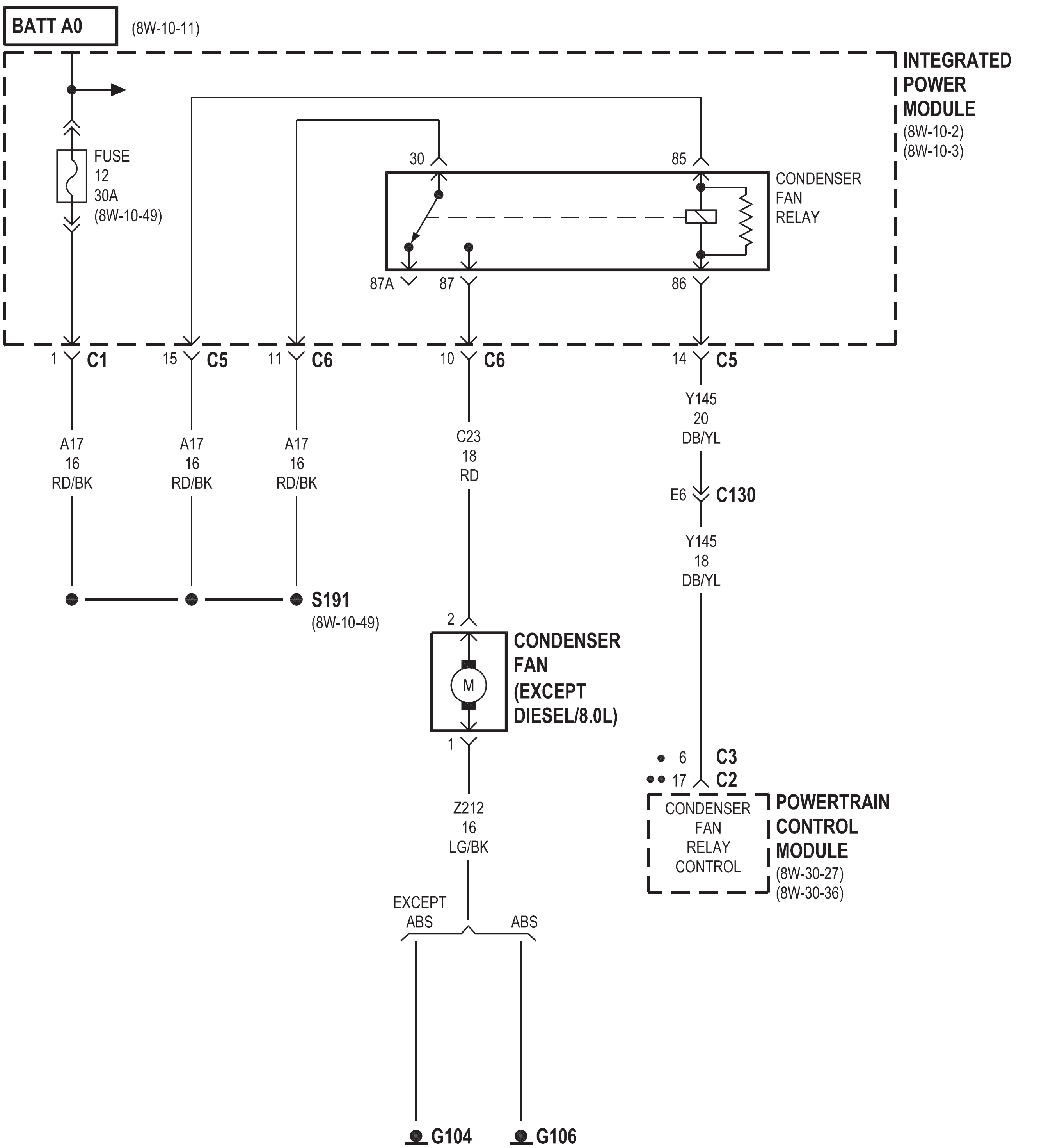
DR304206



BATT A0
(8W-10-11)
RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 16 10A
(8W-10-43)
(8W-10-44)
PTC NO. 1 7.5A
(8W-10-43)
(8W-10-44)
30
85
A/C COMPRESSOR CLUTCH RELAY
87
87A
86
18
C5
11
C5
C3 18 DB/BK
C13 18 DB/OR
M5
K2
C130
C3 18 DB/BK
GAS
DIESEL
GAS
DIESEL
C13 18 DB/OR
C13 18 DB/OR
8.0L
EXCEPT 8.0L
1
C110
C3 18 DB/BK
C3 20 DB/BK
C3 18 DB/BK
11
1
C3
2
C108
A/C COMPRESSOR CLUTCH RELAY CONTROL
POWERTRAIN CONTROL MODULE
(8W-30-27)
(8W-30-36)
C13 18 DB/OR
1
C112
41
C2
1
A/C COMPRESSOR CLUTCH
M
C3 18 DB/BK
ENGINE CONTROL MODULE
(8W-30-83)
1
2
A/C COMPRESSOR CLUTCH
M
Z359 18 BK/BR
2
G107
(8W-15-8)
(8W-15-9)
(8W-15-10)
Z359 18 BK/BR
S176
(8W-15-11)
Z11 12 BK/WT
G120
(8W-15-11)
● NGC
●● EXCEPT NGC

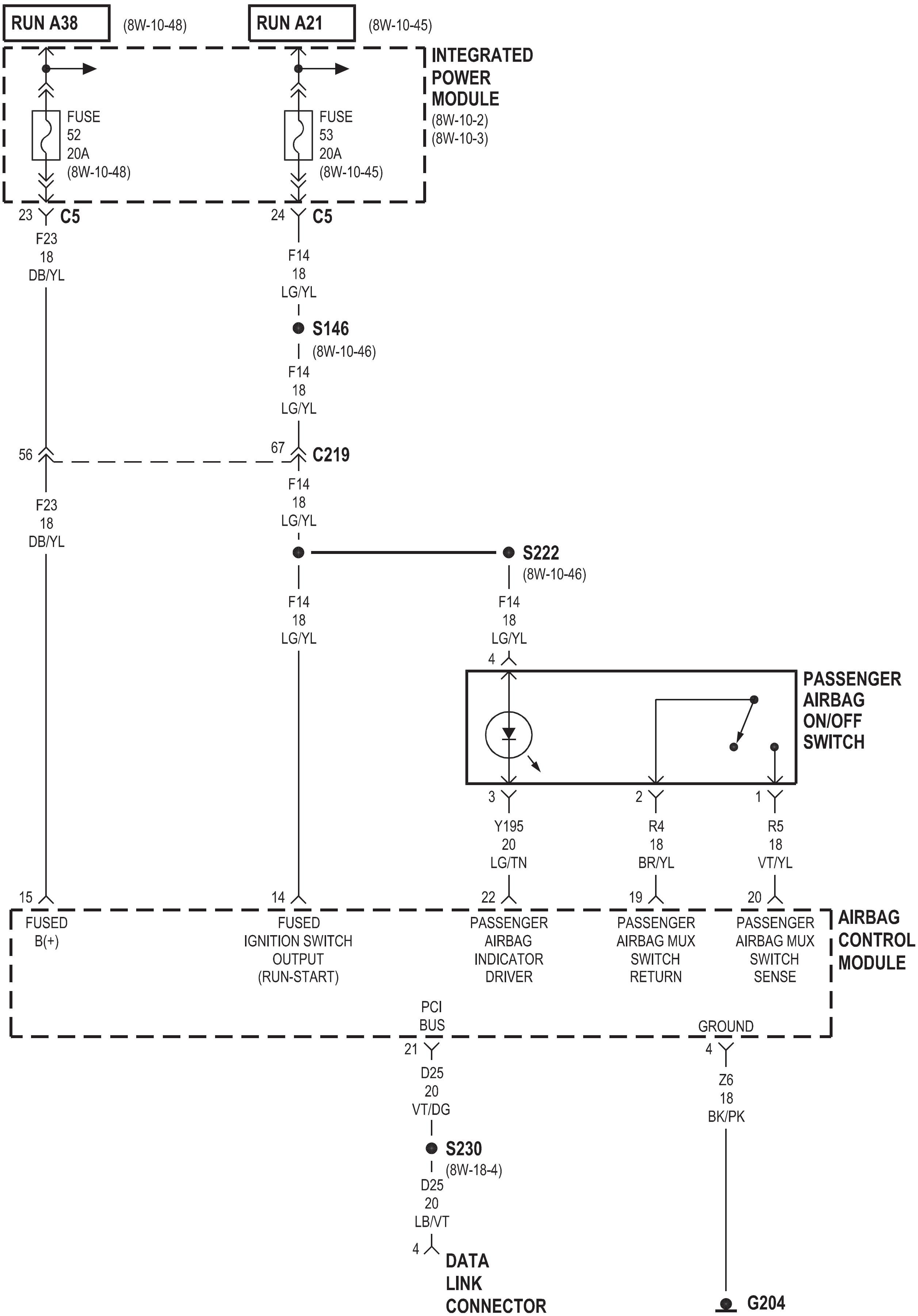

A/C PRESSURE TRANSDUCER
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
3
2
1
K4 18 BK/LB
5.9L/8.0L
3.7L
NGC
3.7L/4.7L
5.9L/8.0L
5.7L
K6 18 VT/WT
K6 18 VT/WT
K7 18 OR
S133 (8W-30-20) (8W-30-21)
S150 (8W-70-9) (8W-70-10)
S144 (8W-70-8)
S130 (8W-70-3) (8W-70-4) (8W-70-5)
K4 18 BK/LB
S144 (8W-70-8)
S130 (8W-70-8)
K6 18 VT/WT
K7 18 OR
K4 18 BK/LB
3.7L
EXCEPT 3.7L
A/T
M/T
S132 (8W-70-4)
S131 (8W-70-3)
S132 (8W-70-5) (8W-70-8)
K4 18 BK/LB
S131 (8W-70-4)
C18 18 DB
K4 18 BK/LB
• 21 C1
•• 19 C2
• 29 C2
•• 31 C2
• 27 C2
•• 4 C1
POWERTRAIN CONTROL MODULE
(8W-30-19)
(8W-30-20)
(8W-30-21)
(8W-30-27)
(8W-30-36)
(8W-30-37)
(8W-30-44)
(8W-30-48)
(8W-30-53)
(8W-30-55)
(8W-30-64)
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
PCI BUS
•• 30 C3
• 38 C1
EXCEPT NGC
NGC
D25 18 VT/BR
D25 20 VT/BR
S231 (8W-18-5) (8W-18-6)
S230 (8W-18-4)
D25 20 VT/BK
D25 20 LB/VT
M2 C130
34 C219
1
DATA LINK CONNECTOR (8W-18-2)
D25 20 VT/BK
• NGC
•• EXCEPT NGC


A/C PRESSURE TRANSDUCER
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
3
2
1
C18
18
DB
K72
18
DG/OR
K55
18
LB/WT
S173
(8W-70-11)
S172
(8W-70-12)
K72
18
DG/OR
K55
18
LB/WT
26
C1
54
C1
32
C1
A/C PRESSURE SIGNAL
5 VOLT SUPPLY
SENSOR GROUND
ENGINE CONTROL MODULE
(8W-30-70)
(8W-30-74)

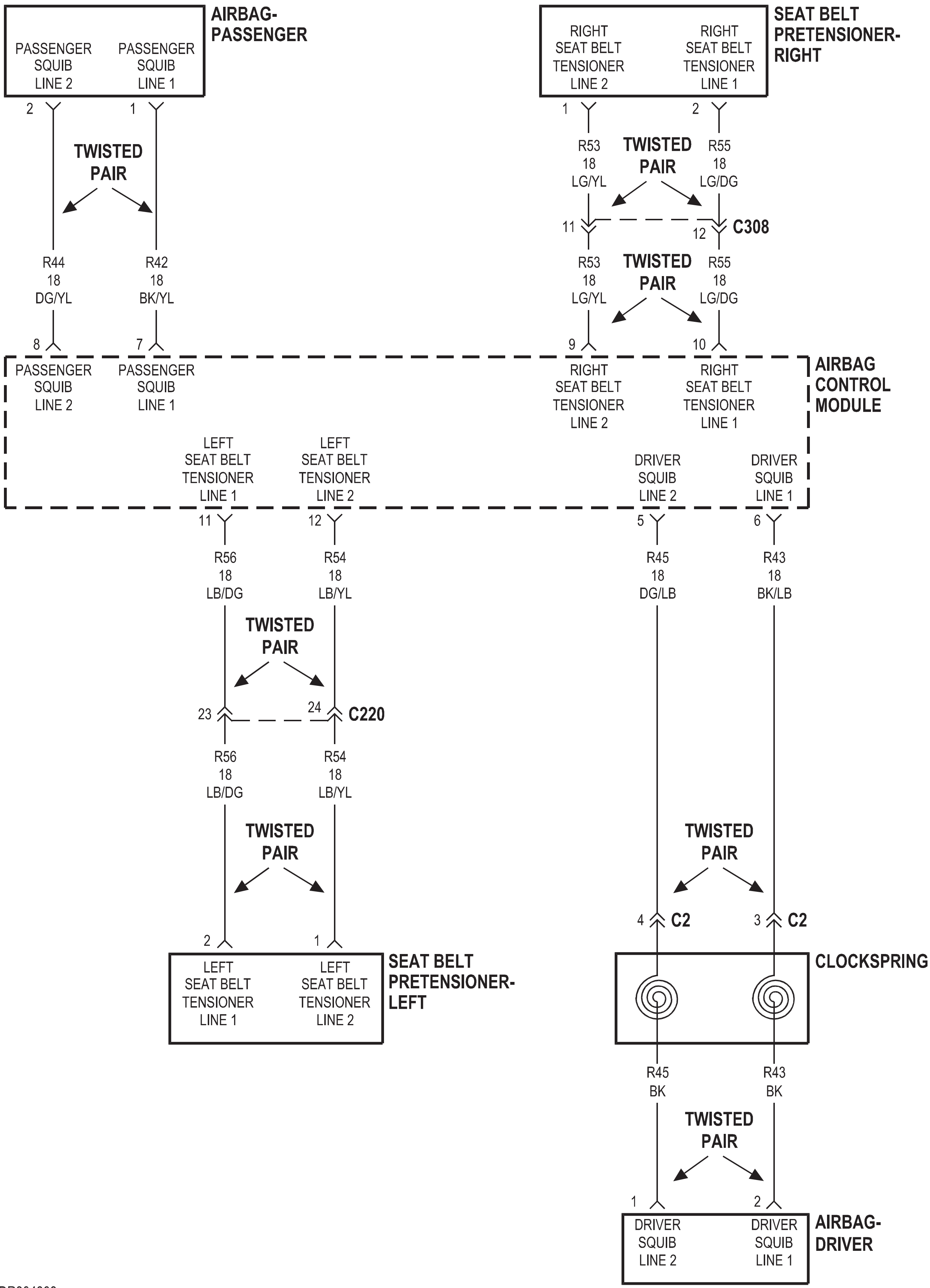


BATT A0
(8W-10-11)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
12
30A
(8W-10-49)
30
85
CONDENSER
FAN
RELAY
87A
87
86
1
C1
15
C5
11
C6
10
C6
14
C5
Y145
20
DB/YL
A17
16
RD/BK
A17
16
RD/BK
A17
16
RD/BK
C23
18
RD
E6
C130
Y145
18
DB/YL
S191
(8W-10-49)
2
CONDENSER
FAN
(EXCEPT
DIESEL/8.0L)
M
1
6
C3
17
C2
CONDENSER
FAN
RELAY
CONTROL
POWERTRAIN
CONTROL
MODULE
(8W-30-27)
(8W-30-36)
Z212
16
LG/BK
EXCEPT
ABS
ABS
G104
G106
• NGC
•• EXCEPT NGC

8W-43 AIRBAG SYSTEM

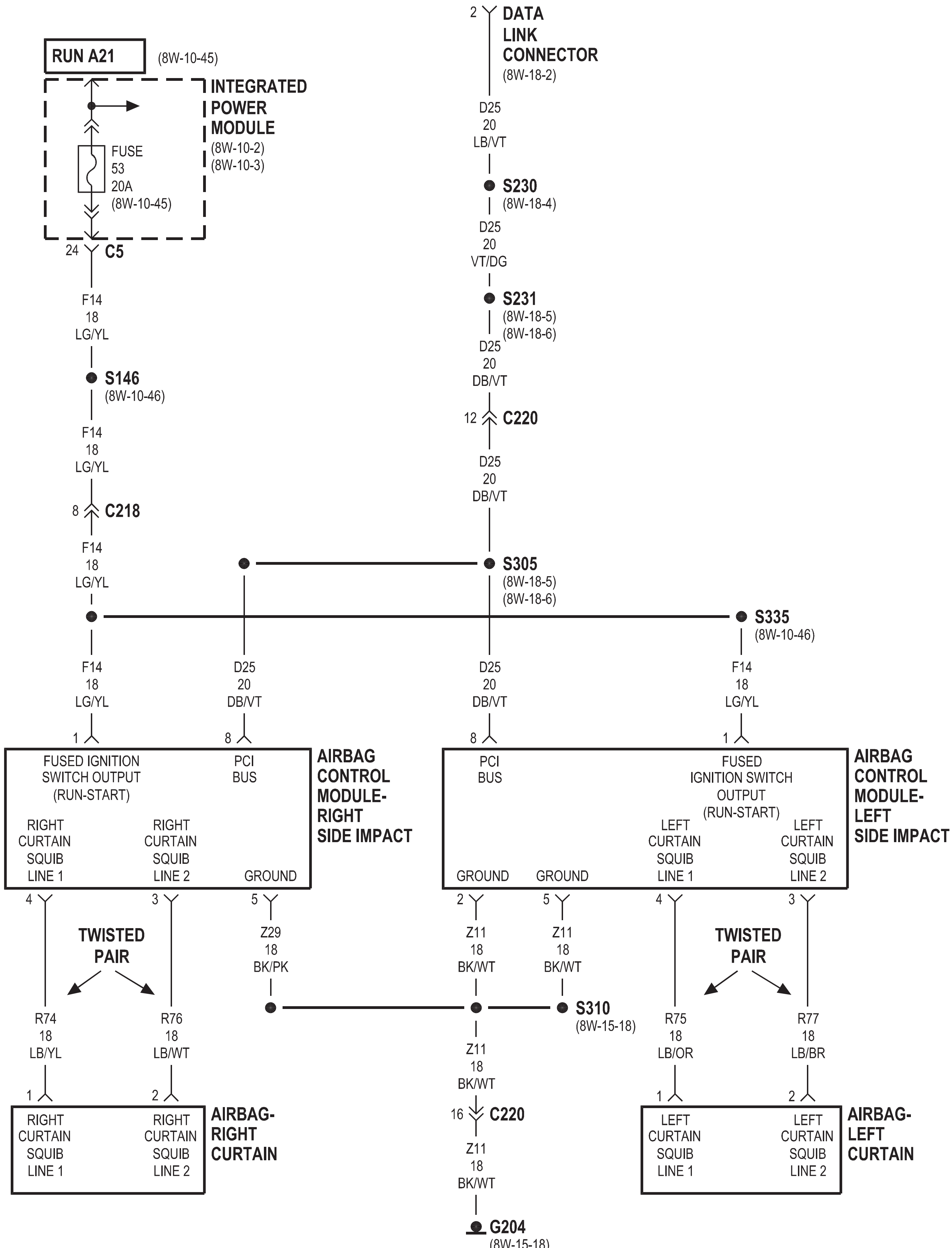


J038W-4 DR304302

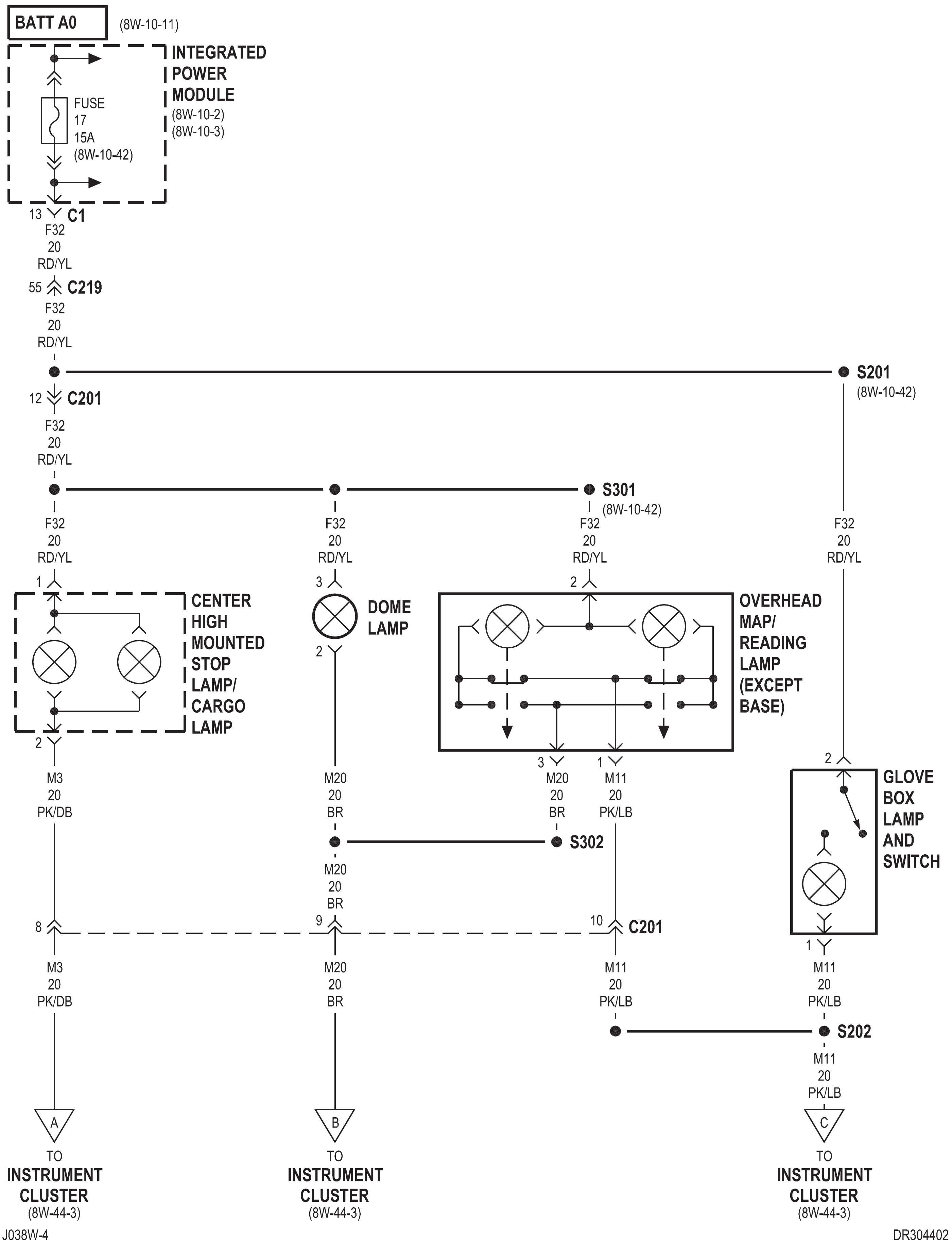


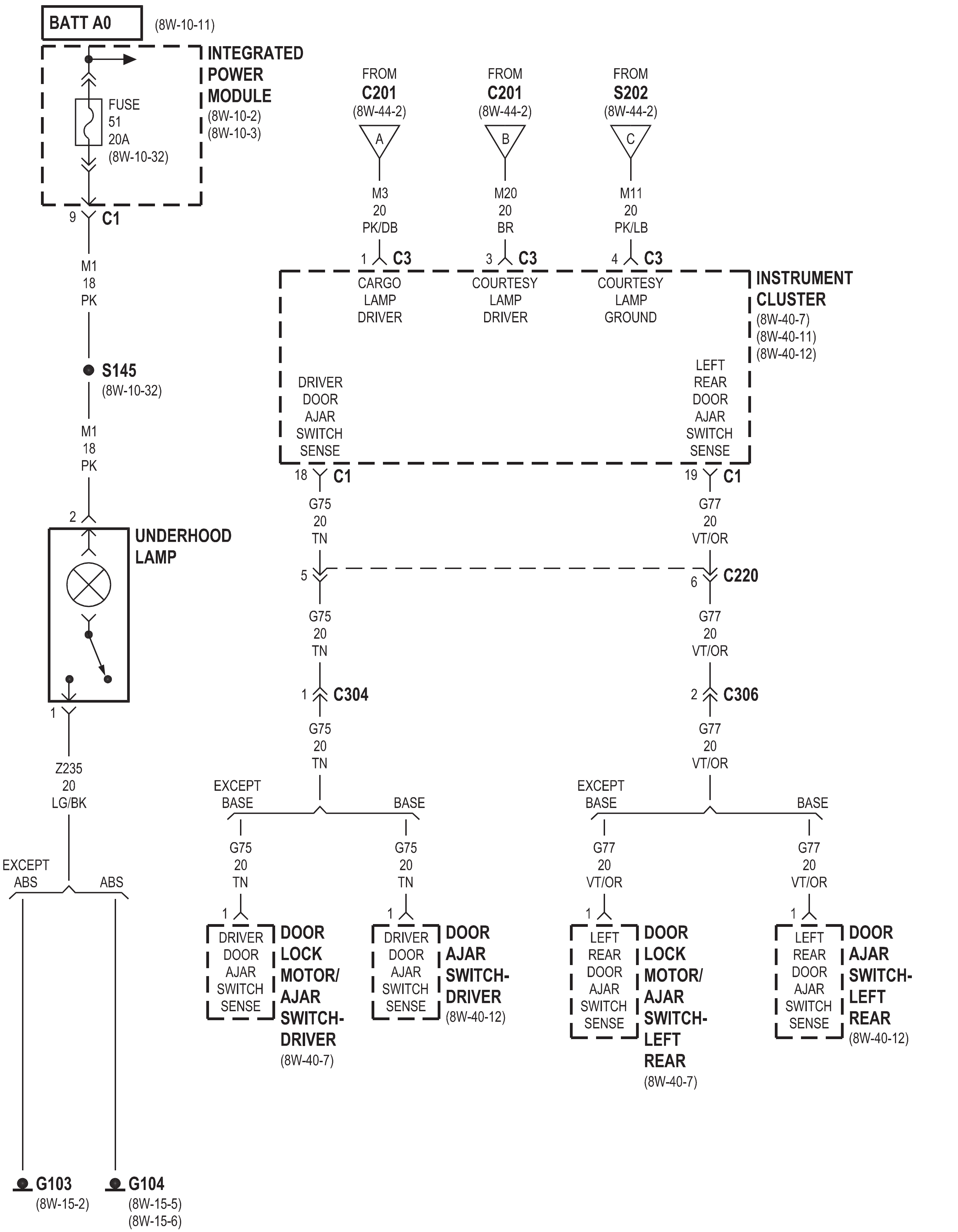
DR304303 J038W-4

SIDE AIRBAGS

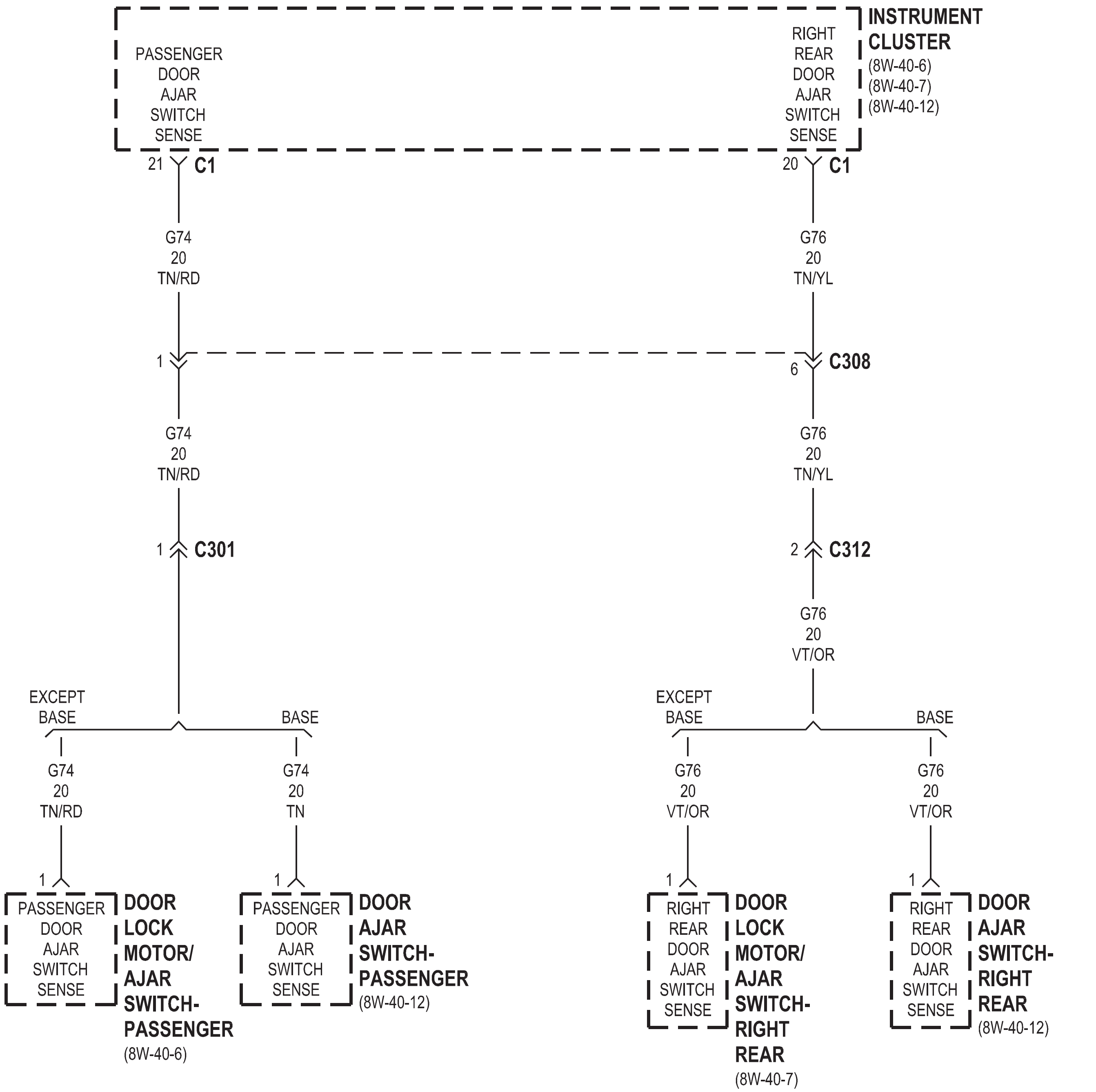


8W-44 INTERIOR LIGHTING

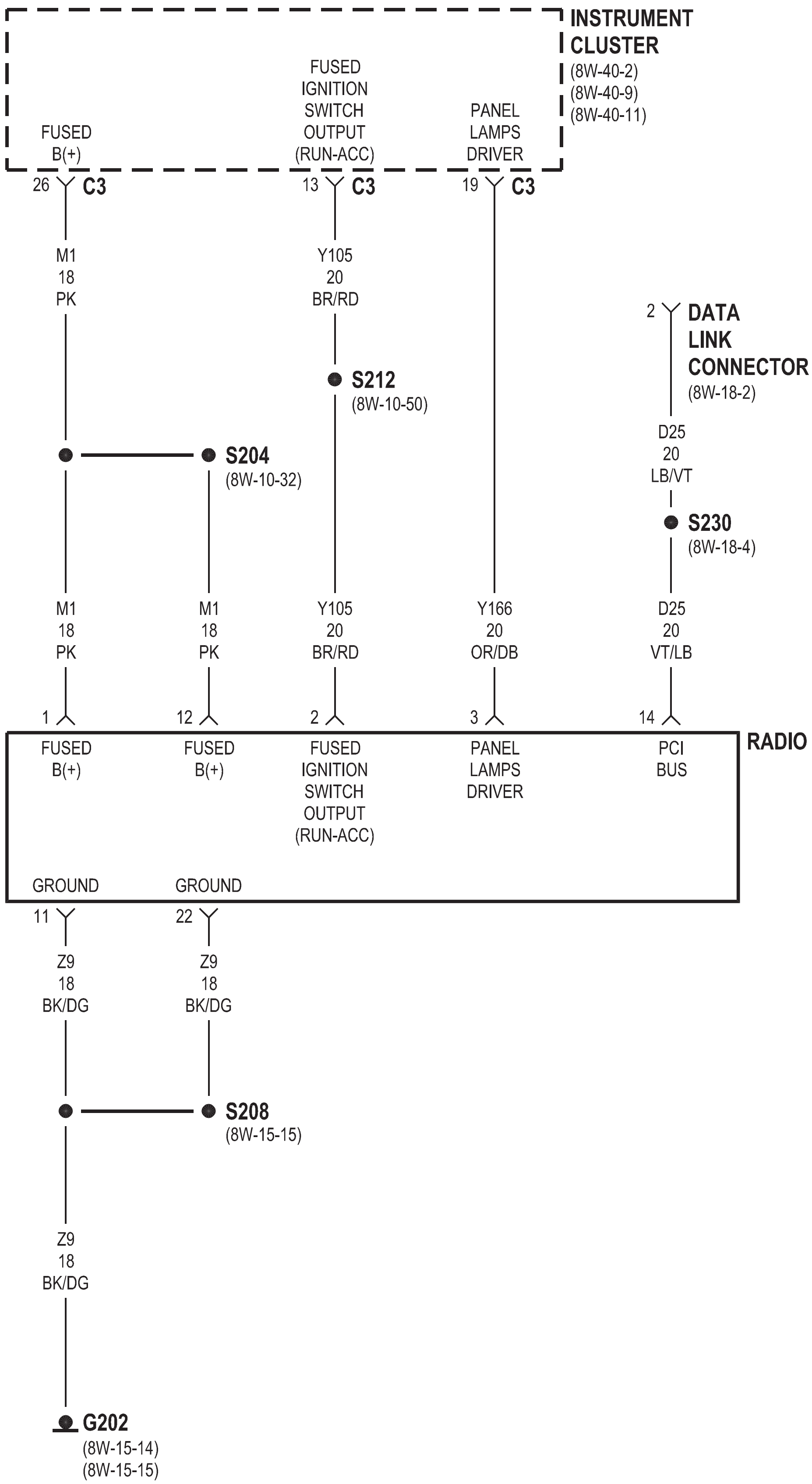

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 17 15A (8W-10-42)
13 C1
F32 20 RD/YL
55 C219
F32 20 RD/YL
S201
(8W-10-42)
12 C201
F32 20 RD/YL
S301
(8W-10-42)
F32 20 RD/YL
F32 20 RD/YL
F32 20 RD/YL
F32 20 RD/YL
1
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP
2
3
DOME LAMP
2
2
OVERHEAD MAP/ READING LAMP (EXCEPT BASE)
3
1
2
GLOVE BOX LAMP AND SWITCH
1
M3 20 PK/DB
M20 20 BR
M20 20 BR
M11 20 PK/LB
S302
M20 20 BR
8
9
10 C201
M3 20 PK/DB
M20 20 BR
M11 20 PK/LB
M11 20 PK/LB
S202
M11 20 PK/LB
A
B
C
TO INSTRUMENT CLUSTER (8W-44-3)
TO INSTRUMENT CLUSTER (8W-44-3)
TO INSTRUMENT CLUSTER (8W-44-3)
J038W-4
DR304402



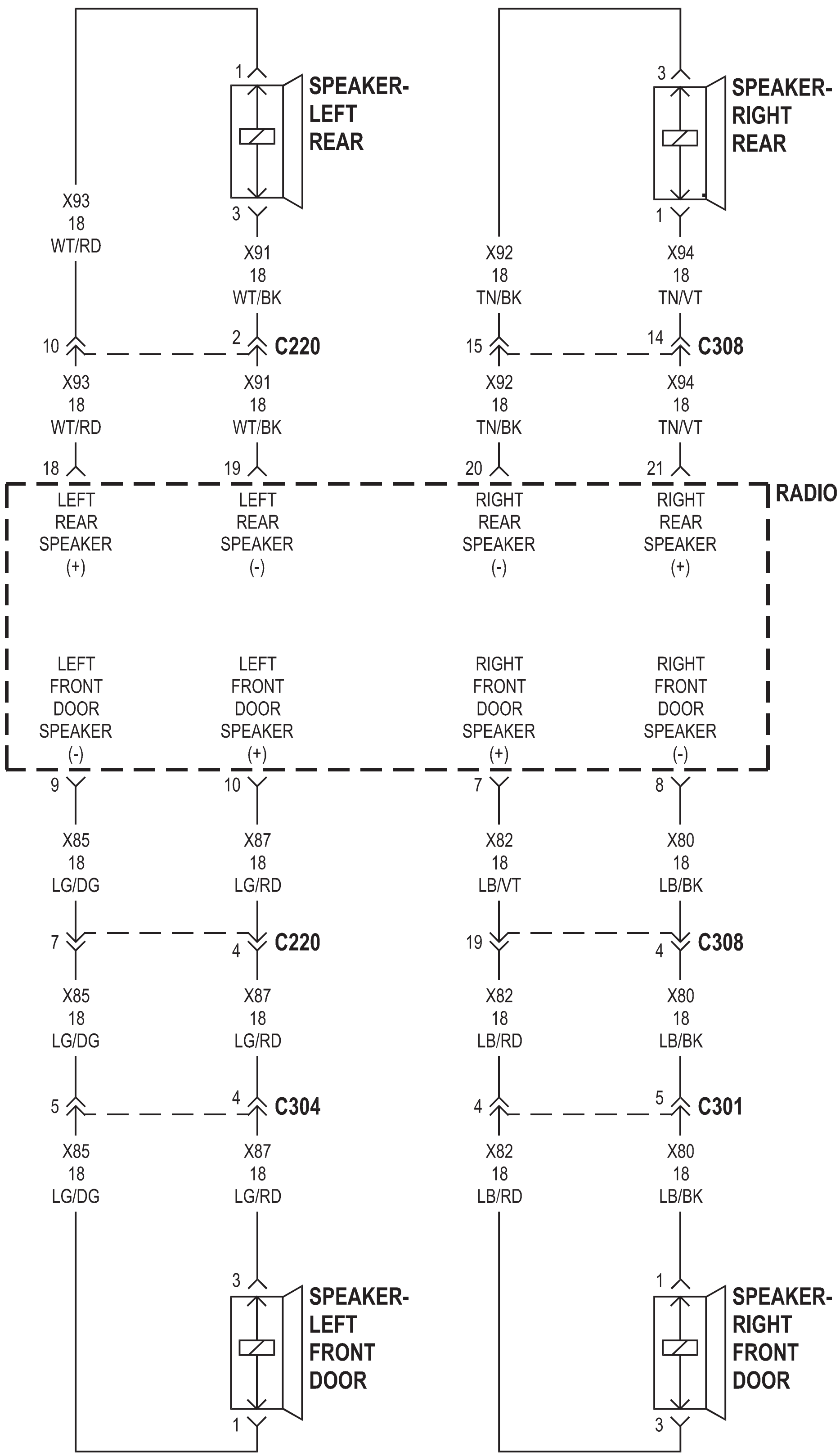
DR304403 J038W-4

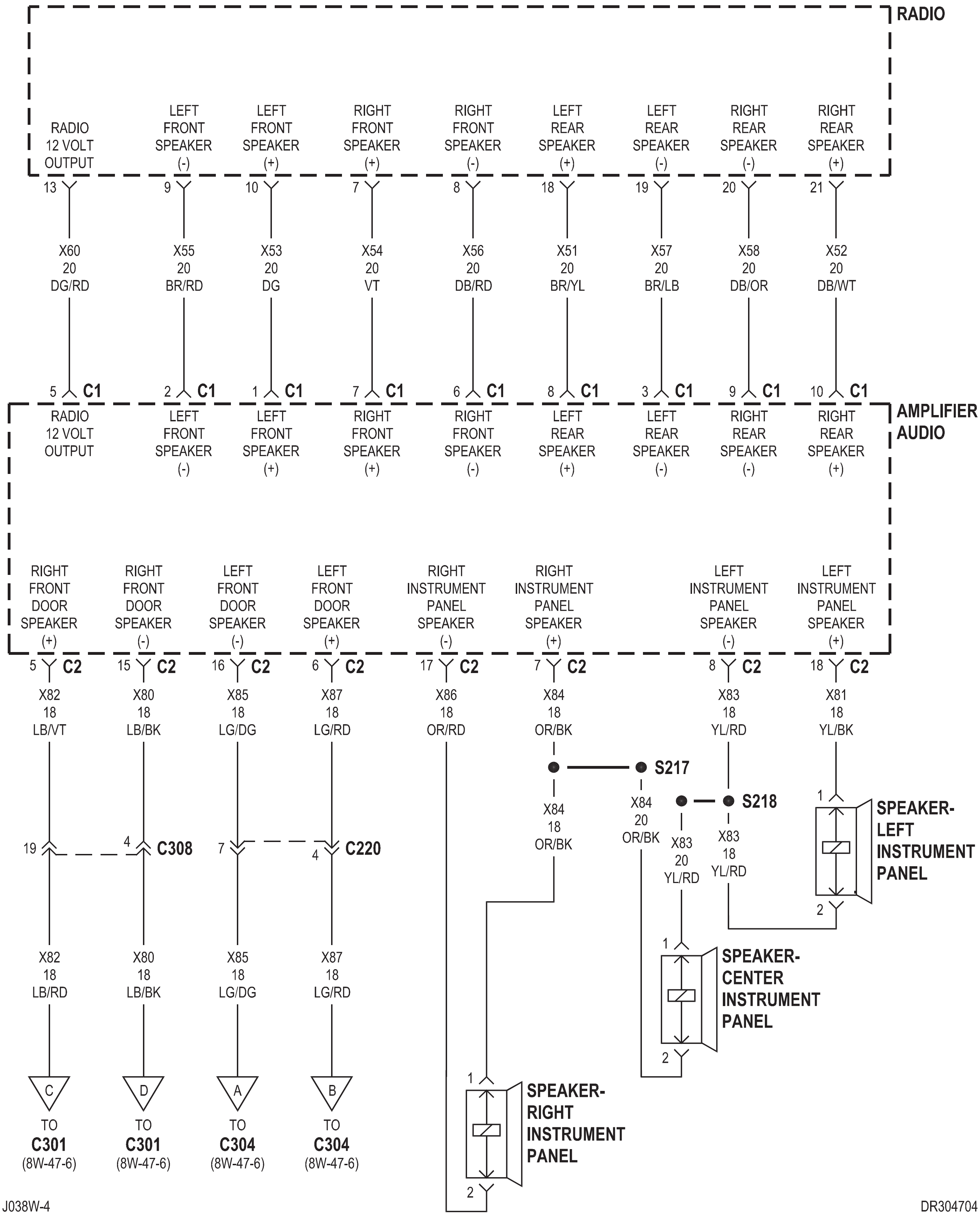

INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-12)
PASSENGER DOOR AJAR SWITCH SENSE
RIGHT REAR DOOR AJAR SWITCH SENSE
21 C1
20 C1
G74 20 TN/RD
G76 20 TN/YL
1
6 C308
G74 20 TN/RD
G76 20 TN/YL
1 C301
2 C312
G76 20 VT/OR
EXCEPT BASE
BASE
EXCEPT BASE
BASE
G74 20 TN/RD
G74 20 TN
G76 20 VT/OR
G76 20 VT/OR
1
1
1
1
PASSENGER DOOR AJAR SWITCH SENSE
DOOR LOCK MOTOR/ AJAR SWITCH- PASSENGER
(8W-40-6)
PASSENGER DOOR AJAR SWITCH SENSE
DOOR AJAR SWITCH- PASSENGER
(8W-40-12)
RIGHT REAR DOOR AJAR SWITCH SENSE
DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR
(8W-40-7)
RIGHT REAR DOOR AJAR SWITCH SENSE
DOOR AJAR SWITCH- RIGHT REAR
(8W-40-12)

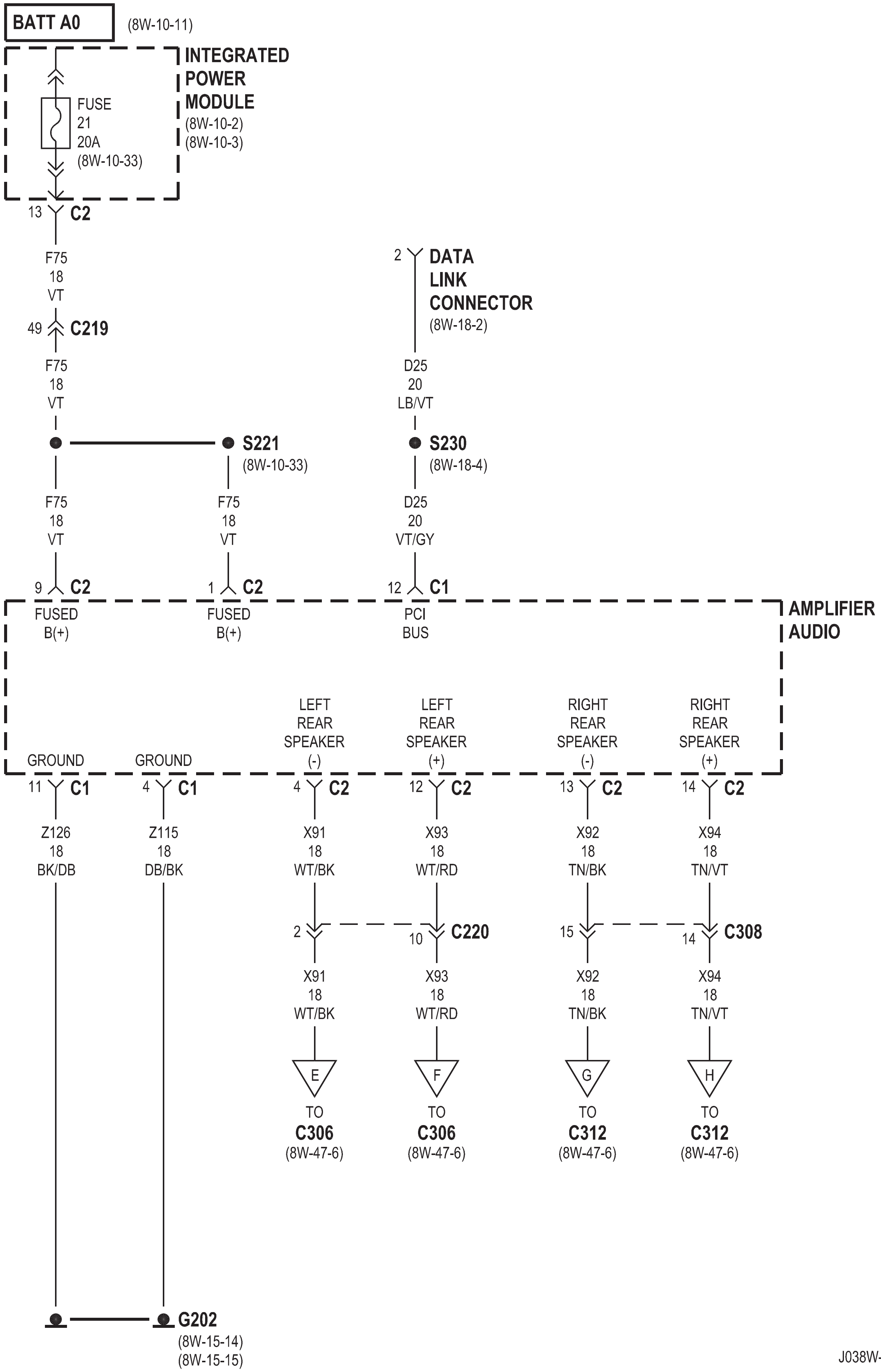
8W-47 AUDIO SYSTEM

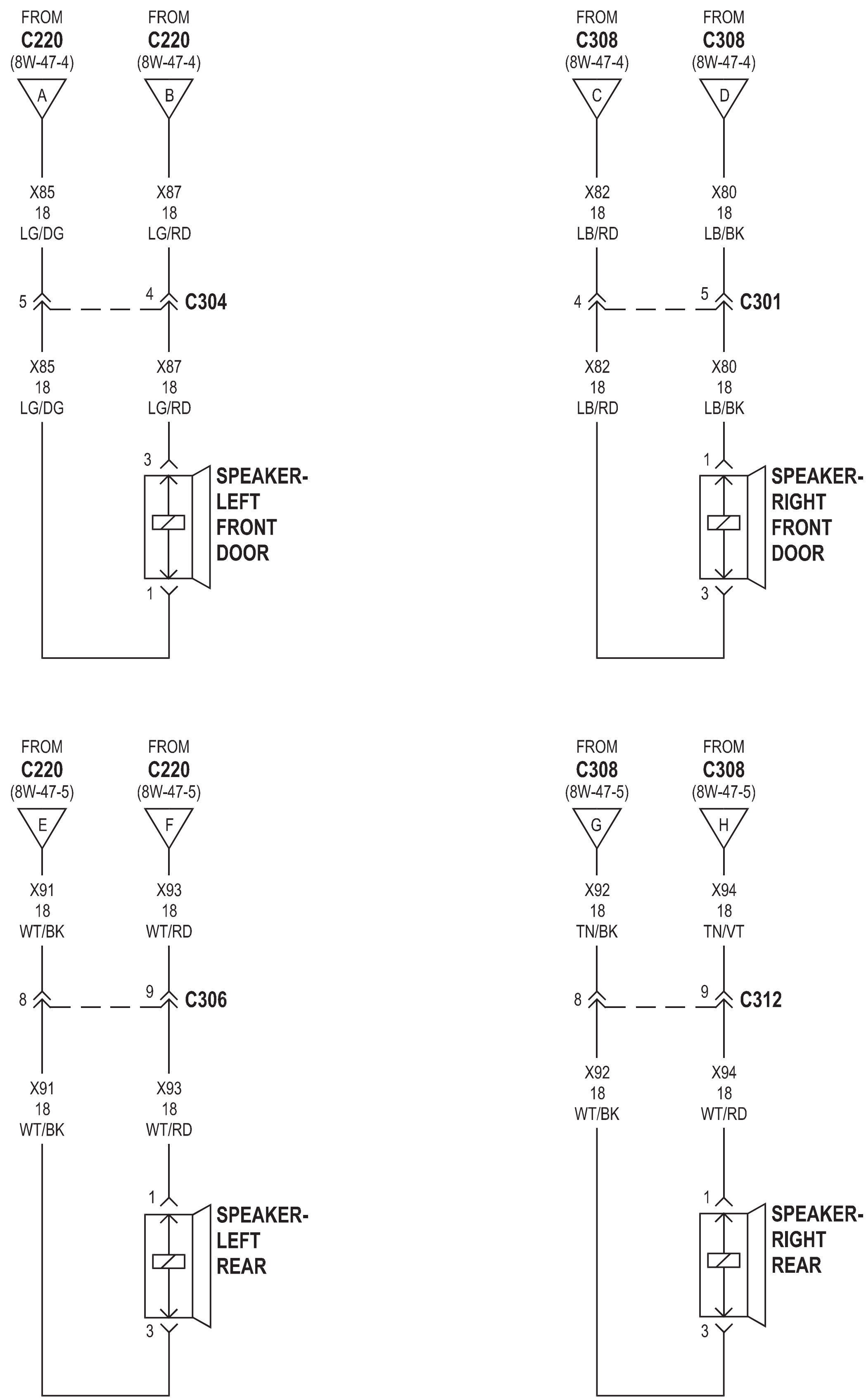

INSTRUMENT
CLUSTER
(8W-40-2)
(8W-40-9)
(8W-40-11)
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-ACC)
PANEL
LAMPS
DRIVER
26 C3
13 C3
19 C3
M1
18
PK
Y105
20
BR/RD
2 DATA
LINK
CONNECTOR
(8W-18-2)
S212
(8W-10-50)
S204
(8W-10-32)
D25
20
LB/VT
S230
(8W-18-4)
M1
18
PK
M1
18
PK
Y105
20
BR/RD
Y166
20
OR/DB
D25
20
VT/LB
1
12
2
3
14
RADIO
FUSED
B(+)
FUSED
B(+)
FUSED
IGNITION
SWITCH
OUTPUT
(RUN-ACC)
PANEL
LAMPS
DRIVER
PCI
BUS
GROUND
GROUND
11
22
Z9
18
BK/DG
Z9
18
BK/DG
S208
(8W-15-15)
Z9
18
BK/DG
G202
(8W-15-14)
(8W-15-15)

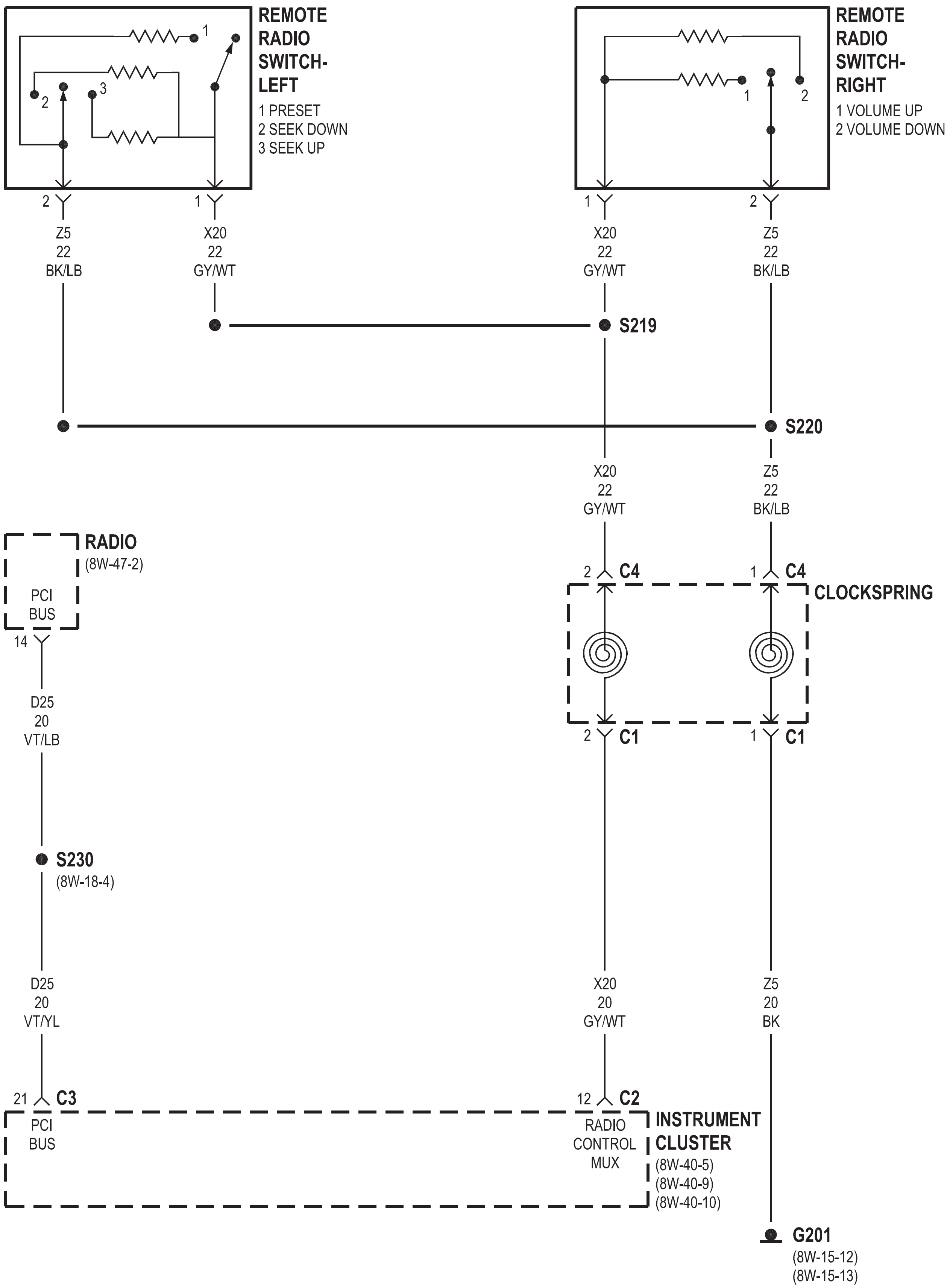
BASE


1
3
SPEAKER-
LEFT
REAR
3
1
SPEAKER-
RIGHT
REAR
X93
18
WT/RD
X91
18
WT/BK
X92
18
TN/BK
X94
18
TN/VT
10
2
C220
15
14
C308
X93
18
WT/RD
X91
18
WT/BK
X92
18
TN/BK
X94
18
TN/VT
18
19
20
21
RADIO
LEFT
REAR
SPEAKER
(+)
LEFT
REAR
SPEAKER
(-)
RIGHT
REAR
SPEAKER
(-)
RIGHT
REAR
SPEAKER
(+)
LEFT
FRONT
DOOR
SPEAKER
(-)
LEFT
FRONT
DOOR
SPEAKER
(+)
RIGHT
FRONT
DOOR
SPEAKER
(+)
RIGHT
FRONT
DOOR
SPEAKER
(-)
9
10
7
8
X85
18
LG/DG
X87
18
LG/RD
X82
18
LB/VT
X80
18
LB/BK
7
4
C220
19
4
C308
X85
18
LG/DG
X87
18
LG/RD
X82
18
LB/RD
X80
18
LB/BK
5
4
C304
4
5
C301
X85
18
LG/DG
X87
18
LG/RD
X82
18
LB/RD
X80
18
LB/BK
3
1
SPEAKER-
LEFT
FRONT
DOOR
1
3
SPEAKER-
RIGHT
FRONT
DOOR

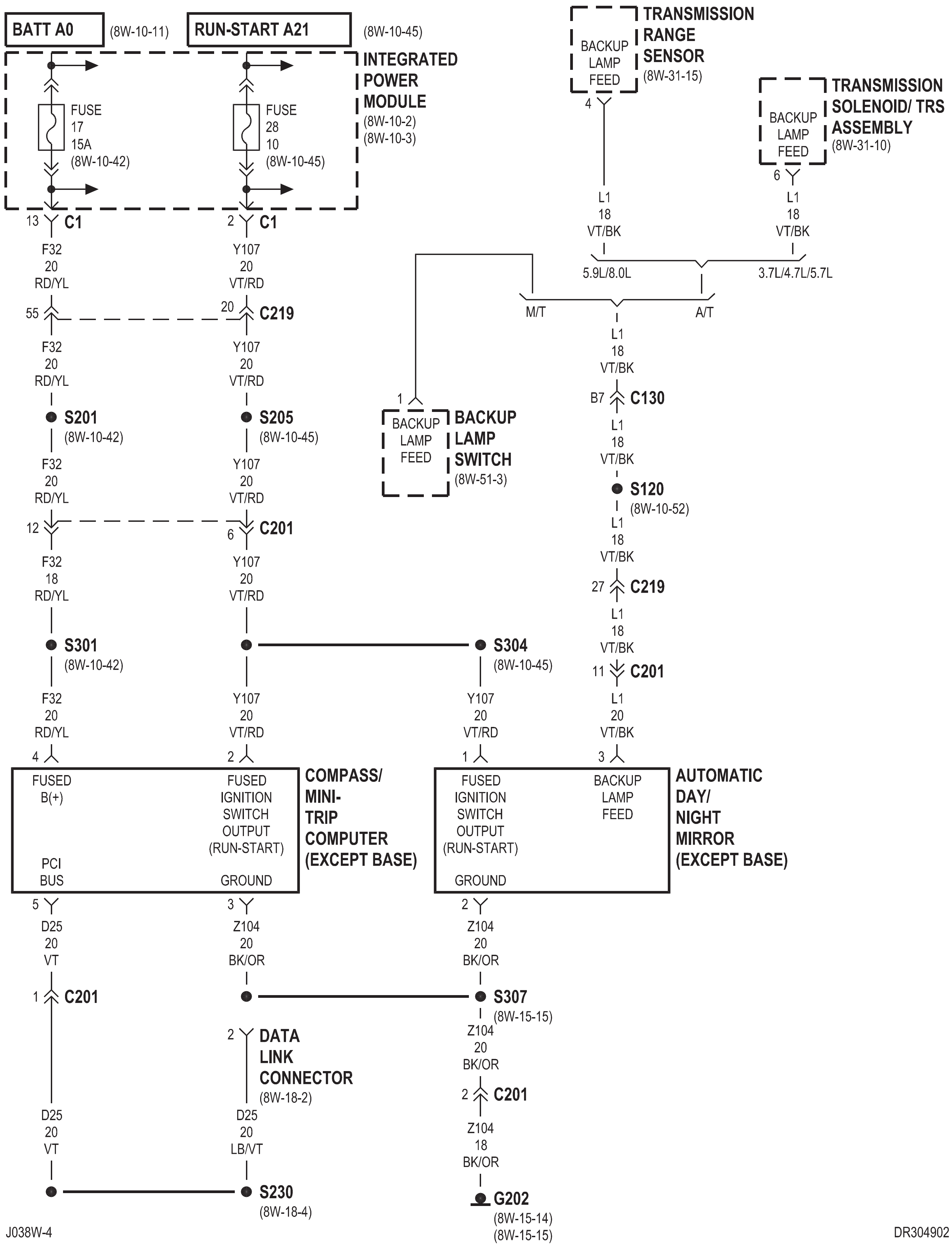

RADIO
RADIO 12 VOLT OUTPUT
LEFT FRONT SPEAKER (-)
LEFT FRONT SPEAKER (+)
RIGHT FRONT SPEAKER (+)
RIGHT FRONT SPEAKER (-)
LEFT REAR SPEAKER (+)
LEFT REAR SPEAKER (-)
RIGHT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)
13 9 10 7 8 18 19 20 21
X60 20 DG/RD
X55 20 BR/RD
X53 20 DG
X54 20 VT
X56 20 DB/RD
X51 20 BR/YL
X57 20 BR/LB
X58 20 DB/OR
X52 20 DB/WT
5 C1
2 C1
1 C1
7 C1
6 C1
8 C1
3 C1
9 C1
10 C1
AMPLIFIER AUDIO
RIGHT FRONT DOOR SPEAKER (+)
RIGHT FRONT DOOR SPEAKER (-)
LEFT FRONT DOOR SPEAKER (-)
LEFT FRONT DOOR SPEAKER (+)
RIGHT INSTRUMENT PANEL SPEAKER (-)
RIGHT INSTRUMENT PANEL SPEAKER (+)
LEFT INSTRUMENT PANEL SPEAKER (-)
LEFT INSTRUMENT PANEL SPEAKER (+)
5 C2
15 C2
16 C2
6 C2
17 C2
7 C2
8 C2
18 C2
X82 18 LB/VT
X80 18 LB/BK
X85 18 LG/DG
X87 18 LG/RD
X86 18 OR/RD
X84 18 OR/BK
X83 18 YL/RD
X81 18 YL/BK
S217
S218
X84 18 OR/BK
X84 20 OR/BK
X83 20 YL/RD
X83 18 YL/RD
19
4 C308
7
4 C220
X82 18 LB/RD
X80 18 LB/BK
X85 18 LG/DG
X87 18 LG/RD
C
D
A
B
TO C301 (8W-47-6)
TO C301 (8W-47-6)
TO C304 (8W-47-6)
TO C304 (8W-47-6)
1
2
SPEAKER-LEFT INSTRUMENT PANEL
SPEAKER-CENTER INSTRUMENT PANEL
SPEAKER-RIGHT INSTRUMENT PANEL

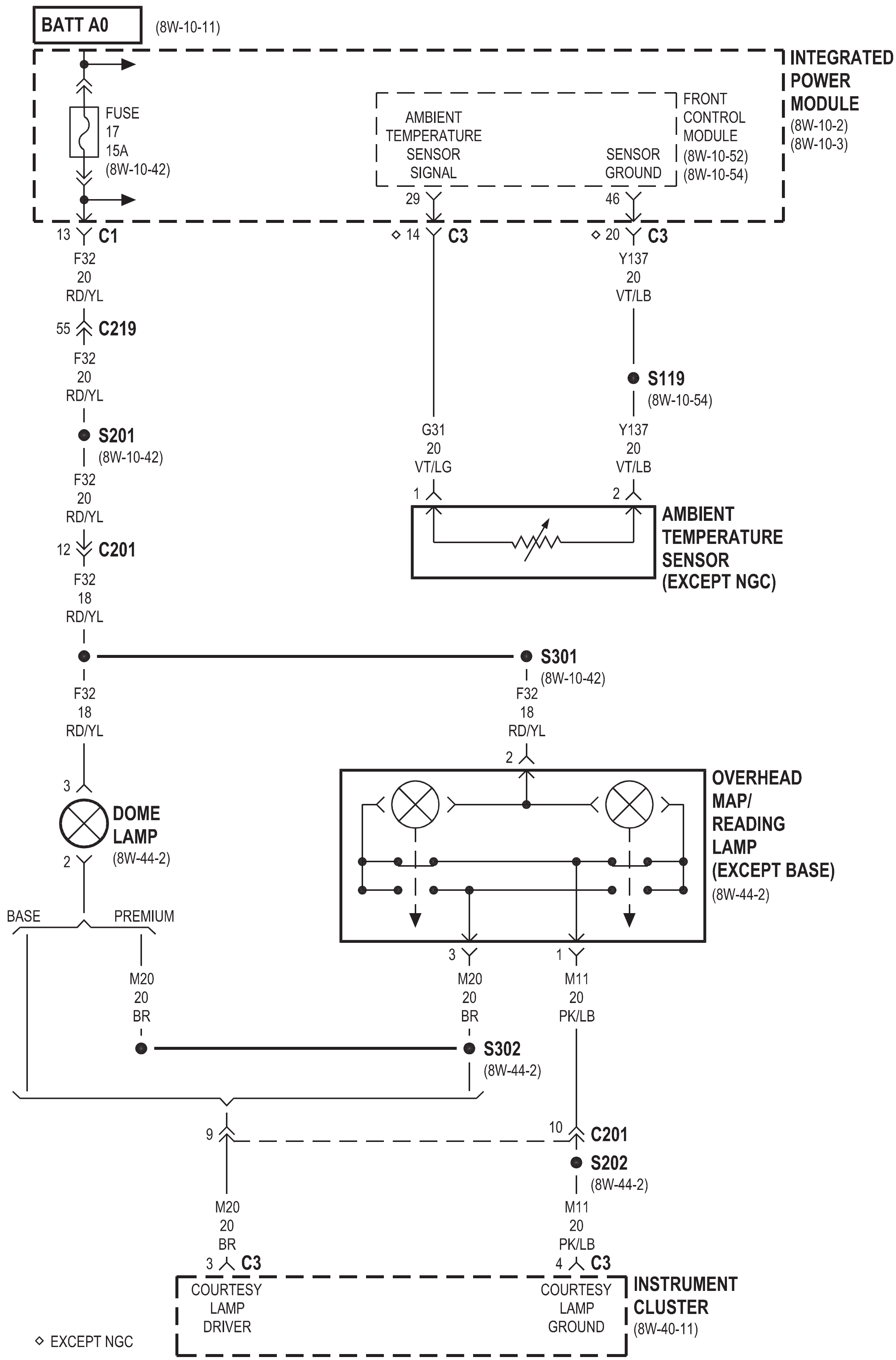

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 21 20A
(8W-10-33)
13 C2
F75 18 VT
49 C219
F75 18 VT
S221
(8W-10-33)
F75 18 VT
F75 18 VT
9 C2
1 C2
2 DATA LINK CONNECTOR
(8W-18-2)
D25 20 LB/VT
S230
(8W-18-4)
D25 20 VT/GY
12 C1
AMPLIFIER AUDIO
FUSED B(+)
FUSED B(+)
PCI BUS
GROUND
GROUND
LEFT REAR SPEAKER (-)
LEFT REAR SPEAKER (+)
RIGHT REAR SPEAKER (-)
RIGHT REAR SPEAKER (+)
11 C1
4 C1
4 C2
12 C2
13 C2
14 C2
Z126 18 BK/DB
Z115 18 DB/BK
X91 18 WT/BK
X93 18 WT/RD
X92 18 TN/BK
X94 18 TN/VT
2
10 C220
15
14 C308
X91 18 WT/BK
X93 18 WT/RD
X92 18 TN/BK
X94 18 TN/VT
E
F
G
H
TO C306 (8W-47-6)
TO C306 (8W-47-6)
TO C312 (8W-47-6)
TO C312 (8W-47-6)
G202
(8W-15-14)
(8W-15-15)


FROM
C220
(8W-47-4)
A
FROM
C220
(8W-47-4)
B
X85
18
LG/DG
X87
18
LG/RD
5
4
C304
X85
18
LG/DG
X87
18
LG/RD
3
1
SPEAKER-
LEFT
FRONT
DOOR
FROM
C308
(8W-47-4)
C
FROM
C308
(8W-47-4)
D
X82
18
LB/RD
X80
18
LB/BK
4
5
C301
X82
18
LB/RD
X80
18
LB/BK
1
3
SPEAKER-
RIGHT
FRONT
DOOR
FROM
C220
(8W-47-5)
E
FROM
C220
(8W-47-5)
F
X91
18
WT/BK
X93
18
WT/RD
8
9
C306
X91
18
WT/BK
X93
18
WT/RD
1
3
SPEAKER-
LEFT
REAR
FROM
C308
(8W-47-5)
G
FROM
C308
(8W-47-5)
H
X92
18
TN/BK
X94
18
TN/VT
8
9
C312
X92
18
WT/BK
X94
18
WT/RD
1
3
SPEAKER-
RIGHT
REAR

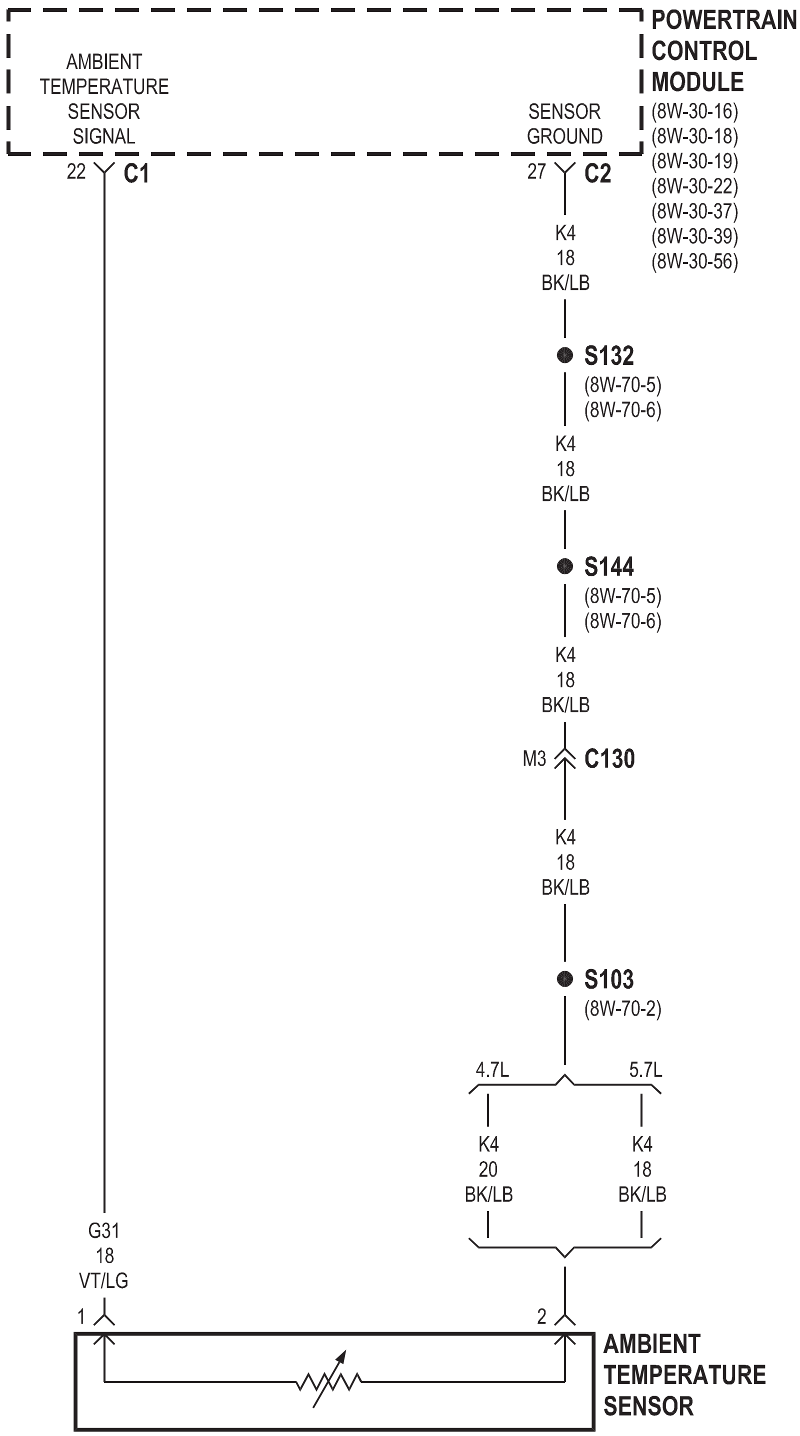

REMOTE RADIO SWITCH- LEFT
1 PRESET
2 SEEK DOWN
3 SEEK UP
REMOTE RADIO SWITCH- RIGHT
1 VOLUME UP
2 VOLUME DOWN
Z5 22 BK/LB
X20 22 GY/WT
S219
S220
RADIO
(8W-47-2)
PCI BUS
14
D25 20 VT/LB
C4
CLOCKSPRING
C1
S230
(8W-18-4)
D25 20 VT/YL
X20 20 GY/WT
Z5 20 BK
21
C3
12
C2
RADIO CONTROL MUX
INSTRUMENT CLUSTER
(8W-40-5)
(8W-40-9)
(8W-40-10)
G201
(8W-15-12)
(8W-15-13)

8W-49 OVERHEAD CONSOLE

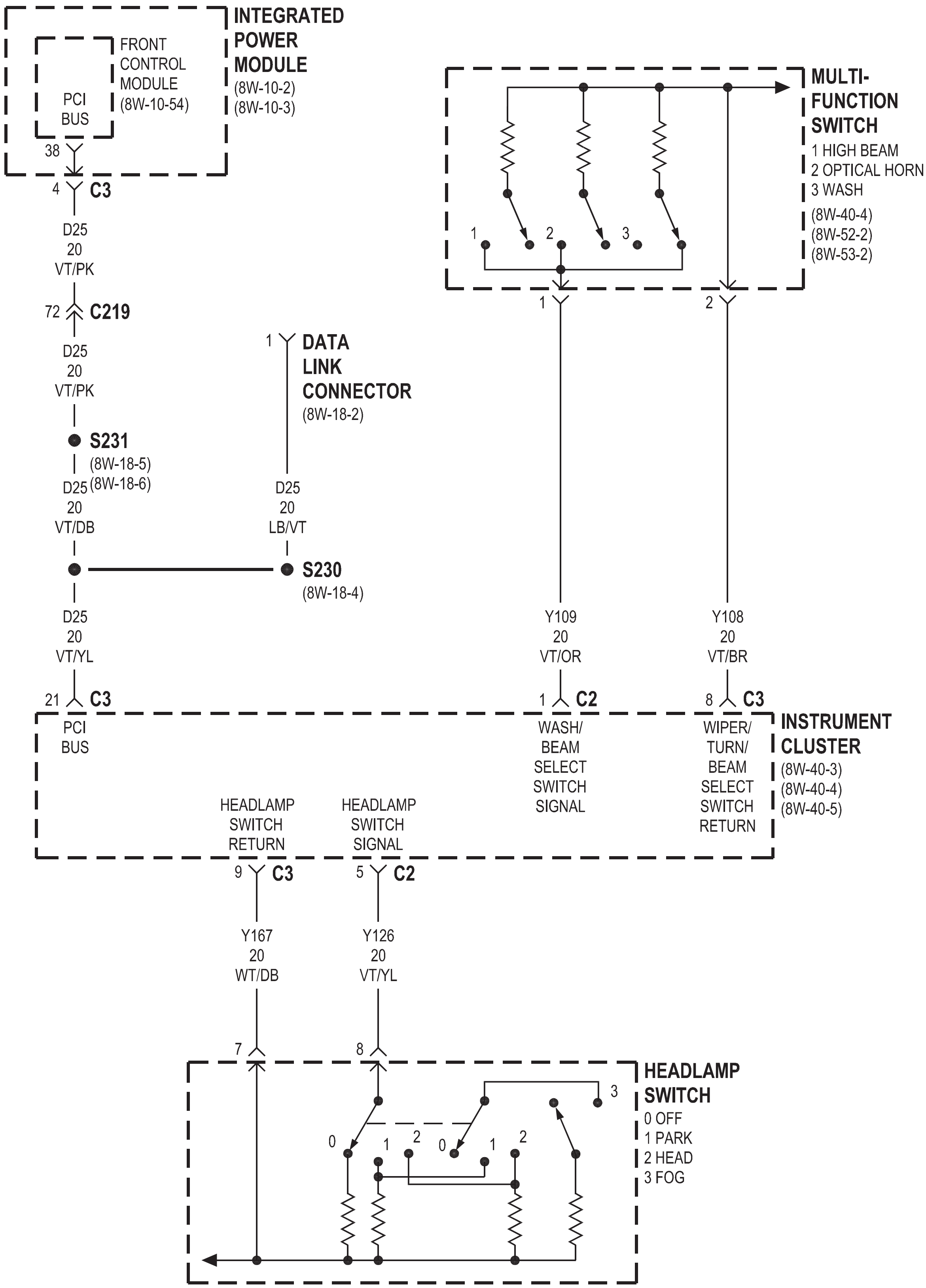

BATT A0
(8W-10-11)
RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 17 15A (8W-10-42)
FUSE 28 10 (8W-10-45)
13 C1
2 C1
F32 20 RD/YL
Y107 20 VT/RD
55
20 C219
S201
(8W-10-42)
S205
(8W-10-45)
F32 20 RD/YL
Y107 20 VT/RD
12
6 C201
F32 18 RD/YL
Y107 20 VT/RD
S301
(8W-10-42)
S304
(8W-10-45)
4
2
1
3
FUSED B(+)
FUSED IGNITION SWITCH OUTPUT (RUN-START)
PCI BUS
GROUND
COMPASS/ MINI-TRIP COMPUTER (EXCEPT BASE)
FUSED IGNITION SWITCH OUTPUT (RUN-START)
BACKUP LAMP FEED
GROUND
AUTOMATIC DAY/ NIGHT MIRROR (EXCEPT BASE)
5
3
2
D25 20 VT
Z104 20 BK/OR
1 C201
S307
(8W-15-15)
2 DATA LINK CONNECTOR
(8W-18-2)
D25 20 VT
D25 20 LB/VT
S230
(8W-18-4)
2 C201
Z104 18 BK/OR
G202
(8W-15-14)
(8W-15-15)
TRANSMISSION RANGE SENSOR
(8W-31-15)
BACKUP LAMP FEED
4
TRANSMISSION SOLENOID/ TRS ASSEMBLY
(8W-31-10)
6
L1 18 VT/BK
5.9L/8.0L
3.7L/4.7L/5.7L
M/T
A/T
1
BACKUP LAMP SWITCH
(8W-51-3)
B7 C130
S120
(8W-10-52)
27 C219
11 C201
L1 20 VT/BK
J038W-4
DR304902



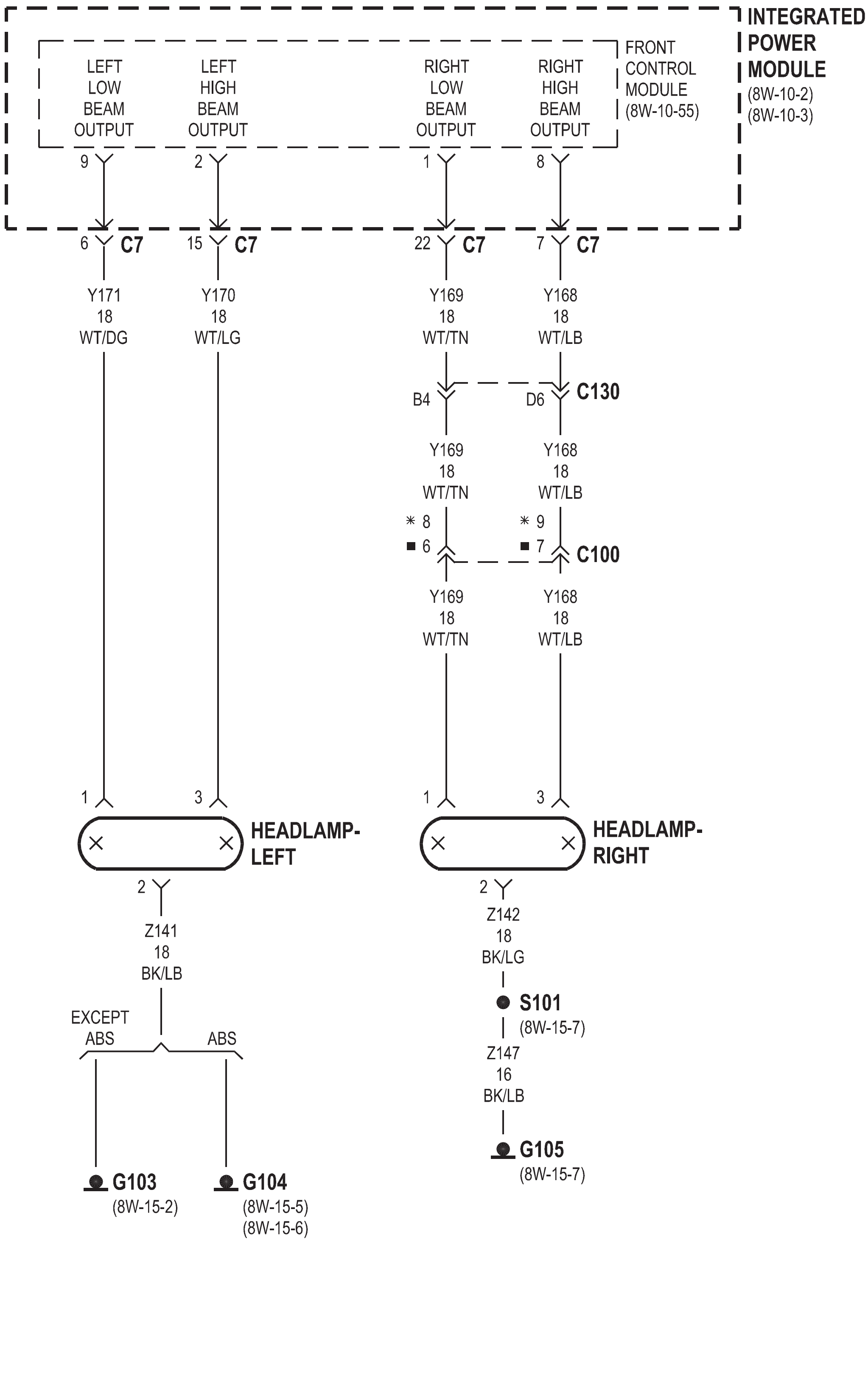
BATT A0
(8W-10-11)
FUSE
17
15A
(8W-10-42)
AMBIENT TEMPERATURE SENSOR SIGNAL
SENSOR GROUND
FRONT CONTROL MODULE
(8W-10-52)
(8W-10-54)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
29
46
13 C1
14 C3
20 C3
F32 20 RD/YL
55 C219
F32 20 RD/YL
S201
(8W-10-42)
F32 20 RD/YL
12 C201
F32 18 RD/YL
Y137 20 VT/LB
S119
(8W-10-54)
G31 20 VT/LG
Y137 20 VT/LB
1
2
AMBIENT TEMPERATURE SENSOR (EXCEPT NGC)
S301
(8W-10-42)
F32 18 RD/YL
F32 18 RD/YL
2
3
DOME LAMP
(8W-44-2)
2
OVERHEAD MAP/ READING LAMP (EXCEPT BASE)
(8W-44-2)
BASE
PREMIUM
3
1
M20 20 BR
M20 20 BR
M11 20 PK/LB
S302
(8W-44-2)
9
10 C201
S202
(8W-44-2)
M20 20 BR
M11 20 PK/LB
3 C3
4 C3
COURTESY LAMP DRIVER
COURTESY LAMP GROUND
INSTRUMENT CLUSTER
(8W-40-11)
◇ EXCEPT NGC

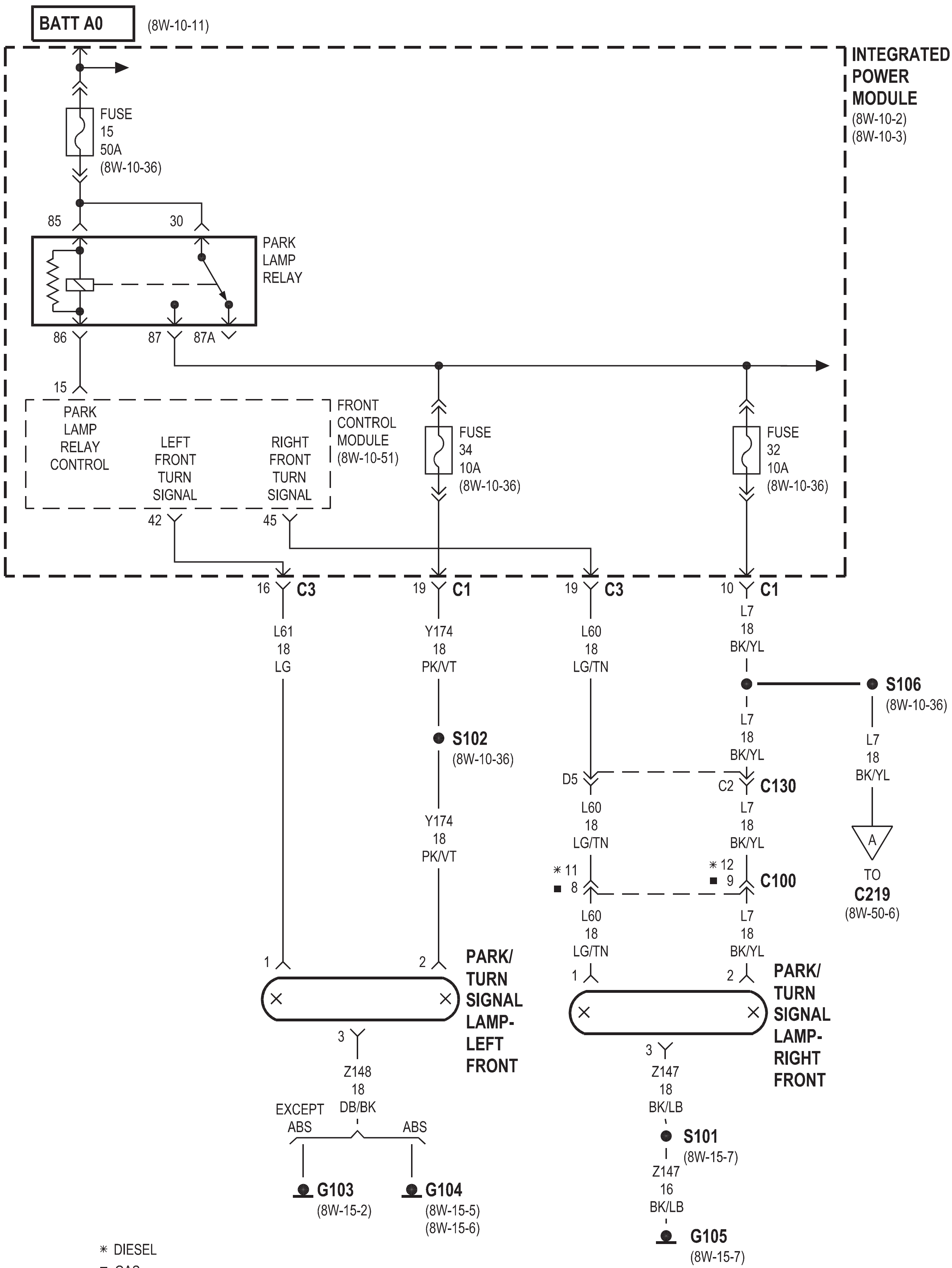

POWERTRAIN
CONTROL
MODULE
(8W-30-16)
(8W-30-18)
(8W-30-19)
(8W-30-22)
(8W-30-37)
(8W-30-39)
(8W-30-56)
AMBIENT
TEMPERATURE
SENSOR
SIGNAL
SENSOR
GROUND
22
C1
27
C2
K4
18
BK/LB
S132
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
S144
(8W-70-5)
(8W-70-6)
K4
18
BK/LB
M3
C130
K4
18
BK/LB
S103
(8W-70-2)
4.7L
5.7L
K4
20
BK/LB
K4
18
BK/LB
G31
18
VT/LG
1
2
AMBIENT
TEMPERATURE
SENSOR

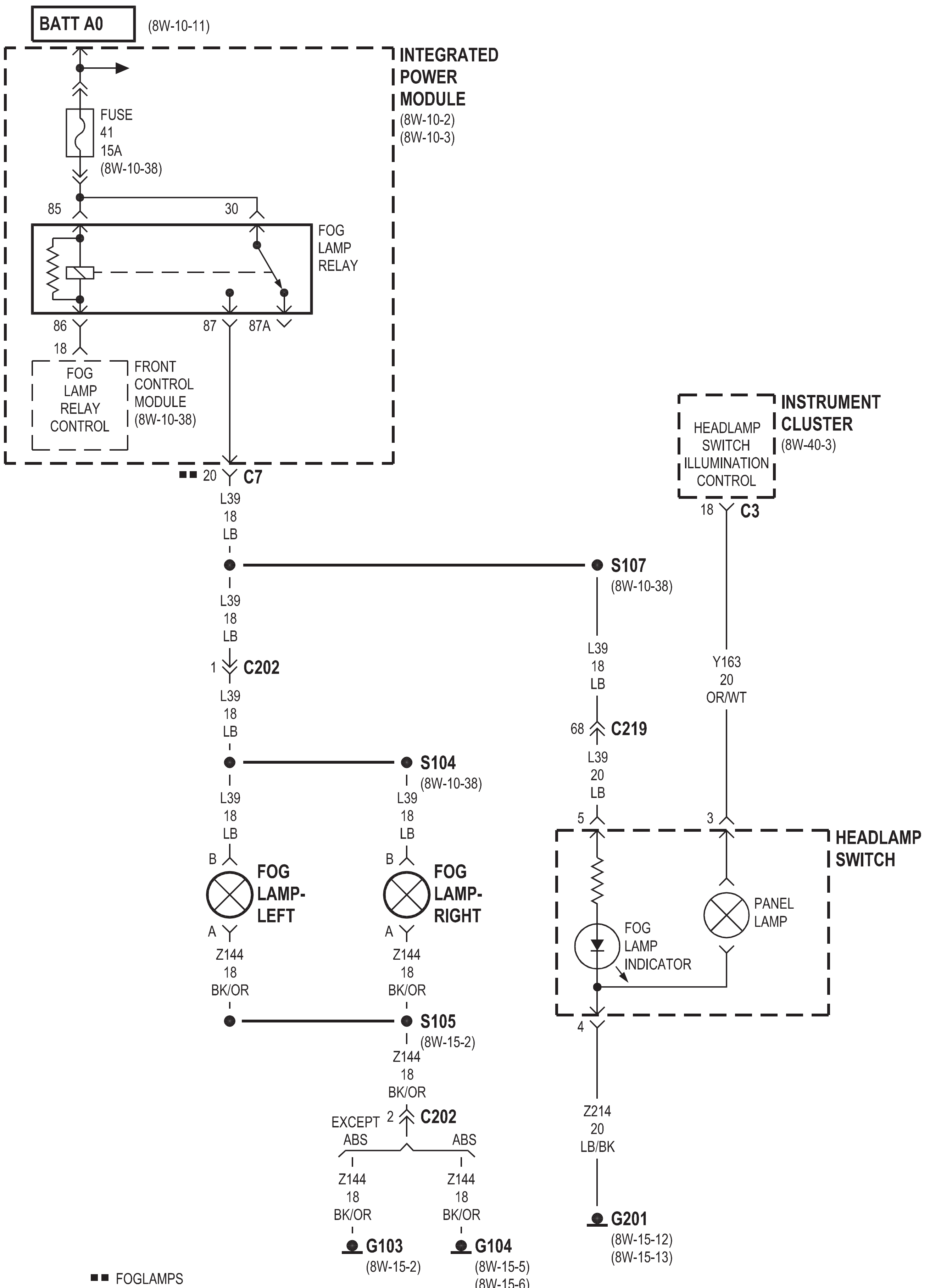
8W-50 FRONT LIGHTING

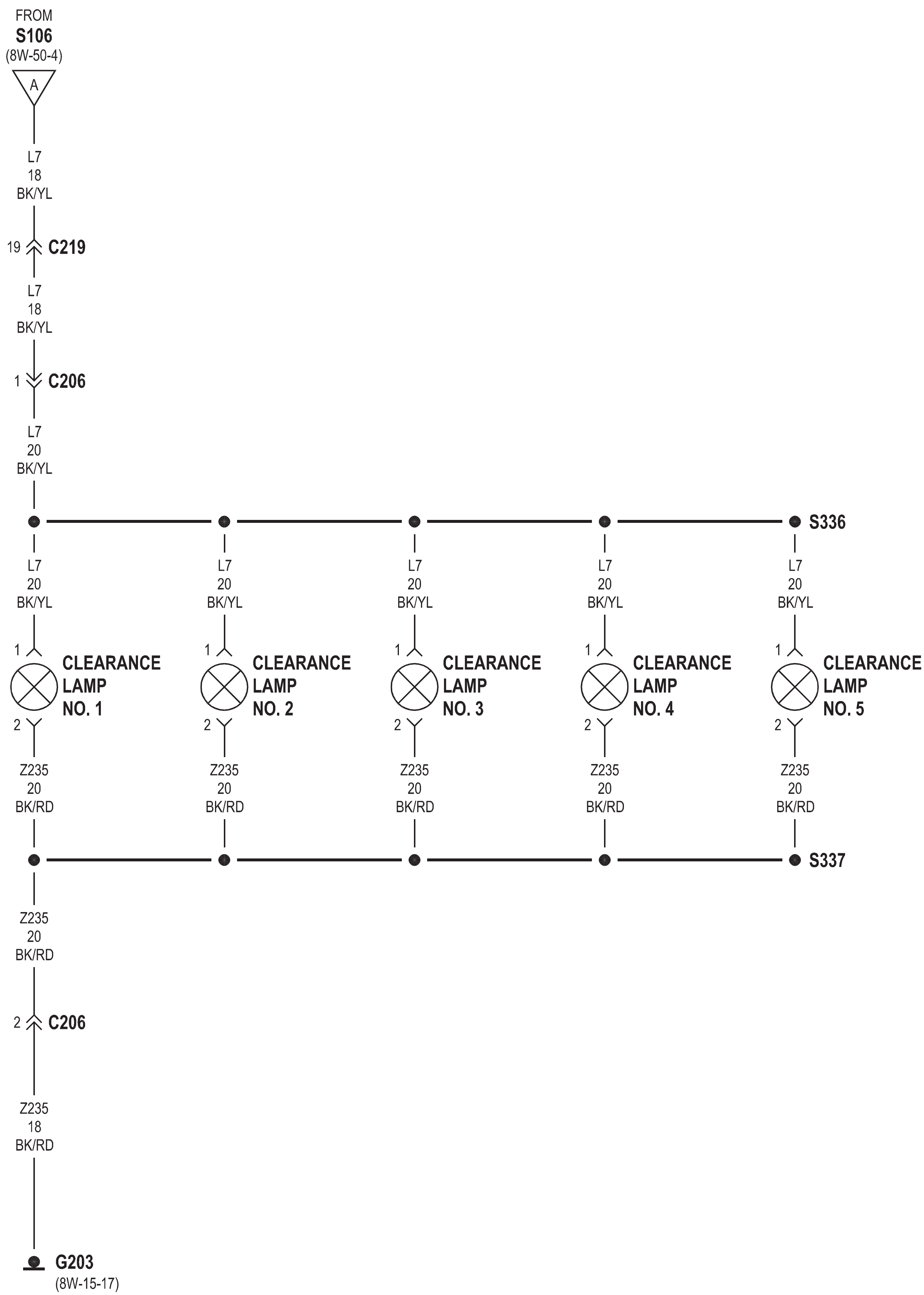


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-54)
PCI BUS
38
4 C3
D25 20 VT/PK
72 C219
D25 20 VT/PK
S231
(8W-18-5)
(8W-18-6)
D25 20 VT/DB
1
DATA LINK CONNECTOR
(8W-18-2)
D25 20 LB/VT
S230
(8W-18-4)
D25 20 VT/YL
21 C3
MULTI-FUNCTION SWITCH
1 HIGH BEAM
2 OPTICAL HORN
3 WASH
(8W-40-4)
(8W-52-2)
(8W-53-2)
1 2 3
1
2
Y109 20 VT/OR
Y108 20 VT/BR
1 C2
8 C3
INSTRUMENT CLUSTER
(8W-40-3)
(8W-40-4)
(8W-40-5)
PCI BUS
WASH/ BEAM SELECT SWITCH SIGNAL
WIPER/ TURN/ BEAM SELECT SWITCH RETURN
HEADLAMP SWITCH RETURN
HEADLAMP SWITCH SIGNAL
9 C3
5 C2
Y167 20 WT/DB
Y126 20 VT/YL
7
8
HEADLAMP SWITCH
0 OFF
1 PARK
2 HEAD
3 FOG
0 1 2 0 1 2 3

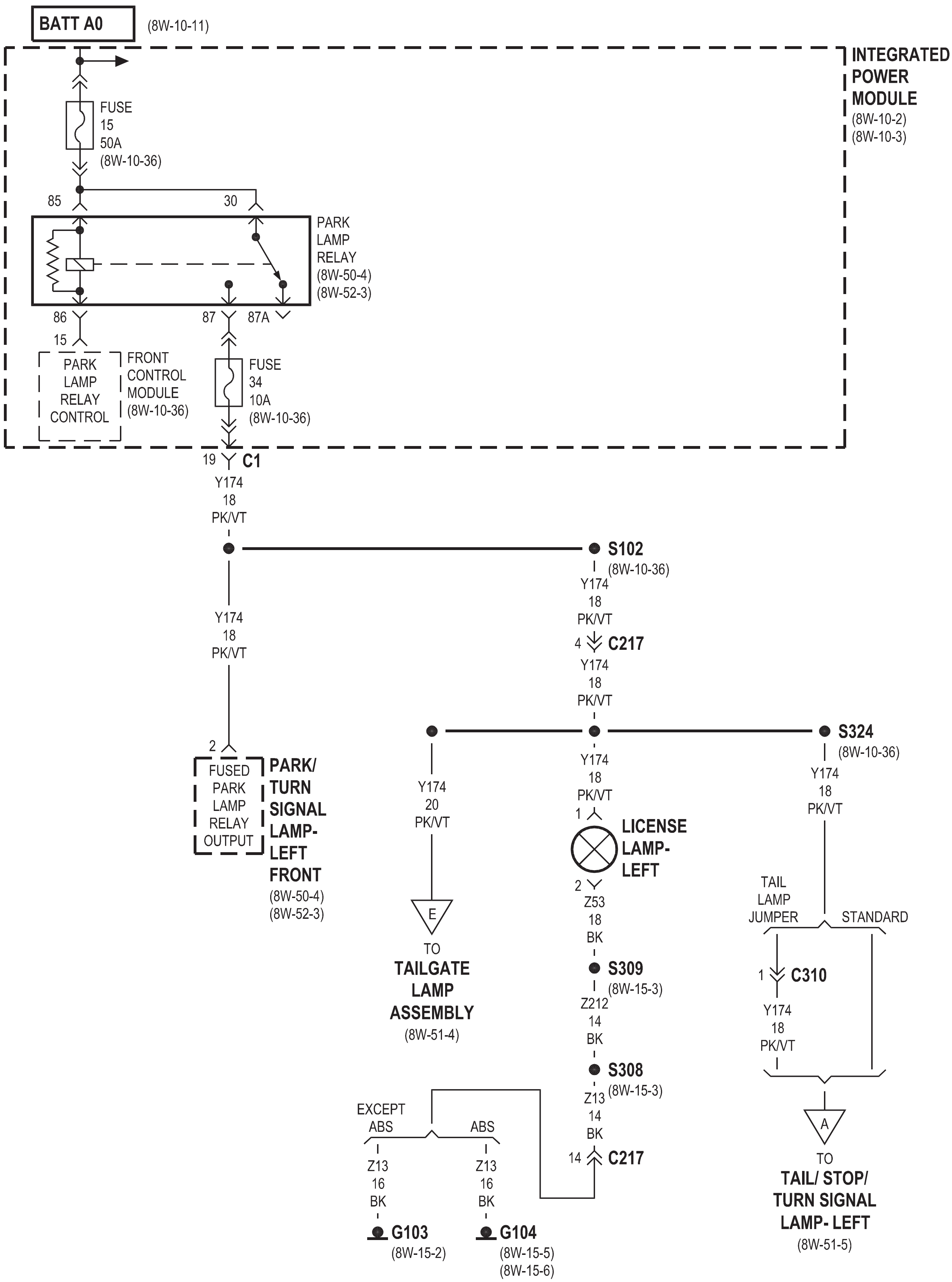

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-55)
LEFT LOW BEAM OUTPUT
LEFT HIGH BEAM OUTPUT
RIGHT LOW BEAM OUTPUT
RIGHT HIGH BEAM OUTPUT
9
2
1
8
6
15
22
7
C7
Y171 18 WT/DG
Y170 18 WT/LG
Y169 18 WT/TN
Y168 18 WT/LB
B4
D6
C130
✱ 8
■ 6
✱ 9
■ 7
C100
HEADLAMP-LEFT
HEADLAMP-RIGHT
1
3
2
Z141 18 BK/LB
EXCEPT ABS
ABS
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
Z142 18 BK/LG
S101
(8W-15-7)
Z147 16 BK/LB
G105
(8W-15-7)
✱ DIESEL
■ GAS

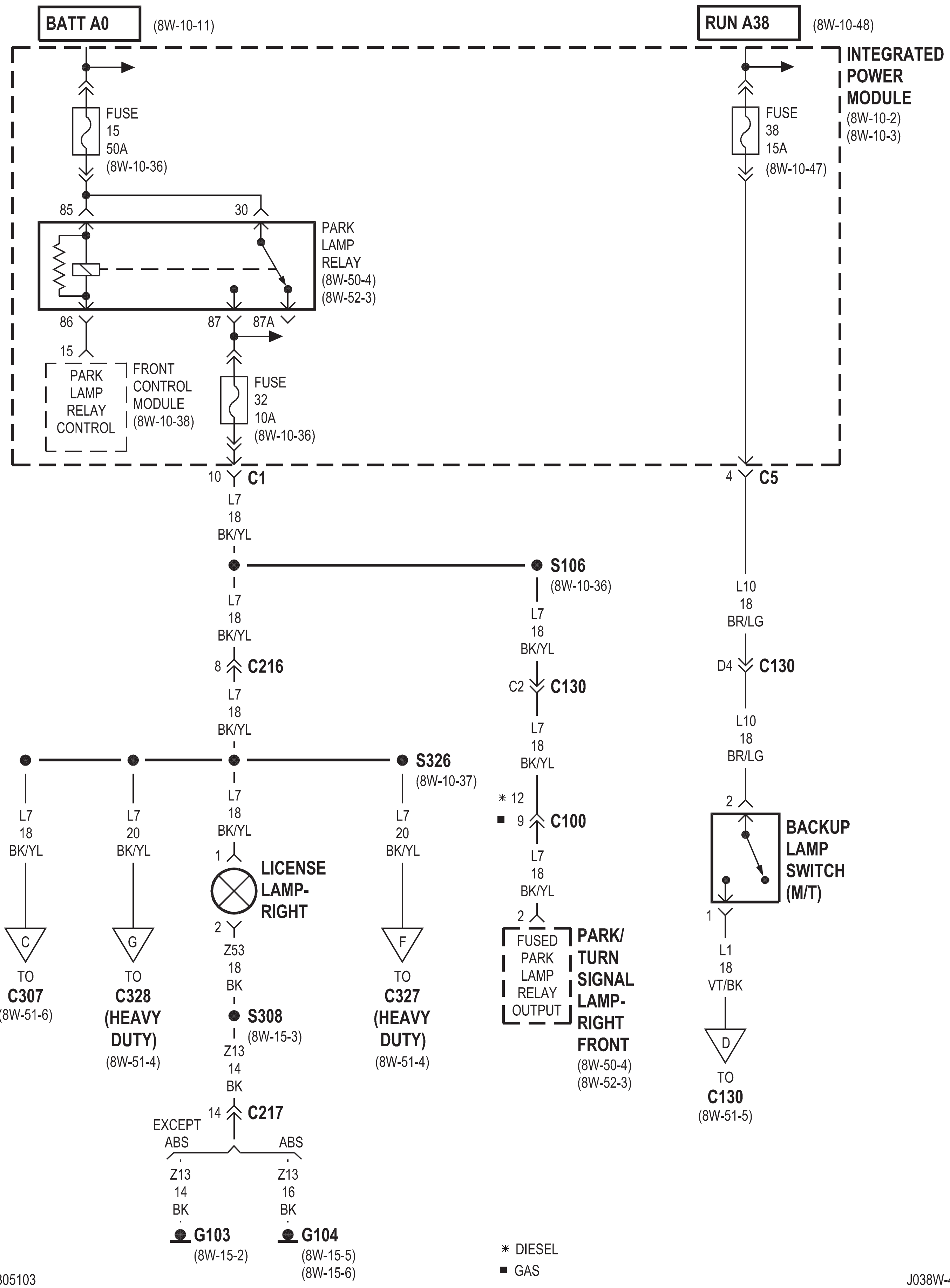

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 15 50A (8W-10-36)
85
30
PARK LAMP RELAY
86
87
87A
15
PARK LAMP RELAY CONTROL
LEFT FRONT TURN SIGNAL
RIGHT FRONT TURN SIGNAL
FRONT CONTROL MODULE (8W-10-51)
FUSE 34 10A (8W-10-36)
FUSE 32 10A (8W-10-36)
42
45
16 C3
19 C1
19 C3
10 C1
L61 18 LG
Y174 18 PK/VT
L60 18 LG/TN
L7 18 BK/YL
S106 (8W-10-36)
S102 (8W-10-36)
L7 18 BK/YL
L7 18 BK/YL
D5
C2 C130
L60 18 LG/TN
Y174 18 PK/VT
L7 18 BK/YL
A
TO C219 (8W-50-6)
✳ 11
■ 8
✳ 12
■ 9
C100
L60 18 LG/TN
L7 18 BK/YL
1
2
PARK/ TURN SIGNAL LAMP- LEFT FRONT
1
2
PARK/ TURN SIGNAL LAMP- RIGHT FRONT
3
Z148 18 DB/BK
EXCEPT ABS
ABS
G103 (8W-15-2)
G104 (8W-15-5) (8W-15-6)
3
Z147 18 BK/LB
S101 (8W-15-7)
Z147 16 BK/LB
G105 (8W-15-7)
✳ DIESEL
■ GAS


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
41
15A
(8W-10-38)
85
30
FOG LAMP RELAY
86
87
87A
18
FOG LAMP RELAY CONTROL
FRONT CONTROL MODULE
(8W-10-38)
20
C7
L39
18
LB
S107
(8W-10-38)
1
C202
S104
(8W-10-38)
B
FOG LAMP-LEFT
A
FOG LAMP-RIGHT
Z144
18
BK/OR
S105
(8W-15-2)
2
C202
EXCEPT ABS
ABS
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
INSTRUMENT CLUSTER
(8W-40-3)
HEADLAMP SWITCH ILLUMINATION CONTROL
18
C3
Y163
20
OR/WT
68
C219
L39
20
LB
5
3
HEADLAMP SWITCH
FOG LAMP INDICATOR
PANEL LAMP
4
Z214
20
LB/BK
G201
(8W-15-12)
(8W-15-13)
FOGLAMPS

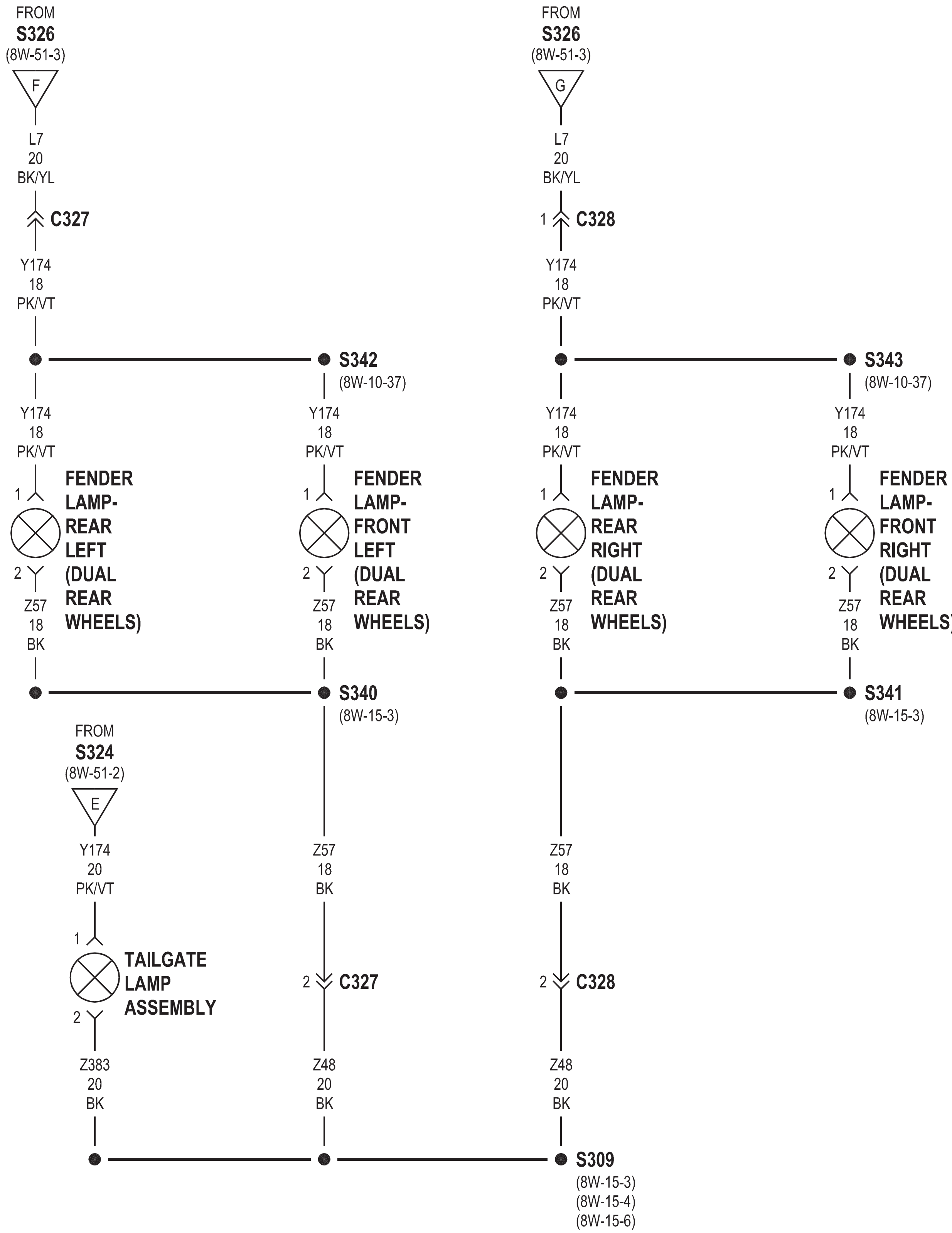

FROM
S106
(8W-50-4)
A
L7
18
BK/YL
19
C219
L7
18
BK/YL
1
C206
L7
20
BK/YL
S336
L7
20
BK/YL
1
CLEARANCE LAMP NO. 1
CLEARANCE LAMP NO. 2
CLEARANCE LAMP NO. 3
CLEARANCE LAMP NO. 4
CLEARANCE LAMP NO. 5
2
Z235
20
BK/RD
S337
Z235
20
BK/RD
2
C206
Z235
18
BK/RD
G203
(8W-15-17)

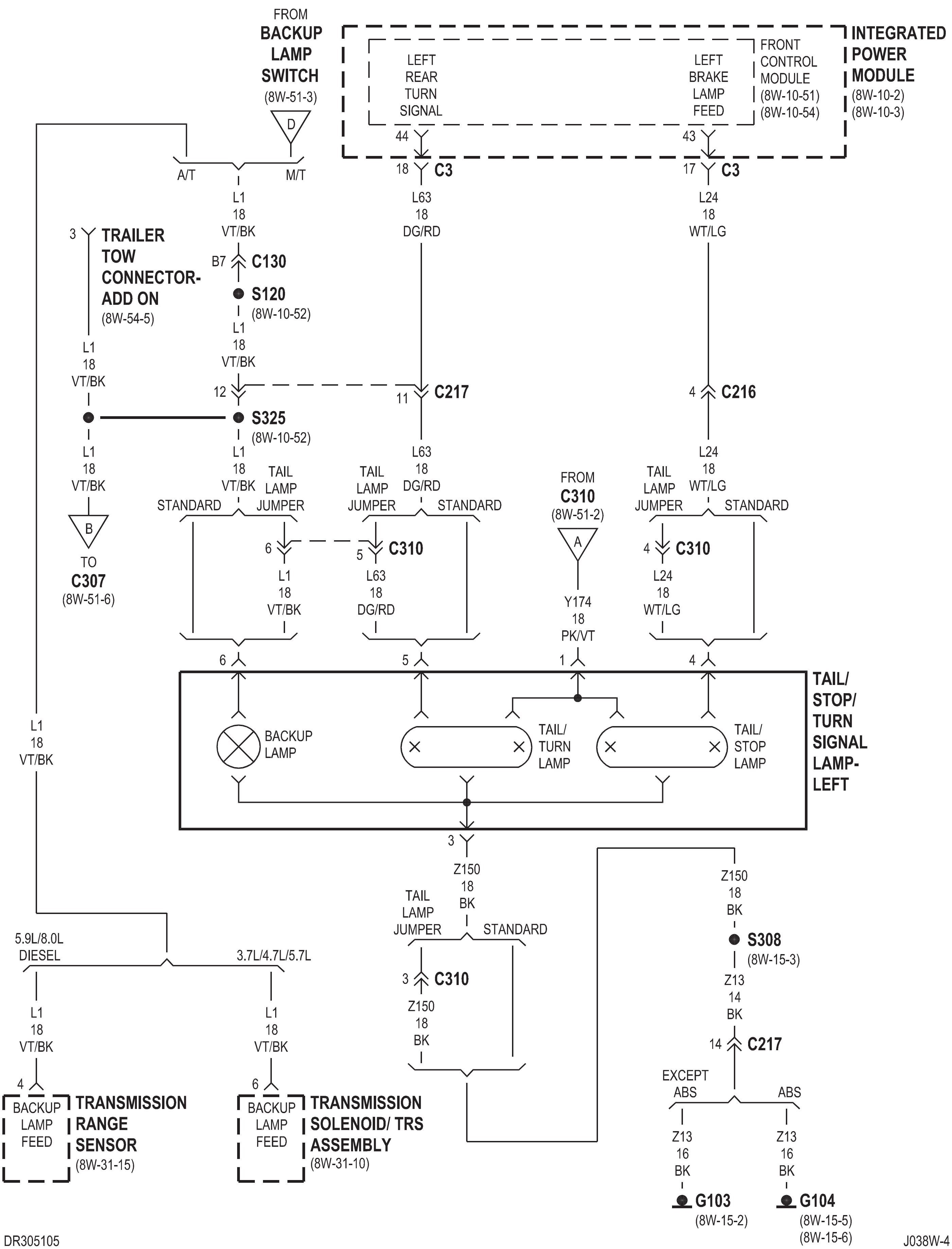
8W-51 REAR LIGHTING

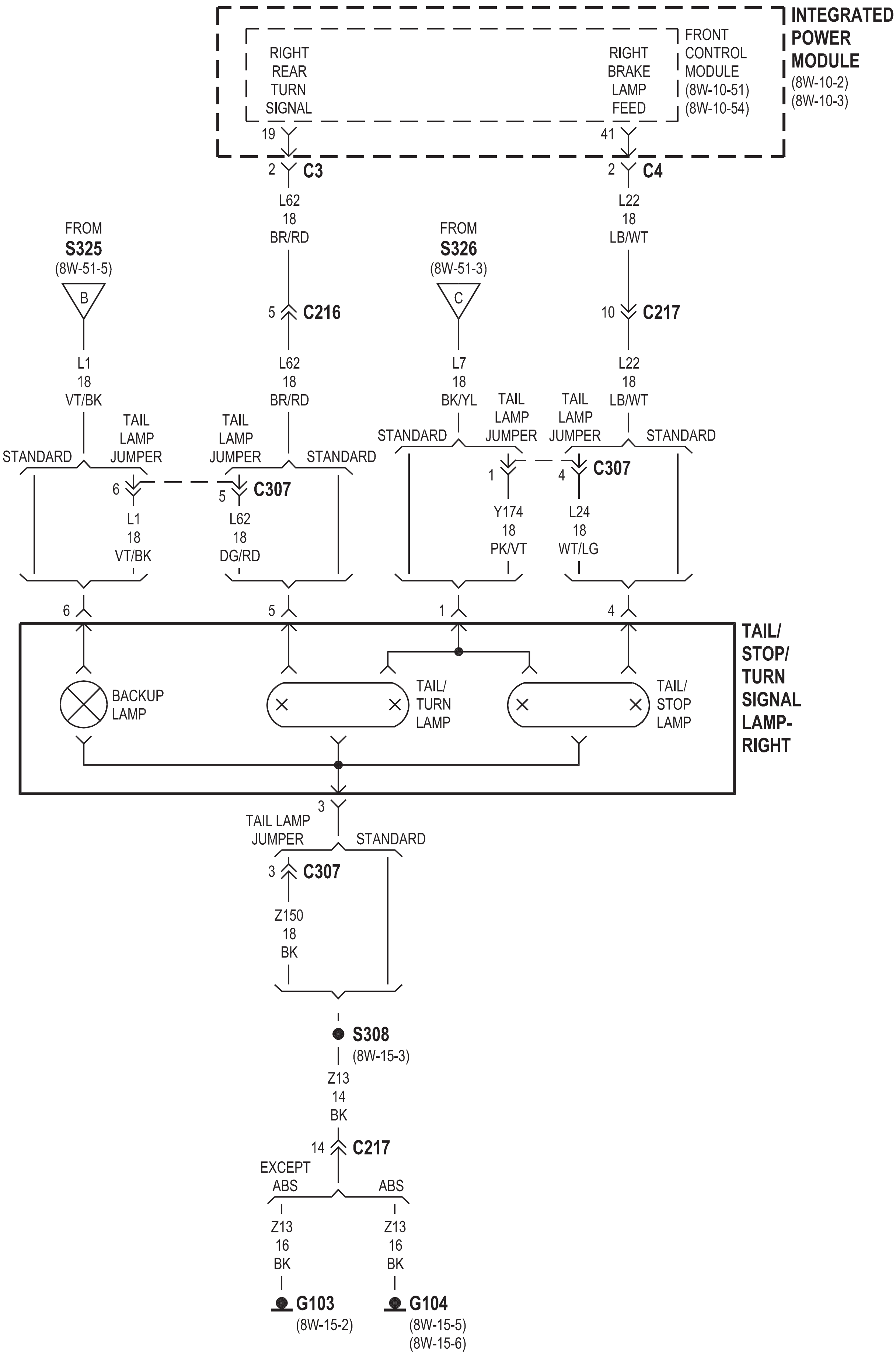

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
15
50A
(8W-10-36)
85
30
PARK LAMP RELAY
(8W-50-4)
(8W-52-3)
86
87
87A
15
PARK LAMP RELAY CONTROL
FRONT CONTROL MODULE
(8W-10-36)
FUSE
34
10A
(8W-10-36)
19
C1
Y174
18
PK/VT
S102
(8W-10-36)
Y174
18
PK/VT
4
C217
Y174
18
PK/VT
2
FUSED PARK LAMP RELAY OUTPUT
PARK/ TURN SIGNAL LAMP- LEFT FRONT
(8W-50-4)
(8W-52-3)
Y174
20
PK/VT
E
TO
TAILGATE LAMP ASSEMBLY
(8W-51-4)
1
LICENSE LAMP- LEFT
2
Z53
18
BK
S309
(8W-15-3)
Z212
14
BK
S308
(8W-15-3)
Z13
14
BK
14
C217
EXCEPT ABS
ABS
Z13
16
BK
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
S324
(8W-10-36)
TAIL LAMP JUMPER
STANDARD
1
C310
A
TO
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
(8W-51-5)

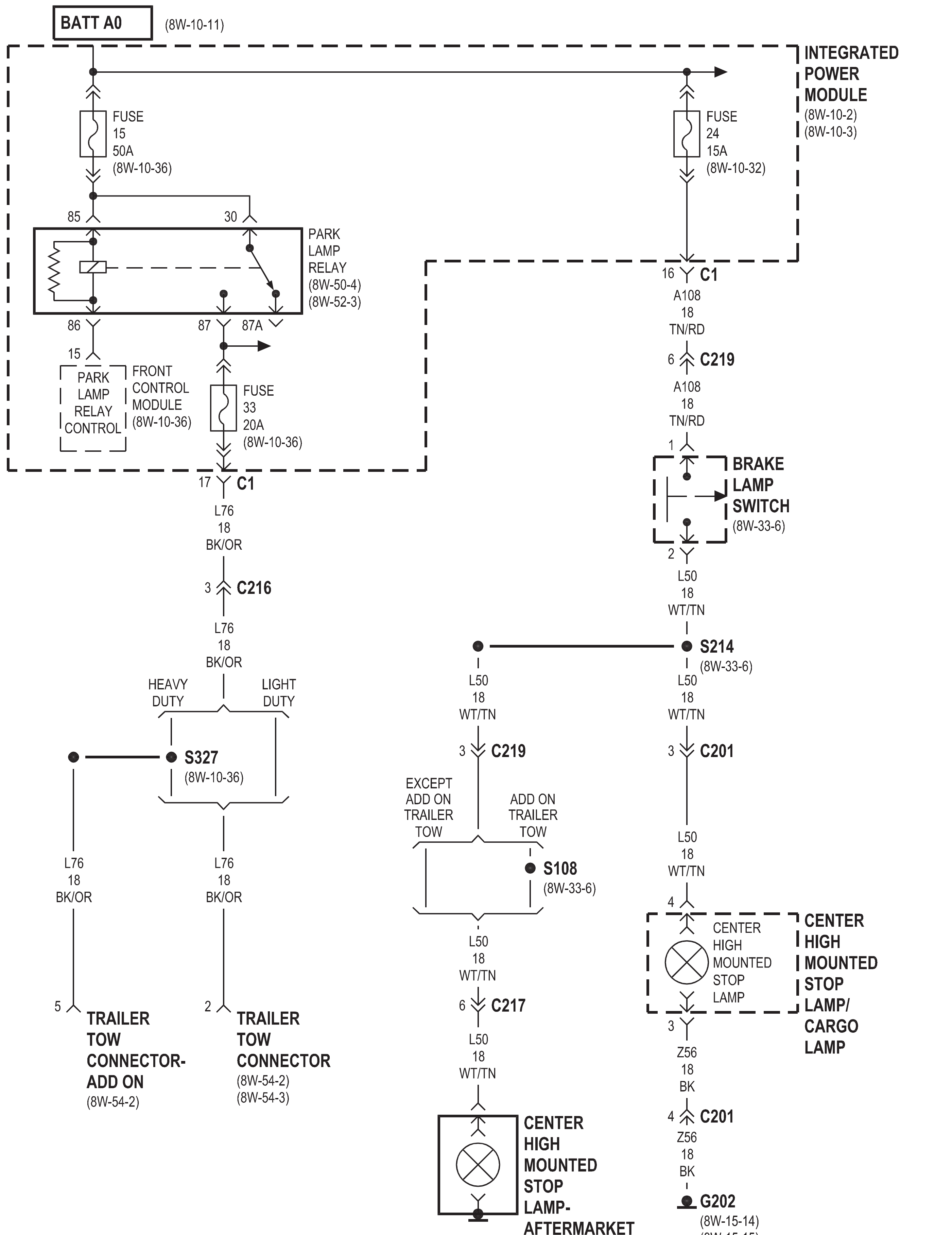


BATT A0
(8W-10-11)
RUN A38
(8W-10-48)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FUSE
15
50A
(8W-10-36)
FUSE
38
15A
(8W-10-47)
85
30
PARK
LAMP
RELAY
(8W-50-4)
(8W-52-3)
86
87
87A
15
PARK
LAMP
RELAY
CONTROL
FRONT
CONTROL
MODULE
(8W-10-38)
FUSE
32
10A
(8W-10-36)
10
C1
4
C5
L7
18
BK/YL
S106
(8W-10-36)
L10
18
BR/LG
8
C216
C2
C130
D4
C130
S326
(8W-10-37)
✳ 12
■ 9
C100
2
1
LICENSE
LAMP-
RIGHT
BACKUP
LAMP
SWITCH
(M/T)
L7
20
BK/YL
C
G
F
D
TO
C307
(8W-51-6)
TO
C328
(HEAVY
DUTY)
(8W-51-4)
Z53
18
BK
S308
(8W-15-3)
Z13
14
BK
TO
C327
(HEAVY
DUTY)
(8W-51-4)
FUSED
PARK
LAMP
RELAY
OUTPUT
PARK/
TURN
SIGNAL
LAMP-
RIGHT
FRONT
(8W-50-4)
(8W-52-3)
L1
18
VT/BK
TO
C130
(8W-51-5)
14
C217
EXCEPT
ABS
ABS
Z13
16
BK
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
✳ DIESEL
■ GAS

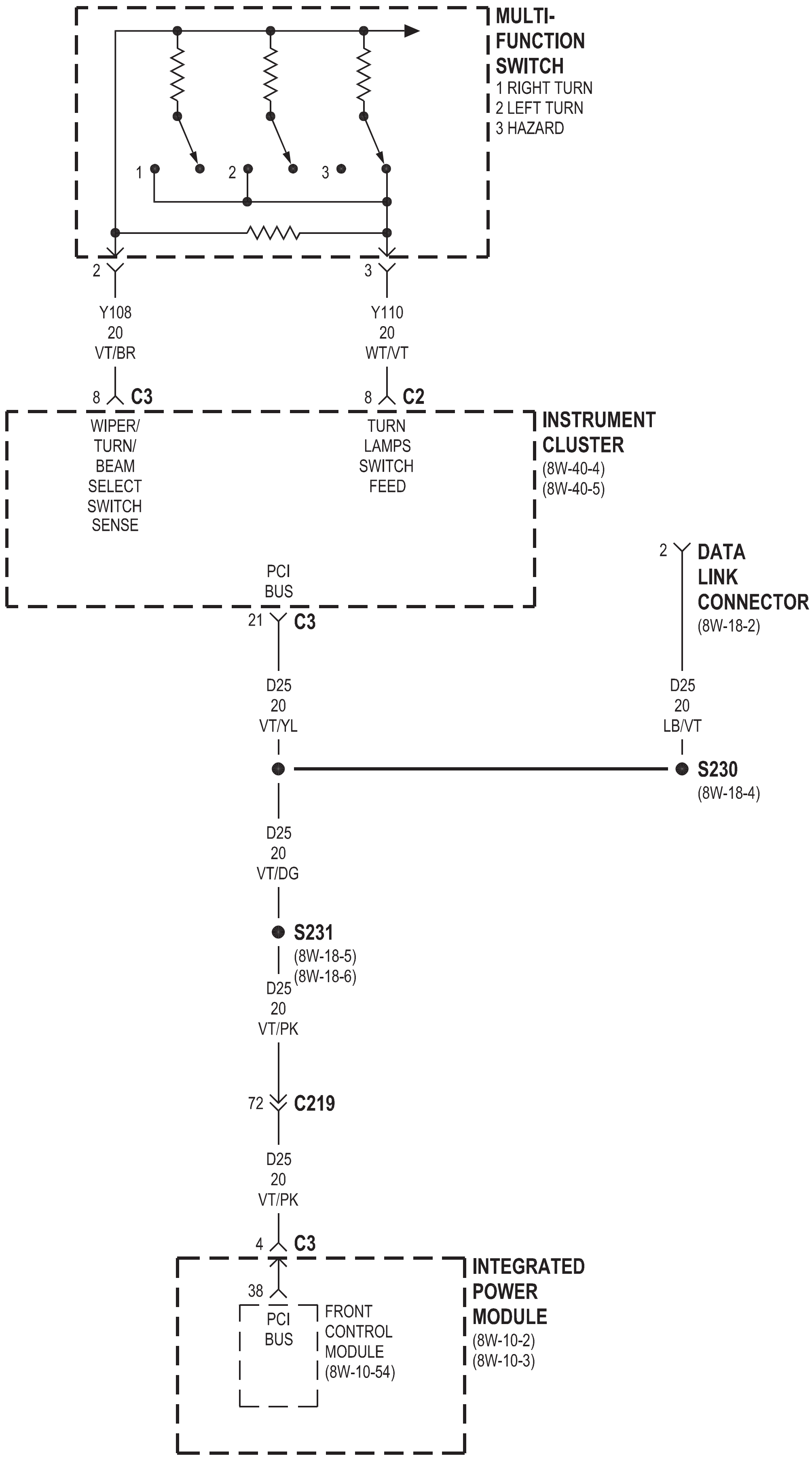

FROM
S326
(8W-51-3)
F
L7
20
BK/YL
C327
Y174
18
PK/VT
S342
(8W-10-37)
Y174
18
PK/VT
1
FENDER LAMP- REAR LEFT (DUAL REAR WHEELS)
2
Z57
18
BK
Y174
18
PK/VT
1
FENDER LAMP- FRONT LEFT (DUAL REAR WHEELS)
2
Z57
18
BK
S340
(8W-15-3)
FROM
S326
(8W-51-3)
G
L7
20
BK/YL
1
C328
Y174
18
PK/VT
S343
(8W-10-37)
Y174
18
PK/VT
1
FENDER LAMP- REAR RIGHT (DUAL REAR WHEELS)
2
Z57
18
BK
Y174
18
PK/VT
1
FENDER LAMP- FRONT RIGHT (DUAL REAR WHEELS)
2
Z57
18
BK
S341
(8W-15-3)
FROM
S324
(8W-51-2)
E
Y174
20
PK/VT
1
TAILGATE LAMP ASSEMBLY
2
Z383
20
BK
Z57
18
BK
2
C327
Z48
20
BK
Z57
18
BK
2
C328
Z48
20
BK
S309
(8W-15-3)
(8W-15-4)
(8W-15-6)

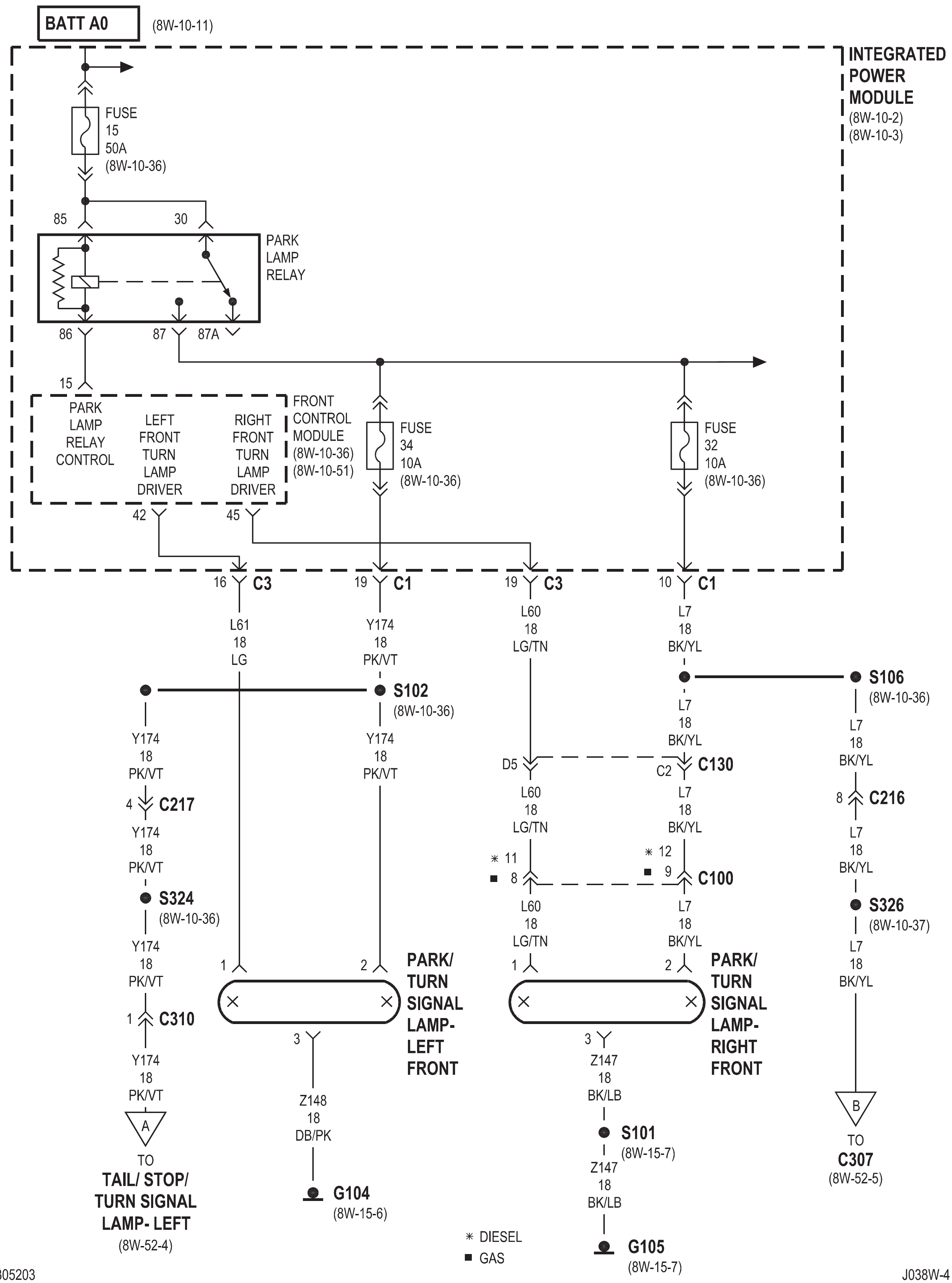

FROM
BACKUP
LAMP
SWITCH
(8W-51-3)
D
A/T
M/T
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)
FRONT
CONTROL
MODULE
(8W-10-51)
(8W-10-54)
LEFT
REAR
TURN
SIGNAL
LEFT
BRAKE
LAMP
FEED
44
43
18 C3
17 C3
L1 18 VT/BK
L63 18 DG/RD
L24 18 WT/LG
3
TRAILER
TOW
CONNECTOR-
ADD ON
(8W-54-5)
B7 C130
S120
(8W-10-52)
12
11 C217
4 C216
S325
(8W-10-52)
STANDARD
TAIL
LAMP
JUMPER
6
5 C310
4 C310
B
TO
C307
(8W-51-6)
FROM
C310
(8W-51-2)
A
Y174 18 PK/VT
6
5
1
4
TAIL/
STOP/
TURN
SIGNAL
LAMP-
LEFT
BACKUP
LAMP
TAIL/
TURN
LAMP
TAIL/
STOP
LAMP
3
Z150 18 BK
3 C310
S308
(8W-15-3)
Z13 14 BK
14 C217
EXCEPT
ABS
ABS
Z13 16 BK
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)
5.9L/8.0L
DIESEL
3.7L/4.7L/5.7L
4
6
BACKUP
LAMP
FEED
TRANSMISSION
RANGE
SENSOR
(8W-31-15)
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-10)

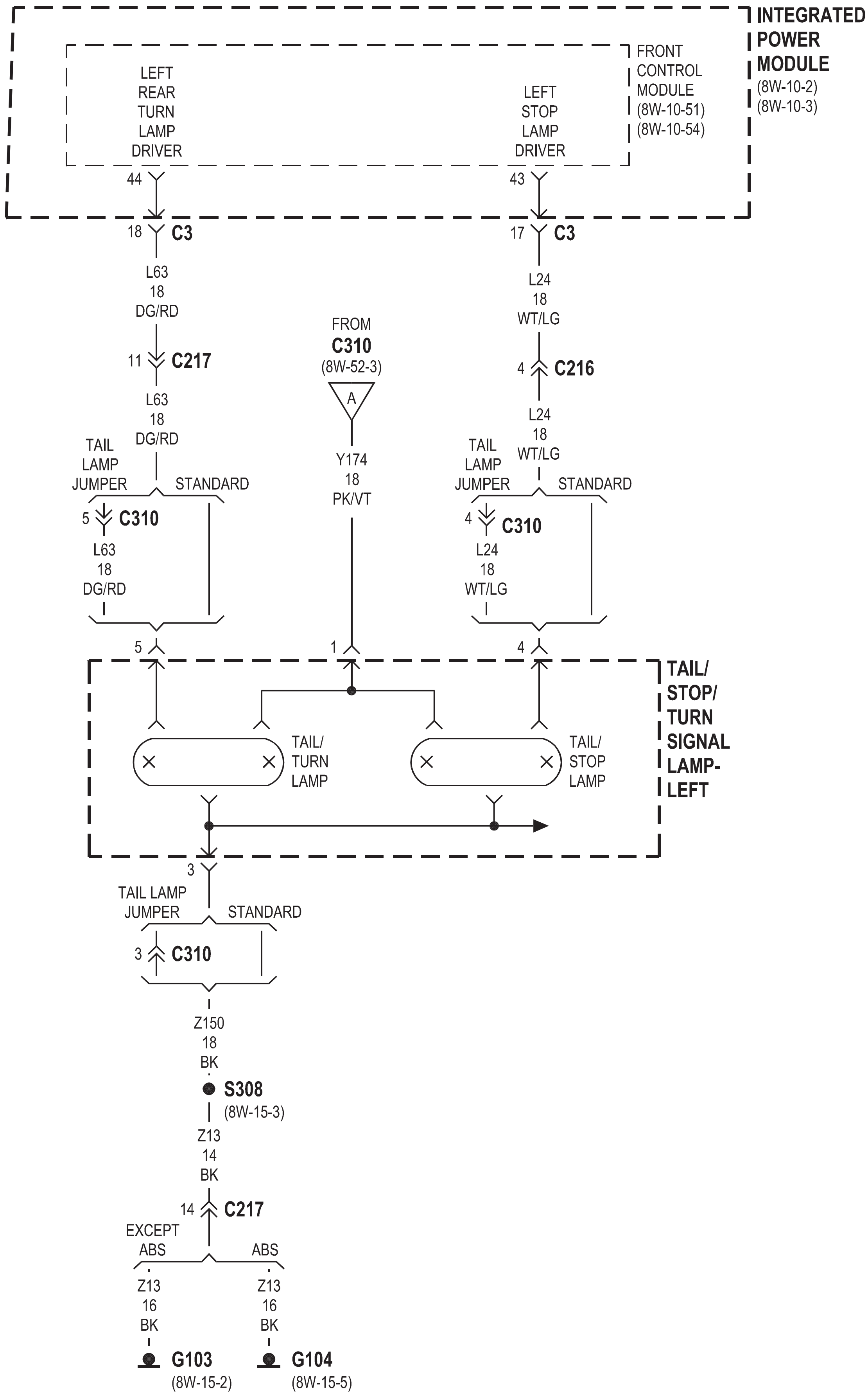

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-51)
(8W-10-54)
RIGHT REAR TURN SIGNAL
RIGHT BRAKE LAMP FEED
19
41
2 C3
2 C4
L62 18 BR/RD
L22 18 LB/WT
FROM S325 (8W-51-5)
B
FROM S326 (8W-51-3)
C
5 C216
10 C217
L1 18 VT/BK
L62 18 BR/RD
L7 18 BK/YL
L22 18 LB/WT
STANDARD
TAIL LAMP JUMPER
6
5 C307
1
4 C307
L1 18 VT/BK
L62 18 DG/RD
Y174 18 PK/VT
L24 18 WT/LG
6
5
1
4
BACKUP LAMP
TAIL/ TURN LAMP
TAIL/ STOP LAMP
TAIL/ STOP/ TURN SIGNAL LAMP- RIGHT
3
TAIL LAMP JUMPER
STANDARD
3 C307
Z150 18 BK
S308
(8W-15-3)
Z13 14 BK
14 C217
EXCEPT ABS
ABS
Z13 16 BK
Z13 16 BK
G103
(8W-15-2)
G104
(8W-15-5)
(8W-15-6)

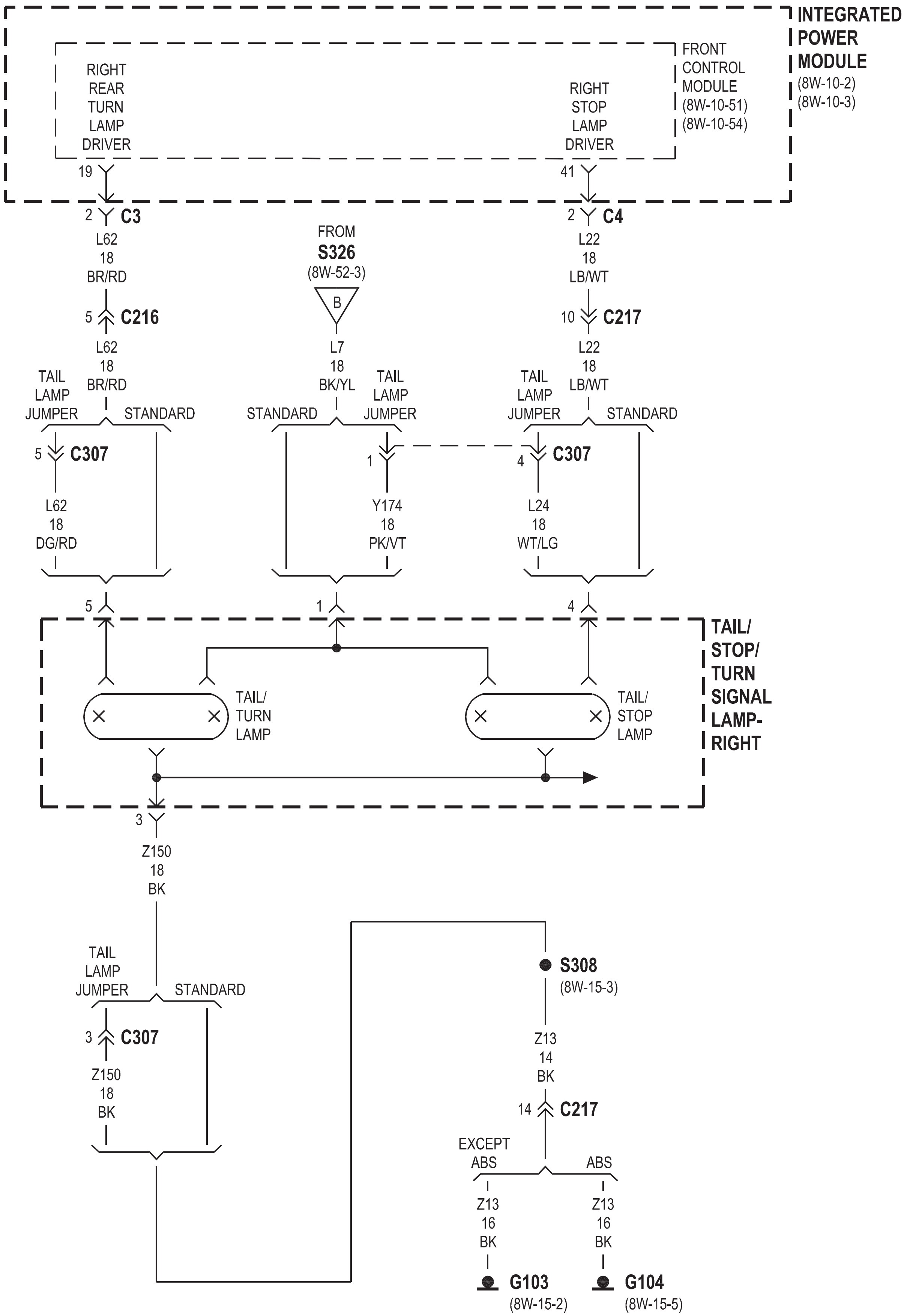

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 15 50A (8W-10-36)
FUSE 24 15A (8W-10-32)
85
30
PARK LAMP RELAY
(8W-50-4)
(8W-52-3)
86
87
87A
15
PARK LAMP RELAY CONTROL
FRONT CONTROL MODULE
(8W-10-36)
FUSE 33 20A (8W-10-36)
17 C1
L76 18 BK/OR
3 C216
L76 18 BK/OR
HEAVY DUTY
LIGHT DUTY
S327
(8W-10-36)
L76 18 BK/OR
L76 18 BK/OR
5
TRAILER TOW CONNECTOR-ADD ON
(8W-54-2)
2
TRAILER TOW CONNECTOR
(8W-54-2)
(8W-54-3)
16 C1
A108 18 TN/RD
6 C219
A108 18 TN/RD
1
BRAKE LAMP SWITCH
(8W-33-6)
2
L50 18 WT/TN
S214
(8W-33-6)
L50 18 WT/TN
L50 18 WT/TN
3 C219
EXCEPT ADD ON TRAILER TOW
ADD ON TRAILER TOW
S108
(8W-33-6)
L50 18 WT/TN
6 C217
L50 18 WT/TN
CENTER HIGH MOUNTED STOP LAMP-AFTERMARKET
3 C201
L50 18 WT/TN
4
CENTER HIGH MOUNTED STOP LAMP
CENTER HIGH MOUNTED STOP LAMP/ CARGO LAMP
3
Z56 18 BK
4 C201
Z56 18 BK
G202
(8W-15-14)
(8W-15-15)

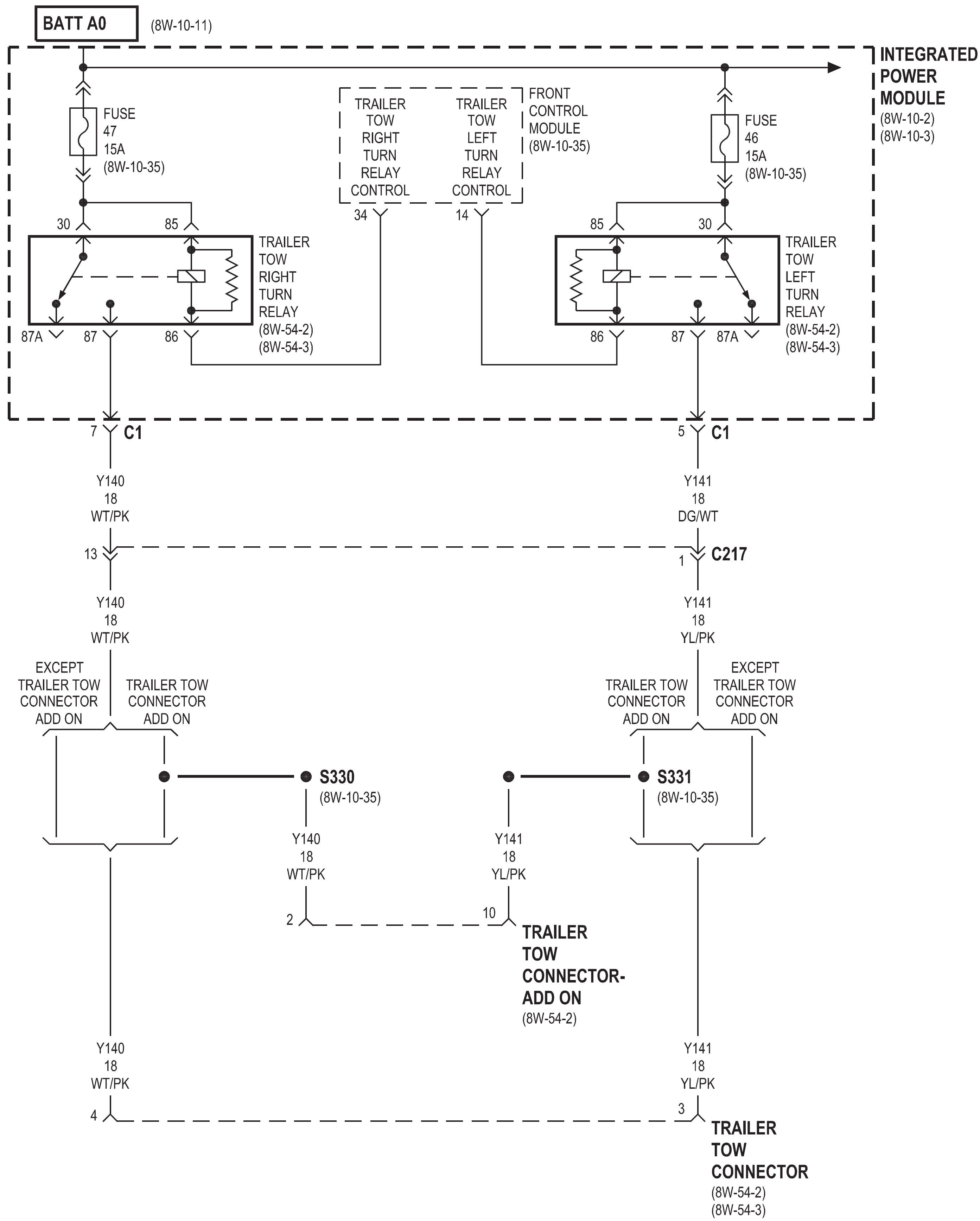
8W-52 TURN SIGNALS


MULTI-
FUNCTION
SWITCH
1 RIGHT TURN
2 LEFT TURN
3 HAZARD
1
2
3
2
3
Y108
20
VT/BR
Y110
20
WT/VT
8
C3
8
C2
WIPER/
TURN/
BEAM
SELECT
SWITCH
SENSE
TURN
LAMPS
SWITCH
FEED
INSTRUMENT
CLUSTER
(8W-40-4)
(8W-40-5)
PCI
BUS
21
C3
2
DATA
LINK
CONNECTOR
(8W-18-2)
D25
20
VT/YL
D25
20
LB/VT
S230
(8W-18-4)
D25
20
VT/DG
S231
(8W-18-5)
(8W-18-6)
D25
20
VT/PK
72
C219
D25
20
VT/PK
4
C3
38
PCI
BUS
FRONT
CONTROL
MODULE
(8W-10-54)
INTEGRATED
POWER
MODULE
(8W-10-2)
(8W-10-3)

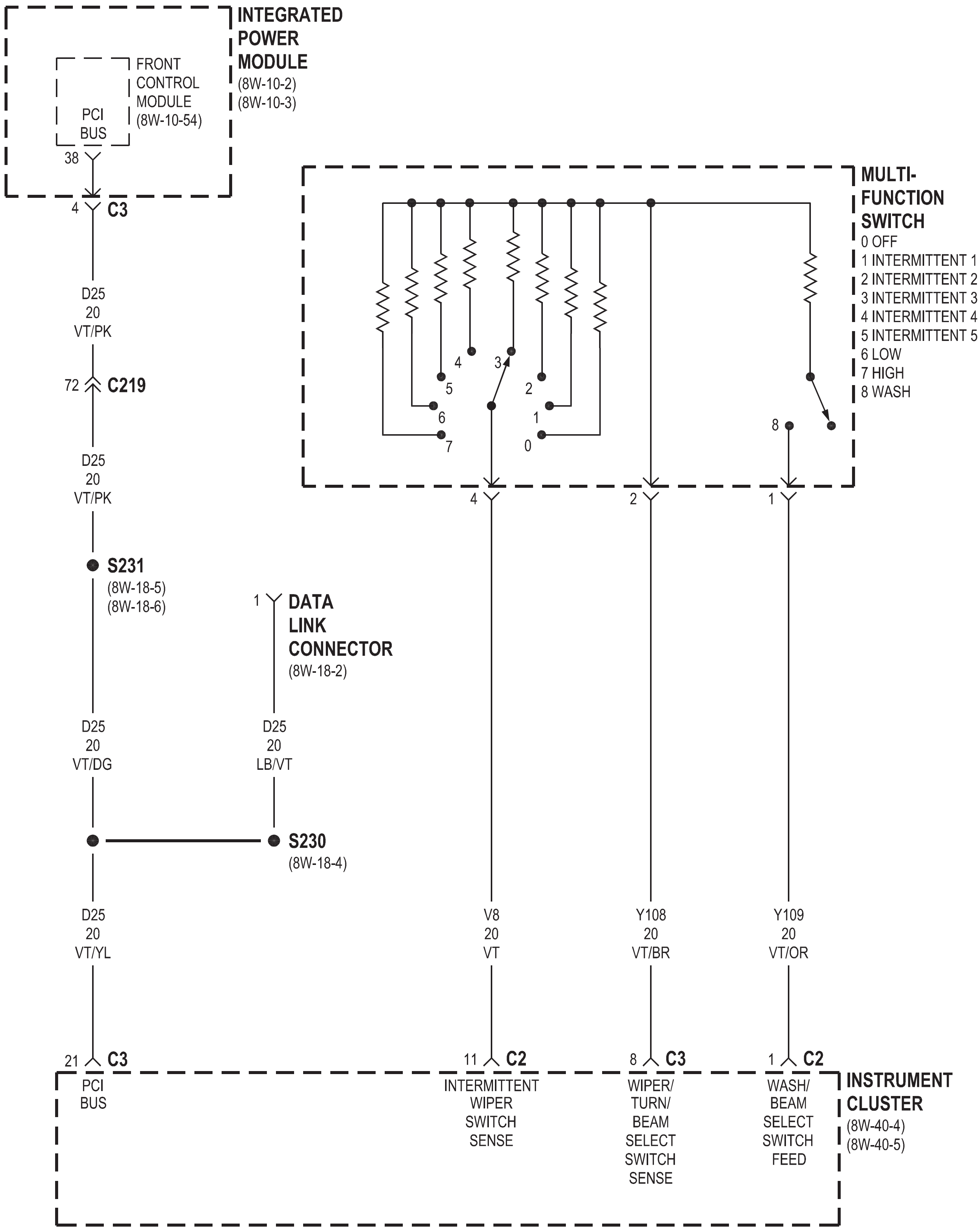

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 15 50A (8W-10-36)
85
30
PARK LAMP RELAY
86
87
87A
15
PARK LAMP RELAY CONTROL
LEFT FRONT TURN LAMP DRIVER
RIGHT FRONT TURN LAMP DRIVER
FRONT CONTROL MODULE
(8W-10-36)
(8W-10-51)
FUSE 34 10A (8W-10-36)
FUSE 32 10A (8W-10-36)
42
45
16 C3
19 C1
19 C3
10 C1
L61 18 LG
Y174 18 PK/VT
L60 18 LG/TN
L7 18 BK/YL
S102
(8W-10-36)
S106
(8W-10-36)
Y174 18 PK/VT
4 C217
S324
(8W-10-36)
1 C310
D5
C2 C130
8 C216
✳ 11
■ 8
✳ 12
■ 9
C100
S326
(8W-10-37)
1
2
PARK/ TURN SIGNAL LAMP- LEFT FRONT
PARK/ TURN SIGNAL LAMP- RIGHT FRONT
3
Z148 18 DB/PK
Z147 18 BK/LB
S101
(8W-15-7)
A
TO
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
(8W-52-4)
G104
(8W-15-6)
✳ DIESEL
■ GAS
G105
(8W-15-7)
B
TO
C307
(8W-52-5)


INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-51)
(8W-10-54)
LEFT REAR TURN LAMP DRIVER
LEFT STOP LAMP DRIVER
44
43
18
C3
17
C3
L63
18
DG/RD
L24
18
WT/LG
11
C217
FROM
C310
(8W-52-3)
A
4
C216
L63
18
DG/RD
L24
18
WT/LG
TAIL LAMP JUMPER
STANDARD
Y174
18
PK/VT
TAIL LAMP JUMPER
STANDARD
5
C310
4
C310
L63
18
DG/RD
L24
18
WT/LG
5
1
4
TAIL/ STOP/ TURN SIGNAL LAMP- LEFT
TAIL/ TURN LAMP
TAIL/ STOP LAMP
3
TAIL LAMP JUMPER
STANDARD
3
C310
Z150
18
BK
S308
(8W-15-3)
Z13
14
BK
14
C217
EXCEPT ABS
ABS
Z13
16
BK
Z13
16
BK
G103
(8W-15-2)
G104
(8W-15-5)

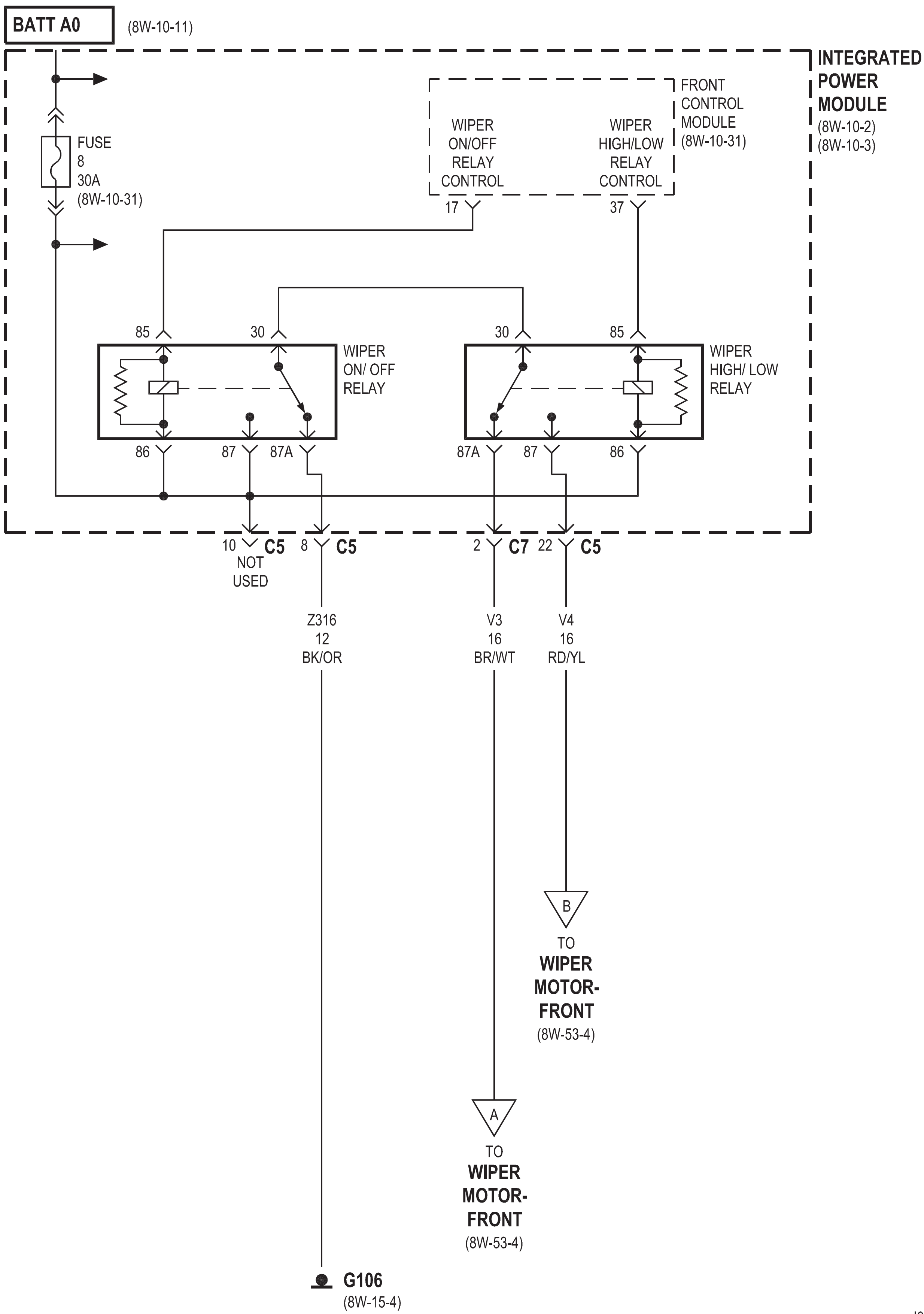

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-51)
(8W-10-54)
RIGHT REAR TURN LAMP DRIVER
RIGHT STOP LAMP DRIVER
19
41
2 C3
2 C4
L62 18 BR/RD
L22 18 LB/WT
FROM S326 (8W-52-3)
B
5 C216
10 C217
L7 18 BK/YL
TAIL LAMP JUMPER
STANDARD
5 C307
1
4 C307
L62 18 DG/RD
Y174 18 PK/VT
L24 18 WT/LG
5
1
4
TAIL/ STOP/ TURN SIGNAL LAMP- RIGHT
TAIL/ TURN LAMP
TAIL/ STOP LAMP
3
Z150 18 BK
3 C307
S308 (8W-15-3)
Z13 14 BK
14 C217
EXCEPT ABS
ABS
Z13 16 BK
G103 (8W-15-2)
G104 (8W-15-5)

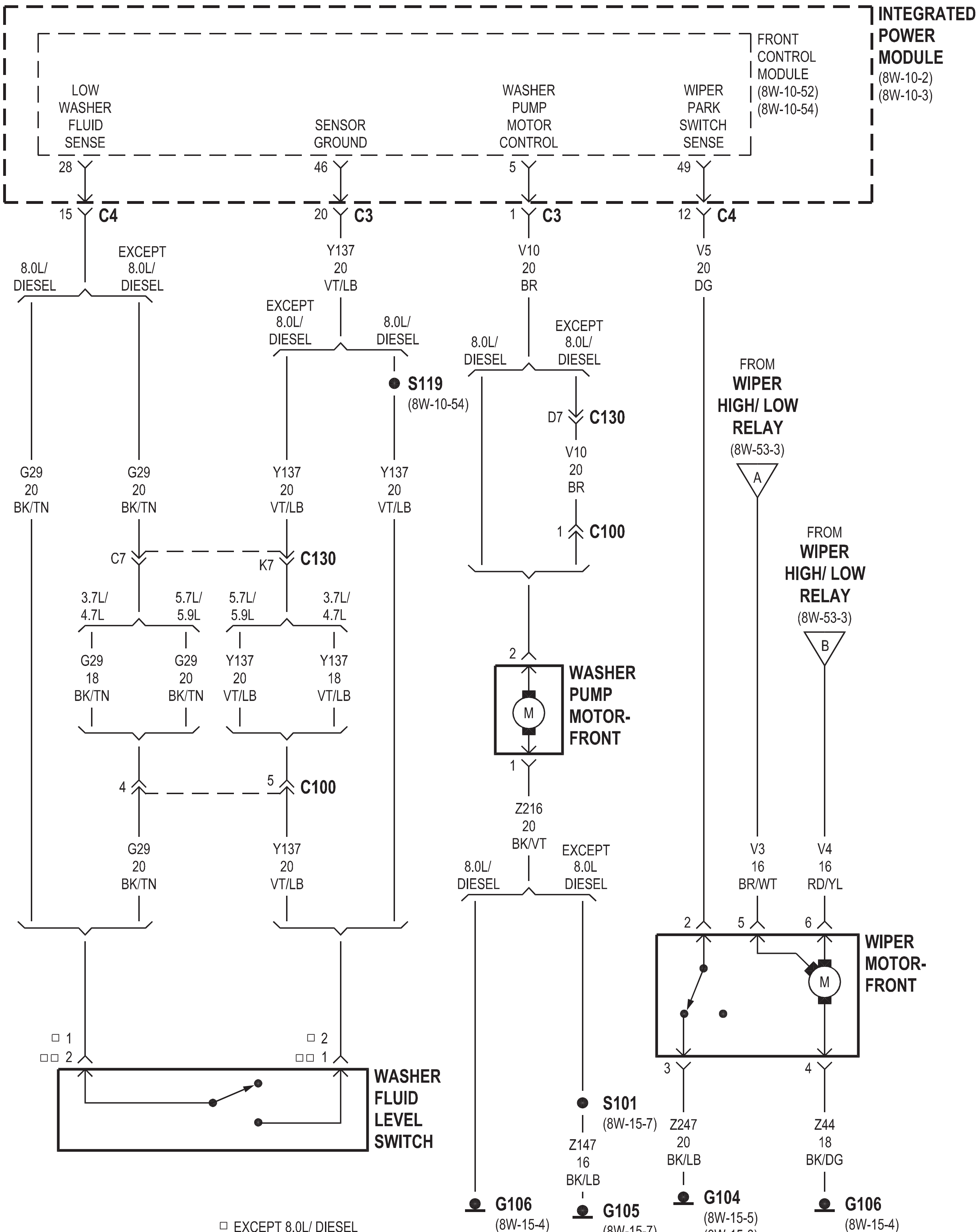

BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 47 15A (8W-10-35)
FUSE 46 15A (8W-10-35)
TRAILER TOW RIGHT TURN RELAY CONTROL
TRAILER TOW LEFT TURN RELAY CONTROL
FRONT CONTROL MODULE (8W-10-35)
34
14
30
85
86
87
87A
TRAILER TOW RIGHT TURN RELAY (8W-54-2) (8W-54-3)
TRAILER TOW LEFT TURN RELAY (8W-54-2) (8W-54-3)
7 C1
5 C1
Y140 18 WT/PK
Y141 18 DG/WT
13
1 C217
Y141 18 YL/PK
EXCEPT TRAILER TOW CONNECTOR ADD ON
TRAILER TOW CONNECTOR ADD ON
S330 (8W-10-35)
S331 (8W-10-35)
2
10
TRAILER TOW CONNECTOR- ADD ON (8W-54-2)
4
3
TRAILER TOW CONNECTOR (8W-54-2) (8W-54-3)

8W-53 WIPERS



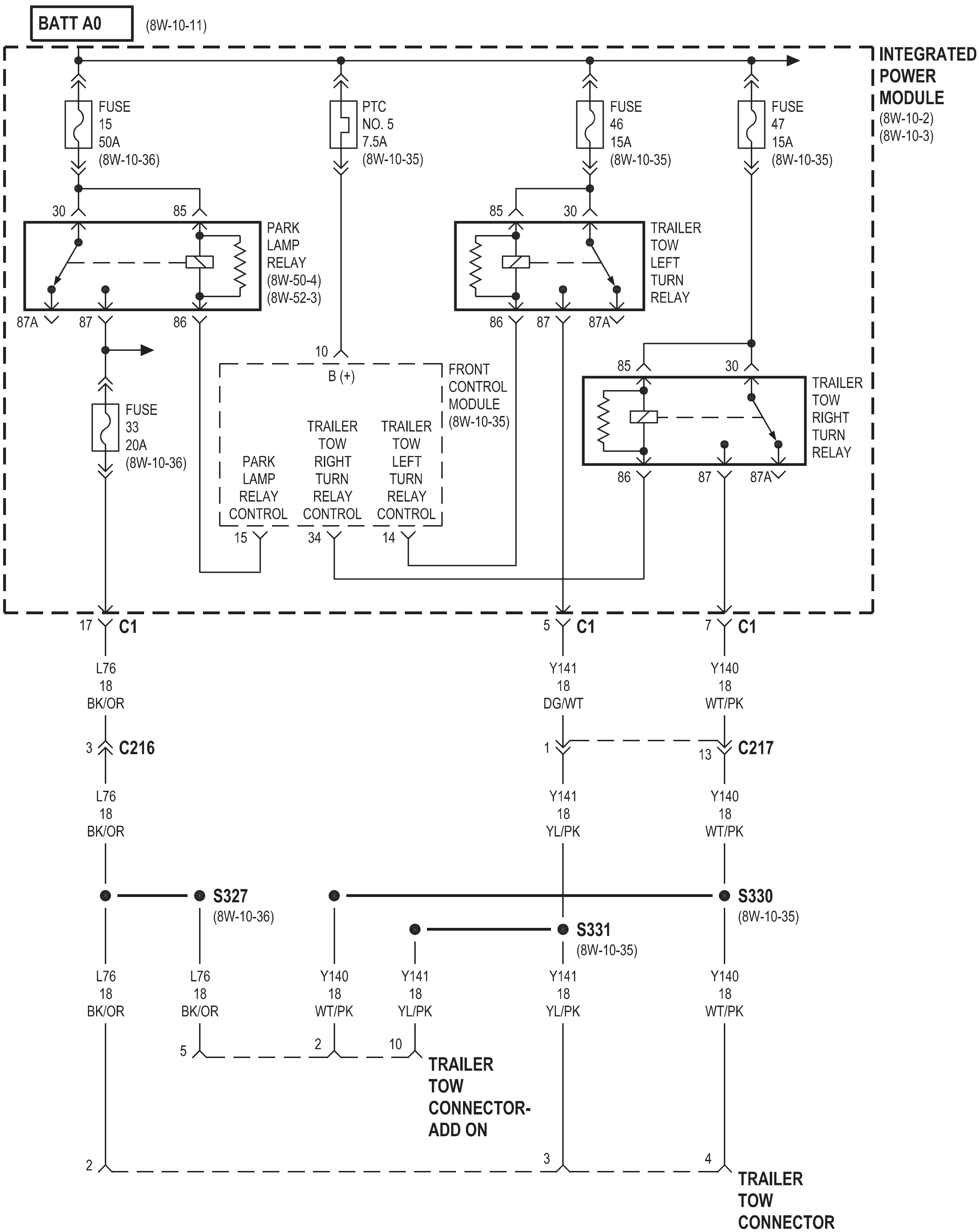
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-54)
PCI BUS
38
4 C3
D25
20
VT/PK
72 C219
D25
20
VT/PK
S231
(8W-18-5)
(8W-18-6)
1 DATA LINK CONNECTOR
(8W-18-2)
D25
20
VT/DG
D25
20
LB/VT
S230
(8W-18-4)
D25
20
VT/YL
MULTI-FUNCTION SWITCH
0 OFF
1 INTERMITTENT 1
2 INTERMITTENT 2
3 INTERMITTENT 3
4 INTERMITTENT 4
5 INTERMITTENT 5
6 LOW
7 HIGH
8 WASH
V8
20
VT
Y108
20
VT/BR
Y109
20
VT/OR
21 C3
PCI BUS
11 C2
INTERMITTENT WIPER SWITCH SENSE
8 C3
WIPER/ TURN/ BEAM SELECT SWITCH SENSE
1 C2
WASH/ BEAM SELECT SWITCH FEED
INSTRUMENT CLUSTER
(8W-40-4)
(8W-40-5)


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
8
30A
(8W-10-31)
FRONT CONTROL MODULE
(8W-10-31)
WIPER ON/OFF RELAY CONTROL
WIPER HIGH/LOW RELAY CONTROL
17
37
85
30
30
85
WIPER ON/ OFF RELAY
WIPER HIGH/ LOW RELAY
86
87
87A
87A
87
86
10 C5
NOT USED
8 C5
2 C7
22 C5
Z316
12
BK/OR
V3
16
BR/WT
V4
16
RD/YL
B
TO
WIPER MOTOR-FRONT
(8W-53-4)
A
TO
WIPER MOTOR-FRONT
(8W-53-4)
G106
(8W-15-4)

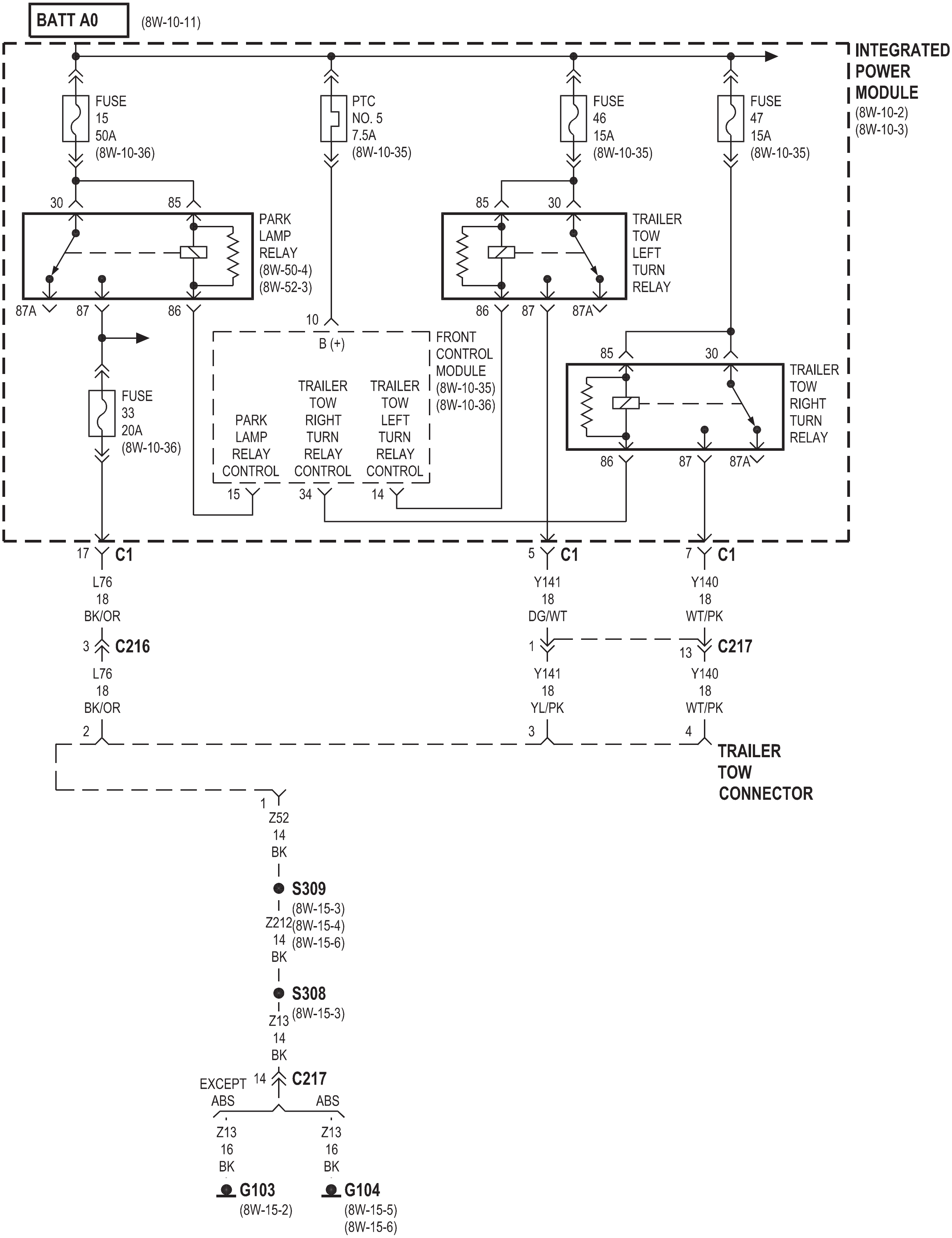

INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FRONT CONTROL MODULE
(8W-10-52)
(8W-10-54)
LOW WASHER FLUID SENSE
SENSOR GROUND
WASHER PUMP MOTOR CONTROL
WIPER PARK SWITCH SENSE
28
46
5
49
15 C4
20 C3
1 C3
12 C4
8.0L/ DIESEL
EXCEPT 8.0L/ DIESEL
Y137 20 VT/LB
V10 20 BR
V5 20 DG
S119
(8W-10-54)
D7 C130
V10 20 BR
1 C100
FROM WIPER HIGH/ LOW RELAY
(8W-53-3)
A
B
G29 20 BK/TN
Y137 20 VT/LB
C7
K7 C130
3.7L/ 4.7L
5.7L/ 5.9L
G29 18 BK/TN
G29 20 BK/TN
Y137 20 VT/LB
Y137 18 VT/LB
4
5 C100
2
1
M
WASHER PUMP MOTOR-FRONT
Z216 20 BK/VT
EXCEPT 8.0L DIESEL
V3 16 BR/WT
V4 16 RD/YL
2
5
6
WIPER MOTOR-FRONT
3
4
□ 1
□□ 2
□ 2
□□ 1
WASHER FLUID LEVEL SWITCH
S101
(8W-15-7)
Z147 16 BK/LB
Z247 20 BK/LB
Z44 18 BK/DG
G106
(8W-15-4)
G105
(8W-15-7)
G104
(8W-15-5)
(8W-15-6)
G106
(8W-15-4)
□ EXCEPT 8.0L/ DIESEL
□□ 8.0L/ DIESEL

8W-54 TRAILER TOW

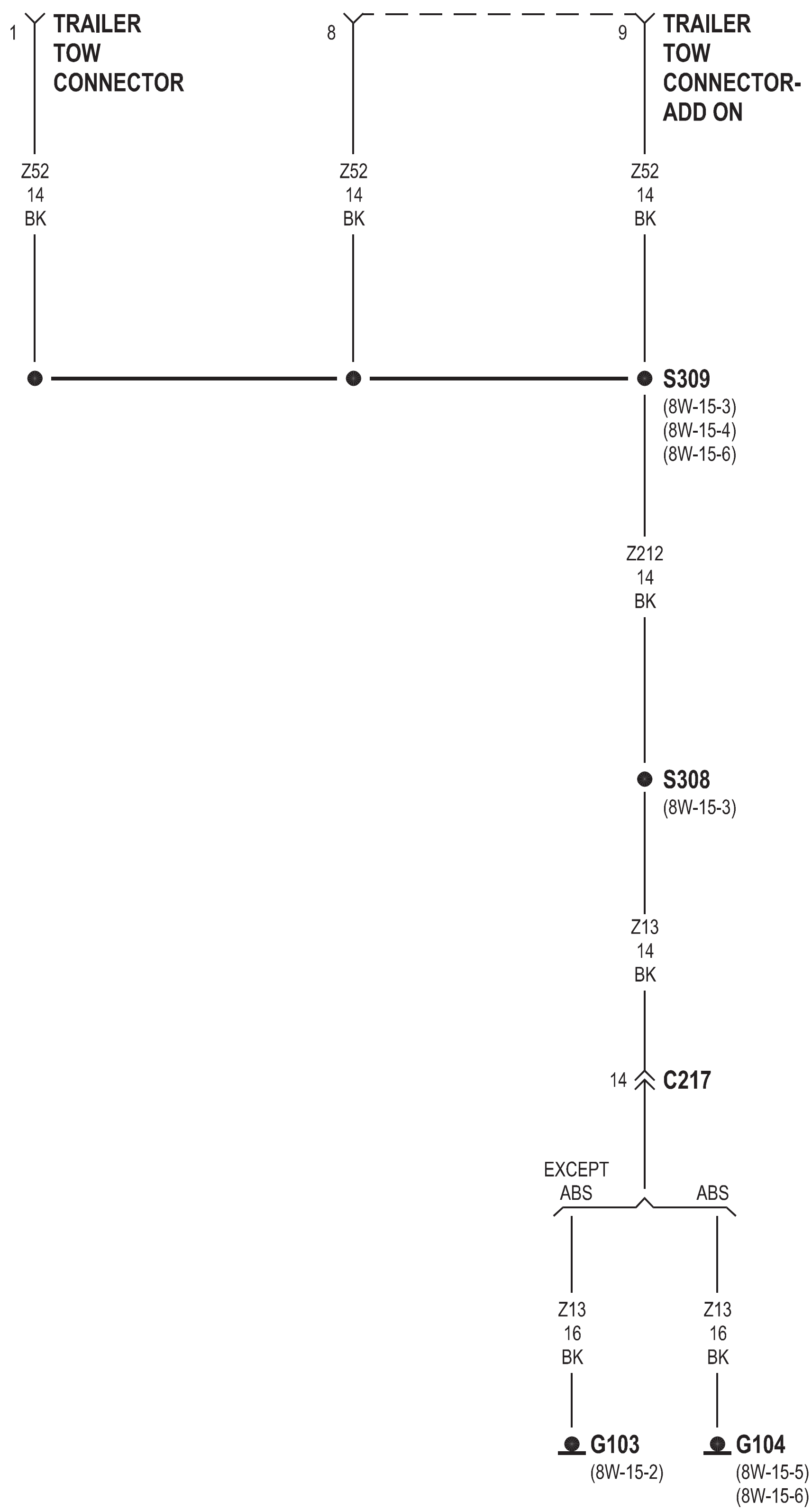
ADD ON TRAILER TOW



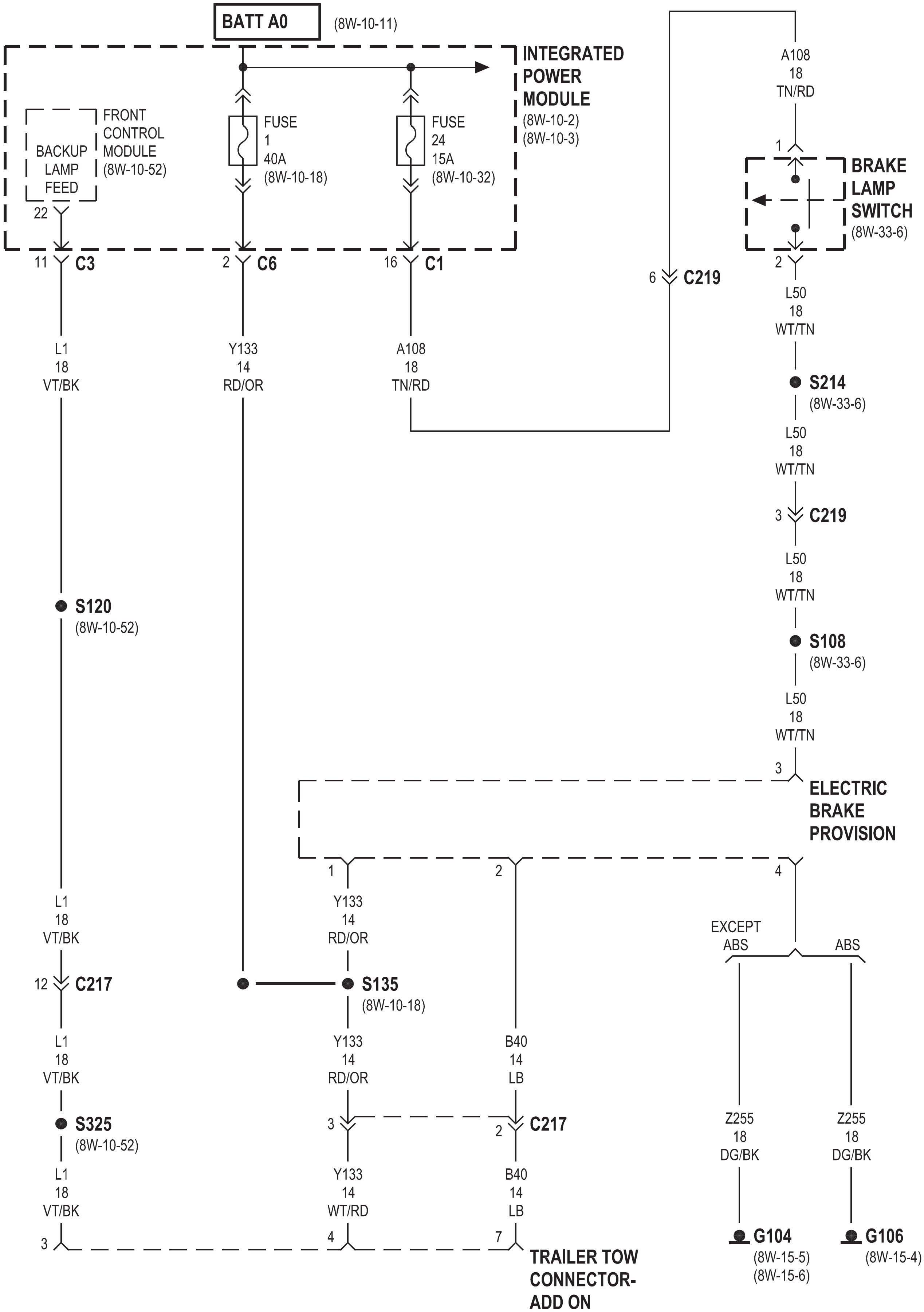
EXCEPT ADD ON TRAILER TOW



ADD ON TRAILER TOW

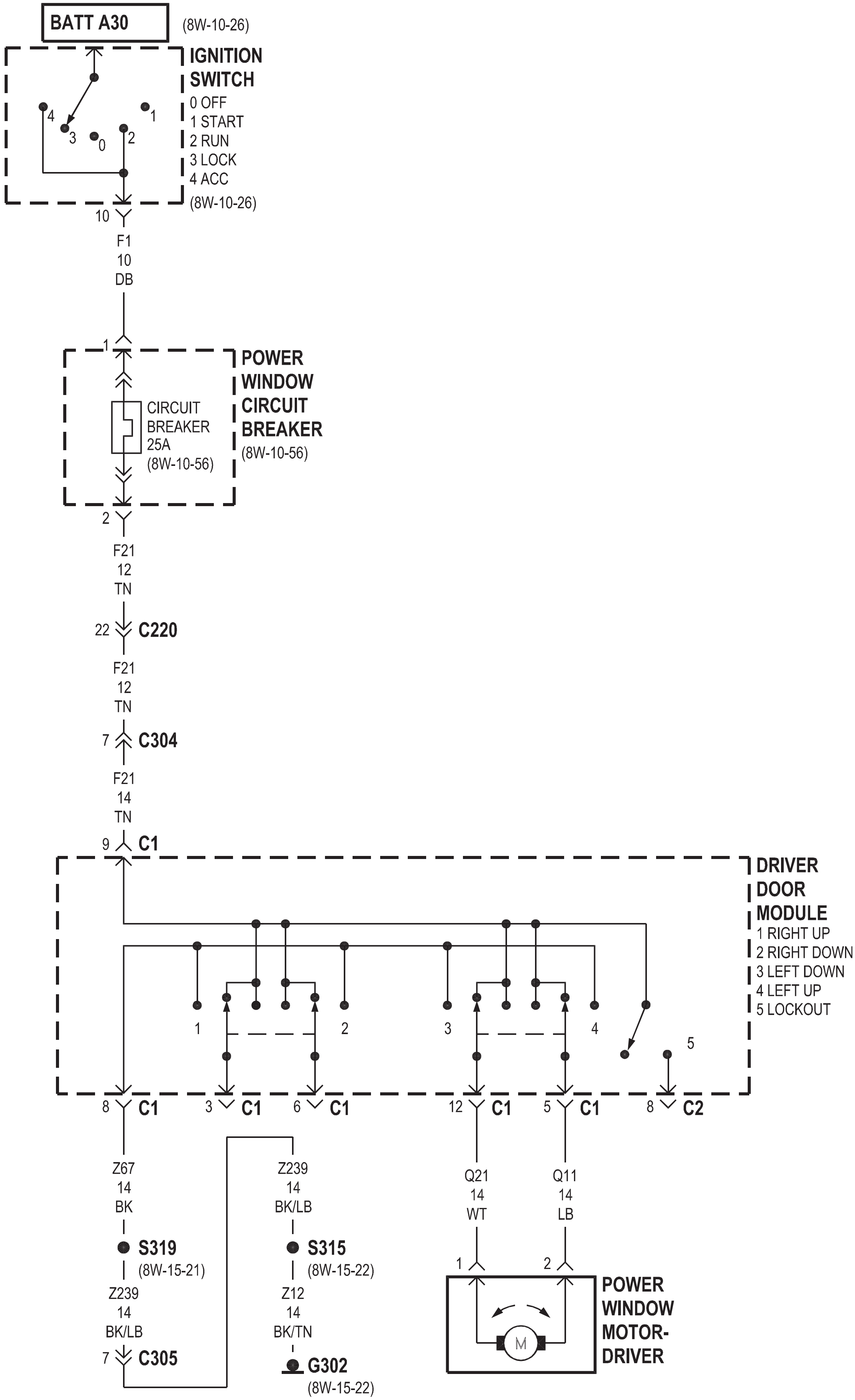


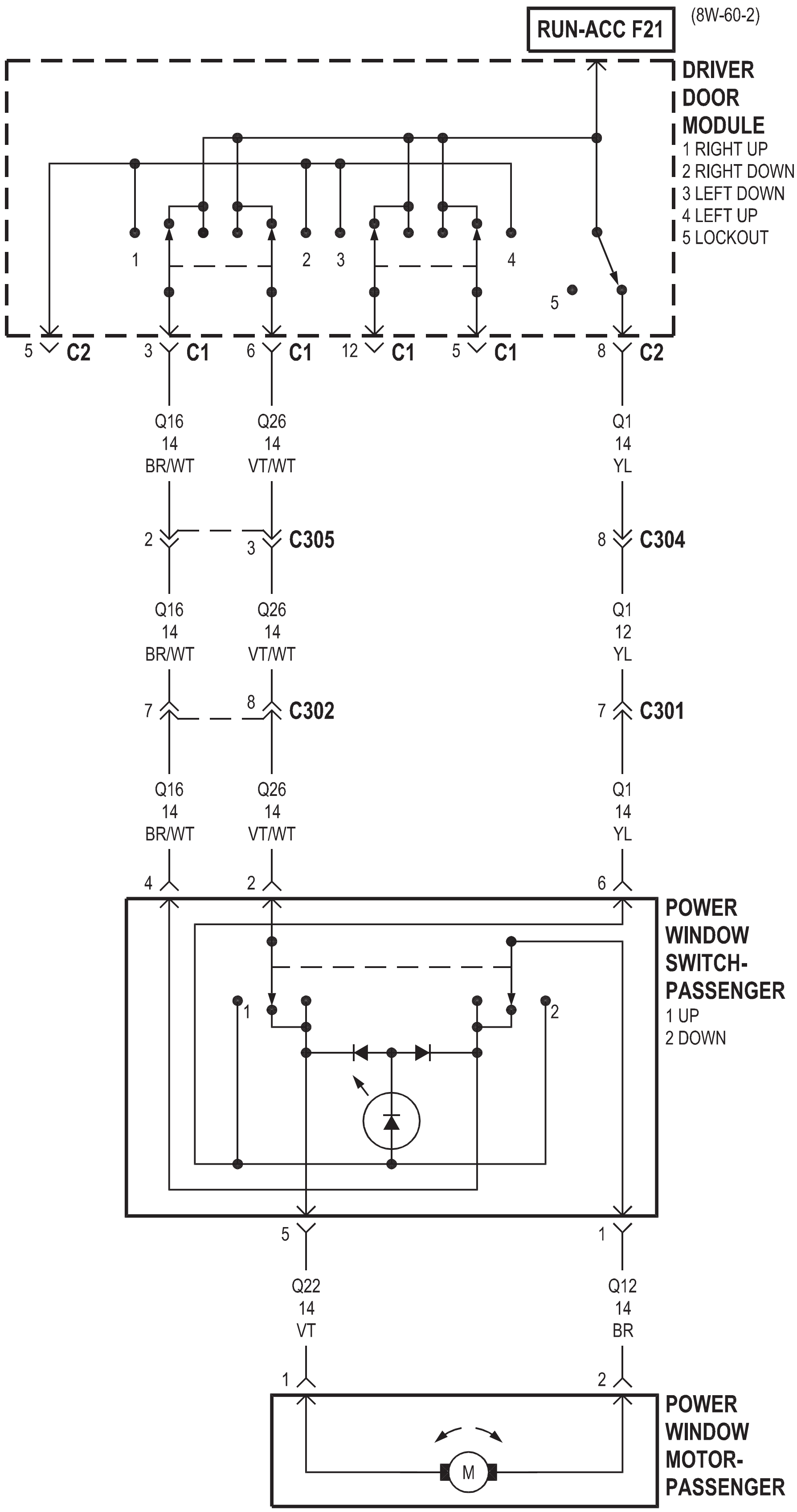
ADD ON TRAILER TOW

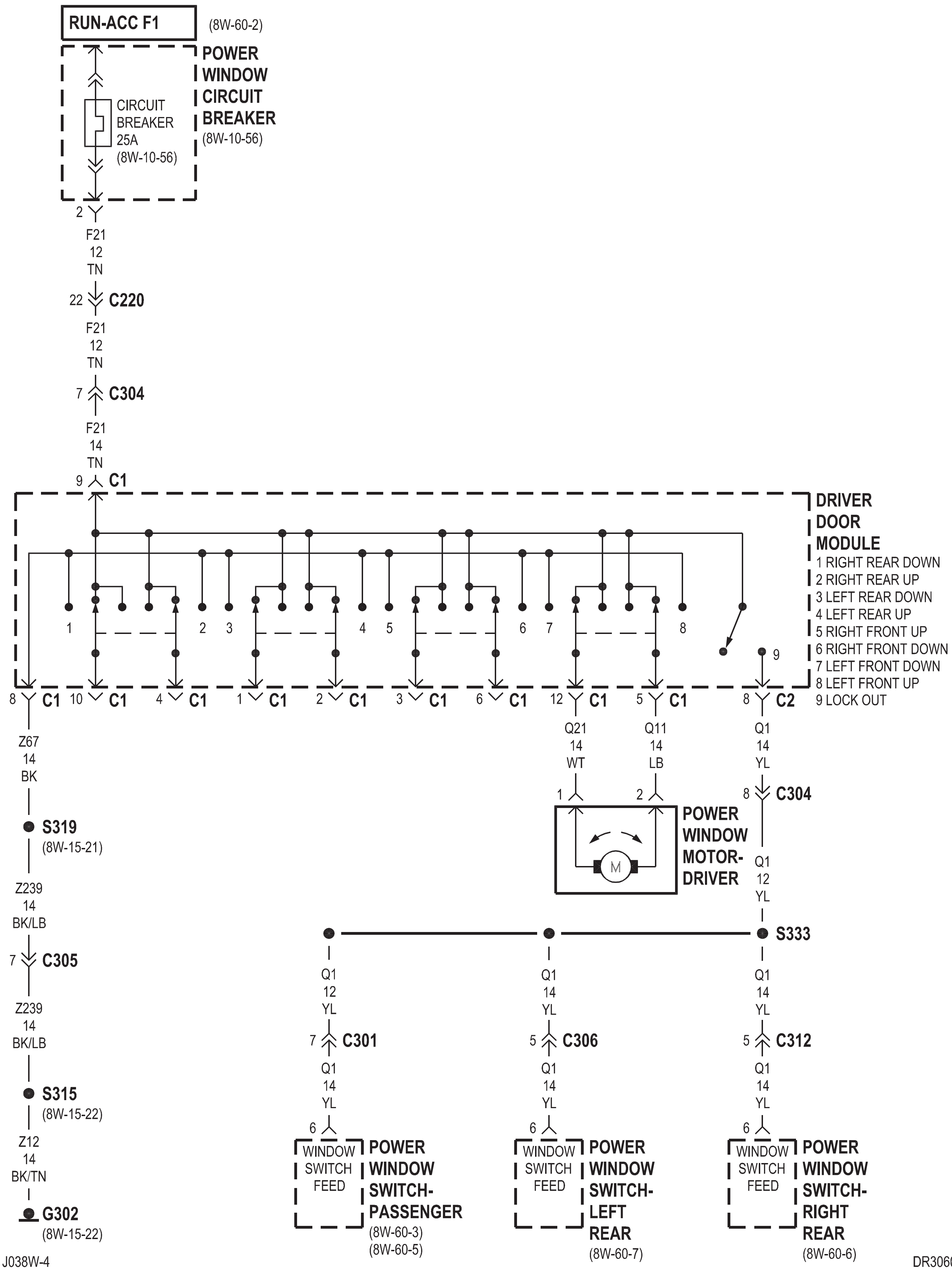


8W-60 POWER WINDOWS

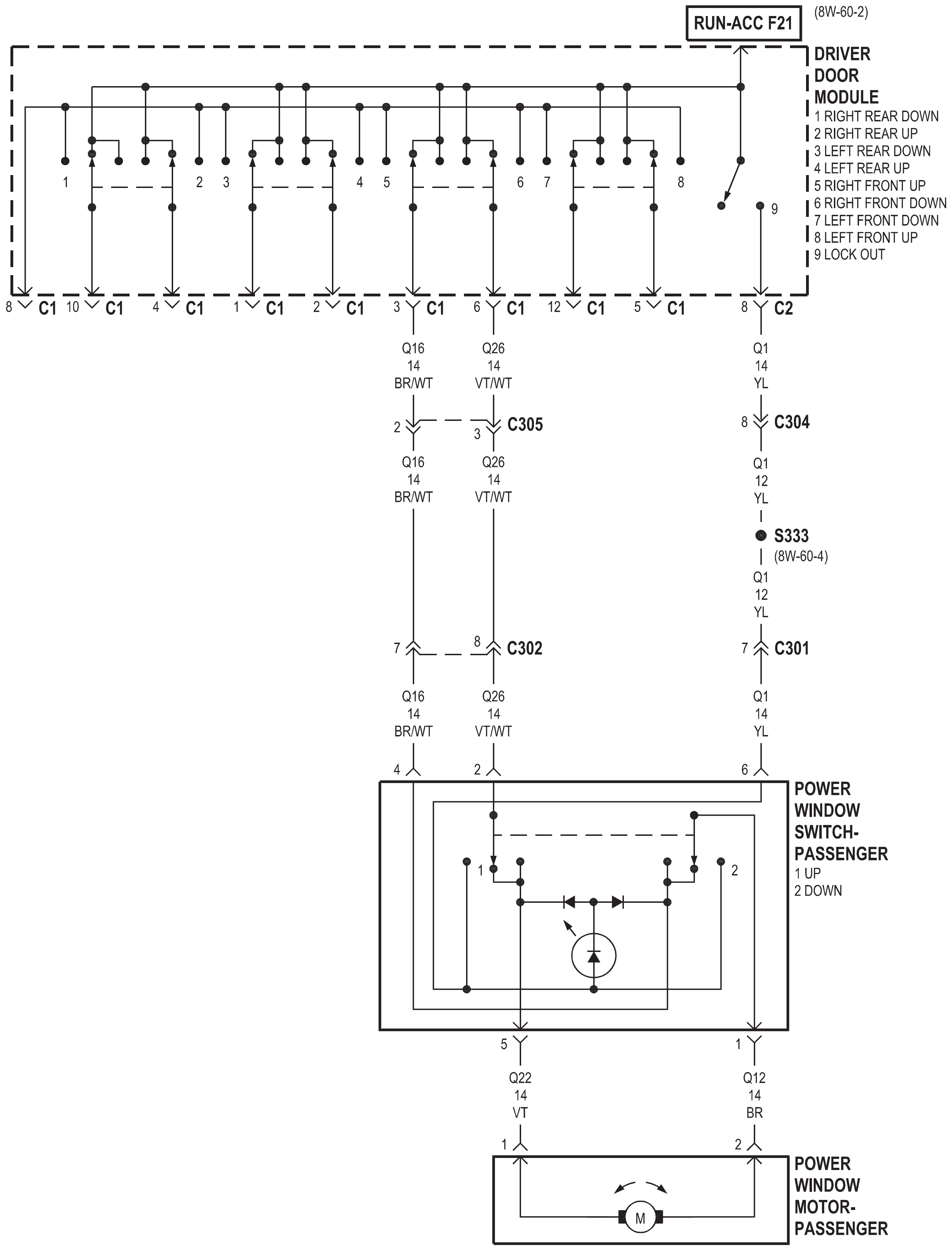
STANDARD CAB

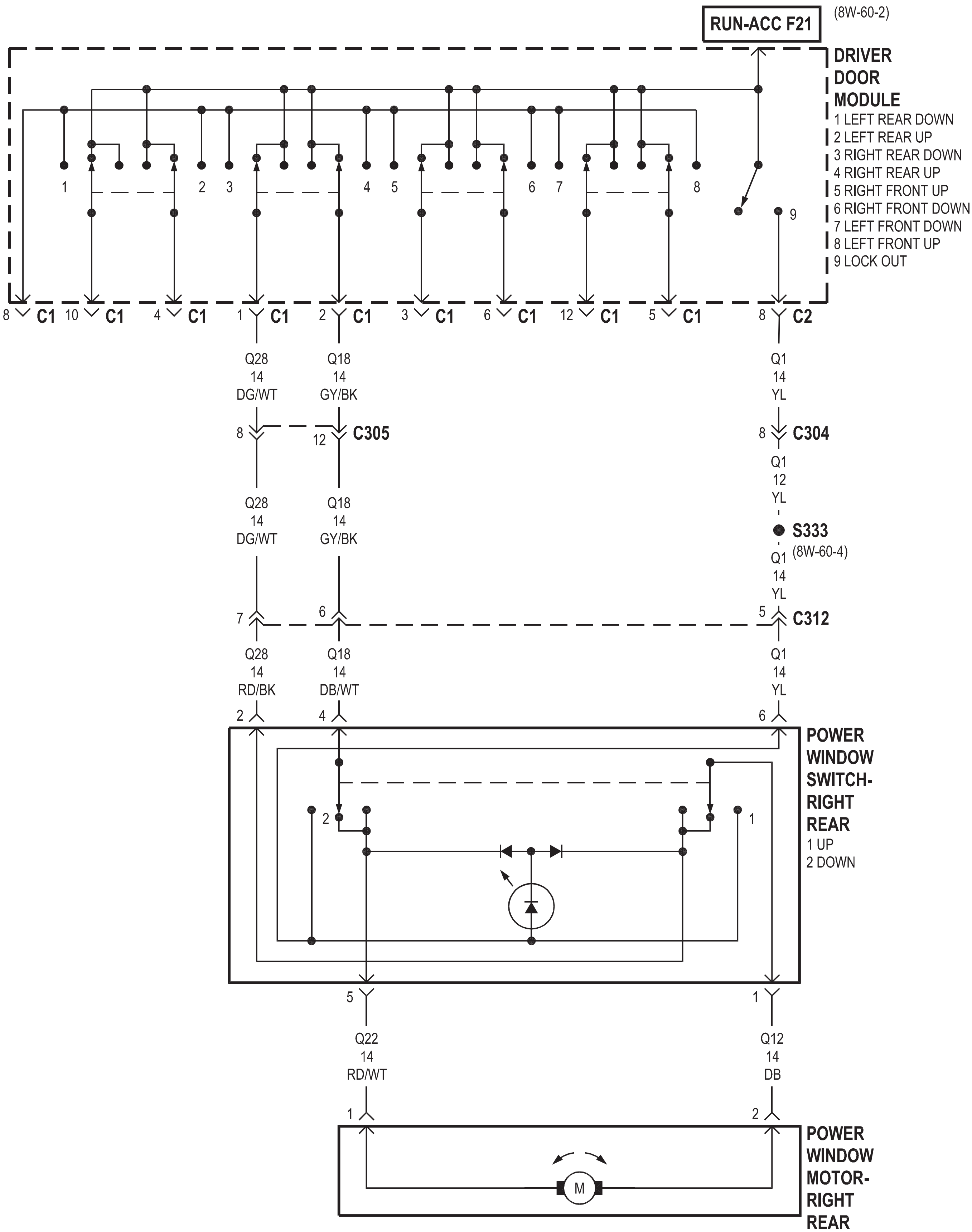


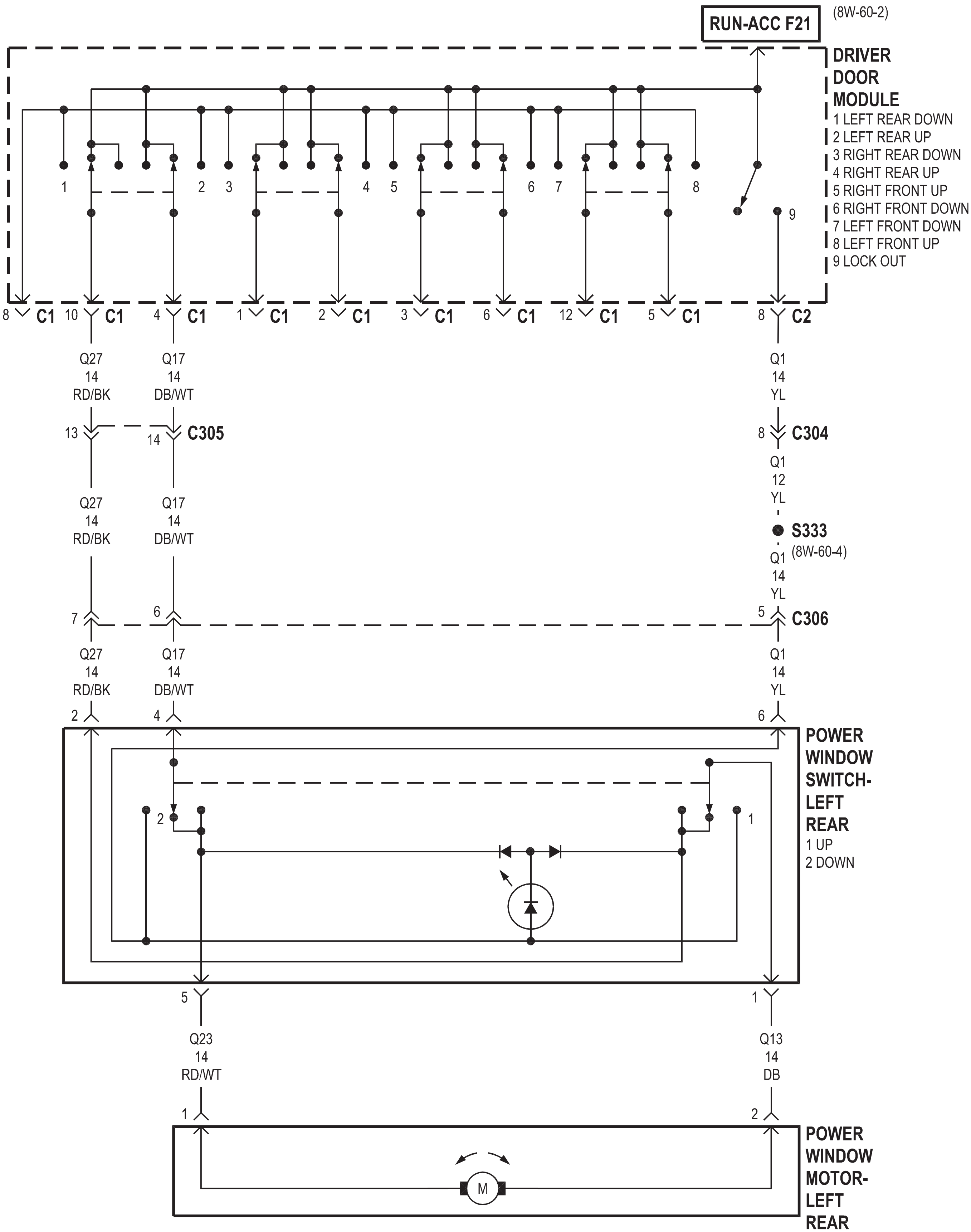

RUN-ACC F21
(8W-60-2)
DRIVER
DOOR
MODULE
1 RIGHT UP
2 RIGHT DOWN
3 LEFT DOWN
4 LEFT UP
5 LOCKOUT
1
2
3
4
5
5 C2
3 C1
6 C1
12 C1
5 C1
8 C2
Q16
14
BR/WT
Q26
14
VT/WT
Q1
14
YL
2
3 C305
8 C304
Q16
14
BR/WT
Q26
14
VT/WT
Q1
12
YL
7
8 C302
7 C301
Q16
14
BR/WT
Q26
14
VT/WT
Q1
14
YL
4
2
6
POWER
WINDOW
SWITCH-
PASSENGER
1 UP
2 DOWN
1
2
5
1
Q22
14
VT
Q12
14
BR
1
2
POWER
WINDOW
MOTOR-
PASSENGER
M



J038W-4 DR306004


RUN-ACC F21
(8W-60-2)
DRIVER
DOOR
MODULE
1 RIGHT REAR DOWN
2 RIGHT REAR UP
3 LEFT REAR DOWN
4 LEFT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
8 C1
10 C1
4 C1
1 C1
2 C1
3 C1
6 C1
12 C1
5 C1
8 C2
Q16
14
BR/WT
Q26
14
VT/WT
Q1
14
YL
2
3
C305
8
C304
Q1
12
YL
S333
(8W-60-4)
7
8
C302
7
C301
4
2
6
POWER
WINDOW
SWITCH-
PASSENGER
1 UP
2 DOWN
5
1
Q22
14
VT
Q12
14
BR
1
2
M
POWER
WINDOW
MOTOR-
PASSENGER


RUN-ACC F21
(8W-60-2)
DRIVER
DOOR
MODULE
1 LEFT REAR DOWN
2 LEFT REAR UP
3 RIGHT REAR DOWN
4 RIGHT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
8 C1
10 C1
4 C1
1 C1
2 C1
3 C1
6 C1
12 C1
5 C1
8 C2
Q28
14
DG/WT
Q18
14
GY/BK
Q1
14
YL
8
12
C305
8
C304
Q1
12
YL
S333
(8W-60-4)
Q1
14
YL
Q28
14
DG/WT
Q18
14
GY/BK
7
6
5
C312
Q28
14
RD/BK
Q18
14
DB/WT
Q1
14
YL
2
4
6
POWER
WINDOW
SWITCH-
RIGHT
REAR
1 UP
2 DOWN
5
1
Q22
14
RD/WT
Q12
14
DB
1
2
POWER
WINDOW
MOTOR-
RIGHT
REAR
M


RUN-ACC F21
(8W-60-2)
DRIVER DOOR MODULE
1 LEFT REAR DOWN
2 LEFT REAR UP
3 RIGHT REAR DOWN
4 RIGHT REAR UP
5 RIGHT FRONT UP
6 RIGHT FRONT DOWN
7 LEFT FRONT DOWN
8 LEFT FRONT UP
9 LOCK OUT
8 C1
10 C1
4 C1
1 C1
2 C1
3 C1
6 C1
12 C1
5 C1
8 C2
Q27 14 RD/BK
Q17 14 DB/WT
Q1 14 YL
13
14 C305
8 C304
Q1 12 YL
S333
(8W-60-4)
7
6
5 C306
POWER WINDOW SWITCH-LEFT REAR
1 UP
2 DOWN
Q23 14 RD/WT
Q13 14 DB
POWER WINDOW MOTOR-LEFT REAR
M

8W-61 POWER DOOR LOCKS

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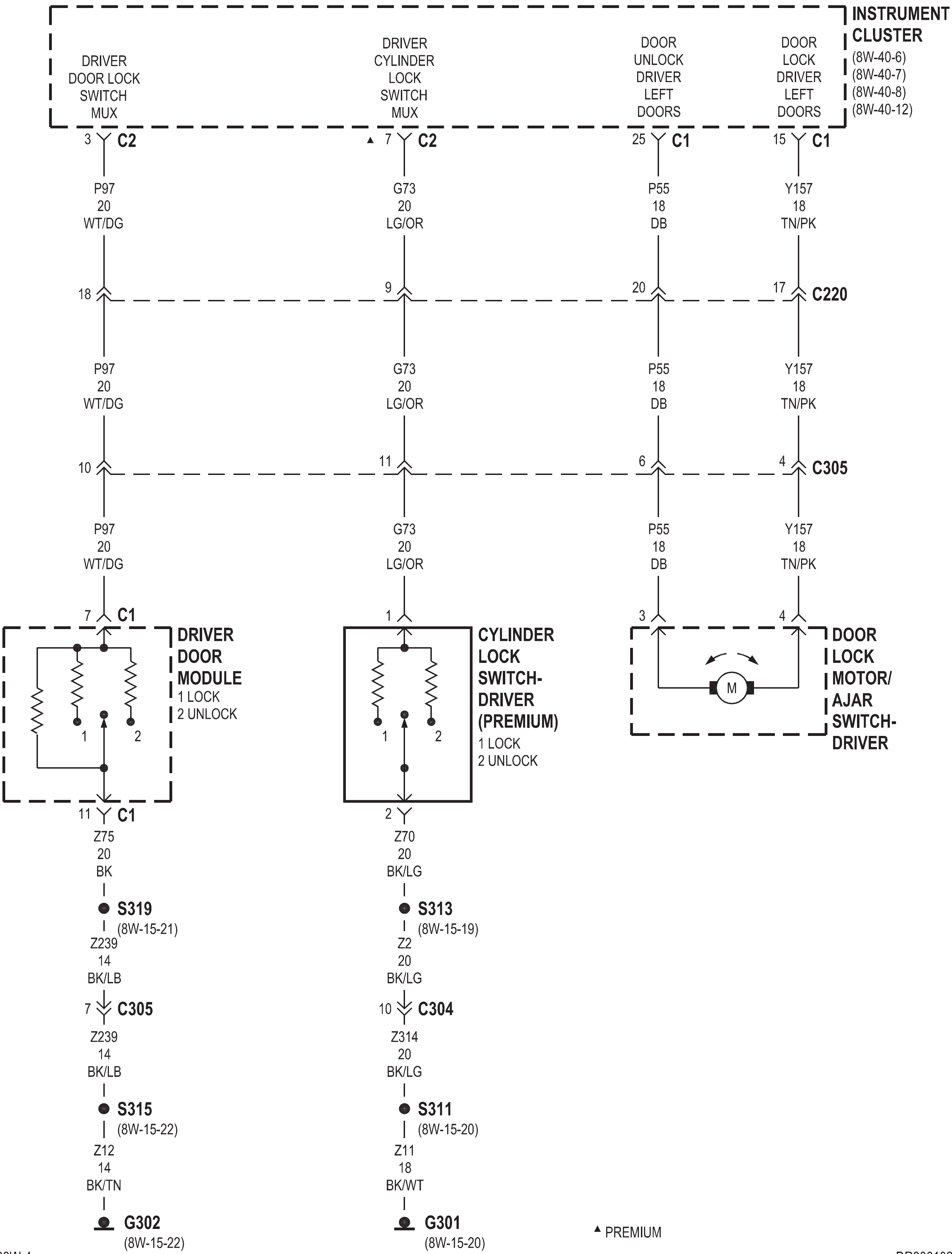
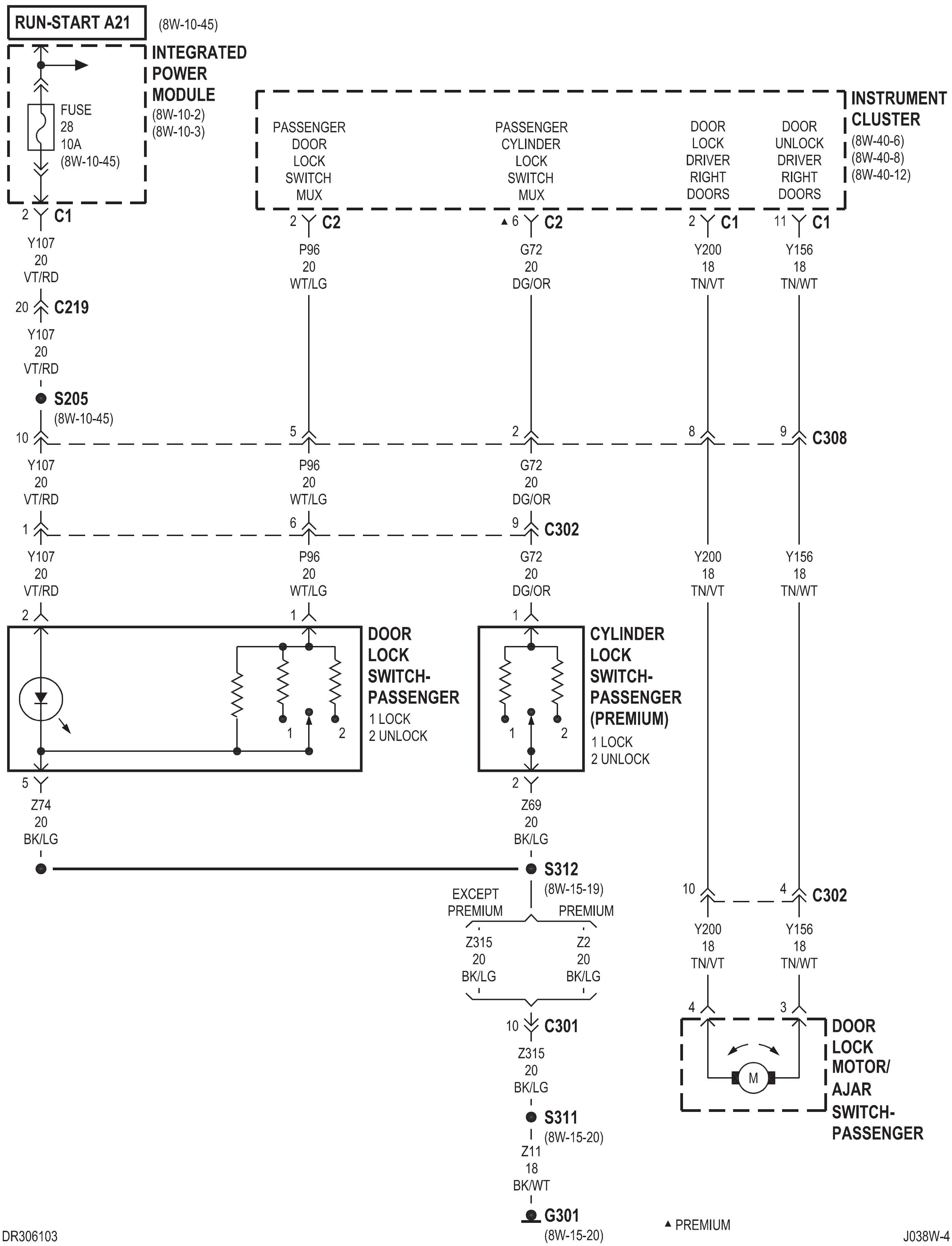
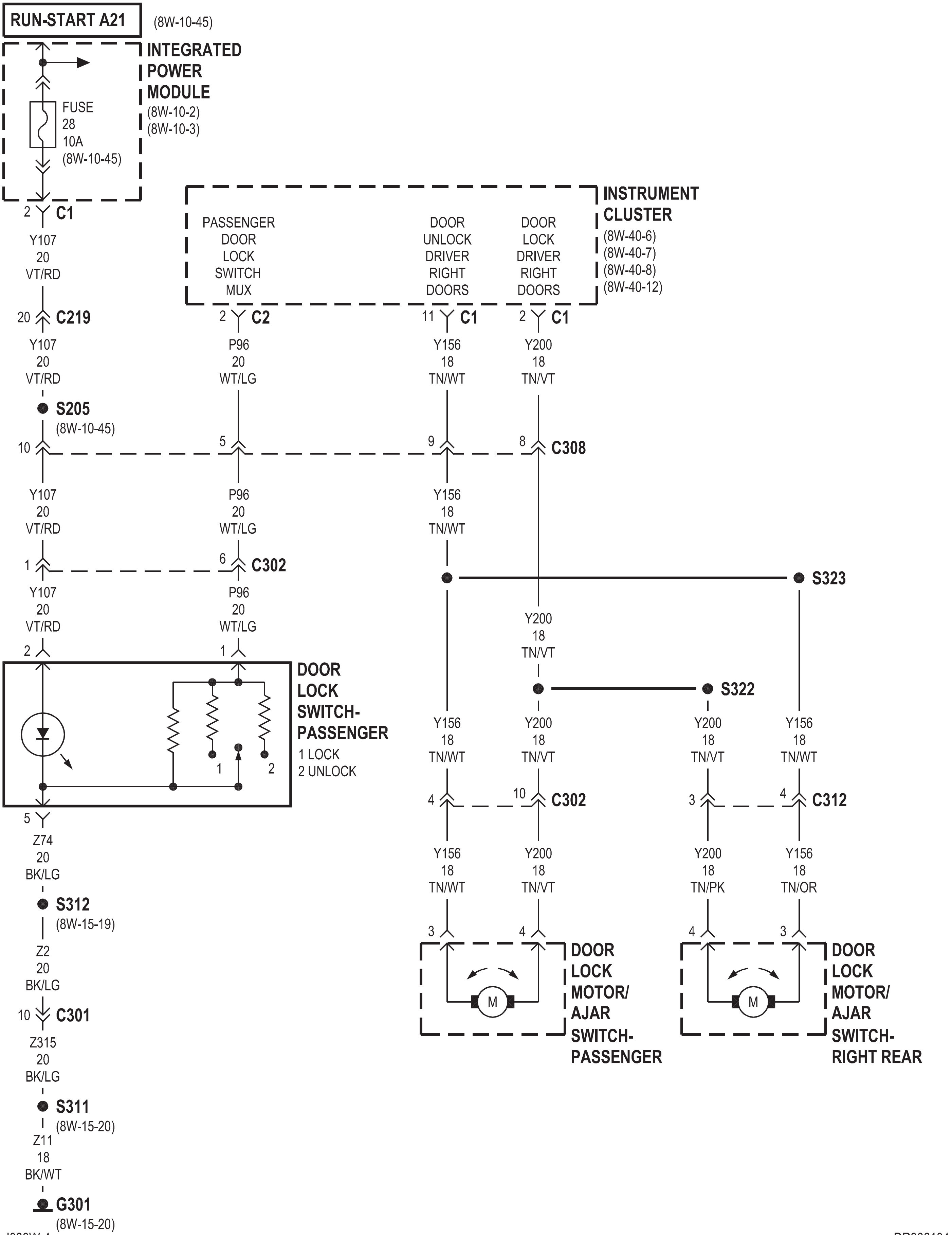
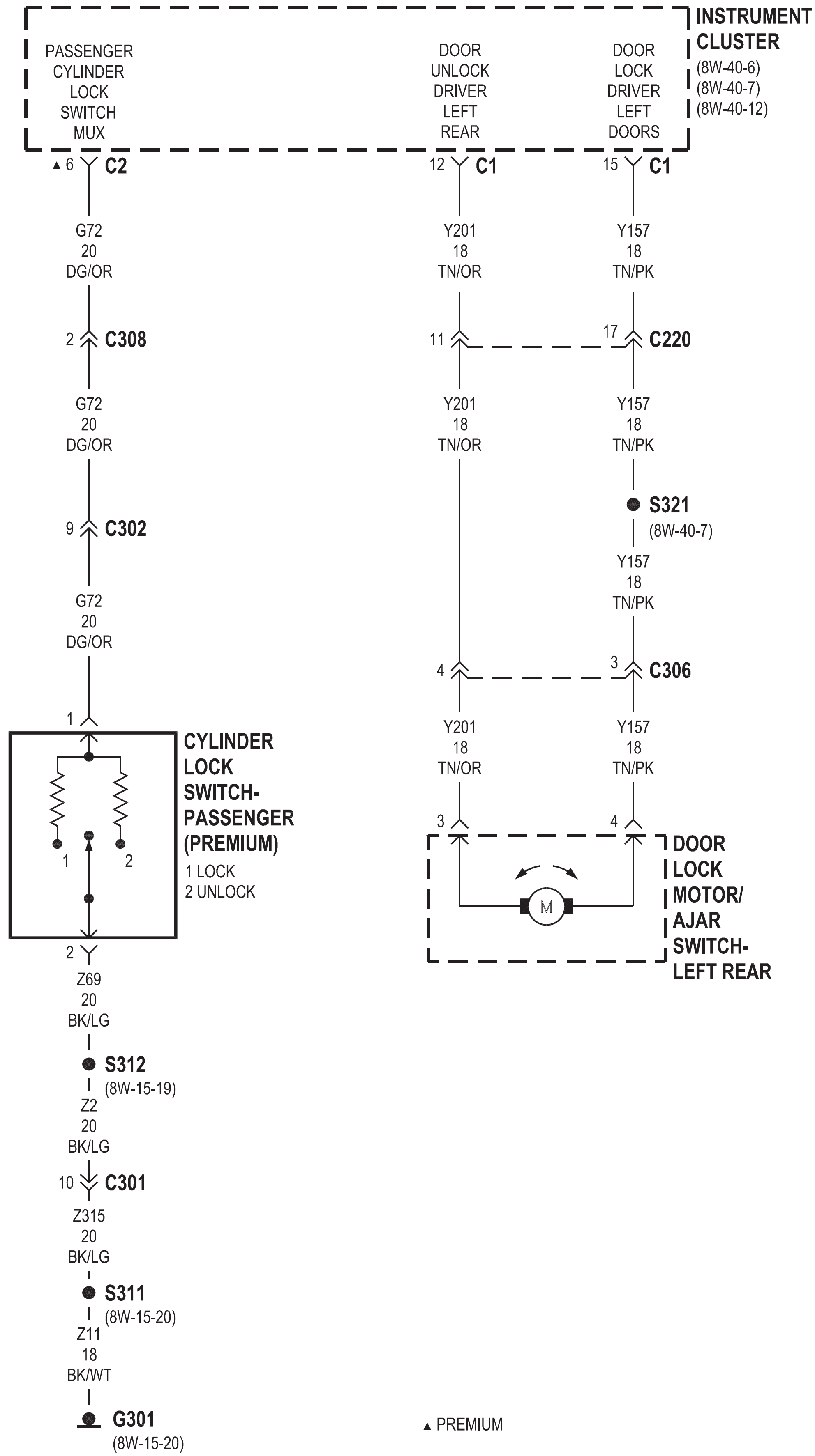

INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-8)
(8W-40-12)
DRIVER DOOR LOCK SWITCH MUX
DRIVER CYLINDER LOCK SWITCH MUX
DOOR UNLOCK DRIVER LEFT DOORS
DOOR LOCK DRIVER LEFT DOORS
3 C2
▲ 7 C2
25 C1
15 C1
P97 20 WT/DG
G73 20 LG/OR
P55 18 DB
Y157 18 TN/PK
18
9
20
17 C220
10
11
6
4 C305
7 C1
1
3
4
DRIVER DOOR MODULE
1 LOCK
2 UNLOCK
CYLINDER LOCK SWITCH-DRIVER (PREMIUM)
1 LOCK
2 UNLOCK
M
DOOR LOCK MOTOR/ AJAR SWITCH-DRIVER
11 C1
2
Z75 20 BK
Z70 20 BK/LG
S319 (8W-15-21)
S313 (8W-15-19)
Z239 14 BK/LB
Z2 20 BK/LG
7 C305
10 C304
Z314 20 BK/LG
S315 (8W-15-22)
S311 (8W-15-20)
Z12 14 BK/TN
Z11 18 BK/WT
G302 (8W-15-22)
G301 (8W-15-20)
▲ PREMIUM



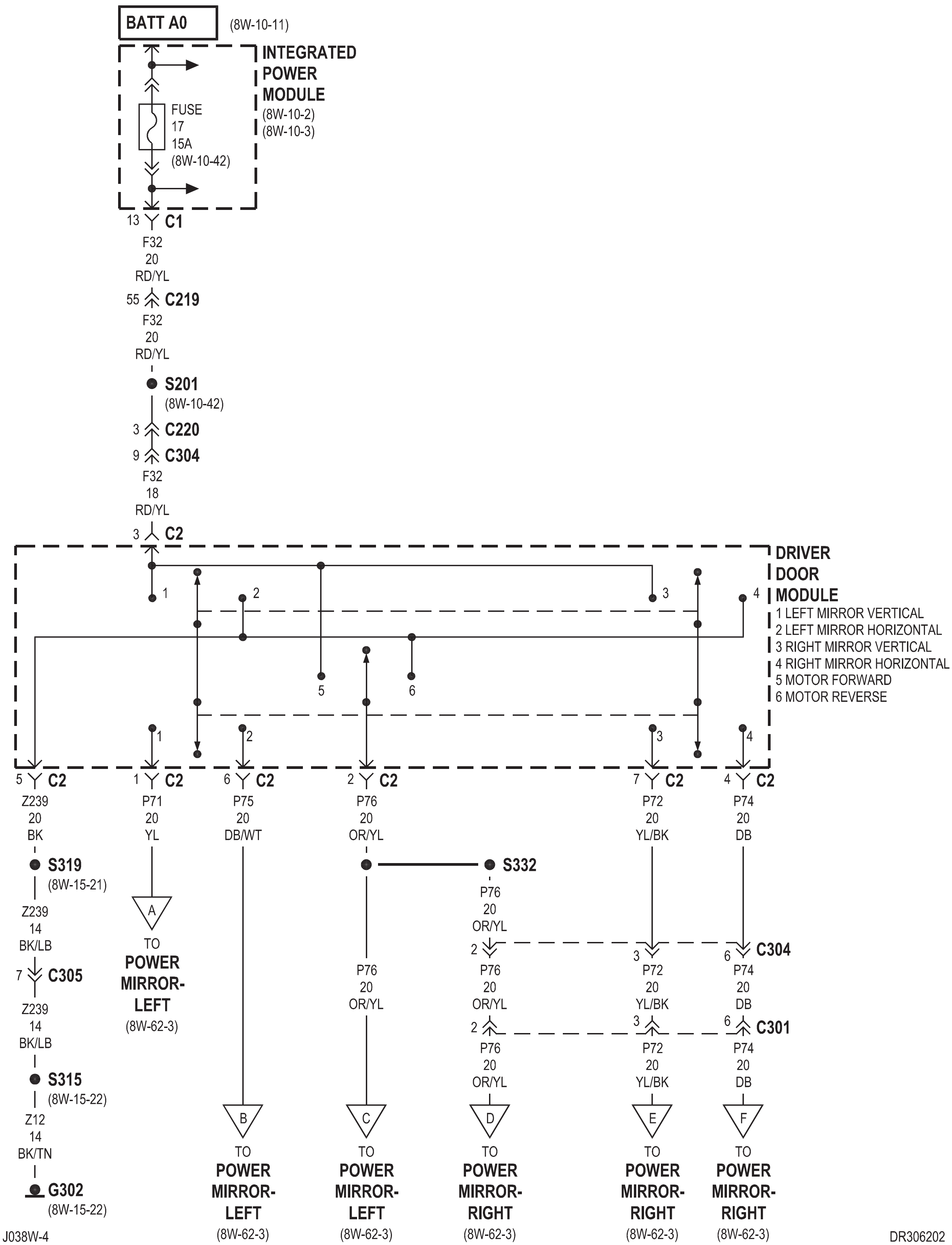
RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 28 10A (8W-10-45)
2 C1
Y107 20 VT/RD
20 C219
S205
(8W-10-45)
INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-8)
(8W-40-12)
PASSENGER DOOR LOCK SWITCH MUX
PASSENGER CYLINDER LOCK SWITCH MUX
DOOR LOCK DRIVER RIGHT DOORS
DOOR UNLOCK DRIVER RIGHT DOORS
2 C2
▲ 6 C2
2 C1
11 C1
P96 20 WT/LG
G72 20 DG/OR
Y200 18 TN/VT
Y156 18 TN/WT
C308
C302
DOOR LOCK SWITCH-PASSENGER
1 LOCK
2 UNLOCK
CYLINDER LOCK SWITCH-PASSENGER (PREMIUM)
1 LOCK
2 UNLOCK
Z74 20 BK/LG
Z69 20 BK/LG
S312
(8W-15-19)
EXCEPT PREMIUM
PREMIUM
Z315 20 BK/LG
Z2 20 BK/LG
10 C301
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)
DOOR LOCK MOTOR/ AJAR SWITCH-PASSENGER
M
▲ PREMIUM

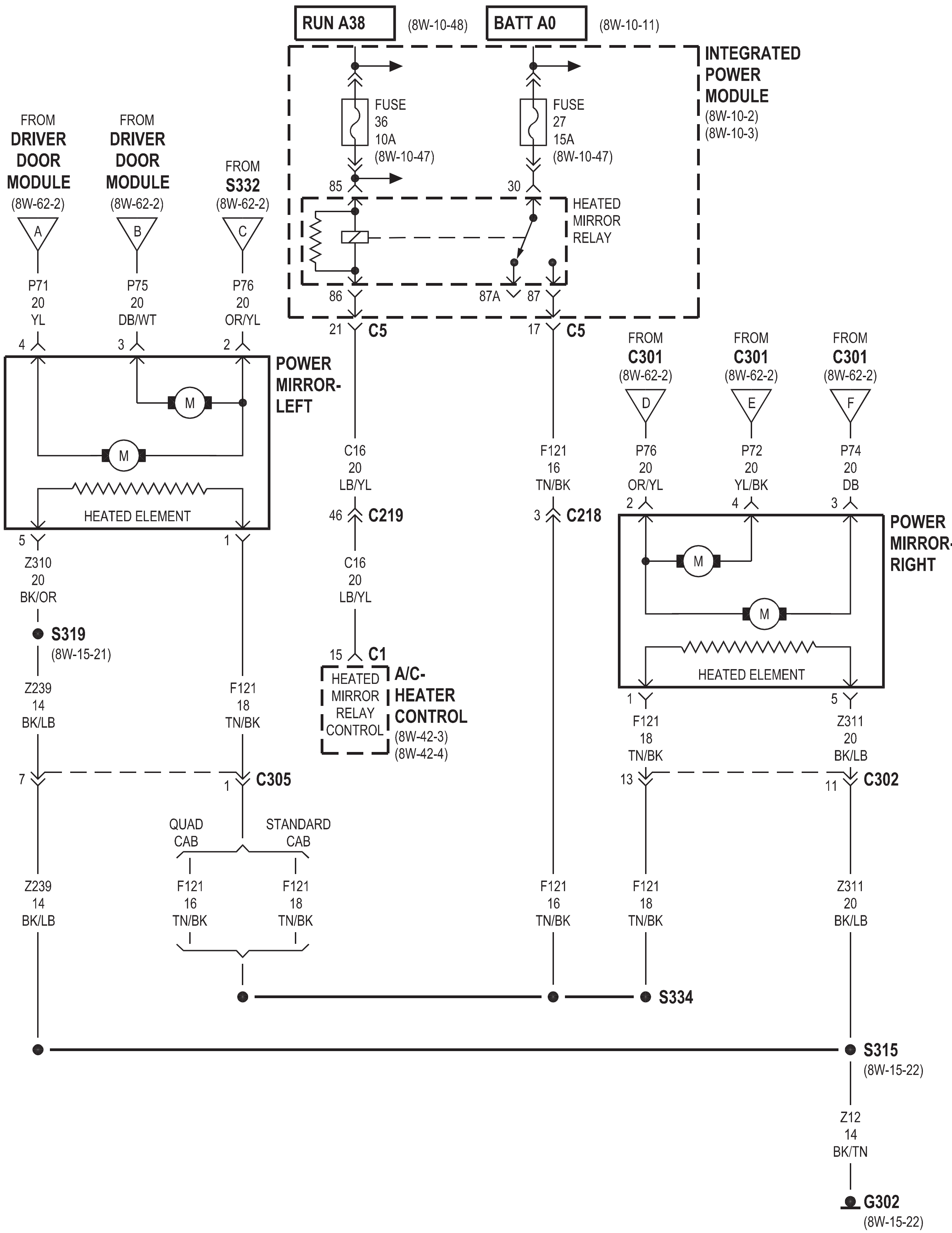

RUN-START A21
(8W-10-45)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 28 10A (8W-10-45)
2 C1
Y107 20 VT/RD
20 C219
Y107 20 VT/RD
S205
(8W-10-45)
10
Y107 20 VT/RD
1
Y107 20 VT/RD
2
INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-8)
(8W-40-12)
PASSENGER DOOR LOCK SWITCH MUX
DOOR UNLOCK DRIVER RIGHT DOORS
DOOR LOCK DRIVER RIGHT DOORS
2 C2
11 C1
2 C1
P96 20 WT/LG
Y156 18 TN/WT
Y200 18 TN/VT
5
9
8 C308
P96 20 WT/LG
Y156 18 TN/WT
6 C302
P96 20 WT/LG
1
S323
Y200 18 TN/VT
S322
DOOR LOCK SWITCH-PASSENGER
1 LOCK
2 UNLOCK
1
2
Y156 18 TN/WT
Y200 18 TN/VT
Y200 18 TN/VT
Y156 18 TN/WT
4
10 C302
3
4 C312
Y156 18 TN/WT
Y200 18 TN/VT
Y200 18 TN/PK
Y156 18 TN/OR
5
Z74 20 BK/LG
S312
(8W-15-19)
Z2 20 BK/LG
10 C301
Z315 20 BK/LG
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)
3
4
4
3
M
M
DOOR LOCK MOTOR/ AJAR SWITCH- PASSENGER
DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR


INSTRUMENT CLUSTER
(8W-40-6)
(8W-40-7)
(8W-40-12)
PASSENGER CYLINDER LOCK SWITCH MUX
DOOR UNLOCK DRIVER LEFT REAR
DOOR LOCK DRIVER LEFT DOORS
▲ 6 C2
12 C1
15 C1
G72 20 DG/OR
Y201 18 TN/OR
Y157 18 TN/PK
2 C308
11
17 C220
G72 20 DG/OR
Y201 18 TN/OR
Y157 18 TN/PK
S321
(8W-40-7)
9 C302
Y157 18 TN/PK
G72 20 DG/OR
4
3 C306
Y201 18 TN/OR
Y157 18 TN/PK
1
CYLINDER LOCK SWITCH-PASSENGER (PREMIUM)
1 LOCK
2 UNLOCK
1
2
3
4
M
DOOR LOCK MOTOR/ AJAR SWITCH-LEFT REAR
2
Z69 20 BK/LG
S312
(8W-15-19)
Z2 20 BK/LG
10 C301
Z315 20 BK/LG
S311
(8W-15-20)
Z11 18 BK/WT
G301
(8W-15-20)

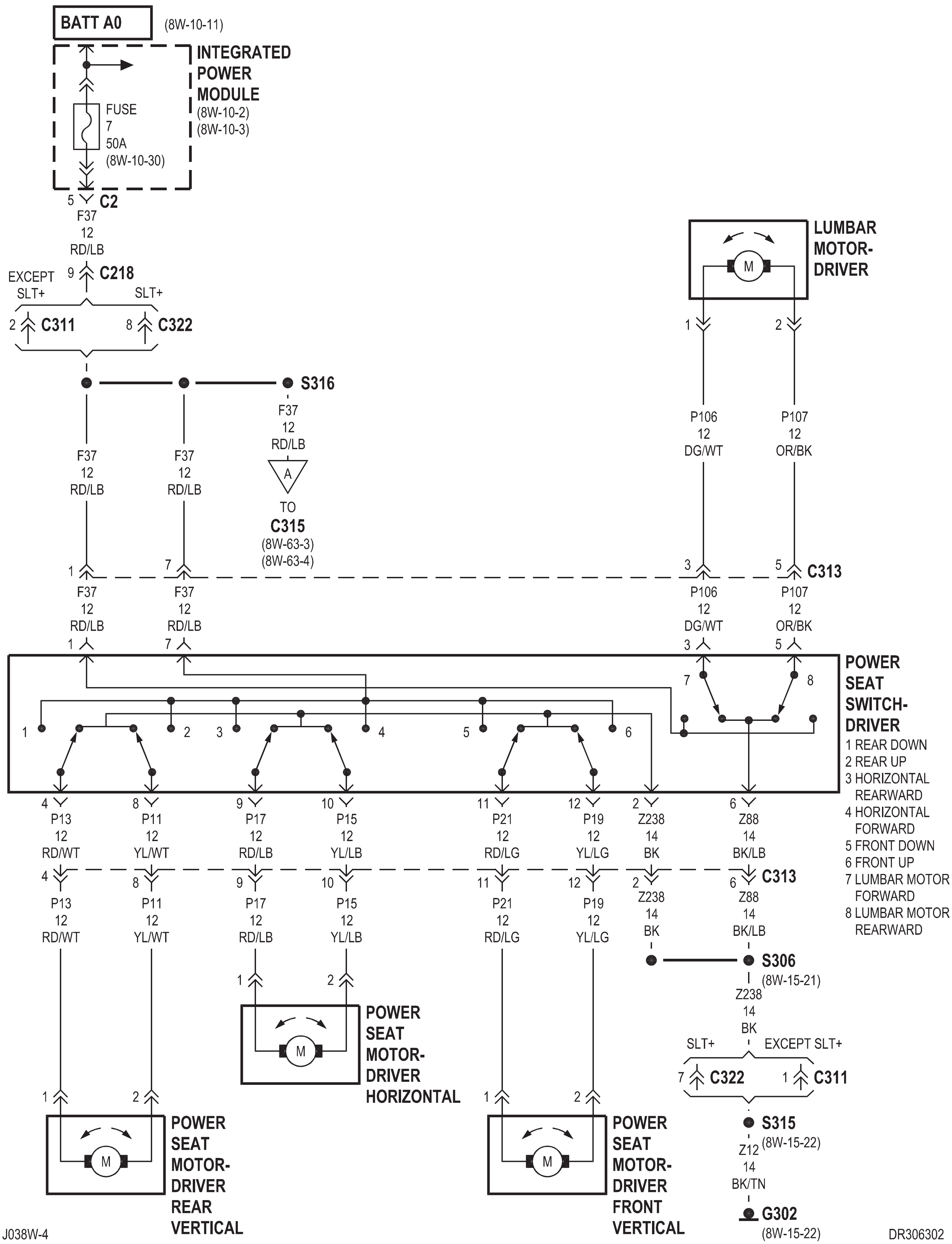
▲ PREMIUM

8W-62 POWER MIRRORS


BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE
17
15A
(8W-10-42)
13 C1
F32
20
RD/YL
55 C219
F32
20
RD/YL
S201
(8W-10-42)
3 C220
9 C304
F32
18
RD/YL
3 C2
DRIVER DOOR MODULE
1 LEFT MIRROR VERTICAL
2 LEFT MIRROR HORIZONTAL
3 RIGHT MIRROR VERTICAL
4 RIGHT MIRROR HORIZONTAL
5 MOTOR FORWARD
6 MOTOR REVERSE
5 C2
Z239
20
BK
S319
(8W-15-21)
Z239
14
BK/LB
7 C305
Z239
14
BK/LB
S315
(8W-15-22)
Z12
14
BK/TN
G302
(8W-15-22)
1 C2
P71
20
YL
A
TO POWER MIRROR-LEFT
(8W-62-3)
6 C2
P75
20
DB/WT
B
TO POWER MIRROR-LEFT
(8W-62-3)
2 C2
P76
20
OR/YL
S332
P76
20
OR/YL
C
TO POWER MIRROR-LEFT
(8W-62-3)
2 C304
P76
20
OR/YL
2 C301
P76
20
OR/YL
D
TO POWER MIRROR-RIGHT
(8W-62-3)
7 C2
P72
20
YL/BK
3
P72
20
YL/BK
E
TO POWER MIRROR-RIGHT
(8W-62-3)
4 C2
P74
20
DB
6 C304
P74
20
DB
6 C301
P74
20
DB
F
TO POWER MIRROR-RIGHT
(8W-62-3)
J038W-4
DR306202

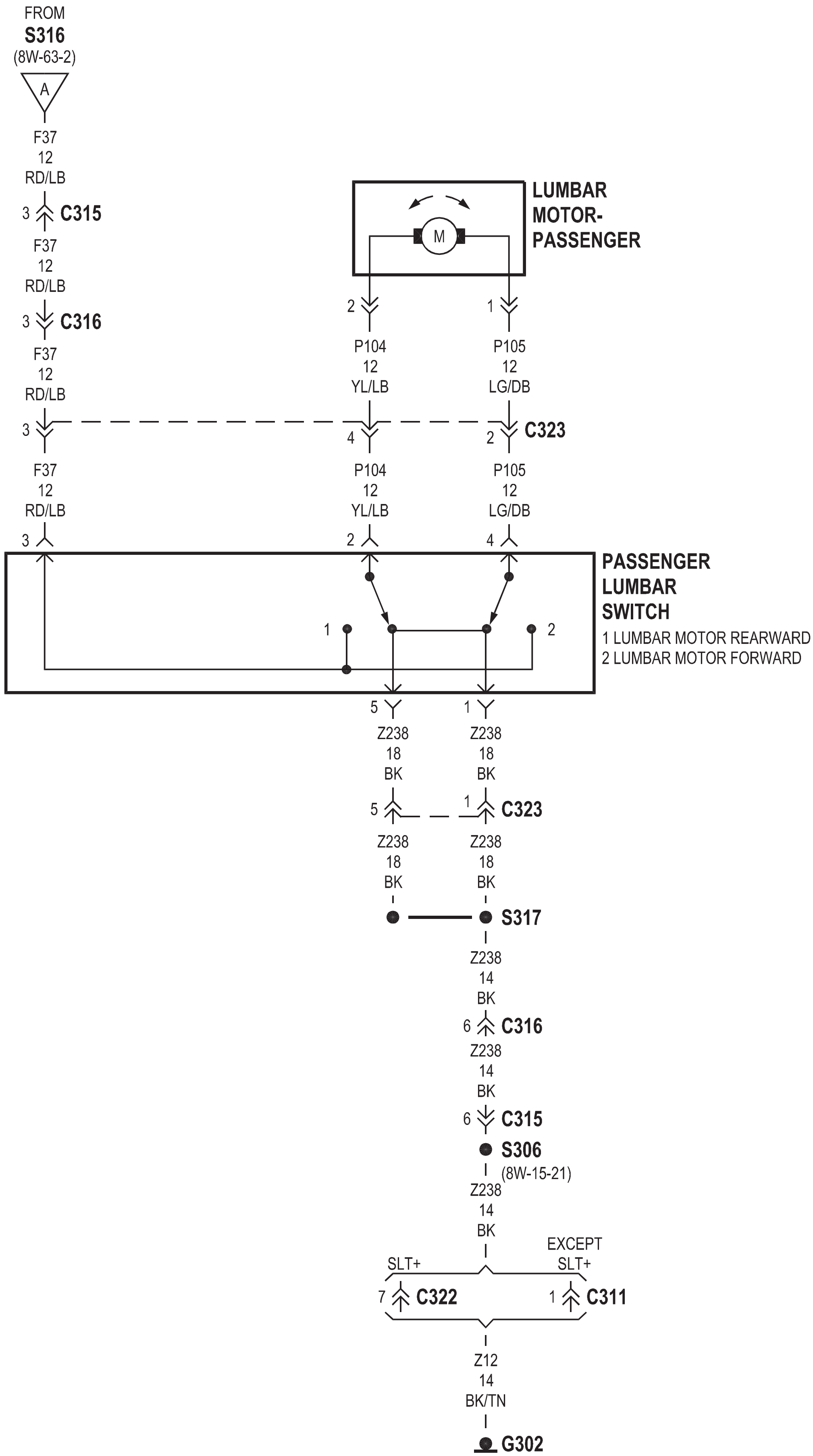

RUN A38
(8W-10-48)
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 36 10A (8W-10-47)
FUSE 27 15A (8W-10-47)
85
30
HEATED MIRROR RELAY
86
87A
87
21 C5
17 C5
FROM DRIVER DOOR MODULE (8W-62-2) A
FROM DRIVER DOOR MODULE (8W-62-2) B
FROM S332 (8W-62-2) C
P71 20 YL
P75 20 DB/WT
P76 20 OR/YL
4
3
2
POWER MIRROR-LEFT
M
M
HEATED ELEMENT
5
1
Z310 20 BK/OR
S319 (8W-15-21)
Z239 14 BK/LB
F121 18 TN/BK
7
1 C305
QUAD CAB
STANDARD CAB
Z239 14 BK/LB
F121 16 TN/BK
F121 18 TN/BK
C16 20 LB/YL
46 C219
C16 20 LB/YL
15 C1
HEATED MIRROR RELAY CONTROL
A/C-HEATER CONTROL
(8W-42-3)
(8W-42-4)
F121 16 TN/BK
3 C218
F121 16 TN/BK
FROM C301 (8W-62-2) D
FROM C301 (8W-62-2) E
FROM C301 (8W-62-2) F
P76 20 OR/YL
P72 20 YL/BK
P74 20 DB
2
4
3
POWER MIRROR-RIGHT
M
M
HEATED ELEMENT
1
5
F121 18 TN/BK
Z311 20 BK/LB
13
11 C302
F121 18 TN/BK
Z311 20 BK/LB
S334
S315 (8W-15-22)
Z12 14 BK/TN
G302 (8W-15-22)

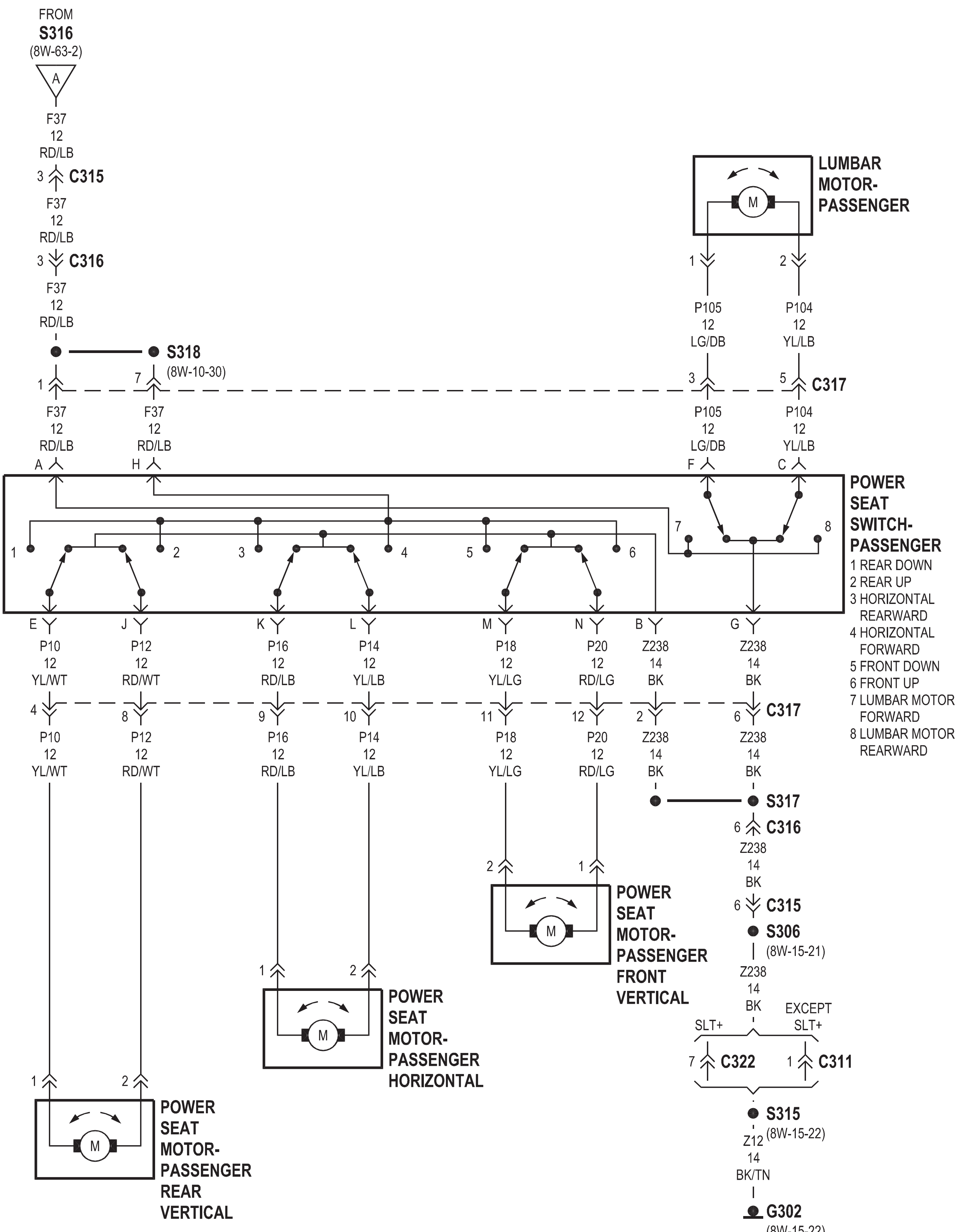
8W-63 POWER SEATS



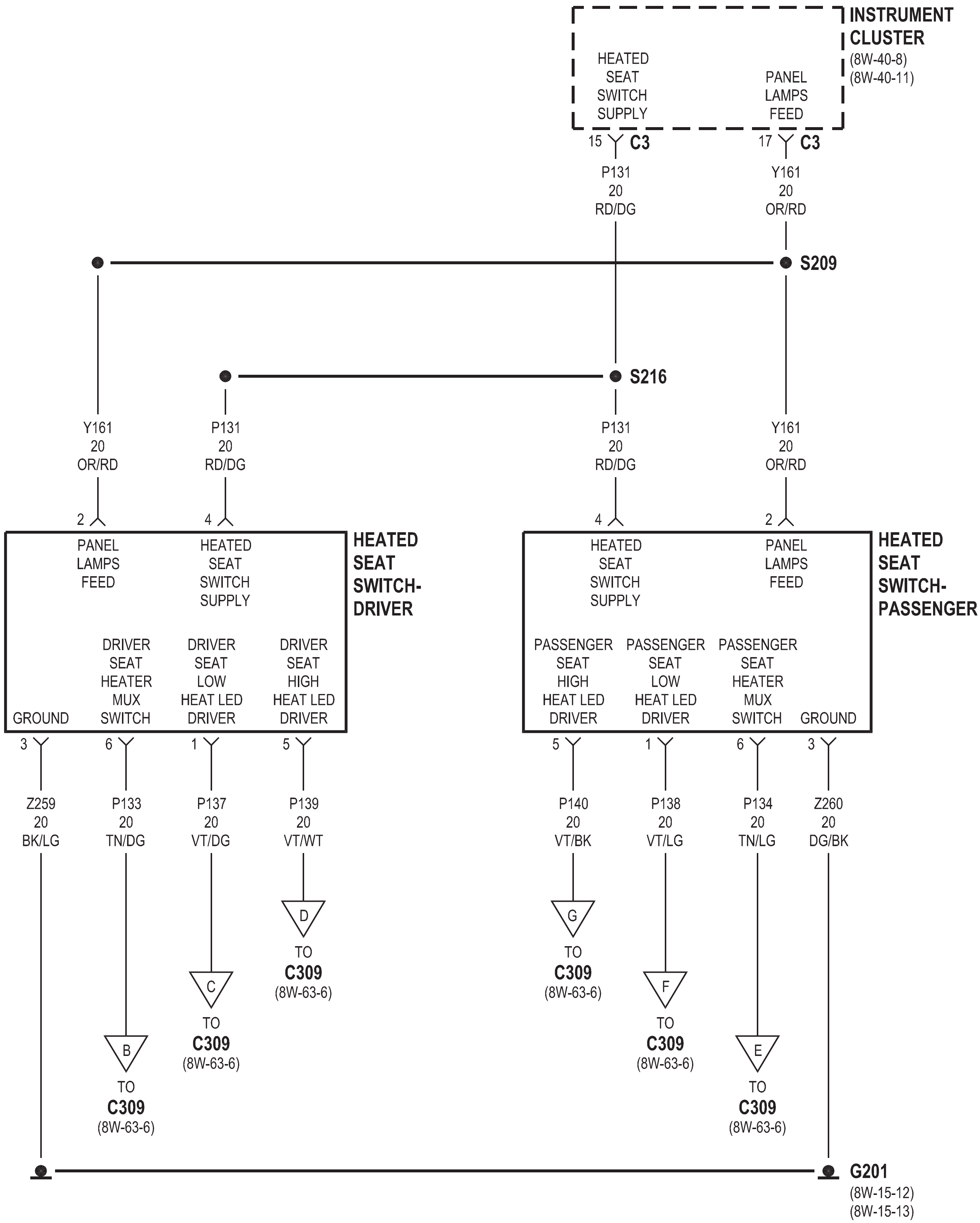
BATT A0
(8W-10-11)
INTEGRATED POWER MODULE
(8W-10-2)
(8W-10-3)
FUSE 7 50A (8W-10-30)
C2
F37 12 RD/LB
C218
EXCEPT SLT+
SLT+
C311
C322
S316
F37 12 RD/LB
A
TO C315
(8W-63-3)
(8W-63-4)
LUMBAR MOTOR-DRIVER
M
P106 12 DG/WT
P107 12 OR/BK
C313
POWER SEAT SWITCH-DRIVER
1 REAR DOWN
2 REAR UP
3 HORIZONTAL REARWARD
4 HORIZONTAL FORWARD
5 FRONT DOWN
6 FRONT UP
7 LUMBAR MOTOR FORWARD
8 LUMBAR MOTOR REARWARD
P13 12 RD/WT
P11 12 YL/WT
P17 12 RD/LB
P15 12 YL/LB
P21 12 RD/LG
P19 12 YL/LG
Z238 14 BK
Z88 14 BK/LB
C313
S306
(8W-15-21)
Z238 14 BK
SLT+
EXCEPT SLT+
C322
C311
S315
(8W-15-22)
Z12 14 BK/TN
G302
(8W-15-22)
POWER SEAT MOTOR-DRIVER HORIZONTAL
POWER SEAT MOTOR-DRIVER REAR VERTICAL
POWER SEAT MOTOR-DRIVER FRONT VERTICAL

STANDARD CAB

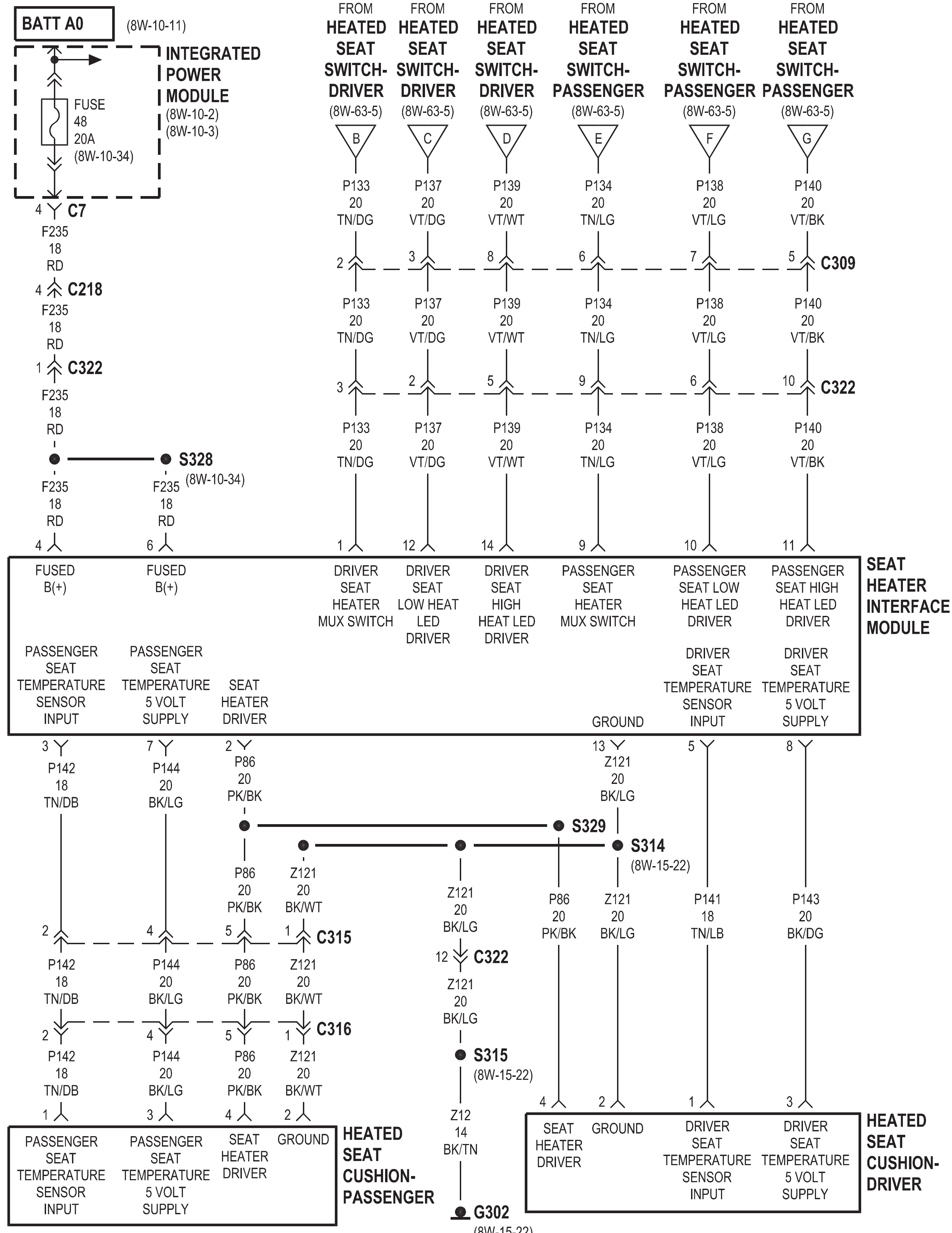



FROM
S316
(8W-63-2)
A
F37
12
RD/LB
C315
C316
S318
(8W-10-30)
C317
LUMBAR
MOTOR-
PASSENGER
M
P105
12
LG/DB
P104
12
YL/LB
POWER
SEAT
SWITCH-
PASSENGER
1 REAR DOWN
2 REAR UP
3 HORIZONTAL
REARWARD
4 HORIZONTAL
FORWARD
5 FRONT DOWN
6 FRONT UP
7 LUMBAR MOTOR
FORWARD
8 LUMBAR MOTOR
REARWARD
P10
12
YL/WT
P12
12
RD/WT
P16
12
RD/LB
P14
12
YL/LB
P18
12
YL/LG
P20
12
RD/LG
Z238
14
BK
S317
C316
C315
S306
(8W-15-21)
EXCEPT
SLT+
SLT+
C322
C311
S315
(8W-15-22)
Z12
14
BK/TN
G302
(8W-15-22)
POWER
SEAT
MOTOR-
PASSENGER
FRONT
VERTICAL
POWER
SEAT
MOTOR-
PASSENGER
HORIZONTAL
POWER
SEAT
MOTOR-
PASSENGER
REAR
VERTICAL

HEATED SEATS



HEATED SEATS



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S107	8W-10-38
S108	8W-33-6
S109	8W-10-38
S110	8W-10-33
S111	8W-20-2
S112	8W-10-23
S114	8W-10-30
S117	8W-34-2
S119	8W-10-54
S120	8W-10-52
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S147	8W-10-24
S148	8W-10-22
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S156	8W-10-43
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S165	8W-20-4
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S175	8W-30-69
S176	8W-15-11
S178	8W-30-17
S179	8W-31-9
S181	8W-30-16
S182	8W-10-25
S183	8W-15-9, 16
S184	8W-30-16
S186	8W-10-44
S191	8W-10-49
S201	8W-10-42
S202	8W-44-2
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S208	8W-15-15
S209	8W-63-5
S210	8W-40-13
S212	8W-10-50
S213	8W-10-33
S214	8W-33-6
S216	8W-63-5
S217	8W-47-4
S218	8W-47-4
S219	8W-47-7
S220	8W-47-7
S221	8W-10-33
S222	8W-10-46
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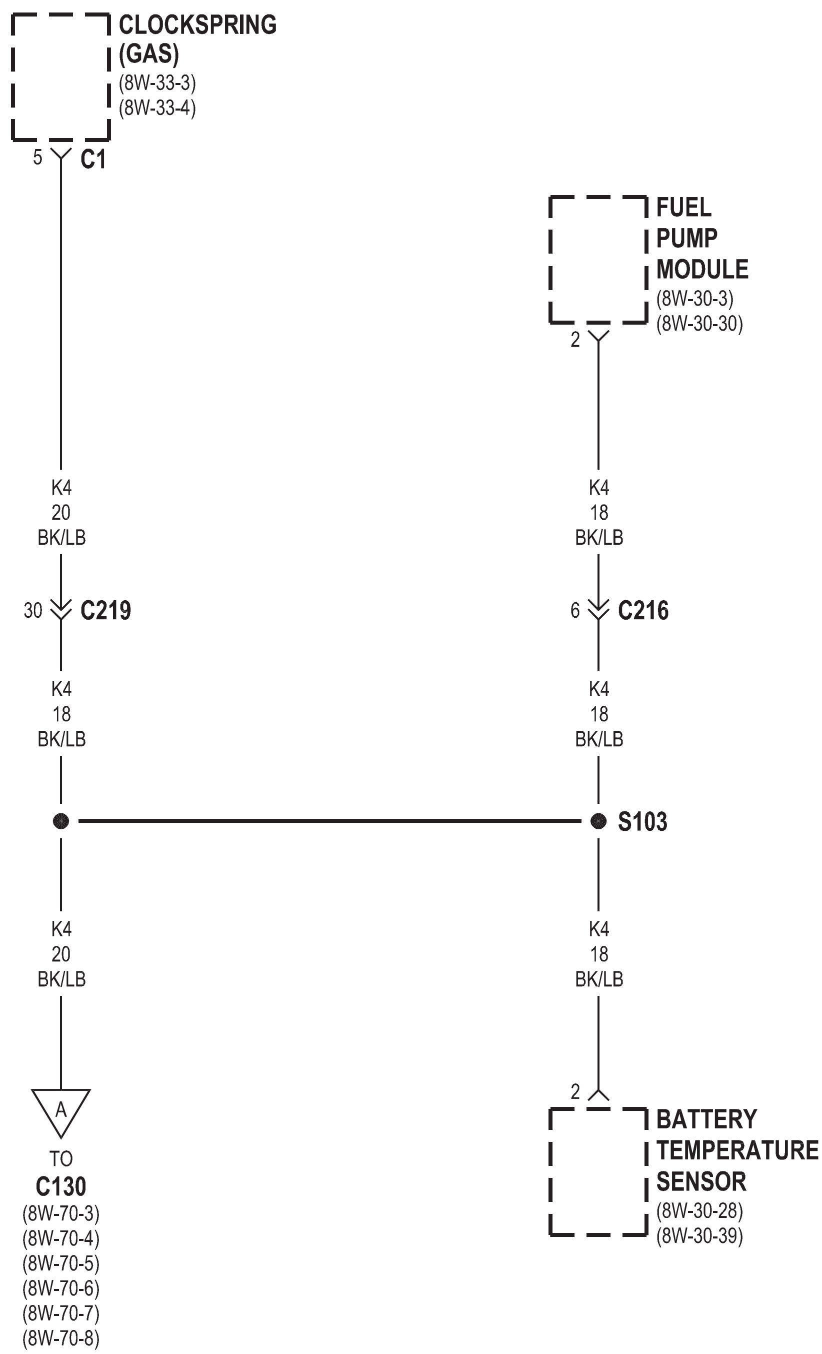
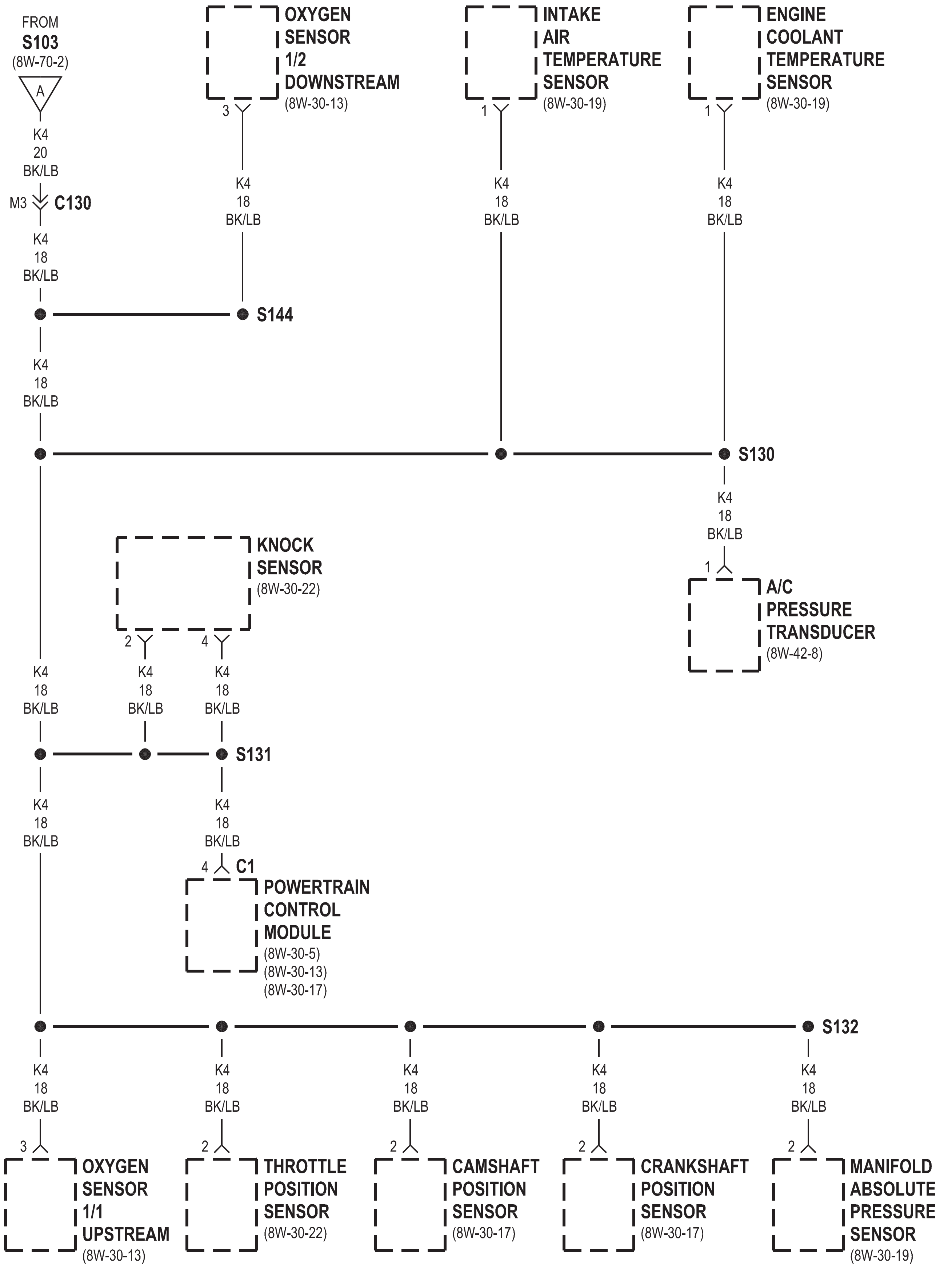
S228	8W-33-4, 18, 90
S230	8W-18-4
S231	8W-18-5, 6
S301	8W-10-42
S302	8W-44-2
S304	8W-10-45
S305	8W-18-5, 6
S306	8W-15-21
S307	8W-15-15
S308	8W-15-3
S309	8W-15-3, 4, 6
S310	8W-15-18
S311	8W-15-20
S312	8W-15-19
S313	8W-15-19
S314	8W-15-22
S315	8W-15-22
S316	8W-63-2, 30
S317	8W-63-3, 4, 21
S318	8W-10-30
S319	8W-15-21
S320	8W-40-2
S321	8W-40-7
S322	8W-61-4
S323	8W-61-4, 8
S324	8W-10-36
S325	8W-10-52
S326	8W-10-37
S327	8W-10-36
S328	8W-10-34
S329	8W-63-6
S330	8W-10-35
S331	8W-10-35
S332	8W-62-2
S333	8W-60-4
S334	8W-62-3, 47
S335	8W-10-46
S336	8W-50-6, 37
S337	8W-50-6, 16
S340	8W-15-3
S341	8W-15-3
S342	8W-10-37
S343	8W-10-37

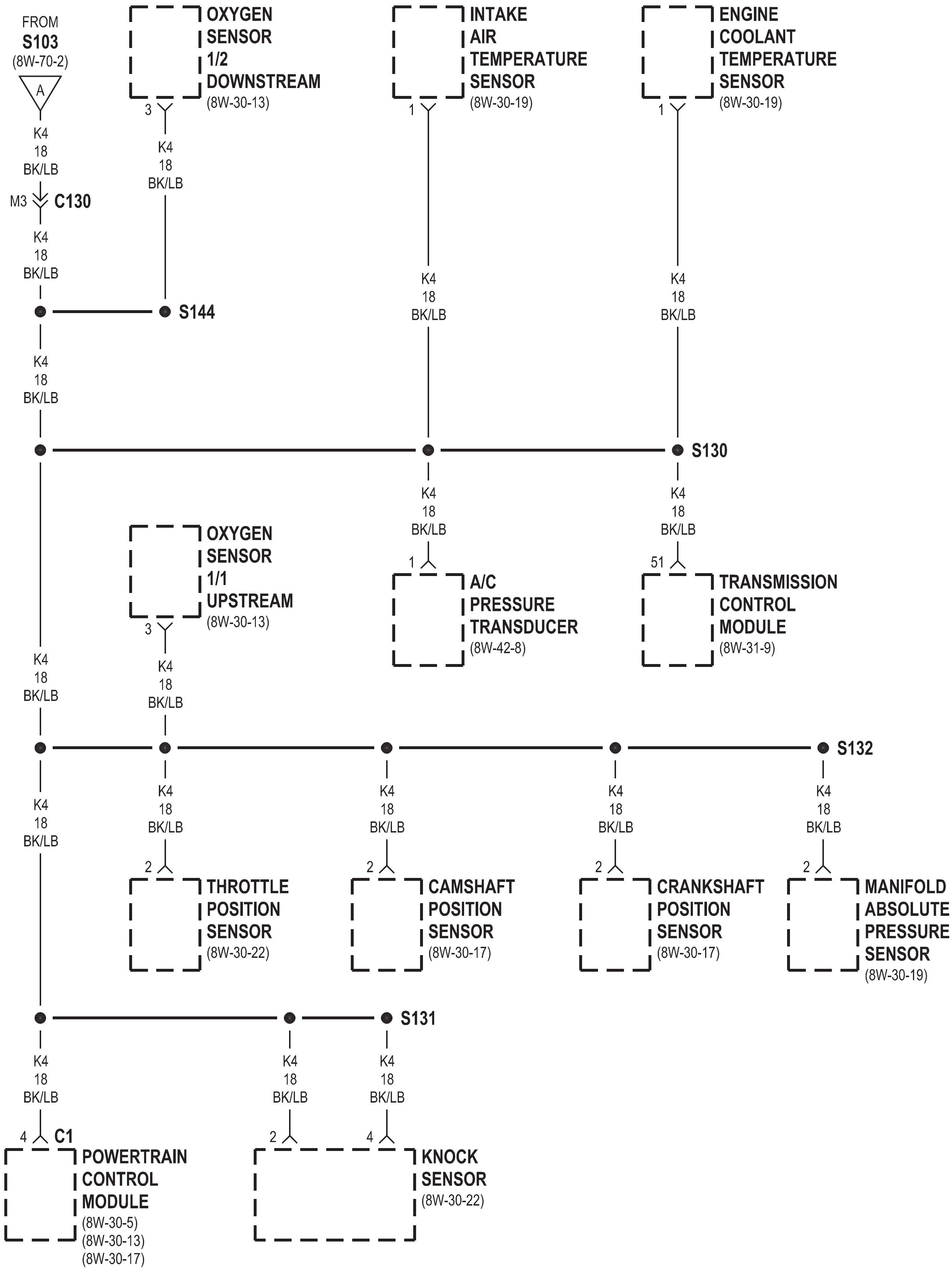


CLOCKSPRING
(GAS)
(8W-33-3)
(8W-33-4)
5
C1
FUEL
PUMP
MODULE
(8W-30-3)
(8W-30-30)
2
K4
20
BK/LB
K4
18
BK/LB
30
C219
6
C216
K4
18
BK/LB
K4
18
BK/LB
S103
K4
20
BK/LB
K4
18
BK/LB
A
TO
C130
(8W-70-3)
(8W-70-4)
(8W-70-5)
(8W-70-6)
(8W-70-7)
(8W-70-8)
2
BATTERY
TEMPERATURE
SENSOR
(8W-30-28)
(8W-30-39)

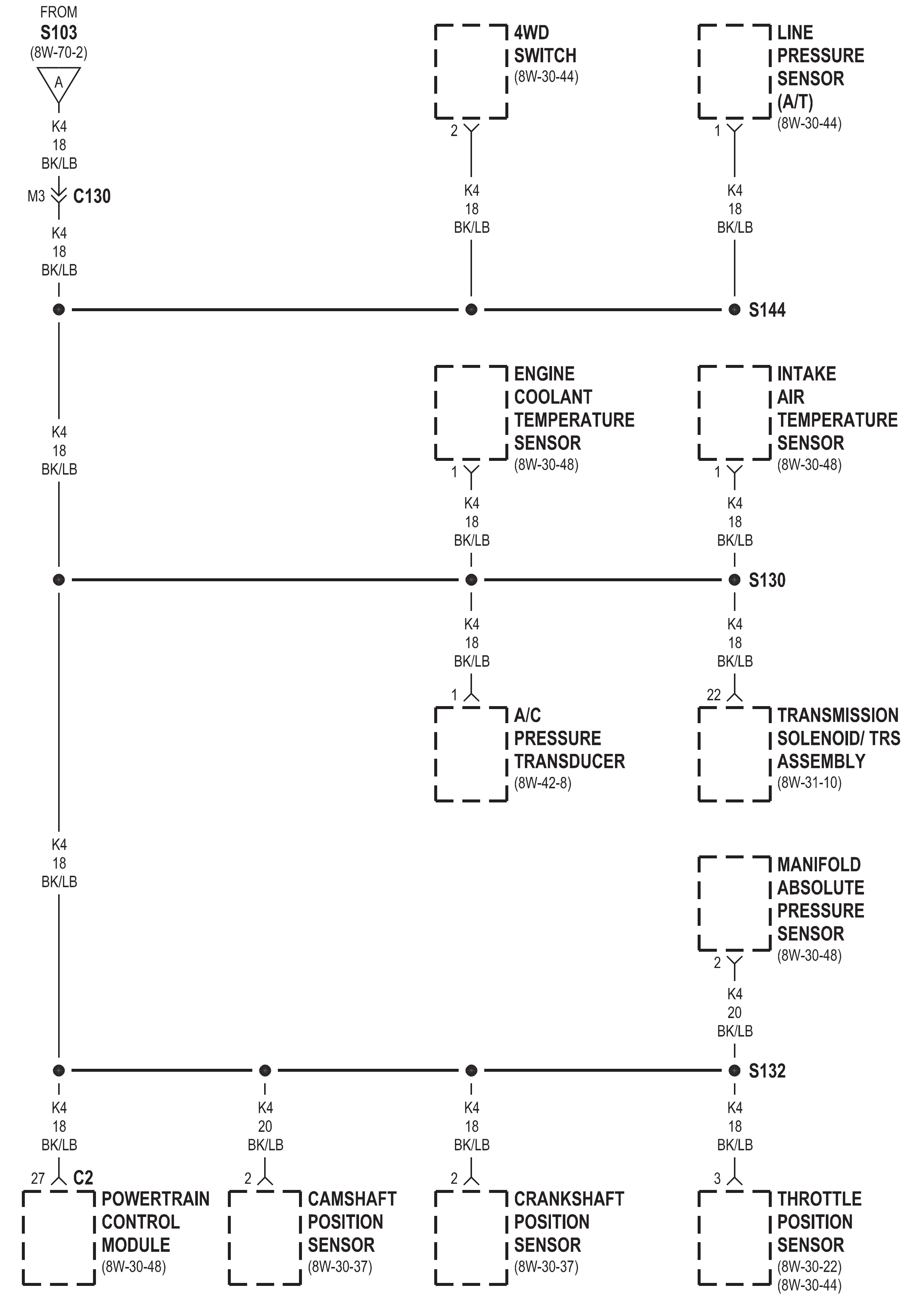
3.7L M/T

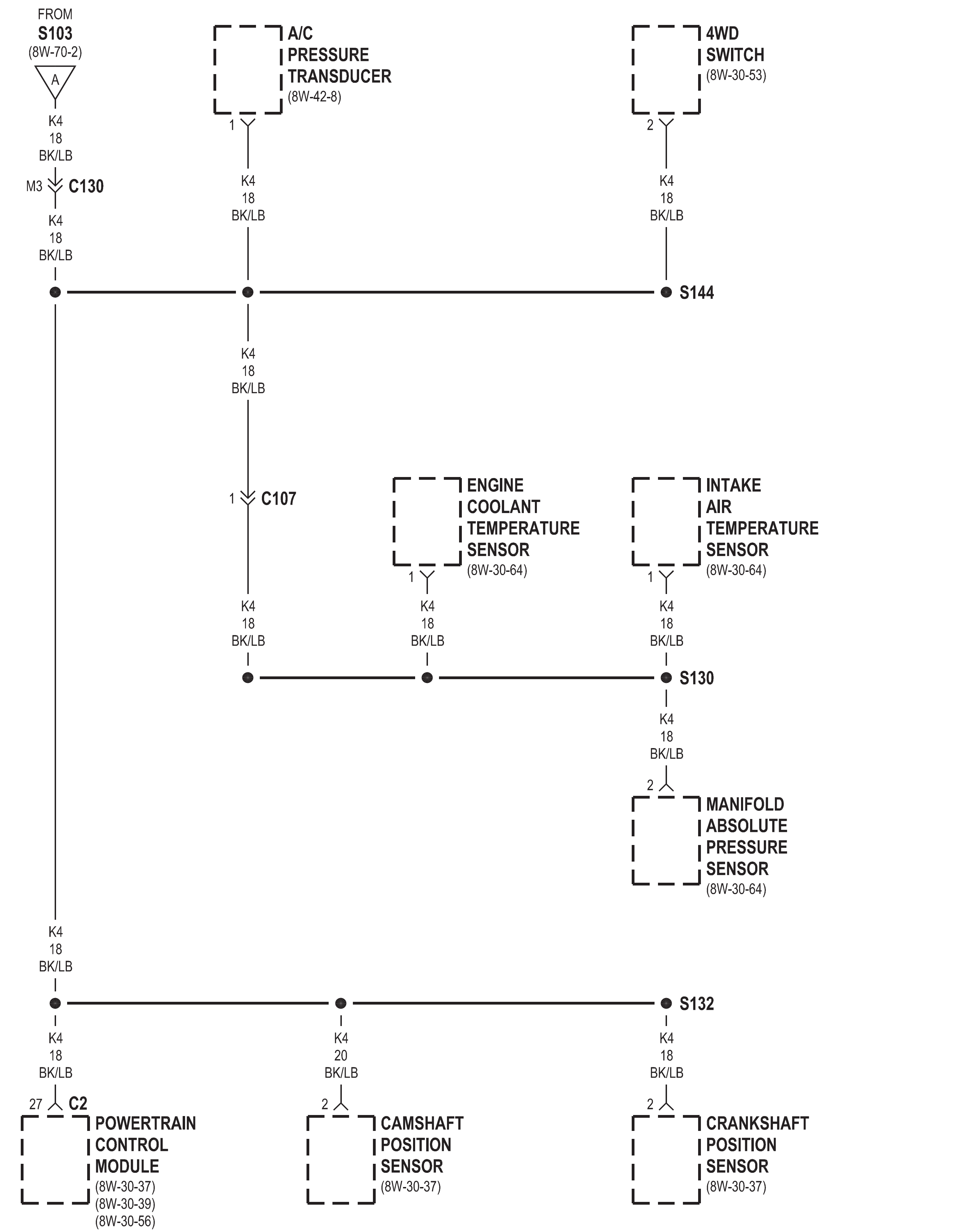

FROM
S103
(8W-70-2)
A
K4
20
BK/LB
M3
C130
K4
18
BK/LB
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-13)
3
S144
INTAKE AIR TEMPERATURE SENSOR
(8W-30-19)
1
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-19)
1
S130
KNOCK SENSOR
(8W-30-22)
2
4
A/C PRESSURE TRANSDUCER
(8W-42-8)
1
S131
4
C1
POWERTRAIN CONTROL MODULE
(8W-30-5)
(8W-30-13)
(8W-30-17)
S132
3
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
2
THROTTLE POSITION SENSOR
(8W-30-22)
2
CAMSHAFT POSITION SENSOR
(8W-30-17)
2
CRANKSHAFT POSITION SENSOR
(8W-30-17)
2
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-19)

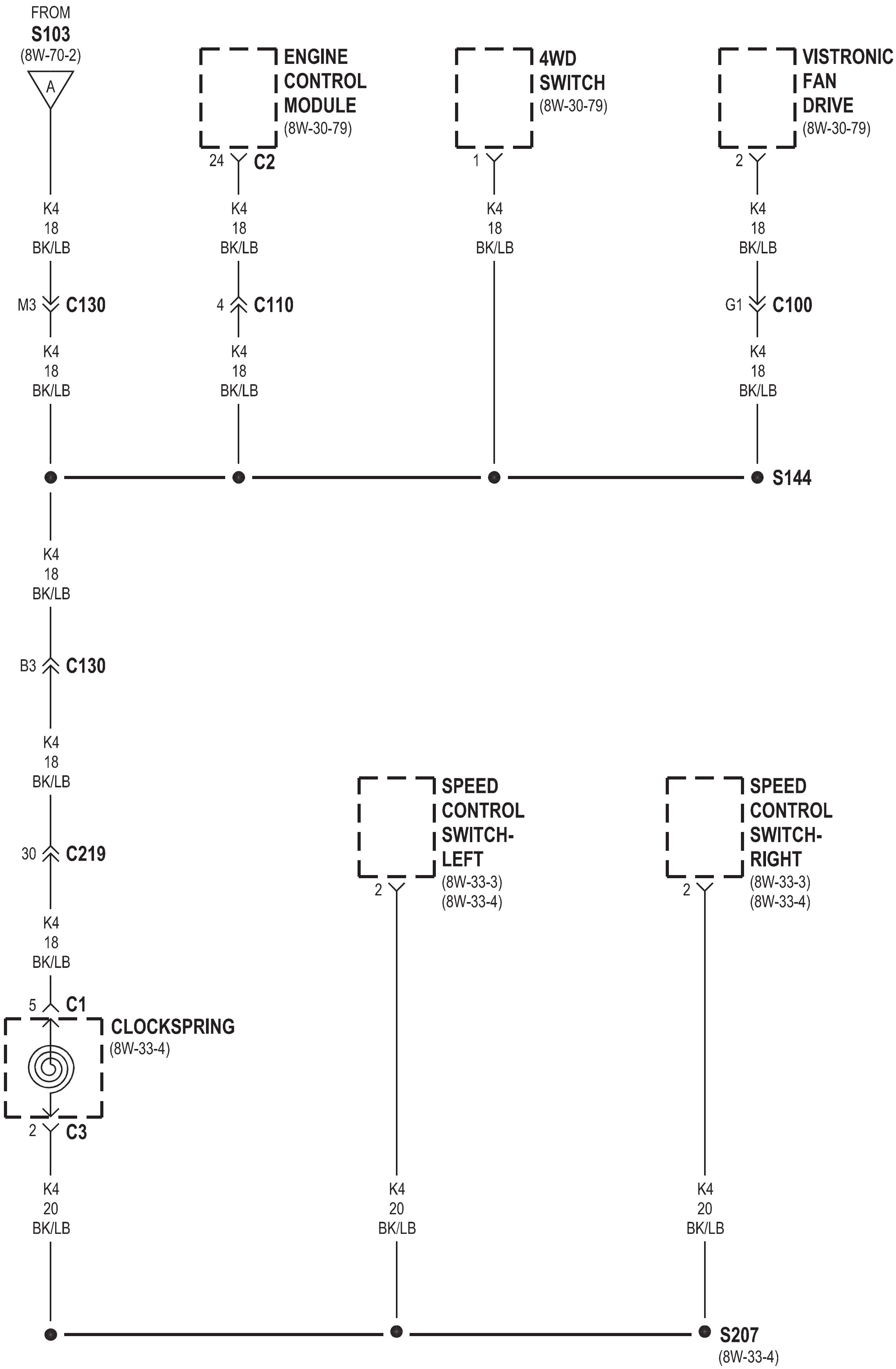
3.7L A/T


FROM
S103
(8W-70-2)
A
K4
18
BK/LB
M3
C130
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-13)
3
INTAKE AIR TEMPERATURE SENSOR
(8W-30-19)
1
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-19)
1
S144
S130
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-13)
3
A/C PRESSURE TRANSDUCER
(8W-42-8)
1
TRANSMISSION CONTROL MODULE
(8W-31-9)
51
S132
THROTTLE POSITION SENSOR
(8W-30-22)
2
CAMSHAFT POSITION SENSOR
(8W-30-17)
2
CRANKSHAFT POSITION SENSOR
(8W-30-17)
2
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-19)
2
S131
4
C1
POWERTRAIN CONTROL MODULE
(8W-30-5)
(8W-30-13)
(8W-30-17)
KNOCK SENSOR
(8W-30-22)
2
4

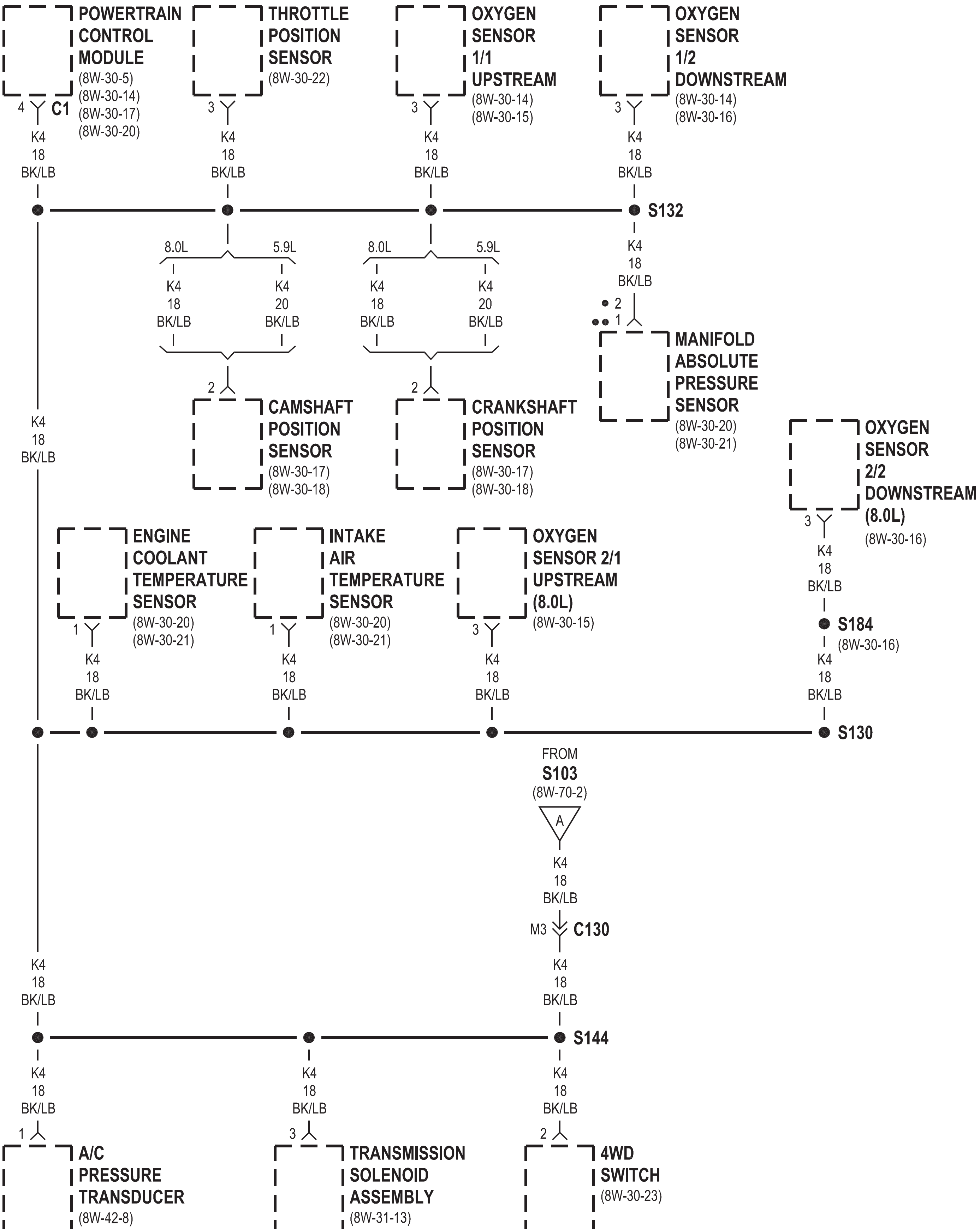
4.7L


FROM
S103
(8W-70-2)
A
K4
18
BK/LB
M3
C130
4WD
SWITCH
(8W-30-44)
LINE
PRESSURE
SENSOR
(A/T)
(8W-30-44)
S144
ENGINE
COOLANT
TEMPERATURE
SENSOR
(8W-30-48)
INTAKE
AIR
TEMPERATURE
SENSOR
(8W-30-48)
S130
A/C
PRESSURE
TRANSDUCER
(8W-42-8)
TRANSMISSION
SOLENOID/ TRS
ASSEMBLY
(8W-31-10)
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
(8W-30-48)
K4
20
BK/LB
S132
27
C2
POWERTRAIN
CONTROL
MODULE
(8W-30-48)
CAMSHAFT
POSITION
SENSOR
(8W-30-37)
CRANKSHAFT
POSITION
SENSOR
(8W-30-37)
THROTTLE
POSITION
SENSOR
(8W-30-22)
(8W-30-44)

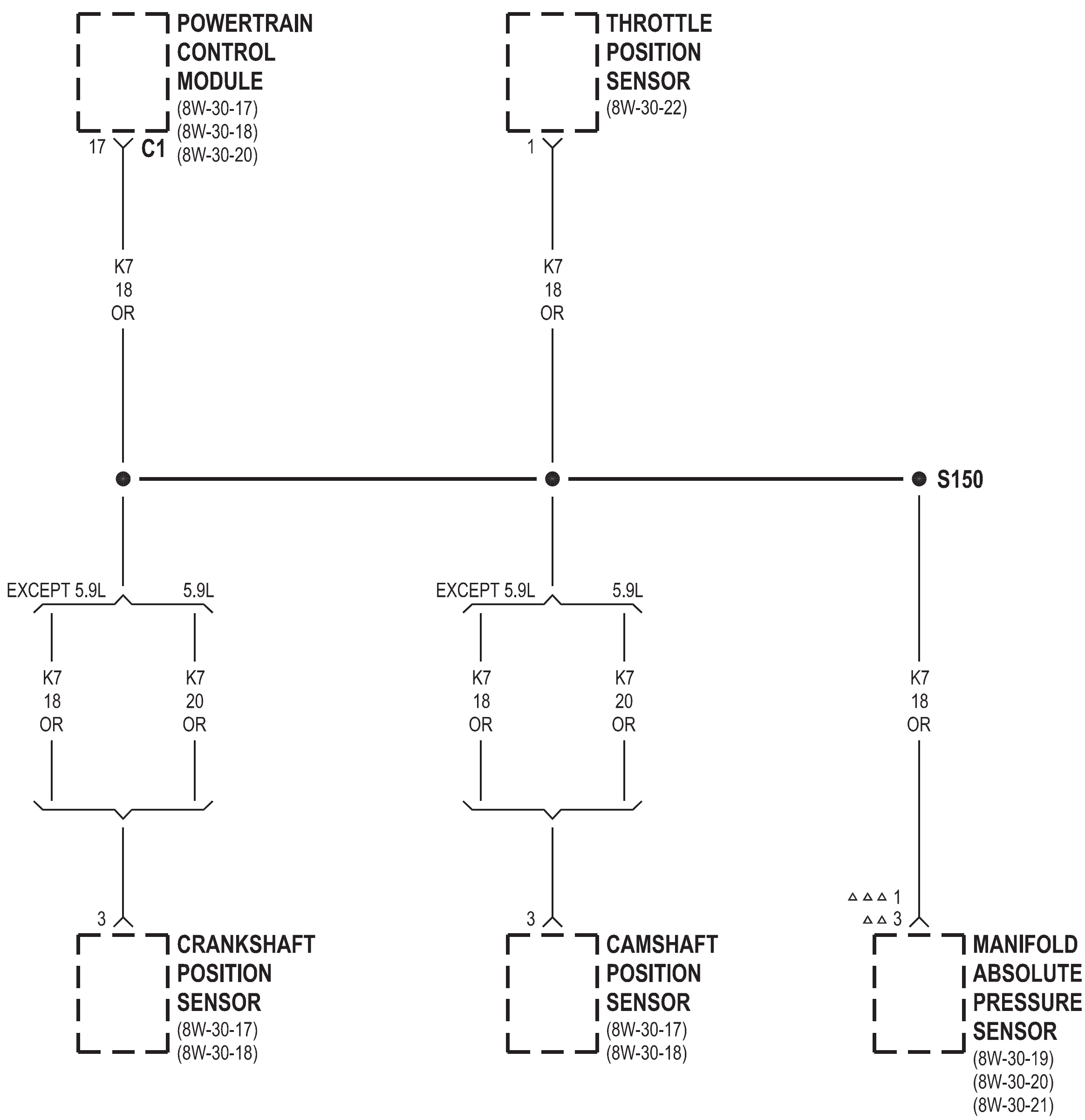

FROM
S103
(8W-70-2)
A
K4
18
BK/LB
M3
C130
K4
18
BK/LB
A/C
PRESSURE
TRANSDUCER
(8W-42-8)
1
K4
18
BK/LB
4WD
SWITCH
(8W-30-53)
2
K4
18
BK/LB
S144
K4
18
BK/LB
1
C107
K4
18
BK/LB
ENGINE
COOLANT
TEMPERATURE
SENSOR
(8W-30-64)
1
K4
18
BK/LB
INTAKE
AIR
TEMPERATURE
SENSOR
(8W-30-64)
1
K4
18
BK/LB
S130
K4
18
BK/LB
2
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
(8W-30-64)
K4
18
BK/LB
S132
K4
18
BK/LB
27
C2
POWERTRAIN
CONTROL
MODULE
(8W-30-37)
(8W-30-39)
(8W-30-56)
K4
20
BK/LB
2
CAMSHAFT
POSITION
SENSOR
(8W-30-37)
K4
18
BK/LB
2
CRANKSHAFT
POSITION
SENSOR
(8W-30-37)


FROM
S103
(8W-70-2)
A
ENGINE
CONTROL
MODULE
(8W-30-79)
24
C2
4WD
SWITCH
(8W-30-79)
1
VISTRONIC
FAN
DRIVE
(8W-30-79)
2
K4
18
BK/LB
M3
C130
4
C110
G1
C100
S144
B3
C130
30
C219
5
C1
CLOCKSPRING
(8W-33-4)
2
C3
SPEED
CONTROL
SWITCH-
LEFT
(8W-33-3)
(8W-33-4)
SPEED
CONTROL
SWITCH-
RIGHT
(8W-33-3)
(8W-33-4)
K4
20
BK/LB
S207
(8W-33-4)

5.9L/8.0L

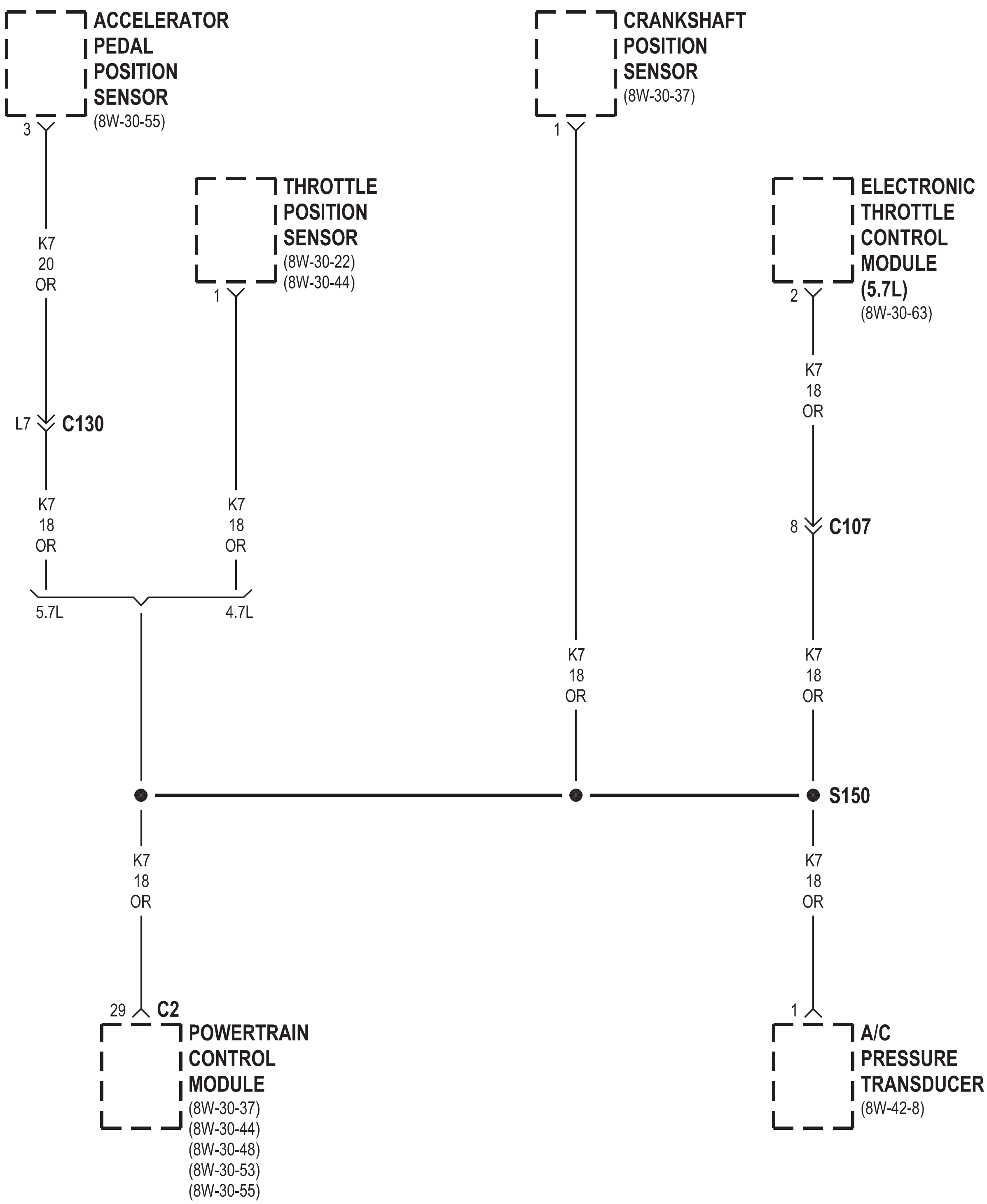

POWERTRAIN CONTROL MODULE
(8W-30-5)
(8W-30-14)
(8W-30-17)
(8W-30-20)
4
C1
THROTTLE POSITION SENSOR
(8W-30-22)
OXYGEN SENSOR 1/1 UPSTREAM
(8W-30-14)
(8W-30-15)
OXYGEN SENSOR 1/2 DOWNSTREAM
(8W-30-14)
(8W-30-16)
3
K4
18
BK/LB
S132
8.0L
5.9L
K4
20
BK/LB
2
1
MANIFOLD ABSOLUTE PRESSURE SENSOR
(8W-30-20)
(8W-30-21)
CAMSHAFT POSITION SENSOR
(8W-30-17)
(8W-30-18)
CRANKSHAFT POSITION SENSOR
(8W-30-17)
(8W-30-18)
OXYGEN SENSOR 2/2 DOWNSTREAM (8.0L)
(8W-30-16)
ENGINE COOLANT TEMPERATURE SENSOR
(8W-30-20)
(8W-30-21)
INTAKE AIR TEMPERATURE SENSOR
(8W-30-20)
(8W-30-21)
OXYGEN SENSOR 2/1 UPSTREAM (8.0L)
(8W-30-15)
S184
(8W-30-16)
S130
FROM
S103
(8W-70-2)
A
M3
C130
S144
A/C PRESSURE TRANSDUCER
(8W-42-8)
TRANSMISSION SOLENOID ASSEMBLY
(8W-31-13)
(8W-31-16)
4WD SWITCH
(8W-30-23)
• 8.0L
•• 5.9L

GAS EXCEPT NGC

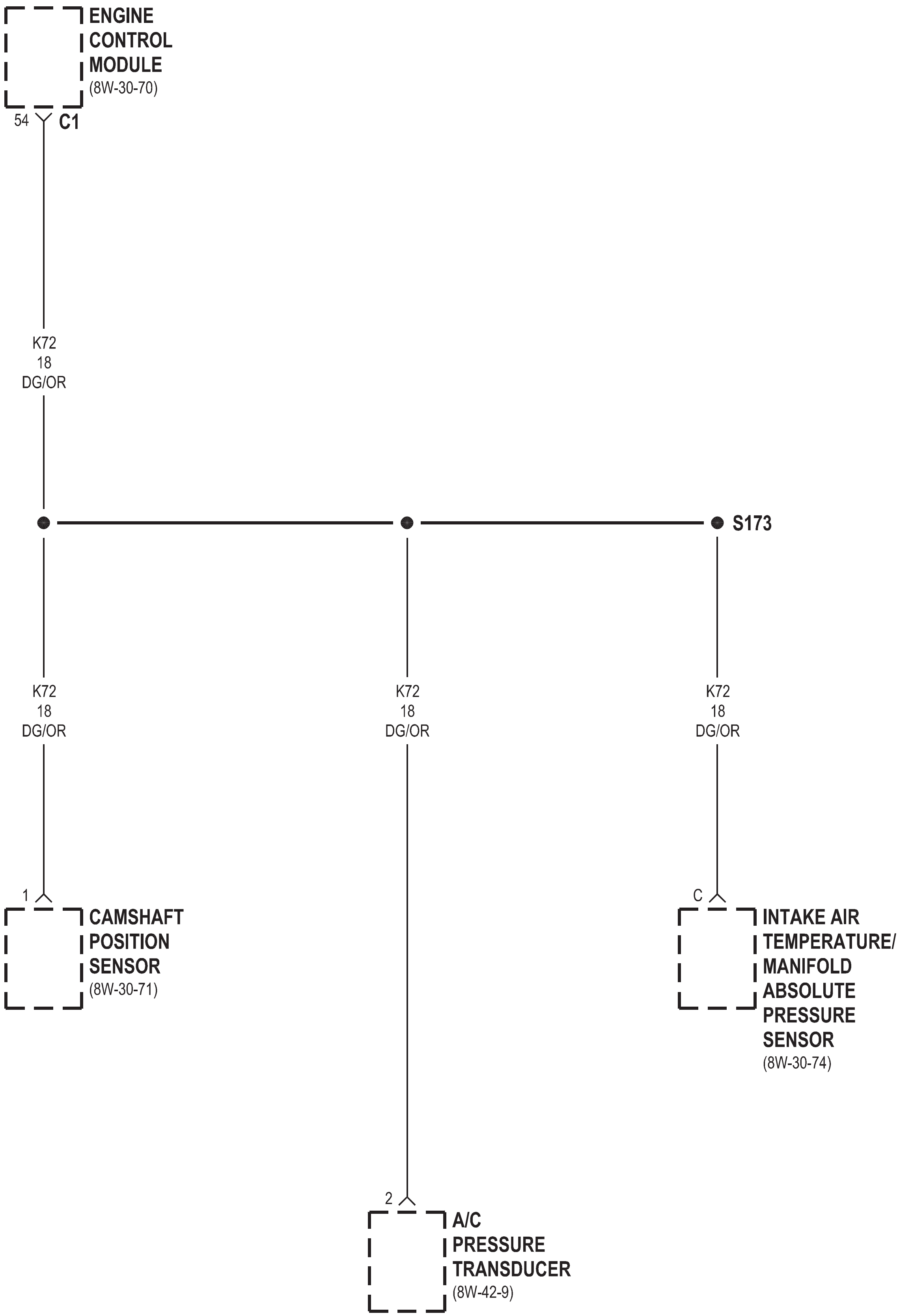


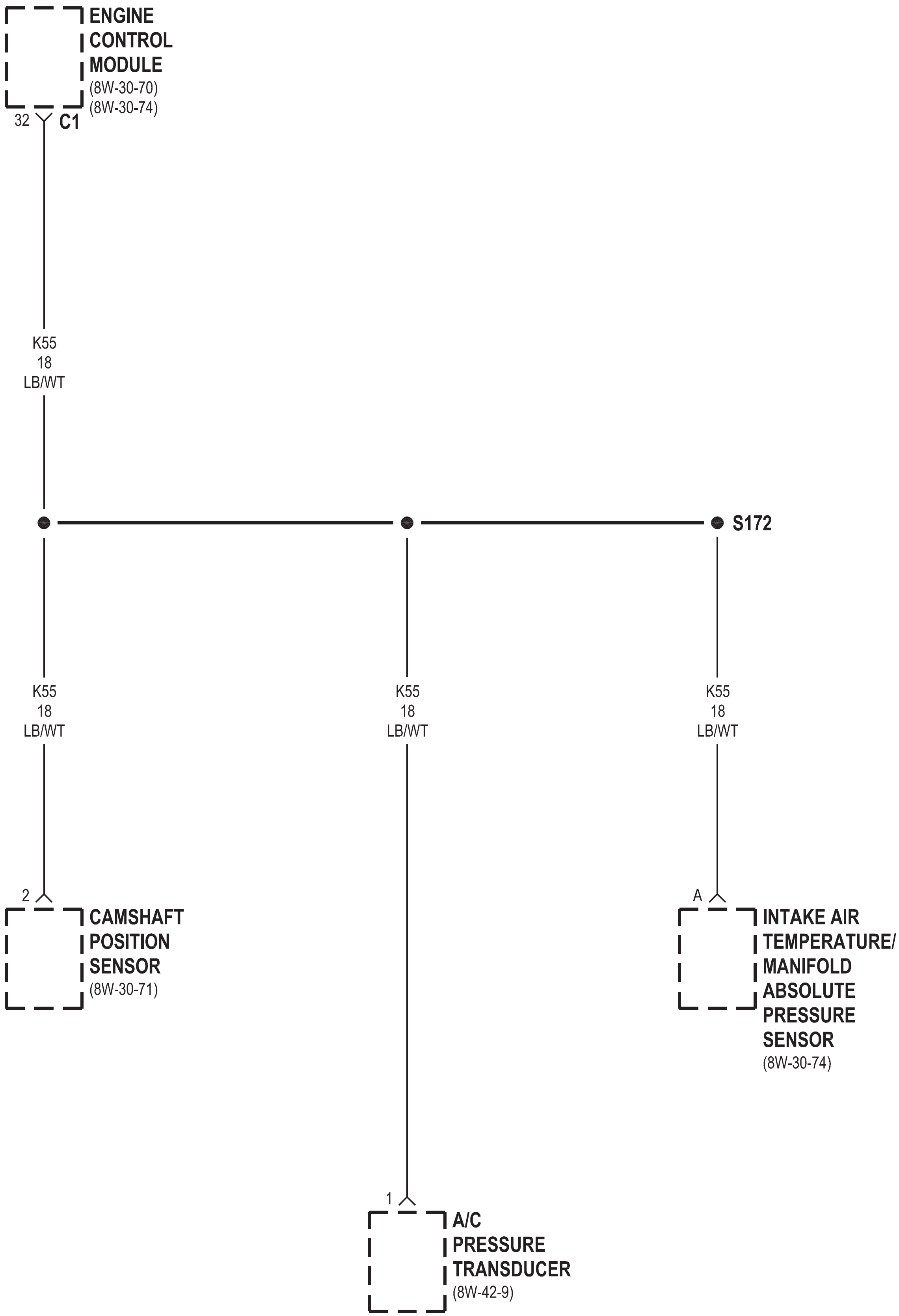
△△△ 8.0L
△△ EXCEPT 8.0L

NGC

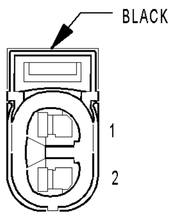


ACCELERATOR PEDAL POSITION SENSOR
(8W-30-55)
3
K7
20
OR
L7
C130
K7
18
OR
THROTTLE POSITION SENSOR
(8W-30-22)
(8W-30-44)
1
K7
18
OR
5.7L
4.7L
CRANKSHAFT POSITION SENSOR
(8W-30-37)
1
K7
18
OR
ELECTRONIC THROTTLE CONTROL MODULE (5.7L)
(8W-30-63)
2
K7
18
OR
8
C107
K7
18
OR
S150
K7
18
OR
29
C2
POWERTRAIN CONTROL MODULE
(8W-30-37)
(8W-30-44)
(8W-30-48)
(8W-30-53)
(8W-30-55)
K7
18
OR
1
A/C PRESSURE TRANSDUCER
(8W-42-8)


ENGINE
CONTROL
MODULE
(8W-30-70)
54
C1
K72
18
DG/OR
S173
K72
18
DG/OR
K72
18
DG/OR
K72
18
DG/OR
1
CAMSHAFT
POSITION
SENSOR
(8W-30-71)
C
INTAKE AIR
TEMPERATURE/
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
(8W-30-74)
2
A/C
PRESSURE
TRANSDUCER
(8W-42-9)

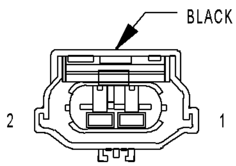

ENGINE
CONTROL
MODULE
(8W-30-70)
(8W-30-74)
32
C1
K55
18
LB/WT
S172
K55
18
LB/WT
K55
18
LB/WT
K55
18
LB/WT
2
CAMSHAFT
POSITION
SENSOR
(8W-30-71)
A
INTAKE AIR
TEMPERATURE/
MANIFOLD
ABSOLUTE
PRESSURE
SENSOR
(8W-30-74)
1
A/C
PRESSURE
TRANSDUCER
(8W-42-9)

8W-80 CONNECTOR PIN-OUTS



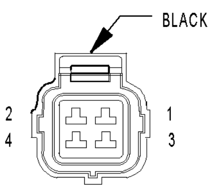
4WD SWITCH (MANUAL TRANSFER CASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K77 18BR/WT	4WD SWITCH SENSE
2	K4 18BK/LB	SENSOR GROUND



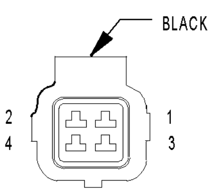
A/C COMPRESSOR CLUTCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	C3 20DB/BK	A/C CLUTCH RELAY OUTPUT
2	Z359 18BK/BR	GROUND



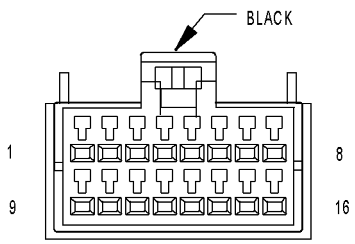
A/C PRESSURE TRANSDUCER - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K6 18VT/WT (EXCEPT NGC)	5 VOLT SUPPLY
2	K7 18OR (NGC)	5-VOLT SUPPLY
3	C18 18DB	A/C PRESSURE SIGNAL
4	-	-



A/C PRESSURE TRANSDUCER (DIESEL) - 4 WAY

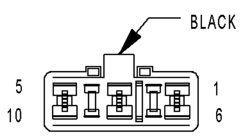
CAV	CIRCUIT	FUNCTION
1	K55 18LB/WT	MASS AIR FLOW SENSOR SIGNAL
2	K72 18DG/OR	5 VOLTS SUPPLY
3	C18 18DB	A/C PRESSURE SIGNAL
4	-	-



A/C-HEATER CONTROL C1

A/C-HEATER CONTROL C1 - BLACK 16 WAY

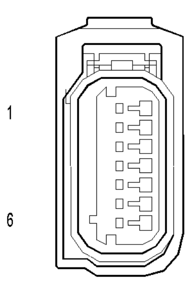
CAV	CIRCUIT	FUNCTION
1	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Z120 20WT/BK	GROUND
3	C57 20DB/GY	SENSOR GROUND
4	C33 20DB/RD	MODE DOOR 2 DRIVER
5	-	-
6	C12 20LG/BK	EVAPORATOR TEMPERATURE SENSOR SIGNAL
7	-	-
8	Y165 20OR/YL	PANEL LAMPS DRIVER
9	C62 20DB/PK	BLEND DOOR DRIVER
10	C35 20DG/YL	MODE DOOR 1 DRIVER
11	C34 20DB/WT	COMMON DOOR DRIVER
12	C32 20GY/DB	RECIRCULATION DOOR DRIVER
13	C46 20YL/LG	PASSENGER BLEND DOOR DRIVER
14	-	-
15	C16 20LB/YL	HEATED MIRROR RELAY CONTROL
16	D25 20VT/LG	PCI BUS



A/C-HEATER CONTROL C2

A/C-HEATER CONTROL C2 - BLACK 10 WAY

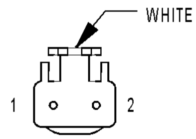
CAV	CIRCUIT	FUNCTION
1	-	-
2	C4 16TN	BLOWER MOTOR LOW DRIVER
3	C6 14LB	BLOWER MOTOR M2 DRIVER
4	-	-
5	Z37 10BK/DB	GROUND
6	-	-
7	C5 16LG	BLOWER MOTOR M1 DRIVER
8	-	-
9	-	-
10	C7 10BK/TN	BLOWER MOTOR HIGH DRIVER



ACCELERATOR PEDAL POSITION SENSOR (5.7L/DIESEL M/T NORMAL BUILD)

ACCELERATOR PEDAL POSITION SENSOR (5.7L/DIESEL M/T NORMAL BUILD) - 6 WAY

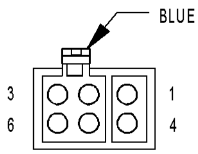
CAV	CIRCUIT	FUNCTION
1	K81 20DB/DG	APPS NO. 2 SIGNAL
2	K6 20VT/WT	5-VOLT SUPPLY
3	K7 20OR	5-VOLT SUPPLY
4	K981 20BR/DG	APPS NO. 2 RETURN
5	K255 20WT/DG	APPS NO. 1 SIGNAL
6	K223 20PK/DB	APPS NO. 1 RETURN



ADJUSTABLE PEDAL MOTOR

ADJUSTABLE PEDAL MOTOR - WHITE 2 WAY

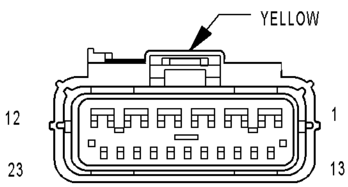
CAV	CIRCUIT	FUNCTION
1	Y151 18LG/BR	ADJUSTABLE PEDAL MOTOR (DOWN)
2	Y152 18LG/OR	ADJUSTABLE PEDAL MOTOR (UP)



ADJUSTABLE PEDAL SWITCH

ADJUSTABLE PEDAL SWITCH - BLUE 6 WAY

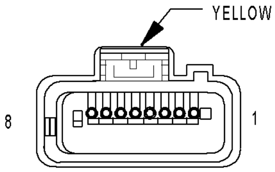
CAV	CIRCUIT	FUNCTION
1	Y151 18LG/BR	ADJUSTABLE PEDAL MOTOR (DOWN)
2	Y153 18DB/RD	ADJUSTABLE PEDAL RELAY OUTPUT
3	-	-
4	Z154 18BK/BR	GROUND
5	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN)
6	Y152 18LG/OR	ADJUSTABLE PEDAL MOTOR (UP)



AIRBAG CONTROL MODULE

AIRBAG CONTROL MODULE - YELLOW 23 WAY

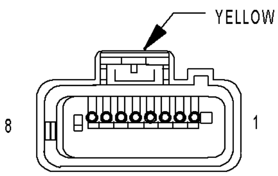
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	Z6 18BK/PK	GROUND
5	R45 18DG/LB	DRIVER SQUIB 1 LINE 2
6	R43 18BK/LB	DRIVER SQUIB 1 LINE 1
7	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1
8	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2
9	R53 18LG/YL	RIGHT SEAT BELT TENSIONER LINE 2
10	R55 18LG/DG	RIGHT SEAT BELT TENSIONER LINE 1
11	R56 18LB/DG	LEFT SEAT BELT TENSIONER LINE 1
12	R54 18LB/YL	LEFT SEAT BELT TENSIONER LINE 2
13	-	-
14	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
15	F23 18DB/YL	FUSED IGNITION SWITCH OUTPUT (RUN)
16	-	-
17	-	-
18	-	-
19	R4 18BR/YL	PASSENGER AIRBAG MUX SWITCH RETURN
20	R5 18VT/YL	PASSENGER AIRBAG MUX SWITCH SENSE
21	D25 20VT/DG	PCI BUS
22	R166 18LG/TN	PASSENGER AIRBAG INDICATOR DRIVER
23	-	-



AIRBAG CONTROL MODULE-LEFT SIDE IMPACT

AIRBAG CONTROL MODULE-LEFT SIDE IMPACT - YELLOW 8 WAY

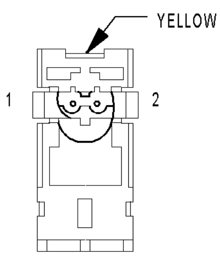
CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	Z11 18BK/WT	GROUND
3	R77 18LB/BR	LEFT CURTAIN SQUIB 1 LINE 2
4	R75 18LB/OR	LEFT CURTAIN SQUIB 1 LINE 1
5	Z11 18BK/WT	GROUND
6	-	-
7	-	-
8	D25 20DB/VT	PCI BUS



AIRBAG CONTROL MODULE-RIGHT SIDE IMPACT

AIRBAG CONTROL MODULE-RIGHT SIDE IMPACT - YELLOW 8 WAY

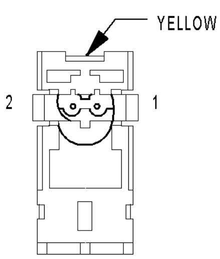
CAV	CIRCUIT	FUNCTION
1	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	-	-
3	R76 18LB/WT	RIGHT CURTAIN SQUIB 1 LINE 2
4	R74 18LB/YL	RIGHT CURTAIN SQUIB 1 LINE 1
5	Z29 18BK/PK	GROUND
6	-	-
7	-	-
8	D25 20DB/VT	PCI BUS



AIRBAG-DRIVER SQUIB 1

AIRBAG-DRIVER SQUIB 1 - YELLOW 2 WAY

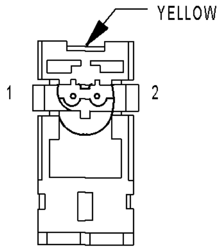
CAV	CIRCUIT	FUNCTION
1	R45 BK	DRIVER SQUIB 1 LINE 2
2	R43 BK	DRIVER SQUIB 1 LINE 1



AIRBAG-LEFT CURTAIN SQUIB

AIRBAG-LEFT CURTAIN SQUIB - YELLOW 2 WAY

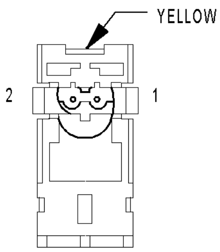
CAV	CIRCUIT	FUNCTION
1	R75 18LB/OR	LEFT CURTAIN SQUIB 1 LINE 1
2	R77 18LB/BR	LEFT CURTAIN SQUIB 1 LINE 2



AIRBAG - PASSENGER SQUIB 1

AIRBAG-PASSENGER SQUIB 1 - YELLOW 2 WAY

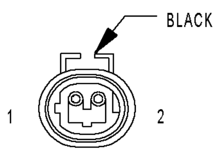
CAV	CIRCUIT	FUNCTION
1	R42 18BK/YL	PASSENGER SQUIB 1 LINE 1
2	R44 18DG/YL	PASSENGER SQUIB 1 LINE 2



AIRBAG-RIGHT CURTAIN SQUIB

AIRBAG-RIGHT CURTAIN SQUIB - YELLOW 2 WAY

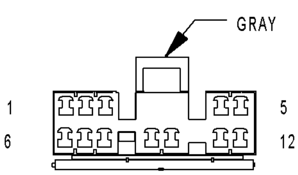
CAV	CIRCUIT	FUNCTION
1	R74 18LB/YL	RIGHT CURTAIN SQUIB 1LINE 1
2	R76 18LB/WT	RIGHT CURTAIN SQUIB 1 LINE 2



AMBIENT TEMPERATURE SENSOR

AMBIENT TEMPERATURE SENSOR - 2 WAY

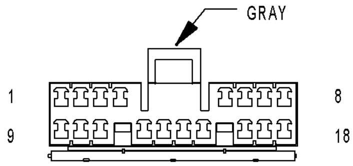
CAV	CIRCUIT	FUNCTION
1	G31 20VT/LG (NGC)	AAT SIGNAL
1	G31 20VT/LG	AMBIENT TEMPERATURE SENSOR SIGNAL
2	Y137 20VT/LB	SENSOR GROUND
2	K4 20VT/LB (NGC)	SENSOR GROUND



AMPLIFIER AUDIO C1

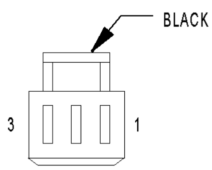
AMPLIFIER AUDIO C1 - GRAY 12 WAY

CAV	CIRCUIT	FUNCTION
1	X53 20DG	LEFT FRONT SPEAKER (+)
2	X55 20BR/RD	LEFT FRONT SPEAKER (-)
3	X57 20BR/LB	LEFT REAR SPEAKER (-)
4	Z115 18DB/BK	GROUND
5	X60 20DG/RD	RADIO 12 VOLT OUTPUT
6	X56 20DB/RD	RIGHT FRONT SPEAKER (-)
7	X54 20VT	RIGHT FRONT SPEAKER (+)
8	X51 20BR/YL	LEFT REAR SPEAKER (+)
9	X58 20DB/OR	RIGHT REAR SPEAKER (-)
10	X52 20DB/WT	RIGHT REAR SPEAKER (+)
11	Z126 18BK/DB	GROUND
12	D25 20VT/GY	PCI BUS



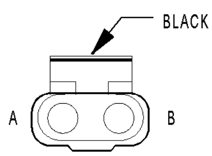
AMPLIFIER AUDIO C2 - GRAY 18 WAY

CAV	CIRCUIT	FUNCTION
1	F75 18VT	FUSED B(+)
2	-	-
3	-	-
4	X91 18WT/BK	LEFT REAR SPEAKER (-)
5	X82 18LB/VT	RIGHT FRONT DOOR SPEAKER (+)
6	X87 18LG/RD	LEFT FRONT DOOR SPEAKER (+)
7	X84 18OR/BK	RIGHT INSTRUMENT PANEL SPEAKER (+)
8	X83 18YL/RD	LEFT INSTRUMENT PANEL SPEAKER (-)
9	F75 18VT	FUSED B(+)
10	-	-
11	-	-
12	X93 18WT/RD	LEFT REAR SPEAKER (+)
13	X92 18TN/BK	RIGHT REAR SPEAKER (-)
14	X94 18TN/VT	RIGHT REAR SPEAKER (+)
15	X80 18LB/BK	RIGHT FRONT DOOR SPEAKER (-)
16	X85 18LG/DG	LEFT FRONT DOOR SPEAKER (-)
17	X86 18OR/RD	RIGHT INSTRUMENT PANEL SPEAKER (-)
18	X81 18YL/BK	LEFT INSTRUMENT PANEL SPEAKER (+)



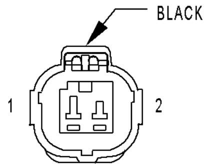
AUTOMATIC DAY/NIGHT MIRROR (EXCEPT BASE) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
2	Z104 20BK/OR	GROUND
3	L1 20VT/BK	BACK-UP LAMP FEED



BACKUP LAMP SWITCH (3.7L/4.7L/5.7L/8.0L) - BLACK 2 WAY

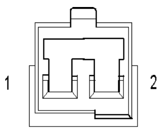
CAV	CIRCUIT	FUNCTION
1	L1 18VT/BK	BACK-UP LAMP FEED
2	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)



BATTERY TEMPERATURE SENSOR

BATTERY TEMPERATURE SENSOR - BLACK 2 WAY

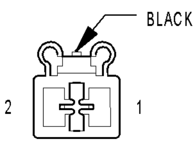
CAV	CIRCUIT	FUNCTION
1	K118 18PK/YL	BATT TEMP SIGNAL
2	K4 18BK/LB	SENSOR GROUND



BLEND DOOR ACTUATOR (SINGLE-ZONE)

BLEND DOOR ACTUATOR (SINGLE-ZONE) - 2 WAY

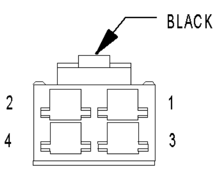
CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C62 20DB/PK	BLEND DOOR DRIVER



BLOWER MOTOR

BLOWER MOTOR - 2 WAY

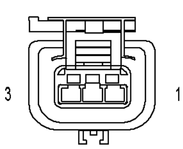
CAV	CIRCUIT	FUNCTION
1	C7 10BK/TN	BLOWER MOTOR HIGH DRIVER
2	C1 10DG	BLOWER MOTOR FEED



BLOWER MOTOR RESISTOR BLOCK

BLOWER MOTOR RESISTOR BLOCK - BLACK 4 WAY

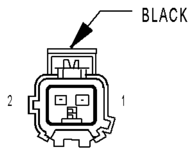
CAV	CIRCUIT	FUNCTION
1	C5 16LG	BLOWER MOTOR M1 DRIVER
2	C7 12BK/TN	BLOWER MOTOR HIGH DRIVER
3	C4 16TN	BLOWER MOTOR LOW DRIVER
4	C6 14LB	BLOWER MOTOR M2 DRIVER



BOOST PRESSURE SENSOR (DIESEL)

BOOST PRESSURE SENSOR (DIESEL) - 3 WAY

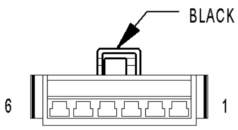
CAV	CIRCUIT	FUNCTION
1	K72 18DG/OR	5 VOLTS SUPPLY
2	K9 18LB	FUEL PRESSURE SENSOR 5 VOLT SUPPLY
3	K55 18LB/WT	MASS AIR FLOW SENSOR SIGNAL



BRAKE FLUID LEVEL SWITCH

BRAKE FLUID LEVEL SWITCH - BLACK 2 WAY

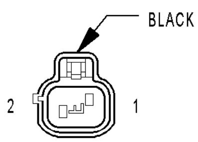
CAV	CIRCUIT	FUNCTION
1	G9 20GY/BK	BRAKE FLUID LEVEL SWITCH SENSE
2	Z231 20BK/DG	GROUND



BRAKE LAMP SWITCH

BRAKE LAMP SWITCH - BLACK 6 WAY

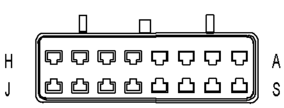
CAV	CIRCUIT	FUNCTION
1	A108 18TN/RD	FUSED B(+)
2	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
3	V30 20DB/RD	SPEED CONTROL BRAKE SWITCH OUTPUT
3	V30 20DB/RD (NGC)	FUSED IGNITION SWITCH (RUN-START)
4	V32 20YL/RD	SPEED CONTROL SUPPLY
4	V32 20YL/RD (5.7L)	BRAKE SWITCH NO. 2 SIGNAL
5	Z241 20BK/VT	GROUND
6	K29 20WT/PK	BRAKE SWITCH SENSE
6	K29 20WT/PK (NGC)	BRAKE SWITCH NO. 1 SIGNAL



BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID

BRAKE TRANSMISSION SHIFT INTERLOCK SOLENOID - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Y204 18OR/WT	BTSI SOLENOID CONTROL
2	Z123 18BK/OR	GROUND



C100 (DIESEL)

C100 (DIESEL) - (DASH TO ENGINE)

CAV	CIRCUIT
A	K152 28WT
B	B6 20WT/DB
C	B7 20WT
D	Z11 18BK/WT
E	-
F	Y1 18LG
G	K4 18BK/LB
H	Y169 18WT/TN
J	Y168 18WT/LB
K	Y3 18WT
L	L60 18LG/TN
M	L7 18BK/YL
N	F15 20DB
P	Y5 18OR
R	-
S	K154 18GY

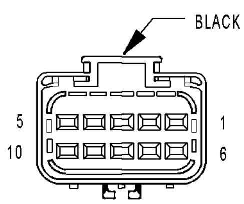
PICTURE

NOT

AVAILABLE

C100 (DIESEL) - (ENGINE TO DASH)

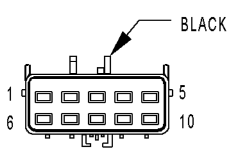
CAV	CIRCUIT
1	K152 18WT
2	B6 20WT/DB
3	B7 20WT
4	Z11 18BK/WT
5	-
6	Y1 18LG
7	K4 18BK/LB
8	Y169 18WT/TN
9	Y168 18WT/LB
10	Y3 18WT
11	L60 18LG/TN
12	L7 18BK/YL
13	F15 20DB
14	Y5 18OR
15	-
16	K154 18GY



C100
(GAS)

C100 (GAS) - BLACK (DASH TO ENGINE)

CAV	CIRCUIT
1	V10 20BR (EXCEPT 8.0L)
2	B6 20WT/DB
3	B7 20WT
4	G29 20BK/TN (EXCEPT 8.0L)
5	Y137 20VT/LB (EXCEPT 8.0L)
6	Y169 18WT/TN
7	Y168 18WT/LB
8	L60 18LG/TN
9	L7 18BK/YL
10	-



C100
(GAS)

C100 (GAS) - BLACK (ENGINE TO DASH)

CAV	CIRCUIT
1	V10 20BR (EXCEPT 8.0L)
2	B6 20WT/DB
3	B7 20WT
4	G29 20BK/TN (EXCEPT 8.0L)
5	Y137 20VT/LB (EXCEPT 8.0L)
6	Y169 18WT/TN
7	Y168 18WT/LB
8	L60 18LG/TN
9	L7 18BK/YL
10	-

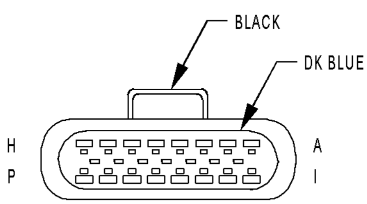
PICTURE

NOT

AVAILABLE

C106 (5.7L) - BLACK

CAV	CIRCUIT
A	K11 18WT/DB
B	K12 18TN
C	K13 18YL/WT
D	K14 18LB/BR
E	K38 18GY
F	K58 18BR/DB
G	K26 18VT/TN
H	K28 18GY/LB
I	K91 18TN/RD
J	K92 18TN/PK
K	K93 18TN/OR
L	K94 18TN/LG
M	K95 18TN/DG
N	K96 18TN/LB
O	K97 18BR
P	K98 18LB



C106
(5.7L)

C106 (5.7L) - BLACK (ENGINE TO TRANSMISSION)

CAV	CIRCUIT
A	K11 18WT/DB
B	K12 18TN
C	K13 18YL/WT
D	K14 18LB/BR
E	K38 18GY
F	K58 18BR/DB
G	K26 18VT/TN
H	K28 18GY/LB
I	K91 18TN/RD
J	K92 18TN/PK
K	K93 18TN/OR
L	K94 18TN/LG
M	K95 18TN/DG
N	K96 18TN/LB
O	K97 18BR
P	K98 18LB/RD

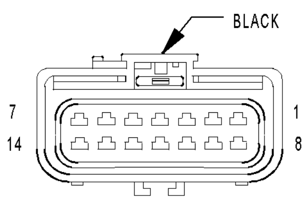
PICTURE

NOT

AVAILABLE

C107 (5.7L) - BLACK

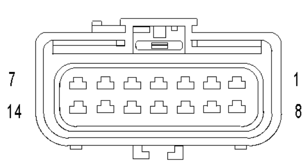
CAV	CIRCUIT
1	K4 18BK/LB
2	K1 18DG/RD
3	K21 18BK/RD
4	K101 18WT
5	K6 18VT/WT
6	K888 18BR/PK
7	A142 16DG/OR
8	K7 18OR
9	K2 18TN/BK
10	K122 18DB/GY
11	K22 18OR/DB
12	-
13	F855 18OR/PK
14	A142 16DG/OR



C107
(5.7L)

C107 (5.7L) - BLACK (ENGINE TO TRANSMISSION)

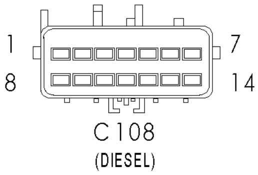
CAV	CIRCUIT
1	K4 18BK/LB
2	K1 18DG/RD
3	K21 18BK/RD
4	K101 18WT
5	K6 18VT/WT
6	K888 18BR/PK
7	A142 16DG/OR
8	K7 18OR
9	K2 18TN/BK
10	K122 18DB/GY
11	K22 18OR/DB
12	-
13	F855 18OR/PK
14	A142 16DG/OR



C108
(DIESEL)

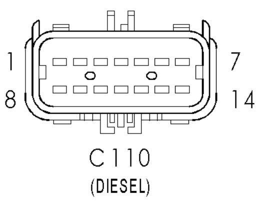
C108 (DIESEL)

CAV	CIRCUIT
1	G7 18WT/OR
2	C13 18DB/OR
3	A93 14RD/BK
4	K118 18PK/YL
5	G8 18LB/BK
6	D25 18VT/YL
7	K77 18BR/WT
8	V32 18YL/WT
9	K152 18WT
10	K22 18OR/DB
11	K154 18GY
12	-
13	-
14	-



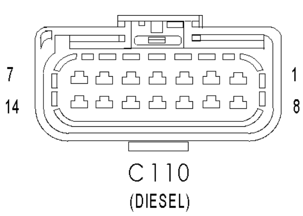
C108 (DIESEL) - (ENGINE TO TRANSMISSION)

CAV	CIRCUIT
1	G7 18WT/OR
2	C13 18DB/OR
3	A53 14RD/BK
4	K118 18PK/YL
5	G8 18LB/BK
6	D25 18VT/YL
7	K77 18BR/WT
8	V32 18YL/RD
9	K152 18WT
10	K22 18OR/DB
11	K154 18GY
12	-
13	-
14	-



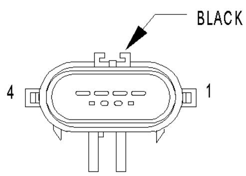
C110 (DIESEL)

CAV	CIRCUIT
1	C3 18DB/BK
2	K29 18WT/PK
3	K4 18BK/LB
4	V37 18RD/LG
5	V37 18RD/LG
6	Y1 18LG
7	Y5 18OR
8	Y3 18WT
9	D20 18LG
10	D21 18PK
11	Y135 18LG/BK
12	-
13	-
14	-



C110 (DIESEL) - (ENGINE TO TRANSMISSION)

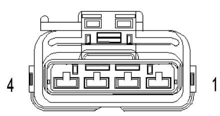
CAV	CIRCUIT
1	C3 18DB/BK
2	K29 18WT/PK
3	K24 18WT/DG
4	K4 18BK/LB
5	V37 18RD/LG
6	Y1 18LG
7	Y5 18OR
8	Y3 18WT
9	D20 18LG
10	D21 18PK
11	Y135 18LG/BK
12	-
13	-
14	-



C112
(DIESEL)

C112 (DIESEL)

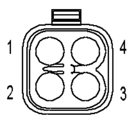
CAV	CIRCUIT
1	C3 18DB/BK
2	A93 14RD/BK
3	Y523 18VT/WT
4	T503 18GY/BR



C112
(DIESEL)

C112 (DIESEL)

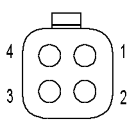
CAV	CIRCUIT
1	C3 18DB/BK
2	A93 14RD/BK
3	K69 18BR/LB
4	K68 18BR/LG



C115
(DIESEL)

C115 (DIESEL)

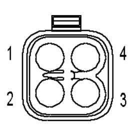
CAV	CIRCUIT
1	K91 14TN/RD
2	K12 14YL/WT
3	K91 14TN/RD
4	K11 14WT/DB



C115
(DIESEL)

C115 (DIESEL) - (INJECTOR SIDE)

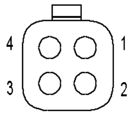
CAV	CIRCUIT
1	K91 14TN/RD
2	K12 14YL/WT
3	K91 14TN/RD
4	K11 14WT/DB



C116
(DIESEL)

C116 (DIESEL)

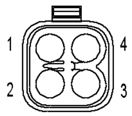
CAV	CIRCUIT
1	K92 14TN/PK
2	K14 14RD/WT
3	K91 14TN/RD
4	K13 14TN



C116
(DIESEL)

C116 (DIESEL) - (INJECTOR SIDE)

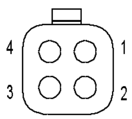
CAV	CIRCUIT
1	K92 14TN/PK
2	K14 14RD/WT
3	K91 14TN/RD
4	K13 14TN



C117
(DIESEL)

C117 (DIESEL)

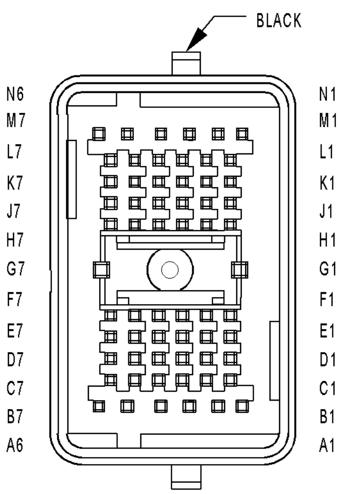
CAV	CIRCUIT
1	K92 14TN/PK
2	K58 14BR/DB
3	K92 14TN/PK
4	K38 14GY



C117
(DIESEL)

C117 (DIESEL) - (INJECTOR SIDE)

CAV	CIRCUIT
1	K92 14TN/PK
2	K58 14BR/DB
3	K92 14TN/PK
4	K38 14GY



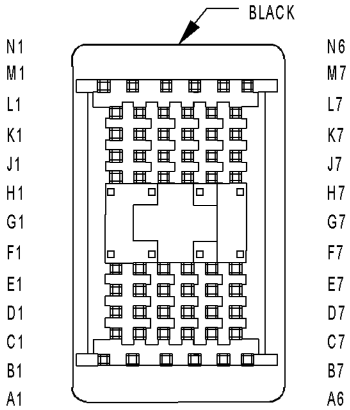
C130

C130 - BLACK (DASH TO ENGINE)

CAV	CIRCUIT
A1	A41 16YL (EXCEPT DIESEL/EXCEPT 8.0L)
A2	A93 12RD/BK (DIESEL)
A3	K108 18WT/TN (NGC)
A4	-
A5	-
A6	-
B1	V35 20LG/RD (EXCEPT 5.7L/EXCEPT 8.0L)
B2	V32 20YL/RD
B3	K51 20DB/YL (EXCEPT DIESEL)
B3	K914 20VT/BR (DIESEL)
B4	Y169 18WT/TN
B5	B6 20WT/DB (ABS)
B6	K118 18PK/YL
B7	L1 18VT/BK
C1	A14 20RD/WT
C2	L7 18BK/YL
C3	D25 20VT/OR (DIESEL/5.7L)
C4	T6 20OR/WT
C5	K6 20VT/WT (5.7L)
C6	K127 18DB/OR (8.0L/3.7L/5.9L)
C6	V38 20VT/OR (5.7L)
C7	G29 20/BK/TN (EXCEPT DIESEL/EXCEPT 8.0L)
C7	F15 20DB (DIESEL)
D1	B7 20WT (ABS)
D2	D15 18WT/DG (EXCEPT 8.0L)
D3	K29 20WT/PK
D4	L10 18BR/LG
D5	L60 18LG/TN
D6	Y168 18WT/LB
D7	V10 20BR (EXCEPT DIESEL/8.0L)
E1	Y116 20YL/GY (ETC)

C130 - BLACK (DASH TO ENGINE)

CAV	CIRCUIT
E2	Y112 20YL/BR (ETC)
E3	Y113 20 YL/OR (ETC)
E4	Y114 20YL/VT (ETC)
E5	Y117 20YL/DB (ETC)
E6	Y145 20DB/YL (EXCEPT DIESEL)
E7	B222 20DG/WT (EXCEPT ABS)
F1	T24 20BR/YL (DIESEL/8.0L)
F1	T752 18DG/OR (EXCEPT DIESEL/EXCEPT 8.0L)
F2	D6 18PK/LB
F6	-
F7	-
G1	-
G2	-
H1	Y215 18YL/PK (5.7L)
H2	-
H6	-
H7	K81 20DB/DG (5.7L)
J1	Y115 20YL/WT (ETC)
J2	G7 20WT/OR (EXCEPT 5.7L)
J2	B22 20DG/YL (5.7L)
J3	K52 18PK/BK (EXCEPT DIESEL)
J4	K31 20BR
J5	Y135 18LG/BK
J6	K30 18PK
J7	A141 18DG/WT (EXCEPT 5.7L/EXCEPT 4.7L)
J7	K255 20WT/DG (5.7L)
K1	V36 20TN/RD (EXCEPT 5.7L)
K2	C13 20DB/OR
K3	Y193 20YL/RD (3.7/5.9L/8.0L)
K4	Y128 20DG/GY (3.7L/5.9L8.0L)
K5	A42 18DG (8.0L/3.7L/5.9L)
K5	K981 20BR/DG (5.7L)
K6	K173 18LG (EXCEPT DIESEL)
K7	Y137 20VT/LB (EXCEPT 8.0L/EXCEPT DIESEL)
L1	K223 20PK/DB (5.7L)
L2	G115 20YL/WT (DIESEL)
L2	T24 20BR/YL (NGC)
L3	-
L4	-
L5	-
L6	G31 20VT/LG (NGC)
L7	K7 20OR (5.7L)
M1	D20 20LG
M2	D25 20VT/BR (EXCEPT DIESEL)
M3	K4 18BK/LB
M4	D21 20PK
M5	C3 20DB/BK
M6	V37 20RD/LG
M7	G8 20LB/BK
N1	A61 16DG/BK (3.7L/5.7L/5.9L)
N2	T16 16RD
N3	A142 16DG/OR (GAS)
N4	Y124 16DG/WT (ETC)
N5	Y125 16DG/WT (ETC)
N6	A51 16RD/WT (3.7L/4.7L/5.7L/5.9L)



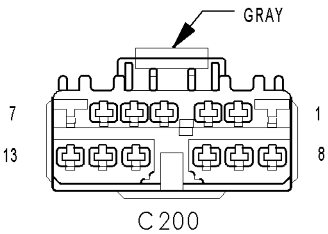
C130

C130 - BLACK (ENGINE TO DASH)

CAV	CIRCUIT
A1	A41 16YL (4.7L/5.7L/3.7L A/T)
A1	A41 14YL (3.7L M/T)
A2	A93 14RD/BK (DIESEL)
A3	K108 18WT/TN (4.7L/5.7L)
A4	-
A5	-
A6	-
B1	V35 18LG/RD (EXCEPT 5.7L)
B2	V32 18YL/RD (EXCEPT 5.7L)
B2	V32 20YL/RD (5.7L)
B3	K4 18BK/LB (DIESEL)
B3	VT/PK (DIESEL)
B3	K51 20DB/YL
B4	Y169 18WT/TN
B5	B6 20WT/DB
B6	K118 18PK/YL
B7	L1 18VT/BK
C1	A14 20RD/WT (EXCEPT DIESEL)
C2	L7 18BK/YL
C3	D25 20VT/OR (3.7L A/T) (5.7L A/T)
C3	VT/YL (DIESEL)
C4	T6 18OR/WT (A/T EXCEPT 5.7L)
C4	T6 20OR/WT (5.7L A/T)
C5	K6 18VT/WT (5.7L)
C6	V38 20VT/OR (5.7L)
C6	K127 18DB/OR (3.7L/5.9L/8.0L)
C7	G29 18BK/TN (3.7L/4.7L)
C7	F15 20DB (DIESEL)
C7	G29 20BK/TN (5.9L/5.7L)
D1	B7 20WT
D2	D15 18WT/DG (3.7L A/T/4.7L A/T/5.7L A/T/DIESEL)
D3	K29 20WT/PK (5.7L)
D3	K29 18WT/PK (EXCEPT 5.7L)
D4	L10 18BR/LG
D5	L60 18LG/TN
D6	Y168 18WT/LB
D7	V10 20BR (EXCEPT 8.0L/DIESEL)
E1	Y116 20YL/GY (5.7L ETC)
E1	Y116 20YL/GY (5.9L/8.0L)
E2	Y112 20LB/BR (5.9L/8.0L)
E2	Y112 20YL/BR (5.7L ETC/DIESEL)
E3	Y113 20YL/OR (5.7L ETC)
E3	Y113 20YL/OR (5.9L/8.0L ETC)
E4	Y114 20YL/VT (5.9L/8.0L ETC)
E4	Y114 20 YL/VT (5.7L ETC)
E5	Y117 20YL/DB (5.7L ETC)
E5	Y117 20YL/DB (5.9L/8.0L ETC)
E6	Y145 20DB/YL (EXCEPT DIESEL)
E7	B222 20DG/WT (5.7L)
F1	T752 18DG/OR (4.7L/5.7L)
F1	T24 20BR/YL (3.7L A/T) (5.9L A/T) (8.0L A/T)
F2	D6 20PK/LB (3.7L A/T) (4.7L A/T) (5.7L A/T)
F3	-
F4	-
F5	-

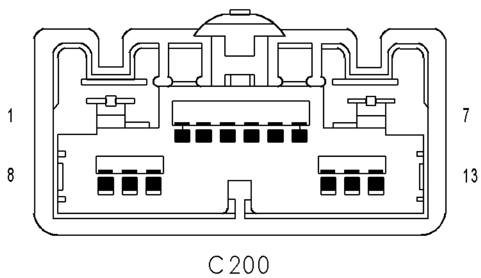
C130 - BLACK (ENGINE TO DASH)

CAV	CIRCUIT
F6	-
F7	-
G1	-
G7	-
H1	Y215 20YL/PK (5.7L)
H2	-
H3	-
H4	-
H6	-
H7	K81 18DB/DG (5.7L)
J1	Y115 20YL/WT (ETC)
J2	B22 20DG/YL (5.7L)
J2	G7 18WT/OR (EXCEPT 5.7L)
J3	K52 18PK/BK (EXCEPT DIESEL)
J4	K31 18BR (EXCEPT DIESEL)
J5	Y135 18LG/BK
J6	K30 18PK (A/T)
J7	K255 18WT/DG (5.7L/DIESEL)
J7	A141 18DG/WT (EXCEPT 5.7L)
K1	V36 18TN/RD (EXCEPT 5.7L)
K2	C13 20DB/OR
K3	Y193 20YL/RD (5.9L/8.0L)
K4	Y128 20DB/GY (5.9L/8.0L)
K5	K981 18BR/DG (5.7L)
K5	A42 18DG (5.9L/8.0L)
K6	K125 18WT/DB (5.9L/8.0L)
K6	Z16 18BK (3.7L A/T) (4.7L A/T) (5.7L A/T)
K7	Y137 20VT/LB (5.7L/5.9L)
K7	Y137 18VT/LB (3.7L/4.7L)
L1	K223 18PK/DB (5.7L)
L2	T24 18BR/YL (NGC)
L3	-
L4	-
L5	-
L6	G31 18VT/LG (NGC)
L7	K7 18OR (5.7L)
M1	D20 20LG (5.7L/DIESEL)
M1	D20 18LG (EXCEPT 5.7L)
M2	D25 20VT/BR (5.7L)
M2	D25 20VT/BK (EXCEPT 5.7L/DIESEL)
M3	K4 18BK/LB
M4	D21 20PK (5.7L)
M4	D21 18PK (EXCEPT 5.7L)
M5	C3 20DB/BK
M6	V37 20RD/LG (5.7L)
M6	V37 18RD/LG (EXCEPT 5.7L)
M7	G8 20LB/BK (5.7L/DIESEL)
N1	A61 16DG/BK (3.7L A/T) (5.7L A/T)
N2	T16 16RD 3.7L/4.7L/5.7L)
N2	T16 16RD (5.9L/8.0L)
N3	A142 16DG/OR (8.0L)
N3	A142 16DG/OR (EXCEPT 8.0L/DIESEL)
N4	Y124 16DG/VT (5.7L/5.9L/8.0LETC/DIESEL)
N5	Y125 16DG/WT (5.7L/5.9L/8.0LETC/DIESEL)
N6	A51 16RD/WT (5.7LA/T)



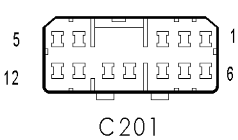
C200 - GRAY (I/P TO HVAC)

CAV	CIRCUIT
1	C7 10BK/TN
2	C34 20DB/WT
3	C4 16TN
4	C32 20GY/DB
5	C6 14LB
6	C5 16LG
7	C1 10DG
8	C33 20DB/RD
9	C12 20LG/BK
10	C57 20DB/GY
11	C62 20DB/PK
12	C46 20YL/LG
13	C35 20DG/YL



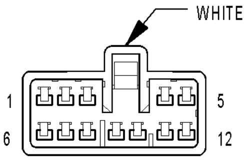
C200 - (HVAC TO I/P)

CAV	CIRCUIT
1	C7 10BK/TN
2	C34 20DB/WT
3	C4 16TN
4	C32 20GY/DB
5	C6 14LB
6	C5 16LG
7	C1 10DG
8	C33 20DB/RD
9	C12 20LG/BK (A/C ONLY)
10	C57 20DB/GY (A/C ONLY)
11	C62 20DB/PK
12	C46 20YL/LG (DUAL-ZONE)
13	C35 20DG/YL



C201 - (I/P TO HEADLINER)

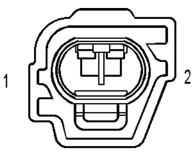
CAV	CIRCUIT
1	D25 20VT
2	Z104 20BK/OR
3	L50 18WT/TN
4	Z56 18BK
5	-
6	Y107 20VT/RD
7	-
8	M3 20PK/DB
9	M20 20BR
10	M11 20PK/LB
11	L1 20VT/BK
12	F32 20RD/YL



C201

C201 - WHITE (HEADLINER TO I/P)

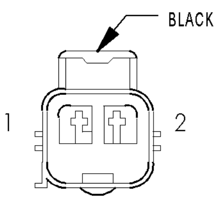
CAV	CIRCUIT
1	D25 20VT
2	Z104 18BK/OR
3	L50 18WT/TN
4	Z56 18BK
5	-
6	Y107 20VT/RD (EXCEPT BASE)
7	-
8	M3 20PK/DB
9	M20 20BR
10	M11 20PK/LB
11	L1 18VT/BK
12	F32 18RD/YL



C202

C202 - (DASH TO FOG LAMPS)

CAV	CIRCUIT
1	L39 18LB
2	Z144 BK/OR



C202

C202 - BLACK (FOG LAMPS TO DASH)

CAV	CIRCUIT
1	L39 18LB
2	Z144 18BK/OR

PICTURE

NOT

AVAILABLE

C206 - (CLEARANCE LAMP TO I/P)

CAV	CIRCUIT
1	L7 20BK/YL
2	Z253 20BK/RD

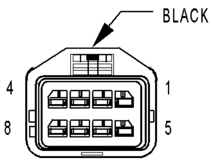
PICTURE

NOT

AVAILABLE

C206 (SLT+)

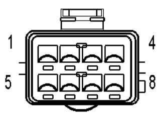
CAV	CIRCUIT
1	L7 18BK/YL
2	Z253 18BK/RD



C216

C216 - BLACK (DASH TO CHASSIS)

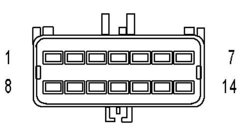
CAV	CIRCUIT
1	B113 20RD/VT
2	B114 20WT/VT
3	L76 18BK/OR
4	L24 18WT/LG
5	L62 18BR/RD
6	K4 18BK/LB
7	G8 20LB/BK
8	L7 18BK/YL



C216

C216 - (CHASSIS TO DASH)

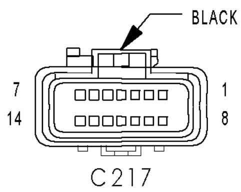
CAV	CIRCUIT
1	B113 18RD/VT
2	B114 18WT/VT
3	L76 18BK/OR
4	L24 18WT/LG
5	L62 18BR/RD
6	K4 18BK/LB
7	G8 18LB/BK
8	L7 18BK/YL



C217

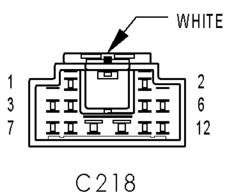
C217 - (CHASSIS TO DASH)

CAV	CIRCUIT
1	Y141 18YL/PK
2	B40 14LB
3	Y133 14WT/RD
4	Y174 18PK/VT
5	A64 16DG/WT
6	L50 18WT/TN
7	Z52 14BK
8	-
9	-
10	L22 18LB/WT
11	L63 18DG/RD
12	L1 18VT/BK
13	Y140 18WT/PK
14	Z13 16BK



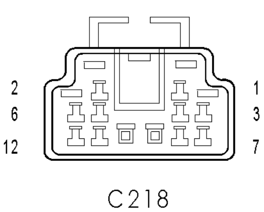
C217 - BLACK (DASH TO CHASSIS)

CAV	CIRCUIT
1	Y141 18DG/WT
2	B40 14LB
3	Y133 14RD/OR
4	Y174 18PK/VT
5	A64 16DG/WT
6	L50 18WT/TN
7	Z52 14BK
8	-
9	-
10	L22 18LB/WT
11	L63 18DG/RD
12	L1 18VT/BK
13	Y140 18 WT/PK
14	Z13 16BK



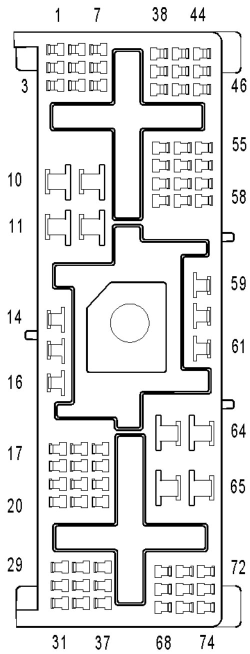
C218 - WHITE (DASH TO BODY)

CAV	CIRCUIT
1	-
2	Y148 18YL/RD
3	F121 16TN/BK
4	F235 18RD
5	-
6	-
7	-
8	F14 18LG/YL
9	F37 12 RD/LB
10	-
11	-
12	-



C218 - (BODY TO DASH)

CAV	CIRCUIT
1	-
2	Y148 16YL/RD
3	F121 16TN/BK (EXCEPT BASE)
4	F235 18RD (SLT+)
5	-
6	-
7	-
8	F14 18LG/YL (SIDE IMPACT AIRBAGS)
9	F37 12RD/LB
10	-
11	-
12	-



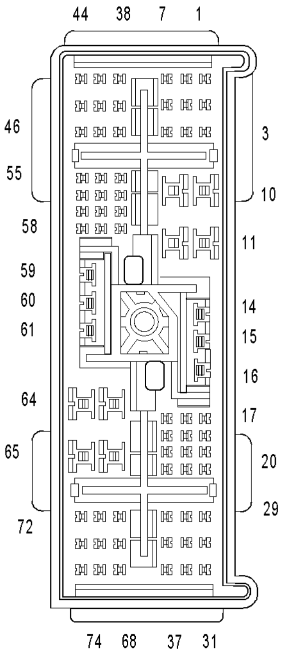
C219

C219 - GRAY (DASH TO I/P)

CAV	CIRCUIT
1	Y113 20YL/OR (ETC)
2	D15 18WT/DG (EXCEPT 8.0L)
3	L50 18WT/TN
4	A51 16RD/WT (GAS EXCEPT 8.0L)
5	D21 20PK
6	A108 18TN/RD
7	A41 16YL
8	D20 20LG
9	-
10	A2 10PK/BK
11	A30 10RD/WT (EXCEPT BASE)
12	-
13	-
14	-
15	-
16	V38 20VT/OR (5.7L)
17	V37 20RD/LG
18	T6 20OR/WT
19	L7 18BK/YL
20	Y107 20VT/RD
21	V32 20YL/RD
22	-
23	A22 16BK/OR
24	G11 20WT/LG
25	V30 20DB/RD (EXCEPT 5.7L)
25	Y135 18LG/BK (5.7L)
25	Z10 20BK/TN (DIESEL)
26	M1 18PK
27	L1 18VT/BK
28	D25 20VT/OR (EXCEPT 4.7L)
29	D25 20VT/BK
30	K4 18BK/LB (GAS EXCEPT 5.7L)
30	K914 20VT/BR (DIESEL)
30	Y215 18YL/PK (5.7L)
31	E1 20TN
32	F15 20DB
33	F35 18RD
34	D25 20VT/BR (GAS)
35	-
36	F30 18RD
37	A34 16LB/RD (5.7L ETC)
38	A21 16DB
39	Y128 20DG/GY (3.7L/5.9L/8.0L/DIESEL)
40	Y125 16DG/WT (5.7L ETC)
41	A1 16RD
42	Y135 18LG/BK

C219 - GRAY (DASH TO I/P)

CAV	CIRCUIT
43	Y153 18DB/RD (EXCEPT BASE)
44	D6 18PK/LB
45	-
46	C16 20LB/YL (EXCEPT BASE)
47	Y193 20YL/RD (EXCEPT NGC/DIESEL)
48	A12 18RD/TN
49	F75 18VT (EXCEPT BASE)
50	Y117 20YL/DB (5.7L ETC)
51	-
52	-
53	Y124 16DG/VT (ETC)
54	Y112 20YL/BR (ETC)
55	F32 20RD/YL
56	F23 18DB/YL
57	T24 20BR/YL (5.7L ETC)
58	Y116 20YL/GY (5.7L ETC)
59	-
60	Y131 14RD/WT
61	A31 14BK/WT
62	-
63	-
64	-
65	-
66	A38 16OR
67	F14 18LG/YL
68	L39 18LB
69	K29 20WT/PK (EXCEPT BASE)
70	A14 20RD/WT
71	Y115 20YL/WT (5.7L ETC)
72	D25 20VT/PK
73	Y105 20BR/RD
74	Y114 20YL/VT (5.7L ETC)



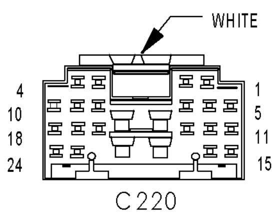
C219

C219 - GRAY (I/P TO DASH)

CAV	CIRCUIT
1	Y113 20YL/OR (SLT+)
2	D15 18WT/DG
3	L50 18WT/TN
4	A51 16RD/WT
5	D21 18PK
6	A108 18TN/RD
7	A41 16YL
8	D20 20LG
9	-
10	A2 10PK/BK
11	A30 10RD/WT
12	-
13	-
14	-
15	-
16	V38 20VT/OR
17	V37 20RD/WT
18	T6 20OR/WT
19	L7 18BK/YL
20	Y107 20VTRD
21	V32 20YL/RD
22	-
23	A22 16BK/OR
24	G11 20WT/LG
25	V30 20DB/RD
26	M1 18PK
27	L1 18VT/BR
28	D25 20VT/OR
29	D25 20VT/BK
30	K4 20BK/LB
31	E1 20TN
32	F15 20DB
33	F35 18RD
34	D25 20VT/BR
35	-
36	F30 18RD
37	-
38	A21 16DB
39	T128 20DG/GY
40	Y125 16DG/WT (SLT+)
41	A1 16RD
42	Y135 20LG/BK
43	Y153 18DB/RD (SLT+)
44	D6 18PK/LB
45	-
46	C16 20LB/YL
47	Y193 20YL/RD
48	A12 18RD/TN
49	F75 18VT
50	Y117 20YL/DB (SLT+)
51	-
52	-
53	Y124 16DG/VT (SLT+)
54	Y112 20YL/BR (SLT+)
55	F32 20RD/YL

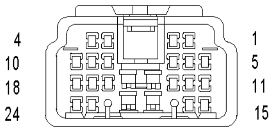
C219 - GRAY (I/P TO DASH)

CAV	CIRCUIT
56	F23 18DB/YL
57	T24 20BR/YL (SLT+)
58	Y116 20YL/GY (SLT+)
59	-
60	Y131 14RD/WT
61	A31 14BK/WT
62	-
63	-
64	-
65	-
66	A38 16OR
67	F14 18LG/YL
68	L39 20LB
69	K29 20WT/PK
70	A14 20RD/WT
71	Y115 20YL/WT (SLT+)
72	D25 20VT/PK
73	Y105 20BR/RD
74	Y114 20YL/VT (SLT+)



C220 - WHITE (I/P TO BODY)

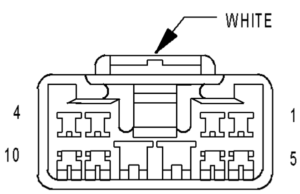
CAV	CIRCUIT
1	Y105 20BR/RD
2	X91 18WT/BK
3	F32 20RD/YL
4	X87 18LG/RD
5	G75 20TN
6	G77 20VT/OR
7	X85 18LG/DG
8	G10 20LG/RD
9	G73 20LG/OR
10	X93 18WT/RD
11	Y201 18TN/OR
12	D25 20DB/VT
13	-
14	-
15	-
16	BK/WT
17	Y157 18TN/PK
18	P97 20WT/DG
19	-
20	P55 18DB
21	-
22	F21 12TN
23	R56 18LB/DG
24	R54 18LB/YL



C220

C220 - (BODY TO I/P)

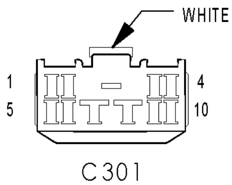
CAV	CIRCUIT
1	Y105 20BR/RD
2	X91 18WT/BK
3	F32 18RD/YL
4	X87 18LG/RD
5	G75 20TN
6	G77 20VT/OR
7	X85 18LG/DG
8	G10 20LG/RD
9	G73 20LG/OR (EXCEPT BASE)
10	X93 18WT/RD
11	-
12	D25 20DB/VT
13	-
14	-
15	-
16	Z11 18 BK/WT
17	Y157 18TN/PK (EXCEPT BASE)
18	P97 20WT/DG (EXCEPT BASE)
19	-
20	P55 18DB (EXCEPT BASE)
21	-
22	F21 12TN (EXCEPT BASE)
23	R56 18LB/DG
24	R54 18LB/YL



C301

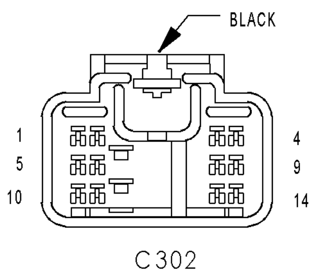
C301 - WHITE (BODY TO PASSENGER DOOR)

CAV	CIRCUIT
1	G74 20TN/RD
2	P76 20OR/YL (EXCEPT BASE)
3	P72 20YL/BK (EXCEPT BASE)
4	X82 18LB/RD
5	X80 18LB/BK
6	P74 20DB (EXCEPT BASE)
7	Q1 12TY (EXCEPT BASE)
8	-
9	-
10	Z315 20BK/LG



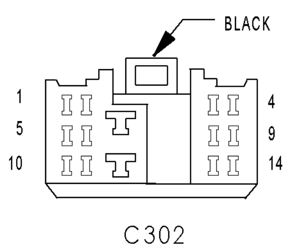
C301 - WHITE (PASSENGER DOOR TO BODY)

CAV	CIRCUIT
1	G74 20TN/RD
2	P76 20OR/YL
3	P72 20YL/BK
4	X82 18LB/RD
5	X80 18LB/BK
6	P74 20DB
7	Q1 14YL
8	-
9	-
10	Z315 20BK/LG



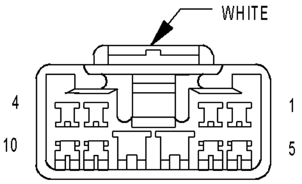
C302 - BLACK (BODY TO PASSENGER DOOR)

CAV	CIRCUIT
1	Y107 20VT/RD
2	-
3	-
4	Y156 18TN/WT
5	-
6	P96 20WT/LG
7	Q16 14BR/WT
8	Q26 14VT/WT
9	G72 20DG/OR
10	Y200 18TN/VT
11	Z311 20BK/LB
12	-
13	F121 18TN/BK
14	-



C302 - BLACK (PASSENGER DOOR TO BODY)

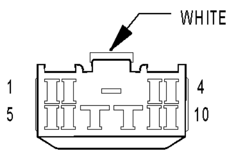
CAV	CIRCUIT
1	Y107 20VT/RD
2	-
3	-
4	Y156 18TN/WT
5	-
6	P96 20WT/LG
7	Q16 14BR/WT
8	Q26 14VT/WT
9	G72 20DG/OR
10	Y200 18TN/VT
11	Z311 20BK/LB
12	-
13	F121 18TN/BK
14	-



C304

C304 - WHITE (BODY TO DRIVER DOOR)

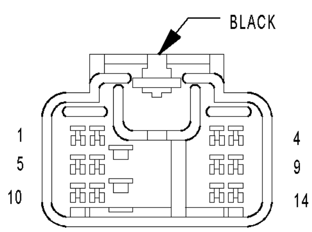
CAV	CIRCUIT
1	G75 20TN
2	P76 20OR/YL (EXCEPT BASE)
3	P72 20YL/BK (EXCEPT BASE)
4	X87 18LG/RD
5	X85 18LG/DG
6	P74 20DB (EXCEPT BASE)
7	F21 12TN (EXCEPT BASE)
8	Q1 12YL (EXCEPT BASE)
9	F32 18RD/YL (EXCEPT BASE)
10	Z314 20BK/LG



C304

C304 - WHITE (DRIVER DOOR TO BODY)

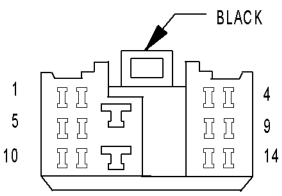
CAV	CIRCUIT
1	G75 20TN
2	P76 20OR/YL
3	P72 20YL/BK
4	X87 18LG/RD
5	X85 18LG/DG
6	P74 20DB
7	F21 14TN
8	Q1 14YL
9	F32 18RD/YL
10	Z314 20BK/LG



C305

C305 - BLACK (BODY TO DRIVER DOOR)

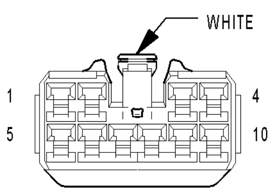
CAV	CIRCUIT
1	F121 18TN/BK
2	Q16 14BR/WT
3	Q26 14VT/WT
4	Y157 18TN/PK
5	-
6	P55 18DB
7	Z239 14BK/LB
8	Q28 14DG/WT
9	-
10	P97 20WT/DG
11	G73 20LG/OR
12	Q18 14GY/BK
13	Q27 14RD/BK
14	Q17 14DB/WT



C305

C305 - BLACK (DRIVER DOOR TO BODY)

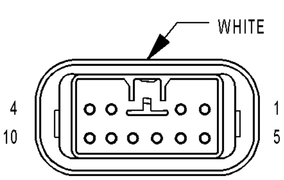
CAV	CIRCUIT
1	F121 18TN/BK
2	Q16 14BR/WT
3	Q26 14VT/WT
4	Y157 18TN/PK
5	-
6	P55 15DB
7	Z239 14BK/LB
8	Q28 14DG/WT
9	-
10	P97 20WT/DG
11	G73 20LG/OR
12	Q18 14GY/BK
13	Q27 14RD/BK
14	Q17 14DB/WT
15	-
16	-



C306

C306 - WHITE (BODY TO LEFT REAR DOOR)

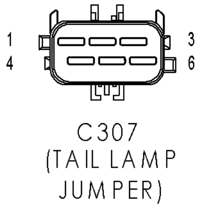
CAV	CIRCUIT
1	Z75 20BK
2	G77 20TN/OR
3	Y157 18TN/PK
4	Y201 18TN/OR
5	Q1 14YL
6	Q17 14DB/WT
7	Q27 14RD/BK
8	X91 18WT/BK
9	X93 18WT/RD
10	-



C306

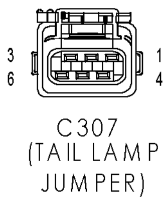
C306 - WHITE (LEFT REAR DOOR TO BODY)

CAV	CIRCUIT
1	Z75 20BK
2	G77 20VT/OR
3	Y157 18TN/PK (EXCEPT BASE)
4	Y201 18TN/OR (EXCEPT BASE)
5	Q1 14YL (EXCEPT BASE)
6	Q17 14DB/WT (EXCEPT BASE)
7	Q27 14/RD/BK (EXCEPT BASE)
8	X91 18WT/BK
9	X93 18WT/RD
10	-



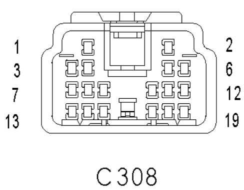
C307 (TAIL LAMP JUMPER) - (CHASSIS TO TAIL LAMPS)

CAV	CIRCUIT
1	L7 18 BK/YL
2	-
3	Z151 18 BK
4	L22 18LB/WT
5	L62 18BR/RD
6	L1 18VT/BK



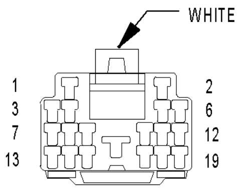
C307 (TAIL LAMP JUMPER) - (TAIL LAMPS TO CHASSIS)

CAV	CIRCUIT
1	L7 18BK/YL
2	-
3	Z151 18BK
4	L22 18WT/LG
5	L62 18DG/RD
6	L1 18VT/BK



C308 - (BODY TO I/P)

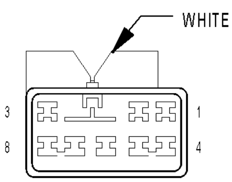
CAV	CIRCUIT
1	G74 20TN/RD
2	G72 20DG/OR (EXCEPT BASE)
3	-
4	X80 18LB/BK
5	P96 20WT/LG (EXCEPT BASE)
6	G76 20TN/YL
7	-
8	Y200 18TN/VY (EXCEPT BASE)
9	Y156 18TN/WT (EXCEPT BASE)
10	Y107 20VT/RD (EXCEPT BASE)
11	R53 18LG/YL
12	R55 18LG/DG
13	-
14	X94 18TN/VT
15	X92 18TN/BK
16	-
17	-
18	-
19	X82 18LB/RD



C308

C308 - WHITE (I/P TO BODY)

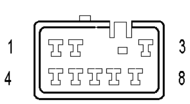
CAV	CIRCUIT
1	G74 20TN/RD
2	G72 20DG/OR
3	-
4	X80 18LB/BK
5	P96 20WT/LG
6	G76 20TN/YL
7	-
8	Y200 18TN/VT
9	Y156 18TN/WT
10	Y107 20VT/RD
11	R53 18LG/YL
12	R55 18LG/DG
13	-
14	X94 18TN/VT
15	X92 18TN/BK
16	-
17	-
18	-
19	X82 18LB/VT



C309

C309 - WHITE (I/P TO BODY)

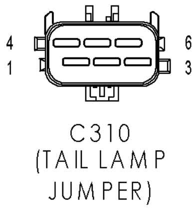
CAV	CIRCUIT
1	-
2	P133 20TN/DG
3	P137 20VT/DG
4	-
5	P140 20VT/BK
6	P134 20TN/LG
7	P138 20VT/LG
8	P139 20VT/WT



C309

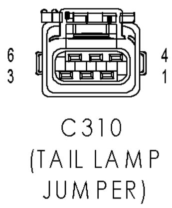
C309 - (BODY TO I/P)

CAV	CIRCUIT
1	-
2	P133 20TN/DG
3	P137 20VT/DG
4	-
5	P140 20VT/BK
6	P134 20TN/LG
7	P138 20VT/LG
8	P139 20VY/WT



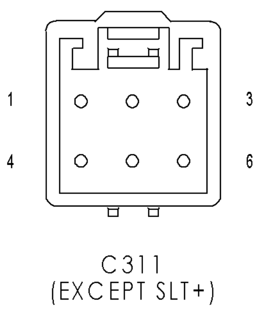
C310 (TAIL LAMP JUMPER) - (CHASSIS TO LEFT TAIL)

CAV	CIRCUIT
1	Y174 18PK/VT
2	-
3	Z150 18BK
4	L24 18WT/LG
5	L63 18DG/RD
6	L1 18VT/BK



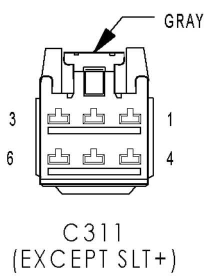
C310 (TAIL LAMP JUMPER) - (LEFT TAIL TO CHASSIS)

CAV	CIRCUIT
1	Y174 18PK/VT
2	-
3	Z150 18BK
4	L24 18WT/LG
5	L63 18DG/RD
6	L1 18VT/BK



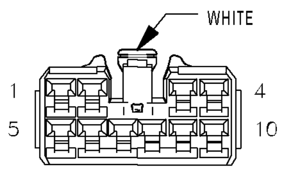
C311 (EXCEPT SLT+) - (SEAT TO BODY)

CAV	CIRCUIT
1	Z238 14BK
2	F37 12RD/LB
3	G10 20LG/RD
4	Y148 16BR/YL
5	Z237 20BK/OR
6	-



C311 (EXCEPT SLT+) - GRAY (BODY TO SEAT)

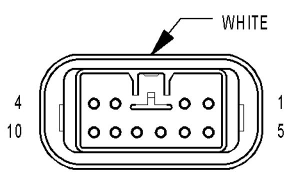
CAV	CIRCUIT
1	Z238 14BK
2	F37 12RD/LB
3	G10 20LG/RD
4	Y148 16YL/RD
5	Z237 20BK/OR
6	-



C312

C312 - WHITE (BODY TO RIGHT REAR DOOR)

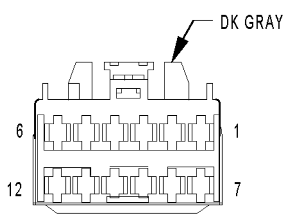
CAV	CIRCUIT
1	Z74 20BK
2	G76 20TN/YL
3	Y200 18TN/VT
4	Y156 18TN/WT
5	Q1 14YL
6	Q18 14GY/BK
7	Q28 14 DG/WT
8	X92 18TN/BK
9	X94 18TN/VT
10	-



C312

C312 - WHITE (RIGHT REAR DOOR TO BODY)

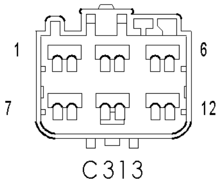
CAV	CIRCUIT
1	Z74 20BK
2	G76 20VT/OR
3	Y200 18TN/OR (EXCEPT BASE)
4	Y156 18TN/PK (EXCEPT BASE)
5	Q1 14YL (EXCEPT BASE)
6	Q18 14DB/WT (EXCEPT BASE)
7	Q28 14RD/BK (EXCEPT BASE)
8	X92 18WT/BK
9	X94 18WT/RD
10	-



C313

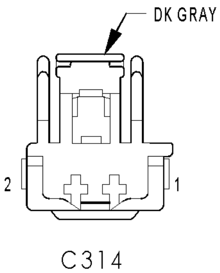
C313 - DK GRAY (JUMPER TO DRIVER SEAT)

CAV	CIRCUIT
1	F37 12RD/LB
2	Z238 14BK
3	P106 12DG/WT
4	P13 12RD/WT
5	P107 12OR/BK
6	Z88 14BK/LB
7	F37 12RD/LB
8	P11 12YL/WT
9	P17 12RD/LB
10	P15 12YL/LB
11	P21 12RD/LG
12	P19 12YL/LG



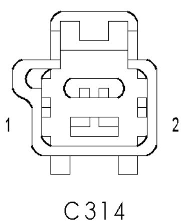
C313 - (DRIVER SEAT TO JUMPER)

CAV	CIRCUIT
1	F37 12RD/LB
2	Z238 14BK
3	P106 12DG/WT
4	P13 12RD/WT
5	P107 12OR/BK
6	Z88 14BK/LB
7	F37 12RD/LB
8	P11 12YL/WT
9	P17 12RD/LB
10	P15 12YL/LB
11	P21 12RD/LG
12	P19 12YL/LG



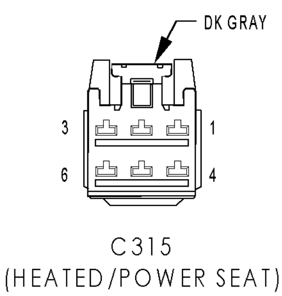
C314 - DK GRAY (DRIVER SEAT TO JUMPER)

CAV	CIRCUIT
1	Y148 16BR/YL
2	Z300 16BK/WT



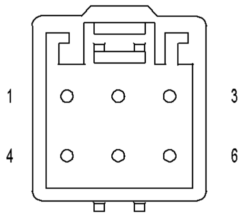
C314 - (JUMPER TO DRIVER SEAT)

CAV	CIRCUIT
1	Y148 16BR/YL
2	Z300 16BK/WT



C315 (HEATED/POWER SEAT) - DK GRAY
(DRIVER SEAT TO JUMPER)

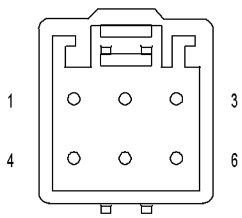
CAV	CIRCUIT
1	Z121 20BK/WT
2	P142 18TN/DB
3	F37 12RD/LB
4	P144 20BK/LG
5	P86 20PK/BK
6	Z238 14BK



C315

C315 - (JUMPER TO DRIVER SEAT)

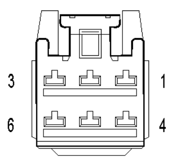
CAV	CIRCUIT
1	Z121 20BK/WT
2	P142 18TN/DB
3	P37 12RD/LB
4	P144 20BK/LG
5	P86 20PK/BK
6	Z238 14BK



C316

C316 - (JUMPER TO PASSENGER SEAT)

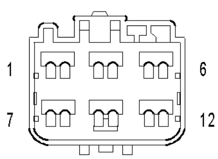
CAV	CIRCUIT
1	Z121 20BK/WT
2	P142 18TN/DB
3	F37 12RD/LB
4	P144 20BK/LG
5	P86 20PK/BK
6	Z238 14BK



C316

C316 - (PASSENGER SEAT TO JUMPER)

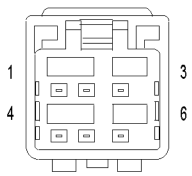
CAV	CIRCUIT
1	Z121 20BK/WT
2	P142 18TN/DB
3	F37 12RD/LB
4	P144 20BK/LG
5	P86 20PK/BK
6	Z238 14BK



C317

C317 - (PASSENGER SEAT TO SEAT SWITCH)

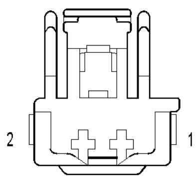
CAV	CIRCUIT
1	F37 12RD/LB
2	Z238 14BK
3	P105 12LG/DB
4	P10 12YL/WT
5	P104 12YL/LB
6	Z238 14BK
7	F37 12RD/LB
8	P12 12RD/WT
9	P16 12 RD/LB
10	P14 12YL/LB
11	P18 12YL/LG
12	P20 12RD/LG



C317

C317 - (SEAT SWITCH PASSENGER SEAT)

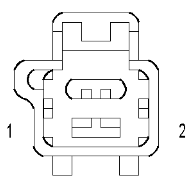
CAV	CIRCUIT
1	Z238 18BK
2	P105 12LG/DB
3	F37 12RD/LB
4	P104 12YL/LB
5	Z238 18BK
6	-



C319

C319 - (JUMPER TO POWER POINT)

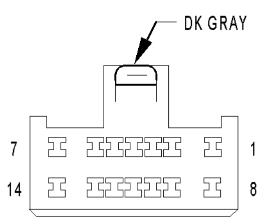
CAV	CIRCUIT
1	Y148 16BR/YL
2	Z300 16BK/WT



C319

C319 - (POWER POINT TO JUMPER)

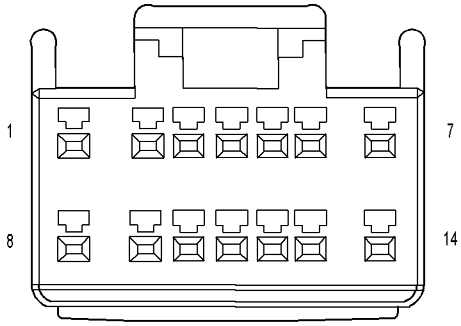
CAV	CIRCUIT
1	Y148 18BR/YL
2	Z300 18BK/WT



C322

C322 - DK GRAY (SEAT TO BODY)

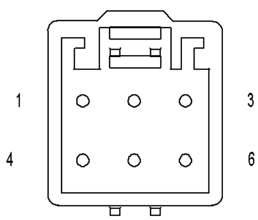
CAV	CIRCUIT
1	F235 18RD (SLT + HEATED POWER DRIVER SEAT)
1	Z300 16BK/WT (MANUAL DRIVER SEAT WITH POWER POINT)
1	Z238 14BK (POWER DRIVER SEAT)
2	P137 20VT/DG (SLT+HEATED POWER DRIVER SEAT)
2	F37 12RD/LB (POWER DRIVER SEAT)
3	G10 20LG/RD (DRIVER POWER/MANUAL SEAT)
3	P133 20TN/DG (SLT+HEATED POWER DRIVER SEAT)
4	G10 20 LG/RD (SLT+HEATED POWER DRIVER SEAT)
4	Y148 16BR/YL (POWER DRIVER SEAT/DRIVER MANUAL SEAT WITH POWER POINT
5	Z237 20BK/OR (POWER DRIVER SEAT)
5	P139 20VT/WT (SLT+HEATED POWER DRIVER SEAT)
6	P138 20VT/LG (SLT+HEATED POWER DRIVER SEAT)
7	Z238 14BK (SLT+HEATED POWER DRIVER SEAT)
8	F37 12RD/LB (SLT+HEATED POWER DRIVER SEAT)
9	P134 20TN/LG (SLT+HEATED POWER DRIVER SEAT)
10	P140 20VT/BK (SLT+HEATED POWER DRIVER SEAT)
11	Z237 20BK/OR (SLT+HEATED POWER DRIVER SEAT)
12	Z121 20BK/LG (SLT+HEATED POWER DRIVER SEAT)
13	-
14	Y148 16BR/YL (SLT+HEATED POWER DRIVER SEAT)



C322

C322 - (BODY TO SEAT)

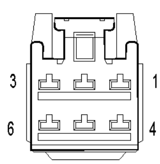
CAV	CIRCUIT
1	F235 18RD
2	P137 20VT/DG
3	P133 20TN/DG
4	G10 20LG/RD
5	P139 20VT/WT
6	P138 20VT/LG
7	Z238 14BK
8	F37 12RD/LB
9	P134 20TN/LG
10	P140 20VT/BK
11	Z237 20BK/OR
12	Z121 20BK/LG
13	-
14	Y148 16YL/RD



C323

C323 - (JUMPER TO PASSENGER LUMBAR)

CAV	CIRCUIT
1	Z238 18BK
2	P105 12LG/DB
3	F37 12RD/LB
4	P104 12YL/LB
5	Z238 18BK
6	-



C323

C323 - (PASSENGER LUMBAR TO JUMPER)

CAV	CIRCUIT
1	Z238 18BK
2	P105 12LG/DB
3	F37 12RD/LB
4	P104 12YL/LB
5	Z238 18BK
6	-

PICTURE NOT AVAILABLE

C327 - BLACK (CHASSIS TO DUAL-REAR-WHEELS)

CAV	CIRCUIT
1	Y174 20PK/VT
2	Z57 20BK

PICTURE NOT AVAILABLE

C327 - BLACK (DUAL-REAR-WHEELS TO CHASSIS)

CAV	CIRCUIT
1	Y174 18PBK/YL
2	Z57 18BK

PICTURE NOT AVAILABLE

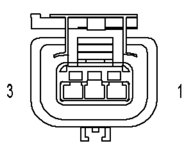
C328 - BLACK (CHASSIS TO DUAL-REAR-WHEELS

CAV	CIRCUIT
1	L7 20BK/YL
2	Z48 20BK

PICTURE NOT AVAILABLE

C328 - BLACK (DUAL-REAR-WHEELS TO CHASSIS)

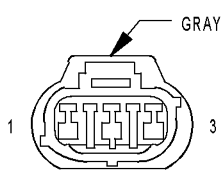
CAV	CIRCUIT
1	Y174 18PK/VT
2	Z57 18BK



CAMSHAFT POSITION SENSOR (DIESEL)

CAMSHAFT POSITION SENSOR (DIESEL) - 3 WAY

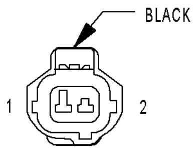
CAV	CIRCUIT	FUNCTION
1	K72 18DG/OR	5 VOLTS SUPPLY
2	K55 18LB/WT	MASS AIR FLOW SENSOR SIGNAL
3	K53 18DB/RD	MASS AIR FLOW SENSOR SIGNAL RETURN



CAMSHAFT POSITION SENSOR (GAS)

CAMSHAFT POSITION SENSOR (GAS) - GRAY 3 WAY

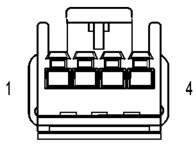
CAV	CIRCUIT	FUNCTION
1	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
1	K44 18TN/YL (4.7L/5.7L)	CMP SIGNAL
2	K4 20BK/LB (5.9L)	5 VOLT SUPPLY
2	K4 18BK/LB (3.7L)	SENSOR GROUND
2	K4 20BK/LB (4.7L/5.7L)	SENSOR GROUND
3	K7 18OR (3.7L)	5 VOLT SUPPLY
3	K7 20OR (5.9L)	5 VOLT SUPPLY
3	K6 20VT/WT (4.7L/5.7L)	5 VOLT SUPPLY



CAPACITOR

CAPACITOR - BLACK 2 WAY

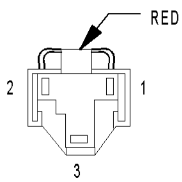
CAV	CIRCUIT	FUNCTION
1	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	-	-



CENTER HIGH MOUNTED STOP LAMP/CARGO LAMP

CENTER HIGH MOUNTED STOP LAMP/CARGO LAMP - 4 WAY

CAV	CIRCUIT	FUNCTION
1	F32 18RD/YL	FUSED B(+)
2	M3 20PK/DB	CARGO LAMP DRIVER
3	Z56 18BK	GROUND
4	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT



CIGAR LIGHTER OUTLET

CIGAR LIGHTER OUTLET - RED 3 WAY

CAV	CIRCUIT	FUNCTION
1	F30 18RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	-	-
3	Z301 18TN/BK	GROUND

PICTURE

NOT

AVAILABLE

CLEARANCE LAMP NO. 1 (HEAVY DUTY) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
2	Z253 20BK/RD	GROUND

PICTURE

NOT

AVAILABLE

CLEARANCE LAMP NO. 2 (HEAVY DUTY) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
2	Z253 20BK/RD	GROUND

PICTURE

NOT

AVAILABLE

CLEARANCE LAMP NO. 3 (HEAVY DUTY) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
2	Z253 20BK/RD	GROUND

PICTURE

NOT

AVAILABLE

CLEARANCE LAMP NO. 4 (HEAVY DUTY) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
2	Z253 20BK/RD	GROUND

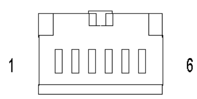
PICTURE

NOT

AVAILABLE

CLEARANCE LAMP NO. 5 (HEAVY DUTY) - 2 WAY

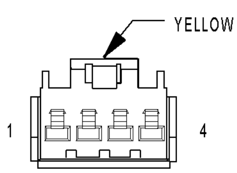
CAV	CIRCUIT	FUNCTION
1	L7 20BK/YL	HEADLAMP SWITCH OUTPUT
2	Z253 20BK/RD	GROUND



CLOCKSPRING C1

CLOCKSPRING C1 - 6 WAY

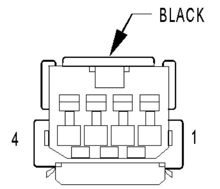
CAV	CIRCUIT	FUNCTION
1	Z5 20BK/LB	GROUND
2	X20 20GY/WT	RADIO CONTROL MUX
3	V38 20VT/OR (5.7L)	S/C SWITCH SIGNAL NO.2
4	V37 20RD/LG	SPEED CONTROL SWITCH SIGNAL
5	K4 20BK/LB	SENSOR GROUND
6	X3 20BK/RD	HORN SWITCH SENSE



CLOCKSPRING C2

CLOCKSPRING C2 - YELLOW 4 WAY

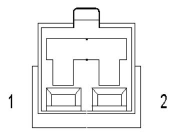
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	R43 18BK/LB	DRIVER SQUIB 1 LINE 1
4	R45 18DG/LB	DRIVER SQUIB 1 LINE 2



CLOCKSPRING C3

CLOCKSPRING C3 - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
B1	X3 20BK/RD	HORN RELAY CONTROL
B2	K4 20BK/LB	SENSOR GROUND
B3	V37 20RD/LG	S/C SWITCH NO.1 SIGNAL
B4	V38 20VT/OR (ELECTRONIC TRANSMISSION CONTROL)	SPEED CONTROL RELAY CONTROL



CLOCKSPRING C4

CLOCKSPRING C4 - 2 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	Z374 20BK/WT	GROUND

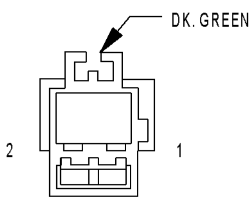
PICTURE

NOT

AVAILABLE

CLOCKSPRING C5 (REMOTE RADIO) - BLACK 2 WAY

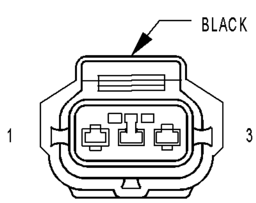
CAV	CIRCUIT	FUNCTION
1	Z5 22BK/LB	GROUND
2	X20 22GY (WITHOUT ETC)	RADIO CONTROL MUX
2	X20 22RD/BK (WITH ETC)	RADIO CONTROL MUX



CLUTCH INTERLOCK
BRAKE SWITCH

CLUTCH INTERLOCK BRAKE SWITCH - DK GREEN 2 WAY

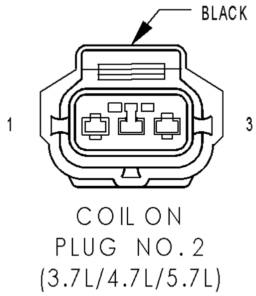
CAV	CIRCUIT	FUNCTION
1	T24 20BR/YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
2	Z248 20BK	GROUND



COIL ON
PLUG NO. 1
(3.7L/4.7L/5.7L)

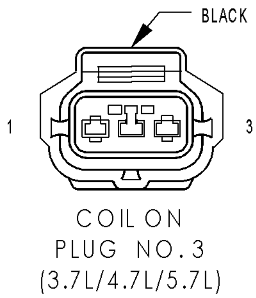
COIL ON PLUG NO. 1 (3.7L/4.7L/5.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K91 18TN/RD	COIL ON PLUG DRIVER NO. 1
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K91 18TN/RD (NGC)	COIL CONTROL NO. 1
3	-	-



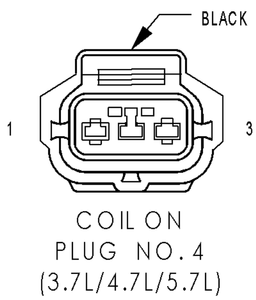
COIL ON PLUG NO. 2 (3.7L/4.7L/5.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K92 18TN/PK	COIL ON PLUG DRIVER NO. 2
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K92 18TN/PK (NGC)	COIL CONTROL NO. 2
3	-	-



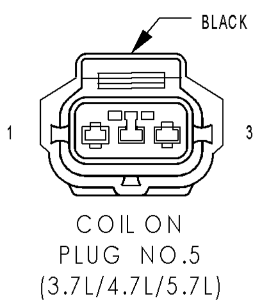
COIL ON PLUG NO. 3 (3.7L/4.7L/5.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K93 18TN/OR	COIL ON PLUG DRIVER NO. 3
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K93 18TN/OR (NGC)	COIL CONTROL NO. 3
3	-	-



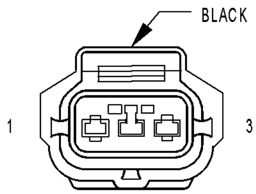
COIL ON PLUG NO. 4 (3.7L/4.7L/5.7L) - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	K94 18TN/LG	COIL ON PLUG DRIVER NO. 4
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K94 18TN/LG (NGC)	COIL CONTROL NO. 4
3	-	-



COIL ON PLUG NO. 5 (3.7L/4.7L/5.7L) - BLACK 3 WAY

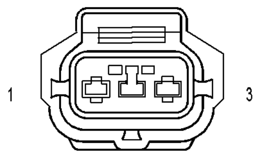
CAV	CIRCUIT	FUNCTION
1	K95 18TN/DG	COIL ON PLUG DRIVER NO. 5
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K95 18TN/DG (NGC)	COIL CONTROL NO. 5
3	-	-



COIL ON PLUG NO. 6 (3.7L/4.7L/5.7L)

COIL ON PLUG NO. 6 (3.7L/4.7L/5.7L) - BLACK 3 WAY

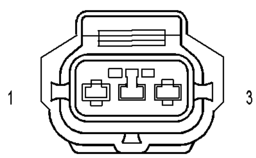
CAV	CIRCUIT	FUNCTION
1	K96 18TN/LB	COIL ON PLUG DRIVER NO. 6
1	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K96 18TN/LB (NGC)	COIL CONTROL NO. 6
3	-	-



COIL ON PLUG NO.7 (4.7L/5.7L)

COIL ON PLUG NO. 7 (4.7L/5.7L) - BLACK 3 WAY

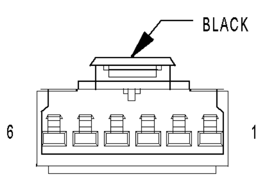
CAV	CIRCUIT	FUNCTION
1	K97 18BR	COIL CONTROL NO. 7
1	A142 16DG/OR (5.7L)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K97 18BR (5.7L)	COIL CONTROL NO. 7
3	-	-



COIL ON PLUG NO.8 (4.7L/5.7L)

COIL ON PLUG NO. 8 (4.7L/5.7L) - BLACK 3 WAY

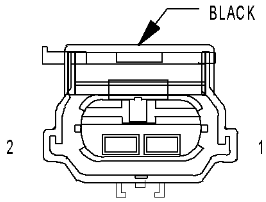
CAV	CIRCUIT	FUNCTION
1	K98 18LB/RD	COIL CONTROL NO. 8
1	A142 16DG/OR (5.7L)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTOMATIC SHUT DOWN RELAY OUTPUT
2	K98 18LB/RD (5.7L)	COIL CONTROL NO. 8
3	-	-



COMPASS/MINI-TRIP COMPUTER (EXCEPT BASE)

COMPASS/MINI-TRIP COMPUTER (EXCEPT BASE) - BLACK 6 WAY

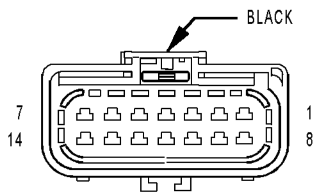
CAV	CIRCUIT	FUNCTION
1	-	-
2	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	Z104 20BK/OR	GROUND
4	F32 20RD/YL	FUSED B(+)
5	D25 20VT	PCI BUS
6	-	-



CONDENSER FAN

CONDENSER FAN - BLACK 2 WAY

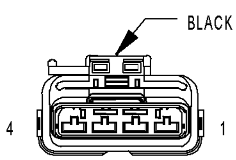
CAV	CIRCUIT	FUNCTION
1	Z212 16LG/BK	GROUND
2	C23 16DG	CONDENSER FAN RELAY OUTPUT



CONTROLLER ANTILOCK BRAKE C1

CONTROLLER ANTILOCK BRAKE C1 - BLACK 14 WAY

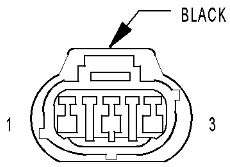
CAV	CIRCUIT	FUNCTION
1	B113 20RD/VT	REAR WHEEL SPEED SENSOR (+)
2	B222 20DG/WT (EXCEPT 4 WHEEL ABS)	VEHICLE SPEED SIGNAL NO.2
3	D25 20VT/BK	PCI BUS
4	A20 20RD/DB	FUSED IGNITION SWITCH OUTPUT (RUN)
5	-	-
6	Z102 12BK/VT	GROUND
7	A10 14RD/DG	FUSED B(+)
8	B114 20WT/VT	REAR WHEEL SPEED SENSOR (-)
9	K29 20WT/PK	BRAKE SWITCH SENSE
10	-	-
11	G9 20GY/BK	BRAKE FLUID LEVEL SWITCH SENSE
12	G7 20WT/OR (EXCEPT 4.7L ABS/5.7L ABS)	VEHICLE SPEED SIGNAL NO.1
12	B22 20DG/YL (4.7L ABS/5.7 ABS)	VEHICLE SPEED SIGNAL NO.1
13	Z101 12BK/PK (4 WHEEL ABS)	GROUND
14	A10 14RD/DG (4 WHEEL ABS)	FUSED B(+)



CONTROLLER ANTILOCK BRAKE C2 (ABS)

CONTROLLER ANTILOCK BRAKE C2 (ABS) - BLACK 4 WAY

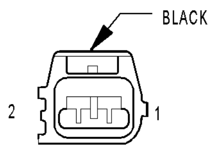
CAV	CIRCUIT	FUNCTION
1	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)
2	B8 20RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
3	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
4	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



CRANKSHAFT POSITION SENSOR

CRANKSHAFT POSITION SENSOR - BLACK 3 WAY

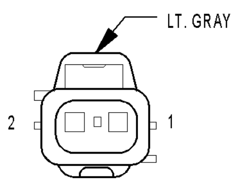
CAV	CIRCUIT	FUNCTION
1	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
1	K7 18OR (5.7L)	5 VOLT SUPPLY
1	K24 18GY/BK (4.7L/)	CKP SIGNAL
2	K4 18BK/LB (3.7L/4.7L/5.7L)	SENSOR GROUND
2	K4 20BK/LB (5.9L)	SENSOR GROUND
3	K7 18OR (3.7L/4.7L)	5 VOLT SUPPLY
3	K24 18GY/BK (5.7L)	CKP SIGNAL
3	K7 20OR (5.9L)	5 VOLT SUPPLY



CYLINDER LOCK SWITCH-DRIVER (PREMIUM)

CYLINDER LOCK SWITCH-DRIVER (PREMIUM) - BLACK 2 WAY

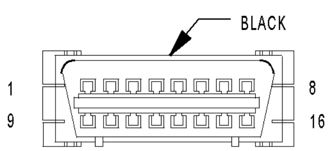
CAV	CIRCUIT	FUNCTION
1	G73 20LG/OR	DRIVER CYLINDER LOCK SWITCH MUX
2	Z70 20BK/LG	GROUND



CYLINDER LOCK SWITCH-PASSENGER (PREMIUM)

CYLINDER LOCK SWITCH-PASSENGER (PREMIUM) - LT GRAY 2 WAY

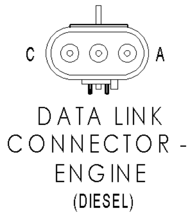
CAV	CIRCUIT	FUNCTION
1	G72 20DG/OR	PASSENGER CYLINDER LOCK SWITCH MUX
2	Z69 20BK/LG	GROUND



DATA LINK CONNECTOR

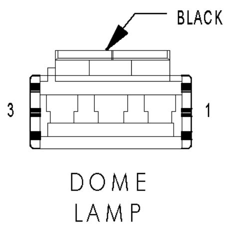
DATA LINK CONNECTOR - BLACK 16 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20LB/VT	PCI BUS
3	-	-
4	Z305 18BK/DG	GROUND
5	Z306 18OR/BK	GROUND
6	-	-
7	D21 18PK	SCI TRANSMIT (PCM)
8	-	-
9	D6 18PK/LB	SCI RECEIVE (TCM)
10	-	-
11	-	-
12	D20 20LG	SCI RECEIVE (PCM)
13	-	-
14	-	-
15	D15 18WT/DG	SCI TRANSMIT (TCM)
16	M1 18PK	FUSED B(+)



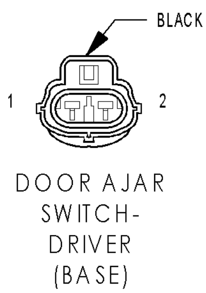
DATA LINK CONNECTOR - ENGINE (DIESEL) - 3 WAY

CAV	CIRCUIT	FUNCTION
A	D1 18VT/BR	CCD BUS (+)
B	D2 18WT/BK	CCD BUS (-)
C	Z11 14BK/WT	GROUND



DOME LAMP - BLACK 3 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	M20 20BR	COURTESY LAMP DRIVER
3	F32 18RD/YL	FUSED B(+)

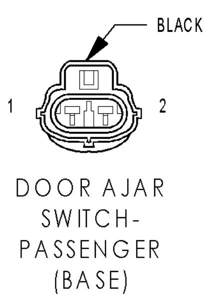


DOOR AJAR SWITCH-DRIVER (BASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
2	Z314 20BK/LG	GROUND

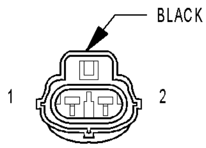
DOOR AJAR SWITCH-LEFT REAR (BASE) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G77 20VT/OR	LEFT REAR DOOR AJAR SWITCH SENSE
2	Z75 20BK	GROUND



DOOR AJAR SWITCH-PASSENGER (BASE) - BLACK 2 WAY

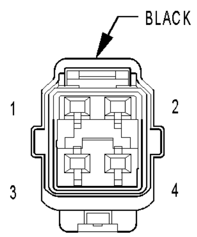
CAV	CIRCUIT	FUNCTION
1	G74 20TN	PASSENGER DOOR AJAR SWITCH SENSE
2	Z315 20BK/LG	GROUND



DOOR AJAR SWITCH-RIGHT REAR (BASE)

DOOR AJAR SWITCH-RIGHT REAR (BASE) - BLACK 2 WAY

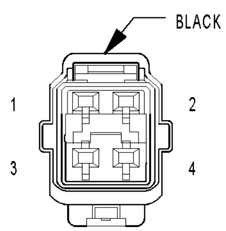
CAV	CIRCUIT	FUNCTION
1	G76 20VT/OR	RIGHT REAR DOOR AJAR SWITCH SENSE
2	Z74 20BK	GROUND



DOOR LOCK MOTOR/ AJAR SWITCH-DRIVER (EXCEPT BASE)

DOOR LOCK MOTOR/AJAR SWITCH-DRIVER (EXCEPT BASE) - BLACK 4 WAY

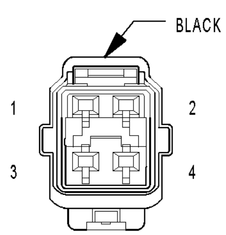
CAV	CIRCUIT	FUNCTION
1	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
2	Z314 20BK/LG	GROUND
3	P55 18 DB	DOOR UNLOCK DRIVER LEFT FRONT
4	Y157 18TN/PK	DOOR LOCK DRIVER LEFT DOORS



DOOR LOCK MOTOR/ AJAR SWITCH- LEFT REAR (EXCEPT BASE)

DOOR LOCK MOTOR/AJAR SWITCH-LEFT REAR (EXCEPT BASE) - BLACK 4 WAY

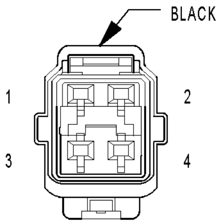
CAV	CIRCUIT	FUNCTION
1	G77 20VT/OR	LEFT REAR DOOR AJAR SWITCH SENSE
2	Z75 20BK	GROUND
3	Y201 18TN/OR	DOOR UNLOCK DRIVER LEFT REAR
4	Y157 18TN/PK	DOOR LOCK DRIVER LEFT DOORS



DOOR LOCK MOTOR/ AJAR SWITCH- PASSENGER (EXCEPT BASE)

DOOR LOCK MOTOR/AJAR SWITCH-PASSENGER (EXCEPT BASE) - BLACK 4 WAY

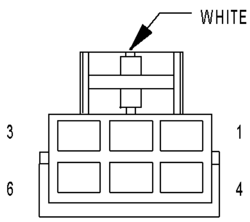
CAV	CIRCUIT	FUNCTION
1	G74 20TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
2	Z315 20BK/LG	GROUND
3	Y156 18TN/WT	DOOR UNLOCK DRIVER RIGHT DOORS
4	Y200 18TN/VT	DOOR LOCK DRIVER RIGHT DOORS



DOOR LOCK MOTOR/ AJAR SWITCH- RIGHT REAR (EXCEPT BASE)

DOOR LOCK MOTOR/AJAR SWITCH-RIGHT REAR (EXCEPT BASE) - BLACK 4 WAY

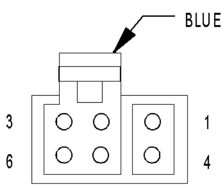
CAV	CIRCUIT	FUNCTION
1	G76 20VT/OR	RIGHT REAR DOOR AJAR SWITCH SENSE
2	Z74 20BK	GROUND
3	Y156 18TN/OR	DOOR UNLOCK DRIVER RIGHT DOORS
4	Y200 18TN/PK	DOOR LOCK DRIVER RIGHT DOORS



DOOR LOCK SWITCH- PASSENGER

DOOR LOCK SWITCH-PASSENGER - WHITE 6 WAY

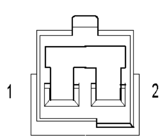
CAV	CIRCUIT	FUNCTION
1	P96 20WT/LG	PASSENGER DOOR LOCK SWITCH MUX
2	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	-	-
5	Z74 20BK/LG	GROUND
6	-	-



DOOR WINDOW/LOCK SWITCH-PASSENGER

DOOR WINDOW/LOCK SWITCH - PASSENGER - BLUE 6 WAY

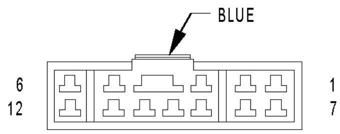
CAV	CIRCUIT	FUNCTION
1	Q12 14BR	RIGHT FRONT WINDOW DRIVER (UP)
2	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT (DOWN)
3	-	-
4	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT (UP)
5	Q22 14VT	RIGHT FRONT WINDOW DRIVER (DOWN)
6	Q1 14YL	POWER WINDOW SWITCH FEED



DRIVER BLEND DOOR ACTUATOR (DUAL-ZONE)

DRIVER BLEND DOOR ACTUATOR (DUAL-ZONE) - 2 WAY

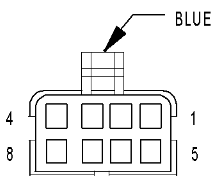
CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C62 20DB/PK	BLEND DOOR DRIVER



DRIVER
DOOR
MODULE C1

DRIVER DOOR MODULE C1 - BLUE 12 WAY

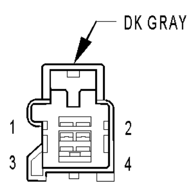
CAV	CIRCUIT	FUNCTION
1	Q28 14DG/WT	RIGHT REAR WINDOW DRIVER (DOWN)
2	Q18 14GY/BK	RIGHT REAR WINDOW DRIVER (UP)
3	Q16 14BR/WT	MASTER WINDOW SWITCH RIGHT FRONT (UP)
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER (UP)
5	Q11 14LB	LEFT FRONT WINDOW DRIVER (UP)
6	Q26 14VT/WT	MASTER WINDOW SWITCH RIGHT FRONT (DOWN)
7	P97 20WT/DG	DRIVER DOOR LOCK SWITCH MUX
8	Z67 14BK	GROUND
9	F21 14TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
11	Z75 20BK	GROUND
12	Q21 14WT	LEFT FRONT WINDOW DRIVER (DOWN)



DRIVER
DOOR
MODULE C2

DRIVER DOOR MODULE C2 - BLUE 8 WAY

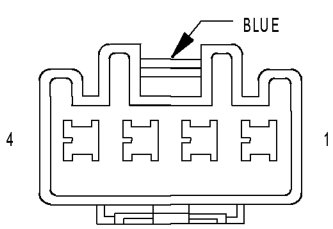
CAV	CIRCUIT	FUNCTION
1	P71 20YL	LEFT MIRROR UP DRIVER
2	P76 20OR/YL	LEFT MIRROR COMMON DRIVER (RIGHT/DOWN)
3	F32 18RD/YL	FUSED B(+)
4	P74 20DB	RIGHT MIRROR LEFT DRIVER
5	Z239 20BK	GROUND
6	P75 20DB/WT	LEFT MIRROR LEFT DRIVER
7	P72 20YL/BK	RIGHT MIRROR UP DRIVER
8	Q1 14YL	POWER WINDOW SWITCH FEED



DRIVER
HEATED SEAT
CUSHION

DRIVER HEATED SEAT CUSHION - DK GRAY 4 WAY

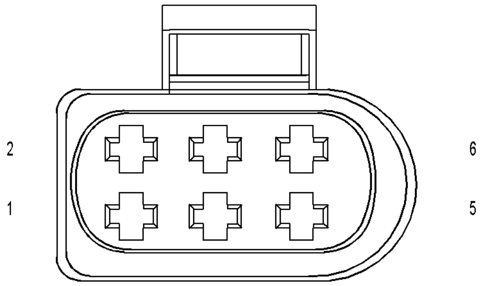
CAV	CIRCUIT	FUNCTION
1	P141 18TN/LB	DRIVER SEAT TEMPERATURE SENSOR INPUT
2	Z121 20BK/LG	GROUND
3	P143 20BK/DG	DRIVER SEAT TEMPERATURE 5 VOLT SUPPLY
4	P86 20PK/BK	SEAT HEATER DRIVER



ELECTRIC
BRAKE
PROVISION

ELECTRIC BRAKE PROVISION - BLUE 4 WAY

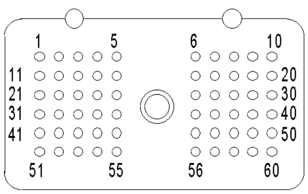
CAV	CIRCUIT	FUNCTION
1	Y133 14RD/OR	FUSED B(+)
2	B40 14LB	TRAILER TOW BRAKE B(+)
3	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
4	Z255 18DG/BK	GROUND



ELECTRONIC THROTTLE CONTROL MODULE (5.7L)

ELECTRONIC THROTTLE CONTROL MODULE (5.7L) - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
1	K22 18OR/DB	TP NO.1 SIGNAL
2	K7 18OR	5 VOLT SUPPLY
3	F888 18BR/PK	ETC MOTOR(+)
4	K122 18DB/GY	TP NO.2 SIGNAL
5	F855 18OR/PK	ETC MOTOR(-)
6	K101 18WT	TP SENSOR RETURN



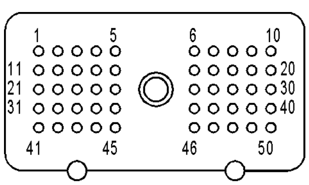
ENGINE CONTROL MODULE C1 (DIESEL)

ENGINE CONTROL MODULE - C1 (DIESEL) - 60 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	D1 18VT/BR	CCD BUS (+)
5	D2 18WT/BK	CCD BUS (-)
6	K65 18OR/RD	FUEL PUMP SUPPLY
7	K20 18DG	GENERATOR FIELD CONTROL
8	-	-
9	-	-
10	-	-
11	-	-
12	K102 18PK/BK	FUEL PRESSURE SENSOR SIGNAL
13	-	-
14	K232 18YL	APPS SIGNAL
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
16	-	-
17	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
18	-	-
19	K31 18BR	FUEL PUMP RELAY CONTROL
20	-	-
21	-	-
22	G17 18WT/TN	SPEEDOMETER SIGNAL
23	K104 18RD/WT	SENSOR GROUND
24	K53 18DB/RD	HALL EFFECT
25	Y501 18DB/YL	5 VOLT SUPPLY
26	C18 18DB	A/C PRESSURE SIGNAL
27	K6 18VT/WT	5 VOLT SUPPLY
28	-	-
29	Y502 18DG/YL	INLET AIR TEMPERATURE/PRESSURE RETURN
30	K118 16WT/DB	BATTERY TEMPERATURE SENSOR SIGNAL
31	G20 18VT/YL	IGNITION SWITCH SENSE
32	K55 18LB/WT	MASS AIR FLOW SENSOR SIGNAL
33	K56 18LG/OR	APPS SENSOR RETURN
34	K49 18VT/BK	APPS IDLE SWITCH
35	-	-
36	K14 16RD/WT	FUEL INJECTOR NO. 4 DRIVER
37	-	-

ENGINE CONTROL MODULE - C1 (DIESEL) - 60 WAY

CAV	CIRCUIT	FUNCTION
38	-	-
39	-	-
40	K13 16TN	FUEL INJECTOR NO. 3 DRIVER
41	-	-
42	K900 18DB/DG	5 VOLT SUPPLY
43	K9 18LB	5 VOLT SUPPLY
44	K101 18WT	APPS NOT IDLE SWITCH
45	K62 18BR/DB	LETF PUMP
46	K58 16BR/DB	FUEL INJECTOR NO. 6 DRIVER
47	-	-
48	-	-
49	-	-
50	K12 16YL/WT	FUEL INJECTOR NO. 2 DRIVER
51	-	-
52	K167 18BR/YL	ACCELERATOR PEDAL POSITION SENSOR GROUND NO. 1
53	G910 18VT/RD	FUEL PRESSURE SENSOR SIGNAL RETURN
54	K72 18DG/OR	MAP SENSOR SIGNAL
55	-	-
56	K38 16GY	FUEL INJECTOR NO. 5 DRIVER
57	K92 16TN/PK	COIL ON PLUG DRIVER NO. 2
58	-	-
59	K91 16TN/RD	COIL ON PLUG DRIVER NO. 1
60	-	-



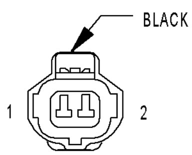
ENGINE CONTROL MODULE C2 (DIESEL)

ENGINE CONTROL MODULE - C2 (DIESEL) - 50 WAY

CAV	CIRCUIT	FUNCTION
1	K22 18DR/DB	THROTTLE POSITION SENSOR SIGNAL
2	K24 18WT/DG	CRANKSHAFT POSITION SENSOR SIGNAL
3	K69 18 BR/LB	INJECTOR CONTROL SIGNAL NO.1
4	-	-
5	K154 18GY	GLOW PLUG RELAY NO. 1 OUTPUT
6	K152 18WT	GLOW PLUG RELAY NO. 1 CONTROL
7	-	-
8	-	-
9	-	-
10	Y5 18OR	FAN SPEED SENSOR
11	G7 18WT/OR	VEHICLE SPEED SIGNAL
12	G60 18GY/YL	ENGINE OIL PRESSURE SWITCH SENSE
13	-	-
14	-	-
15	-	-
16	D21 18PK	SCI TRANSMIT
17	-	-
18	-	-
19	D20 18LG	SCI RECEIVE
20	A140 16DG/WT	FUSED B(+)
21	Z816 16BK/TN	GROUND
22	-	-
23	Y3 18WT	-
24	K4 18BK/LB	SENSOR GROUND
25	-	-
26	G8 18 LB/BK	FUEL LEVEL SENSOR SIGNAL
27	K77 18 BR/WT	TRANSFER CASE POSITION SENSOR INPUT

ENGINE CONTROL MODULE - C2 (DIESEL) - 50 WAY

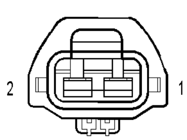
CAV	CIRCUIT	FUNCTION
28	D25 18VT/YL	PCI BUS
29	-	-
30	A140 16DG/WT	FUSED B(+)
31	-	-
32	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
33	-	-
34	-	-
35	K68 18BR/LG	INLET AIR PRESSURE SENSE
36	V32 18YL/RD	SPEED CONTROL SUPPLY
37	K29 18WT/PK	BRAKE SWITCH SENSE
38	-	-
39	-	-
40	A140 16BG/WT	FUSED B(+)
41	C13 18DB/OR	A/C CLUTCH RELAY CONTROL
42	-	-
43	Y1 18LG	PARK LOCKOUT SOLENOID CONTROL
44	-	-
45	-	-
46	V37 18RD/YL	S/C SWITCH SIGNAL
47	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
48	-	-
49	Z816 16BK/TN	GROUND
50	Z816 16BK/TN	GROUND



ENGINE COOLANT TEMPERATURE SENSOR (3.7L/4.7L/5.7L)

ENGINE COOLANT TEMPERATURE SENSOR (3.7L/4.7L/5.7L) - BLACK 2 WAY

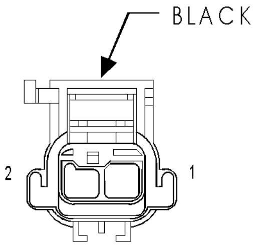
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
2	K2 18TN/BK (4.7L/5.7L)	ECT SIGNAL



ENGINE COOLANT TEMPERATURE SENSOR (DIESEL)

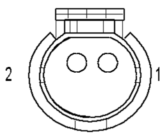
ENGINE COOLANT TEMPERATURE SENSOR (DIESEL) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	K104 18RD/WT	SENSOR GROUND
2	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL



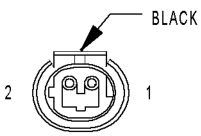
ENGINE OIL PRESSURE SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	G60 18GY/YL	ENGINE OIL PRESSURE SWITCH SENSE
2	-	-



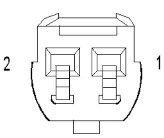
EVAP/PURGE SOLENOID (EXCEPT NGC) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	K52 18PK/BK	EVAPORATIVE SOLENOID CONTROL
2	Y134 20GY/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)



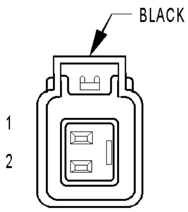
EVAP/PURGE SOLENOID (NGC) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K108 18WT/TN	EVAP PURGE RETURN
2	K52 18PK/BK	EVAP PURGE CONTROL



EVAPORATOR TEMPERATURE SENSOR - 2 WAY

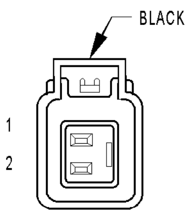
CAV	CIRCUIT	FUNCTION
1	C57 20DB/GY	SENSOR GROUND
2	C12 20LG/BK	EVAPORATOR TEMPERATURE SENSOR SIGNAL



FENDER LAMP -
FRONT LEFT

FENDER LAMP-FRONT LEFT - BLACK 2 WAY

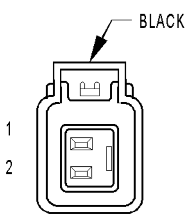
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	Z57 18BK	GROUND



FENDER LAMP -
FRONT RIGHT

FENDER LAMP-FRONT RIGHT - BLACK 2 WAY

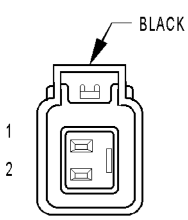
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	Z57 18BK	GROUND



FENDER LAMP -
REAR LEFT

FENDER LAMP-REAR LEFT - BLACK 2 WAY

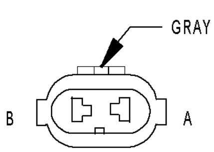
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	Z57 18BK	GROUND



FENDER LAMP -
REAR RIGHT

FENDER LAMP-REAR RIGHT - BLACK 2 WAY

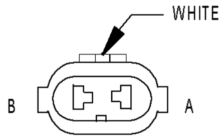
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	Z57 18BK	GROUND



FOG LAMP-
LEFT

FOG LAMP-LEFT - GRAY 2 WAY

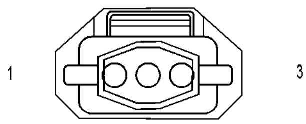
CAV	CIRCUIT	FUNCTION
A	Z144 18BK/OR	GROUND
B	L39 18/LB	FOG LAMP RELAY OUTPUT



FOG LAMP-RIGHT

FOG LAMP-RIGHT - WHITE 2 WAY

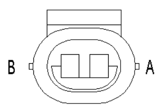
CAV	CIRCUIT	FUNCTION
A	Z144 18BK/OR	GROUND
B	L39 18LB	FOG LAMP RELAY OUTPUT



FUEL CONTROL ACTUATOR (DIESEL)

FUEL CONTROL ACTUATOR (DIESEL) - 3 WAY

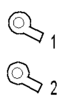
CAV	CIRCUIT	FUNCTION
1	K915 18VT/RD	FUEL RAIL SENSOR RETURN
2	K102 18PK/BK	FUEL PUMP DRIVER
3	K72 18DG/OR	5 VOLT SUPPLY



FUEL HEATER (DIESEL)

FUEL HEATER (DIESEL) - 2 WAY

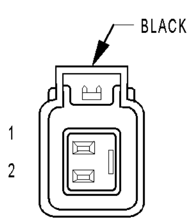
CAV	CIRCUIT	FUNCTION
A	A93 14RD/BK	FUEL HEATER RELAY OUTPUT
B	Z378 14BK	GROUND



FUEL INJECTOR NO.1 (DIESEL)

FUEL INJECTOR NO. 1 (DIESEL) - 2 WAY

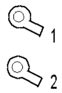
CAV	CIRCUIT	FUNCTION
1	K91 14TN/RD	COMMON INJECTOR DRIVER
2	K11 14WT/DB	FUEL INJECTOR NO. 1 CONTROL



FUEL INJECTOR NO. 1

FUEL INJECTOR NO. 1 - BLACK 2 WAY

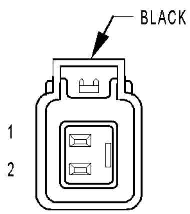
CAV	CIRCUIT	FUNCTION
1	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
1	K11 18WT/DB (NGC)	INJECTOR CONTROL NO. 1
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO.2 (DIESEL)

FUEL INJECTOR NO. 2 (DIESEL) - 2 WAY

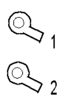
CAV	CIRCUIT	FUNCTION
1	K91 14TN/RD	COMMON INJECTOR DRIVER
2	K12 14YL/WT	FUEL INJECTOR NO.1 CONTROL



FUEL INJECTOR NO. 2

FUEL INJECTOR NO. 2 - BLACK 2 WAY

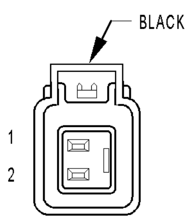
CAV	CIRCUIT	FUNCTION
1	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
1	K12 18TN (NGC)	INJECTOR CONTROL NO. 2
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO.3 (DIESEL)

FUEL INJECTOR NO. 3 (DIESEL) - 2 WAY

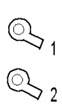
CAV	CIRCUIT	FUNCTION
1	K91 14TNRD	COMMON INJECTOR DRIVER
2	K13 14TN	FUEL INJECTOR NO. 3 CONTROL



FUEL INJECTOR NO. 3

FUEL INJECTOR NO. 3 - BLACK 2 WAY

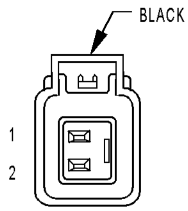
CAV	CIRCUIT	FUNCTION
1	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
1	K13 18YL/WT (NCG)	INJECTOR CONTROL NO. 3
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO.4 (DIESEL)

FUEL INJECTOR NO. 4 (DIESEL) - 2 WAY

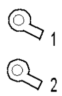
CAV	CIRCUIT	FUNCTION
1	K92 14TN/PK	COMMON INJECTOR DRIVER
2	K14 14RD/WT	FUEL INJECTOR NO. 4 CONTROL



FUEL INJECTOR NO. 4

FUEL INJECTOR NO. 4 - BLACK 2 WAY

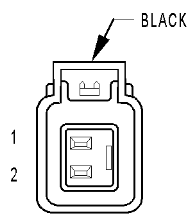
CAV	CIRCUIT	FUNCTION
1	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
1	K14 18LB/BR (NGC)	INJECTOR CONTROL NO. 4
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO.5 (DIESEL)

FUEL INJECTOR NO. 5 (DIESEL) - 2 WAY

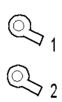
CAV	CIRCUIT	FUNCTION
1	K92 14TN/PK	COMMON INJECTOR DRIVER
2	K38 14GY	FUEL INJECTOR NO. 5 CONTROL



FUEL INJECTOR NO. 5

FUEL INJECTOR NO. 5 - BLACK 2 WAY

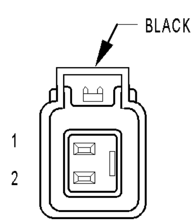
CAV	CIRCUIT	FUNCTION
1	K38 18GY	FUEL INJECTOR NO. 5 DRIVER
1	K38 18GY (NGC)	INJECTOR CONTROL NO. 5
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR NO.6 (DIESEL)

FUEL INJECTOR NO. 6 (DIESEL) - 2 WAY

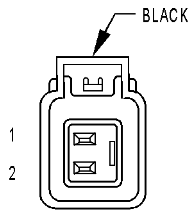
CAV	CIRCUIT	FUNCTION
1	K92 14TN/PK	COMMON INJECTOR DRIVER
2	K58 14BR/DB	FUEL INJECTOR NO. 6 CONTROL



FUEL INJECTOR NO. 6

FUEL INJECTOR NO. 6 - BLACK 2 WAY

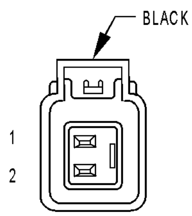
CAV	CIRCUIT	FUNCTION
1	K58 18BR/DB	FUEL INJECTOR NO. 6 DRIVER
1	K58 18BR/DB (NGC)	INJECTOR CONTROL NO. 6
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR
NO. 7
(4.7L/5.7L/5.9L/8.0L)

FUEL INJECTOR NO. 7 (4.7L/5.7L/5.9L/8.0L) - BLACK 2 WAY

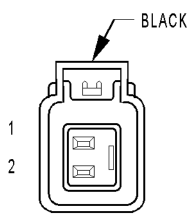
CAV	CIRCUIT	FUNCTION
1	K26 18VT/TN	FUEL INJECTOR NO. 7 DRIVER
1	K26 18VT/TN (NGC)	INJECTOR CONTROL NO. 7
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR
NO. 8
(4.7L/5.7L/5.9L/8.0L)

FUEL INJECTOR NO. 8 (4.7L/5.7L/5.9L/8.0L) - BLACK 2 WAY

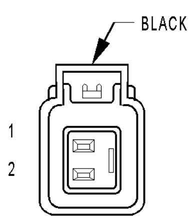
CAV	CIRCUIT	FUNCTION
1	K28 18GY/LB	FUEL INJECTOR NO. 8 DRIVER
1	K28 18GY/LB (NGC)	INJECTOR CONTROL NO. 8
2	A142 16DG/OR (NGC)	ASD RELAY OUTPUT
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR
NO. 9
(8.0L)

FUEL INJECTOR NO. 9 (8.0L) - BLACK 2 WAY

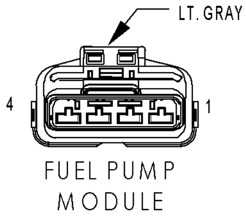
CAV	CIRCUIT	FUNCTION
1	K115 18TN	FUEL INJECTOR NO. 9 DRIVER
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



FUEL INJECTOR
NO. 10
(8.0L)

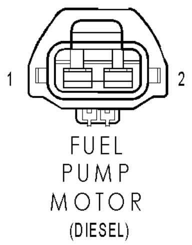
FUEL INJECTOR NO. 10 (8.0L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K116 18WT/DB	FUEL INJECTOR NO. 10 DRIVER
2	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT



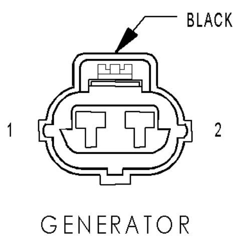
FUEL PUMP MODULE - LT GRAY 4 WAY

CAV	CIRCUIT	FUNCTION
1	Z211 18BK	GROUND
2	K4 18BK/LB	SENSOR GROUND
3	G8 18LB/BK	FUEL LEVEL SENSOR SIGNAL
4	A64 16DG/WT	FUEL PUMP RELAY OUTPUT



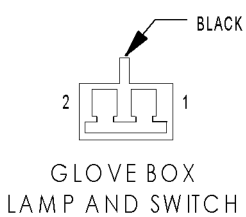
FUEL PUMP MOTOR (DIESEL) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	K31 18BR	FUEL PUMP SIGNAL RETURN
2	K65 18OR/RD	FUEL PUMP RELAY CONTROL



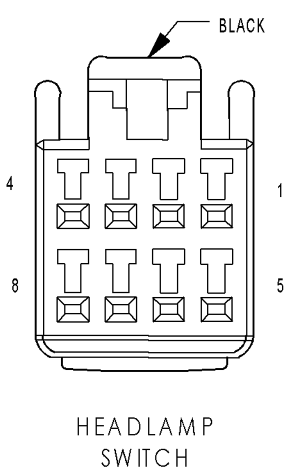
GENERATOR - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	K125 18WT/DB (JTEC/DIESEL)	GENERATOR SOURCE
1	K20 18DG (NGC)	GEN FIELD CONTROL
2	K20 18DG (JTEC/DIESEL)	GENERATOR FIELD CONTROL



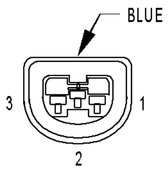
GLOVE BOX LAMP AND SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	M11 20PK/LB	COURTESY LAMP GROUND
2	F32 20RD/YL	FUSED B(+)



HEADLAMP SWITCH - BLACK 8 WAY

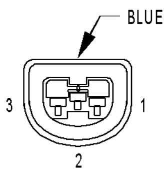
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	Y163 20OR/WT	HEADLAMP SWITCH ILLUMINATION CONTROL
4	Z214 20LB/BK	GROUND
5	L39 20LB	FOG LAMP RELAY OUTPUT
6	Y111 20VT/WT	PANEL LAMPS DIMMER SIGNAL
7	Y167 20WT/DB	HEADLAMP SWITCH RETURN
8	Y126 20VT/YL	HEADLAMP SWITCH SIGNAL



HEADLAMP-LEFT

HEADLAMP-LEFT - BLUE 3 WAY

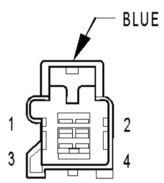
CAV	CIRCUIT	FUNCTION
1	Y171 18WT/DG	LEFT LOW BEAM OUTPUT
2	Z141 18BK/LB	GROUND
3	Y170 18WT/LG	LEFT HIGH BEAM OUTPUT



HEADLAMP-RIGHT

HEADLAMP-RIGHT - BLUE 3 WAY

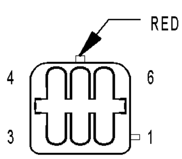
CAV	CIRCUIT	FUNCTION
1	Y169 18WT/TN	RIGHT LOW BEAM OUTPUT
2	Z142 18BK/LG	GROUND
3	Y168 18WT/LB	RIGHT HIGH BEAM OUTPUT



HEATED SEAT CUSHION-PASSENGER

HEATED SEAT CUSHION-PASSENGER - BLUE 4 WAY

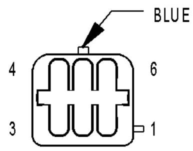
CAV	CIRCUIT	FUNCTION
1	P142 20TN/DB	PASSENGER SEAT TEMPERATURE SENSOR INPUT
2	Z121 20BK/WT	GROUND
3	P144 20BK/LG	PASSENGER SEAT TEMPERATURE 5 VOLT SUPPLY
4	P86 20PK/BK	SEAT HEATER DRIVER



HEATED SEAT SWITCH-DRIVER

HEATED SEAT SWITCH-DRIVER - RED 6 WAY

CAV	CIRCUIT	FUNCTION
1	P137 20VT/DG	DRIVER SEAT LOW HEAT LED DRIVER
2	Y161 20OR/RD	PANEL LAMPS FEED
3	Z259 20BK/LG	GROUND
4	P131 20RD/DG	HEATED SEAT SWITCH SUPPLY
5	P139 20VT/WT	DRIVER SEAT HIGH HEAT LED DRIVER
6	P133 20TN/DG	DRIVER SEAT HEATER MUX SWITCH



HEATED SEAT SWITCH-PASSENGER

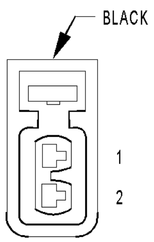
HEATED SEAT SWITCH-PASSENGER - BLUE 6 WAY

CAV	CIRCUIT	FUNCTION
1	P138 20VT/LG	PASSENGER SEAT LOW HEAT LED DRIVER
2	Y161 20OR/RD	PANEL LAMPS FEED
3	Z260 20DG/BK	GROUND
4	P131 20RD/DG	HEATED SEAT SWITCH SUPPLY
5	P140 20VT/BK	PASSENGER SEAT HIGH HEAT LED DRIVER
6	P134 20TN/LG	PASSENGER SEAT HEATER MUX SWITCH

PICTURE NOT AVAILABLE

HORN SWITCH - WHITE 2 WAY

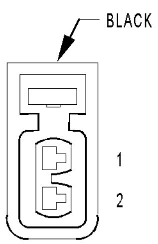
CAV	CIRCUIT	FUNCTION
1	X3 20BK/RD	HORN SWITCH SENSE
2	-	-



HORN-HIGH NOTE

HORN-HIGH NOTE - BLACK 2 WAY

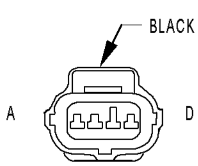
CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z307 18BK/WT	GROUND



HORN-LOW NOTE

HORN-LOW NOTE - BLACK 2 WAY

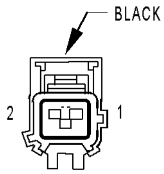
CAV	CIRCUIT	FUNCTION
1	X2 18DG/RD	HORN RELAY OUTPUT
2	Z308 18BK/BR	GROUND



IDLE AIR CONTROL MOTOR (3.7L/5.9L/8.0)

IDLE AIR CONTROL MOTOR (3.7L/5.9L/8.0L) - BLACK 4 WAY

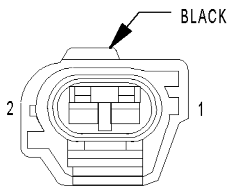
CAV	CIRCUIT	FUNCTION
C	K39 18GY/RD	IDLE AIR CONTROL MOTOR NO. 3 DRIVER
B	K60 18YL/BK	IDLE AIR CONTROL MOTOR NO. 2 DRIVER
A	K40 18BR/WT	IDLE AIR CONTROL MOTOR NO. 1 DRIVER
D	K59 18VT/BK	IDLE AIR CONTROL MOTOR NO. 4 DRIVER



IDLE AIR CONTROL MOTOR (NGC)

IDLE AIR CONTROL MOTOR (NGC) - BLACK 2 WAY

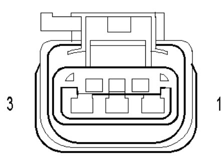
CAV	CIRCUIT	FUNCTION
1	K60 18YL/BK	IAC RETURN
2	K39 18GY/RD	IAC MOTOR CONTROL



IGNITION COIL (5.9L)

IGNITION COIL (5.9L) - BLACK 2 WAY

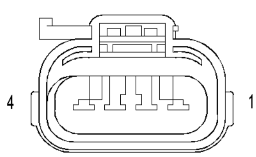
CAV	CIRCUIT	FUNCTION
1	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
2	K19 18BK/GY	IGNITION COIL NO. 1 DRIVER



IGNITION COIL LEFT (8.0L)

IGNITION COIL-LEFT (8.0L) - 3 WAY

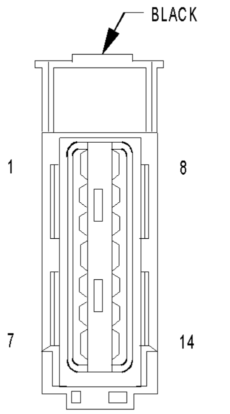
CAV	CIRCUIT	FUNCTION
1	K17 18DB/TN	IGNITION COIL NO. 8 DRIVER
2	A142 14DG.OR	AUTO SHUT DOWN RELAY OUTPUT
3	K32 18YL/GY	IGNITION COIL NO. 4 DRIVER



IGNITION COIL RIGHT (8.0L)

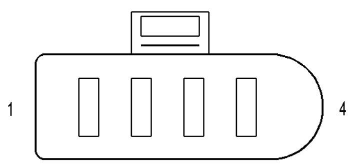
IGNITION COIL-RIGHT (8.0L) - 4 WAY

CAV	CIRCUIT	FUNCTION
1	K19 18BK/GY	IGNITION COIL NO. 1 DRIVER
2	A142 14DG/OR	AUTO SHUT DOWN RELAY OUTPUT
3	K18 18RD/YL	IGNITION COIL NO. 3 DRIVER
4	K43 18DG/GY	IGNITION COIL NO. 6 DRIVER



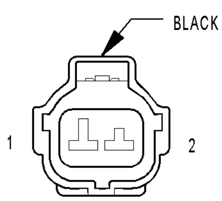
IGNITION SWITCH - BLACK 14 WAY

CAV	CIRCUIT	FUNCTION
1	A2 12PK/BK	FUSED B(+)
2	A51 16RD/WT	FUSED B(+)
3	A21 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
4	A1 16RD	FUSED B(+)
5	G26 20LB	KEY-IN IGNITION SWITCH SENSE
6	Z42 20BK/DG	GROUND
7	A22 16BK/OR	FUSED B(+)
8	C1 12DG	BLOWER MOTOR FEED
9	A31 14DB	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
10	F1 10BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
11	Y131 14RD/WT	FUSED B(+)
12	A30 10CK/WT	FUSED B(+)
13	A41 16YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
14	A38 16OR	FUSED IGNITION SWITCH OUTPUT (RUN)



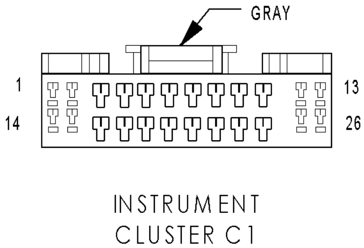
INLET AIR TEMPERATURE/ PRESSURE SENSOR (DIESEL) - 4 WAY

CAV	CIRCUIT	FUNCTION
1	Y502 18DG/YL	INLET AIR TEMPERATURE/PRESSURE RETURN
2	Y523 18VT/WT	INLET AIR TEMPERATURE SENSE
3	Y501 18DB/YL	SUPPLY VOLTAGE
4	Y503 18GY/BR	INLET AIR PRESSURE SENSE



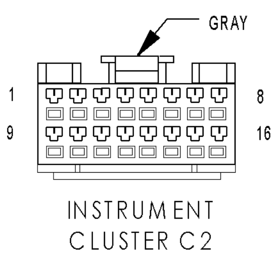
INPUT SPEED SENSOR (3.7L/4.7L/5.7L) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



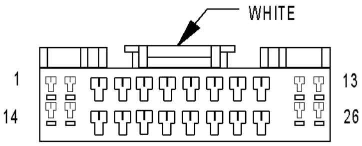
INSTRUMENT CLUSTER C1 - GRAY 26 WAY

CAV	CIRCUIT	FUNCTION
1	F35 18RD	FUSED B(+)
2	Y200 18TN/VT	DOOR LOCK DRIVER RIGHT DOORS
3	Y204 18OR/WT	BTSI SOLENOID CONTROL
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	G10 20LG/RD	SEAT BELT SWITCH SENSE
11	Y156 18TN/WT	DOOR UNLOCK DRIVER RIGHT DOORS
12	Y201 18TN/OR	DOOR UNLOCK DRIVER LEFT REAR
13	Z105 18TN/BK	GROUND
14	F35 18RD	FUSED B(+)
15	Y157 18TN/PK	DOOR LOCK DRIVER LEFT DOORS
16	-	-
17	X3 20BK/RD	HORN SWITCH SENSE
18	G75 20TN	DRIVER DOOR AJAR SWITCH SENSE
19	G77 20VT/OR	LEFT REAR DOOR AJAR SWITCH SENSE
20	G76 20TN/YL	RIGHT REAR DOOR AJAR SWITCH SENSE
21	G74 20TN/RD	PASSENGER DOOR AJAR SWITCH SENSE
22	-	-
23	L50 18WT/TN	BRAKE LAMP SWITCH OUTPUT
24	G26 20LB	KEY-IN IGNITION SWITCH SENSE
25	P55 18DB	DOOR UNLOCK DRIVER LEFT FRONT
26	-	-



INSTRUMENT CLUSTER C2 - GRAY 16 WAY

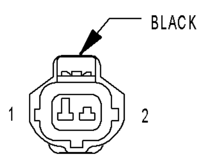
CAV	CIRCUIT	FUNCTION
1	Y109 20VT/OR	WASH/BEAM SELECT SWITCH FEED
2	P96 20WT/LG	PASSENGER DOOR LOCK SWITCH MUX
3	P97 20WT/DG	DRIVER DOOR LOCK SWITCH MUX
4	Y111 20VT/WT	PANEL LAMPS DIMMER SIGNAL
5	Y126 20VT/YL	HEADLAMP SWITCH RETURN
6	G72 20DG/OR	PASSENGER CYLINDER LOCK SWITCH MUX
7	G73 20LG/OR	DRIVER CYLINDER LOCK SWITCH MUX
8	Y110 20WT/VT	TURN LAMPS SWITCH FEED
9	-	-
10	-	-
11	V8 20VT	INTERMITENT WIPER SWITCH SENSE
12	X20 20GY/WT (PREMIUM)	RADIO CONTROL MUX
13	-	-
14	Y193 20YL/RD	TRANS RANGE SENSOR MUX
15	-	-
16	-	-



INSTRUMENT CLUSTER C3

INSTRUMENT CLUSTER C3 - WHITE 26 WAY

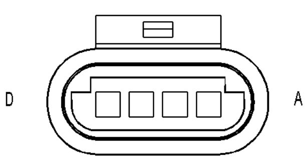
CAV	CIRCUIT	FUNCTION
1	M3 20 PK/DB	CARGO LAMP DRIVER
2	-	-
3	M20 20BR	COURTESY LAMP DRIVER
4	M11 20PK/LB	COURTESY LAMP GROUND
5	-	-
6	Y165 20OR/YL	PANEL LAMPS DRIVER
7	-	-
8	Y108 20VT/BR	WIPER/TURN/BEAM SELECT SWITCH RETURN
9	Y167 20WT/DB	HEADLAMP SWITCH RETURN
10	Y128 20DG/GY	TRANS RANGE SENSOR ELECTRONIC CLUSTER 5 VOLT SUPPLY
11	Z202 20LB/BK	GROUND
12	Z203 20VT/BK	GROUND
13	Y105 20BK/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
14	E1 20TN	FUSED B(+)
15	P131 20RD/DG (ELECTRIC 4X4)	HEATED SEAT SWITCH SUPPLY
16	Y189 20OR/BK (SLT+)	PANEL LAMPS FEED
17	Y161 20OR/RD (ELECTRIC 4X4)	PANEL LAMPS FEED
18	Y163 20OR/WT	HEADLAMP SWITCH ILLUMINATION CONTROL
19	Y166 20OR/DB	PANEL LAMPS DRIVER
20	-	-
21	D25 20VT/YL	PCI BUS
22	G11 20WT/LG	PARK BRAKE SWITCH SENSE
23	Z106 20LG/BK	GROUND
24	A51 16RD/WT	IGNITION SWITCH OUTPUT (OFF-RUN-START)
25	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
26	M1 18PK	FUSED B(+)



INTAKE AIR TEMPERATURE SENSOR

INTAKE AIR TEMPERATURE SENSOR - BLACK 2 WAY

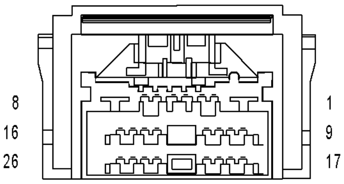
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL



INTAKE AIR TEMPERATURE/ MANIFOLD ABSOLUTE PRESSURE SENSOR (DIESEL)

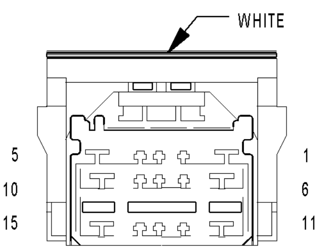
INTAKE AIR TEMPERATURE/MANIFOLD ABSOLUTE PRESSURE SENSOR (DIESEL) - 4 WAY

CAV	CIRCUIT	FUNCTION
A	K55 18LB/WT	MAP SENSOR SIGNAL
B	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
C	K72 18DG/OR	5 VOLT SUPPLY
D	K9 18LB	5 VOLT SUPPLY



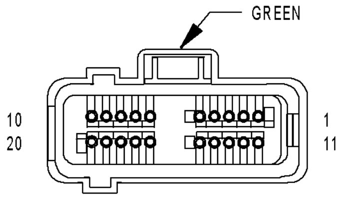
INTEGRATED POWER MODULE C1 - 26 WAY

CAV	CIRCUIT	FUNCTION
1	A112 12RD/TN (DIESEL)	FUSED B(+)
1	A17 16RD/BK (EXCEPT DIESEL)	FUSED B(+)
2	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	A20 20RD/DB	FUSED IGNITION SWITCH OUTPUT (RUN)
5	Y141 18DG/WT	TRAILER TOW LEFT TURN RELAY OUTPUT
6	-	-
7	Y140 18WT/PK	TRAILER TOW RIGHT TURN RELAY OUTPUT
8	Y131 14RD/WT	FUSED B(+)
9	M1 18PK	FUSED B(+)
10	L7 18BK/YL	TRAILER TOW RELAY OUTPUT
11	A21 16DB	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	F35 18RD	FUSED B(+)
13	F32 20RD/YL	FUSED B(+)
14	X2 18DG/RD	HORN RELAY OUTPUT
15	A64 16DG/WT (EXCEPT 4.7L)	FUEL PUMP RELAY OUTPUT
16	A108 18TN/RD	FUSED B(+)
17	L76 18BK/OR	FUSED PARK LAMP RELAY OUTPUT
18	F32 18RD/YL	FUSED B(+)
19	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
20	-	-
21	-	-
22	-	-
23	Y145 18DB/YL	CONDENSER FAN RELAY CONTROL
24	-	-
25	- -	-
26	-	-



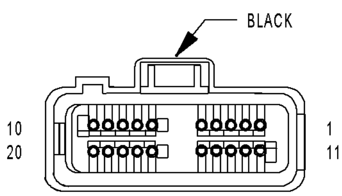
INTEGRATED POWER MODULE C2 - WHITE 15 WAY

CAV	CIRCUIT	FUNCTION
1	A30 10RD/WT (EXCEPT BASE)	FUSED B(+)
2	A34 16LB/RD (ETC)	FUSED B(+)
3	Y148 18YL/RD	FUSED B(+)
4	A61 16DG/BK (3.9L/5.7L/5.9L)	FUEL PUMP RELAY OUTPUT
5	F37 12RD/LB (EXCEPT BASE)	FUSED B(+)
6	A2 10PK/BK	FUSED B(+)
7	A14 20RD/WT	FUSED B(+)
8	A10 14RD/DG	FUSED B(+)
9	A12 18RD/TN	FUSED B(+)
10	A22 16BK/OR	FUSED B(+)
11	-	-
12	F30 18RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
13	F75 18VT (EXCEPT BASE)	FUSED B(+)
14	A1 16RD	FUSED B(+)
15	-	-



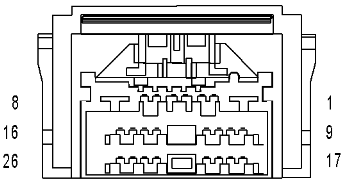
INTEGRATED POWER MODULE C3 - GREEN 20 WAY

CAV	CIRCUIT	FUNCTION
1	V10 20BR	WASHER PUMP MOTOR SENSE
2	L62 18BR/RD	RIGHT REAR TURN LAMP DRIVER
3	Z21 18BK/LG	GROUND
4	D25 20VT/PK	PCI BUS
5	Z12 18BK/TN	GROUND
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	L1 18VT/BK	BACKUP LAMP FEED
12	-	-
13	-	-
14	G31 20VT/LG (EXCEPT BASE)	AMBIENT TEMPERATURE SENSOR SIGNAL
15	-	-
16	L61 18LG	LEFT FRONT TURN LAMP DRIVER
17	L24 18WT/LG	LEFT STOP LAMP DRIVER
18	L63 18DG/RD	LEFT REAR TURN LAMP DRIVER
19	L60 18LG/TN	RIGHT FRONT TURN LAMP DRIVER
20	Y137 20VT/LB	SENSOR GROUND



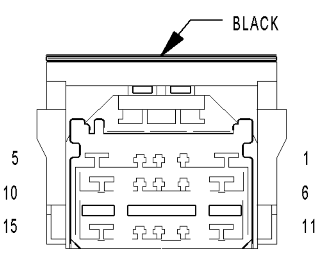
INTEGRATED POWER MODULE C4 - BLACK 20 WAY

CAV	CIRCUIT	FUNCTION
1	Z2 18BK/LG	GROUND
2	L22 18LB/WT	RIGHT STOP LAMP DRIVER
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	Y134 20GY/RD (3.7L/5.9L)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
11	K173 20LG (DIESEL)	GROUND
12	V5 20DG	WIPER PARK SWITCH SENSE
13	-	-
14	-	-
15	G29 20BK/TN	WASHER FLUID SWITCH SENSE
16	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
17	-	-
18	-	-
19	-	-
20	-	-



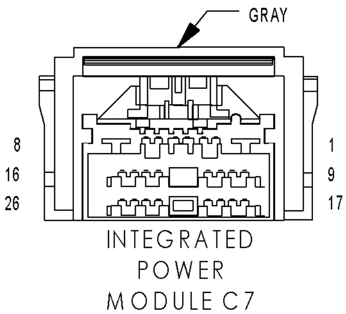
INTEGRATED POWER MODULE C5 - 26 WAY

CAV	CIRCUIT	FUNCTION
1	A38 16OR	FUSED IGNITION SWITCH OUTPUT (RUN)
2	K173 18LG (GAS EXCEPT 5.9L)	GROUND
2	K173 18LG (5.9L)	GROUND
2	K173 20LG (DIESEL)	GROUND
3	-	-
4	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
5	C23 16DG	CONDENSER FAN RELAY OUTPUT
6	F15 20DB (DIESEL)	FUSED IGNITION SWITCH OUTPUT (RUN)
7	G115 20YL/WT (DIESEL)	FUSED B(+)
8	Z316 12BK/OR	GROUND
9	-	-
10	-	-
11	C13 18DB/OR	A/C COMPRESSOR CLUTCH RELAY CONTROL
12	-	-
13	A42 18DG (CALIFORNIA)	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
14	Z114 18BK/LG (DIESEL)	GROUND
14	Y145 20DB/YL (EXCEPT DIESEL)	
15	A17 16RD/BK (EXCEPT DIESEL)	
15	Y135 18LG/BK (DIESEL)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
16	K30 18PK	TRANSMISSION CONTROL RELAY CONTROL
17	F121 16TN/BK	HEATED MIRROR RELAY OUTPUT
18	C3 18DB/BK	A/C COMPRESSOR CLUTCH RELAY OUTPUT
19	-	-
20	-	-
21	C16 20LB/YL	HEATED MIRROR RELAY CONTROL
22	V4 16RD/YL	WIPER RELAY HIGH SPEED OUTPUT
23	F23 18DB/YL	FUSED B(+)
24	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
25	-	-
26	F15 20DB	FUSED IGNITION SWITCH OUTPUT (RUN)
26	Y106 20OR/RD (ELECTRIC TRANSFER CASE)	FUSED IGNITION SWITCH OUTPUT (RUN)



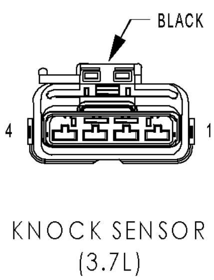
INTEGRATED POWER MODULE C6 - BLACK 15 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	Y133 14RD/OR	FUSED B(+)
3	-	-
4	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	A93 12RD/BK (DIESEL)	FUEL HEATER RELAY OUTPUT
10	C23 16DG (EXCEPT DIESEL)	
11	A112 12RD/TN (DIESEL)	FUSED B(+)
11	A17 16RD/BK (EXCEPT DIESEL)	
12	A31 14BK/WT	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
13	-	-
14	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
15	-	-



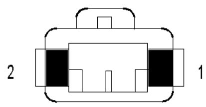
INTEGRATED POWER MODULE C7 - GRAY 26 WAY

CAV	CIRCUIT	FUNCTION
1	T40 14BR	STARTER MOTOR RELAY OUTPUT
2	V3 16BR/WT	WIPER RELAY LOW SPEED OUTPUT
3	Y105 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
4	F235 18RD	FUSED B(+)
5	-	-
6	Y171 18WT/DG	LEFT LOW BEAM DRIVER
7	Y168 18WT/LB	RIGHT HIGH BEAM DRIVER
8	-	-
9	A64 16DG/WT	FUEL PUMP RELAY OUTPUT
10	-	-
11	K51 20DB/YL	AUTO SHUT DOWN RELAY CONTROL
12	K127 18DB/OR (CALIFORNIA)	OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
13	-	-
14	-	-
15	Y170 18WT/LG	LEFT HIGH BEAM DRIVER
16	Y153 18DB/RD	ADJUSTABLE PEDAL RELAY OUTPUT
17	-	-
18	-	-
19	K31 20BR	-
20	L39 18LB (FOG LAMPS)	FOG LAMP RELAY OUTPUT
21	A41 16YL	FUSED IGNITION SWITCH OUTPUT (START)
22	Y169 18WT/TN	RIGHT LOW BEAM DRIVER
23	T24 20BR/YL (EXCEPT NGC)	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
23	T752 18DG/OR (NGC)	
24	E1 20TN	FUSED B(+)
25	A141 18DG/WT (EXCEPT NGC)	FUSED AUTO SHUT DOWN RELAY OUTPUT
26	-	-



KNOCK SENSOR (3.7L) - BLACK 4 WAY

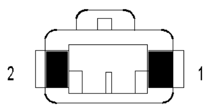
CAV	CIRCUIT	FUNCTION
1	K73 18YL/BK	KNOCK SENSOR NO. 1 SIGNAL
2	K4 18BK/LB	SENSOR GROUND
3	K74 18BR/VT	KNOCK SENSOR NO. 2 SIGNAL
4	K4 18BK/LB	SENSOR GROUND



KNOCK SENSOR-LEFT (5.7L)

KNOCK SENSOR-LEFT (5.7L) - BLACK 2 WAY

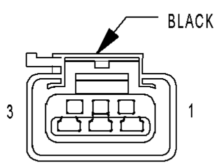
CAV	CIRCUIT	FUNCTION
1	K73 18YL/BK	KNOCK SENSOR NO. 1 SIGNAL
2	Y205 18BR/WT	KNOCK SIGNAL RETURN



KNOCK SENSOR-RIGHT (5.7L)

KNOCK SENSOR-RIGHT (5.7L) - BLACK 2 WAY

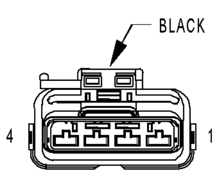
CAV	CIRCUIT	FUNCTION
1	K74 18BR/VT	KNOCK SENSOR NO. 2 SIGNAL
2	Y206 18DB/VT	kNOCK SIGNAL RETURN



LEAK DETECTION PUMP (NGC)

LEAK DETECTION PUMP (NGC) - BLACK 3 WAY

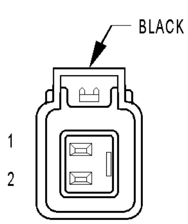
CAV	CIRCUIT	FUNCTION
1	Z54 18BK/PK	GROUND
2	K107 18OR	NVLD SWITCH SIGNAL
3	K106 18WT/DG	NVLD SOLENOID CONTROL



LEAK DETECTION PUMP

LEAK DETECTION PUMP - BLACK 4 WAY

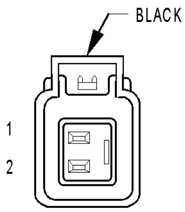
CAV	CIRCUIT	FUNCTION
1	-	-
2	K125 18WT/DB	GENERATOR SOURCE
3	K106 18WT/DG	LEAK DETECTION PUMP SWITCH SENSE
4	K107 18OR	LEAK DETECTION PUMP SOLENOID CONTROL



LICENSE LAMP-LEFT

LICENSE LAMP-LEFT - BLACK 2 WAY

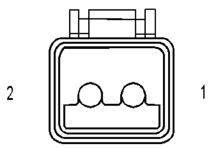
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	Z53 18BK	GROUND



LICENSE LAMP-RIGHT

LICENSE LAMP-RIGHT - BLACK 2 WAY

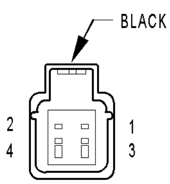
CAV	CIRCUIT	FUNCTION
1	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
2	Z53 18BK	GROUND



LIFT PUMP MOTOR (DIESEL)

LIFT PUMP MOTOR (DIESEL) - 2 WAY

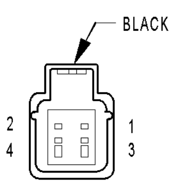
CAV	CIRCUIT	FUNCTION
1	K62 18BK/OR	LIFT PUMP FEED
2	Z11 18BK/WT	GROUND



LINE PRESSURE SENSOR (3.7L/5.7L)

LINE PRESSURE SENSOR (3.7L/5.7L) - BLACK 4 WAY

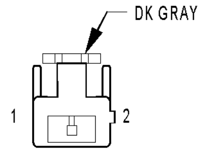
CAV	CIRCUIT	FUNCTION
1	Z113 18BK	GROUND
2	T39 18GY/LB	5 VOLT SUPPLY
3	T38 18VT/TN	LINE PRESSURE SENSOR SIGNAL
4	-	-



LINE PRESSURE SENSOR (4.7L)

LINE PRESSURE SENSOR (4.7L) - BLACK 4 WAY

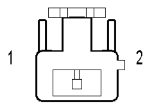
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
2	K6 18VT/WT	5 VOLT SUPPLY
3	T38 18VT/TN	LINE PRESSURE SENSOR SIGNAL
4	-	-



LUMBAR MOTOR-DRIVER

LUMBAR MOTOR-DRIVER - DK GRAY 2 WAY

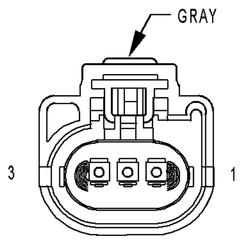
CAV	CIRCUIT	FUNCTION
1	P106 12DG/WT	LUMBAR MOTOR FORWARD
2	P107 12OR/BK	LUMBAR MOTOR REARWARD



LUMBAR MOTOR-PASSENGER

LUMBAR MOTOR-PASSENGER - 2 WAY

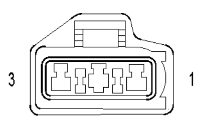
CAV	CIRCUIT	FUNCTION
1	P105 12LG/DB	LUMBAR MOTOR FORWARD
2	P104 12YL/LB	LUMBAR MOTOR REARWARD



MANIFOLD ABSOLUTE PRESSURE SENSOR (3.7L/4.7L/5.7L)

MANIFOLD ABSOLUTE PRESSURE SENSOR (3.7L/4.7L/5.7L) - GRAY 3 WAY

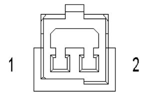
CAV	CIRCUIT	FUNCTION
1	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
2	K4 18BK/LB	SENSOR GROUND
2	K4 20BK/LB (NGC)	SENSOR GROUND
3	K7 18OR	5 VOLT SUPPLY
3	K6 18VT/WT (NGC)	5 VOLT SUPPLY



MANIFOLD ABSOLUTE PRESSURE SENSOR (5.9L/8.0L)

MANIFOLD ABSOLUTE PRESSURE SENSOR (5.9L/8.0L) - 3 WAY

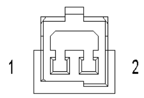
CAV	CIRCUIT	FUNCTION
1	K4 18BK/LB	SENSOR GROUND
1	K7 18OR (8.0L)	5 VOLT SUPPLY
2	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
2	K4 18BK/LB (8.0L)	SENSOR GROUND
3	K1 18DG/RD (8.0L)	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
3	K7 18OR	5 VOLT SUPPLY



MODE DOOR ACTUATOR 1 (PANEL TO FLOOR)

MODE DOOR ACTUATOR 1 (PANEL TO FLOOR) - 2 WAY

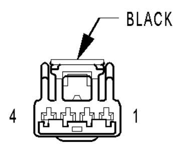
CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C35 20DG/YL	MODE DOOR 1 DRIVER



MODE DOOR ACTUATOR 2 (DEFROST TO FLOOR)

MODE DOOR ACTUATOR 2 (DEFROST TO FLOOR) - 2 WAY

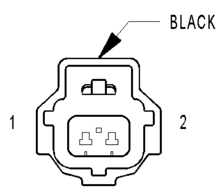
CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C33 20DB/RD	MODE DOOR 2 DRIVER



MULTI-FUNCTION SWITCH

MULTI-FUNCTION SWITCH - BLACK 4 WAY

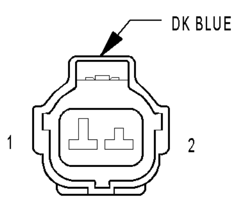
CAV	CIRCUIT	FUNCTION
1	Y109 20VT/OR	WASH/BEAM SELECT SWITCH SIGNAL
2	Y108 20VT/BR	WIPER/TURN/BEAM SELECT SWITCH RETURN
3	Y110 20WT/VT	TURN LAMPS SWITCH SIGNAL
4	V8 20VT	INTERMITTENT WIPER SWITCH SIGNAL



OUTPUT SPEED SENSOR (3.7L/4.7L/5.7L)

OUTPUT SPEED SENSOR (3.7L/4.7L/5.7L) - BLACK 2 WAY

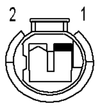
CAV	CIRCUIT	FUNCTION
1	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



OUTPUT SPEED SENSOR (5.9L)

OUTPUT SPEED SENSOR (5.9L) - DK BLUE 2 WAY

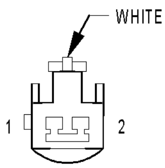
CAV	CIRCUIT	FUNCTION
1	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



OUTPUT SPEED SENSOR (DIESEL)

OUTPUT SPEED SENSOR (DIESEL) - 2 WAY

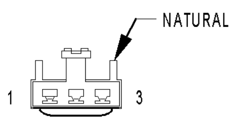
CAV	CIRCUIT	FUNCTION
1	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
2	T13 18DB/BK	SPEED SENSOR GROUND



OVERDRIVE SWITCH

OVERDRIVE SWITCH - WHITE 2 WAY

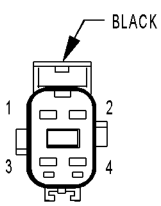
CAV	CIRCUIT	FUNCTION
1	T6 20OR/WT	OVERDRIVE OFF SWITCH SENSE
2	Z71 20BK/TN	GROUND



OVERHEAD MAP/READING LAMP (EXCEPT BASE)

OVERHEAD MAP/READING LAMP (EXCEPT BASE) - NATURAL 3 WAY

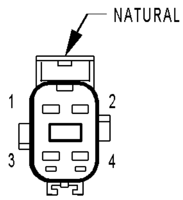
CAV	CIRCUIT	FUNCTION
1	M11 20PK/LB	COURTESY LAMP GROUND
2	F32 18RD/YL	FUSED B(+)
3	M20 20BR	COURTESY LAMP DRIVER



OXYGEN SENSOR 1/1 UPSTREAM

OXYGEN SENSOR 1/1 UPSTREAM - BLACK 4 WAY

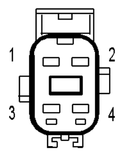
CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	FUSED AUTO SHUT DOWN RELAY OUTPUT
1	K41 18BK/DG (NGC)	O2 1/1 HEATER CONTROL
2	Z192 18BK/WT (NGC)	GROUND
2	K199 18BR/VT	OXYGEN SENSOR 1/1 HEATER CONTROL
3	K4 18BK/LB	SENSOR GROUND
3	Y213 18PK/LB (NGC)	O2 UPSTREAM RETURN
4	K99 18BR/OR (NGC)	O2 1/1 SIGNAL
4	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL



OXYGEN SENSOR
1/2 DOWNSTREAM

OXYGEN SENSOR 1/2 DOWNSTREAM - NATURAL 4 WAY

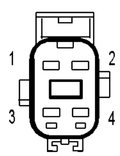
CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT (EXCEPT CALIFORNIA)	FUSED AUTO SHUT DOWN RELAY OUTPUT
1	A42 18DG (CALIFORNIA)	OXYGEN SENSOR RELAY OUTPUT
1	K199 18BR/VT (NGC)	O2 1/2 HEATER CONTROL
2	Z188 18BK/LB (NGC)	SENSOR GROUND
2	Z193 18BK/WT (CALIFORNIA)	GROUND
2	K299 18BR/WT (EXCEPT CALIFORNIA)	OXYGEN SENSOR 1/2 HEATER CONTROL
3	K4 18BK/LB	SENSOR GROUND
3	K904 18BR/DG (NGC)	O2 RETURN DOWNSTREAM
4	K141 18TN/WT (NGC)	02 1/2 SIGNAL
4	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL



OXYGEN SENSOR
2/1 UPSTREAM
(CALIFORNIA 4.7L/
CALIFORNIA 5.9L)

OXYGEN SENSOR 2/1 UPSTREAM (CALIFORNIA 4.7L/CALIFORNIA 5.9L) - 4 WAY

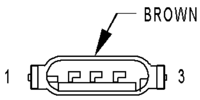
CAV	CIRCUIT	FUNCTION
1	A141 18DG/WT	FUSED AUTO SHUT DOWN RELAY OUTPUT
1	K299 18BR/WT (NGC)	O2 2/1 HEATER CONTROL
2	Z193 18BK/DG (NGC)	GROUND
2	K299 18BR/WT	OXYGEN SENSOR 2/1 HEATER CONTROL
3	K4 18BK/LB	SENSOR GROUND
3	Y213 18PK/LB (NGC)	O2 UPSTREAM RETURN
4	K241 18LG/RD (NGC)	02 2/1 SIGNAL
4	K241 18LG/RD	OXYGEN SENSOR 2/1 SIGNAL



OXYGEN SENSOR
2/2 DOWNSTREAM
(CALIFORNIA 4.7L/
CALIFORNIA 5.9L)

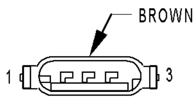
OXYGEN SENSOR 2/2 DOWNSTREAM (CALIFORNIA 4.7L/CALIFORNIA 5.9L) - 4 WAY

CAV	CIRCUIT	FUNCTION
1	A42 18DG	OXYGEN SENSOR DOWNSTREAM RELAY OUTPUT
1	K399 18BR/GY (NGC)	O2 2/2 HEATER CONTROL
2	Z186 18BK/LB (NGC)	GROUND
2	Z192 18RD	GROUND
3	K4 18DB	SENSOR GROUND
3	K904 18BR/DG (NGC)	O2 RETURN DOWNSTREAM
4	K341 18TN/WT (NGC)	O2 2/2 SIGNAL
4	K341 18OR	OXYGEN SENSOR 2/2 SIGNAL



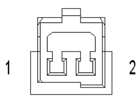
PARK/TURN SIGNAL LAMP-LEFT FRONT - BROWN 3 WAY

CAV	CIRCUIT	FUNCTION
1	L61 18LG	LEFT FRONT TURN LAMP DRIVER
2	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
3	Z148 18DB/BK	GROUND



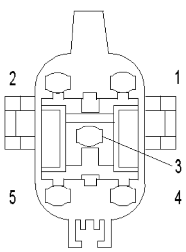
PARK/TURN SIGNAL LAMP-RIGHT FRONT - BROWN 3 WAY

CAV	CIRCUIT	FUNCTION
1	L60 18LG/TN	RIGHT FRONT TURN LAMP DRIVER
2	L7 18BK/YL	HEADLAMP SWITCH OUTPUT
3	Z147 18BK/LB	GROUND



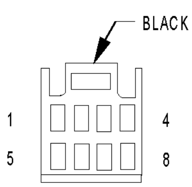
PASSENGER BLEND DOOR ACTUATOR (DUAL-ZONE) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C46 20YL/LG	PASSENGER BLEND DOOR DRIVER



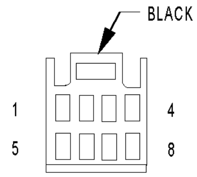
PASSENGER LUMBAR SWITCH - 5 WAY

CAV	CIRCUIT	FUNCTION
1	Z238 18BK	GROUND
2	P104 12YL/LB	LUMBAR MOTOR REARWARD
3	F37 12RD/LB	FUSED B(+)
4	P105 12LG/DB	LUMBAR MOTOR FORWARD
5	Z238 18BK	GROUND



POWER MIRROR-LEFT - BLACK 8 WAY

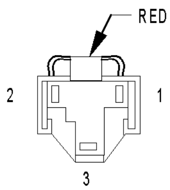
CAV	CIRCUIT	FUNCTION
1	F121 18TN/BK	HEATED MIRROR RELAY OUTPUT
2	P76 20OR/YL	LEFT MIRROR COMMON DRIVER (RIGHT/DOWN)
3	P75 20DB/WT	LEFT MIRROR LEFT DRIVER
4	P71 20YL	LEFT MIRROR UP DRIVER
5	Z310 20BK/OR	GROUND
6	-	-
7	-	-
8	-	-



POWER MIRROR-RIGHT

POWER MIRROR-RIGHT - BLACK 8 WAY

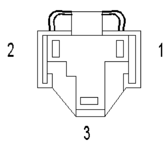
CAV	CIRCUIT	FUNCTION
1	F121 18TN/BK	HEATED MIRROR RELAY OUTPUT
2	P76 20OR/YL	LEFT MIRROR COMMON DRIVER (RIGHT/DOWN)
3	P74 20DB	RIGHT MIRROR LEFT DRIVER
4	P72 20YL/BK	RIGHT MIRROR UP DRIVER
5	Z311 20BK/LB	GROUND
6	-	-
7	-	-
8	-	-



POWER OUTLET

POWER OUTLET - RED 3 WAY

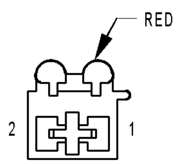
CAV	CIRCUIT	FUNCTION
1	A12 18RD/TN	FUSED B(+)
2	-	-
3	Z300 18BK/LB	GROUND



POWER OUTLET-CONSOLE (EXCEPT BASE)

POWER OUTLET-CONSOLE (EXCEPT BASE) - 3 WAY

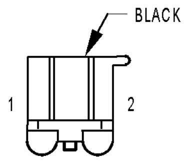
CAV	CIRCUIT	FUNCTION
1	Y148 18BR/YL	FUSED B(+)
2	-	-
3	Z300 18BK/WT	GROUND



POWER SEAT MOTOR-DRIVER FRONT VERTICAL

POWER SEAT MOTOR-DRIVER FRONT VERTICAL - RED 2 WAY

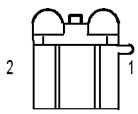
CAV	CIRCUIT	FUNCTION
1	P21 12RD/LG	LEFT SEAT FRONT DOWN
2	P19 12YL/LG	LEFT SEAT FRONT UP



POWER SEAT
MOTOR-DRIVER
HORIZONTAL

POWER SEAT MOTOR-DRIVER HORIZONTAL - BLACK 2 WAY

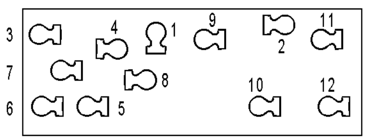
CAV	CIRCUIT	FUNCTION
1	P17 12RD/LB	LEFT SEAT HORIZONTAL REARWARD
2	P15 12YL/LB	LEFT SEAT HORIZONTAL FORWARD



POWER SEAT
MOTOR-DRIVER
REAR VERTICAL

POWER SEAT MOTOR-DRIVER REAR VERTICAL - 2 WAY

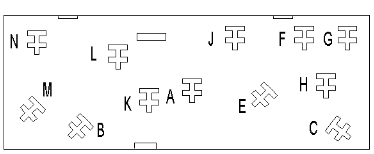
CAV	CIRCUIT	FUNCTION
1	P12 12RD/WT′	RIGHT SEAT REAR DOWN
2	P10 12YL/WT	RIGHT SEAT REAR UP



POWER SEAT
SWITCH-DRIVER

POWER SEAT SWITCH-DRIVER - 12 WAY

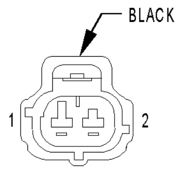
CAV	CIRCUIT	FUNCTION
1	F37 12RD/LB	FUSED B(+)
2	Z238 14BK	GROUND
3	P106 12DG/WT	LUMBAR MOTOR FORWARD
4	P13 12RD/WT	LEFT SEAT REAR DOWN
5	P107 12OR/BK	LUMBAR MOTOR REARWARD
6	Z88 14BK/LB	GROUND
7	F37 12RD/LB	FUSED B(+)
8	P11 12YL/WT	LEFT SEAT REAR UP
9	P17 12RD/LB	LEFT SEAT HORIZONTAL REARWARD
10	P15 12YL/LB	LEFT SEAT HORIZONTAL FORWARD
11	P21 12RD/LG	LEFT SEAT FRONT DOWN
12	P19 12YL/LG	LEFT SEAT FRONT UP



POWER SEAT
SWITCH-PASSENGER

POWER SEAT SWITCH-PASSENGER - 12 WAY

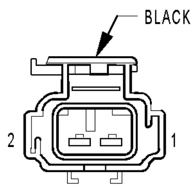
CAV	CIRCUIT	FUNCTION
A	F37 12RD/LB	FUSED B(+)
B	Z238 14BK	GROUND
C	P104 12YL/LB	LUMBAR MOTOR REARWARD
E	P10 12YL/WT	RIGHT SEAT REAR DOWN
F	P105 12LG/DB	LUMBAR MOTOR FORWARD
G	Z238 14BK	GROUND
H	F37 12RD/LB	FUSED B(+)
J	P12 12RD/WT	RIGHT SEAT REAR UP
K	P16 12RD/LB	RIGHT SEAT HORIZONTAL REARWARD
L	P14 12YL/LB	RIGHT SEAT HORIZONTAL FORWARD
M	P18 12YL/LG	RIGHT SEAT FRONT DOWN
N	P20 12RD/LG	RIGHT SEAT FRONT UP



POWER STEERING
PRESSURE SWITCH
(3.7L/4.7L/5.7L)

POWER STEERING PRESSURE SWITCH (3.7L/4.7L/5.7L) - BLACK 2 WAY

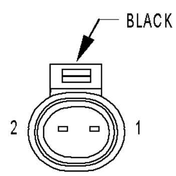
CAV	CIRCUIT	FUNCTION
1	Z244 20BK/DG	GROUND
2	S28 18YL/BK	P/S SWITCH SIGNAL



POWER WINDOW
MOTOR-DRIVER

POWER WINDOW MOTOR-DRIVER - BLACK 2 WAY

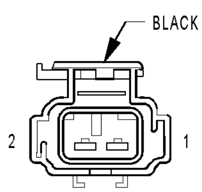
CAV	CIRCUIT	FUNCTION
1	Q21 14WT	LEFT FRONT WINDOW DRIVER (DOWN)
2	Q11 14LB	LEFT FRONT WINDOW DRIVER (UP)



POWER WINDOW
MOTOR-LEFT REAR

POWER WINDOW MOTOR-LEFT REAR - BLACK 2 WAY

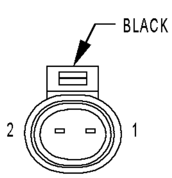
CAV	CIRCUIT	FUNCTION
1	Q23 14RD/WT	DRIVER REAR WINDOW DRIVER (DOWN)
2	Q13 14DB	DRIVER REAR WINDOW DRIVER (UP)



POWER WINDOW
MOTOR-PASSENGER

POWER WINDOW MOTOR-PASSENGER - BLACK 2 WAY

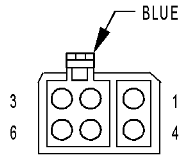
CAV	CIRCUIT	FUNCTION
1	Q22 14VT	RIGHT FRONT WINDOW DRIVER (DOWN)
2	Q12 14BR	RIGHT FRONT WINDOW DRIVER (UP)



POWER WINDOW
MOTOR-RIGHT REAR

POWER WINDOW MOTOR-RIGHT REAR - BLACK 2 WAY

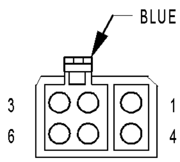
CAV	CIRCUIT	FUNCTION
1	Q24 14RD/WT	PASSENGER REAR WINDOW DRIVER (DOWN)
2	Q12 14DB	PASSENGER REAR WINDOW DRIVER (UP)



POWER WINDOW SWITCH-LEFT REAR

POWER WINDOW SWITCH-LEFT REAR - BLUE 6 WAY

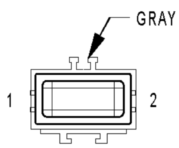
CAV	CIRCUIT	FUNCTION
1	Q13 14DB	DRIVER REAR WINDOW DRIVER (UP)
2	Q27 14RD/BK	LEFT REAR WINDOW DRIVER (DOWN)
3	-	-
4	Q17 14DB/WT	LEFT REAR WINDOW DRIVER (UP)
5	Q23 14RD/WT	DRIVER REAR WINDOW DRIVER (DOWN)
6	Q1 14YL	POWER WINDOW SWITCH FEED



POWER WINDOW SWITCH-RIGHT REAR

POWER WINDOW SWITCH-RIGHT REAR - BLUE 6 WAY

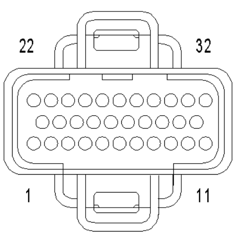
CAV	CIRCUIT	FUNCTION
1	Q12 14DB	PASSENGER REAR WINDOW DRIVER (UP)
2	Q28 14RD/BK	RIGHT REAR WINDOW DRIVER (DOWN)
3	-	-
4	Q18 14DB/WT	RIGHT REAR WINDOW DRIVER (UP)
5	Q24 14RD/WT	PASSENGER REAR WINDOW DRIVER (DOWN)
6	Q1 14YL	POWER WINDOW SWITCH FEED



POWER WINDOW-CIRCUIT BREAKER

POWER WINDOW-CIRCUIT BREAKER - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	F1 10DB	IGNITION SWITCH OUTPUT (RUN-ACC)
2	F21 12TN	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)



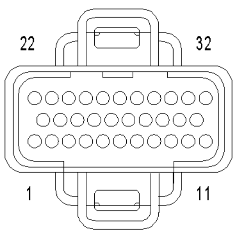
POWERTRAIN CONTROL MODULE C1 (DIESEL)

POWERTRAIN CONTROL MODULE - C1 (DIESEL) - 32 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	K914 18VT/RD	SENSOR GROUND
5	-	-
6	T24 18GY/BK	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
7	-	-
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	A14 18RD/WT	FUSED B(+)
23	K22 18OR/DB	ACCELERATOR PEDAL POSITION SENSOR SIGNAL

POWERTRAIN CONTROL MODULE - C1 (DIESEL) - 32 WAY

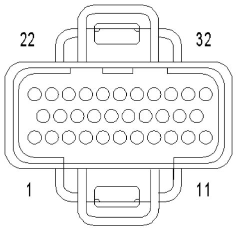
CAV	CIRCUIT	FUNCTION
24	-	-
25	-	-
26	-	-
27	-	-
28	-	-
29	-	-
30	-	-
31	Z82 14BK/TN	GROUND
32	Z81 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE C2 (DIESEL)

POWERTRAIN CONTROL MODULE - C2 (DIESEL) - 32 WAY

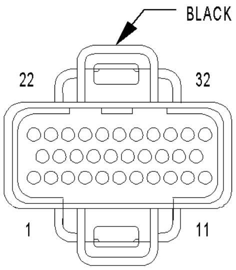
CAV	CIRCUIT	FUNCTION
1	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	K88 18VT/WT	GOVERNOR PRESSURE SOLENOID CONTROL
9	-	-
10	-	-
11	K54 18OR/BK	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
12	-	-
13	-	-
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	T60 18BR	3-4 SHIFT SOLENOID CONTROL
22	-	-
23	-	-
24	-	-
25	T13 18DB/BK	SPEED SENSOR GROUND
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SIGNAL
28	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/RD	GOVERNOR PRESSURE SENSOR SIGNAL
30	K30 18PK	TRANSMISSION CONTROL RELAY CONTROL
31	K6 18VT/WT	5 VOLT SUPPLY
32	-	-



POWERTRAIN CONTROL MODULE C3 (DIESEL)

POWERTRAIN CONTROL MODULE - C3 (DIESEL) - 32 WAY

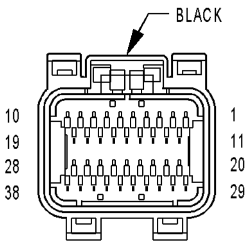
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	-	-
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	V32 18YL/RD	SPEED CONTROL SUPPLY
12	T16 14RD	TRANSMISSION CONTROL RELAY OUTPUT
13	T6 18OR/WT	OVERDRIVE OFF SWITCH SENSE
14	-	-
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	K29 18WT/PK	BRAKE SWITCH SENSE
25	-	-
26	-	-
27	D15 18WT/DG	SCI TRANSMIT
28	-	-
29	D6 18PK/LB	SCI RECEIVE
30	D25 18VT/BR	PCI BUS
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL



POWERTRAIN CONTROL MODULE C1 (JTEC)

POWERTRAIN CONTROL MODULE C1 (JTEC) - BLACK 32 WAY

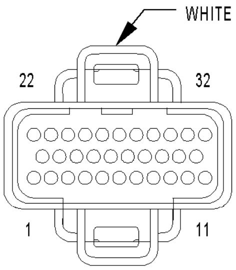
CAV	CIRCUIT	FUNCTION
1	K93 18TN/OR (3.7L)	COIL DRIVER NO. 3
1	K18 18RD/YL (8.0L)	IGNITION COIL NO.1 DRIVER
2	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	K94 18TN/LG (3.7L)	COIL DRIVER NO. 4
3	K32 18YL/GY (8.0L)	IGNITION COIL NO.4 DRIVER
4	K4 18BK/LB	SENSOR GROUND
5	K96 18TN/LB (3.7L)	COIL DRIVER NO. 6
5	K43 18DG/GY (8.0L)	IGNITION COIL NO.5 DRIVER
6	T24 18BR/YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
7	K91 18TN/RD (3.7L)	COIL DRIVER NO. 1
7	K19 18BK/GY (5.9L/8.0L)	IGNITION COIL NO. 1 DRIVER
8	K24 18GY/BK	CRANKSHAFT POSITION SENSOR SIGNAL
9	K98 18LB/RD (4.7L)	COIL DRIVER NO. 8
9	K17 18DB/TN (8.0L)	IGNITION COIL NO. 2 DRIVER
10	K39 18GY/RD	IDLE AIR CONTROL NO. 3 DRIVER
11	K60 18YL/BK	IDLE AIR CONTROL NO. 2 DRIVER
12	S28 18YL/BK (3.7L)	POWER STEERING PRESSURE SWITCH SIGNAL
13	G113 18OR (5.9L)	PTO SWITCH SENSE
13	A41 14YL (3.7L)	FUSED IGNITION SWITCH OUTPUT (RUN-START)
14	K77 18BR/WT (5.9L) (MANUAL TRANSFER CASE)	TRANSFER CASE POSITION SENSOR INPUT
15	K21 18BK/RD	INTAKE AIR TEMPERATURE SENSOR SIGNAL
16	K2 18TN/BK	ENGINE COOLANT TEMPERATURE SENSOR SIGNAL
17	K7 18OR	5 VOLT SUPPLY
18	K44 18TN/YL	CAMSHAFT POSITION SENSOR SIGNAL
19	K59 18VT/BK	IDLE AIR CONTROL NO. 4 DRIVER
20	K40 18BR/WT	IDLE AIR CONTROL NO. 1 DRIVER
21	K95 18TN/DG (3.7L)	COIL DRIVER NO. 5
22	A14 18RD/WT	FUSED B(+)
23	K22 18OR/DB	THROTTLE POSITION SENSOR SIGNAL
24	K41 18BK/DG	OXYGEN SENSOR 1/1 SIGNAL
25	K141 18TN/WT	OXYGEN SENSOR 1/2 SIGNAL
26	K241 18LG/RD (CALIFORNIA)	OXYGEN SENSOR 2/1 SIGNAL
27	K1 18DG/RD	MANIFOLD ABSOLUTE PRESSURE SENSOR SIGNAL
28	-	-
29	K341 18TN/WT (CALIFORNIA)	OXYGEN SENOR 2/2 SIGNAL
30	-	-
31	Z82 14BK/TN	GROUND
32	Z81 14BK/TN	GROUND



POWERTRAIN CONTROL MODULE C1 (NGC)

POWERTRAIN CONTROL MODULE C1 (NGC) - BLACK 38 WAY

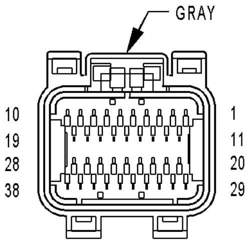
CAV	CIRCUIT	FUNCTION
1	K98 18LB/RD	COIL CONTROL NO.8
2	-	-
3	K97 18BR	COIL CONTROL NO.7
4	K28 18GY/LB	INJECTOR CONTROL NO.8
5	K26 18VT/TN	INJECTOR CONTROL NO.7
6	-	-
7	-	-
8	B222 20DG/WT (5.7L)	VEHICLE SPEED SIGNAL NO. 2
9	Z81 16BK/TN	GROUND
10	-	-
11	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT
12	A51 16RD/WT (4.7)	FUSED IGNITION SWITCH OUTPUT (OFF-RUN-START)
12	Y135 LG/BK (5.7)	FUSED IGNITION SWITCH OUTPUT
13	B22 20DG/YL (5.7L)	VEHICLE SPEED SIGNAL NO.1
13	G7 18WT/OR (4.7L)	VEHICLE SPEED SIGNAL
14	-	-
15	-	-
16	-	-
17	-	-
18	Z82 16BK/TN	GROUND
19	-	-
20	G60 18GY/YL	OIL PRESSURE SIGNAL
21	C18 18DB	A/C PRESSURE SIGNAL
22	G31 18VT/LG	AAT SIGNAL
23	-	-
24	-	-
25	D20 18LG	SCI RECEIVE (PCM)
26	D6 18PK/LB	SCI RECEIVE (TCM)
27	K6 18VT/WT (4.7L)	5-VOLT SUPPLY
28	-	-
29	A14 20RD/WT	FUSED B+
30	A41 16YL	FUSED IGNITION SWITCH OUTPUT
31	K141 18TN/WT	O2 1/2 SIGNAL
32	Y213 18PK/LB	O2 RETURN UPSTREAM
33	K341 18TN/WT (4.7L)	O2 2/2 SIGNAL
34	-	-
35	-	-
36	D21 18PK	SCI TRANSMIT (PCM)
37	D15 18WT/DG (4.7L)	SCI TRANSMIT (TCM)
38	D25 20VT/BR	PCI BUS



POWERTRAIN CONTROL MODULE C2 (JTEC)

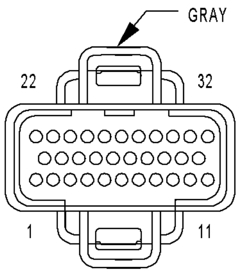
POWERTRAIN CONTROL MODULE C2 (JTEC) - WHITE 32 WAY

CAV	CIRCUIT	FUNCTION
1	T54 18VT (5.9L/8.0L)	TRANSMISSION TEMPERATURE SENSOR SIGNAL
2	K26 18VT/TN (5.9L/8.0L)	FUEL INJECTOR NO. 7 DRIVER
3	K115 18TN (8.0L)	FUEL INJECTOR NO.9 DRIVER
4	K11 18WT/DB	FUEL INJECTOR NO. 1 DRIVER
5	K13 18YL/WT	FUEL INJECTOR NO. 3 DRIVER
6	K38 18GY	FUEL INJECTOR NO. 5 DRIVER
7	K97 18BR (4.7L)	COIL DRIVER NO. 7
8	K88 18VT/WT (5.9L)	GOVERNOR PRESSURE SOLENOID CONTROL
9	K92 18TN/PK (3.7L)	COIL DRIVER NO. 2
10	K20 18DG	GENERATOR FIELD
11	K54 18OR/BK (5.9L)	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
12	K58 18BR/DB	FUEL INJECTOR NO. 6 DRIVER
13	K28 18GY/LB (5.9L/8.0L)	FUEL INJECTOR NO. 8 DRIVER
14	K116 18WT/DB (8.0L)	FUEL INJECTOR NO.10 DRIVER
15	K12 18TN	FUEL INJECTOR NO. 2 DRIVER
16	K14 18LB/BR	FUEL INJECTOR NO. 4 DRIVER
17	Y145 18DB/YL	CONDENSER FAN RELAY CONTROL
18	-	-
19	C18 18DB	A/C PRESSURE SIGNAL
20	-	-
21	T60 18BR (5.9L/8.0L)	3-4 SHIFT SOLENOID CONTROL
22	-	-
23	G60 18GY/YL	ENGINE OIL PRESSURE SENSOR SIGNAL
24	-	-
25	T13 18DB/BK (5.9L8.0L)	SPEED SENSOR GROUND
26	-	-
27	G7 18WT/OR	VEHICLE SPEED SIGNAL
28	T14 18LG/WT (5.9L/8.0L)	OUTPUT SPEED SENSOR SIGNAL
29	T25 18LG/RD (5.9L/8.0L)	GOVERNOR PRESSURE SENSOR SIGNAL
30	K30 18PK (5.9L/8.0L)	TRANSMISSION CONTROL RELAY CONTROL
31	K6 18VT/WT	5 VOLT SUPPLY
32	-	-



POWERTRAIN CONTROL MODULE C2 (NGC) - GRAY 38 WAY

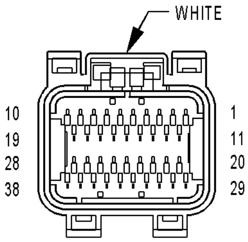
CAV	CIRCUIT	FUNCTION
1	K96 18TN/LB	COIL CONTROL NO.6
2	K95 18TN/DG	COIL CONTROL NO.5
3	K94 18TN/LG	COIL CONTROL NO.4
4	K58 18BR/DB	INJECTOR CONTROL NO.6
5	K38 18GY	INJECTOR CONTROL NO.5
6	F888 18BR/PK (5.7L)	ETC MOTOR (+) CONTROL
7	K93 18TN/OR	COIL CONTROL NO.3
8	-	-
9	K92 18TN/PK	COIL CONTROL NO.3
10	K91 18TN/RD	COIL CONTROL NO.1
11	K14 18LB/BR	INJECTOR CONTROL NO.4
12	K13 18YL/WT	INJECTOR CONTROL NO.3
13	K12 18TN	INJECTOR CONTROL NO.2
14	K11 18WT/DB	INJECTOR CONTROL NO.1
15	K101 18WT (5.7L)	TP SENSOR RETURN
16	-	-
17	K299 18BR/WT (4.7L)	O2 2/1 HEATER CONTROL
18	K41 18DK/DG	O2 1/1 HEATER CONTROL
19	K20 18DG	GEN FIELD CONTROL
20	K2 18TN/BK	ECT SIGNAL
21	K22 18OR/DB	TP NO.1 SIGNAL
22	-	-
23	K1 18DG/RD	MAP SIGNAL
24	Y205 18BR/WT (5.7L)	KNOCK SENSOR NO.1 RETURN
25	K73 18YL/BK (5.7L)	KNOCK SENSOR NO. 1 SIGNAL
26	K77 18BR/WT	TRANSFER CASE POSITION SENSOR INPUT
27	K4 18BK/LB	SENSOR GROUND
28	K60 18YL/BK (4.7L)	IAC SIGNAL
28	K122 18DB/GY (5.7L)	TP NO.2 SIGNAL
29	K7 18OR	5 VOLT SUPPLY
30	K21 18BK/RD	IAT SIGNAL
31	K99 18BR/OR	O2 1/1 SIGNAL
32	K902 18BR/DG	O2 RETURN DOWNSTREAM
33	K241 18LG/RD (4.7L)	O2 2/1 SIGNAL
34	K44 18TN/YL	CMP SIGNAL
35	K24 18GY/BK	CKP SIGNAL
36	K74 18BR/VT (5.7L)	KNOCK SENSOR NO. 2 SIGNAL
37	Y206 18DB/VT (5.7L)	KNOCK SENSOR NO.2 RETURN
38	K39 18GY/RD	IAC CONTROL
38	F855 18OR/PK (5.7L)	ETC MOTOR (-) CONTROL



POWERTRAIN CONTROL MODULE C3 (JTEC)

POWERTRAIN CONTROL MODULE C3 (JTEC) - GRAY 32 WAY

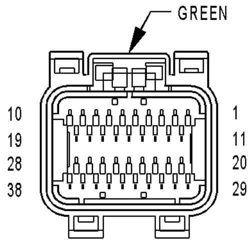
CAV	CIRCUIT	FUNCTION
1	C13 18DB/OR	A/C CLUTCH RELAY CONTROL
2	-	-
3	K51 18DB/YL	AUTO SHUT DOWN RELAY CONTROL
4	V36 18TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
5	V35 18LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
6	-	-
7	K73 18YL/BK (3.7L)	KNOCK SENSOR NO. 1 SIGNAL
8	K199 18BR/VT	OXYGEN SENSOR 1/1 HEATER CONTROL
9	K127 18DB/OR	OXYGEN SENSOR DOWNSTREAM RELAY CONTROL
10	K106 18WT/DG	LEAK DETECTION PUMP SWITCH SENSE
11	V32 18YL/RD	SPEED CONTROL SUPPLY
12	A142 16DG/OR	AUTO SHUT DOWN RELAY OUTPUT
13	T6 18OR/WT (5.9L)	OVERDRIVE OFF SWITCH SENSE
13	T10 18YL/DG (5.9L DIESEL)	TORQUE MANAGEMENT REQUEST SENSE
14	K107 18OR	LEAK DETECTION PUMP SOLENOID CONTROL
15	K118 18PK/YL	BATTERY TEMPERATURE SENSOR SIGNAL
16	K299 18BR/WT (CALIFORNIA)	OXYGEN SENSOR 2/1 HEATER CONTROL
16	K299 18BR/WT (EXCEPT CALIFORNIA)	OXYGEN SENSOR 1/2 HEATER CONTROL
17	-	-
18	K74 18BR/VT (3.7L)	KNOCK SENSOR NO. 2 SIGNAL
19	K31 18BR	FUEL PUMP RELAY CONTROL
20	K52 18PK/BK	EVAPORATIVE EMISSION SOLENOID CONTROL
21	-	-
22	-	-
23	-	-
24	K29 18WT/PK	BRAKE SWITCH SENSE
25	K125 18WT/DB	GENERATOR SOURCE
26	G8 18LB/BK	FUEL LEVEL SENSOR SIGNAL
27	D21 18PK	SCI TRANSMIT
28	-	-
29	D20 18LG	SCI RECEIVE
30	D25 18VT/BR	PCI BUS
31	-	-
32	V37 18RD/LG	SPEED CONTROL SWITCH SIGNAL



POWERTRAIN CONTROL MODULE C3 (NGC)

POWERTRAIN CONTROL MODULE C3 (NGC) - WHITE 38 WAY

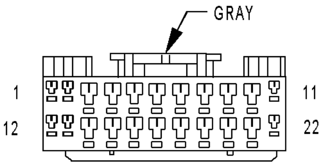
CAV	CIRCUIT	FUNCTION
1	-	-
2	-	-
3	K51 20DB.YL	ASD RELAY CONTROL
4	-	-
5	V35 18LG/RD (4.7L)	S/C VENT CONTROL
6	Y145 20DB/YL	CONDENSER FAN RELAY CONTROL
7	V32 20YL/RD (4.7L)	S/C POWER SUPPLY
8	K106 18WT/DG (4.7L)	NVLD SOLENOID CONTROL
9	K199 18BR/VT	O2 1/2 HEATER CONTROL
10	K399 18BR/GY (4.7L)	O2 2/2 HEATER CONTROL
11	C13 20DB/OR	A/C CLUTCH RELAY CONTROL
12	V36 18TN/RD (4.7L)	S/C VACUUM CONTROL
13	-	-
14	V32 20YL/RD (5.7L)	BRAKE SWITCH NO.2 SIGNAL
15	Y215 20YL/PK (5.7L)	S/C SWITCH RETURN
16	K223 18PK/DB (5.7L)	APPS NO.1 RETURN
17	K981 18BR/DG (5.7L)	APPS NO.2 RETURN
18	V38 20VT/OR (5.7L)	S/C SWITCH NO.2 SIGNAL
19	A142 16DG/OR	ASD RELAY OUTPUT
20	K108 18WT/TN	EVAP PURGE SOL SIGNAL
21	T24 20BR/YL	TRS T24 SENSE (P/N SENSE)
22	G113 18OR	PTO SWITCH SENSE
23	K29 18WT/PK	BRAKE SWITCH SIGNAL
24	-	-
25	K255 18WT/DG (5.7L)	APPS NO.1 SIGNAL
26	-	-
27	-	-
28	A142 16DG/OR	ASD RELAY OUTPUT
29	K52 18PK/BK	EVAP PURGE SOL CONTROL
30	S28 18YL/BK	P/S SWITCH SIGNAL
31	-	-
32	K118 18PK/YL	BATT TEMP SIGNAL
33	G8 18LB/BK	FUEL LEVEL SIGNAL
34	V37 18RD/LG	S/C SWITCH NO.1 SIGNAL
35	K107 18OR	NVLD SWITCH SIGNAL
36	K81 18DB/DG (5.7L)	APPS NO.2 SIGNAL
37	K31 18BR	FUEL PUMP RELAY CONTROL
38	T752 18DG/OR	STARTER RELAY CONTROL



POWERTRAIN CONTROL MODULE C4 (NGC)

POWERTRAIN CONTROL MODULE C4 (NGC) - GREEN 38 WAY

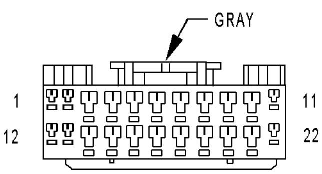
CAV	CIRCUIT	FUNCTION
1	T60 18BR (4.7L)	OVERDRIVE SOLENOID CONTROL
2	T159 18DG/WT (4.7L)	4C SOLENOID CONTROL
3	Y207 18RD/WT (5.7L)	TPS NO. 1 OUTPUT
4	T140 18VT/LG (4.7L)	PRESSURE CONTROL SOLENOID CONTROL
5	Y208 18DB/YL (5.7L)	APPS NO. 1 OUTPUT
6	T119 18WT/DB (4.7L)	2C SOLENOID CONTROL
7	T10 18YL/DG (5.7L)	TORQUE MANAGEMENT REQUEST SENSE
8	T59 18PK (4.7L)	UNDERDRIVE SOLENOID CONTROL
9	Y209 18TN/BK (5.7L)	SENSOR GROUND
10	T120 18LG (4.7L)	LR SOLENOID CONTROL
11	T118 18YL/DB (4.7L)	PRESSURE CONTROL SOLENOID CONTROL
11	Y210 18YL/RD (5.7L EATX)	RPM SIGNAL
12	Z13 16BK/RD (4.7L)	GROUND
13	Z13 16BK/RD (4.7L)	GROUND
14	Z13 16BK/RD (4.7L)	GROUND
15	T1 18LG/BK (4.7L)	TRS T1 SENSE
16	T3 18VT (4.7L)	TRS T3 SENSE
17	T6 18OR/WT (4.7L)	OVERDRIVE OFF SWITCH SENSE
18	K30 18PK (4.7L)	TRANSMISSION CONTROL RELAY CONTROL
19	T16 16RD (4.7L)	TRANSMISSION CONTROL RELAY OUTPUT
20	T48 18DB (4.7L)	4C PRESSURE SWITCH SENSE
21	T29 18GY (4.7L)	UNDERDRIVE PRESSURE SWITCH SENSE
22	T9 18OR/BK (4.7L)	OVERDRIVE PRESSURE SWITCH SENSE
23	-	-
24	-	-
25	-	-
26	T4 18PK/OR (4.7L)	TRS T2 SENSE
27	-	-
28	T16 16RD (4.7L)	TRANSMISSION CONTROL RELAY OUTPUT
29	T50 18DG (4.7L)	LOW/REVERSE PRESSURE SWITCH SENSE
30	T147 18LB (4.7L)	2C PRESSURE SWITCH SENSE
31	T38 18VT/TN (4.7L)	LINE PRESSURE SENSOR SIGNAL
32	T14 18LG/WT (4.7L)	OUTPUT SPEED SENSOR SIGNAL
33	T52 18RD/BK (4.7L)	INPUT SPEED SENSOR SIGNAL
34	T13 18DB/BK (4.7L)	SPEED SENSOR GROUND
35	T54 18VT (4.7L)	TRANSMISSION TEMPERATURE SENSOR SIGNAL
36	-	-
37	T42 18VT/WT (4.7L)	TRS T42 SENSE
38	T16 16RD (4.7L)	TRANSMISSION CONTROL RELAY OUTPUT



RADIO
(BASE)

RADIO (BASE) - GRAY 22 WAY

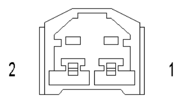
CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B(+)
2	Y105 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
3	Y166 20OR/DB	PANEL LAMPS DRIVER
4	-	-
5	-	-
6	-	-
7	X82 18LB/VT	RIGHT FRONT DOOR SPEAKER (+)
8	X80 18LB/BK	RIGHT FRONT DOOR SPEAKER (-)
9	X85 18LG/DG	LEFT FRONT DOOR SPEAKER (-)
10	X87 18LG/RD	LEFT FRONT DOOR SPEAKER (+)
11	Z9 18BK/DG	GROUND
12	M1 18PK	FUSED B(+)
13	-	-
14	D25 20VT/LB	PCI BUS
15	-	-
16	-	-
17	-	-
18	X93 18WT/RD	LEFT REAR SPEAKER (+)
19	X91 18WT/BK	LEFT REAR SPEAKER (-)
20	X92 18TN/BK	RIGHT REAR SPEAKER (-)
21	X94 18TN/VT	RIGHT REAR SPEAKER (+)
22	Z9 18BK/DG	GROUND



RADIO
(PREMIUM)

RADIO (PREMIUM) - GRAY 22 WAY

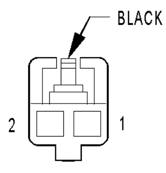
CAV	CIRCUIT	FUNCTION
1	M1 18PK	FUSED B(+)
2	Y105 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
3	Y166 20OR/DB	PANEL LAMPS DRIVER
4	-	-
5	-	-
6	-	-
7	X54 20VT	RIGHT FRONT SPEAKER (+)
8	X56 20DB/RD	RIGHT FRONT SPEAKER (-)
9	X55 20BR/RD	LEFT FRONT SPEAKER (-)
10	X53 20DG	LEFT FRONT SPEAKER (+)
11	Z9 18BK/DG	GROUND
12	M1 18PK	FUSED B(+)
13	X60 20DG/RD	RADIO 12V OUTPUT
14	D25 20VT/LB	PCI BUS
15	-	-
16	-	-
17	-	-
18	X51 20BR/YL	LEFT REAR SPEAKER (+)
19	X57 20BR/LB	LEFT REAR SPEAKER (-)
20	X58 20DB/OR	RIGHT REAR SPEAKER (-)
21	X52 20DB/WT	RIGHT REAR SPEAKER (+)
22	Z9 18BK/DG	GROUND



RECIRCULATION DOOR ACTUATOR

RECIRCULATION DOOR ACTUATOR - 2 WAY

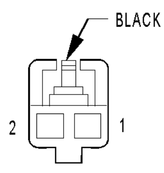
CAV	CIRCUIT	FUNCTION
1	C34 20DB/WT	COMMON DOOR DRIVER
2	C32 20GY/DB	RECIRCULATION DOOR DRIVER



REMOTE RADIO SWITCH-LEFT

REMOTE RADIO SWITCH-LEFT - BLACK 2 WAY

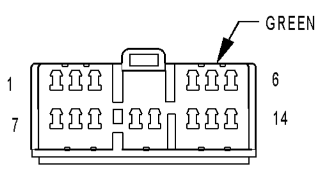
CAV	CIRCUIT	FUNCTION
1	X20 22GY (EXCEPT ETC)	RADIO CONTROL MUX
1	X20 22RD/BK (ETC)	RADIO CONTROL MUX
2	Z5 22BK/LB	GROUND



REMOTE RADIO SWITCH-RIGHT

REMOTE RADIO SWITCH-RIGHT - BLACK 2 WAY

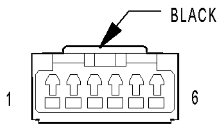
CAV	CIRCUIT	FUNCTION
1	X20 22GY (EXCEPT ETC)	RADIO CONTROL MUX
1	X20 22RD/BK (ETC)	RADIO CONTROL MUX
2	Z5 22BK/LB	GROUND



SEAT HEATER INTERFACE MODULE

SEAT HEATER INTERFACE MODULE - GREEN 14 WAY

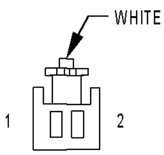
CAV	CIRCUIT	FUNCTION
1	P133 20TN/DG	DRIVER SEAT HEATER MUX SWITCH
2	P86 20PK/BK	SEAT HEATER DRIVER
3	P142 18TN/DB	PASSENGER SEAT TEMPERATURE SENSOR INPUT
4	F235 18RD	FUSED B(+)
5	P141 18TN/LB	DRIVER SEAT TEMPERATURE SENSOR INPUT
6	F235 18RD	FUSED B(+)
7	P144 20BK/LG	PASSENGER SEAT TEMPERATURE 5 VOLT SUPPLY
8	P143 20BK/DG	DRIVER SEAT TEMPERATURE 5 VOLT SUPPLY
9	P134 20TN/LG	PASSENGER SEAT HEATER MUX SWITCH
10	P138 20VT/LG	PASSENGER SEAT LOW HEAT LED DRIVER
11	P140 20VT/BK	PASSENGER SEAT HIGH HEAT LED DRIVER
12	P137 20VT/DG	DRIVER SEAT LOW HEAT LED DRIVER
13	Z121 20BK/LG	GROUND
14	P139 20VT/WT	DRIVER SEAT HIGH HEAT LED DRIVER



SENTRY KEY IMMOBILIZER MODULE

SENTRY KEY IMMOBILIZER MODULE - BLACK 6 WAY

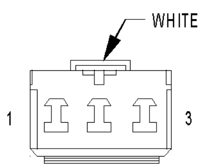
CAV	CIRCUIT	FUNCTION
1	-	-
2	D25 20VT/WT	PCI BUS
3	-	-
4	Y135 20LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
5	Z110 20BK/GY	GROUND
6	A14 20RD/WT	FUSED B(+)



SPEAKER-CENTER INSTRUMENT PANEL

SPEAKER-CENTER INSTRUMENT PANEL - WHITE 2 WAY

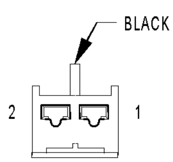
CAV	CIRCUIT	FUNCTION
1	X83 20YL/RD	LEFT INSTRUMENT PANEL SPEAKER (-)
2	X84 20OR/BK	RIGHT INSTRUMENT PANEL SPEAKER (+)



SPEAKER-LEFT FRONT DOOR

SPEAKER-LEFT FRONT DOOR - WHITE 3 WAY

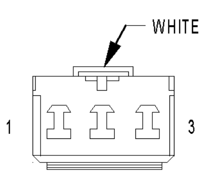
CAV	CIRCUIT	FUNCTION
1	X85 18LG/DG	LEFT FRONT DOOR SPEAKER (-)
2	-	-
3	X87 18LG/RD	LEFT FRONT DOOR SPEAKER (+)



SPEAKER-LEFT INSTRUMENT PANEL

SPEAKER-LEFT INSTRUMENT PANEL - BLACK 2 WAY

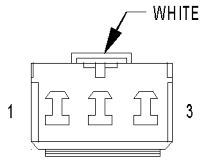
CAV	CIRCUIT	FUNCTION
1	X81 18YL/BK	LEFT INSTRUMENT PANEL SPEAKER (+)
2	X83 18YL/RD	LEFT INSTRUMENT PANEL SPEAKER (-)



SPEAKER-LEFT REAR

SPEAKER-LEFT REAR - WHITE 3 WAY

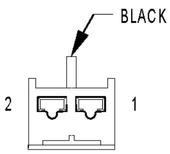
CAV	CIRCUIT	FUNCTION
1	X93 18WT/RD	LEFT REAR SPEAKER (+)
2	-	-
3	X91 18WT/BK	LEFT REAR SPEAKER (-)



SPEAKER-
RIGHT FRONT
DOOR

SPEAKER-RIGHT FRONT DOOR - WHITE 3 WAY

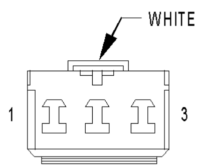
CAV	CIRCUIT	FUNCTION
1	X80 18LB/BK	RIGHT FRONT DOOR SPEAKER (-)
2	-	-
3	X82 18LB/VT	RIGHT FRONT DOOR SPEAKER (+)



SPEAKER-
RIGHT INSTRUMENT
PANEL

SPEAKER-RIGHT INSTRUMENT PANEL - BLACK 2 WAY

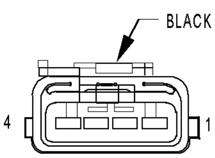
CAV	CIRCUIT	FUNCTION
1	X84 18OR/BK	RIGHT INSTRUMENT PANEL SPEAKER (+)
2	X86 18OR/RD	RIGHT INSTRUMENT PANEL SPEAKER (-)



SPEAKER-RIGHT
REAR

SPEAKER-RIGHT REAR - WHITE 3 WAY

CAV	CIRCUIT	FUNCTION
1	X94 18TN/VT	RIGHT REAR SPEAKER (+)
2	-	-
3	X92 18TN/BK	RIGHT REAR SPEAKER (-)



SPEED
CONTROL SERVO

SPEED CONTROL SERVO - BLACK 4 WAY

CAV	CIRCUIT	FUNCTION
1	V36 20TN/RD	SPEED CONTROL VACUUM SOLENOID CONTROL
1	V36 20TN/RD (NGC)	S/C VACUUM CONTROL
2	V35 20LG/RD (NGC)	S/C VENT CONTROL
2	V35 20LG/RD	SPEED CONTROL VENT SOLENOID CONTROL
3	V30 20DB/RD	SPEED CONTROL BRAKE SWITCH OUTPUT
3	V30 20DB/RD (NGC)	S/C BRAKE SWITCH OUTPUT
4	Z10 20BK/TN	GROUND

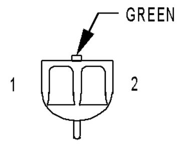
PICTURE

NOT

AVAILABLE

SPEED CONTROL SWITCH-LEFT (ETC) - WHITE 3 WAY

CAV	CIRCUIT	FUNCTION
1	V38 20VT/OR	S/C SWITCH NO.2 SIGNAL
2	Y215 20BK/LB	S/C SWITCH RETURN
3	V37 20RD/LG	S/C SWITCH NO.1 SIGNAL



SPEED CONTROL SWITCH-LEFT (EXCEPT ETC)

SPEED CONTROL SWITCH-LEFT (EXCEPT ETC) - GREEN 2 WAY

CAV	CIRCUIT	FUNCTION
A	V37 20RD/LG	S/C SWITCH NO.1 SIGNAL
B	K4 20BK/LB	SENSOR GROUND

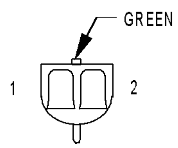
PICTURE

NOT

AVAILABLE

SPEED CONTROL SWITCH-RIGHT (ETC) - WHITE 3 WAY

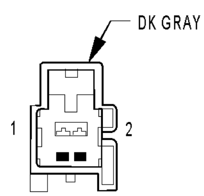
CAV	CIRCUIT	FUNCTION
1	V38 20VT/OR	S/C SWITCH NO.2 SIGNAL
2	Y215 20BK/LB	S/C SWITCH RETURN
3	V37 20RD/LG	S/C SWITCH NO.1 SIGNAL



SPEED CONTROL SWITCH-RIGHT (EXCEPT ETC)

SPEED CONTROL SWITCH-RIGHT (EXCEPT ETC) - GREEN 2 WAY

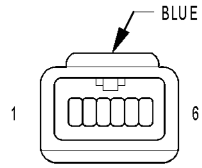
CAV	CIRCUIT	FUNCTION
A	V37 20RD/LG	S/C SWITCH NO.1 SIGNAL
B	K4 20BK/LB	SENSOR GROUND



SWITCH-DRIVER SEAT BELT

SWITCH-DRIVER SEAT BELT - DK GRAY 2 WAY

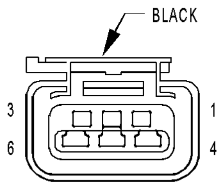
CAV	CIRCUIT	FUNCTION
1	Z237 20BK/OR	GROUND
2	G10 20LG/RD	SEAT BELT SWITCH SENSE



SWITCH-PASSENGER AIRBAG ON-OFF

SWITCH-PASSENGER AIRBAG ON-OFF - BLUE 6 WAY

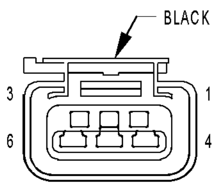
CAV	CIRCUIT	FUNCTION
1	R5 18VT/YL	PASSENGER AIRBAG MUX SWITCH SENSE
2	R4 18BR/YL	PASSENGER AIRBAG MUX SWITCH RETURN
3	R166 18LG/TN	PASSENGER AIRBAG INDICATOR DRIVER
4	F14 18LG/YL	FUSED IGNITION SWITCH OUTPUT (RUN-START)
5	-	-
6	-	-



TAIL/STOP/ TURN SIGNAL LAMP-LEFT

TAIL/STOP/TURN SIGNAL LAMP-LEFT - BLACK 6 WAY

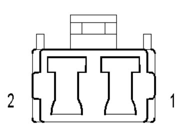
CAV	CIRCUIT	FUNCTION
1	Y174 18PK/VT	FUSED PARK LAMP RELAY OUTPUT
2	-	-
3	Z150 18BK	GROUND
4	L24 18WT/LG	LEFT STOP LAMP FEED
5	L63 18DG/RD	LEFT REAR TURN LAMP DRIVER
6	L1 18VT/BK	BACK-UP LAMP FEED



TAIL/STOP/ TURN SIGNAL LAMP-RIGHT

TAIL/STOP/TURN SIGNAL LAMP-RIGHT - BLACK 6 WAY

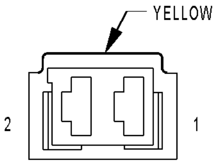
CAV	CIRCUIT	FUNCTION
1	L7 18PK/VT	HEADLAMP SWITCH OUTPUT
2	-	-
3	Z151 18BK	GROUND
4	L22 18WT/LG	RIGHT STOP LAMP FEED
5	L62 18DG/RD	RIGHT REAR TURN LAMP DRIVER
6	L1 18VT/BK	BACK-UP LAMP FEED



TENSION REDUCER- SEAT BELT (STANDARD CAB)

TENSION REDUCER-SEAT BELT (STANDARD CAB) - 2 WAY

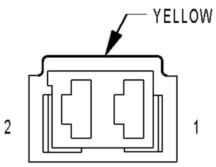
CAV	CIRCUIT	FUNCTION
1	Y105 20BR/RD	FUSED IGNITION SWITCH OUTPUT (RUN-ACC)
2	G10 20LG/RD	SEAT BELT SWITCH SENSE



TENSIONER-
LEFT SEAT BELT

TENSIONER-LEFT SEAT BELT - YELLOW 2 WAY

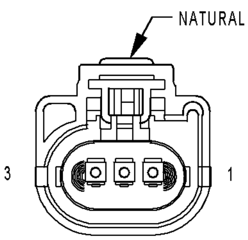
CAV	CIRCUIT	FUNCTION
1	R54 18LB/YL	LEFT SEAT BELT TENSIONER LINE 2
2	R56 18LB/DG	LEFT SEAT BELT TENSIONER LINE 1



TENSIONER-
RIGHT SEAT BELT

TENSIONER-RIGHT SEAT BELT - YELLOW 2 WAY

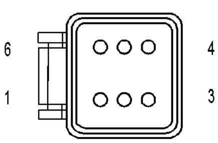
CAV	CIRCUIT	FUNCTION
1	R53 18LG/YL	RIGHT SEAT BELT TENSIONER LINE 2
2	R55 18LG/DG	RIGHT SEAT BELT TENSIONER LINE 1



THROTTLE
POSITION SENSOR

THROTTLE POSITION SENSOR - NATURAL 3 WAY

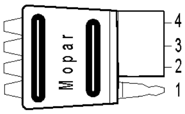
CAV	CIRCUIT	FUNCTION
1	K7 18OR	5 VOLT SUPPLY
2	K22 18OR/DB (4.7L/5.9L)	TP NO.1 SIGNAL
2	K4 18BK/LB (3.7L)	SENSOR GROUND
3	K4 18BK/LB (4.7L/5.9L)	SENSOR GROUND
3	K22 18OR/DB (3.7L)	TP NO.1 SIGNAL



THROTTLE
POSITION
SENSOR
(DIESEL)

THROTTLE POSITION SENSOR (DIESEL) - 6 WAY

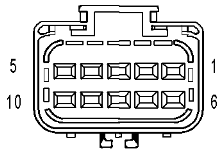
CAV	CIRCUIT	FUNCTION
1	K104 18RD/WT	SENSOR GROUND
2	K101 18WT	THROTTLE POSITION SENSOR RETURN
3	K232 18YL	THROTTLE POSITION SIGNAL
4	K56 18LG/OR	SUPPLY VOLTAGE
5	K900 18DB/DG	SENSOR GROUND
6	K49 18VT/BK	No Function Defined



TRAILER TOW CONNECTOR

TRAILER TOW CONNECTOR - 4 WAY

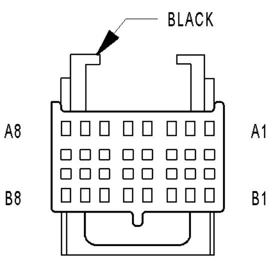
CAV	CIRCUIT	FUNCTION
1	Z52 14BK	GROUND
2	L76 18BK/OR	PARK LAMP RELAY OUTPUT
3	Y141 18YL/PK	TRAILER TOW LEFT TURN RELAY OUTPUT
4	Y140 18WT/PK	TRAILER TOW RIGHT TURN RELAY OUTPUT



TRAILER TOW CONNECTOR-ADD ON

TRAILER TOW CONNECTOR-ADD ON - 10 WAY

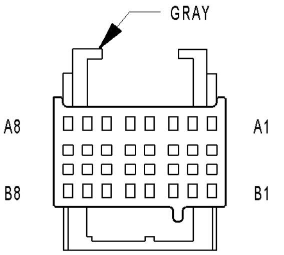
CAV	CIRCUIT	FUNCTION
1	-	-
2	Y140 18WT/PK	TRAILER TOW RIGHT TURN RELAY OUTPUT
3	L1 18VT/BK	BACKUP LAMP FEED
4	Y133 14WT/RD	FUSED B(+)
5	L76 18BK/OR	PARK LAMP RELAY OUTPUT
6	-	-
7	B40 14LB	TRAILER TOW BRAKE B(+)
8	Z52 14BK	GROUND
9	Z52 14BK	GROUND
10	Y141 18YL/PK	TRAILER TOW LEFT TURN RELAY OUTPUT



TRANSFER CASE CONTROL MODULE C1

TRANSFER CASE CONTROL MODULE C1 - BLACK 16 WAY

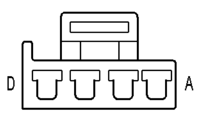
CAV	CIRCUIT	FUNCTION
A1	D25 20VT/DB	PCI BUS
A2	-	-
A3	-	-
A4	Y122 20DG/BR	4WD LOW INDICATOR
A5	Y123 20DG/OR	4WD HIGH INDICATOR
A6	Y120 20YL/DG	MODE SELECT
A7	Y116 20YL/GY	MODE SENSOR GROUND
A8	Z366 18BK/RD	GROUND
B1	-	-
B2	-	-
B3	-	-
B4	Y121 20YL/LG	NEUTRAL INDICATOR
B5	Y187 20RD	2WD/AWD INDICATOR
B6	Y112 20YL/BR	MODE SENSOR D
B7	-	-
B8	Z114 20LG/BK	SENSOR GROUND



TRANSFER CASE CONTROL MODULE C2

TRANSFER CASE CONTROL MODULE C2 - GRAY 16 WAY

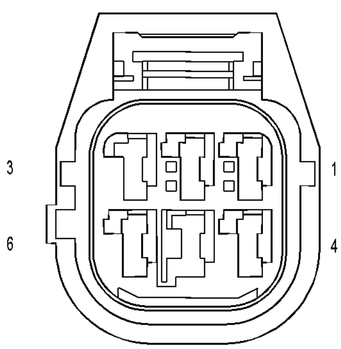
CAV	CIRCUIT	FUNCTION
A1	Y114 20YL/VT	MODE SENSOR B
A2	Y113 20YL/OR	MODE SENSOR A
A3	-	-
A4	-	-
A5	-	-
A6	T24 20BR/YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)
A7	-	-
A8	Y117 20YL/DB	5 VOLT MODE SENSOR SUPPLY
B1	-	-
B2	Y115 20YL/WT	MODE SENSOR C
B3	-	-
B4	-	-
B5	-	-
B6	-	-
B7	-	-
B8	Y118 20YL/LB	5 VOLT SELECTOR SWITCH SUPPLY



TRANSFER CASE CONTROL MODULE C3

TRANSFER CASE CONTROL MODULE C3 - 4 WAY

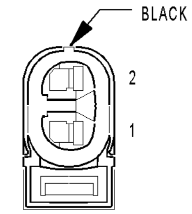
CAV	CIRCUIT	FUNCTION
A	Z21 16BK/LG	GROUND
B	A34 16LB/RD	FUSED B(+)
C	Y124 16DG/VT	SHIFT MOTOR CONTROL A
D	Y125 16DG/WT	SHIFT MOTOR CONTROL B



TRANSFER CASE MODE SENSOR

TRANSFER CASE MODE SENSOR - 6 WAY

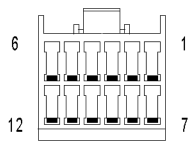
CAV	CIRCUIT	FUNCTION
1	Y112 20YL/BR	MODE SENSOR D
2	Y117 20YL/DB	5 VOLT MODE SENSOR SUPPLY
3	Y114 20YL/VT	MODE SENSOR B
4	Y116 20YL/GY	MODE SENSOR GROUND
5	Y113 20YL/OR	MODE SENSOR A
6	Y115 20 YL/WT	MODE SENSOR C



TRANSFER CASE POSITION SENSOR (4.7L/5.9L)

TRANSFER CASE POSITION SENSOR (4.7L/5.9L) - BLACK 2 WAY

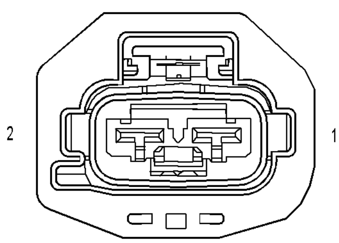
CAV	CIRCUIT	FUNCTION
1	K77 18BR/WT	TRANSFER CASE POSITION SENSOR INPUT
2	K4 18BK/LB	SENSOR GROUND



TRANSFER CASE SELECTOR SWITCH

TRANSFER CASE SELECTOR SWITCH - 12 WAY

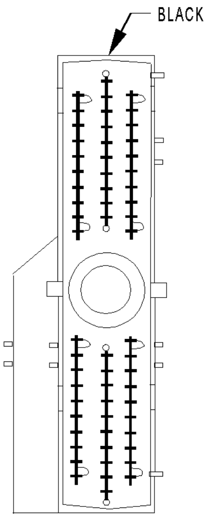
CAV	CIRCUIT	FUNCTION
1	Y118 20YL/LB	5 VOLT SELECTOR SWITCH SUPPLY
2	Y187 20RD	2WD/AWD INDICATOR
3	-	-
4	Y121 20YL/LG	NEUTRAL INDICATOR
5	Y120 20YL/DG	MODE SELECT
6	Y189 20OR/BK	PANEL LAMPS FEED
7	Y107 20VT/RD	FUSED IGNITION SWITCH OUTPUT (RUN)
8	Y122 20DG/BR	4WD LOW INDICATOR
9	Y123 20DG/OR	4WD HIGH INDICATOR
10	-	-
11	Z358 20BK/YL	MODE SELECTOR SWITCH GROUND
12	-	-



TRANSFER CASE SHIFT MOTOR

TRANSFER CASE SHIFT MOTOR - 2 WAY

CAV	CIRCUIT	FUNCTION
1	Y125 16DG/WT	SHIFT MOTOR CONTROL B
2	Y124 16DG/VT	SHIFT MOTOR CONTROL A



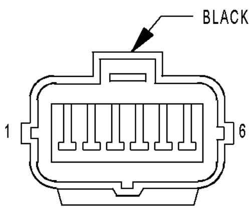
TRANSMISSION CONTROL MODULE

TRANSMISSION CONTROL MODULE - BLACK 60 WAY

CAV	CIRCUIT	FUNCTION
1	T1 18LG/BK	TRS T1 SENSE
2	T4 18PK/OR	TRS T2 SENSE
3	T3 18VT	TRS T3 SENSE
4	-	-
5	-	-
6	Y210 18YL/RD (5.7L)	EATX RPM SIGNAL
6	K24 18GY/BK (3.7L)	CRANKSHAFT POSITION SENSOR SIGNAL
7	D15 18WT/DG	SCI TRANSMIT (TCM)
8	A41 16YL	FUSED IGNITION SWITCH OUTPUT (START)
9	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
10	T10 18YL/DG	TORQUE MANAGEMENT REQUEST SENSE
11	A51 16RD/WT	FUSED IGNITION SWITCH OUTPUT (RUN-START)
12	Y208 18DB/YL (5.7L)	APPS NO.1 OUTPUT
12	K22 18OR/DB (3.7L)	THROTTLE POSITION SENSOR SIGNAL
13	T13 18DB/BK	SPEED SENSOR GROUND
14	T14 18LG/WT	OUTPUT SPEED SENSOR SIGNAL
15	K30 19PK	TRANSMISSION CONTROL RELAY CONTROL
16	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
17	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
18	T118 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
19	T119 18WT/DB	2C SOLENOID CONTROL
20	T120 18LG	LR SOLENOID CONTROL
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	-	-
28	B22 20DG/YL (5.7L)	VEHICLE SPEED SIGNAL
28	G7 18WT/OR (3.7L)	VEHICLE SPEED SIGNAL
29	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
30	T38 18VT/TN	LINE PRESSURE SENSOR SIGNAL
31	-	-
32	-	-
33	-	-
34	-	-
35	-	-
36	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
37	Z13 16BK/RD	GROUND
38	T39 18GY/LB	5 VOLT SUPPLY
39	Z13 16BK/RD	GROUND
40	T140 18VT/LG	MS SOLENOID CONTROL
41	T41 18BK/WT	TRS T41 SENSE(C1)
42	T42 18VT/WT	TRS T42 SENSE
43	D25 20VT/OR	PCI BUS
44	-	-
45	Y207 18RD/WT (5.7L)	TPS NO.1 OUTPUT
46	D6 18PK/LB	SCI TRANSMIT
47	T147 18LB	2C PRESSURE SWITCH SENSE
48	T48 18DB	4C PRESSURE SWITCH SENSE
49	T6 20OR/WT	OVERDRIVE OFF SWITCH SENSE
50	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
51	Y209 18TN/BK (5.7L)	SENSOR GROUND
51	K4 18BK/LB (3.7L)	SENSOR GROUND

TRANSMISSION CONTROL MODULE - BLACK 60 WAY

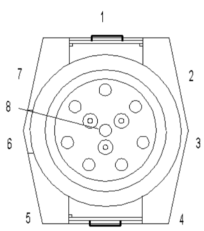
CAV	CIRCUIT	FUNCTION
52	T52 18RD/BK	INPUT SPEED SENSOR SIGNAL
53	Z113 18BK	GROUND
54	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL
55	T59 18PK	UNDERDRIVE SOLENOID CONTROL
56	A61 16DG/BK	FUSED B(+)
57	Z13 16BK/RD	GROUND
58	-	-
59	T159 18DG/WT	4C SOLENOID CONTROL
60	T60 18BR	OVERDRIVE SOLENOID CONTROL



TRANSMISSION RANGE SENSOR (5.9L/DIESEL)

TRANSMISSION RANGE SENSOR (5.9L/DIESEL) - BLACK 6 WAY

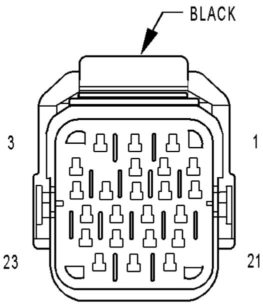
CAV	CIRCUIT	FUNCTION
1	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
2	Y193 20YL/RD	TRANS RANGE SENSOR ELECTRONIC CLUSTER MUX
3	-	-
4	L1 18VT/BK	BACKUP LAMP FEED
5	Y128 20DG/GY	TRANS RANGE SENSOR ELECTRONIC CLUSTER 5 VOLT SUPPLY
6	T24 20BR/YL	PARK/NEUTRAL POSITION SWITCH SENSE (T41)



TRANSMISSION SOLENOID ASSEMBLY (5.9L/8.0L)

TRANSMISSION SOLENOID ASSEMBLY (5.9L/8.0L) - 8 WAY

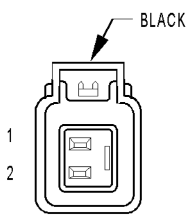
CAV	CIRCUIT	FUNCTION
1	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
2	K6 18VT/WT	5 VOLT SUPPLY
3	K4 18BK/LB	SENSOR GROUND
4	T25 18LG/RD	GOVERNOR PRESSURE SENSOR SIGNAL
5	K88 18VT/WT	GOVERNOR PRESSURE SOLENOID CONTROL
6	T60 18BR	3-4 SHIFT SOLENOID CONTROL
7	K54 18OR/BK	TORQUE CONVERTER CLUTCH SOLENOID CONTROL
8	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL



TRANSMISSION SOLENOID/TRS ASSEMBLY (3.7L/4.7L/5.7L)

TRANSMISSION SOLENOID/TRS ASSEMBLY (3.7L/4.7L/5.7L) - BLACK 23 WAY

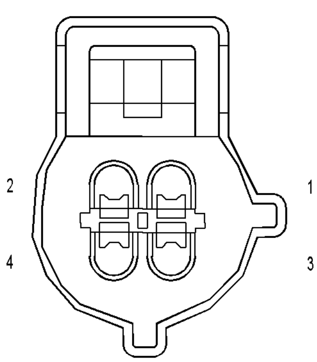
CAV	CIRCUIT	FUNCTION
1	L10 18BR/LG	FUSED IGNITION SWITCH OUTPUT (RUN)
2	T120 18LG	LR SOLENOID CONTROL
3	T24 18BR/YL	TRS T41 SENSE
4	T41 18BK/WT (5.7L)	TRS T41 SENSE
4	T24 20BR/YL (4.7L)	TRS T41 SENSE
5	T42 18VT/WT	TRS T42 SENSE
6	L1 18VT/BK	BACK-UP LAMP FEED
7	T60 18BR	OVERDRIVE SOLENOID CONTROL
8	T3 18VT	TRS T3 SENSE
9	T1 18LG/BK	TRS T1 SENSE
10	T16 16RD	TRANSMISSION CONTROL RELAY OUTPUT
11	T48 18DB	4C PRESSURE SWITCH SENSE
12	T118 18YL/DB	PRESSURE CONTROL SOLENOID CONTROL
13	T4 18PK/OR	TRS T2 SENSE
14	T50 18DG	LOW/REVERSE PRESSURE SWITCH SENSE
15	T147 18LB	2C PRESSURE SWITCH SENSE
16	T9 18OR/BK	OVERDRIVE PRESSURE SWITCH SENSE
17	T59 18PK	UNDERDRIVE SOLENOID CONTROL
18	T29 18GY	UNDERDRIVE PRESSURE SWITCH SENSE
19	T159 18DG/WT	4C SOLENOID CONTROL
20	T119 18WT/DB	2C SOLENOID CONTROL
21	T140 18VT/LG	PRESSURE CONTROL SOLENOID CONTROL
22	T13 18DB/BK (5.7L)	SPEED SENSOR GROUND
22	K4 18BK/LB (4.7L)	SENSOR GROUND
23	T54 18VT	TRANSMISSION TEMPERATURE SENSOR SIGNAL



UNDERHOOD LAMP

UNDERHOOD LAMP - BLACK 2 WAY

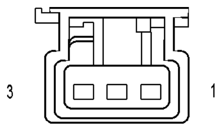
CAV	CIRCUIT	FUNCTION
1	Z235 20LB/BK	GROUND
2	M1 18PK	FUSED B(+)



VACUUM PUMP (DIESEL)

VACUUM PUMP (DIESEL) - 4 WAY

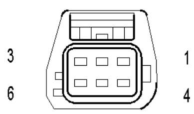
CAV	CIRCUIT	FUNCTION
1	-	-
2	Y135 18LG/BK	FUSED IGNITION SWITCH OUTPUT (RUN-START)
3	-	-
4	Z11 18BK/WT	GROUND



VEHICLE SPEED SENSOR (DIESEL)

VEHICLE SPEED SENSOR (DIESEL) - 3 WAY

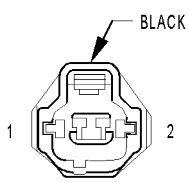
CAV	CIRCUIT	FUNCTION
1	K6 18VT/WT	5 VOLT SUPPLY
2	K167 18BR/TL	ACCELERATOR PEDAL POSITION SENSOR GROUND NO. 1
3	G17 18WT/TN	SPEEDOMETER SIGNAL



VISTRONIC FAN DRIVE (DIESEL)

VISTRONIC FAN DRIVE (DIESEL) - 6 WAY

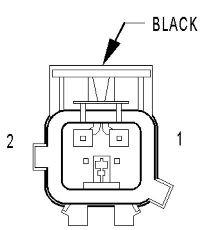
CAV	CIRCUIT	FUNCTION
1	Y1 18LG	PARK LOCKOUT SOLENOID CONTROL
2	K4 18BK/LB	SENSOR GROUND
3	Y5 18OR	FAN SPEED
4	-	-
5	Y3 18WT	SENSOR SUPPLY
6	F15 20DB	FUSED IGNTION SWITCH OUTPUT (RUN)



WASHER FLUID LEVEL SWITCH

WASHER FLUID LEVEL SWITCH - BLACK 2 WAY

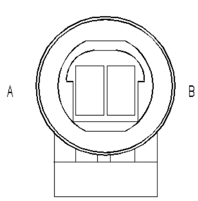
CAV	CIRCUIT	FUNCTION
1	Y137 20VT/LB EXCEPT 8.0L/DIESEL	SENSOR GROUND
2	G29 20BK/TN	WASHER FLUID SWITCH SENSE
2	Y137 20VT/LB 8.0L/DIESEL	SENSOR GROUND



WASHER PUMP MOTOR-FRONT

WASHER PUMP MOTOR-FRONT - BLACK 2 WAY

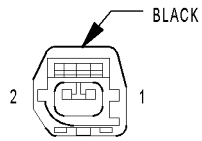
CAV	CIRCUIT	FUNCTION
1	Z216 20BK/VT	GROUND
2	V10 20BR	WASHER PUMP MOTOR CONTROL



WATER IN FUEL SENSOR (DIESEL)

WATER IN FUEL SENSOR (DIESEL) - 2 WAY

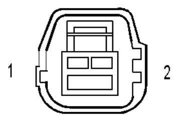
CAV	CIRCUIT	FUNCTION
1	K104 18RD/WT	SENSOR GROUND
2	G20 18VT/YL	IGNITION SWITCH SENSE



WHEEL SPEED SENSOR-LEFT FRONT (ABS)

WHEEL SPEED SENSOR-LEFT FRONT (ABS) - BLACK 2 WAY

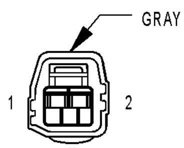
CAV	CIRCUIT	FUNCTION
1	B8 20RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)



WHEEL SPEED SENSOR-REAR (ABS)

WHEEL SPEED SENSOR-REAR (ABS) - 2 WAY

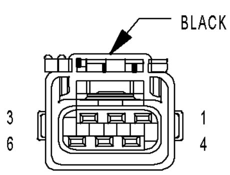
CAV	CIRCUIT	FUNCTION
1	B114 18WT/VT	REAR WHEEL SPEED SENSOR (-)
2	B113 18RD/VT	REAR WHEEL SPEED SENSOR (+)



WHEEL SPEED SENSOR-RIGHT FRONT (ABS)

WHEEL SPEED SENSOR-RIGHT FRONT (ABS) - GRAY 2 WAY

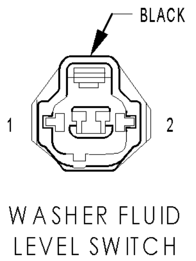
CAV	CIRCUIT	FUNCTION
1	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



WIPER MOTOR-FRONT

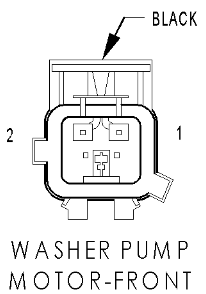
WIPER MOTOR-FRONT - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	V5 20DG	WIPER PARK SWITCH SENSE
3	Z247 20BK/LB	GROUND
4	Z44 18BK/DG	GROUND
5	V3 16BR/WT	WIPER RELAY LOW SPEED OUTPUT
6	V4 16RD/YL	WIPER RELAY HIGH SPEED OUTPUT



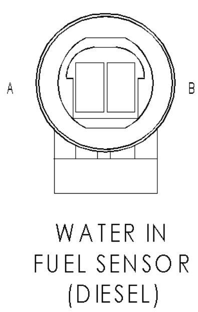
WASHER FLUID LEVEL SWITCH - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Y137 20VT/LB	SENSOR GROUND
2	G29 20BK/TN	WASHER FLUID SWITCH SENSE



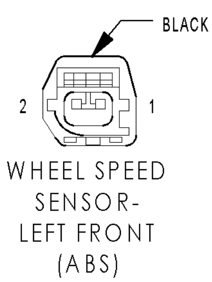
WASHER PUMP MOTOR-FRONT - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	Z216 20BK/VT	GROUND
2	V10 20BR	WASHER PUMP MOTOR CONTROL



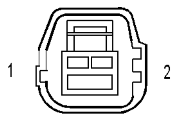
WATER IN FUEL SENSOR (DIESEL) - 2 WAY

CAV	CIRCUIT	FUNCTION
1	K104 18RD/WT	SENSOR GROUND
2	G20 18VT/YL	IGNITION SWITCH SENSE



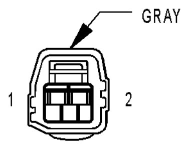
WHEEL SPEED SENSOR-LEFT FRONT (ABS) - BLACK 2 WAY

CAV	CIRCUIT	FUNCTION
1	B8 20RD/DB	LEFT FRONT WHEEL SPEED SENSOR (-)
2	B9 20RD	LEFT FRONT WHEEL SPEED SENSOR (+)



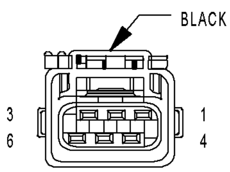
WHEEL SPEED SENSOR-REAR (ABS)- 2 WAY

CAV	CIRCUIT	FUNCTION
1	B114 18WT/VT	REAR WHEEL SPEED SENSOR (-)
2	B113 18RD/VT	REAR WHEEL SPEED SENSOR (+)



WHEEL SPEED SENSOR-RIGHT FRONT (ABS) - GRAY 2 WAY

CAV	CIRCUIT	FUNCTION
1	B6 20WT/DB	RIGHT FRONT WHEEL SPEED SENSOR (-)
2	B7 20WT	RIGHT FRONT WHEEL SPEED SENSOR (+)



WIPER MOTOR-FRONT - BLACK 6 WAY

CAV	CIRCUIT	FUNCTION
1	-	-
2	V5 20DG	WIPER PARK SWITCH SENSE
3	Z247 20BK/LB	GROUND
4	Z44 18BK/DG	GROUND
5	V3 16BR/WT	WIPER RELAY LOW SPEED OUTPUT
6	V4 16RD/YL	WIPER RELAY HIGH SPEED OUTPUT

8W-91 CONNECTOR/GROUND/SPLICE LOCATION

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CONNECTOR/GROUND/SPLICE LOCATION

DESCRIPTION

This section provides illustrations identifying connector, ground, and splice locations in the vehicle. Connector, ground, and splice indexes are provided. Use the wiring diagrams in each section for connector, ground, and splice identification. Refer to the index for the proper figure number. For items that are not shown in this section N/S is placed in the Fig. column.

CONNECTORS

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
4WD Switch (Manual Transfer Case)	BK	Near T/O for Backup Lamp Switch	16
A/C Compressor Clutch	BK	At A/C Compressor	3, 5, 8, 9, 10
A/C Pressure Transducer	BK	Left Side of A/C Compressor	3, 5, 8, 9, 10
A/C-Heater Control C1	BK	Center of Instrument Panel	36, 37, 38
A/C-Heater Control C2	BK	Center of Instrument Panel	36, 37
Adjustable Pedal Motor	WT	Left of Instrument Panel	33
Adjustable Pedal Switch	BL	Left of Instrument Panel	37, 39
Airbag Control Module	YL	Lower Center of Instrument Panel	37, 38
Airbag Control Module-Left Side Impact	YL	Left B-Pillar	44, 45
Airbag Control Module-Right Side Impact	YL	Right B-Pillar	N/S
Airbag-Driver Squib 1	YL	On Steering Wheel	32
Airbag-Left Curtain Squib	YL	Top Left B-Pillar	44, 45
Airbag-Passenger Squib 1	YL	Right Front of Instrument Panel	37, 40
Airbag-Right Curtain Squib	YL	Top Right B-Pillar	N/S
Ambient Temperature Sensor	BK	Left Rear of Hood	31
Amplifier Audio C1	GY	Top Center of Instrument Panel	37, 40
Amplifier Audio C2	GY	Top Center of Instrument Panel	37, 40
Automatic Day/Night Mirror (Except Base)	BK	Top Center of Windshield	N/S
Backup Lamp Switch	BK	Left Rear of Transmission	16
Battery Temperature Sensor	BK	Below Battery Tray	26, 28, 29, 30
Blend Door Actuator (Single Zone)	BK	Behind Right Side of Instrument Panel	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Blower Motor	BK	Behind Right Side of Instrument Panel	N/S
Blower Motor Resistor Block	BK	Behind Right Side of Instrument Panel	N/S
Brake Lamp Switch	BK	Top of Brake Pedal Arm	32, 37, 39
Brake Provision-Electric		Rear of Engine	26, 27
Brake Transmission Shift Interlock Solenoid	BK	Near Steering Column	33, 37, 39
C100	BK	Near G107	21, 22, 23, 24, 25
C102		Near Integrated Power Module	28
C106 (5.7L)	BK	Left Rear Engine	5
C107 (5.7L)	BK	Left Rear Engine	5
C112 (Diesel)	BK	Near T/O for Water In Fuel Sensor	N/S
C113	BK	Left Side Engine	10
C114	BK	Left side Engine	10
C115 (Diesel)	BK	Left Side Engine	10
C130	BK	Left Rear of Engine	21, 22, 23, 24, 26
C200	GY	Under Instrument Panel	40
C201	WT	Near Left Instrument Panel Speaker	37, 39
C205	BK	Left Rear Side of Engine Compartment	N/S
C206	BK	Right Instrument Panel	37, 40, 46
C216	BK	Middle Left Frame	26, 28, 48
C217	BK	Middle Left Frame	26, 28, 37, 48
C218	WT	Left Side of Instrument Panel	26, 27, 41, 44
C219	GY	Left Side of Instrument Panel	26, 27, 33, 37, 39, 41
C220	WT	Left Side of Instrument Panel	37, 39, 41
C301	WT	Right Kick Panel	41
C302	BK	Left Front Door	41
C304	WT	Left Side of Instrument Panel	42, 44, 45
C305	BK	At Left Front Door	42, 44, 45
C306	WT	Middle Front of Door	43, 45
C307	BK	Near Right License Lamp	48, 49
C308	WT	Under Instrument Panel	40, 41
C309	WT	Left Side of Instrument Panel	39, 41, 44, 45
C310	BK	Left Rear of Frame	48, 49
C311	BK	Left Rear of Frame	44, 45
C312	WT	Under Seat	N/S
C313	DK GY	At Driver Seat	N/S
C314	DK GY	At Driver Seat	N/S
C315	DK GY	At Driver Seat	N/S
C316	BK	At Passenger Seat	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
C317	BK	At Passenger Seat	N/S
C319	BK	Bottom Left of Left Door	N/S
C322	DK GY	Left Rear of Frame	N/S
C323	BK	Left Side of Instrument Panel	N/S
C327	BK	Right Rear Fender	48, 49
C328	BK	Left Rear Fender	48, 49, 50
Camshaft Position Sensor	GY	Right Front Side of Engine	3, 6, 8, 9
Capacitor		Left Rear of Engine Compartment	N/S
Center High Mounted Stop Lamp/Cargo Lamp	BK	Rear of Cab	47
Cigar Lighter Outlet	NAT	Rear of Cigar Lighter	34, 37, 38
Clearance Lamp No. 1	BK	Left Roof	46
Clearance Lamp No. 2	BK	Left-Center Roof	46
Clearance Lamp No. 3	BK	Center Roof	46
Clearance Lamp No. 4	BK	Right-Center Roof	46
Clearance Lamp No. 5	BK	Right Roof	46
Clockspring C1	BK	Steering Column	33
Clockspring C2	YL	Steering Column	33
Clockspring C3	BK	Steering Column	N/S
Clockspring C4	BK	Steering Column	N/S
Clutch Interlock Brake Switch	BK	At Clutch Pedal	26, 27
Coil On Plug No.1	BK	Left Top Side of Intake Manifold	4
Coil On Plug No.2	BK	Right Top Side of Intake Manifold	3
Coil On Plug No.3	BK	Left Top Side of Intake Manifold	4
Coil On Plug No.4	BK	Right Top Side of Intake Manifold	3
Coil On Plug No.5	BK	Left Top Side of Intake Manifold	4
Coil On Plug No.6	BK	Right Top Side of Intake Manifold	3
Coil On Plug No.7	BK	Left Top Side of Intake Manifold	4
Coil On Plug No.8	BK	Right Top Side of Intake Manifold	3
Compass/Mini-Trip Computer	BK	In Overhead Console	N/S
Condenser Fan	BK	Near Condenser	26, 27
Controller Anti-Lock Brake C1	BK	Left Fender Side Shield	26, 27, 28
Controller Anti-Lock Brake C2 (ABS)	BK	Left Fender Side Shield	26, 28
Crankshaft Position Sensor	BK	Right Rear of Engine Block	3, 6, 8, 9
Cylinder Lock Switch-Driver (Premium)	BK	In Left Front Door	42
Cylinder Lock Switch-Passenger (Premium)	LT GY	In Right Front Door	N/S
Data Link Connector	BK	Left Bottom of Instrument Panel	37, 39
Data Link Connector - Engine (Diesel)	BK	Near T/O for Water In Fuel Sensor	N/S
Dome Lamp	BK	Center of Headliner	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Door Ajar Switch-Driver (Base)	BK	Left Front Door	42
Door Ajar Switch-Left Rear (Base)	BK	Left Rear Door	43
Door Ajar Switch-Passenger (Base)	BK	Right Front Door	N/S
Door Ajar Switch-Right Rear (Base)	BK	Right Rear Door	43
Door Lock Motor/Ajar Switch-Driver (Except Base)	BK	Left Front Door	42
Door Lock Motor/Ajar Switch-Left Rear (Except Base)	BK	Left Rear Door	43
Door Lock Motor/Ajar Switch-Passenger (Except Base)	BK	Right Front Door	N/S
Door Lock Motor/Ajar Switch-Right Rear (Except Base)	BK	Right Rear Door	43
Door Lock Switch-Passenger	BL	In Right Front Door	N/S
Driver Airbag Squib	BK	In Steering Column	N/S
Driver Blend Door Actuator (Dual Zone)	BK	Right Side of HVAC	N/S
Driver Door Module C1	BL	In Left Front Door	42
Driver Door Module C2	BL	In Left Front Door	42
Engine Control Module C1	BK	Left Engine	10
Engine Control Module C2	BK	Left Engine	10
Engine Coolant Temperature Sensor	BK	Near Generator	4, 7, 9
Engine Oil Pressure Sensor	BK	Lower Left Side of Engine	4, 6, 8, 9, 11
Evap/Purge Solenoid	BK	Left Fender Side Shield	26, 28
Evaporator Temperature Sensor	BK	Right Side of HVAC	N/S
Fog Lamp-Left	WT	Left Front Facia	N/S
Fog Lamp-Right	WT	Right Front Facia	N/S
Fuel Control Actuator (Diesel)	BK	Left Rear Engine	23
Fuel Heater (Diesel)	BK	Left Side Engine	10
Fuel Injector No.1	BK	At Fuel Injector	4, 8
Fuel Injector No. 2	BK	At Fuel Injector	3, 7
Fuel Injector No. 3	BK	At Fuel Injector	4, 8
Fuel Injector No. 4	BK	At Fuel Injector	3, 7
Fuel Injector No. 5	BK	At Fuel Injector	4, 8
Fuel Injector No. 6	BK	At Fuel Injector	3, 7
Fuel Injector No. 7	BK	At Fuel Injector	4, 8
Fuel Injector No. 8	BK	At Fuel Injector	3, 7
Fuel Pump Module	LT GY	At Fuel Tank	48
Fuel Pump Motor (Diesel)	BK	Left Side Engine	10
Generator	BK	Front of Engine	4, 6, 7, 10
Glove Box Lamp and Switch	BK	At Glove Box	37, 40
Governor Pressure Sensor	BK	Left Rear of Transmission	N/S
Headlamp Switch	BK	Left Side of Instrument Panel	34, 37, 39
Headlamp-Left	BL	At Headlamp	26, 30, 31

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Headlamp-Right	BL	At Headlamp	1, 25, 29
Heated Seat Cushion - Driver	BL	Under Driver Seat	N/S
Heated Seat Cushion - Passenger	BL	Under Passenger Seat	N/S
Heated Seat Switch-Driver	RD	Center of Instrument Panel	35, 37, 38
Heated Seat Switch-Passenger	BL	Center of Instrument Panel	35, 37, 38
Horn Switch	WT	In Steering Wheel	N/S
Horn-High Note	BK	Left Front Fender	26, 30, 31
Horn-Low Note	BK	Left Front Fender	26, 31
Idle Air Control Motor	BK	On Throttle Body	4, 8
Ignition Coil	GY	Left Rear of Engine	7, 17
Ignition Coil - Left (8.0L)	BK	Right Side Engine	9
Ignition Coil - Right (8.0L)	BK	Right Side Engine	9
Ignition Switch	BK	Steering Column	33
Inlet Air Temperature/Manifold Absolute Pressure Sensor	BK	Right Side Engine	10
Input Speed Sensor	BK	At Transmission	14, 15
Instrument Cluster C1	GY	Rear of Instrument Cluster	37
Instrument Cluster C2	GY	Rear of Instrument Cluster	37
Instrument Cluster C3	WT	Rear of Instrument Cluster	39
Intake Air Heater Relay		Right Engine Compartment	2
Intake Air Temperature/Manifold Absolute Temperature Sensor (Diesel)	BK	Left rear Engine	N/S
Intake Air Temperature Sensor	BK	On Intake Manifold	4, 7, 9
Integrated Power Module C1	BK	Left Front Fender	29, 30
Integrated Power Module C2	WT	Left Front Fender	29, 30
Integrated Power Module C3	GR	Left Front Fender	29, 30
Integrated Power Module C4	WT	Left Front Fender	29, 30
Integrated Power Module C5	BK	Left Front Fender	29, 30
Integrated Power Module C6	BK	Left Front Fender	28, 29, 30
Integrated Power Module C7	GY	Left Front Fender	29, 30
Integrated Power Module FCM	BK	In IPM	N/S
Knock Sensor	BK	Left Rear of Engine	5, 6, 17
Leak Detection Pump (Except 8.0L)	BK	Left Middle of Chassis	48
Leak Detection Pump (8.0L)	BK	Left Transmission	13
License Lamp-Left	BK	At Rear Bumper	48, 49
License Lamp-Right	BK	At Rear Bumper	48, 49
Lift Pump Motor	BK	Near T/O for WIF Sensor	N/S
Line Pressure Sensor	BK	Right Rear of Transmission	14, 18, 19
Lumbar Motor-Driver	DK GY	At Driver Seat	N/S
Lumbar Motor-Passenger	BK	At Passenger Seat	N/S
Manifold Absolute Pressure Sensor (4.7L)	GY	Left Front of Intake Manifold	4

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Manifold Absolute Pressure Sensor (5.9L)	BK	Left Front of Intake Manifold	8
Mode Door Actuator 1	BK	Right Side of HVAC	N/S
Mode Door Actuator 2	BK	Right Side of HVAC	N/S
Multi-Function Switch	BK	On Steering Column	N/S
Natural Vacuum Leak Detection Assembly	BK	Rear of Transmission	18, 19
Output Speed Sensor	DB	Left Side of Transmission	11, 12, 14, 15
Overdrive Switch	WT	Center of Instrument Panel	37
Overhead Map/Reading Lamp (Except Base)	NAT	Center of Headliner	N/S
Oxygen Sensor 1/1 Upstream	BK	Left Front of Side of Transmission	11, 12, 14, 16
Oxygen Sensor 1/2 Downstream	NAT	Left Rear of Side of Transmission	11, 14, 16
Oxygen Sensor 2/1 Upstream	BK	Right Front Side of Transmission	11, 12, 14, 16, 17, 18, 19
Oxygen Sensor 2/2 Downstream	BK	Right Rear Side of Transmission	11, 12, 14, 16, 17, 18, 19
Park Brake Switch		At Park Brake	26, 27
Park/Turn Signal Lamp-Left Front	BK	At Lamp	26, 30, 31
Park/Turn Signal Lamp-Right Front	BK	At Lamp	1, 25, 29
Passenger Airbag On/Off Switch		Right Side of Instrument Panel	35, 37, 40
Passenger Blend Door Actuator (Dual Zone)	BK	Right Side of HVAC	N/S
Passenger Lumbar Switch		At Passenger Seat	N/S
Power Mirror-Left	BK	At Mirror	42
Power Mirror-Right	BK	At Mirror	N/S
Power Outlet	RD	Center of Instrument Panel	37
Power Outlet-Console	BK	Center of Instrument Panel	N/S
Power Seat Motor-Driver Front Vertical	RD	At Driver Seat	N/S
Power Seat Motor-Driver Horizontal	BK	At Driver Seat	N/S
Power Seat Motor-Driver Rear Vertical	BK	At Driver Seat	N/S
Power Seat Switch-Driver	BK	At Driver Seat	N/S
Power Seat Switch-Passenger	BK	At Passenger Seat	N/S
Power Steering Pressure Switch	BK	Near Power Steering Pump	4, 5
Power Window Circuit Breaker		Under Instrument Panel	33, 37, 39
Power Window Motor-Driver	BK	In Driver Door at Motor	42
Power Window Motor-Left Rear	BK	In Door at Motor	43
Power Window Motor-Passenger	BK	In Passenger Door at Motor	N/S
Power Window Motor-Right Rear	BK	In Door at Motor	43
Power Window Switch-Left Rear	BL	In Door	43
Power Window Switch-Right Rear	BL	In Door	43
Powertrain Control Module C1	BK	Right Rear Engine Compartment	21, 22, 23, 24

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Powertrain Control Module C2	WT	Right Rear Engine Compartment	21, 22, 23, 24
Powertrain Control Module C3	GY	Right Rear Engine Compartment	21, 22, 23, 24
Powertrain Control Module C4	GN	Right Rear Engine Compartment	21
PTO Sense		Near G107	21, 22, 24
Radio (Base)	GY	Rear of Radio	37, 38
Radio (Premium)	BK	Rear of Radio	37, 38
Recirculation Door Actuator	BK	Right Side of HVAC	N/S
Red Brake Warning Indicator Switch	BK	Near Master Cylinder	26, 28, 31
Remote Radio Switch-Left	BK	At Steering Wheel	N/S
Remote Radio Switch-Right	BK	At Steering Wheel	N/S
Seat Belt Pretensioner-Left	YL	Left B-Pillar	44, 45
Seat Belt Pretensioner-Right	YL	Right B-Pillar	N/S
Seat Belt Switch-Driver	DK GY	Left B-Pillar	N/S
Seat Belt Tension Reducer (Standard Cab)	YL	Left B-Pillar	44
Seat Heater Interface Module	GN	Under Driver Seat	N/S
Sentry Key Immobilizer Module	BK	On Steering Column	32
Side Marker - Left Front (Dual Wheels)	BK	Front of Left Rear Fender	50
Side Marker - Left Rear (Dual Wheels)	BK	Rear of Left Rear Fender	50
Side Marker - Right Front (Dual Wheels)	BK	Front of Right Rear Fender	50
Side Marker - Right Rear (Dual Wheels)	BK	Rear of Right Rear Fender	50
Speaker-Center Instrument Panel	WT	Center of Instrument Panel	37, 38
Speaker-Left Front Door	WT	In Left Front Door	42
Speaker-Left Instrument Panel	BK	Left Side of Instrument Panel	37, 39
Speaker-Left Rear (Standard Cab)	WT	In Lower Left B-Pillar	44
Speaker-Left Rear Door (Quad Cab)	WT	In Left Rear Door	43
Speaker-Right Front Door	WT	In Right Front Door	N/S
Speaker-Right Instrument Panel	BK	Right Side of Instrument Panel	37, 40
Speaker-Right Rear (Standard Cab)	BK	In Lower Right B-Pillar	N/S
Speaker-Right Rear Door (Quad Cab)	BK	In Right Rear Door	43
Speed Control Servo	BK	Left Front Side of Engine Compartment	26, 28
Speed Control Switch - Left (Except ETC)	GN	Steering Wheel	N/S
Speed Control Switch - Right (Except ETC)	GN	Steering Wheel	N/S
Speed Control Switch-Left (ETC)	WT	At Steering Wheel	N/S

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

CONNECTOR NAME/NUMBER	COLOR	LOCATION	FIG.
Speed Control Switch-Right (ETC)	WT	At Steering Wheel	N/S
Tail/Stop/Turn Signal Lamp-Left	BK	At Lamp	N/S
Tail/Stop/Turn Signal Lamp-Right	BK	At Lamp	N/S
Throttle Position Sensor	NAT	Throttle Body	4, 8
Trailer Tow Connector	BK	At Trailer Hitch	49
Trailer Tow Connector-Add On	BK	At Trailer Hitch	49, 51
Transfer Case Control Module C1	BK	Left Side of Instrument Panel	37, 39
Transfer Case Control Module C2	GY	Left Side of Instrument Panel	37, 39
Transfer Case Control Module C3	BK	Left Side of Instrument Panel	37, 39
Transfer Case Mode Sensor	BK	Left Front Side of Transfer Case	20
Transfer Case Position Sensor	BK	Front Middle of Transfer Case	14, 15, 16, 20
Transfer Case Selector Switch	BK	Center of Instrument Panel	35, 37, 38
Transfer Case Shift Motor	BK	Left Rear of Transmission	20
Transmission Control Module	BK	Left Rear of Engine Compartment	21
Transmission Range Sensor	BK	Left side of Transmission	11, 12
Transmission Solenoid Assembly	BK	Left Side of Transmission	11, 12
Transmission Solenoid/TRS Assembly (3.7L/4.7L)	BK	Left Side of Transmission	14, 15
Underhood Lamp	BK	Underside of Hood	31
Vistronic Fan Drive		Front Engine Compartment	30
Washer Fluid Level Switch	BK	At Reservoir	25, 29, 30
Washer Pump Motor-Front	BK	At Washer Fluid Reservoir	25, 29, 30
Water In Fuel Sensor (Diesel)	BK	Right Side Engine	10
Wheel Speed Sensor-Left Front	BK	Left Rear Lower Side of Engine Compartment	26, 31
Wheel Speed Sensor-Rear	BK	Right Rear of Body	49
Wheel Speed Sensor-Right Front	GY	Right Rear Lower Side of Engine Compartment	25
Wiper Motor-Front	BK	Left Side of Cowl	26, 28

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

GROUNDS

GROUND NUMBER	LOCATION	FIG.
G100	Left Front Engine	N/S
G101	Left Front Engine	N/S
G102	Left Front Chassis	N/S
G103	Left Front Engine Compartment	26
G104	Left Front Engine Compartment	26
G105	Right Front Chassis	25
G106	Left Rear Engine Compartment	26, 31
G107	Right Rear Engine Compartment	10, 21, 22, 24
G201	Right Side of Instrument Panel	39
G202	Center of Instrument Panel	37, 38
G203	Center of Instrument Panel	37, 38
G204	Right Side of Instrument Panel	37
G301	Left Front Body	41, 44, 45
G302	Left Front Body	41, 44, 45

SPLICES

SPLICE NUMBER	LOCATION	FIG.
S101	Left Front Fender	25
S102	Left Front Fender	26
S103	Left Rear of Engine Compartment	26
S104	Front Facia	N/S
S105	Front Facia	N/S
S106	Left Rear of Engine Compartment	26
S107	Left Front Fender	26
S108	Headlamp and Dash, Left Side	26, 28
S109	Left Front Fender	26, 28, 29
S110	Left Front Fender	26
S111	Center Rear of Engine Compartment	22, 24
S114	Left Rear of Engine Compartment	26, 27, 28
S115	Left Rear of Engine Compartment	26, 28, 31
S117	Left Rear of Engine Compartment	N/S
S118	Right Rear Engine Compartment	21
S119	Left Rear of Engine Compartment	N/S
S120	Left Front Fender	26
S121	Left Front Fender	23, 26
S122	Left Front Fender	26
S123	Left Front Fender	12, 26
S124	Center Rear of Engine Compartment	9, 11, 12, 23
S125	Center Rear of Engine Compartment	21, 23

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICE NUMBER	LOCATION	FIG.
S126	Center Rear of Engine Compartment	N/S
S128	Right Rear of Engine	3, 22
S129	Top Front of Transmission	3, 23
S130	Top Front of Transmission	3, 8, 9, 12, 14, 16, 17, 21, 22, 24
S131	Left Rear of Engine Compartment	22
S132	Left Rear of Engine Compartment	21, 22, 24
S133	Left Rear of Engine	11, 22
S134	Left Rear of Engine Compartment	15
S135	Headlamp and Dash, Left Side	26
S136	Left Front Fender	21, 29
S137	Left Rear of Engine Compartment	21
S138	Left Rear of Engine	3, 11
S139	Right Front of Transmission	14, 16, 17, 24
S141	Right Rear of Engine	3
S142	Left Side of Engine	22
S143	Left Side of Engine Compartment	21
S144	Top Front of Transmission	3, 14, 16, 17, 23, 24
S145	Left Front Fender	26
S146	Left Front Fender	26
S147	Right Rear of Engine	7
S148	Top Front of Transmission	3, 14, 16, 17, 22, 23, 24
S149	Left Rear of Engine	3, 4, 14
S150	Top Center of Engine	3, 5, 8
S153	Rear Engine Compartment	22
S154	Left Top Engine	5, 22
S155	Left Rear Engine Compartment near T/O for Fuel Control Actuator	N/S
S156	Left Rear Engine Compartment	23
S157	Near T/O for Camshaft Position Sensor	N/S
S158	Near T/O for C114	10
S159	Near T/O for Engine Control Module	N/S
S160	Top Left Engine	10
S170	Left Engine	10
S171	Top Left Engine	10
S172	In T/O for Fuel Control Actuator	N/S
S173	Near T/O for Engine Control Module	N/S
S174	Near T/O for C114	N/S
S175	Near T/O for Engine Control Module	N/S
S176	Left Side Engine Near T/O for Fuel Control Actuator	N/S
S181	Top of Transmission	12
S182	Top of Transmission	12

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICE NUMBER	LOCATION	FIG.
S183	Top of Transmission	12
S184	Top of Transmission	12
S191	Near Integrated Power Module	29
S197	Left Rear Engine Compartment	23
S201	Left Side of Instrument Panel	37
S204	Left Side of Instrument Panel	37
S205	Left Side of Instrument Panel	39
S206	At Steering Column	N/S
S207	At Steering Column	N/S
S208	Center of Instrument Panel	37, 38
S209	Center of Instrument Panel	37
S210	Center of Instrument Panel	39
S212	Left Side of Instrument Panel	33, 39
S213	Center of Instrument Panel in T/O for Instrument Cluster Connectors	N/S
S214	Left Side of Instrument Panel	33, 39
S216	Center of Instrument Panel	37
S217	Left Side of Instrument Panel	37, 40
S218	Left Side of Instrument Panel	39
S219	Center of Instrument Panel	N/S
S220	Center of Instrument Panel	N/S
S221	Center of Instrument Panel	37, 38
S222	Center of Instrument Panel	37
S224	Right Side of HVAC	N/S
S225	Center of Instrument Panel	37
S226	Right Side of HVAC	N/S
S230	Right Instrument Panel	37
S231	Left Instrument Panel	39
S301	Center of Headliner	N/S
S302	Center of Headliner	N/S
S304	Center of Headliner	N/S
S305	Center of Body	44, 45
S306	Left Side of Frame	N/S
S307	Center of Headliner	N/S
S308	Left Rear Chassis	48, 49
S309	Center Rear of Chassis	49
S310	Center of Body	44, 45
S311	Left Front of Body	41, 44, 45
S312	Right Door	N/S
S313	Left Front Door	42
S314	Left Rear Frame Rail	N/S
S315	Left Front Body	41, 44, 45

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

SPLICE NUMBER	LOCATION	FIG.
S316	At Driver Seat	N/S
S317	At Passenger Seat	N/S
S318	At Passenger Seat	N/S
S319	Left Front Door	42
S320	Center of Body	44
S321	Left Front Body	N/S
S322	Left Front Body	N/S
S323	Left Front Body	45
S324	Left Rear Chassis	48, 49
S325	Left Rear Chassis	48, 49
S326	Left Rear Chassis	48, 49
S327	Left Rear Chassis	48, 49
S328	At Driver Seat	N/S
S329	At Driver Seat	N/S
S330	Center Rear of Chassis	49
S331	Center Rear of Chassis	49
S332	Left Front Door	42
S333	Left Front Body	45
S334	Left Front Body	41, 44, 45
S335	Left Front Body	41, 44, 45
S338	Left Rear Fender	50
S339	Left Rear Fender	50

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

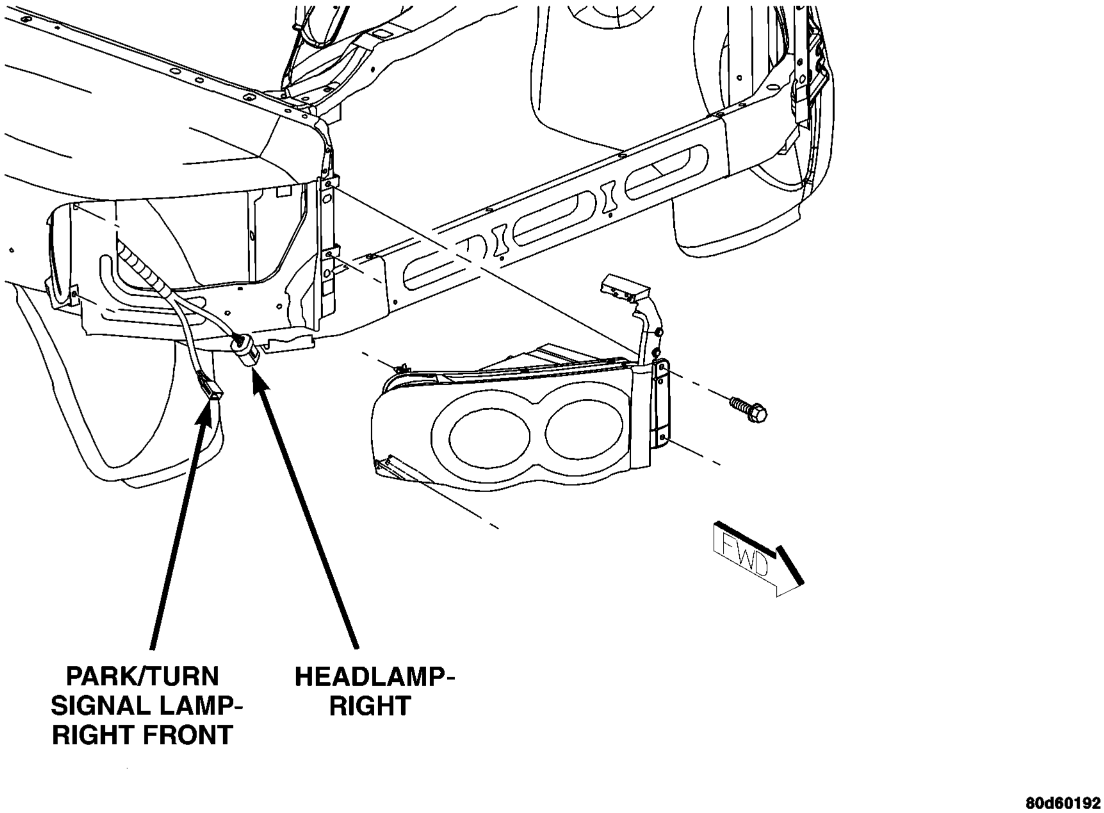


Fig. 1 RIGHT SIDE FRONT LIGHTING

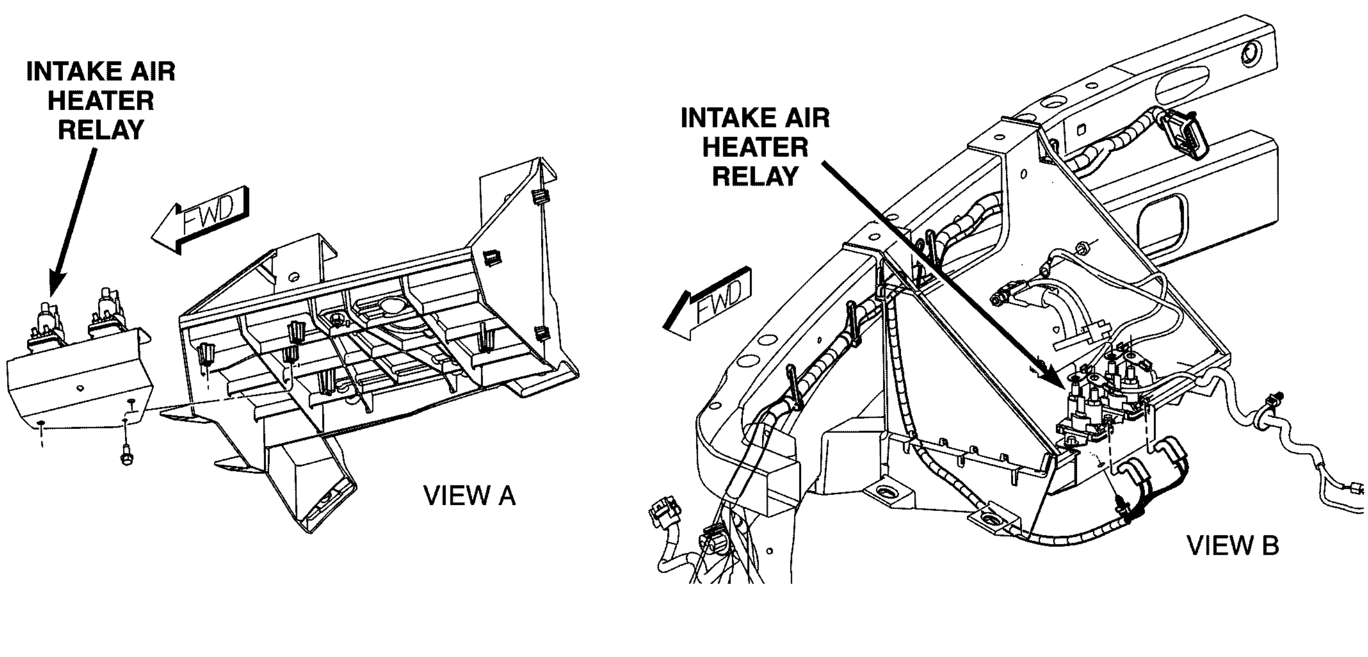


Fig. 2 LEFT FRONT BUMPER AND RIGHT BATTERY TRAY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

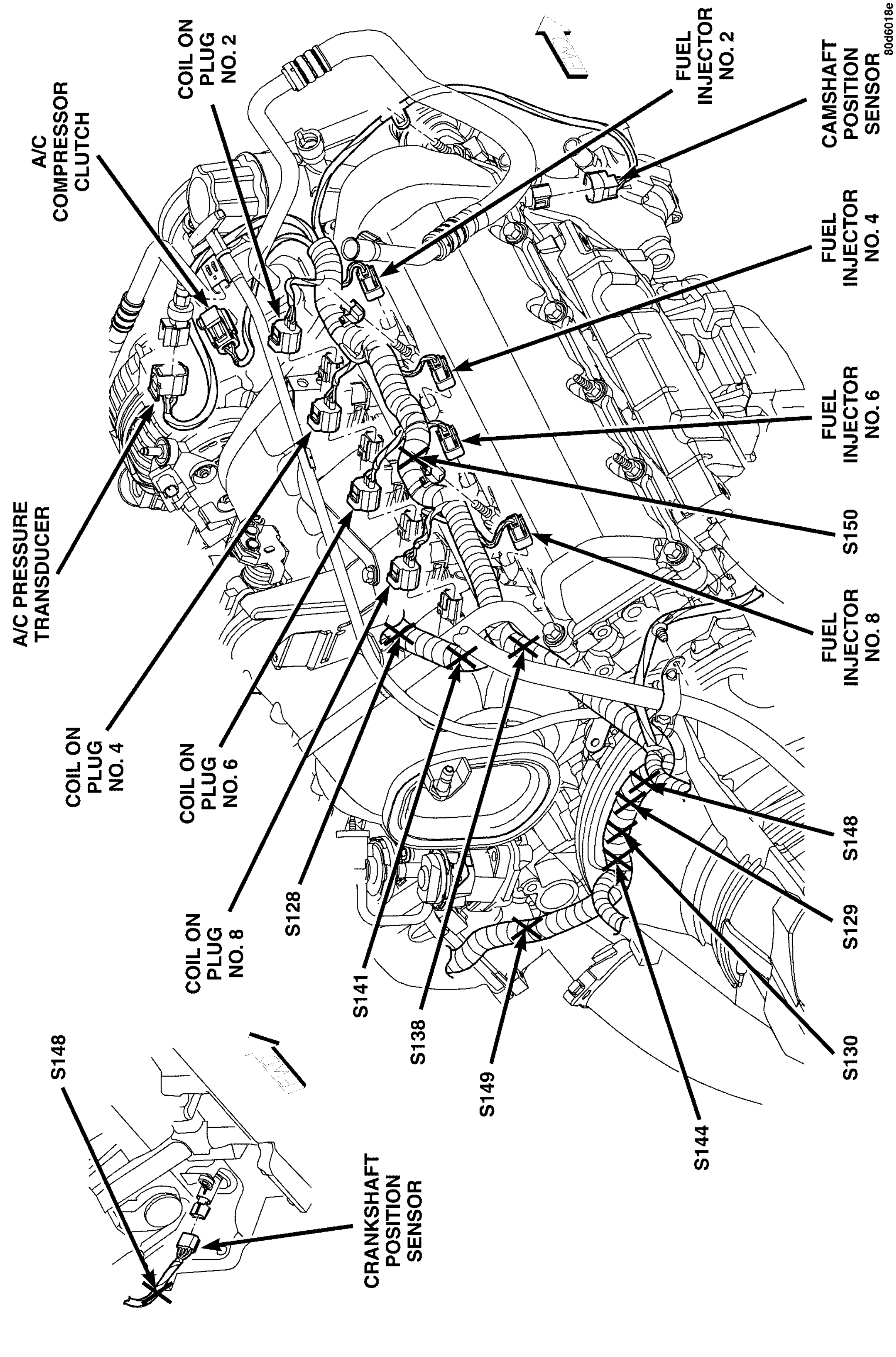


Fig. 3 RIGHT SIDE ENGINE, 4.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

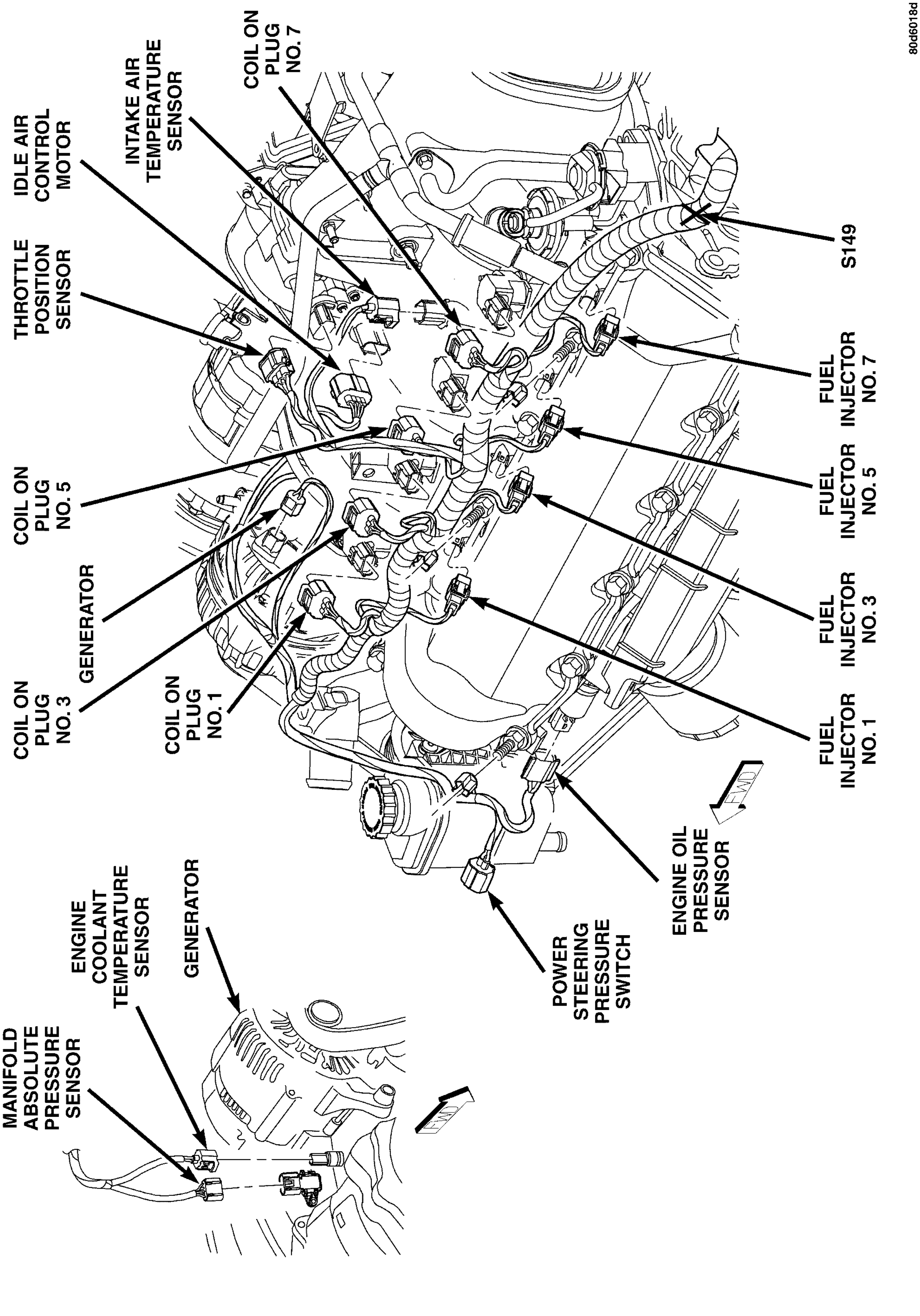


Fig. 4 LEFT SIDE ENGINE, 4.7L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

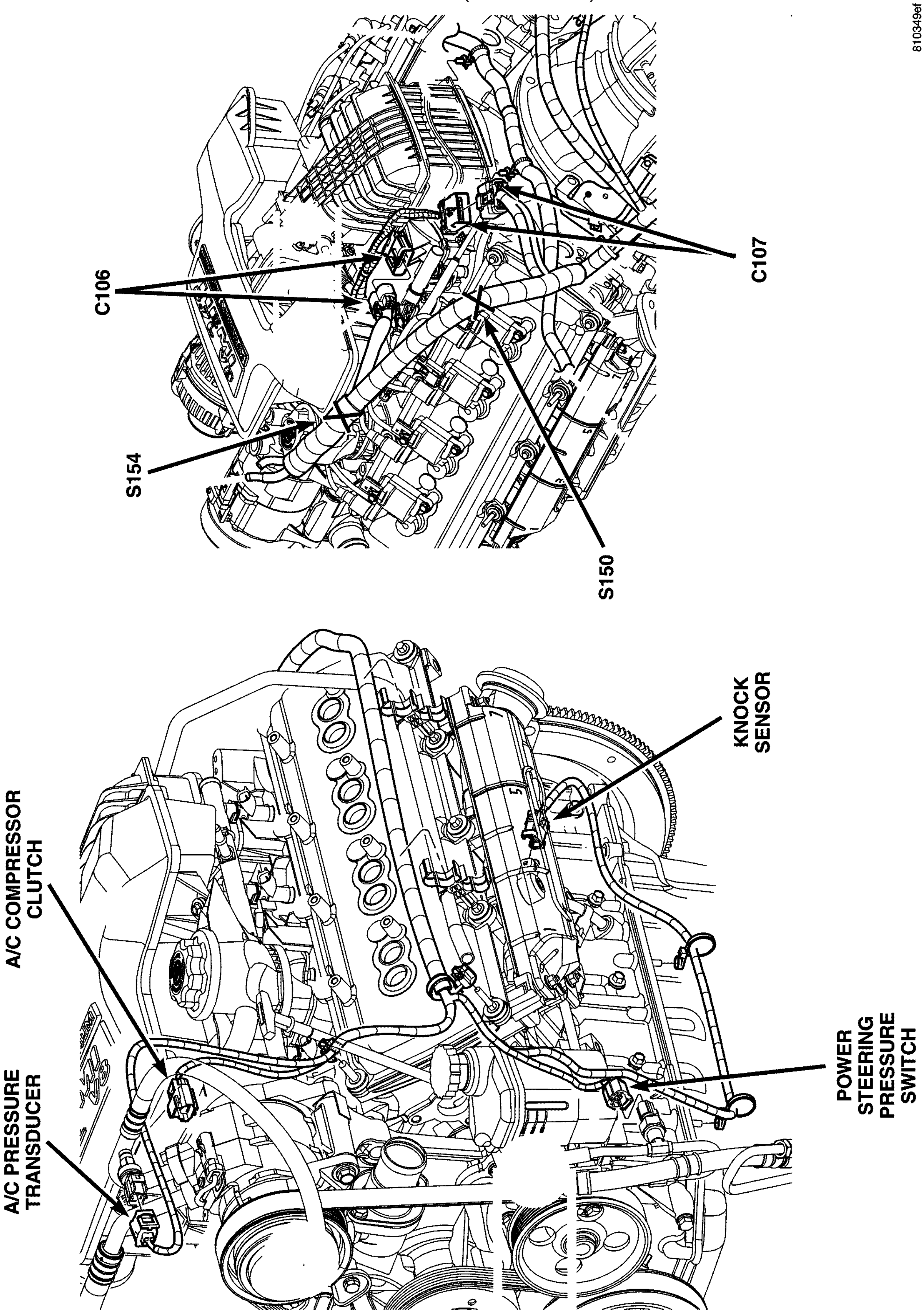


Fig. 5 LEFT SIDE ENGINE (5.7L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

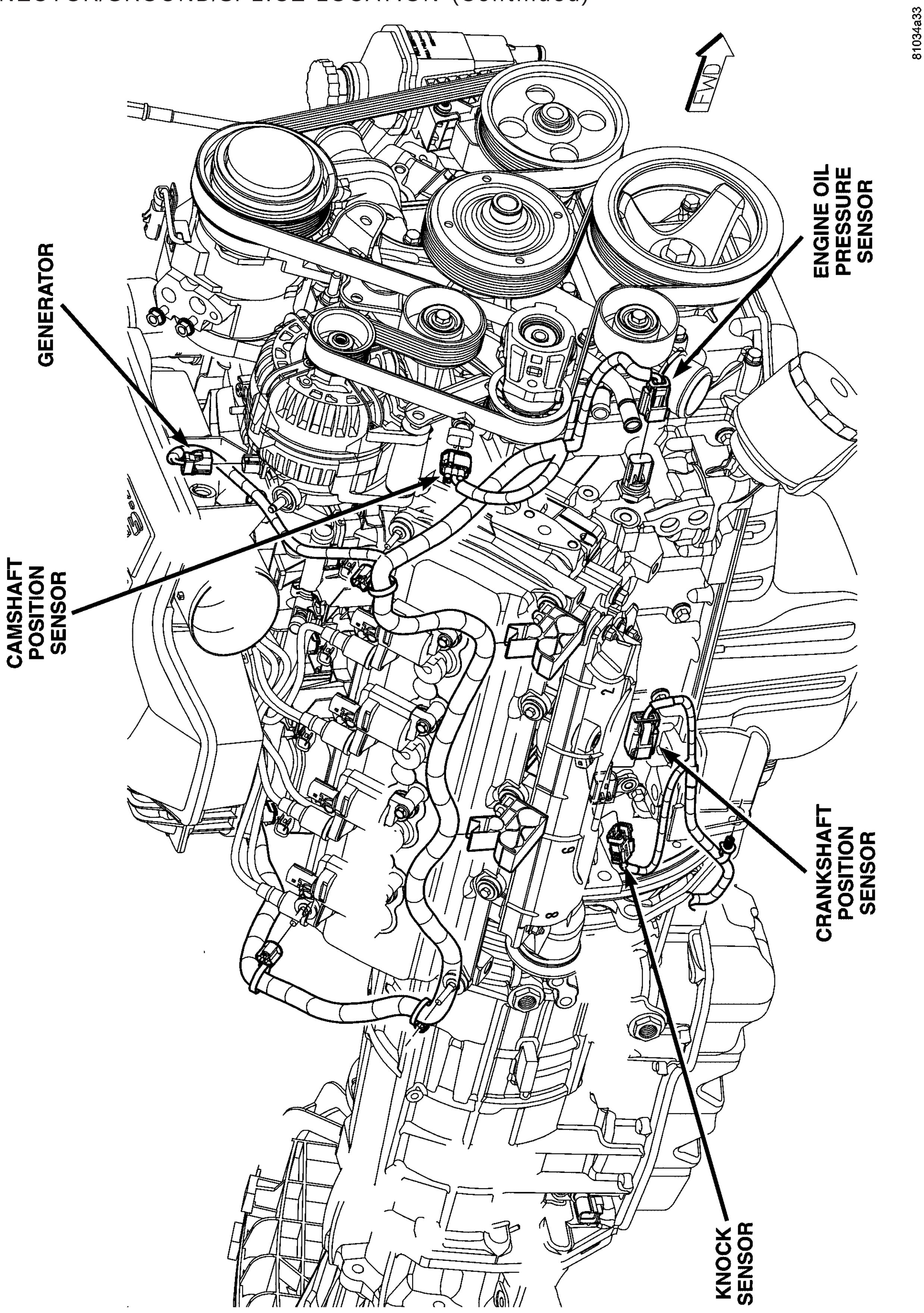


Fig. 6 RIGHT SIDE ENGINE (5.7L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

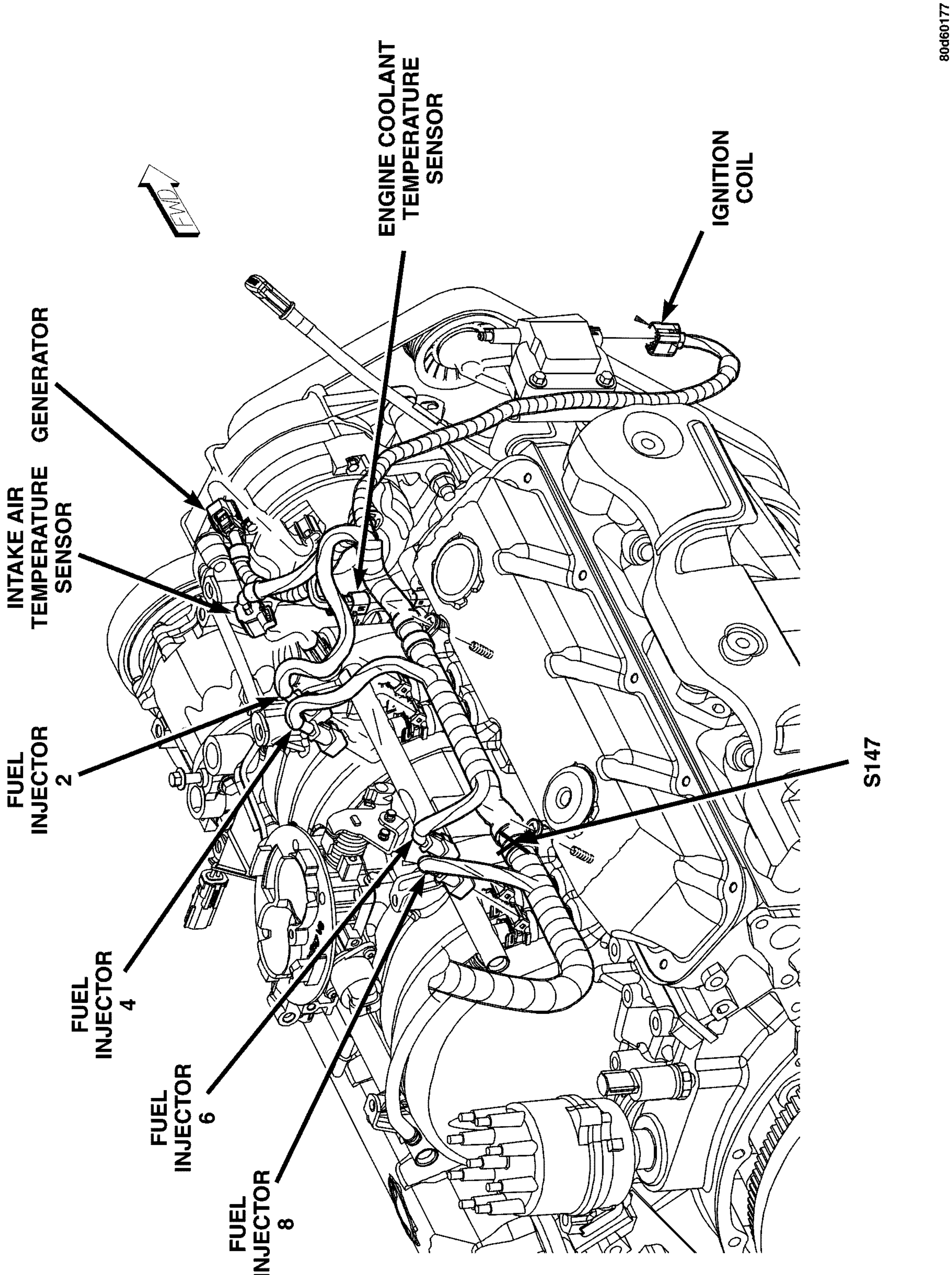


Fig. 7 RIGHT SIDE ENGINE, 5.9L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

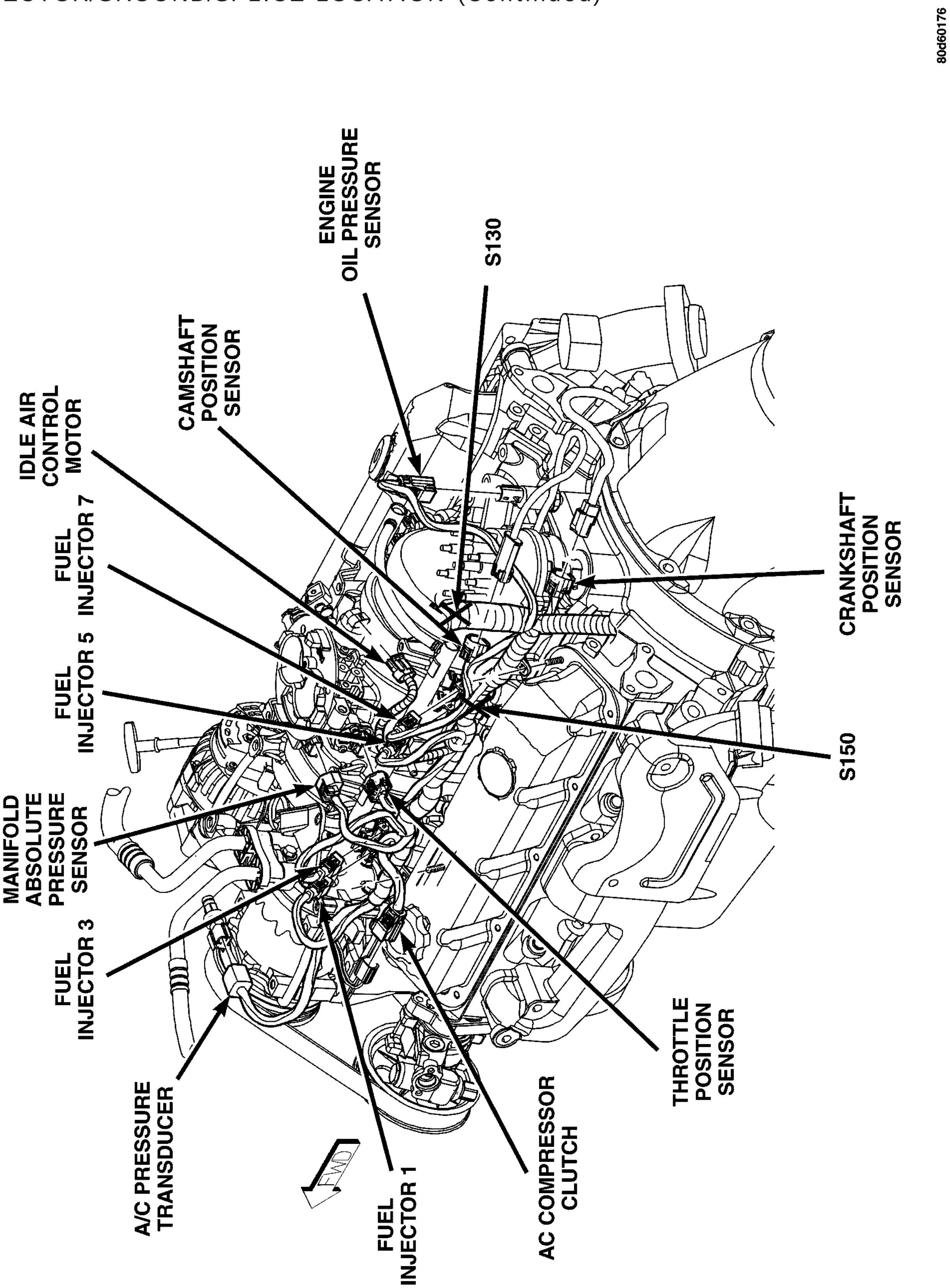


Fig. 8 LEFT SIDE ENGINE, 5.9L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

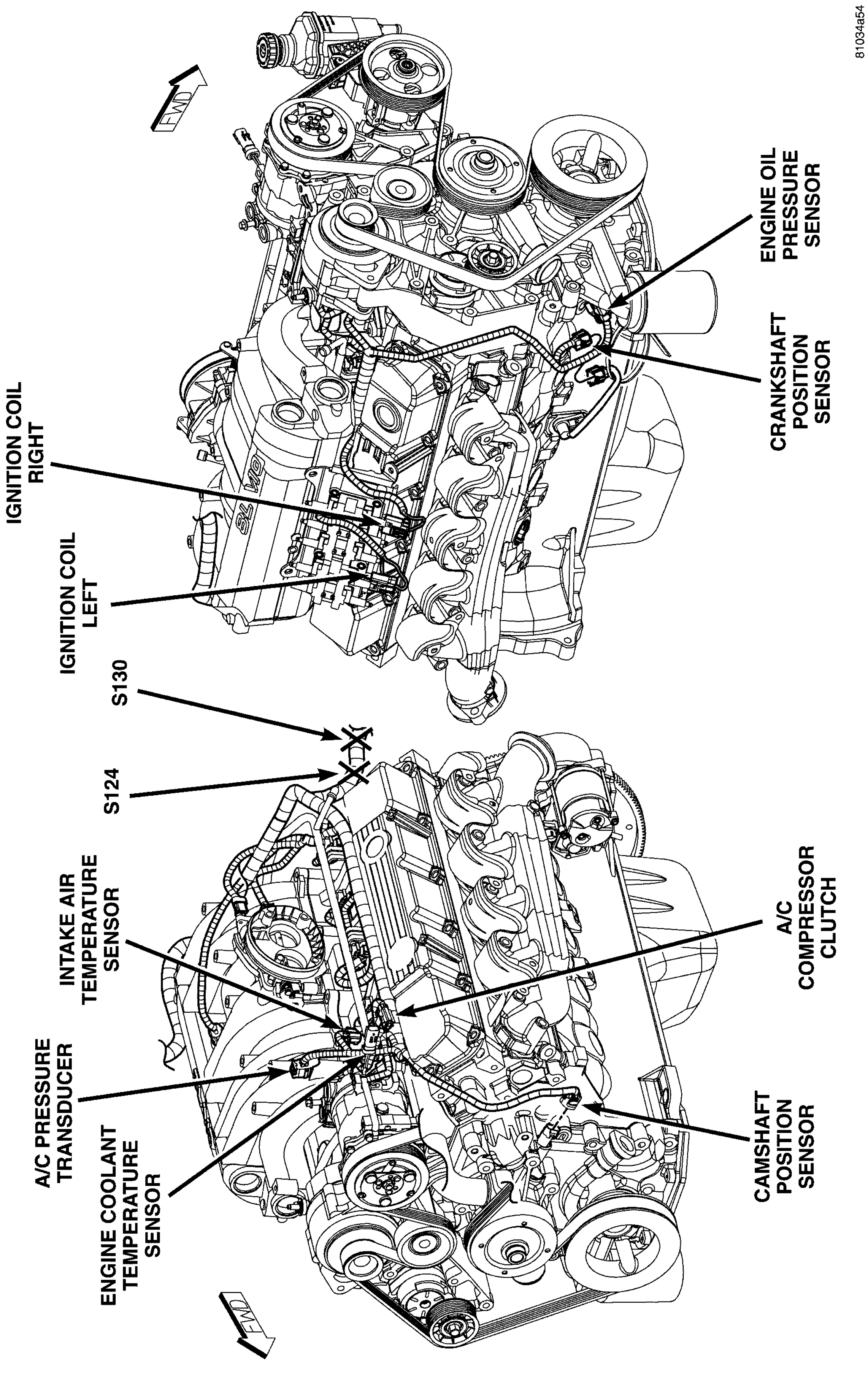


Fig. 9 ENGINE (8.0L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

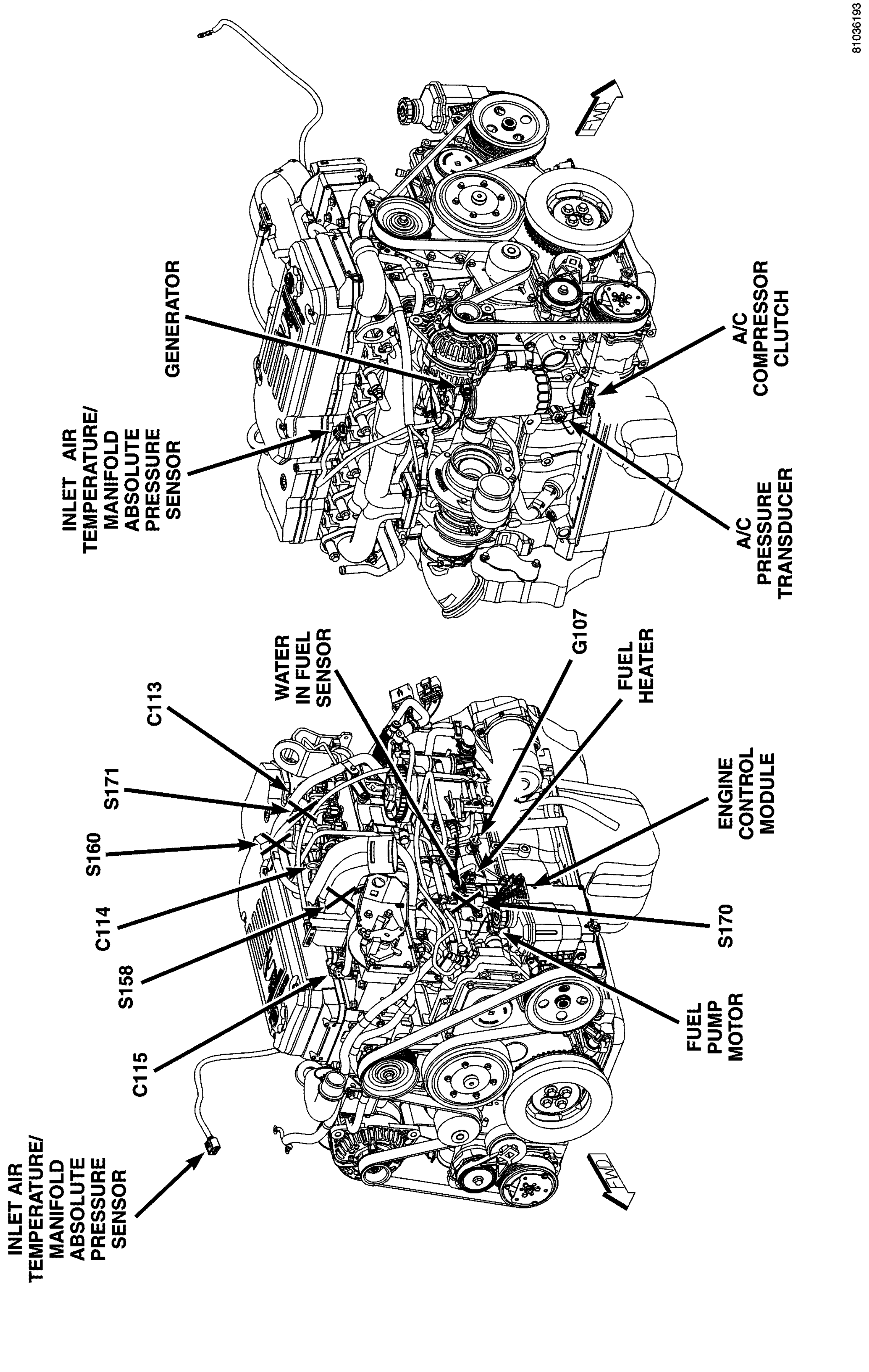


Fig. 10 ENGINE (DIESEL)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

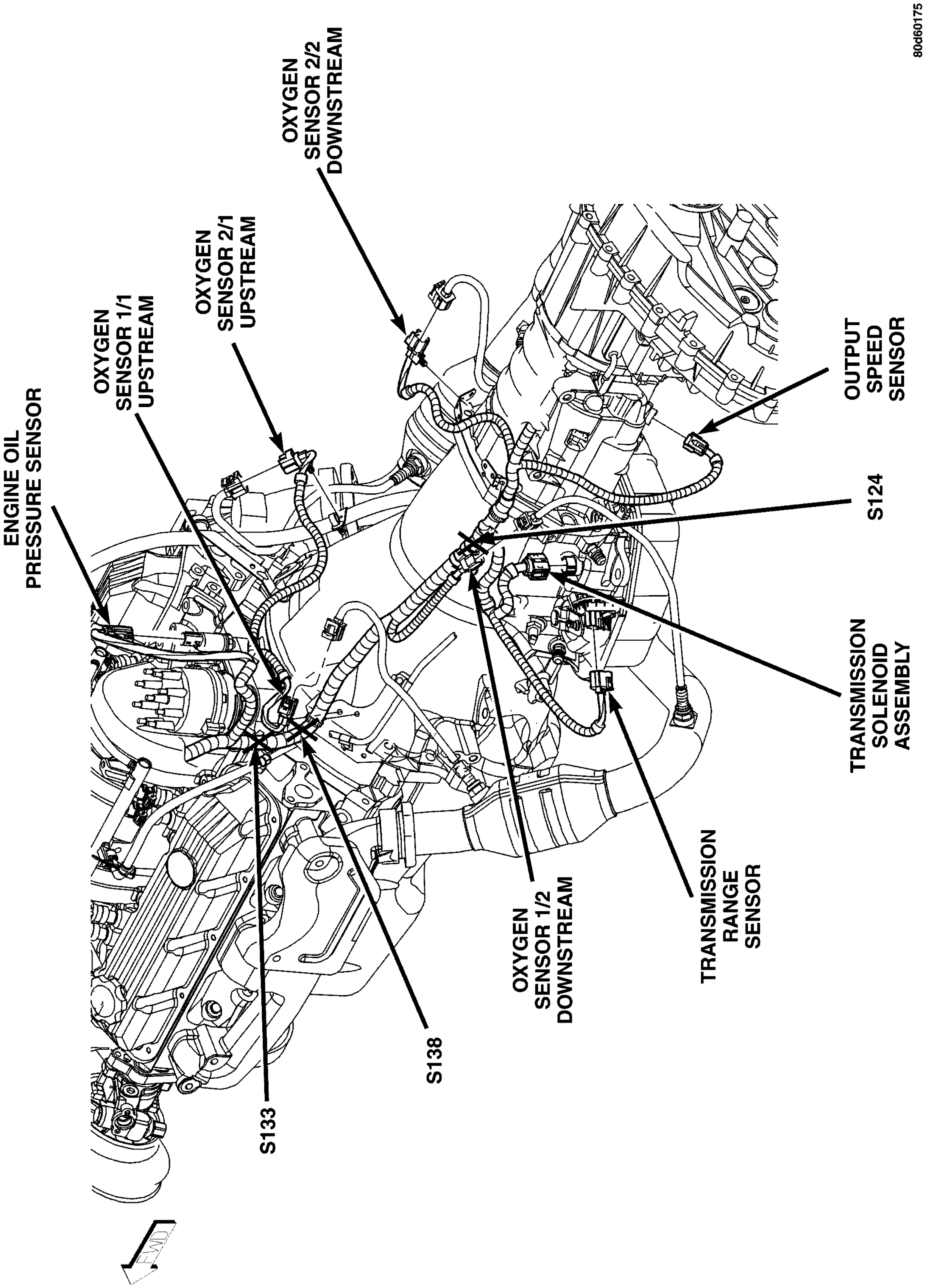


Fig. 11 LEFT SIDE ENGINE AND TRANSMISSION, 5.9L

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

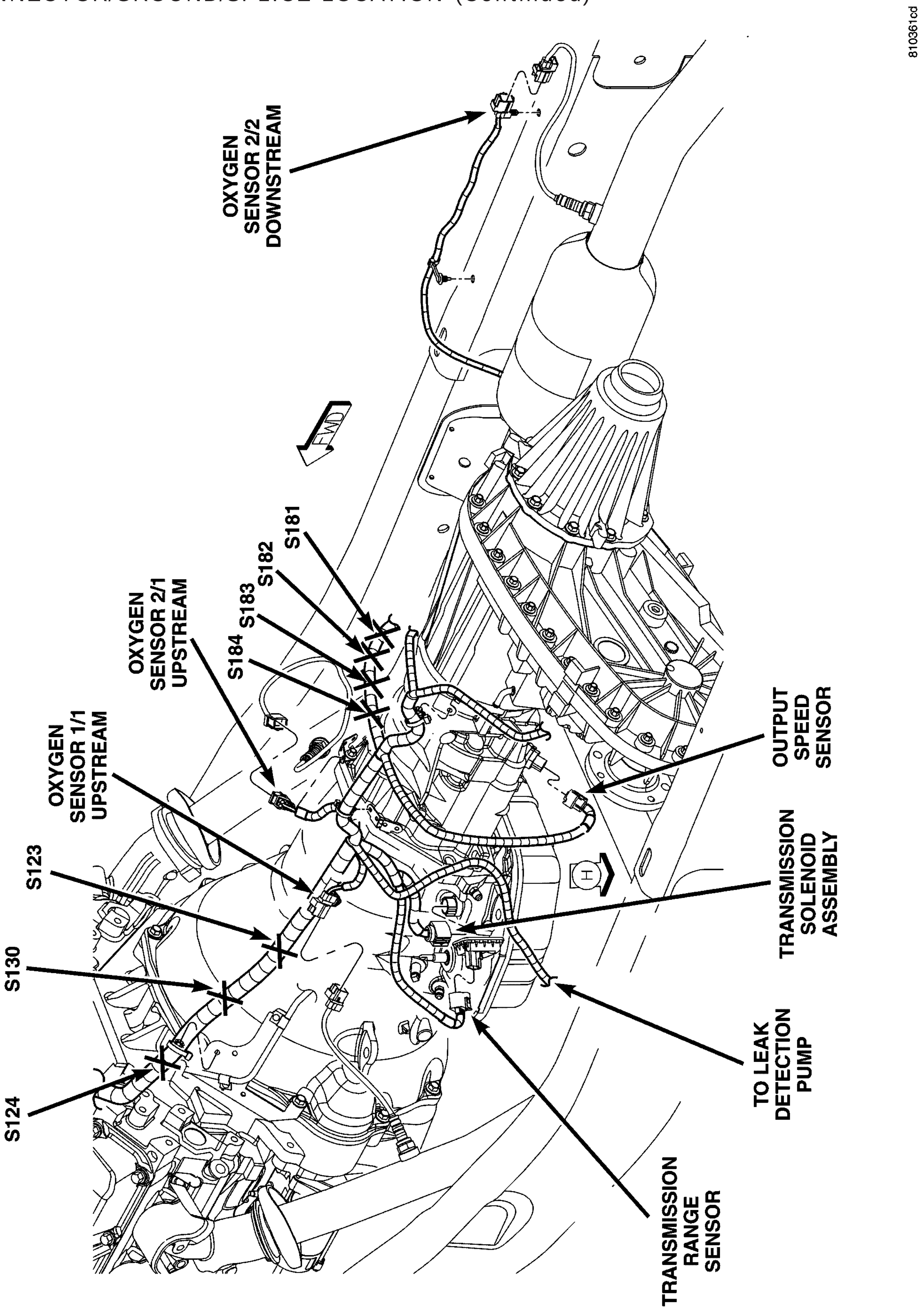


Fig. 12 LEFT SIDE ENGINE AND TRANSMISSION (8.0L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

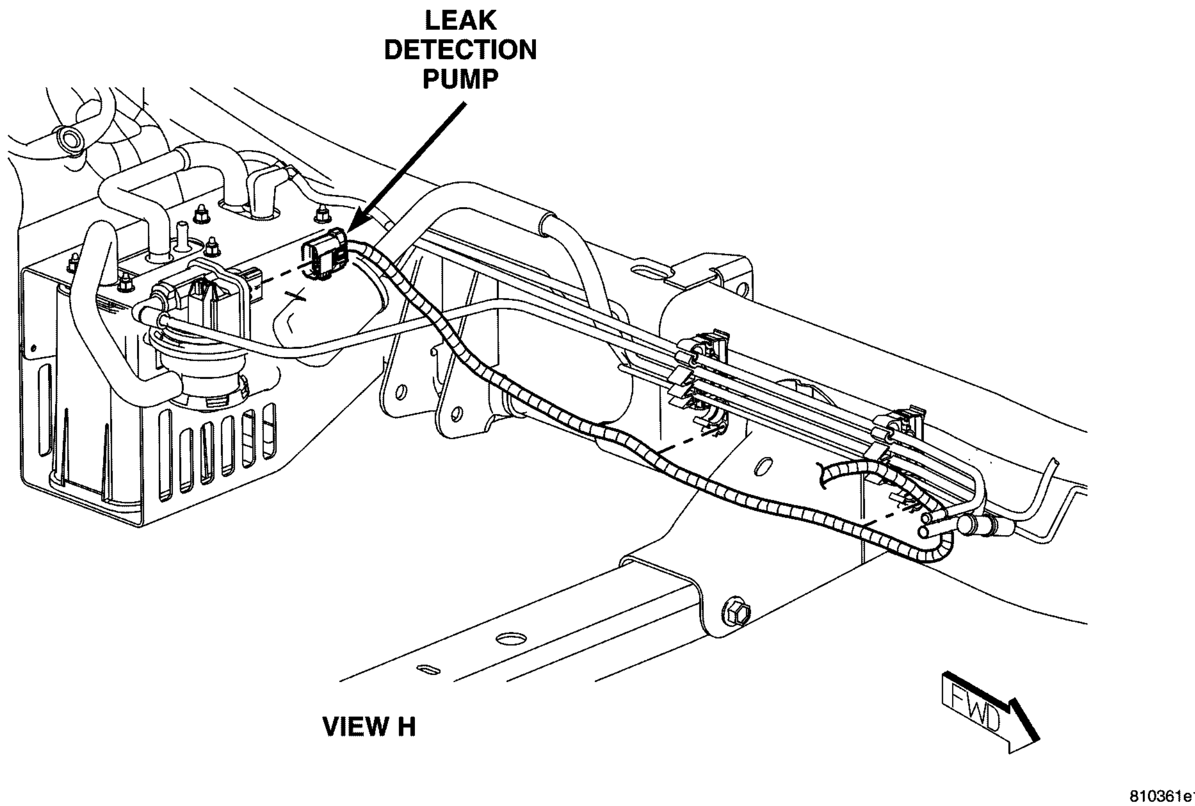


Fig. 13 LEAK DETECTION PUMP (8.0L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

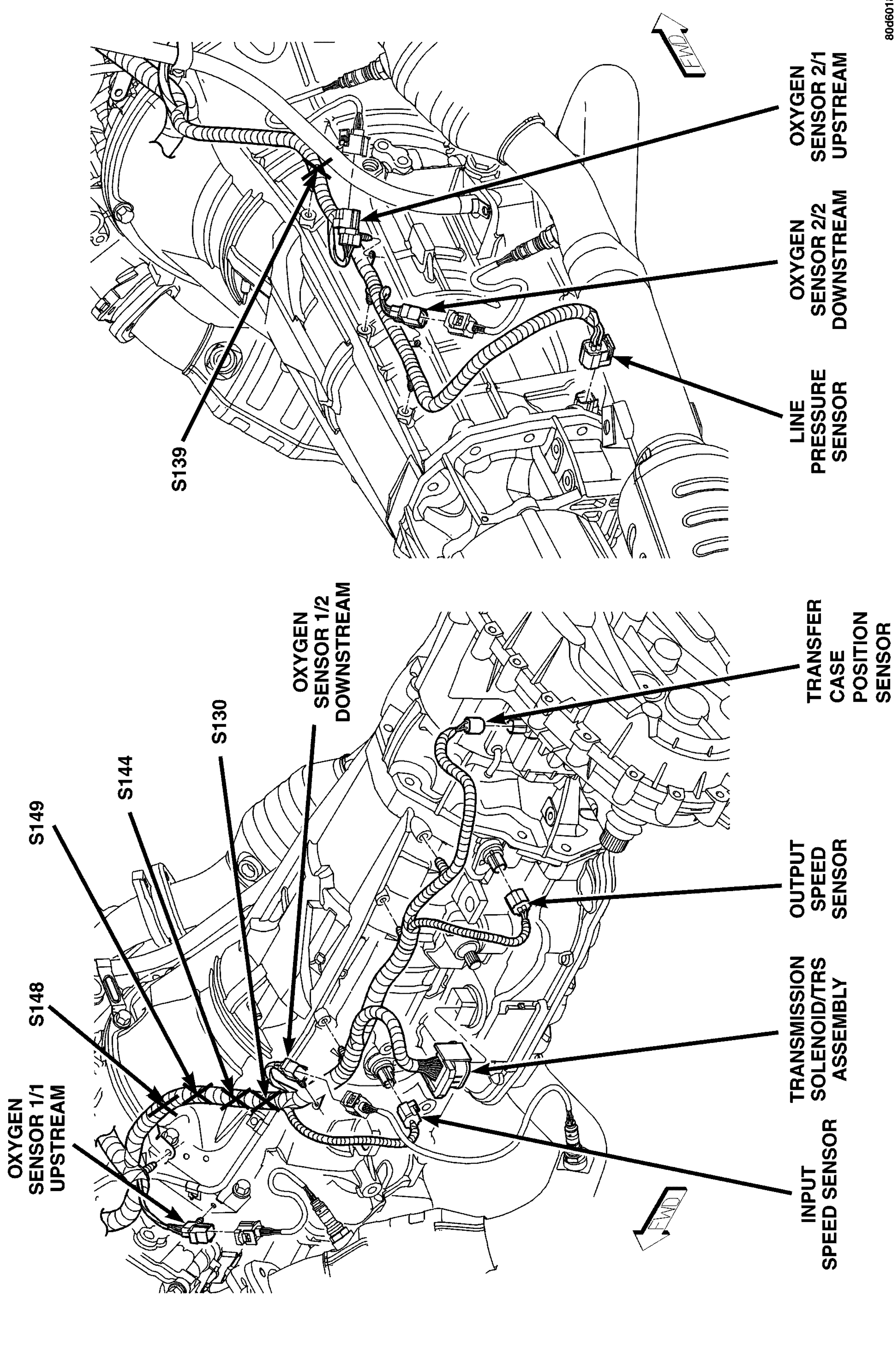


Fig. 14 TRANSMISSION 45RFE (4X4)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

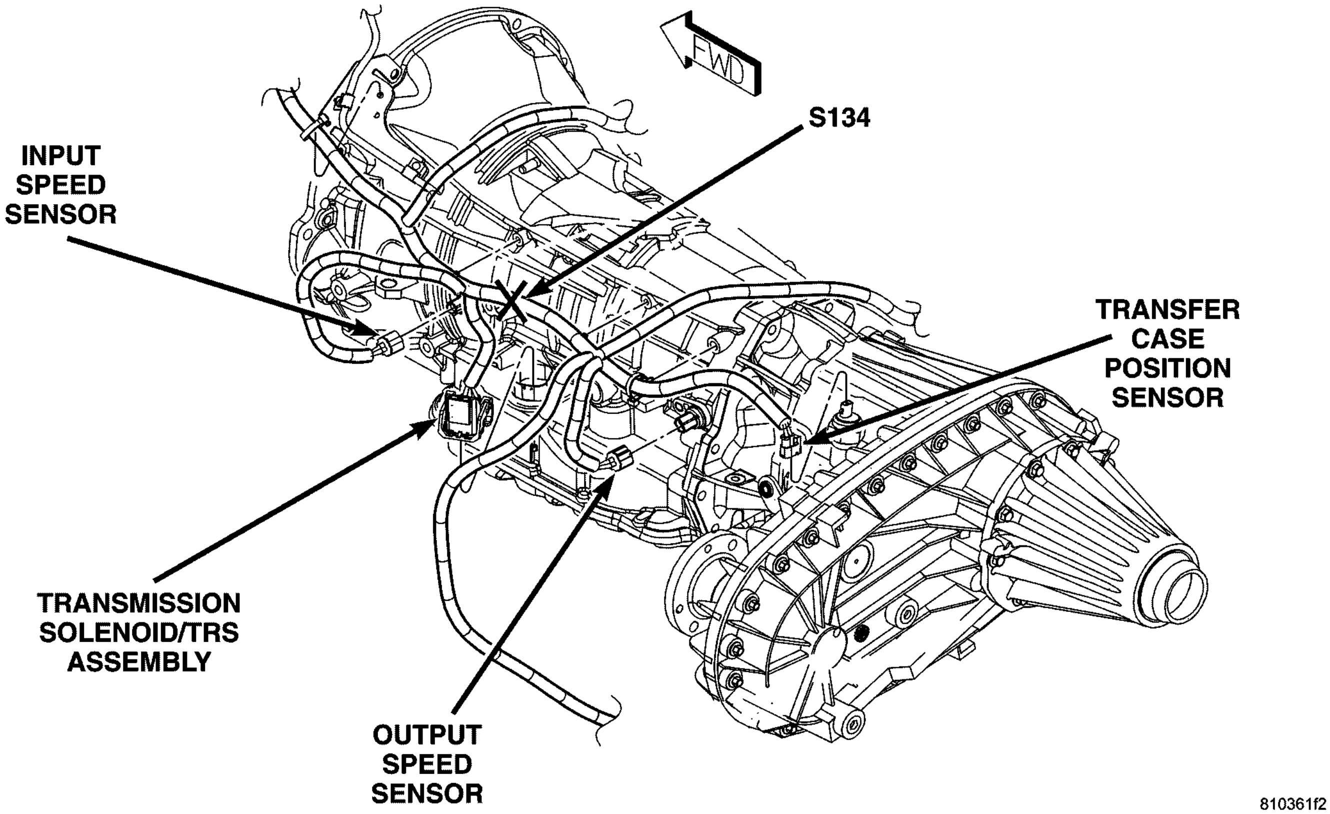


Fig. 15 TRANSMISSION 45RFE (4X4) (5.7L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

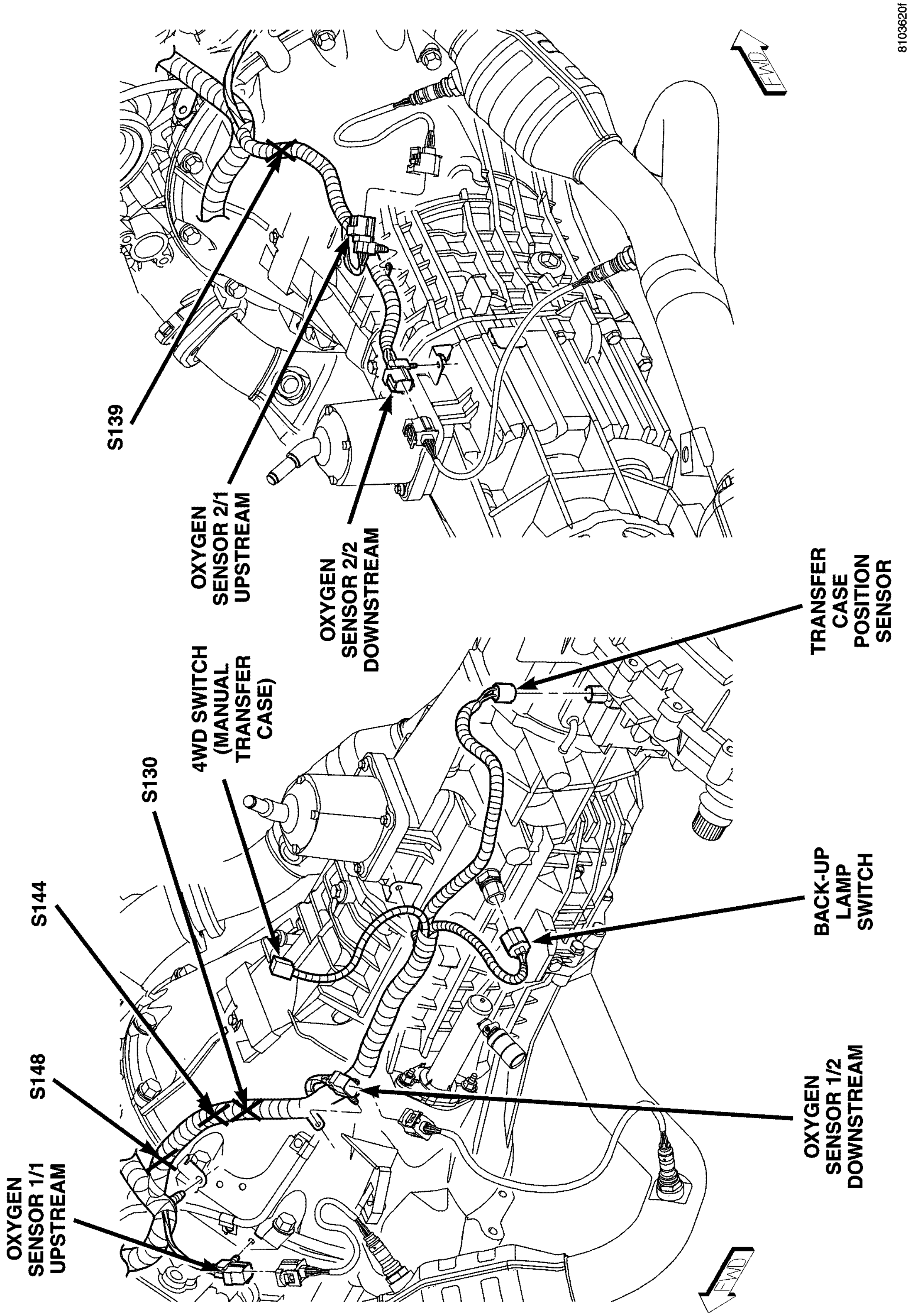


Fig. 16 MANUAL TRANSMISSION (4X4)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

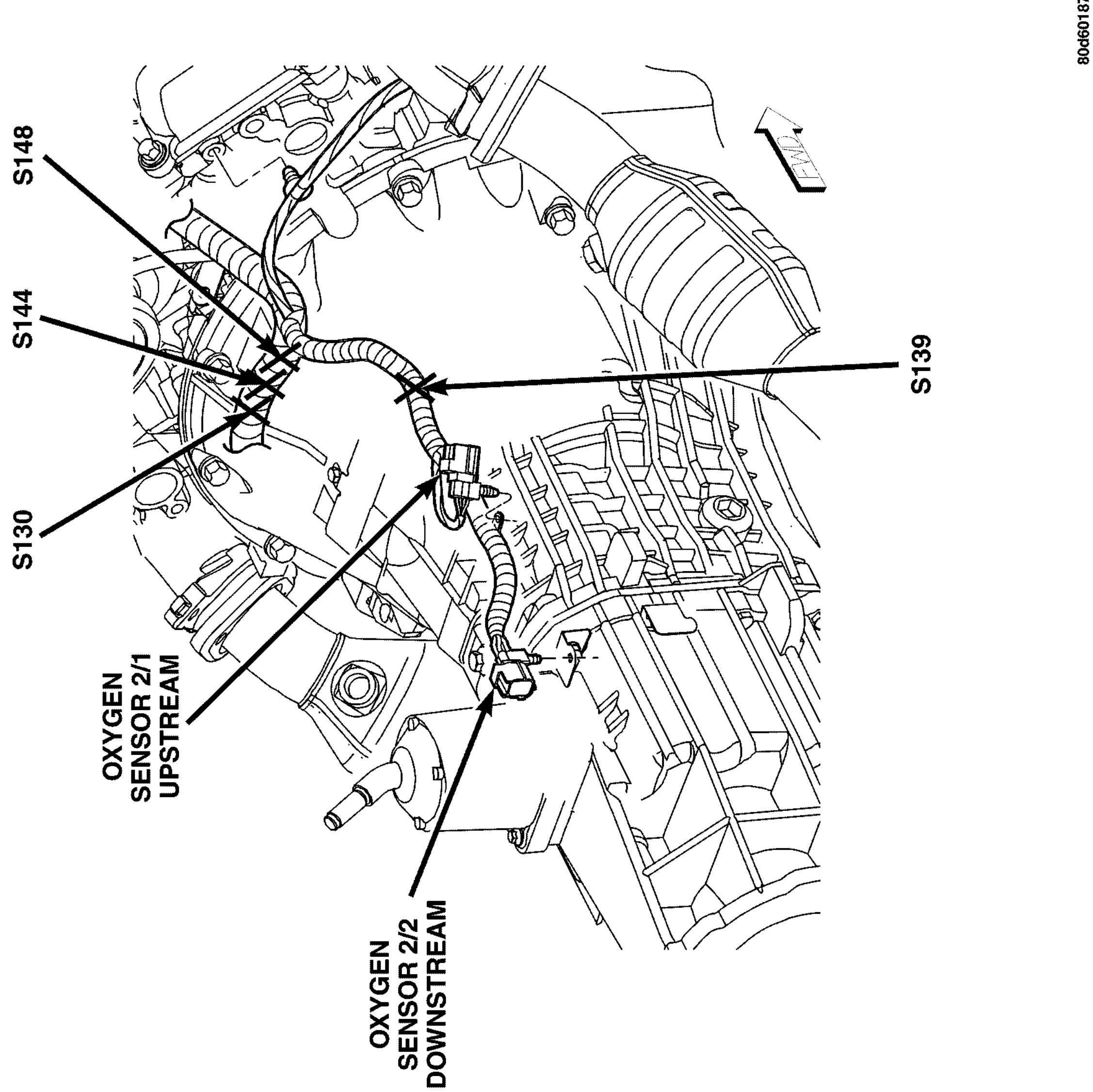
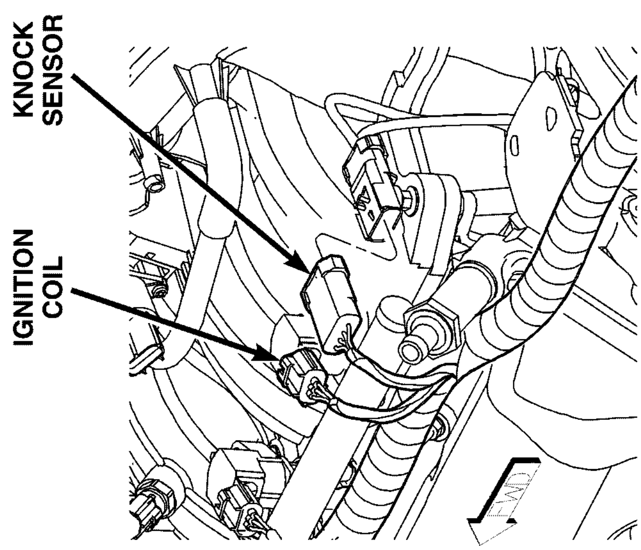


Fig. 17 TRANSMISSION, 4.7L



CONNECTOR/GROUND/SPLICE LOCATION (Continued)

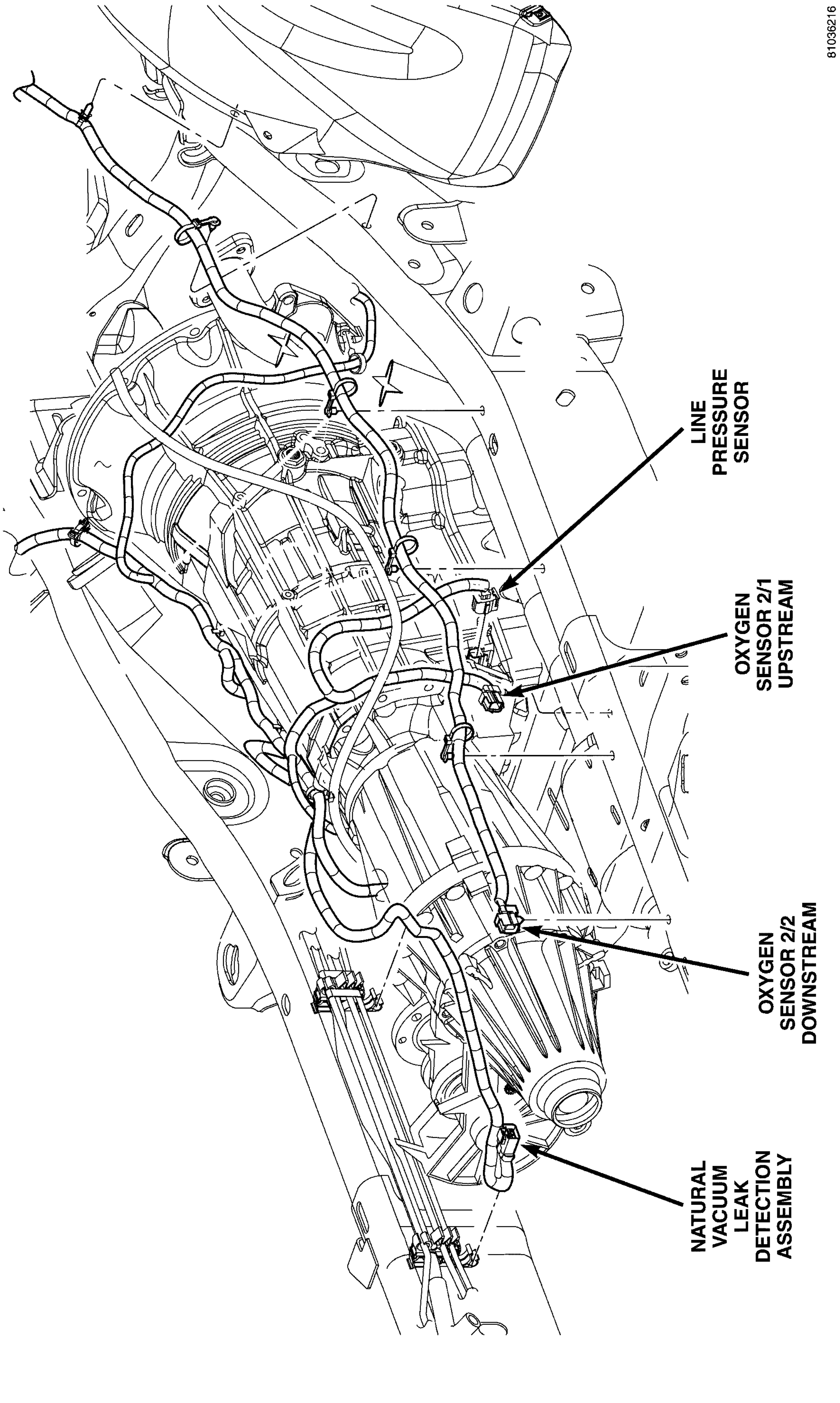


Fig. 18 TRANSMISSION 45RFE AUTO (5.7L HEAVY DUTY) (MANUAL SIMILAR)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

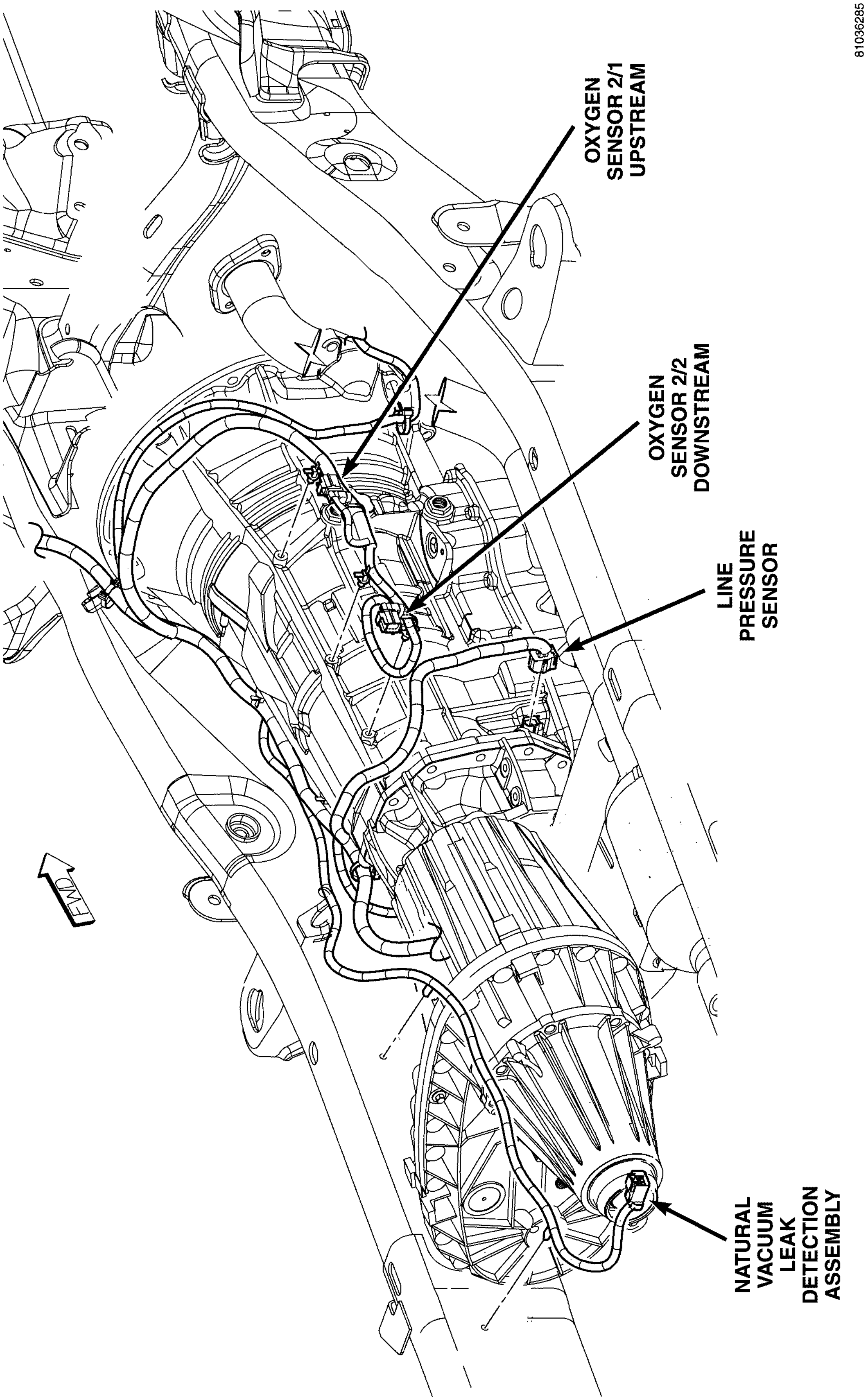


Fig. 19 45RFE TRANSMISSION (5.7L) (LIGHT DUTY)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

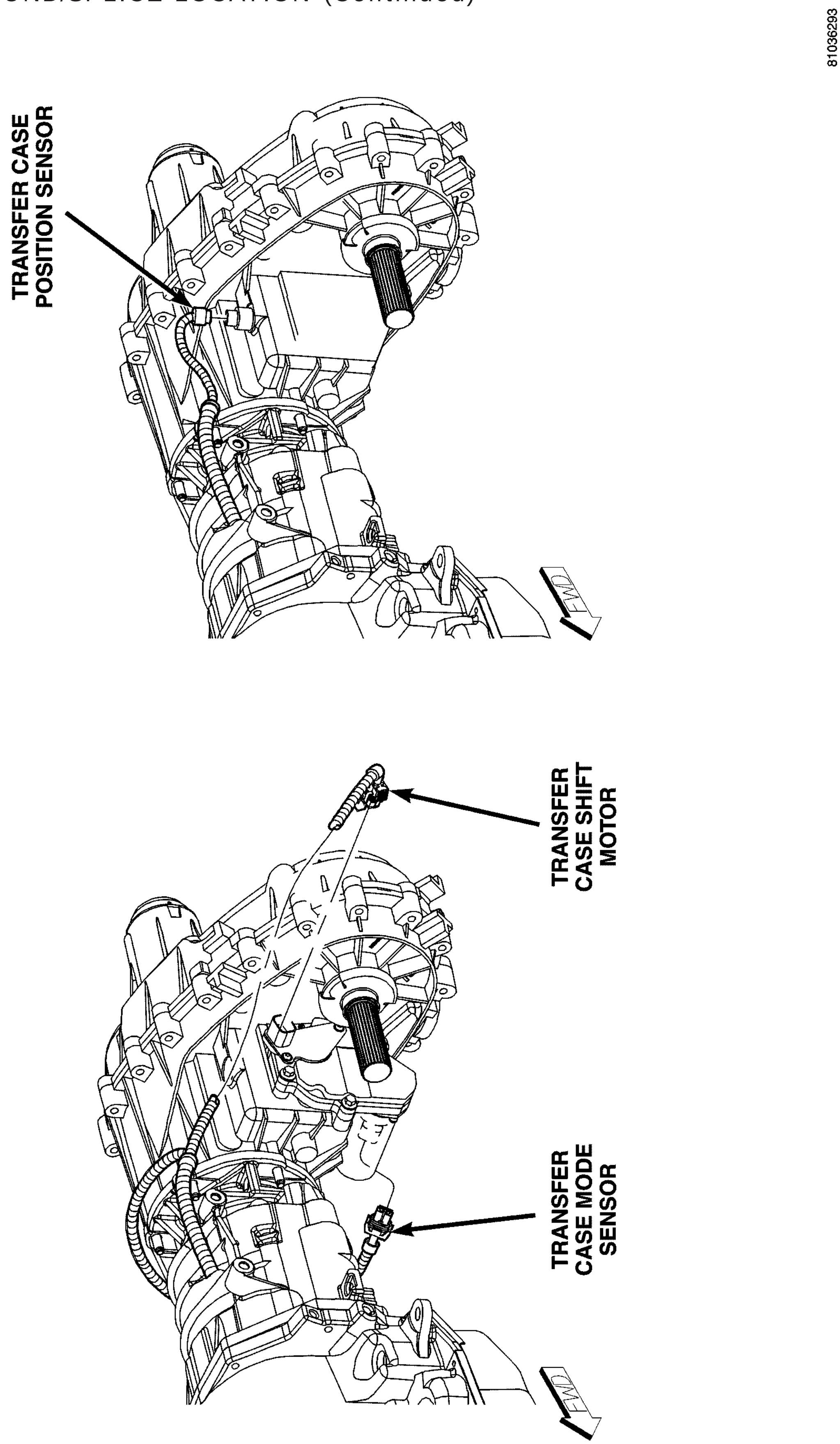


Fig. 20 LEFT FRONT TRANSFER CASE

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

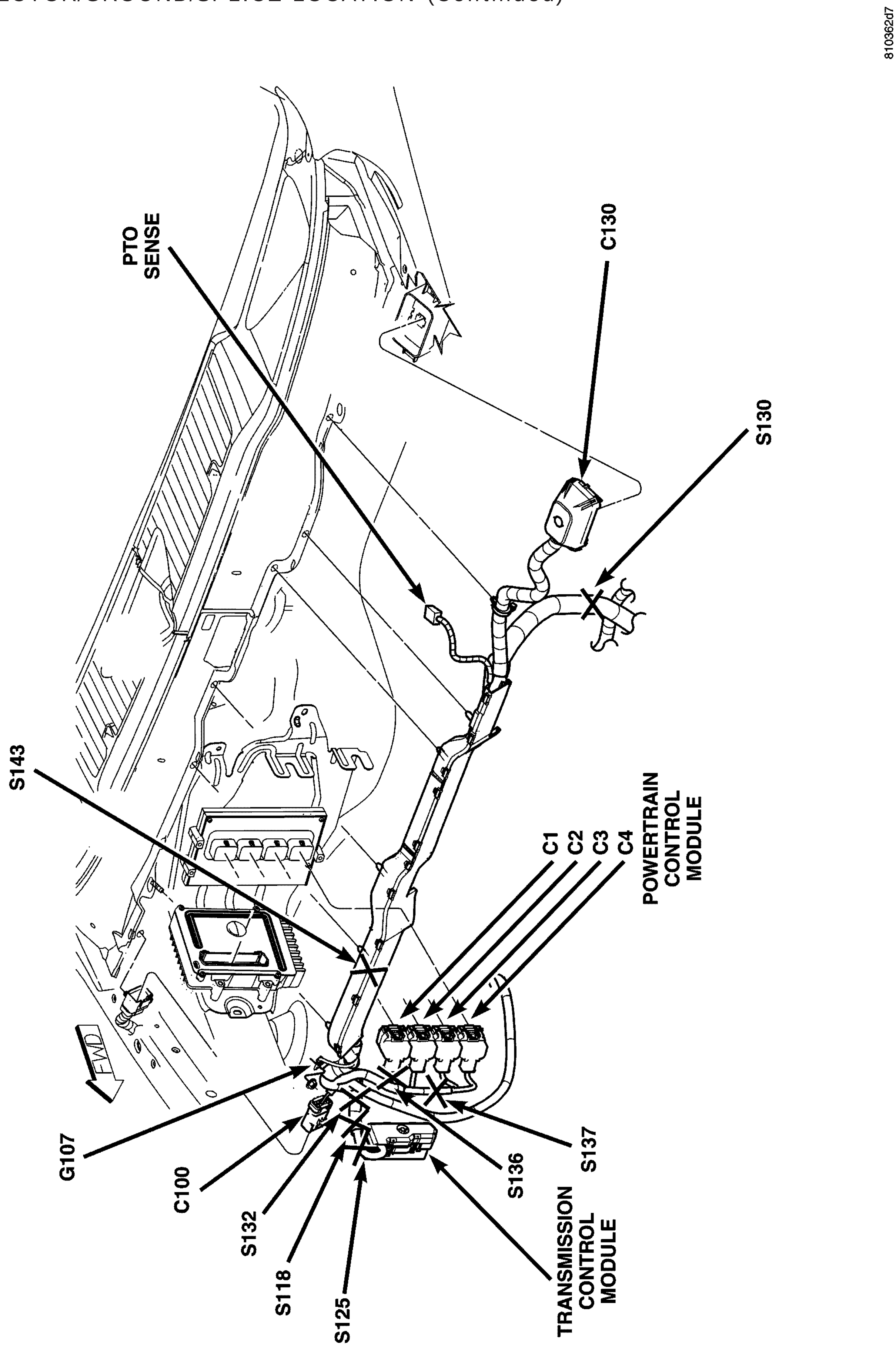


Fig. 21 REAR ENGINE COMPARTMENT (4.7L/5.7L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

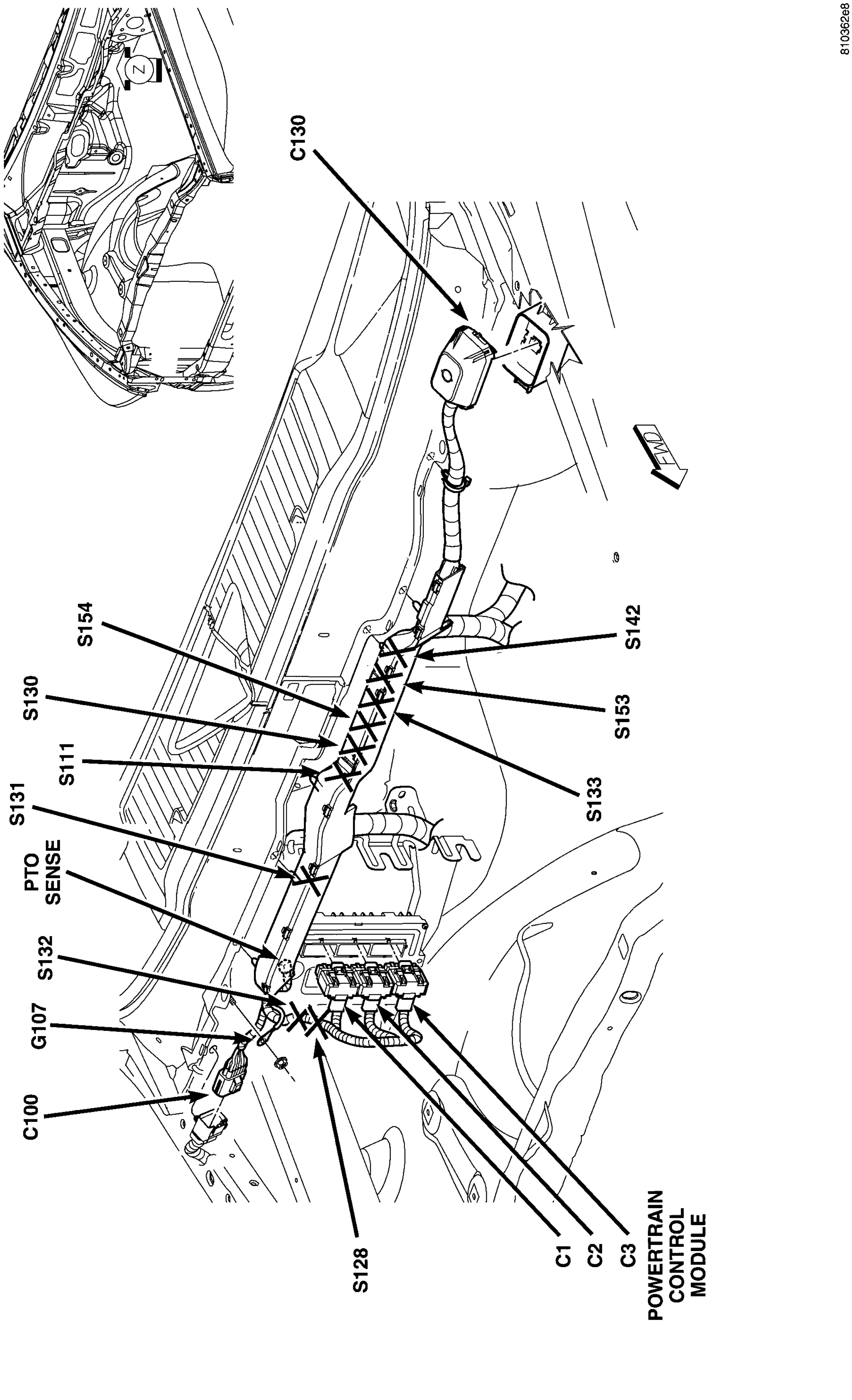


Fig. 22 REAR ENGINE COMPARTMENT (8.0L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

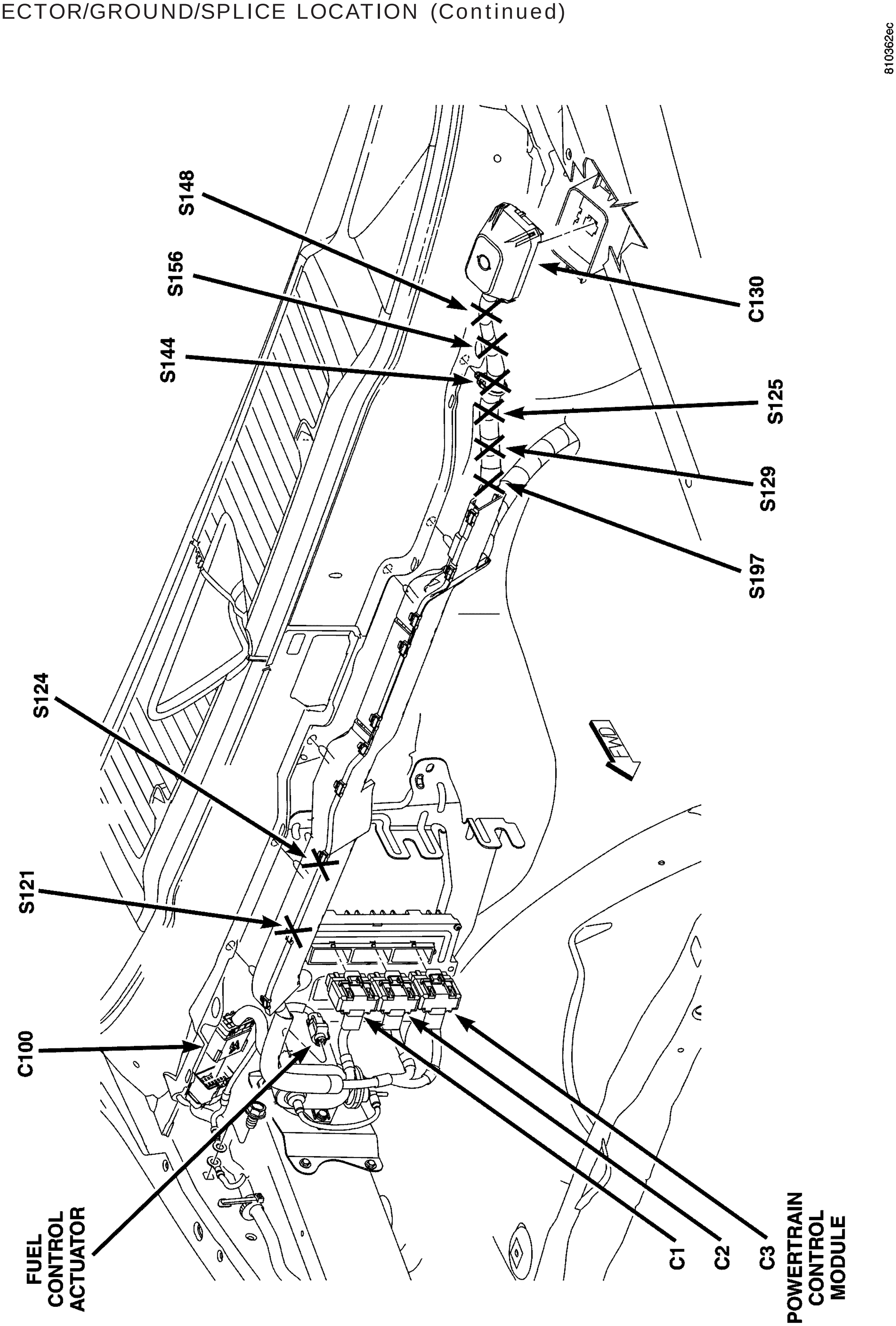


Fig. 23 REAR ENGINE COMPARTMENT (DIESEL)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

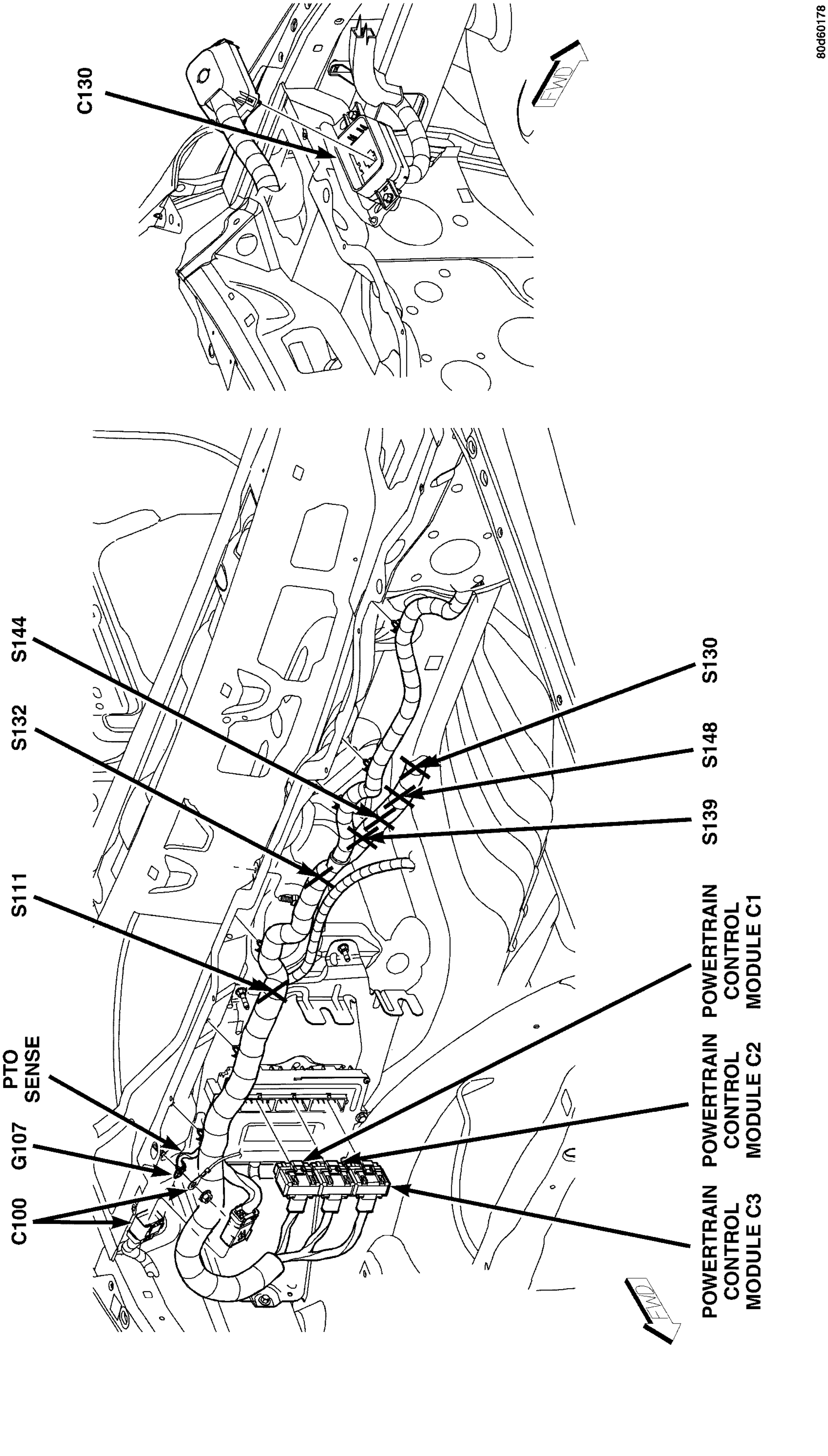


Fig. 24 TOP REAR ENGINE COMPARTMENT (5.9L)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

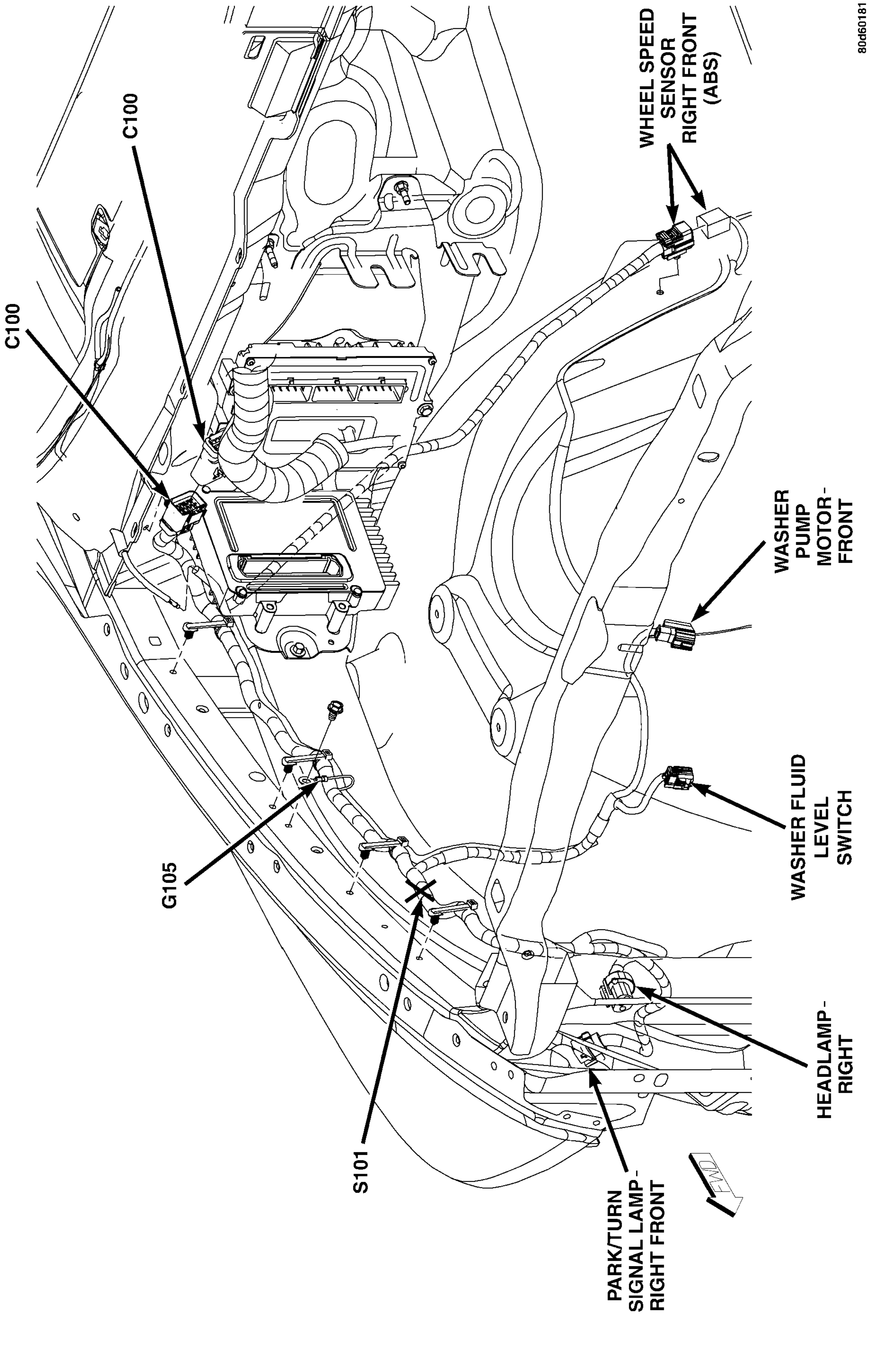


Fig. 25 RIGHT SIDE ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

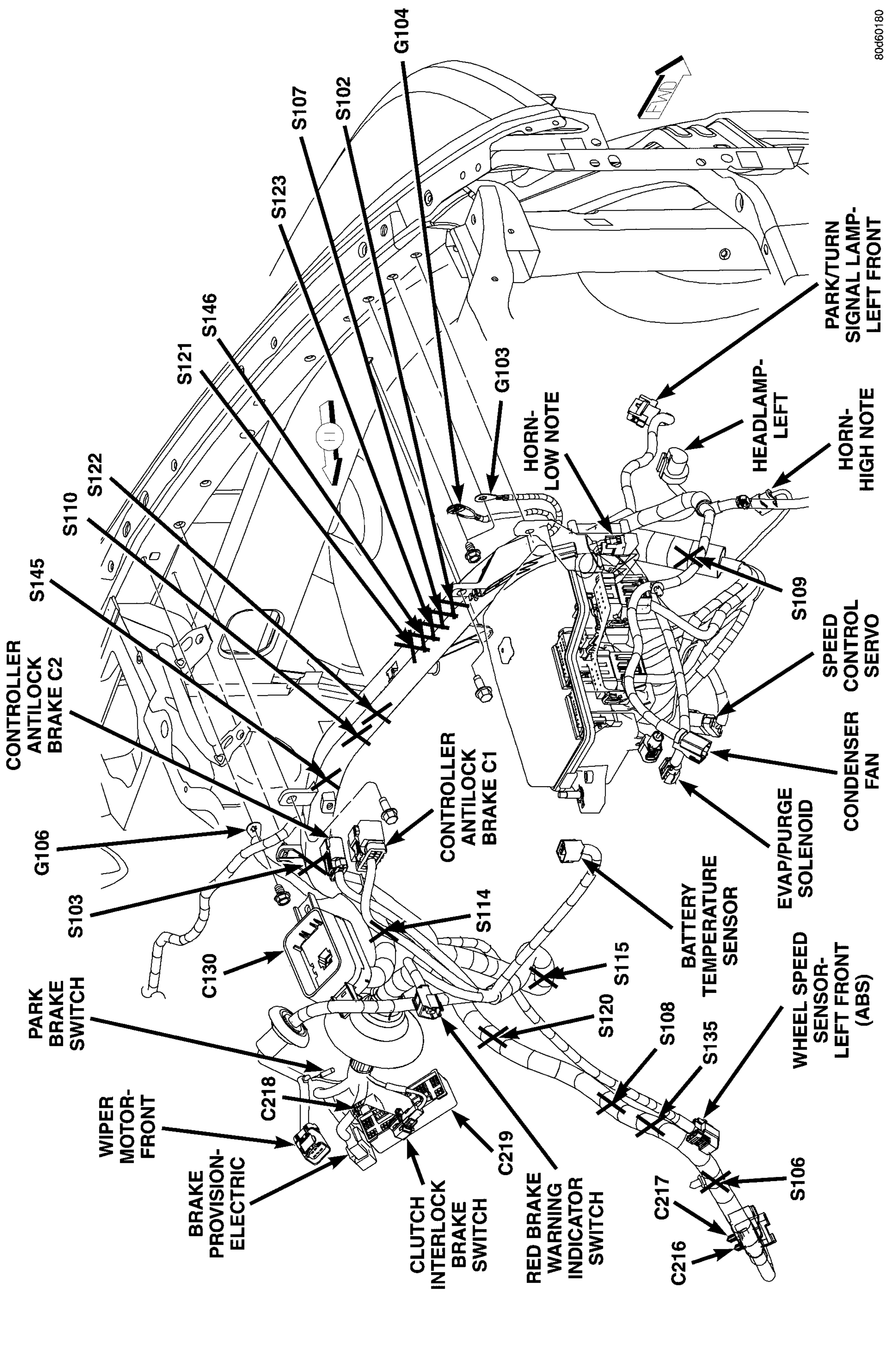


Fig. 26 LEFT SIDE ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

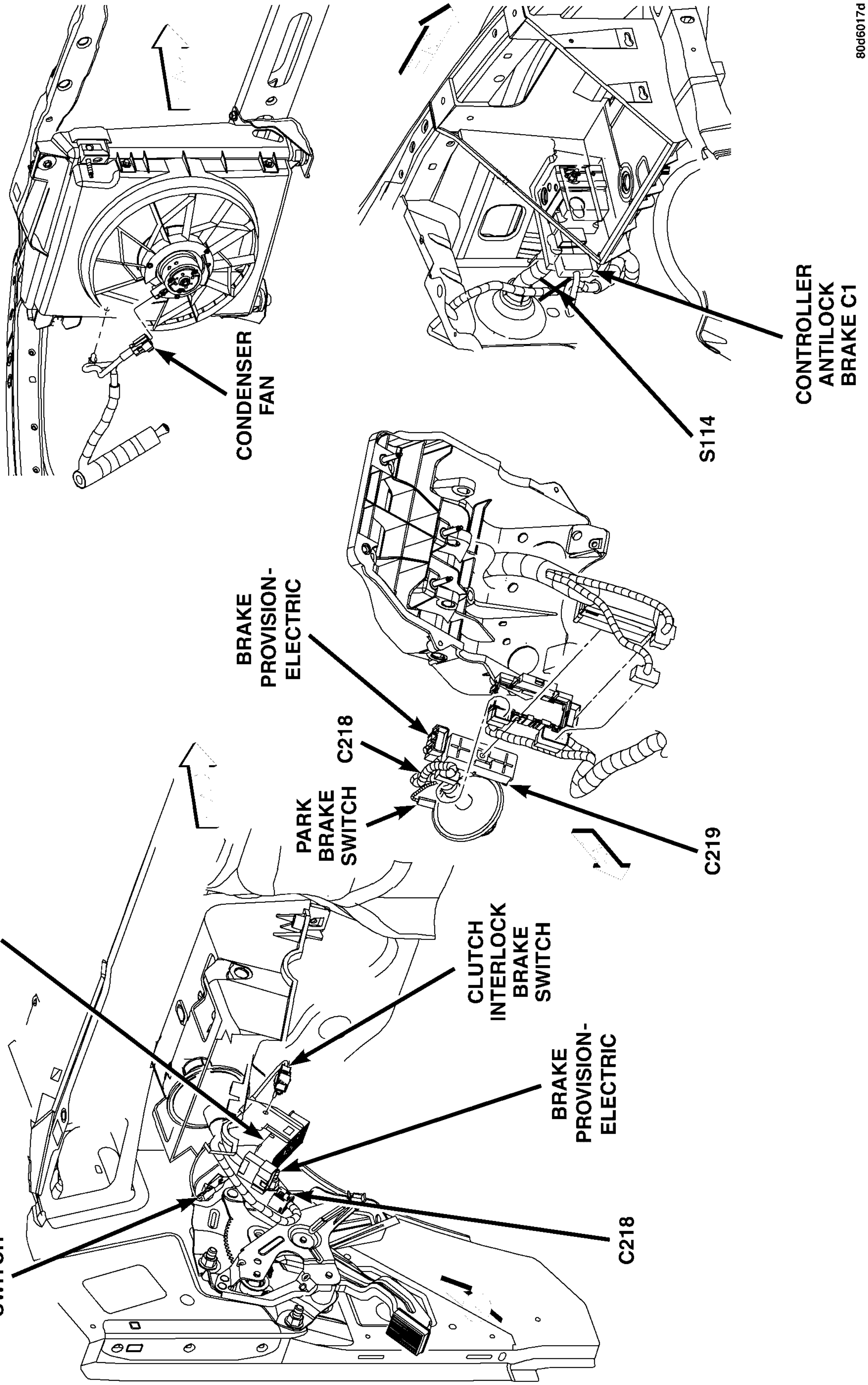


Fig. 27 LEFT SIDE ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

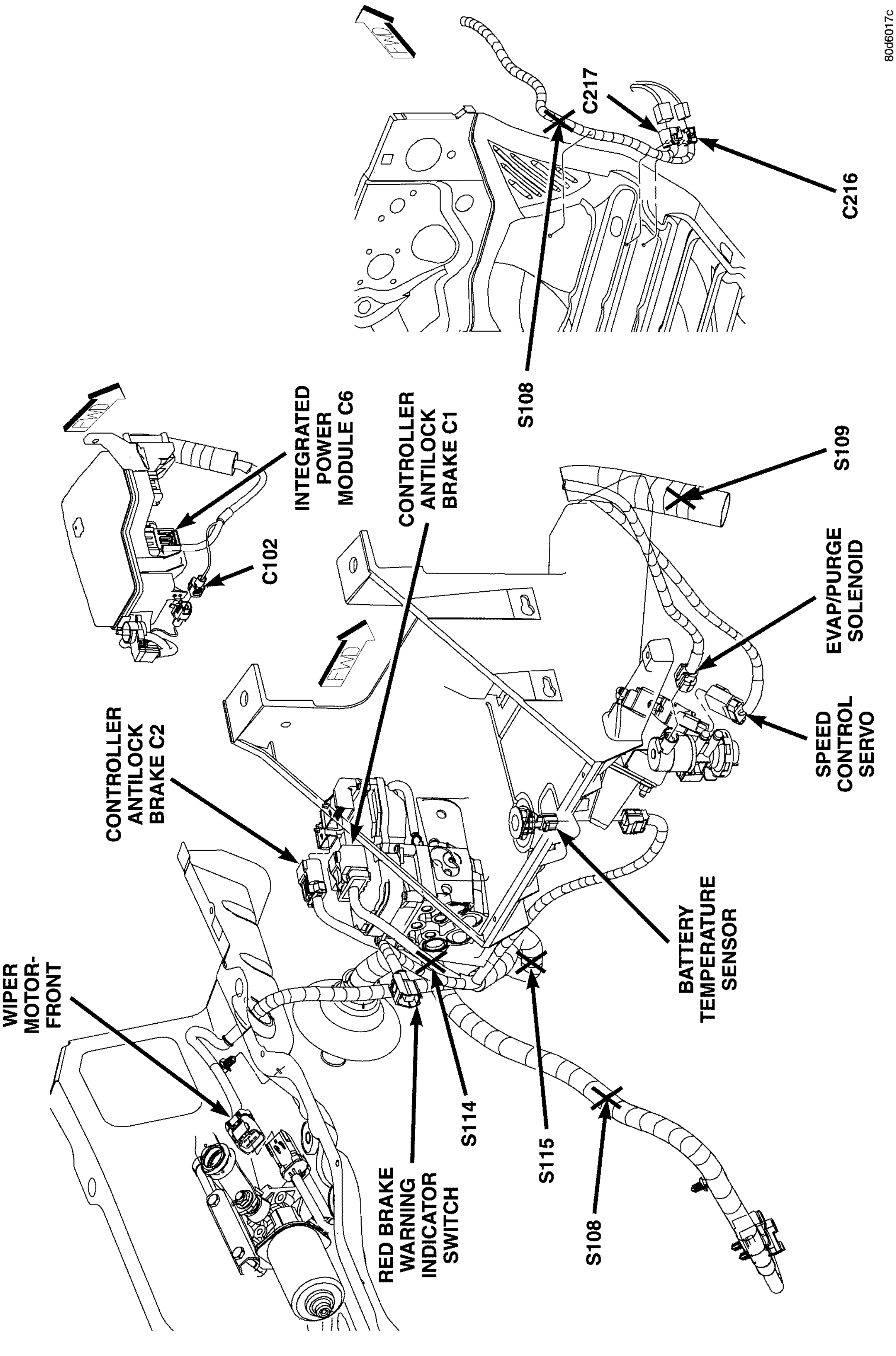


Fig. 28 LEFT SIDE ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

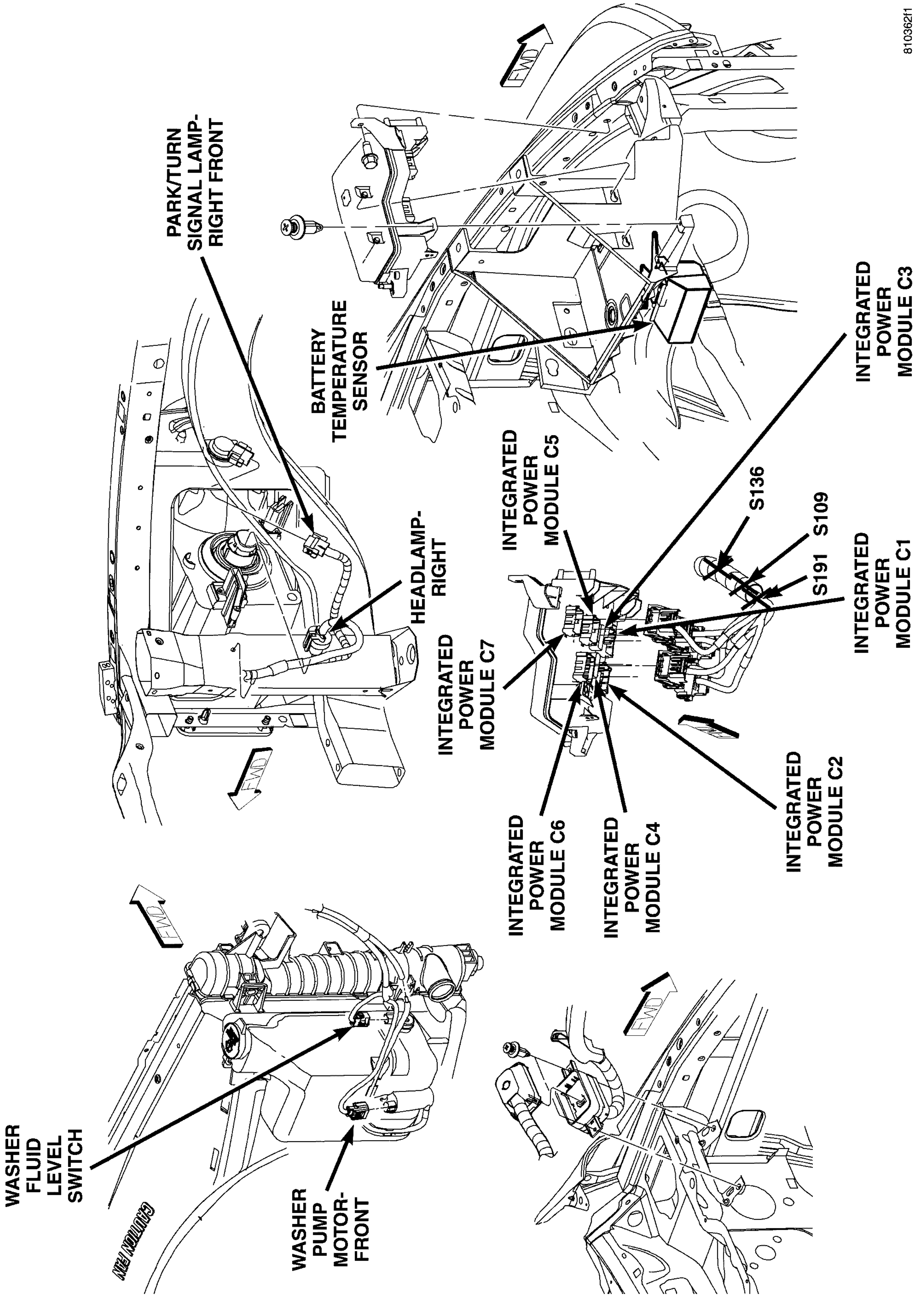


Fig. 29 LEFT SIDE ENGINE COMPARTMENT

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

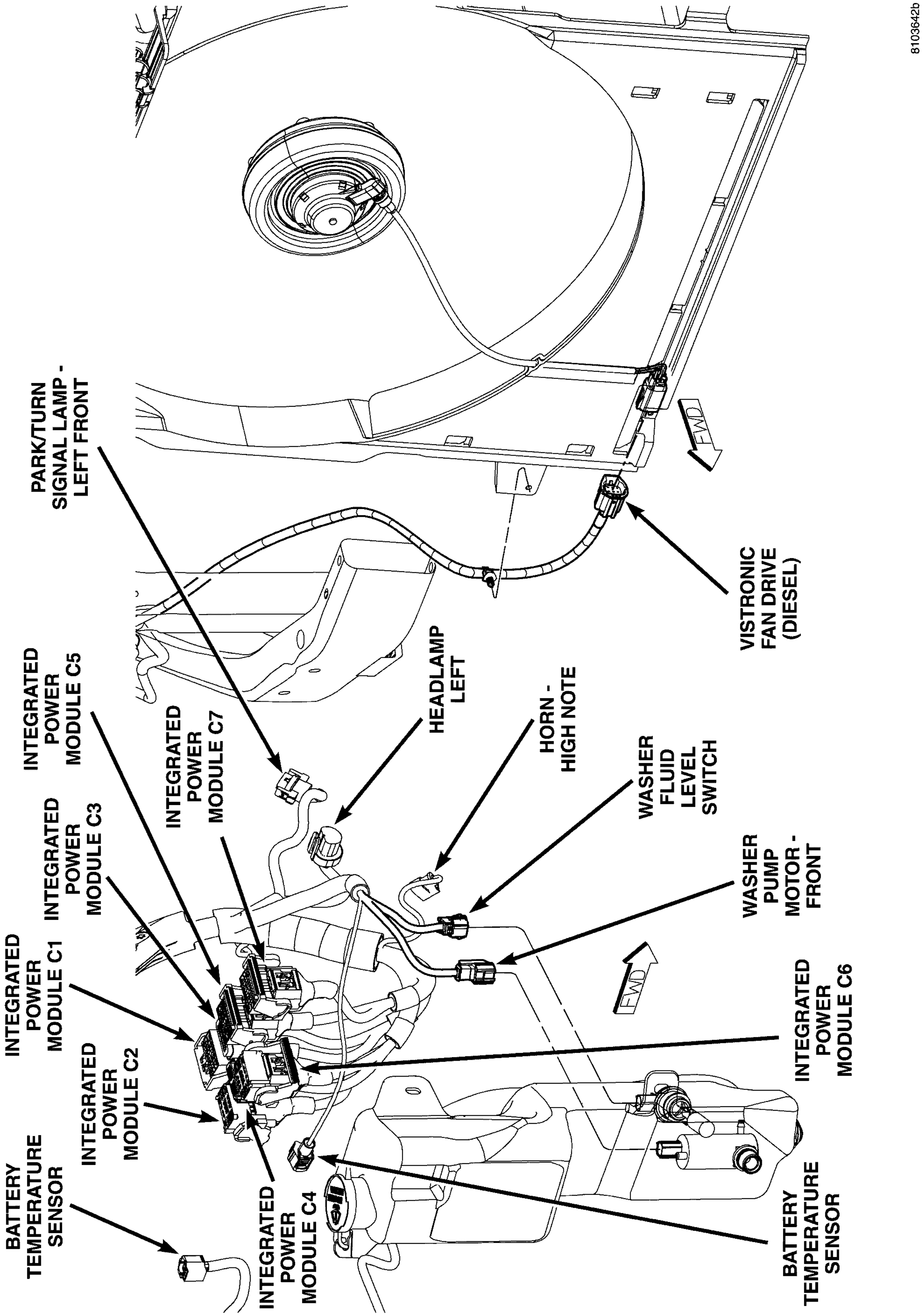


Fig. 30 INTEGRATED POWER MODULE AND FAN

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

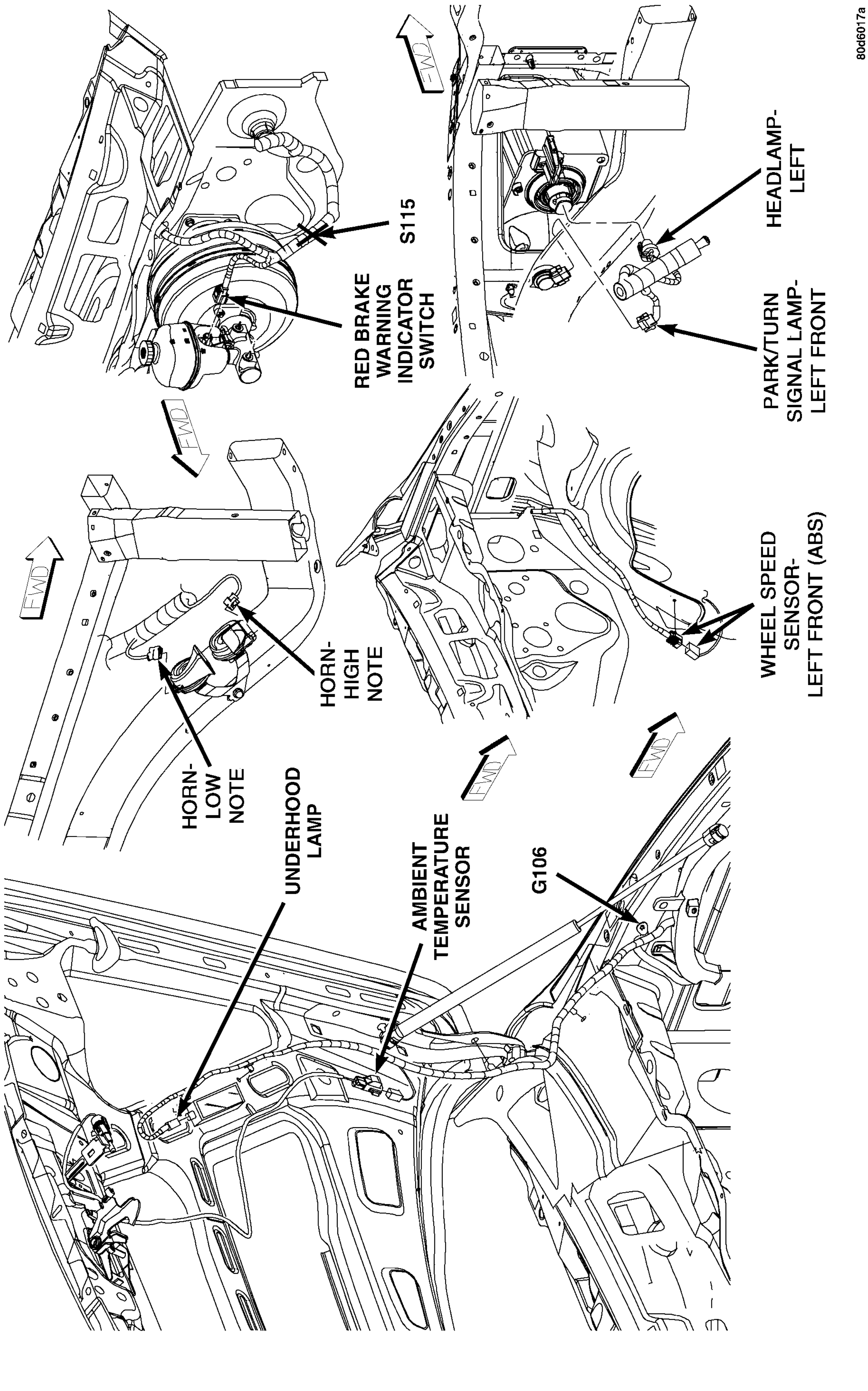


Fig. 31 LEFT SIDE ENGINE COMPARTMENT AND HOOD

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

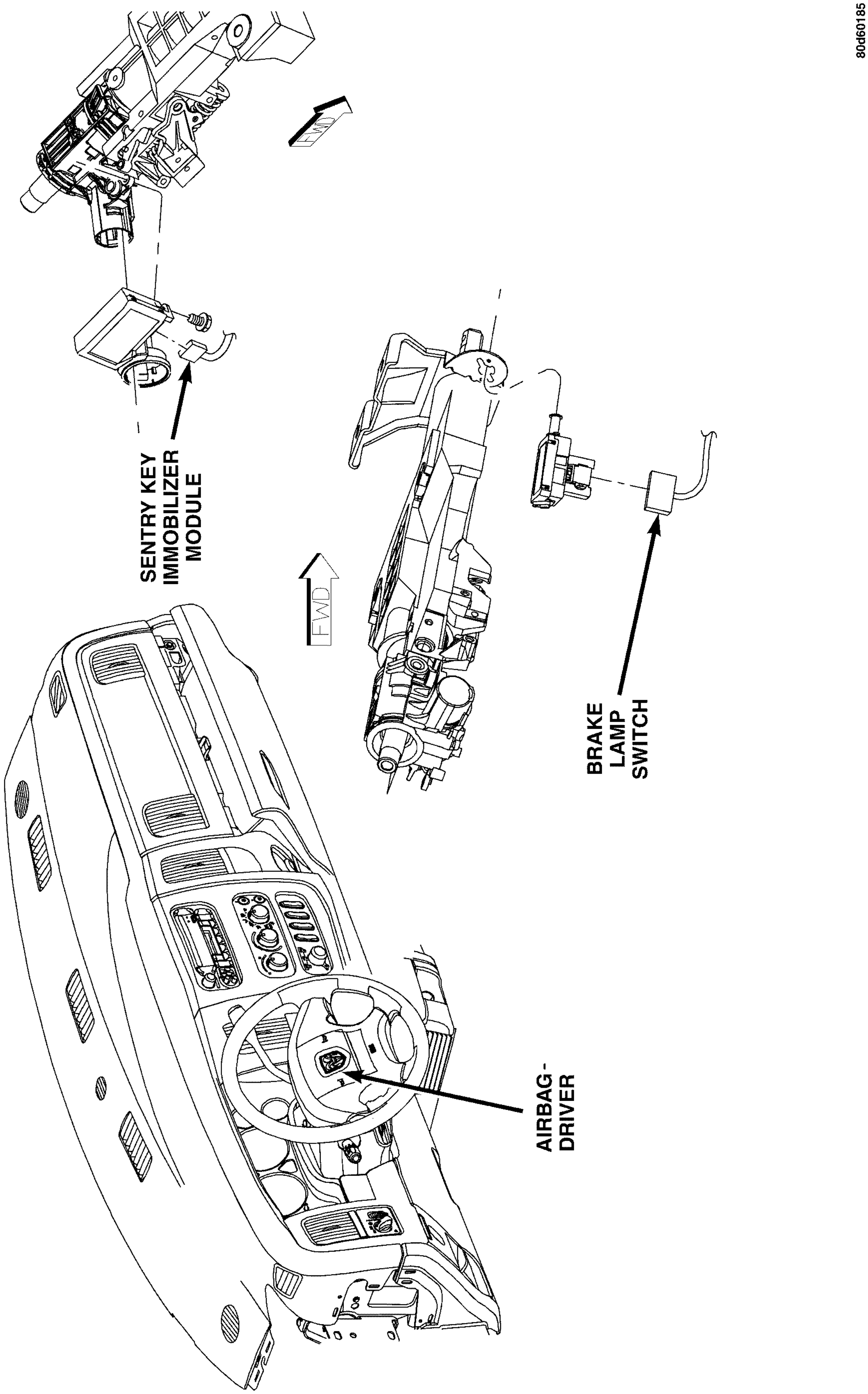


Fig. 32 STEERING COLUMN

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

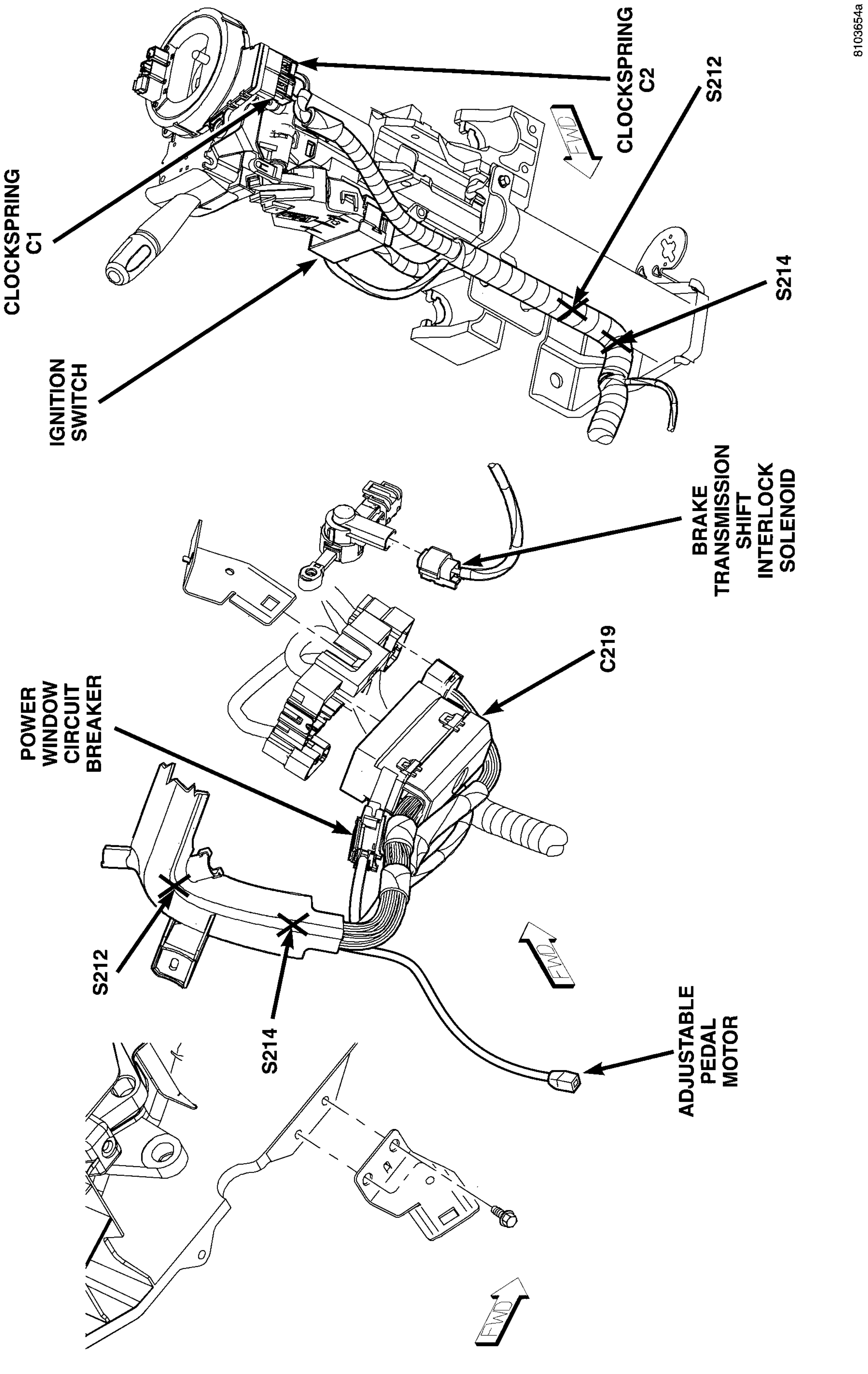


Fig. 33 LEFT STEERING COLUMN

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

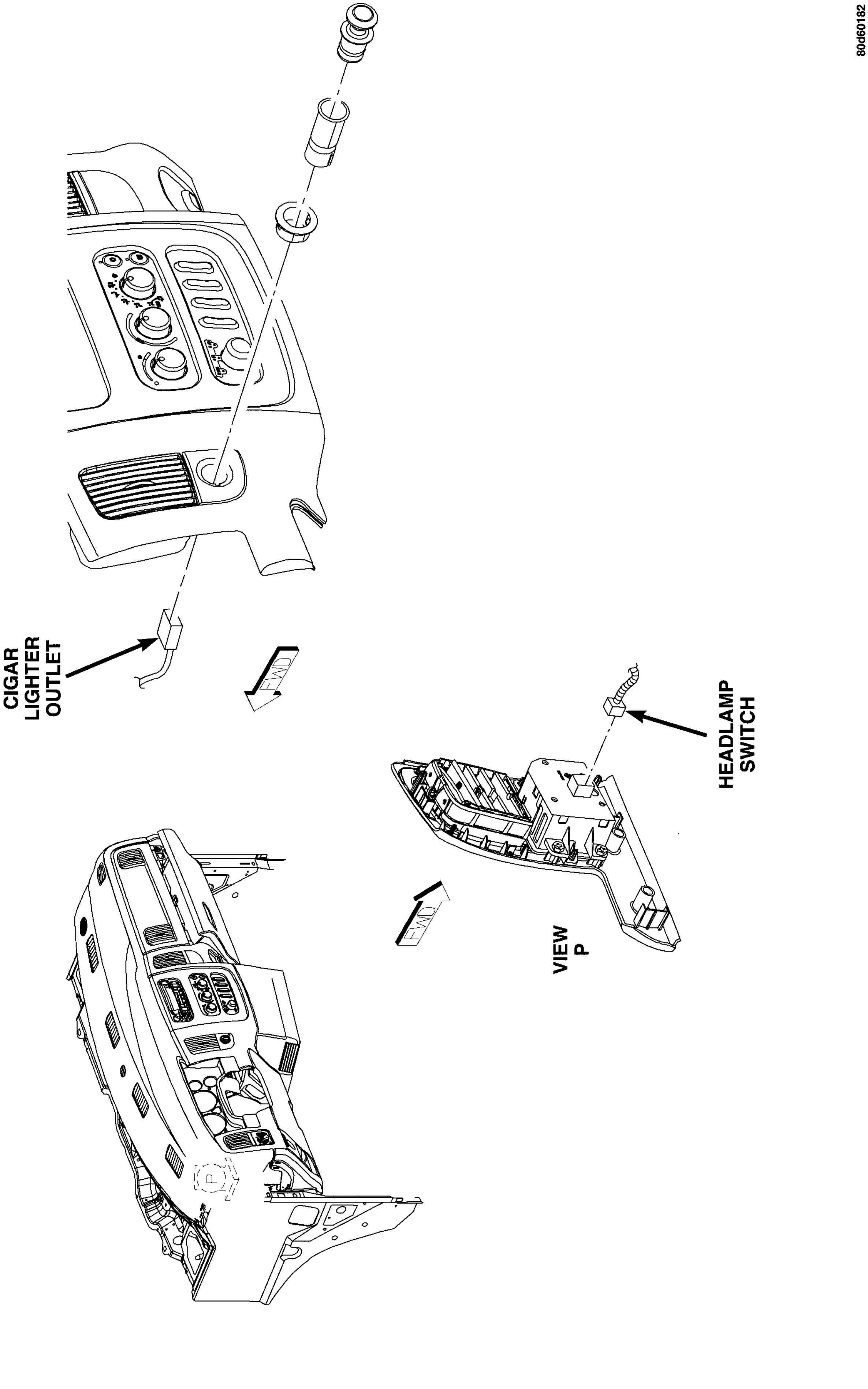


Fig. 34 INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

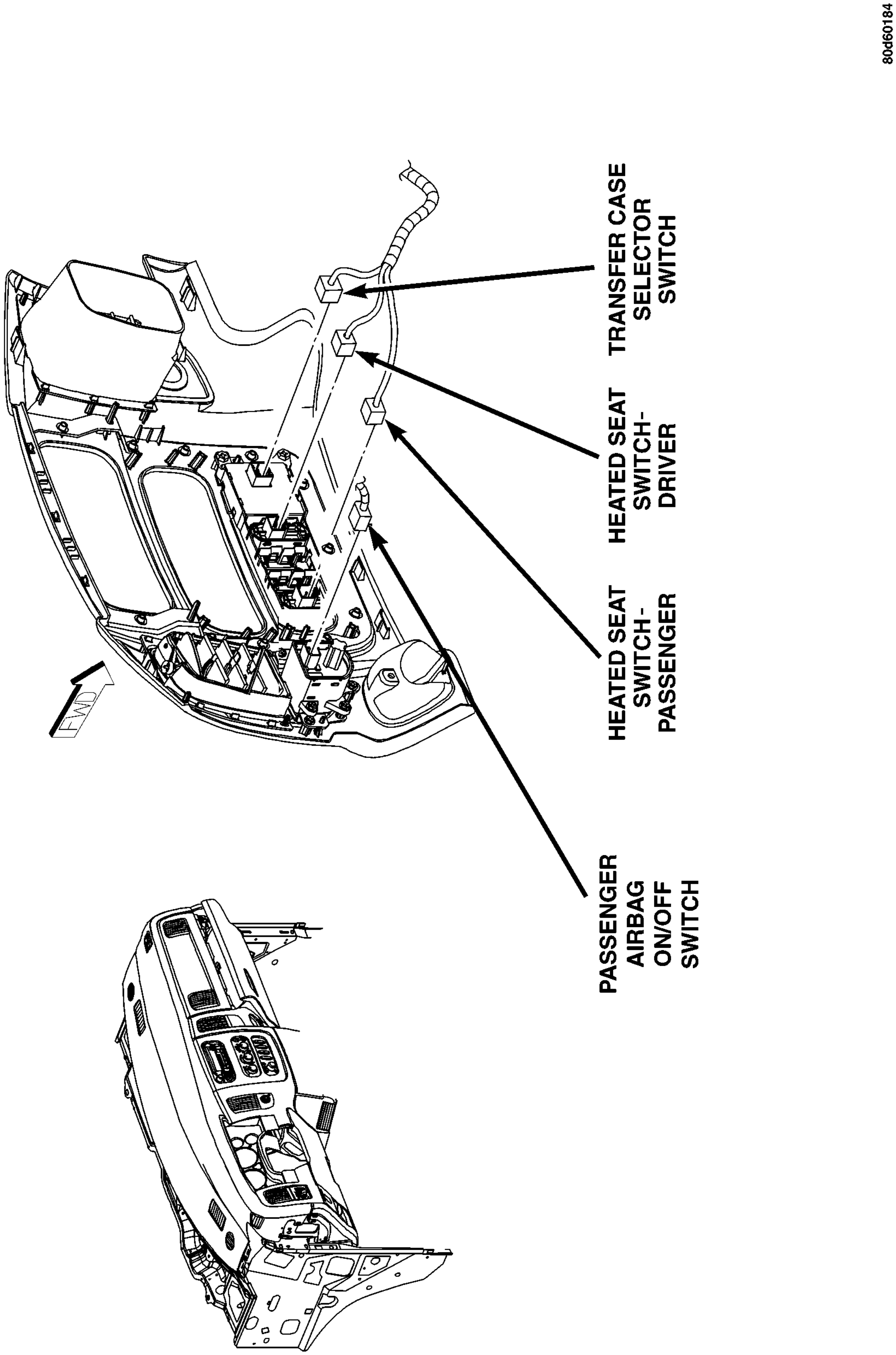


Fig. 35 REAR INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

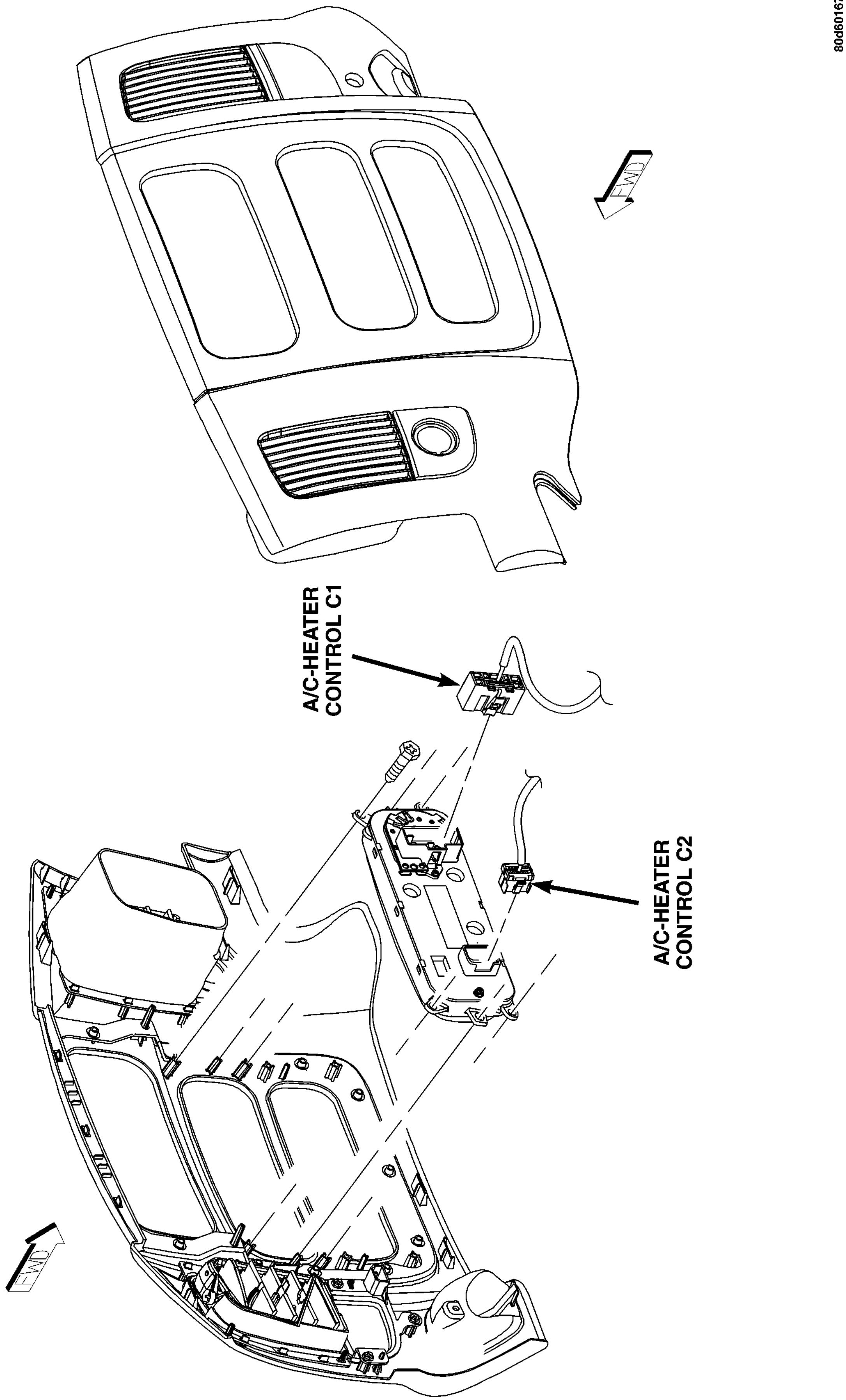


Fig. 36 CENTER INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

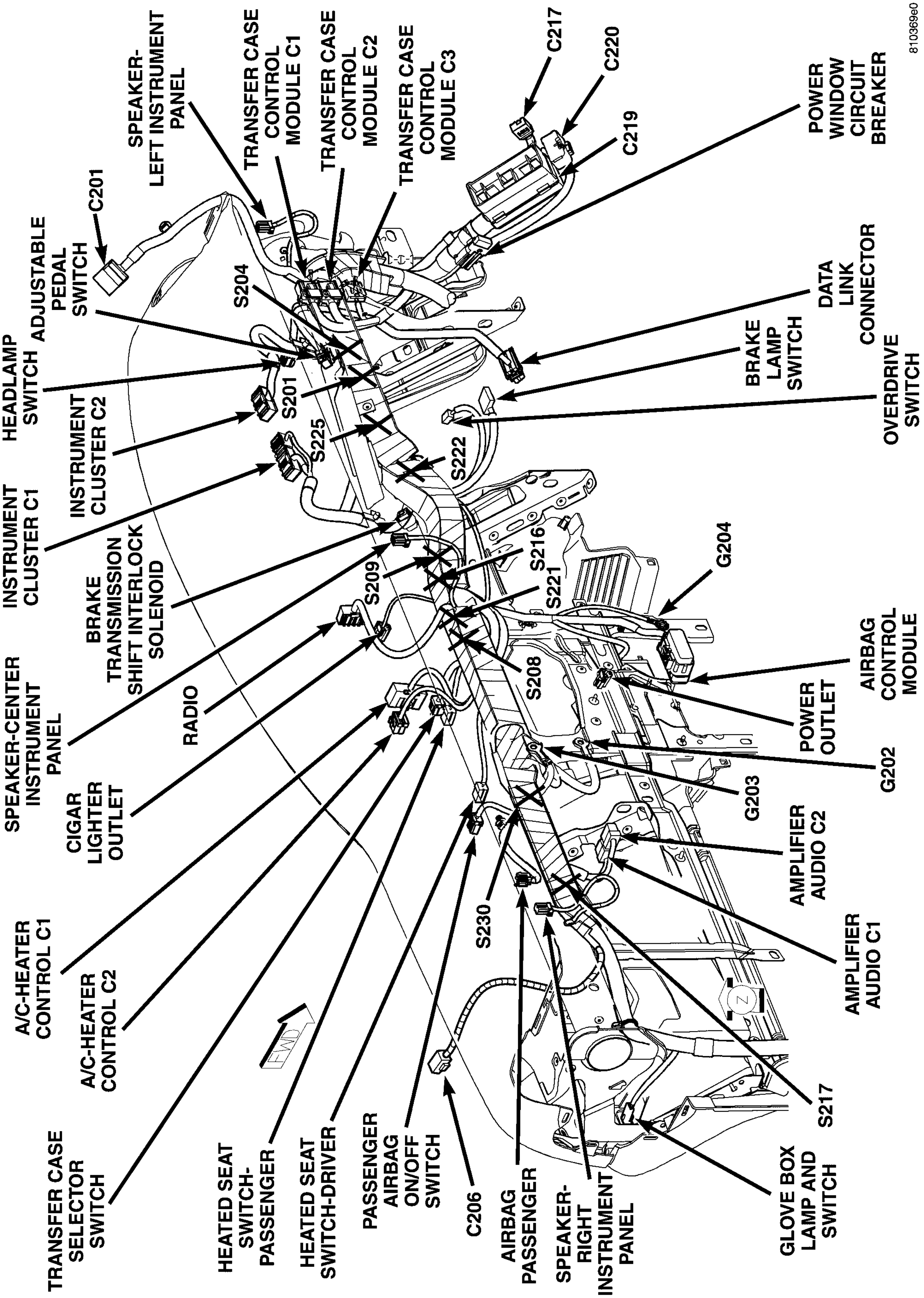


Fig. 37 INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

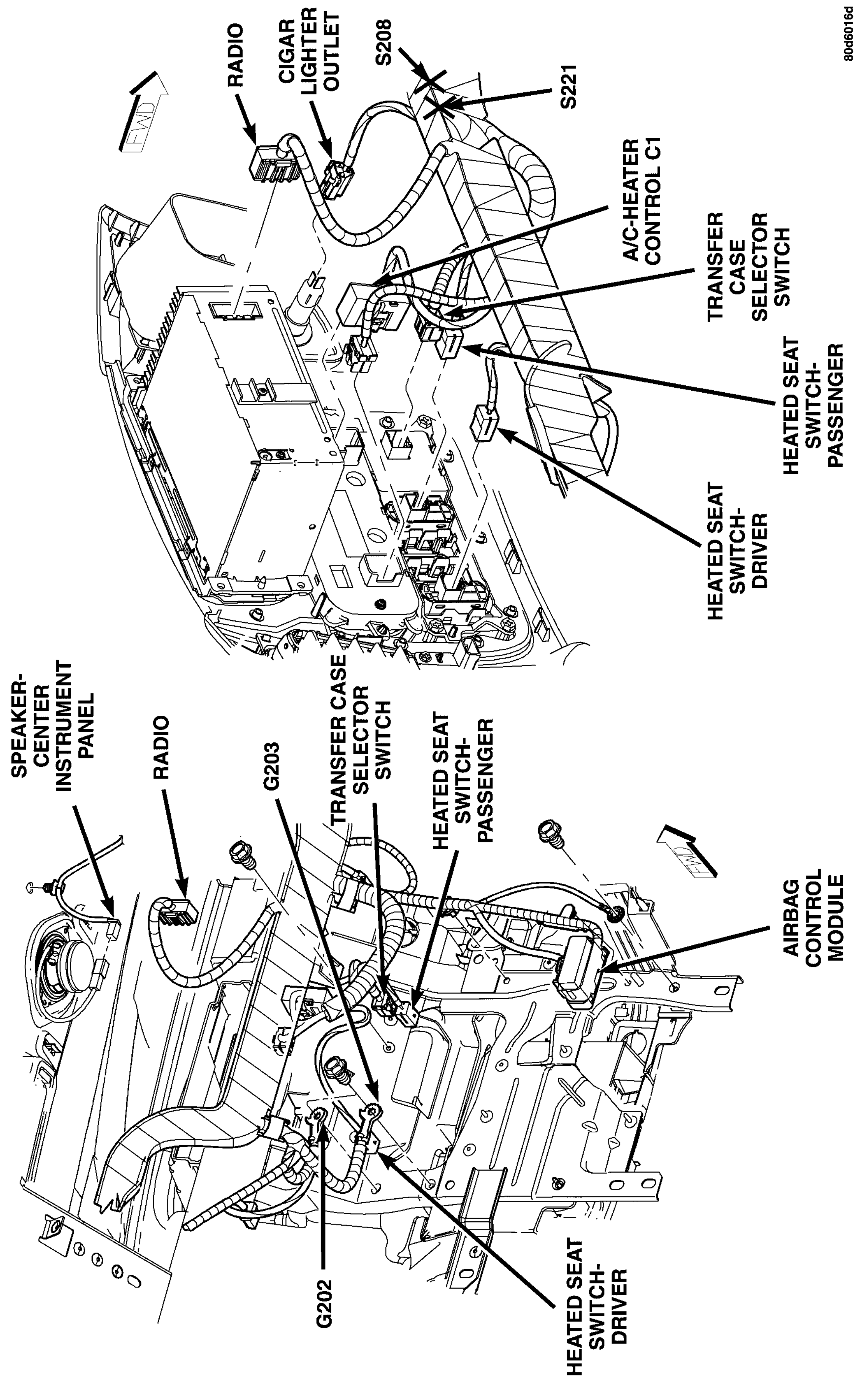


Fig. 38 CENTER INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

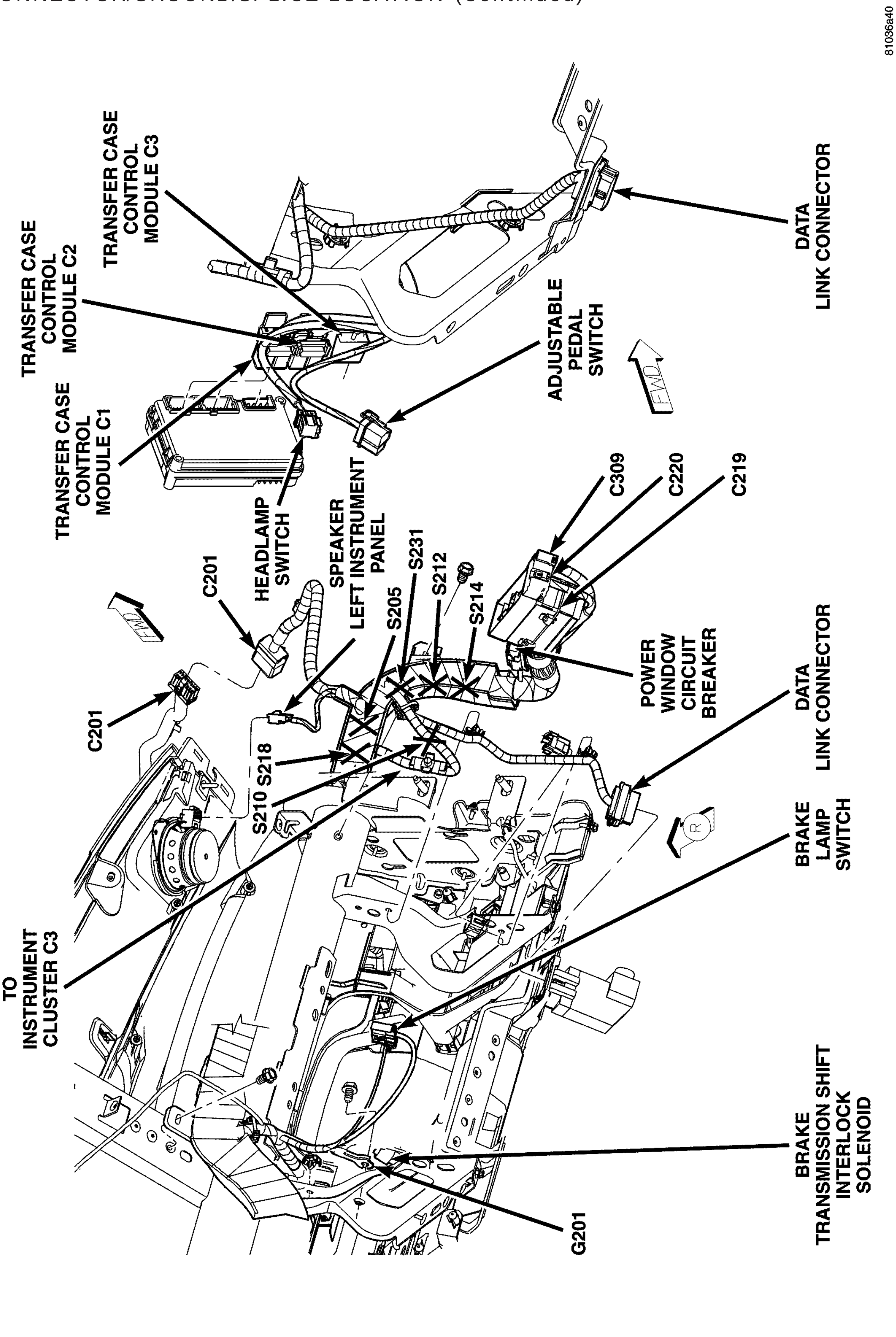


Fig. 39 LEFT INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

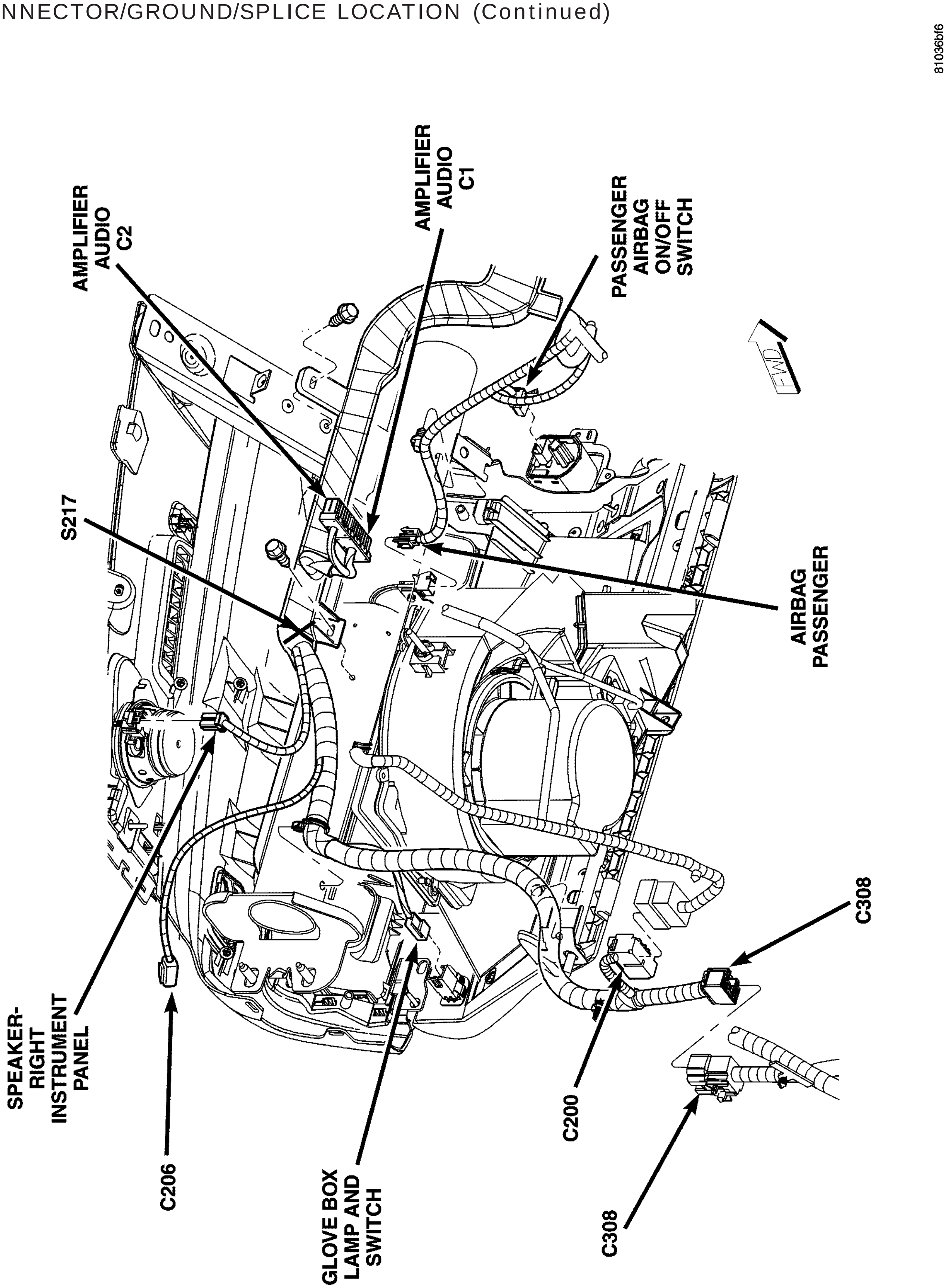


Fig. 40 RIGHT INSTRUMENT PANEL

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

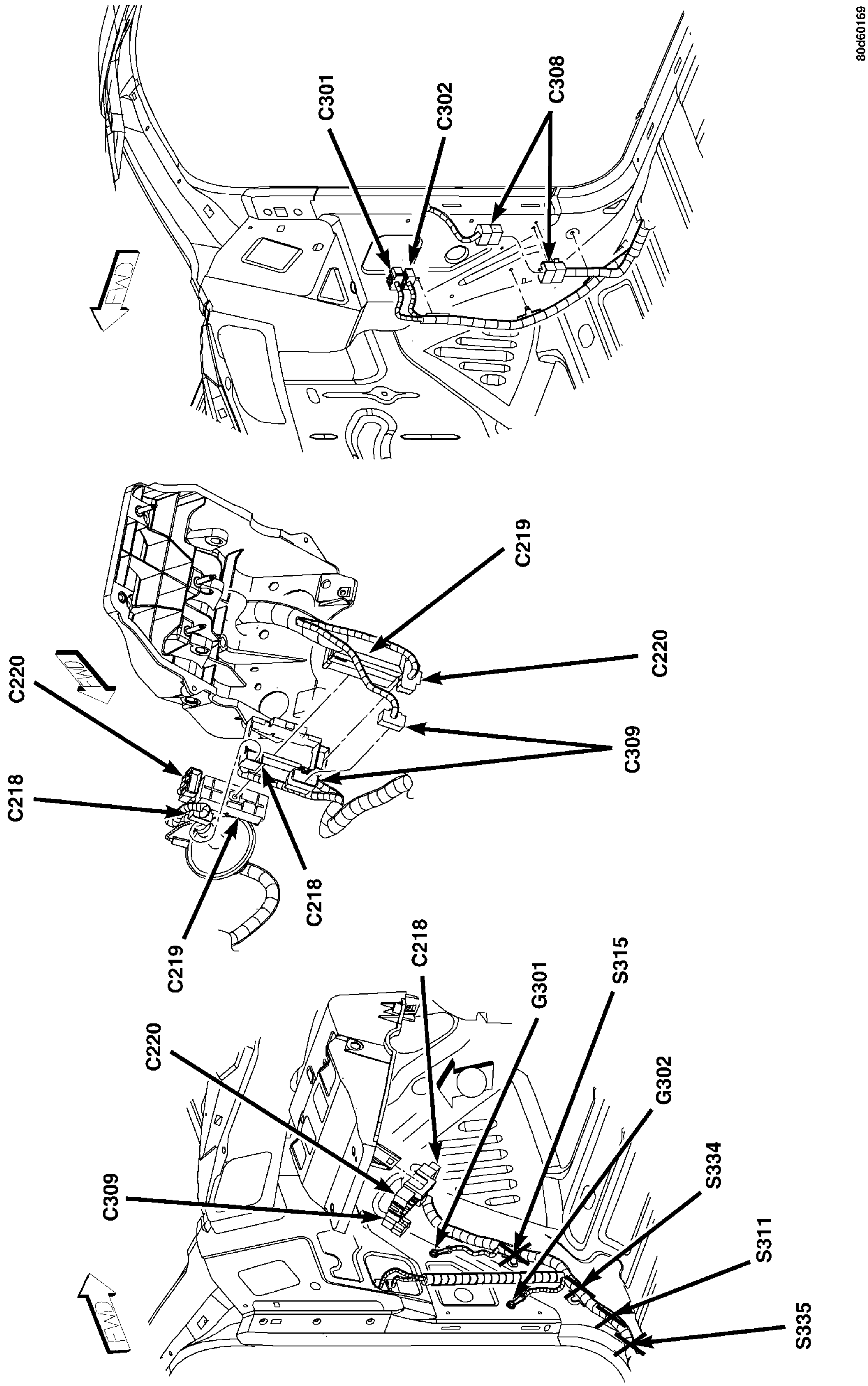


Fig. 41 STANDARD CAB FRONT BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

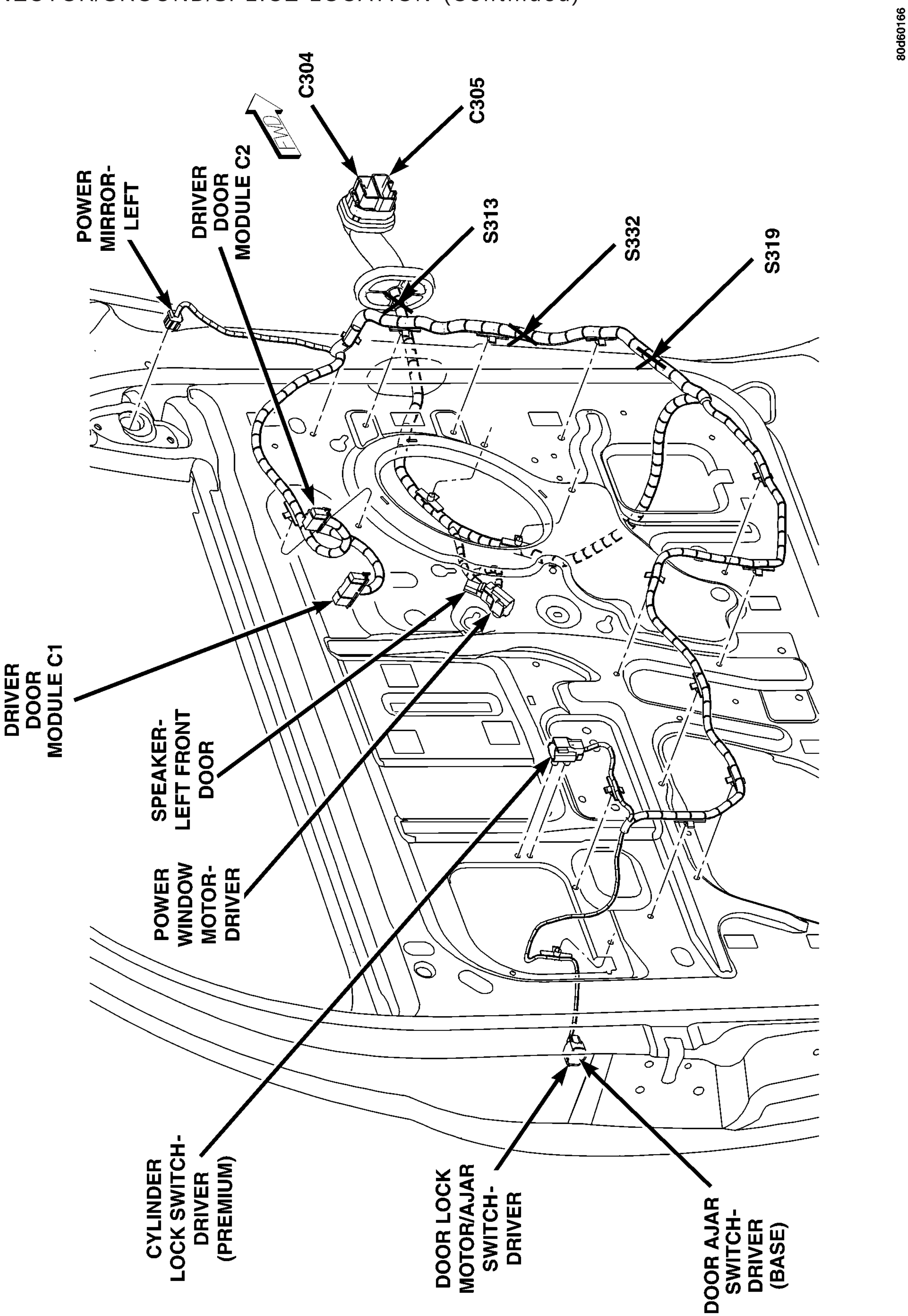


Fig. 42 STANDARD CAB LEFT FRONT DOOR PREMIUM

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

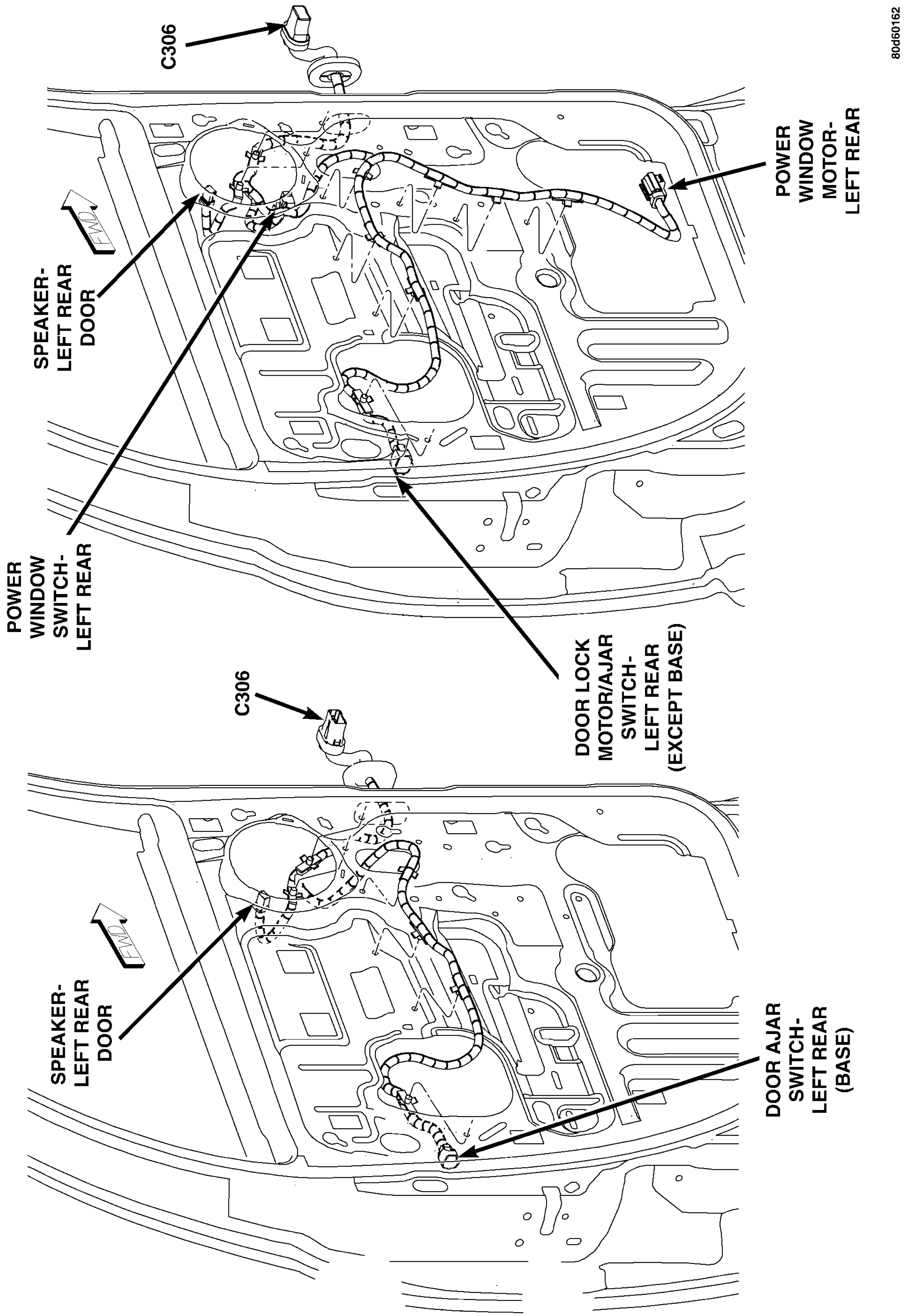


Fig. 43 LEFT REAR DOOR (RIGHT SIDE SIMILAR)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

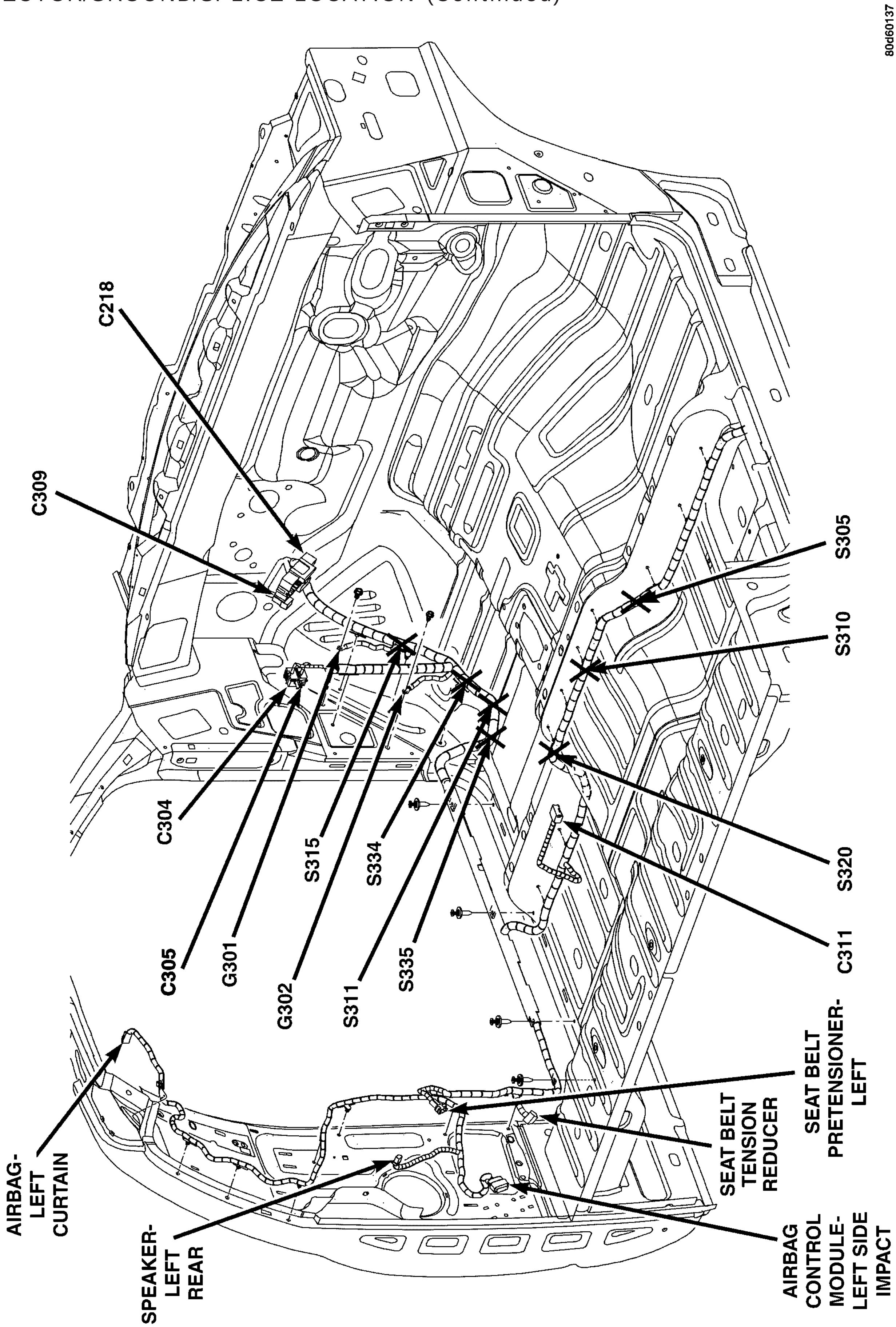


Fig. 44 STANDARD CAB LEFT SIDE BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

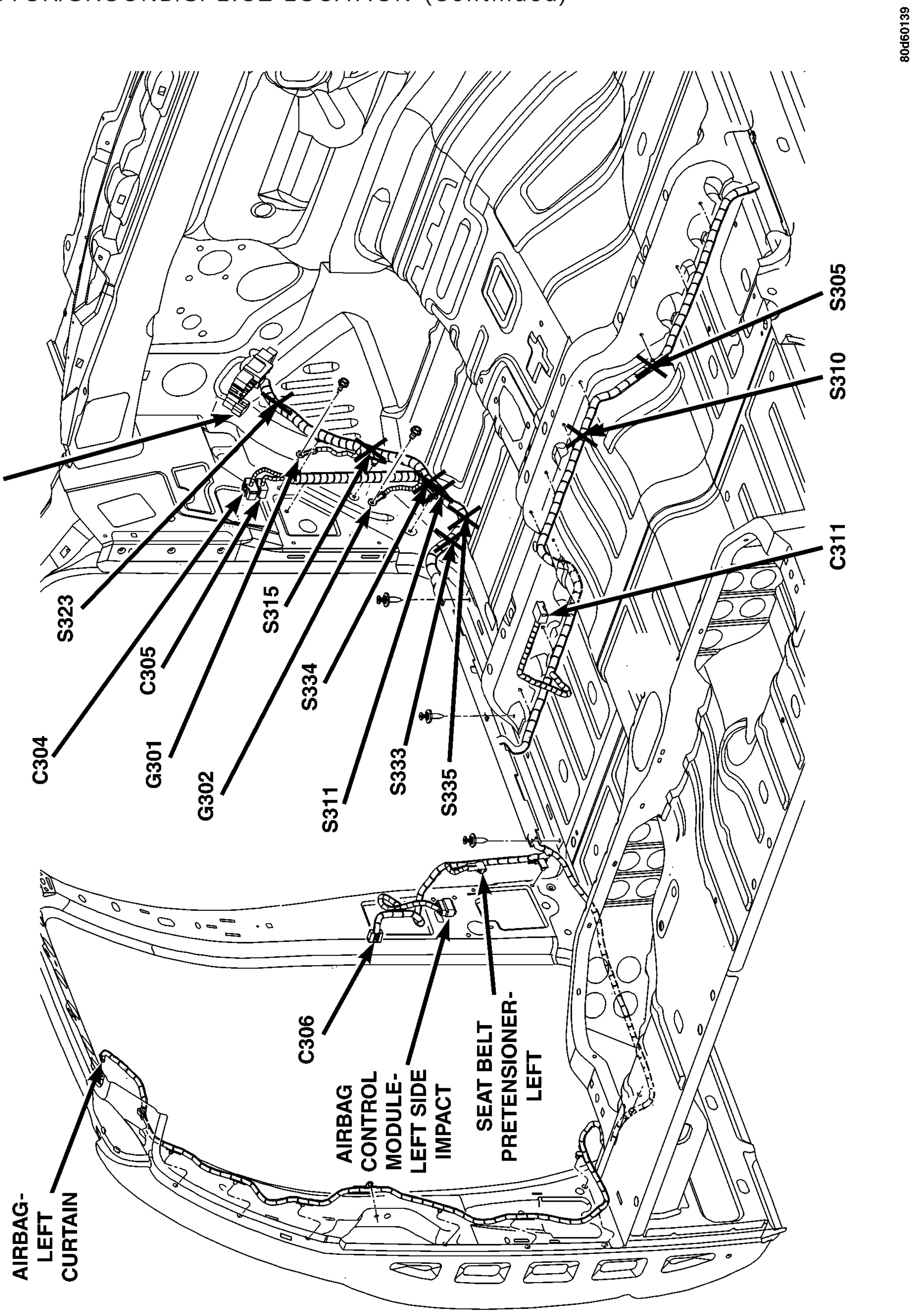


Fig. 45 QUAD CAB LEFT SIDE BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

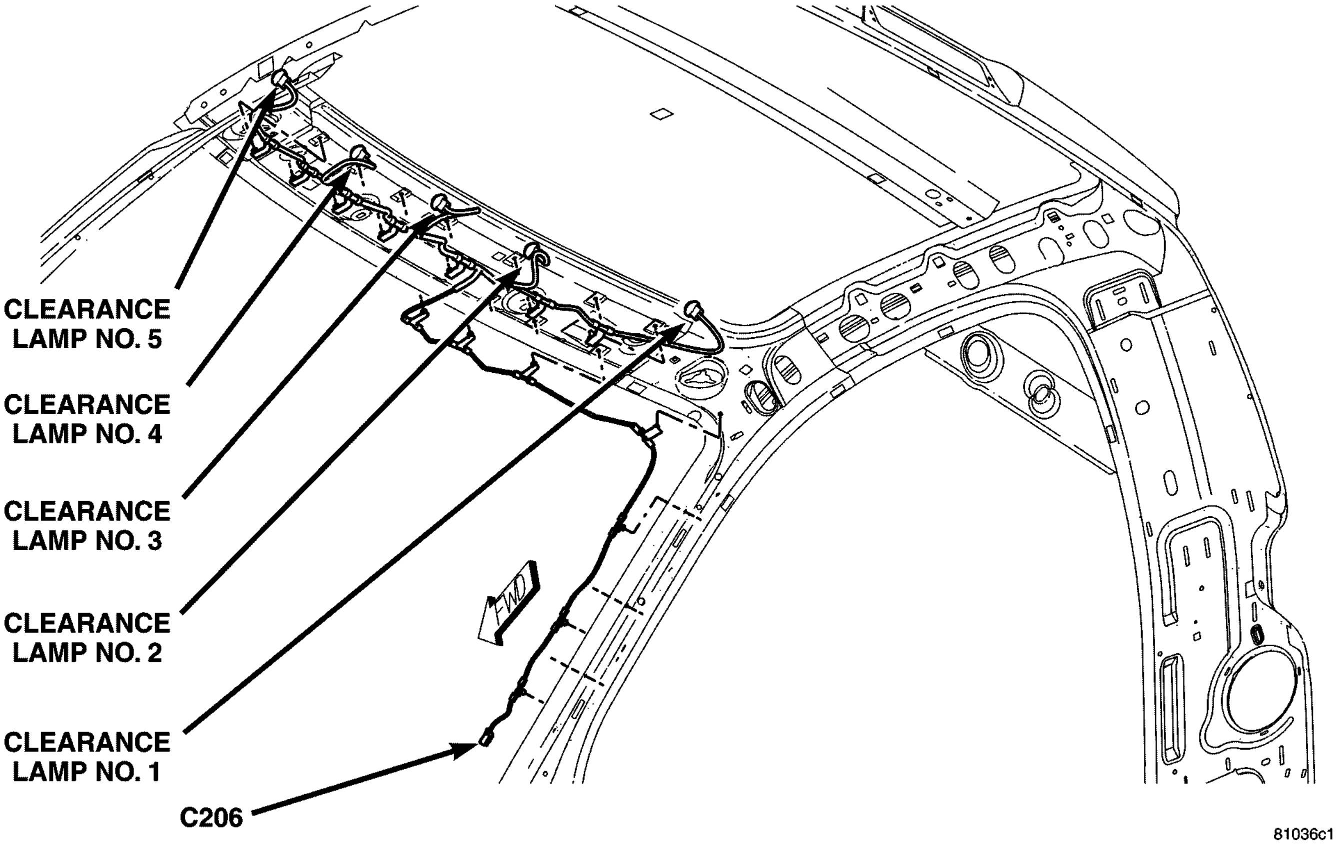


Fig. 46 ROOF

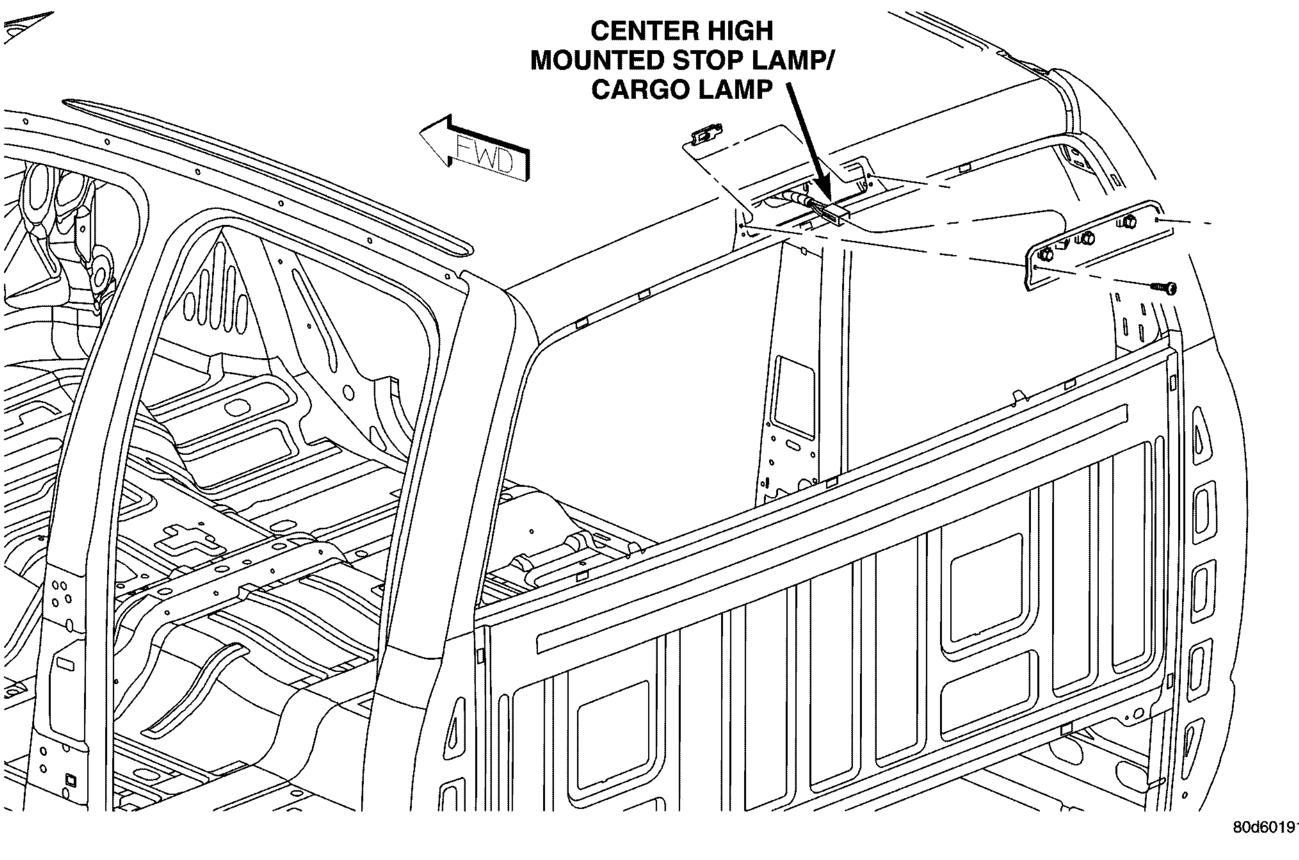


Fig. 47 REAR BODY

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

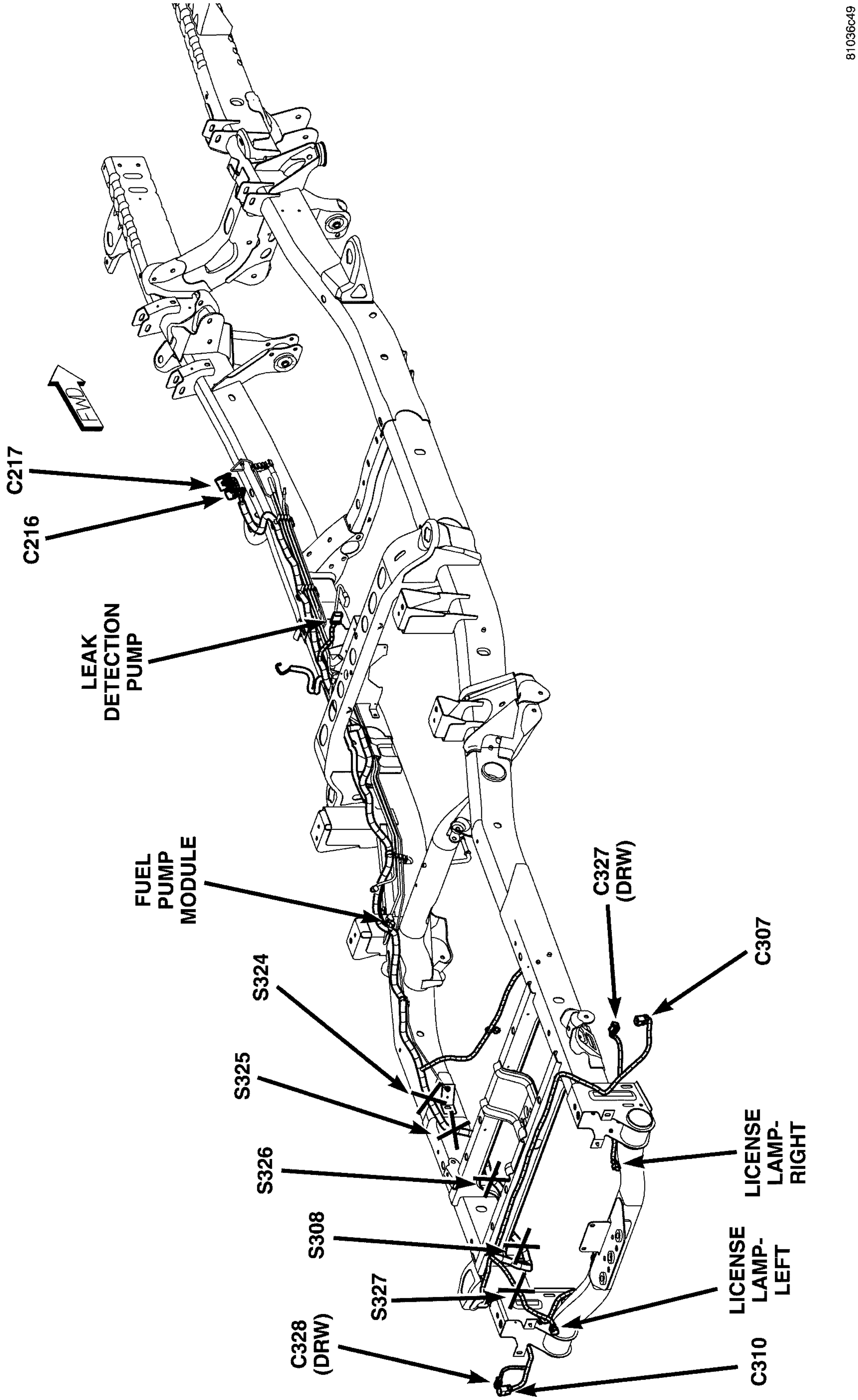


Fig. 48 CHASSIS

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

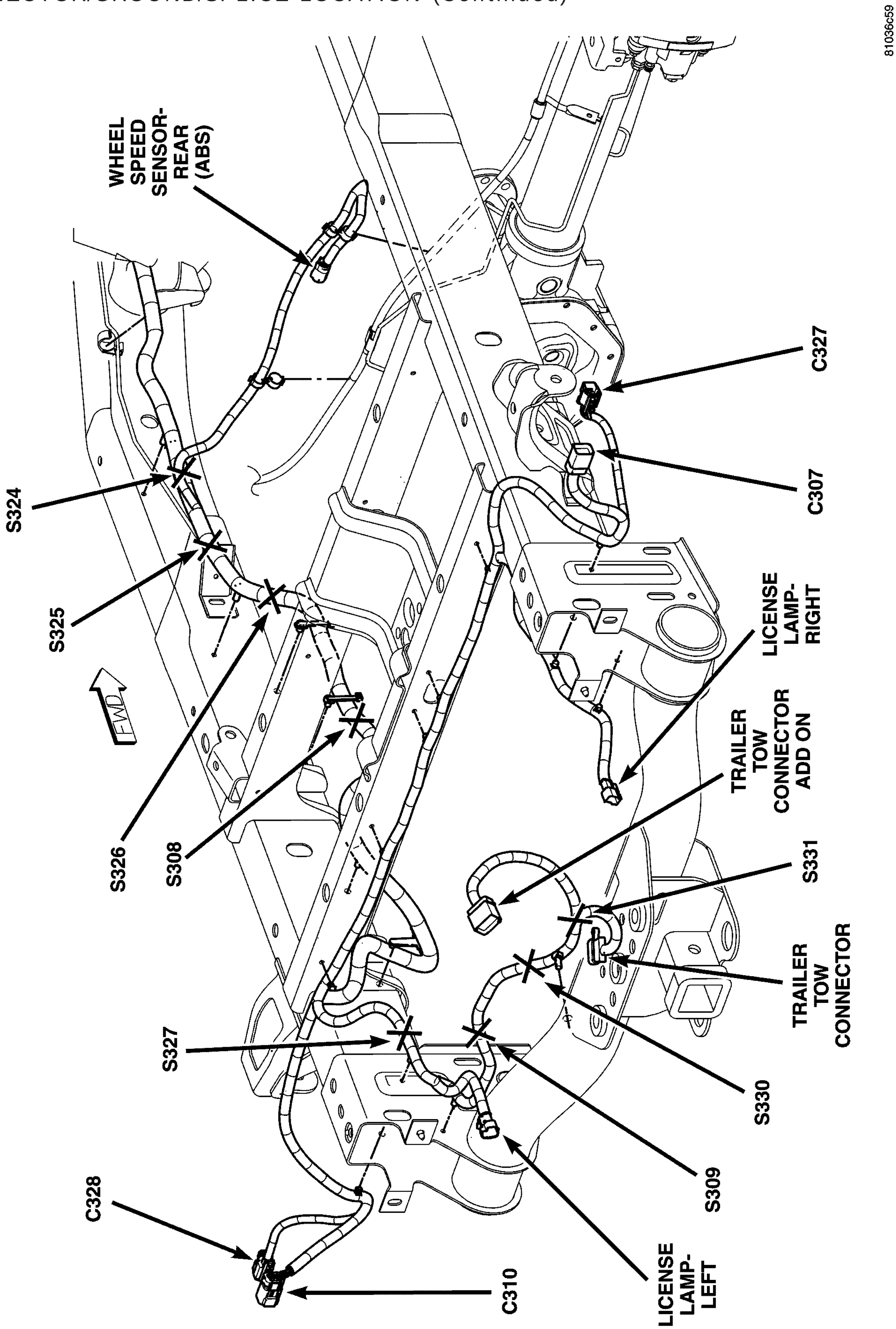


Fig. 49 REAR CHASSIS

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

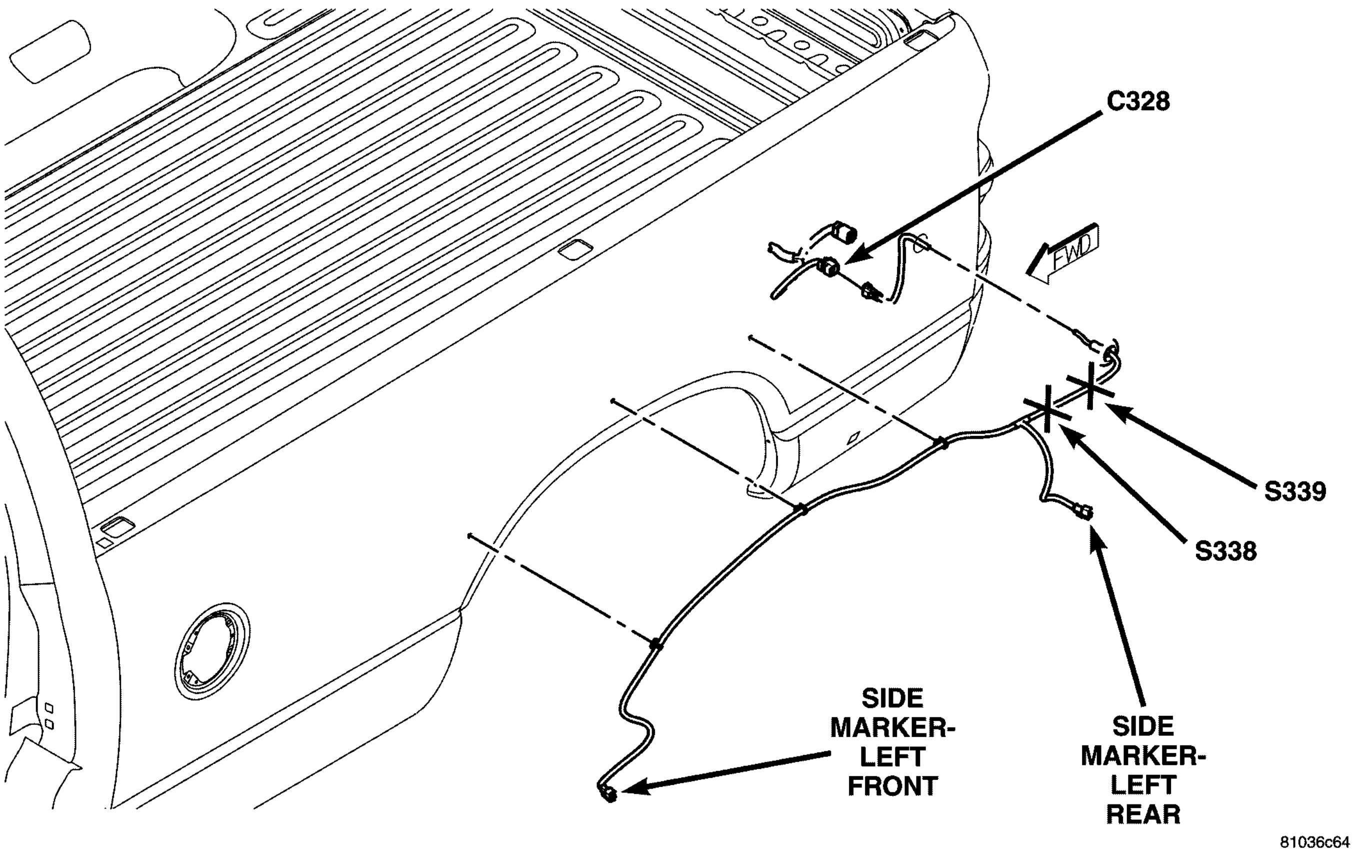


Fig. 50 LEFT REAR FENDER (RIGHT SIDE SIMILAR)

CONNECTOR/GROUND/SPLICE LOCATION (Continued)

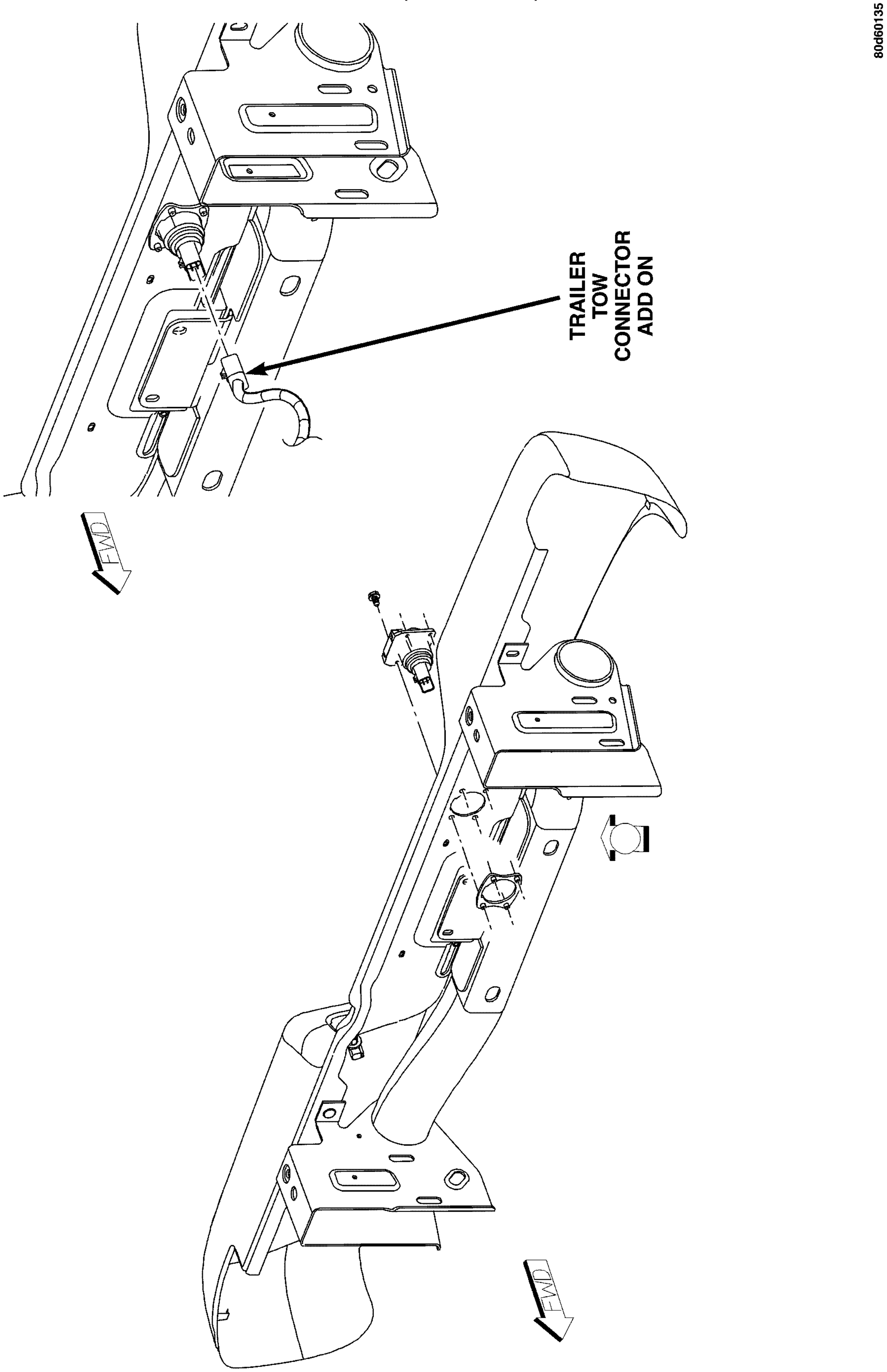


Fig. 51 REAR BUMPER

8W-97 POWER DISTRIBUTION

TABLE OF CONTENTS

POWER DISTRIBUTION

DESCRIPTION

This group covers the various standard and optional power distribution components used on this model. The power distribution system for this vehicle consists of the following components:

- Integrated Power Module (IPM)
- Front Control Module (FCM)
- Power Distribution Center (PDC)
- Power Outlets
- Cigar Lighter Outlets
- Relays

Refer to Wiring Diagrams for complete circuit schematics.

The power distribution system also incorporates various types of circuit control and protection features, including:

- Automatic resetting circuit breakers
- Blade-type fuses
- Cartridge fuses
- Relays

Following are general descriptions of the major components in the power distribution system. See the owner's manual in the vehicle glove box for more information on the features and use of all of the power distribution system components.

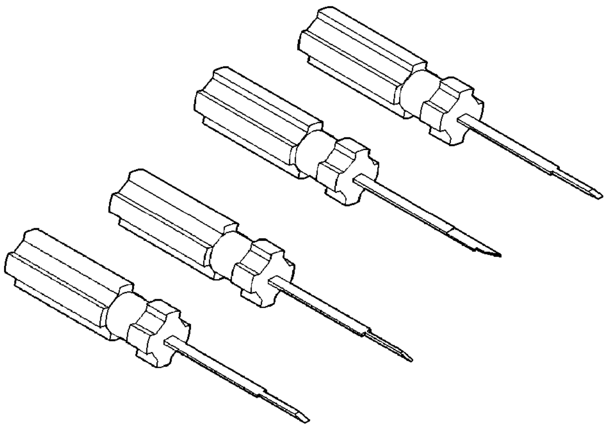
OPERATION

The power distribution system for this vehicle is designed to provide safe, reliable, and centralized distribution points for the electrical current required to operate all of the many standard and optional factory-installed electrical and electronic powertrain, chassis, safety, security, comfort and convenience systems. At the same time, the power distribution system was designed to provide ready access to these electrical distribution points for the vehicle technician to use when conducting diagnosis and repair of faulty circuits. The power distribution system can also prove useful for the sourcing of additional electrical circuits that may be required to provide the electrical current needed to operate many accessories that the vehicle owner may choose to have installed in the aftermarket.

POWER DISTRIBUTION (Continued)

SPECIAL TOOLS

POWER DISTRIBUTION SYSTEMS



Terminal Pick Kit 6680

CIGAR LIGHTER OUTLET

DESCRIPTION

On models equipped a cigar lighter outlet is installed to the left of the center stack area in the lower instrument panel. The cigar lighter outlet is secured by a snap fit within the bezel.

The cigar lighter outlet, plastic cap and the knob and heating element unit are available for service replacement. These components cannot be repaired and, if faulty or damaged, they must be replaced.

OPERATION

The cigar lighter consists of two major components: a knob and heating element unit, and the cigar lighter base or outlet shell. The receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The cigar lighter receives battery voltage from a fuse in the junction block when the ignition switch is in the Accessory or Run positions.

The cigar lighter knob and heating element are encased within a spring-loaded housing, which also features a sliding protective heat shield. When the knob and heating element are inserted in the outlet shell, the heating element resistor coil is grounded through its housing to the outlet shell. If the cigar lighter knob is pushed inward, the heat shield slides up toward the knob exposing the heating element, and the heating element extends from the housing toward the insulated contact in the bottom of the outlet shell.

Two small spring-clip retainers are located on either side of the insulated contact inside the bottom of the outlet shell. These clips engage and hold the heating element against the insulated contact long enough for the resistor coil to heat up. When the heating element is engaged with the contact, battery current can flow through the resistor coil to ground, causing the resistor coil to heat.

When the resistor coil becomes sufficiently heated, excess heat radiates from the heating element causing the spring-clips to expand. Once the spring-clips expand far enough to release the heating element, the spring-loaded housing forces the knob and heating element to pop back outward to their relaxed position. When the cigar lighter knob and element are pulled out of the outlet shell, the protective heat shield slides downward on the housing so that the heating element is recessed and shielded around its circumference for safety.

DIAGNOSIS AND TESTING - CIGAR LIGHTER OUTLET

For complete circuit diagrams, refer to **Wiring Diagrams**.

(1) Check the fused B(+) fuse in the integrated power module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Run position. Check for battery voltage at the fused B(+) fuse in the integrated power module. If OK, go to Step 3. If not OK, repair the open or short as required.

(3) Remove the cigar lighter knob and element from the cigar lighter outlet shell. Check for continuity between the inside circumference of the cigar lighter outlet shell and a good ground. there should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Turn the ignition switch to the Run position. Check for battery voltage at the insulated contact located at the back of the cigar lighter outlet shell. If OK, replace the faulty cigar lighter knob and element. If not OK, go to Step 5.

(5) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Check for continuity between the ground circuit cavity of the cigar lighter wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Turn the ignition switch to the Accessory or Run positions. Check for battery voltage at the fused B(+) circuit cavity of the cigar lighter wire harness connector. If OK, replace the faulty cigar lighter outlet. If not OK, repair the open fused B(+) circuit to the integrated power module fuse as required.

INTEGRATED POWER MODULE

DESCRIPTION

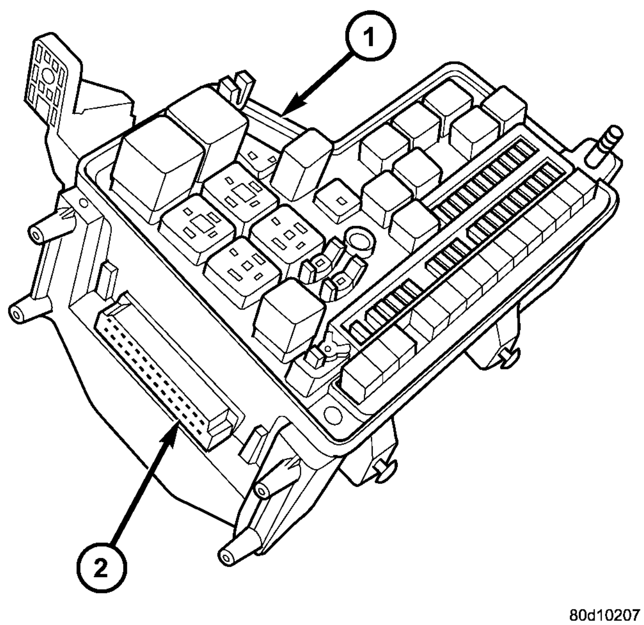


Fig. 1 DR INTEGRATED POWER MODULE

1 - POWER DISTRIBUTION CENTER HOUSING
2 - FRONT CONTROL MODULE ELECTRICAL CONNECTOR

The Integrated Power Module (IPM) (Fig. 1) is a combination of the Power Distribution Center (PDC) and the Front Control Module (FCM). The IPM is located in the engine compartment, next to the battery on this model. The power distribution center mates directly with the Front Control Module (FCM) to form the Integrated Power Module Fuse and Relay Center. The power distribution center (PDC) is a printed circuit board based module that contains fuses and relays, while the front control module contains the electronics controlling the integrated power module and other functions. This integrated power module connects directly to the battery positive via a stud located on top of the unit. The ground connection is via electrical connectors. The integrated power module provides the primary means of voltage distribution and protection for the entire vehicle.

The molded plastic integrated power module housing includes a base and cover. The integrated power module cover is easily opened or removed for service access by unscrewing the cover retaining nut and has a fuse and relay layout map integral to the inside surface of the cover. This integrated power module housing base and cover are secured in place via bolts to the left front fender support assembly.

Replaceable components of the integrated power module assembly are broken down into the following components: the Power Distribution Center (PDC), the integrated power module cover, the Front Control Module (FCM) and the Integrated Power Module Assembly which includes the power distribution center, the cover and FCM. **Refer to the Front Control Module in the Electronic Control Module section** of this service manual for information on the front control module.

OPERATION

All of the current from the battery and the generator output enters the integrated power module via a stud on the top of the module. The integrated power module cover is removed to access the fuses or relays. Internal connections of all of the power distribution center circuits is accomplished by a combination of bus bars and a printed circuit board. Refer to the Wiring section of the service manual for complete integrated power module circuit schematics.

REMOVAL

(1) Disconnect the negative and positive battery cables.

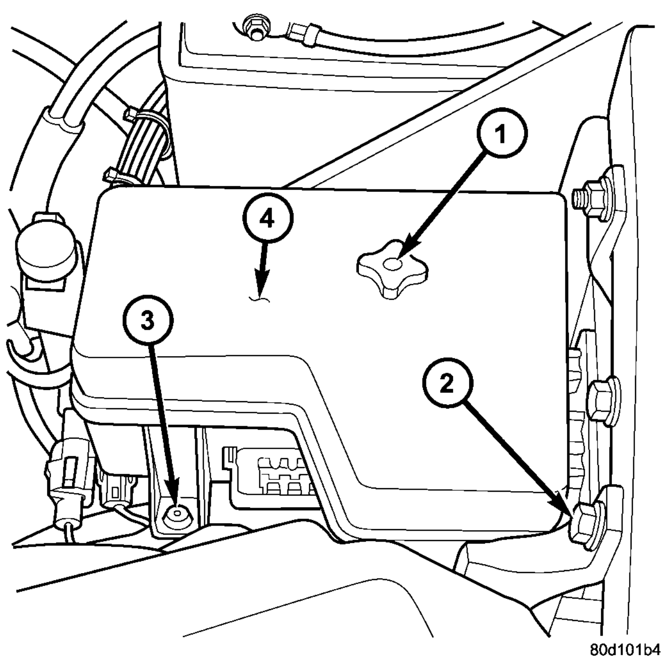


Fig. 2 DR INTEGRATED POWER MODULE

1 - COVER RETAINING BOLT
2 - INTEGRATED POWER MODULE RETAINING BOLT
3 - RETAINING SCREW
4 - INTEGRATED POWER MODULE COVER

(2) Unsnap cover and remove the B+ terminal nut from the integrated power module B+ terminal. Remove the B+ cable from the integrated power module.

(3) Disconnect the gray connector from the integrated power module.

INTEGRATED POWER MODULE (Continued)

(4) Remove the integrated power module retaining bolt and screw (Fig. 2).

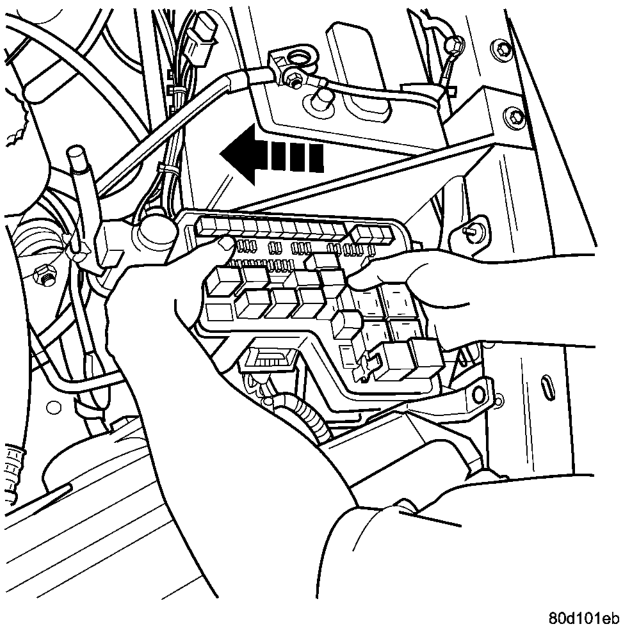


Fig. 3 REMOVING INTEGRATED POWER MODULE

(5) Grasp the integrated power module with two hands and slide the assembly in the direction shown (Fig. 3) to free the module from its mounting bracket. Position the assembly upside down to access the electrical connectors located on the bottom of the unit.

(6) Disconnect the electrical connectors by depressing the locking tab and rotating the connector arm outboard, until the connector is free from the module assembly. Be certain to pull the connectors straight off.

(7) Position the integrated power module on a bench and remove the four front control module retaining screws.

(8) Disconnect the front control module by pulling it straight off the integrated power module.

INSTALLATION

(1) Connect the front control module by pushing it straight on the integrated power module electrical receptacle.

(2) Install the four front control module retaining screws. Torque to 30 in. lbs. +/-5.

NOTE: Integrated power module electrical connectors are color coded to ease location reference (Fig. 4).

(3) Connect the electrical connectors by pushing straight on and rotating the connector arm inboard, until the connector is firmly locked in place on the module assembly.

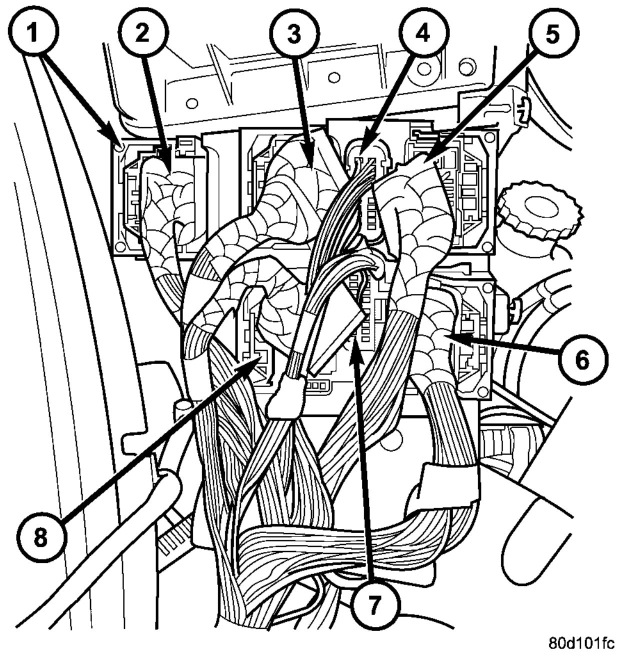


Fig. 4 INTEGRATED POWER MODULE ELECTRICAL CONNECTIONS

1 - RETAINING LATCH
2 - GRAY CONNECTOR
3 - GREEN CONNECTOR
4 - GREEN CONNECTOR
5 - BLUE CONNECTOR
6 - WHITE CONNECTOR
7 - BLACK CONNECTOR
8 - BLACK CONNECTOR

(4) Grasp the integrated power module with two hands and install the assembly on the battery tray (Fig. 5).

(5) Install the integrated power module retaining bolt and screw.

(6) Connect the gray connector on the integrated power module housing.

(7) Install the B+ terminal cable and nut on the integrated power module B+ terminal. Snap the cover in place.

(8) Connect the negative and positive battery cables.

FRONT CONTROL MODULE

DESCRIPTION

The Front Control Module (FCM) is a micro controller based module located in the left front corner of the engine compartment. On this model the integrated power module must be positioned aside in order to access the front control module. The front control module mates to the power distribution center to form the Integrated Power Module (IPM). The integrated power module connects directly to the bat-

FRONT CONTROL MODULE (Continued)

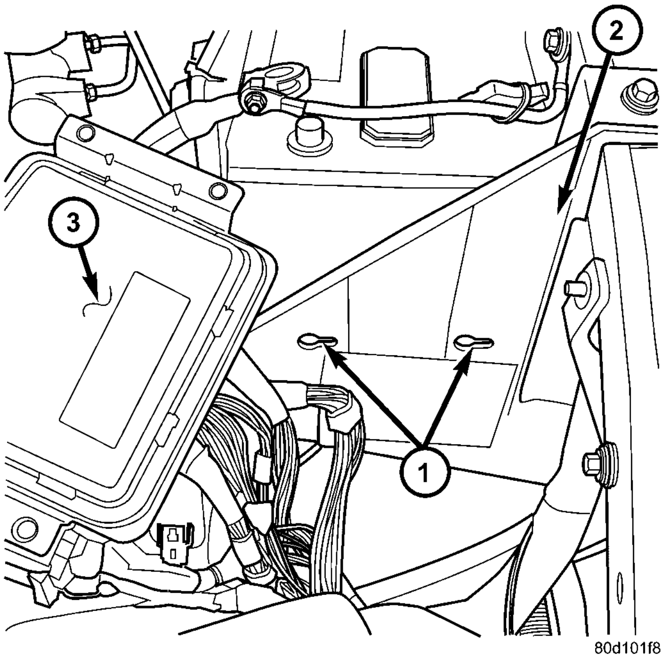


Fig. 5 INTEGRATED POWER MODULE MOUNTING TABS

1 - INTEGRATED POWER MODULE MOUNTING HOLES
2 - BATTERY TRAY ASSEMBLY
3 - FRONT CONTROL MODULE

tery and provides the primary means of circuit protection and power distribution for all vehicle electrical systems. The front control module controls power to some of these vehicle systems electrical and electromechanical loads based on inputs received from hard wired switch inputs and data received on the PCI bus circuit (J1850).

For information on the **Integrated Power Module Refer to the Power Distribution Section** of the service manual.

OPERATION

As messages are sent over the PCI bus circuit, the front control module reads these messages and controls power to some of the vehicles electrical systems by completing the circuit to ground (low side driver) or completing the circuit to 12 volt power (high side driver). The following functions are **Controlled** by the Front Control Module:

- Headlamp Power with Voltage Regulation
- Windshield Wiper “ON/OFF” Relay Actuation
- Windshield Wiper “HI/LO” Relay Actuation
- Windshield Washer Pump Motor
- Fog Lamp Relay Actuation
- Park Lamp Relay Actuation
- Horn Relay Actuation

The following inputs are **Received/Monitored** by the Front Control Module:

- B+ Connection Detection
- Power Ground
- Ambient Temperature Sensing
- Ignition Switch Run
- Washer Fluid Level Switch
- Windshield Wiper Park Switch
- PCI Bus Circuit

DIAGNOSIS AND TESTING - FRONT CONTROL MODULE

The front control module is a printed circuit board based module with a on-board micro-processor. The front control module interfaces with other electronic modules in the vehicle via the Programmable Communications Interface (PCI) data bus (J1850). In order to obtain conclusive testing the Programmable Communications Interface (PCI) data bus network and all of the electronic modules that provide inputs to, or receive outputs from the front control module must be checked. All PCI (J1850) communication faults must be resolved prior to further diagnosing any front control module related issues.

The front control module was designed to be diagnosed with an appropriate diagnostic scan tool, such as the DRB III®. The most reliable, efficient, and accurate means to diagnose the front control module requires the use of a DRB III® scan tool and the proper Body Diagnostic Procedures manual.

Before any testing of the front control module is attempted, the battery should be fully charged and all wire harness and ground connections inspected around the affected areas on the vehicle.

REMOVAL

(1) Disconnect the positive and negative battery cables from the battery.

(2) Partially remove the integrated power module from the engine compartment (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - REMOVAL).

(3) Remove the front control module retaining screws.

(4) Using both hands, pull the front control module **straight** from the integrated power module assembly to disconnect the 49-way electrical connector and remove the front control module from the vehicle.

INSTALLATION

(1) Install the front control module on the integrated power module assembly by pushing the 49-way electrical connector straight in.

(2) Install the front control module retaining screws. Torque the screws to 7 in. lbs.

(3) Install the integrated power module (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - INSTALLATION).

(4) Connect the positive and negative battery cables.

IOD FUSE

DESCRIPTION

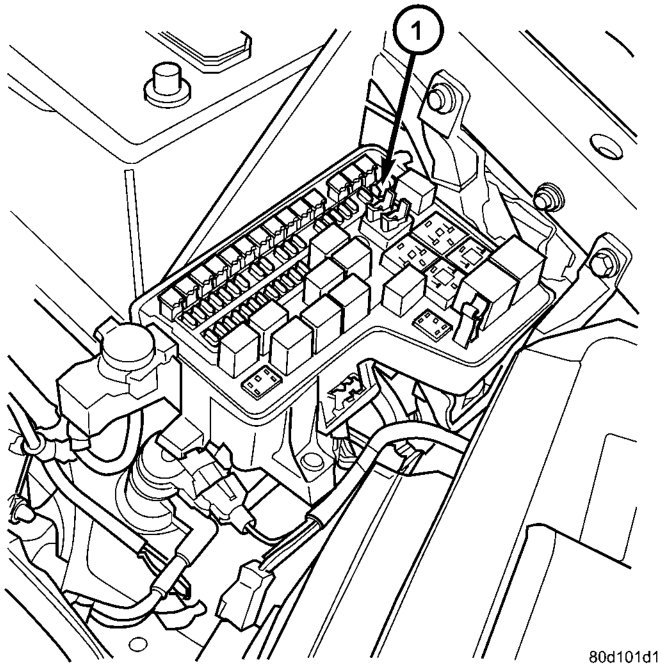


Fig. 6 IOD FUSE LOCATION

1 - IOD FUSE

All vehicles are equipped with an Ignition-Off Draw (IOD) fuse that is disconnected within the Integrated Power Module when the vehicle is shipped from the factory. Dealer personnel are to reconnect the IOD fuse in the Integrated Power Module as part of the preparation procedures performed just prior to new vehicle delivery.

A laser printed fuse layout map is integral to the Integrated Power Module cover to ensure proper fuse identification. The IOD fuse is a 20 ampere mini blade-type fuse, located in fuse cavity # 51 (Fig. 6). The fuse is secured within a black molded plastic fuse holder and puller unit that serves both as a tool for disconnecting and reconnecting the fuse in its Integrated Power Module cavity, and as a fuse holder that conveniently stores the fuse in the same Integrated Power Module cavity after it has been disconnected.

CIRCUITS INCLUDED WITH IOD FUSE

- Cluster (CCN)
- Diagnostic Connector
- Map Lamps
- Glove Box Lamp
- Courtesy Lamps
- Radio
- Underhood Lamp

OPERATION

The term ignition-off draw identifies a normal condition where power is being drained from the battery with the ignition switch in the Off position. The IOD fuse feeds the memory and sleep mode functions for some of the electronic modules in the vehicle as well as various other accessories that require battery current when the ignition switch is in the Off position. The only reason the IOD fuse is disconnected is to reduce the normal IOD of the vehicle electrical system during new vehicle transportation and pre-delivery storage to reduce battery depletion, while still allowing vehicle operation so that the vehicle can be loaded, unloaded and moved as needed by both vehicle transportation company and dealer personnel.

The IOD fuse is disconnected from Integrated Power Module fuse cavity # 51 when the vehicle is shipped from the assembly plant. Dealer personnel must reconnect the IOD fuse when the vehicle is being prepared for delivery in order to restore full electrical system operation. Once the vehicle is prepared for delivery, the IOD function of this fuse becomes transparent and the fuse that has been assigned the IOD designation becomes only another Fused B(+) circuit fuse.

The IOD fuse can be used by the vehicle owner as a convenient means of reducing battery depletion when a vehicle is to be stored for periods not to exceed about thirty days. However, it must be remembered that disconnecting the IOD fuse will not eliminate IOD, but only reduce this normal condition. If a vehicle will be stored for more than about thirty days, the battery negative cable should be disconnected to eliminate normal IOD; and, the battery should be tested and recharged at regular intervals during the vehicle storage period to prevent the battery from becoming discharged or damaged.

REMOVAL

The Ignition-Off Draw (IOD) fuse is disconnected from Integrated Power Module fuse cavity # 51 when the vehicle is shipped from the assembly plant. Dealer personnel must reconnect the IOD fuse when the vehicle is being prepared for delivery in order to restore full electrical system operation.

(1) Turn the ignition switch to the Off position.

(2) Remove the Integrated Power Module cover.

(3) Grasp the outer tabs of the IOD fuse holder unit in fuse cavity # 51 between the thumb and forefinger and pull the unit firmly upward.

(4) Install the Integrated Power Module cover.

IOD FUSE (Continued)

INSTALLATION

(1) Turn the ignition switch to the Off position.

(2) Remove the Integrated Power Module cover.

(3) To install the IOD fuse, use a thumb to press the IOD fuse holder unit in fuse cavity # 51 firmly into the Integrated Power Module.

(4) Install the Integrated Power Module cover.

POWER OUTLET

DESCRIPTION

Two power outlets are utilized on this model. One in the instrument panel center lower bezel and the other in the center console. The power outlet bases are secured by a snap fit within the instrument panel or trim panel. A plastic protective cap snaps into the power outlet base when the power outlet is not being used, and hangs from the power outlet base mount by an integral bail strap while the power outlet is in use.

The power outlet receptacle unit and the accessory power outlet protective cap are available for service. The power outlet receptacle cannot be repaired and, if faulty or damaged, it must be replaced.

OPERATION

The power outlet base or receptacle shell is connected to ground, and an insulated contact in the bottom of the shell is connected to battery current. The power outlet receives battery voltage from a fuse in the integrated power module at all times.

While the power outlet is very similar to a cigar lighter base unit, it does not include the two small spring-clip retainers inside the bottom of the receptacle shell that are used to secure the cigar lighter heating element to the insulated contact.

DIAGNOSIS AND TESTING - POWER OUTLET

For complete circuit diagrams, refer to **Wiring Diagrams**.

(1) Check the fused B(+) fuse in the integrated power module. If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse in the integrated power module. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit to the battery as required.

(3) Remove the plastic protective cap from the power outlet receptacle. Check for continuity between the inside circumference of the power outlet receptacle and a good ground. There should be continuity. If OK, go to Step 4. If not OK, go to Step 5.

(4) Check for battery voltage at the insulated contact located at the back of the power outlet receptacle. If not OK, go to Step 5.

(5) Disconnect and isolate the battery negative cable. Remove the power outlet receptacle from the instrument panel. Disconnect the wire harness connector from the power outlet receptacle. Check for continuity between the ground circuit cavity of the power outlet wire harness connector and a good ground. There should be continuity. If OK, go to Step 6. If not OK, repair the open ground circuit to ground as required.

(6) Connect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the power outlet wire harness connector. If OK, replace the faulty power outlet receptacle. If not OK, repair the open fused B(+) circuit to the integrated power module fuse as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Pull the cigar lighter knob and element out of the cigar lighter receptacle base, or unsnap the protective cap from the power outlet receptacle base.

(3) Look inside the cigar lighter or power outlet receptacle base and note the position of the rectangular retaining bosses of the mount that secures the receptacle base to the panel (Fig. 7).

(4) Insert a pair of external snap ring pliers into the cigar lighter or power outlet receptacle base and engage the tips of the pliers with the retaining bosses of the mount.

(5) Squeeze the pliers to disengage the mount retaining bosses from the receptacle base and, using a gentle rocking motion, pull the pliers and the receptacle base out of the mount.

(6) Pull the receptacle base away from the instrument panel far enough to access the instrument panel wire harness connector.

(7) Disconnect the instrument panel wire harness connector from the cigar lighter or power outlet receptacle base connector receptacle.

(8) Remove the cigar lighter or power outlet mount from the instrument panel.

INSTALLATION

(1) Reconnect the instrument panel wire harness connector to the cigar lighter or power outlet receptacle base connector receptacle.

(2) Install the cigar lighter or power outlet mount into the instrument panel.

(3) Align the splines on the outside of the cigar lighter or power outlet receptacle base connector receptacle with the grooves on the inside of the mount.

POWER OUTLET (Continued)

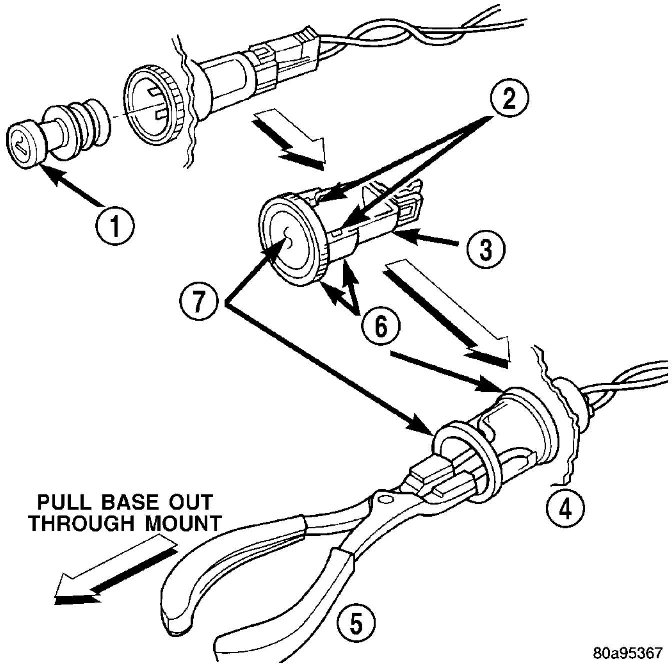


Fig. 7 Cigar Lighter and Power Outlet Remove/ Install

1 - KNOB AND ELEMENT
2 - RETAINING BOSSES-ENGAGE PLIERS HERE
3 - BASE
4 - PARTIALLY REMOVED
5 - EXTERNAL SNAP-RING PLIERS
6 - MOUNT
7 - BASE

(4) Press firmly on the cigar lighter or power outlet receptacle base until the retaining bosses of the mount are fully engaged in their receptacles.

(5) Install the cigar lighter knob and element into the cigar lighter receptacle base, or the protective cap into the power outlet receptacle base.

(6) Reconnect the battery negative cable.

RELAY

DESCRIPTION

A relay (Fig. 8) is an electromechanical device that switches fused battery current to a electrical component when the ignition switch is turned to the Accessory or Run positions, or when controlled by a electronic module. The relays are located in the integrated power module.

The relay is a International Standards Organization (ISO) relay. Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions.

A relay cannot be repaired or adjusted and, if faulty or damaged, it must be replaced.

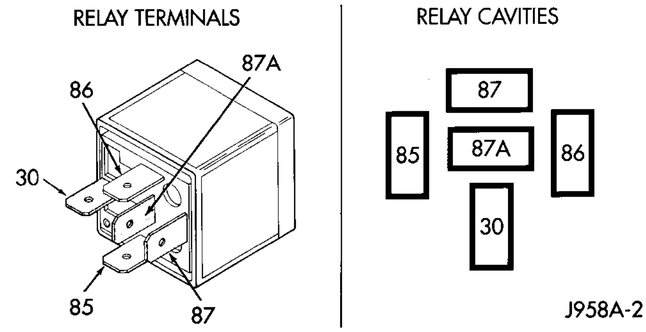


Fig. 8 ISO Relay

30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

OPERATION

The ISO relay consists of an electromagnetic coil, a resistor and three (two fixed and one movable) electrical contacts. The movable (common feed) relay contact is held against one of the fixed contacts (normally closed) by spring pressure. When the electromagnetic coil is energized, it draws the movable contact away from the normally closed fixed contact, and holds it against the other (normally open) fixed contact.

When the electromagnetic coil is de-energized, spring pressure returns the movable contact to the normally closed position. The resistor is connected in parallel with the electromagnetic coil in the relay, and helps to dissipate voltage spikes that are produced when the coil is de-energized.

DIAGNOSIS AND TESTING - RELAY

The relays are located in the integrated power module. For complete circuit diagrams, refer to **Wiring Diagrams**.

(1) Remove the relay from its mounting location.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 60.7 - 80.3 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, perform the Relay Circuit Test that follows. If not OK, replace the faulty relay.

RELAY (Continued)

DIAGNOSIS & TESTING - RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) of the integrated power module is connected to battery voltage and should be hot at all times. Check for battery voltage at the fused B(+) circuit cavity in the integrated power module receptacle for the relay. If OK, go to Step 2. If not OK, repair the fused B(+) circuit to the integrated power module fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the fused B(+) fuse in the integrated power module that feeds the accessory when the relay is energized by the ignition switch. There should be continuity between the integrated power module cavity for relay terminal 87 and the fused B(+) fuse in the integrated power module at all times. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit to the integrated power module fuse as required.

(4) The coil ground terminal (85) is connected to the electromagnet in the relay. It receives battery feed to energize the relay when the ignition switch is in the Accessory or Run positions. Turn the ignition switch to the On position. Check for battery voltage at the fused ignition switch output (acc/run) circuit cavity for relay terminal 85 in the integrated power module receptacle for the relay. If OK, go to Step 5. If not OK, repair the open fused ignition switch output (acc/run) circuit to the ignition switch as required.

(5) The coil battery terminal (86) is connected to the electromagnet in the relay. The integrated power module cavity for this terminal should have continuity to ground at all times. If not OK, repair the open ground circuit to ground as required.

REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Remove the relay by grasping it firmly and pulling it straight out from its receptacle. A slight back and fourth rocking motion may help the removal process.

INSTALLATION

(1) Position the relay to the proper receptacle.

(2) Align the relay terminals with the terminal cavities in the receptacle.

(3) Push firmly and evenly on the top of the relay until the terminals are fully seated in the terminal cavities in the receptacle.

(4) Connect the negative battery cable.

MICRO RELAY

DESCRIPTION

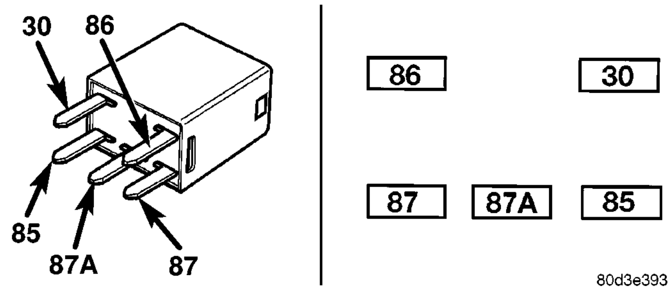


Fig. 9 DR ISO Micro Relay

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

A micro-relay is a conventional International Standards Organization (ISO) micro relay (Fig. 9). Relays conforming to the ISO specifications have common physical dimensions, current capacities, terminal patterns, and terminal functions. The relay is contained within a small, rectangular, molded plastic housing and is connected to all of the required inputs and outputs by five integral male spade-type terminals that extend from the bottom of the relay base.

Relays cannot be adjusted or repaired and, if faulty or damaged, the unit must be replaced.

OPERATION

A micro-relay is an electromechanical switch that uses a low current input from one source to control a high current output to another device. The movable common feed contact point is held against the fixed normally closed contact point by spring pressure. When the relay coil is energized, an electromagnetic field is produced by the coil windings. This electromagnetic field draws the movable relay contact point away from the fixed normally closed contact point, and holds it against the fixed normally open contact point. When the relay coil is de-energized, spring pressure returns the movable contact point back against the fixed normally closed contact point. A resistor is connected in parallel with the relay coil in the relay, and helps to dissipate voltage spikes and electromagnetic interference that can be generated as the electromagnetic field of the relay coil collapses.

DIAGNOSIS AND TESTING - MICRO-RELAY

(1) Remove the relay from its mounting location.

(2) A relay in the de-energized position should have continuity between terminals 87A and 30, and

MICRO RELAY (Continued)

no continuity between terminals 87 and 30. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Resistance between terminals 85 and 86 (electromagnet) should be 67.5 - 82.5 ohms. If OK, go to Step 4. If not OK, replace the faulty relay.

(4) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, reinstall the relay and use a DRB III® scan tool to perform further testing. Refer to the appropriate diagnostic information.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

REMOVAL

(1) Disconnect and isolate the negative battery cable.

(2) Remove the relay by grasping it firmly and pulling it straight out from its receptacle. A slight back and fourth rocking motion may help the removal process.

INSTALLATION

(1) Align the micro-relay terminals with the terminal cavities in the receptacle.

(2) Push firmly and evenly on the top of the relay until the terminals are fully seated in the terminal cavities in the receptacle.

(3) Connect the battery negative cable.

ENGINE

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ENGINE - 3.7L

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ENGINE - 3.7L

DESCRIPTION

The 3.7 liter (226 CID) six-cylinder engine is an 90° single overhead camshaft engine (Fig. 1). The cast iron cylinder block is made up of two different components; the first component is the cylinder bore and upper block, the second component is the bed-plate that comprises the lower portion of the cylinder block and houses the lower half of the crankshaft main bearings. The cylinders are numbered from front to rear with the left bank being numbered 1,3, and 5 and the right bank being numbered 2,4, and 6. The firing order is 1–6–5–4–3–2. The engine serial number is located at the right front side of the engine block

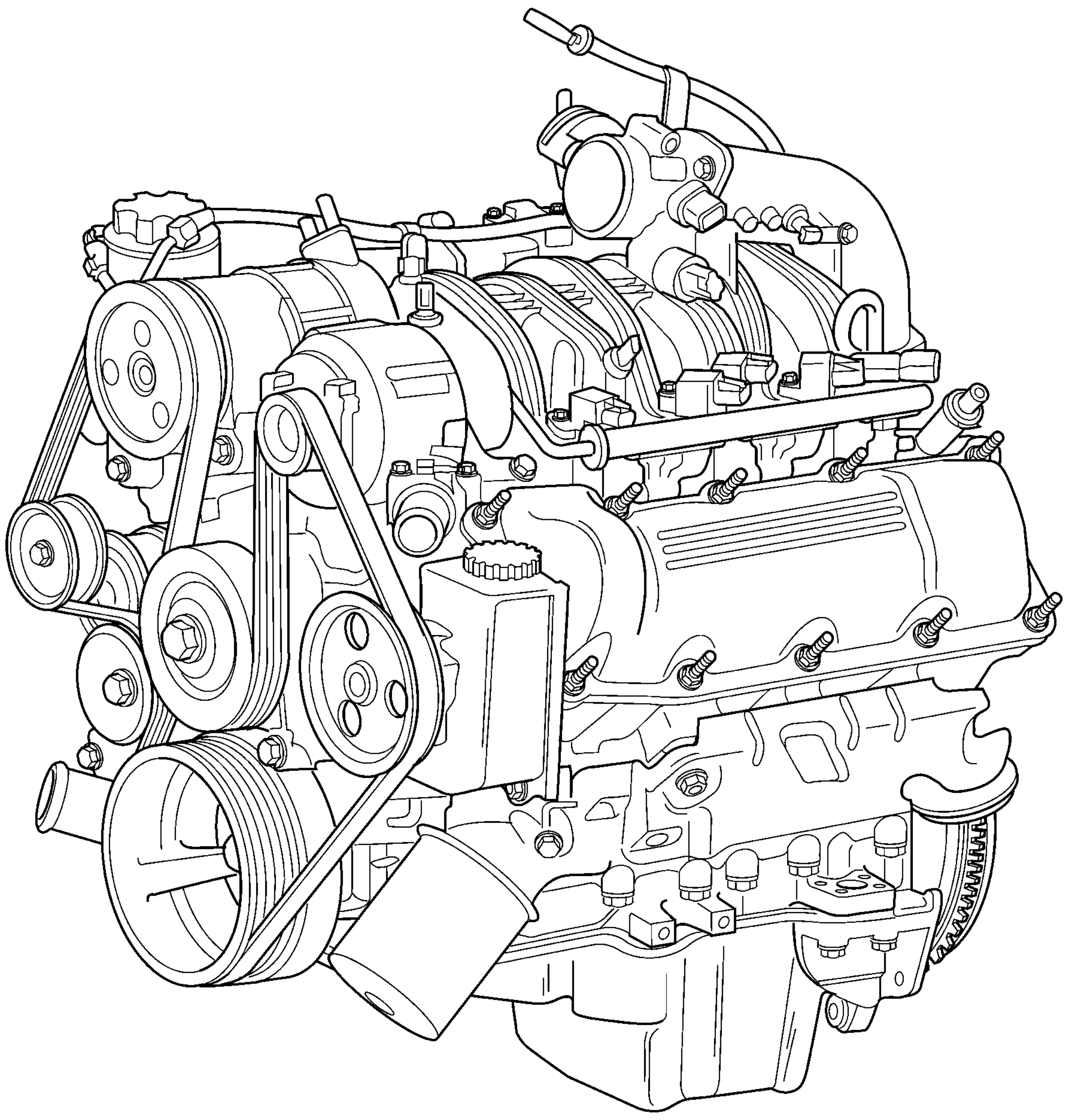


Fig. 1 3.7 L ENGINE

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Incorrect right bank cam timing.	6. Refer to engine timing in this section.
	7. Dirt or water in fuel system.	7. Clean system and replace fuel filter.
	8.Faulty fuel pump, relay or wiring.	8.Repair or replace as necessary.
	9. Faulty cam or crank sensor	9. Refer to Ignition system.
ENGINE STALLS OR ROUGH IDLE	1. Vacuum leak.	1. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	2. Faulty crank position sensor	2. Replace crank position sensor.
	3. Faulty coil.	3. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).

ENGINE - 3.7L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
	4. Incorrect cam timing.	4. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt or water in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	4. Blown cylinder head gasket.	4. Replace cylinder head gasket.
	5. Low compression.	5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), repair as necessary.
	6. Burned, warped or pitted valves.	6. Replace as necessary.
	7. Plugged or restricted exhaust system.	7. Inspect and replace as necessary.
	8. Faulty coil.	8. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	9. Incorrect cam timing.	9. Refer to Engine TIming in this section.
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt in fuel system.	2. Clean fuel system.
	3. Burned, warped or pitted valves.	3. Replcae as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Faulty coil.	2. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	3. Dirt or water in fuel system.	3. Clean system and replace fuel filter.

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Replace as necessary.
	5. Worn rocker arms.	5. Replace as necessary.
	6. Worn lash adjusters	6. Replace as necessary.
	7. Worn valve guides.	7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
	8. Excessive runout of valve seats on valve faces.	8. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Service or replace crankshaft.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check thrust washers for wear.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

ENGINE - 3.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - REAR - REMOVAL).
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
	5. Timing chain cover seal, damaged or misaligned.	5. Replace seal (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT OIL SEAL - FRONT - REMOVAL).
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL).
	3. Low oil pressure.	3. Check oil pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
	5. Worn oil pump.	5. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).
	9. Oil pick up tube loose, damaged or clogged.	9. Replace as necessary.

ENGINE - 3.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
	3. Incorrect ring size installed.	3. Replace rings (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
	4. Worn valve guides.	4. Ream guides and replace valves (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
	5. Leaking valve guide seals.	5. Replace valve guide seals.

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner hose.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression,While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

ENGINE - 3.7L (Continued)

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:
- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage

ENGINE - 3.7L (Continued)

of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 2)

NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 2)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 2)

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

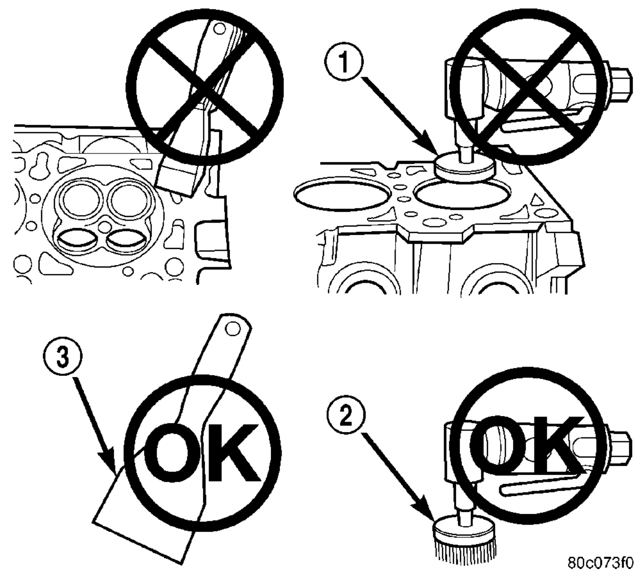


Fig. 2 Proper Tool Usage For Surface Preparation

1 - ABRASIVE PAD
2 - 3M ROLOC™ BRISTLE DISC
3 - PLASTIC/WOOD SCRAPER

REMOVAL

(1) Disconnect the battery negative cable.
(2) Remove hood. Mark hood hinge location for reinstallation.
(3) Remove air cleaner assembly.
(4) Remove radiator core support bracket.
(5) Remove fan shroud with viscous fan assembly.
(6) Remove drive belt.
(7) Remove A/C compressor and secure away from engine.
(8) Remove generator and secure away from engine.

NOTE: Do NOT remove the phenolic pulley from the P/S pump. It is not required for P/S pump removal.

(9) Remove power steering pump with lines attached and secure away from engine.
(10) Drain cooling system.
(11) Disconnect the heater hoses from the engine.

ENGINE - 3.7L (Continued)

(12) Disconnect heater hoses from heater core and remove hose assembly.

(13) Disconnect throttle and speed control cables.

(14) Remove upper radiator hose from engine.

(15) Remove lower radiator hose from engine.

(16) Remove radiator/cooling module assembly.

(17) Disconnect the engine to body ground straps at the left side of cowl.

(18) Disconnect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs
- Crankshaft Position Sensor

(19) Remove coil over plugs.

(20) Release fuel rail pressure.

(21) Remove fuel rail and secure away from engine.

NOTE: It is not necessary to release the quick connect fitting from the fuel supply line for engine removal.

(22) Remove the PCV hose.

(23) Remove the breather hoses.

(24) Remove the vacuum hose for the power brake booster.

(25) Disconnect knock sensors.

(26) Remove engine oil dipstick tube.

(27) Remove intake manifold.

(28) Install engine lifting fixture,special tool#8247, using original fasteners from the removed intake manifold, and fuel rail. Torque to factory specifications.

NOTE: Recheck bolt torque for engine lift plate before removing engine.

(29) Secure the left and right engine wiring harnesses away from engine.

(30) Raise vehicle.

(31) Disconnect oxygen sensor wiring.

(32) Disconnect crankshaft postion sensor.

(33) Disconnect the engine block heater power cable, if equipped.

(34) Disconnect the front propshaft at the front differential and secure out of way.

NOTE: It is necessary to disconnect the front propshaft for access to the starter and left side exhaust flange.

(35) Remove the starter.

(36) Remove the ground straps from the left and right side of the block.

(37) Disconnect the right and left exhaust pipes at the manifolds and from the crossover, and remove from the vehicle.

NOTE: The exhaust clamps at the manifolds cannot be reused. New clamps must be used or leaks may occur.

(38) Remove the structural cover.

(39) Remove torque convertor bolts, and mark location for reassembly.

(40) Remove transmission bellhousing to engine bolts.

(41) Remove left and right engine mount thru bolts.

(42) Lower the vehicle.

(43) Support the transmission with a suitable jack.

(44) Connect a suitable engine hoist to the engine lift plate.

(45) Remove engine from vehicle.

INSTALLATION

(1) Position the engine in the vehicle.

(2) Install both left and right side engine mounts onto engine.

(3) Raise the vehicle.

(4) Install the transmission bellhousing to engine mounting bolts. Tighten the bolts to 41 N·m (30ft. lbs.).

(5) Tighten the engine mount thru bolts.

(6) Install the torque convertor bolts.

(7) Connect the ground straps on the left and right side of the engine.

(8) Install the starter.

(9) Connect the crankshaft position sensor.

(10) Install the engine block heater power cable, if equipped.

CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

(11) Install the structural cover.

NOTE: New clamps must be used on exhaust manifold flanges. Failure to use new clamps may result in exhaust leaks.

(12) Install the left and right exhaust pipes.

(13) Connect the left and right oxygen sensors.

(14) Lower vehicle.

(15) Remove the engine lift plate.

(16) Connect the knock sensors.

ENGINE - 3.7L (Continued)

(17) Connect the engine to body ground straps at the left side of the cowl.
(18) Install the intake manifold.
(19) Install the engine oil dipstick tube.
(20) Install the power brake booster vacuum hose.
(21) Install the breather hoses.
(22) Install the PCV hose.
(23) Install the fuel rail.
(24) Install the coil over plugs.
(25) Connect the engine wiring harness at the following points:

- Intake air temperature (IAT) sensor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs
- Crankshaft Position Sensor

(26) Reinstall the radiator/cooling module assembly.
(27) Connect lower radiator hose.
(28) Connect upper radiator hose.
(29) Connect throttle and speed control cables.
(30) Install the heater hose assembly.
(31) Install coolant recovery bottle.
(32) Install the power steering pump.
(33) Install the generator.
(34) Install the A/C compressor.
(35) Install the drive belt.
(36) Install the fan shroud with the viscous fan assembly.
(37) Install the radiator core support bracket.
(38) Install the air cleaner assembly.
(39) Refill the engine cooling system.
(40) Recharge the air conditioning.
(41) Install the hood.
(42) Check and fill engine oil.
(43) Connect the battery negative cable.
(44) Start the engine and check for leaks.

SPECIFICATIONS

SPECIFICATIONS – 3.7L ENGINE

DESCRIPTION	SPECIFICATION
Engine Type	90° SOHC V-6 12-Valve
Displacement	3.7 Liters / 3700 cc 226 (Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	90.8 mm (3.40 in.)
Compression Ratio	9.1:1
Horsepower	210 BHP @ 5200 RPM
Torque	225 LB-FT @ 4200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-6-5-4-3-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.0 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
Ring Groove Diameter	
No. 1	83.73 - 83.13 mm (3.296 - 3.273 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Floating
Clearance In Piston	0.006 - 0.015 mm (0.0002 - 0.0005 in.)
Diameter	24.017 - 24.020 mm (0.9455 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.20 - 0.36 mm (0.0079 - 0.0142 in.)

ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
Second Compression Ring	0.37 - 0.63 mm
	(0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm
	(0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 - .094 mm
	(0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm
	(0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm
	(.0007 - .0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm
	(0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm
	(0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm
	(0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.015 - 0.055 mm
	(0.0006 - 0.0022 in.)
Side Clearance	0.10 - 0.35 mm
	(0.004 - 0.0138 in.)
Piston Pin Clearance	.015 - .028 mm
	(0.0006 - 0.0011 in.)
Bearing Bore Out of Round	0.004 mm
(MAX)	(0.0002 in.)
Total Weight (Less Bearing)	612 grams (21.588 ounces)
CRANKSHAFT	
Main Bearing Journal	
Diameter	63.488 - 63.512 mm
	(2.4996 - 2.5005 in.)
Bearing Clearance	0.002 - 0.034 mm
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.006 mm (0.0004 in.)

DESCRIPTION	SPECIFICATION
End Play	0.052 - 0.282 mm
	(0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	57.908 - 57.892 mm
Bearing Clearance	0.015 - 0.055 mm
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.006 mm (0.0002 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm
	(1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm
	(1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm
	(0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm
	(0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)
VALVE TIMING	
Intake	
Opens (ATDC)	0.0°
Closes (ATDC)	236°
Duration	236°
Exhaust	
Opens (BTDC)	233°
Closes (ATDC)	17°
Duration	250°
Valve Overlap	17°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm
	(1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm
	1.4516 - 1.4618 in.)

ENGINE - 3.7L (Continued)

DESCRIPTION	SPECIFICATION
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	0.018 - 0.069 mm (0.0008 - 0.0028 in.)
Exhaust	0.047 - 0.098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	12.00 mm (0.472 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake	48.92 mm (1.9260 in.)
Exhaust	49.81 mm (1.9610 in.)
Spring Force (Valve Closed)	
Intake	361.0 - 390.0 N @ 40.12 mm (81.15 - 87.67 lbs. @ 1.5795 in.)
Exhaust	390.0 - 430.0 N @ 40.12 mm (87.67 - 96.66 lbs. @ 1.5795 in.)

DESCRIPTION	SPECIFICATION
Spring Force (Valve Open)	
Intake	984.0 - 1040.0 N @ 28.12 mm 221.2 - 233.8 lbs. @ 1.107 in.)
Exhaust	965.0 - 1055.0 N @ 28.12 mm 216.9 - 237.1 lbs. @ 1.107 in.)
Number of Coils	
Intake	7.30
Exhaust	7.45
Wire Diameter	
Intake and Exhaust	4.77 × 3.80mm (0.1878 - 0.1496 in.)
Installed Height (Spring Seat to Bottom of Retainer)	
Nominal	
Intake	40.12 mm (1.579 in.)
Exhaust	40.12 mm (1.579 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	0.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors/End Face (MAX)	0.095 mm (0.0038 in.)

ENGINE - 3.7L (Continued)

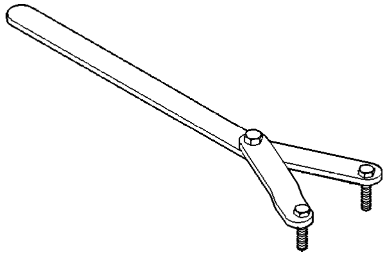
DESCRIPTION	SPECIFICATION
Cover Out - of -Flat (MAX)	0.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor to pocket (Diametral) clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	0.150 mm (0.006 in.)
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

TORQUE

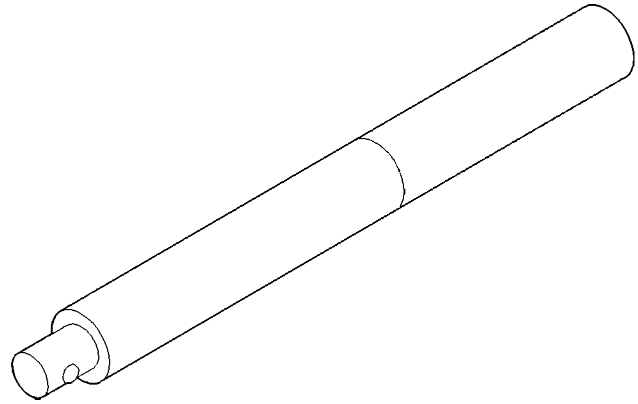
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Counterbalance shaft retaining bolt	28	—	250
Timing Chain Cover—Bolts	58	43	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	Refer	To	Procedure
M8 Bolts	-	-	-
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	95	70	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm	28	—	250
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	58	43	—

ENGINE - 3.7L (Continued)

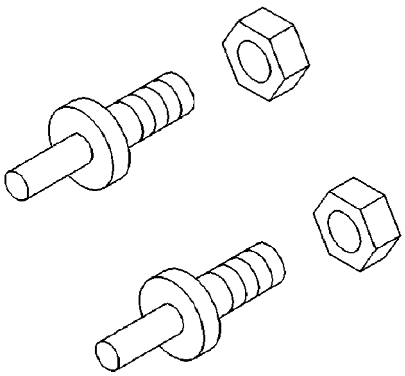
SPECIAL TOOLS



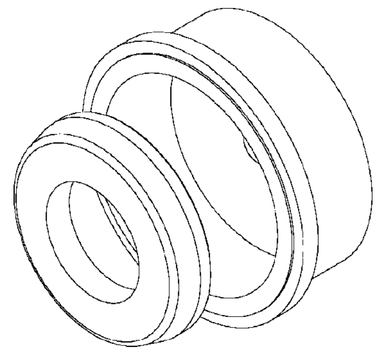
Spanner Wrench 6958



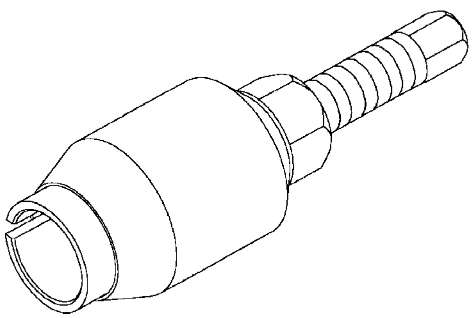
Handle C-4171



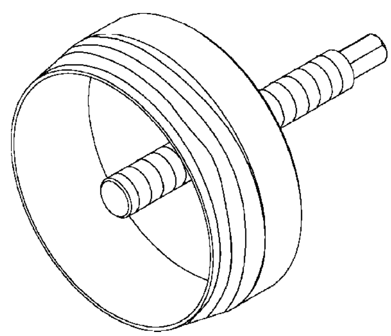
Adapter Pins 8346



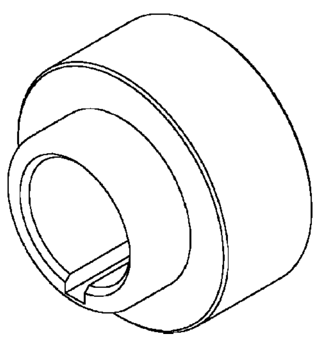
Rear Crankshaft Seal Installer 8349



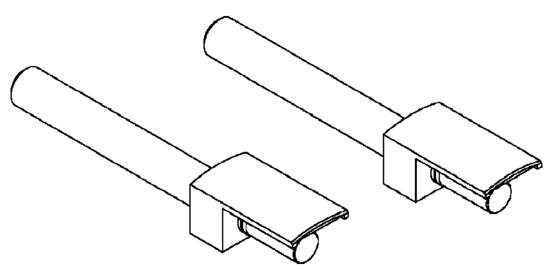
Front Crankshaft Seal Remover 8511



Rear Crankshaft Seal Remover 8506

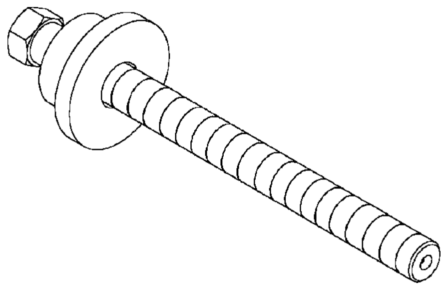


Front Crankshaft Seal Installer 8348

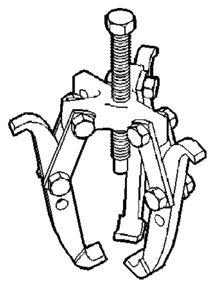


Connecting Rod Guides 8507

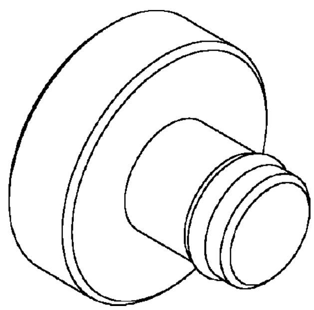
ENGINE - 3.7L (Continued)



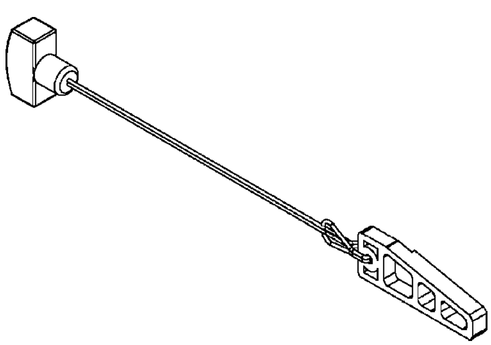
Crankshaft Damper Installer 8512



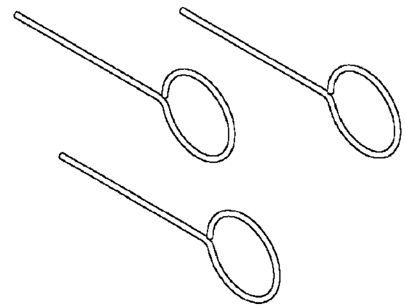
Puller 1026



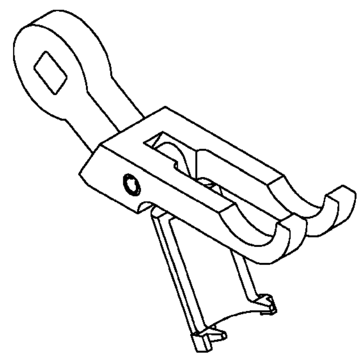
Crankshaft Damper Removal Insert 8513



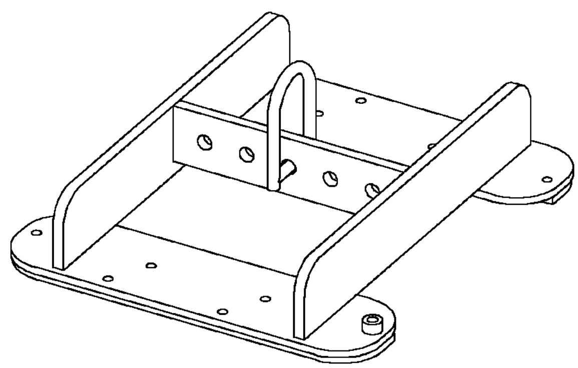
Chain Tensioner Wedge 8379



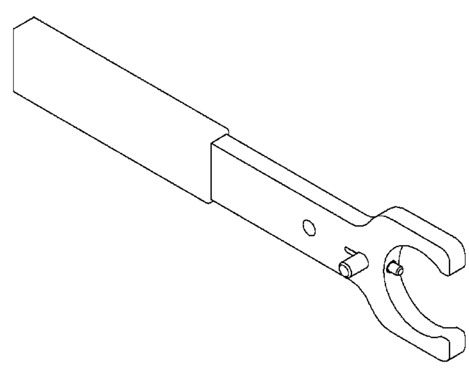
Chain Tensioner Pins 8514



VALVE SPRING COMPRESSOR 8426

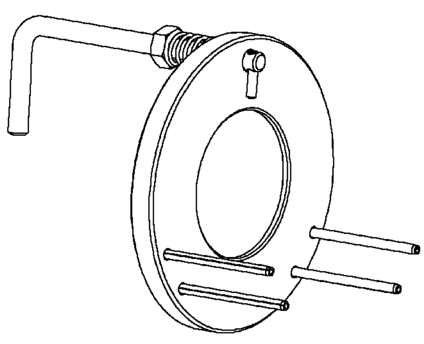


ENGINE LIFTING FIXTURE 8427

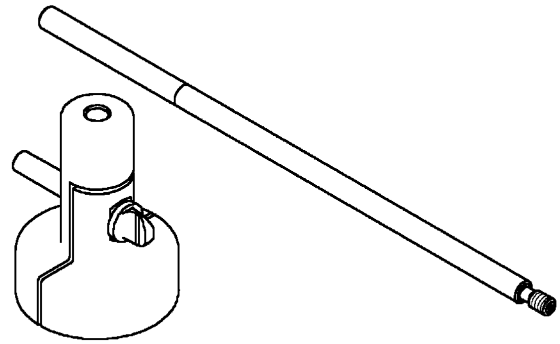


CAMSHAFT HOLDER 8428

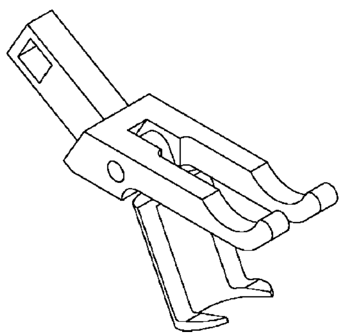
ENGINE - 3.7L (Continued)



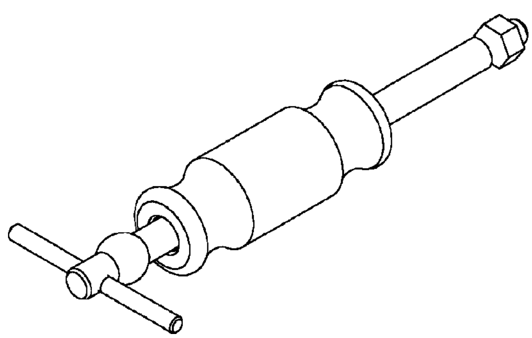
HOLDER SECONDARY CAMSHAFT CHAIN 8429



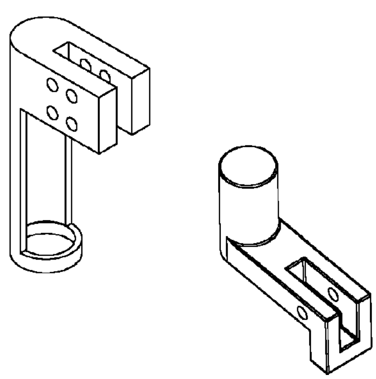
INSTALLER - REMOVER - COUNTER BALANCE SHAFT 8641



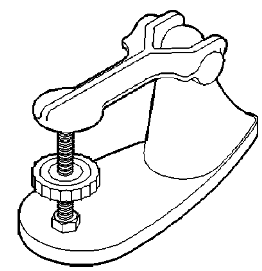
Remover, Rocker Arm 8516



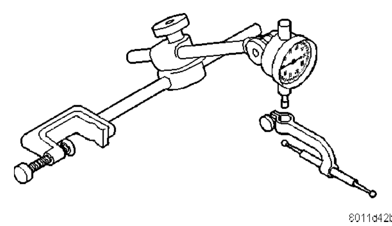
Idler Shaft Remover 8517



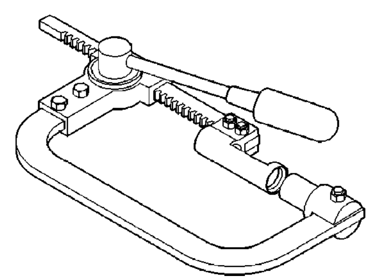
Valve Spring Compressor Adapters 8519



Valve Spring Tester C-647

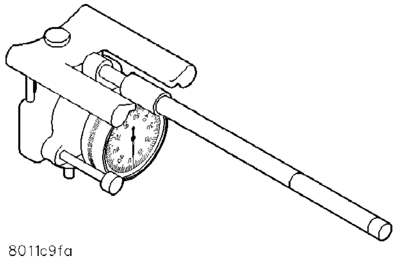


Dial Indicator C-3339

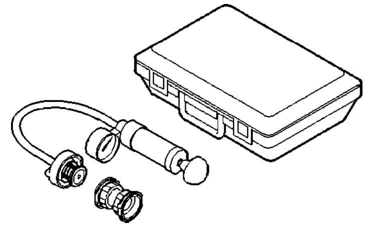


Valve Spring Compressor C-3422-B

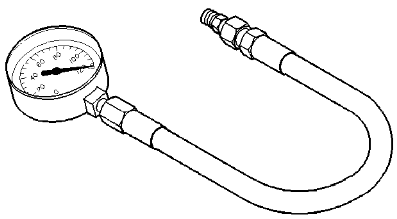
ENGINE - 3.7L (Continued)



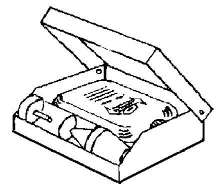
Bore Size Indicator C-119



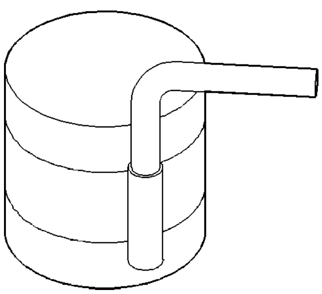
Pressure Tester Kit 7700



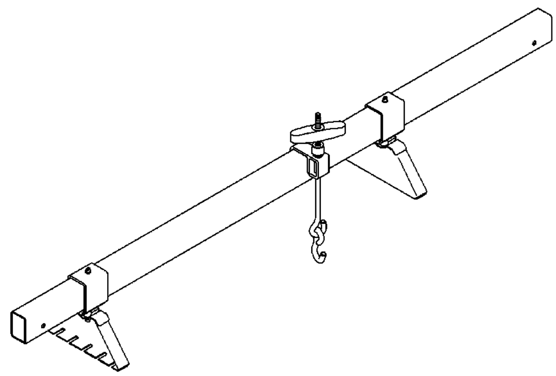
Oil Pressure Gauge C-3292



Bloc–Chek–Kit C-3685–A



Piston Ring Compressor C-385



ENGINE SUPPORT FIXTURE 8534

AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 3) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 3) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 3) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

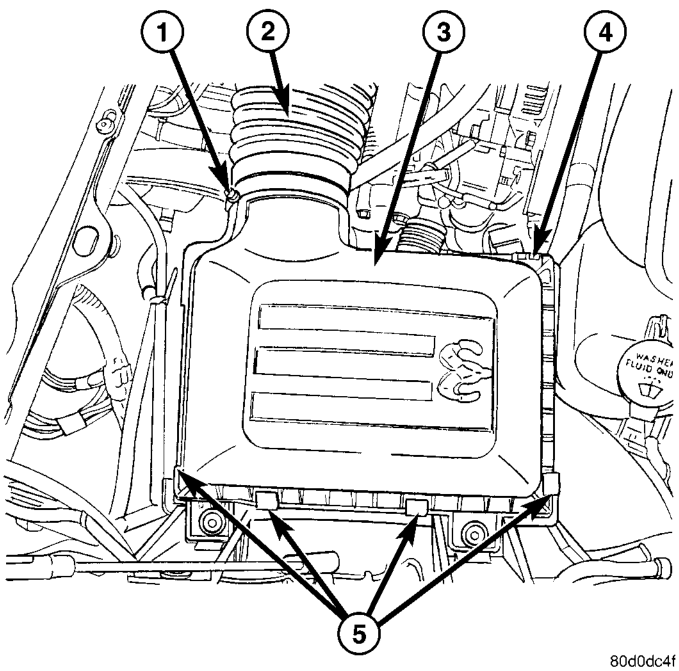


Fig. 3 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 3) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 4).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 3).

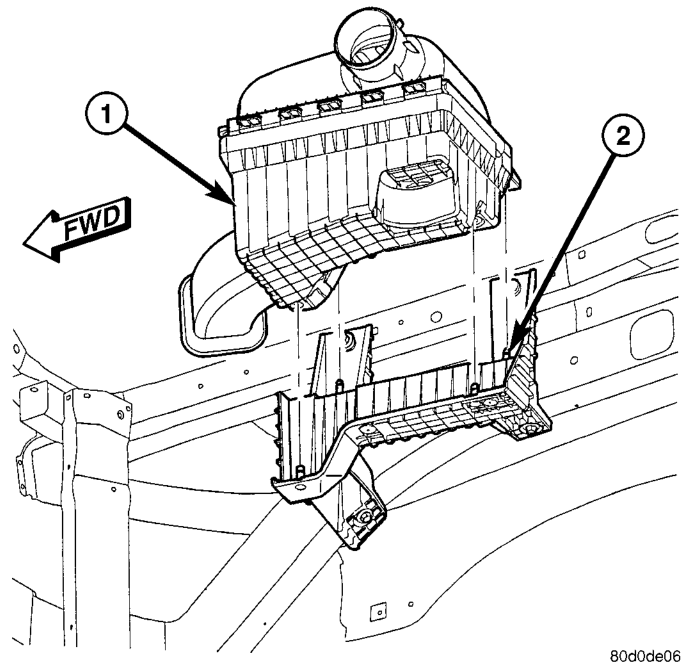


Fig. 4 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 3) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD - LEFT

DIAGNOSIS AND TESTING - CYLINDER HEAD GASKET

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant

CYLINDER HEAD - LEFT (Continued)

• Excessive steam (white smoke) emitting from exhaust
• Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50–70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the left side exhaust manifold.

(4) Drain the engine coolant(Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Lower the vehicle.

(6) Remove the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the master cylinder and booster assembly(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - REMOVAL).

(8) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(9) Remove the fan shroud and fan blade assembly(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(10) Remove accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the power steering pump and set aside.

(12) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 5).

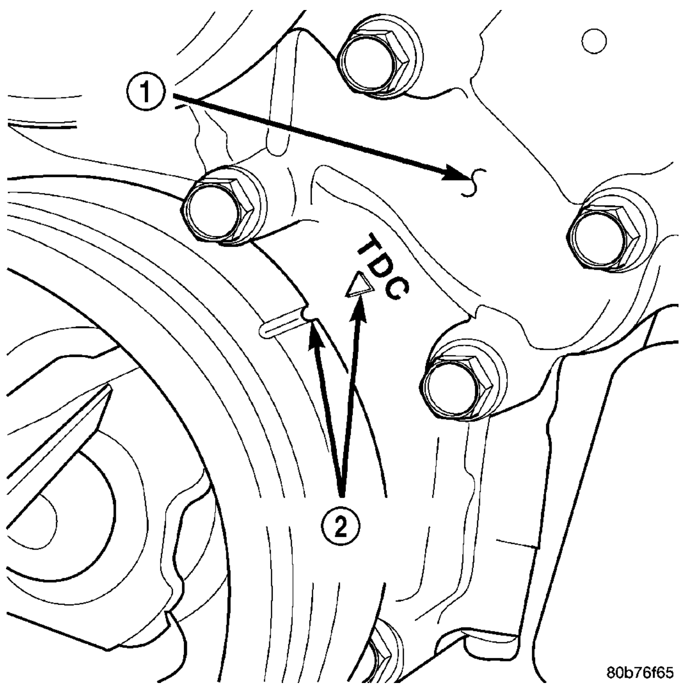


Fig. 5 Engine Top Dead Center

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(13) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 6). Rotate the crankshaft one turn if necessary.

(14) Remove the crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(15) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

CYLINDER HEAD - LEFT (Continued)

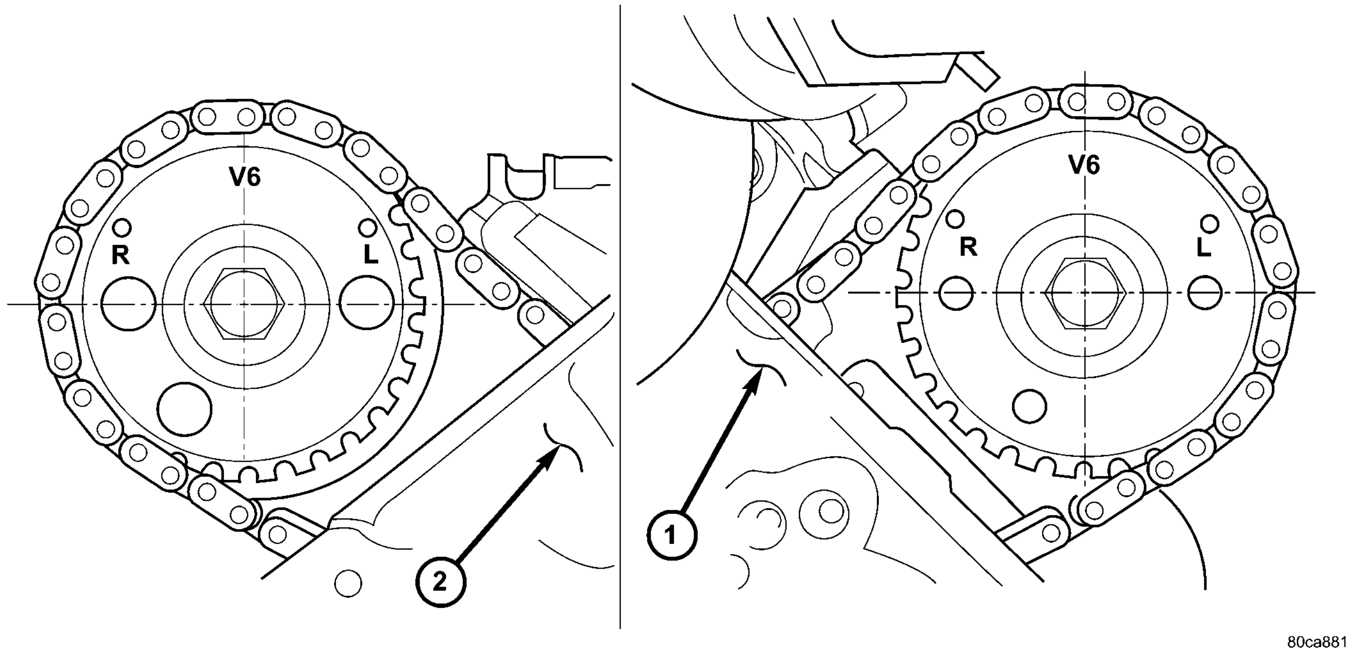


Fig. 6 CAMSHAFT SPROCKET V6 MARKS (#1 TDC, Exhaust stroke)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

(16) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture (Fig. 7).

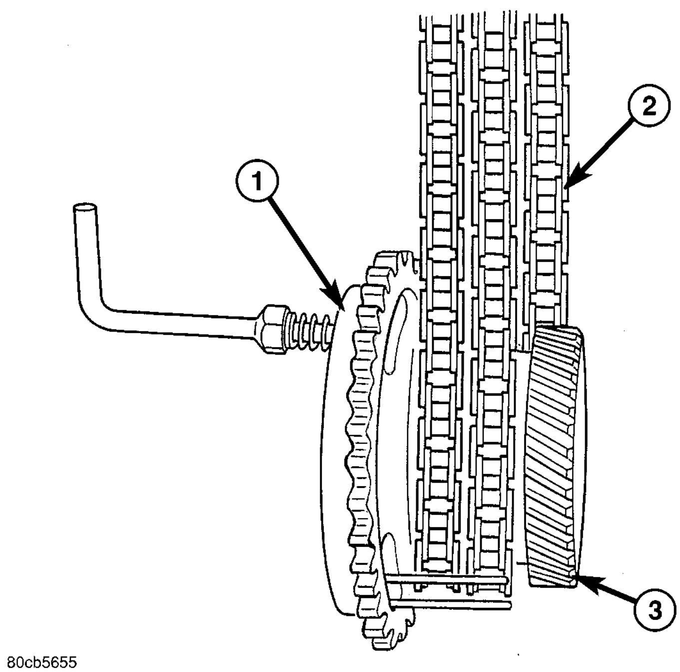


Fig. 7 Using Special Tool 8429

1 - SPECIAL TOOL 8429
2 - CAMSHAFT CHAIN
3 - CRANKSHAFT TIMING GEAR

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(17) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(18) Remove the left side secondary chain tensioner. Refer to Timing Chain and Sprockets.

(19) Remove the cylinder head access plug (Fig. 8).

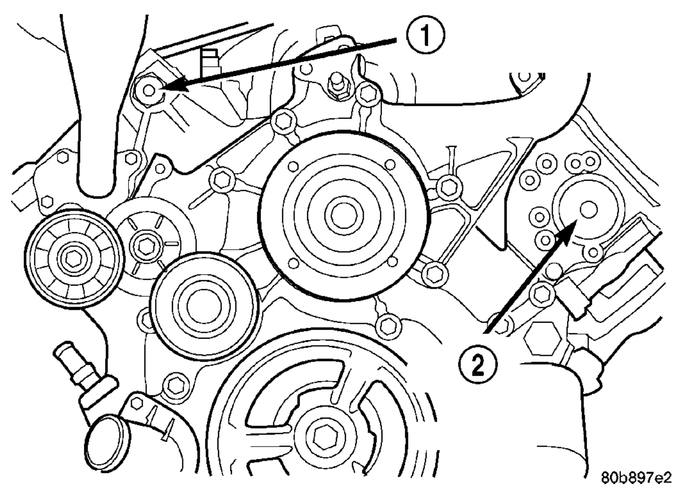


Fig. 8 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

(20) Remove the left side secondary chain guide(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

CYLINDER HEAD - LEFT (Continued)

(21) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with twelve bolts.

(22) Remove the cylinder head retaining bolts.

(23) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 9).

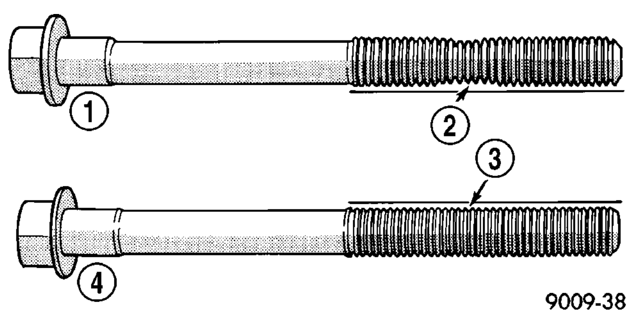


Fig. 9 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 10).

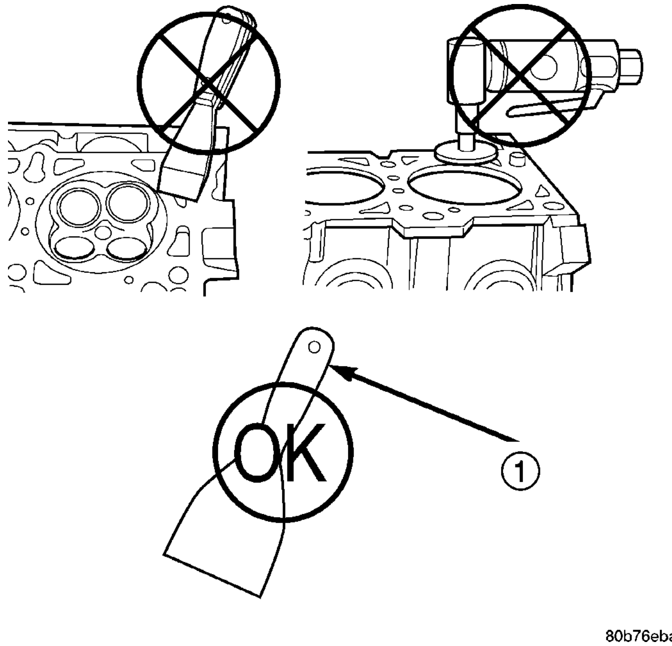


Fig. 10 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the eight M11 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–8, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1–8, all reached 27 N·m (20 ft. lbs.), by repeating step-1 without loosening the bolts. Tighten bolts 9 thru 12 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1–8, 90 degrees (Fig. 11).

CYLINDER HEAD - LEFT (Continued)

• Step 4: Tighten bolts 1–8, 90 degrees, again. Tighten bolts 9–12, 26 N·m (19 ft. lbs.)

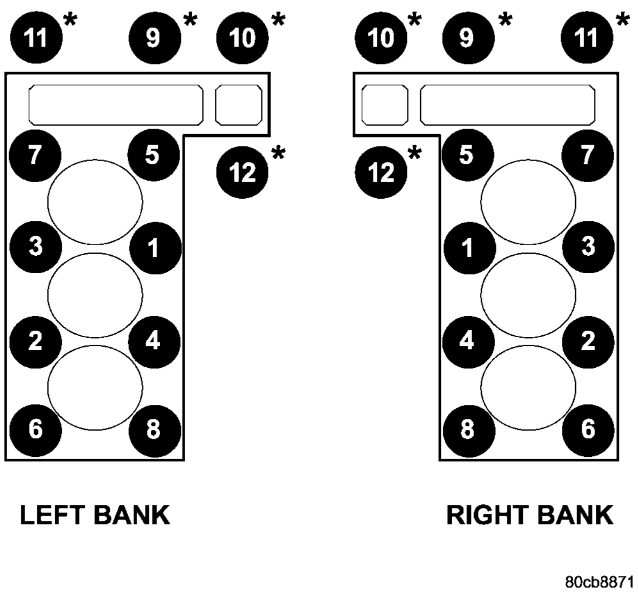


Fig. 11 Cylinder head Tightening Sequence

* - INDICATES SEALANT ON THREADS

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Special Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the left side secondary chain guide(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/ CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the cylinder head access plug.

(11) Re-set and Install the left side secondary chain tensioner(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(12) Remove Special Tool 8429.

(13) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Tighten damper bolt 175 N·m (130 Ft. Lbs.).

(15) Install the power steering pump.

(16) Install the fan blade assembly and fan shroud(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(17) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Reinstall the master cylinder and booster assembly(Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/POWER BRAKE BOOSTER - INSTALLATION).

(19) Install the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(20) Refill the cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the left exhaust manifold.

(23) Lower the vehicle.

(24) Connect the negative cable to the battery.

(25) Start the engine and check for leaks.

CAMSHAFT(S)

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8379 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Set engine to TDC cylinder #1, camshaft sprocket V6 marks at the 12 o'clock position.

CAMSHAFT(S) (Continued)

(3) Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8379 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 12).

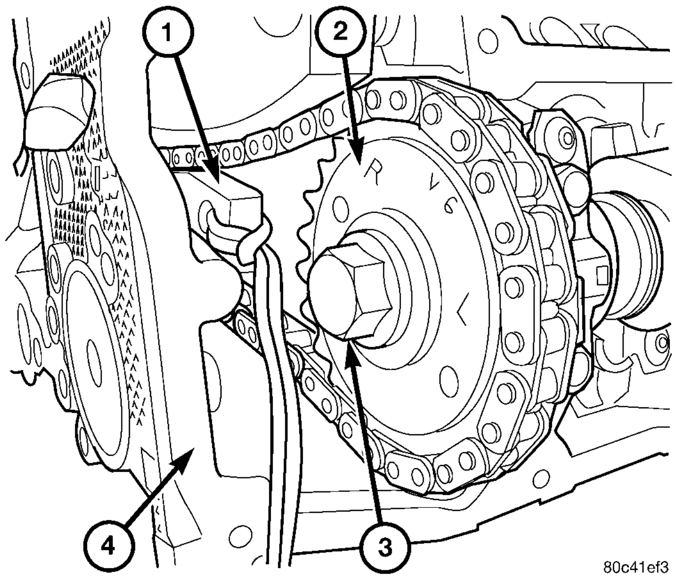


Fig. 12 SECURING TIMING CHAIN TENSIONERS USING TIMING CHAIN WEDGE — Typical

1 - SPECIAL TOOL 8379
2 - CAMSHAFT SPROCKET
3 - CAMSHAFT SPROCKET BOLT
4 - CYLINDER HEAD

(6) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket (Fig. 13).

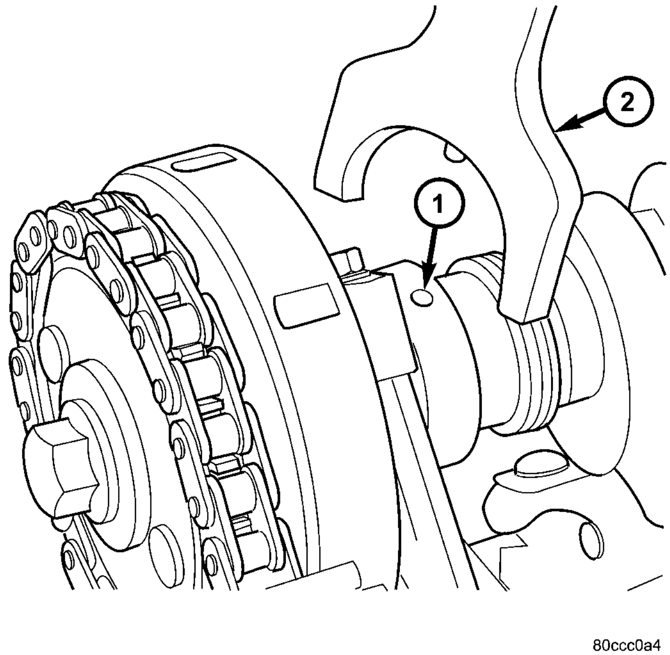


Fig. 13 Special Tool 8428

1 - Camshaft hole
2 - Special Tool 8428

(7) Using Special Tool 8428 Camshaft Wrench, gently allow the camshaft to rotate 5° clockwise until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

CAMSHAFT(S) (Continued)

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

NOTE: Caps should be installed so that the stamped numbers on the caps are in numerical order, (1 thru 4) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 14).

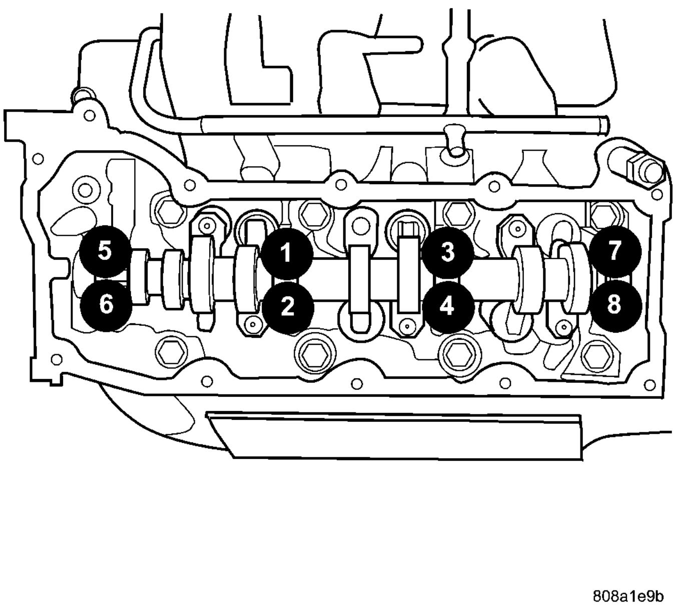


Fig. 14 CAMSHAFT BEARING CAPS TIGHTENING

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

(8) Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8379 timing chain wedge.

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

CYLINDER HEAD COVER(S)

DESCRIPTION

The cylinder head covers are made of single layer stamped steel, and are not interchangable from side-to-side (Fig. 15).

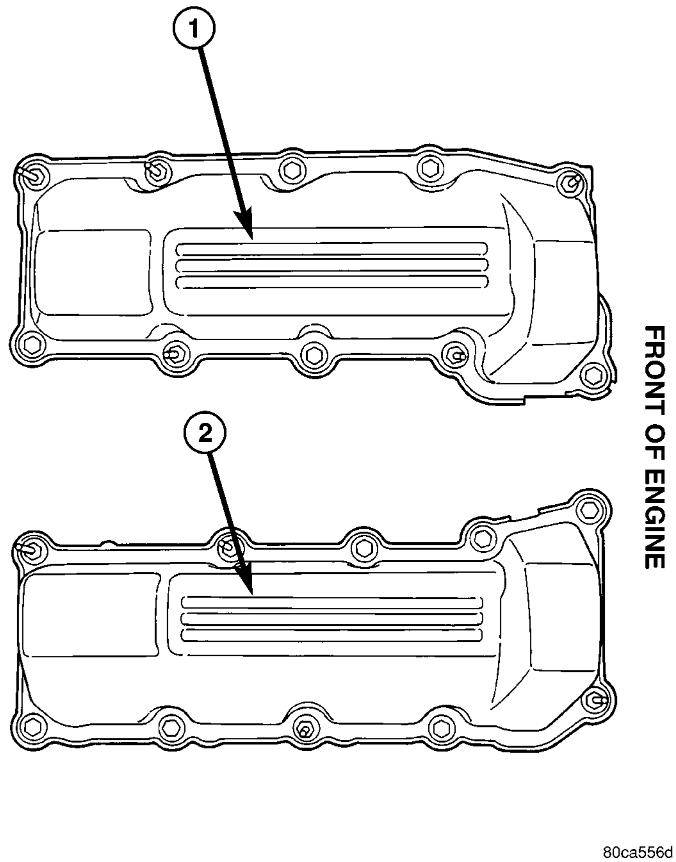


Fig. 15 CYLINDER HEAD COVERS

1 - LEFT SIDE CYLINDER HEAD COVER
2 - RIGHT SIDE CYLINDER HEAD COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the resonator assemble and air inlet hose.

(3) Disconnect injector connectors and un-clip the injector harness.

(4) Route injector harness in front of cylinder head cover.

(5) Disconnect the left side breather tube and remove the breather tube.

CYLINDER HEAD COVER(S) (Continued)

(6) Remove the cylinder head cover mounting bolts (Fig. 16).
(7) Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, providing no cuts, tears, or deformation has occurred.

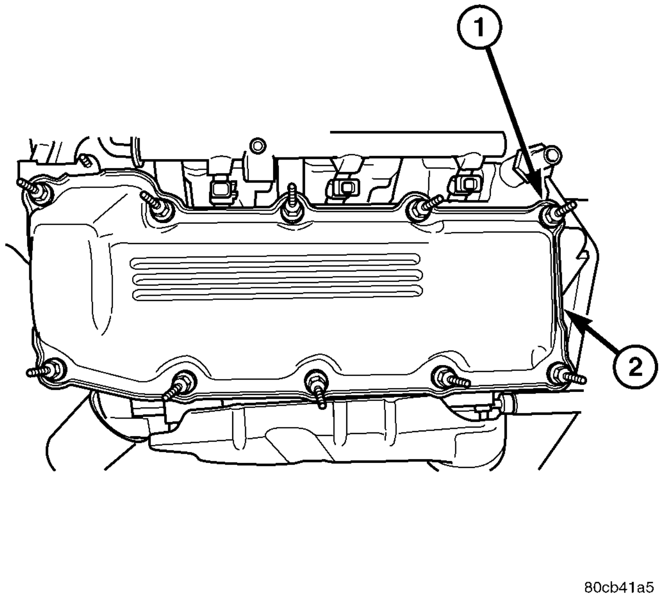


Fig. 16 CYLINDER HEAD COVER -TYPICAL

1 - SCREWS
2 - CYLINDER HEAD COVER

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).
(3) Install left side breather and connect breather tube.
(4) Connect injector electrical connectors and injector harness retaining clips.
(5) Install the resonator and air inlet hose.
(6) Connect negative cable to battery.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

STANDARD PROCEDURE - REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves and valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(1) Using a suitable dial indicator measure the center of the valve seat Total run out must not exceed 0.051 mm (0.002 in).
(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.
(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).
(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 40.74 mm (1.6039 in.).

INTAKE/EXHAUST VALVES & SEATS (Continued)

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle (Fig. 17).

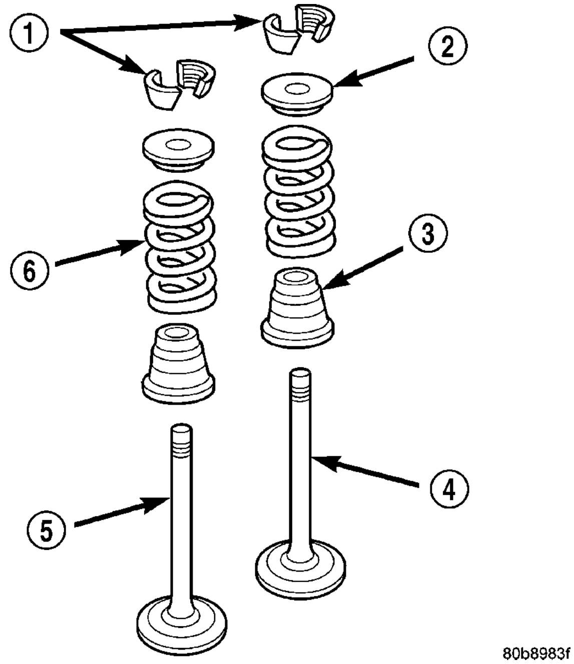


Fig. 17 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

REMOVAL

NOTE: The cylinder heads must be removed in order to perform this procedure.

(1) Remove rocker arms and lash adjusters(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). (Fig. 18).

(2) Remove the camshaft bearing caps and the camshaft.

NOTE: All six valve springs and valves are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422–B or C-3422–C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

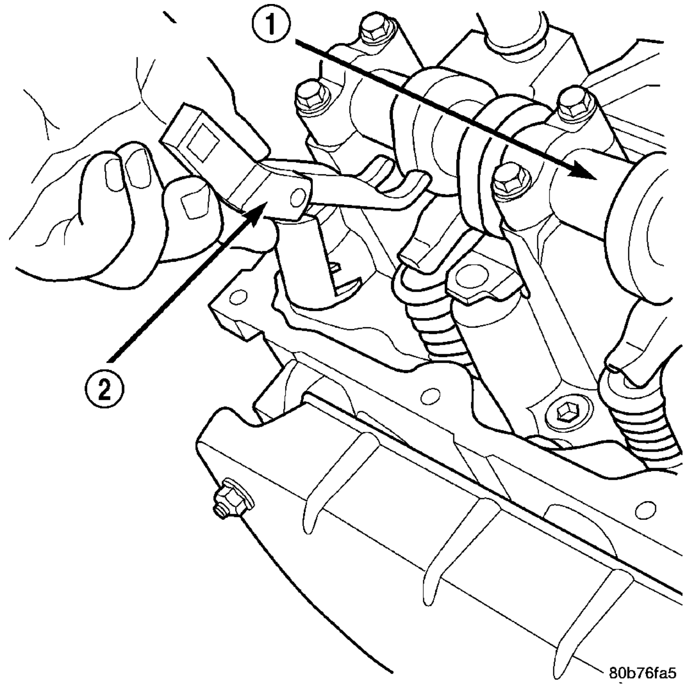


Fig. 18 Rocker Arm Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(5) Remove the valve spring compressor.

(6) Remove the spring retainer, and the spring.

NOTE: Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

NOTE: The valve stem seals are common between intake and exhaust.

(8) Remove the valve stem seal. Mark the valve for proper installation.

TESTING VALVE SPRINGS

NOTE: Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.12 mm (1.579 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until Ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer

INTAKE/EXHAUST VALVES & SEATS (Continued)

adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 19).

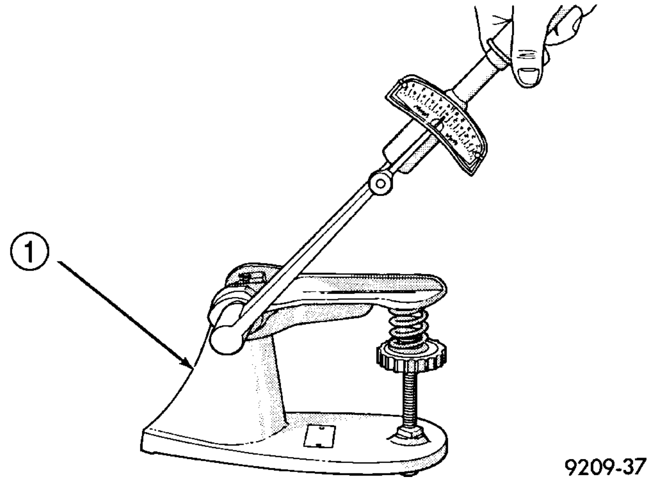


Fig. 19 Testing Valve Springs

1 - SPECIAL TOOL C-647

INSTALLATION

(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(3) Install the spring and the spring retainer (Fig. 20).

(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9–13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 21).

(8) Position the hydraulic lash adjusters and rocker arms(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

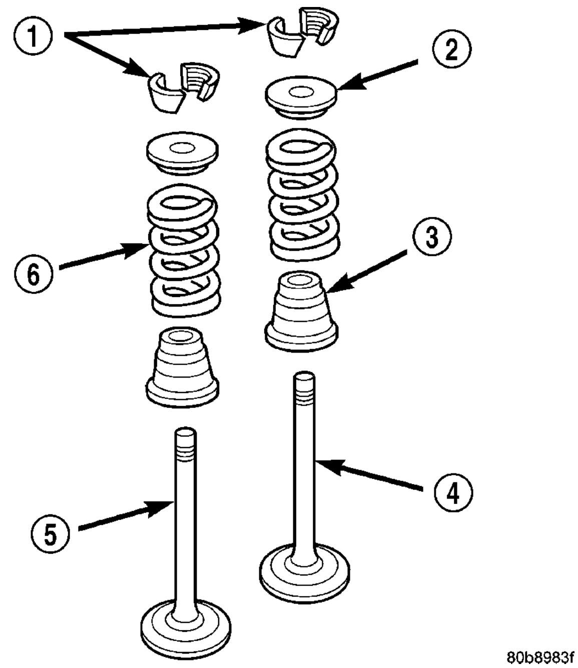


Fig. 20 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

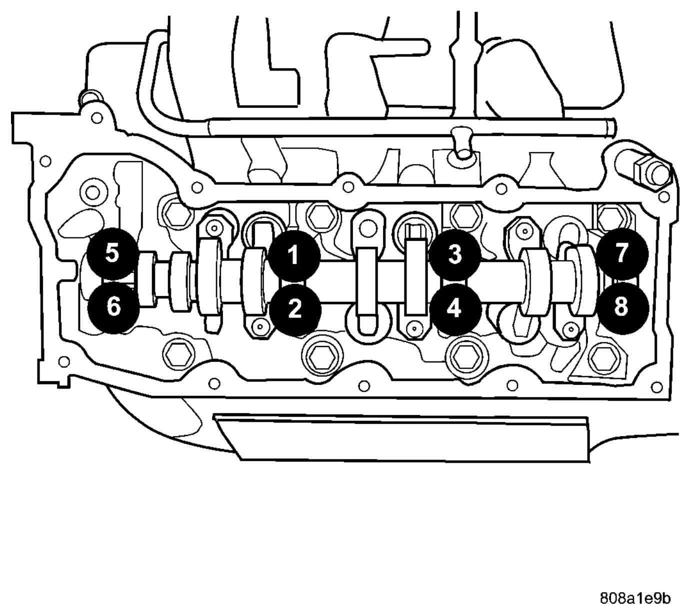


Fig. 21 Camshaft Bearing Caps Tightening Sequence

ROCKER ARM

DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) For rocker arm removal on cylinder #4, Rotate the crankshaft until cylinder #1 is at BDC intake stroke.

(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.

(4) For rocker arm removal on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(5) For rocker arm removal on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 22).

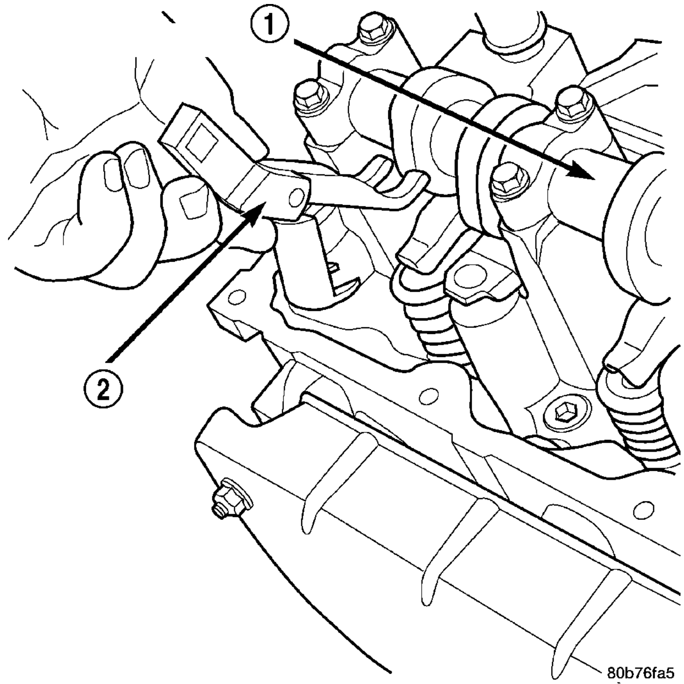


Fig. 22 Rocker Arm - Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

(1) For rocker arm installation on cylinders #4, Rotate the crankshaft until cylinder #1 is at BDC intake stroke.

(2) For rocker arm installation on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.

(3) For rocker arm installation on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(4) For rocker arm installation on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 23).

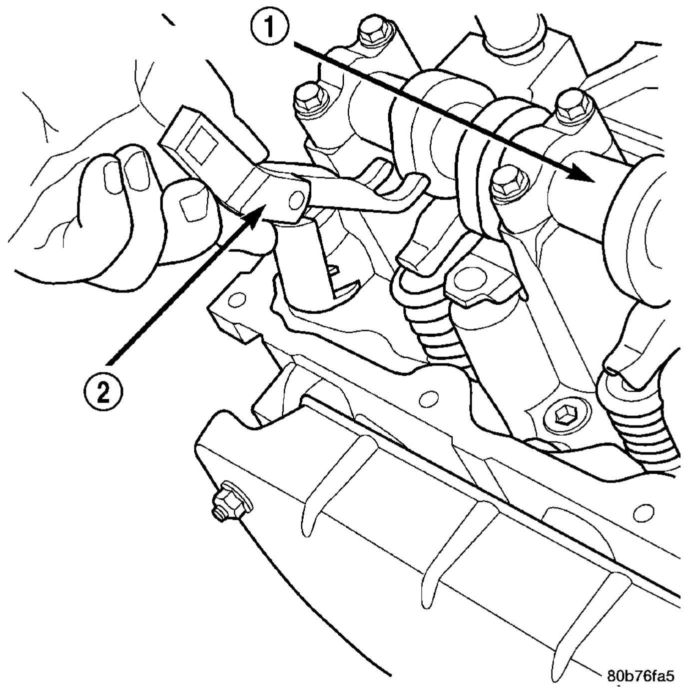


Fig. 23 Rocker Arm - Installation

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(6) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE GUIDE SEALS

DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

VALVE SPRINGS

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are NOT common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

(1) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(5) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(6) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(7) Remove the valve spring compressor.

NOTE: The valve springs are NOT common between intake and exhaust.

(8) Remove the spring retainer, and the spring.

(9) Remove the valve stem seal.

NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(1) Apply shop air to the cylinder to hold the valves in place while the spring is installed.

NOTE: The valve stem seals are common between intake and exhaust.

(2) Install the valve stem seal.

NOTE: The valve springs are NOT common between intake and exhaust.

(3) Install the spring retainer, and the spring.

(4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

(5) Install the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(6) Remove the valve spring compressor.

(7) Disconnect the shop air to the cylinder.

(8) Install the spark plug for the cylinder the valve spring and seal was installed on.

(9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.

(10) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

CYLINDER HEAD - RIGHT

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

CYLINDER HEAD - RIGHT (Continued)

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Oil leak or excessive cam bore wear in cylinder head.

(11) Faulty lash adjuster.

a. Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

b. Remove suspected lash adjusters, and replace.

c. Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

REMOVAL

(1) Disconnect battery negative cable.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the right side exhaust manifold.

(4) Drain the engine coolant(Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Lower the vehicle.

(6) Remove the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(8) Remove the fan shroud(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove oil fill housing from cylinder head.

(10) Remove accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark.

(12) Verify the V6 mark on the camshaft sprocket is at the 12 o'clock position. Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(14) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8429 Timing Chain Holding Fixture.

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(16) Mark the secondary timing chain, one link on each side of the V6 mark on the camshaft drive gear.

(17) Remove the right side secondary chain tensioner(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(18) Remove the cylinder head access plug.

(19) Remove the right side secondary chain guide(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 N·m (44 in. lbs.).

(20) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with twelve bolts.

(21) Remove the cylinder head retaining bolts.

(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads (Fig. 24). If all the threads do not contact the scale, the bolt should be replaced.

CYLINDER HEAD - RIGHT (Continued)

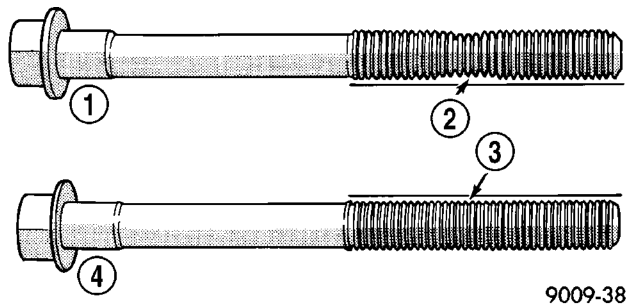


Fig. 24 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 25).

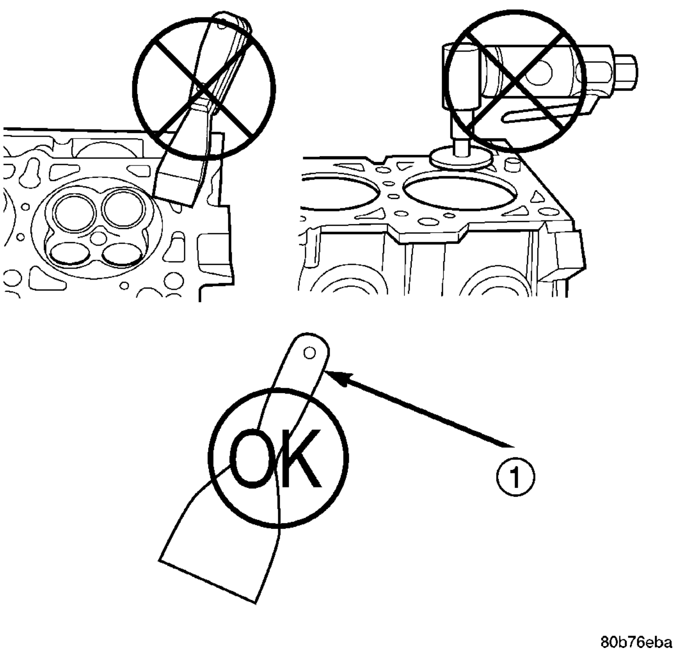


Fig. 25 Proper Tool Usage For Surface Preparation

1 - PLASTIC/WOOD SCRAPER

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four M8 cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the eight M10 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence using the following steps and torque values:

- Step 1: Tighten bolts 1–8, 27 N·m (20 ft. lbs.).
- Step 2: Verify that bolts 1–8, all reached 27 N·m (20 ft. lbs.), by repeating step-1 without loosening the bolts. Tighten bolts 9 thru 12 to 14 N·m (10 ft. lbs.).
- Step 3: Tighten bolts 1–8, 90 degrees (Fig. 26).
- Step 4: Tighten bolts 1–8, 90 degrees, again. Tighten bolts 9–12, 26 N·m (19 ft. lbs.)

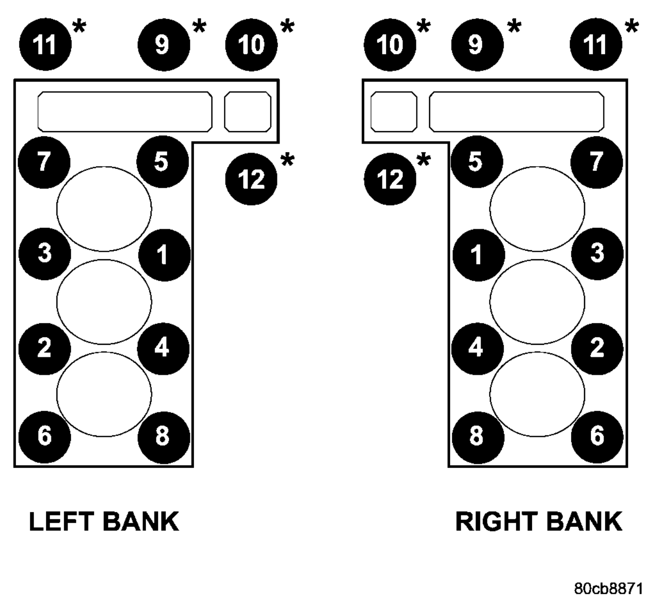


Fig. 26 Cylinder Head Tightening Sequence

* - INDICATES SEALANT ON THREADS

CAUTION: The nut on the right side camshaft sprocket should not be removed for any reason, as the sprocket and camshaft sensor target wheel is serviced as an assembly. If the nut was removed retorque nut to 5 ft. lbs.(60 in. lbs.).

CYLINDER HEAD - RIGHT (Continued)

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V6 mark on the gear then using Special Tool 8428 Camshaft Wrench, position the gear onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torquing of bolt resulting in bolt failure.

(8) Install the camshaft drive gear retaining bolt.
(9) Install the right side secondary chain guide(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/ CHAIN AND SPROCKETS - INSTALLATION).
(10) Install the cylinder head access plug.
(11) Re-set and install the right side secondary chain tensioner(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(12) Remove Special Tool 8429.
(13) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(14) Install the crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Tighten damper bolt 175 N·m (130 Ft. Lbs.).
(15) Install accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(16) Install the fan shroud(Refer to 7 - COOLING/ ENGINE/RADIATOR FAN - INSTALLATION).
(17) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(18) Install the intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(19) Install oil fill housing onto cylinder head.
(20) Refill the cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).
(21) Raise the vehicle.
(22) Install the exhaust pipe onto the right exhaust manifold.
(23) Lower the vehicle.
(24) Reconnect battery negative cable.
(25) Start the engine and check for leaks.

CAMSHAFT(S)

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. Four bearing journals are machined into the camshaft. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8379 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

(1) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(2) Set engine to TDC cylinder #1, camshaft sprocket V6 marks at the 12 o'clock position.
(3) Mark one link on the secondary timing chain on both sides of the V6 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8379 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide.
(6) Remove the camshaft position sensor.
(7) Hold the camshaft with Special Tool 8428 Camshaft Wrench, while removing the camshaft sprocket bolt and sprocket.

CAMSHAFT(S) (Continued)

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

NOTE: Caps should be installed so that the stamped numbers on the caps are in numerical order, (1 thru 4) from the front to the rear of the engine. All caps should be installed so that the stamped arrows on the caps point toward the front of the engine.

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 27).

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V6 mark between the two marked chain links (Two links marked during removal).

(7) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft.

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt overtorque resulting in bolt failure.

(8) Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.

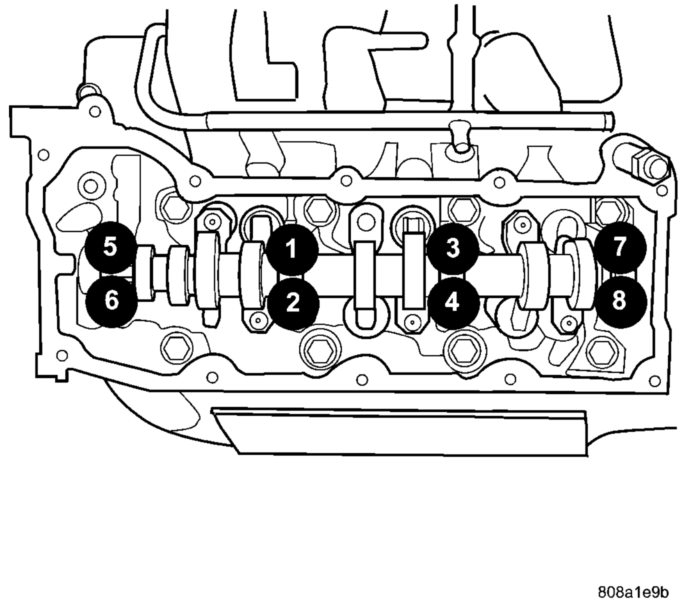


Fig. 27 CAMSHAFT BEARING CAPS TIGHTENING

(9) Remove timing chain wedge special tool 8379.

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346, torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor.

(12) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

CYLINDER HEAD COVER(S)

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove air cleaner assembly, resonator assembly and air inlet hose.

(3) Drain cooling system, below the level of the heater hoses(Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove air conditioning compressor retaining bolts and move compressor to the left.

(6) Remove heater hoses.

(7) Disconnect injector and ignition coil connectors.

(8) Disconnect and remove positive crankcase ventilation (PCV) hose.

(9) Remove oil fill tube.

(10) Un-clip injector and ignition coil harness and move away from cylinder head cover.

(11) Remove right rear breather tube and filter assembly.

CYLINDER HEAD COVER(S) (Continued)

(12) Remove cylinder head cover retaining bolts.
(13) Remove cylinder head cover.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(3) Install right rear breather tube and filter assembly.
(4) Connect injector, ignition coil electrical connectors and harness retaining clips.
(5) Install the oil fill tube.
(6) Install PCV hose.
(7) Install heater hoses.
(8) Install air conditioning compressor retaining bolts.
(9) Install accessory drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(10) Fill Cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).
(11) Install air cleaner assembly, resonator assembly and air inlet hose.
(12) Connect battery negative cable.

ROCKER ARM

DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(2) For rocker arm removal on cylinder #4, Rotate the crankshaft until cylinder #1 is at BDC intake stroke.
(3) For rocker arm removal on cylinder #1, Rotate the crankshaft until cylinder #1 is at BDC combustion stroke.
(4) For rocker arm removal on cylinders #3 and #5, Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(5) For rocker arm removal on cylinders #2 and #6, Rotate the crankshaft until cylinder #1 is at TDC ignition stroke.
(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 28).

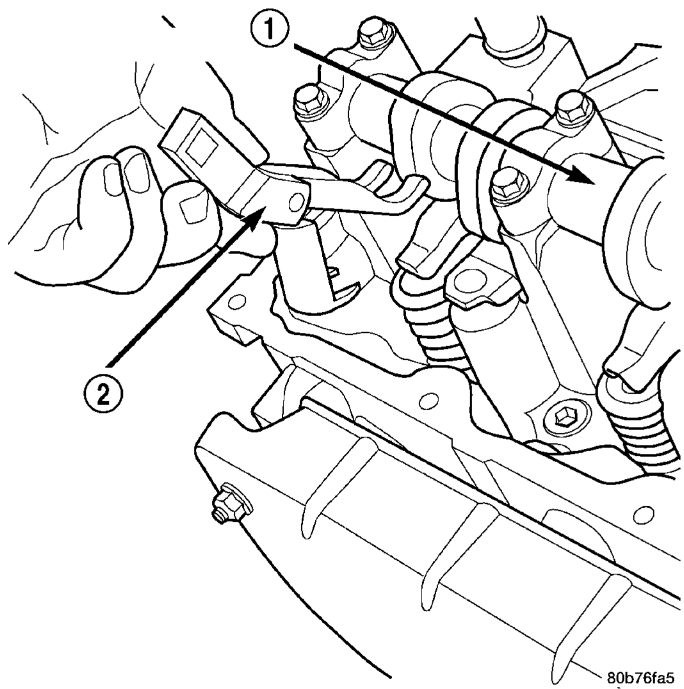


Fig. 28 Rocker Arm - Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

VALVE GUIDE SEALS

DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

VALVE SPRINGS

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. There are different springs for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

VALVE SPRINGS (Continued)

REMOVAL

(1) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters.

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed.

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(5) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(6) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(7) Remove the valve spring compressor.

NOTE: The valve springs are NOT common between intake and exhaust.

(8) Remove the spring retainer, and the spring.

(9) Remove the valve stem seal.

NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

NOTE: All six valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(1) Apply shop air to the cylinder to hold the valves in place while the spring is installed.

NOTE: The valve stem seals are common between intake and exhaust.

(2) Install the valve stem seal.

NOTE: The valve springs are NOT common between intake and exhaust.

(3) Install the spring retainer, and the spring.

(4) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

(5) Install the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(6) Remove the valve spring compressor.

(7) Disconnect the shop air to the cylinder.

(8) Install the spark plug for the cylinder the valve spring and seal was installed on.

(9) Using Special Tool 8516 Valve Spring Compressor, install the rocker arms and the hydraulic lash adjusters.

(10) Install the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.

STANDARD PROCEDURE—CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

ENGINE BLOCK (Continued)

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 29).

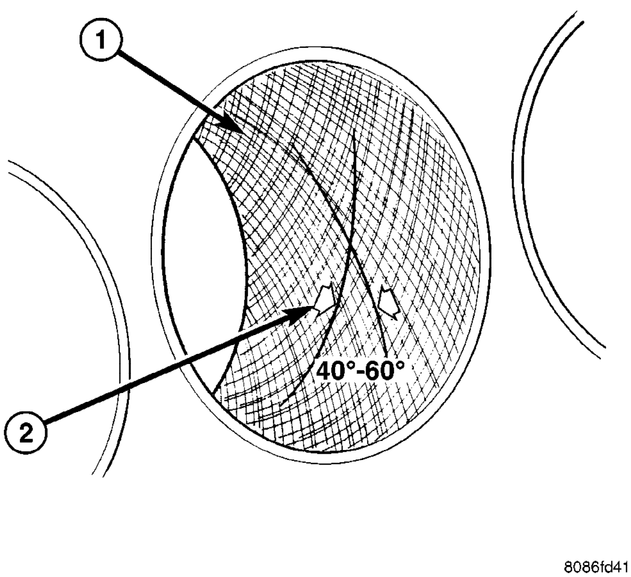


Fig. 29 CYLINDER BORE CROSSHATCH PATTERN

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the 1/4 inch NPT plugs to 20 N·m (177 in. lbs.) torque. Tighten the 3/8 inch NPT plugs to 27 N·m (240 in. lbs.) torque.

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 30).

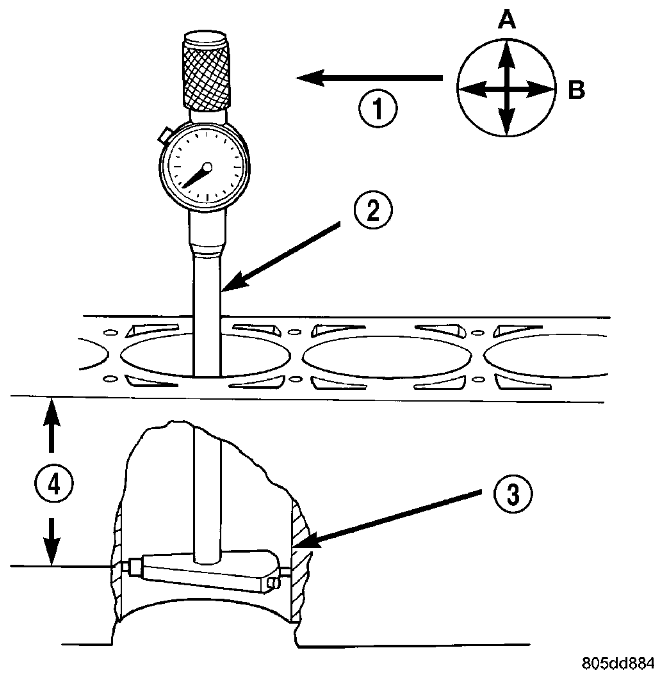


Fig. 30 BORE GAUGE-TYPICAL

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM (1.5 in)

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

ENGINE BLOCK (Continued)

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a three throw split pin design with six counterweights for balancing purposes. The crankshaft is supported by four select fit main bearings with the number two serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number six counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel (Fig. 31). The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

(1) Remove the engine(Refer to 9 - ENGINE - REMOVAL).

(2) Remove the engine oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

(3) Remove the bedplate mounting bolts. Note the location of the two stud bolts for installation.

(4) Remove the connecting rods from the crankshaft.

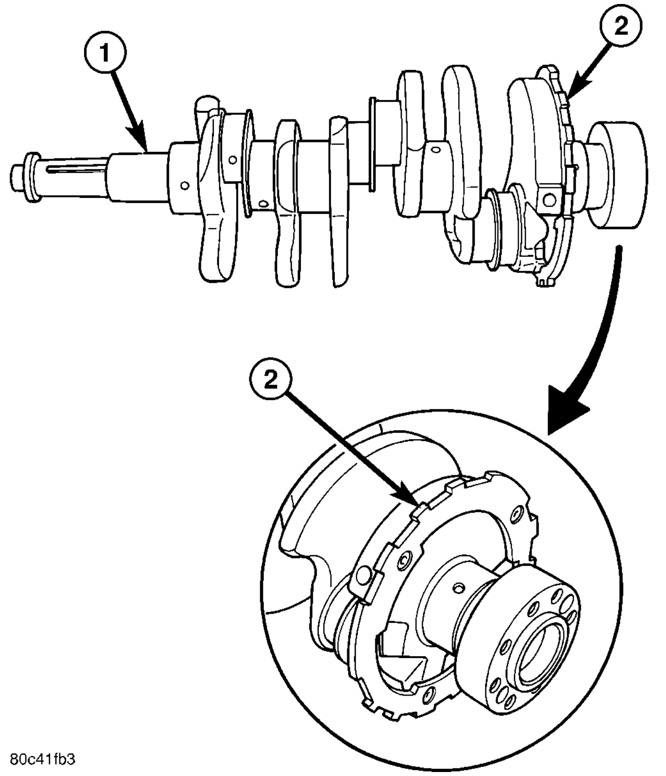


Fig. 31 CRANKSHAFT AND TARGET RING

1 - CRANKSHAFT
2 - CRANKSHAFT POSITION SENSOR TARGET RING

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause severe damage to the crankshaft.

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are shown below.

(5) Carefully pry on the pry points (Fig. 32) to loosen the bedplate then remove the bedplate.

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

(6) Remove the crankshaft.

(7) Remove the crankshaft tone wheel.

CRANKSHAFT (Continued)

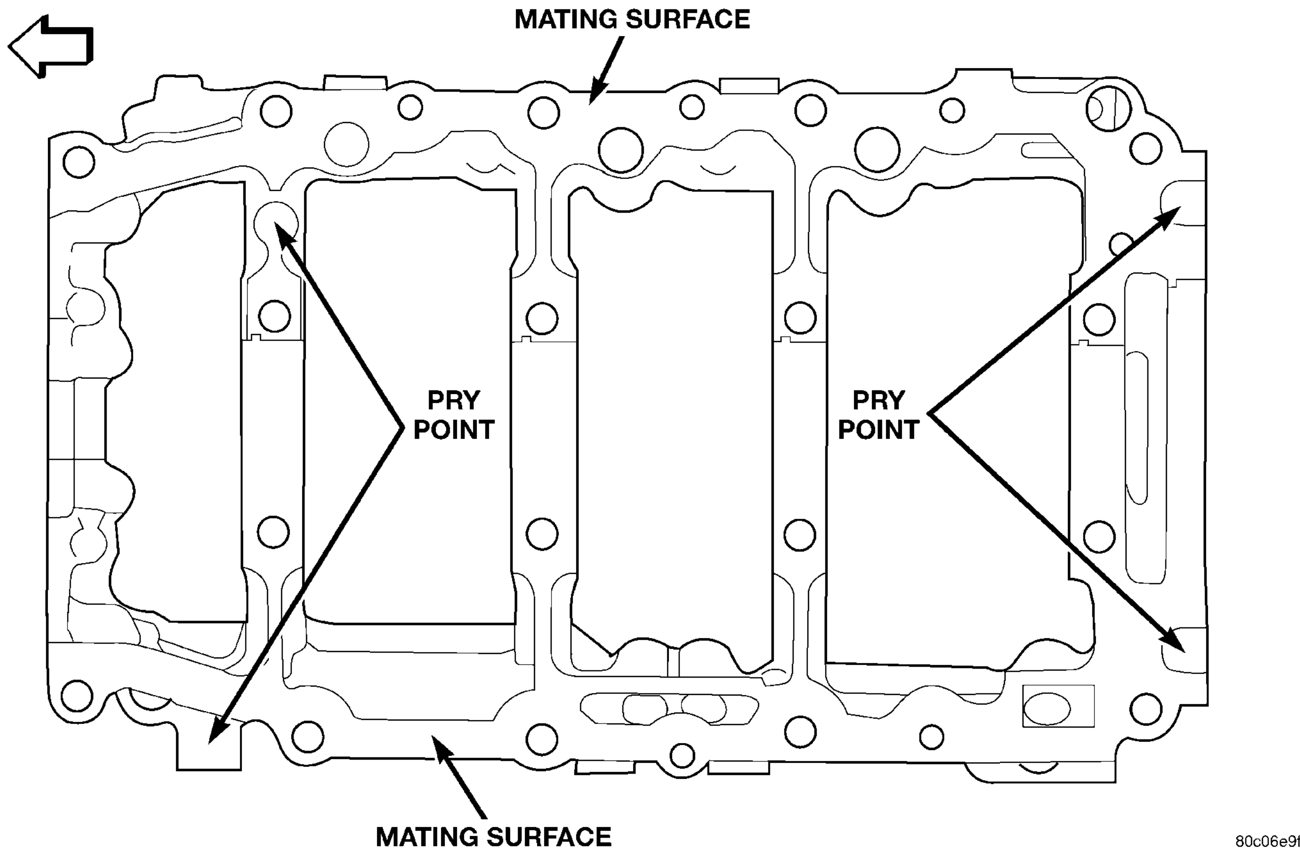


Fig. 32 BEDPLATE PRY POINT LOCATION

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washers.

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

CRANKSHAFT (Continued)

INSTALLATION

CAUTION: Main bearings are select fit. Refer to Crankshaft Main Bearings in this section for proper bearing selections.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the tone wheel retaining screws prior to installation.

(1) Lubricate upper main bearing halves with clean engine oil.

(2) Install the crankshaft tone wheel. Torque the mounting screws to 15 N·m (11 ft. lbs.).

(3) Position crankshaft in cylinder block.

(4) Install the thrust washers (Fig. 33).

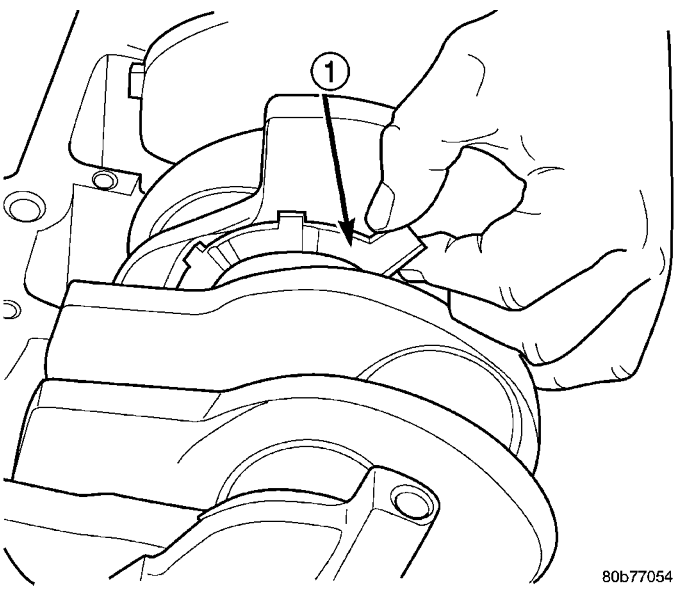


Fig. 33 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

CAUTION: The bedplate to cylinder block mating surface must be coated with Mopar® Engine RTV sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

(5) Apply a 2.5mm (0.100 inch) bead of Mopar® Engine RTV sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 34).

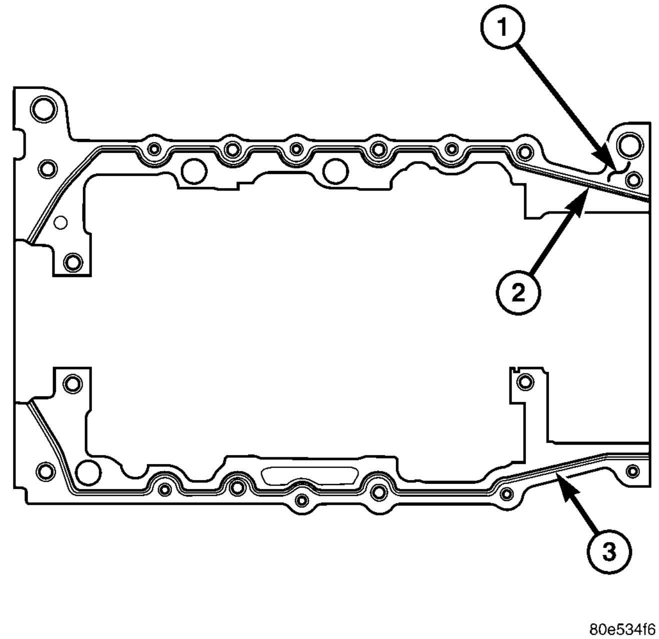


Fig. 34 BEDPLATE SEALANT

1 - CYLINDER BLOCK
2 - SEALENT
3 - SEALANT

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

CRANKSHAFT (Continued)

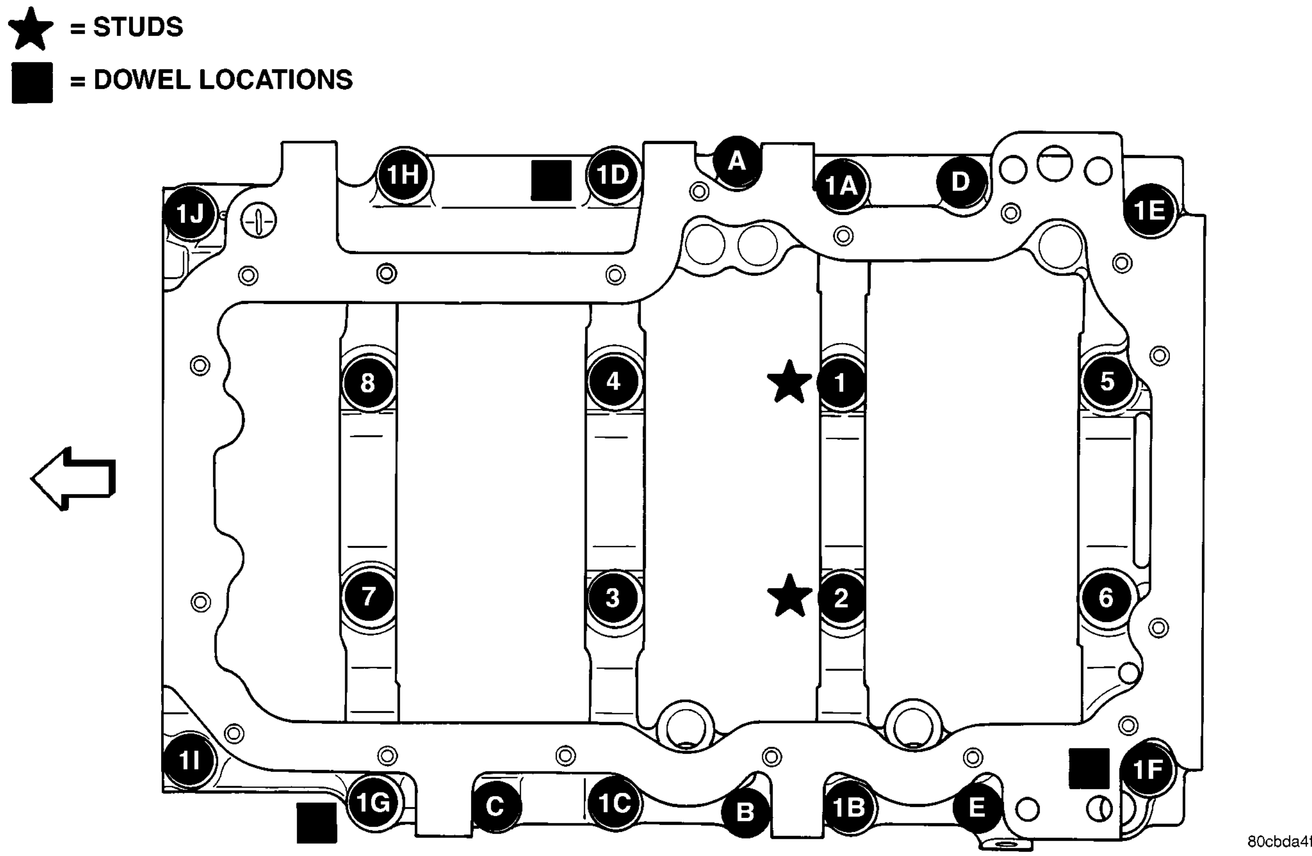


Fig. 35 BEDPLATE TIGHTENING SEQUENCE

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 35).

- Hand tighten bolts **1D,1G and 1F** until the bedplate contacts the block.
- Tighten bolts **1A–1J** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–8** to 7 N·m (5 ft. lbs.)
- Turn bolts **1–8** an additional 90°.
- Tighten bolts **A–E** 27 N·m (20 ft. lbs.).

(8) Measure crankshaft end play.

(9) Install the connecting rods and measure side clearance(Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

(10) Install oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Install the engine(Refer to 9 - ENGINE - INSTALLATION).

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE

MAIN BEARING FITTING

SELECT FIT IDENTIFICATION

The main bearings are "select fit" to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 36). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4. The crankshaft position sensor target wheel is mounted to the number 6 counter weight on the crankshaft.

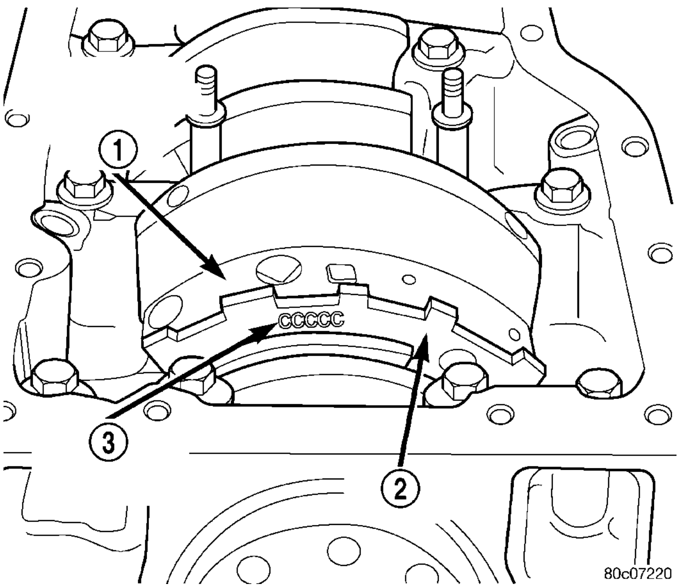


Fig. 36 MARKINGS ON TARGET WHEEL

1 - REARMOST CRANKSHAFT COUNTER WEIGHT
2 - TARGET WHEEL
3 - MAIN BEARING SELECT FIT MARKINGS

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - REMOVAL).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - INSPECTION).

Check crankshaft end play.

CRANKSHAFT MAIN BEARING SELECTION

(1) Service main bearings are available in four grades. The chart below identifies the four service grades available.

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
″R″ Size	63.488 - 63.496 mm (2.4995 - 2.4998 in.)	
″S″ Size	63.496 - 63.500 mm (2.4998 - 2.4999 in.)	
″T″ Size	63.500 - 63.504 mm (2.4999 - 2.501 in.)	
″U″ Size	63.504 - 63.512 mm (2.5001 - 2.5004 in.)	
Bearing size		
Bearing Code	Size	Application
Upper Bearing		
A	.2.443 - 2.447 mm (.0961 - .0963 in.)	Use with crankshaft size ″R″
B	2.439 - 2.443 mm (0.960 -.o961 in.)	Use with crankshaft ″S, T″
C	2.435 - 2.439 mm	Use with crankshaft ″U″

CRANKSHAFT MAIN BEARINGS (Continued)

Crankshaft MARKING	JOURNAL SIZE SIZE mm (in.)	
	(.0958 - .0960 in.)	
Lower Bearing Main ″1″ and ″4″		
″1″	2.441 - 2.447 mm (.0961 -.0963 in.)	Use with crankshaft ″R, S″
″2″	2.435 - 2.441 mm (.0958 - .0962 in.)	Use with crankshaft ″T, U″
Lower Main Bearing ″2″ and ″3″		
″3″	2.429 - 2.435 mm (.0956 - .0958 in.)	Use with crankshaft ″R, S″
″4″	2.423 - 2.429 mm (.0953 - .0956 in.)	Use with crankshaft ″T, U″
Bearing Clearances		
Main ″1, 4″		
Crankshaft ″R″	.004 - .034 mm (.00015 - .0013 in.)	
Crankshaft ″S″	.004 - .030 mm (.00015 - .0011 in.)	
Crankshaft ″T″	.006 - .032 mm (.0002 - .0012 in.)	
Crankshaft ″U″	.002 - .032 mm (.00007 -. 0012 in.)	
Main ″2, 3″		
Crankshaft ″R″	.016 - .046 mm (.0006 - .0018 in.)	
Crankshaft ″S″	.016 - .042 mm (.00062 - .016 in.)	
Crankshaft ″T″	.018 - .044 mm (.0007 - .0017 in.)	
Crankshaft ″U″	.014 - .044 mm (.0005 - .0017 in.)	

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Remove A/C compressor mouning fasteners and set aside.

(4) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Remove upper radiator hose.

(6) Disconnect electrical connector for fan mounted inside radiator shroud.

(7) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 37).

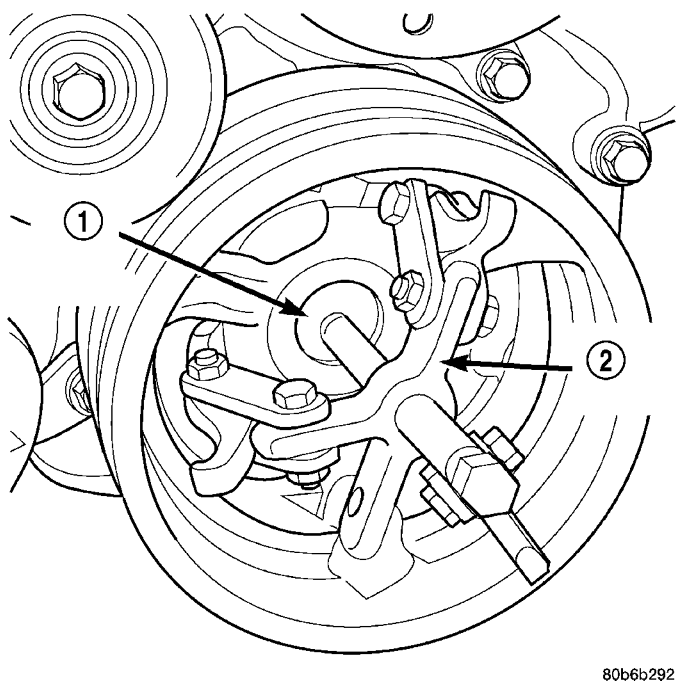


Fig. 37 Crankshaft Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

CRANKSHAFT OIL SEAL - FRONT (Continued)

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 38).

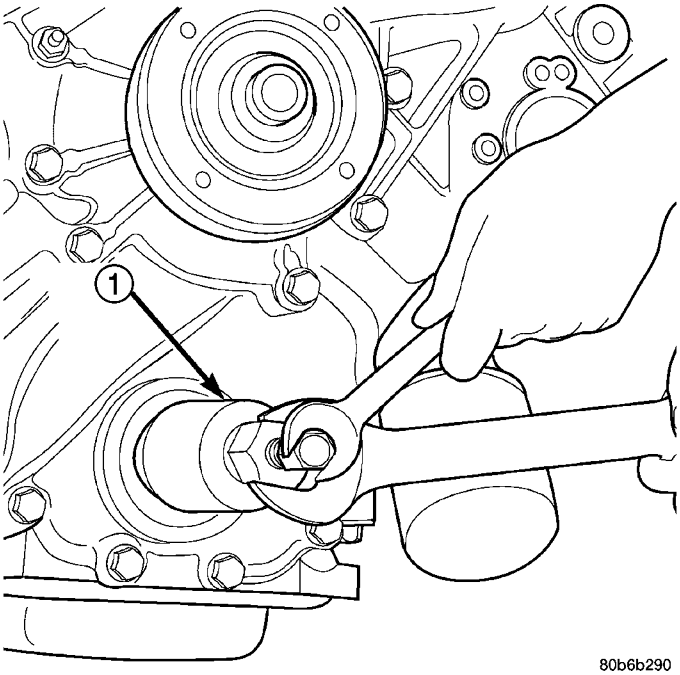


Fig. 38 Crankshaft Front Seal Removal

1 - SPECIAL TOOL 8511

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 39).

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(6) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Connect negative cable to battery.

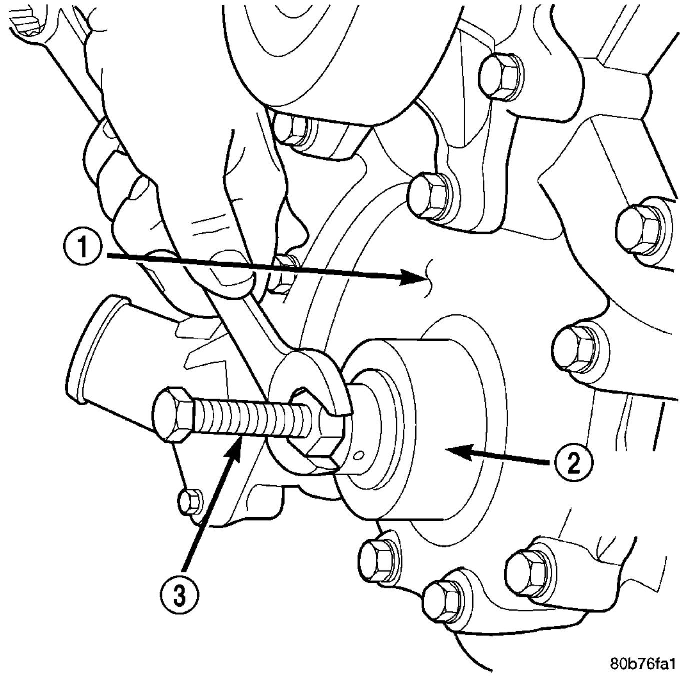


Fig. 39 Crankshaft Front Seal Installation

1 - TIMING CHAIN COVER
2 - SPECIAL TOOL 8348
3 - SPECIAL TOOL 8512

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

CRANKSHAFT OIL SEAL - REAR (Continued)

(3) Using Special Tool 8506 (Fig. 40), remove the crankshaft rear oil seal.

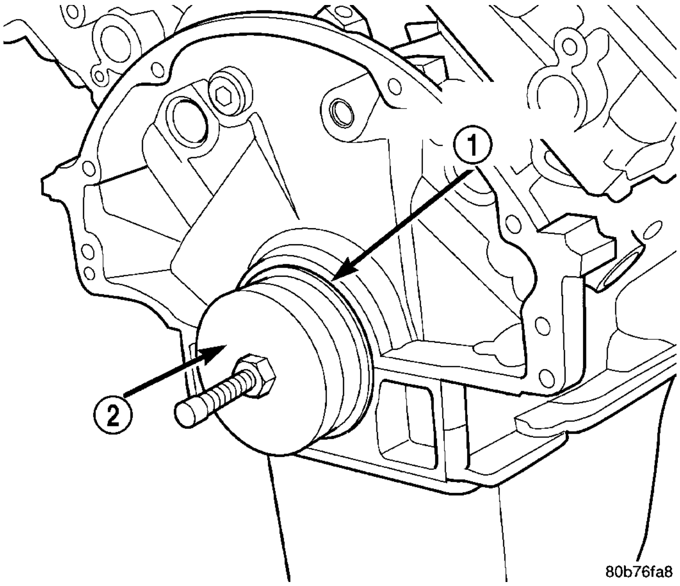


Fig. 40 Crankshaft Rear Oil Seal Removal

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8506

INSTALLATION

(1) Lubricate the crankshaft flange with engine oil.

(2) Position the magnetic seal guide Special Tool 8349–2 (Fig. 41) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

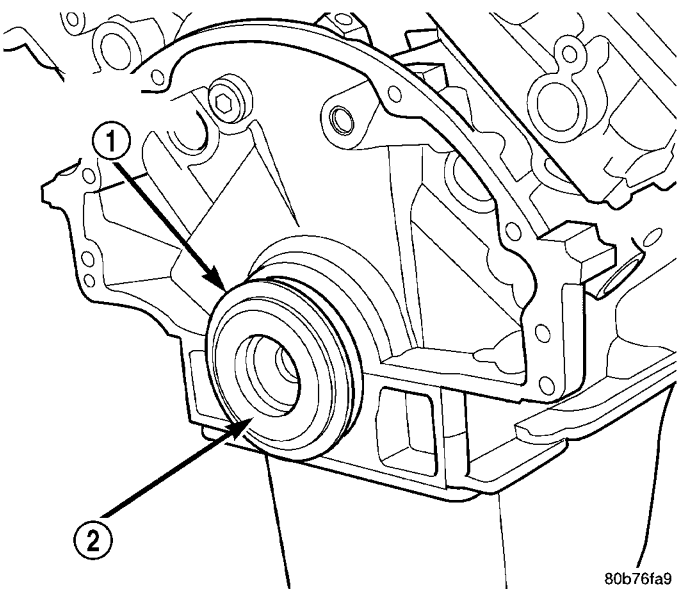


Fig. 41 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–2 GUIDE

(3) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 42), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

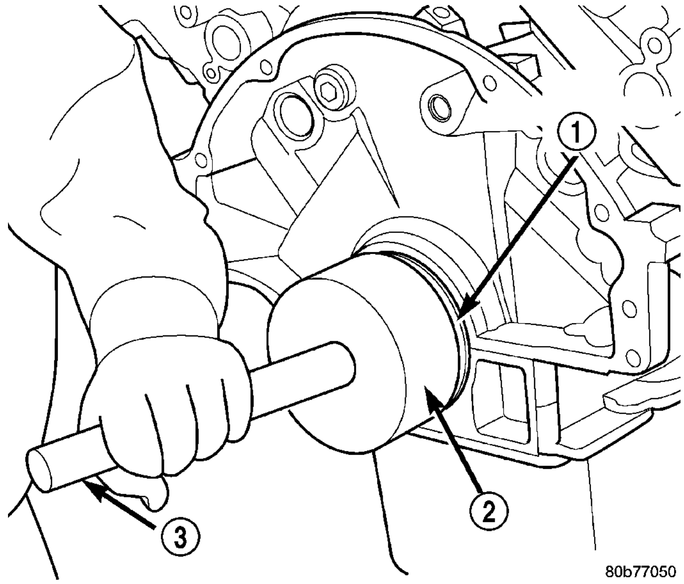


Fig. 42 Crankshaft Rear Oil Seal Installation

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–1 INSTALLER
3 - SPECIAL TOOL C-4171 HANDLE

(4) Install the flexplate.

(5) Install the transmission.

FLEX PLATE

REMOVAL

(1) Remove the transmission.
(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.
(2) Tighten the flexplate retaining bolts to 95 N·m (70 ft. lbs.) in the sequence shown (Fig. 43).
(3) Install the transmission.

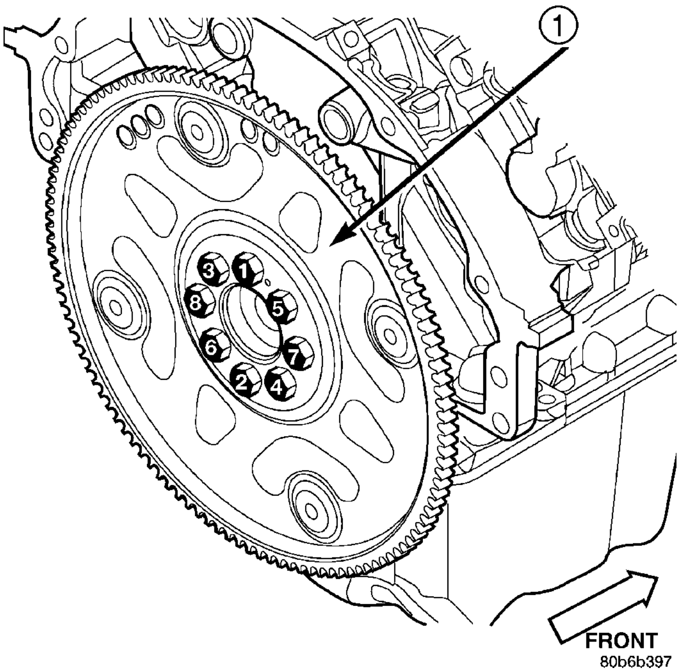


Fig. 43 Flexplate Tightening Sequence

1 - FLEXPLATE

PISTON & CONNECTING ROD

DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A full floating piston pin is used to attach the piston to the connecting rod (Fig. 44).

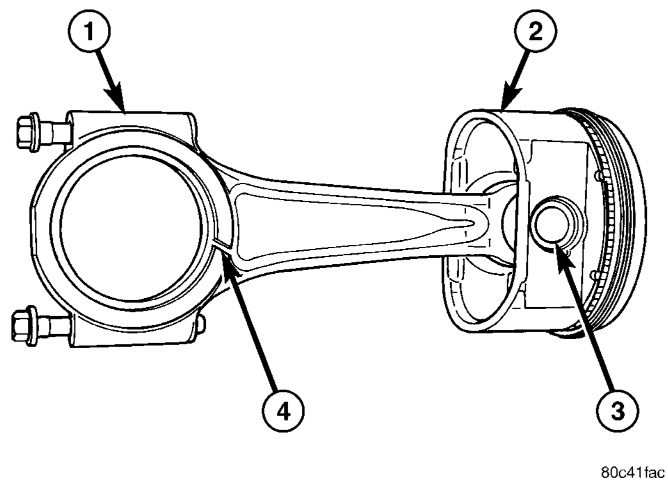


Fig. 44 PISTON AND ROD ASSEMBLY

1 - CONNECTING ROD
2 - PISTON
3 - PISTON PIN
4 - OIL SLINGER SLOT

PISTON & CONNECTING ROD (Continued)

STANDARD PROCEDURE

CONNECTING ROD BEARING FITTING

Inspect the connecting rod bearings for scoring. Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 45). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs (Fig. 46).

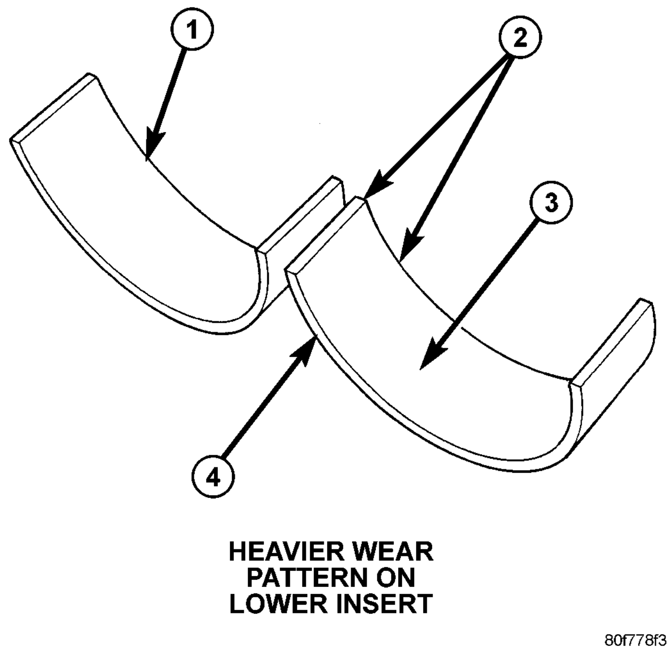


Fig. 45 Connecting Rod Bearing Inspection

1 - UPPER BEARING HALF
2 - MATING EDGES
3 - GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
4 - WEAR PATTERN - ALWAYS GREATER ON UPPER BEARING

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

(1) Wipe the oil from the connecting rod journal.

(2) Lubricate the upper bearing insert and position in connecting rod. Center bearing insert in connecting rod (Fig. 47)

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 48) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

(4) Install the lower bearing insert in the bearing cap. Center bearing insert in connecting rod (Fig. 47).

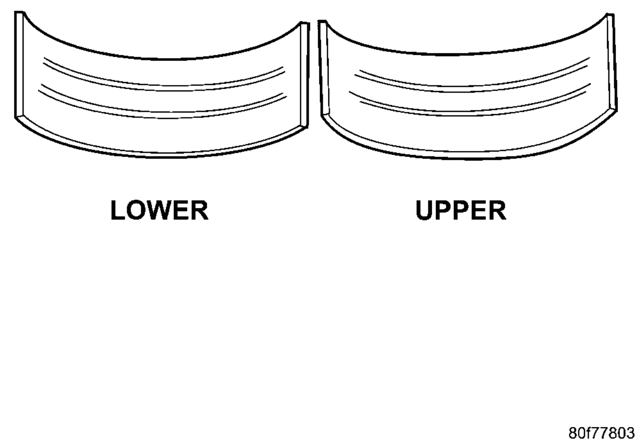


Fig. 46 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

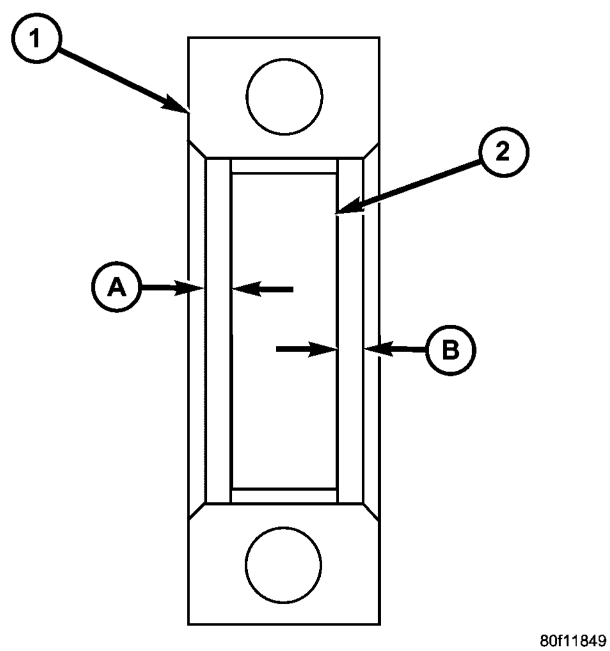


Fig. 47 Bearing Insert Location

1 - Connecting Rod
2 - Bearing Insert
- A, B less then .50 mm (.0196 in.)

The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

PISTON & CONNECTING ROD (Continued)

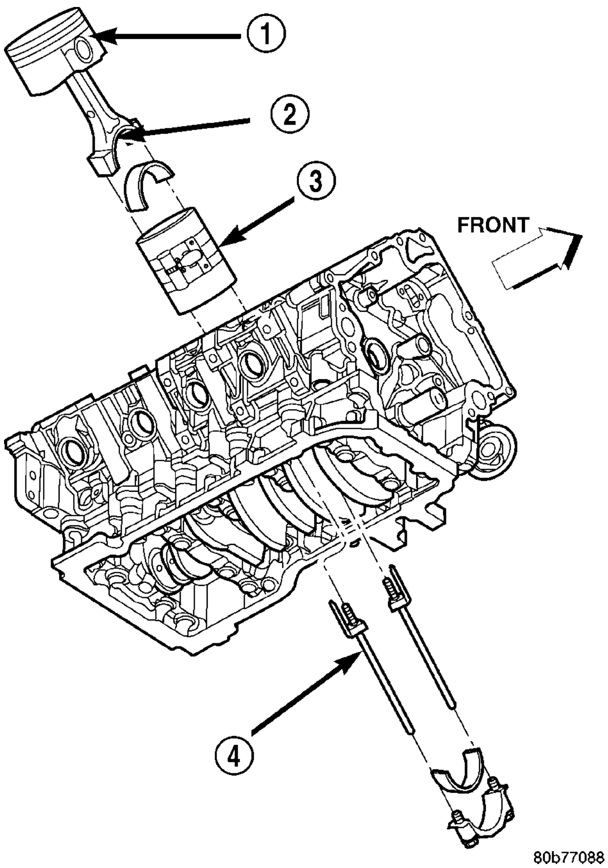


Fig. 48 Piston and Connecting Rod -Installation - Typical

1 - "F" TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 49). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(7) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(8) If bearing-to-journal clearance exceeds the specification, determin which services bearing set to use the bearing sizes are as follows:

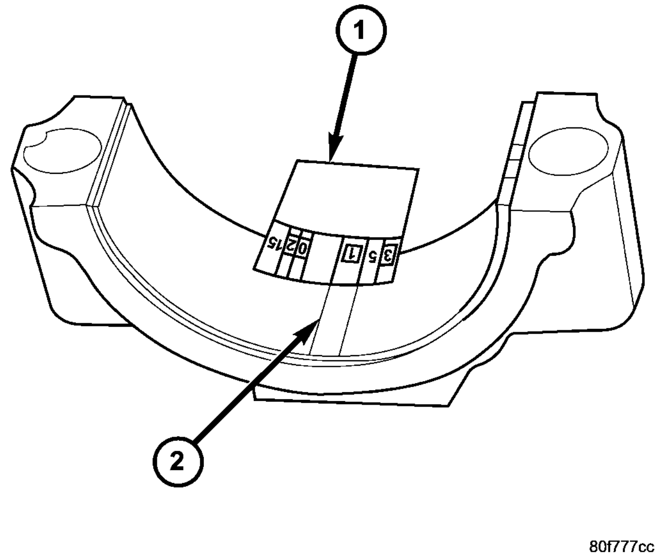


Fig. 49 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	57.883-57.867 mm (2.2788-2.2783 in.)
Std.	STANDARD	57.908-57.892 mm (2.2798-2.2792 in.)
.250 US	.250 mm (.010 in.)	57.658-57.646 mm (2.2700-2.2695 in.)

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

PISTON & CONNECTING ROD (Continued)

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 50). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

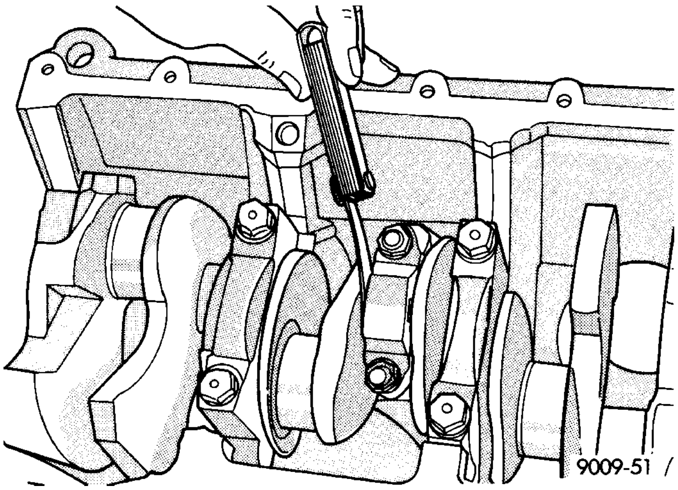


Fig. 50 Checking Connecting Rod Side Clearance - Typical

STANDARD PROCEDURE—PISTON FITTING

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 52).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 51). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components:

• Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

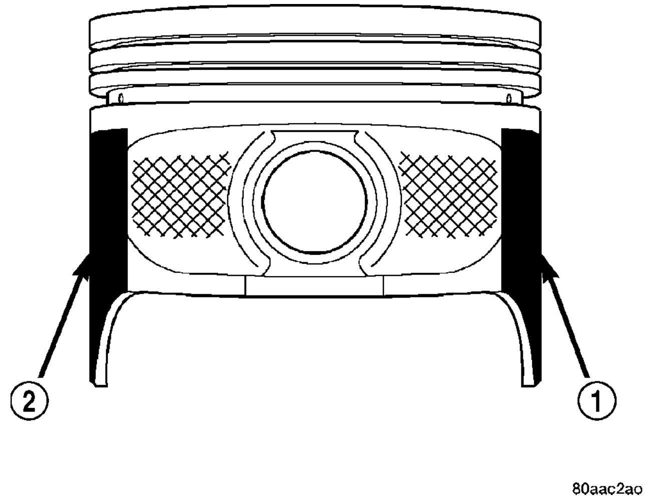


Fig. 51 DO NOT MEASURE MOLY COATED PISTON

1 - MOLY COATED
2 - MOLY COATED

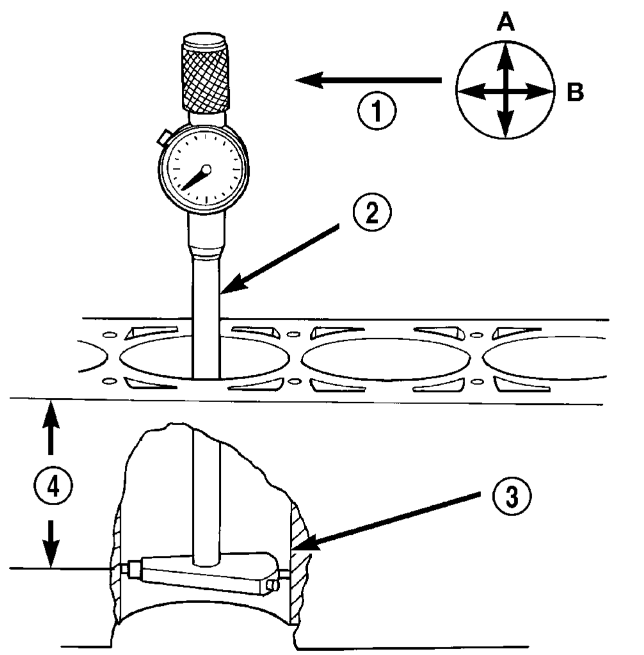


Fig. 52 BORE GAUGE -TYPICAL

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM (1.5 in)

• Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

• Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

• Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

PISTON & CONNECTING ROD (Continued)

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool.

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings.

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 53).

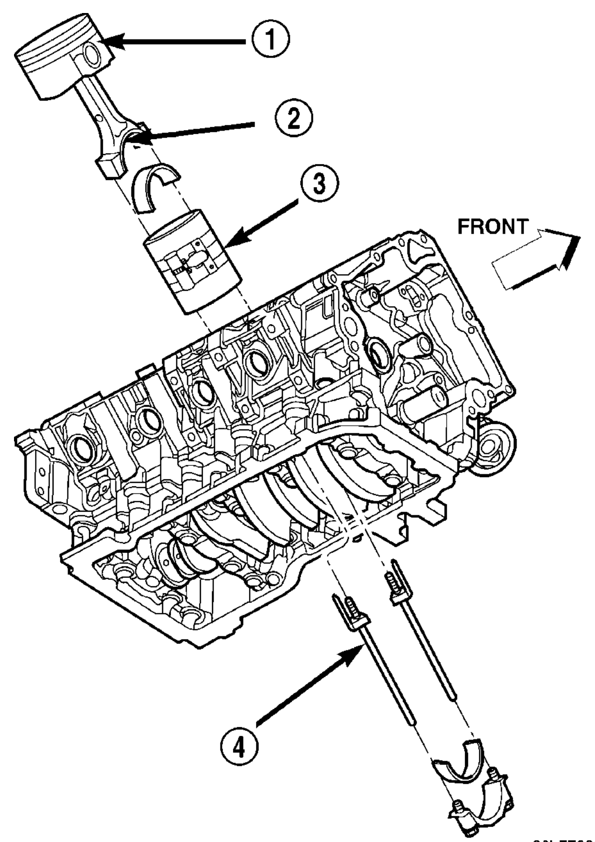


Fig. 53 PISTON AND CONNECTING ROD INSTALLATION

1 - “F” TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

PISTON & CONNECTING ROD (Continued)

(5) The pistons are marked on the piston pin bore surface with an raised "F" indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine (Fig. 54).

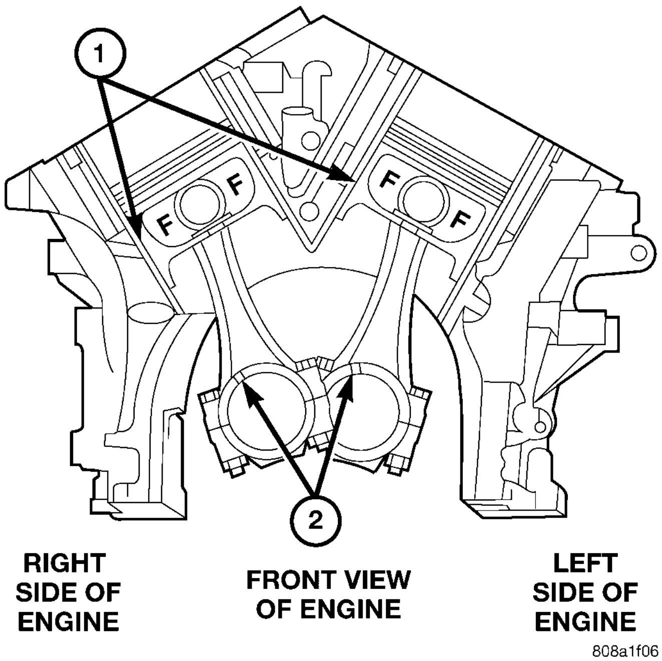


Fig. 54 PISTON AND CONNECTING ROD ORIENTATION

1 - MAJOR THRUST SIDE OF PISTON
2 - OIL SLINGER SLOT

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

(8) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.

(10) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
- Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Fill crankcase with proper engine oil to correct level.

(12) Connect negative cable to battery.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 55). Replace any rings not within specification.

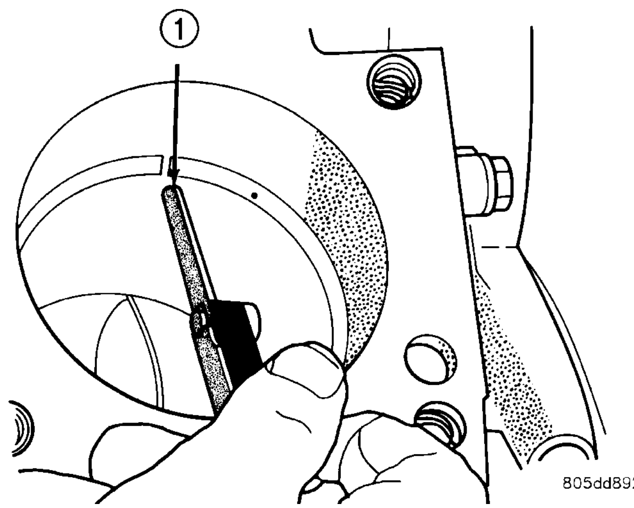


Fig. 55 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

PISTON RINGS (Continued)

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 56)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

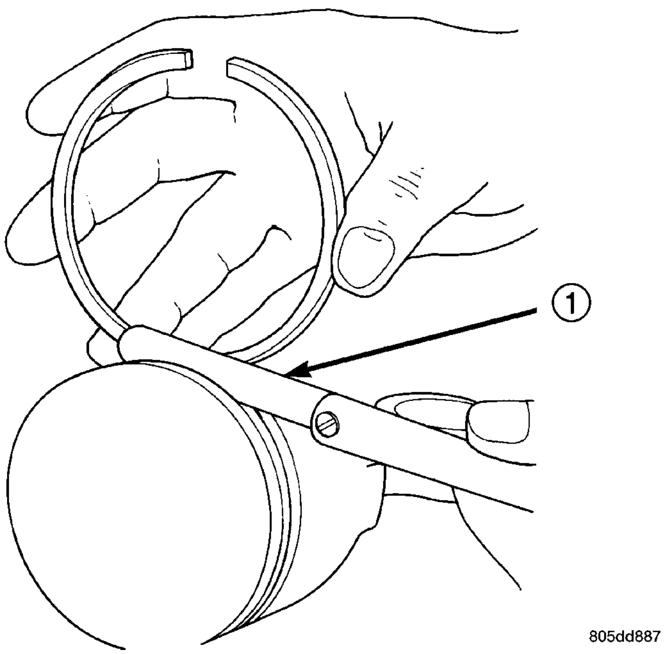


Fig. 56 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RING SPECIFICATION CHART

Ring Position	**Groove Clearance**	**Maximum Clearance**
Upper Ring	.051-.094mm (0.0020- .0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.20-0.36mm (0.0079-0.0142 in.)	0.43mm (0.0017 in.)
Intermediate Ring	0.37-0.63mm (0.0146-0.0249 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.0099- 0.03 in.)	1.55mm (0.061 in.)

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:
- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

PISTON RINGS (Continued)

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 57) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 58).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 58).

(12) Position piston ring end gaps as shown in (Fig. 59). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

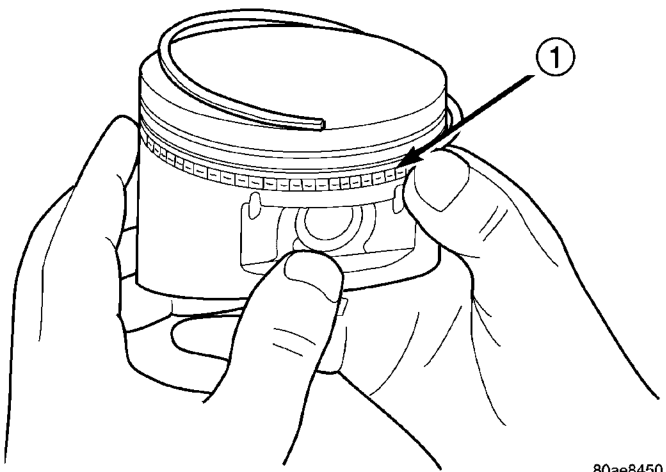


Fig. 57 Side Rail—Installation

1 - SIDE RAIL END

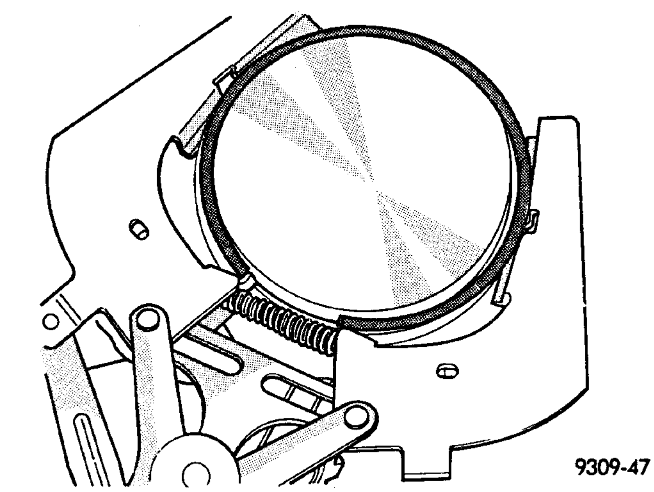


Fig. 58 Upper and Intermediate Rings—Installation

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

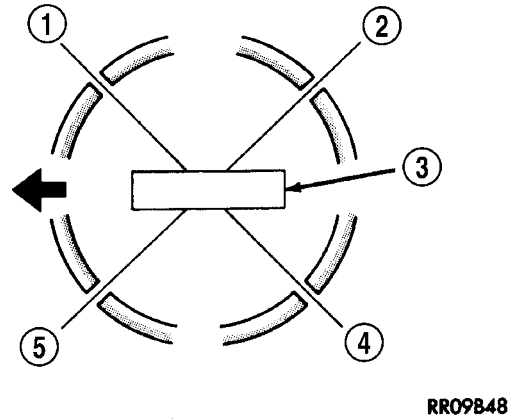


Fig. 59 Piston Ring End Gap Position

1 - SIDE RAIL UPPER
2 - NO. 1 RING GAP
3 - PISTON PIN
4 - SIDE RAIL LOWER
5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 60).

(7) Remove fan and viscous assembly.

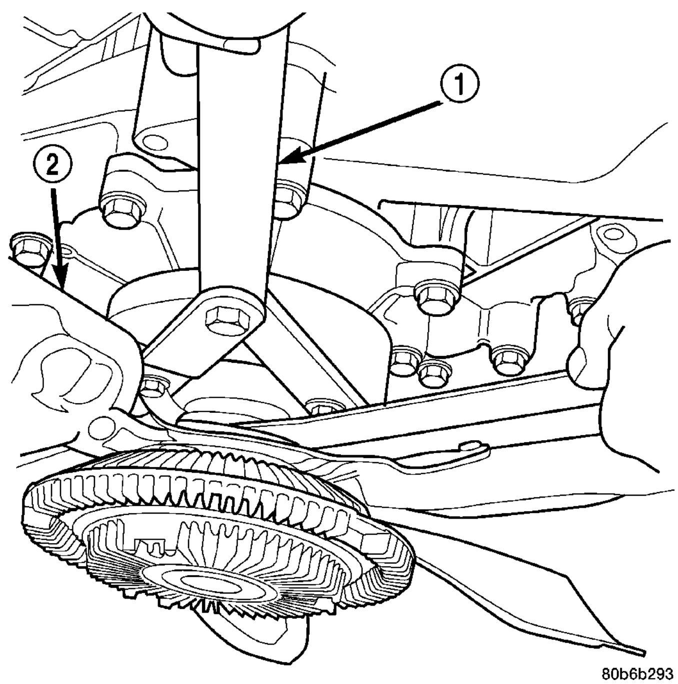


Fig. 60 FAN ASSEMBLY-REMOVAL/ASSEMBLY

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

VIBRATION DAMPER (Continued)

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 61).

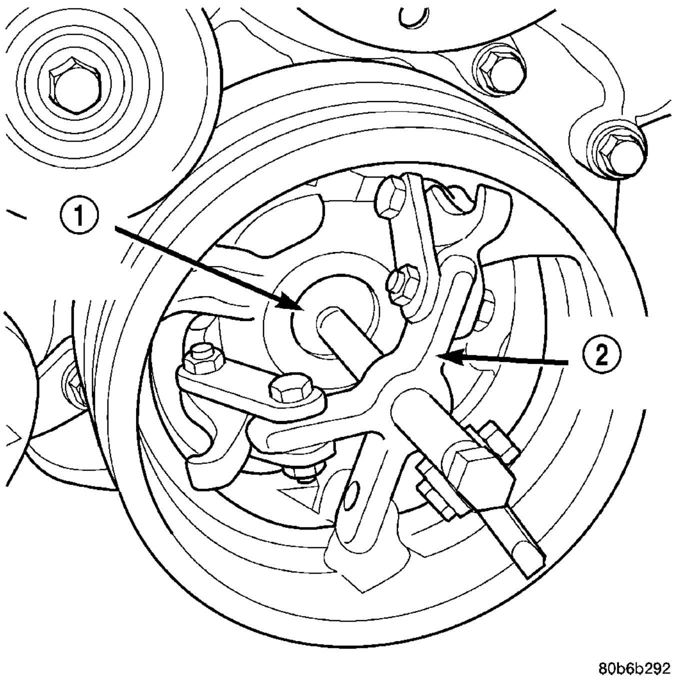


Fig. 61 CRANKSHAFT DAMPER-REMOVAL

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512–A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512–A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

(2) Assemble Special Tool 8512–A as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 62). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

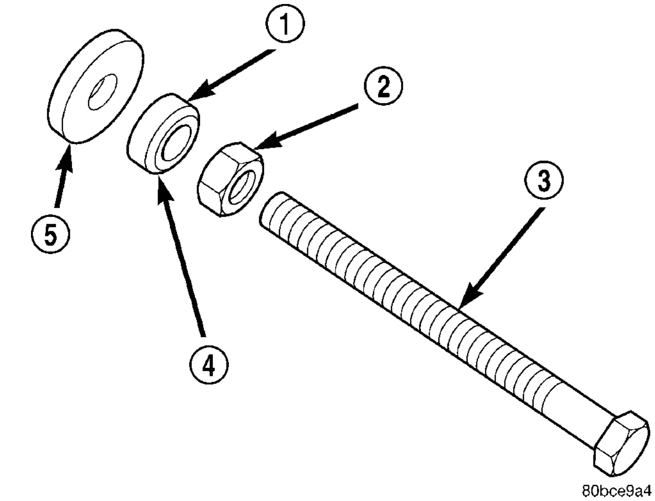


Fig. 62 PROPER ASSEMBLY METHOD FOR SPECIAL TOOL 8512–A

1 - BEARING
2 - NUT
3 - THREADED ROD
4 - BEARING HARDENED SURFACE (FACING NUT)
5 - HARDENED WASHER

(3) Using Special Tool 8512–A, press damper onto crankshaft (Fig. 63).

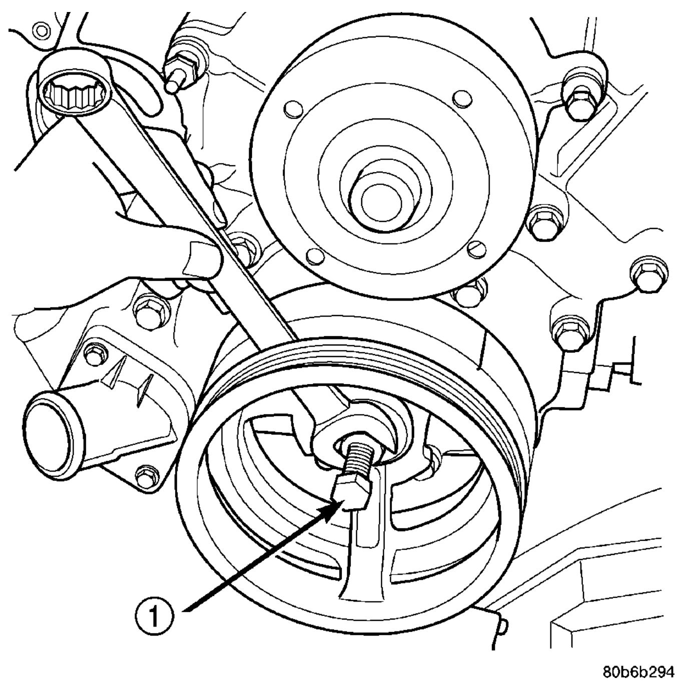


Fig. 63 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

VIBRATION DAMPER (Continued)

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect negative cable to battery.

STRUCTURAL COVER

DESCRIPTION

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional power-train stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 64) in the sequence shown.

(5) Pivot the exhaust pipe downward and remove the structural cover.

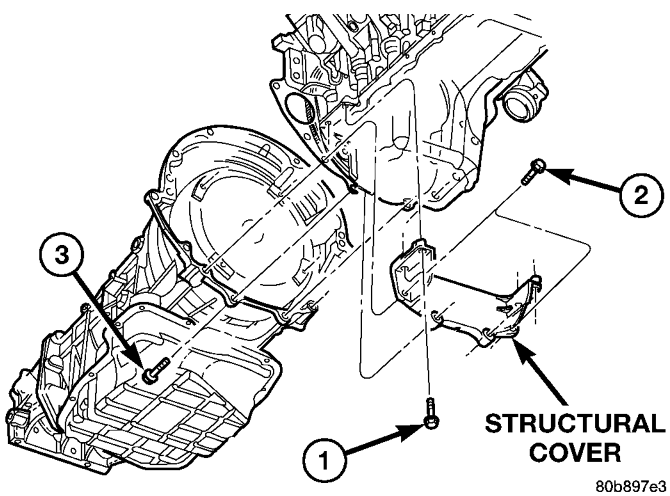


Fig. 64 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 65) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 65) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

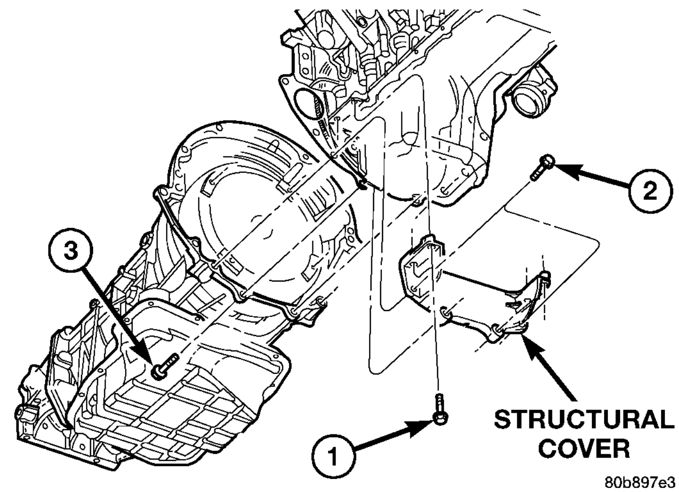


Fig. 65 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the engine oil filter.
(5) Remove the oil drain trough.
(6) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(7) Support the front axle with a suitable jack.
(8) Remove the (4) bolts that attach the engine mounts to the front axle.
(9) Remove the (3) bolts that attach the front axle to the left engine bracket.
(10) Lower the front axle.
(11) Remove the through bolts
(12) Raise the engine far enough to be able to remove the left and right engine mounts.
(13) Remove the (8) mount to engine attaching bolts
(14) Remove the engine mounts.

4WD

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the skid plate.
(5) Remove the front crossmember.
(6) Remove the engine oil filter.
(7) Remove the oil drain trough.
(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(9) Support the front axle with a suitable jack.
(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 66).

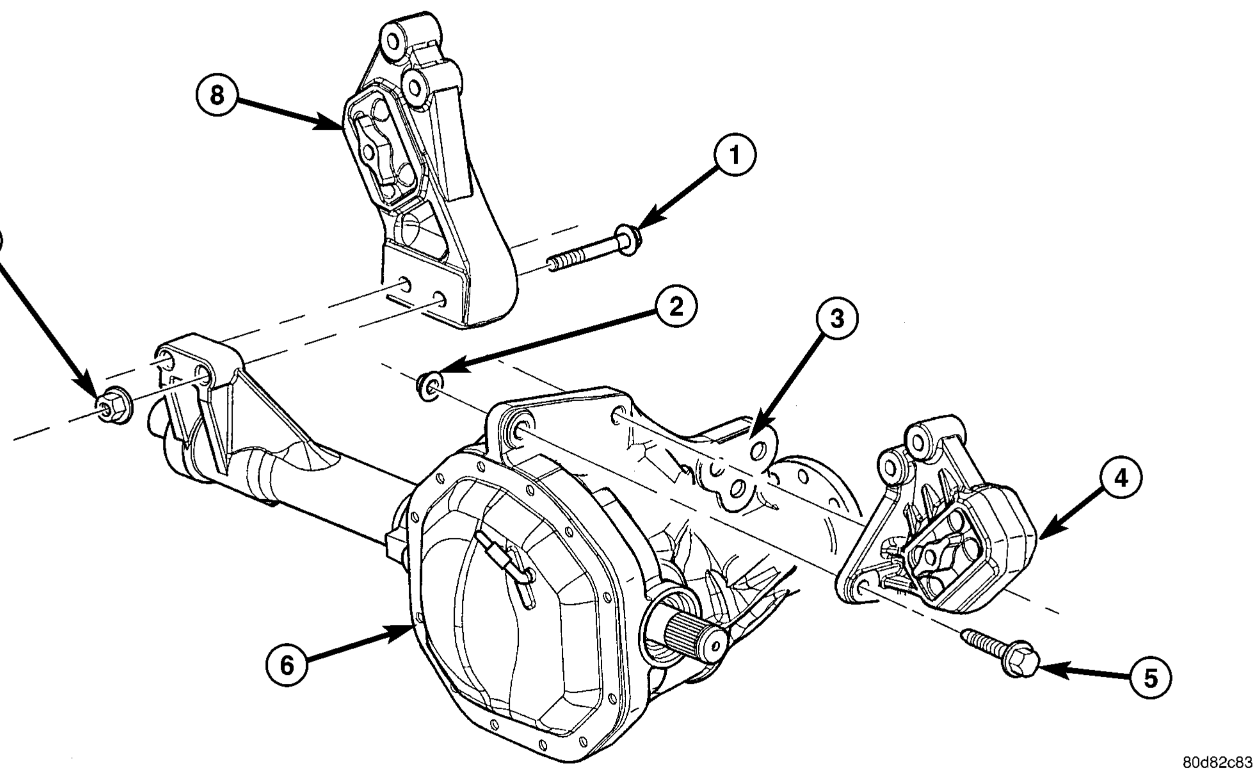


Fig. 66 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

FRONT MOUNT (Continued)

(11) Remove the (3) bolts that attach the front axle to the left engine bracket.

(12) Lower the front axle.

(13) Remove the (6) through bolts

(14) Raise the engine far enough to be able to remove the left (Fig. 67) and right (Fig. 68) engine mounts.

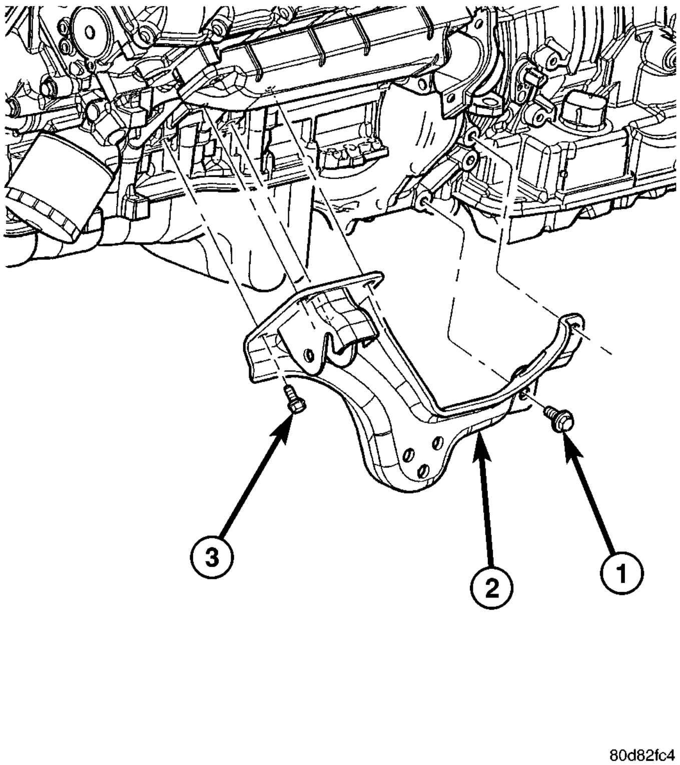


Fig. 67 ENGINE MOUNT SUPPORT BRACKET

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET
3 - BOLT

(15) Remove the engine mounts.

INSTALLATION

2WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).

(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.

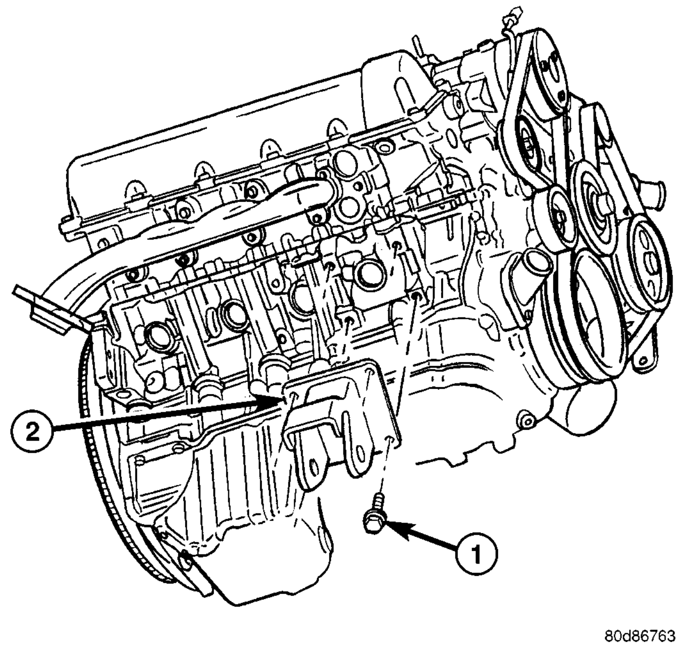


Fig. 68 ENGINE MOUNT SUPPORT BRACKET RH

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET

(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).

(5) Install the oil drain trough.

(6) Install the engine oil filter.

(7) Lower the vehicle.

(8) Install the viscous fan (Refer to 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(9) Reconnect the negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).

(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).

(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the

FRONT MOUNT (Continued)

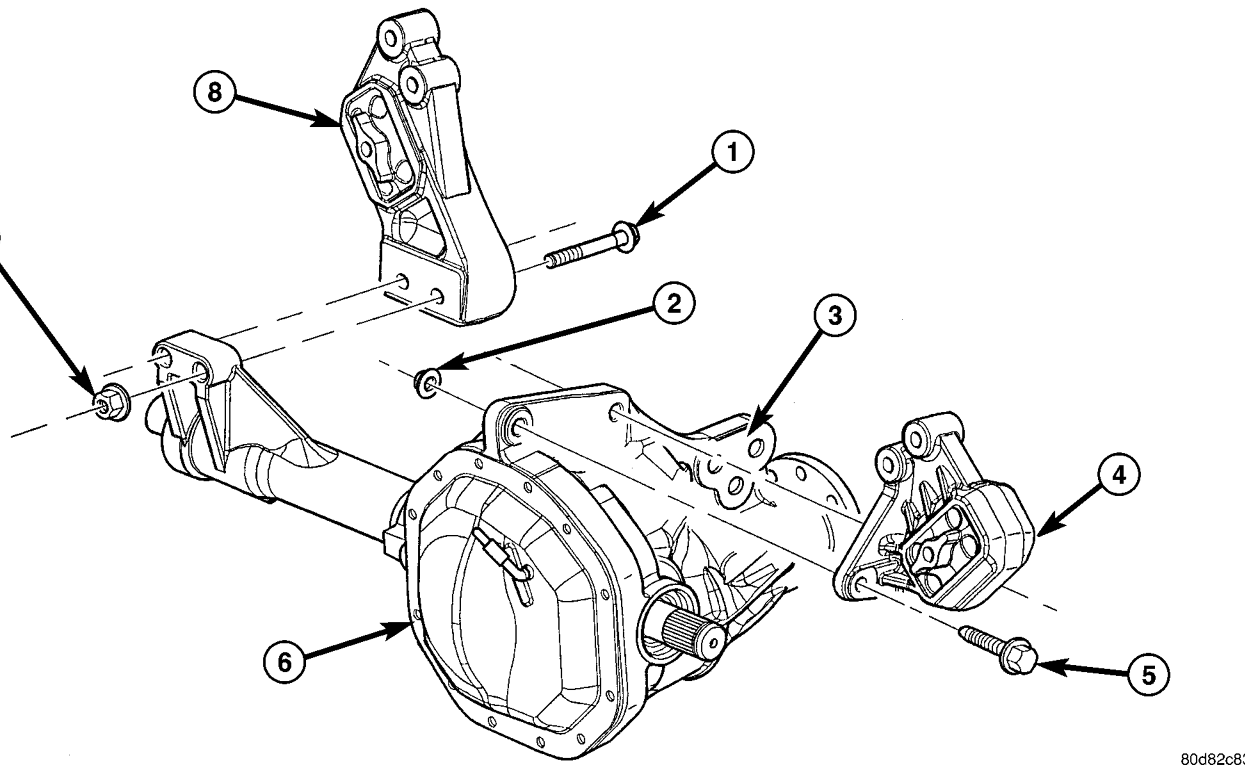


Fig. 69 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 69).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the oil drain trough.

(10) Install the engine oil filter.

(11) Install the front crossmember.

(12) Install the skid plate.

(13) Lower the vehicle.

(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(15) Reconnect the negative battery cable.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the nuts from the transmission mount (Fig. 70).

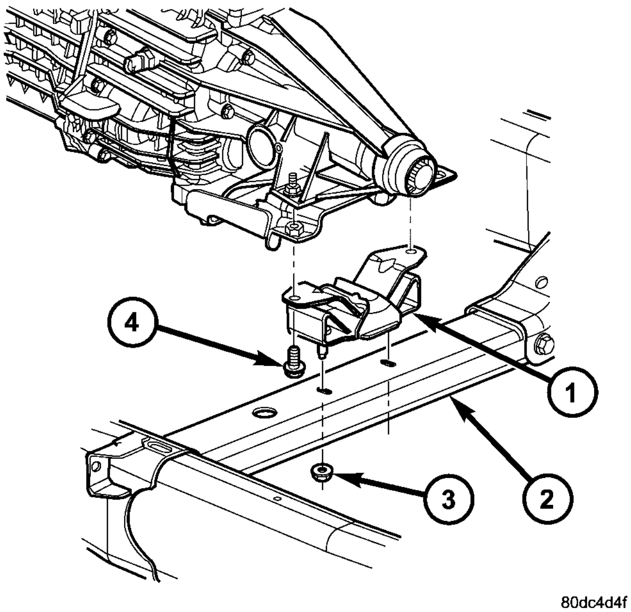


Fig. 70 TRANSMISSION MOUNT

1 - MOUNT
2 - CROSSMEMBER
3 - NUT
4 - BOLT

(4) Remove the two bolts that attach the transmission mount to the engine bracket.

(5) Raise the transmission enough to remove the mount from the crossmember.

(6) Remove the mount.

INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

(1) Install the two bolts that attach the transmission mount to the transmission bracket.

(2) Torque the bolts to 61N·m (45 ft.lbs.) torque.

(3) Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.

(4) Install the nuts onto the transmission mount studs through the crossmember access slot.

(5) Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

The lubrication system is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 71)

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orientation of the rocker arm, the camshaft intake lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

LUBRICATION (Continued)

ENGINE LUBRICATION FLOW CHART - BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head* 4. Counterbalance Shaft Rear Journal
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1. Front Timing Chain Idler Shaft 2. Counterbalance Shaft - Front Journal 3. Both Secondary Chain Tensioners
Left Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
Right Cylinder Head	Refer to Engine Lubrication Flow Chart - Cylinder Heads: Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads	

ENGINE LUBRICATION FLOW CHART - CYLINDER HEADS: TABLE 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

LUBRICATION (Continued)

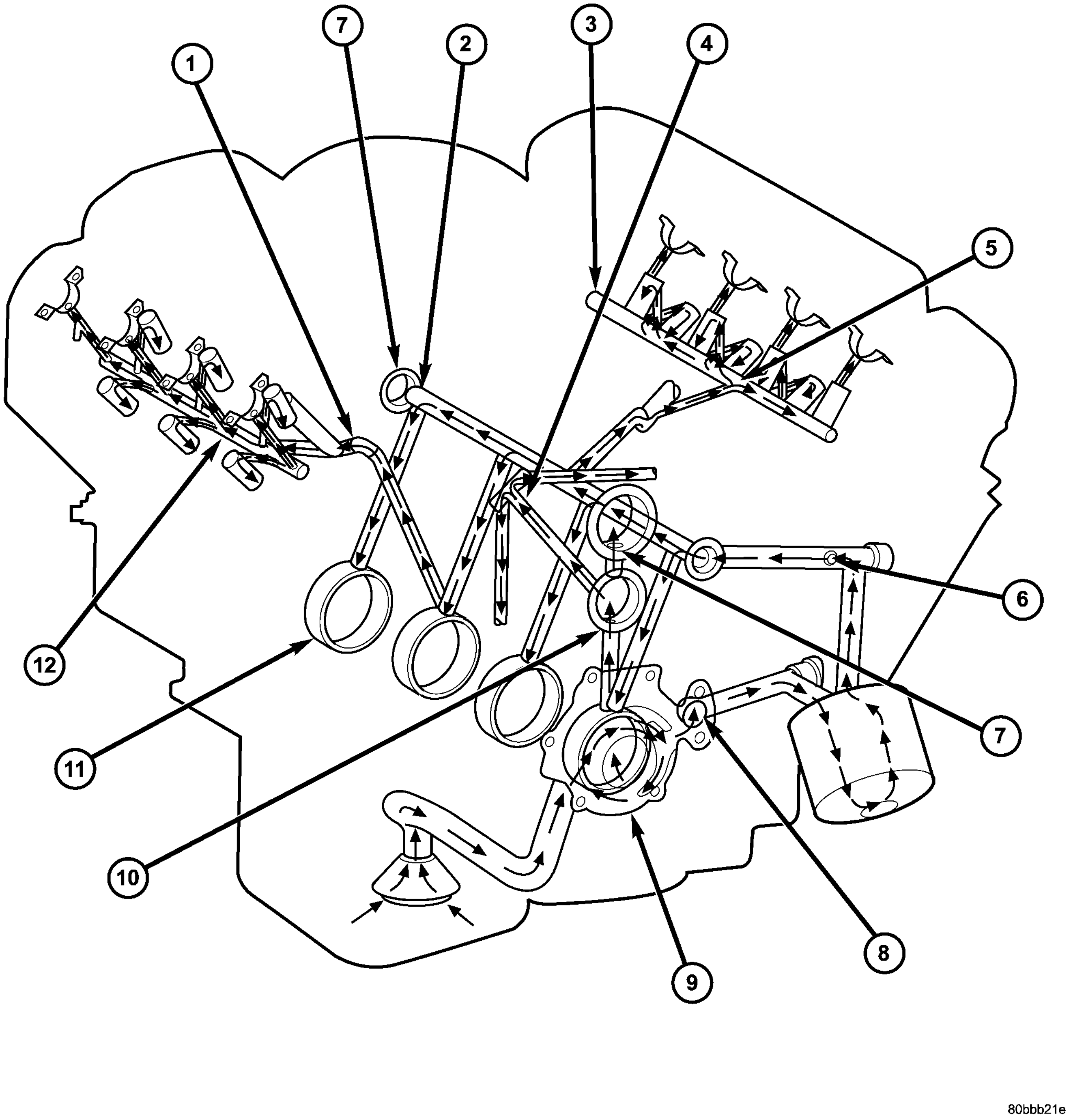


Fig. 71 LUBRICATION OIL FLOW

1 - OIL FLOW TO RIGHT CYLINDER HEAD
2 - CYLINDER BLOCK MAIN OIL GALLERY
3 - LEFT CYLINDER HEAD OIL GALLERY
4 - OIL FLOW TO BOTH SECONDARY TENSIONERS
5 - OIL FLOW TO LEFT CYLINDER HEAD
6 - OIL PRESSURE SENSOR LOCATION
7 - OIL FLOW TO COUNTER BALANCE SHAFT
8 - OIL PUMP OUTLET TO CYLINDER BLOCK
9 - OIL PUMP
10 - OIL FLOW TO CRANKSHAFT MAIN JOURNALS
11 - CRANKSHAFT MAIN BEARING JOURNALS
12 - RIGHT CYLINDER HEAD OIL GALLERY

LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kPa (3 PSI) of test pressure.

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 72)and install gauge assembly C-3292.

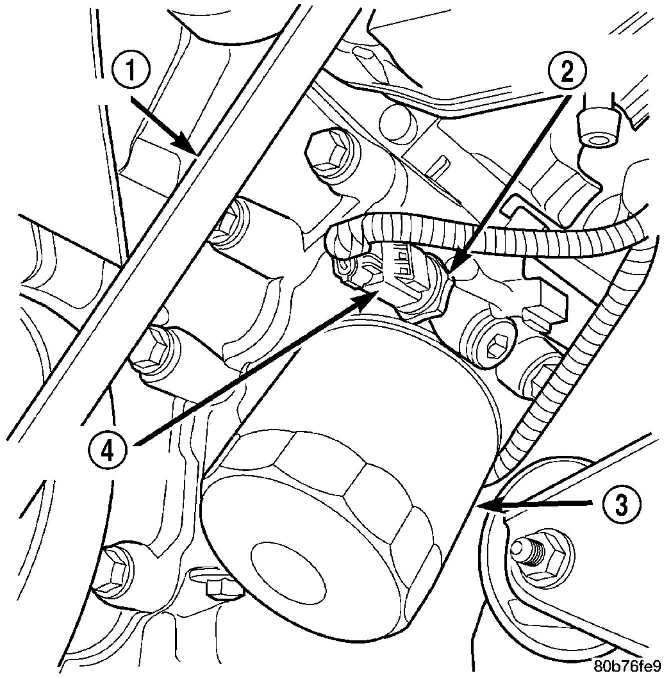


Fig. 72 OIL PRESSURE SENDING UNIT -TYPICAL

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.

(4) If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

OIL PAN

DESCRIPTION

The engine oil pan is made of laminated steel and has a single plane sealing surface. The sandwich style oil pan gasket has an integrated windage tray and steel carrier (Fig. 73). The sealing area of the gasket is molded with rubber and is designed to be reused as long as the gasket is not cut, torn or ripped.

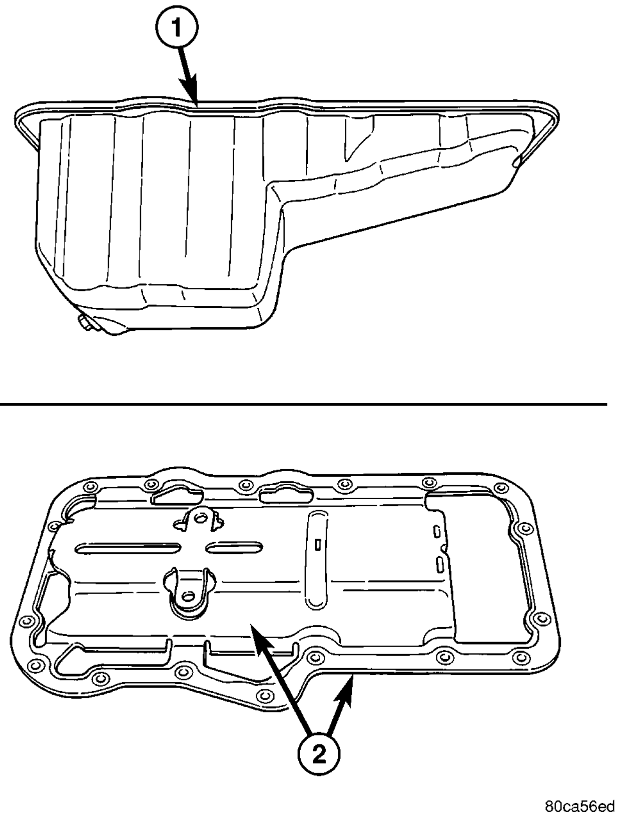


Fig. 73 Oil Pan And Gasket

1 - OIL PAN
2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4) Remove the structural dust cover, if equipped.

(5) Drain engine oil.

(6) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSS-MEMBER - REMOVAL).

CAUTION: Only raise the engine enough to provide clearance for oil pan removal. Check for proper clearance at fan shroud to fan and cowl to intake manifold.

(7) Raise engine using special tool # 8534 to provide clearance to remove oil pan.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan.

(8) Remove the oil pan mounting bolts and oil pan.

(9) Unbolt oil pump pickup tube and remove tube.

(10) Inspect the integral windage tray (Fig. 74) and gasket and replace as needed.

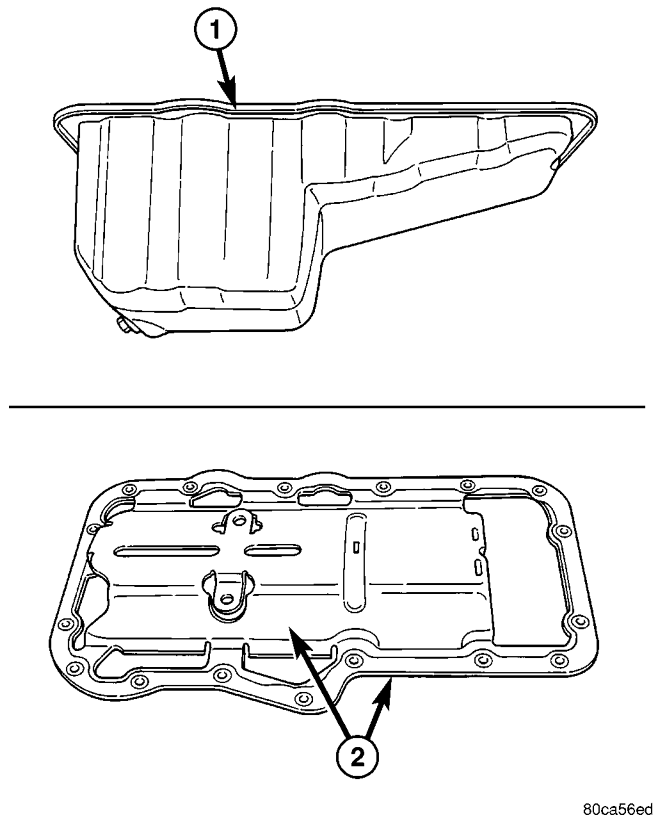


Fig. 74 Oil Pan And Gasket

1 - OIL PAN
2 - WINDAGE TRAY AND INTEGRATED OIL PAN GASKET

CLEANING

(1) Clean oil pan in solvent and wipe dry with a clean cloth.

(2) Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.

(3) Clean oil screen and tube thoroughly in clean solvent.

OIL PAN (Continued)

INSPECTION

(1) Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

(2) Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

(1) Clean the oil pan gasket mating surface of the bedplate and oil pan.

(2) Inspect integrated oil pan gasket, and replace as necessary.

(3) Position the integrated oil pan gasket/windage tray assembly.

(4) Install the oil pickup tube

(5) Install the mounting bolt and nuts. Tighten nuts to 28 N·m (20 ft. lbs.).

(6) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 75).

(7) Lower the engine into mounts using special tool # 8534.

(8) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(9) Remove special tool # 8534.

(10) Install structural dust cover, if equipped.

(11) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSS-MEMBER - INSTALLATION).

(12) Fill engine oil.

(13) Reconnect the negative battery cable.

(14) Start engine and check for leaks.

OIL PRESSURE SENSOR/ SWITCH

DESCRIPTION

The 3–wire, solid-state engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

The oil pressure sensor uses three circuits. They are:

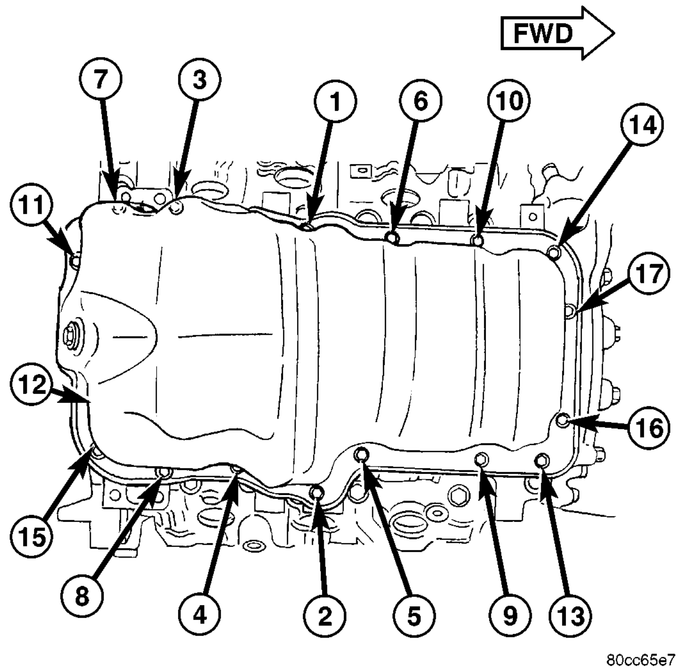


Fig. 75 Oil Pan Mounting Bolt Sequence

- A 5–volt power supply from the Powertrain Control Module (PCM)
- A sensor ground through the PCM's sensor return
- A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3–wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

A 5–volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

OIL PRESSURE SENSOR/SWITCH (Continued)

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Remove front splash shield.
(4) Disconnect oil pressure sender wire (Fig. 76).
(5) Remove the pressure sender (Fig. 76).

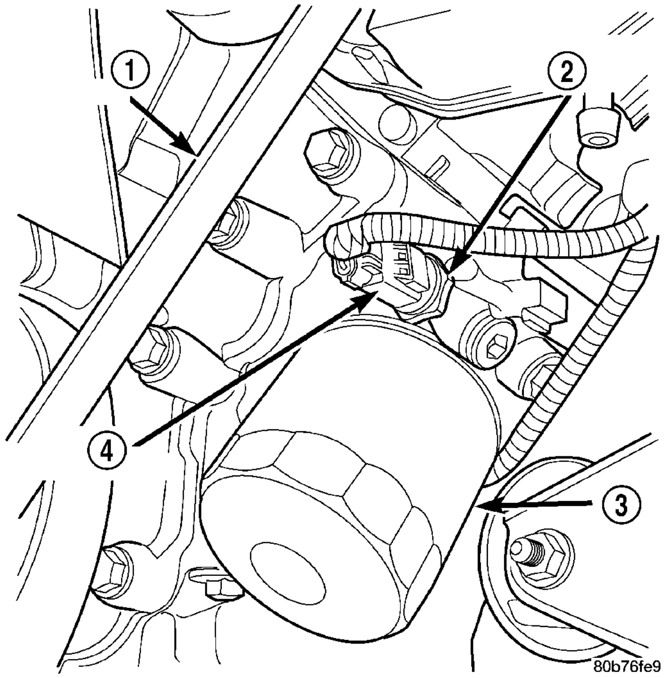


Fig. 76 OIL PRESSURE SENDING UNIT

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

INSTALLATION

(1) Install oil pressure sender.
(2) Connect oil pressure sender wire.
(3) Install front splash shield.
(4) Lower vehicle.
(5) Connect the negative battery cable.

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(4) Remove the four bolts, primary timing chain tensioner and the oil pump.

DISASSEMBLY

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

(3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 77). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 78). If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 79). If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 80). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 81). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 82).

OIL PUMP (Continued)

NOTE: The 3.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

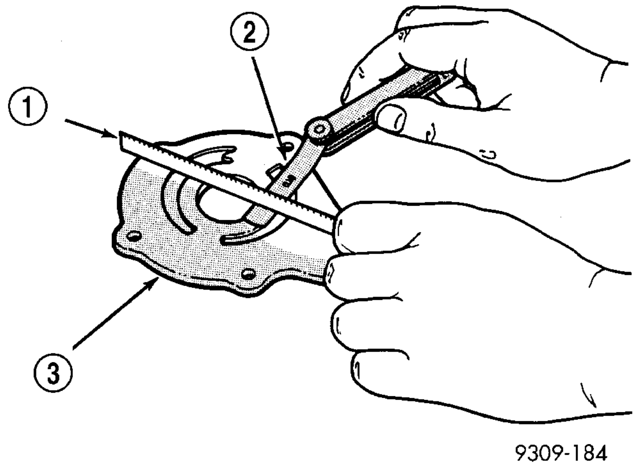


Fig. 77 Checking Oil Pump Cover Flatness

1 - STRAIGHT EDGE
2 - FEELER GAUGE
3 - OIL PUMP COVER

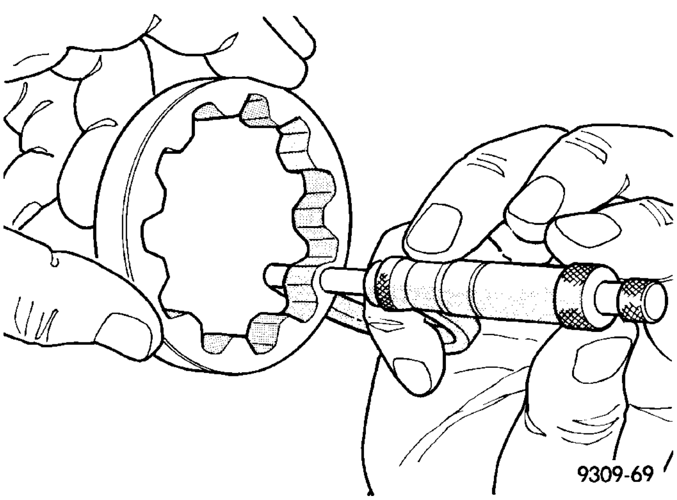


Fig. 78 Measuring Outer Rotor Thickness

ASSEMBLY

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

(2) Install inner and outer rotors

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

(4) Prime oil pump before installation by filling rotor cavity with engine oil.

(5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

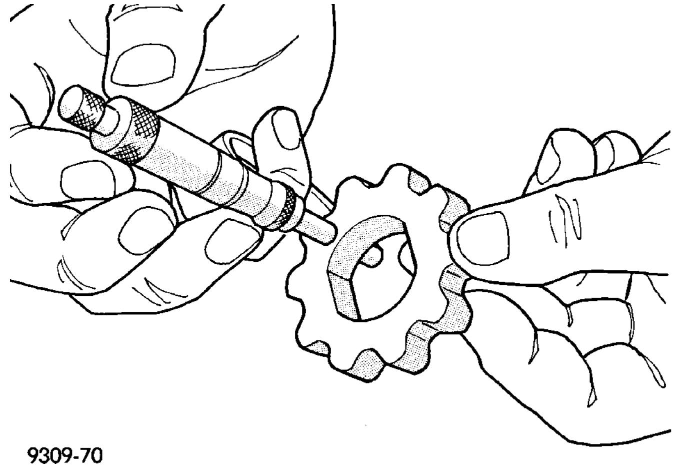


Fig. 79 Measuring Inner Rotor Thickness

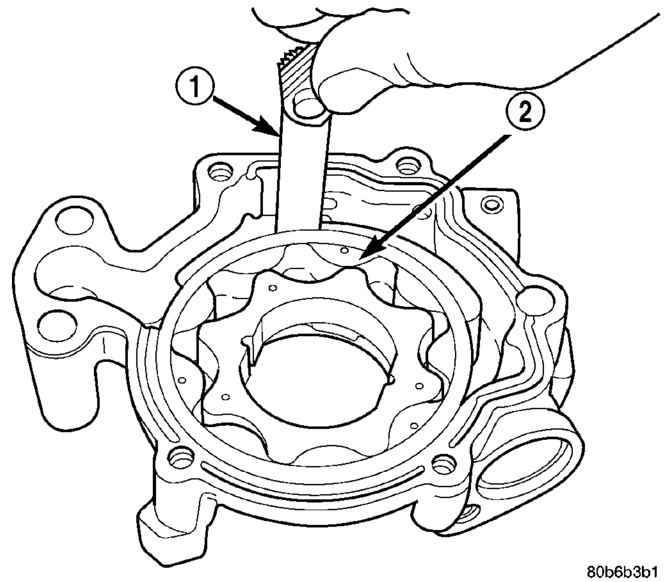


Fig. 80 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER ROTOR

INSTALLATION

(1) Position the oil pump onto the crankshaft and install one oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install three retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 83).

(4) Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(5) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

OIL PUMP (Continued)

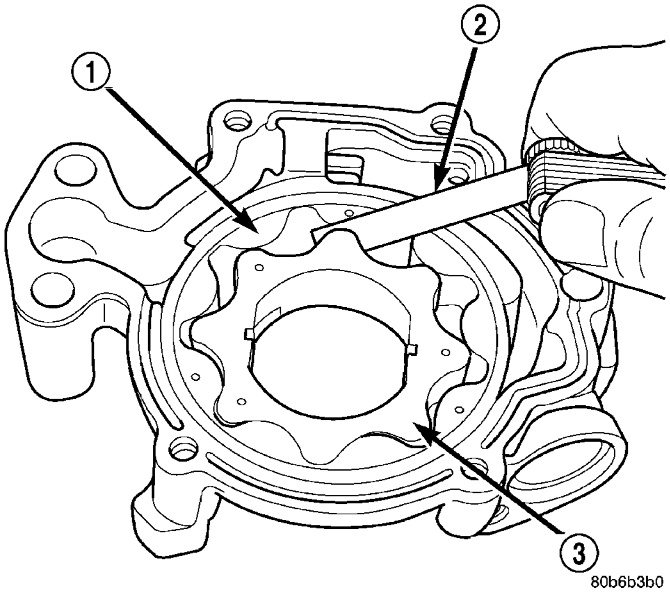


Fig. 81 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

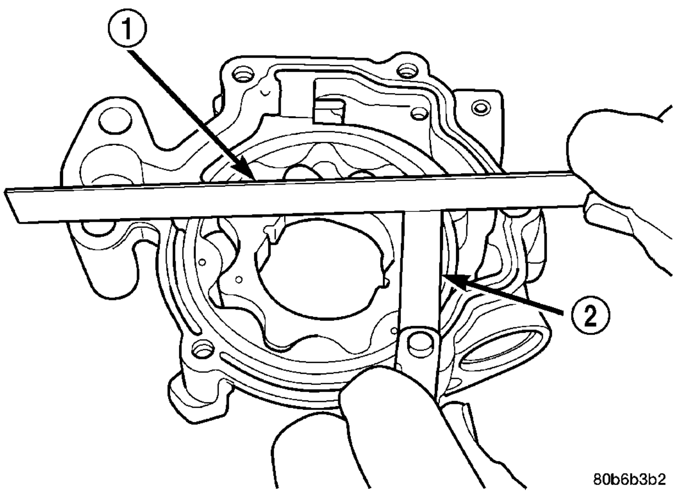


Fig. 82 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

(6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

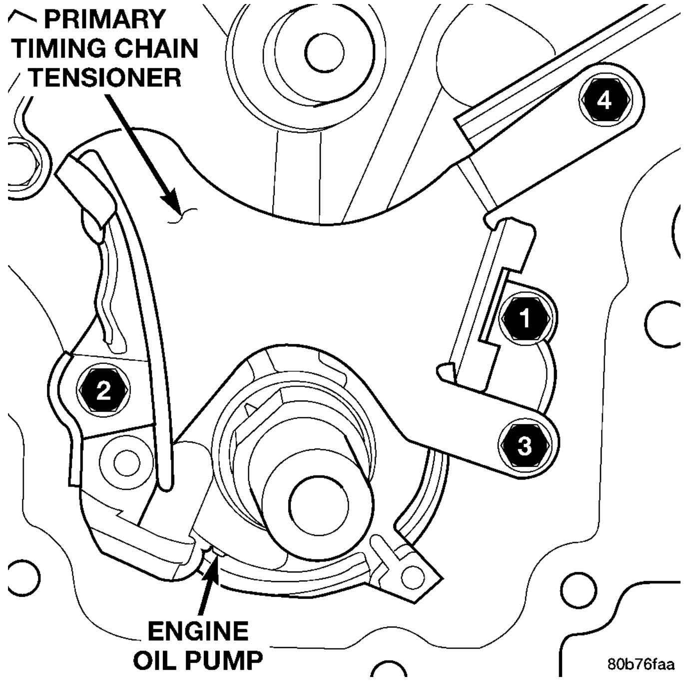


Fig. 83 Oil Pump And Primary Timing Chain Tensioner Tightening Sequence

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise (Fig. 84) to remove it from the cylinder block oil filter boss.

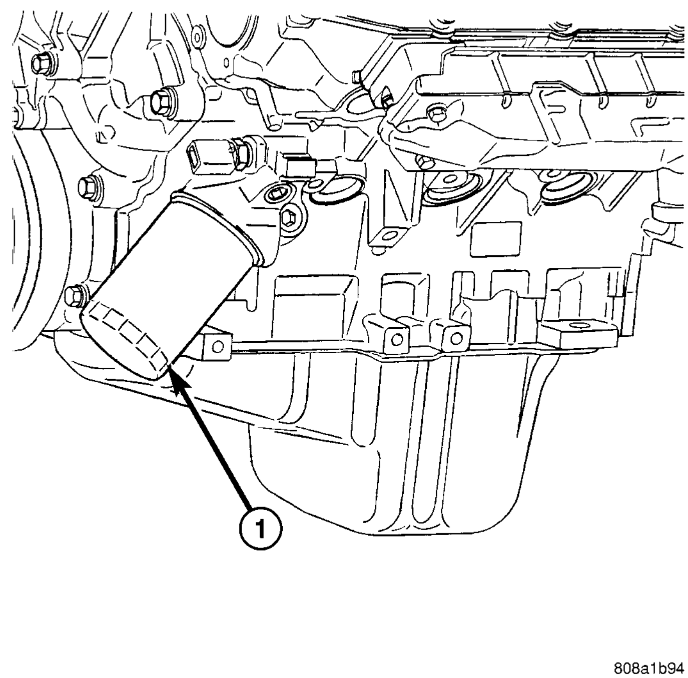


Fig. 84 OIL FILTER

1 - ENGINE OIL FILTER

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

OIL FILTER (Continued)

NOTE: Make sure filter gasket was removed with filter.

(5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 85) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

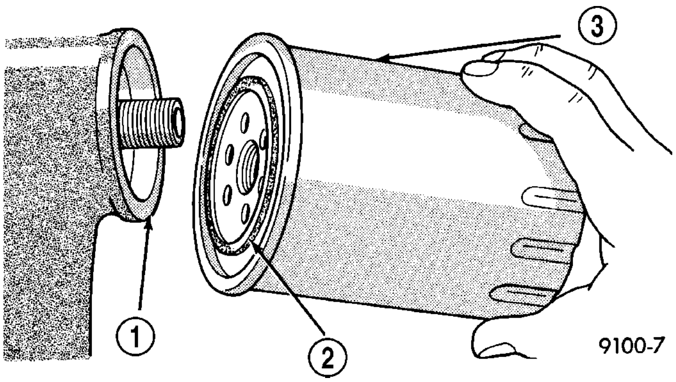


Fig. 85 Oil Filter Sealing Surface-Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30 in the 4.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 86).

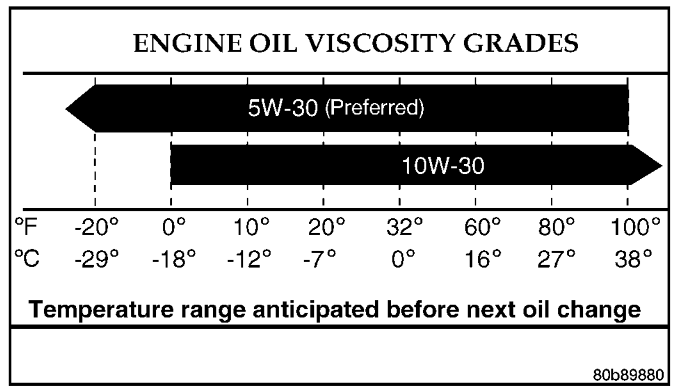


Fig. 86 TEMPERATURE/ENGINE OIL VISCOSITY - 4.7L ENGINE

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 87).

9400-9

Fig. 87 Engine oil Container Standard Notations

OIL (Continued)

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 88).

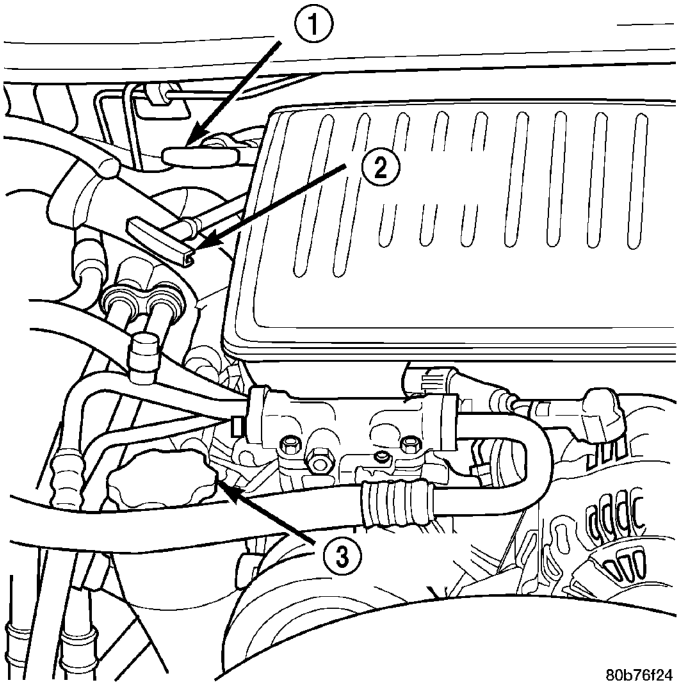


Fig. 88 ENGINE OIL DIPSTICK 4.7L ENGINE

1 - TRANSMISSION DIPSTICK
2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

INTAKE MANIFOLD

DESCRIPTION

The intake manifold (Fig. 89) is made of a composite material and features 300 mm (11.811 in.) long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of six individual press in place port gaskets to prevent leaks. The throttle body attaches directly to the intake manifold. Eight studs and two bolts are used to fasten the intake to the head.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

INTAKE MANIFOLD (Continued)

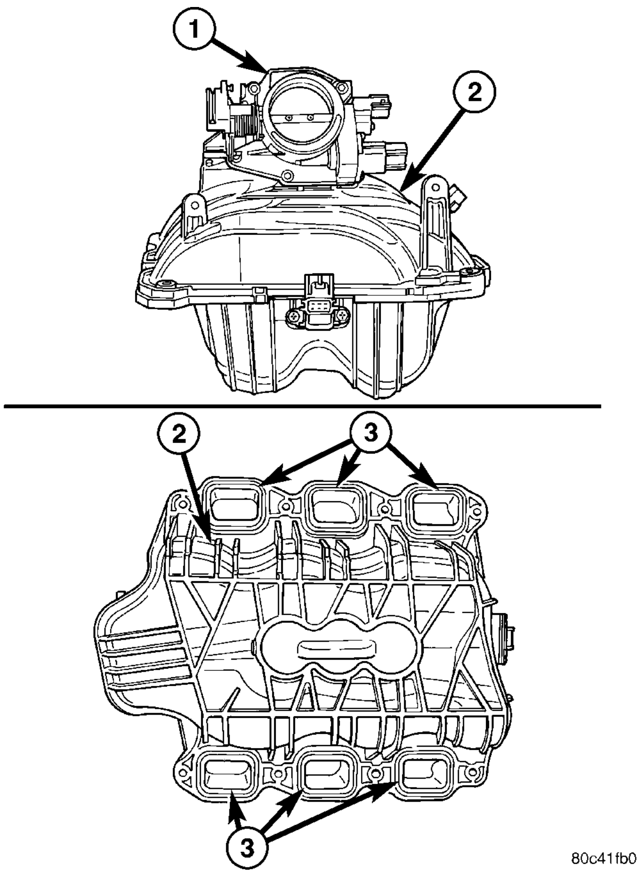


Fig. 89 Intake Manifold

1 - THROTTLE BODY
2 - INTAKE MANIFOLD
3 - INTAKE PORT GASKETS

(2) Spray a small stream of water (spray bottle) at the suspected leak area.

(3) If engine RPM'S change, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect throttle and speed control cables.

(4) Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for component locations.

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.

(6) Disconnect generator electrical connections.

(7) Disconnect air conditioning compressor electrical connections.

(8) Disconnect left and right radio suppressor straps.

(9) Disconnect and remove ignition coil towers.

(10) Remove top oil dipstick tube retaining bolt and ground strap.

(11) Bleed fuel system. Refer to FUEL SYSTEM.

(12) Remove fuel rail.

(13) Remove throttle body assembly and mounting bracket.

(14) Drain cooling system below coolant temperature level. Refer to COOLING SYSTEM.

(15) Remove the heater hoses from the engine front cover and the heater core.

(16) Unclip and remove heater hoses and tubes from intake manifold.

(17) Remove coolant temperature sensor. Refer to FUEL SYSTEM.

(18) Remove intake manifold retaining fasteners in reverse order of tightening sequence.

(19) Remove intake manifold.

INSTALLATION

(1) Install intake manifold gaskets.

(2) Install intake manifold.

(3) Install intake manifold retaining bolts and tighten in sequence shown in to 12 N·m (105 in. lbs.) (Fig. 90).

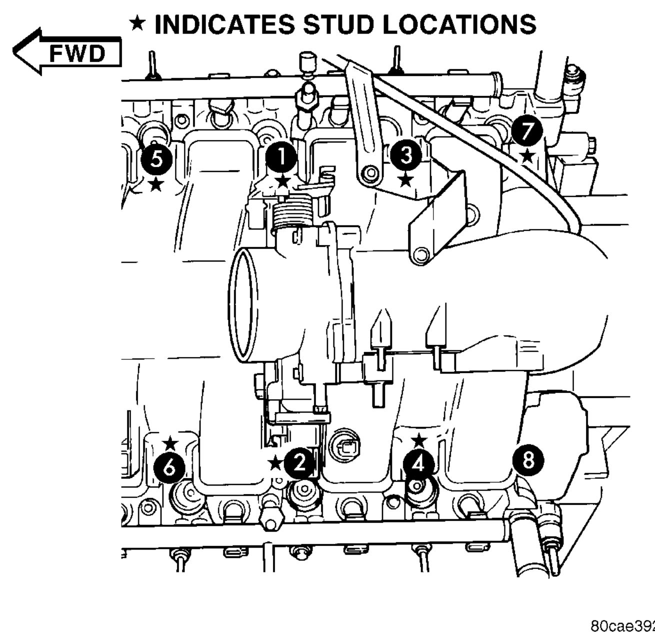


Fig. 90 Intake Manifold Tightening Sequence

(4) Install left and right radio suppressor straps.

(5) Install throttle body assembly.

(6) Connect throttle cable and speed control cable to throttle body.

(7) Install fuel rail.

(8) Install ignition coil towers.

INTAKE MANIFOLD (Continued)

(9) Position and install heater hoses and tubes onto intake manifold.

(10) Install the heater hoses to the heater core and engine front cover.

(11) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(12) Install top oil dipstick tube retaining bolt and ground strap.

(13) Connect generator electrical connections.

(14) Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive crankcase ventilation (PCV) hose.

(15) Fill cooling system.

(16) Install resonator assembly and air inlet hose.

(17) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 91) are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields (Fig. 92) are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

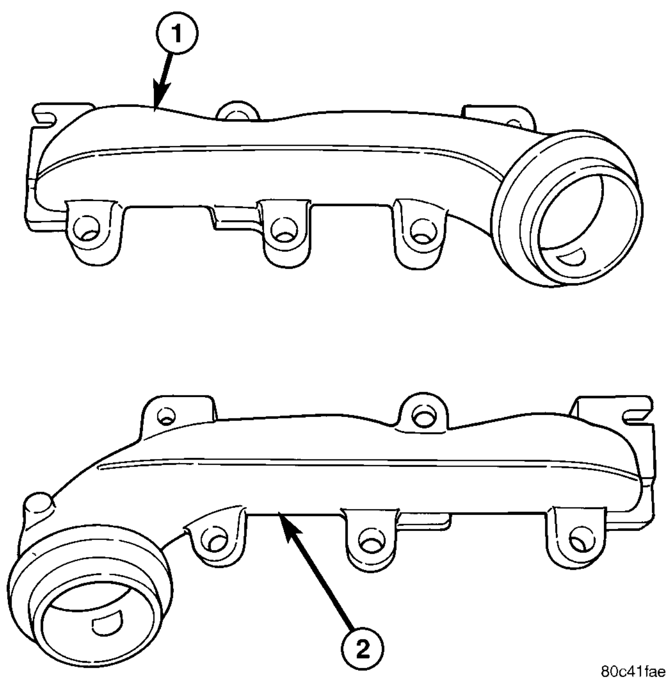


Fig. 91 EXHAUST MANIFOLDS

1 - LEFT SIDE EXHAUST MANIFOLD
2 - RIGHT SIDE EXHAUST MANIFOLD

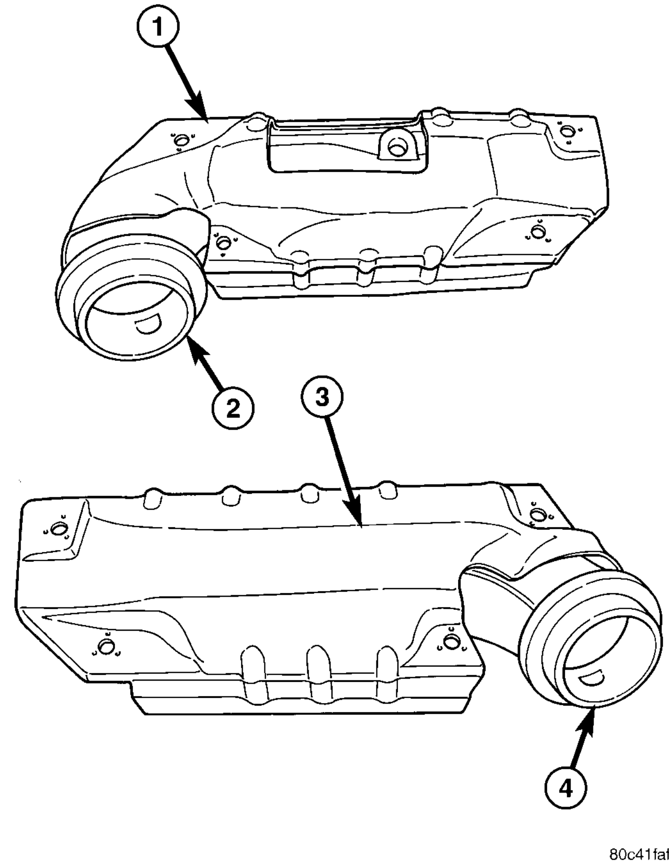


Fig. 92 Exhaust Manifold Heat Shields

1 - RIGHT SIDE EXHAUST MANIFOLD HEAT SHIELD
2 - RIGHT SIDE EXHAUST MANIFOLD FLANGE
3 - LEFT SIDE EXHAUST MANIFOLD HEAT SHIELD
4 - LEFT SIDE EXHAUST MANIFOLD FLANGE

REMOVAL

RIGHT EXHAUST MANIFOLD

(1) Disconnect the negative cable from the battery.

(2) Raise and support the vehicle.

(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.

(4) Lower the vehicle.

(5) Remove the exhaust heat shield (Fig. 93).

(6) Remove bolts, nuts and washers attaching manifold to cylinder head.

(7) Remove manifold and gasket from the cylinder head.

EXHAUST MANIFOLD (Continued)

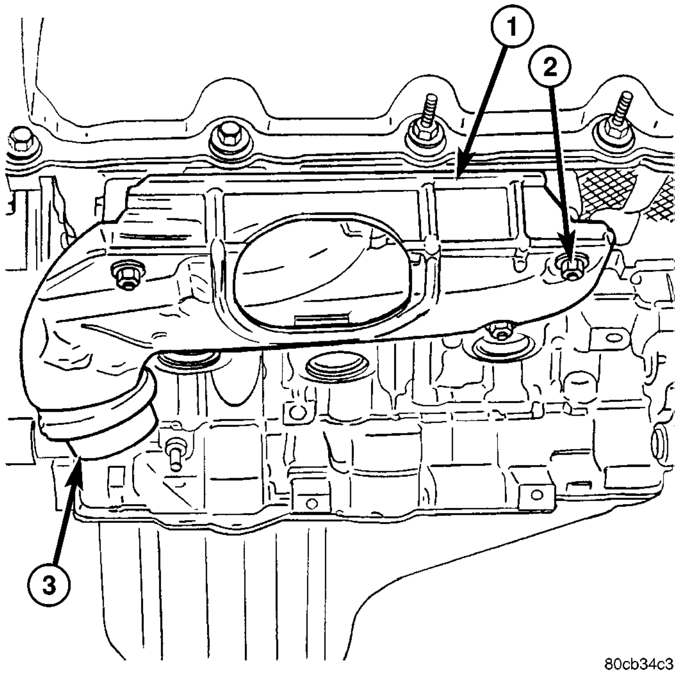


Fig. 93 Exhaust Manifold Right

1 - HEAT SHIELD
2 - NUTS
3 - MANIFOLD FLANGE

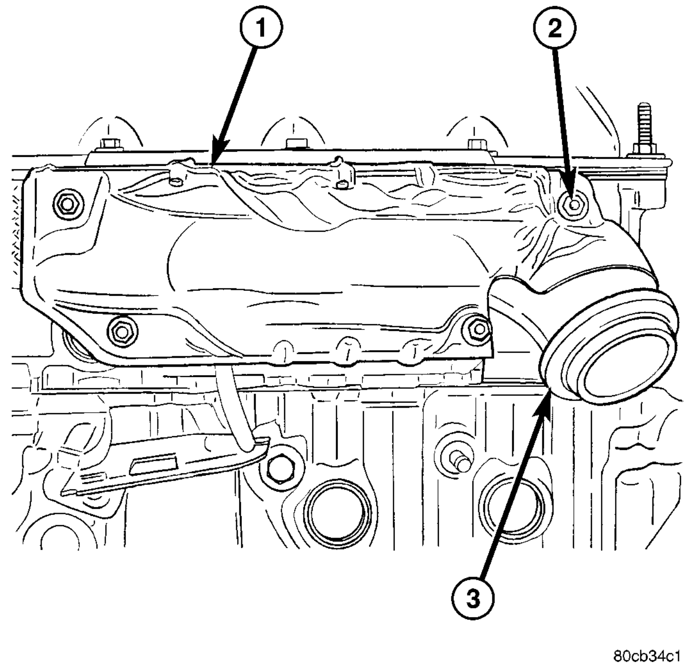


Fig. 94 Exhaust Manifold left

1 - HEAT SHIELD
2 - NUTS
3 - MANIFOLD FLANGE

LEFT EXHAUST MANIFOLD

(1) Disconnect the negative cable from the battery.
(2) Raise and support the vehicle.
(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.
(4) Lower the vehicle.
(5) Remove the exhaust heat shields (Fig. 94).
(6) Remove bolts, nuts and washers attaching manifold to cylinder head.
(7) Remove manifold and gasket from the cylinder head.

INSTALLATION

RIGHT EXHAUST MANIFOLD

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

(1) Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.
(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.
(3) Install the exhaust heat shields.
(4) Raise and support the vehicle.

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(5) Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

LEFT EXHAUST MANIFOLD

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

(1) Position the engine exhaust manifold and gasket on the two studs located on the cylinder head. Install conical washers and nuts on these studs.
(2) Install remaining conical washers. Starting at the center arm and working outward, tighten the bolts and nuts to 25 N·m (18 ft. lbs.) torque.
(3) Install the exhaust heat shields.
(4) Raise and support the vehicle.

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(5) Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

VALVE TIMING

DESCRIPTION

The timing drive system has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain, two secondary timing chain drives (Fig. 95) and a counterbalance shaft drive.

OPERATION

The primary timing chain is a single inverted tooth chain type. The primary chain drives the large 50 tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and designed oil pump leakage. The idler sprocket assembly connects the primary chain drive, secondary chain drives, and the counterbalance shaft. The idler sprocket assembly consists of two integral 26 tooth sprockets a 50 tooth sprocket and a helical gear that is press-fit to the assembly. The spline joint for the 50 tooth sprocket is a non – serviceable press fit anti rattle type. A spiral ring is installed on the outboard side of the 50 tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft.

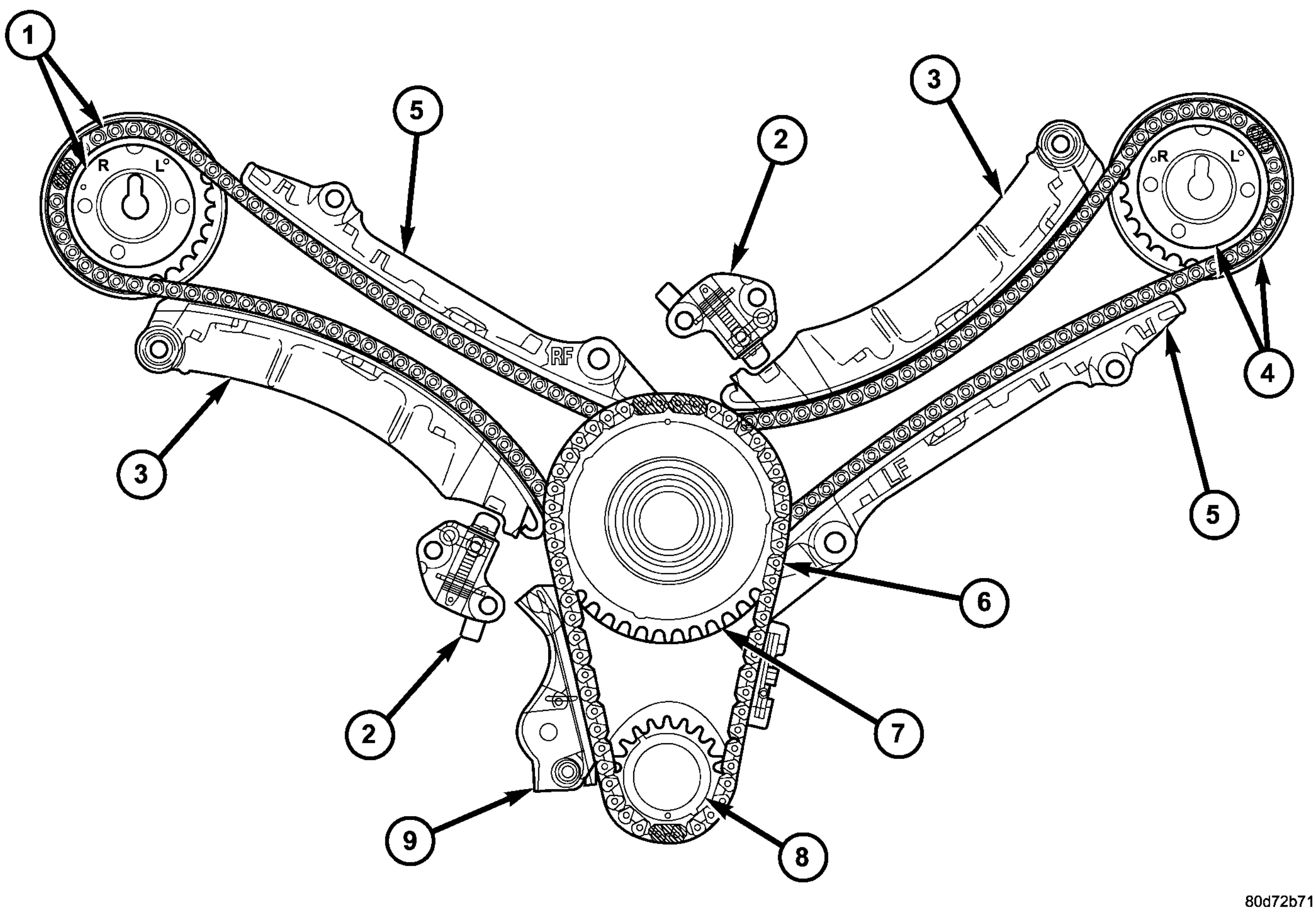


Fig. 95 Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT INTERCHANGEABLE)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE (LEFT AND RIGHT SIDE ARE NOT INTERCHANGEABLE)
6 - PRIMARY CHAIN
7 - IDLER SPROCKET
8 - CRANKSHAFT SPROCKET
9 - PRIMARY CHAIN TENSIONER

VALVE TIMING (Continued)

The idler shaft is a light press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are roller type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a 26 tooth cam sprocket directly from the 26 tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner incorporates a controlled leak path through a device known as a vent disc located in the nose of the piston to manage chain loads. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

STANDARD PROCEDURE

MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

(1) Remove the timing chain cover. Refer to Timing Chain Cover in this section for procedure.

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston. The measurement at point (A) must be less than 15mm (.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. Refer to Timing Chain and Sprockets in this section for procedure.

SERVICE PROCEDURE - TIMING VERIFICATION

CAUTION: The 3.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

Engine base timing can be verified by the following procedure:

(1) Remove the cylinder head covers. Refer to the procedure in this section.

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 96). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

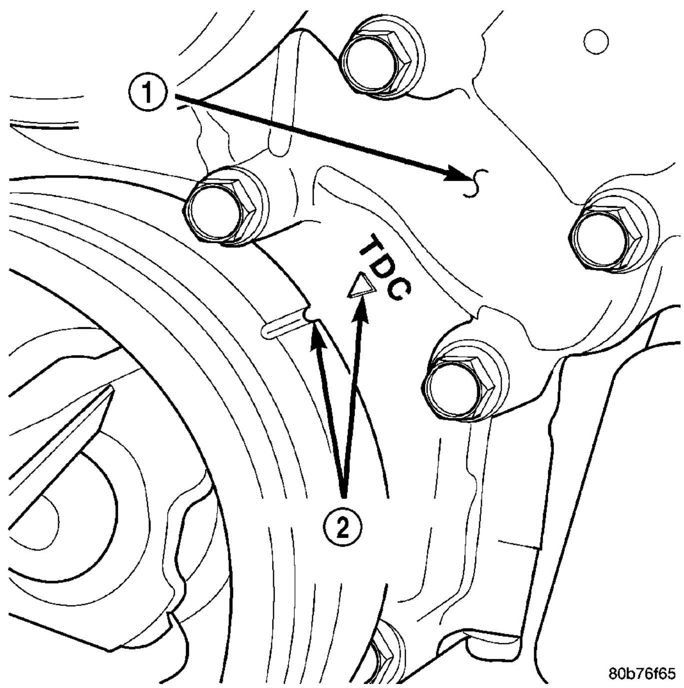


Fig. 96 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(3) Note the location of the V6 mark stamped into the camshaft drive gears. If the V6 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V6 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke. (Fig. 100)

VALVE TIMING (Continued)

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.

(6) If both camshaft drive gear V6 marks are at the twelve o'clock or the six o'clock position the engine base timing is correct. Reinstall the cylinder head covers.

COUNTER BALANCE SHAFT TIMING

(1) Ensure that the engine is at TDC with both camshaft sprocket V6 marks in the 12 o'clock position. (Fig. 100)

(2) Look down the left cylinder head chain cavity. The timing dot on the counter balance shaft drive gear should be in the 6 o'clock position (Fig. 97).

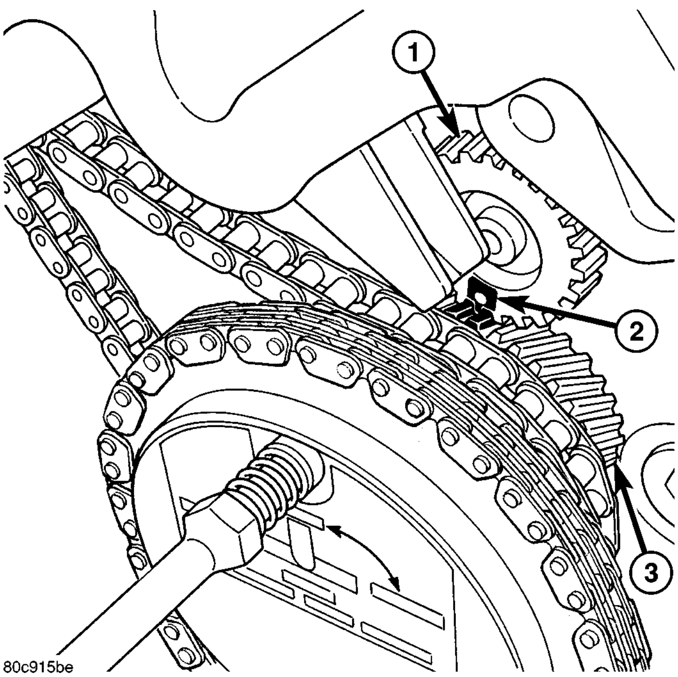


Fig. 97 COUNTERBALANCE SHAFT ALIGNMENT MARKS

1 - COUNTERBALANCE SHAFT GEAR
2 - TIMING MARK
3 - IDLER SPROCKET GEAR

TIMING - SINGLE CAMSHAFT

NOTE: to adjust the timing on one camshaft, preform the following procedure.

(1) Using Chain Tensioner Wedge (Fig. 99), Special Tool 8379, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position. (Fig. 98)

(2) Remove the camshaft drive gear retaining bolt.

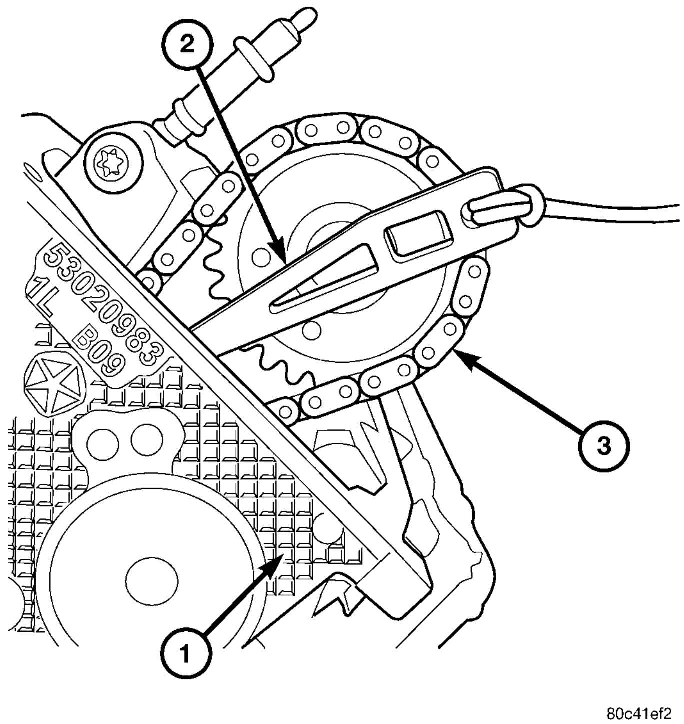


Fig. 98 SECURING TIMING CHAIN TENSIONER USING TIMING CHAIN WEDGE

1 - CYLINDER HEAD
2 -SPECIAL TOOL 8379
3 - TIMING CHAIN

VALVE TIMING (Continued)

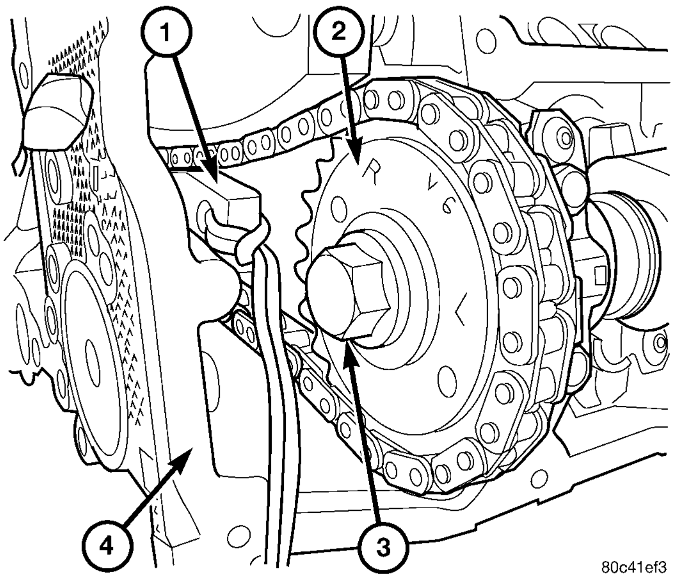


Fig. 99 CAMSHAFT DRIVE GEAR REMOVAL/ INSTALLATION

1 - SPECIAL TOOL 8279 TIMING CHAIN WEDGE
2 - CAMSHAFT DRIVE GEAR
3 - RETAINING BOLT
4 - CYLINDER HEAD

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V6 mark is at the same position as the V6 mark on the opposite camshaft drive gear.

(5) Using Special Tool 8428 Camshaft Wrench, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear.

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122 N·m (90 ft. Lbs.).

(7) Remove Special Tool 8379.

(8) Rotate the crankshaft two full revolutions, then verify that the camshaft drive gear V6 marks are in fact aligned.

(9) Install the cylinder head covers. Refer to Cylinder Head Cover in this section.

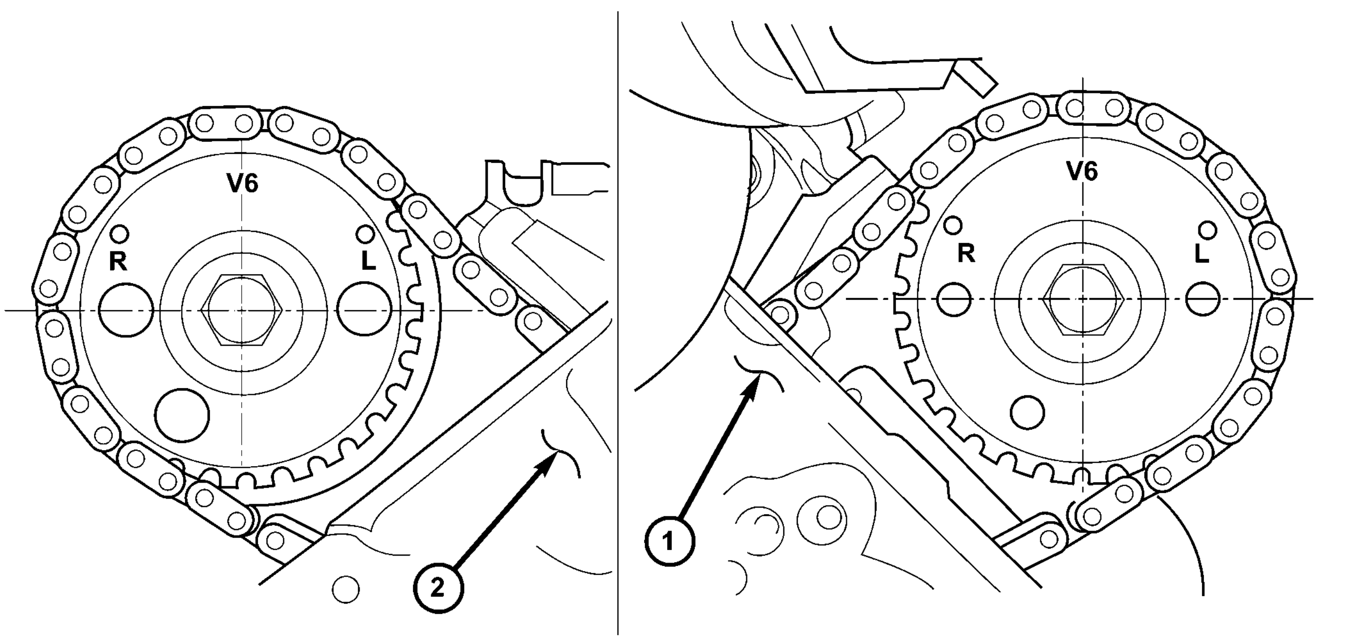


Fig. 100 CAMSHAFT SPROCKET V6 MARKS (#1 TDC, Exhaust stroke)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

BALANCE SHAFT

REMOVAL

(1) Remove the primary and secondary timing chains. Refer to TIMING CHAIN and SPROCKET.

NOTE: The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft.Remove the retaining bolt from the counterbalance shaft thrust plate (Fig. 101).

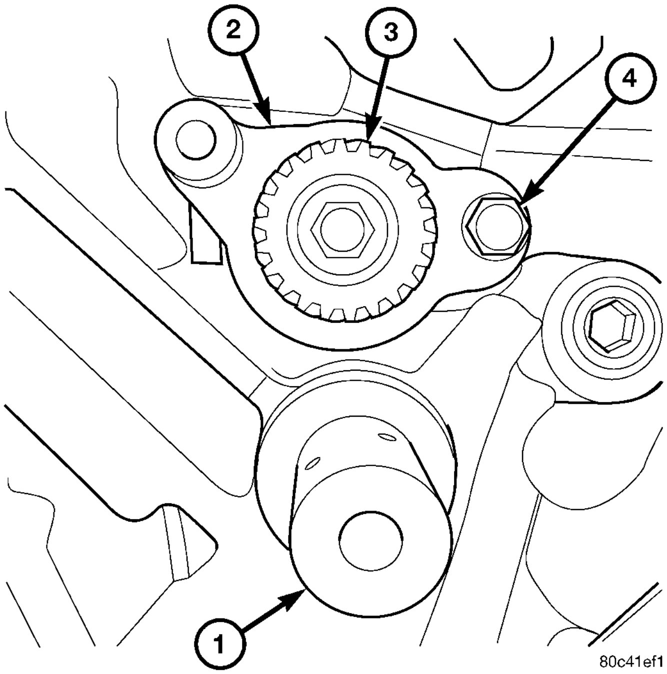


Fig. 101 Counterbalance Shaft Retaining Plate

1 - IDLER SHAFT
2 - COUNTERBALANCE SHAFT THRUST PLATE
3 - COUNTERBALANCE SHAFT DRIVE GEAR
4 - RETAINING BOLT

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, remove the counterbalance shaft from the engine (Fig. 102).

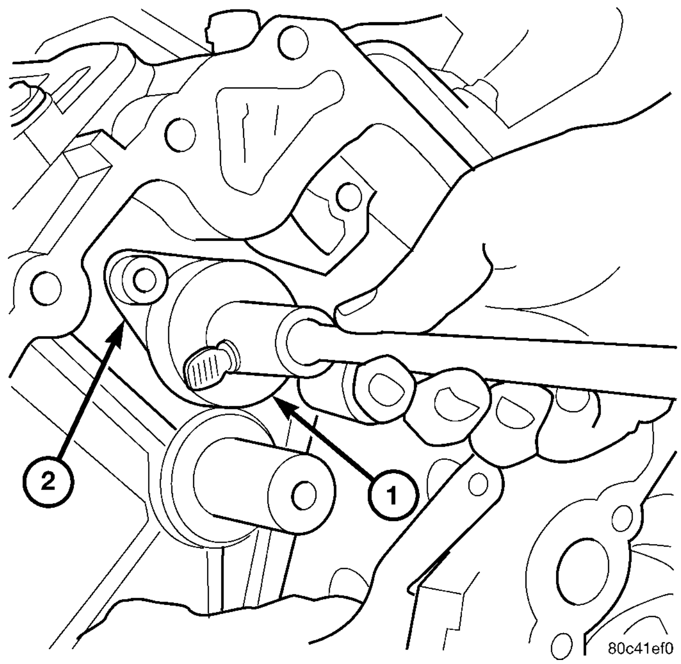


Fig. 102 Counterbalance Shaft Removal/Installation Tool

1 - COUNTERBALANCE SHAFT REMOVAL AND INSTALLATION TOOL
2 - COUNTERBALANCE SHAFT THRUST PLATE

INSTALLATION

NOTE: The balance shaft and gear are serviced as an assembly. Do not attempt to remove the gear from the balance shaft.

(1) Coat counterbalance shaft bearing journals with clean engine oil.

NOTE: The balance shaft is heavy, and care should be used when installing shaft, so bearings are not damaged.

(2) Using Special Tool 8641 Counterbalance shaft remover/installer tool, carefully install counterbalance shaft into engine.

(3) Install Counterbalance shaft thrust plate retaining bolt finger tight.Do not tighten bolt at this time.

(4) Position the right side of the thrust plate with the right chain guide bolt, install bolt finger tight.

(5) Torque the thrust plate retaining bolt to 28 N·m (250 in. lbs.).

(6) Remove the chain guide bolt so that guide can be installed.

IDLER SHAFT

REMOVAL

(1) Remove the primary and secondary timing chains and sprockets. Refer to procedure in this section.

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft, to install the removal tool.

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.

(3) Cover the radiator core with a suitable cover.

IDLER SHAFT (Continued)

CAUTION: Use care when removing the idler shaft, Do not strike the radiator cooling fins with the slide hammer.

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft.

INSTALLATION

(1) Thoroughly clean the idler shaft bore.
(2) Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft, with clean engine oil.

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.
(4) Coat the idler shaft with clean engine oil.
(5) Install the timing chains and sprockets. Refer to procedure in this section.

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.
(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove electric cooling fan and fan shroud assembly.
(4) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(5) Disconnect both heater hoses at timing cover.
(6) Disconnect lower radiator hose at engine.
(7) Remove accessory drive belt tensioner assembly (Fig. 103).
(8) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(9) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(10) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

CAUTION: The 3.7L engine uses an anerobic sealer instead of a gasket to seal the front cover to the engine block, from the factory. For service, Mopar® Engine RTV sealant must be substituted.

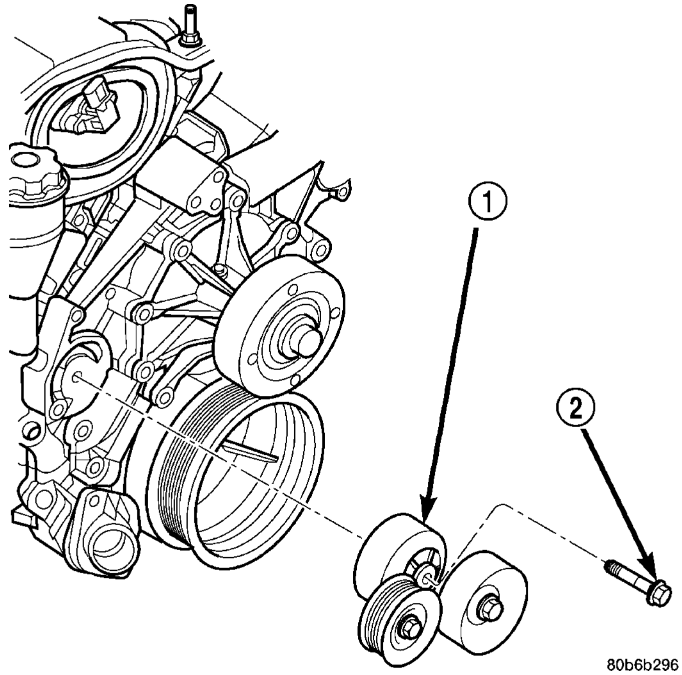


Fig. 103 ACCESSORY DRIVE BELT TENSIONER

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

NOTE: It is not necessary to remove the water pump for timing cover removal.

(11) Remove the bolts holding the timing cover to engine block (Fig. 104).

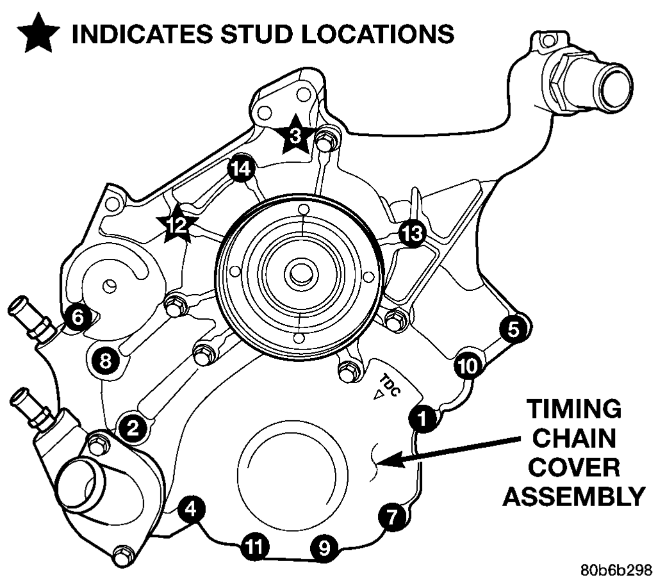


Fig. 104 TIMING CHAIN COVER FASTENERS

(12) Remove the timing cover.

TIMING BELT / CHAIN COVER(S) (Continued)

INSTALLATION

CAUTION: Do not use oil based liquids to clean timing cover or block surfaces. Use only rubbing alcohol, along with plastic or wooden scrapers. Use no wire brushes or abrasive wheels or metal scrapers, or damage to surfaces could result.

(1) Clean timing chain cover and block surface using rubbing alcohol.

CAUTION: The 3.7L uses a special anerobic sealer instead of a gasket to seal the timing cover to the engine block, from the factory. For service repairs, Mopar® Engine RTV must be used as a substitute.

(2) Inspect the water passage o-rings for any damage, and replace as necessary.

(3) Apply Mopar® Engine RTV sealer to front cover following the path below using a 3 to 4mm thick bead (Fig. 105).

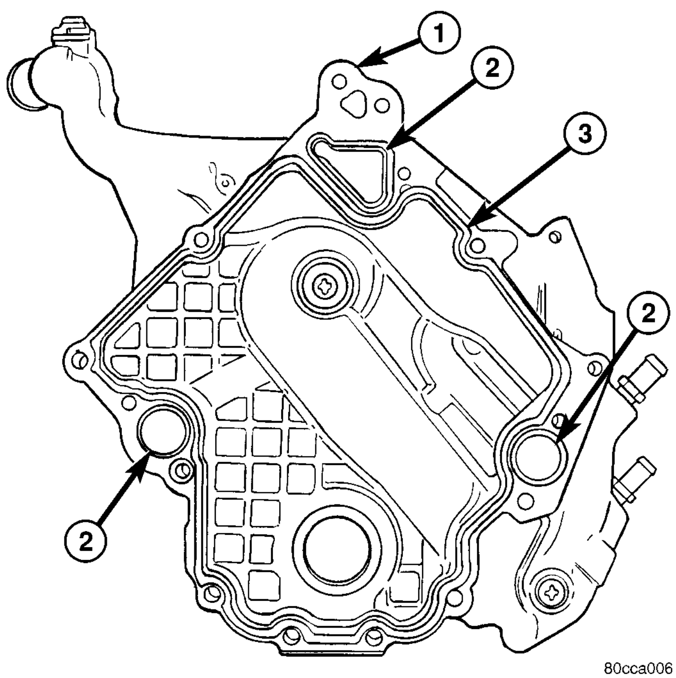


Fig. 105 TIMING COVER SEALANT

1 - TIMING CHAIN COVER
2 - WATER PASSAGE ORING
3 - MOPAR® ENGINE RTV SEALER

(4) Install cover. Tighten fasteners in sequence as shown in to 58 N·m (43 ft. lbs.) (Fig. 106).

(5) Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(6) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

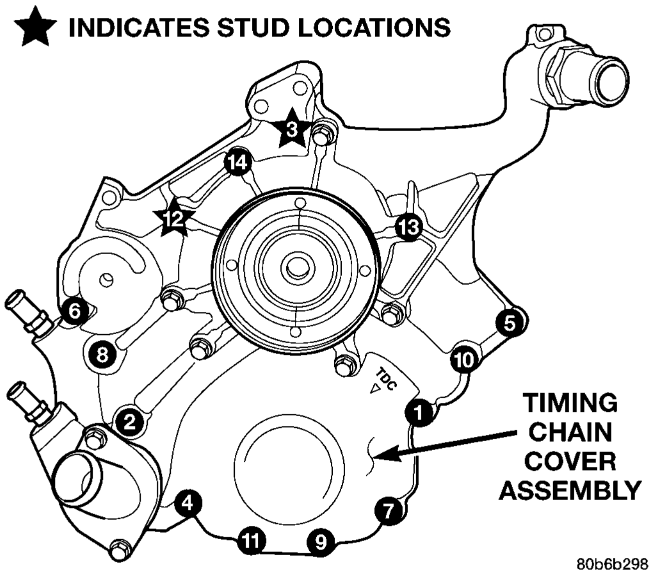


Fig. 106 TIMING CHAIN COVER FASTENERS

(7) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(8) Install accessory drive belt tensioner assembly (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).

(9) Install radiator upper and lower hoses.

(10) Install both heater hoses.

(11) Install electric fan shroud and viscous fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(12) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(13) Connect the battery negative cable.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove right and left cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove radiator fan shroud(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 108) and the camshaft sprocket "V6" marks are at the 12 o'clock position (#1 TDC exhaust stroke) (Fig. 107).

(6) Remove power steering pump(Refer to 19 - STEERING/PUMP - REMOVAL).

(7) Remove access plug from left and right cylinder heads for access to chain guide fasteners (Fig. 109).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

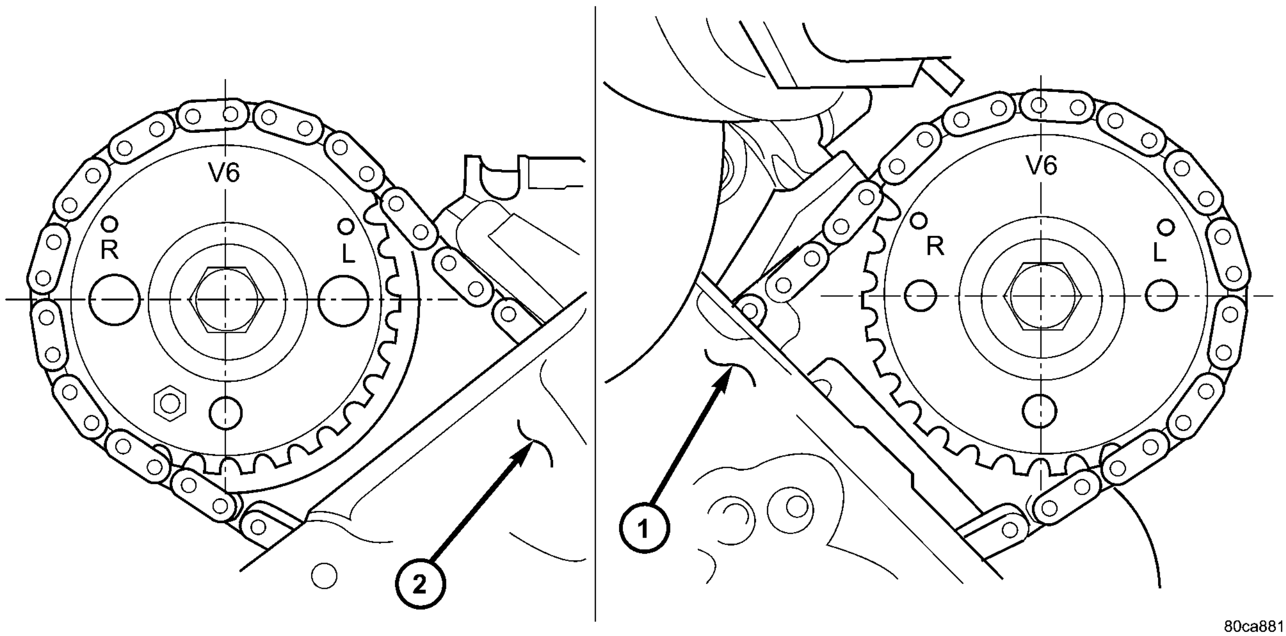


Fig. 107 CAMSHAFT SPROCKET V6 MARKS, (#1 TDC EXHAUST STROKE)

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

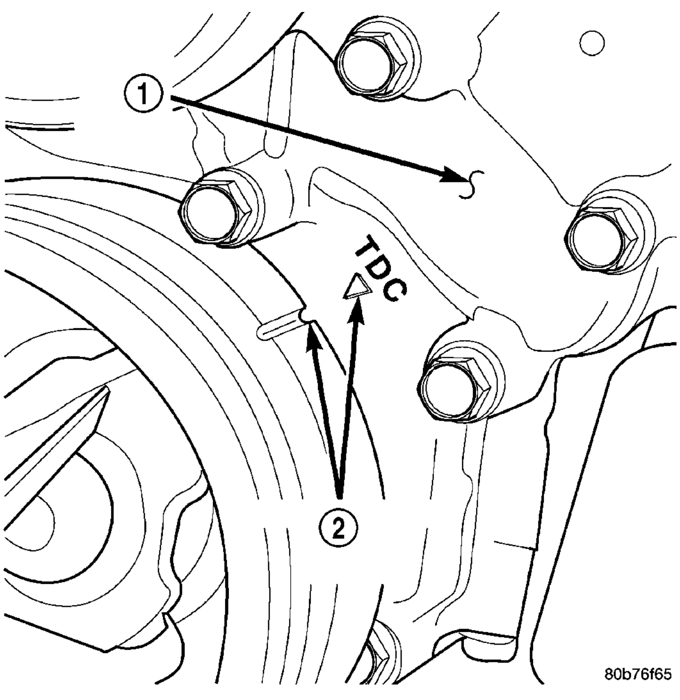


Fig. 108 Engine Top Dead Center

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

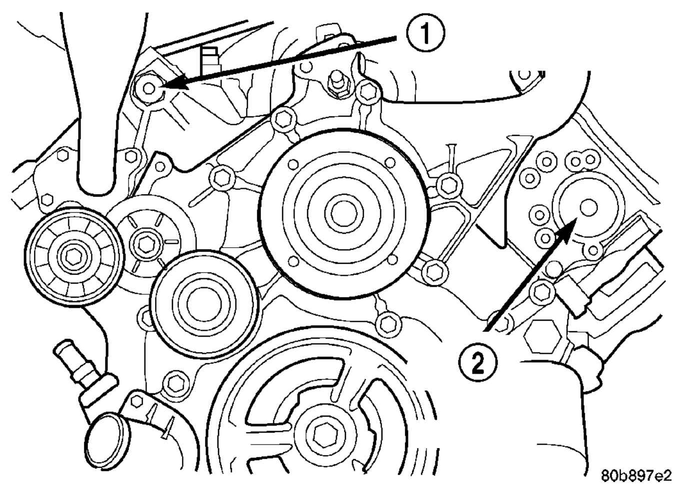


Fig. 109 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

TIMING BELT/CHAIN AND SPROCKETS (Continued)

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(10) Collapse and pin primary chain tensioner.

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor (Fig. 110).

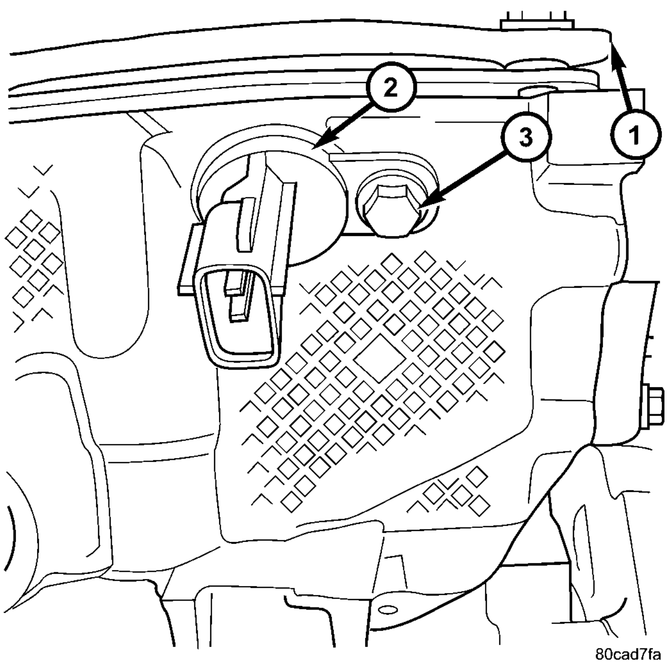


Fig. 110 Camshaft Position Sensor

1 - CYLINDER HEAD
2 - CAMSAHFT POSITION SENSOR
3 - SCREW

CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with Special Tool 8428 Camshaft Wrench, remove the left camshaft sprocket. Slowly rotate the camshaft approximately 5 degrees clockwise to a neutral position.

(15) While holding the right camshaft steel tube with Special Tool 8428 Camshaft Wrench, remove the right camshaft sprocket.

(16) Remove idler sprocket assembly bolt.

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove primary chain tensioner.

INSPECTION

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- Secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner tensioner arm and chain should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner (Fig. 111). Slowly open vise to transfer piston spring force to lock pin.

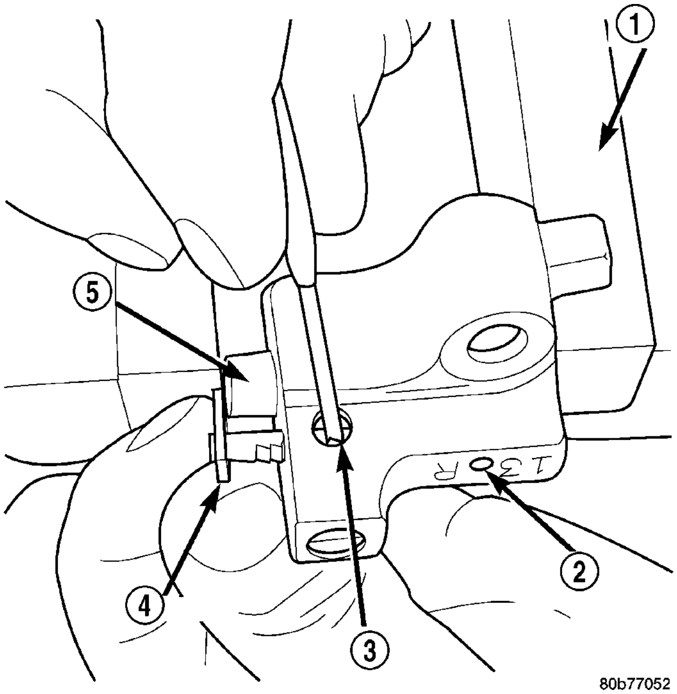


Fig. 111 RESETTING SECONDARY CHAIN TENSIONERS

1 - VISE
2 - INSERT LOCK PIN
3 - RATCHET PAWL
4 - RATCHET
5 - PISTON

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

(3) Install right side chain tensioner arm. Install Torx® bolt. Tighten Torx® bolt to 28 N·m (250 in. lbs.).

CAUTION: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(5) Install left side chain tensioner arm, and Torx® bolt. Tighten Torx® bolt to 28 N·m (250 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8429 to hold chains in place for installation.

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket.

(9) Lubricate idler shaft and bushings with clean engine oil.

NOTE: The idler sprocket must be timed to the counterbalance shaft drive gear before the idler sprocket is fully seated.

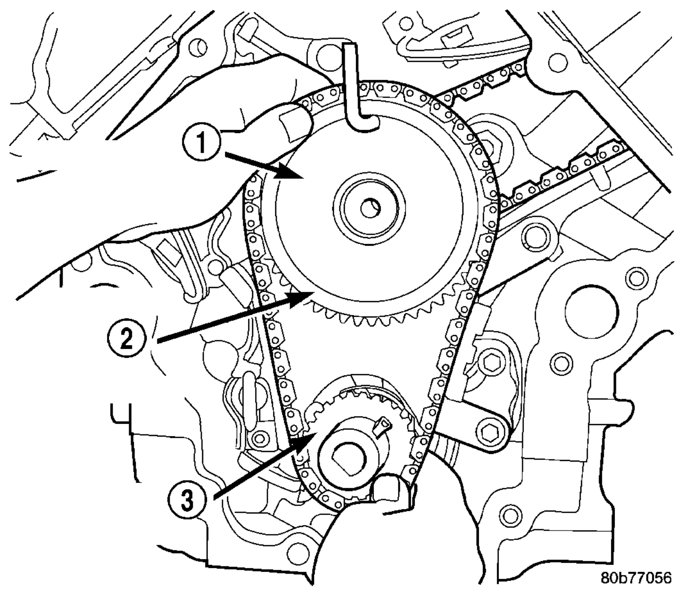


Fig. 112 INSTALLING IDLER GEAR, PRIMARY AND SECONDARY TIMING CHAINS

1 - SPECIAL TOOL 8429
2 - PRIMARY CHAIN IDLER SPROCKET
3 - CRANKSHAFT SPROCKET

TIMING BELT/CHAIN AND SPROCKETS (Continued)

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 112). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or equivalent. This will maintain tension on chains to aid in installation. Align the timing mark on the idler sprocket gear to the timing mark on the counterbalance shaft drive gear, then seat idler sprocket fully (Fig. 113). Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

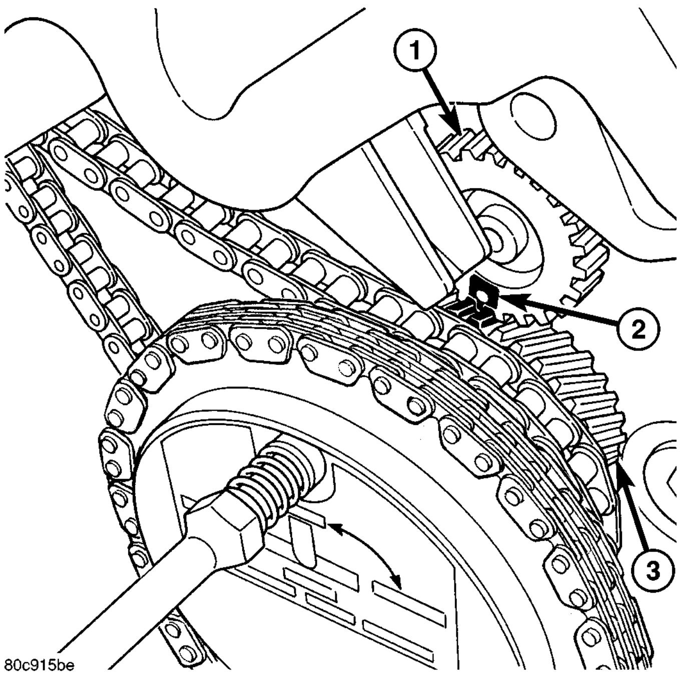


Fig. 113 COUNTERBALANCE SHAFT ALIGNMENT MARKS

1 - COUNTERBALANCE SHAFT GEAR
2 - TIMING MARK
3 - IDLER SPROCKET GEAR

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

(11) Align left camshaft sprocket “L” dot to plated link on chain.

(12) Align right camshaft sprocket “R” dot to plated link on chain.

CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in over-torque of bolt resulting in bolt failure.

(13) Remove Special Tool 8429, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the “V6” marks on camshaft sprockets are at the 12 o’clock position.

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

(15) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

(16) Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(17) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 114) and right (Fig. 115). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

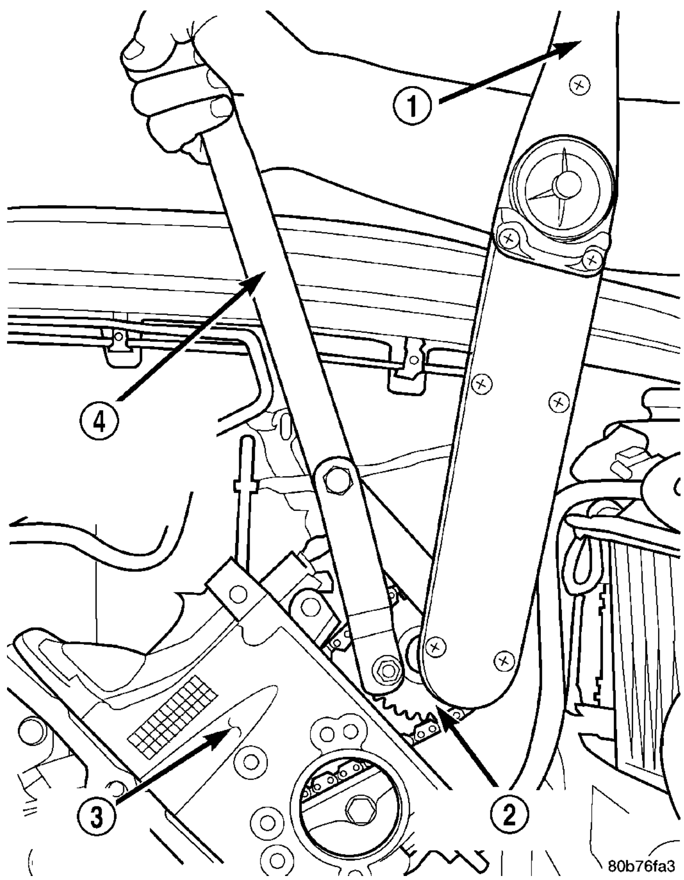


Fig. 114 TIGHTENING LEFT SIDE CAMSHAFT SPROCKET BOLT

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

TIMING BELT/CHAIN AND SPROCKETS (Continued)

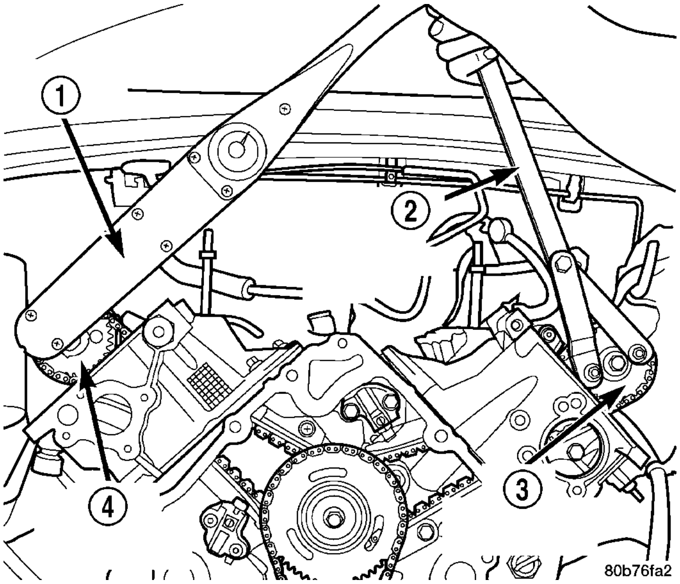


Fig. 115 TIGHTENING RIGHT SIDE CAMSHAFT SPROCKET BOLT

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

(18) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock
- primary chain crankshaft sprocket dot is at 6 o'clock
- secondary chain camshaft sprockets "V6" marks are at 12 o'clock
- counterbalancer shaft drive gear dot is aligned to the idler sprocket gear dot

(19) Lubricate all three chains with engine oil.

(20) After installing all chains, it is recommended that the idler gear end play be checked. The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced (Fig. 116).

(21) Install timing chain cover and crankshaft damper. Refer to procedures.

(22) Install cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

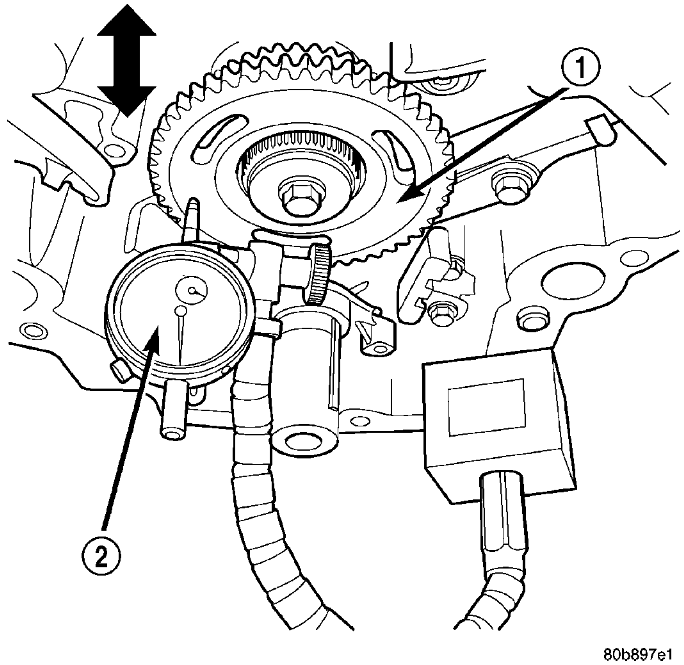


Fig. 116 MEASURING IDLER GEAR END PLAY

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(23) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.).

(24) Install the oil fill housing.

(25) Install access plug in left cylinder head.

(26) Install power steering pump(Refer to 19 - STEERING/PUMP - INSTALLATION).

(27) Fill cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

(28) Connect negative cable to battery.

ENGINE - 4.7L

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ENGINE - 4.7L

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Dirt or water in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump, relay or wiring.	7. Repair or replace as necessary.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low.	1. (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/IDLE AIR CONTROL MOTOR - REMOVAL).
	2. Idle mixture too lean or too rich.	2. Refer to Powertrain Diagnosis Information.
	3. Vacuum leak.	3. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect engine timing.	5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt or water in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	4. Blown cylinder head gasket.	4. Replace cylinder head gasket.

ENGINE - 4.7L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
	5. Low compression.	5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	6. Burned, warped or pitted valves.	6. Replace as necessary.
	7. Plugged or restricted exhaust system.	7. Inspect and replace as necessary.
	8. Faulty coil.	8. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt in fuel system.	2. Clean fuel system.
	3. Burned, warped or pitted valves.	3. Replcae as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Faulty coil.	2. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	3. Dirt or water in fuel system.	3. Clean system and replace fuel filter.

ENGINE - 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Replace as necessary.
	5. Worn rocker arms.	5. Replace as necessary.
	6. Worn lash adjusters	6. Replace as necessary.
	7. Worn valve guides.	7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
	8. Excessive runout of valve seats on valve faces.	8. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Service or replace crankshaft.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check thrust washers for wear.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

ENGINE - 4.7L (Continued)

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner hose.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression,While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

ENGINE - 4.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant

ENGINE - 4.7L (Continued)

to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

REMOVAL

NOTE: This procedure applies to both the 4X2 and 4X4 vehicles, steps that apply to the 4X4 vehicle only, are identified.

(1) Disconnect the battery negative and positive cables.

(2) Remove the battery and the battery tray.

(3) Raise vehicle on hoist.

(4) Remove exhaust crossover pipe from exhaust manifolds.

(5) **4X4 vehicles** Disconnect axle vent tube from left side engine mount.

(6) Remove the through bolt retaining nut and bolt from both the left and right side engine mounts.

(7) **4X4 vehicles** Remove locknut from left and right side engine mount brackets.

(8) Disconnect two ground straps from the lower left hand side and one ground strap from the lower right hand side of the engine.

(9) Disconnect crankshaft position sensor. (Fig. 1)

NOTE: The following step applies to 4X4 vehicles equipped with automatic transmission only.

(10) **4X4 vehicles** Remove the axle isolator bracket from the engine, transmission and the axle.

(11) Remove structural cover (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).

(12) Remove starter (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(13) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

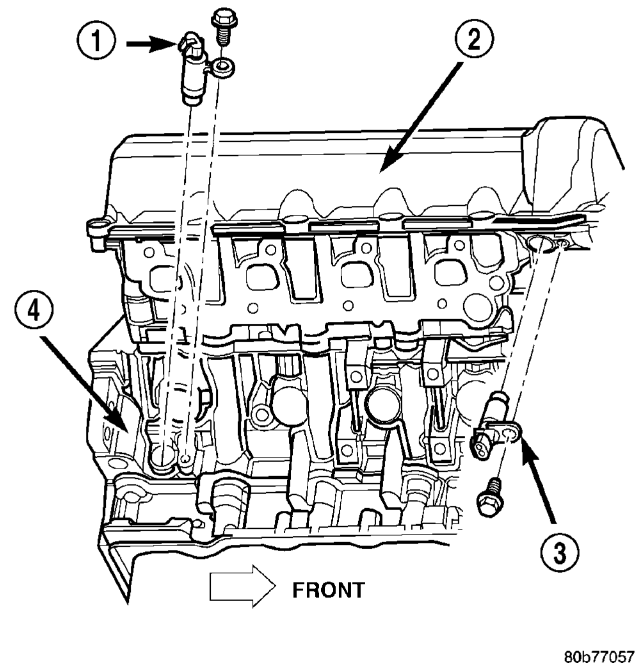


Fig. 1 Crankshaft Position Sensor

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

(14) Remove torque converter bolts (Automatic Transmission Only).

(15) Remove transmission to engine mounting bolts.

(16) Disconnect the engine block heater power cable from the block heater, if equipped.

(17) Lower vehicle.

(18) Remove throttle body resonator assembly and air inlet hose.

(19) Disconnect throttle and speed control cables.

(20) Disconnect tube from both the left and right side crankcase breathers (Fig. 2). Remove breathers

(21) Discharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(22) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(23) Remove shroud, fan assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL) and accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(24) Disconnect transmission oil cooler lines at the radiator.

ENGINE - 4.7L (Continued)

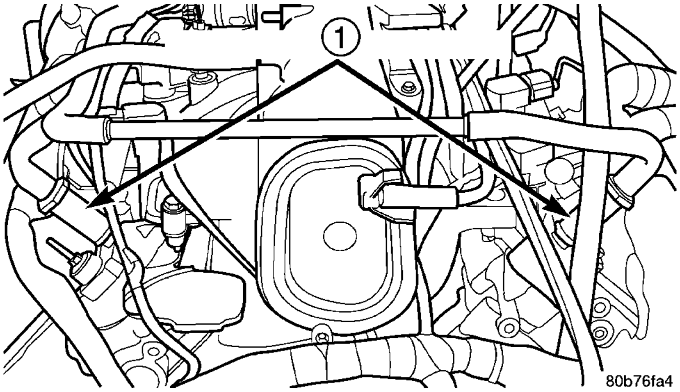


Fig. 2 Crankcase Breather Connection Points

1 - CRANKCASE BREATHERS

(25) Disconnect radiator upper and lower hoses.

(26) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL), A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) and transmission oil cooler.

(27) Remove generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(28) Disconnect the two heater hoses from the timing chain cover and heater core.

(29) Unclip and remove heater hoses and tubes from the intake manifold.

(30) Disconnect engine harness at the following points :

- Intake air temperature (IAT) sensor (Fig. 3)
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold absolute pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(31) Disconnect the vacuum lines at the throttle body and intake manifold.

(32) Release fuel rail pressure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE) then disconnect the fuel supply quick connect fitting at the fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(33) Remove power steering pump and position out of the way.

(34) Install Special Tools 8400 Lifting Studs, into the cylinder heads.

(35) Install Engine Lifting Fixture Special Tool 8347 (Fig. 4) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.

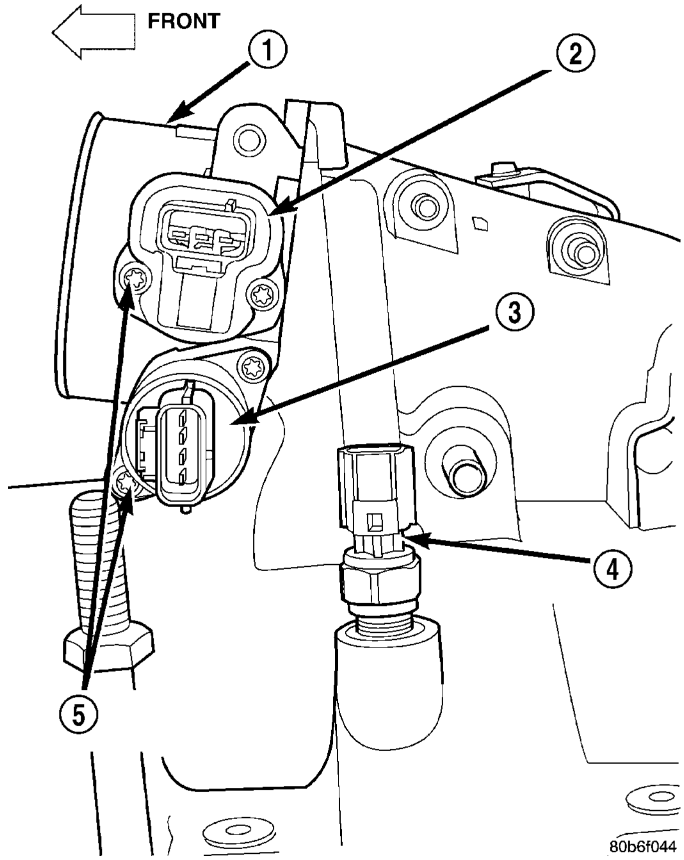


Fig. 3 Throttle Body Connection Points

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

- Position the two remaining fixture arms onto the two Special Tools 8400 Lifting Studs, in the cylinder heads.
- Pull foward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.
- Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.
- Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.

(36) Disconnect body ground strap at the right side cowl (Fig. 5).

(37) Disconnect body ground strap at the left side cowl (Fig. 6).

NOTE: It will be necessary to support the transmission in order to remove the engine.

(38) Position a suitable jack under the transmission.

(39) Remove engine from the vehicle.

ENGINE - 4.7L (Continued)

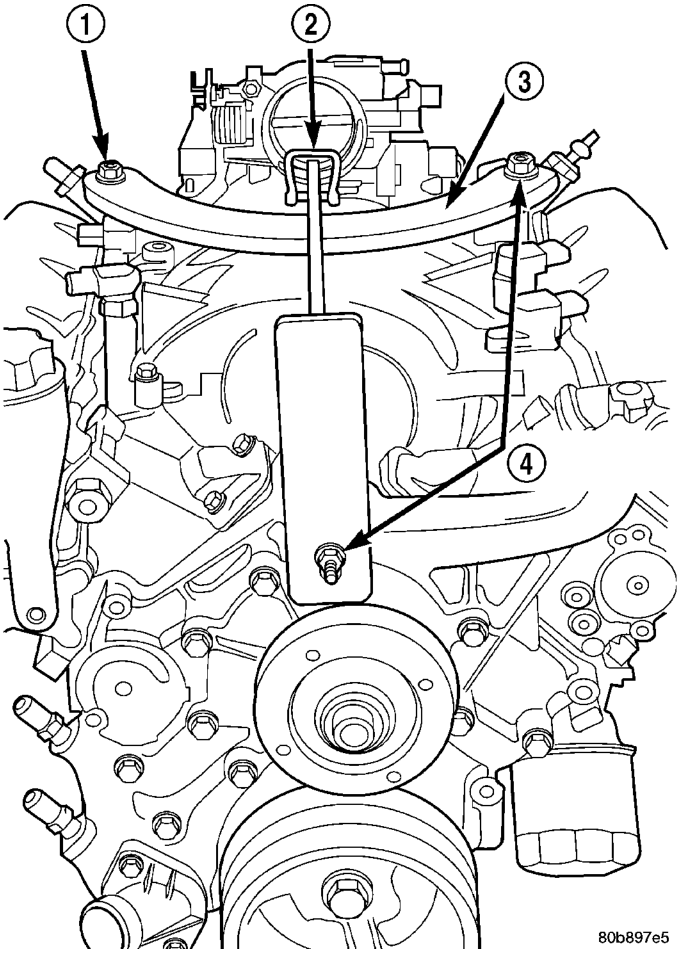


Fig. 4 Engine Lifting Fixture Attachment Locations

1 - ATTACHING LOCATION
2 - ADJUSTABLE HOOK
3 - SPECIAL TOOL 8347 ENGINE LIFT FIXTURE
4 - ATTACHING LOCATIONS

INSTALLATION

(1) Position engine in the vehicle.

Position both the left and right side engine mount brackets and install the through bolts and nuts. Tighten nuts to **4X2 vehicles** 95 N·m (70 ft. lbs.). **4X4 vehicles** 102 N·m (75 ft. lbs.).

(2) **4X4 vehicles** Install locknuts onto the engine mount brackets. Tighten locknuts to 41 N·m (30 ft. lbs.).

(3) Remove jack from under the transmission.

(4) Remove Engine Lifting Fixture Special Tool 8347 (Fig. 4).

(5) Remove Special Tools 8400 Lifting Studs.

(6) Position generator wiring behind the oil dipstick tube, then install the oil dipstick tube upper mounting bolt.

(7) Connect both left and right side body ground straps.

(8) Install power steering pump.

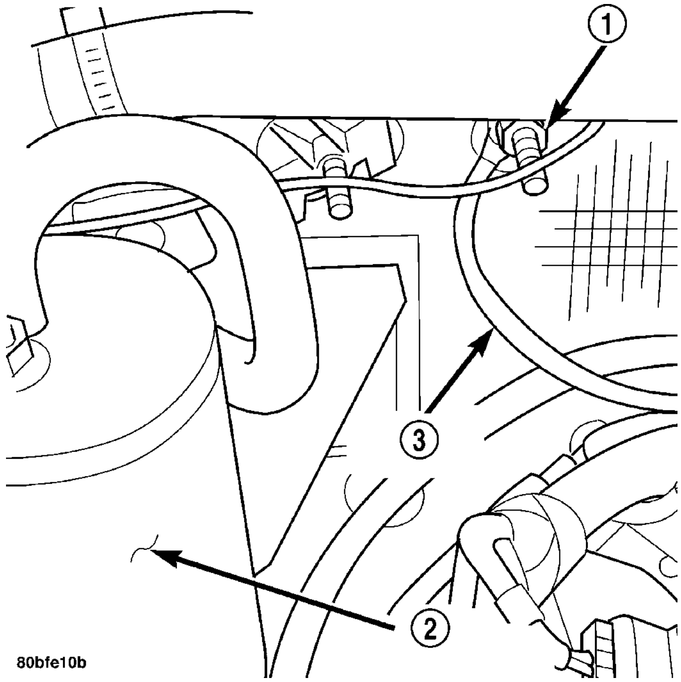


Fig. 5 Body Ground Strap—Right Side Removal / Installation

1 - NUT
2 - A/C ACCUMULATOR
3 - GROUND STRAP

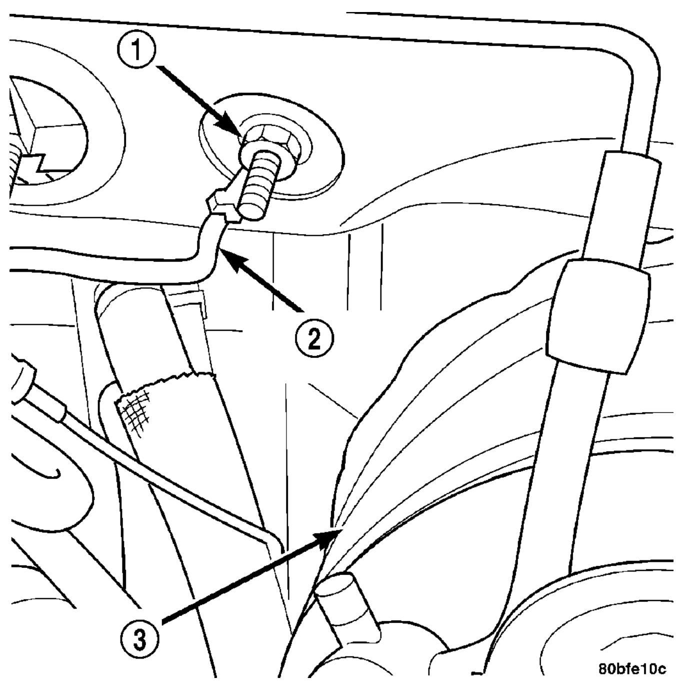


Fig. 6 Body Ground Strap—Left Side Removal / Installation

1 - NUT
2 - GROUND STRAP
3 - BRAKE BOOSTER

ENGINE - 4.7L (Continued)

(9) Connect fuel supply line quick connect fitting (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ QUICK CONNECT FITTING - STANDARD PROCEDURE).

(10) Connect the vacuum lines at the throttle body and intake manifold.

(11) Connect engine harness at the following points (Fig. 3):

- Intake Air Temperature (IAT) Sensor
- Idle Air Control (IAC) Motor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(12) Position and install heater hoses and tubes onto intake manifold.

(13) Install the heater hoses onto the heater core and the engine front cover.

(14) Install generator (Refer to 8 - ELECTRICAL/ CHARGING/GENERATOR - INSTALLATION).

(15) Install A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION), radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION) and transmission oil cooler.

(16) Connect radiator upper and lower hoses.

(17) Connect the transmission oil cooler lines to the radiator.

(18) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION), fan assembly and shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(19) Install A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(20) Install both breathers. Connect tube to both crankcase breathers (Fig. 2).

(21) Connect throttle and speed control cables.

(22) Install throttle body resonator assembly and air inlet hose. Tighten clamps 4 N·m (35 in. lbs.).

(23) Raise vehicle.

(24) Install transmission to engine mounting bolts. Tighten the bolts to 41 N·m (30 ft. lbs.).

(25) Install torque converter bolts (Automatic Transmission Only).

(26) Connect crankshaft position sensor (Fig. 1).

(27) **4X4 vehicles** Position and install the axle isolator bracket onto the axle, transmission and engine block. Tighten bolts to specification (Refer to 9 - ENGINE - SPECIFICATIONS).

(28) Install starter (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - INSTALLATION).

CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

(29) Install structural cover (Refer to 9 - ENGINE/ ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION).

(30) Install exhaust crossover pipe.

(31) Install engine block heater power cable, If equipped.

(32) **4X4 vehicles** Connect axle vent tube to left side engine mount.

(33) Lower vehicle.

(34) Check and fill engine oil.

(35) Recharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(36) Refill the engine cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(37) Install the battery tray and battery.

(38) Connect the battery positive and negative cables.

(39) Start the engine and check for leaks.

ENGINE - 4.7L (Continued)

SPECIFICATIONS

4.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Horsepower	235 BHP @ 4800 RPM
Torque	295 LB-FT @ 3200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.010 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
Ring Groove Diameter	
No. 1	83.73 - 83.97 mm (3.296 - 3.269 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Pressed Fit
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9455 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 - .094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 - .229 mm (.0007 - .0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.015 - 0.055 mm (0.0006 - 0.0022 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter (Interference Fit)	.025 - .048 mm (0.001 - 0.0019 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	555 grams (19.5771 ounces)
CRANKSHAFT	
Main BearingJournal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.018 - 0.052 mm (0.0008 - 0.0021 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)

ENGINE - 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.015 - 0.055 mm (0.0006 -0.0022 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm
	(1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm (1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm (0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 - .200 mm (0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)
VALVE TIMING	
Intake	
Opens (BTDC)	4.4°
Closes (ATDC)	239.1°
Duration	243.5°
Exhaust	
Opens (BTDC)	240.5°
Closes (ATDC)	13.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm (1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm 1.4516 - 1.4618 in.)

DESCRIPTION	SPECIFICATION
Length (Overall)	
Intake	113.45 - 114.21 mm (4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm (4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm (0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm (0.2717 - 0.2728 in.)
Stem - to - Guide Clearance	
Intake	.018 - .069 mm (0.0008 - 0.0028 in.)
Exhaust	.047 - .098 mm (0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	11.25 mm (0.443 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Length (Approx)	
Intake and Exhaust	49.0 mm (1.9291 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	313.0 - 354.0 N @ 40.12 mm (70.3652 - 79.58237 lbs. @ 1.5795 in.)
Spring Force (Valve Open)	
Intake and Exhaust	776.0 - 870.0 N @ 28.88 mm 174.4517 - 195.5838 lbs. @ 1.1370 in.)

ENGINE - 4.7L (Continued)

DESCRIPTION	SPECIFICATION
Number of Coils	
Intake and Exhaust	7.3
Wire Diameter	
Intake and Exhaust	4.6 - 3.67 mm (0.1811 - 0.1445 in.)
Installed Height (Spring Seat to Bottom of Retainer)	
Nominal	
Intake	40.12 mm (1.5795 in.)
Exhaust	40.12 mm (1.5795 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)

DESCRIPTION	SPECIFICATION
OIL PUMP	
Clearance Over Rotors / End Face (MAX)	.095 mm - (0.0038 in.)
Cover Out - of -Flat (MAX)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.02 mm (0.4731 in.)
Outer Rotor to Pocket Diametral Clearance (MAX)	.235 mm (.0093 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	.150 mm (0.006 in.)
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 758 kPa (25 - 110 psi)
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

ENGINE - 4.7L (Continued)

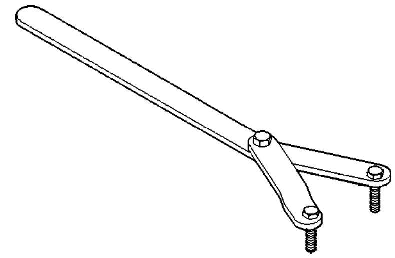
TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	58	43	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	81	60	—
M8 Bolts	26	19	—
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250
Oil Dipstick Tube to Engine Block—Bolt	15	—	130
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	13	—	115
Water Pump—Bolts	58	43	—

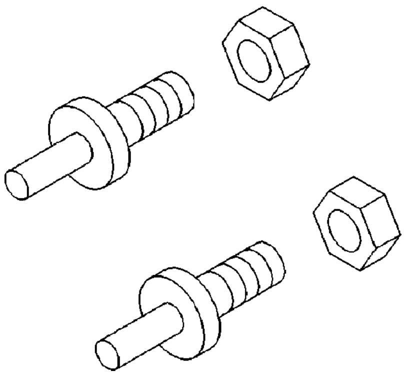
ENGINE - 4.7L (Continued)

SPECIAL TOOLS

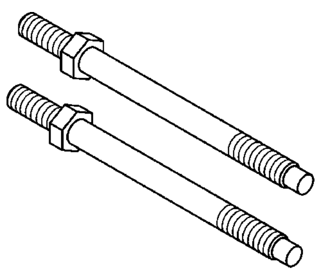
4.7L ENGINE



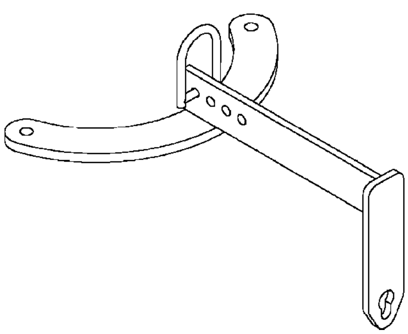
Spanner Wrench 6958



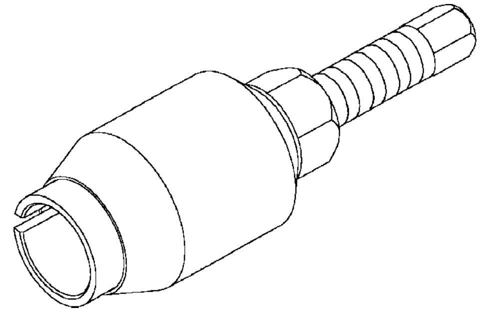
Adapter Pins 8346



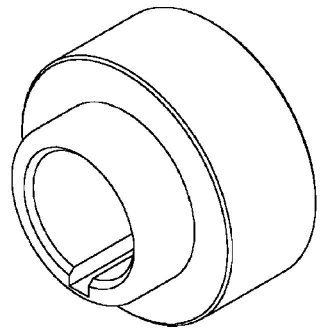
Engine Lifting Studs 8400



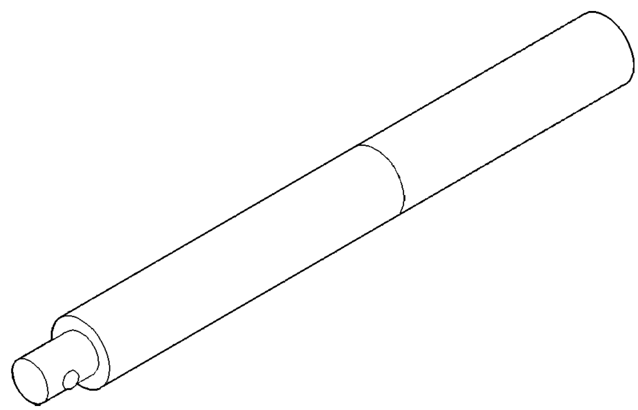
Engine Lift Fixture 8347



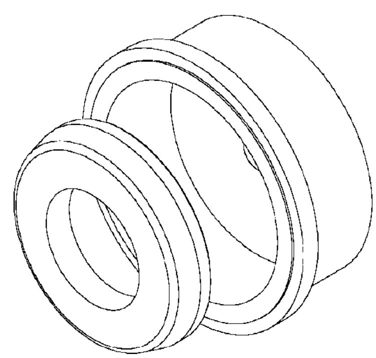
Front Crankshaft Seal Remover 8511



Front Crankshaft Seal Installer 8348

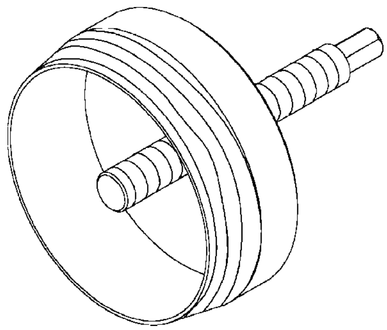


Handle C-4171

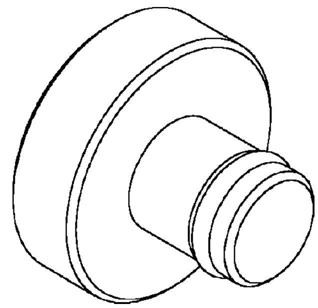


Rear Crankshaft Seal Installer 8349

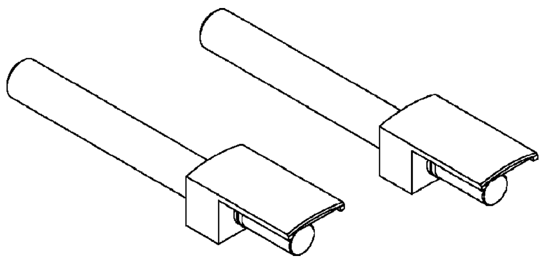
ENGINE - 4.7L (Continued)



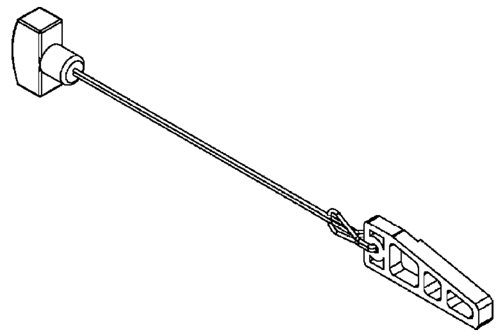
Rear Crankshaft Seal Remover 8506



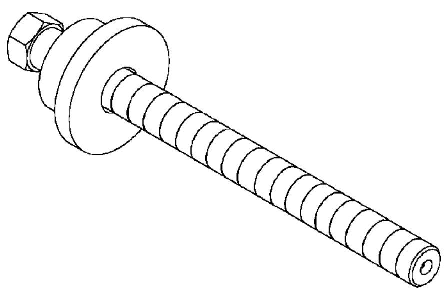
Crankshaft Damper Removal Insert 8513



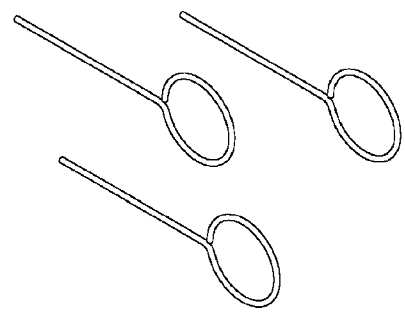
Connecting Rod Guides 8507



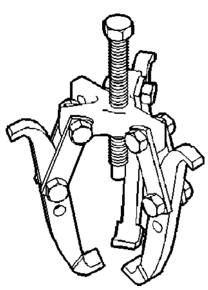
Chain Tensioner Wedge 8350



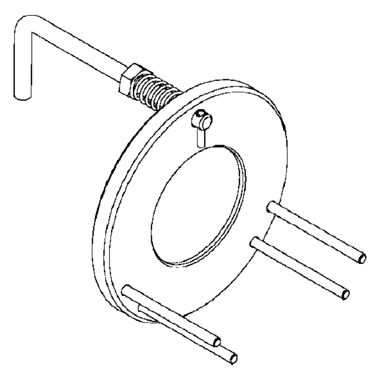
Crankshaft Damper Installer 8512



Chain Tensioner Pins 8514

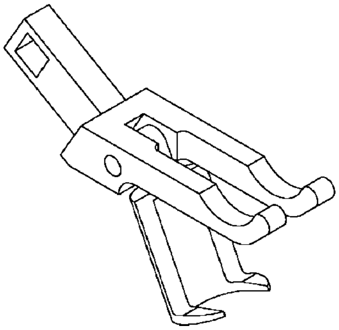


Puller 1026

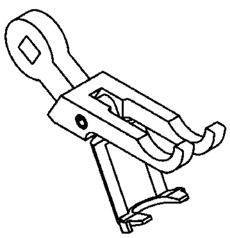


Secondary Chain Holder 8515

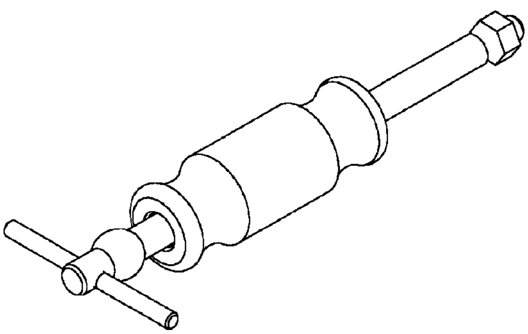
ENGINE - 4.7L (Continued)



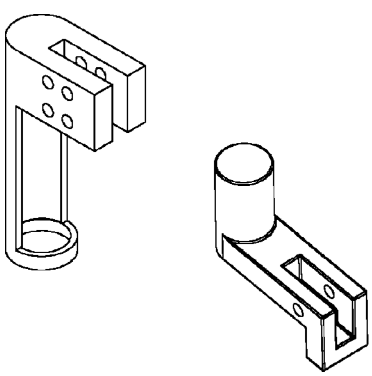
Remover, Rocker Arm 8516



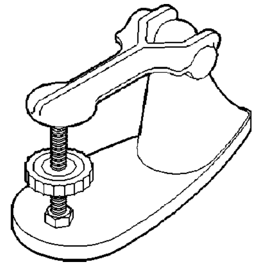
Valve Spring Compressor 8387



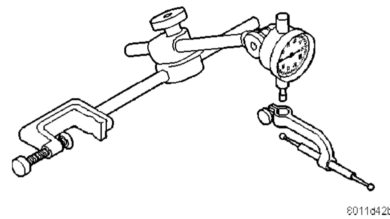
Idler Shaft Remover 8517



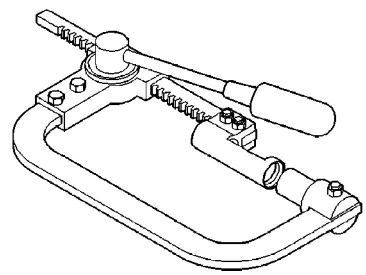
Valve Spring Compressor Adapters 8519



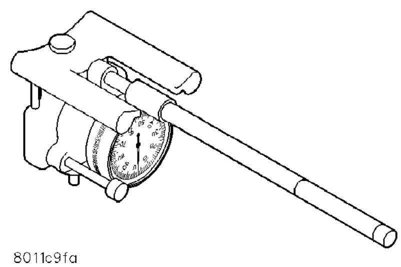
Valve Spring Tester C-647



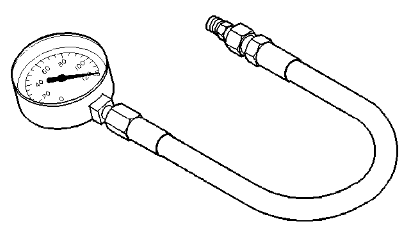
Dial Indicator C-3339



Valve Spring Compressor C-3422-B

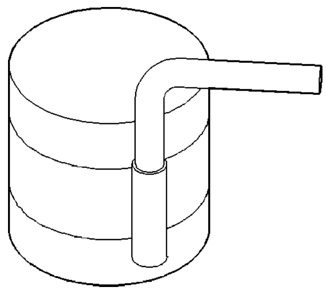


Bore Size Indicator C-119

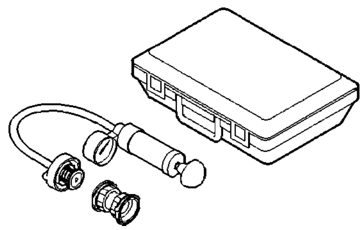


Oil Pressure Gauge C-3292

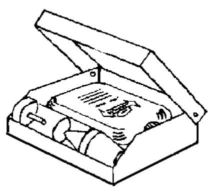
ENGINE - 4.7L (Continued)



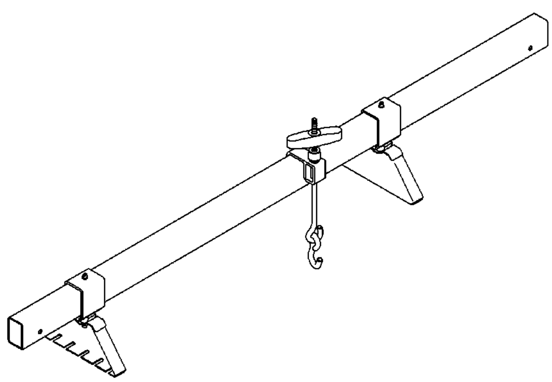
Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A



ENGINE SUPPORT FIXTURE 8534

AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 7) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 7) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 7) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

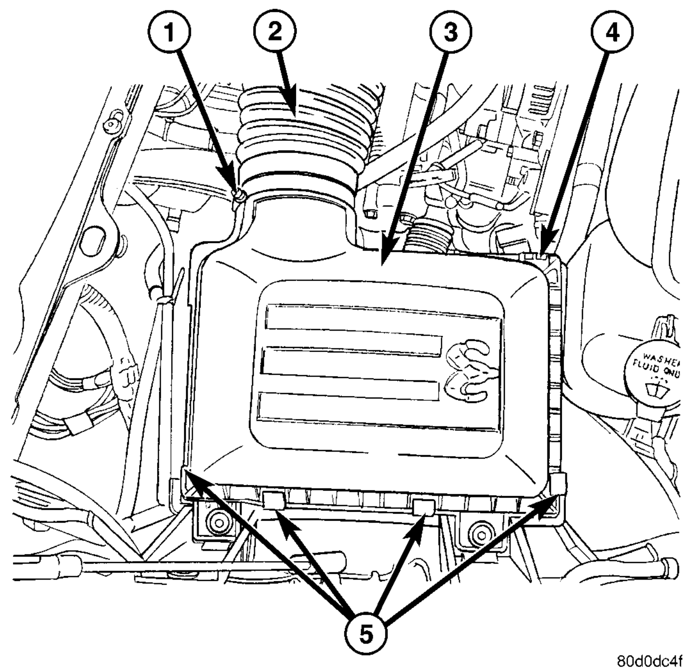


Fig. 7 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 7) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 8).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 7).

AIR CLEANER ELEMENT (Continued)

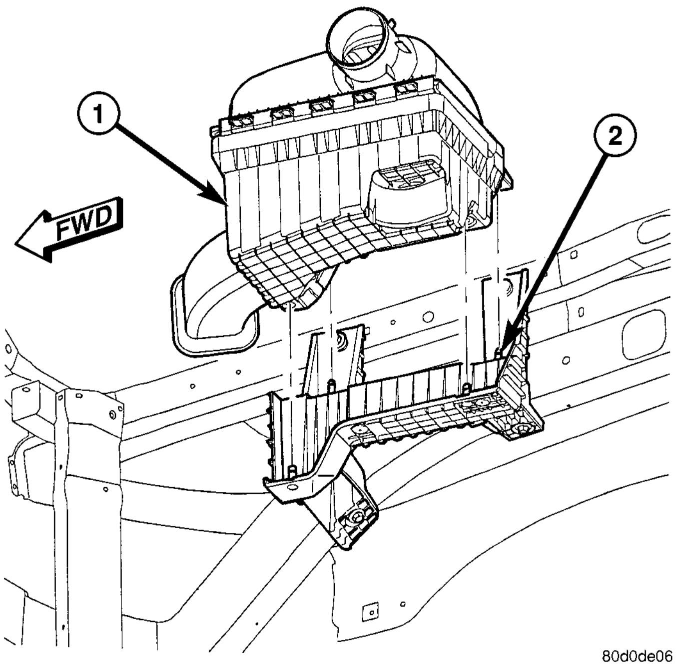


Fig. 8 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 7) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

DESCRIPTION

DESCRIPTION - CYLINDER HEAD

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

DESCRIPTION - VALVE GUIDES

The valve guides are made of powered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

REMOVAL

REMOVAL - LEFT CYLINDER HEAD

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the left side exhaust manifold.

(4) Drain the engine coolant. Refer to COOLING SYSTEM.

(5) Lower the vehicle.

(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the master cylinder and booster assembly. Refer to section 5 brakes.

(8) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(9) Remove the fan shroud and fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(10) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the power steering pump and set aside.

(12) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 9).

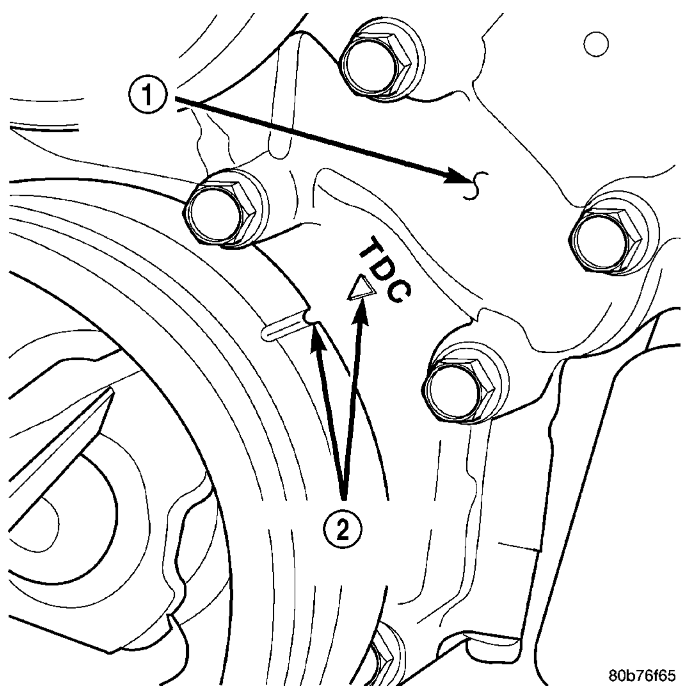


Fig. 9 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

CYLINDER HEAD (Continued)

(13) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 11). Rotate the crankshaft one turn if necessary.

(14) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(15) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(16) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 10).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(17) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 11).

(18) Remove the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(19) Remove the cylinder head access plug (Fig. 12).

(20) Remove the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(21) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

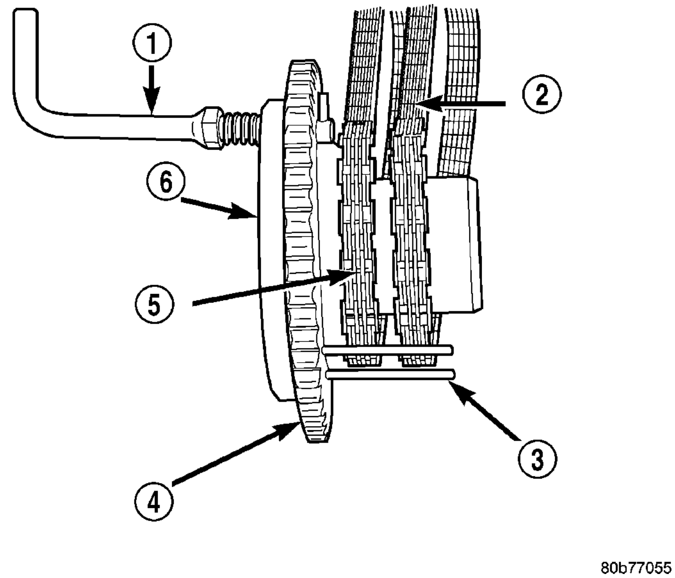


Fig. 10 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

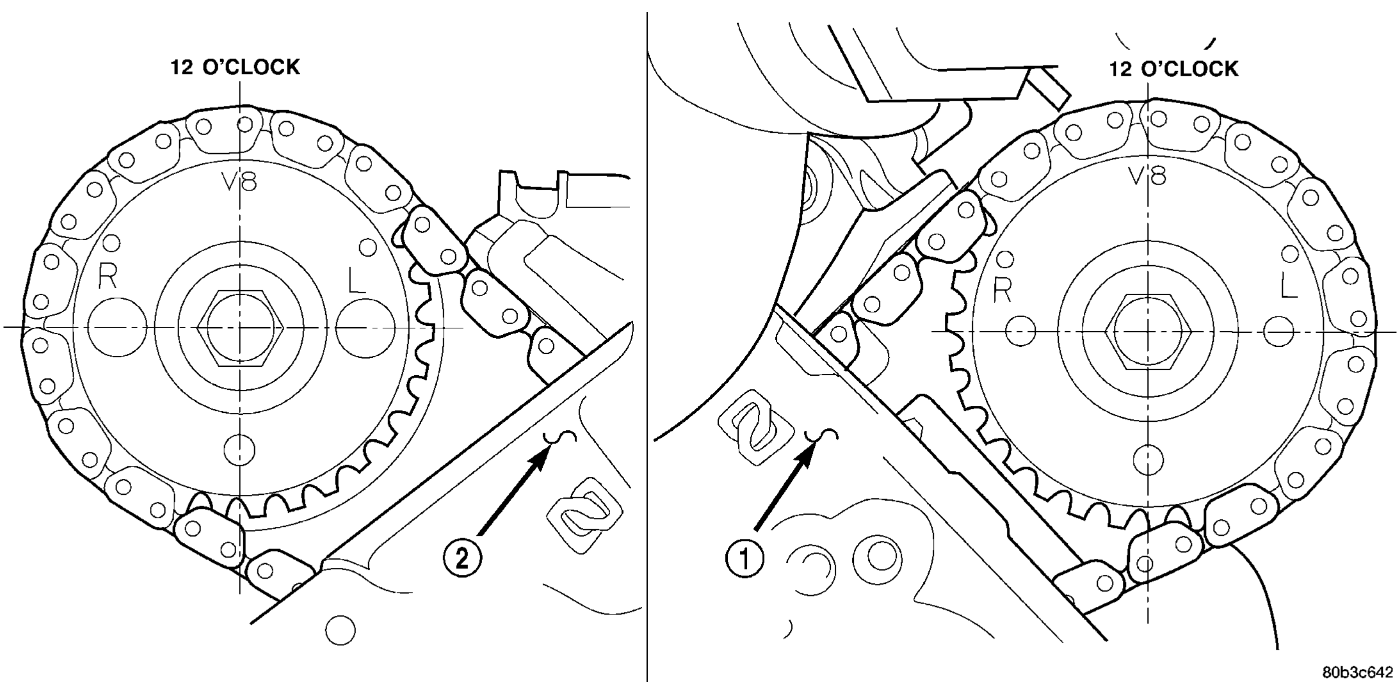


Fig. 11 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

CYLINDER HEAD (Continued)

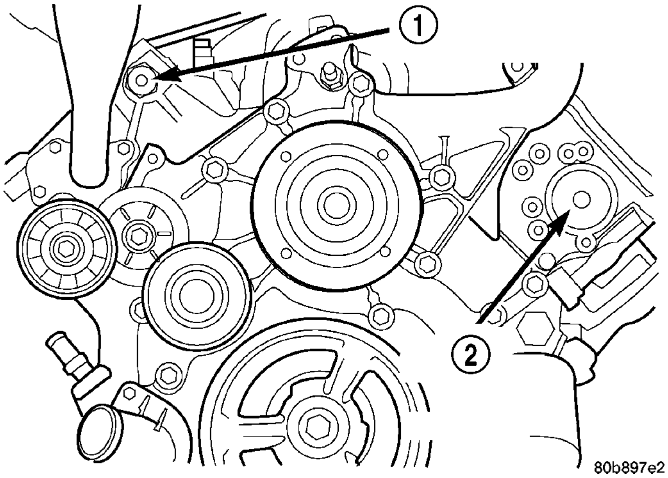


Fig. 12 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(22) Remove the cylinder head retaining bolts.

(23) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

REMOVAL - RIGHT CYLINDER HEAD

(1) Disconnect battery negitive cable.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the right side exhaust manifold.

(4) Drain the engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Lower the vehicle.

(6) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(7) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(8) Remove the fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(9) Remove oil fill housing from cylinder head.

(10) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 13).

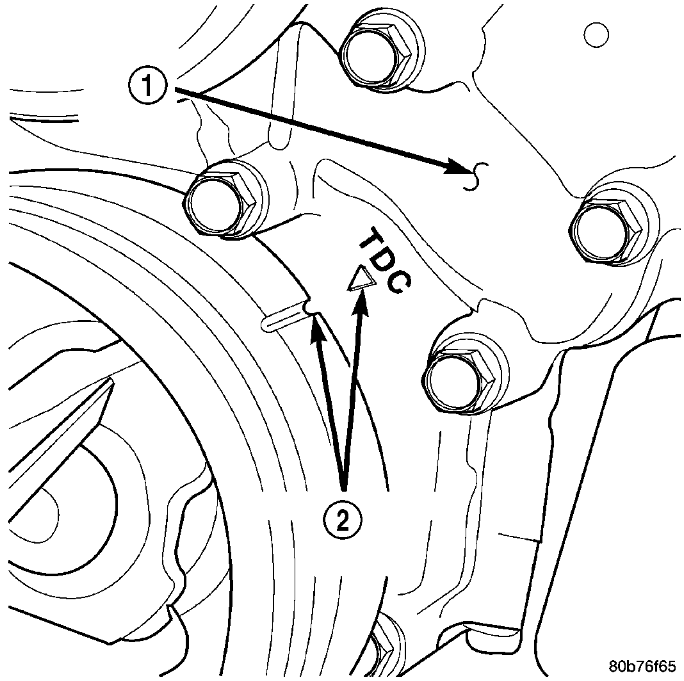


Fig. 13 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 14). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(14) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 15).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 14).

(17) Remove the right side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(18) Remove the cylinder head access plug (Fig. 16).

(19) Remove the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(20) Remove the retaining bolt and the camshaft drive gear.

CYLINDER HEAD (Continued)

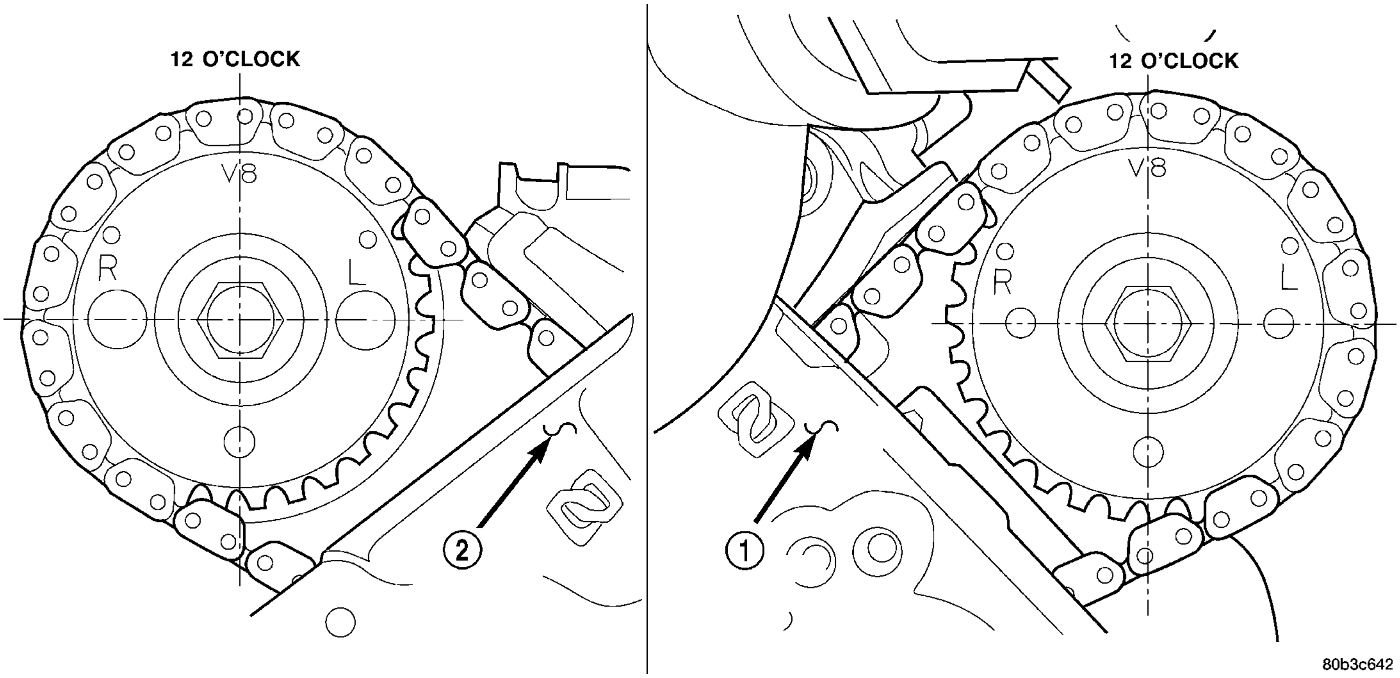


Fig. 14 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

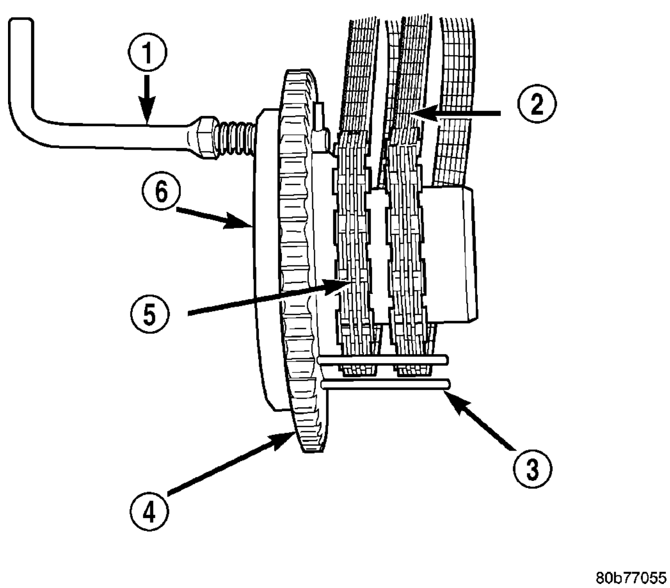


Fig. 15 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

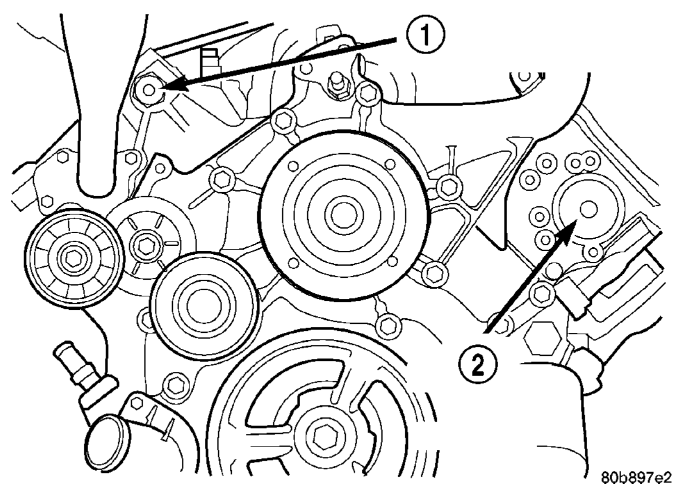


Fig. 16 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

CYLINDER HEAD (Continued)

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(21) Remove the cylinder head retaining bolts.
(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

CLEANING

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components. (Refer to 9 - ENGINE - STANDARD PROCEDURE)

INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.
(2) Inspect the valve seats for damage. Service the valve seats as necessary.
(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

INSTALLATION

INSTALLATION - LEFT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 17).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 18).
(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

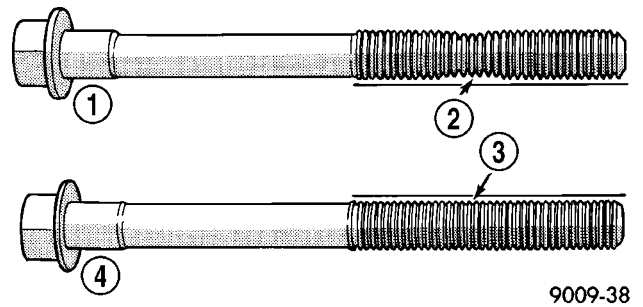


Fig. 17 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

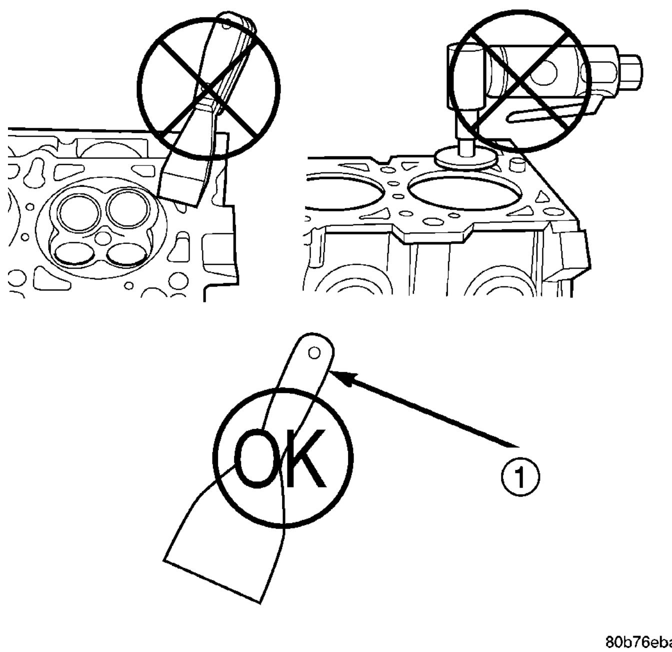


Fig. 18 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M11 bolts.
(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

CYLINDER HEAD (Continued)

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 19) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

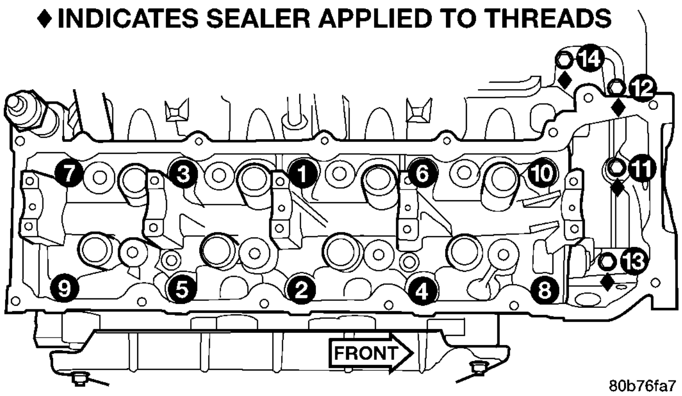


Fig. 19 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the left side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the cylinder head access plug (Fig. 20).

(11) Re-set and Install the left side secondary chain tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(12) Remove Special Tool 8515.

(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(15) Install the power steering pump.

(16) Install the fan blade assembly and fan shroud (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(17) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Reinstall the master cylinder and booster assembly. Refer to section 5 brakes.

(19) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(20) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the left exhaust manifold.

(23) Lower the vehicle.

(24) Connect the negative cable to the battery.

(25) Start the engine and check for leaks.

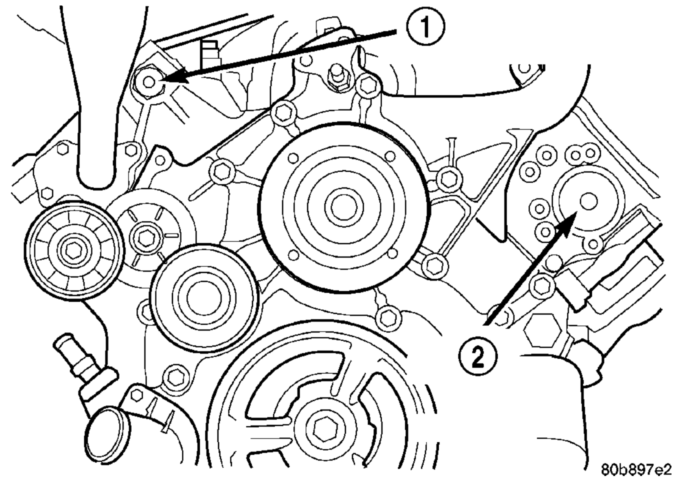


Fig. 20 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

INSTALLATION - RIGHT CYLINDER HEAD

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 21).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 22).

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

CYLINDER HEAD (Continued)

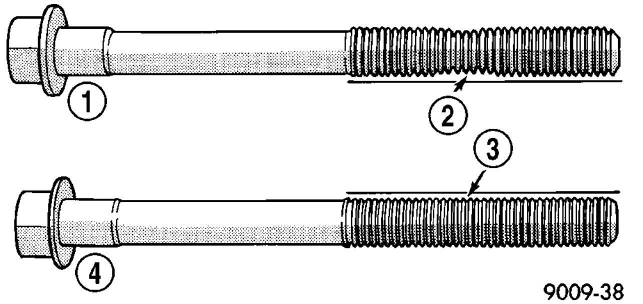


Fig. 21 Checking Cylinder Head Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

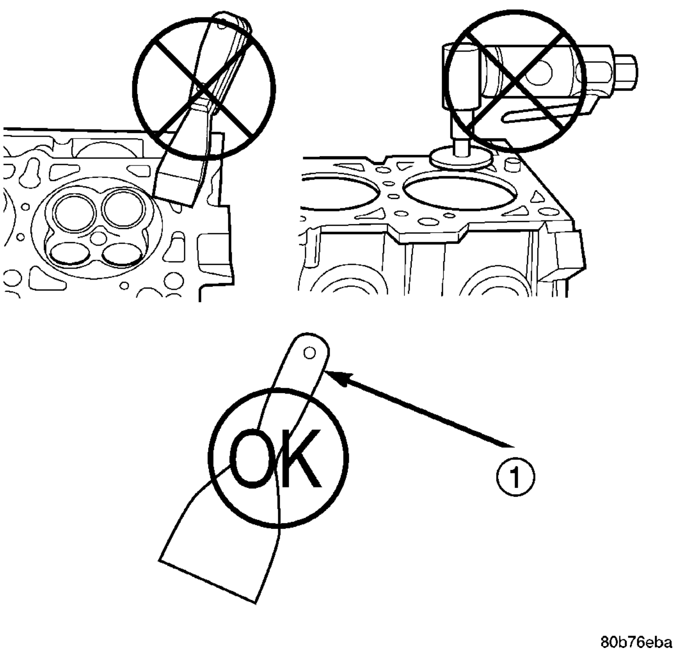


Fig. 22 Proper Tool Usage for

1 - PLASTIC/WOOD SCRAPER

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M10 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 23) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

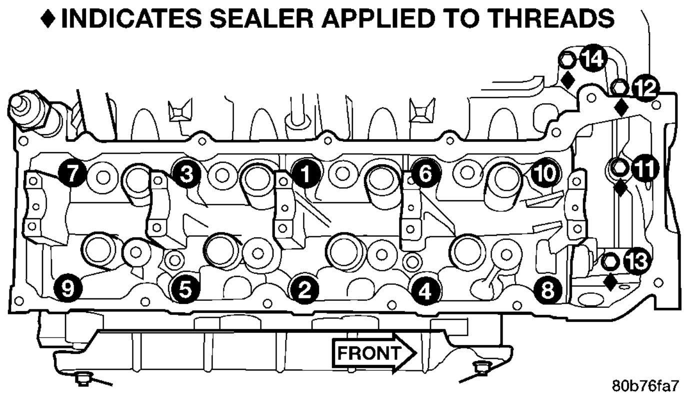


Fig. 23 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the right side secondary chain guide (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(10) Install the right side cylinder head access plug (Fig. 24).

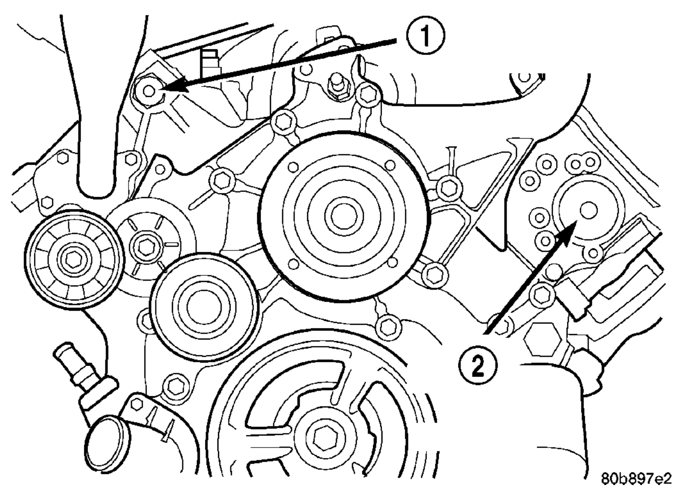


Fig. 24 Cylinder Head Access Plugs

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

CYLINDER HEAD (Continued)

(11) Re-set and install the right side secondary chain tensioner.

(12) Remove Special Tool 8515.

(13) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(15) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(16) Install the fan shroud.

(17) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(18) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(19) Install oil fill housing onto cylinder head.

(20) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Raise the vehicle.

(22) Install the exhaust pipe onto the right exhaust manifold.

(23) Lower the vehicle.

(24) Reconnect battery negitive cable.

(25) Start the engine and check for leaks.

CAMSHAFT(S) - LEFT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8350 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 25).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

CAMSHAFT(S) - LEFT (Continued)

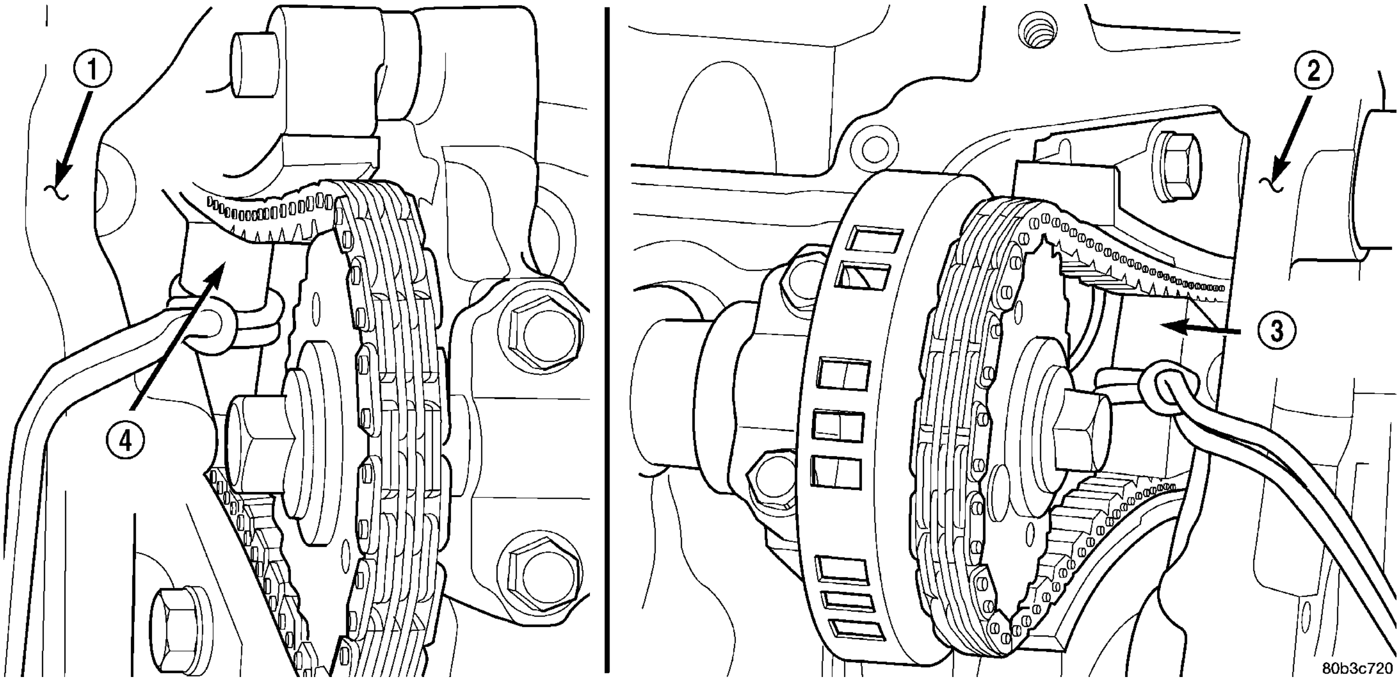


Fig. 25 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 26).

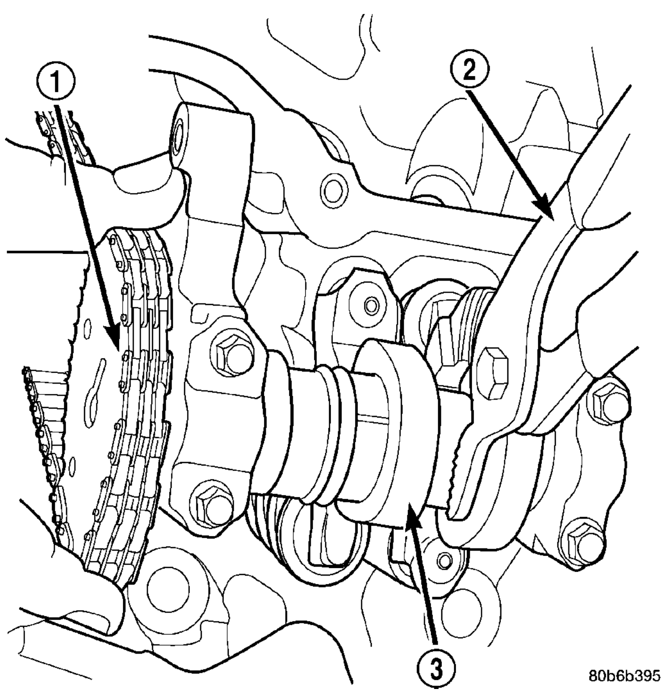


Fig. 26 Camshaft Sprocket and Chain

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

(7) Using the pliers, gently allow the camshaft to rotate 15° clockwise until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

CAMSHAFT(S) - LEFT (Continued)

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 27).

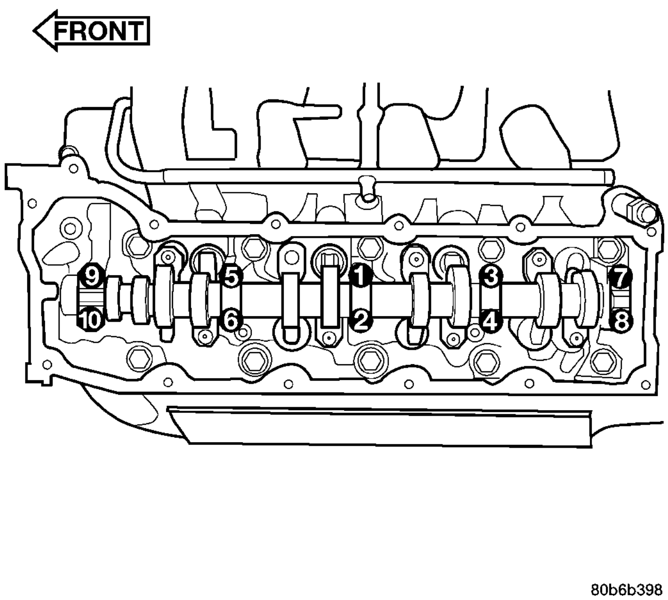


Fig. 27 Camshaft Bearing Caps Tightening Sequence

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 28).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

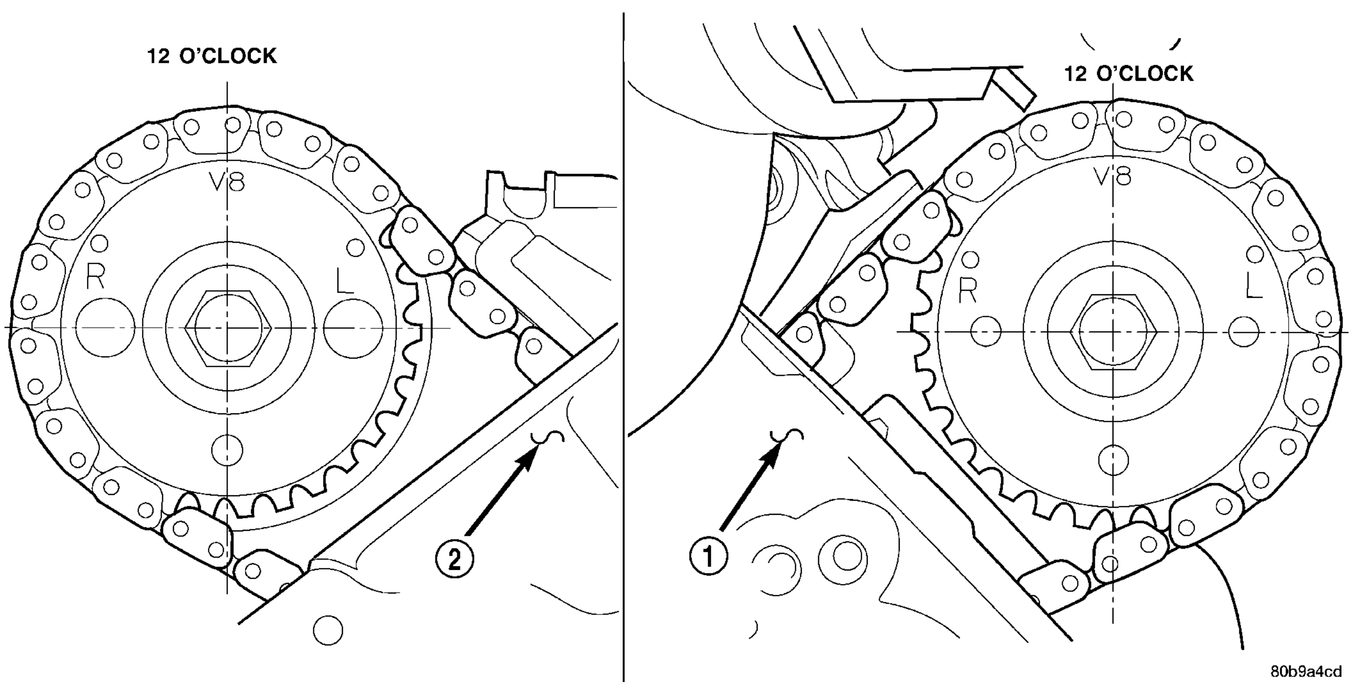


Fig. 28 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD

2 - RIGHT CYLINDER HEAD

CAMSHAFT(S) - LEFT (Continued)

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 29).

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

(8) Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8350 timing chain wedge (Fig. 30).

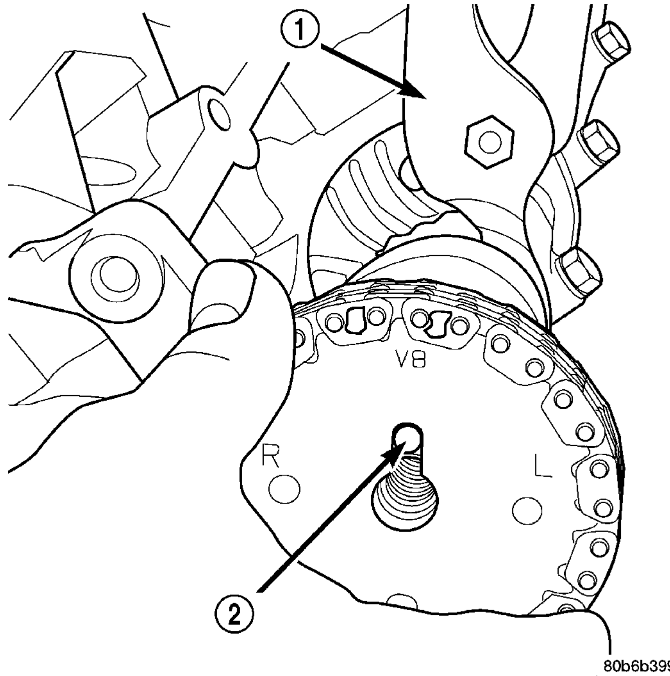


Fig. 29 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

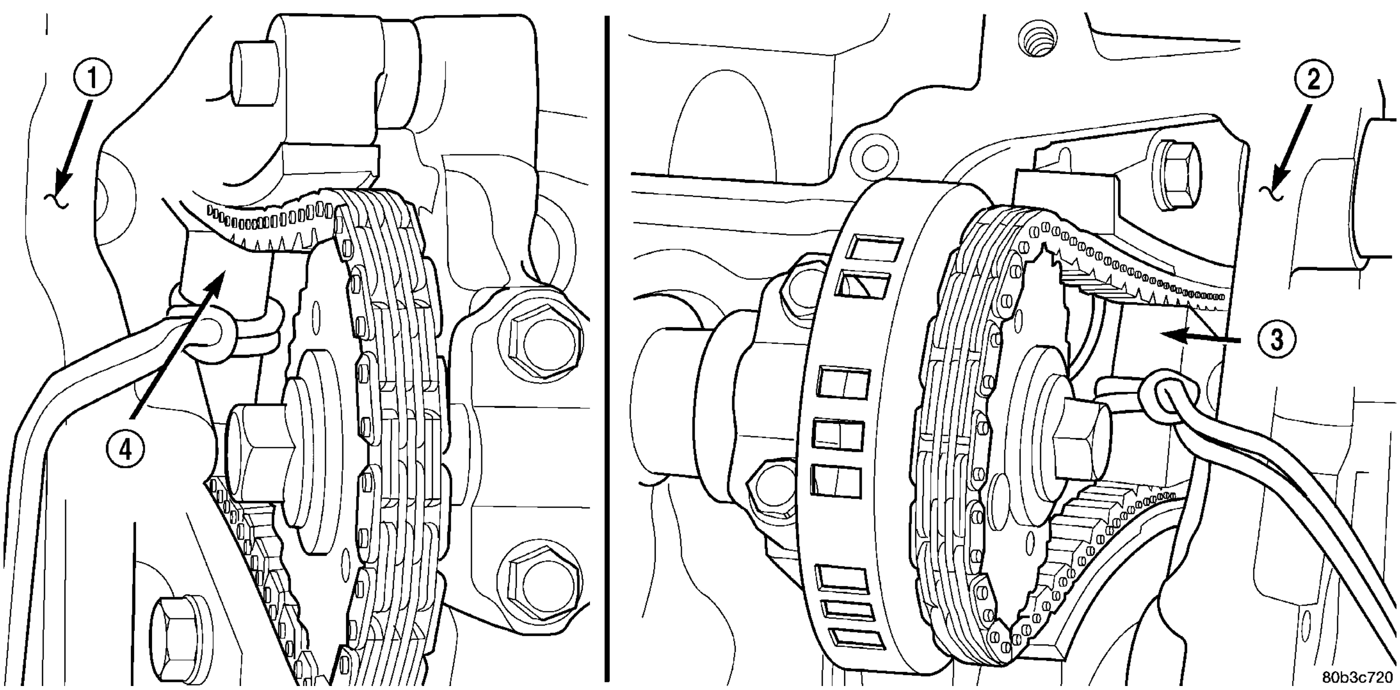


Fig. 30 SPECIAL TOOL 8350

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

CAMSHAFT(S) - LEFT (Continued)

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 31), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

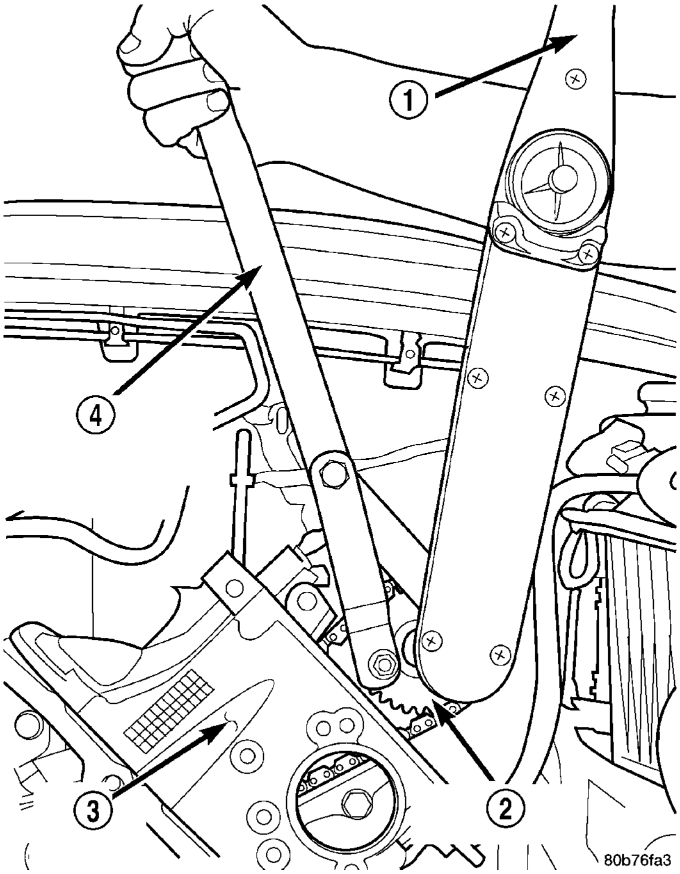


Fig. 31 Tightening Left Side Cam Sprocket Retaining Bolt

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

CAMSHAFT(S) - RIGHT

DESCRIPTION

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction-welded to the steel camshaft tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8350 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

(1) Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

CAMSHAFT(S) - RIGHT (Continued)

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 32).

(6) Remove the camshaft position sensor (Fig. 33).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 34).

(8) Using the pliers, gently allow the camshaft to rotate 45° counter-clockwise until the camshaft is in the neutral position (no valve load).

(9) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(10) Remove the camshaft bearing caps and the camshaft.

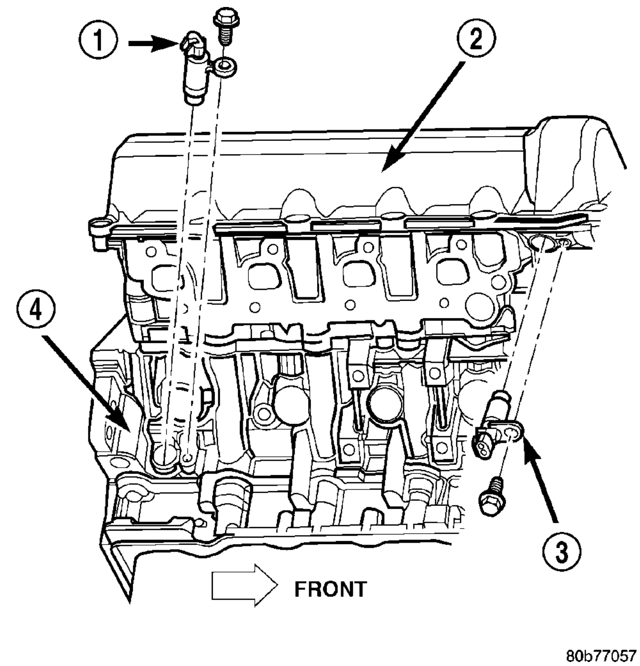


Fig. 33 Camshaft Position Sensor

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

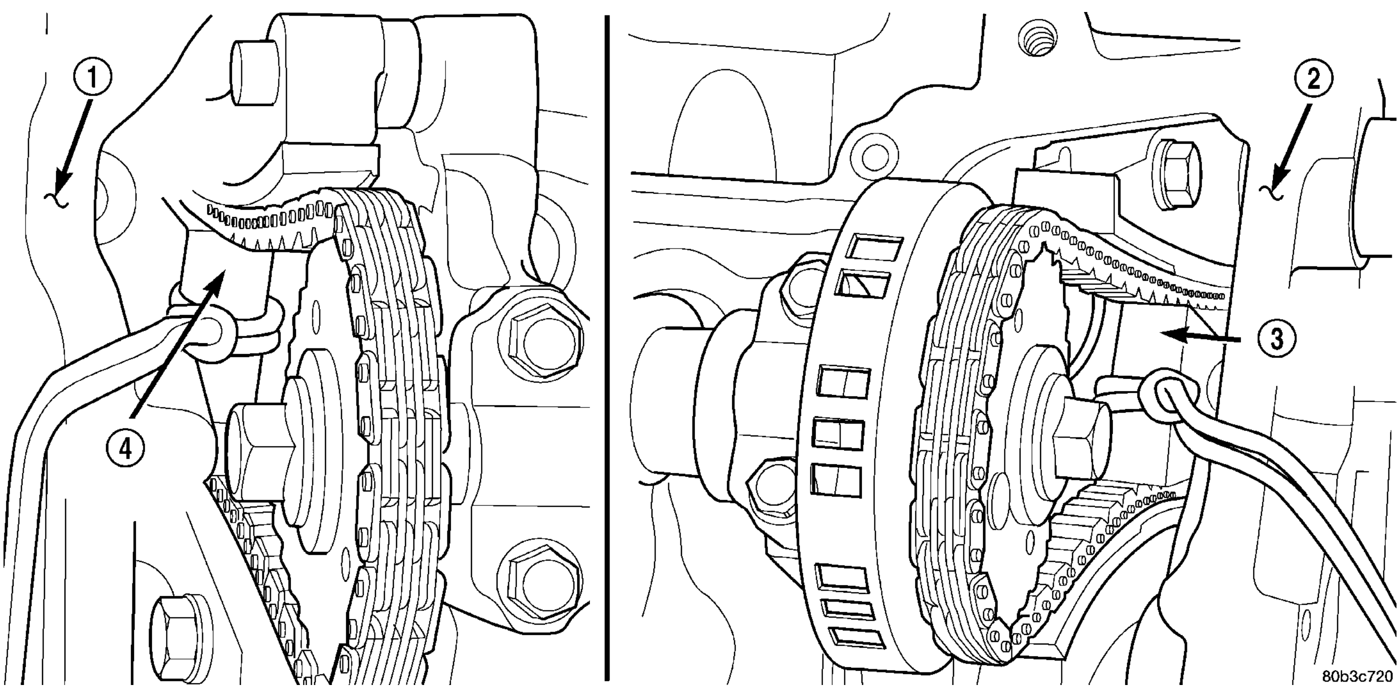


Fig. 32 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

CAMSHAFT(S) - RIGHT (Continued)

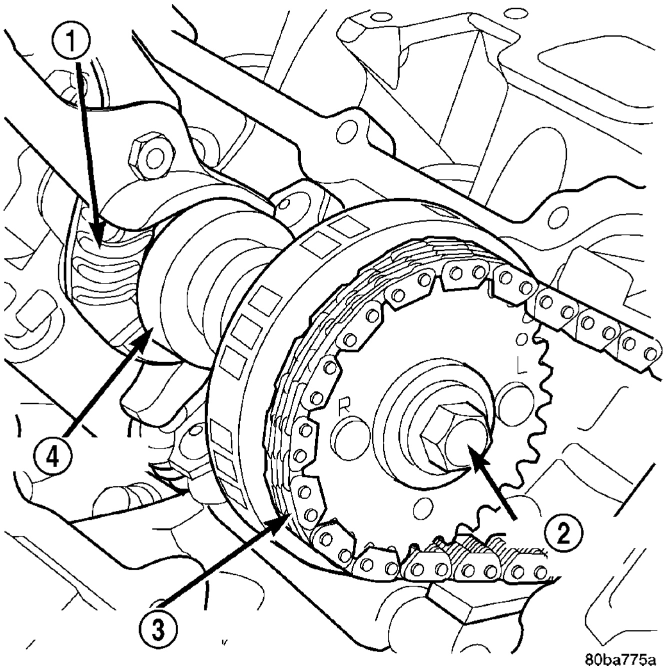


Fig. 34 Camshaft Sprocket and Chain

1 - ADJUSTABLE PLIERS
2 - SPROCKET BOLT
3 - CAMSHAFT SPROCKET AND CHAIN
4 - CAMSHAFT

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 35).

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 36).

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 37).

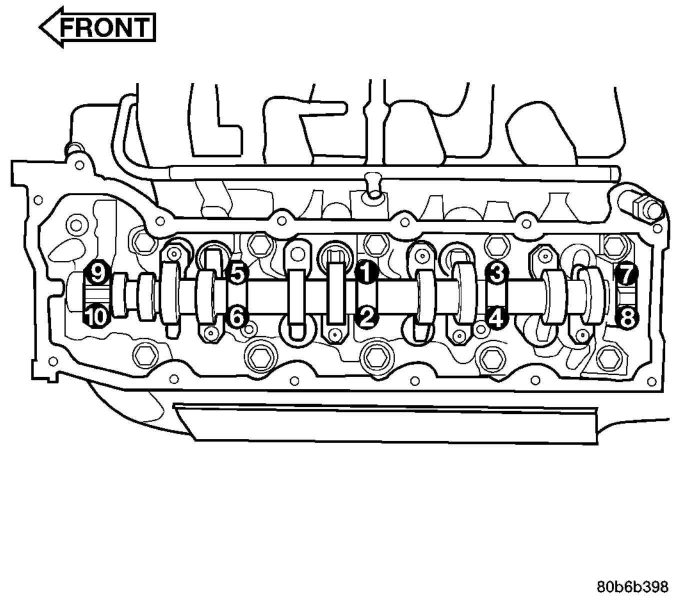


Fig. 35 Camshaft Bearing Caps Tightening Sequence

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt over-torque resulting in bolt failure.

(8) Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove timing chain wedge special tool 8350 (Fig. 32).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 38), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor (Fig. 33).

(12) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

CAMSHAFT(S) - RIGHT (Continued)

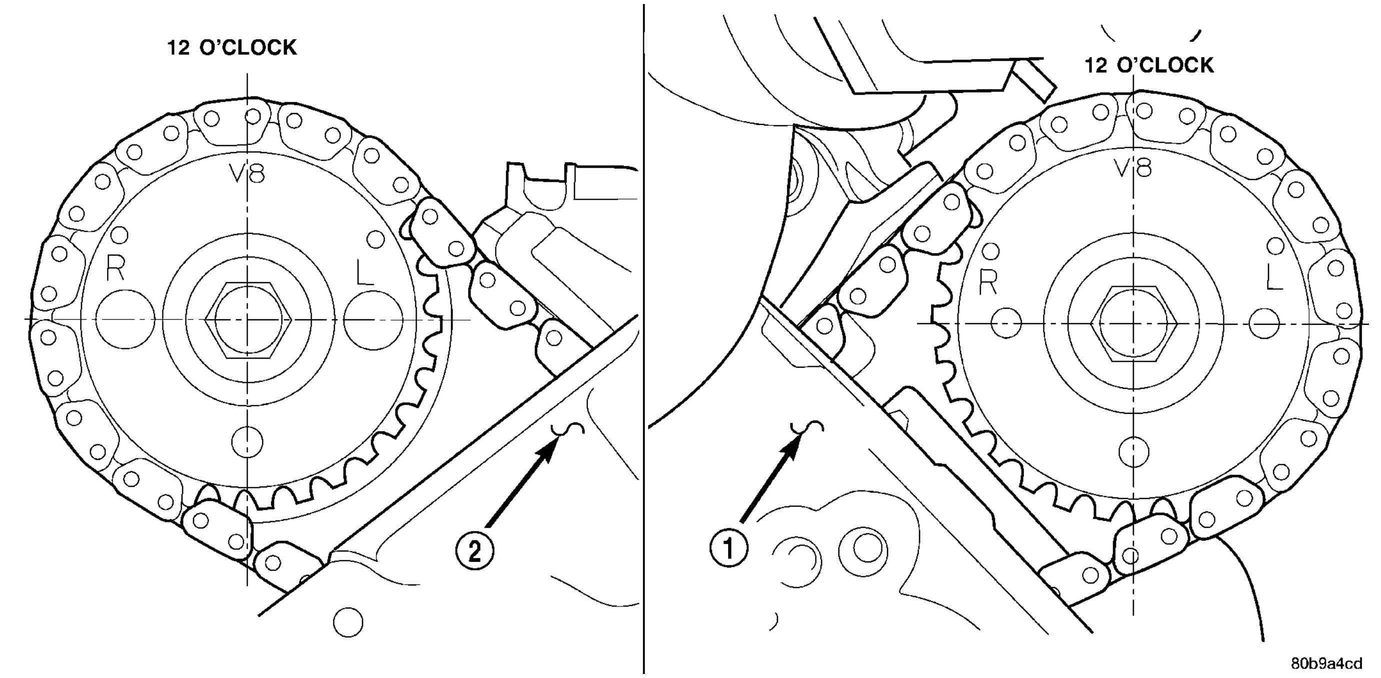


Fig. 36 Timing Chain to Sprocket Alignment

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

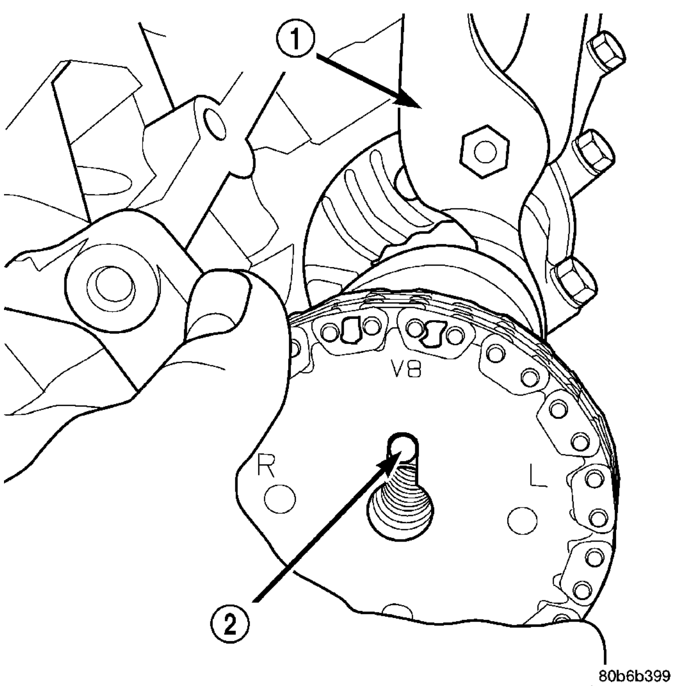


Fig. 37 Camshaft Sprocket Installation

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

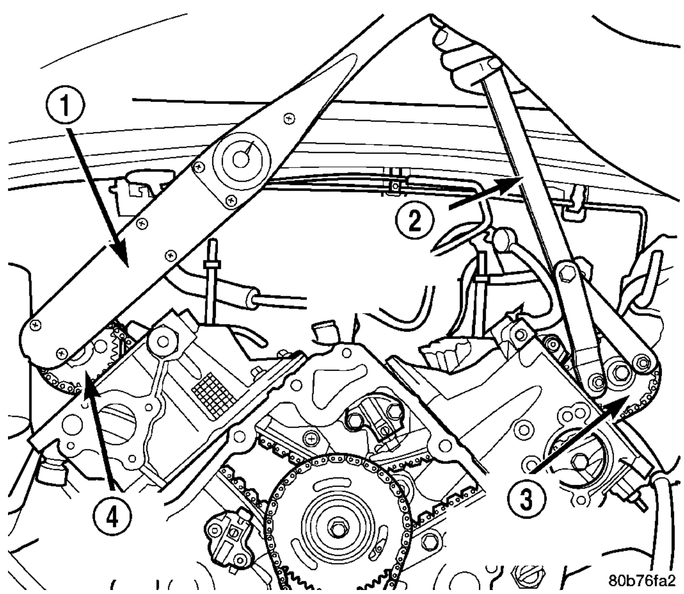


Fig. 38 Tightening Right Side Cam Sprocket Retaining Bolt

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

CYLINDER HEAD COVER(S)

DESCRIPTION

The cylinder head covers are made of die cast magnesium, and are not interchangeable from side-to-side. It is imperative that nothing rest on the cylinder head covers. Prolonged contact with other items may wear a hole in the cylinder head cover.

REMOVAL

REMOVAL - RIGHT SIDE

(1) Disconnect battery negative cable.
(2) Remove air cleaner assembly, resonator assembly and air inlet hose.
(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(4) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(5) Remove air conditioning compressor retaining bolts and move compressor to the left.
(6) Remove heater hoses.
(7) Disconnect injector and ignition coil connectors.
(8) Disconnect and remove positive crankcase ventilation (PCV) hose.
(9) Remove oil fill tube.
(10) Un-clip injector and ignition coil harness and move away from cylinder head cover.
(11) Remove right rear breather tube and filter assembly.
(12) Remove cylinder head cover retaining bolts.
(13) Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

REMOVAL - LEFT SIDE

(1) Disconnect negative cable from battery.
(2) Remove the resonator assemble and air inlet hose.
(3) Disconnect injector connectors and un-clip the injector harness.
(4) Route injector harness in front of cylinder head cover.
(5) Disconnect the left side breather tube and remove the breather tube.
(6) Remove the cylinder head cover mounting bolts.
(7) Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

CLEANING

Clean cylinder head cover gasket surface.
Clean head rail, if necessary.

INSTALLATION

INSTALLATION - RIGHT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location shown in (Fig. 39).

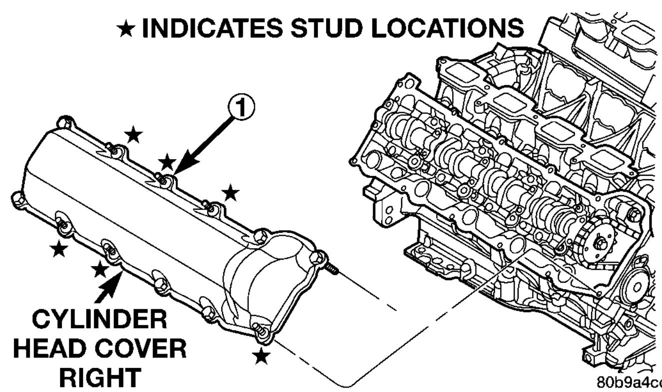


Fig. 39 Cylinder Head Cover—Right

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(4) Install right rear breather tube and filter assembly.
(5) Connect injector, ignition coil electrical connectors and harness retaining clips.
(6) Install the oil fill tube.
(7) Install PCV hose.
(8) Install heater hoses.
(9) Install air conditioning compressor retaining bolts.
(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

CYLINDER HEAD COVER(S) (Continued)

(11) Fill Cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(12) Install air cleaner assembly, resonator assembly and air inlet hose.

(13) Connect battery negative cable.

INSTALLATION—LEFT SIDE

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the cylinder head cover. Prolonged contact with other objects may wear a hole in the engine cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in (Fig. 40).

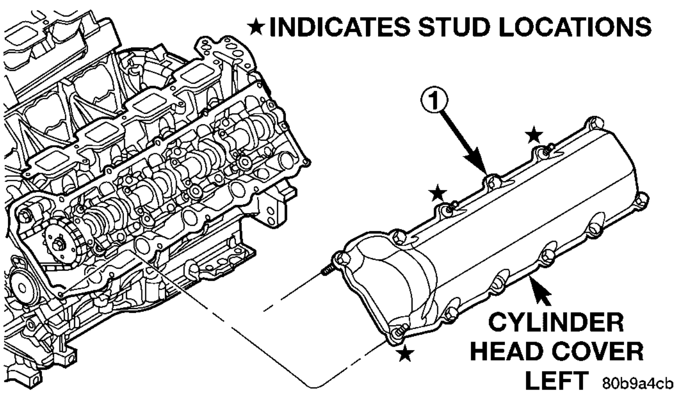


Fig. 40 Cylinder Head Cover—Left

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).

(4) Install left side breather and connect breather tube.

(5) Connect injector electrical connectors and injector harness retaining clips.

(6) Install the resonator and air inlet hose.

(7) Connect negative cable to battery.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

REMOVAL

NOTE: The cylinder heads must be removed in order to perform this procedure.

(1) Remove rocker arms and lash adjusters(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). (Fig. 41).

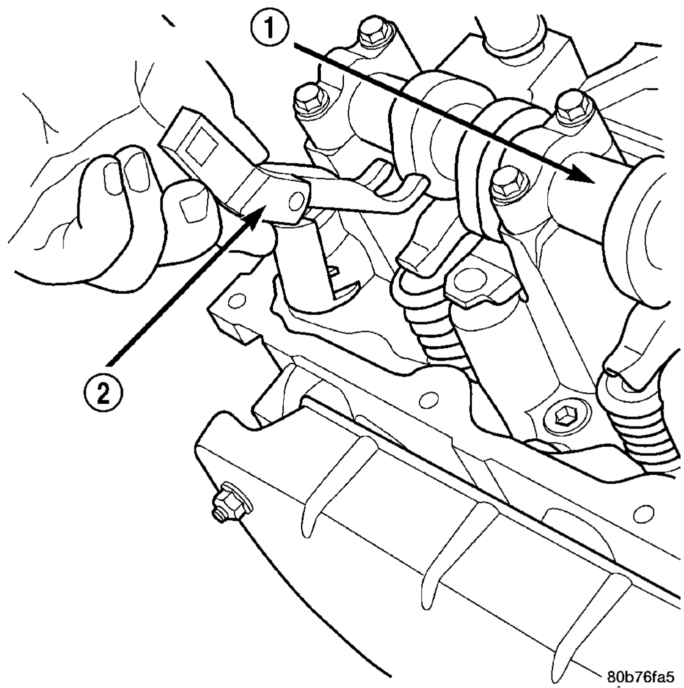


Fig. 41 Rocker Arm Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(2) Remove the camshaft bearing caps and the camshaft.

NOTE: All six valve springs and valves are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422–B or C-3422–C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

INTAKE/EXHAUST VALVES & SEATS (Continued)

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(5) Remove the valve spring compressor.
(6) Remove the spring retainer, and the spring.

NOTE: Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

NOTE: The valve stem seals are common between intake and exhaust.

(8) Remove the valve stem seal. Mark the valve for proper installation.

TESTING VALVE SPRINGS

NOTE: Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.12 mm (1.579 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until Ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications (Fig. 42).

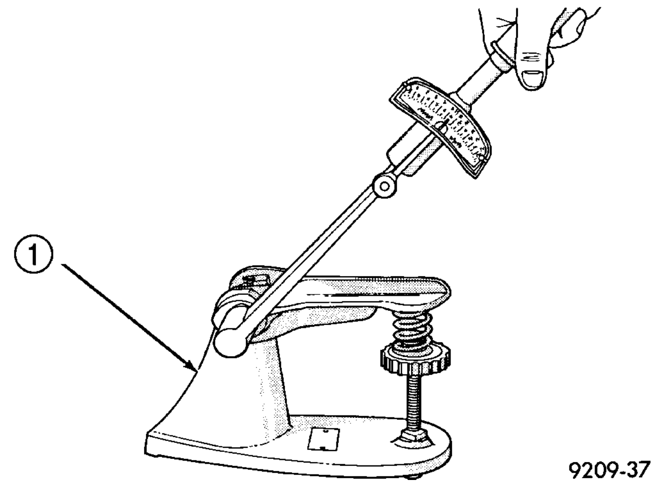


Fig. 42 Testing Valve Springs

1 - SPECIAL TOOL C-647

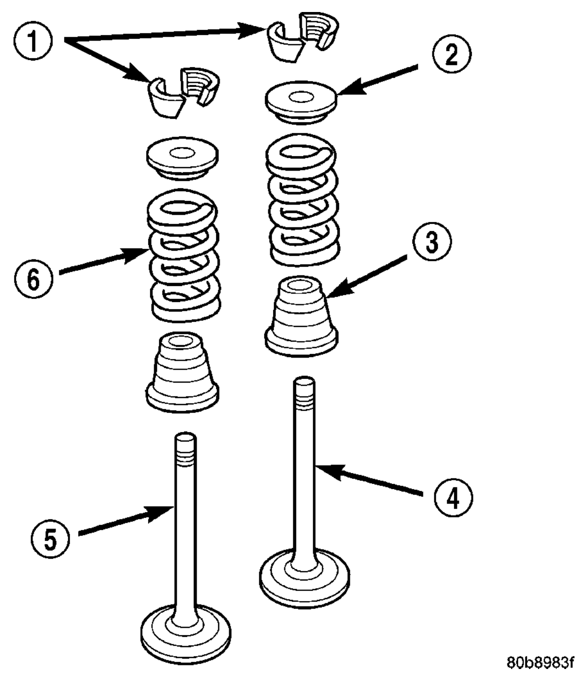


Fig. 43 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

INSTALLATION

(1) coat the valve stem with clean engine oil and insert it into the cylinder head.
(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.
(3) Install the spring and the spring retainer (Fig. 43).
(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.
(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.
(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

INTAKE/EXHAUST VALVES & SEATS (Continued)

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9–13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 44).

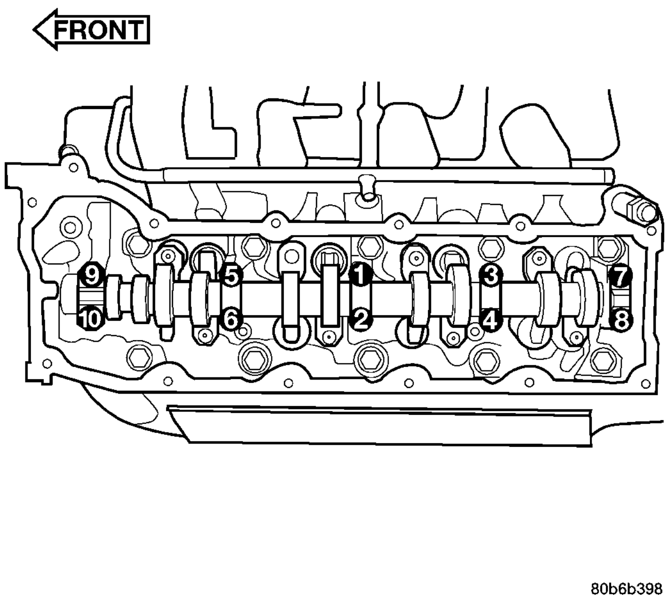


Fig. 44 Camshaft Bearing Caps Tightening Sequence

(8) Position the hydraulic lash adjusters and rocker arms.

ROCKER ARM / ADJUSTER ASSEMBLY

DESCRIPTION

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) Turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Oil leak or excessive cam bore wear in cylinder head.

(11) Faulty lash adjuster.

a. Check lash adjusters for sponginess while installed in cylinder head and cam on camshaft at base circle. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

b. Remove suspected lash adjusters, and replace.

c. Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(3) For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(4) For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(5) For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(6) Using special tool 8516 Rocker Arm Remover, press downward on the valve spring, remove rocker arm (Fig. 45).

INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

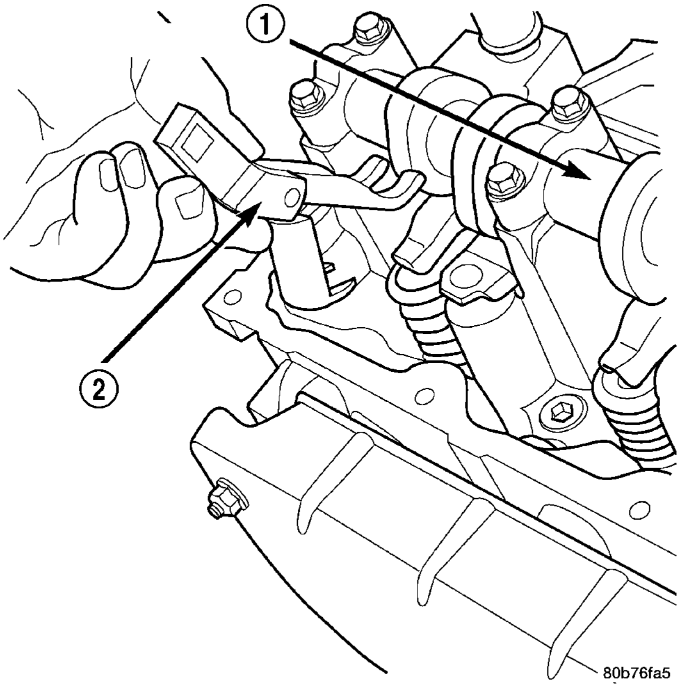


Fig. 45 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(4) For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 45).

(6) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE SPRINGS

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

REMOVAL

(1) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using Special Tool 8516 Rocker Arm Remover, remove the rocker arms and the hydraulic lash adjusters (Fig. 46).

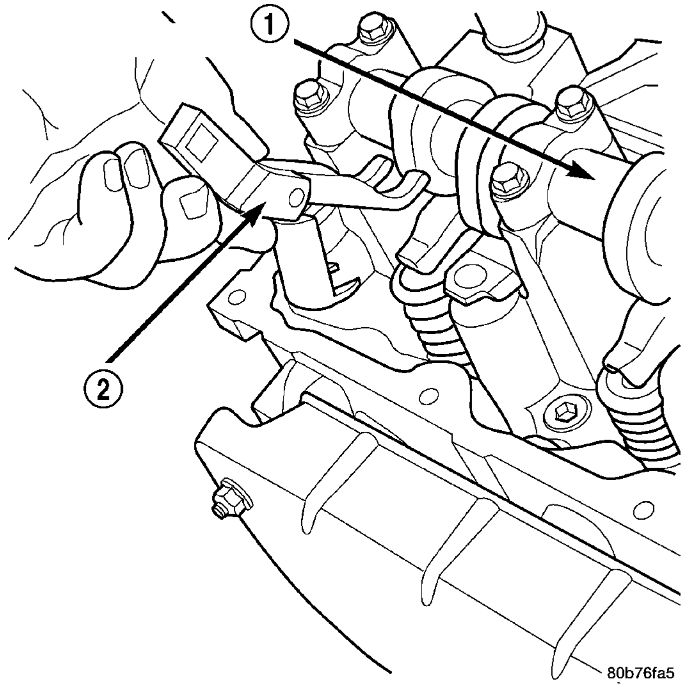


Fig. 46 Rocker Arm—Removal

1 - CAMSHAFT
2 - SPECIAL TOOL 8516

(3) Remove the spark plug for the cylinder the valve spring and seal are to be removed from.

(4) Apply shop air to the cylinder to hold the valves in place when the spring is removed

(5) Remove the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - REMOVAL).

NOTE: All eight valve springs and seals are removed in the same manner; this procedure only covers one valve seal and valve spring.

(6) Using Special Tool 8387 Valve Spring Compressor, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(7) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(8) Remove the valve spring compressor.

VALVE SPRINGS (Continued)

(9) Remove the spring retainer, and the spring.
(10) Remove the valve stem seal.

NOTE: The valve stem seals are common between intake and exhaust.

INSTALLATION

(1) coat the valve stem with clean engine oil and install the valve stem seal. Make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(2) Install the spring and the spring retainer (Fig. 47).

(3) Using Special Tool 8387 Valve Spring Compressor, compress the spring and install the two valve spring retainer halves.

(4) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

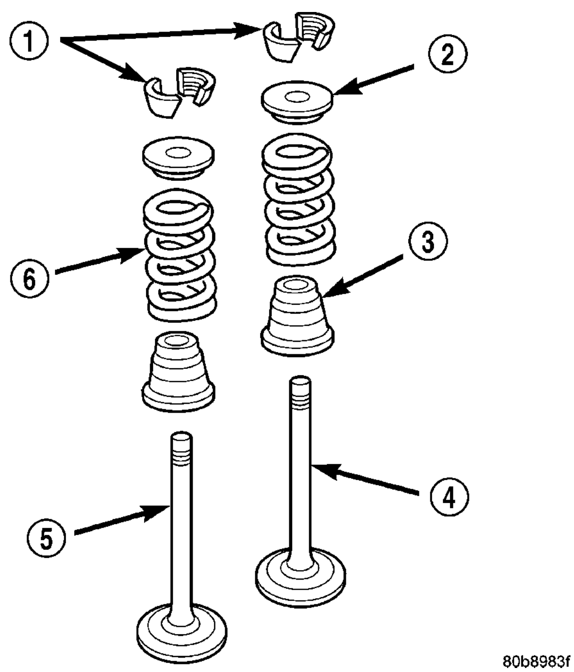


Fig. 47 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

(5) Install the camshaft (Refer to 9 - ENGINE/CYLINDER HEAD/CAMSHAFT(S) - INSTALLATION).

(6) Position the hydraulic lash adjusters and rocker arms (Fig. 46).

(7) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE STEM SEALS

DESCRIPTION

The valve stem seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant bypass to a single poppet inlet thermostat is included in the cast aluminum front cover.

STANDARD PROCEDURE—CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

ENGINE BLOCK (Continued)

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 48).

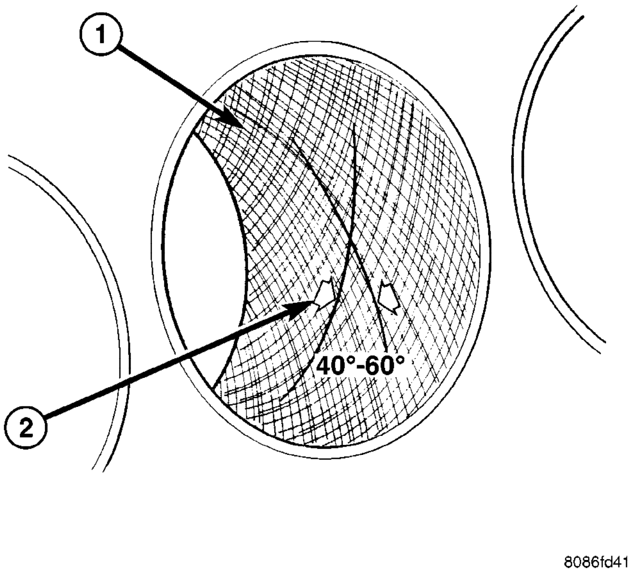


Fig. 48 CYLINDER BORE CROSSHATCH PATTERN

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper cross-hatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the cross-hatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and deter-gent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Thoroughly clean the oil pan and engine block gas-ket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the 1/4 inch NPT plugs to 20 N·m (177 in. lbs.) torque. Tighten the 3/8 inch NPT plugs to 27 N·m (240 in. lbs.) torque.

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCRE-MENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 49).

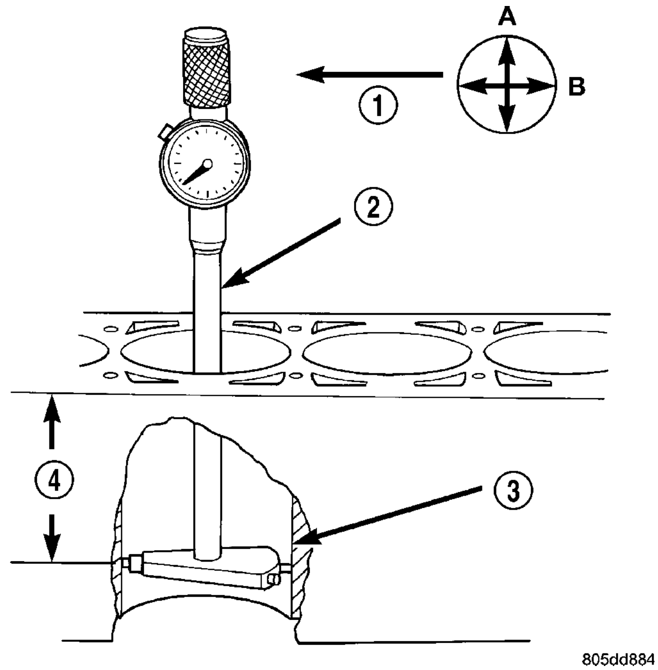


Fig. 49 BORE GAUGE-TYPICAL

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM (1.5 in)

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpen-dicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 50). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 51). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

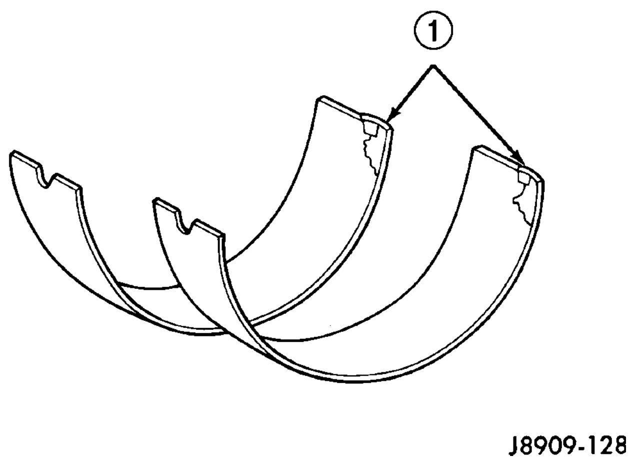


Fig. 50 Locking Tab Inspection

1 - ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

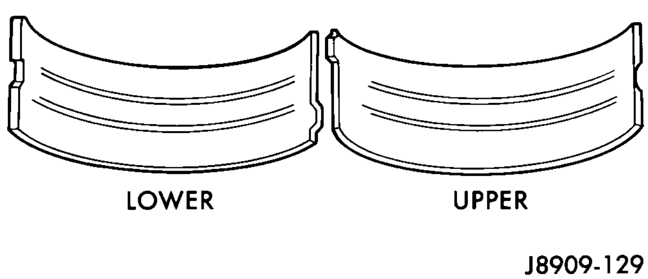


Fig. 51 Scoring Caused by Insufficient Lubrication or Damaged Crankshaft Journal

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

(1) Wipe the oil from the connecting rod journal.

(2) Lubricate the upper bearing insert and install in connecting rod.

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 52) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

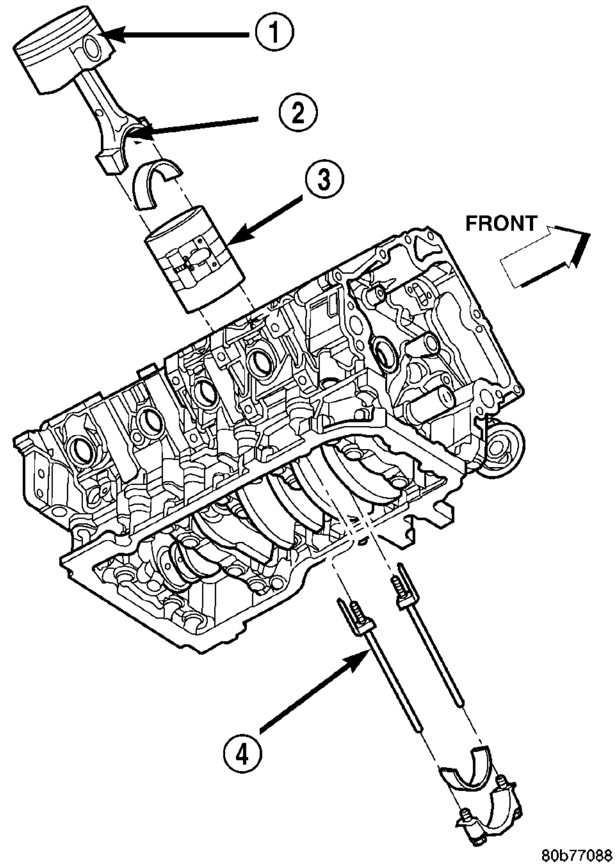


Fig. 52 Piston and Connecting Rod - Installation

1 - “F” TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

(4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 53). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a**

CONNECTING ROD BEARINGS (Continued)

tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.

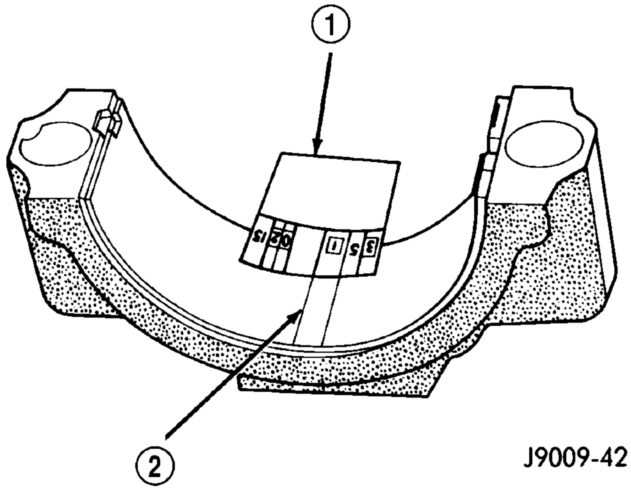


Fig. 53 Measuring Bearing Clearance with Plastigage

1 - PLASTIGAGE SCALE
2 - COMPRESSED PLASTIGAGE

(7) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(8) If bearing-to-journal clearance exceeds the specification, determin which services bearing set to use the bearing sizes are as follows:

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.)	50.758-50.742 mm (1.9984-1.9978 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 54). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

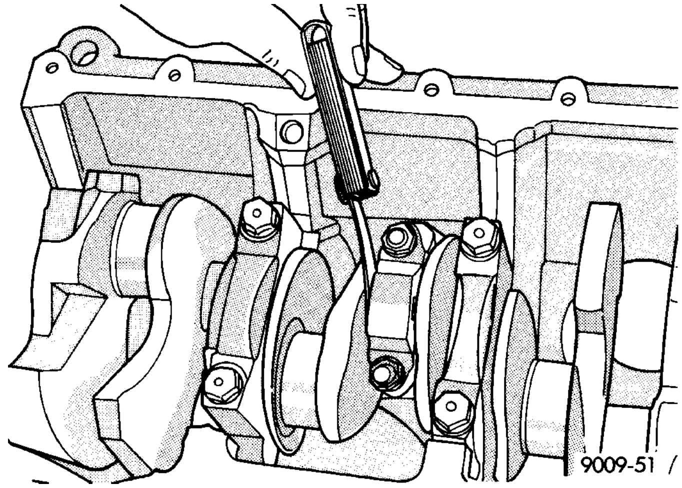


Fig. 54 Checking Connecting Rod Side Clearance - Typical

CORE PLUGS

REMOVAL

(1) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(2) Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (Fig. 55)

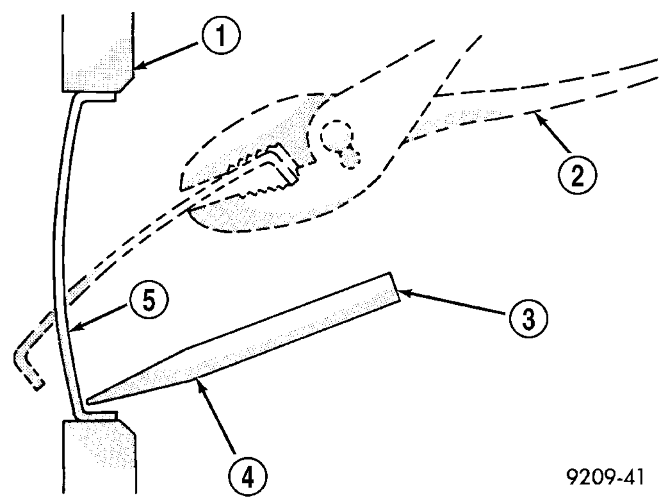


Fig. 55 Engine Core Plug Removal

1 - CYLINDER BLOCK
2 - REMOVE PLUG WITH PLIERS
3 - STRIKE HERE WITH HAMMER
4 - DRIFT PUNCH
5 - CUP PLUG

(3) Using a suitable pair of pliers, grasp the core plug and remove.

CORE PLUGS (Continued)

INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

(1) Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

(2) Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.

(3) Refill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by five select fit main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number eight counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

(1) Remove the engine. (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the engine oil pump.(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

(3) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.

(6) Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are on both the left and right sides, only the left side is shown.

(7) Carefully pry on the pry points (Fig. 56) to loosen the bedplate then remove the bedplate.

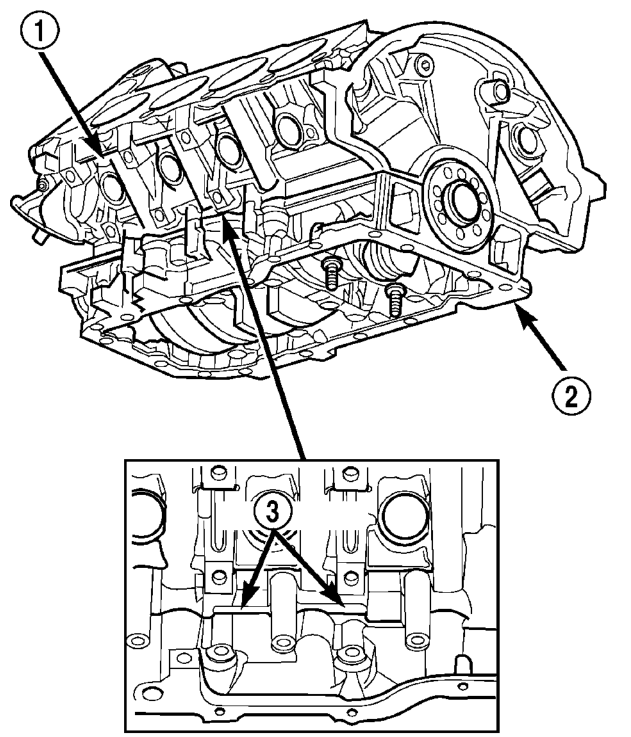


Fig. 56 Bedplate Pry Point Location

1 - CYLINDER BLOCK
2 - BEDPLATE
3 - PRY POINT

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

(8) Remove the crankshaft.

(9) Remove the crankshaft target wheel.

CRANKSHAFT (Continued)

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washers for scoring, scratches, wear or blueing. If either condition exist replace the thrust washer.

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) for proper bearing selections.

(1) Lubricate upper main bearing halves with clean engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the target wheel retaining screws prior to installation.

(2) Install the crankshaft target wheel. Torque the mounting screws to 15 N·m (12 ft. lbs.).

(3) Position crankshaft in cylinder block.

(4) Install the thrust washers (Fig. 57).

CAUTION: The bedplate to cylinder block mateing surface must be coated with sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

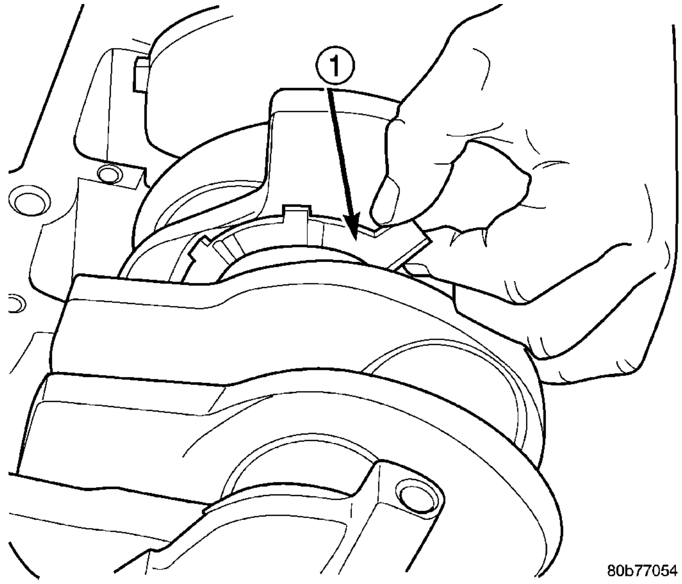


Fig. 57 Crankshaft Thrust Washer Installation

1 - CRANKSHAFT THRUST WASHER

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

(5) Apply a 2.5mm (0.100 inch) (Fig. 58) bead of Mopar® Gen II Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 59).

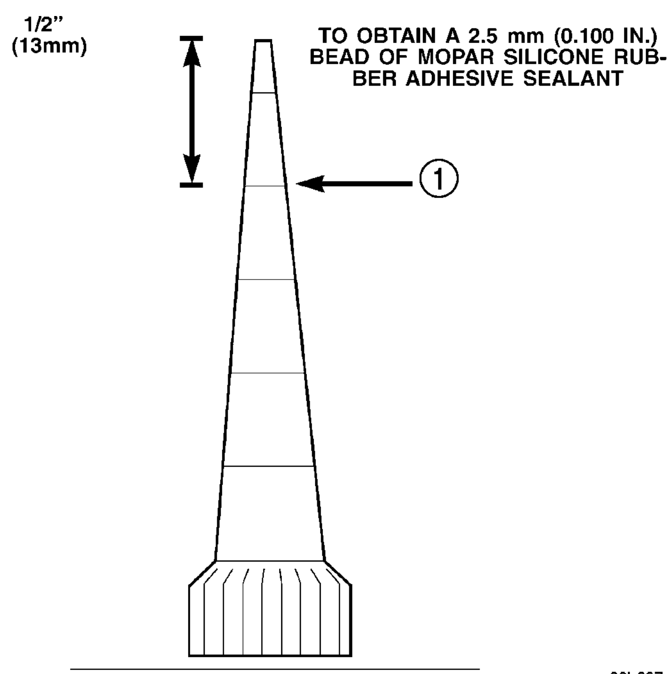


Fig. 58 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

1 - CUT HERE

CRANKSHAFT (Continued)

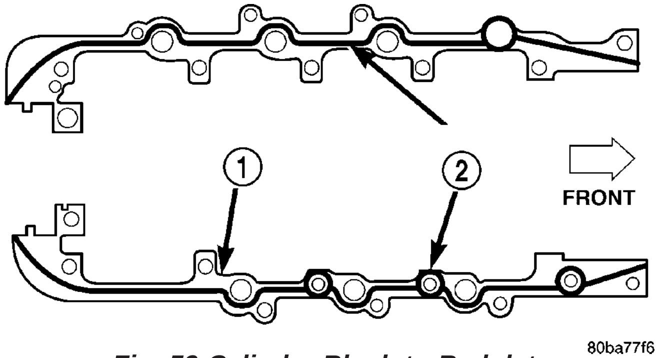


Fig. 59 Cylinder Block-to-Bedplate Sealent Bead Location

1 - CYLINDER BLOCK
2 - SEALANT BEAD LOCATION

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 60).

- Tighten bolts **A – L** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
- Turn bolts **1–10** an additional 90°.
- Tighten bolts **A1– A6** to 27 N·m (20 ft. lbs.)

(8) Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE).

(9) Install the connecting rods and measure side clearance. (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 61).

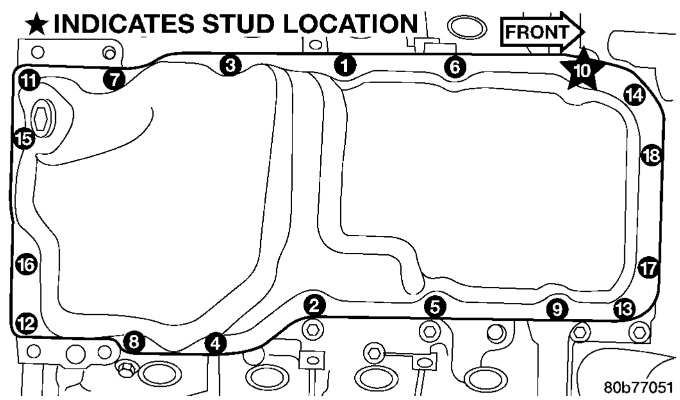


Fig. 61 Oil Pan Tightening Sequence

(12) Install the engine (Refer to 9 - ENGINE - INSTALLATION).

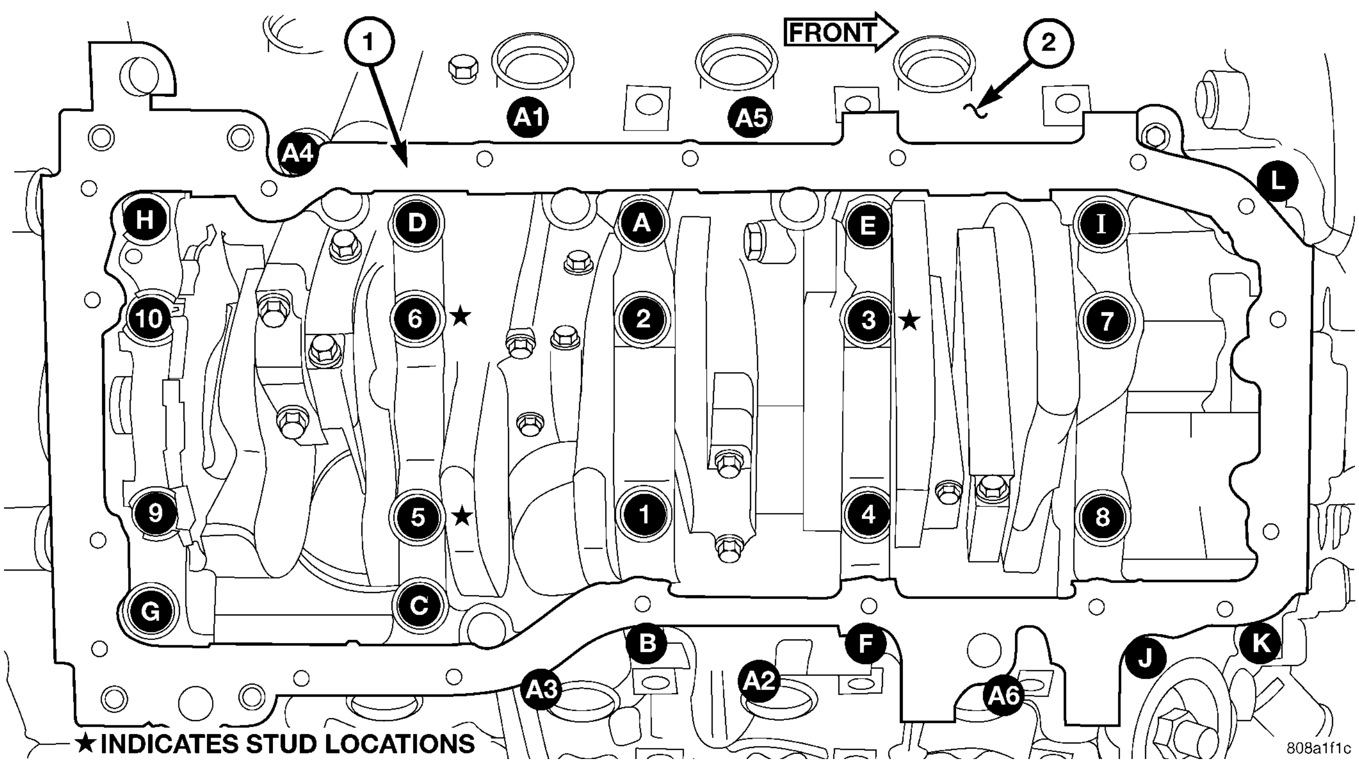


Fig. 60 Bedplate Tightening Sequence

1 - BEDPLATE
2 - CYLINDER BLOCK

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed from the cylinder block.

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 62). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

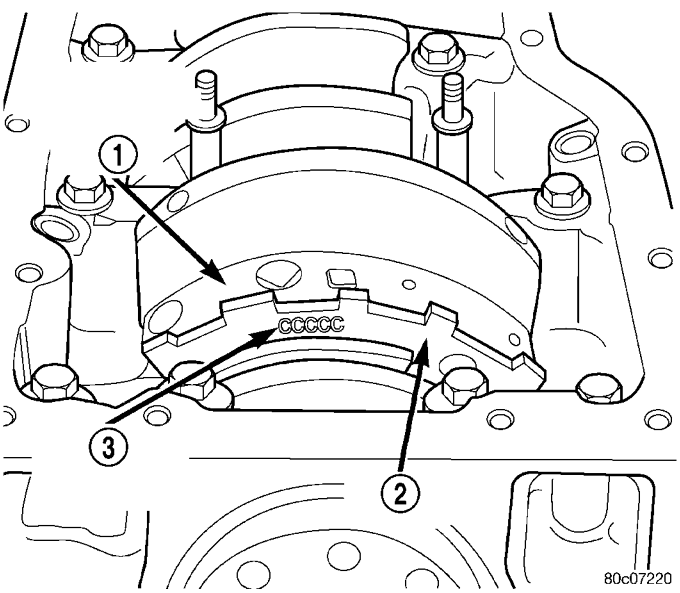


Fig. 62 Main Bearing Markings on Target Wheel

1 - REARMOST CRANKSHAFT COUNTER WEIGHT
2 - TARGET WHEEL
3 - MAIN BEARING SELECT FIT MARKINGS

NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

MAIN BEARING SELECTION CHART—4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm O/S (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 63).

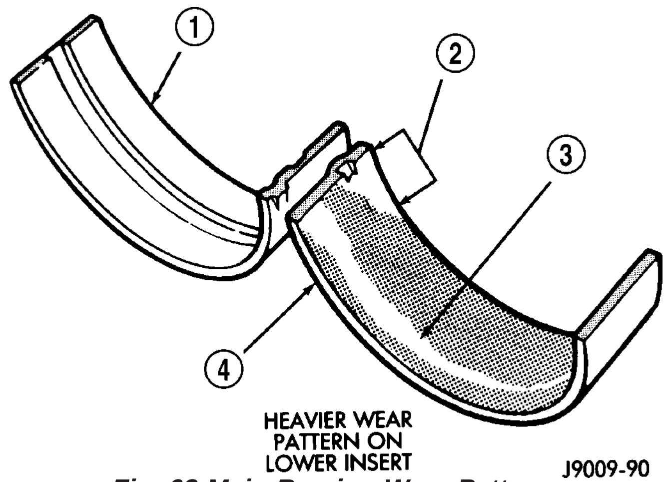


Fig. 63 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Remove A/C compressor mouning fasteners and set aside.

(4) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Remove upper radiator hose.

(6) Disconnect electrical connector for fan mounted inside radiator shroud.

(7) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(8) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 64).

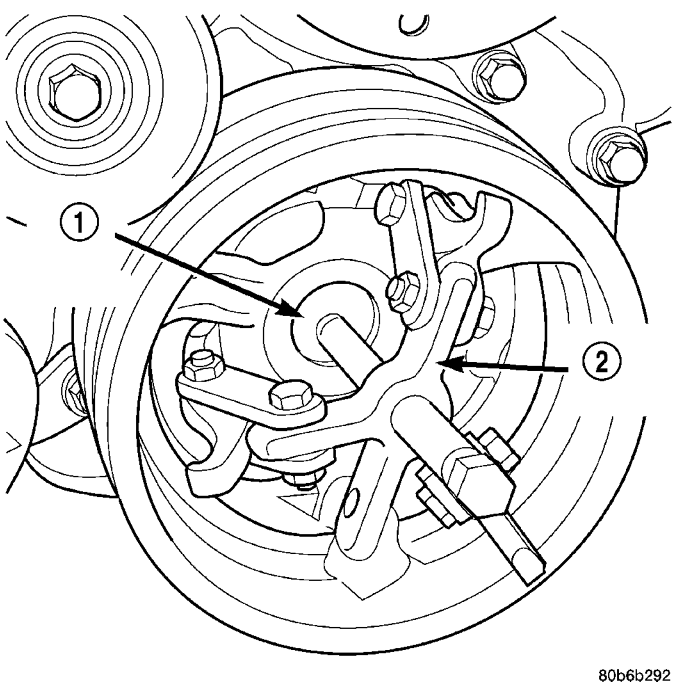


Fig. 64 Crankshaft Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

(11) Using Special Tool 8511, remove crankshaft front seal (Fig. 65).

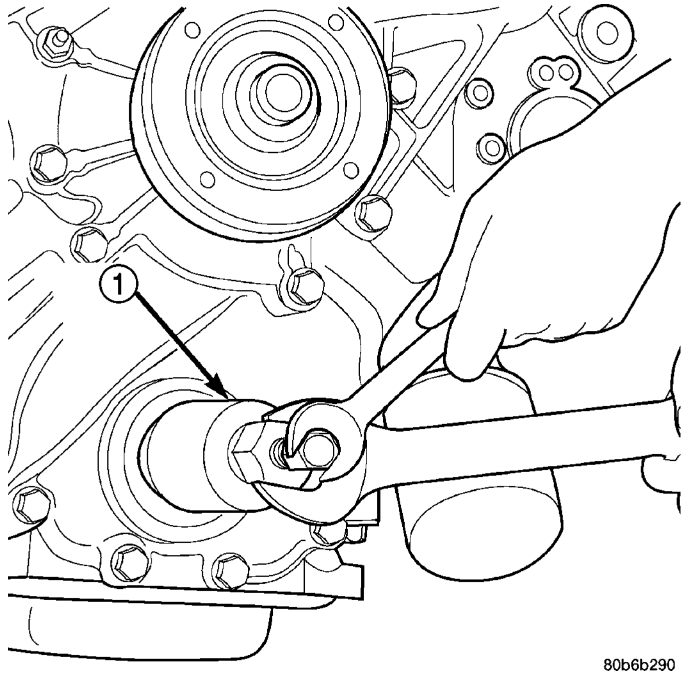


Fig. 65 Crankshaft Front Seal Removal

1 - SPECIAL TOOL 8511

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 66).

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(6) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Connect negative cable to battery.

CRANKSHAFT OIL SEAL - FRONT (Continued)

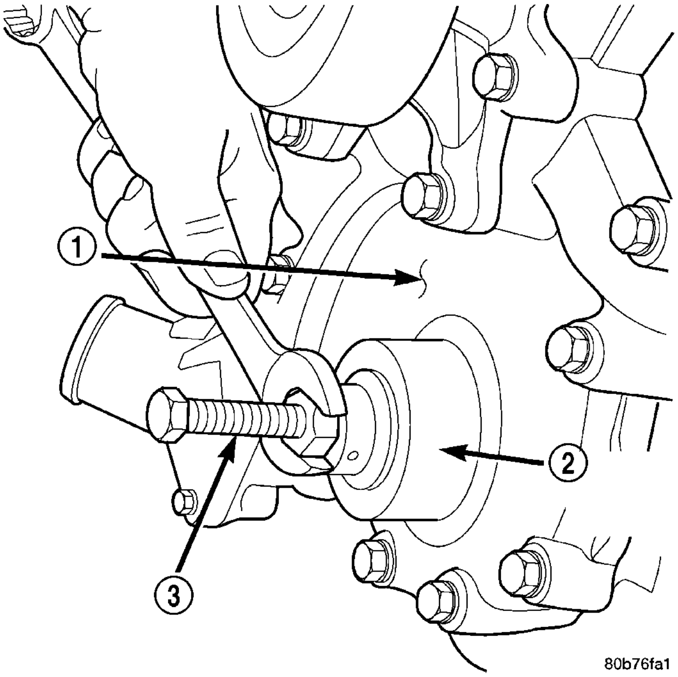


Fig. 66 Crankshaft Front Seal Installation

1 - TIMING CHAIN COVER
2 - SPECIAL TOOL 8348
3 - SPECIAL TOOL 8512

CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.

(4) If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

CRANKSHAFT OIL SEAL - REAR (Continued)

(3) Using Special Tool 8506 (Fig. 67), remove the crankshaft rear oil seal.

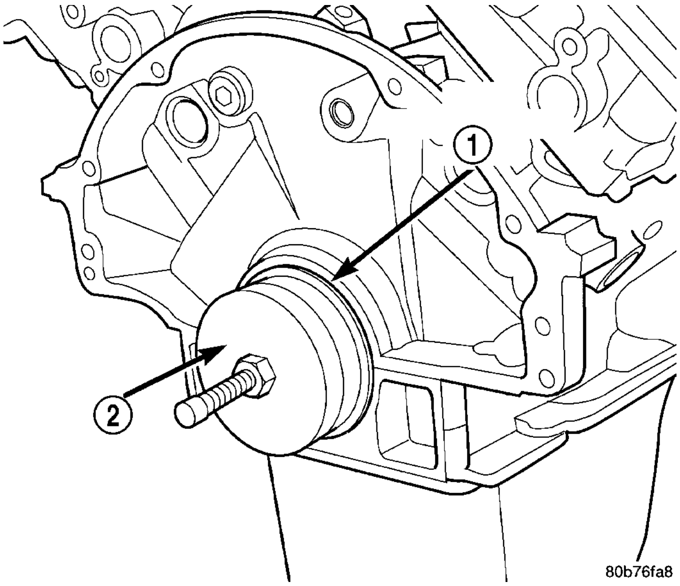


Fig. 67 Crankshaft Rear Oil Seal Removal

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8506

INSTALLATION

(1) Lubricate the crankshaft flange with engine oil.

(2) Position the magnetic seal guide Special Tool 8349–2 (Fig. 68) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

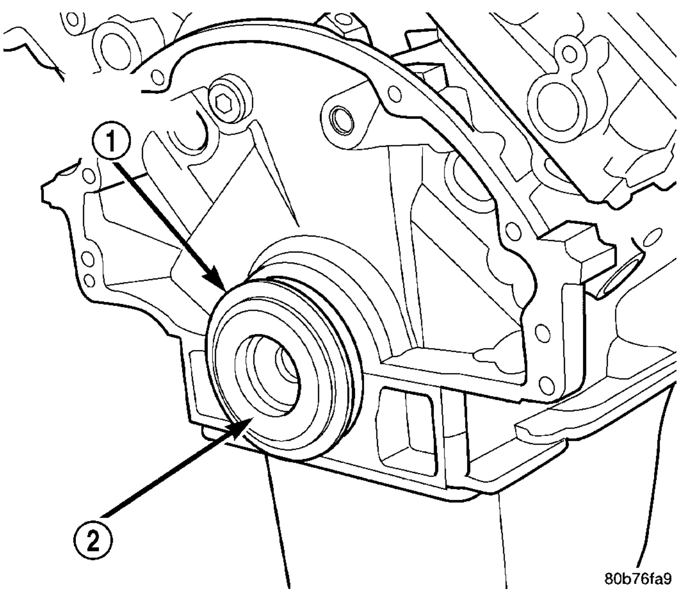


Fig. 68 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–2 GUIDE

(3) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 69), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

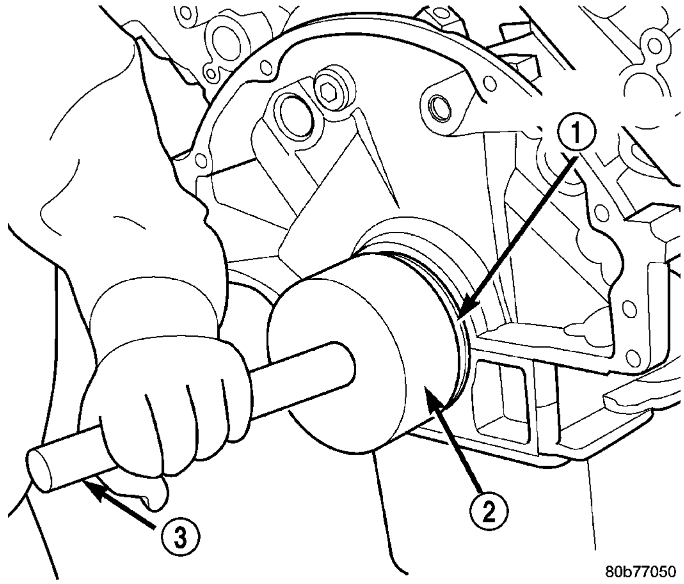


Fig. 69 Crankshaft Rear Oil Seal Installation

1 - REAR CRANKSHAFT SEAL
2 - SPECIAL TOOL 8349–1 INSTALLER
3 - SPECIAL TOOL C-4171 HANDLE

(4) Install the flexplate.

(5) Install the transmission.

FLEX PLATE

REMOVAL

(1) Remove the transmission.
(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.
(2) Tighten the flexplate retaining bolts to 60 N·m (45 ft. lbs.) in the sequence shown (Fig. 70).
(3) Install the transmission.

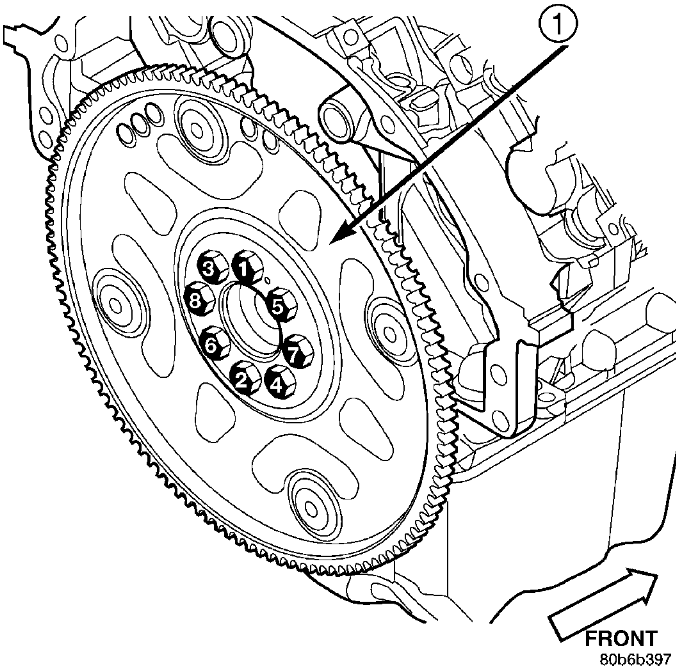


Fig. 70 Flexplate Tightening Sequence

1 - FLEXPLATE

PISTON & CONNECTING ROD

DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. The anodized top ring groove and crown has been replaced with a coated top ring that is blue in color on the bottom surface. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of forged powdered metal, with a "fractured cap" design. A pressed fit piston pin is used to attach the piston and connecting rod.

STANDARD PROCEDURE—PISTON FITTING

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.
(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 72).
(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.
(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 71). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.
(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

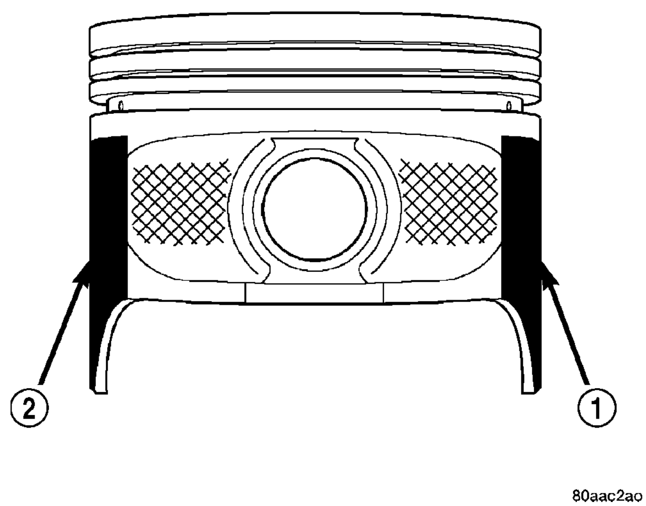


Fig. 71 DO NOT MEASURE MOLY COATED PISTON

1 - MOLY COATED
2 - MOLY COATED

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the following components:
• Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
• Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) -

PISTON & CONNECTING ROD (Continued)

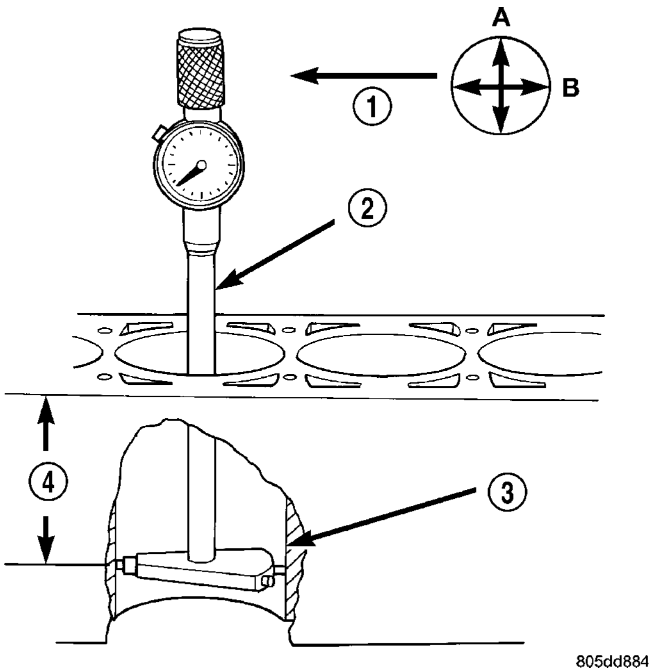


Fig. 72 BORE GAUGE -TYPICAL

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM
(1.5 in)

REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

- Timing chain cover (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
- Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/ CYLINDER HEAD - REMOVAL).

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 73).

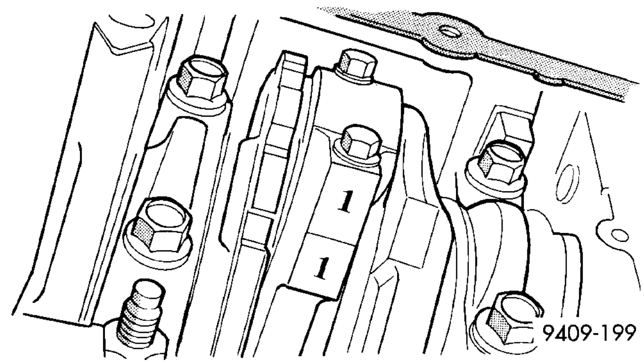


Fig. 73 Identify Connecting Rod to Cylinder Position—Typical

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

PISTON & CONNECTING ROD (Continued)

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings.

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 74).

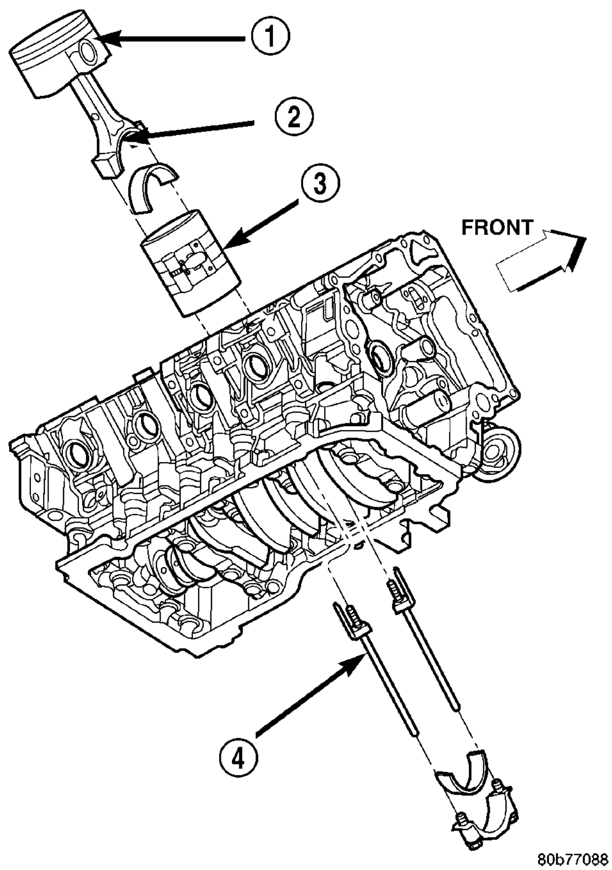


Fig. 74 PISTON AND CONNECTING ROD INSTALLATION

1 - “F” TOWARD FRONT OF ENGINE
2 - OIL SLINGER SLOT
3 - RING COMPRESSOR
4 - SPECIAL TOOL 8507

(5) The pistons are marked on the piston pin bore surface with an raised “F” indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine (Fig. 75).

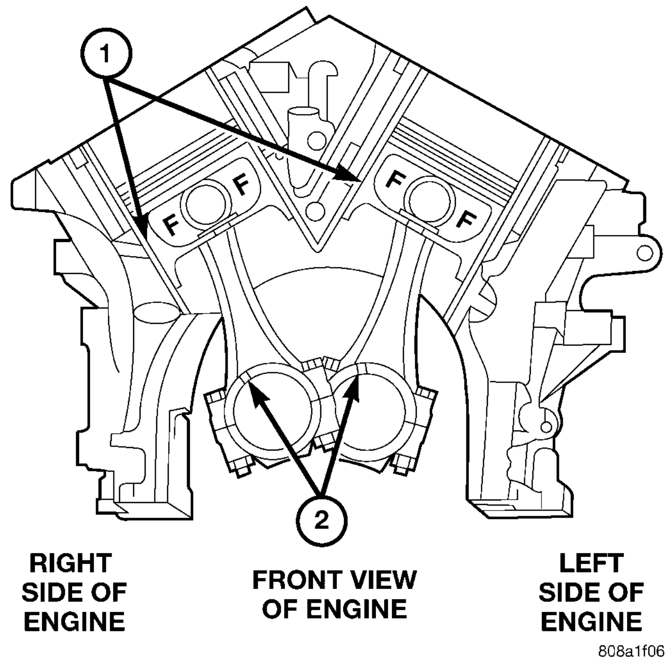


Fig. 75 PISTON AND CONNECTING ROD ORIENTATION

1 - MAJOR THRUST SIDE OF PISTON
2 - OIL SLINGER SLOT

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

(8) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.

(10) Install the following components:

- Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).
- Timing chain and cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

PISTON & CONNECTING ROD (Continued)

• Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

• Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Fill crankcase with proper engine oil to correct level.

(12) Connect negative cable to battery.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 76). Replace any rings not within specification.

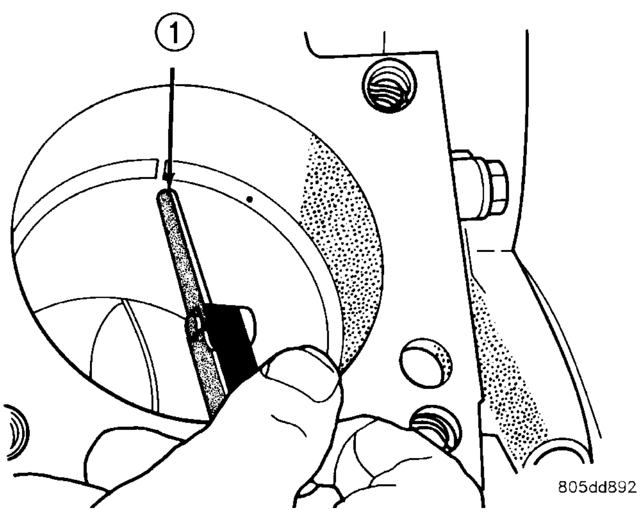


Fig. 76 Ring End Gap Measurement - Typical

1 - FEELER GAUGE

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 77)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

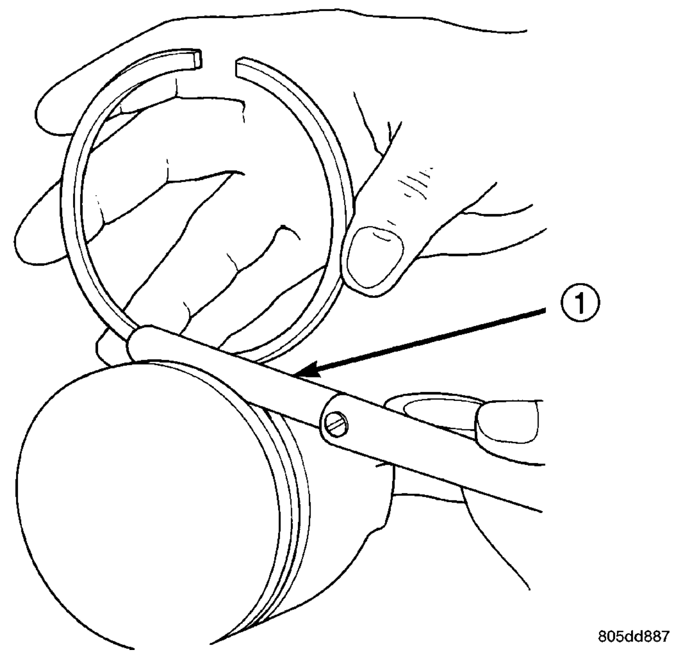


Fig. 77 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RINGS (Continued)

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020- .0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.20-0.36mm (0.0079-0.0142 in.)	0.43mm (0.0017 in.)
Intermediate Ring	0.37-0.63mm (0.0146-0.0249 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.0099- 0.03 in.)	1.55mm (0.061 in.)

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:
- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 78) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 79).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 79).

(12) Position piston ring end gaps as shown in (Fig. 80). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

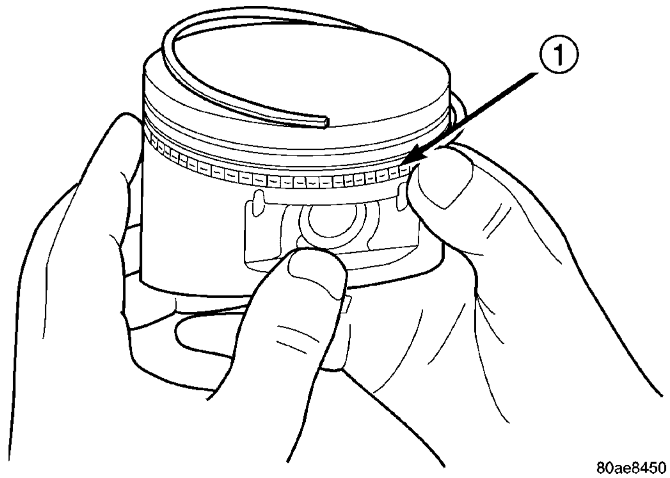


Fig. 78 Side Rail—Installation

1 - SIDE RAIL END

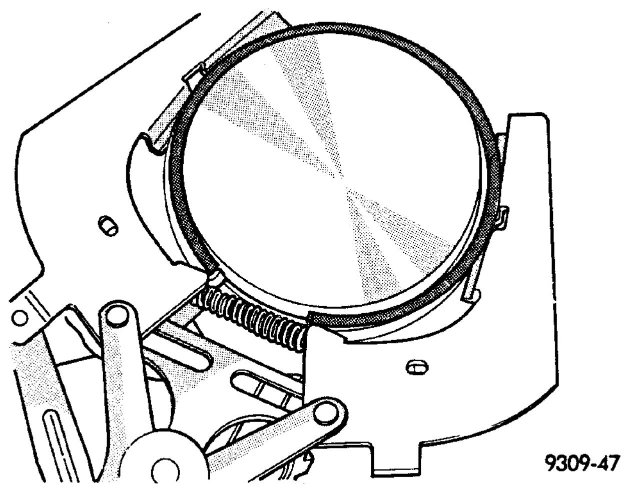


Fig. 79 Upper and Intermediate Rings—Installation

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 81).

(7) Remove fan and viscous assembly.

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

VIBRATION DAMPER (Continued)

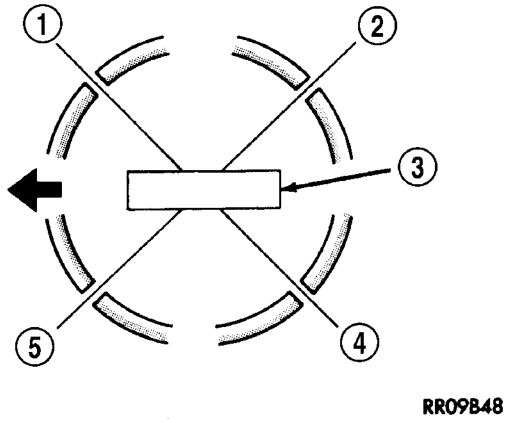


Fig. 80 Piston Ring End Gap Position

1 - SIDE RAIL UPPER
2 - NO. 1 RING GAP
3 - PISTON PIN
4 - SIDE RAIL LOWER
5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

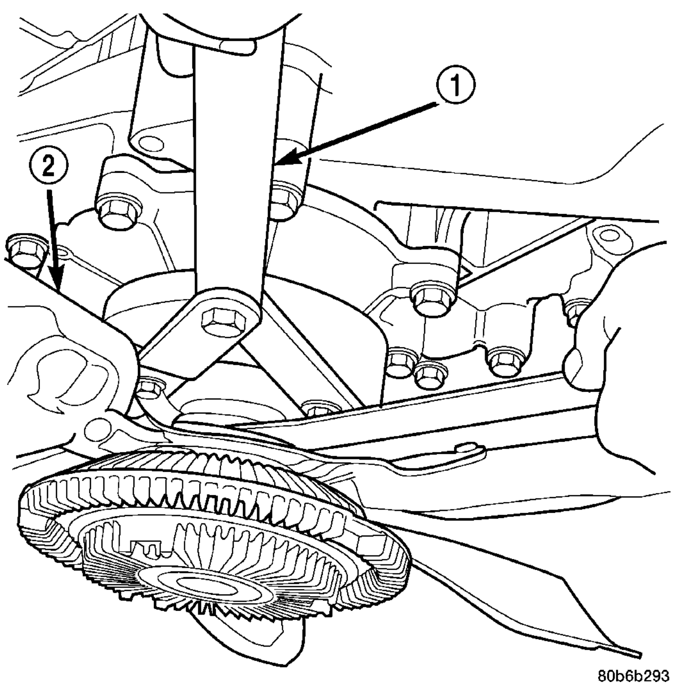


Fig. 81 FAN ASSEMBLY-REMOVAL/ASSEMBLY

1 - SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 - FAN

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 82).

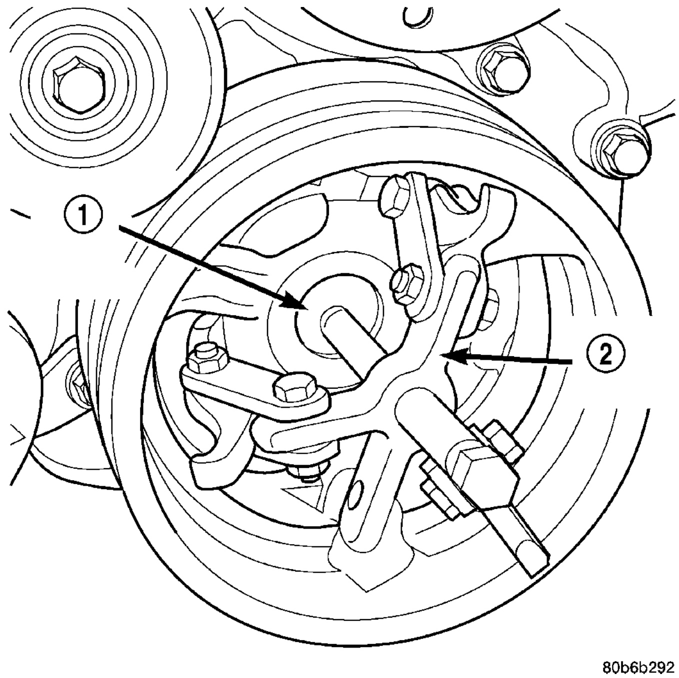


Fig. 82 CRANKSHAFT DAMPER-REMOVAL

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512–A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512–A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

(2) Assemble Special Tool 8512–A as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 83). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

(3) Using Special Tool 8512–A, press damper onto crankshaft (Fig. 84).

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

VIBRATION DAMPER (Continued)

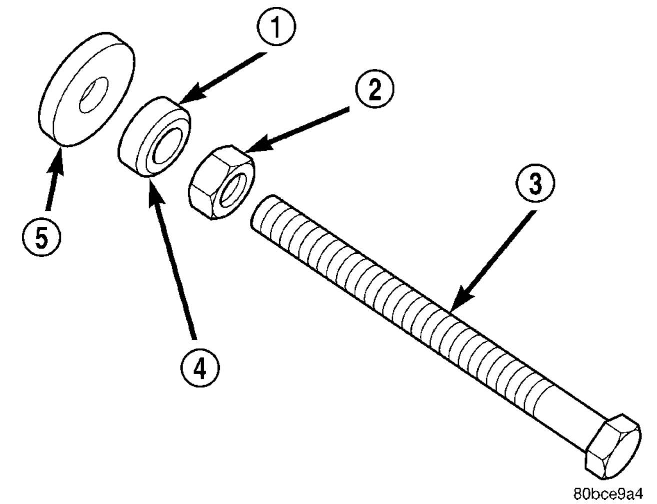


Fig. 83 PROPER ASSEMBLY METHOD FOR SPECIAL TOOL 8512–A

1 - BEARING
2 - NUT
3 - THREADED ROD
4 - BEARING HARDENED SURFACE (FACING NUT)
5 - HARDENED WASHER

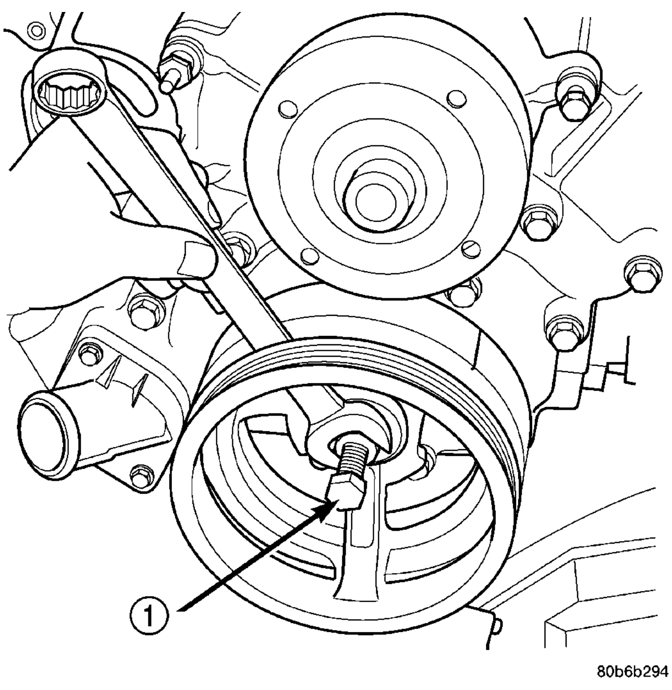


Fig. 84 Crankshaft Damper Installation

1 - SPECIAL TOOL 8512

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect negative cable to battery.

STRUCTURAL COVER

DESCRIPTION

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 85) in the sequence shown.

(5) Pivot the exhaust pipe downward and remove the structural cover.

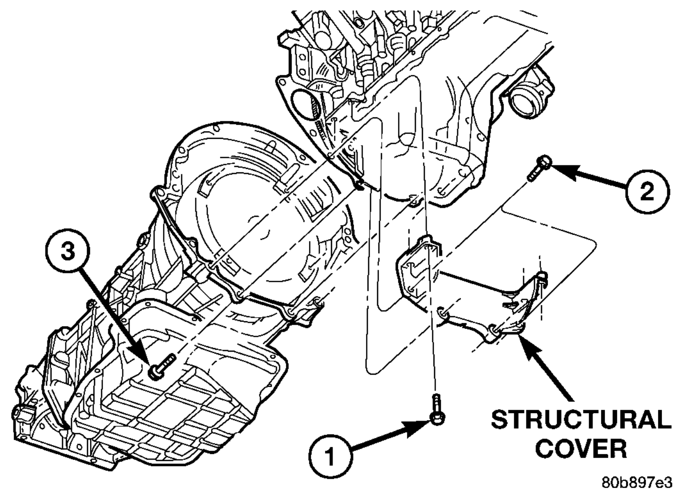


Fig. 85 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

STRUCTURAL COVER (Continued)

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 86) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 86) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

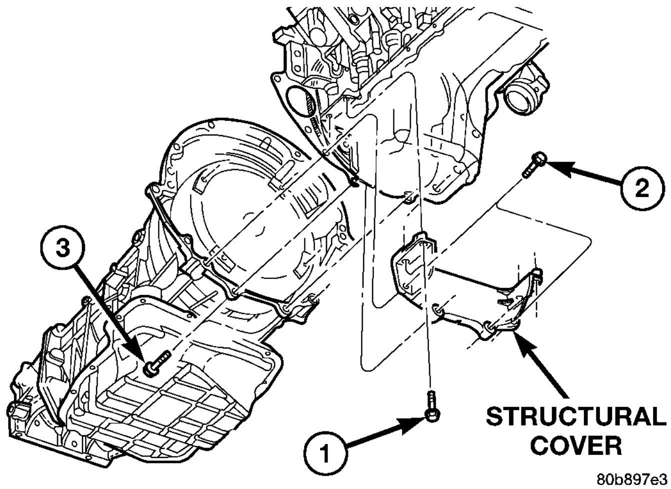


Fig. 86 Structural Cover

1 - BOLT
2 - BOLT
3 - BOLT

(5) Install the exhaust pipe on left hand exhaust manifold.
(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the engine oil filter.
(5) Remove the oil drain trough.
(6) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(7) Support the front axle with a suitable jack.
(8) Remove the (4) bolts that attach the engine mounts to the front axle.
(9) Remove the (3) bolts that attach the front axle to the left engine bracket.
(10) Lower the front axle.
(11) Remove the through bolts
(12) Raise the engine far enough to be able to remove the left and right engine mounts.
(13) Remove the (8) mount to engine attaching bolts
(14) Remove the engine mounts.

4WD

(1) Disconnect the negative cable from the battery.
(2) Remove the viscous fan.
(3) Raise the vehicle.
(4) Remove the skid plate.
(5) Remove the front crossmember.
(6) Remove the engine oil filter.
(7) Remove the oil drain trough.
(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(9) Support the front axle with a suitable jack.
(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 87).
(11) Remove the (3) bolts that attach the front axle to the left engine bracket.
(12) Lower the front axle.
(13) Remove the (6) through bolts
(14) Raise the engine far enough to be able to remove the left (Fig. 89) and right (Fig. 88) engine mounts.
(15) Remove the engine mounts.

INSTALLATION

2WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).
(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.
(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.
(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).

FRONT MOUNT (Continued)

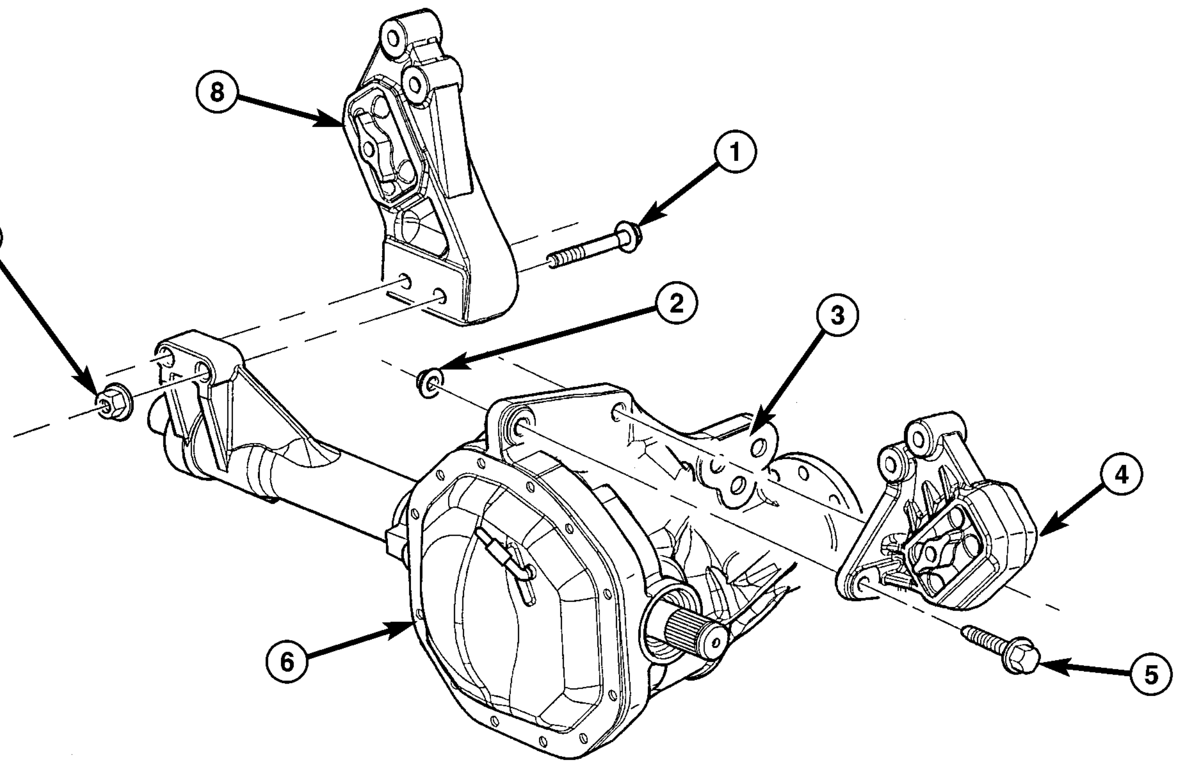


Fig. 87 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

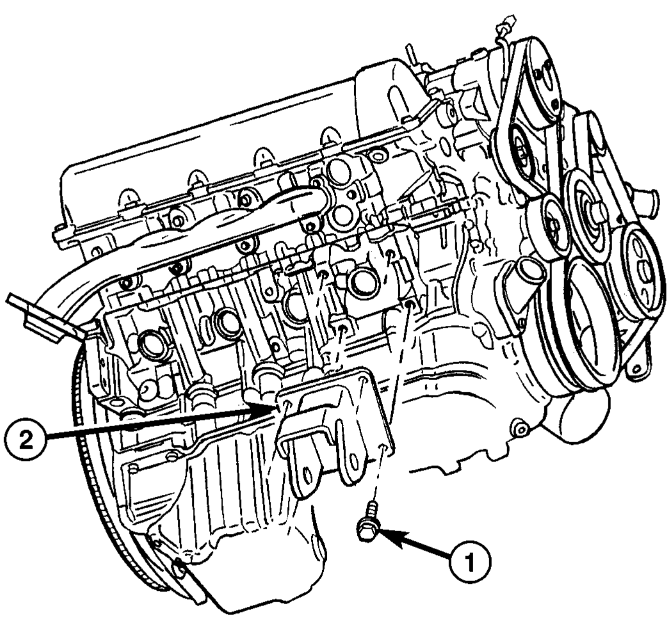


Fig. 88 ENGINE MOUNT SUPPORT BRACKET RH

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET

(5) Install the oil drain trough.
(6) Install the engine oil filter.
(7) Lower the vehicle.
(8) Install the viscous fan (Refer to 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(9) Reconnect the negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).
(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).
(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

FRONT MOUNT (Continued)

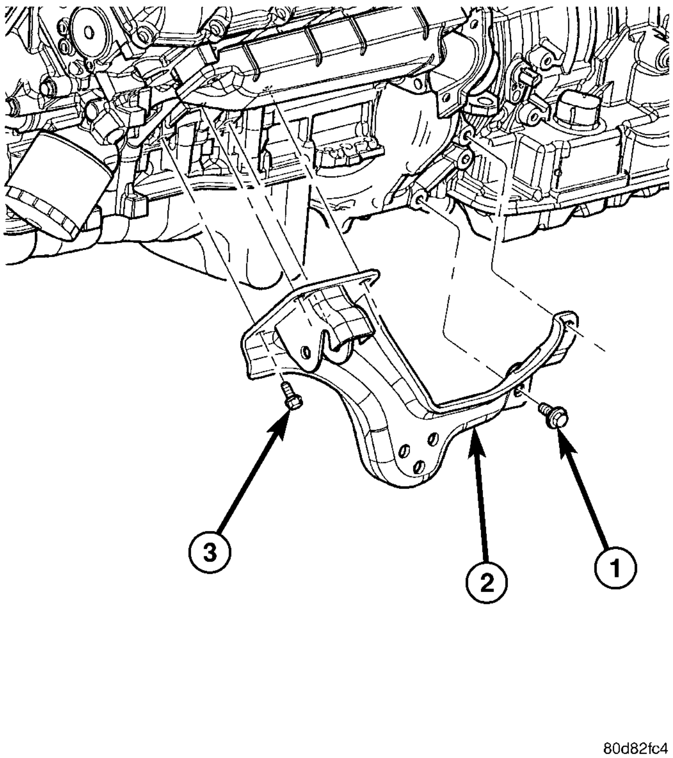


Fig. 89 ENGINE MOUNT SUPPORT BRACKET

1 - BOLT
2 - ENGINE MOUNT SUPPORT BRACKET
3 - BOLT

(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 90).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the oil drain trough.

(10) Install the engine oil filter.

(11) Install the front crossmember.

(12) Install the skid plate.

(13) Lower the vehicle.

(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(15) Reconnect the negative battery cable.

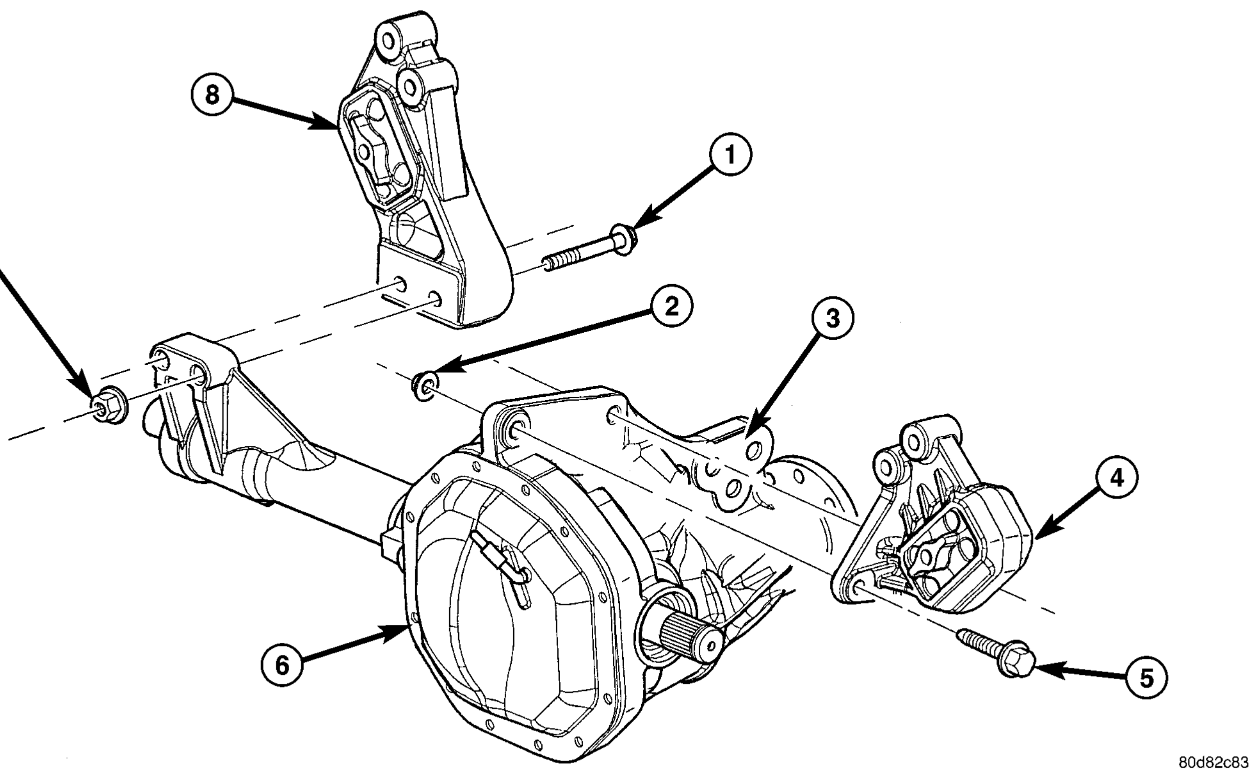


Fig. 90 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the nuts from the transmission mount (Fig. 91).

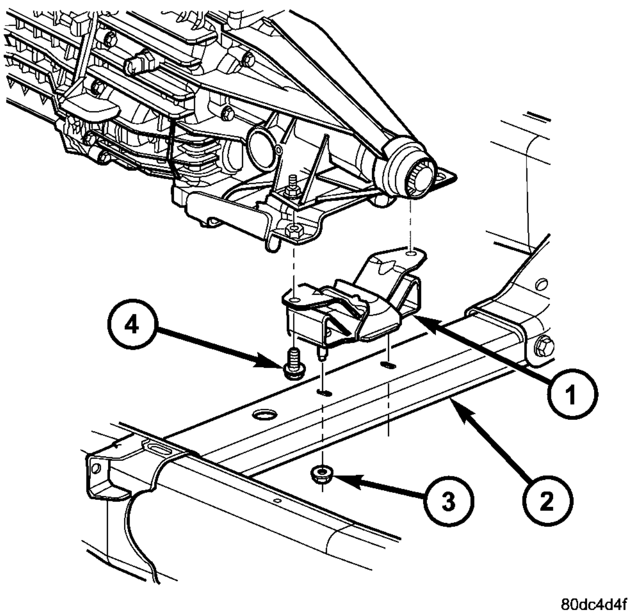


Fig. 91 TRANSMISSION MOUNT

1 - MOUNT
2 - CROSSMEMBER
3 - NUT
4 - BOLT

(4) Remove the two bolts that attach the transmission mount to the engine bracket.

(5) Raise the transmission enough to remove the mount from the crossmember.

(6) Remove the mount.

INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

(1) Install the two bolts that attach the transmission mount to the transmission bracket.

(2) Torque the bolts to 61N·m (45 ft.lbs.) torque.

(3) Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.

(4) Install the nuts onto the transmission mount studs through the crossmember access slot.

(5) Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

The lubrication system (Fig. 92) is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 92).

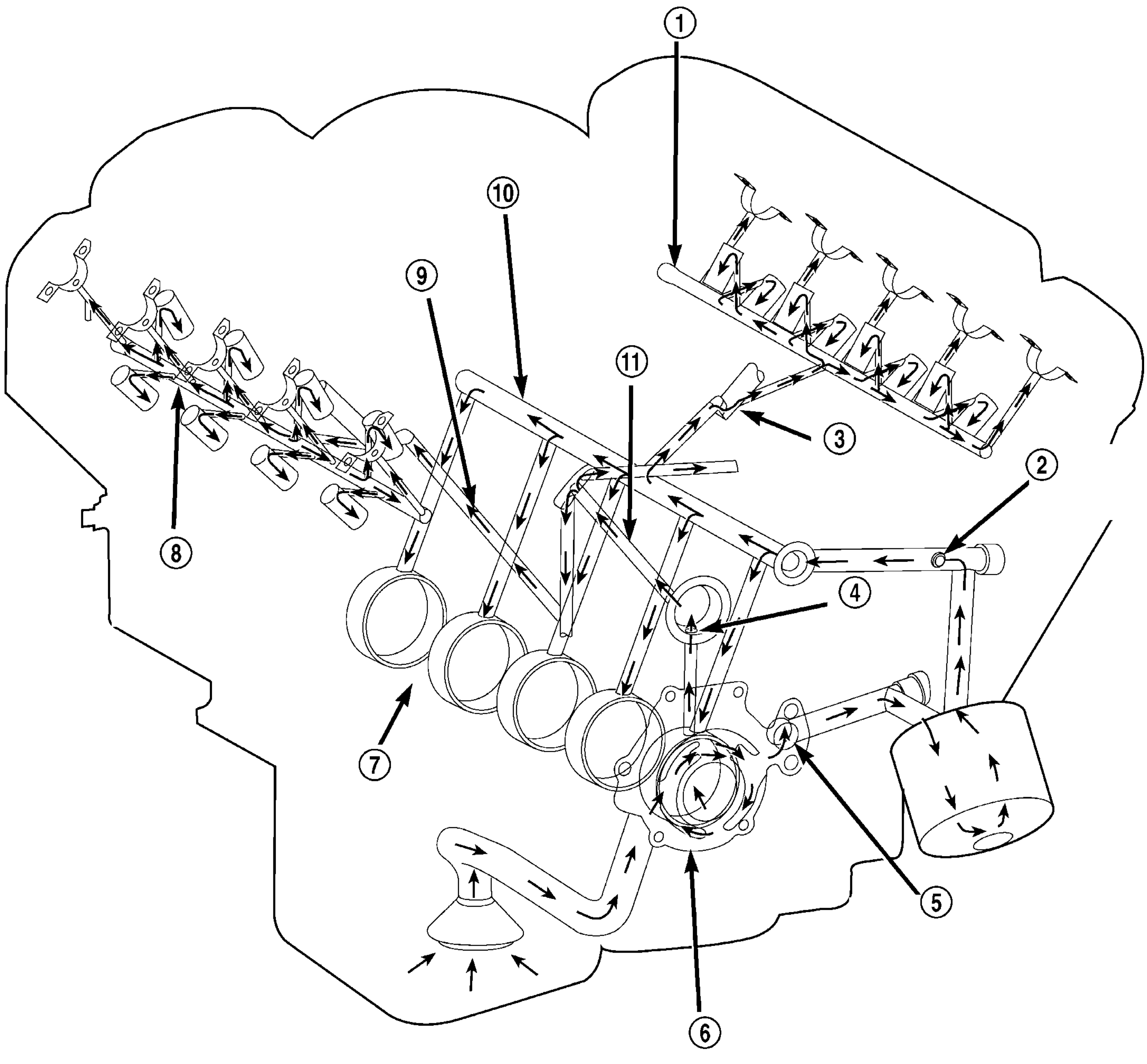


Fig. 92 Engine Oil Lubrication System

1 - LEFT CYLINDER HEAD OIL GALLERY
2 - OIL PRESSURE SENSOR LOCATION
3 - TO LEFT CYLINDER HEAD
4 - OIL FEED TO IDLER SHAFT
5 - OIL PUMP OUTLET TO BLOCK
6 - OIL PUMP
7 - TO CRANKSHAFT MAIN JOURNALS
8 - RIGHT CYLINDER HEAD OIL GALLERY
9 - TO RIGHT CYLINDER HEAD
10 - CYLINDER BLOCK MAIN GALLERY
11 - OIL FEED TO BOTH SECONDARY TENSIONERS

LUBRICATION (Continued)

The camshaft exhaust valve lobes and rocker arms are lubricated through a small hole in the rocker arm; oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the orentation of the rocker arm, the camshaft intake lobes are not lubed in the same manner as the exhaust lobes. The intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, and as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubricating the lobes and the rocker arms.

ENGINE LUBRICATION FLOW CHART—BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head*
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1.Front Timing Chain Idler Shaft 2.Both Secondary Chain Tensioners
Left Cylinder Head	See Table 2
Right Cylinder Head	See Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads.	

ENGINE LUBRICATION FLOW CHART—CYLINDER HEADS: TABLE 2

FROM	TO
Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 93)and install gauge assembly C-3292.

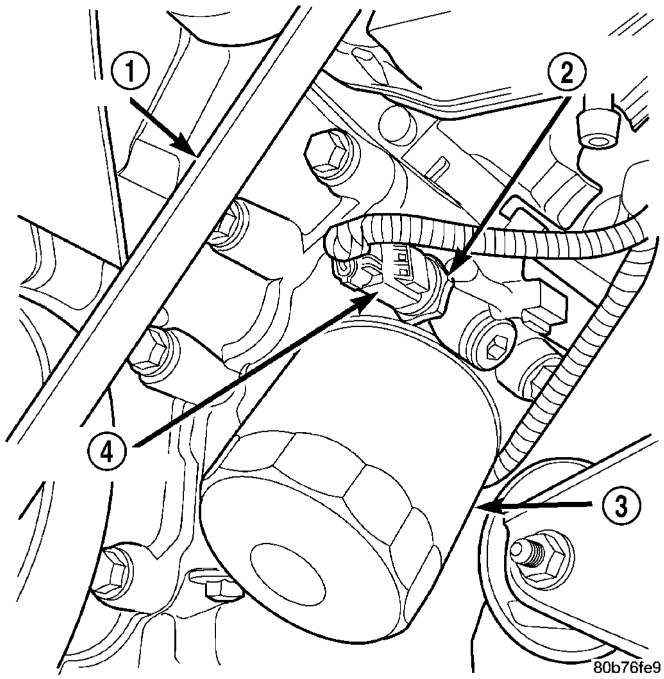


Fig. 93 OIL PRESSURE SENDING UNIT -TYPICAL

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

DIAGNOSIS AND TESTING—ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kPa (3 PSI) of test pressure.

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal,

LUBRICATION (Continued)

camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30 in the 4.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 94).

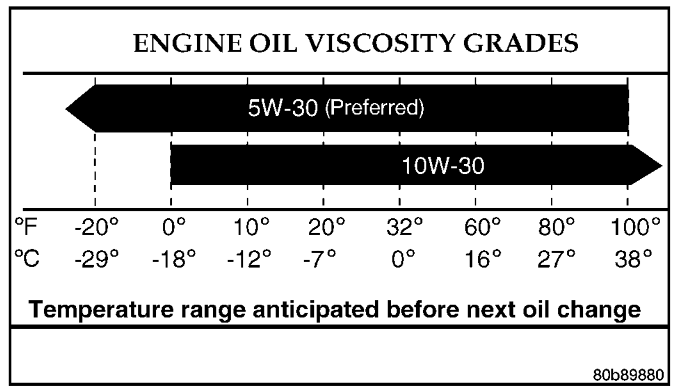


Fig. 94 TEMPERATURE/ENGINE OIL VISCOSITY - 4.7L ENGINE

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 95).

9400-9

Fig. 95 Engine oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 96).

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

OIL (Continued)

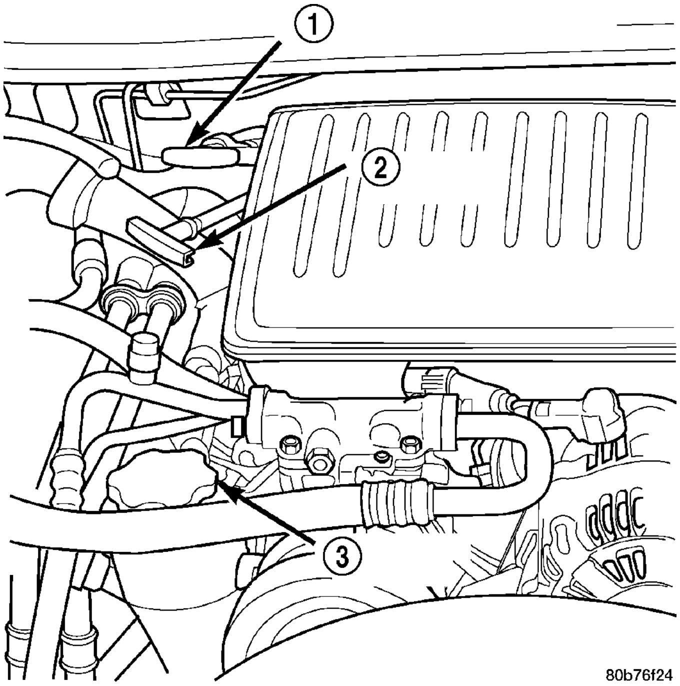


Fig. 96 ENGINE OIL DIPSTICK 4.7L ENGINE

1 - TRANSMISSION DIPSTICK
2 - ENGINE OIL DIPSTICK
3 - ENGINE OIL FILL CAP

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise (Fig. 97)to remove it from the cylinder block oil filter boss.

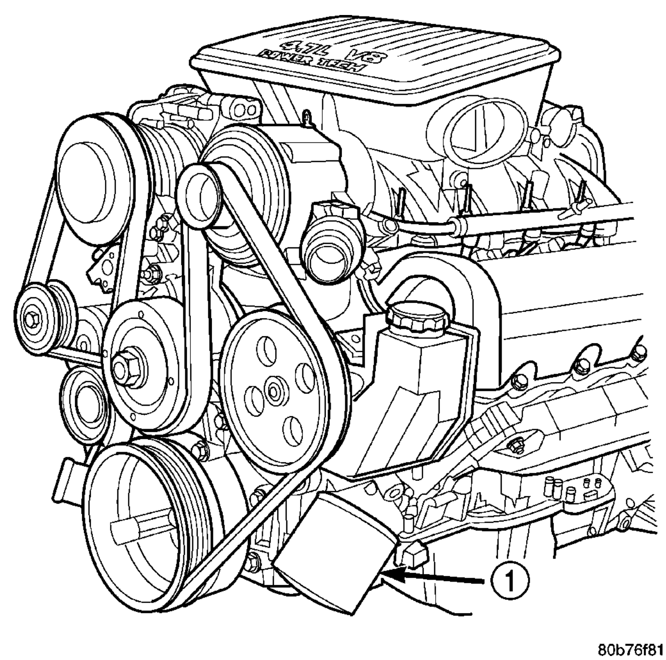


Fig. 97 Oil Filter - 4.7L Engine

1 - ENGINE OIL FILTER

OIL FILTER (Continued)

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

NOTE: Make sure filter gasket was removed with filter.

(5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 98) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

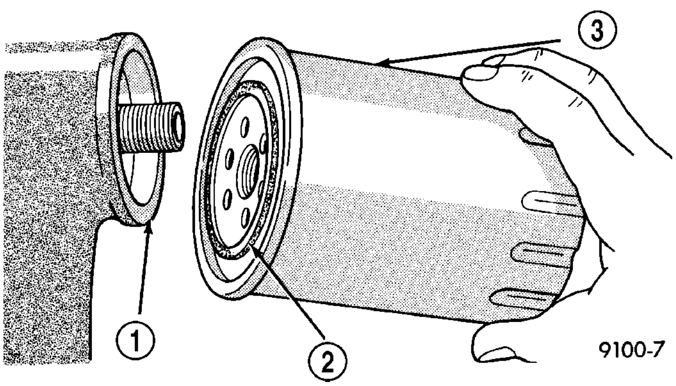


Fig. 98 Oil Filter Sealing Surface-Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4)

(5) Remove the structural dust cover, if equipped.

(6) Drain engine oil.

(7) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).

CAUTION: Only raise the engine enough to provide clearance for oil pan removal. Check for proper clearance at fan shroud to fan and cowl to intake manifold.

(8) Raise engine using special tool # 8534 to provide clearance to remove oil pan.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan.

(9) Remove the oil pan mounting bolts and oil pan.

(10) Unbolt oil pump pickup tube and remove tube.

(11) Inspect the integral windage tray and gasket and replace as needed.

INSTALLATION

(1) Clean the oil pan gasket mating surface of the bedplate and oil pan.

(2) Position the oil pan gasket and pickup tube with new o-ring. Install the mounting bolt and nuts. Tighten bolt and nuts to 28 N·m (20 ft. lbs.).

(3) Position the oil pan and install the mounting bolts. Tighten the mounting bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 99).

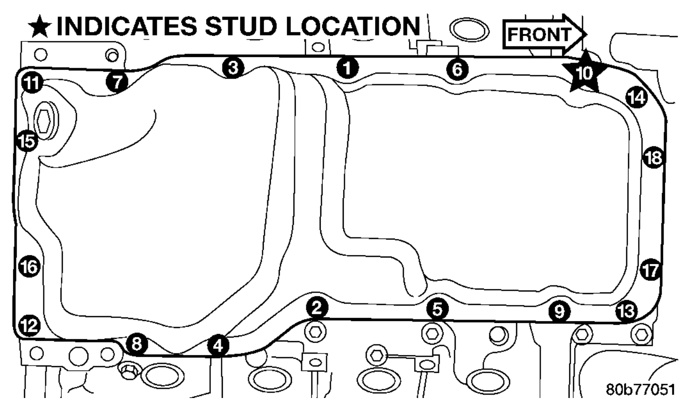


Fig. 99 Oil Pan Mounting Bolts and Oil Pan

(4) Lower the engine into mounts using special tool # 8534.

(5) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(6) Remove special tool # 8534.

(7) Install structural dust cover, if equipped.

(8) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(9) Fill engine oil.

(10) Reconnect the negative battery cable.

(11) Start engine and check for leaks.

OIL PRESSURE SENSOR/ SWITCH

DESCRIPTION

DESCRIPTION

The 3–wire, solid-state engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

DESCRIPTION

The 3–wire, electrical/mechanical engine oil pressure sensor (sending unit) is located in an engine oil pressure gallery.

OPERATION

OPERATION

The oil pressure sensor uses three circuits. They are:

- A 5–volt power supply from the Powertrain Control Module (PCM)
- A sensor ground through the PCM's sensor return
- A signal to the PCM relating to engine oil pressure

The oil pressure sensor has a 3–wire electrical function very much like the Manifold Absolute Pressure (MAP) sensor. Meaning different pressures relate to different output voltages.

A 5–volt supply is sent to the sensor from the PCM to power up the sensor. The sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on either a CCD or PCI bus circuit (depending on vehicle line) to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

OPERATION

The oil pressure sensor uses two circuits. They are:

- A signal to the PCM relating to engine oil pressure
- A sensor ground through the PCM's sensor return

The oil pressure sensor returns a voltage signal back to the PCM relating to engine oil pressure. This signal is then transferred (bussed) to the instrument panel on a CCD bus circuit to operate the oil pressure gauge and the check gauges lamp. Ground for the sensor is provided by the PCM through a low-noise sensor return.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Remove front splash shield.
(4) Disconnect oil pressure sender wire (Fig. 100).
(5) Remove the pressure sender (Fig. 100).

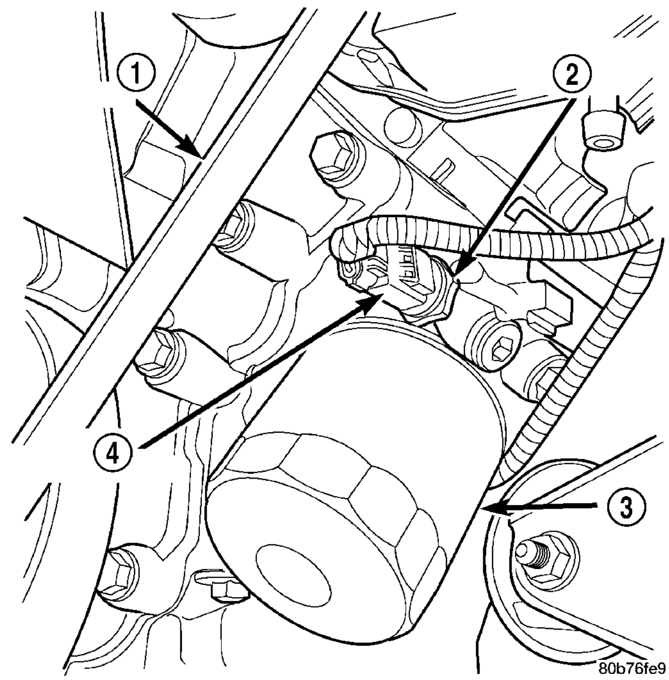


Fig. 100 OIL PRESSURE SENDING UNIT

1 - BELT
2 - OIL PRESSURE SENSOR
3 - OIL FILTER
4 - ELEC. CONNECTOR

INSTALLATION

(1) Install oil pressure sender.
(2) Connect oil pressure sender wire.
(3) Install front splash shield.
(4) Lower vehicle.
(5) Connect the negative battery cable.

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Remove the timing chains and tensioners (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(4) Remove the four bolts, primary timing chain tensioner and the oil pump.

OIL PUMP (Continued)

DISASSEMBLY

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

(3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 101). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 102). If the outer rotor thickness measures at 12.005 mm (0.472 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (3.382 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 103). If the inner rotor thickness measures at 12.005 mm (0.472 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 104). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 105). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 106).

NOTE: The 3.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

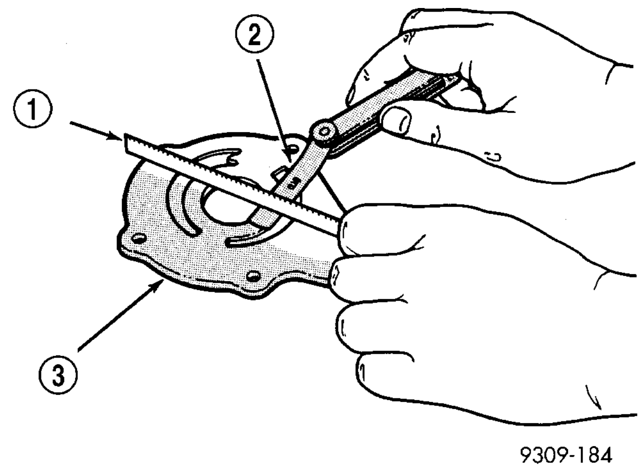


Fig. 101 Checking Oil Pump Cover Flatness

1 - STRAIGHT EDGE
2 - FEELER GAUGE
3 - OIL PUMP COVER

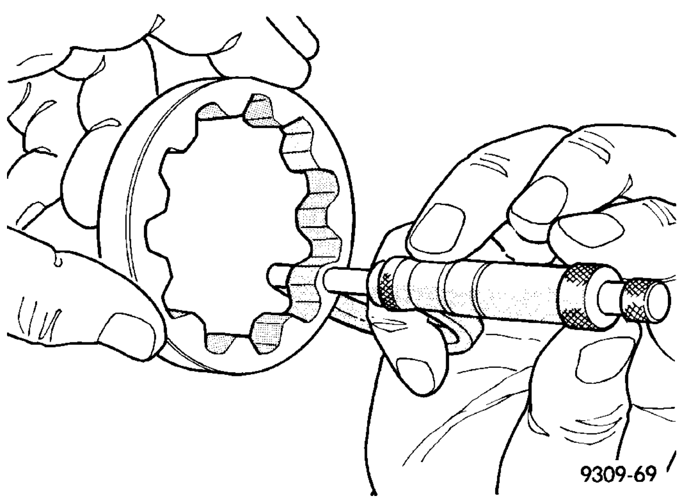


Fig. 102 Measuring Outer Rotor Thickness

OIL PUMP (Continued)

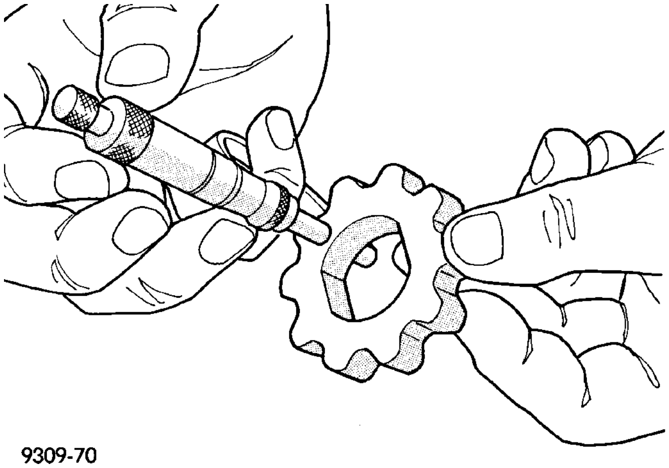


Fig. 103 Measuring Inner Rotor Thickness

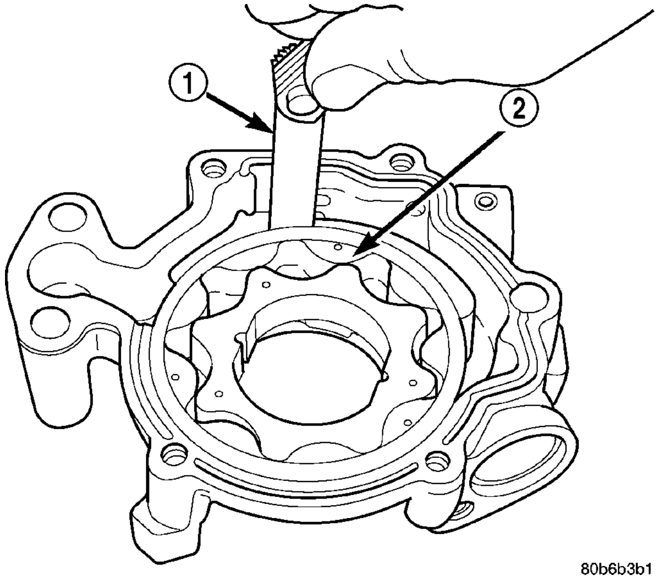


Fig. 104 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER ROTOR

ASSEMBLY

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

(2) Install inner and outer rotors

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

(4) Prime oil pump before installation by filling rotor cavity with engine oil.

(5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

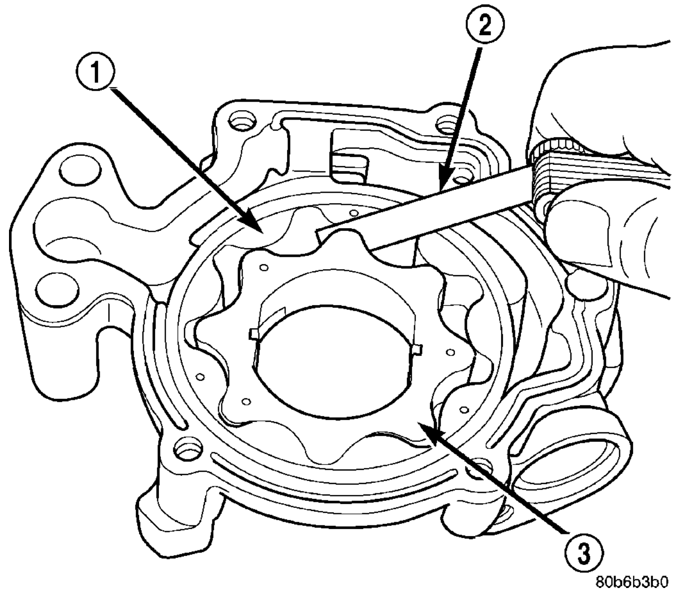


Fig. 105 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

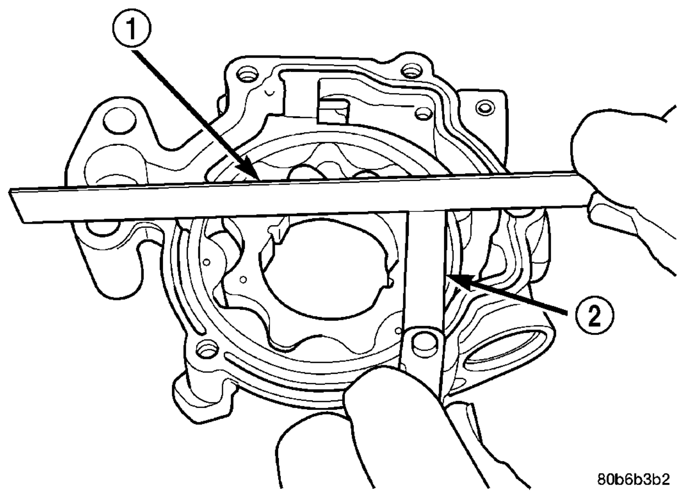


Fig. 106 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

OIL PUMP (Continued)

INSTALLATION

(1) Position the oil pump onto the crankshaft and install one oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install three retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 107).

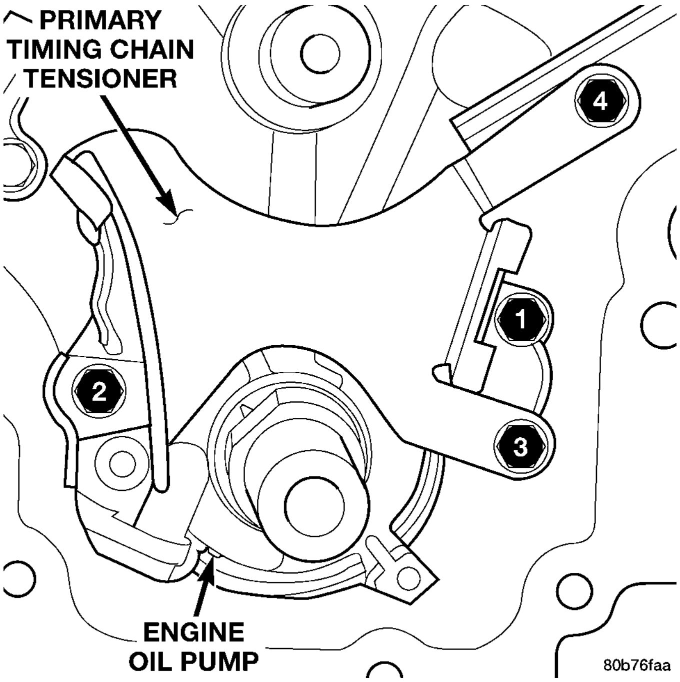


Fig. 107 Oil Pump And Primary Timing Chain Tensioner Tightening Sequence

(4) Install the secondary timing chain tensioners and timing chains (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(5) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(6) Install the pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks. Eight studs and two bolts are used to fasten the intake to the head.

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect throttle and speed control cables.

(4) Disconnect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect brake booster hose and positive crankcase ventilation (PCV) hose.

(6) Disconnect generator electrical connections.

(7) Disconnect air conditioning compressor electrical connections.

(8) Disconnect left and right radio suppressor straps.

(9) Disconnect and remove ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - REMOVAL).

(10) Remove top oil dipstick tube retaining bolt and ground strap.

(11) Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(12) Remove fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL).

(13) Remove throttle body assembly and mounting bracket.

(14) Drain cooling system below coolant temperature level (Refer to 7 - COOLING - STANDARD PROCEDURE).

(15) Remove the heater hoses from the engine front cover and the heater core.

INTAKE MANIFOLD (Continued)

(16) Unclip and remove heater hoses and tubes from intake manifold (Fig. 108).

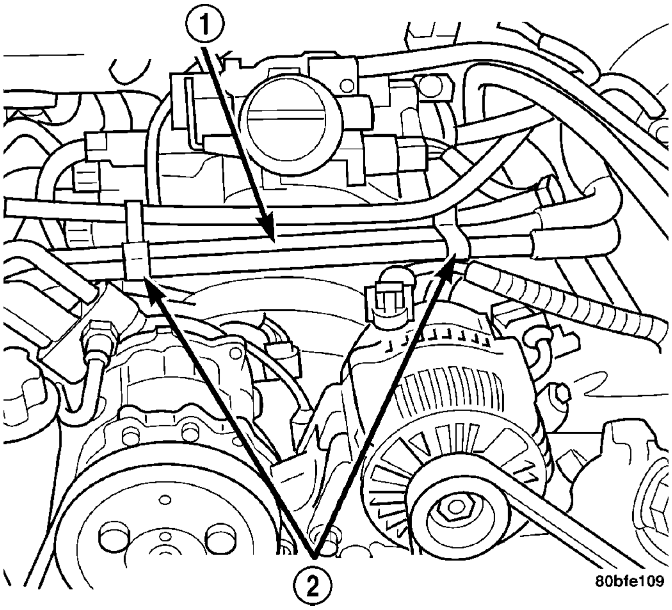


Fig. 108 Heater Hoses and Tubes Removal / Installation

1 - HEATER HOSES AND TUBES
2 - ROUTING/RETAINING CLIPS

(17) Remove coolant temperature sensor (Refer to 7 - COOLING/ENGINE/ENGINE COOLANT TEMPERATURE SENSO - REMOVAL).

(18) Remove intake manifold retaining fasteners in reverse order of tightening sequence (Fig. 109).

(19) Remove intake manifold.

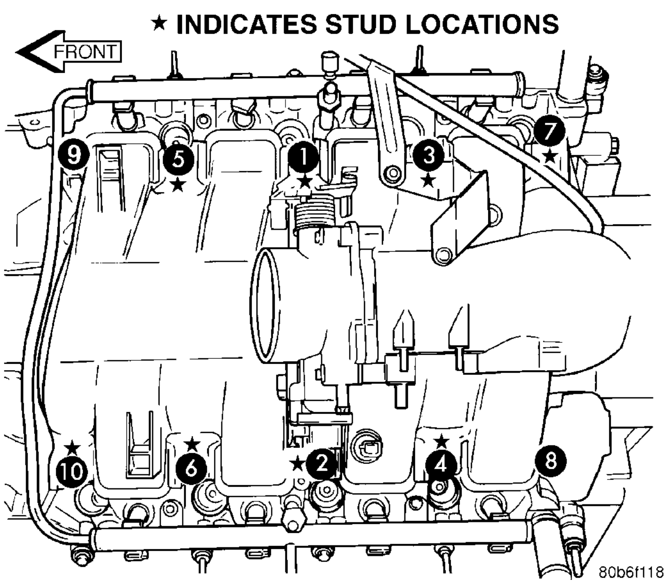


Fig. 109 Intake Manifold Tightening Sequence

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

(1) Install intake manifold gaskets.

(2) Position intake manifold.

(3) Install intake manifold retaining bolts and tighten in sequence shown in (Fig. 109) to 12 N·m (105 in. lbs.).

(4) Install left and right radio suppressor straps.

(5) Install throttle body assembly.

(6) Install throttle cable bracket.

(7) Connect throttle cable and speed control cable to throttle body.

(8) Install fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - INSTALLATION).

(9) Install ignition coil towers (Refer to 8 - ELECTRICAL/IGNITION CONTROL/IGNITION COIL - INSTALLATION).

(10) Position and install heater hoses and tubes onto intake manifold.

(11) Install the heater hoses to the heater core and engine front cover.

(12) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(13) Install top oil dipstick tube retaining bolt and ground strap.

(14) Connect generator electrical connections.

(15) Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.

(16) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(17) Install resonator assembly and air inlet hose.

(18) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

REMOVAL

RIGHT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.

(2) Remove air cleaner assembly, resonator assembly and air inlet hose.

(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(5) Remove A/C accumulator support bracket fastener.

(6) Drain coolant below heater hose level (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Remove heater hoses at engine.

(8) Remove fasteners attaching exhaust manifold heat shield.

(9) Remove heat shield.

(10) Remove upper exhaust manifold attaching fasteners.

(11) Raise vehicle on hoist.

(12) Disconnect exhaust pipe from manifold.

(13) Remove fasteners attaching starter. Move starter aside.

(14) Remove lower exhaust manifold attaching fasteners.

(15) Remove exhaust manifold and gasket (Fig. 110). Manifold is removed from below the engine compartment.

EXHAUST MANIFOLD (Continued)

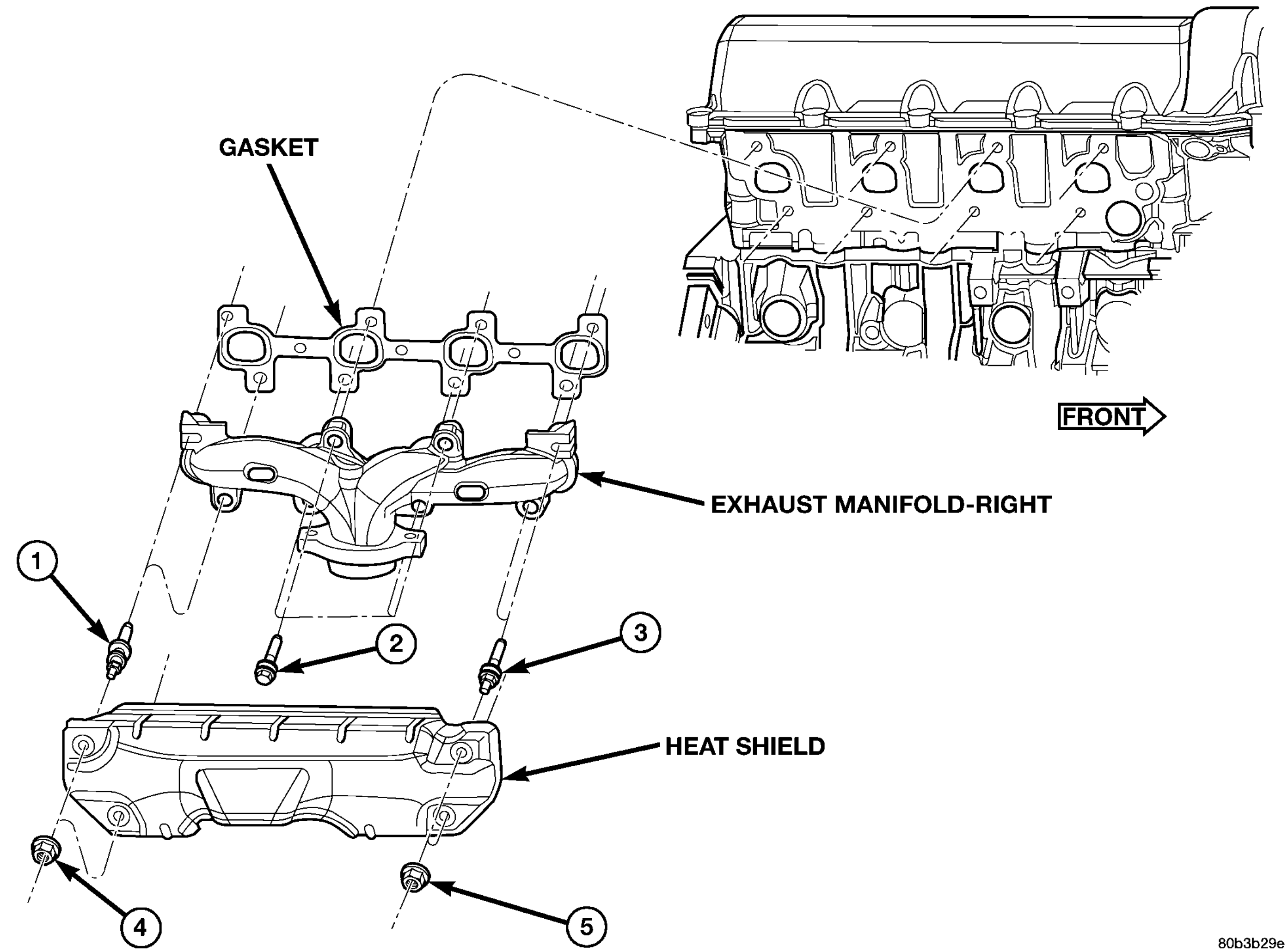


Fig. 110 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

LEFT EXHAUST MANIFOLD

(1) Disconnect negative cable for battery.

(2) Hoist vehicle.

(3) Disconnect exhaust pipe at manifold.

(4) Lower vehicle.

(5) Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.

(6) Remove heat shield (Fig. 111).

(7) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 111).

(8) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 111).

(9) Remove exhaust manifold and gasket (Fig. 111). Manifold is removed from below the engine compartment.

CLEANING

(1) Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.

(2) Clean all gasket residue from the manifold mating surface.

INSPECTION

(1) Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.

(2) Using a straight edge and a feeler gauge, check the mating surface for warp and twist.

(3) Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

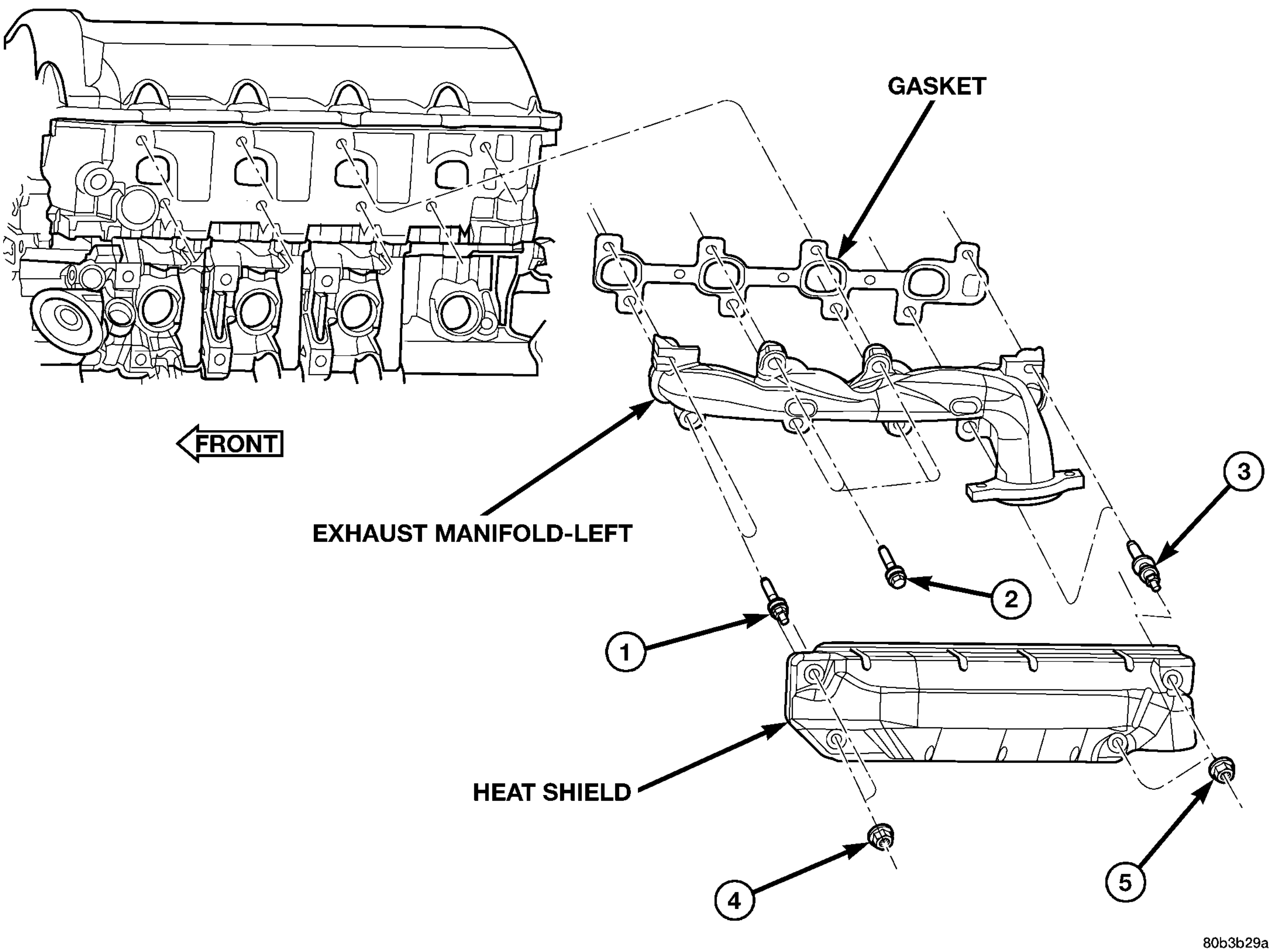


Fig. 111 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

INSTALLATION

RIGHT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket (Fig. 112) from below engine compartment.

(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Install starter and fasteners.

(6) Connect exhaust pipe to manifold.

(7) Connect heater hoses at engine.

(8) Install fastener attaching A/C accumulator.

(9) Install A/C compressor and fasteners.

(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(11) Install air cleaner assembly, resonator assembly and air inlet hose.

(12) Install battery and connect cables.

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

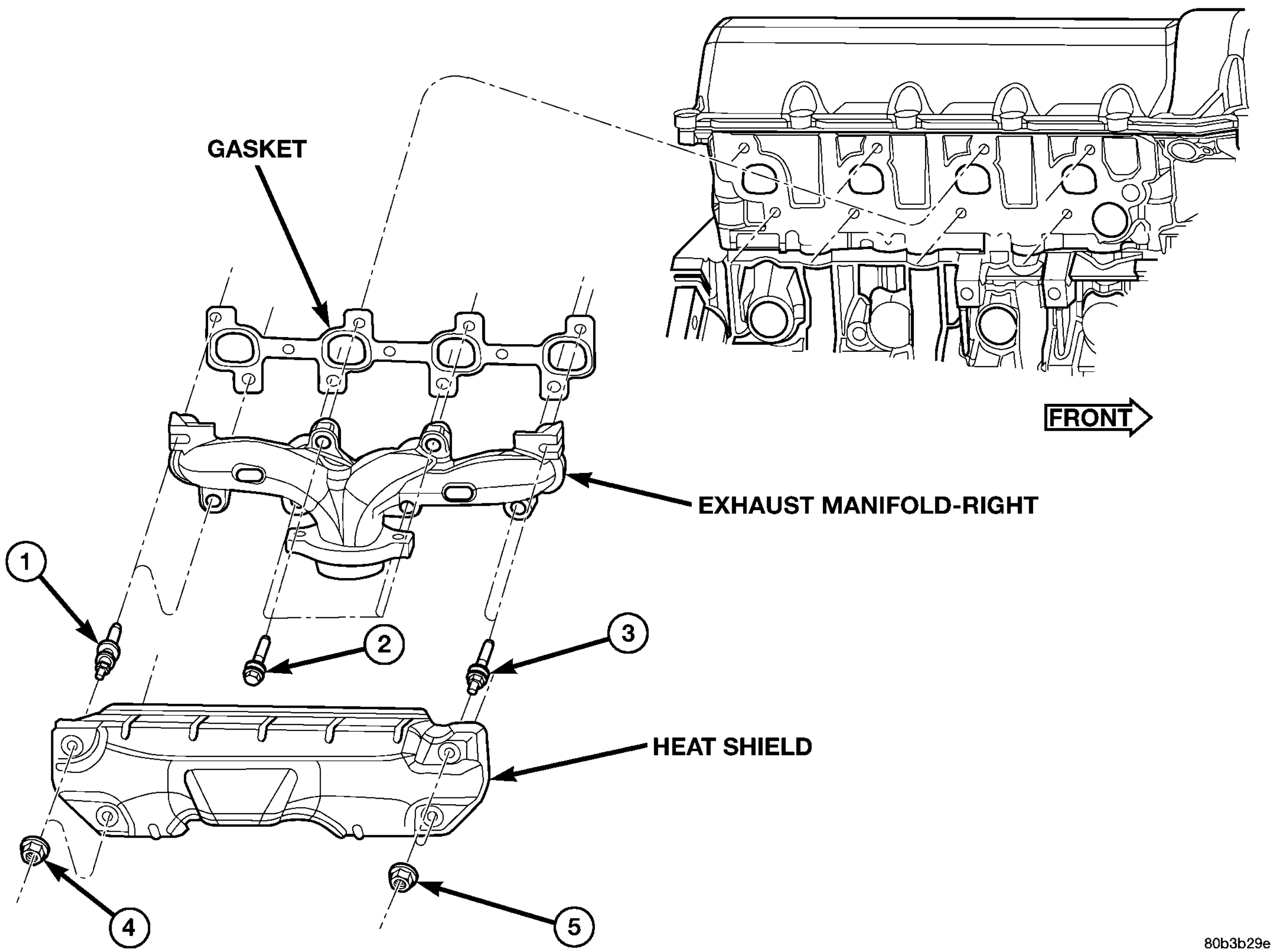


Fig. 112 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

EXHAUST MANIFOLD (Continued)

LEFT EXHAUST MANIFOLD

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners (Fig. 113). DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 113). Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield (Fig. 113). Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Connect exhaust pipe to manifold.

(6) Connect negative cable to battery.

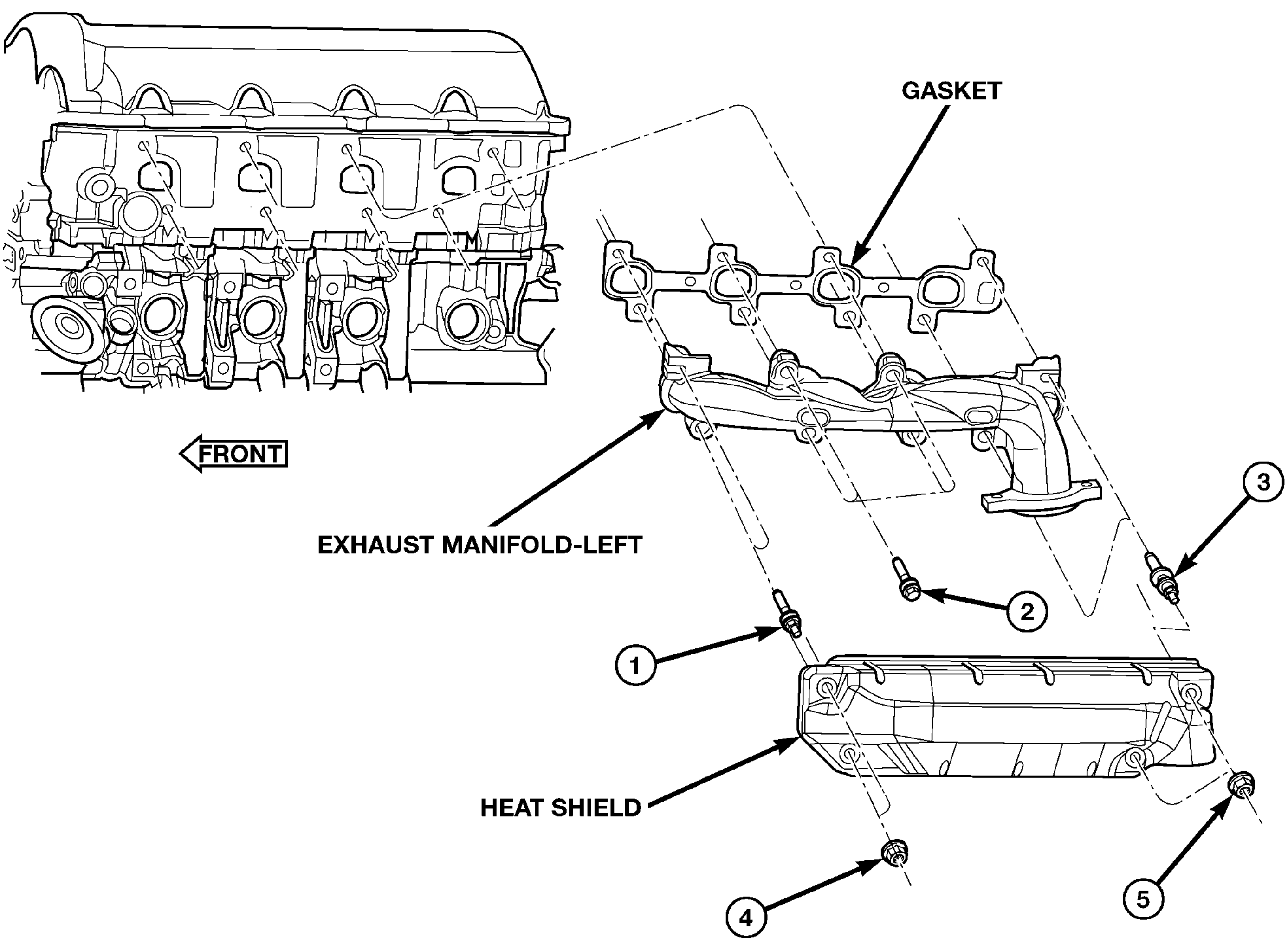


Fig. 113 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)		4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)	25 N·m (18 ft. lbs.)	5	Nut (Qty 2)	
3	Stud (Qty 2)				

VALVE TIMING

DESCRIPTION—TIMING DRIVE SYSTEM

The timing drive system (Fig. 114) has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non-free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consists of a primary chain and two secondary timing chain drives.

OPERATION - TIMING DRIVE SYSTEM

The primary timing chain is a single inverted tooth type. The primary chain drives the large fifty tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and oil pump leakage. The idler sprocket assembly connects the primary and secondary chain drives. The idler sprocket assembly consists of two integral thirty tooth sprockets and a fifty tooth sprocket that is splined to the assembly. The spline joint is a non – serviceable press fit anti rattle type. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is press-fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are inverted tooth type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a thirty tooth cam sprocket

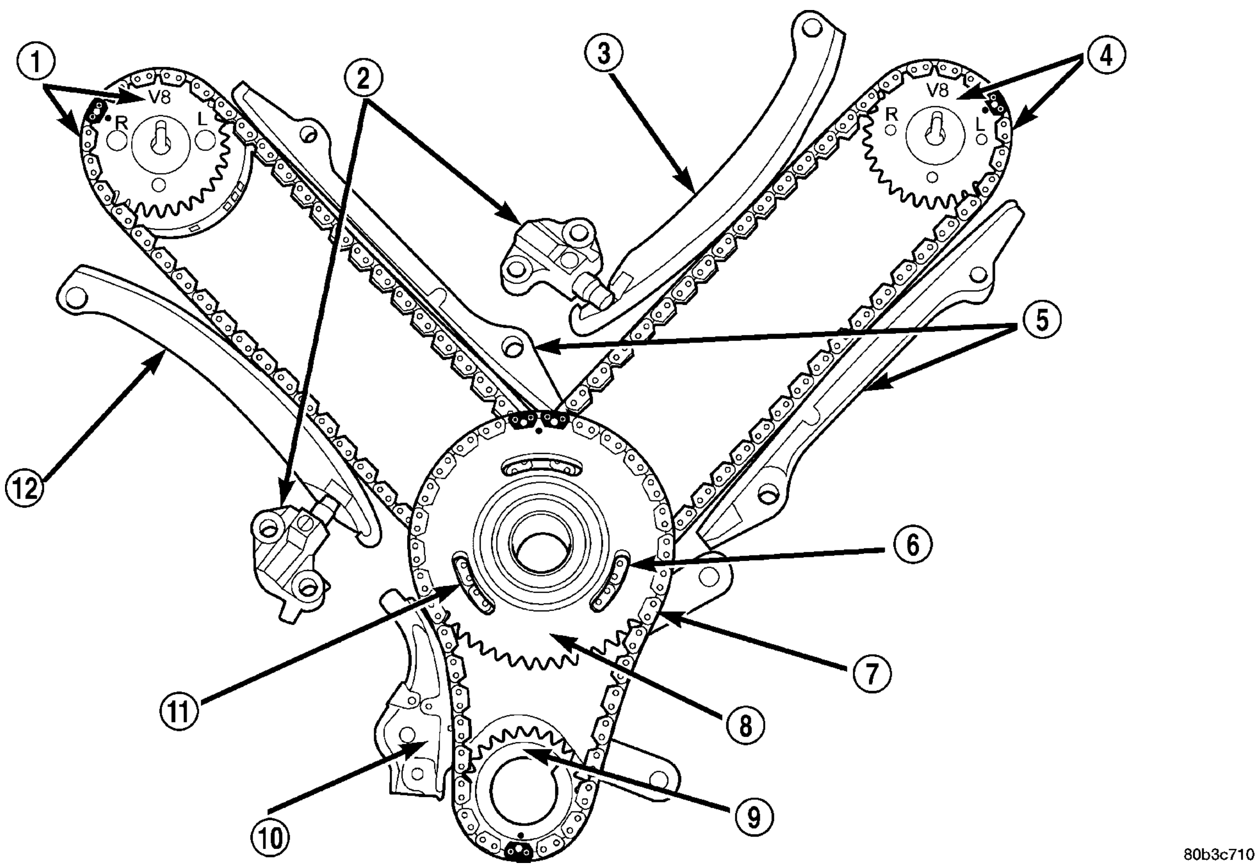


Fig. 114 Timing Drive System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

VALVE TIMING (Continued)

directly from the thirty tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tension in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

STANDARD PROCEDURE

STANDARD PROCEDURE—MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

(1) Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston (Fig. 115). The measurement at point (A) must be less than 15mm (0.5906 inches).

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. (Refer to 9 - ENGINE/VALVE TIMING/ TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

NOTE: If the secondary chains are to be replaced the primary chain must also be replaced.

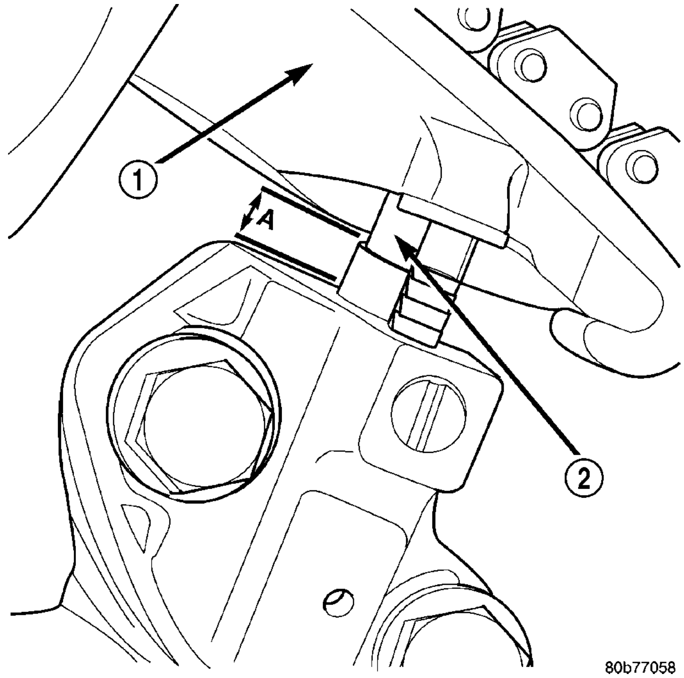


Fig. 115 Measuring Secondary Timing Chains For Wear

1 - SECONDARY TENSIONER ARM
2 - SECONDARY CHAIN TENSIONER PISTON

STANDARD PROCEDURE - ENGINE TIMING - VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

VALVE TIMING (Continued)

Engine base timing can be verified by the following procedure:

(1) Remove the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 116). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 117). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC (cylinder #1) on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC (cylinder #1) on the compression stroke.

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.

(6) If both camshaft drive gear V8 marks are at the twelve o'clock or the six o' clock position the engine base timing is correct. Reinstall the cylinder head covers.

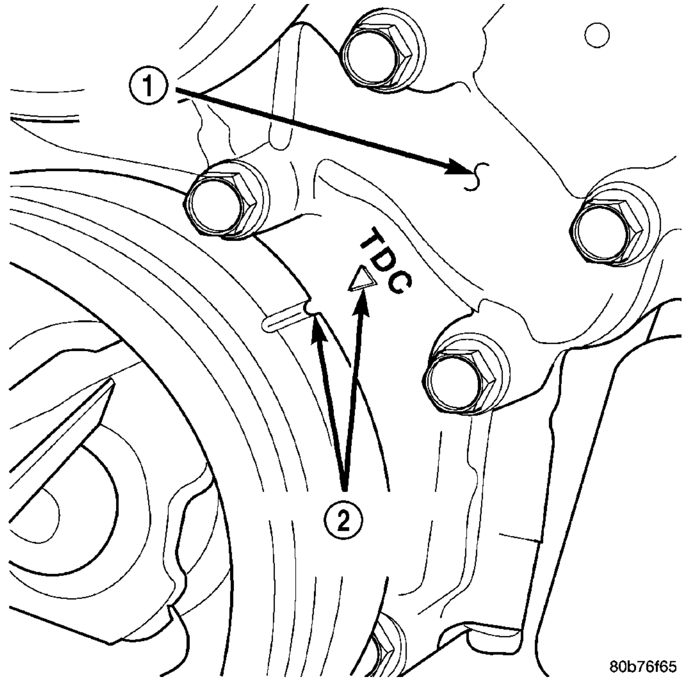


Fig. 116 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

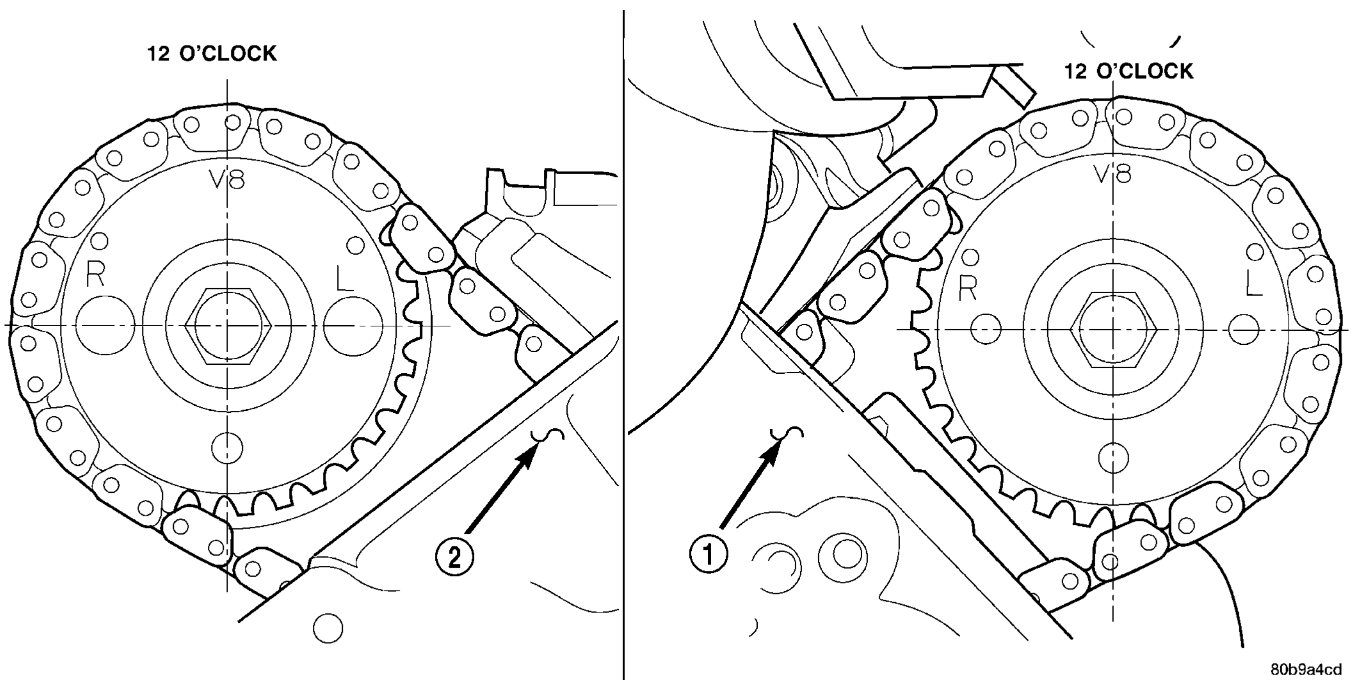


Fig. 117 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

VALVE TIMING (Continued)

SINGLE CAMSHAFT TIMING

NOTE: to adjust the timing on one camshaft, preform the following procedure.

(1) Using Chain Tensioner Wedge, special tool 8350, stabilize the secondary chain drive (Fig. 118). For reference purposes, mark the chain-to-sprocket position (Fig. 118).

(2) Remove the camshaft drive gear retaining bolt.

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(5) Using a suitable pair of adjustable pliers, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear (Fig. 119).

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

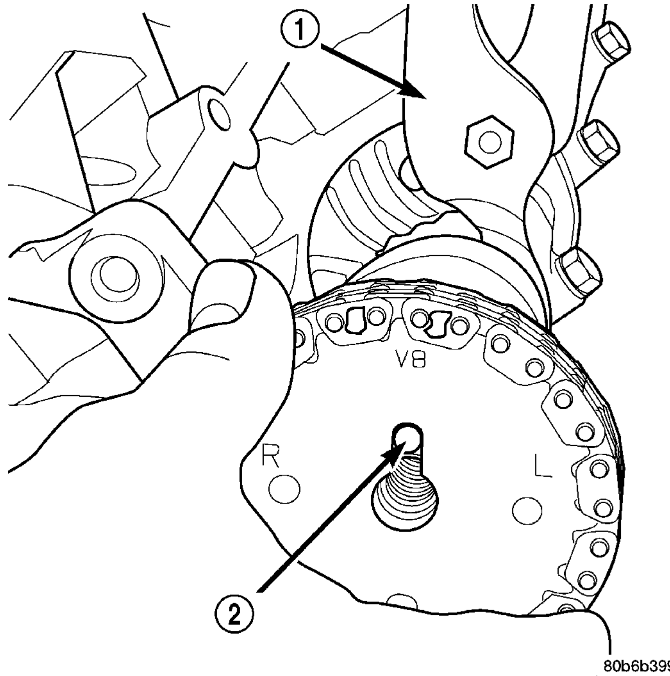


Fig. 119 Camshaft Dowel

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench,

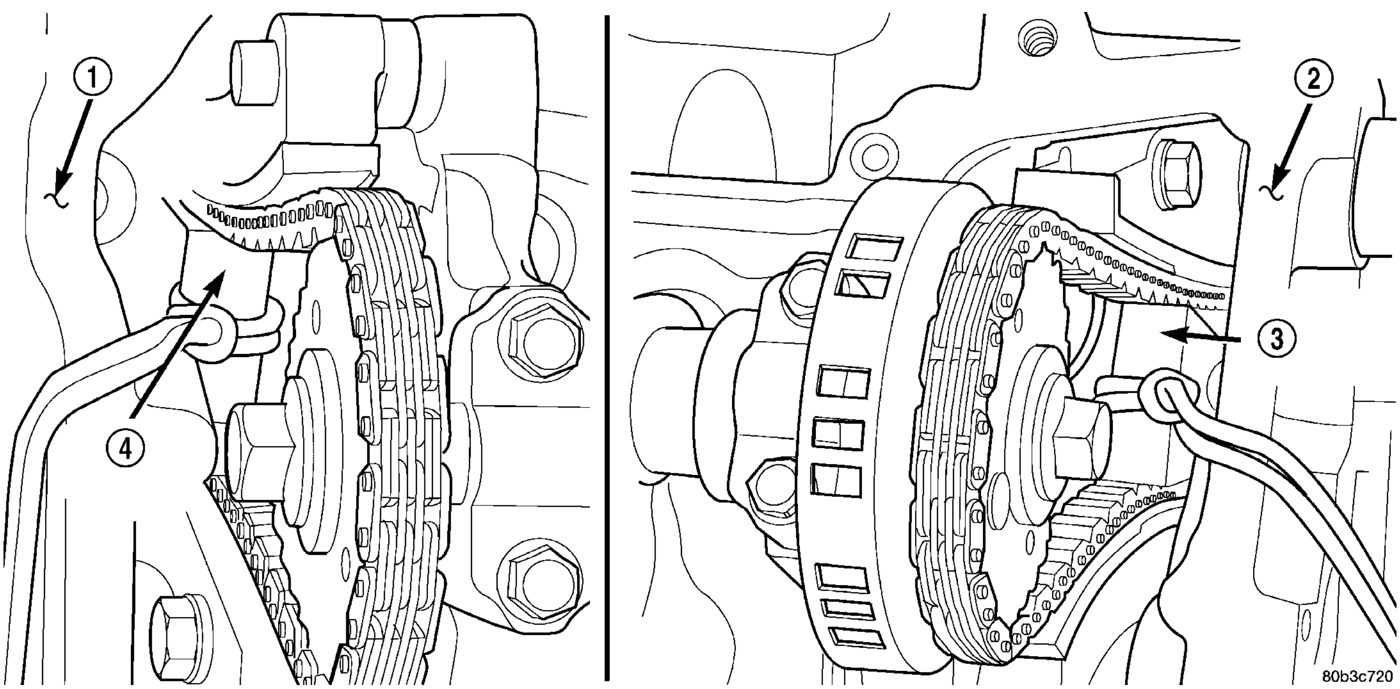


Fig. 118 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD
3 - SPECIAL TOOL 8350 WEDGE
4 - SPECIAL TOOL 8350 WEDGE

VALVE TIMING (Continued)

Tighten retaining bolt to 122N·m (90 ft. Lbs.) (Fig. 120) (Fig. 121).

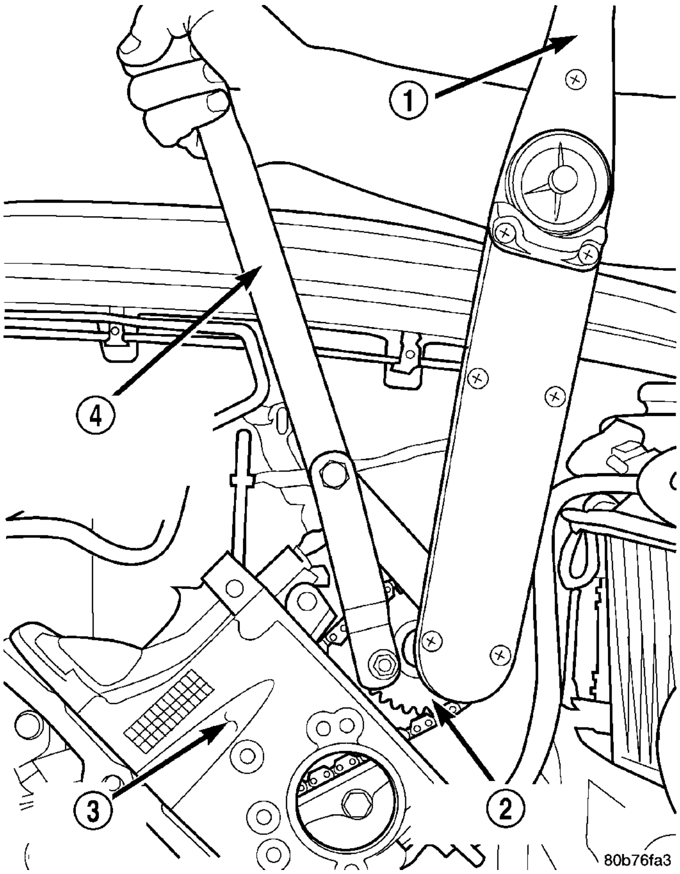


Fig. 120 Camshaft Sprocket Left Cylinder Head

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

(7) Remove special tool 8350.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.

(9) Install the cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(4) Disconnect both heater hoses at timing cover.

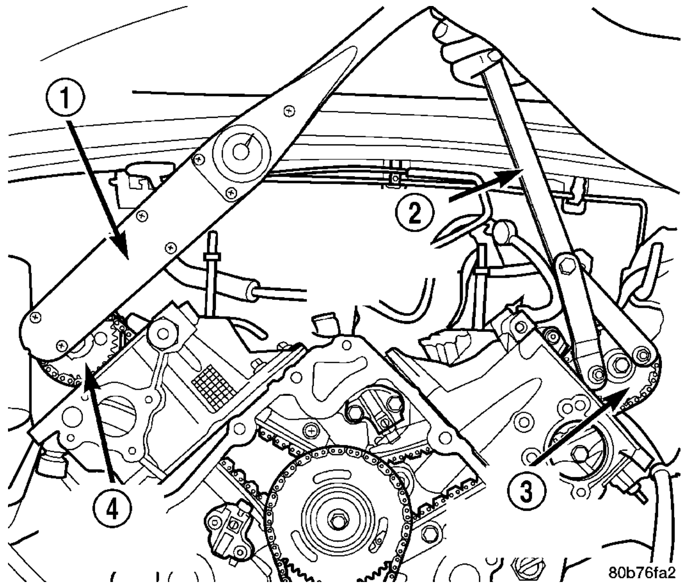


Fig. 121 Camshaft Sprocket Installation—Right Cylinder Head

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

(5) Disconnect lower radiator hose at engine.

(6) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Remove accessory drive belt tensioner assembly (Fig. 122).

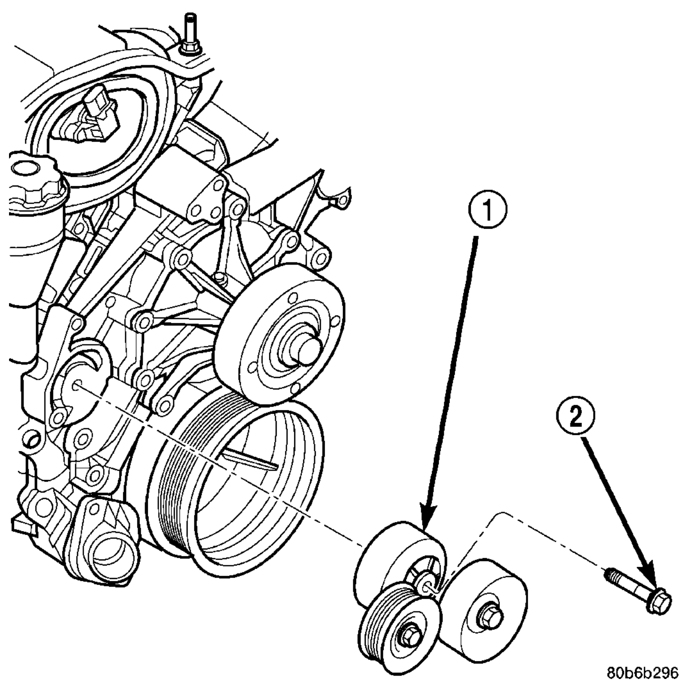


Fig. 122 Accessory Drive Belt Tensioner

1 - TENSIONER ASSEMBLY
2 - FASTENER TENSIONER TO FRONT COVER

TIMING BELT / CHAIN COVER(S) (Continued)

(8) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(9) Remove A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(10) Remove cover and gasket (Fig. 123).

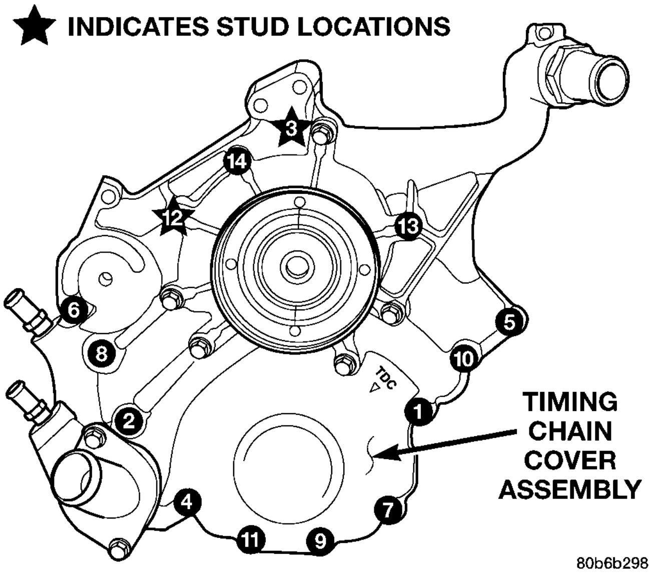


Fig. 123 Timing Chain Cover Fasteners

INSTALLATION

(1) Clean timing chain cover and block surface. Inspect cover gasket and replace as necessary.

(2) Install cover and gasket. Tighten fasteners in sequence as shown in (Fig. 123) to 54 N·m (40 ft. lbs.).

(3) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(4) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(5) Install crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(6) Install accessory drive belt tensioner assembly (Refer to 7 - COOLING/ACCESSORY DRIVE/BELT TENSIONERS - INSTALLATION).

(7) Install radiator lower hose.

(8) Install both heater hoses.

(9) Install radiator shroud and viscous fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(10) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(11) Connect the battery negative cable.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove right and left cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove radiator fan shroud.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 124) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o'clock position (Fig. 125).

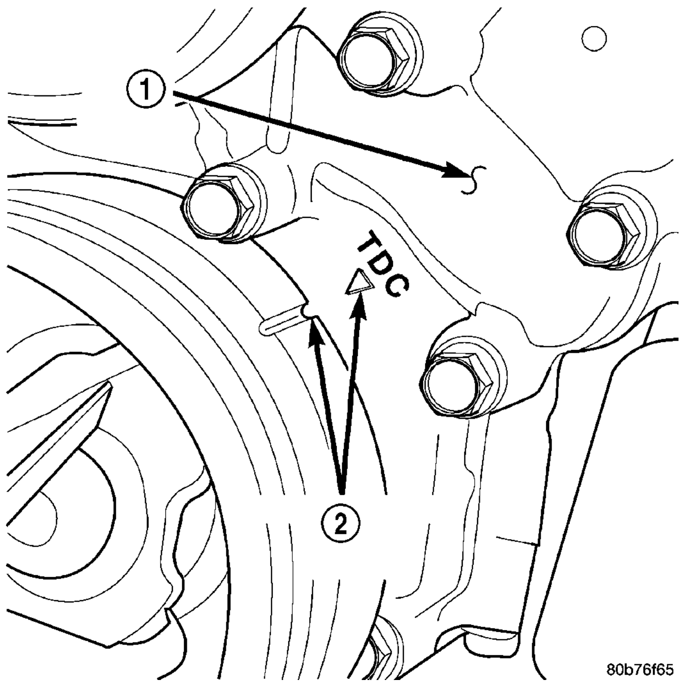


Fig. 124 Engine Top Dead Center (TDC) Indicator Mark

1 - TIMING CHAIN COVER
2 - CRANKSHAFT TIMING MARKS

(6) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 126).

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

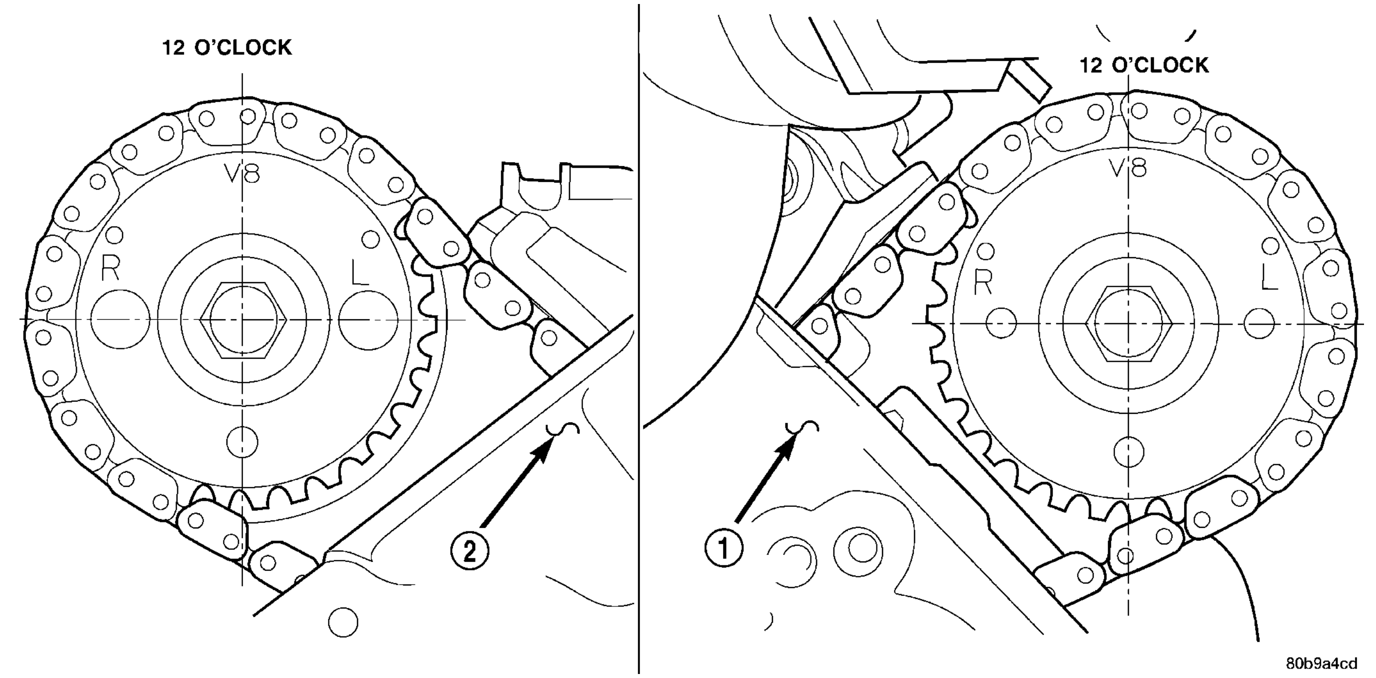


Fig. 125 Camshaft Sprocket V8 Marks

1 - LEFT CYLINDER HEAD
2 - RIGHT CYLINDER HEAD

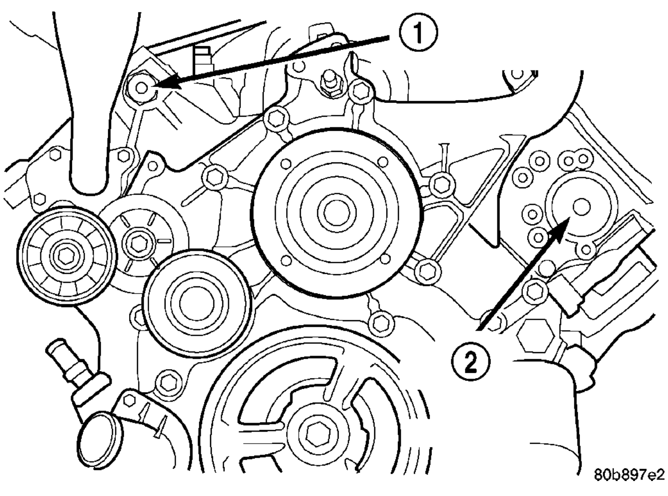


Fig. 126 Cylinder Head Access Plug Location

1 - RIGHT CYLINDER HEAD ACCESS PLUG
2 - LEFT CYLINDER HEAD ACCESS PLUG

(10) Collapse and pin primary chain tensioner (Fig. 127).

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor from right cylinder head (Fig. 128).

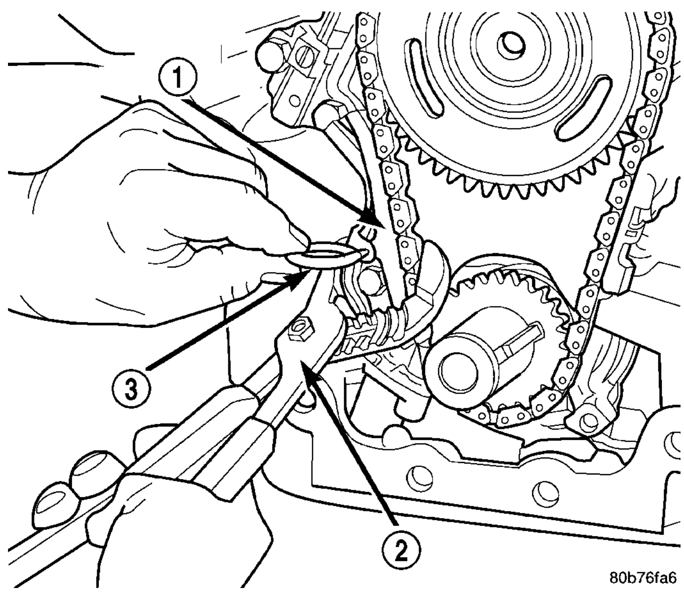


Fig. 127 Collapsing And Pinning Primary Chain Tensioner

1 - PRIMARY CHAIN TENSIONER
2 - ADJUSTABLE PLIERS
3 - SPECIAL TOOL 8514

CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

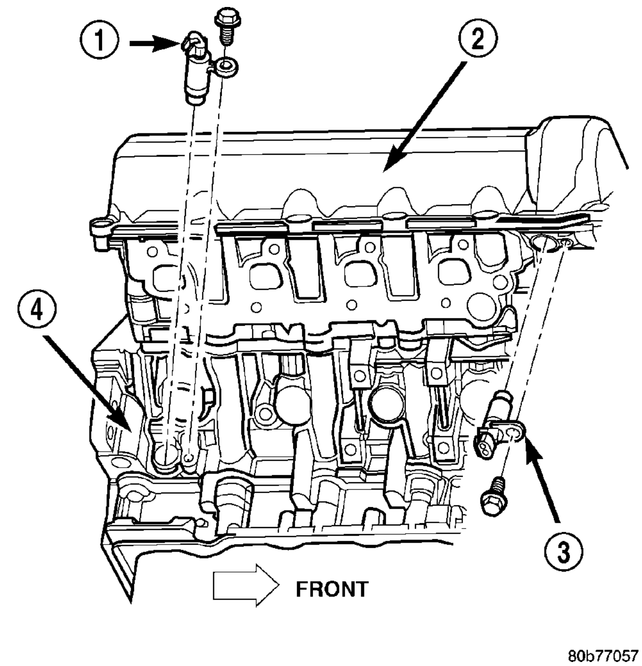


Fig. 128 Camshaft Position Sensor—Removal

1 - CRANKSHAFT POSITION SENSOR
2 - CYLINDER HEAD COVER
3 - CAMSHAFT POSITION SENSOR
4 - RIGHT SIDE CYLINDER BLOCK

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 129) remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.

(15) While holding the right camshaft steel tube with adjustable pliers, (Fig. 130) remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.

(16) Remove idler sprocket assembly bolt.

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove chain tensioner.

INSPECTION

Inspect the following components:

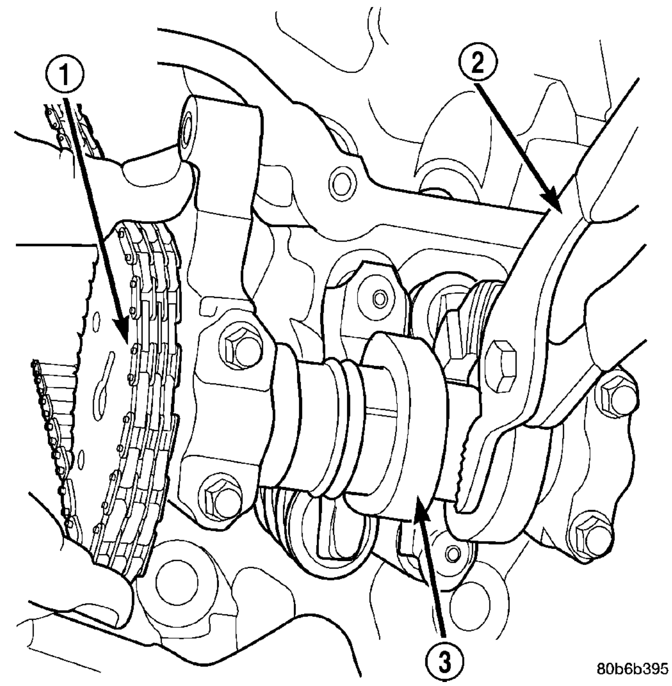


Fig. 129 Camshaft Rotation—Left Side

1 - CAMSHAFT SPROCKET AND CHAIN
2 - ADJUSTABLE PLIERS
3 - CAMSHAFT

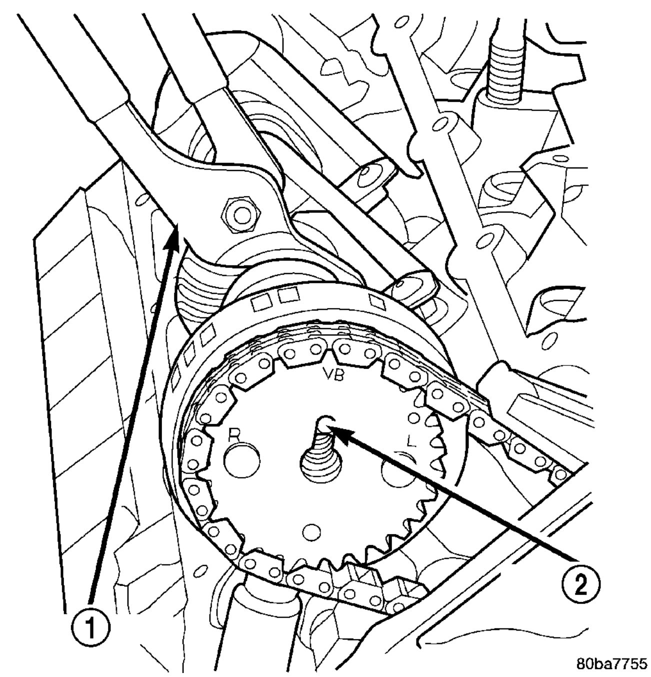


Fig. 130 Camshaft Rotation—Right Side

1 - ADJUSTABLE PLIERS
2 - CAMSHAFT DOWEL

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.

TIMING BELT/CHAIN AND SPROCKETS (Continued)

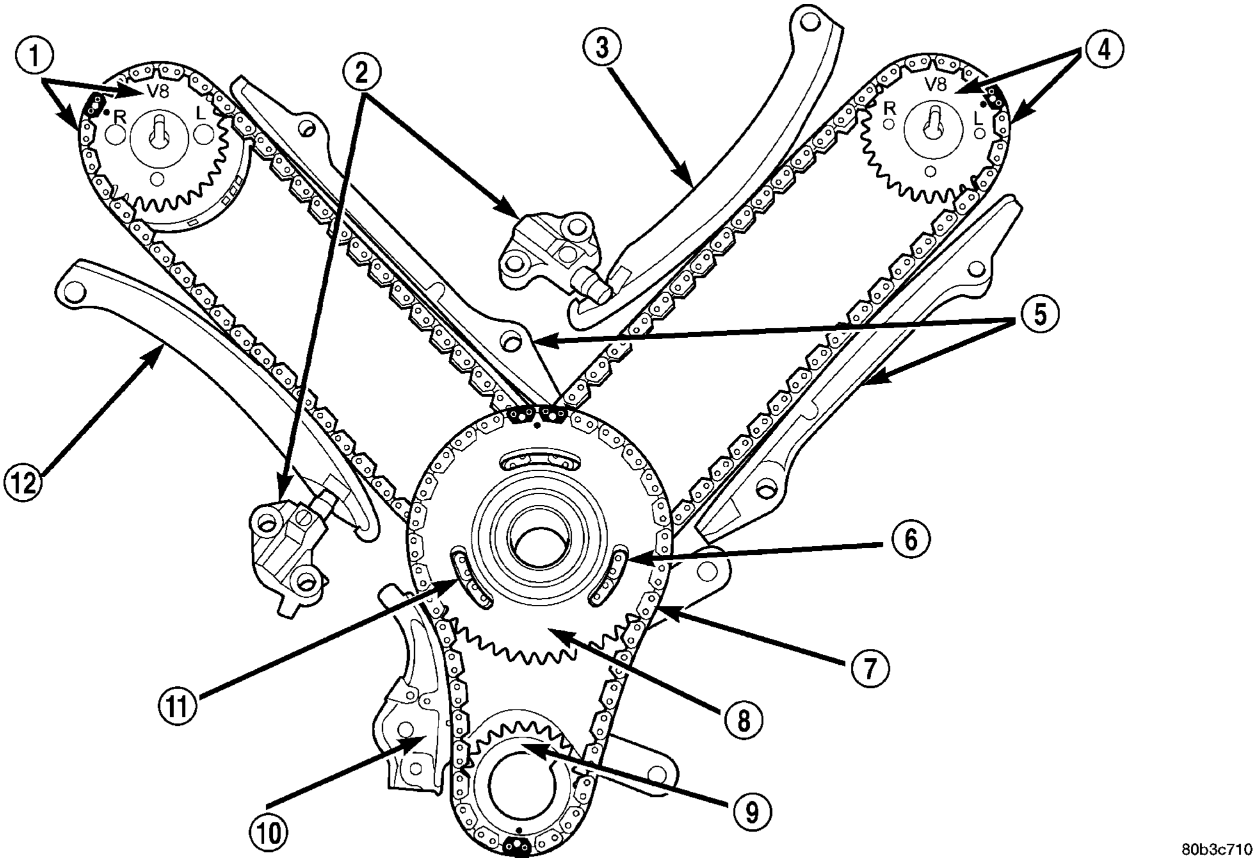


Fig. 131 Timing Chain System

1 - RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 - SECONDARY TIMING CHAIN TENSIONER (LEFT AND RIGHT SIDE NOT COMMON)
3 - SECONDARY TENSIONER ARM
4 - LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 - CHAIN GUIDE
6 - TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 - PRIMARY CHAIN
8 - IDLER SPROCKET
9 - CRANKSHAFT SPROCKET
10 - PRIMARY CHAIN TENSIONER
11 - TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 - SECONDARY TENSIONER ARM

- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner and tensioner arm should be replaced.
- Primary chain tensioner plastic faces. Replace as required (Fig. 131).

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner. Slowly open vise to transfer piston spring force to lock pin (Fig. 132).

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

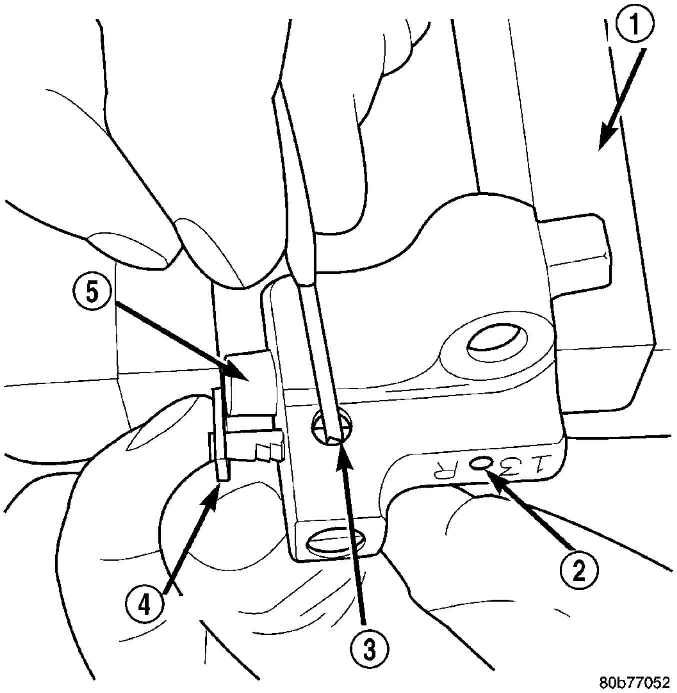


Fig. 132 Resetting Secondary Chain Tensioners

1 - VISE
2 - INSERT LOCK PIN
3 - RATCHET PAWL
4 - RATCHET
5 - PISTON

NOTE: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 133).

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket (Fig. 131).

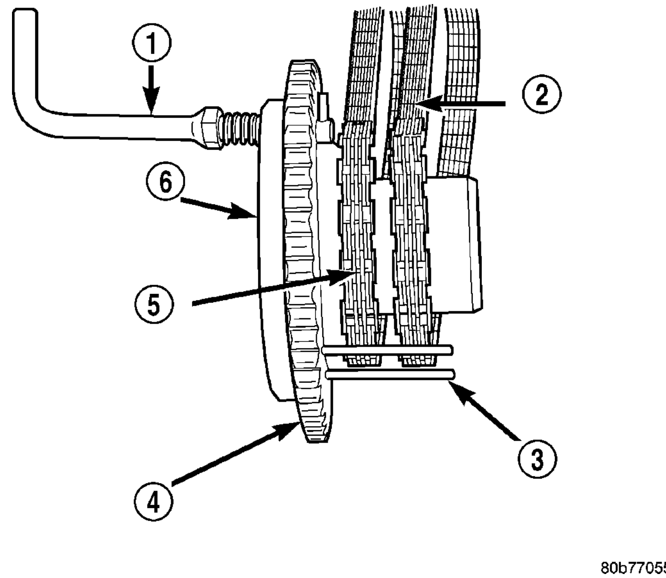


Fig. 133 Installing Secondary Timing Chains on Idler Sprocket

1 - LOCK ARM
2 - RIGHT CAMSHAFT CHAIN
3 - SECONDARY CHAINS RETAINING PINS (4)
4 - IDLER SPROCKET
5 - LEFT CAMSHAFT CHAIN
6 - SPECIAL TOOL 8515

(9) Lubricate idler shaft and bushings with clean engine oil.

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 134). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or the equivalent, This will maintain tension on chains to aid in installation.

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

(11) Align left camshaft sprocket "L" dot to plated link on chain.

(12) Align right camshaft sprocket "R" dot to plated link on chain.

CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in overtorque of bolt resulting in bolt failure.

(13) Remove Special Tool 8515, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the "V8" marks on camshaft sprockets are at the 12 o'clock position (Fig. 131).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

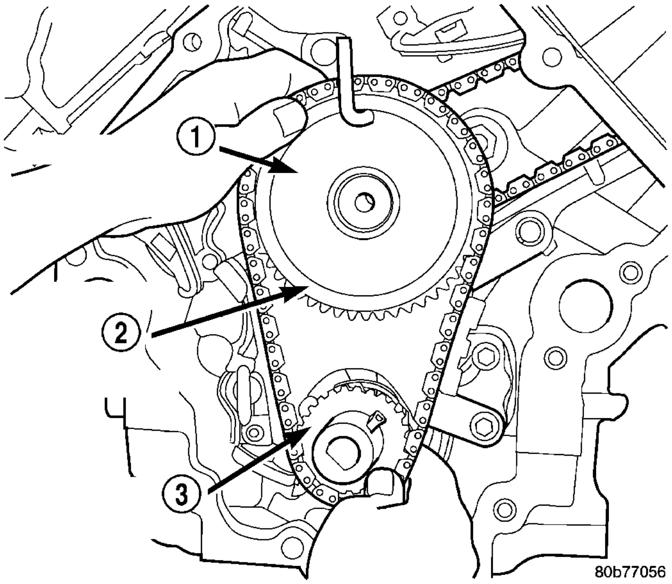


Fig. 134 Installing Idler Gear, Primary and Secondary Timing Chains

1 - SPECIAL TOOL 8429
2 - PRIMARY CHAIN IDLER SPROCKET
3 - CRANKSHAFT SPROCKET

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

(15) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

(16) Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

(17) Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(18) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 135) and right (Fig. 136). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

(19) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock (Fig. 131)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 131)
- secondary chain camshaft sprockets "V8" marks are at 12 o'clock (Fig. 131)

(20) Lubricate all three chains with engine oil.

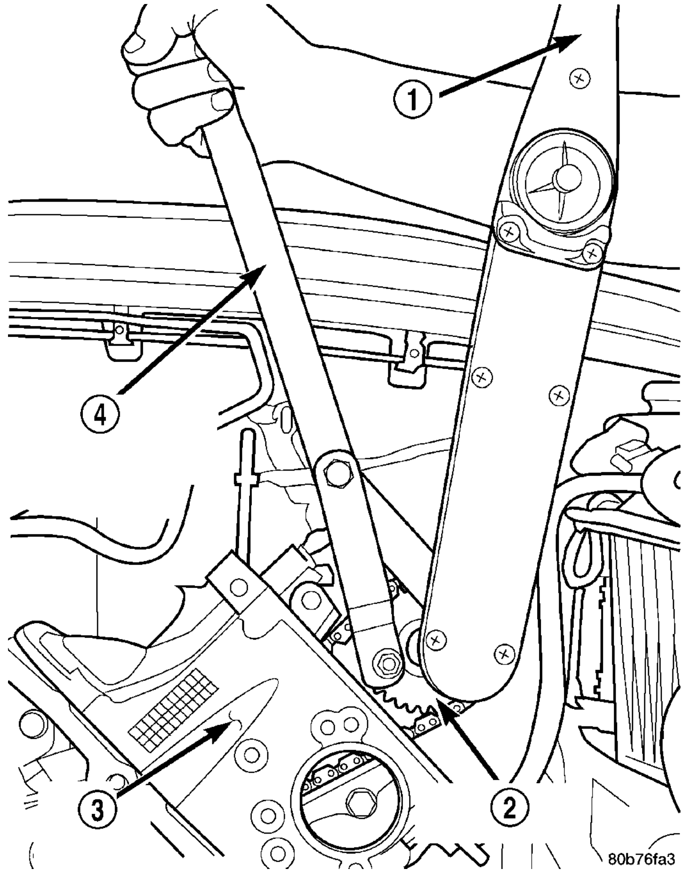


Fig. 135 Tightening Left Side Camshaft Sprocket Bolt

1 - TORQUE WRENCH
2 - CAMSHAFT SPROCKET
3 - LEFT CYLINDER HEAD
4 - SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 137). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

(22) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(23) Install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(24) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.) (Fig. 126).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

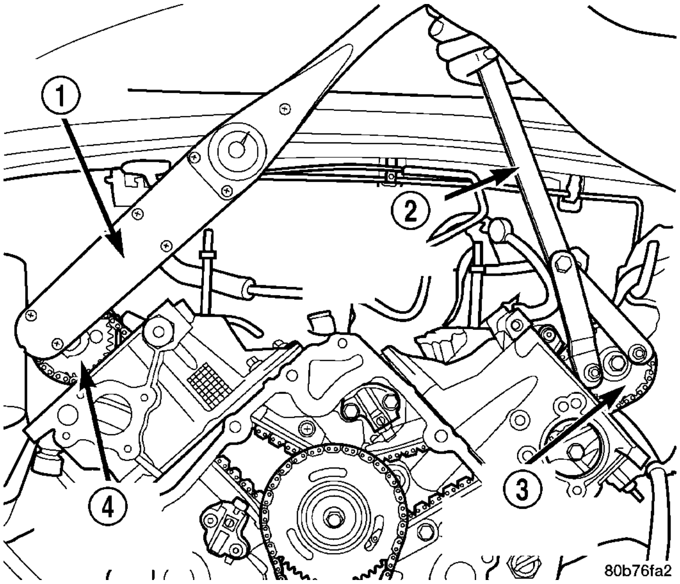


Fig. 136 Tightening Right Side Camshaft Sprocket Bolt

1 - TORQUE WRENCH
2 - SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 - LEFT CAMSHAFT SPROCKET
4 - RIGHT CAMSHAFT SPROCKET

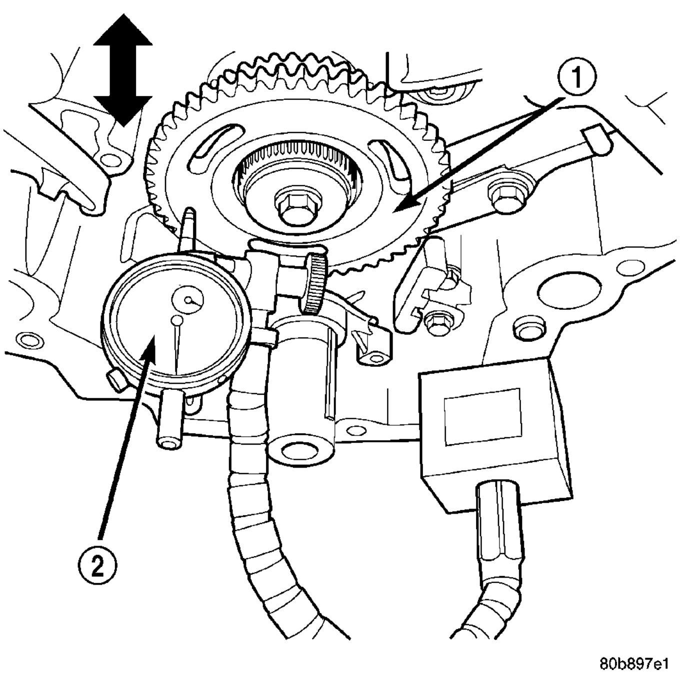


Fig. 137 Measuring Idler Gear End Play

1 - IDLER SPROCKET ASSEMBLY
2 - DIAL INDICATOR

(25) Install the oil fill housing.
(26) Install access plug in left cylinder head (Fig. 126).
(27) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).
(28) Install radiator fan shroud.
(29) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(30) Connect negative cable to battery.

IDLER SHAFT

REMOVAL

(1) Remove the primary and secondary timing chains and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL) .

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft, to install the removal tool.

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore.
(3) Cover the radiator core with a suitable cover.

CAUTION: Use care when removing the idler shaft, Do not strike the radiator cooling fins with the slide hammer.

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft.

INSTALLATION

(1) Thoroughly clean the idler shaft bore.
(2) Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft, with clean engine oil.

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.
(4) Coat the idler shaft with clean engine oil.
(5) Install the timing chains and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

ENGINE - 5.7L

TABLE OF CONTENTS

ENGINE - 5.7L

DESCRIPTION

The 5.7L engine (Fig. 1)(345 CID) eight-cylinder engine is a 90° V-Type lightweight, deep skirt cast iron block, aluminum heads, single cam, overhead valve engine with hydraulic roller tappets. The heads incorporate splayed valves with a hemispherical style combustion chamber and dual spark plugs. The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

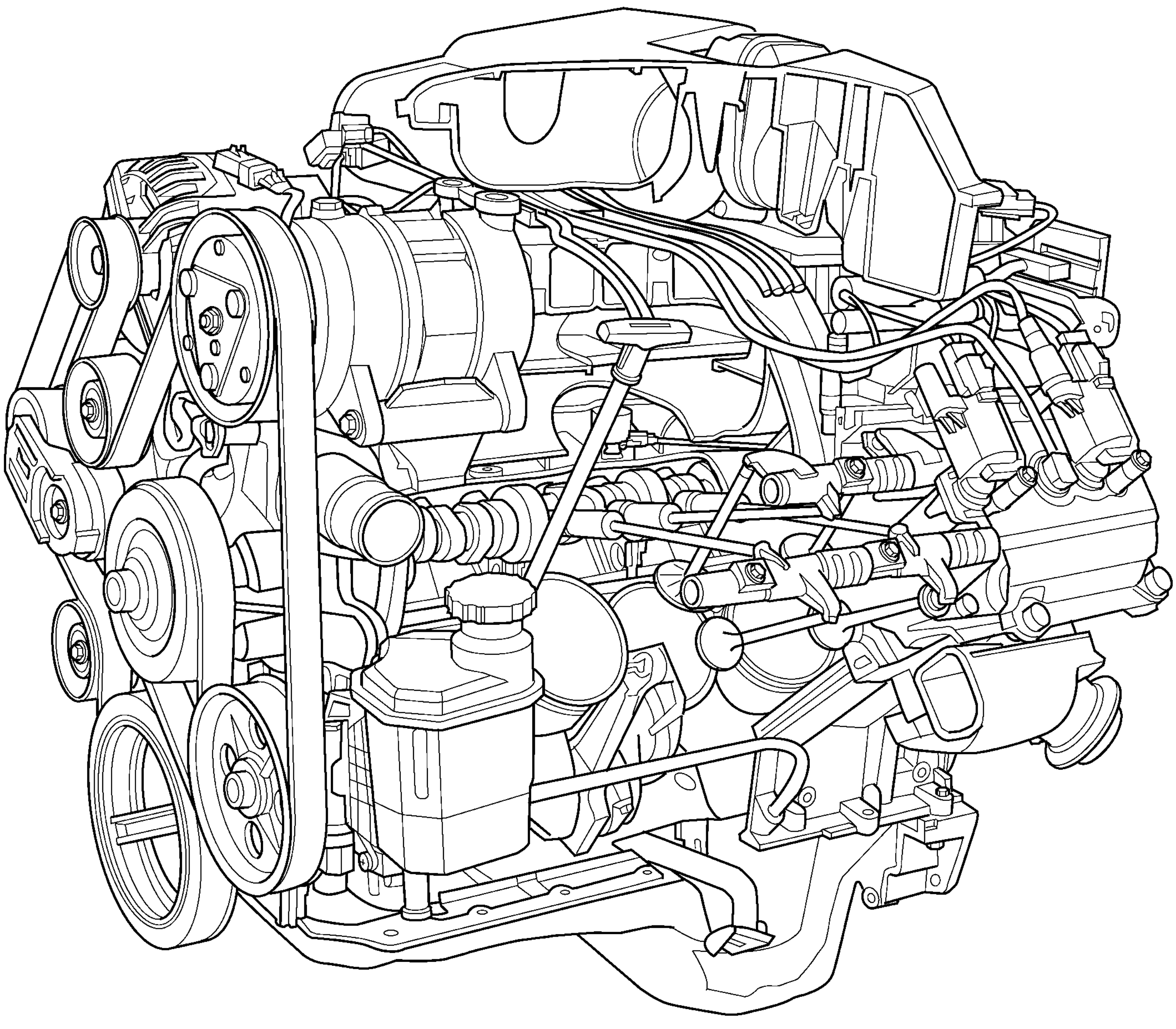


Fig. 1 5.7L ENGINE

ENGINE - 5.7L (Continued)

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—PERFORMANCE and (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)—MECHANICAL for possible causes and corrections of malfunctions. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING) and (Refer to 14 - FUEL SYSTEM/FUEL INJECTION - DIAGNOSIS AND TESTING) for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
- Engine Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING).
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery	1. Charge or replace as necessary.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals.
	3. Faulty starter.	3. (Refer to 8 - ELECTRICAL/ STARTING - DIAGNOSIS AND TESTING).
	4. Faulty coil or control unit.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect spark plug gap.	5. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	6. Dirt or water in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump, relay or wiring.	7. Repair or replace as necessary.
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set to low.	1. (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/IDLE AIR CONTROL MOTOR - REMOVAL).
	2. Idle mixture too lean or too rich.	2. Refer to Powertrain Diagnosis Information.
	3. Vacuum leak.	3. Inspect intake manifold and vacuum hoses, repair or replace as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	5. Incorrect engine timing.	5. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).

ENGINE - 5.7L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
1. ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt or water in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. (Refer to 14 - FUEL SYSTEM/ FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	4. Blown cylinder head gasket.	4. Replace cylinder head gasket.
	5. Low compression.	5. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	6. Burned, warped or pitted valves.	6. Replace as necessary.
	7. Plugged or restricted exhaust system.	7. Inspect and replace as necessary.
	8. Faulty coil.	8. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES ON ACCELERATION	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Dirt in fuel system.	2. Clean fuel system.
	3. Burned, warped or pitted valves.	3. Replcae as necessary.
	4. Faulty coil.	4. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
1. ENGINE MISSES AT HIGH SPEED	1. Spark plugs dirty or incorrectly gapped.	1. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING).
	2. Faulty coil.	2. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/IGNITION COIL - REMOVAL).
	3. Dirt or water in fuel system.	3. Clean system and replace fuel filter.

ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTIONS
NOISY VALVES	1. High or low oil level in crankcase.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	4. Dirt in lash adjusters.	4. Replace as necessary.
	5. Worn rocker arms.	5. Replace as necessary.
	6. Worn lash adjusters	6. Replace as necessary.
	7. Worn valve guides.	7. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
	8. Excessive runout of valve seats on valve faces.	8. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE)
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Service or replace crankshaft.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS)
	2. Low oil pressure.	2. Check oil pump, if Ok, check rod and main bearings for excessive wear.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Replace as necessary.
	5. Excessive end play.	5. Check thrust washers for wear.
	6. Crankshaft journal out-of round.	6. Service or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque

ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DESCRIPTION).

(5) Remove the ASD relay (Refer to 8 - ELECTRICAL/IGNITION CONTROL/AUTO SHUT DOWN RELAY - REMOVAL).

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

(8) (Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner hose.

(6) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(7) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. Set piston of cylinder to be tested at TDC compression,While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary. Inspect valve springs. Replace as necessary.
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

ENGINE - 5.7L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

ENGINE - 5.7L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

ENGINE - 5.7L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:
- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the air cleaner resonator and duct work as an assembly.

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove the viscous fan/drive (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(6) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(7) Remove the upper crossmember and top core support.

NOTE: It is not necessary to drain A/C system for engine removal.

(8) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

(9) Remove generator assembly (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(10) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(11) Remove the intake manifold and IAFM as an assembly(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(12) Disconnect the heater hoses.

NOTE: It is not necessary to disconnect P/S hoses from pump, for P/S pump removal.

(13) Remove the power steering pump and set aside.

(14) Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(15) Raise and support the vehicle on a hoist and drain the engine oil.

(16) Remove engine front mount thru-bolt nuts.

(17) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(18) Disconnect exhaust pipe at manifolds.

(19) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

ENGINE - 5.7L (Continued)

(20) Remove the structural dust cover and transmission inspection cover,(Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - REMOVAL).

(21) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).

(22) Remove transmission bell housing to engine block bolts.

(23) Lower the vehicle.

(24) Install engine lift fixture, special tool # 8984.

(25) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Install engine lift fixture Special tool # 8984.

(2) Position the engine in the engine compartment.

(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Position the thru-bolt into the support cushion brackets.

(5) Lower engine assembly until engine mount through bolts rest in mount perches.

(6) Install remaining transmission to engine block mounting bolts and tighten.

(7) Tighten engine mount through bolts.

(8) Install drive plate to torque converter bolts. (Automatic transmission models)

(9) Install the structural dust cover and transmission dust cover,(Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION) .

(10) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(11) Install exhaust pipe to manifold.

(12) Lower the vehicle.

(13) Remove engine lift fixture, special tool # 8984.

(14) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(15) Reinstall the power steering pump.

(16) Connect the heater hoses.

(17) Install the intake manifold.

(18) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).

(19) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(20) Install a/c compressor and lines (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(21) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(22) Install upper radiator support crossmember.

(23) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(24) Connect the radiator lower hose.

(25) Connect the transmission oil cooler lines to the radiator.

(26) Install the fan shroud.

(27) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(28) Connect the radiator upper hose.

(29) Install the washer bottle.

(30) Connect the transmission cooler lines.

(31) Install the air cleaner resonator and duct work..

(32) Add engine oil to crankcase (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).

(33) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(34) Connect battery negative cable.

(35) Start engine and inspect for leaks.

(36) Road test vehicle.

ENGINE - 5.7L (Continued)

SPECIFICATIONS

5.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	99.5 x 90.9 mm (3.91 x 3.58 in.)
Displacement	5.7L (345 c.i.)
Compression Ratio	9.6:1
Firing Order	1–8–4–3–6–5–7–2
Lubrication	Pressure Feed – Full Flow Filtration
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Aluminum
Crankshaft	Nodular Iron
Camshaft	Hollow assembled camshaft
Pistons	Aluminum Alloy w/strut
Connecting Rods	Powdered metal
CAMSHAFT	
Bearing Journal Diameter	
No. 1	58.2 mm (2.29 in.)
No. 2	57.8 mm (2.27 in.)
No. 3	57.4 mm (2.26 in.)
No. 4	57.0 mm (2.24 in.)
No. 5	43.633 mm (1.72 in.)
Bearing to Journal Clearance Standard	
No. 1	0.040 – 0.080 mm (.0015 – .003 in.)
No. 2	0.050 – 0.090 mm (0.0019 – .0035 in.)
No. 3	0.040 – 0.080 mm (.0015 – .003 in.)
No. 4	0.050 – 0.090 mm (0.0019 – .0035 in.)
No. 5	0.040 – 0.080 mm (.0015 – .003 in.)
Camshaft End Play	0.080 - 0.290 mm (0.0031 - 0.0114 in.)
CONNECTING RODS	
Piston Pin bore Diameter	23.955 – 23.975 mm (0.9431 – 0.9438 in.)
Side Clearance	0.10 - 0.35mm (0.003 - 0.0137 in.)
CRANKSHAFT	
Rod Journal	
Diameter	53.992 – 54.008 mm (2.125 – 2.126 in.)
Out of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.003 mm (0.0001 in.)
Bearing Clearance	0.020 – 0.060 mm (0.0007 – 0.0023 in.)
Main Bearing Journal	
Diameter	64.988 – 65.012 mm (2.5585 – 2.5595 in.)
Out of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.003 mm (0.0001 in.)
Bearing Clearance	0.023 – 0.051mm (0.0009 – 0.002 in.)
Crankshaft End Play	0.052 – 0.282 mm (0.002 – 0.011 in.)
Service Limit	0.282 mm (0.011 in.)

ENGINE - 5.7L (Continued)

DESCRIPTION	SPECIFICATION
CYLINDER BLOCK	
Cylinder Bore	
Diameter	99.50 – mm (3.917 – in.)
Out of Round (Max.)	0.00762 – mm .0003 (in.)
Taper (Max.)	0.0127 – mm 0005 (in.)
Lifter Bore	
Diameter	21.45 – 21.425 mm (0.8444 – 0.8435 in.)
CYLINDER HEAD AND VALVES	
Valve Seat	
Angle	44.50° – 45.00°
Runout (Max.)	0.05 mm (0.0019 in.)
Width (Finish)	
Intake	1.018 – 1.62 mm (0.0464 – 0.0637 in.)
Exhaust	1.48 – 1.92 mm (0.0582 – 0.0755 in.)
Valves	
Face Angle	45.0° – 45.5°
Head Diameter	
Intake	50.67 mm – 50.93 mm (1.99 in.) – (2.00 in.)
Exhaust	39.27mm – 39.53mm (1.54 in.) – (1.55 in.)
Length (Overall)	
Intake	123.38 – 123.76 mm (4.857 in. – 4.872 in.)
Exhaust	120.475 – 120.855 mm (4.743 in. – 4.758 in.)
Valve Lift (@ zero lash)	
Intake	12 mm (0.472 in.)
Exhaust	11.7 mm (0.460 in.)
Stem Diameter	
Intake	7.935 - 7.953 mm (0.312 - 0.313 in.)

DESCRIPTION	SPECIFICATION
Exhaust	7.905 - 7.925 mm (0.311 - 0.312 in.)
Guide Bore	7.975 - 8.000 mm (0.313 - 0.314 on.)
Stem to Guide Clearance	
Intake	0.022 - 0.065 mm (0.0008 - 0.0025 in.)
Exhaust	0.050 - 0.095 mm (0.0019 - 0.0037 in.)
Valve Springs	
Spring Tension	
Valve closed	422 N @ 46.0 mm (95 lbs. @ 1.81 in.)
Valve open	@ 33.5 mm
Number of Coils	7.4
Installed Height	46.0 mm (1.81 in.)
Wire Diameter	5.39 x 4.52mm (0.212 – 0.177in.)
HYDRAULIC TAPPETS	
Body Diameter	21.387 - 21.405 mm (0.8420 - 0.8427 in.)
Clearance (to bore)	0.020 - 0.063 mm (0.0007 - 0.0024 in.)
Dry Lash	3.0 mm (at the valve) (0.1181 in.)
OIL PRESSURE	
Curb Idle (Min.*)	25 kPa (4 psi)
@ 3000 rpm	170-758 kPa (25-110 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance over Rotors (Max.)	.095 mm (0.0038 in.)
Outer Rotor to pump body	

ENGINE - 5.7L (Continued)

DESCRIPTION	SPECIFICATION
Clearance (Max.)	0.235 mm (0.009 in.)
Tip Clearance between Rotors (Max.)	.150 mm (0.006 in.)
PISTONS	
Clearance at Top of Skirt measured at 45.0 mm (1.77 in.) below deck	0.0215 - 0.0485 mm (0.0008 - 0.0019 in.)
Land Clearance (Diam.)	
Groove #1	0.6715 - 0.7105 mm (0.0264 - 0.0279 in.)
Groove #2	.5455 - .6245 (0.0214 - 0.0245 in.)
Piston Length	54.70 – 55.30mm (2.153 – 2.177 in.)
Piston Ring Groove Width	
Groove #1	1.51 - 1.54 mm (0.0594 - 0.0606 in.)
Groove #2	1.51 - 1.53 mm (0.0594 - 0.0602 in.)
Groove #3	3.030 - 3.055 mm (0.1192 - 0.1202 in.)
Weight	413 grams (14.56 oz.)
PISTON PINS	
Clearance in Piston	0.009 - 0.018 mm (0.00035 - 0.00070 in.)
Diameter	24.0 - 24.003 mm (0.9448 - 0.9449 in.)
Length	69.75 - 70.25 mm (2.74 - 2.76 in.)
PISTON RINGS	
Ring Gap	
Compression Ring (Top)	0.23 - 0.38 mm (0.0090 - 0.0149 in.)

DESCRIPTION	SPECIFICATION
Compression Ring (2nd)	0.35 - 0.60 mm (0.0137 - 0.0236 in.)
Oil Control (Steel Rails)	0.15 - 0.66 mm (0.0059 - 0.0259 in.)
Ring Side Clearance	
Compression Rings	
Top	0.02 - 0.068 mm (0.0007 - 0.0026 in.)
2nd	0.02 - 0.058 mm (0.0007 - 0.0022 in.)
Ring Width	
Compression rings	1.472 - 1.490 mm (0.05795 - 0.0586 in.)
Oil Ring (Steel Rails) & Max.	0.447 - 0.473 mm (0.0175 - 0.0186 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	27°
Opens (BTDC)	233°
Intake Valve	
Closes (ATDC)	253°
Opens (BTDC)	7°
Valve Overlap	34°

ENGINE - 5.7L (Continued)

TORQUE

TORQUE CHART 5.7L ENGINE

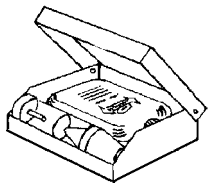
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Block Pipe Plugs (1/4 NPT)	20	—	177
(3/8 NPT)	27	—	240
Camshaft Sprocket—Bolt	122	90	—
Camshaft Tensioner Plate—Bolts	28	—	250
Timing Chain Case Cover—Bolts	28	—	250
Lifting Stud	55	40	—
Connecting Rod Cap—Bolts	21 plus 90° Turn	15 plus 90° Turn	—
Main Bearing Cap—Bolts M-12	27 plus 90° Turn	—	—
Crossbolts M-8	28	—	—
Cylinder Head—Bolts M-12 Bolts			
Step 1	34	25	—
Step 2	54	40	—
Step 3	Turn 90°	Turn 90°	—
M-8 Bolts			—
Step 1	20	15	—
Step 2	34	25	—
Cylinder Head Cover—Bolts	8	—	70
Exhaust Manifold to Cylinder Head	25	—	220
Flywheel—Bolts	95	70	—
Front Insulator—Through bolt/nut	95	70	—
Front Insulator to Support Bracket			
—Stud Nut (4WD)	41	30	—
—Through Bolt/Nut (4WD)	102	75	—
Front Insulator to Block—Bolts (2WD)	95	70	—
Generator—Mounting Bolt	55	40	—
Intake Manifold—Bolts	Refer to Procedure		

DESCRIPTION	N·m	Ft.	In.
Oil Pan—Bolts	12	—	105
Oil Dipstick Tube	12	—	105
Oil Pan—Drain Plug	34	25	—
Oil Pump—Attaching Bolts	28	—	250
Oil Pump Pickup Tube – Bolt and Nut	28	—	250
Rear Seal Retainer Attaching Bolts	15	—	132
Rear Insulator to Bracket—Through-Bolt (2WD)	68	50	—
Rear Insulator to Crossmember Support Bracket—Nut (2WD)	41	30	—
Rear Insulator to Crossmember—Nuts (4WD)	68	50	—
Rear Insulator to Transmission—Bolts (4WD)	68	50	—
Rear Insulator Bracket—Bolts (4WD Automatic)	68	50	—
Rear Support Bracket to Crossmember Flange—Nuts	41	30	—
Rear Support Plate to Transfer Case—Bolts	41	30	—
Rocker Arm—Bolts	22	—	195
Spark Plugs	—	—	—
Thermostat Housing—Bolts	28	—	250
Throttle Body—Bolts	12	—	105
Transfer Case to Insulator Mounting Plate—Nuts	204	105	—
Transmission Support Bracket—Bolts (2WD)	68	50	—
Vibration Damper—Bolt	176	129	—
Water Pump to Timing Chain Case Cover—Bolts	28	—	250

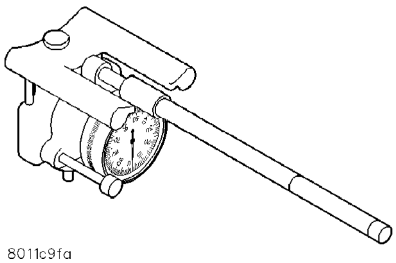
ENGINE - 5.7L (Continued)

SPECIAL TOOLS

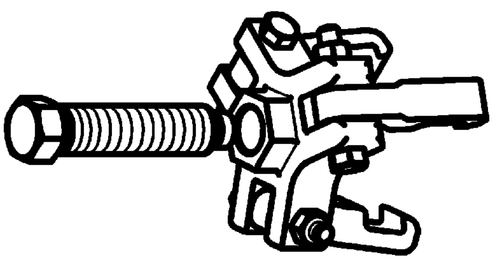
5.7L ENGINE



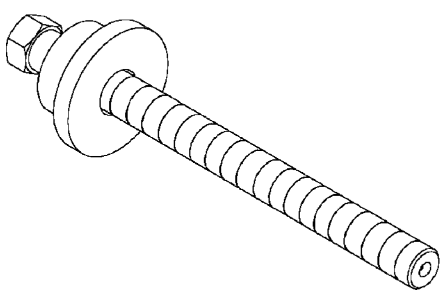
Bloc–Chek–Kit C-3685–A



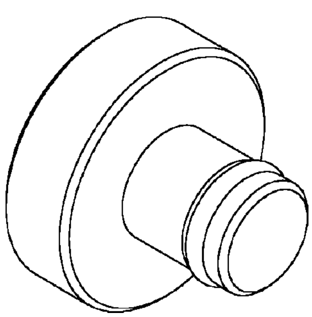
Bore Size Indicator C-119



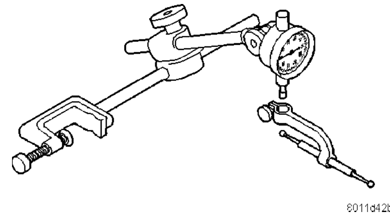
Puller 8454



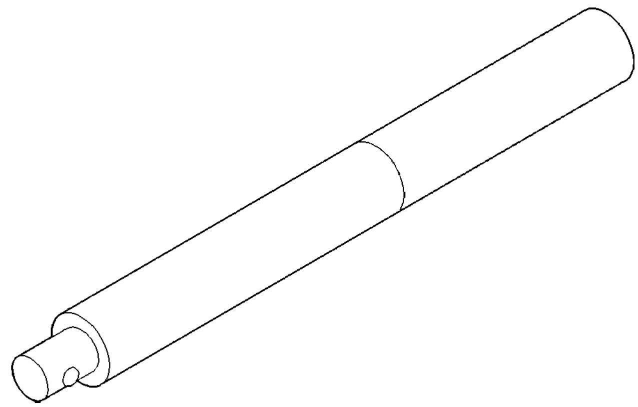
Crankshaft Damper Installer 8512



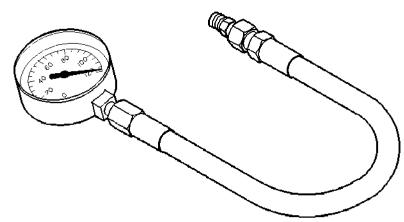
Crankshaft Damper Removal Insert 8513 - A



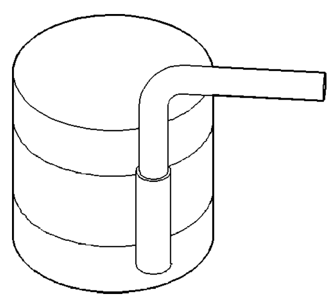
Dial Indicator C-3339



Handle C-4171

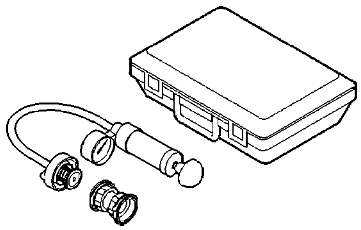


Oil Pressure Gauge C-3292

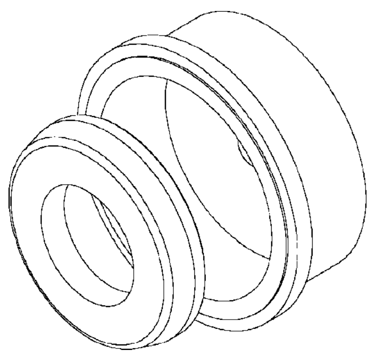


Piston Ring Compressor C-385

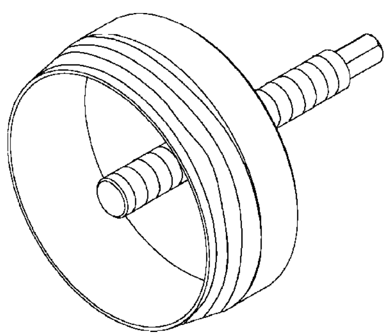
ENGINE - 5.7L (Continued)



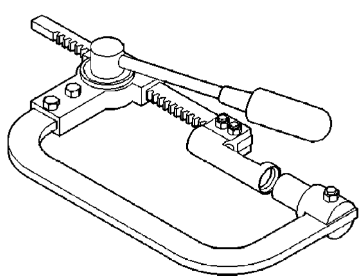
Pressure Tester Kit 7700



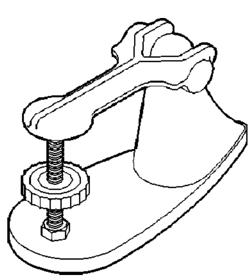
Rear Crankshaft Seal Installer 8349



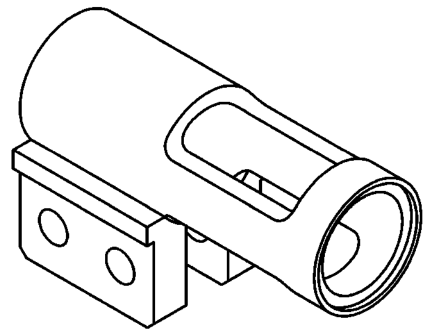
Rear Crankshaft Seal Remover 8506



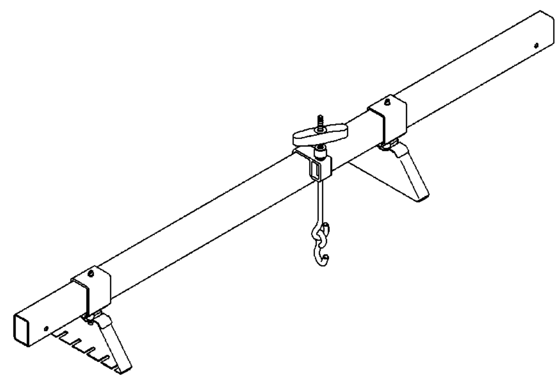
Valve Spring Compressor C-3422-B



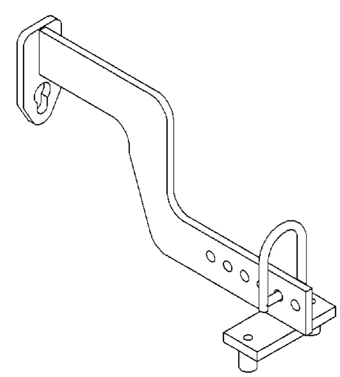
Valve Spring Tester C-647



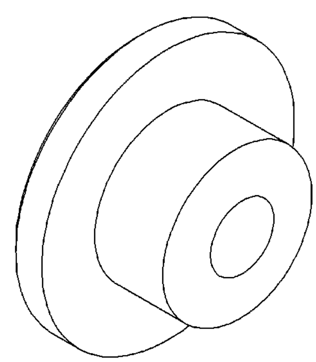
Adapter, Valve Spring Compressor Off-vehicle 8464



ENGINE SUPPORT FIXTURE 8534



ENGINE LIFT FIXTURE 8984



REAR CAM PLUG INSTALLER 9048

AIR INTAKE SYSTEM

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 2) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 2) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 2) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

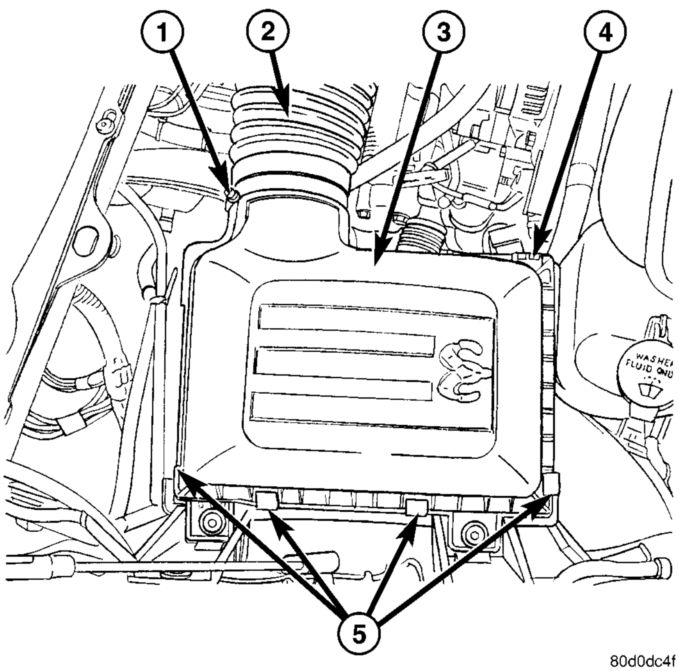


Fig. 2 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 2) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 3).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 2).

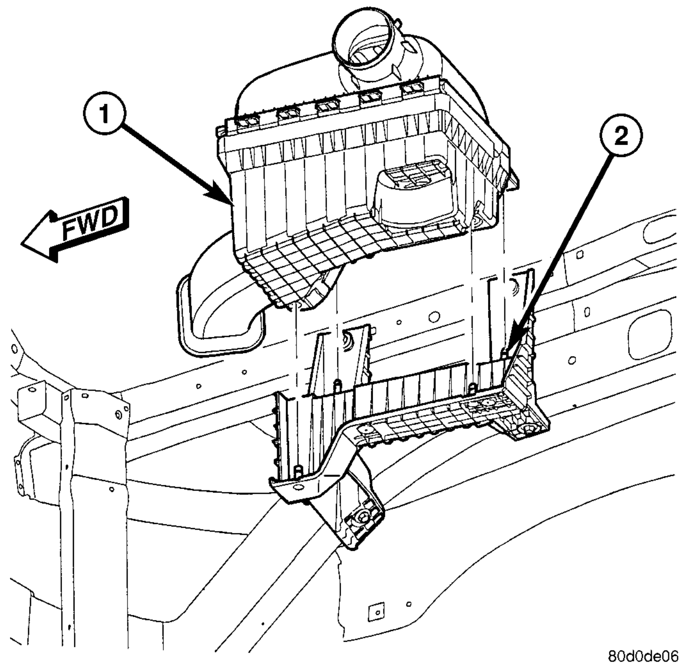


Fig. 3 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 2) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

OPERATION—CYLINDER HEAD

The cylinder head closes the combustion chamber allowing the pistons to compress the air fuel mixture to the correct ratio for ignition. The valves located in the cylinder head open and close to either allow clean air into the combustion chamber or to allow the exhaust gases out, depending on the stroke of the engine.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

• Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

CYLINDER HEAD (Continued)

– Loss of engine power
– Engine misfiring
– Poor fuel economy

• Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

– Engine overheating
– Loss of coolant
– Excessive steam (white smoke) emitting from exhaust
– Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test in this section. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50–70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system.

(3) Remove the air cleaner resonator and duct work.

(4) Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect heater hoses.

(9) Remove cylinder head covers and gaskets.

(10) Remove intake manifold and throttle body as an assembly.

(11) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(12) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.

(2) Inspect the valve seats for damage. Service the valve seats as necessary.

(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

(4) Inspect pushrods. Replace worn or bent pushrods.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

CAUTION: The head gaskets are not interchangeable between left and right sides. They are marked “L” and “R” to indicate left and right sides.

(3) Position new cylinder head gaskets onto the cylinder block.

CYLINDER HEAD (Continued)

CAUTION: The head gaskets are marked "TOP" to indicate which side goes up.

(4) Position cylinder heads onto head gaskets and cylinder block.

(5) Tighten the cylinder head bolts in three steps (Fig. 4):

- Step 1— Snug tighten M12 cylinder head bolts, in sequence, to 34 N·m (25 ft. lbs.) and M8 bolts to 20 N·m (15 ft. lbs.) torque.
- Step 2— Tighten M12 cylinder head bolts, in sequence, to 54 N·m (40 ft. lbs.) and verify M8 bolts to 20 N·m (15 ft. lbs.) torque..
- Step 3— Turn M12 cylinder head bolts, in sequence, 90 degrees and tighten M8 bolts to 34 N·m (25 ft. lbs.) torque.

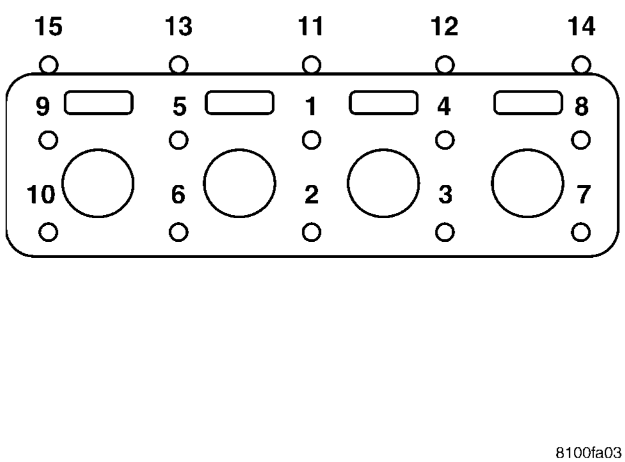


Fig. 4 CYLINDER HEAD TIGHTENING SEQUENCE

(6) Install push rods and rocker arm assemblies in their original position.

(7) Install the intake manifold and throttle body assembly.

(8) If required, adjust spark plugs to specifications. Install the plugs.

(9) Connect the heater hoses.

(10) Install the fuel supply line.

(11) Install the generator and drive belt.

(12) Install cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(13) Connect the evaporation control system.

(14) Install the air cleaner.

(15) Fill cooling system.

(16) Connect the negative cable to the battery.

(17) Start engine check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect coil on plug connectors.

CAUTION: The ground straps must be installed in the same location as removed. The covers are machined to accept the ground straps in those locations only.

(3) Remove cylinder head cover retaining bolts, and ground straps.

(4) Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location and install left and right ground straps.

CAUTION: The ground straps must be installed in the same location as removed. The covers are machined to accept the ground straps in those locations only.

NOTE: The right hand ground strap is located on the front inboard stud. The left hand ground strap is located on the rear inboard stud.

(3) Tighten cylinder head cover bolts and double ended studs to 8 N·m (70 in. lbs). Begin torque sequence in the middle of head cover and torque bolts moving outward in a crisscross pattern from top to bottom.

(4) Install ignition coil on plug, and torque fasteners to 12 N·m (105 in. lbs)

(5) Connect, ignition coil electrical connectors.

(6) Install PCV hose.

(7) Connect battery negative cable.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

DESCRIPTION - VALVE GUIDES

The valve guides are made of powered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, and valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

DESCRIPTION

Both the intake and exhaust valves are made of steel. The intake valve is 50.93 mm (2.00 inches) in diameter and the exhaust valve is 39.53 mm (1.55 inches) in diameter. All valves use three bead lock keepers to retain the springs and promote valve rotation.

STANDARD PROCEDURE - REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves and valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(1) Using a suitable dial indicator measure the center of the valve seat Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.018 - 1.62 mm (0.0464 - 0.0637 in.) and the exhaust seat must be 1.48 - 1.92 mm (0.058 - 0.075 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 46.0 mm (1.81 in.).

VALVE FACE AND VALVE SEAT ANGLE CHART

DESCRIPTION	SPECIFICATION
SEAT WIDTH	
INTAKE	1.018 - 1.62 mm (0.0464 - 0.0637 in.)
EXHAUST	1.48 - 1.92 mm (0.058 - 0.075 in.)
FACE ANGLE (INT. AND EXT.)	45° - 45½°
SEAT ANGLE (INT. AND EXT.)	44½° - 45°

(5) The valve seat must maintain an angle of 44.5 – 45.0 degrees angle.

(6) The valve face must maintain a face angle of 45.0 – 45.5 degrees angle (Fig. 5).

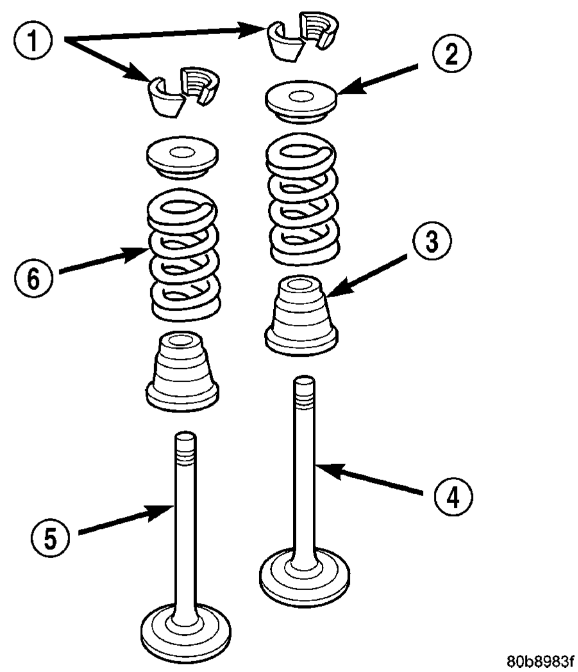


Fig. 5 Valve Assembly Configuration

1 - VALVE LOCKS (3–BEAD)
2 - RETAINER
3 - VALVE STEM OIL SEAL
4 - INTAKE VALVE
5 - EXHAUST VALVE
6 - VALVE SPRING

REMOVAL

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(2) Compress valve springs using Valve Spring Compressor Tool special tool # C-3422and adapter 8464.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool special tool # C- 3422and adapter 8464, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer.

(8) Install cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSY

REMOVAL

(1) Remove cylinder head cover.(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

(2) Loosen the rocker shafts using the following sequence: **Center, center-left, center-right, left, right,**.

CAUTION: The rocker shaft assemblies are not interchangeable between intake and exhaust. The intake rocker arms are marked with an "I".

(3) Remove the rocker shafts. Note location for reassembly.

CAUTION: The longer push rods are for the exhaust side, and the shorter push rods are for intake side.

(4) Remove the pushrods. Note pushrod location for reassembly.

INSTALLATION

CAUTION: The longer push rods are for the exhaust side, and the shorter push rods are for intake side.

(1) Install the push rods in the same order as removed.

CAUTION: Verify that pushrod is installed into rocker arm and lifter correctly while installing rocker shaft assembly. Recheck after rocker shaft has been torqued to specification.

CAUTION: The rocker shaft assemblies are not interchangeable between intake and exhaust. The intake rocker arms are marked with the letter "I".

(2) Install rocker shaft assemblies in the same order as removed.

CAUTION: Ensure that hold downs and rocker arms are not overlapped when torquing bolts.

(3) Tighten the rocker shaft bolts to 22 N·m (195 in. lbs.) torque,using the following sequence: **Center, center-right, center-left, right, left**.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(4) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

VALVE STEM SEALS

DESCRIPTION

The valve guide seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

VALVE SPRINGS

REMOVAL

(1) Disconnect negative battery cable.
(2) Remove air cleaner assembly.
(3) Remove air intake resonator.
(4) Remove spark plug cables.
(5) Remove ignition coil connectors (Fig. 6).

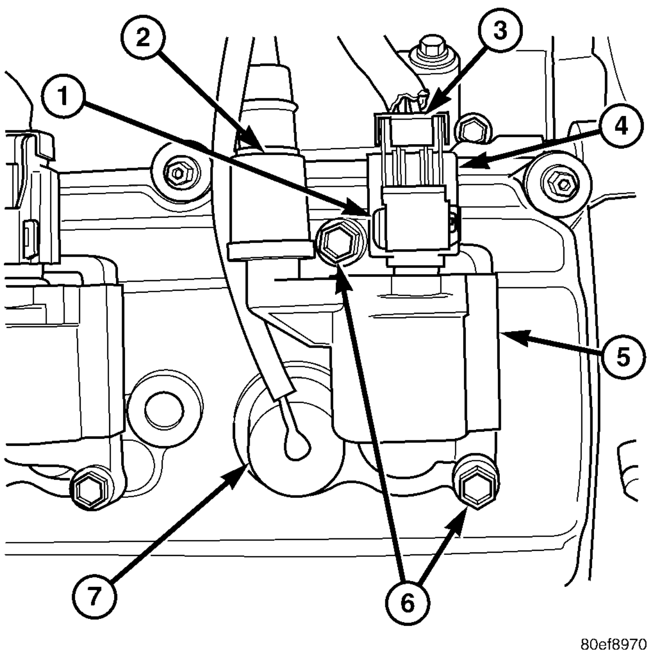


Fig. 6 IGNITION COIL R/I — 5.7L V-8

1 - SLIDE LOCK (SLIDE OUTWARD TO UNLOCK)
2 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK SPARK PLUG)
3 - RELEASE LOCK / TAB (PUSH HERE)
4 - ELEC. CONNECTOR
5 - IGNITION COIL
6 - COIL MOUNTING BOLTS (2)
7 - SPARK PLUG CABLE (TO OPPOSITE CYLINDER BANK IGNITION COIL)

(6) Remove ignition coils.
(7) Remove one spark plug.
(8) Remove valve cover.

CAUTION: The piston must be at TDC, and both valves closed on the cylinder to be serviced.

(9) Remove exhaust/intake rocker arm shafts.
(10) Install spring compressor, special tool# 9065.

NOTE: All valve springs and seals are removed in the same manner.

(11) Charge cylinder with air.

NOTE: Tap the top of the valve spring retainer to loosen the spring retainers locks.

(12) Compress valve spring and remove valve retainer locks.
(13) Release spring compressor and remove valve spring.

NOTE: The valve springs are interchangeable between intake and exhaust.

(14) Remove valve seal.

INSTALLATION

(1) Install valve seal.
(2) Install valve spring.
(3) Using special tool# 9065, compress valve spring and install valve spring retainer and locks.
(4) Release air charge in cylinder.
(5) Remove spring compressor tool # 9065.

CAUTION: Verify that the pushrods are fully seated into lifter and rocker arm. Recheck after rocker arm shaft has been torqued to specification.

(6) Install rocker arm shaft and pushrods(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).
(7) Tighten the rocker shaft bolts to 22 N·m (195 in. lbs.) torque,using the following sequence: **Center, center-right, center-left, right, left**.
(8) Install cylinder head cover.
(9) Tighten cylinder head cover bolts and double ended studs(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION) .
(10) Install spark plugs.
(11) Install ignition coil on plug, and torque fasteners to 12 N·m (105 in. lbs)
(12) Install ignition coil connectors.
(13) Install spark plug cables.
(14) Install air intake resonator.
(15) Install air cleaner assembly.
(16) Connect negative battery cable.

ENGINE BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the 1/4 inch NPT plugs to 20 N·m (177 in. lbs.) torque. Tighten the 3/8 inch NPT plugs to 27 N·m (240 in. lbs.) torque.

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 7).

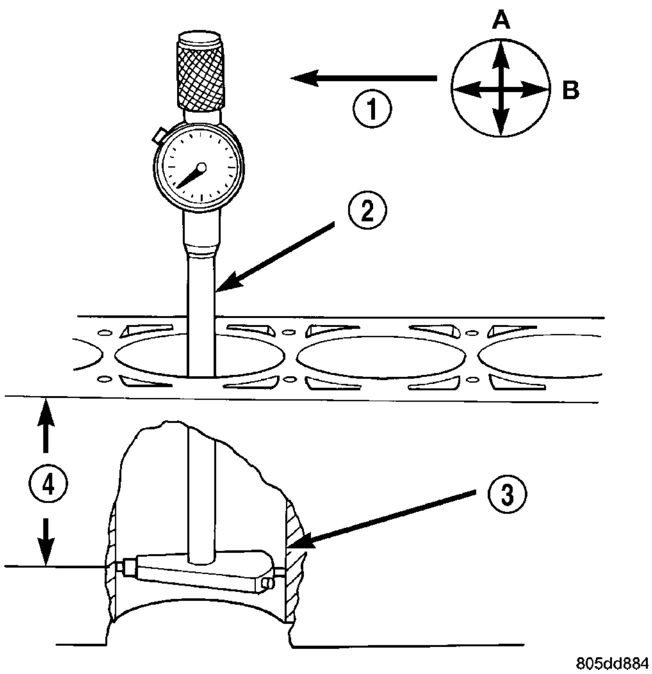


Fig. 7 BORE GAUGE-TYPICAL

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM
(1.5 in)

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL - CAMSHAFT CORE HOLE PLUG

CAUTION: Do not damage the rear surface of the camshaft or the core plug sealing surface, when removing the core plug.

(1) Remove the rear cam bearing core plug.

REMOVAL - CAMSHAFT

(1) Remove the battery negative cable.
(2) Remove the air cleaner assembly.
(3) Drain coolant.
(4) Remove the accessory drive belt.
(5) Remove the generator.
(6) Remove the A/C compressor, and set aside
(7) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).
(8) Remove intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).
(9) Remove cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(10) Remove both left and right cylinder heads(Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).
(11) Remove the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(12) Remove timing case cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(13) Remove the oil pick up tube.

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(14) Remove the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(15) Remove timing chain(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(16) Remove camshaft tensioner/thrust plate assembly.

NOTE: Identify lifters to ensure installation in original location.

(17) Remove the lifters and retainer assembly.

(18) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSPECTION

(1) The cam bearings are not serviceable. Do not attempt to replace cam bearings for any reason.

INSTALLATION

INSTALLATION - CAMSHAFT CORE HOLE PLUG

CAUTION: The new core hole plug must be installed to the proper depth or camshaft damage could develope. The plug must be installed squarely in the bore.

(1) Install a new core hole plug at the rear of camshaft, using special tool # 9048. Clean plug and apply mopar® lock and seal adhesive to the edge of the plug, before installing. The plug must be installed to a depth of + / - 0.25mm from the end of the machined bevel, that is the end of the bevel that is closest to the cam bearing.

INSTALLATION - CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft

(2) Install camshaft Tensioner plate assembly. Tighten bolts to 28 N·m (250 in. lbs.) torque.

(3) Install timing chain and sprockets(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(4) Measure camshaft end play(Refer to 9 - ENGINE - SPECIFICATIONS). If not within limits install a new thrust plate.

(5) Install the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(6) Install the oil pick up tube.

(7) Each lifter reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the lifters must be replaced.**

(8) Install lifters and retainer assembly.

(9) Install both left and right cylinder heads(Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(10) Install pushrods

(11) Install rocker arms(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(12) Install timing case cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(13) Install the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(14) Install cylinder head covers(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(15) Install intake manifold(Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(16) Install the A/C compressor, and set aside

(17) Install the generator.

(18) Install the accessory drive belt.

(19) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(20) Install the air cleaner assembly.

(21) Install the battery negative cable.

(22) Refill coolant.

(23) Refill engine oil.

(24) Start engine and check for leaks.

CRANKSHAFT

REMOVAL

(1) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(2) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Remove the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove the oil pump pickup.

(5) Remove the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(6) Remove the timing drive(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(7) Identify rod bearing caps before removal. Remove rod bearing caps with bearings.

(8) Identify main bearing caps before removal. Remove main bearing caps and bearings one at a time.

(9) Remove the thrust washers.

(10) Remove the crankshaft out of the block.

CRANKSHAFT (Continued)

(11) Remove the rear oil seal retainer(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT REAR OIL SEAL RETAINE - REMOVAL).

(12) Remove and discard the crankshaft rear oil seal.

(13) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Select the proper main bearings(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE).

(2) Install main bearings in block and caps, and lubricate bearings.

(3) Position the crankshaft into the cylinder block.

(4) Install the thrust washers.

NOTE: The main cap crossbolts are torqued after final torque of the main cap bolts. Always use a new washer/seal on crossbolts.

(5) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten in two steps using the following sequence (Fig. 8).

- Step 1 – 27 N·m (20ft. lbs.) torque.
- Step 2 – Turn main cap bolts an additional 90°.

(6) Install the crossbolts with new washer/gasket.

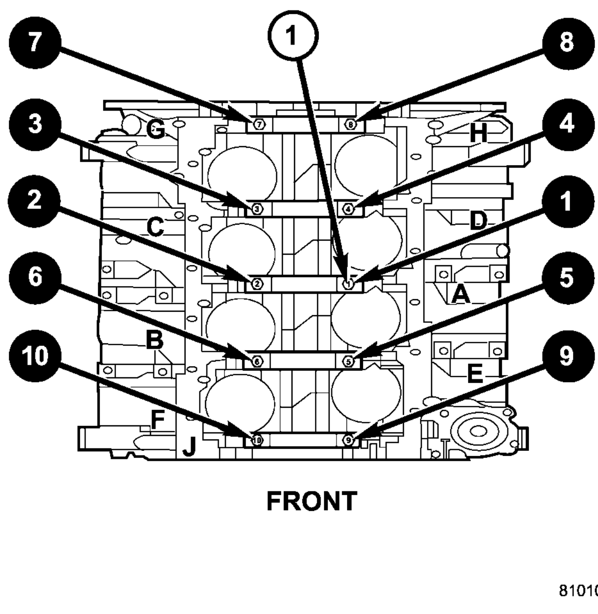


Fig. 8 MAINCAP TIGHTENING SEQUENCE

1 - Stud Location

Starting with crossbolt A (Fig. 8) torque each crossbolt to 28 N·m torque.

(7) Repeat crossbolt torque procedure.

(8) Measure crankshaft end play(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE).

(9) Position the connecting rods onto the crankshaft and install the rod bearing caps(Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - INSTALLATION).

(10) Install timing drive(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(11) Install oil pump and pickup(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(12) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(13) Install the oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(14) Install the rear main seal and retainer.

(15) Install the vibration damper.

(16) Install the engine(Refer to 9 - ENGINE - INSTALLATION).

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING - FITTING

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Crankshaft removed from the cylinder block.

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.0002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are “select fit” to achieve proper oil clearances. For main bearing selection, the crankshaft counterweight has grade identification marks stamped into it. These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5.

NOTE: Service main bearings are coded. These codes identify what size (grade) the bearing is.

CRANKSHAFT MAIN BEARINGS (Continued)

MAIN BEARING SELECTION CHART - 5.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	64.988–64.995 mm (2.5585– 2.5588in.)
B	NOMINAL	64.996–65.004 mm (2.5588–2.5592 in.)
C	0.008 mm O/S (0.0004 in.) O/S	65.005–65.012 mm (2.5592–2.5595 in.)

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 9).

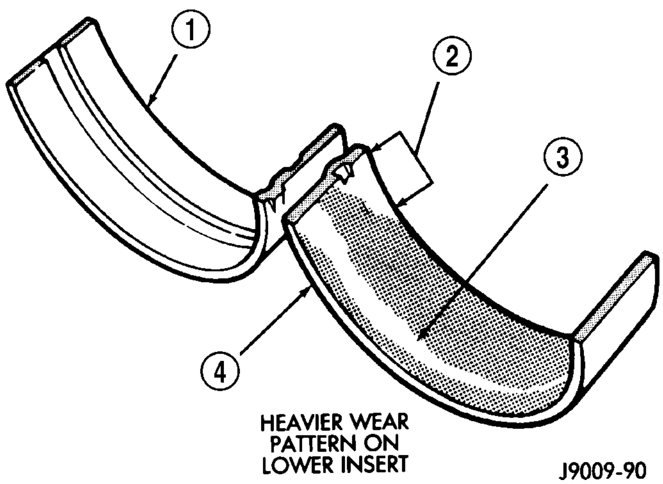


Fig. 9 Main Bearing Wear Patterns

1 - UPPER INSERT
2 - NO WEAR IN THIS AREA
3 - LOW AREA IN BEARING LINING
4 - LOWER INSERT

NOTE: If any of the crankshaft journals are scored, the crankshaft must be repaired or replaced.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove upper radiator hose.

(5) Remove radiator shroud attaching fasteners.

(6) Remove radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(7) Remove crankshaft damper bolt.

(8) Remove damper using Special Tools 8513A Insert and 8454 Three Jaw Puller.

(9) Using Special Tool 9071, remove crankshaft front seal.

INSTALLATION

CAUTION: The front crankshaft seal must be installed dry. Do not apply lubricant to sealing lip or to outer edge.

(1) Using Special Tool 8348 and 8512A, install crankshaft front seal.

CAUTION: To prevent severe damage to the Crankshaft or Damper, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(2) Install vibration damper (Refer to 9 - ENGINE/ ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install radiator cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(4) Install upper radiator hose.

(5) Install accessory drive belt refer (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Connect negative cable to battery.

CRANKSHAFT OIL SEAL - REAR

DIAGNOSIS AND TESTING - REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft bore cup plugs, oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces. See Engine, for proper repair procedures of these items.

(4) If no leaks are detected, pressurized the crankcase as outlined in the section, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks or scratches. The crankshaft seal flange is specially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING), under the Oil Leak row, for components inspections on possible causes and corrections.

(7) After the oil leak root cause and appropriate corrective action have been identified, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

REMOVAL

NOTE: This procedure can be performed in vehicle.

(1) If being preformed in vehicle, remove the transmission.

(2) Remove the flexplate (Refer to 9 - ENGINE/ ENGINE BLOCK/FLEX PLATE - REMOVAL).

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

(3) Using Special Tool 8506, remove the crankshaft rear oil seal.

INSTALLATION

CAUTION: The rear seal must be installed dry for proper operation. Do not lubricate the seal lip or outer edge.

(1) Position the plastic seal guide onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle, with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

(3) Install the flexplate.

(4) Install the transmission.

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the transmission.

(3) Remove the drive plate / flywheel.

(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(5) Remove the rear oil seal retainer mounting bolts.

(6) Carefully remove the retainer from the engine block.

CRANKSHAFT REAR OIL SEAL RETAINER (Continued)

INSTALLATION

(1) Throughly clean all gasket resdue from the engine block.

(2) Use extream care and clean all gasket resdue from the retainer.

(3) Position the gasket onto the retainer.

(4) Position the retainer onto the engine block.

(5) Install the retainer mounting bolts. Tighten the bolts to 15 N·m (132 in. lbs.) using a crisscross pattern, starting with the bolt on the lower right.

(6) Install a new rear seal(Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).

(7) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(8) Install the drive plate / flywheel.

(9) Install the transmission.

(10) Check and verify engine oil level.

(11) Start engine and check for leaks.

FLEX PLATE

REMOVAL

(1) Remove the transmission.

(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.

(2) Tighten the flexplate retaining bolts to 95 N·m (70 ft. lbs.).

(3) Install the transmission.

PISTON & CONNECTING ROD

DESCRIPTION

CAUTION: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

The pistons are made of a high strength aluminum alloy. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The piston top ring groove and land is anodized. The connecting rods are made of forged powdered metal, with a “fractured cap” design. A pressed fit piston pin is used to attach the piston and connecting rod.

STANDARD PROCEDURE—PISTON FITTING

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 38.0 mm (1.5 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 11).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 10). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

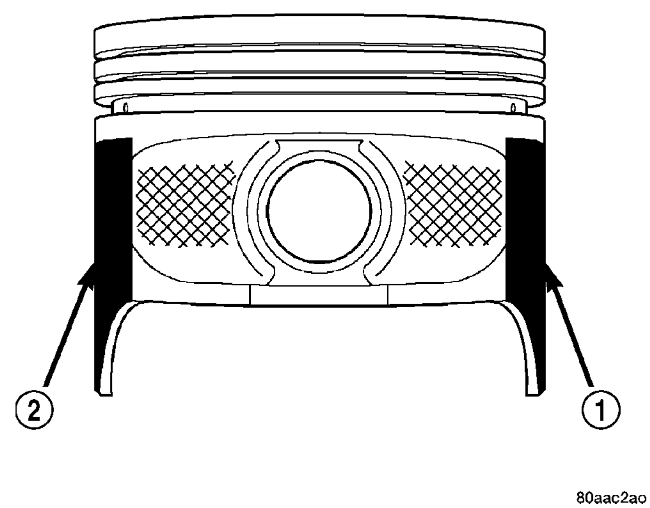


Fig. 10 Moly Coated Piston

1 - MOLY COATED
2 - MOLY COATED

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components:

- Oil pan and gasket/windage tray (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
- Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
- Timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

PISTON & CONNECTING ROD (Continued)

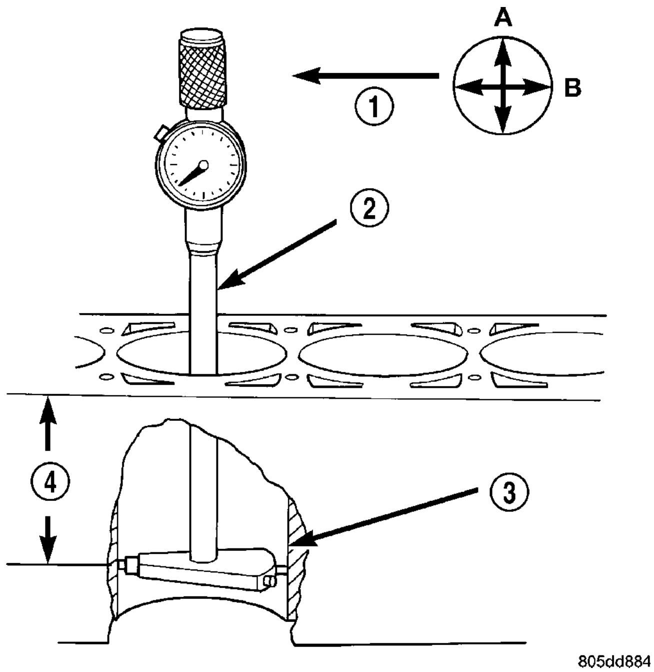


Fig. 11 Bore Gauge—Typical

1 - FRONT
2 - BORE GAUGE
3 - CYLINDER BORE
4 - 38 MM
(1.5 in)

• Cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL) and (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 12).

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

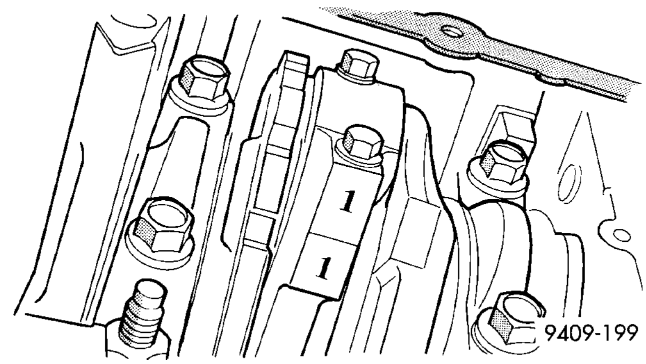


Fig. 12 Identify Connecting Rod to Cylinder Position—Typical

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

PISTON & CONNECTING ROD (Continued)

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Before installing piston and connecting rod assemblies into the bore, install the piston rings(Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads.

(5) The pistons are marked on the piston pin bore surface with an raised "F" or arrow on top of piston indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine.

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

(8) Tap piston down in cylinder bore using a hammer handle. While at the same time, guide connecting rod into position on rod journal.

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 21 N·m (15 ft. lbs.) plus a 90° turn.

(10) Install the following components:

• Cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

• Cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

• Install the intake manifold.

• Oil pan and gasket/windage tray. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Fill crankcase with proper engine oil to correct level.

(12) Connect negative cable to battery.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 13). Replace any rings not within specification.

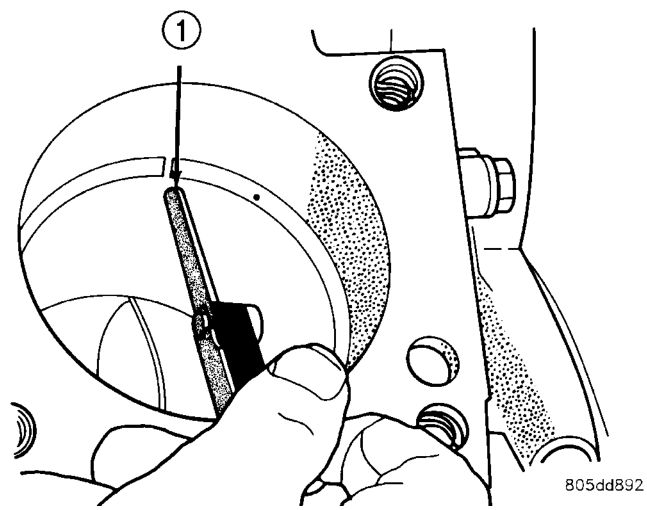


Fig. 13 Ring

1 - FEELER GAUGE

PISTON RINGS (Continued)

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 14)make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

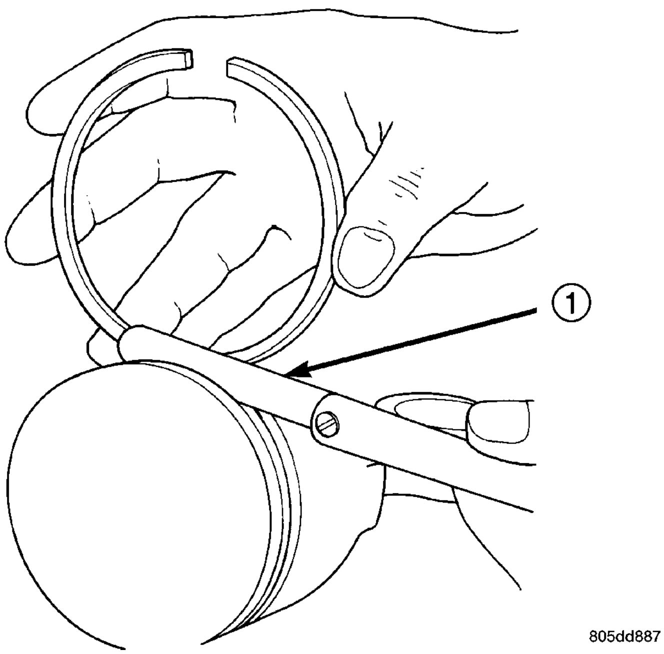


Fig. 14 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	0.6715-.0.7105mm (0.0264- 0.0279 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.5455-0.6245mm (0.0214-0.0245 in.)	0.10mm (0.004 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.23-0.38mm (0.0090-0.0149 in.)	0.43mm (0.017 in.)
Intermediate Ring	0.35-0.60mm (0.0137-0.0236 in.)	0.74mm (0.029 in.)
Oil Control Ring (Steel Rail)	0.015-0.66mm (0.0059- 0.0259 in.)	1.55mm (0.061 in.)

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

PISTON RINGS (Continued)

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 15) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 16).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 16).

(12) Position piston ring end gaps as shown in (Fig. 17). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

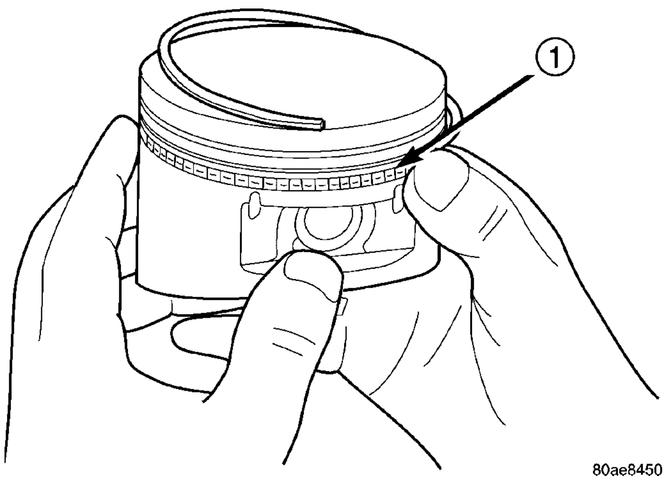


Fig. 15 SIDE RAIL - INSTALLATION

1 - SIDE RAIL END

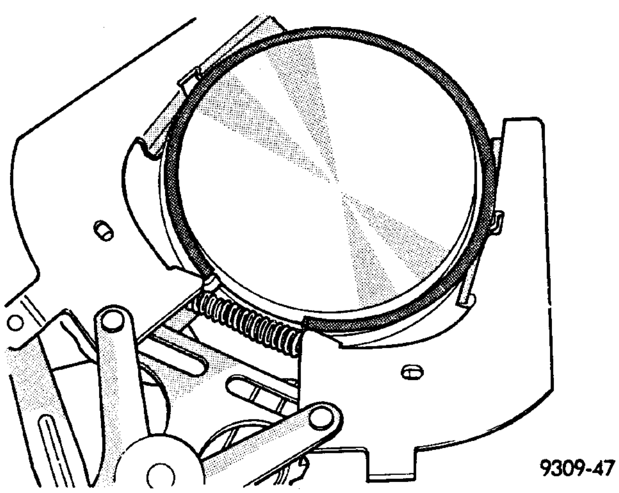


Fig. 16 UPPER AND INTERMEDIATE RINGS

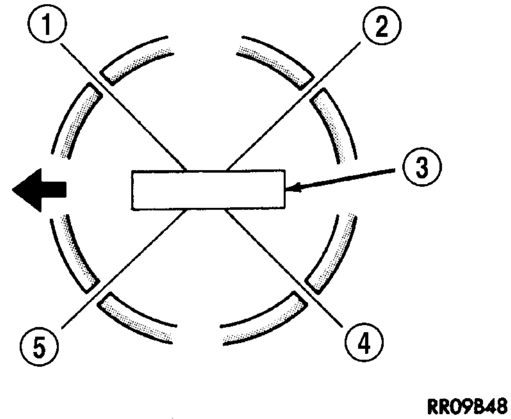


Fig. 17 PISTON RING END GAP POSITION

1 - SIDE RAIL UPPER
2 - NO. 1 RING GAP
3 - PISTON PIN
4 - SIDE RAIL LOWER
5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Remove radiator upper hose.

(5) Remove upper fan shroud.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump.

(7) Remove fan and viscous assembly.

(8) Remove crankshaft damper bolt.

(9) Remove damper using Special Tools 8513A Insert and 8454 Three Jaw Puller.

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512–A, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512–A, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

(2) Assemble Special Tool 8512–A as follows, The nut is threaded onto the shaft first. Then the roller

VIBRATION DAMPER (Continued)

bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST**face the nut). Then the hardened washer slides onto the threaded rod (Fig. 18). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

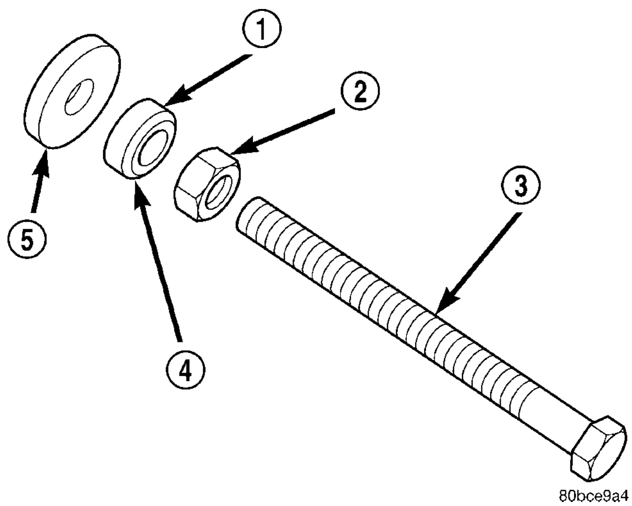


Fig. 18 Proper Assembly Method for Special Tool 8512

1 - BEARING
2 - NUT
3 - THREADED ROD
4 - BEARING HARDENED SURFACE (FACING NUT)
5 - HARDENED WASHER

(3) Using Special Tool 8512–A, press damper onto crankshaft.

(4) Install then tighten crankshaft damper bolt to 176 N·m (129 ft. lbs.).

(5) Install fan blade assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Install radiator upper hose.

(8) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(9) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(10) Connect negative cable to battery.

STRUCTURAL COVER

DESCRIPTION

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the bolts retaining structural cover.

(3) Remove the structural cover.

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover, and engine noise.

(1) Position the structural cover in the vehicle.

(2) Install all bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against the corner formed by the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover and engine noise.

(4) Torque the structural cover bolt that is closest to the front face of block on the passenger side of block to 54 N·m (40 ft. lbs.).

(5) Torque the structural cover bolt that is closest to the rear face of block on the drivers side to 54 N·m (40 ft. lbs.).

(6) Torque the remaining structural cover bolts that go into the **block** in an "X" pattern to 54 N·m (40 ft. lbs.).

(7) Torque the structural cover bolts that go into the **transmission** in an "X" pattern to 54 N·m (40 ft. lbs.).

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect negative battery cable.
(2) Raise vehicle.
(3) Remove engine mount through bolts.
(4) Raise engine using engine support fixture special tool # 8534.
(5) Remove engine mount to insulator bolts (Fig. 19), (Fig. 20).
(6) Remove insulator from engine.

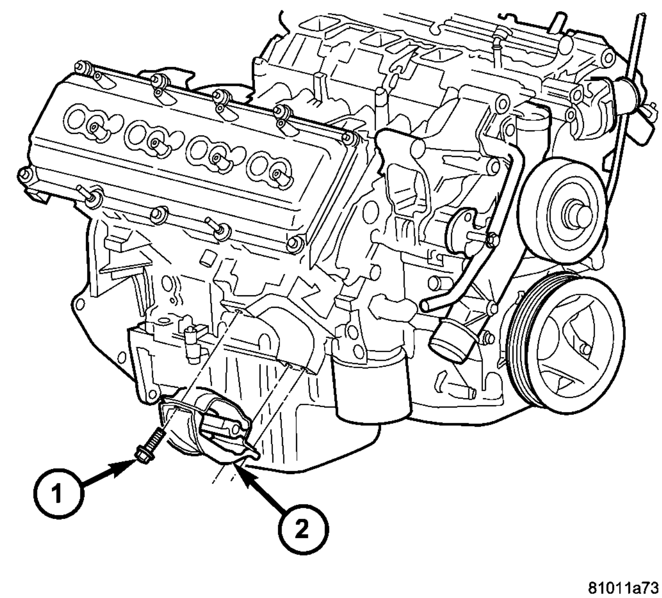


Fig. 19 RH INSULATOR

1 - BOLT
2 - INSULATOR

4WD

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle.
(3) Remove the skid plate.
(4) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSS-MEMBER - REMOVAL).
(5) Remove the engine oil filter.
(6) Support the engine using engine support fixture, special tool # 8534.
(7) Support the front axle with a suitable jack.
(8) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 21).
(9) Remove the (3) bolts that attach the front axle to the left engine bracket.
(10) Lower the front axle.
(11) Remove the (6) through bolts

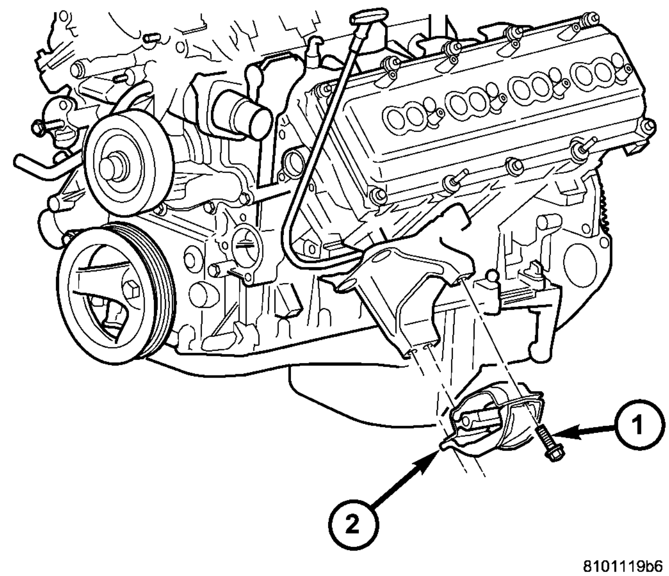


Fig. 20 LH INSULATOR

1 - BOLT
2 - INSULATOR

(12) Raise the engine far enough to be able to remove the left and right engine mounts.
(13) Remove the engine mounts.

INSTALLATION

2WD

(1) Install insulator on the engine (Fig. 22).

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(2) Install upper and lower mount mounting bolts. Tighten bolts to 61 N·m (45 ft. lbs.).
(3) Lower the engine using engine support fixture special tool # 8534.
(4) Install mount through bolts.
(5) Tighten through bolts on both sides to 61 N·m (45 ft. lbs.).
(6) Lower vehicle.
(7) Connect negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).

FRONT MOUNT (Continued)

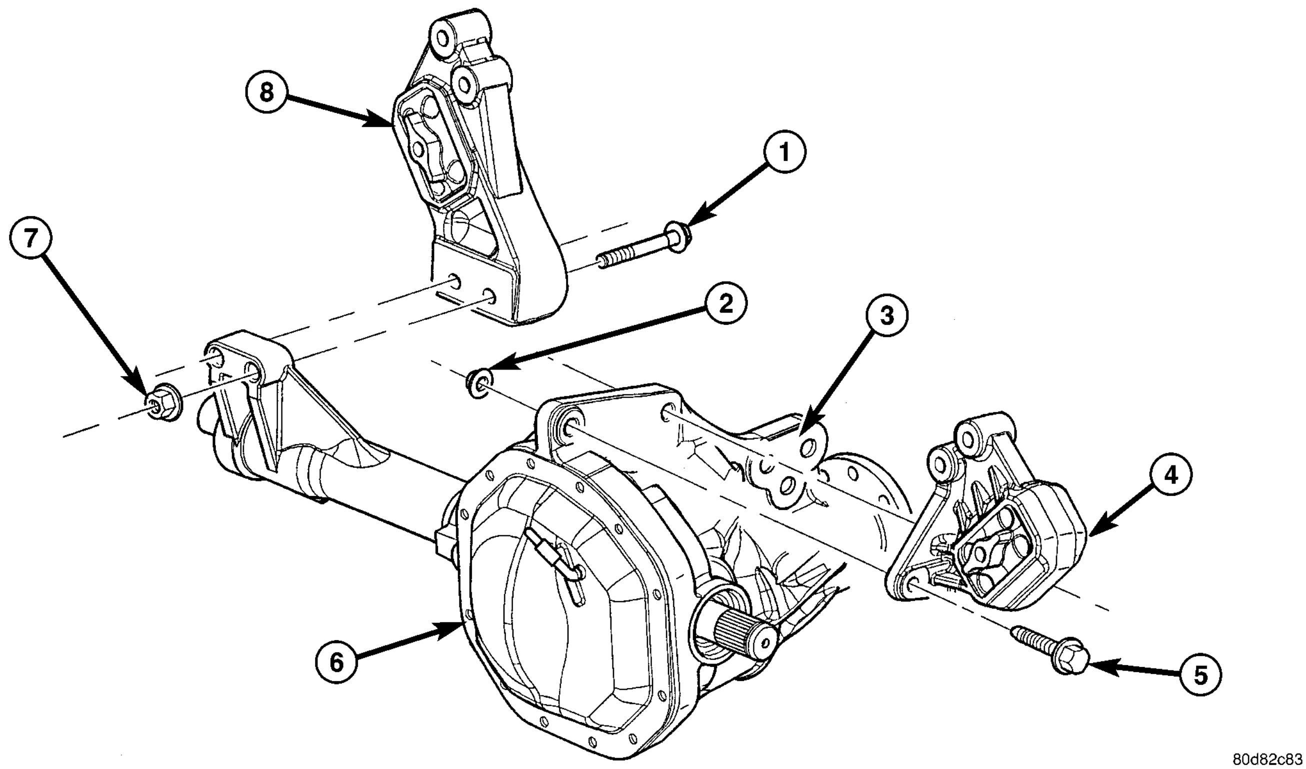


Fig. 21 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

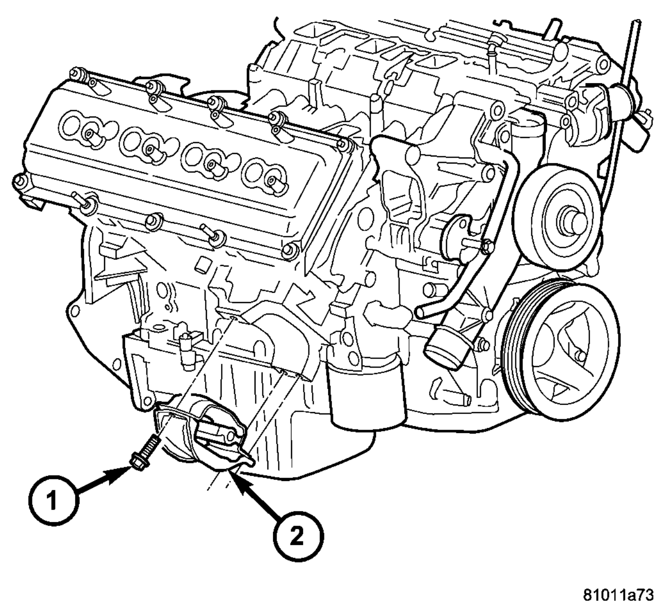


Fig. 22 RH INSULATOR

1 - BOLT
2 - INSULATOR

(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).

(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(4) Lower the engine using engine support fixture special tool # 8534, until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 23).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

(6) Loose assemble the lower through bolts.

(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).

(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).

(9) Install the engine oil filter, if removed.

(10) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSS-MEMBER - INSTALLATION).

(11) Install the skid plate.

(12) Lower the vehicle.

FRONT MOUNT (Continued)

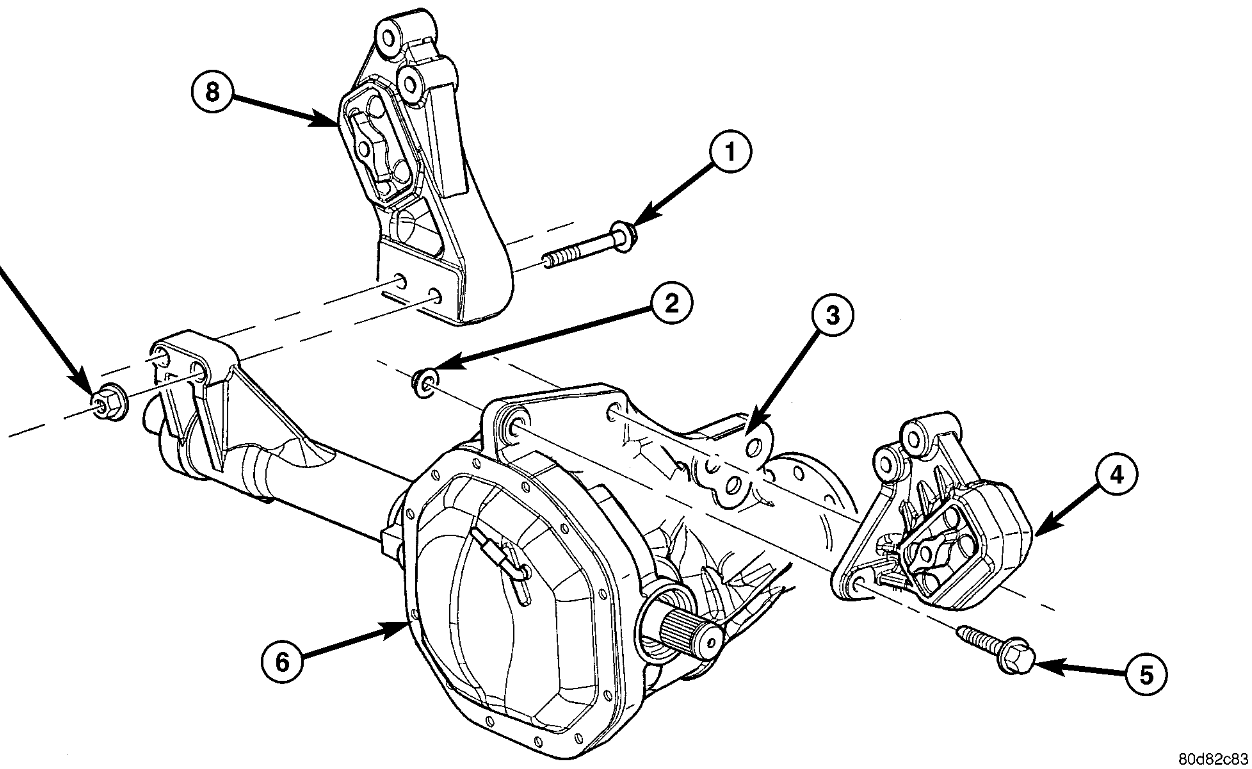


Fig. 23 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

(13) Reconnect the negative battery cable.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Using a suitable jack, support transmission.
(3) Remove the nuts from the transmission mount (Fig. 24).
(4) Remove the two bolts that attach the transmission mount to the engine bracket.
(5) Raise the transmission enough to remove the mount from the crossmember.
(6) Remove the mount.

INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

(1) Install the two bolts that attach the transmission mount to the transmission bracket.
(2) Torque the bolts to 61N·m (45 ft.lbs.) torque.

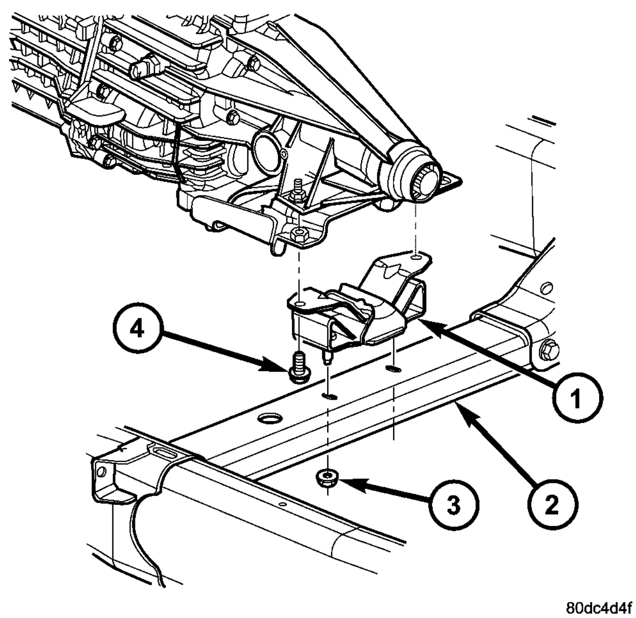


Fig. 24 TRANSMISSION MOUNT

1 - MOUNT
2 - CROSSMEMBER
3 - NUT
4 - BOLT

REAR MOUNT (Continued)

(3) Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.

(4) Install the nuts onto the transmission mount studs through the crossmember access slot.

(5) Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

The lubrication system (Fig. 25) is a full flow filtration pressure feed type.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit and install gauge assembly C-3292.

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle–25 kPa (4 psi) minimum
- 3000 rpm–170 - 758 kPa (25 - 110 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

DIAGNOSIS AND TESTING - ENGINE OIL LEAK

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak.

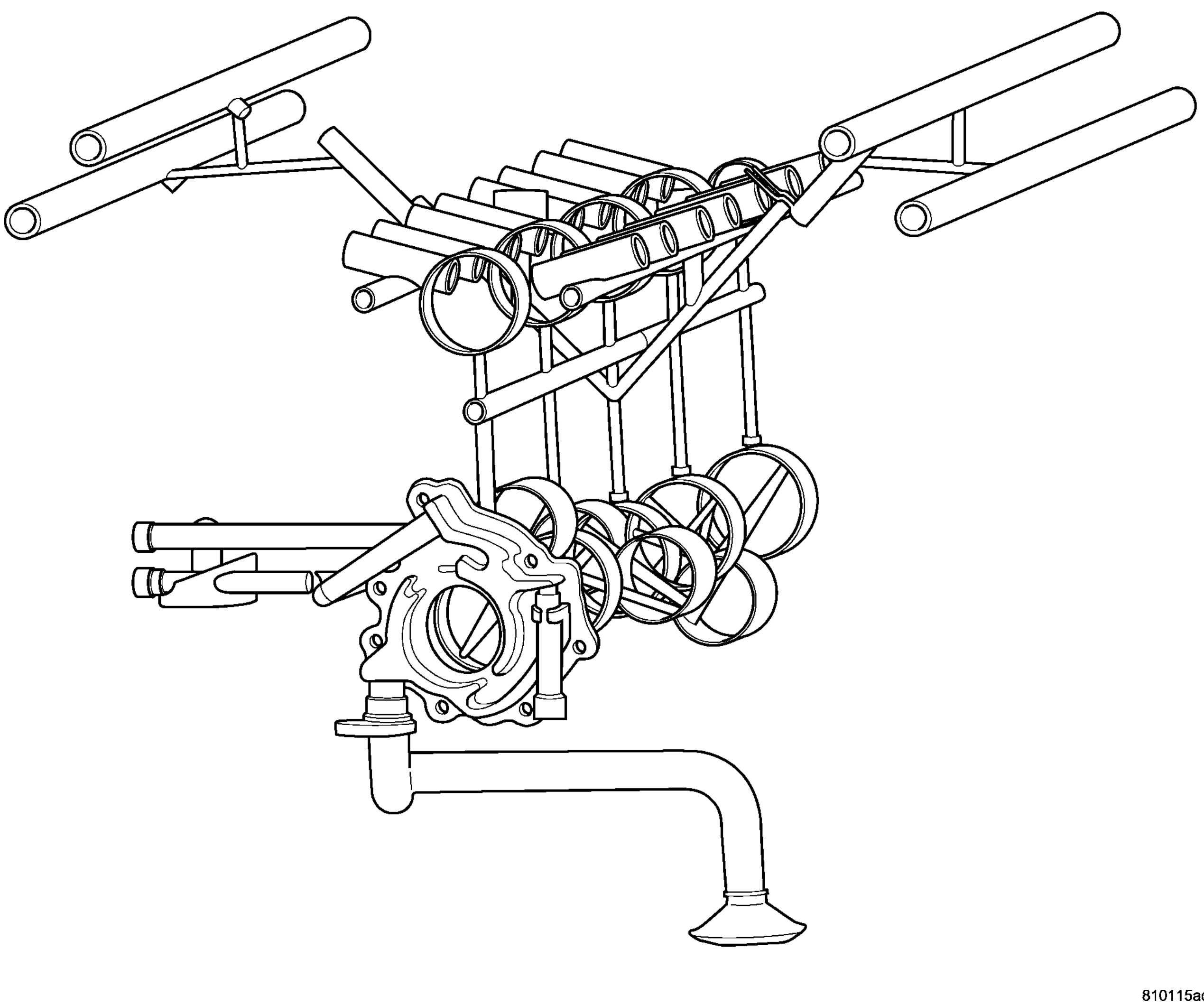


Fig. 25 Engine Oil Lubrication System

LUBRICATION (Continued)

If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection. **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Remove the PCV valve from the IAFM. Cap or plug the PCV valve grommet.

(2) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kPa (3 PSI) of test pressure.

(3) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(4) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(5) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve.

(6) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, distributor seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

OIL

STANDARD PROCEDURE - ENGINE OIL SERVICE

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

OIL (Continued)

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 in the 5.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation.

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 26).

9400-9

Fig. 26 API SYMBOL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the left hand of the engine on the 5.7L engines.

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about ten minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately five minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules(Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION).

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase. Torque to 34 N·m (25 ft. lbs.).

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Cor-

OIL FILTER (Continued)

poration recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss.

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

NOTE: Make sure filter gasket was removed with filter.

(5) With a wiping cloth, clean the gasket sealing surface of oil and grime.

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 27) hand tighten filter one half turn, or 180°,do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

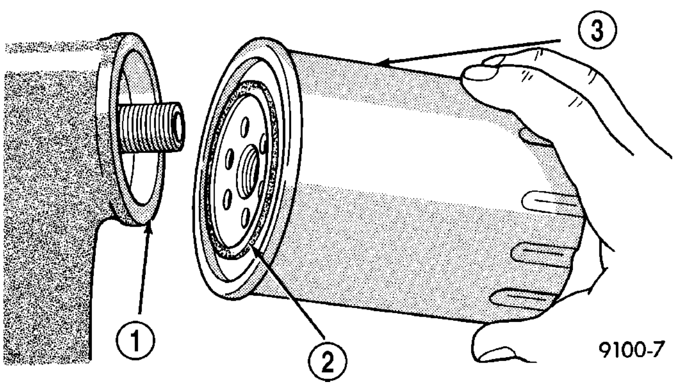


Fig. 27 Oil Filter Sealing Surface - Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

(1) Disconnect the negative battery cable.

(2) Install engine support fixture special tool # 8534. **Do not raise engine at this time.**

(3) Loosen both left and right side engine mount through bolts. Do not remove bolts.

(4) Remove the structural dust cover, if equipped.

(5) Drain engine oil.

(6) Remove the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - REMOVAL).

CAUTION: Only raise the engine enough to provide clearance for oil pan removal. Check for proper clearance at fan shroud to fan and cowl to intake manifold.

(7) Raise engine using special tool # 8534 to provide clearance to remove oil pan.

NOTE: Do not pry on oil pan or oil pan gasket. Gasket is integral to engine windage tray and does not come out with oil pan.

(8) Remove the oil pan mounting bolts and oil pan.

NOTE: The double ended oil pan studs must be installed in the same location that they were removed from.

(9) Unbolt oil pump pickup tube and remove tube.

(10) Inspect the integral windage tray and gasket and replace as needed.

INSTALLATION

(1) Clean the oil pan gasket mating surface of the block and oil pan.

(2) Inspect the integral windage tray and gasket and replace as needed.

(3) Reinstall the oil pump pickup tube with new o-ring. Tighten tube to pump fasteners to 28 N·m (250 in. lbs.).

NOTE: The double ended oil pan studs must be installed in the same location that they were removed from.

(4) Position the oil pan and install the mounting bolts and studs.. Tighten the mounting bolts to 12 N·m (105 in.lbs.).

(5) Lower the engine into mounts using special tool # 8534.

(6) Install both the left and right side engine mount through bolts. Tighten the nuts to 68 N·m (50 ft. lbs.).

(7) Remove special tool # 8534.

(8) Install structural dust cover, if equipped.

(9) Install the front crossmember(Refer to 13 - FRAME & BUMPERS/FRAME/FRONT CROSSMEMBER - INSTALLATION).

(10) Fill engine oil.

(11) Reconnect the negative battery cable.

(12) Start engine and check for leaks.

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Remove the four bolts, and the oil pump.

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If these components are disassembled and or removed from the pump the entire oil pump assembly must be replaced.

(1) Remove the pump cover.

(2) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(3) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 28). If the measurement is 0.235mm (0.009 in.) or more the oil pump assembly must be replaced.

(4) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 29). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(5) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 30).

(6) Reinstall the pump cover. Torque fasteners to 15 N·m (132 in. lbs.).

NOTE: The 5.7 Oil pump is released as an assembly. There are no DaimlerChrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

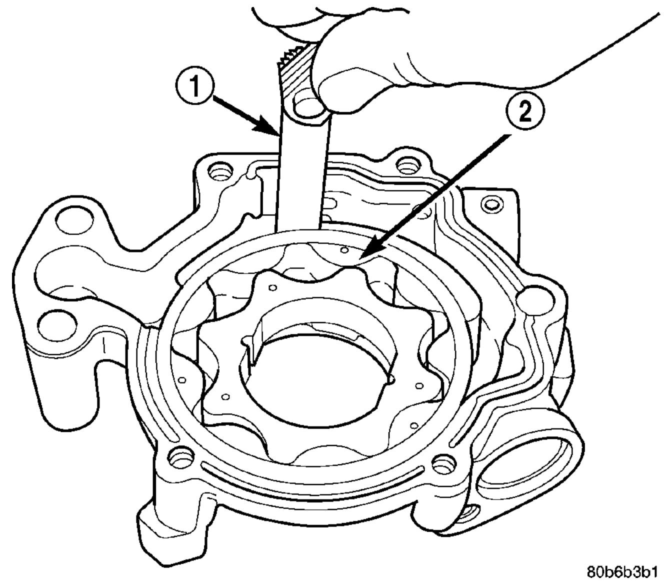


Fig. 28 Measuring Outer Rotor Clearance

1 - FEELER GAUGE
2 - OUTER ROTOR

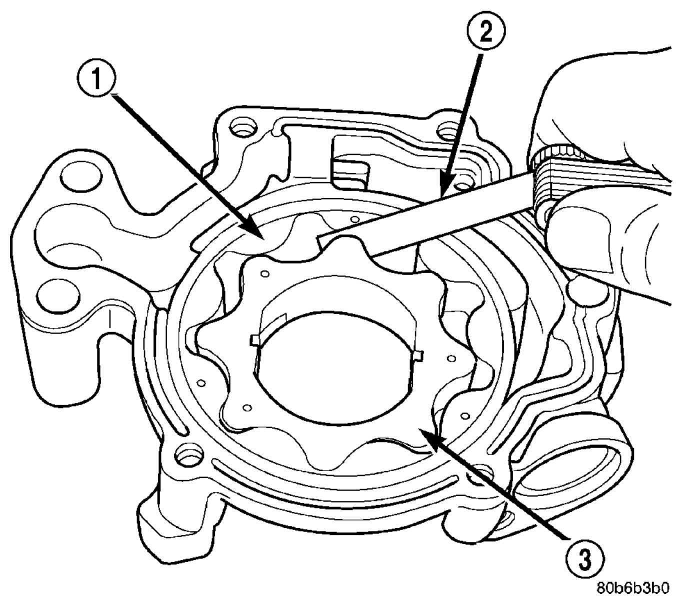


Fig. 29 Measuring Clearance Between Rotors - Typical

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

OIL PUMP (Continued)

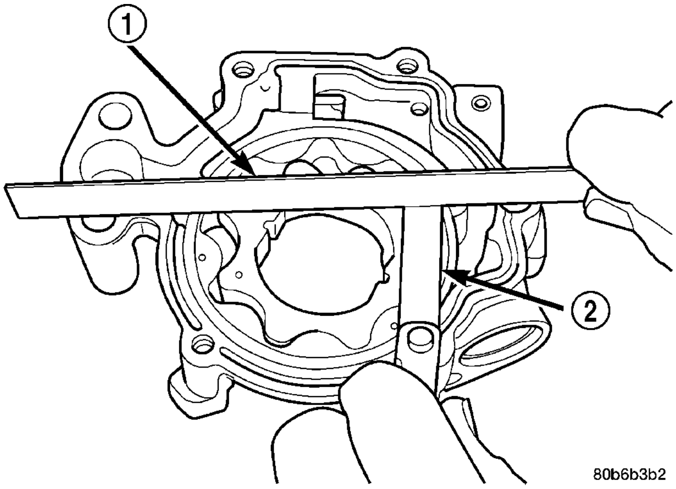


Fig. 30 Measuring Clearance Over Rotors - Typical

1 - STRAIGHT EDGE
2 - FEELER GAUGE

INSTALLATION

(1) Position the oil pump onto the crankshaft and install the 4 oil pump retaining bolts.

(2) Tighten the oil pump retaining bolts to 28 N·m (250 in. lbs.).

(3) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(4) Install the pick-up tube and oil pan(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks.

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove resonator assembly and air inlet hose.

(3) Disconnect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor

(4) Disconnect brake booster hose and positive crankcase ventilation (PCV) hose.

(5) Remove generator and set aside.

NOTE: It is not necessary to remove lines or remove freon from A/C compressor.

(6) Remove air conditioning compressor and set aside..

(7) Bleed fuel system (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(8) Remove intake manifold retaining fasteners in a crisscross pattern starting from the outside bolts and ending at the middle bolts.

(9) Remove intake manifold and IAFM as an assembly.

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

INSTALLATION

(1) Install intake manifold seals.

(2) Position intake manifold and IAFM.

(3) Install intake manifold retaining bolts, and tighten in sequence from the middle bolts towards

the outside in a crisscross pattern. Torque fasteners to 12 N·m (105 in. lbs.).

(4) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Install generator.

(6) Install A/C compressor.

(7) Connect Brake booster hose and Positive crankcase ventilation (PCV) hose.

(8) Install resonator assembly and air inlet hose.

(9) Connect negative cable to battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

EXHAUST MANIFOLD

(1) Disconnect negative battery cable.

(2) Raise vehicle.

(3) Remove exhaust pipe to manifold bolts.

(4) Lower vehicle.

(5) Install engine support fixture special tool #8534.

(6) Raise engine enough to remove manifolds.

CAUTION: Do not damage engine harness while raising the engine.

(7) Remove heat shield.

(8) Remove manifold bolts.

(9) Remove manifold and gasket.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

EXHAUST MANIFOLD

(1) Install manifold gasket and manifold.

(2) Install manifold bolts and tighten to 25 N·m (18 ft. lbs.).

(3) Install heat shield and tighten nuts to 15 N·m (11 ft. lbs.).

(4) Lower engine.

CAUTION: Do not damage engine harness while lowering the engine.

(5) Remove engine support fixture from engine.

(6) Raise vehicle.

(7) Tighten right and left side engine mount through bolts.

(8) Install exhaust flange to pipe bolts.

(9) Lower vehicle.

(10) Connect negative battery cable.

TIMING/CHAIN COVER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove air cleaner assembly.

(3) Drain cooling system.

(4) Remove accessory drive belt.

(5) Remove fan and fan drive assembly (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(6) Remove coolant bottle and washer bottle.

(7) Remove fan shroud.

NOTE: It is not necessary to disconnect A/C lines or discharge freon.

(8) Remove A/C compressor and set aside.

(9) Remove the generator.

(10) Remove upper radiator hose.

(11) Disconnect both heater hoses at timing cover.

(12) Disconnect lower radiator hose at engine.

(13) Remove accessory drive belt tensioner and both idler pulleys.

TIMING/CHAIN COVER (Continued)

(14) Remove crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

NOTE: Do not remove the hoses from the power steering pump.

(15) Remove power steering pump and set aside.
(16) Remove the dipstick support bolt.
(17) Drain the engine oil.
(18) Remove the oil pan and pick up tube(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

NOTE: It is not necessary to remove water pump for timing cover removal.

(19) Remove timing cover bolts and remove cover.

INSTALLATION

(1) Clean timing chain cover and block surface.

NOTE: Always install a new gasket on timing cover.

(2) Install cover and new gasket. Tighten fasteners to 28 N·m (250 in. lbs.).

NOTE: The large lifting stud is torqued to 55 N·m (40 ft. lbs.).

(3) Install the oil pan and pick up tube(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(4) Install the A/C compressor.
(5) Install the generator.
(6) Install power steering pump.
(7) Install the dipstick support bolt.
(8) Install the thermostat housing.
(9) Install crankshaft damper(Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
(10) Install accessory drive belt tensioner assembly and both idler pulleys.
(11) Install radiator lower hose.
(12) Install both heater hoses.
(13) Install radiator fan shroud.
(14) Install the fan and fan drive assembly
(15) Install the accessory drive belt.
(16) Install the coolant bottle and washer bottle.
(17) Install the upper radiator hose.
(18) Install the air cleaner assembly.
(19) Fill cooling system.
(20) Refill engine oil.
(21) Connect the battery negative cable.

TIMING/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.
(2) Drain cooling system.
(3) Remove Timing Chain Cover.

CAUTION: The camshaft pin and the slot in the cam sprocket must be clocked at 12:00. The crankshaft keyway must be clocked at 2:00. The crankshaft sprocket must be installed so that the dots and or paint marking is at 6:00.

(4) Re-install the vibration damper bolt finger tight. Using a suitable socket and breaker bar, rotate the crankshaft to align timing chain sprockets and keyways as shown (Fig. 31).

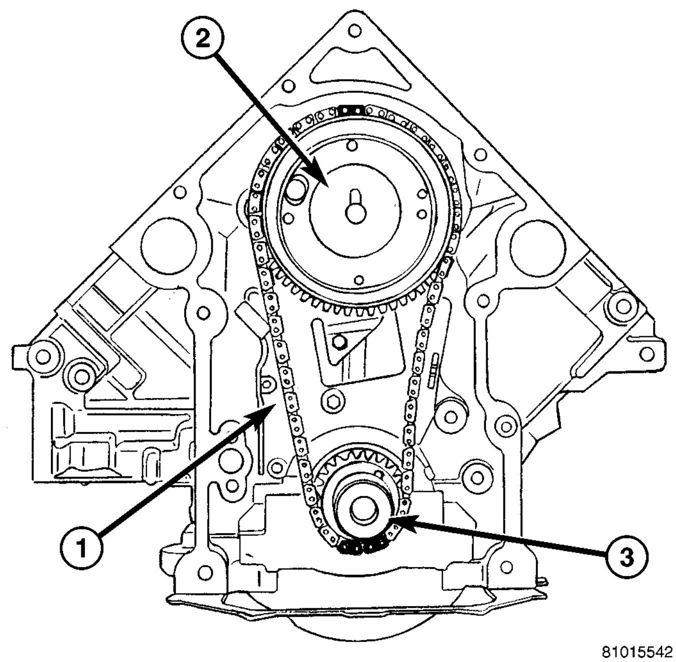


Fig. 31 5.7L TIMING MARK ALIGNMENT

1 - Chain Tensioner
2 - Camshaft Sprocket
3 - Crankshaft Sprocket

(5) Retract tensioner shoe until hole in shoe lines up with hole in bracket. Slide a suitable pin into the holes.
(6) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.
(7) If tensioner assembly is to be replaced, remove the tensioner to block bolts and remove tensioner assembly.

TIMING/CHAIN AND SPROCKETS (Continued)

INSTALLATION

(1) If tensioner assembly is being replaced, install tensioner and mounting bolts. Torque bolts to 28 N·m (250 in. lbs.).

(2) Retract tensioner if required.

CAUTION: The camshaft pin and the slot in the cam sprocket must be clocked at 12:00. The crankshaft keyway must be clocked at 2:00. The crankshaft sprocket must be installed so that the dots and or paint marking is at 6:00.

(3) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores (Fig. 32).

CAUTION: The timing chain must be installed with the single plated link aligned with the dot and or paint marking on the camshaft sprocket. The crankshaft sprocket is aligned with the dot and or paint marking on the sprocket between two plated timing chain links.

(4) Place timing chain around both sprockets (Fig. 32).

(5) Lift sprockets and chain (keep sprockets tight against the chain in position as shown).

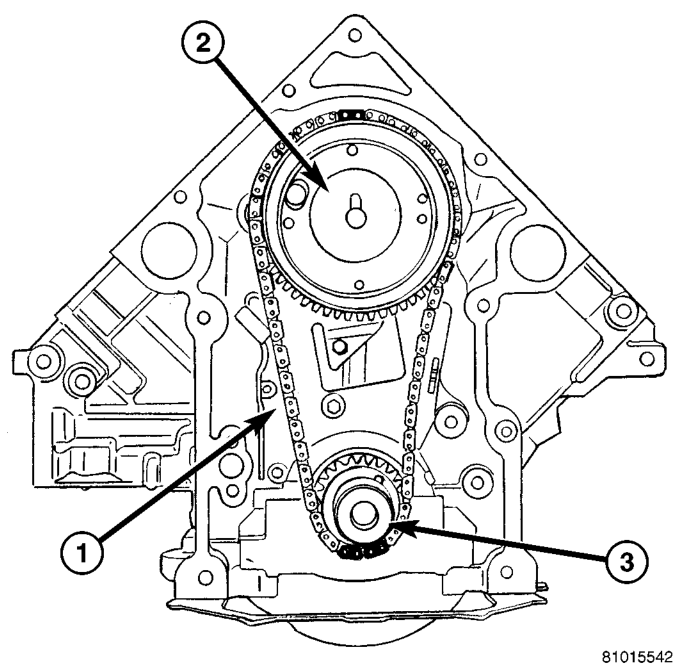


Fig. 32 5.7L TIMING MARK ALIGNMENT

1 - Chain Tensioner
2 - Camshaft Sprocket
3 - Crankshaft Sprocket

(6) Slide both sprockets evenly over their respective shafts and check alignment of timing marks.

(7) Install the camshaft bolt. Tighten the bolt to 122 N·m (90 ft. lbs.) torque.

(8) **Remove tensioner pin.** Again, verify alignment of timing marks.

(9) Install the oil pump(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(10) Install the oil pan and pick up(Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Install the timing chain cover(Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(12) Fill cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

(13) Connect battery negative cable.

(14) Start engine and check for oil and coolant leaks.

TIMING CHAIN/TENSIONER

DESCRIPTION

The timing chain tensioner is a stamped steel constant tension mechanical design. It is mounted to the front of the engine, behind the timing chain drive.

OPERATION

The timing chain tension is maintained by routing the timing chain through the tensioner assembly. A nylon covered spring steel arm presses on the timing chain maintaining the correct chain tension.

ENGINE - 5.9L

TABLE OF CONTENTS

ENGINE - 5.9L

DESCRIPTION

The 5.9 Liter (360 CID) eight-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

The engine lubrication system consists of a rotor type oil pump and a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7 on the left bank and 2, 4, 6, 8 on the right bank. The firing order is 1-8-4-3-6-5-7-2 (Fig. 1).

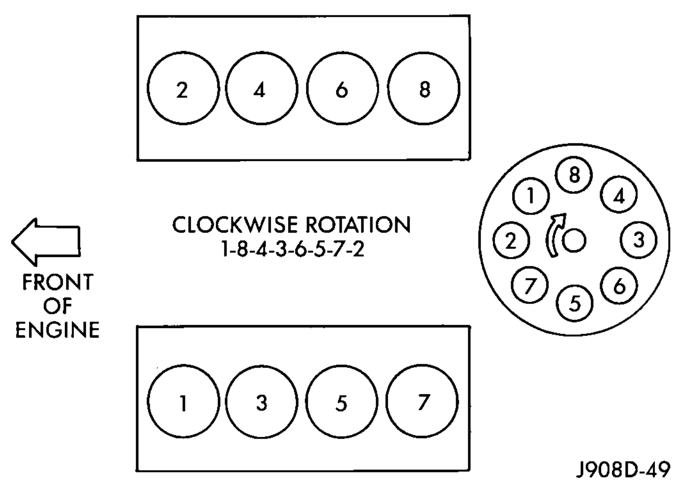


Fig. 1 Firing Order

ENGINE - 5.9L (Continued)

The engine serial number is stamped into a machined pad located on the left, front corner of the cylinder block. When component part replacement is necessary, use the engine type and serial number for reference (Fig. 2).

1NK 5.9L XXXY S PPPPP NNNN

1 = 2001 Model
NK = Toluca Engine
5.9L = Displacement In Liters
XXX = Engine Build Day (e.g., 027 = 27th Day of the Year
Y = Last Digit of Year Engine Build (0 = 2000)
S = Shift Engine Built
PPPPP = Last 5 Digits of Engine Assembly Part Number
NNNN = Engine Serial Code (1263 = The 1263rd engine built that day)

8087d8b1

Fig. 2 Engine Identification Number

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING)
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - PERFORMANCE

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE). Check charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION)
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ DISTRIBUTOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables

ENGINE - 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ IDLE AIR CONTROL MOTOR - DESCRIPTION)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG CABLE - DIAGNOSIS AND TESTING)
	6. Faulty coil	6. Test and replace, if necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG CABLE - REMOVAL)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)

ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/ lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/ OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

ENGINE - 5.9L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/ flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

ENGINE - 5.9L (Continued)

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise, the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating)
- Leaks between adjacent cylinders or into water jacket
- Any causes for combustion/compression pressure loss

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn OFF the engine.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

ENGINE - 5.9L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

ENGINE - 5.9L (Continued)

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

STANDARD PROCEDURE - CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 40° to 60° for proper seating of rings (Fig. 3).

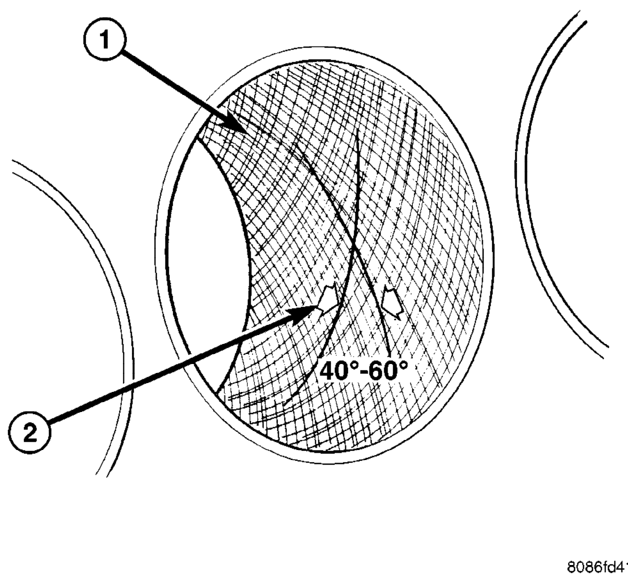


Fig. 3 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 40° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

ENGINE - 5.9L (Continued)

(3) Recover refrigerant from a/c system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(4) Remove the a/c condenser, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL).

(5) Remove the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).

(6) Remove the washer bottle from the fan shroud.

(7) Remove the viscous fan/drive (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(8) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(9) Remove the upper crossmember and top core support.

(10) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(11) Remove the A/C compressor with the lines attached. Secure compressor out of the way.

(12) Remove generator assembly (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(13) Remove the air cleaner resonator and duct work as an assembly.

(14) Disconnect the throttle linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).

(15) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).

(16) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(17) Remove the distributor cap and wiring.

(18) Disconnect the heater hoses.

(19) Disconnect the power steering hoses, if equipped.

(20) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(21) Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(22) On Manual Transmission vehicles, remove the shift lever (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/SHIFT COVER - REMOVAL).

(23) Raise and support the vehicle on a hoist and drain the engine oil.

(24) Remove engine front mount thru-bolt nuts.

(25) Disconnect the transmission oil cooler lines from their retainers at the oil pan bolts.

(26) Disconnect exhaust pipe at manifolds.

(27) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(28) Remove the dust shield and transmission inspection cover.

(29) Remove drive plate to converter bolts (Automatic transmission equipped vehicles).

(30) Remove transmission bell housing to engine block bolts.

(31) Lower the vehicle.

(32) Install an engine lifting fixture.

(33) Separate engine from transmission, remove engine from vehicle, and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install engine lifting device.

(3) Lower engine into compartment and align engine with transmission:

- Manual Transmission: Align clutch disc assembly (if disturbed). Install transmission input shaft into clutch disc while mating engine and transmission surfaces. Install two transmission to engine block mounting bolts finger tight.
- Automatic Transmission: Mate engine and transmission and install two transmission to engine block mounting bolts finger tight.

(4) Lower engine assembly until engine mount through bolts rest in mount perches.

(5) Install remaining transmission to engine block mounting bolts and tighten.

(6) Tighten engine mount through bolts.

(7) Install drive plate to torque converter bolts. (Automatic transmission models)

(8) Install the dust shield and transmission cover.

(9) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(10) Install exhaust pipe to manifold.

(11) Install the transmission cooler line brackets to the oil pan.

(12) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(13) Lower the vehicle.

(14) Remove engine lifting fixture.

(15) On Manual Transmission vehicles, install the shift lever (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/SHIFT COVER - INSTALLATION).

(16) Connect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Connect the power steering hoses, if equipped.

(18) Connect the heater hoses.

ENGINE - 5.9L (Continued)

(19) Install the distributor cap and wiring.
(20) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).
(21) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).
(22) Connect the throttle linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION).
(23) Install the air cleaner resonator and duct work..
(24) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).
(25) Install a/c compressor and lines (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).
(26) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(27) Install upper radiator support crossmember.
(28) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).
(29) Connect the radiator lower hose.
(30) Connect the transmission oil cooler lines to the radiator.
(31) Install the fan shroud.
(32) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).
(33) Connect the radiator upper hose.
(34) Install the washer bottle.
(35) Install the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).
(36) Connect the transmission cooler lines.
(37) If equipped, install the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION).
(38) Evacuate and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).
(39) Add engine oil to crankcase (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).
(40) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(41) Connect battery negative cable.
(42) Start engine and inspect for leaks.
(43) Road test vehicle.

SPECIFICATIONS

5.9L ENGINE

ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° V-8 OHV
Bore and Stroke	101.6 x 90.9 mm (4.00 x 3.58 in.)
Displacement	5.9L (360 c.i.)
Compression Ratio	9.1:1
Firing Order	1–8–4–3–6–5–7–2
Lubrication	Pressure Feed – Full Flow Filtration
Cooling System	Liquid Cooled – Forced Circulation
Cylinder Block	Cast Iron
Cylinder Head	Cast Iron
Crankshaft	Nodular Iron
Camshaft	Nodular Cast Iron
Pistons	Aluminum Alloy w/strut
Connecting Rods	Forged Steel
Compression Pressure	689.5 kPa (100 psi) (Min.)
CAMSHAFT	
Bearing Diameter	
No. 1	50.800 – 50.825 mm (2.000 – 2.001 in.)
No. 2	50.394 – 50.419 mm (1.984 – 1.985 in.)
No. 3	50.013 – 50.038 mm (1.969 – 1.970 in.)
No. 4	49.606 – 49.632 mm (1.953 – 1.954 in.)
No. 5	39.688 – 39.713 mm (1.5625 – 1.5635 in.)

ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
Bearing Journal Diameter	
No. 1	50.723 – 50.775 mm (1.997 – 1.999 in.)
No. 2	50.317 – 50.368 mm (1.981 – 1.983 in.)
No. 3	49.936 – 49.987 mm (1.966 – 1.968 in.)
No. 4	49.53 – 49.581 mm (1.950 – 1.952 in.)
No. 5	39.611 – 39.662 mm (1.5595 – 1.5615 in.)
Bearing to Journal Clearance	
Standard	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
Service Limit	0.127 mm (0.005 in.)
Camshaft End Play	0.051 – 0.254 mm (0.002 – 0.010 in.)
CONNECTING RODS	
Piston Pin bore Diameter	24.966 – 24.978 mm (0.9829 – 0.9834 in.)
Side Clearance	0.152 – 0.356 mm (0.006 – 0.014 in.)
CRANKSHAFT	
Rod Journal	
Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.013 – 0.056 mm (0.0005 – 0.0022 in.)
Main Bearing Journal	
Diameter	71.361 – 71.387 mm (2.8095 – 2.8105 in.)
Out of Round (Max.)	0.127 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	
Journal #1	0.013 – 0.038 mm

DESCRIPTION	SPECIFICATION
	(0.0005 – 0.0015 in.)
Journals # 2 - 5	0.013 – 0.051 mm (0.0005 – 0.002 in.)
Service Limit	
Journal #1	0.0381 mm (0.0015 in.)
Journals #2-5	0.064 mm (0.0025 in.)
Crankshaft End Play	0.051 – 0.178 mm (0.002 – 0.007 in.)
Service Limit	0.254 mm (0.010 in.)
CYLINDER BLOCK	
Cylinder Bore	
Diameter	101.60 – 101.65 mm (4.000 – 4.002 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Lifter Bore	
Diameter	22.99 – 23.01 mm (0.9051 – 0.9059 in.)
Distributor Drive Bushing Press Fit	
Bushing to Bore Interference	0.0127 – 0.3556 mm (0.0005 – 0.0140 in.)
Shaft to Bushing Clearance	0.0178 – 0.0686 mm (0.0007 – 0.0027 in.)
CYLINDER HEAD AND VALVES	
Valve Seat	
Angle	44.25° – 44.75°
Runout (Max.)	0.0762 mm (0.003 in.)
Width (Finish)	
Intake	1.016 – 1.524 mm (0.040 – 0.060 in.)
Exhaust	1.524 – 2.032 mm (0.060 – 0.080 in.)
Valves	
Face Angle	43.25° – 43.75°
Head Diameter	

ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
Intake Exhaust	47.752 mm (1.88 in.) 41.072 (1.617 in.)
Length (Overall) Intake Exhaust	 126.21 – 126.85 mm (4.969 – 4.994 in.) 126.44 – 127.30 mm (4.978 – 5.012 in.)
Lift (@ zero lash) Intake Exhaust	 10.414 mm (0.410 in.) 10.592 mm (0.417 in.)
Stem Diameter Intake Exhaust	 9.449 - 9.474 mm (0.372 - 0.373 in.) 9.423 - 9.449 mm (0.371 - 0.372 in.)
Guide Bore	9.500 - 9.525 mm (0.374 - 0.375 on.)
Stem to Guide Clearance Intake Exhaust	 0.0254 - 0.0762 mm (0.001 - 0.003 in.) 0.0508 - 0.1016 mm (0.002 - 0.004 in.)
Service Limit	0.4318 - (0.017 in.)
Valve Springs Free Length	 49.962 mm (1.967 in.)
Spring Tension Valve closed Valve open	 378 N @ 41.66 mm (85 lbs. @ 1.64 in.) 890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)
HYDRAULIC TAPPETS	
Body Diameter	22.949 - 22.962 mm (0.9035 - 0.9040 in.)
Clearance (to bore)	0.0279 - 0.0610 mm

DESCRIPTION	SPECIFICATION
	(0.0011 - 0.0024 in.)
Dry Lash	1.524 - 5.334 mm (0.060 - 0.210 in.)
Push Rod Length	175.64 - 176.15 mm (6.915 - 6.935 in.)
OIL PRESSURE	
Curb Idle (Min.*)	41.4 kPa (6 psi)
@ 3000 rpm	207 - 552 kPa (30 - 80 psi)
Oil Pressure Bypass Valve Setting	 62 - 103 kPa (9 - 15 psi)
Switch Actuating Pressure	34.5 - 48.3 kPa (5 - 7 psi)
*** If oil pressure is zero at curb idle, DO NOT RUN ENGINE.**	
OIL PUMP	
Clearance over Rotors (Max.)	0.1016 mm (0.004 in.)
Cover Out of Flat (Max.)	0.0381 mm (0.0015 in.)
Inner Rotor Thickness (Min.)	20.955 mm (0.825 in.)
Outer Rotor Clearance (Max.) Diameter (Min.) Thickness (Min.)	 0.3556 mm (0.014 in.) 62.7126 mm (2.469 in.) 20.955 mm (0.825 in.)
Tip Clearance between Rotors (Max.)	 0.2032 mm (0.008 in.)
PISTONS	
Clearance at Top of Skirt	0.013 - 0.038 mm (0.0005 - 0.0015 in.)
Land Clearance (Diam.)	0.508 - 0.660 mm (0.020 - 0.026 in.)
Piston Length	81.03 mm (3.19 in.)
Piston Ring Groove Depth Groove #1 and 2	 4.761 - 4.912 mm

ENGINE - 5.9L (Continued)

DESCRIPTION	SPECIFICATION
	(0.187 - 0.193 in.)
Groove #3	3.996 - 4.177 mm (0.157 - 0.164 in.)
Weight	582 - 586 grams (20.53 - 20.67 oz.)
PISTON PINS	
Clearance in Piston	0.006 - 0.019 mm (0.00023 - 0.00074 in.)
Diameter	25.007 - 25.015 mm (0.9845 - 0.9848 in.)
End Play	NONE
Length	67.8 - 68.3 mm (2.67 - 2.69 in.)
PISTON RINGS	
Ring Gap	
Compression Ring (Top)	0.30 - 0.55 mm (0.012 - 0.022 in.)
Compression Ring (2nd)	0.55 - 0.80 mm (0.022 - 0.031 in.)
Oil Control (Steel Rails)	0.381 - 1.397 mm (0.015 - 0.055 in.)
Ring Side Clearance	
Compression Rings	0.040 - 0.085 mm (0.0016 - 0.0033 in.)
Oil Ring (Steel Rails) MAX	0.05 - 0.21 mm (0.002 - 0.008 in.)
Ring Width	
Compression rings	1.530 - 1.555 mm (0.060 - 0.061 in.)
Oil Ring (Steel Rails) Max.	0.447 - 0.473 mm (0.018 - 0.019 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	33°
Opens (BBDC)	56°
Duration	269°
Intake Valve	
Closes (ATDC)	62°
Opens (BBDC)	7°
Duration	249°
Valve Overlap	41°

OVERSIZE AND UNDERSIZE ENGINE COMPONENT MARKINGS CHART

OS-US	Item	Identification	Location of Identification
U/S .025 MM (.001 in.)	Crankshaft	R or M M-2-3 ect. (indicating No. 2 and 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 and 4 connecting rod journal)	Milled flat on No. three crankshaft counter-weight.
O/S .508 mm (.020 in.)	Cylinder Bores	A	Following engine serial number.
O/S .203 mm (.008 in.)	Tappets	◊	3/8″ diamond -shaped stamp Top pad — Front of engine and flat ground on outside surface of each O/S tappet bore.
O/S	Valve Stems	X	Milled pad

ENGINE - 5.9L (Continued)

OS-US	Item	Identification	Location of
.127 mm (.005 in.)			adjacent to two 3/8″ tapped holes on each end of cylinder head.

TORQUE

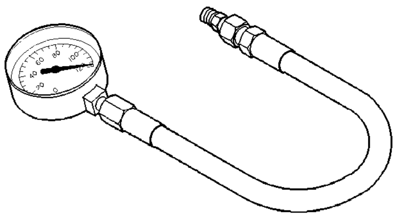
TORQUE CHART 5.9L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket Bolt	68	50	—
Camshaft Thrust Plate Bolts	24	—	210
Timing Chain Case Cover Bolts	41	30	—
Connecting Rod Cap Bolts	61	45	—
Main Bearing Cap Bolts	115	85	—
Crankshaft Pulley Bolts	24	—	210
Cylinder Head Bolts			
Step 1	68	50	—
Step 2	143	105	—
Cylinder Head Cover Bolts	11	—	95
Engine Support Bracket to Block Bolts (4WD)	41	30	—
Exhaust Manifold to Cylinder Head Bolts/Nuts	34	25	—
Flywheel Bolts	75	55	—
Front Insulator Through bolt/nut	95	70	—
Front Insulator to Support Bracket			
Stud Nut (4WD)	41	30	—
Through Bolt/Nut (4WD)	102	75	—
Front Insulator to Block Bolts (2WD)	95	70	—
Generator Mounting Bolt	41	30	—
Intake Manifold Bolts	Refer to Procedure		
Oil Pan Bolts	24	—	215
Oil Pan Drain Plug	34	25	—
Oil Pump Attaching Bolts	41	30	—
Oil Pump Cover Bolts	11	—	95
Rear Insulator to Bracket Through-Bolt (2WD)	68	50	—
Rear Insulator to Crossmember Support Bracket Nut (2WD)	41	30	—
Rear Insulator to Crossmember Nuts (4WD)	68	50	—
Rear Insulator to Transmission Bolts (4WD)	68	50	—
Rear Insulator Bracket Bolts (4WD Automatic)	68	50	—
Rear Support Bracket to Crossmember Flange Nuts	41	30	—
Rear Support Plate to Transfer Case Bolts	41	30	—
Rocker Arm Bolts	28	21	—
Spark Plugs	41	30	—
Starter Motor Mounting Bolts	68	50	—
Thermostat Housing Bolts	25	—	225
Throttle Body Bolts	23	—	200
Torque Converter Drive Plate Bolts	31	—	270
Transfer Case to Insulator Mounting Plate Nuts	204	105	—
Transmission Support Bracket Bolts (2WD)	68	50	—
Vibration Damper Bolt	244	180	—
Water Pump to Timing Chain Case Cover Bolts	41	30	—

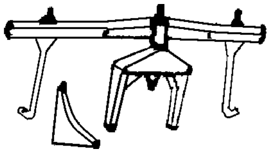
ENGINE - 5.9L (Continued)

SPECIAL TOOLS

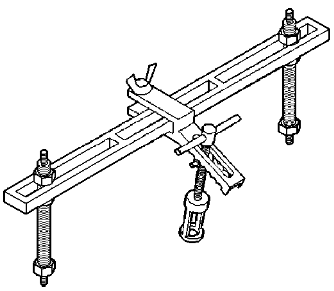
5.9L ENGINE



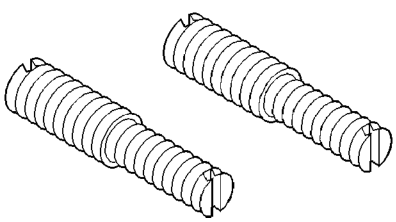
Oil Pressure Gauge C-3292



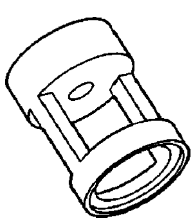
Engine Support Fixture C-3487–A



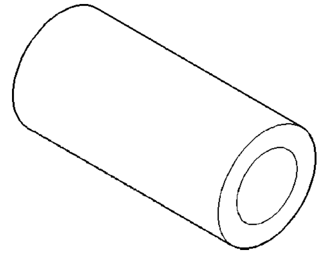
Valve Spring Compressor MD-998772–A



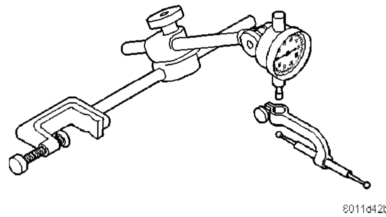
Adaptor 6633



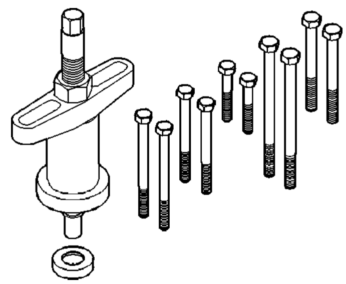
Adaptor 6716A



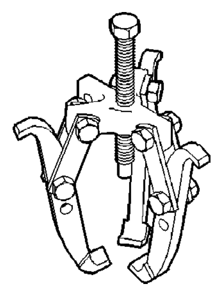
Valve Guide Sleeve C-3973



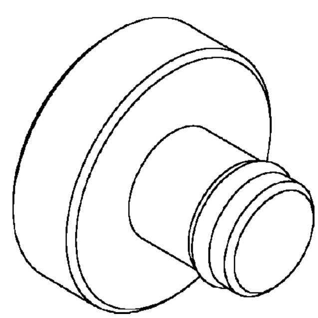
Dial Indicator C-3339



Puller C-3688

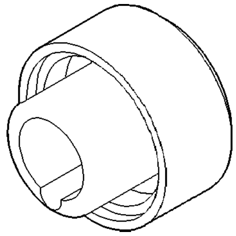


Puller 1026

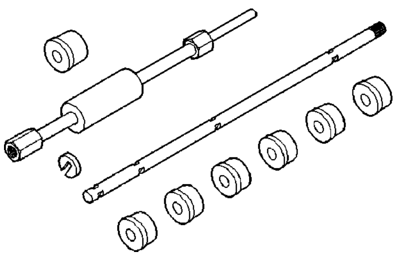


Crankshaft Damper Removal Insert 8513

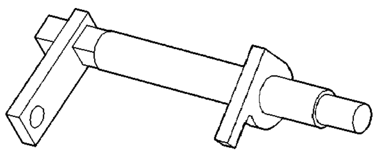
ENGINE - 5.9L (Continued)



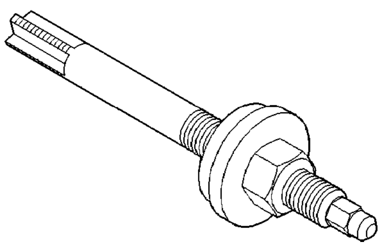
Front Oil Seal Installer 6635



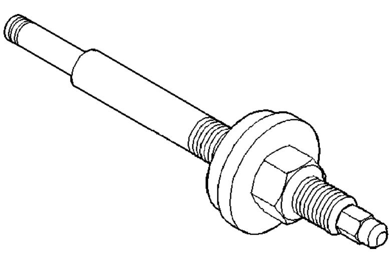
Cam Bearing Remover/Installer C3132–A



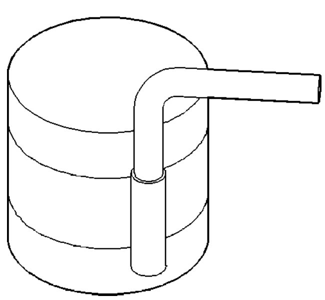
Camshaft Holder C-3509



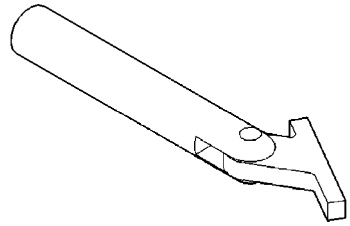
Distributor Bushing Puller C-3052



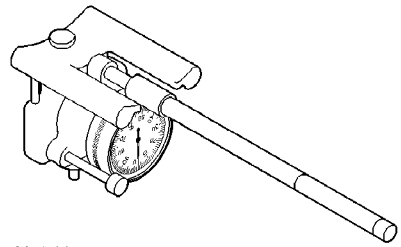
Distributor Bushing Driver/Burnisher C-3053



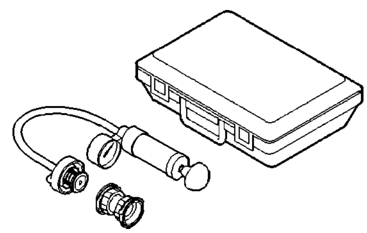
Piston Ring Compressor C-385



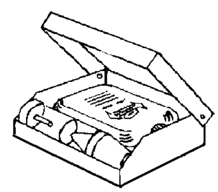
Crankshaft Main Bearing Remover C-3059



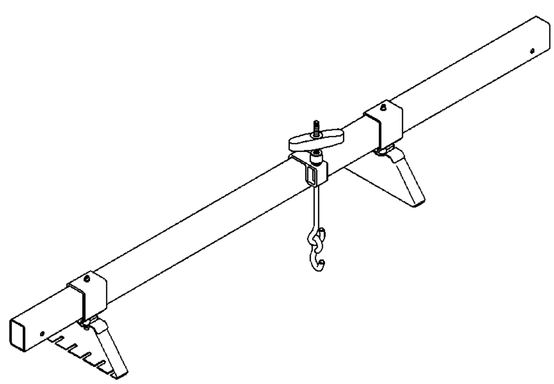
Cylinder Bore Gauge C-119



Pressure Tester Kit 7700



Bloc–Check–Kit C-3685–A



ENGINE SUPPORT FIXTURE 8534

AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 4) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 4) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

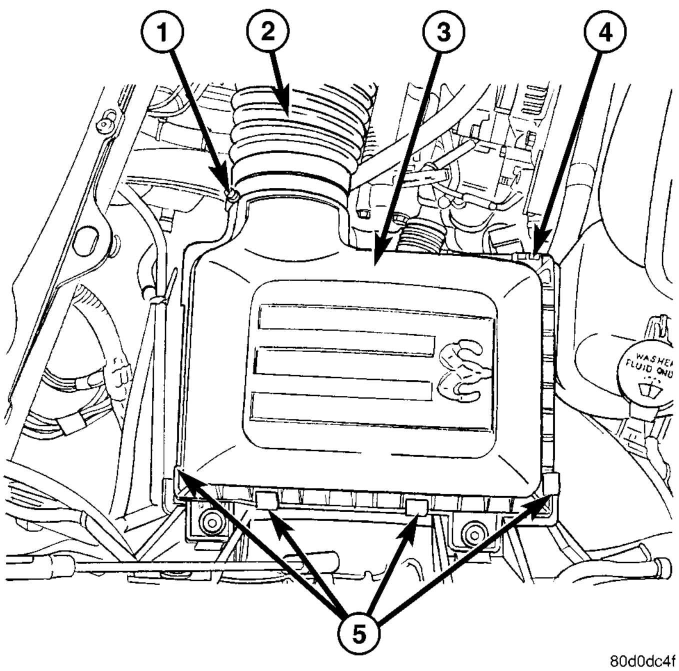


Fig. 4 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 5).

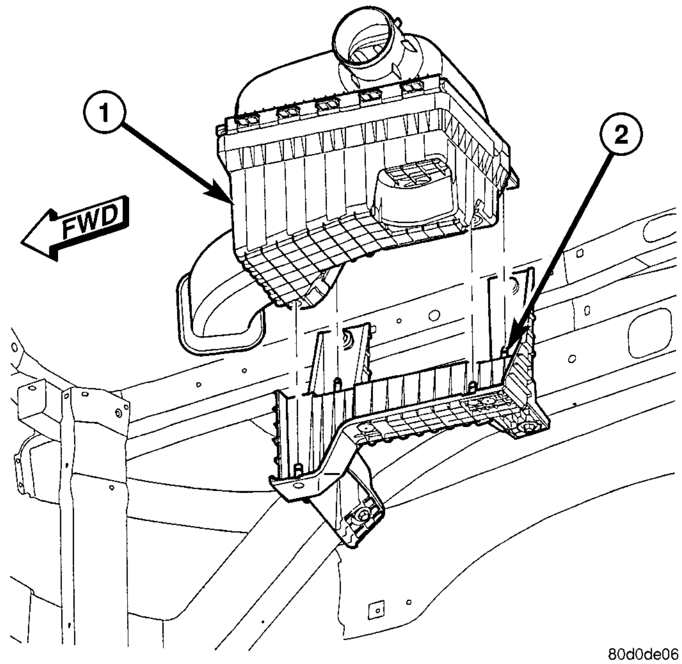


Fig. 5 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 4).

(3) Pry up 4 spring clips (Fig. 4) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

DESCRIPTION

DESCRIPTION—CYLINDER HEAD

The cast iron cylinder heads (Fig. 6) are mounted to the cylinder block using ten bolts. The spark plugs are located in the peak of the wedge between the valves.

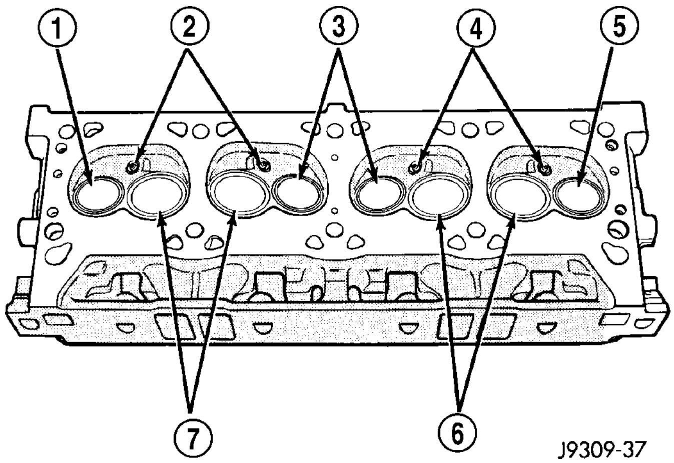


Fig. 6 Cylinder Head Assembly—V-8 Gas Engines

1 - EXHAUST VALVE
2 - SPARK PLUGS
3 - EXHAUST VALVES
4 - SPARK PLUGS
5 - EXHAUST VALVE
6 - INTAKE VALVES
7 - INTAKE VALVES

DESCRIPTION - CYLINDER HEAD COVER GASKET

The cylinder head cover gasket (Fig. 7) is a steel-backed silicone gasket, designed for long life usage.

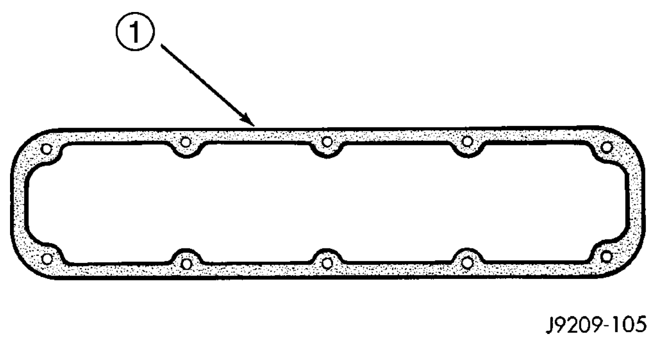


Fig. 7 Cylinder Head Cover Gasket V-8 Gas Engines

1 - CYLINDER HEAD COVER GASKET

OPERATION

OPERATION—CYLINDER HEAD

The cylinder head closes the combustion chamber allowing the pistons to compress the air fuel mixture to the correct ratio for ignition. The valves located in the cylinder head open and close to either allow clean air into the combustion chamber or to allow the exhaust gases out, depending on the stroke of the engine.

OPERATION - CYLINDER HEAD COVER GASKET

The steel-backed silicone gasket is designed to seal the cylinder head cover for long periods of time through extensive heat and cold, without failure. The gasket is designed to be reusable.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

- Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
  - Loss of engine power
  - Engine misfiring
  - Poor fuel economy
- Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
  - Engine overheating
  - Loss of coolant
  - Excessive steam (white smoke) emitting from exhaust
  - Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test in this section. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50–70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

CYLINDER HEAD (Continued)

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the air cleaner resonator and duct work.

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator.

(5) Remove closed crankcase ventilation system.

(6) Disconnect the evaporation control system.

(7) Perform the Fuel System Pressure Release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(9) Remove distributor cap and wires.

(10) Disconnect the coil wires.

(11) Disconnect heat indicator sending unit wire.

(12) Disconnect heater hoses and bypass hose.

(13) Remove the master cylinder and booster assembly. Refer to section 5 brakes.

(14) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(15) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL) and throttle body as an assembly. Discard the flange side gaskets and the front and rear cross-over gaskets.

(16) Remove exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(17) Remove rocker arm assemblies and push rods. Identify to ensure installation in original locations.

(18) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(19) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out-of-flatness exceeds 0.00075mm/mm (0.0001in/in.) times the span length in any direction, either replace head or lightly machine the head surface.

FOR EXAMPLE:—A 305 mm (12 in.) span is 0.102 mm (0.004 in.) out-of-flat. The allowable out-of-flat is 305 x 0.00075 (12 x 0.00075) equals 0.23 mm (0.009 in.). This amount of out-of-flat is acceptable.

The cylinder head surface finish should be 1.78-3.00 microns (70-125 microinches).

Inspect push rods. Replace worn or bent rods.

INSTALLATION

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Clean cylinder block front and rear gasket surfaces using a suitable solvent.

(3) Position new cylinder head gaskets onto the cylinder block.

(4) Position cylinder heads onto head gaskets and cylinder block.

(5) Starting at top center, tighten all cylinder head bolts, in sequence (Fig. 8).

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

(6) Install push rods and rocker arm assemblies in their original position. Tighten the bolts to 28 N·m (21 ft. lbs.) torque.

(7) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION) and throttle body assembly.

(8) Install exhaust manifolds (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

CYLINDER HEAD (Continued)

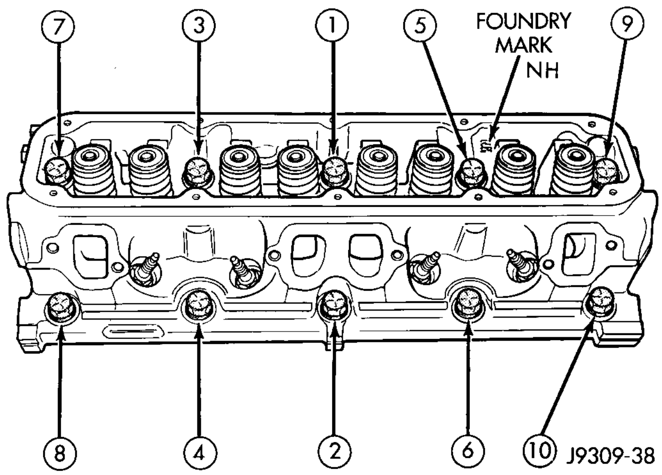


Fig. 8 Cylinder Head Bolt Tightening Sequence

(9) If required, adjust spark plugs to specifications. Install the plugs and tighten to 41 N·m (30 ft. lbs.) torque.

(10) Install coil wire.

(11) Connect heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(15) Install the fuel supply line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque. Tighten the adjusting strap bolt to 23 N·m (200 in. lbs.) torque.

(17) Install the intake manifold-to-generator bracket support rod. Tighten the bolts.

(18) Place the cylinder head cover gaskets in position and install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(19) Install closed crankcase ventilation system.

(20) Connect the evaporation control system.

(21) Reinstall the master cylinder and booster assembly. Refer to section 5 brakes.

(22) Install the air cleaner.

(23) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(24) Connect the negative cable to the battery.

(25) Start engine check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

NOTE: A steel backed silicon gasket is used with the cylinder head cover (Fig. 9). This gasket can be used again.

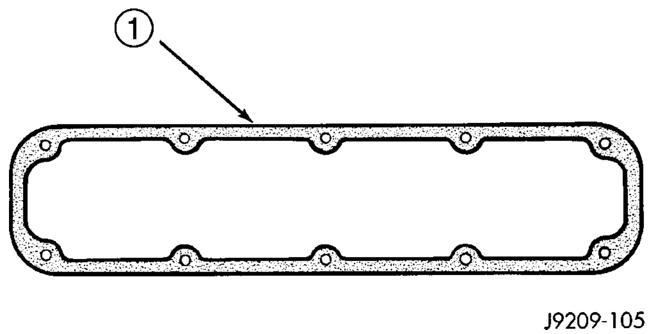


Fig. 9 Cylinder Head Cover Gasket

1 - CYLINDER HEAD COVER GASKET

(1) Disconnect the negative cable from the battery.

(2) Disconnect the spark plug wires form the spark plugs and set aside.

(3) Disconnect closed ventilation system and evaporation control system from cylinder head cover.

(4) Remove cylinder head cover and gasket.

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) The cylinder head cover gasket can be used again. Install the gasket onto the head rail.

(2) Position the cylinder head cover onto the gasket. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(3) Install closed crankcase ventilation system and evaporation control system.

(4) Connect the spark plug wires to the spark plugs.

(5) Connect the negative cable to the battery.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

Both the intake and exhaust valves are made of steel. The intake valve is 48.768 mm (1.92 inches) in diameter and the exhaust valve is 41.148 mm (1.62 inches) in diameter and has a 2.032 mm (0.080 inch) wafer interia welded to the tip for durability. These valves are not splayed.

STANDARD PROCEDURE—VALVES, GUIDES AND SPRINGS

VALVE CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

VALVE GUIDES

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 10). The special sleeve places the valve at the correct height for checking with a dial indicator.

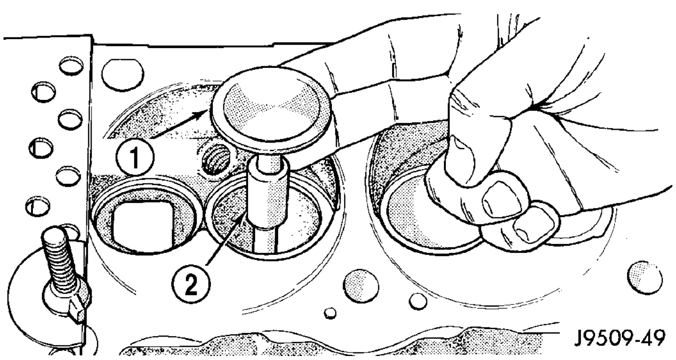


Fig. 10 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 11).

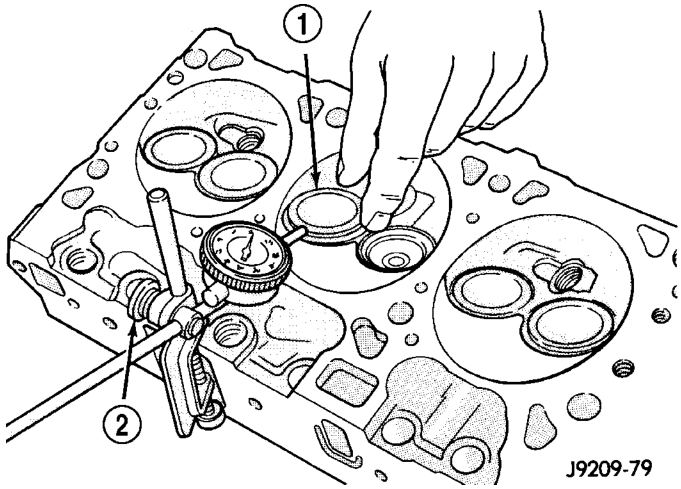


Fig. 11 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

VALVE GUIDES

Service valves with oversize stems are available. Refer to REAMER SIZES CHART

REAMER SIZES CHART

REAMER O/S	VALVE GUIDE SIZE
0.076 mm (0.003 in.)	8.026 - 8.052 mm (0.316 - 0.317 in.)
0.381 mm (0.015 in.)	8.331 - 8.357 mm (0.328 - 0.329 in.)

(1) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 in.). Use a two step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

INTAKE/EXHAUST VALVES & SEATS (Continued)

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 43-1/4° to 43-3/4° face angle and a 44-1/4° to 44-3/4° seat angle (Fig. 12).

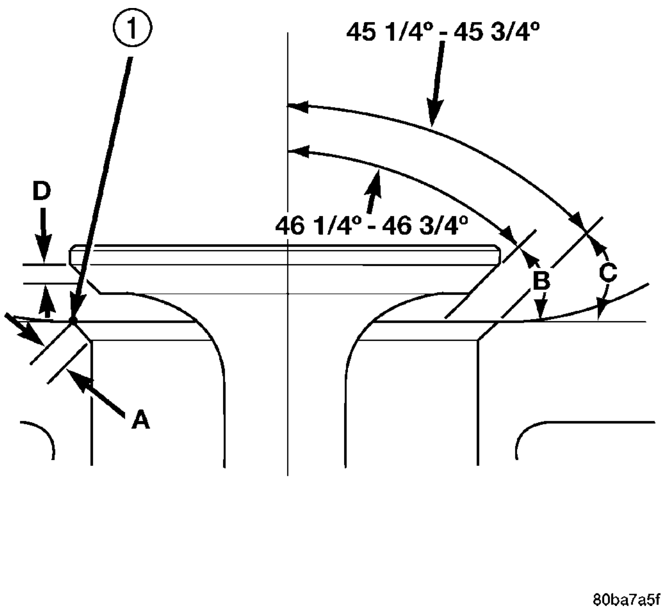


Fig. 12 Valve Face and Seat Angles

1 - CONTACT POINT
A,B,C and D

VALVE FACE AND VALVE SEAT ANGLE CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH INTAKE EXHAUST	 1.016 - 1.524 mm (0.040 - 0.060 in.) 1.524 - 2.032 mm (0.060 - 0.080 in.)
B	FACE ANGLE (INT. AND EXT.)	43¼° - 43¾°
C	SEAT ANGLE (INT. AND EXT.)	44¼° - 44¾°
D	CONTACT SURFACE	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 13). Valves with less than 1.190 mm (0.047 in.) margin should be discarded.

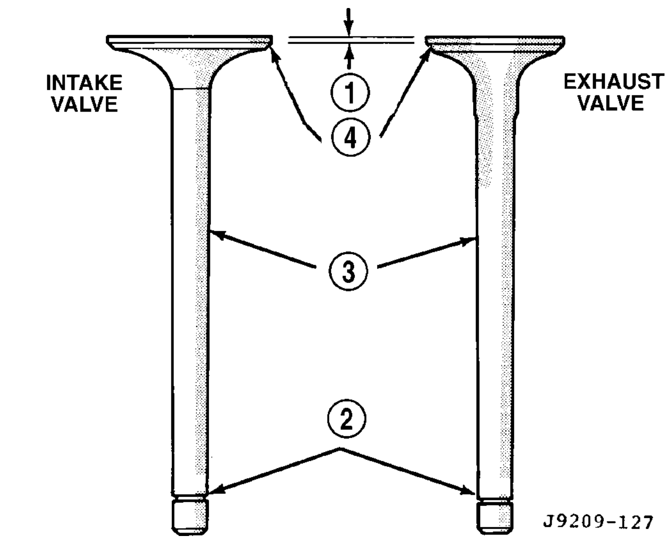


Fig. 13 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

VALVE SEATS

CAUTION: DO NOT un-shroud valves during valve seat refacing (Fig. 14).

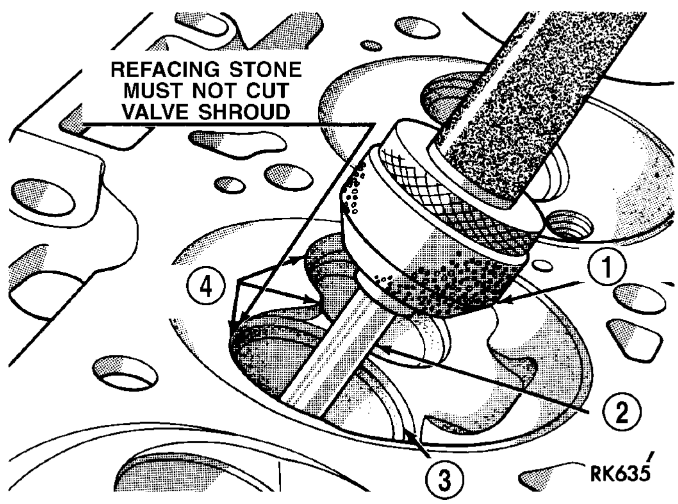


Fig. 14 Refacing Valve Seats

1 - STONE
2 - PILOT
3 - VALVE SEAT
4 - SHROUD

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseat-

INTAKE/EXHAUST VALVES & SEATS (Continued)

ing stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.

(3) Inspect the valve seat with Prussian blue, to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of intake seats should be 1.016-1.524 mm (0.040-0.060 in.). The width of the exhaust seats should be 1.524-2.032 mm (0.060-0.080 in.).

VALVE SPRINGS

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 in.. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 in. mark on the threaded stud. Be sure the zero mark is to the front (Fig. 15). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

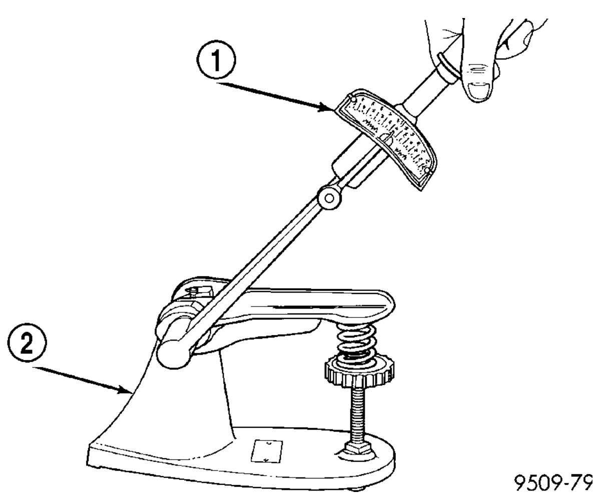


Fig. 15 Testing Valve Spring for Compressed Length

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(2) Compress valve springs using Valve Spring Compressor Tool MD- 998772A and adapter 6716A.

(3) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 16). The special sleeve places the valve at the correct height for checking with a dial indicator.

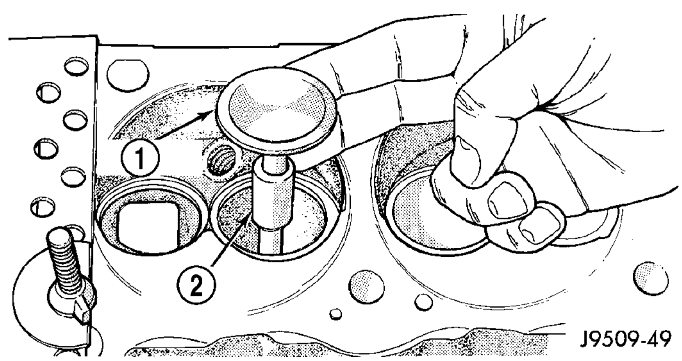


Fig. 16 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 17).

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

INSTALLATION

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INTAKE/EXHAUST VALVES & SEATS (Continued)

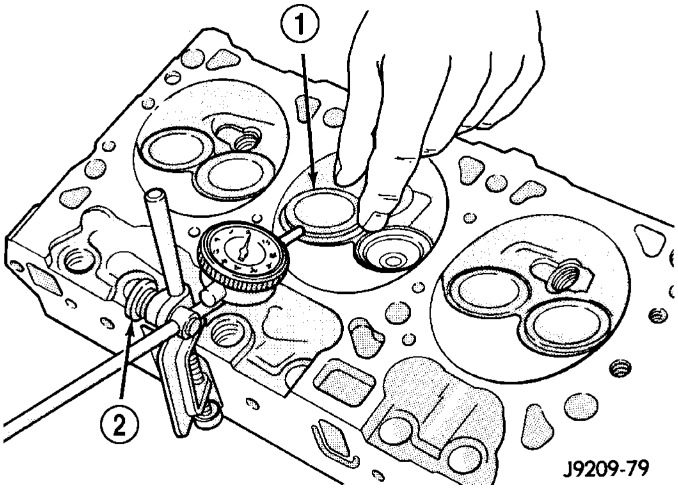


Fig. 17 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Coat valve stems with lubrication oil and insert them in cylinder head.

(5) If valves or seats are reground, check valve stem height. If valve is too long, replace cylinder head.

(6) Install new seals on all valve guides. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. If valves and/or seats are ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. This should bring spring height back to normal 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(8) Install cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSEMBLY

REMOVAL

(1) Remove cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove the rocker arm bolts and pivots (Fig. 18). Place them on a bench in the same order as removed.

(3) Remove the push rods and place them on a bench in the same order as removed.

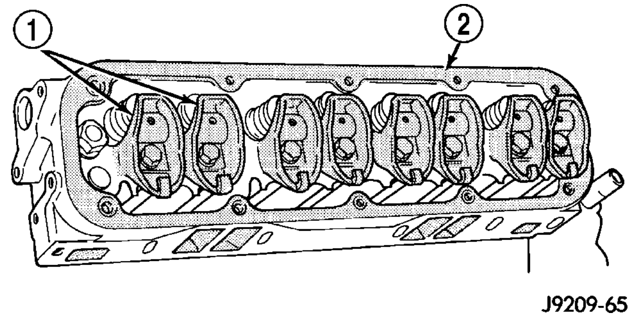


Fig. 18 Rocker Arms

1 - ROCKER ARMS
2 - CYLINDER HEAD

INSTALLATION

(1) Rotate the crankshaft until the “V8” mark lines up with the TDC mark on the timing chain case cover. This mark is located 147° ATDC from the No.1 firing position.

(2) Install the push rods in the same order as removed.

(3) Install rocker arm and pivot assemblies in the same order as removed. Tighten the rocker arm bolts to 28 N·m (21 ft. lbs.) torque.

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

(4) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leakage.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper. Refer to Honing Cylinder Bores in the Service Procedures portion of this Section.

Inspect the oil line plug, the oil line plug is located in the vertical passage at the rear of the block between the oil-to-filter and oil-from-filter passages (Fig. 19). Improper installation or missing plug could cause erratic, low, or no oil pressure.

The oil plug must come out the bottom. Use flat dowel, down the oil pressure sending unit hole from the top, to remove oil plug.

ENGINE BLOCK (Continued)

(1) Remove oil pressure sending unit from back of block.

(2) Insert a 3.175 mm (1/8 in.) finish wire, or equivalent, into passage.

(3) Plug should be 190.0 to 195.2 mm (7-1/2 to 7-11/16 in.) from machined surface of block (Fig. 19). If plug is too high, use a suitable flat dowel to position properly.

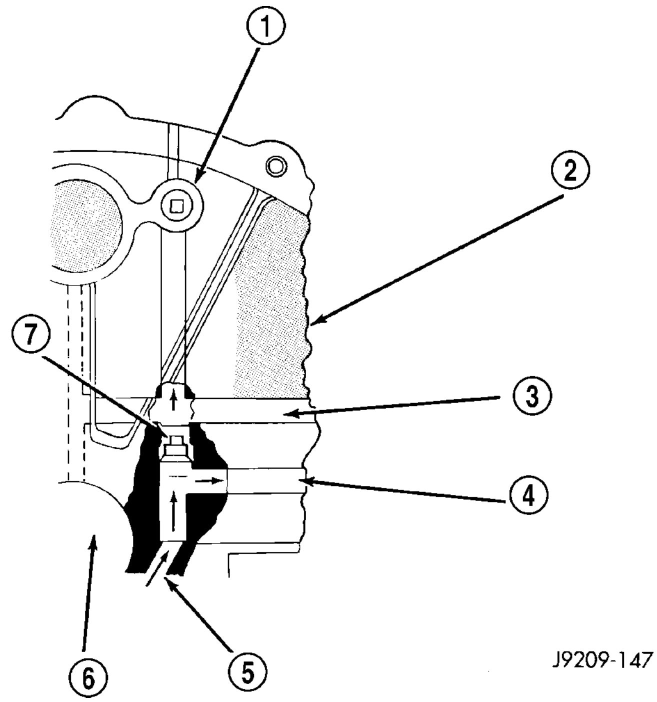


Fig. 19 Oil Line Plug

1 - RIGHT OIL GALLERY
2 - CYLINDER BLOCK
3 - OIL FROM FILTER TO SYSTEM
4 - OIL TO FILTER
5 - FROM OIL PUMP
6 - CRANKSHAFT
7 - PLUG

(4) If plug is too low, remove oil pan and No. 4 main bearing cap. Use suitable flat dowel to position properly. Coat outside diameter of plug with Mopar® Stud and Bearing Mount Adhesive. Plug should be 54.0 to 57.7 mm (2-1/8 to 2-5/16 in.) from bottom of the block.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL—CAMSHAFT

NOTE: The camshaft has an integral oil pump and distributor drive gear (Fig. 20).

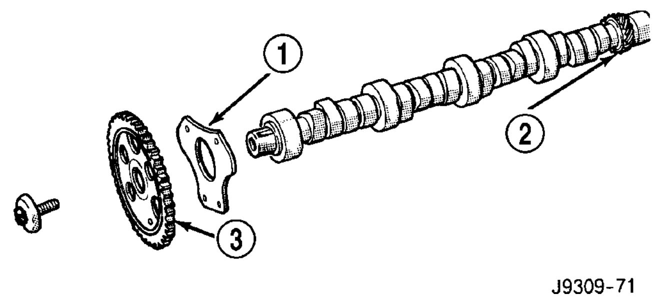


Fig. 20 Camshaft and Sprocket Assembly

1 - THRUST PLATE
2 - OIL PUMP AND DISTRIBUTOR DRIVE GEAR INTEGRAL WITH CAMSHAFT
3 - CAMSHAFT SPROCKET

(1) Remove the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(2) Remove the A/C Condenser (if equipped)

(3) Remove the engine cover.

(4) Remove intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(6) Remove timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL) and timing chain (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(7) Remove rocker arms.

(8) Remove push rods and tappets. Identify each part so it can be installed in its original location.

(9) Remove distributor and lift out the oil pump and distributor drive shaft.

(10) Remove camshaft thrust plate, note location of oil tab (Fig. 21).

(11) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 51 mm (2 inches) of its final position in cylinder block.

(2) Install Camshaft Holder Tool C-3509 with tongue back of distributor drive gear (Fig. 22).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

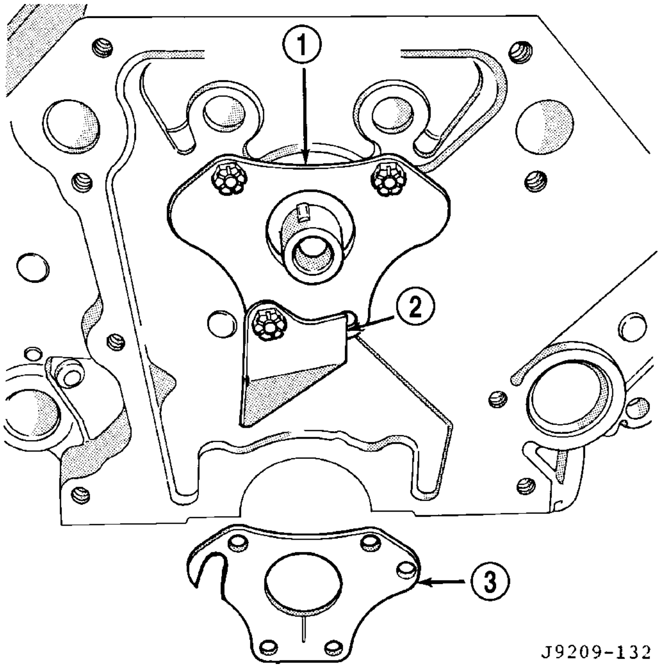


Fig. 21 Timing Chain Oil

1 - THRUST PLATE FRONT SIDE
2 - CHAIN OIL TAB
3 - THRUST PLATE REAR SIDE

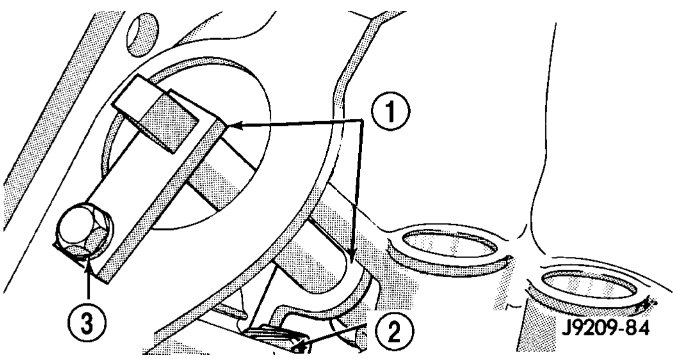


Fig. 22 Camshaft Holding Tool C-3509 (Installed Position)

1 - SPECIAL TOOL C-3509
2 - DRIVE GEAR
3 - DISTRIBUTOR LOCK BOLT

(3) Hold tool in position with a distributor lock-plate bolt. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab. **Make sure tang enters lower right hole in thrust plate.** Tighten bolts to 24 N·m (210 in. lbs.) torque. Top edge of tab should be flat against thrust plate in order to catch oil for chain lubrication.

(5) Install timing chain and gears (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Measure camshaft end play (Refer to 9 - ENGINE - SPECIFICATIONS). If not within limits install a new thrust plate.

(7) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(8) Install distributor and distributor drive shaft.

(9) Install push rods and tappets.

(10) Install rocker arms.

(11) Install timing case cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(12) Install cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(13) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(14) Install the engine cover.

(15) Install the A/C Condenser (if equipped)

(16) Install the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(17) Start engine check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 23) is of a cast nodular steel splayed type design, with five main bearing journals.The crankshaft is located at the bottom of the engine block and is held in place with five main bearing caps. The number 3 counterweight is the location for journal size identification.

Undersize Journal	Identification Stamp
0.025 mm (0.001 inch) (Rod)	R1-R2-R3 or R4
0.025 mm (0.001 inch) (Main)	M1-M2-M3-M4 or M5

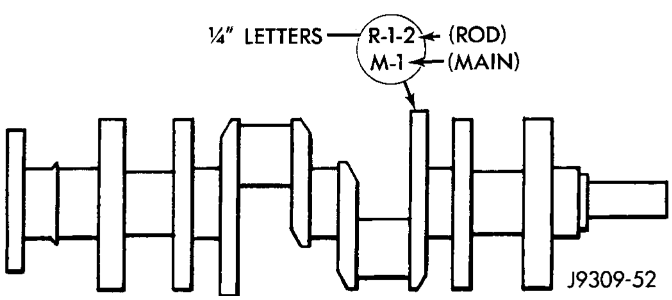


Fig. 23 Crankshaft with Journal Size Identification

OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

REMOVAL

NOTE: This procedure can be done in vehicle. However the transmission must be removed first.

(1) If crankshaft is to be removed while engine is in vehicle remove the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

(2) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove the oil pump from the rear main bearing cap (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(4) Remove the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Identify rod bearing caps before removal. Remove rod bearing caps with bearings.

CAUTION: Support crankshaft before removing main bearing caps. failure to do so will allow the crankshaft to fall damaging the crankshaft.

(7) Using a suitable jack, support the crankshaft.

(8) Identify main bearing caps before removal. Remove main bearing caps and bearings one at a time.

(9) Lower the crankshaft out of the block.

(10) Remove and discard the crankshaft rear oil seals.

(11) Remove and discard the front crankshaft oil seal.

INSTALLATION

(1) Clean Gasket Maker residue and sealant from the cylinder block and rear cap mating surface. Do this before applying the Mopar® Gasket Maker and the installation of rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing towards the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 24). DO NOT over apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

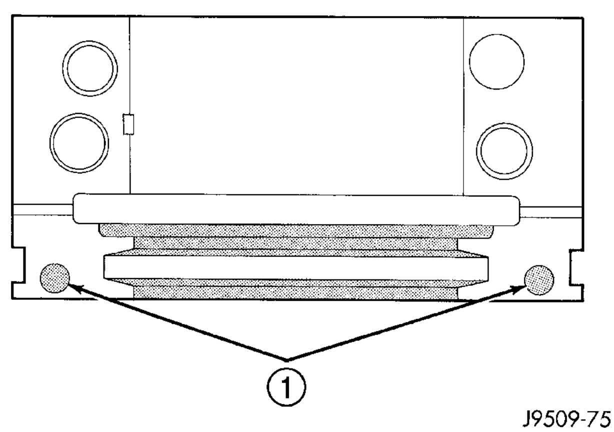


Fig. 24 Sealant Application to Bearing Cap

1 - MOPAR® GASKET MAKER 5 mm (0.20 IN.) ON BOTH SIDES OF REAR MAIN CAP

CRANKSHAFT (Continued)

(8) To align the bearing cap, use cap slot, alignment dowel and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than 2 times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(12) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(13) Position the connecting rods onto the crankshaft and install the rod bearing caps. Tighten the nuts to 61 N·m (45 ft. lbs.).

(14) Apply Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap to block joint to provide cap to block and oil pan sealing (Fig. 25). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(15) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(16) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

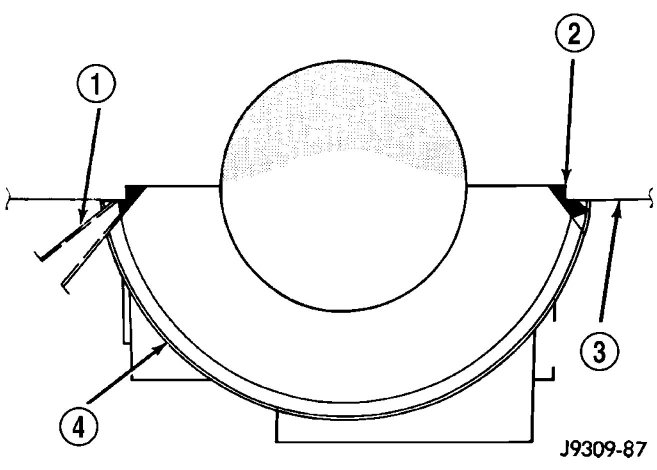


Fig. 25 Apply Sealant to Bearing Cap to Block Joint

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

(17) If the transmission was removed, install the transmission. Refer to 21 - TRANSMISSION/TRANSAXLE.

CRANKSHAFT MAIN BEARINGS

DESCRIPTION

Main bearings (Fig. 26) are located in the cylinder block. One half of the main bearing is located in the crankshaft main bore the other half of the matching bearing is located in the main bearing cap. there are five main bearings. Number three main bearing is flanged, this flange controls crankshaft thrust.

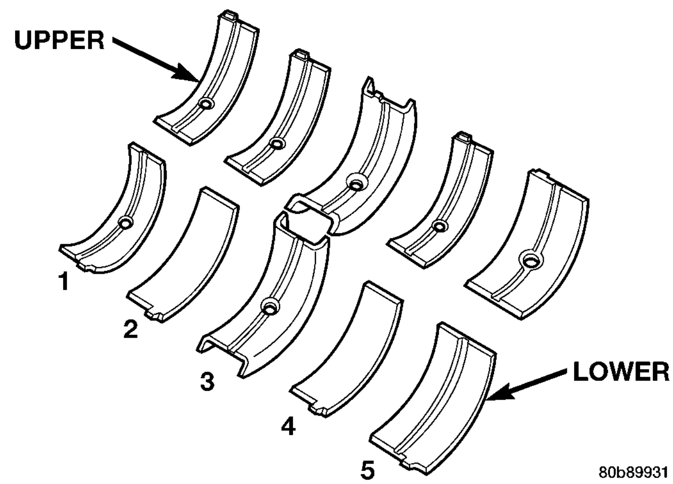


Fig. 26 Main Bearing Orientation

OPERATION

The main bearings encircle the crankshaft main bearing journals, this aligns the crankshaft to the centerline of the engine and allows the crankshaft to turn without wobbling or shaking therefore eliminating vibration. The main bearings are available in standard and undersizes.

STANDARD PROCEDURE—CRANKSHAFT MAIN BEARING FITTING

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of No.2 and 4 are interchangeable.

Upper and lower No.3 bearing halves are flanged to carry the crankshaft thrust loads. They are NOT interchangeable with any other bearing halves in the engine (Fig. 27). Bearing shells are available in standard and the following undersizes: Never install an undersize bearing that will reduce clearance below specifications.

CRANKSHAFT MAIN BEARINGS (Continued)

Main Bearing Undersize Availability List

- 0.25 mm (0.001 inch)
- 0.051 mm (0.002 inch)
- 0.076 mm (0.003 inch)
- 0.254 mm (0.010 inch)
- 0.305 mm (0.012 inch)

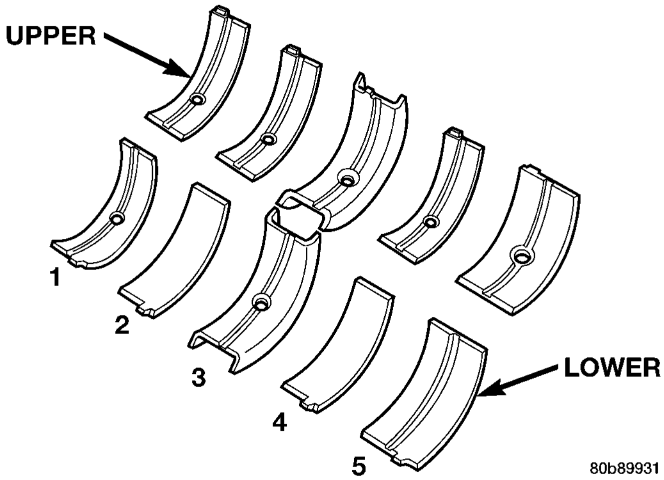


Fig. 27 Main Bearing

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from the rear main bearing cap (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Identify bearing caps before removal. Remove bearing caps one at a time.

(4) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 28).

(5) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 28).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Install the bearing caps. Clean and oil the bolts. Tighten the capbolts to 115 N·m (85 ft. lbs.) torque.

(4) Install the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

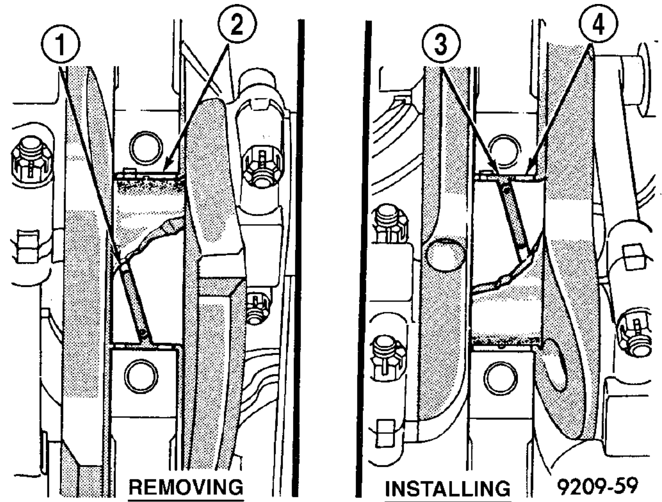


Fig. 28 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

(5) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(6) Start engine check for leaks.

CRANKSHAFT OIL SEAL - FRONT

DESCRIPTION

The crankshaft front seal is a one piece viton seal with a steel housing. The front seal is located in the engine front cover.

OPERATION

The crankshaft seals prevent oil from leaking from around the crankshaft, either from the rear of the engine or from the engine front cover.

REMOVAL

The oil seal can be replaced without removing the timing chain cover, provided that the cover is not misaligned.

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) If front seal is suspected of leaking, check front oil seal alignment to crankshaft. The seal installation/alignment Tool 6635, should fit with minimum interference. If tool does not fit, the cover must be removed and installed properly.

CRANKSHAFT OIL SEAL - FRONT (Continued)

(4) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal bore of cover.

INSTALLATION

(1) Place the smaller diameter of the oil seal over Front Oil Seal Installation Tool 6635 (Fig. 29). Seat the oil seal in the groove of the tool.

(2) Position the seal and tool onto the crankshaft (Fig. 30).

(3) Using the vibration damper bolt, tighten the bolt to draw the seal into position on the crankshaft (Fig. 31).

(4) Remove the vibration damper bolt and seal installation tool.

(5) Inspect the seal flange on the vibration damper.

(6) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(7) Connect the negative cable to the battery.

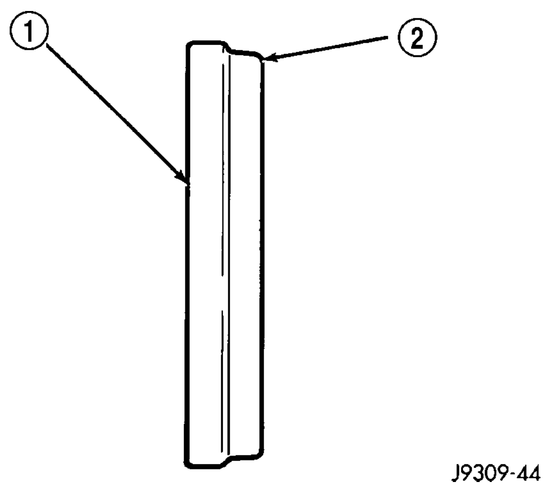


Fig. 29 Placing Oil Seal on Installation Tool 6635

1 - CRANKSHAFT FRONT OIL SEAL
2 - INSTALL THIS END INTO SPECIAL TOOL 6635

CRANKSHAFT OIL SEAL - REAR

DESCRIPTION

The crankshaft rear seal is a two piece viton seal. One part of the two piece rear seal is located in a slot in the cylinder block oppsite the crankshaft main bearing cap, the second part of the two piece seal is located in the main bearing cap itself.

OPERATION

The crankshaft seals prevent oil from leaking from around the crankshaft, either from the rear of the engine or from the engine front cover.

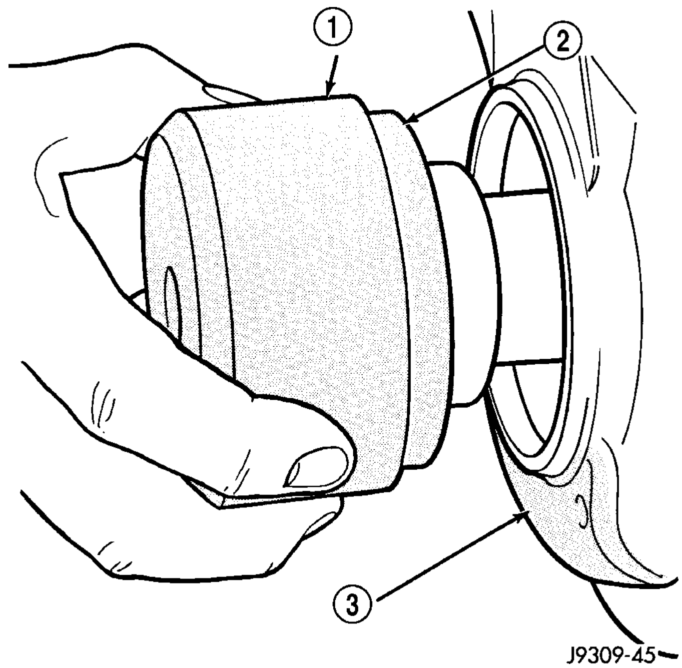


Fig. 30 Position Tool and Seal onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

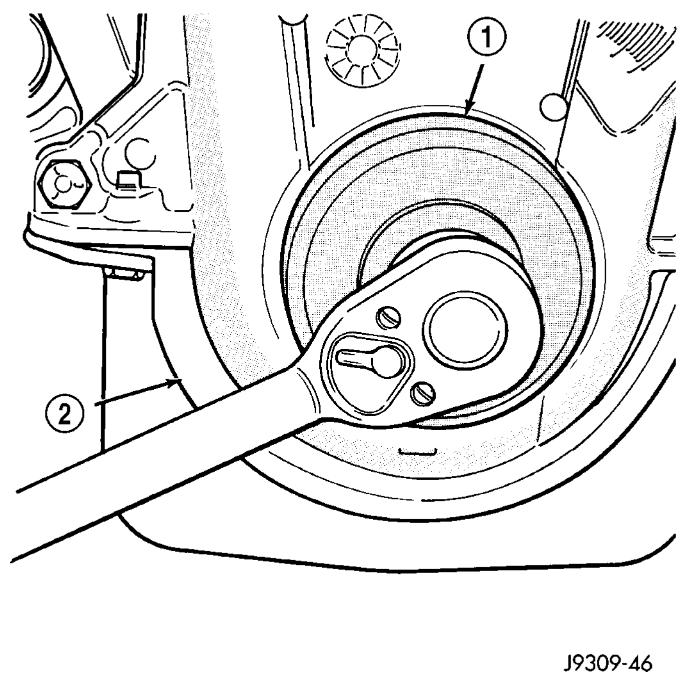


Fig. 31 Installing Oil Seal

1 - SPECIAL TOOL 6635
2 - TIMING CHAIN COVER

REMOVAL

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Remove the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - REMOVAL). Discard the old upper seal.

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap. Remove and discard the old lower oil seal.

(4) Carefully remove and discard the old upper oil seal.

LOWER SEAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(3) Remove the rear main bearing cap and discard the old lower seal.

INSTALLATION

The service seal is a two piece, Viton seal. The upper seal half can be installed with crankshaft removed from engine or with crankshaft installed. When a new upper seal is installed, install a new lower seal. The lower seal half can be installed only with the rear main bearing cap removed.

UPPER SEAL —CRANKSHAFT REMOVED

(1) Clean the cylinder block rear cap mating surface. Be sure the seal groove is free of debris. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil.

(3) Install the new upper rear bearing oil seal with the white paint facing toward the rear of the engine.

(4) Position the crankshaft into the cylinder block.

(5) Lightly oil the new lower seal lips with engine oil.

(6) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing towards the rear of the engine.

(7) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

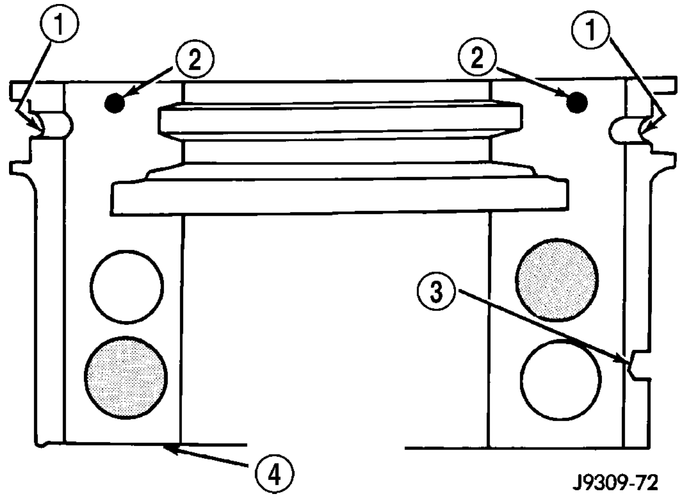


Fig. 32 Sealant Application to Bearing Cap

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT SLOTS
2 - MOPAR® GASKET MAKER (OR EQUIVALENT)
3 - CAP ALIGNMENT SLOT
4 - REAR MAIN BEARING CAP

(8) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(9) Clean and oil all cap bolts. Install all main bearing caps. Install all cap bolts and alternately tighten to 115 N·m (85 ft. lbs.) torque.

(10) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(11) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing (Fig. 33). Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(12) Install new front crankshaft oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION).

(13) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

CRANKSHAFT OIL SEAL - REAR (Continued)

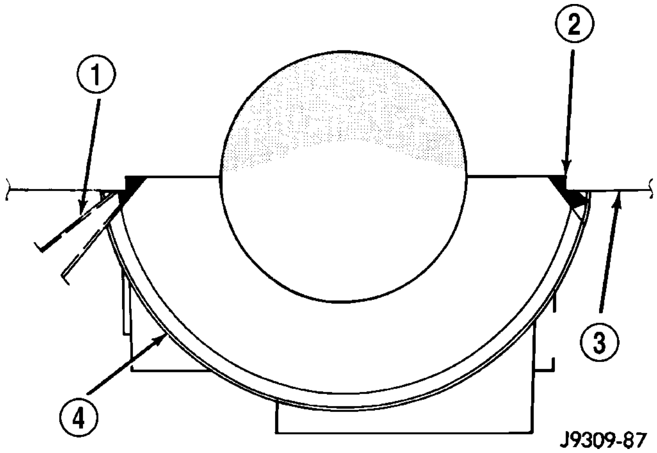


Fig. 33 Apply Sealant to Bearing Cap-to-Block Joint

1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT NOZZLE TIP
2 - SEALANT APPLIED
3 - CYLINDER BLOCK
4 - REAR MAIN BEARING CAP

UPPER SEAL—CRANKSHAFT INSTALLED

(1) Clean the cylinder block mating surfaces before oil seal installation. Check for burrs at the oil hole on the cylinder block mating surface to rear cap.

(2) Lightly oil the new upper seal lips with engine oil. To allow ease of installation of the seal, loosen at least the two main bearing caps forward of the rear bearing cap.

(3) Rotate the new upper seal into the cylinder block, being careful not to shave or cut the outer surface of the seal. To ensure proper installation, use the installation tool provided with the kit. Install the new seal with the white paint facing toward the rear of the engine.

(4) Install the new lower rear bearing oil seal into the bearing cap with the white paint facing toward the rear of the engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application. Be sure the white paint faces toward the rear of the engine.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten ALL cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap-to-block and oil pan sealing (Fig. 33). Apply enough sealant until a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

LOWER SEAL

(1) Clean the rear main cap mating surfaces including the oil pan gasket groove.

(2) Carefully install a new upper seal. Refer to UPPER SEAL—CRANKSHAFT INSTALLED.

(3) Lightly oil the new lower seal lips with engine oil.

(4) Install a new lower seal in bearing cap with the white paint facing the rear of engine.

(5) Apply 5 mm (0.20 in.) drop of Mopar® Gasket Maker, or equivalent, on each side of the rear main bearing cap (Fig. 32). DO NOT over-apply sealant or allow the sealant to contact the rubber seal. Assemble bearing cap to cylinder block immediately after sealant application.

(6) To align the bearing cap, use cap slot, alignment dowel, and cap bolts. DO NOT remove excess material after assembly. DO NOT strike rear cap more than two times for proper engagement.

(7) Install the rear main bearing cap with cleaned and oiled cap bolts. Alternately tighten the cap bolts to 115 N·m (85 ft. lbs.) torque.

(8) Install oil pump (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(9) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, at bearing cap-to-block joint to provide cap to block and oil pan sealing. Apply enough sealant so that a small amount is squeezed out. Withdraw nozzle and wipe excess sealant off the oil pan seal groove.

(10) Immediately install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

DISTRIBUTOR BUSHING

REMOVAL

(1) Remove distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - REMOVAL).

(2) Remove the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(3) Insert Distributor Drive Shaft Bushing Puller Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 34).

(4) Hold puller screw and tighten puller nut until bushing is removed.

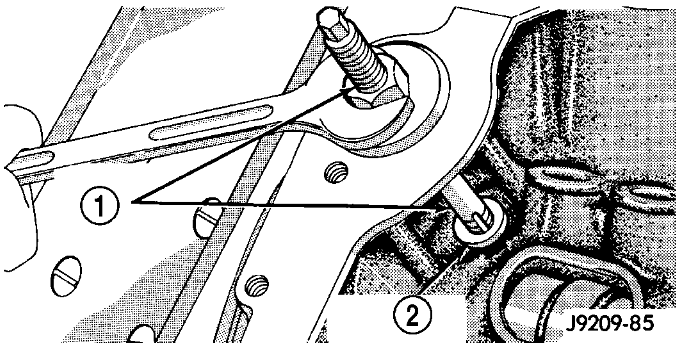


Fig. 34 Distributor Driveshaft Bushing Removal

1 - SPECIAL TOOL C-3052
2 - BUSHING

INSTALLATION

(1) Slide new bushing over burnishing end of Distributor Drive Shaft Bushing Driver/Burnisher Tool C-3053. Insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 35).

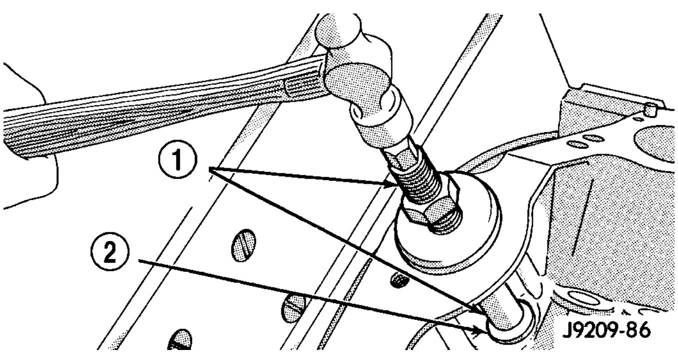


Fig. 35 Distributor Driveshaft Bushing Installation

1 - SPECIAL TOOL C-3053
2 - BUSHING

(3) As the burnisher is pulled through the bushing, the bushing is expanded tight in the block and burnished to correct size (Fig. 36). **DO NOT ream this bushing.**

CAUTION: This procedure MUST be followed when installing a new bushing or seizure to shaft may occur.

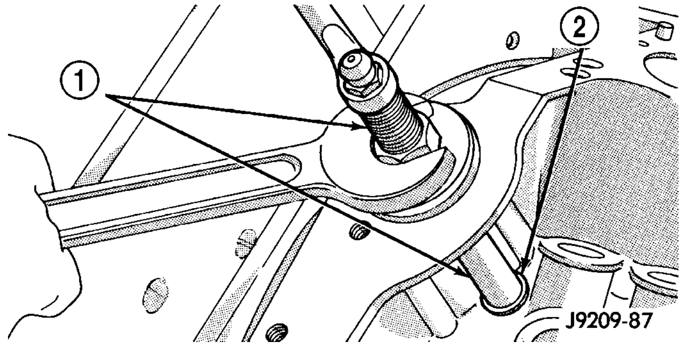


Fig. 36 Burnishing Distributor Driveshaft Bushing

1 - SPECIAL TOOL C-3053
2 - BUSHING

(4) Install the intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install the distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/DISTRIBUTOR - INSTALLATION).

HYDRAULIC LIFTERS

DIAGNOSIS AND TESTING—HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on

HYDRAULIC LIFTERS (Continued)

intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 37).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Universal Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

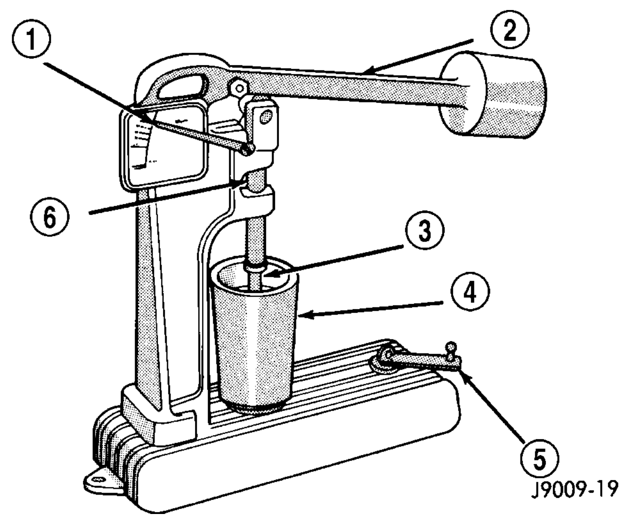


Fig. 37 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

REMOVAL

(1) Remove the air cleaner assembly and air in-let hose.

(2) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

HYDRAULIC LIFTERS (Continued)

(3) Remove rocker assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original locations.

(4) Remove intake manifold (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(5) Remove yoke retainer and aligning yokes.

(6) Slide Hydraulic Tappet Remover/Installer Tool C-4129-A through opening in cylinder head and seat tool firmly in the head of tappet.

(7) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(8) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets with Mopar® Engine Oil Supplement or equivalent.

(2) Install tappets and push rods in their original positions. Ensure that the oil feed hole in the side of the tappet body faces up (away from the crankshaft).

(3) Install aligning yokes with ARROW toward camshaft.

(4) Install yoke retainer. Tighten the bolts to 23 N·m (200 in. lbs.) torque. Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(6) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(7) Install air cleaner assembly and air in-let hose.

(8) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

PISTON & CONNECTING ROD

DESCRIPTION

The pistons are made of aluminum and have three ring grooves, the top two grooves are for the compression rings and the bottom groove is for the oil control ring. The connecting rods are forged steel and are coined prior to heat treat. The piston pins are press fit.

STANDARD PROCEDURE - PISTON FITTING

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch) at 21°C (70°F).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 38).

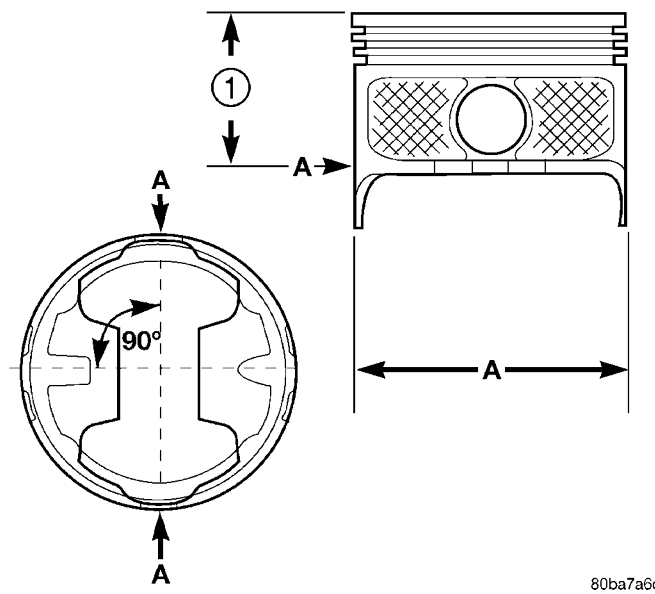


Fig. 38 Piston Measurements

1 - 49.53 mm
(1.95 IN.)

PISTON & CONNECTING ROD (Continued)

PISTON MEASUREMENT CHART

PISTON SIZE	A DIA = PISTON DIAMETER		BORE DIAMETER	
	MIN. mm (in.)	MAX. mm (in.)	MIN. mm (in.)	MAX. mm (in.)
A	—	—	—	—
B	101.580 (3.9992)	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)
C	101.592 (3.9997)	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)
D	101.605 (4.0002)	101.618 (4.0007)	101.630 (4.0012)	101.643 (4.0017)
E	—	—	—	—

DESCRIPTION	SPECIFICATION
PISTON PIN BORE	25.007 - 25.015 mm (.9845 - .9848 in.)
RING GROOVE HEIGHT	
OIL RAIL	4.033 - 4.058 mm (.1588 - .1598 in.)
COMPRESSION RAIL	1.529 - 1.554 mm (.0602 - .0612 in.)
TOTAL FINISHED WEIGHT	470.8 ± 2 grams (16.607 ± .0706 ounces)

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure each connecting rod and connecting rod cap is identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing the assemblies from the engine, rotate crankshaft so that the connecting rod is centered in cylinder bore and at BDC. **Be careful not to nick crankshaft journals.**

(7) After removal, install bearing cap on the mating rod.

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, be sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

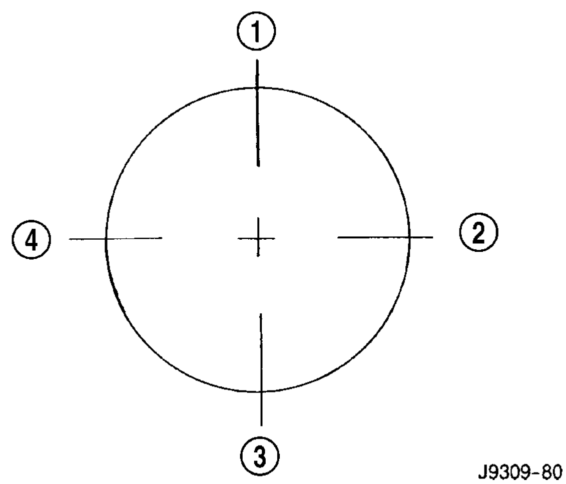


Fig. 39 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

(3) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts. The long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch, or groove, on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps. Be sure connecting rod, connecting rod cap, and cylinder bore number are the same. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(9) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(10) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(11) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 in. from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler gauge in the gap. The top compression ring gap should be between 0.254-0.508 mm (0.010-0.020 in.). The second compression ring gap should be between 0.508-0.762 mm (0.020-0.030 in.). The oil ring gap should be 0.254-1.270 mm (0.010-0.050 in.).

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Rings with excess gaps should not be used.

(2) Install rings, and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression, or the word “TOP” (Fig. 40) (Fig. 42).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 41) (Fig. 42). An identification mark on the ring is a drill point, a stamped letter “O”, an oval depression or the word “TOP” facing up.

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 in.) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 in.) side clearance.

(e) Pistons with insufficient, or excessive, side clearance should be replaced.

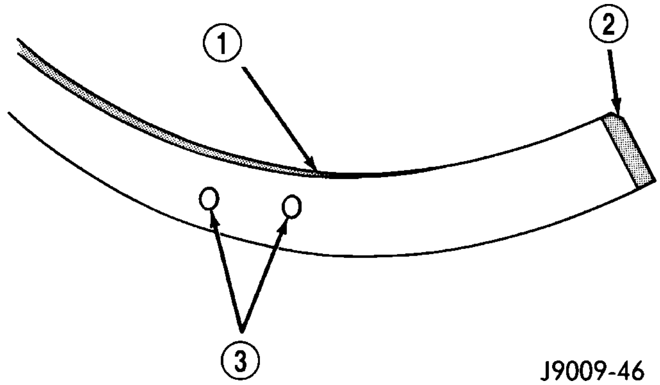


Fig. 40 Second Compression Ring Identification (Typical)

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

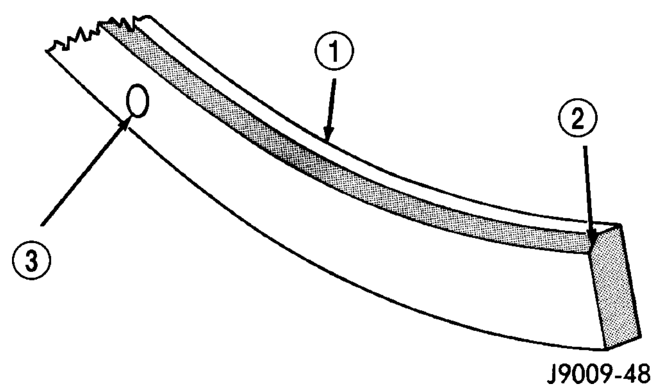


Fig. 41 Top Compression Ring Identification (Typical)

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

(3) Orient the rings:

(a) Arrange top compression ring 90° counterclockwise from the oil ring rail gap (Fig. 43).

PISTON RINGS (Continued)

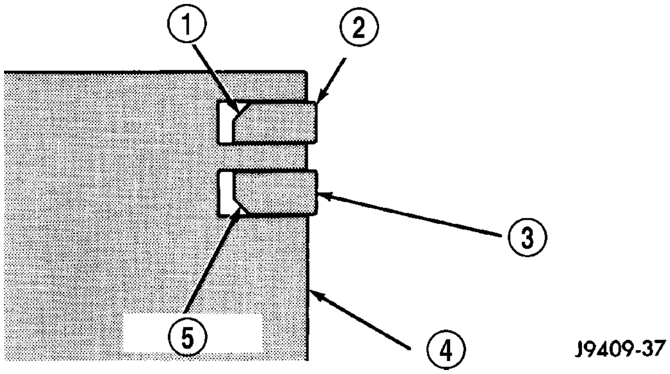


Fig. 42 Compression Ring Chamfer Location (Typical)

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

(b) Arrange second compression ring 90° clockwise from the oil ring rail gap (Fig. 43).

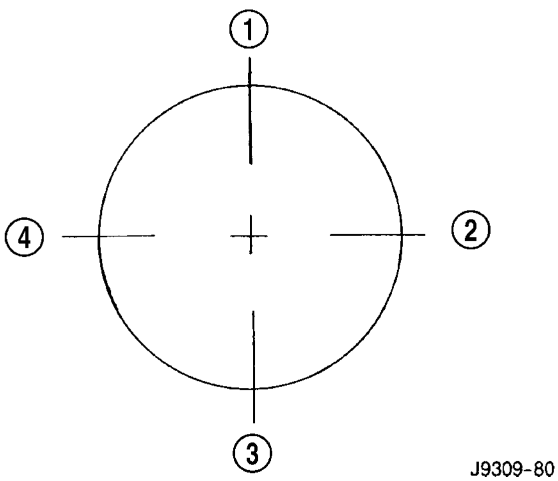


Fig. 43 Proper Ring Installation

1 - OIL RING SPACER GAP
2 - SECOND COMPRESSION RING GAP OIL RING RAIL GAP (TOP)
3 - OIL RING RAIL GAP (BOTTOM)
4 - TOP COMPRESSION RING GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the cooling system fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove vibration damper bolt and washer from end of crankshaft.

(5) Position Special Tool 8513 Insert into the crankshaft nose.

(6) Install Special Tool 1026 Three Jaw Puller onto the vibration damper (Fig. 44).

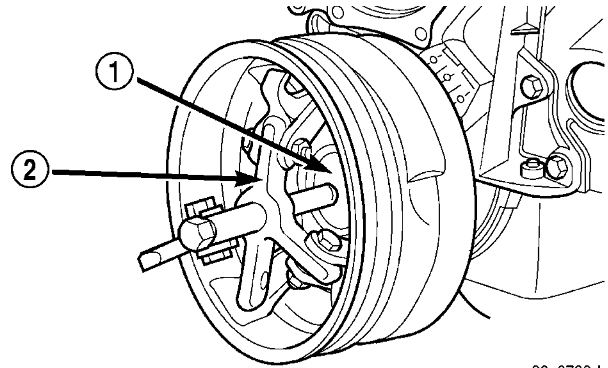


Fig. 44 Vibration Damper Removal

1 - SPECIAL TOOL 8513 INSERT
2 - SPECIAL TOOL 1026

(7) Pull vibration damper off of the crankshaft.

INSTALLATION

CAUTION: Thoroughly remove any contaminants from the crankshaft nose and the vibration damper bore. Failure to do so can cause sever damage to the crankshaft.

(1) Position the vibration damper onto the crankshaft.

(2) Place installing tool, part of Puller Tool Set C-3688 in position and press the vibration damper onto the crankshaft (Fig. 45).

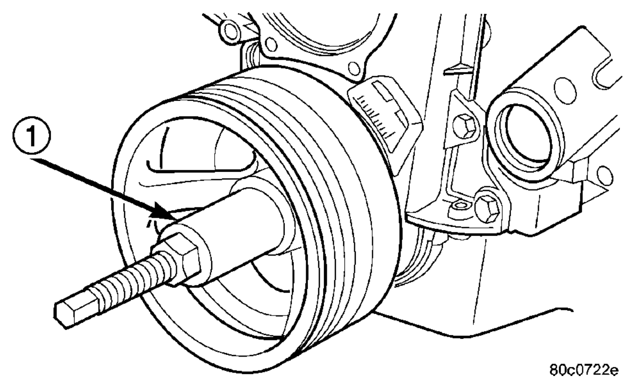


Fig. 45 Vibration Damper Installation

1 - SPECIAL TOOL C-3688

(3) Install the crankshaft bolt and washer. Tighten the bolt to 244 N·m (180 ft. lbs.) torque.

(4) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(5) Position the fan shroud and install the bolts. Tighten the retainer bolts to 11 N·m (95 in. lbs.) torque.

(6) Install the cooling fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - INSTALLATION).

(7) Connect the battery negative cable.

FRONT MOUNT

REMOVAL

2WD

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the engine oil filter.
(5) Remove the oil drain trough.
(6) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(7) Support the front axle with a suitable jack.
(8) Remove the (4) bolts that attach the engine mounts to the front axle.
(9) Remove the (3) bolts that attach the front axle to the left engine bracket.
(10) Lower the front axle.
(11) Remove the through bolts
(12) Raise the engine far enough to be able to remove the left and right engine mounts.
(13) Remove the (8) mount to engine attaching bolts
(14) Remove the engine mounts.

4WD

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the viscous fan before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(3) Raise the vehicle.
(4) Remove the skid plate.
(5) Remove the front crossmember.
(6) Remove the engine oil filter.
(7) Remove the oil drain trough.
(8) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.
(9) Support the front axle with a suitable jack.
(10) Remove the (4) bolts that attach the engine mounts to the front axle (Fig. 46).

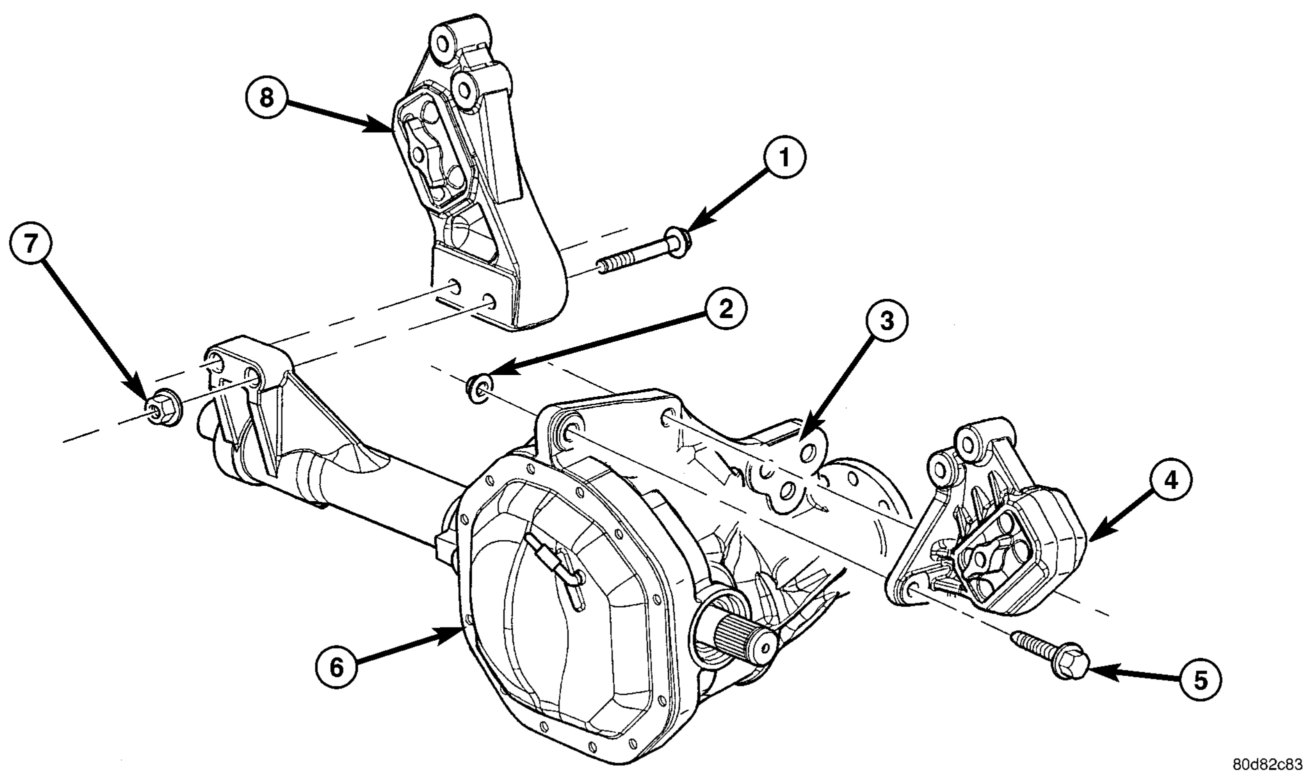


Fig. 46 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

FRONT MOUNT (Continued)

(11) Remove the (3) bolts that attach the front axle to the left engine bracket.

(12) Lower the front axle.

(13) Remove the (6) through bolts

(14) Raise the engine far enough to be able to remove the left (Fig. 47) and right (Fig. 48) engine mounts.

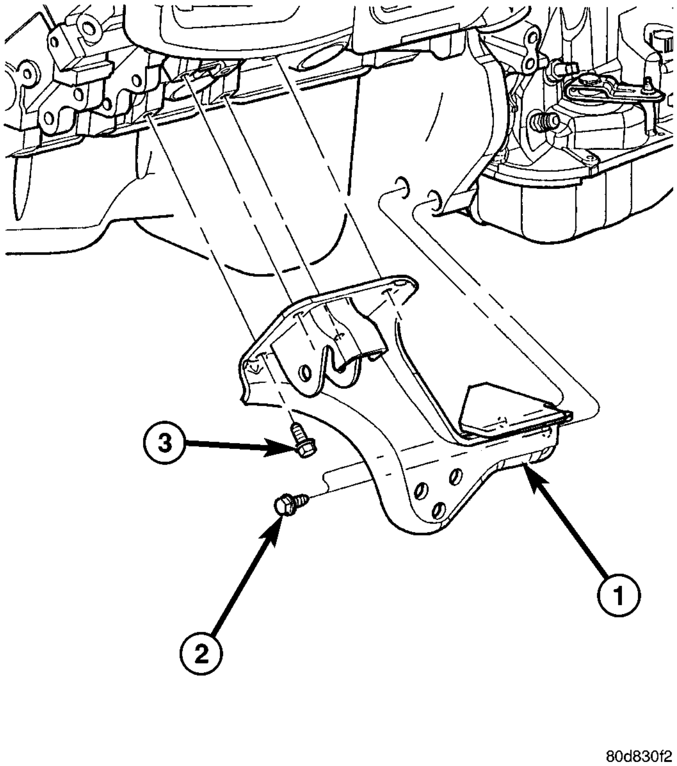


Fig. 47 ENGINE SUPPORT BRACKET 5.9L

1 - ENGINE SUPPORT BRACKET
2 - BOLT
3 - BOLT

(15) Remove the engine mounts.

INSTALLATION

2WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the engine block with (8) bolts. Torque bolts to 54 N·m (40 ft. lbs.).

(2) Insert the (2) through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(3) Lower the engine until the through bolts rest onto the slots in the frame brackets.

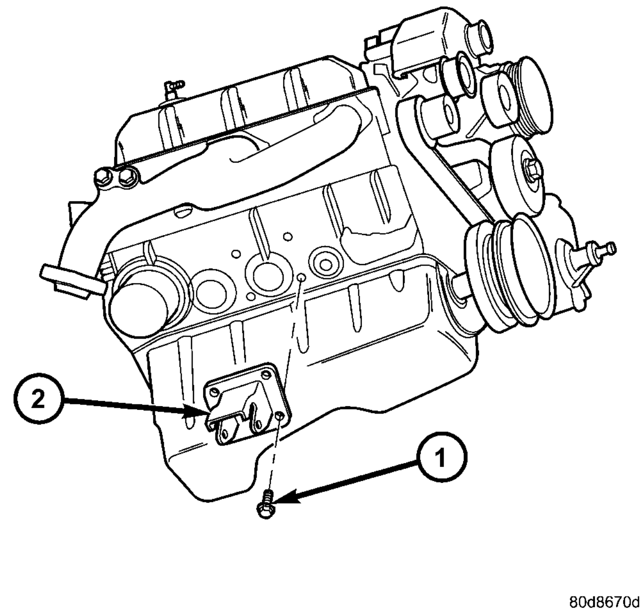


Fig. 48 ENGINE SUPPORT RH 4X4

1 - BOLT
2 - ENGINE SUPPORT

(4) Tighten the through bolt nuts to 94 N·m (70 ft. lbs.).

(5) Install the oil drain trough.

(6) Install the engine oil filter.

(7) Lower the vehicle.

(8) Install the viscous fan (Refer to 7 - COOLING/ ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).

(9) Reconnect the negative battery cable.

4WD

NOTE: For mount to engine block and left engine bracket to front axle bolts, apply Mopar® Lock and Seal Adhesive, Medium Strength Threadlocker.

(1) Install the right and left side engine mounts to the front axle. Torque nuts to 94 N·m (70 ft. lbs.).

(2) Raise the front axle into the frame and install the left and right side through bolts. Torque nuts to 94 N·m (70 ft. lbs.).

(3) Insert the two upper through bolts into the right and left side engine mounts and loose assemble the two nuts onto the through bolts.

(4) Lower the engine until the left and right side engine brackets rest on the through bolts, and the lower engine bracket through holes align with the engine mounts, and the left engine bracket holes align with the front axle slots (Fig. 49).

(5) Loose assemble the (3) bolts that attach the front axle to the left engine bracket.

FRONT MOUNT (Continued)

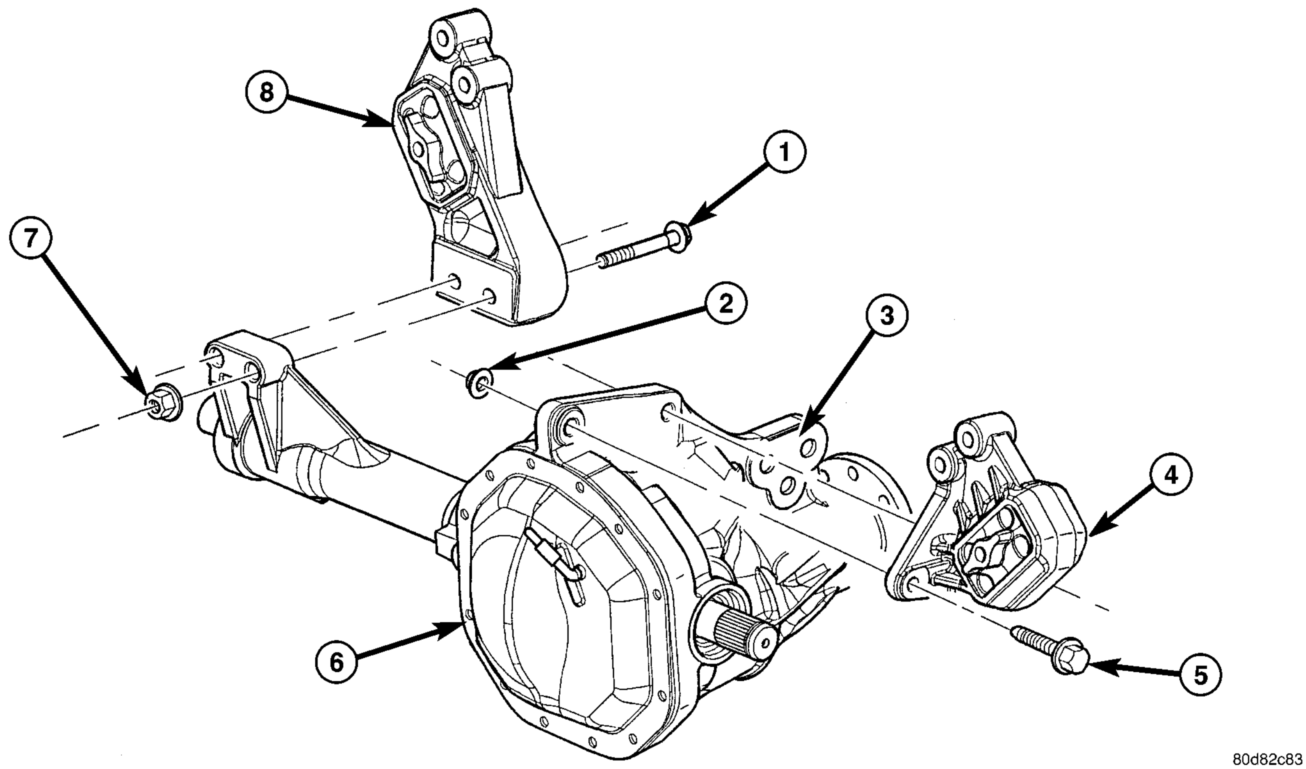


Fig. 49 ENGINE INSULATOR MOUNTS 4X4

1 - RH INSULATOR TO AXLE BOLT
2 - NUT
3 - PINION SUPPORT MOUNT
4 - LH INSULATOR MOUNT
5 - LH INSULATOR TO AXLE BOLT
6 - FRONT AXLE
7 - NUT
8 - RH INSULATOR MOUNT

(6) Loose assemble the lower through bolts.
(7) Torque the nuts for the (4) through bolts to 101 N·m (75 ft. lbs.).
(8) Torque the (3) bolts that attach the front axle to the left engine bracket to 101 N·m (75 ft. lbs.).
(9) Install the oil drain trough.
(10) Install the engine oil filter.
(11) Install the front crossmember.
(12) Install the skid plate.
(13) Lower the vehicle.
(14) Install the viscous fan (Refer to 7 - COOLING/ENGINE/FAN DRIVE VISCOUS CLUTCH - REMOVAL).
(15) Reconnect the negative battery cable.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.
(2) Using a suitable jack, support transmission.
(3) Remove the nuts from the transmission mount (Fig. 50).
(4) Remove the two bolts that attach the transmission mount to the engine bracket.

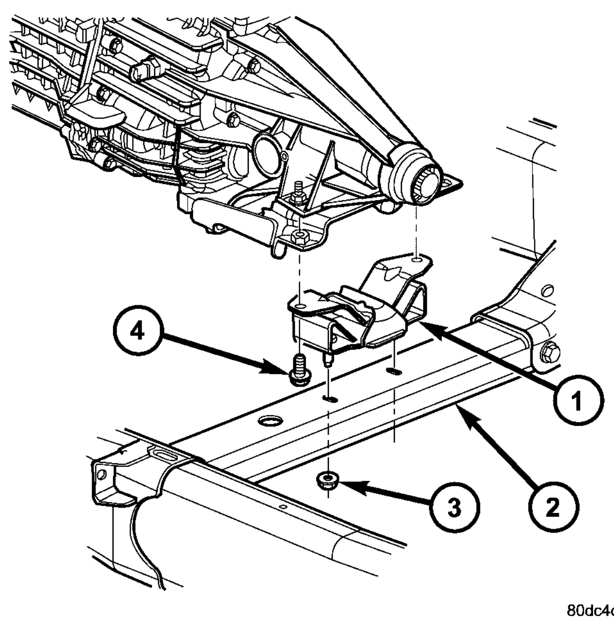


Fig. 50 TRANSMISSION MOUNT

1 - MOUNT
2 - CROSSMEMBER
3 - NUT
4 - BOLT

REAR MOUNT (Continued)

(5) Raise the transmission enough to remove the mount from the crossmember.

(6) Remove the mount.

INSTALLATION

NOTE: Threadlocking compound must be applied to the bolts before installation.

(1) Install the two bolts that attach the transmission mount to the transmission bracket.

(2) Torque the bolts to 61N·m (45 ft.lbs.) torque.

(3) Lower the transmission so the transmission mount rests on the crossmember, and the studs of the transmission mount are aligned in the slots in the crossmember.

(4) Install the nuts onto the transmission mount studs through the crossmember access slot.

(5) Torque the nuts to 54N·m (40 ft. lbs.).

LUBRICATION

DESCRIPTION

A gear-type positive displacement pump (Fig. 51) is mounted at the underside of the rear main bearing cap. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan.

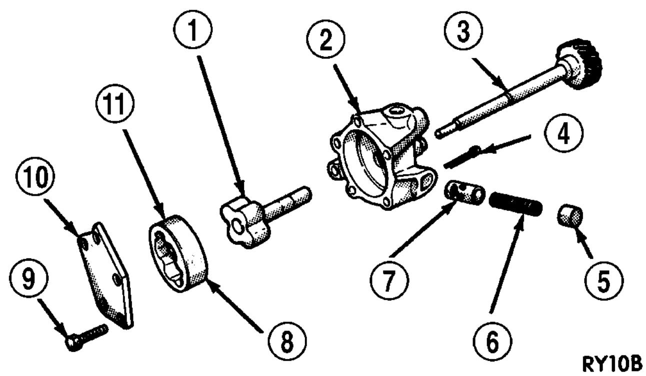


Fig. 51 Positive Displacement Oil Pump—Typical

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

OPERATION

The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery, which extends the entire length on the right side of the block. The oil then goes down to the No. 1 main bearing, back up to the left side of the block, and into the oil gallery on the left side of the engine.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets, which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan (Fig. 52).

LUBRICATION (Continued)

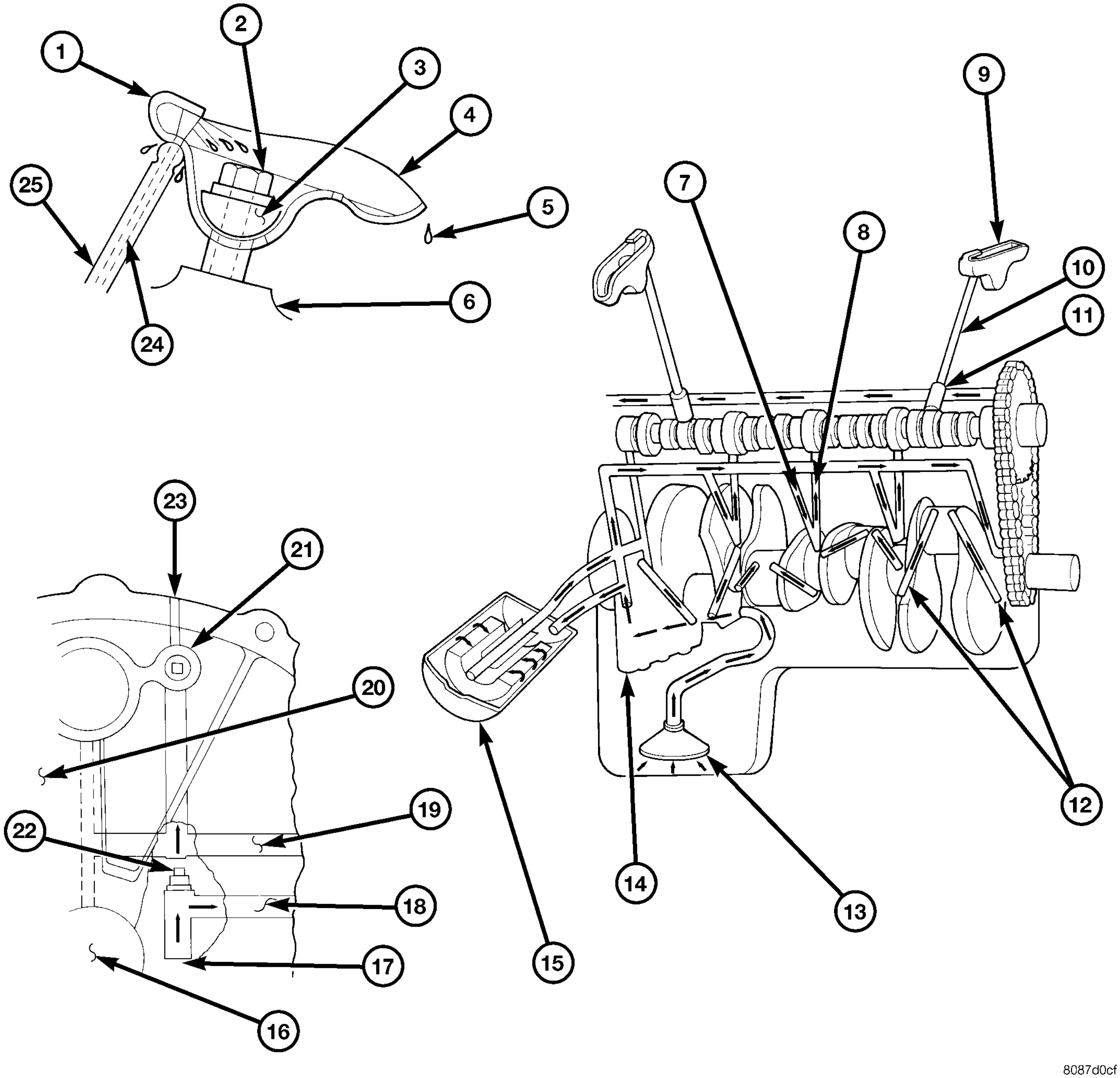


Fig. 52 Oil Lubrication System

1 - OIL DEFLECTOR TAB
2 - BOLT
3 - ROCKER ARM PIVOT
4 - ROCKER ARM
5 - DRIP OILING FOR VALVE TIP
6 - CYLINDER HEAD BOSS
7 - TO MAIN BEARINGS
8 - TO CAMSHAFT BEARINGS
9 - ROCKER ARM
10 - HOLLOW PUSH ROD
11 - TAPPET
12 - TO CONNECTING ROD BEARINGS
13 - OIL INTAKE
14 - OIL PUMP
15 - OIL FILTER
16 - CRANKSHAFT
17 - FROM OIL PUMP
18 - OIL TO FILTER
19 - OIL FROM FILTER TO SYSTEM
20 - PASSAGE TO CAMSHAFT REAR BEARING
21 - RIGHT OIL GALLERY
22 - PLUG
23 - OIL PASSAGE FOR OIL PRESSURE INDICATOR LIGHT
24 - OIL SUPPLY VIA HOLLOW PUSH ROD SUPPLY IS FROM OIL GALLERY METERED THROUGH HYDRAULIC TAPPET
25 - OIL SUPPLY FROM HOLLOW PUSH ROD

LUBRICATION (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAKS

Begin with a through visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil-soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

(6) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(7) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(8) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(9) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(10) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(11) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose. Proceed to next step.

(12) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. (Refer to 9 - ENGINE - SPECIFICATIONS).

OIL

STANDARD PROCEDURE - ENGINE OIL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 53).

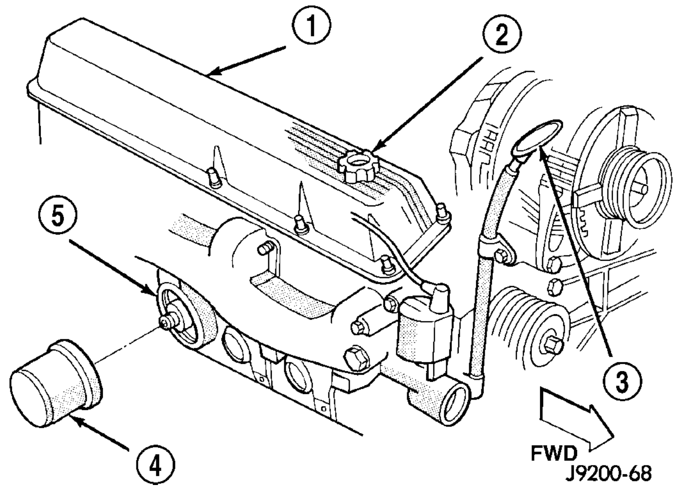


Fig. 53 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

OIL (Continued)

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss (Fig. 54).

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 55) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

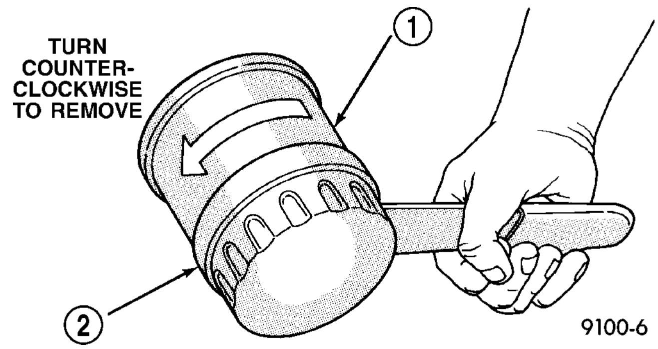


Fig. 54 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 55) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

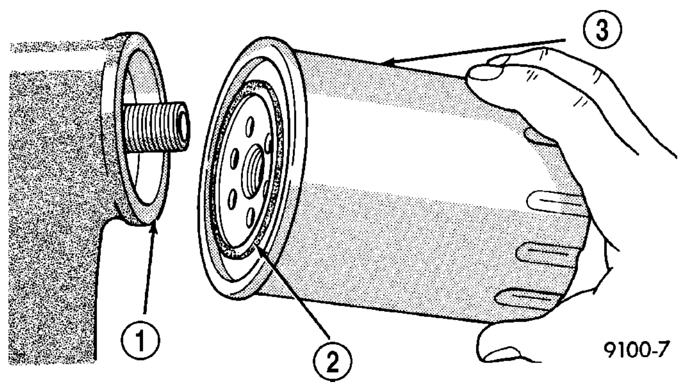


Fig. 55 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove engine oil dipstick.

(3) Raise vehicle.

(4) Drain engine oil.

(5) Remove exhaust pipe.

(6) Remove left engine to transmission strut.

(7) Loosen the right side engine support bracket cushion thru-bolt nut and raise the engine slightly. Remove oil pan by sliding backward and out.

(8) Remove the one-piece gasket.

CLEANING

Clean the block and pan gasket surfaces.

OIL PAN (Continued)

Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Trim or remove excess sealant film in the rear main cap oil pan gasket groove. **DO NOT remove the sealant inside the rear main cap slots.**

(3) If present, trim excess sealant from inside the engine.

(4) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 56).

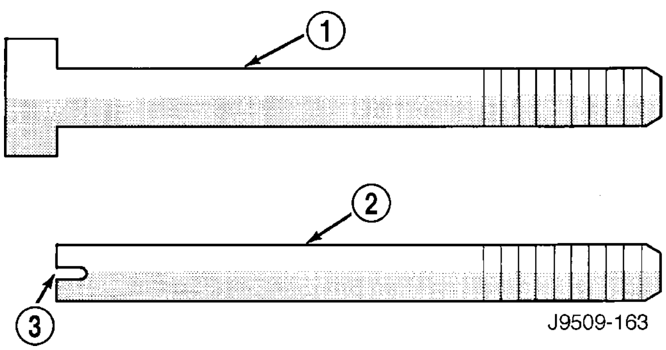


Fig. 56 Fabrication of Alignment Dowels

1 - 5/16” X 1½” BOLT
2 - DOWEL
3 - SLOT

(5) Install the dowels in the cylinder block (Fig. 57).

(6) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent in the corner of the cap and the cylinder block.

(7) Slide the one-piece gasket over the dowels and onto the block.

(8) Position the oil pan over the dowels and onto the gasket.

(9) Install the oil pan bolts. Tighten the bolts to 24 N·m (215 in. lbs.) torque.

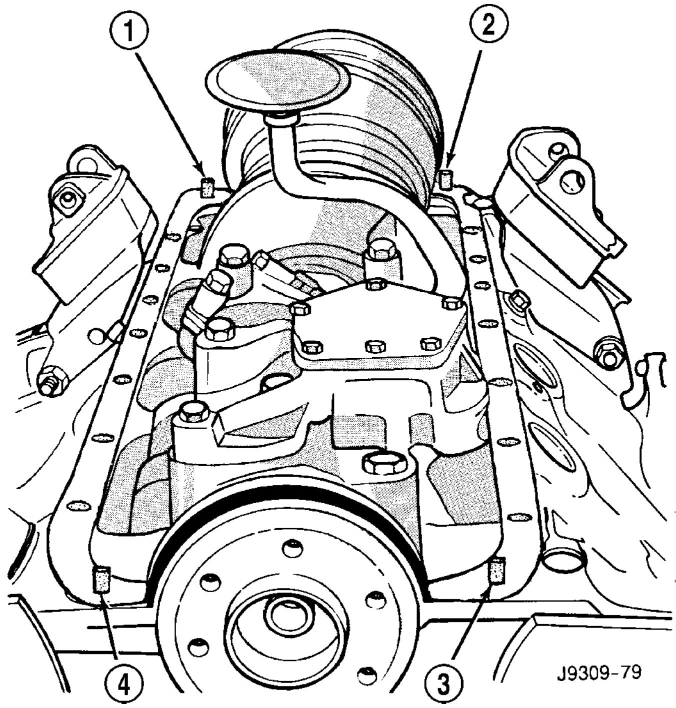


Fig. 57 Position of Dowels in Cylinder Block

1 - DOWEL
2 - DOWEL
3 - DOWEL
4 - DOWEL

(10) Remove the dowels. Install the remaining oil pan bolts. Tighten these bolts to 24 N·m (215 in. lbs.) torque.

(11) Lower the engine into the support cushion brackets and tighten the thru bolt nut to the proper torque.

(12) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(13) Install the engine to transmission strut.

(14) Install exhaust pipe.

(15) Lower vehicle.

(16) Install dipstick.

(17) Connect the negative cable to the battery.

(18) Fill crankcase with oil to proper level.

OIL PUMP

REMOVAL

(1) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Remove the oil pump from rear main bearing cap.

DISASSEMBLY

(1) Remove the relief valve as follows:

(a) Remove cotter pin. Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 58).

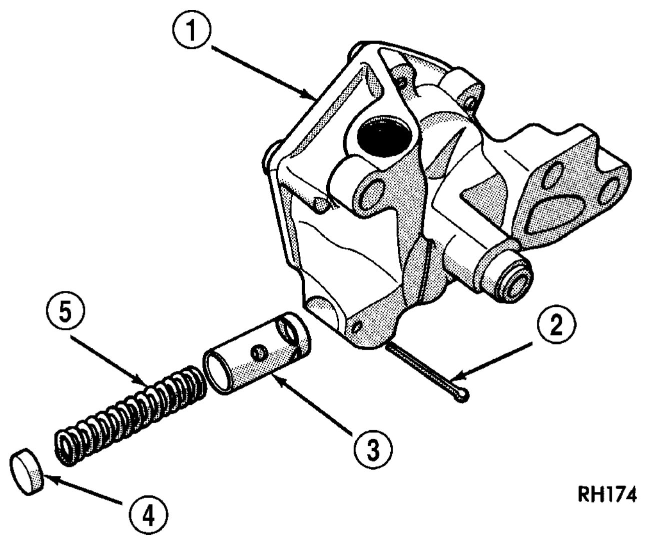


Fig. 58 Oil Pressure Relief Valve

1 - OIL PUMP ASSEMBLY
2 - COTTER PIN
3 - RELIEF VALVE
4 - RETAINER CAP
5 - SPRING

(2) Remove oil pump cover (Fig. 59).

(3) Remove pump outer rotor and inner rotor with shaft (Fig. 59).

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear.

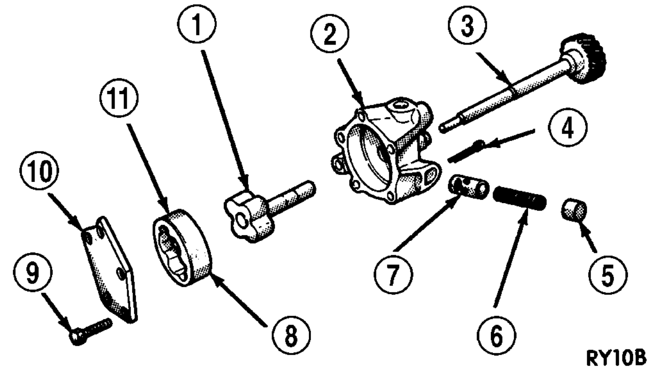


Fig. 59 Oil Pump

1 - INNER ROTOR AND SHAFT
2 - BODY
3 - DISTRIBUTOR DRIVESHAFT (REFERENCE)
4 - COTTER PIN
5 - RETAINER CAP
6 - SPRING
7 - RELIEF VALVE
8 - LARGE CHAMFERED EDGE
9 - BOLT
10 - COVER
11 - OUTER ROTOR

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 60). If a 0.038 mm (0.0015 inch) feeler gauge can be inserted between cover and straightedge, pump assembly should be replaced.

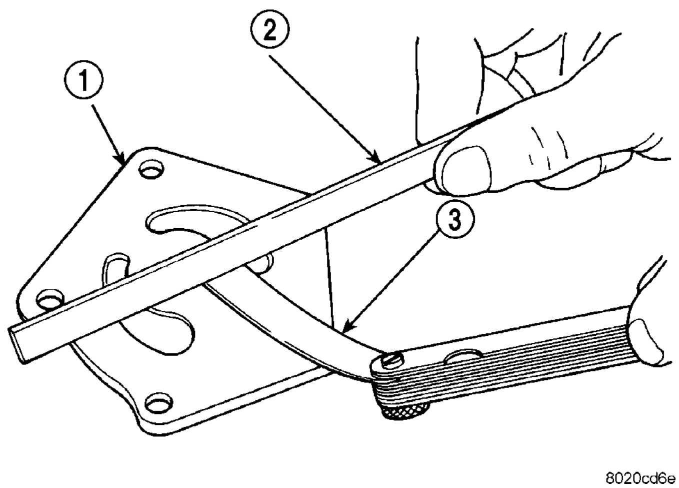


Fig. 60 Checking Oil Pump Cover Flatness

1 - COVER
2 - STRAIGHT EDGE
3 - FEELER GAUGE

OIL PUMP (Continued)

Measure thickness and diameter of OUTER rotor. If outer rotor thickness measures 20.9 mm (0.825 inch) or less or if the diameter is 62.7 mm (2.469 inches) or less, replace outer rotor (Fig. 61).

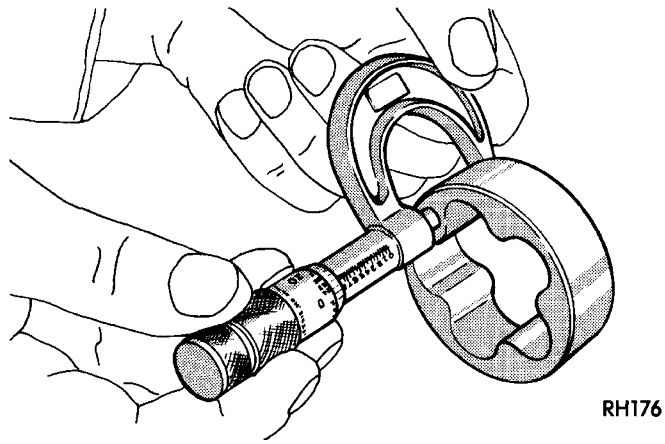


Fig. 61 Measuring Outer Rotor Thickness

If inner rotor measures 20.9 mm (0.825 inch) or less, replace inner rotor and shaft assembly (Fig. 62).

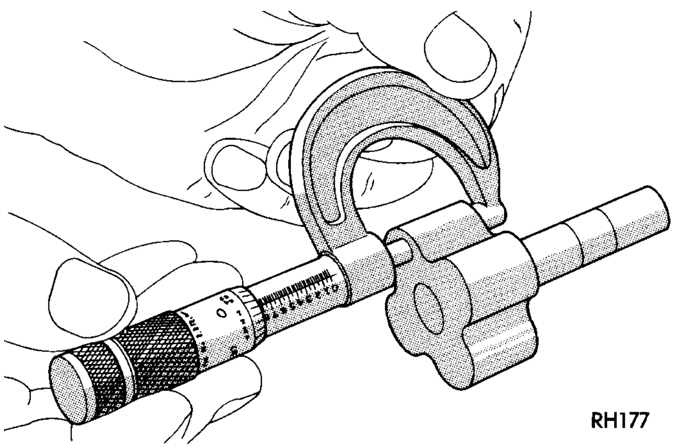


Fig. 62 Measuring Inner Rotor Thickness

Slide outer rotor into pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 63). If clearance is 0.356 mm (0.014 inch) or more, replace oil pump assembly.

Install inner rotor and shaft into pump body. If clearance between inner and outer rotors is 0.203 mm (0.008 inch) or more, replace shaft and both rotors (Fig. 64).

Place a straightedge across the face of the pump, between bolt holes. If a feeler gauge of 0.102 mm (0.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 65).

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

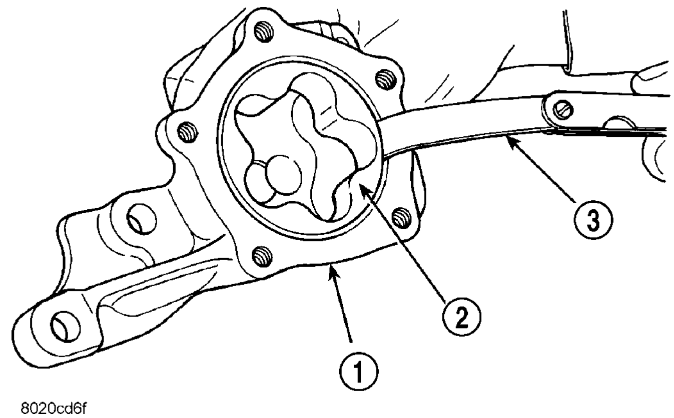


Fig. 63 Measuring Outer Rotor Clearance in Housing

1 - PUMP BODY
2 - OUTER ROTOR
3 - FEELER GAUGE

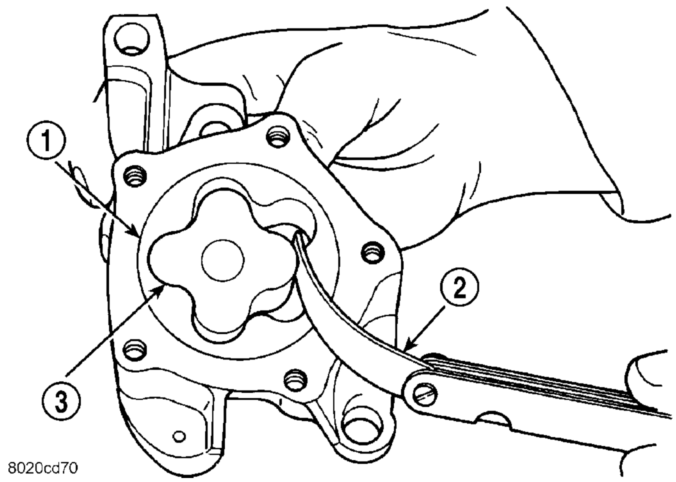


Fig. 64 Measuring Clearance Between Rotors

1 - OUTER ROTOR
2 - FEELER GAUGE
3 - INNER ROTOR

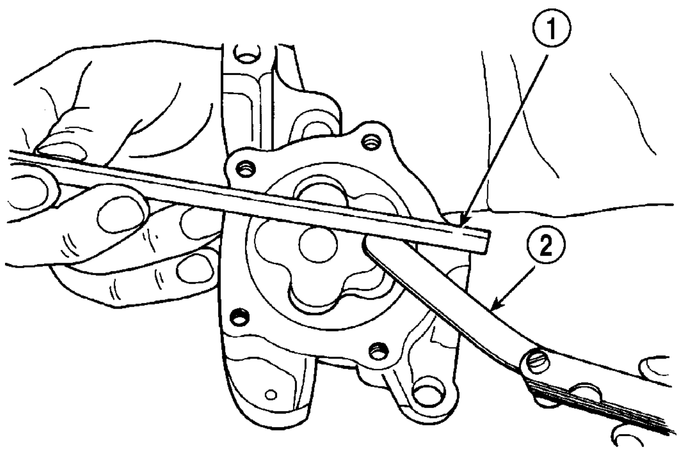


Fig. 65 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGE

OIL PUMP (Continued)

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications (Fig. 66).

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

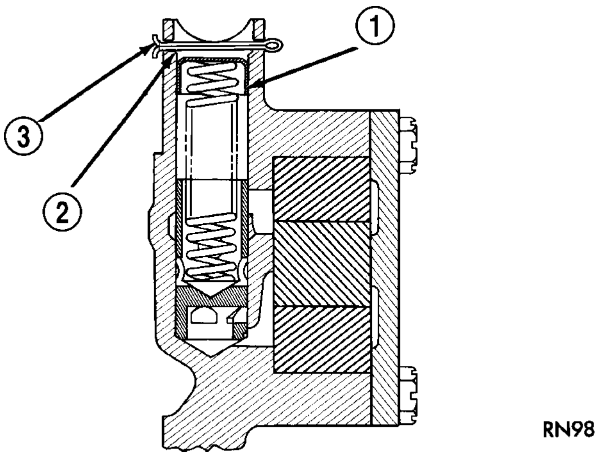


Fig. 66 Proper Installation of Retainer Cap

1 - RETAINER CAP
2 - CHAMFER
3 - COTTER KEY

ASSEMBLY

(1) Install pump rotors and shaft, using new parts as required.

(2) Position the oil pump cover onto the pump body. Tighten cover bolts to 11 N·m (95 in. lbs.) torque.

(3) Install the relief valve and spring. Insert the cotter pin.

(4) Tap on a new retainer cap.

(5) Prime oil pump before installation by filling rotor cavity with engine oil.

INSTALLATION

(1) Install oil pump. During installation slowly rotate pump body to ensure driveshaft-to-pump rotor shaft engagement.

(2) Hold the oil pump base flush against mating surface on No.5 main bearing cap. Finger tighten pump attaching bolts. Tighten attaching bolts to 41 N·m (30 ft. lbs.) torque.

(3) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 67) is a single plane design with equal length runners and uses a separate plenum, therefore the manifold does have a plenum gasket. It also uses separate flange gaskets and front and rear cross-over gaskets. Extreme care must be used when sealing the gaskets to ensure that excess sealant does not enter the intake runners causing a restriction. Whenever the intake manifold is removed inspect the plenum pan for evidence of excess oil buildup, this condition indicates that the plenum pan gasket is leaking.

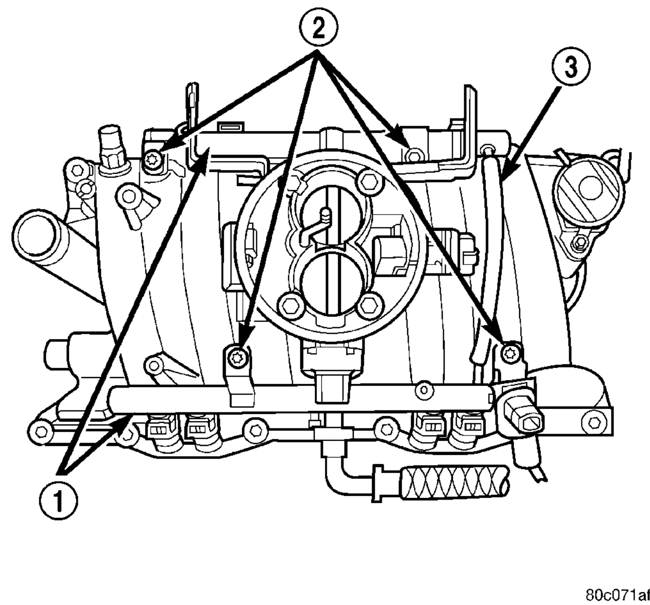


Fig. 67 Intake Manifold and Throttle Body—V-8 Gas Engines Typical

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

OPERATION

The intake manifold, meters and delivers air to the combustion chambers allowing the fuel delivered by the fuel injectors to ignite, thus producing power.

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

INTAKE MANIFOLD (Continued)

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS, OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPMs occur, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL).

(4) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(5) Remove the accessory drive bracket.

(6) Remove the air cleaner.

(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL) and if so equipped, the speed control and transmission kickdown cables.

(9) Remove the return spring.

(10) Remove the distributor cap and wires.

(11) Disconnect the coil wires.

(12) Disconnect the heat indicator sending unit wire.

(13) Disconnect the heater hoses and bypass hose.

(14) Remove the closed crankcase ventilation and evaporation control systems.

(15) Remove intake manifold bolts.

(16) Lift the intake manifold and throttle body out of the engine compartment as an assembly.

(17) Remove and discard the flange side gaskets and the front and rear end seals.

(18) Remove the throttle body bolts and lift the throttle body off the intake manifold (Fig. 68). Discard the gasket.

(19) If required, remove the plenum pan and gasket. Discard gasket.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

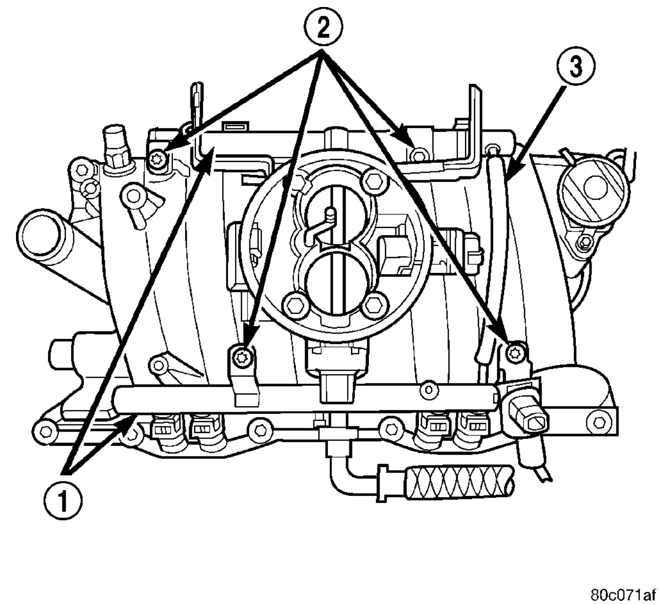


Fig. 68 Throttle Body Assembly

1 - FUEL RAIL ASSEMBLY
2 - FUEL RAIL MOUNTING BOLTS
3 - FUEL RAIL CONNECTING HOSES

Clean cylinder block gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) If removed, position new plenum gasket and install plenum pan (Fig. 69).

(2) Tighten plenum pan mounting bolts as follows:

- Step 1. Tighten bolts to 5.4 N·m (48 in. lbs.)
- Step 2. Tighten bolts to 9.5 N·m (84 in. lbs.)
- Step 3. Check all bolts are at 9.5 N·m (84 in. lbs.)

(3) Install the flange gaskets. Ensure that the vertical port alignment tab is resting on the deck face of the block. Also the horizontal alignment tabs must be in position with the mating cylinder head gasket tabs (Fig. 71). The words MANIFOLD SIDE should be visible on the center of each flange gasket.

(4) Apply Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, to the four corner joints. An excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in) in diameter and 15 mm (0.6 in.) long.

INTAKE MANIFOLD (Continued)

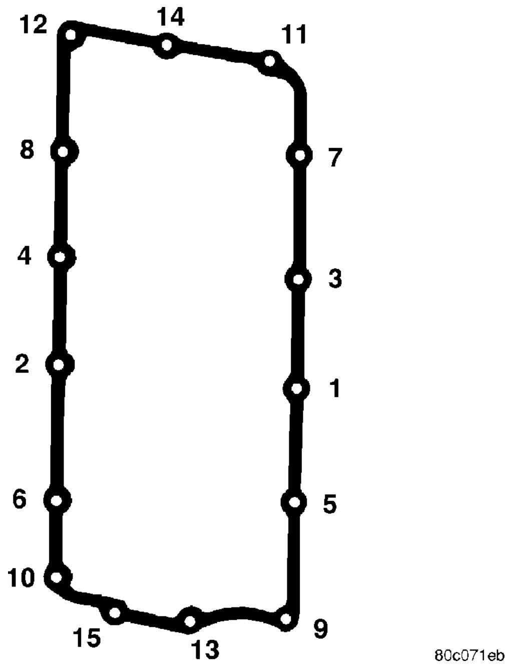


Fig. 69 Plenum Pan Bolt Tightening Sequence

(5) Install the front and rear end seals (Fig. 70) Make sure the molded dowel pins on the end seals fully enter the corresponding holes in the cylinder block.

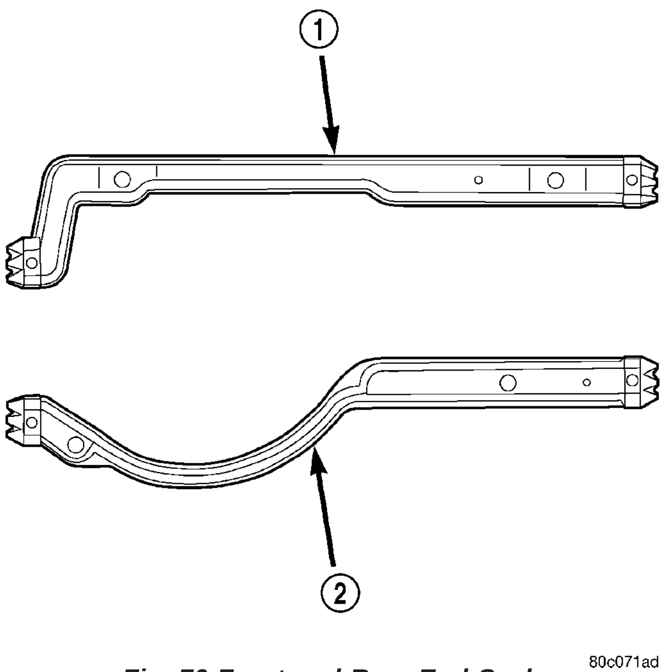


Fig. 70 Front and Rear End Seals

1 - FRONT CROSS-OVER GASKET
2 - REAR CROSS-OVER GASKET

(6) Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, inspect to make sure seals are in place.

(7) Using a new gasket, install the throttle body onto the intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

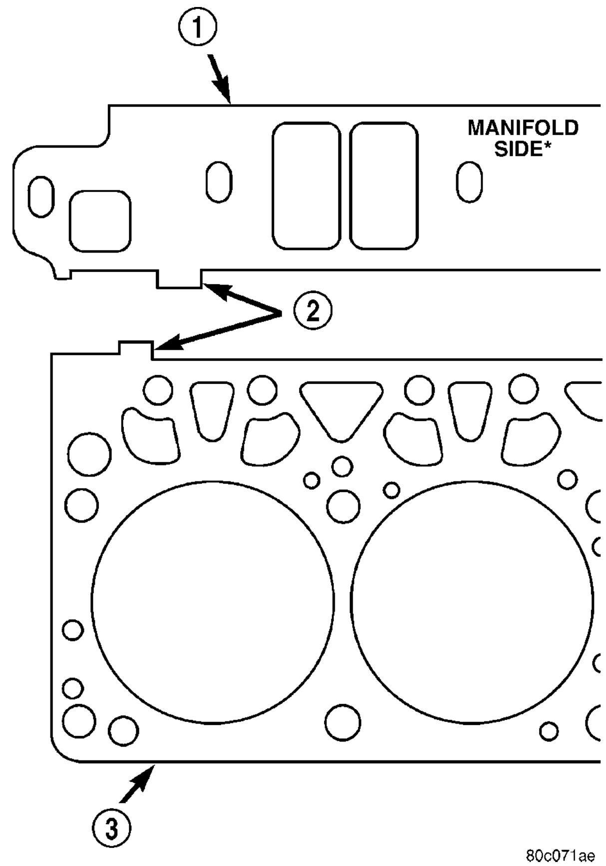


Fig. 71 Intake Manifold Flange Gasket Alignment

1 - FLANGE GASKET
2 - ALIGNMENT TABS
3 - CYLINDER HEAD GASKET

(8) Install the intake manifold bolts and tighten as follows (Fig. 72):

- Step 1. Tighten bolts 1 through 4 to 8 N·m (72 in. lbs.) Tighten in alternating steps 1.4 N·m (12 in. lbs.) at a time
- Step 2. Tighten bolts 5 through 12 to 8 N·m (72 in. lbs.)
- Step 3. Check all bolts are torqued to 8 N·m (72 in. lbs.)
- Step 4. Tighten all bolts in sequence to 16 N·m (12 ft. lbs.)
- Step 5. Check all bolts are torqued to 16 N·m (12 ft. lbs.)

(9) Install closed crankcase ventilation and evaporation control systems.

(10) Connect the coil wires.

(11) Connect the heat indicator sending unit wire.

(12) Connect the heater hoses and bypass hose.

(13) Install distributor cap and wires.

(14) Hook up the return spring.

(15) Connect the accelerator linkage (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION) and if so

INTAKE MANIFOLD (Continued)

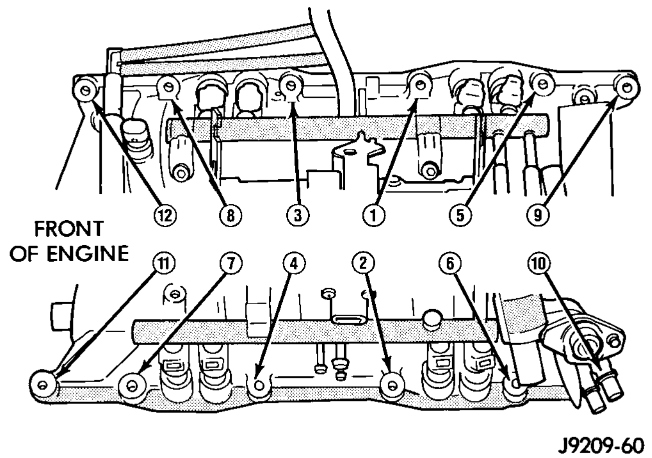


Fig. 72 Intake Manifold Bolt Tightening Sequence

equipped, the speed control and transmission kick-down cables.

(16) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Install the accessory drive bracket and A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(18) Install the generator and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION). Tighten generator mounting bolt to 41 N·m (30 ft. lbs.) torque.

(19) Install the air cleaner.

(20) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Connect the negative cable to the battery.

EXHAUST MANIFOLD

DESCRIPTION

The exhaust manifolds (Fig. 73) are constructed of cast iron and are LOG type with balanced flow. One exhaust manifold is attached to each cylinder head.

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise and support the vehicle.

(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold.

(4) Lower the vehicle.

(5) Remove the exhaust heat shields.

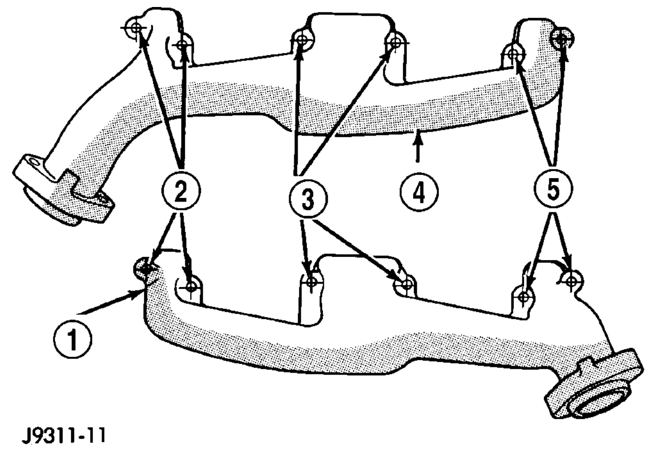


Fig. 73 Exhaust Manifolds—V-8 Gas Engines Typical

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

(6) Remove bolts, nuts and washers attaching manifold to cylinder head.

(7) Remove manifold from the cylinder head.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

CAUTION: If the studs came out with the nuts when removing the engine exhaust manifold, install new studs. Apply sealer on the coarse thread ends. Water leaks may develop at the studs if this precaution is not taken.

(1) Position the engine exhaust manifolds on the two studs located on the cylinder head. Install conical washers and nuts on these studs (Fig. 74).

(2) Install two bolts and conical washers at the inner ends of the engine exhaust manifold outboard arms. Install two bolts WITHOUT washers on the center arm of engine exhaust manifold (Fig. 74). Starting at the center arm and working outward, tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(3) Install the exhaust heat shields.

(4) Raise and support the vehicle.

EXHAUST MANIFOLD (Continued)

(5) Assemble exhaust pipe to manifold and secure with bolts, nuts and retainers. Tighten the bolts and nuts to 34 N·m (25 ft. lbs.) torque.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

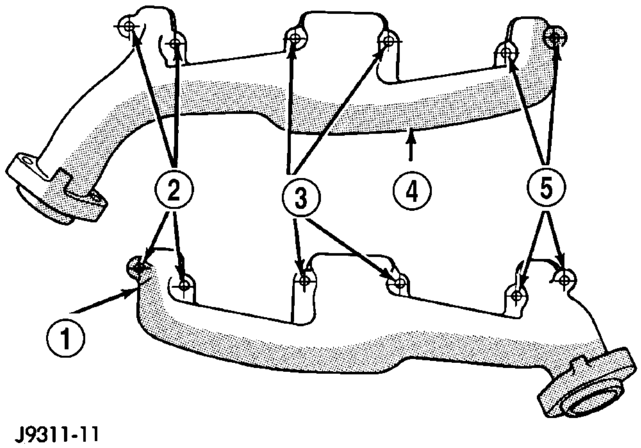


Fig. 74 Engine Exhaust Manifold Installation - 5.9L Engines

1 - EXHAUST MANIFOLD (LEFT)
2 - BOLTS & WASHERS
3 - NUTS & WASHERS
4 - EXHAUST MANIFOLD (RIGHT)
5 - BOLTS & WASHERS

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).

(3) Remove power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(4) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(5) Loosen oil pan bolts and remove the front bolt at each side.

(6) Remove the cover bolts.

(7) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) The water pump mounting surface must be cleaned.

(3) Using a new cover gasket, carefully install chain case cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

NOTE: Special Tool 6635 must be used to align the front cover and seal with the crankshaft.

(4) Position the special tool 6635 onto the crankshaft (Fig. 75).

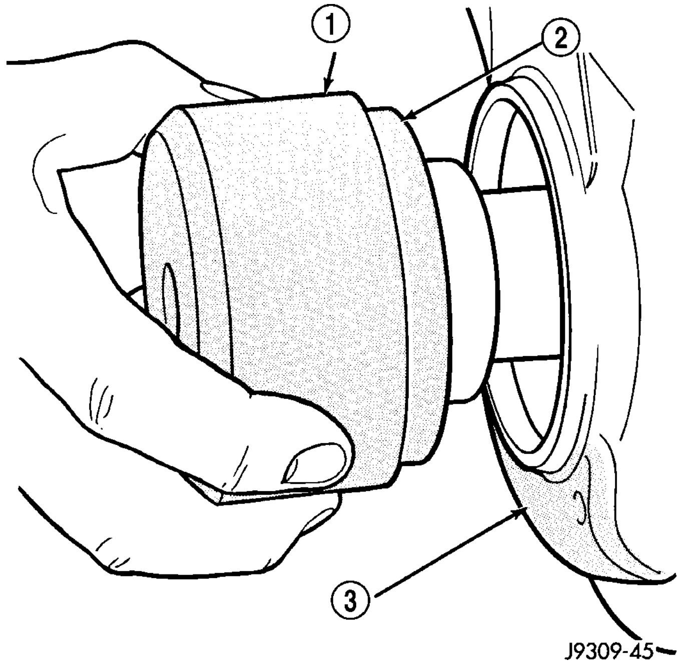


Fig. 75 Position Special Tool 6635 onto Crankshaft

1 - SPECIAL TOOL 6635
2 - OIL SEAL
3 - TIMING CHAIN COVER

(5) Tighten chain case cover bolts to 41 N·m (30 ft.lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

(6) Remove special tool 6635.

(7) Inspect the seal flange on the vibration damper.

(8) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(9) Install water pump and housing assembly using new gaskets (Refer to 7 - COOLING/ENGINE/WATER PUMP - INSTALLATION).

(10) Install power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(11) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(12) Install the cooling system fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(13) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(14) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(15) Connect the negative cable to the battery.

(16) Start engine check for leaks.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove Timing Chain Cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(3) Re-install the vibration damper bolt finger tight. Using a suitable socket and breaker bar, rotate the crankshaft to align timing marks as shown in (Fig. 76).

(4) Remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

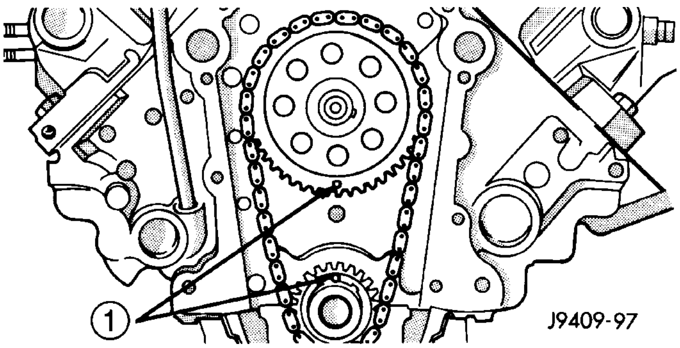


Fig. 76 Alignment of Timing Marks

1 - TIMING MARKS

INSPECTION—MEASURING TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 77).

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

INSTALLATION

(1) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

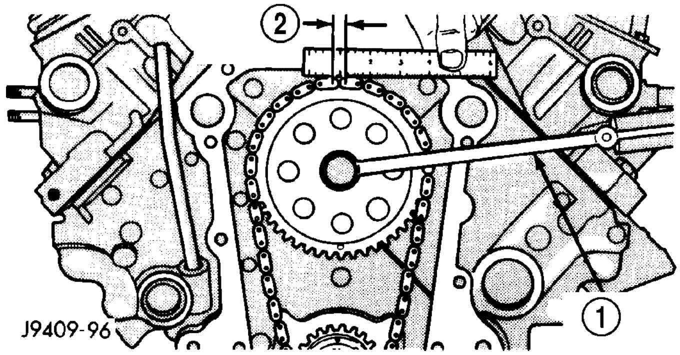


Fig. 77 Measuring Timing Chain Stretch

1 - TORQUE WRENCH
2 - 3.175 MM (0.125 IN.)

(2) Place timing chain around both sprockets.

(3) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(4) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(5) Slide both sprockets evenly over their respective shafts and use a straightedge to check alignment of timing marks (Fig. 78).

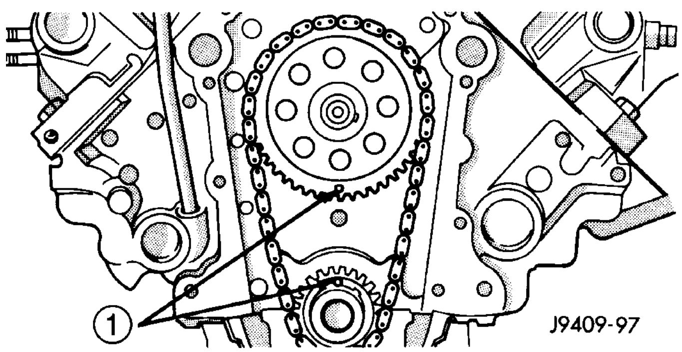


Fig. 78 Alignment of Timing Marks

1 - TIMING MARKS

(6) Install the camshaft bolt. Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(7) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(8) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

ENGINE 5.9L DIESEL

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ENGINE 5.9L DIESEL

DESCRIPTION

The cylinder block is constructed of cast iron. The casting is a skirted design which incorporates longitudal ribs for superior strength and noise reduction. The block incorporates metric straight thread o-ring fittings at lubrication oil access points. The engine (Fig. 1) is manufactured with the cylinders being a non-sleeved type cylinder. However, one approved service method is to bore out the cylinders and add cylinder sleeves to the cylinder block.

The cylinders are numbered front to rear (Fig. 2); 1 to 6. The firing order is 1–5–3–6–2–4.

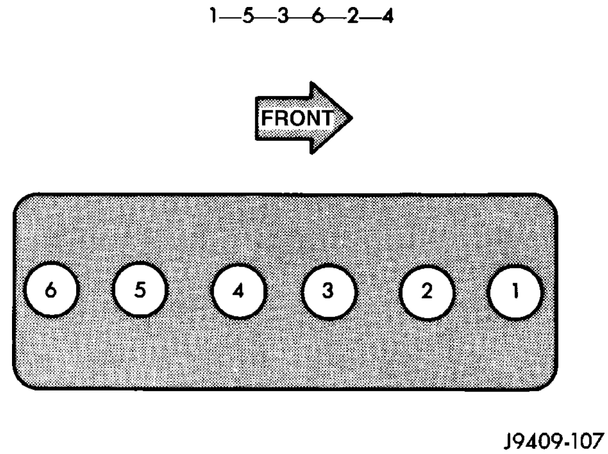


Fig. 2 Cylinder Numbering

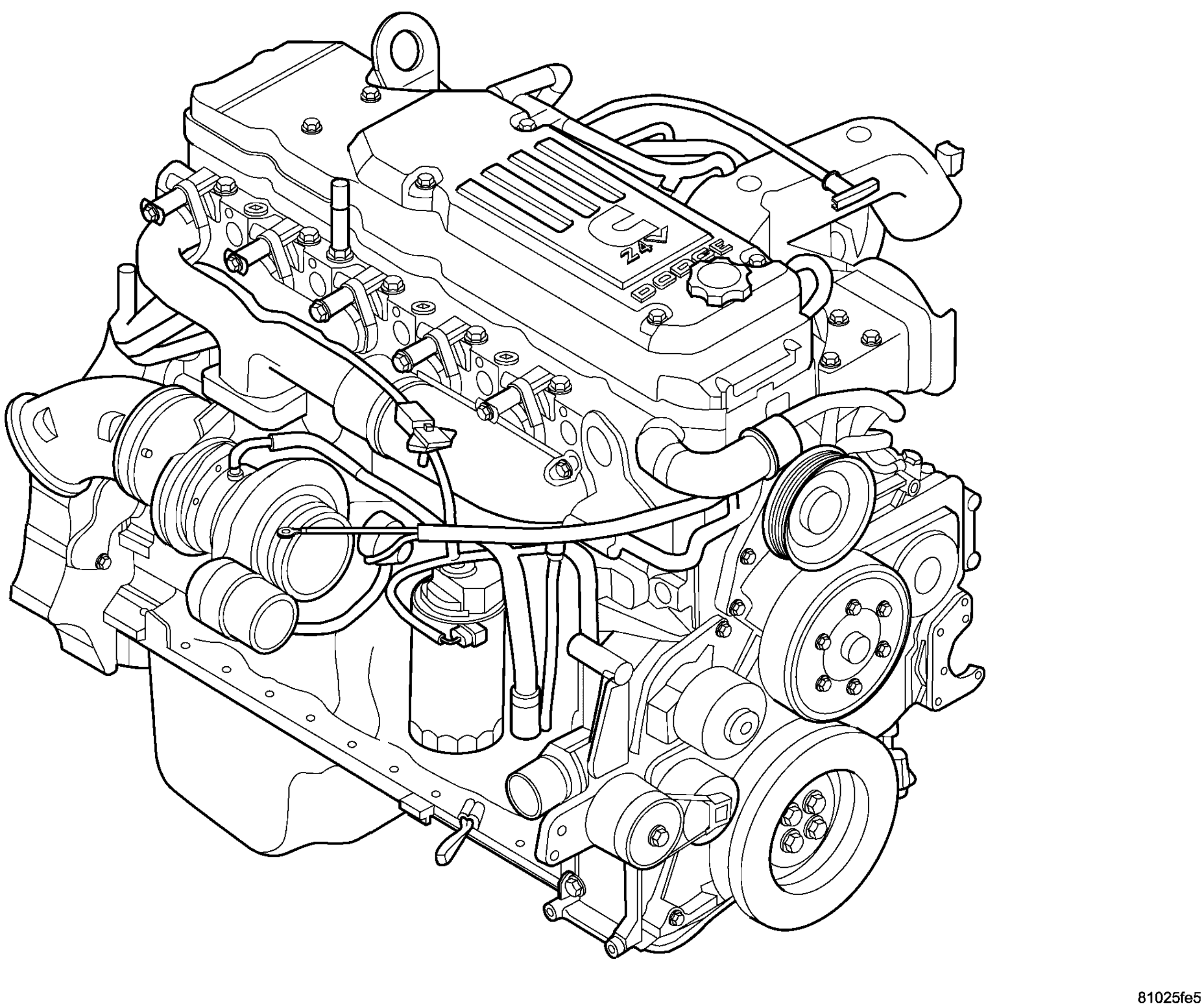


Fig. 1 Cummins® 24-Valve Turbo-Diesel Engine

ENGINE 5.9L DIESEL (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	1. Low oil level.	1. (a) Check and fill with clean engine oil.
		(b) Check for a severe external oil leak that could reduce the pressure.
	2. Oil viscosity thin, diluted or wrong specification.	2. (a) Verify the correct engine oil is being used. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
		2. (b) Look for reduced viscosity from fuel dilution.
	3. Improperly operating pressure switch/gauge.	3. Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	4. Relief valve stuck open.	4. Check/replace valve.
	6. If cooler was replaced, shipping plugs may have been left in cooler	6. Check/remove shipping plugs.
	7. Worn oil pump.	7. Check and replace oil pump.
	8. Suction tube loose or seal leaking.	8. Check and replace seal.
	9. Loose main bearing cap.	9. Check and install new bearing. Tighten cap to proper torque.
	10. Worn bearings or wrong bearings installed.	10. Inspect and replace connecting rod or main bearings. Check and replace directed piston cooling nozzles.
	11. Directed piston cooling nozzles under piston, bad fit into main carrier.	11. Check directed piston cooling nozzles position.
	12. Loose oil rifle plug with saddle-jet style nozzles	12.Tighten oil rifle plug.
	13. Loose directed piston cooling nozzle.	13. Tighten directed piston cooling nozzle.
	14. Both J-jet and saddle jet style cooling nozzle installed.	14. Install correct style jet.
LUBRICATING OIL PRESSURE TOO HIGH	1. Pressure switch/gauge not operating properly.	1. Verify pressure switch is functioning correctly. If not, replace switch/gauge.
	2. Engine running too cold.	2. Refer to Coolant Temperature Below Normal (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
	3. Oil viscosity too thick.	3. Make sure the correct oil is being used. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
	4. Oil pressure relief valve stuck closed or binding	4. Check and replace valve.

ENGINE 5.9L DIESEL (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL LOSS	1. External leaks.	1. Visually inspect for oil leaks. Repair as required.
	2. Crankcase being overfilled.	2. Verify that the correct dipstick is being used.
	3. Incorrect oil specification or viscosity.	3. (a) Make sure the correct oil is being used (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
		(b) Look for reduced viscosity from dilution with fuel.
		(c) Review/reduce oil change intervals.
	4. Oil cooler leak	4. Check and replace the oil cooler.
	5. High blow-by forcing oil out the breather.	5. Check the breather tube area for signs of oil loss. Perform the required repairs.
	6. Turbocharger leaking oil to the air intake.	6. Inspect the air ducts for evidence of oil transfer. Repair as required.
COMPRESSION KNOCKS	1. Air in the fuel system.	1. Identify location of air leak and repair. Do not bleed high pressure fuel system.
	2. Poor quality fuel or water/gasoline contaminated fuel.	2. Verify by operating from a temporary tank with good fuel. Clean and flush the fuel tank. Replace fuel/water separator filter.
	3. Engine overloaded.	3. Verify the engine load rating is not being exceeded.
	4. Improperly operating injectors.	5. Check and replace misfiring/inoperative injectors.
EXCESSIVE VIBRATION	1. Loose or broken engine mounts.	1. Replace engine mounts.
	2. Damaged fan or improperly operating accessories.	2. Check and replace the vibrating components.
	3. Improperly operating vibration damper	3. Inspect/replace vibration damper.
	4. Improperly operating electronically controlled viscous fan drive.	4. Inspect/replace fan drive.
	5. Worn or damaged generator bearing.	5. Check/replace generator.
	6. Flywheel housing misaligned.	6. Check/correct flywheel alignment.
	7. Loose or broken power component.	7. Inspect the crankshaft and rods for damage that causes an unbalance condition. Repair/replace as required.
	8. Worn or unbalanced driveline components.	8. Check/repair driveline components.
EXCESSIVE ENGINE NOISES	1. Drive belt squeal, insufficient tension or abnormally high loading.	1. Check the automatic tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub, generator and power steering pump turn freely.
	2. Intake air or exhaust leaks.	2. Refer to Excessive Exhaust Smoke (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).

ENGINE 5.9L DIESEL (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	3. Excessive valve lash.	3. Adjust valves. Make sure the push rods are not bent and rocker arms, adjusting screws, crossheads, are not severely worn. Replace bent or severely worn components.
	4. Turbocharger noise.	4. Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required.
	5. Gear train noise.	5. Visually inspect and measure gear backlash. Replace gears as required.
	6. Power function knock.	6. Check/replace rod and main bearings.

DIAGNOSIS AND TESTING—SMOKE DIAGNOSIS CHARTS

The following charts include possible causes and corrections for **excess or abnormal** exhaust smoke.

Small amounts of exhaust smoke (at certain times) are to be considered normal for a diesel powered engine.

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	CORRECTION
Air filter dirty or plugged.	Check Filter Minder® at air filter (Refer to 9 - ENGINE/ AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
Air intake system restricted.	Check entire air intake system including all hoses and tubes for restrictions, collapsed parts or damage. Repair/replace as necessary.
Air Leak in Intake System.	Check entire air intake system including all hoses and tubes for cracks, loose clamps and/or holes in rubber ducts. Also check intake manifold for loose mounting hardware.
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures Information.
Engine Control Module (ECM) not calibrated or ECM has incorrect calibration.	Refer to Powertrain Diagnostic Procedures Information.
Exhaust system restriction is above specifications.	Check exhaust pipes for damage/restrictions. Repair as necessary.
Fuel grade is not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel injection pump malfunctioning.	A DTC may have been set. If so, refer to Powertrain Diagnostic Procedures Information.
Fuel injector malfunctioning.	A DTC may have been set. Perform ″Cylinder Cutout Test″ using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures Information and, to (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Fuel return system restricted.	Check fuel return lines for restriction (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING).
Intake manifold restricted.	Remove restriction.

ENGINE 5.9L DIESEL (Continued)

EXCESSIVE BLACK SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Manifold Air Pressure (Boost) Sensor or sensor circuit malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Raw fuel in intake manifold.	Fuel injectors leaking on engine shutdown. Do Fuel Injector Test (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Turbocharger air intake restriction.	Remove restriction.
Turbocharger damaged.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).
Turbocharger has excess build up on compressor wheel and/or diffuser vanes.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - CLEANING).
Turbocharger wheel clearance out of specification.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).

EXCESSIVE WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Air in fuel supply: Possible leak in fuel supply side (between transfer pump and fuel tank module).	(Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL TRANSFER PUMP - DIAGNOSIS AND TESTING).
Coolant leaking into combustion chamber.	Do pressure test of cooling system (Refer to 7 - COOLING - DIAGNOSIS AND TESTING).
Diagnostic Trouble Codes (DTC's) active or multiple, intermittent DTC's.	Refer to Powertrain Diagnostic Procedures Information.
In very cold ambient temperatures, engine block heater is malfunctioning (if equipped).	(Refer to 7 - COOLING/ENGINE/ENGINE BLOCK HEATER - REMOVAL).
Engine coolant temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information. Also check thermostat operation (Refer to 7 - COOLING/ENGINE/ ENGINE COOLANT THERMOSTAT - DIAGNOSIS AND TESTING).
Engine Control Module (ECM) not calibrated or has incorrect calibration.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Fuel filter plugged.	Refer to Powertrain Diagnostic Manual for fuel system testing.
Fuel grade not correct or fuel quality is poor.	Temporarily change fuel brands and note condition. Change brand if necessary.
Fuel heater element or fuel heater temperature sensor malfunctioning. This will cause wax type build-up in fuel filter.	Refer to Fuel Heater Testing (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL HEATER - DIAGNOSIS AND TESTING).
Fuel injector malfunctioning.	A DTC should have been set. Perform ″Cylinder cutout Test″ using DRB scan tool to isolate individual cylinders. Also refer to Powertrain Diagnostic Procedures Information and, (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - DIAGNOSIS AND TESTING).
Fuel injector hold-downs loose.	Torque to specifications.

ENGINE 5.9L DIESEL (Continued)

EXCESSIVE WHITE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Fuel injector protrusion not correct.	Check washer (shim) at bottom of fuel injector for correct thickness. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION)
Fuel injection pump malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Fuel supply side restriction to transfer pump.	Refer to Powertrain Diagnostic Manual for fuel system testing.
Fuel transfer (lift) pump malfunctioning.	A DTC may have been set. Refer to Powertrain Diagnostic Procedures Information.
Intake/Exhaust valve adjustments not correct (too tight).	(Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/ EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
Intake manifold air temperature sensor malfunctioning.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information.
Intake manifold heater circuit not functioning correctly in cold weather.	A DTC should have been set. Refer to Powertrain Diagnostic Procedures Information. Also check heater elements for correct operation.
Intake manifold heater elements not functioning correctly in cold weather.	A DTC should have been set if heater elements are malfunctioning. Refer to Powertrain Diagnostic Procedures Information.
Internal engine damage (scuffed cylinder).	Analyze engine oil and inspect oil filter to locate area of probable damage.
Restriction in fuel supply side of fuel system.	Refer to Powertrain Diagnostic Manual for fuel system testing.

EXCESSIVE BLUE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Dirty air cleaner or restricted turbocharger intake duct.	Check Filter Minder® at air filter housing. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL).
Air leak in boost system between turbocharger compressor outlet and intake manifold.	Service air charge system..
Obstruction in exhaust manifold.	Remove exhaust manifold and inspect for blockage (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).
Restricted turbocharger drain tube.	Remove turbocharger drain tube and remove obstruction.
Crankcase ventilation system plugged.	Inspect crankcase ventilation system for function
Valve seals are worn, brittle, or improperly installed.	Replace valve stem oil seals (Refer to 9 - ENGINE/ CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - REMOVAL).
Valve stems and/or guides are worn.	Remove valves and inspect valves and guides. (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).
Broken or Improperly installed piston rings.	Tear down engine and inspect piston rings.

ENGINE 5.9L DIESEL (Continued)

EXCESSIVE BLUE SMOKE	
POSSIBLE CAUSE	**CORRECTION**
Excessive piston ring end gap.	Remove pistons and measure piston ring end gap (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE).
Excessive cylinder bore wear and taper.	Remove pistons and measure cylinder bore wear and taper (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).
Cylinder damage.	Remove pistons and inspect cylinder bore for cracks or porosity. Repair with cylinder liner if necessary. (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).
Piston damage.	Remove pistons and inspect for cracks, holes. Measure piston for out-of-round and taper (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - INSPECTION).
Turbocharger failure.	(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION).

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION/LEAKAGE TESTS

CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure batteries are completely charged and the engine starter motor is in good operating condition. Otherwise, the indicated compression pressures may not be valid for diagnostic purposes.

(1) Disconnect the fuel inlet line to the fuel transfer pump. Plug the fuel line from the fuel tank.

(2) Start the engine and idle until the engine stalls (runs out of fuel).

(3) Disconnect all three injector wire harness connectors at the rocker housing.

(4) Remove the breather cover and cylinder head cover.

(5) Remove the high pressure fuel line between the cylinder head and fuel rail for the cylinder to be tested.

(6) Remove the exhaust rocker lever.

(7) Use Tool 9010 to remove the injector and copper sealing washer.

(8) Install the exhaust rocker lever and torque to 43 N·m (32 ft. lbs.).

(9) Cover the remaining rocker levers with clean shop towels to prevent any oil splatter under the hood.

(10) Place a rag over the compression test tool fitting. Crank the engine for 2–3 seconds to purge any fuel that may have drained into the cylinder when the injector was removed.

(11) Connect the compression test gauge.

(12) Crank the engine for 5 seconds and record the pressure reading. Repeat this step three times and calculate the average of the three readings.

(13) Combustion pressure leakage can be checked if cylinder pressure is below the specification. Perform the leakage test procedure on each cylinder according to the tester manufacturer instructions.

(14) Upon completion of the test check an erase any engine related fault codes.

CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss

(1) Start and operate the engine until it attains normal operating temperature.

(2) Remove the breather cover and cylinder head cover.

(3) Disconnect all three injector wire harness connectors at the rocker housing.

(4) Bring the cylinder to be tested to TDC.

(5) Remove the high pressure fuel line between the cylinder head and the fuel rail for the cylinder to be tested.

(6) Install capping Tool 9011 onto the rail.

(7) Remove the high pressure connector nut and high pressure connector with Tool 9015.

(8) Remove the exhaust and intake rocker lever.

ENGINE 5.9L DIESEL (Continued)

(9) Use Tool 9010 to remove the injector and copper sealing washer.

(10) Install compression test Tool 9007 into the injector bore.

(11) Connect the leakage tester and perform the leakage test procedure on each cylinder according to the tester manufacturer's instructions.

(12) Upon completion of the test check and erase any engine related fault codes.

STANDARD PROCEDURE

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.

ENGINE 5.9L DIESEL (Continued)

• Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Disconnect the negative cable(s) from the battery.

(2) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(3) Place a shop towel around the fuel injectors to catch any fluid that may possibly be under pressure in the cylinder head. Remove the fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

(4) With all injectors removed, rotate the crankshaft using the crankshaft barring tool (PN 7471–B).

(5) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(6) Be sure all fluid has been removed from the cylinders.

(7) Repair engine or components as necessary to prevent this problem from occurring again.

(8) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(9) Install fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION).

(10) Drain engine oil. Remove and discard the oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(11) Install the drain plug. Tighten the plug to 50 N·m (37 ft. lbs.) torque.

(12) Install a new oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

(13) Fill engine crankcase with the specified amount and grade of oil (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - SPECIFICATIONS).

(14) Connect the negative cable(s) to the battery.

(15) Start the engine and check for any leaks.

REMOVAL

REMOVAL—ENGINE

(1) Disconnect both battery negative cables.

(2) Disconnect engine grid heater harness at grid heater relays.

(3) Disconnect electrical connections from rear of alternator.

(4) Recover A/C refrigerant. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(5) Raise vehicle on a hoist.

(6) Drain engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Remove engine oil drain plug and drain engine oil.

(8) Remove fan/drive assembly. Refer to Section 7 – Fan/Drive Removal

(9) Remove radiator upper hose.

(10) Remove upper fan shroud mounting bolts.

(11) Disconnect the coolant recovery bottle hose from the radiator fill neck and remove bottle.

(12) Using a 36mm wrench, remove viscous fan/drive assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(13) Remove cooling fan and shroud together.

(14) Disconnect heater core supply and return hoses from the cylinder head fitting and coolant pipe.

(15) Raise vehicle on a hoist.

(16) Remove transmission and transfer case (if equipped).

(17) Disconnect exhaust pipe from turbocharger extension pipe.

(18) Disconnect engine harness to vehicle harness connectors.

(19) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(20) Remove flywheel/flexplate.

(21) Remove transmission adapter

(22) Disconnect A/C suction/discharge hose from the rear of the A/C compressor.

(23) Lower vehicle.

(24) Disconnect lower radiator hose from radiator outlet.

(25) Automatic transmission models:

(26) Disconnect transmission oil cooler lines from in front of radiator using special tool #6931

(27) Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(28) If A/C equipped, disconnect A/C condenser refrigerant lines.

(29) Disconnect charge air cooler piping.

(30) Remove charge air cooler mounting bolts.

(31) Remove charge air cooler (and A/C condenser if equipped) from vehicle.

(32) Remove damper and speed indicator ring from front of engine.

(33) Disconnect engine block heater connector.

(34) Disconnect A/C compressor and pressure sensor electrical connectors.

ENGINE 5.9L DIESEL (Continued)

(35) Remove the passenger battery ground cable from the engine block. Remove the driver side battery ground cable from the engine block.

(36) Remove power steering pump from engine by removing 3 bolts.

(37) Remove accelerator linkage cover.

(38) Disconnect cables from APPS if early model build

(39) If late model build,

(40) Disconnect the ECM power connector.

(41) Disconnect the ECM ground wire from the hydroform screw.

(42) Disconnect the fuel supply and return hoses.

(43) Remove the cylinder head cover. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(44) Disconnect the 3 injector harness connectors at the rocker housing. Disconnect the wire harnesses from the injectors.

(45) Remove the rear engine lift bracket.

(46) Remove cylinder #4, #5, and #6 intake and exhaust rocker arms, pedestals, and push tubes. Note the original location for re-assembly.

(47) Loosen #6 fuel line shield bolts and rotate shield out of the way.

(48) Remove cylinder #5 and #6 high pressure fuel lines. Remove the fuel connector tube nut and fuel connector tube. 46. Remove cylinder #5 and #6 fuel injector.

(49) Remove rocker housing.

(50) Remove two cylinder head bolts in location 4 and 12 according to the diagram below and install Tool # 9009 (Fig. 3).

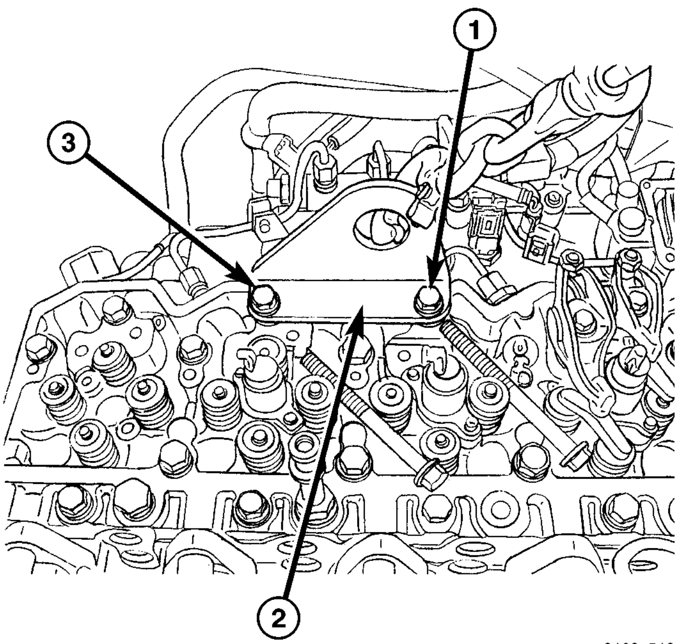


Fig. 3 ENGINE LIFT BRACKET

1 - Head bolt
2 - Engine Lift Bracket
3 - Head Bolt

(51) Loosen but do not remove engine mount through bolts and nuts.

(52) Disconnect hood support struts and position hood out of the way.

(53) Attach a chain with two hooks to the engine lift brackets.

(54) While keeping engine level, lift straight up out of the mounts.

(55) Rotate nose of engine upward and pull out of chassis.

REMOVAL—CRANKCASE BREATHER

(1) Remove the oil fill cap.

(2) Remove the breather cover bolts (Fig. 4).

(3) Remove breather cover.

(4) Disconnect breather tube and lube oil drain tube from breather.

(5) Remove breather mounting bolts.

(6) Remove breather from cylinder head cover.

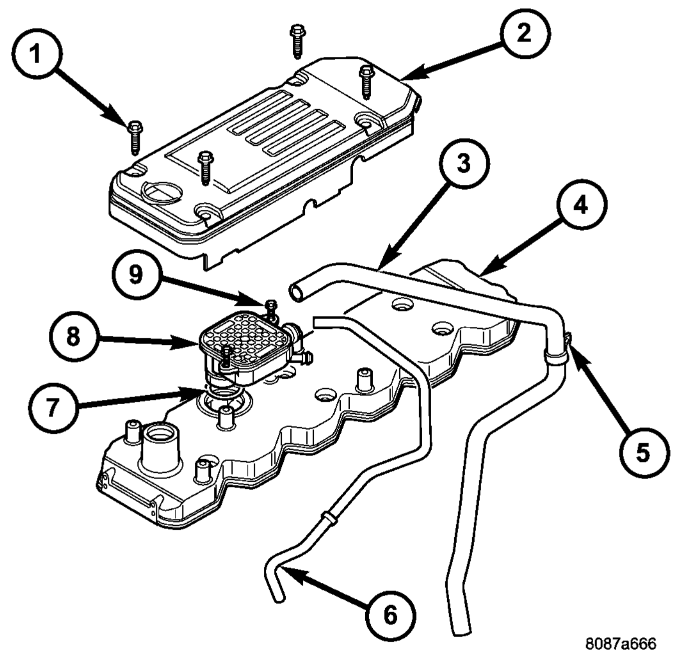


Fig. 4 Crankcase Breather Vapor Canister

1 - BREATHER COVER BOLT
2 - BREATHER COVER
3 - BREATHER TUBE
4 - ROCKER COVER
5 - BREATHER TUBE MOUNTING BRACKET
6 - LUBE OIL DRAIN TUBE
7 - O-RING
8 - BREATHER
9- BREATHER MOUNTING BOLT

INSTALLATION

INSTALLATION—ENGINE

(1) Remove cylinder head bolts in locations 4 and 12 according to the diagram below. Install special Tool 9009.

ENGINE 5.9L DIESEL (Continued)

(2) Lower engine into the engine compartment and install the engine the engine mount through bolts and nuts.

(3) Tighten the mount through bolts and nuts to 88 N-m (65 ft-lbs) torque.

(4) Remove the engine lifting device (Tool 9009).

(5) Check cylinder head capscrew length and install into cylinder head.

(6) Torque alternately to 70 N-m (52 ft-lbs). Torque alternately to 105 N-m (77 ft-lbs). Rotate 90 degrees.

(7) Install rocker housing. Torque to 24 N-m (18 ft-lbs). Refer to Section 9 Rocker Housing Installation

(8) Replace injector o-ring and sealing washer on injectors #5 and #6. Install injectors and alternately tighten hold-down capscrews to 10 N-m (89 in-lbs).

(9) Install fuel connector tube and fuel connector tube nut. Torque to 50 N-m (37 ft-lb). 10.

(10) Install #5 and #6 high pressure fuel lines. Follow correct torque sequence per section 14. Torque fuel line fittings to 30 N-m (22 ft-lb). Torque brace capscrew to 24 N-m (18 ft-lb).

(11) Install rear engine lift bracket. Torque to 77 N-m (57 ft-lb).

(12) Install push tubes, rocker arms, and pedestals for cylinders #4, #5, and #6. Torque the mounting bolts to 36 N-m (27 ft-lbs).

(13) Reset valve lash on cylinders #4, #5, and #6. Torque adjusting nuts to 24 N-m (18 ft-lbs).

(14) Install cylinder head cover. Torque to 24 N-m (18 ft-lbs).(Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(15) Connect breather tube and lube oil drain tube to breather housing. Install breather housing. Torque capscrews to 24 N-m (18 ft-lbs)

(16) Connect fuel supply and return hoses.

(17) Connect ECM ground to hydroform screw. Connect ECM power connector.

(18) Install the APPS cable(s) to the APPS. Install the throttle linkage cover.

(19) Install the power steering pump.

(20) Install the damper and speed indicator ring. Torque to 40 N-m (30 ft-lb) plus 60 degrees.

(21) Connect the engine block heater connection.

(22) Connect the A/C compressor and pressure sensor connectors

(23) Install the charge air cooler and a/c condenser (if equipped). Install and tighten the charge air cooler mounting bolts to 2 N-m (17 in-lbs).

(24) Connect the charge air cooler piping. Torque all clamps to 8 N-m (72 in-lbs).

(25) Connect the a/c refrigerant lines to the a/c condenser (if equipped).

(26) Install the radiator upper support panel.

(27) Install radiator.

(28) Connect the transmission quick-connect oil cooler lines.

(29) Raise vehicle.

(30) Connect a/c compressor suction/discharge hose (if equipped).

(31) Install the radiator lower hose and clamps.

(32) Install the battery negative cables to the engine block on the driver and passenger side.

(33) Install the transmission adapter with a new camshaft rectangular ring seal. Torque to 77 N-m (57 ft-lb).

(34) Install the flywheel/flexplate. Torque to 137 N-m (101 ft-lb).

(35) Install the starter motor. Torque to 43 N-m (32 ft-lb). (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(36) Connect engine to vehicle harness connectors.

(37) Install transmission and transfer case (if equipped).

(38) Connect the exhaust pipe to the turbocharger elbow.

(39) Connect the transmission auxiliary oil cooler lines (if equipped).

(40) Lower the vehicle.

(41) Connect the heater core supply and return hoses.

(42) Install the cooling fan and upper fan shroud at the same time. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(43) Install the coolant recovery bottle.

(44) Install the windshield washer bottle.

(45) Install the upper radiator hose and clamps.

(46) Raise vehicle.

(47) Connect electronically controlled fan drive wire harness. Install lower radiator fan shroud.

(48) Change oil filter and install new engine oil.

(49) Fill the cooling system with coolant. (Refer to 7 - COOLING - STANDARD PROCEDURE).

(50) Connect grid heater harness at grid heater relays.

(51) Connect electrical connections to rear of alternator.

(52) Start the engine and inspect for engine oil, coolant, and fuel leaks.

INSTALLATION—CRANKCASE BREATHER

(1) Install a new o-ring onto the breather element.

(2) Lubricate o-ring and install into cylinder head cover. Torque capscrews to 10 N·m (89 in. lbs.).

(3) Connect breather tube and lube oil drain tube.

(4) Install breather cover (Fig. 4). Torque to 24 N·m (18 ft. lbs.)

(5) Install oil fill cap.

ENGINE 5.9L DIESEL (Continued)

SPECIFICATIONS

5.9L DIESEL

DESCRIPTION	SPECIFICATION
Engine Type	In-Line 6 Cyl. Turbo Diesel
Bore and Stroke	102.0 X 120.0 mm (4.02 X 4.72 in.)
Displacement	5.9L (359 cu. in.)
Compression Ratio 305/250/235 H.P. Version	 17.2:1
Horsepower (A/T and 5 Speed M/T)	235 @ 2700 rpm (CARB) 250 @2900 rpm (49 State)
Horsepower (6 Speed M/T Only)	305 @ 2900 rpm
Torque Rating (A/T and 5 Speed M/T)	460 ft. lbs. @ 1400 rpm
Torque Rating (6 Speed M/T Only)	555 ft. lbs. @ 1400 rpm
Firing Order	1-5-3-6-2-4
Lubrication System	Pressure Feed-Full Flow With Bypass Valve
Cylinder Block	Cast Iron
Crankshaft	Induction Hardened Forged Steel
Cylinder Head	Cast Iron With Valve Seat Inserts
Combustion Chambers	High Swirl Bowl
Camshaft	Chilled Ductile Iron
Pistons	Cast Aluminum
Connecting Rods	Cross Rolled Micro Alloy
PISTONS AND CONNECTING RODS	
Piston Skirt Diameter	 101.864 – 101.887 mm (4.010 – 4.011 in.)
Ring Groove Clearance Intermediate (Min.) (Max) Oil Control (Min) (Max)	 0.045 mm (.0018 inch) 0.095 mm (0.0037 inch) 0.040 mm (.0016 inch) 0.085 mm (0.0033 inch)
Piston Pins Pin Diameter (Min.) (Max) Bore Diameter (Min) (Max)	 39.990 mm (1.5744 inch) 40.003 mm (1.5749 in.) 40.006 mm (1.5750 inch. 40.012 mm (1.5753 in.)
Piston Ring End Gap Top Ring Intermediate Oil Control	 0.26 – 0.36 mm (0.010 – 0.014 in.) 0.85 – 1.15 mm (0.33 – 0.045 in.) 0.25 – 0.55 mm (0.010 – 0.021 in.)
Connecting Rods Pin Bore Diameter (Max. w/busing installed) Side Clearance	 40.019 mm – 40.042 mm (1.5764 – 1.5765 in.) 0.100 – 0.330 mm (0.004 – 0.013 in.)
CYLINDER HEAD	
Overall Flatness End to End (Max.)	0.305 mm (0.012 in.)
Overall Flatness Side to Side (Max.)	0.076 mm (0.003 in.)
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	45°
Valve Stem Diameter (Min) (Max)	 6.96 mm (0.2740 in.) 7.01 mm (0.2760 in.)
Valve Rim Thickness (Min.)	0.79 mm (0.031 in.)
OIL PRESSURE	
At Idle	69 kPa (10 psi)
At 2,500 rpm	207 kPa (30 psi)
Regulating Valve Opening Pressure	517 kPa (75 psi)
Oil Filter Bypass Pressure Setting	344.75 kPa (50 psi)

ENGINE 5.9L DIESEL (Continued)

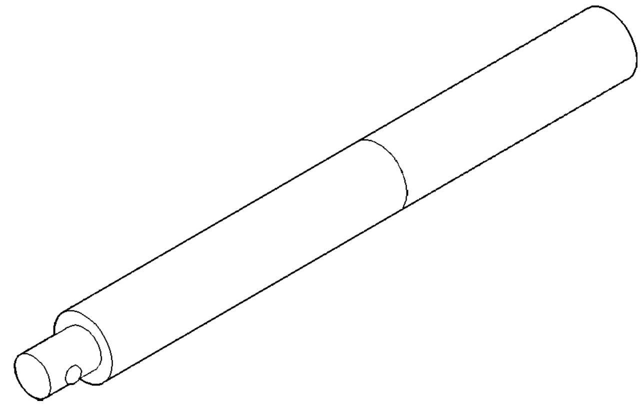
TORQUE

TORQUE CHART 5.9L DIESEL ENGINE

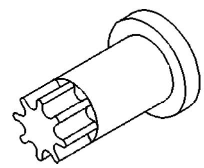
DESCRIPTION	N·m	In. Lbs.	Ft. Lbs.
Connecting Rod—Bolts			
Step 1	30	—	22
Step 2	60	—	44
Step 3	Rotate 60 degrees		
Crankshaft Main Cap—Bolts			
Step 1	50		37
Step 2	80		59
Step 3	Rotate 90°		
Cylinder Head—Bolts			
Step 1	70	—	52
Step 2	Back off 360 degrees		
Step 3	105	—	77
Step 4 Verify	105	—	77
Step 5	Rotate All Bolts 1/4 Turn		
Cylinder Head Cover Bolts	24	—	18
Breather Cover Bolts	24	—	18
HPC Nut	50		37
Fuel Delivery Lines—Banjo	24	—	18
Fuel Drain Line—Banjo	24	—	18
Fuel line—rail to cylinder head	30	—	22
Fuel line—pump to fuel rail	30	—	22
Injector fuel line brace	24	—	18
Fuel rail holddown bolt	24		18
Oil Pan—Bolts	28	—	21
Oil Pan—Drain Plug	50	—	37
Oil Pressure Regulator—Plug	80	—	60
Oil Pressure Switch	18	—	13
Oil Pump—Bolts			
Step1	8	—	6
Step2	24	—	18
Oil Suction Tube (Flange)—Bolts	24	—	18
Oil Suction Tube (Brace)—Bolt	43	—	32
Rocker Arm/Pedestal—Bolts	36	—	27

SPECIAL TOOLS

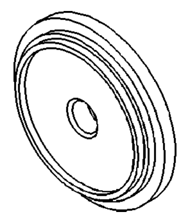
5.9L DIESEL ENGINE



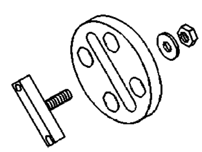
Universal Driver Handle - C4171



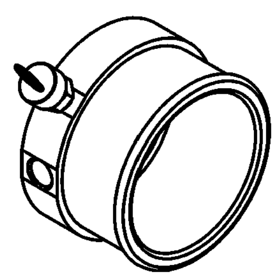
Crankshaft Barring Tool - 7471 - B



Crankshaft Front Oil Seal Installer - 8281

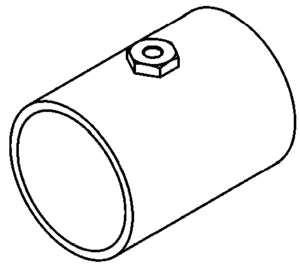


Valve Spring Compressor - 8319A

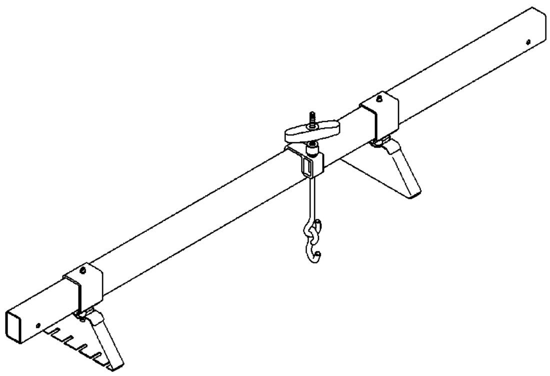


Test Plug - 8442

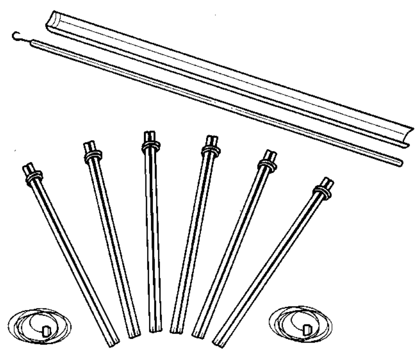
ENGINE 5.9L DIESEL (Continued)



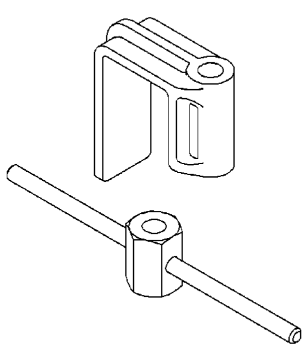
Adapter - 8462



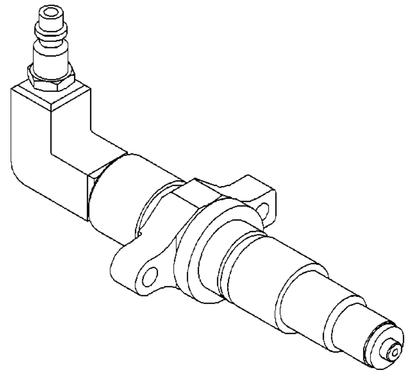
Engine Support Fixture - 8534



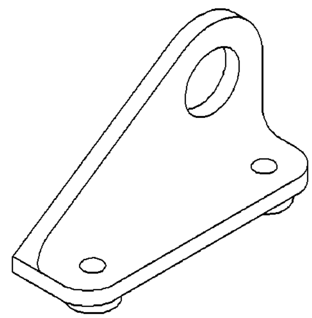
TAPPET INSTALLATION TOOL - 8502



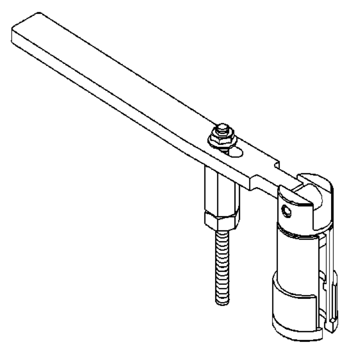
STEEL BRACKET - 8534-A



Compression Test Adapter - 9007

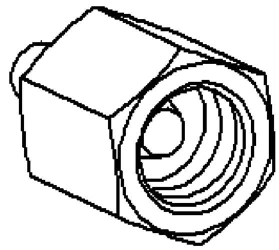


Engine Lift Bracket - 9009

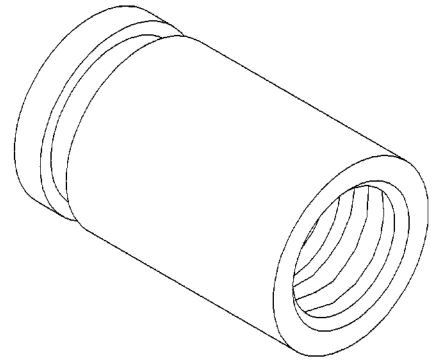


Fuel Injector Remover - 9010

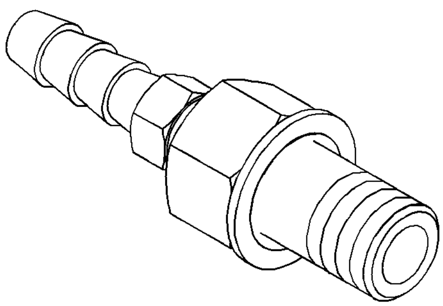
ENGINE 5.9L DIESEL (Continued)



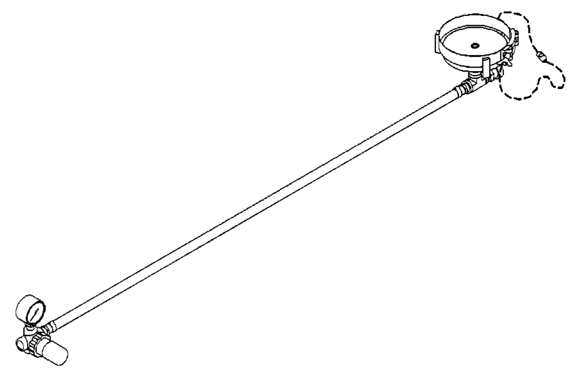
FUEL BLOCKOFF PLUG - 9011



Fuel Injector Tube (Connector) Remover - 9015



FUEL TEST FITTING - 9013



TURBO TEST ADAPTER - 9022

ENGINE DATA PLATE

DESCRIPTION

The engine data plate contains specific information that is helpful to servicing and obtaining parts for the engine. The data plate can be found in two places. Some models have a data plate is located on the left side of the engine, affixed to the APPS bracket. Some models will have the data plate affixed to the breather cover on the left side of the engine. Information that can be found on the data plate includes:

- Date of Engine Manufacture
- Engine Serial Number
- Control Parts List (CPL)
- Engine Rated Horsepower
- Engine Firing Order
- Engine Displacement
- Valve Lash Reset Specifications

If the engine data plate is missing or not legible, the engine serial number is used for engine identification. The engine serial number is stamped on the right side of the block, on top of the oil cooler cavity (Fig. 5).

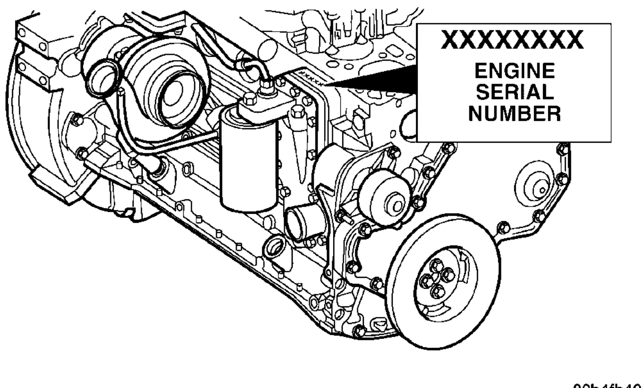


Fig. 5 Engine Serial Number Location

AIR CLEANER ELEMENT

REMOVAL

Testing Air Cleaner Element using Filter Minder™

Do not attempt to unnecessarily remove top of air cleaner housing for air cleaner element inspection on diesel engines.

The air cleaner (filter) housing is equipped with an air Filter Minder™ gauge (Fig. 6). This air flow restriction gauge will determine when air cleaner element is restricted and should be replaced.

The Filter Minder™ consists of a diaphragm and calibrated spring sealed inside of a plastic housing (Fig. 7). A yellow colored disc attached to diaphragm moves along a graduated scale on side of Filter Minder. After engine has been shut off, a ratcheting device located within Filter Minder will hold yellow disc at highest restriction that air cleaner element has experienced. A drop in air pressure due to an air cleaner element restriction moves diaphragm and yellow disc will indicate size of air drop.

CAUTION: Certain engine degreasers or cleaners may discolor or damage plastic housing of Filter Minder. Cover and tape Filter Minder if any engine degreasers or cleaners are to be used.

To test, turn engine off. If yellow disc (Fig. 7) has reached red colored zone on graduated scale, air cleaner element should be replaced. Refer to Removal / Installation.

Resetting Filter Minder: After air cleaner (filter) element has been replaced, press rubber button on top of Filter Minder (Fig. 7). This will allow yellow colored disc to reset. After button has been pressed, yellow disc should spring back to UP position.

If Filter Minder gauge has reached red colored zone, and after an examination of air cleaner (filter) element, element appears to be clean, high reading may be due to a temporary condition such as snow build-up at air intake. Temporary high restrictions may also occur if air cleaner (filter) element has gotten wet such as during a heavy rain or snow. If this occurs, allow element to dry out during normal engine operation. Reset rubber button on top of Filter Minder and retest after element has dried.

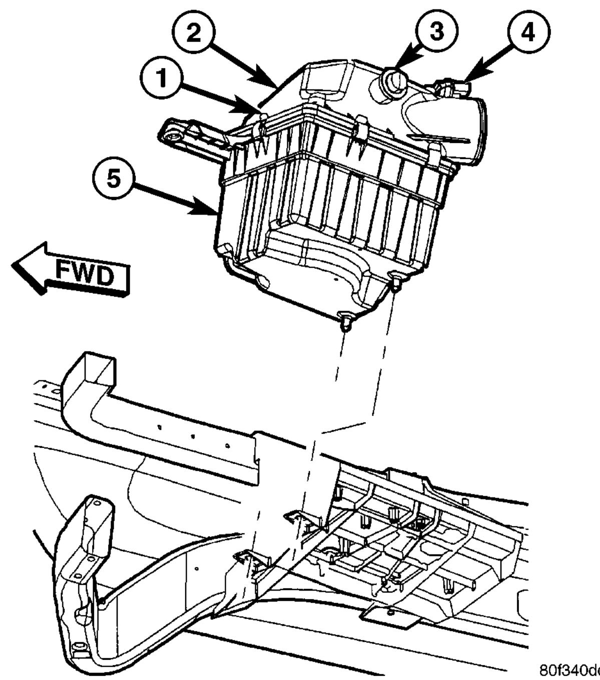


Fig. 6 5.9L DIESEL AIR CLEANER - FILTER MINDER™

1 - CLIPS
2 - FILTER COVER
3 - FILTER MINDER™
4 - INLET AIR TEMPERATURE/ PRESSURE SENSOR
5 - FILTER HOUSING

AIR CLEANER ELEMENT (Continued)

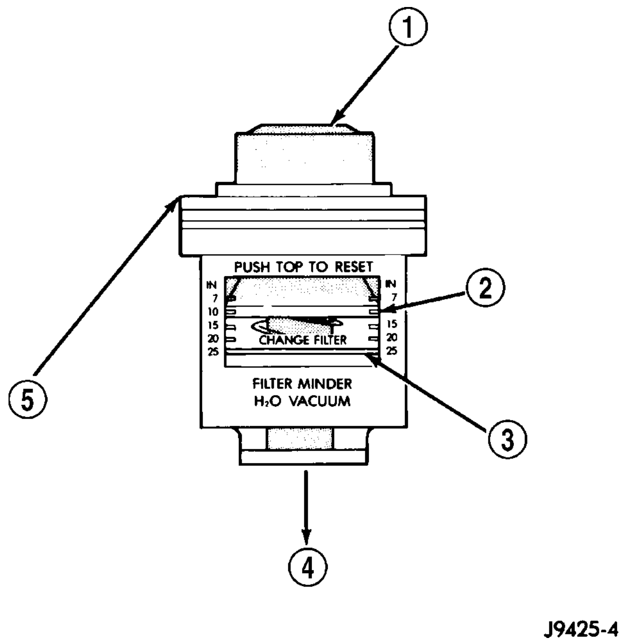


Fig. 7 FILTER MINDER™ - 5.9L DIESEL

1 - PRESS BUTTON TO RESET
2 - YELLOW DISC
3 - RED ZONE
4 - TO AIR FILTER HOUSING
5 - FILTER MINDER

Filter Removal

(1) The housing cover is equipped with spring clips (Fig. 6) and is hinged with plastic tabs. Unlatch clips from top of air cleaner housing and tilt housing cover up for cover removal.

(2) Remove air cleaner element from air cleaner housing.

INSTALLATION

(1) Before installing new air cleaner element (filter), clean inside of air cleaner housing.

(2) Position air cleaner cover to tabs on front of air cleaner housing. Latch spring clips to seal cover to housing.

CYLINDER HEAD

DESCRIPTION

The cylinder head is constructed of cast iron and is a one piece cross flow design with four valves per cylinder. The arrangement of two intake and two exhaust valves per cylinder allows for a centrally located injector. The cylinder head also includes an integral intake manifold, an integral thermostat housing, and a longitudal fuel return rifle, which exits at the rear of the head. The 24 valve design also includes integrally cast valve guides and hardened intake and exhaust valve seat inserts.

REMOVAL

(1) Disconnect battery negative cables.

(2) Raise vehicle on hoist.

(3) Drain engine coolant.

(4) Disconnect exhaust pipe from turbocharger elbow.

(5) Lower vehicle.

(6) Disconnect air inlet temperature/pressure sensor.

(7) Remove air cleaner housing and snorkel from the vehicle. Cap off turbocharger air inlet to prevent intrusion of dirt or foreign material.

(8) Disconnect cab heater core supply and return hoses from the cylinder head and heater pipe.

(9) Disconnect turbocharger oil drain tube at rubber hose connection. Cap off open ports to prevent intrusion of dirt or foreign material.

(10) Disconnect turbocharger oil supply line at the turbocharger end. Cap off open ports to prevent intrusion of dirt or foreign material.

(11) Remove exhaust manifold-to-cylinder head bolts, spacers, heat shield, retention straps, and cab heater plumbing. Remove exhaust manifold and turbocharger from the vehicle as an assembly.

(12) Remove cooling fan assembly.

(13) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(14) Remove cooling fan support from cylinder block.

(15) Remove upper generator bolt, loosen lower generator bolt, and rotate generator away from cylinder head.

(16) Disconnect radiator upper hose from the thermostat housing.

(17) Disconnect the Intake Air Temperature, Manifold Air Pressure, and Coolant Temperature sensor connector.

(18) Remove the engine harness to cylinder head attaching bolts and P-clips at front of head.

(19) Remove the throttle linkage cover (Fig. 8).

(20) Remove the six (6) accelerator pedal position sensor assembly-to-cylinder head bracket bolts (Fig. 9) and secure the entire assembly out of the way. Disconnect the APPS connector (Fig. 10). **It is not necessary to disconnect the cables from the throttle control assembly.**

(21) Remove the intake air grid heater wires from the grid heater.

(22) Remove engine oil level indicator tube attaching bolt at fuel filter housing bracket and inlet air connection..

(23) Remove the charge air cooler-to-air inlet housing pipe.

CYLINDER HEAD (Continued)

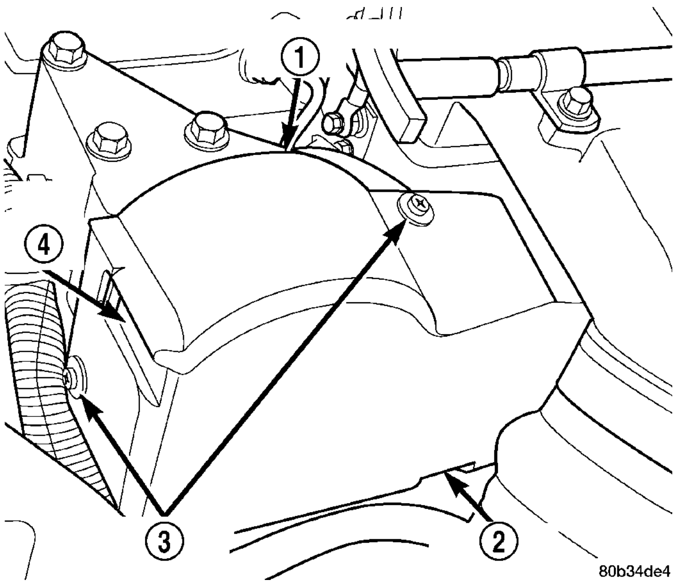


Fig. 8 Throttle Linkage Cover

1 - CABLE/LEVER/LINKAGE COVER
2 - PUSH UP LOWER TAB
3 - SCREWS/CLIPS (2)
4 - TAB PUSH HERE

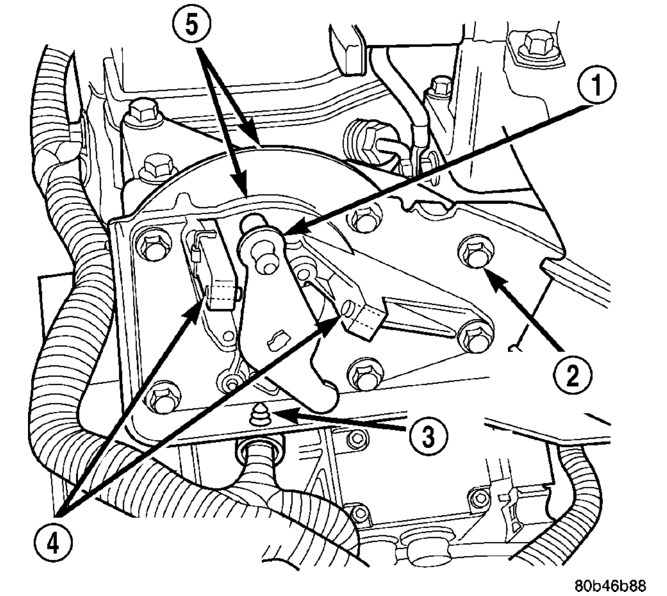


Fig. 9 APPS Assembly

1 - LEVER
2 - MOUNTING BOLTS (6)
3 - WIRE HARNESS CLIP
4 - CALIBRATION SCREWS (NO ADJUSTMENT)
5 - APPS ASSEMBLY

(24) Remove the engine wire harness attaching bolt and wire harness push-in fastener from air inlet housing.

(25) Remove the air inlet housing and intake grid heater from the intake manifold cover.

(26) Remove the two grid heater harness-to-cylinder head attaching bolts at front of cylinder head.

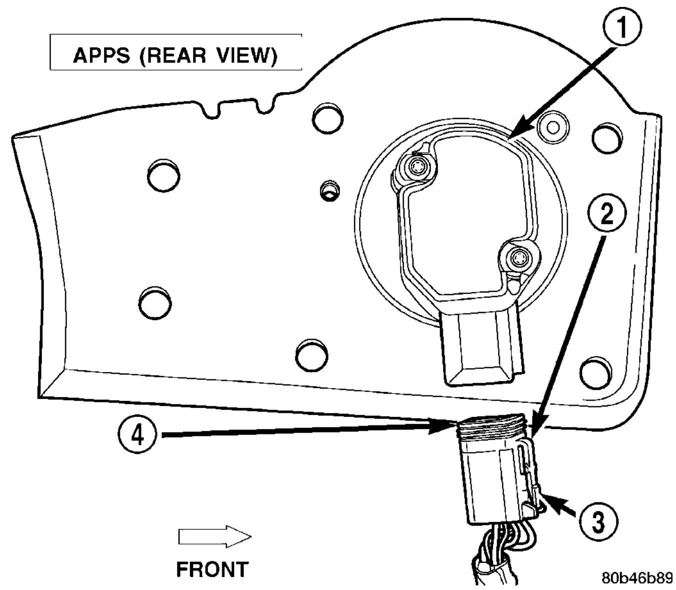


Fig. 10 APPS Connector

1 - APPS
2 - TAB
3 - PUSH FOR REMOVAL
4 - APPS CONNECTOR

(27) Remove the engine lift bracket from the rear of the cylinder head.

(28) **Remove the high pressure pump to fuel rail fuel line as follows:**

(a) Loosen fuel line nuts at fuel pump and at fuel rail.

(b) Use a back-up wrench on the fitting at the fuel pump to keep it from loosening.

(29) Remove the fuel rail to cylinder head fuel lines as follows:

(a) Loosen No. 6 high pressure fuel line shield and position out of way.

(b) Loosen the fuel line nuts at the fuel rail and at the cylinder head.

(c) Remove the fuel line bracket bolts at the intake manifold cover.

(30) Remove the fuel rail as follows:

(a) Remove fuel rail pressure sensor connector.

(b) Remove banjo fitting at pressure limiting valve.

(c) Remove fuel rail bolts and fuel rail.

(31) Remove the low pressure lines as follows:

(a) Remove the fuel drain banjo fitting on the front side of fuel filter housing.

(b) Remove the fuel drain banjo fitting on rear side of fuel filter housing.

(c) Remove the fuel drain line support bracket on rear side of filter housing.

(d) Remove fuel drain hose.

CYLINDER HEAD (Continued)

(e) Remove banjo fitting at bottom of fuel filter housing.

(f) Disconnect fuel supply hose at lift pump.

(32) Disconnect fuel heater, water in fuel sensor, and fuel lift pump connectors.

(33) Remove the fuel filter assembly-to-cylinder head bolts and remove filter assembly from vehicle.

(34) Remove wire harness P-clip from cylinder head (located behind filter housing).

(35) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(36) Disconnect rocker housing injector harness connectors.

(37) Remove injector harness nuts from injectors.

(38) Remove the rocker levers (Fig. 11), cross heads and push rods (Fig. 12). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder exhaust and the #6 cylinder intake and exhaust push rods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

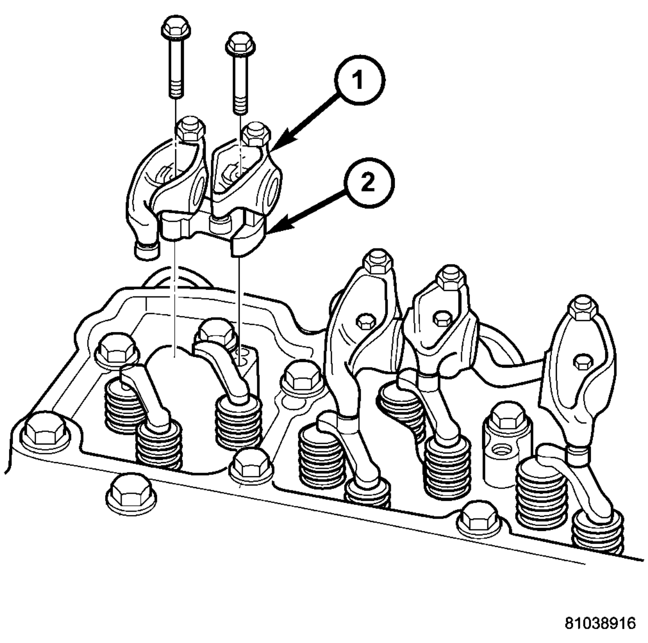


Fig. 11 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

(39) Remove the fuel return line and banjo bolt at the rear of the cylinder head. Be careful not to drop the two (2) sealing washers.

(40) Remove the fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

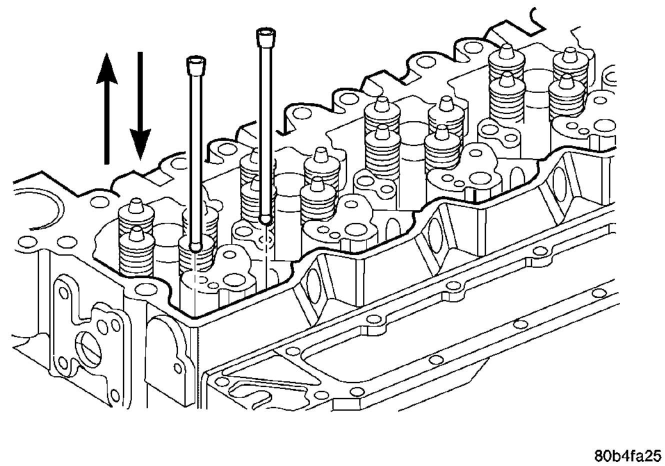


Fig. 12 Push Rod Removal

(41) Remove rocker housing bolts and rocker housing and gasket.

(42) Reinstall the engine lift bracket at the rear of cylinder head. Torque to 77 N·m (57 ft. lbs.).

(43) Remove twenty six (26) cylinder head-to-block bolts.

(44) Attach an engine lift crane to engine lift brackets and lift cylinder head off engine and out of vehicle.

(45) Remove the head gasket and inspect for failure.

CLEANING

CLEANING—CYLINDER HEAD

CAUTION: Do not wire brush head surface while fuel injectors are still installed. Fuel injector damage can result.

Remove fuel injector before cleaning (if not already removed during cylinder head removal).

Clean the carbon from the injector nozzle seat with a nylon or brass brush.

Scrape the gasket residue from all gasket surfaces.

Wash the cylinder head in hot soapy water solution (88°C or 140°F).

After rinsing, use compressed air to dry the cylinder head.

Polish the gasket surface with 400 grit paper. Use an orbital sander or sanding block to maintain a flat surface.

CLEANING—CROSSHEADS

Clean all crossheads in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn deposits. Rinse in hot water and blow dry with compressed air.

CYLINDER HEAD (Continued)

CLEANING—PUSHRODS

Clean the pushrods in a suitable solvent. Rinse in hot water and blow dry with compressed air. If necessary, use a wire brush or wheel to remove stubborn deposits.

INSPECTION

INSPECTION - CYLINDER HEAD

Inspect the cylinder head for cracks in the combustion surface. Pressure test any cylinder head that is visibly cracked. A cylinder head that is cracked between the injector bore and valve seat can be pressure tested and reused if OK; however, if the crack extends **into** the valve seat insert bore, the cylinder head **must** be replaced.

Visually inspect the cylinder block and head combustion surfaces for localized dips or imperfections. Check the cylinder head and block combustion surfaces for overall out-of-flatness. If either the visual or manual inspection exceeds the limits, then the head or block must be surfaced.

Check the top surface for damage caused by the cylinder head gasket leaking between cylinders.

Inspect the block and head surface for nicks, erosion, etc.

Check the head distortion. Maximum overall variation end to end is 0.305 mm (0.012 inch) (Fig. 13), and maximum overall variation side to side 0.076 mm (.003 in.).

DO NOT proceed with the in-chassis overhaul if the cylinder head or block surface is damaged or not flat (within specifications).

Check block surface for distortion. Maximum variation end-to-end is 0.076 mm (.003 in.), side-to-side 0.051 mm (.002).

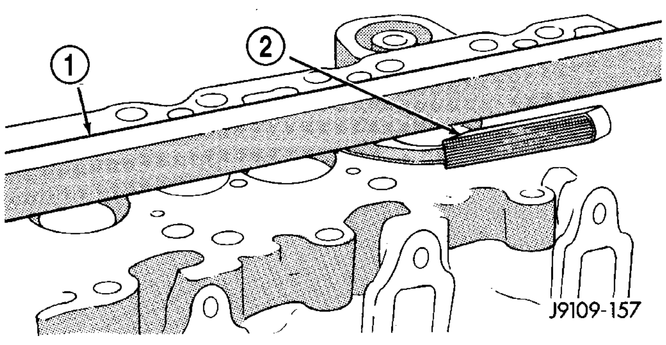


Fig. 13 Cylinder Head Combustion Deck Face

1 - STRAIGHT EDGE
2 - FEELER GAUGE

Visually inspect the cylinder head bolts for damaged threads, corroded/pitted surfaces, or a reduced diameter due to bolt stretching.

If the bolts are not damaged, their "free length" should be measured using the cap screw stretch gauge provided with the replacement head gasket. Place the head of the bolt against the base of the slot and align the bolt with the straight edge of gauge (Fig. 14). If the end of the bolt touches the foot of the gauge, the bolt **must** be discarded. **The maximum bolt free length is 132.1 mm (5.200 in.).**

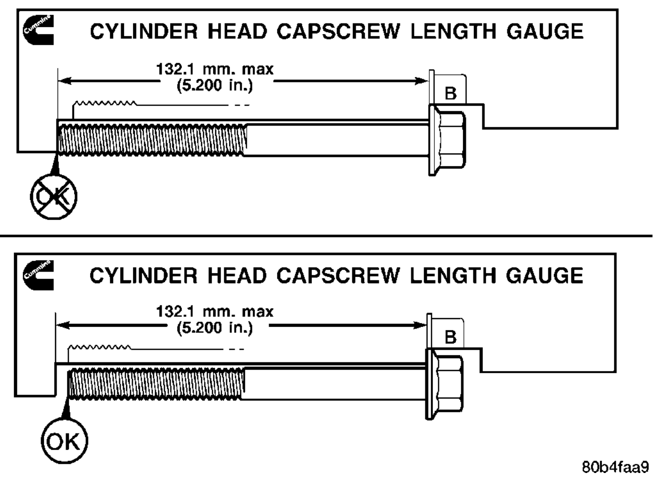


Fig. 14 Head Bolt Stretch Gauge

INSPECTION—CROSSHEADS

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 15). Replace any crossheads that exhibit abnormal wear or cracks.

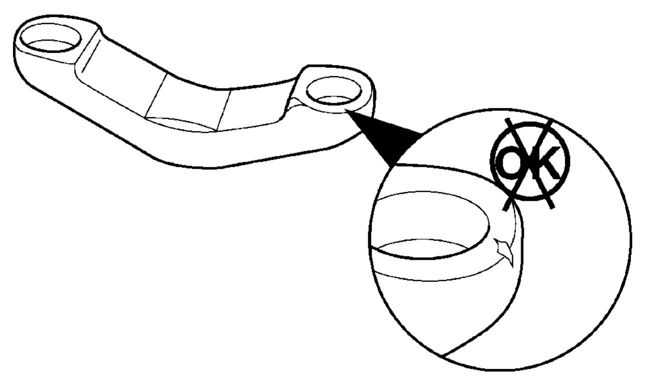


Fig. 15 Inspecting Crosshead for Cracks

CYLINDER HEAD (Continued)

INSPECTION—PUSHRODS

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 16).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 17). Replace any push rod that appears to be bent.

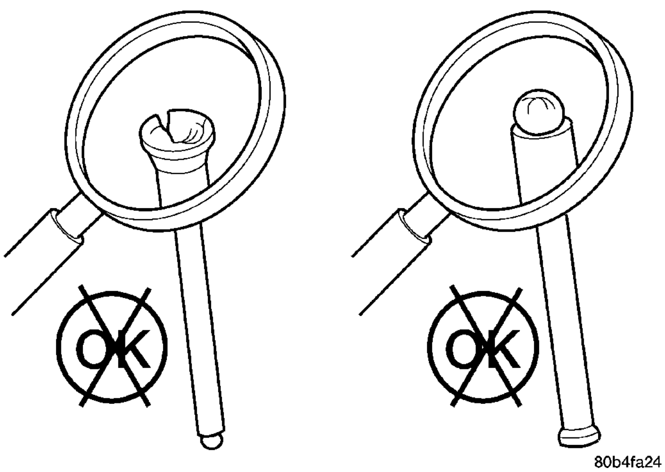


Fig. 16 Inspecting Push Rod for Cracks

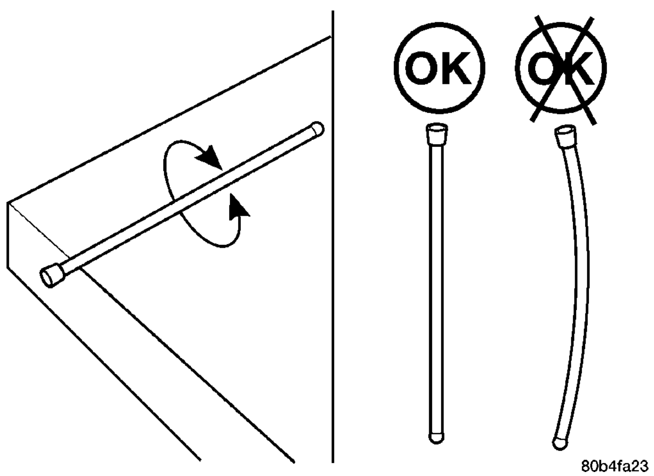


Fig. 17 Inspecting Push Rod for Flatness

INSTALLATION

WARNING: THE OUTSIDE EDGE OF THE HEAD GASKET IS VERY SHARP. WHEN HANDLING THE NEW HEAD GASKET, USE CARE NOT TO INJURE YOURSELF.

(1) Install a new gasket with the part number side up, and locate the gasket over the dowel sleeves.

(2) Using an engine lifting crane, lower the cylinder head onto the engine.

(3) Lightly lubricate head bolts with engine oil and install. Using the sequence shown in (Fig. 18), tighten bolts in the following steps:

(a) Torque bolts to 70 N·m (52 ft. lbs.)

(b) Back off 360 degrees in sequence

(c) Torque bolts to 105 N·m (77 ft. lbs.)

(d) Re-check all bolts to 105 N·m (77 ft. lbs.)

(e) Tighten all bolts an additional ¼ turn (90°)

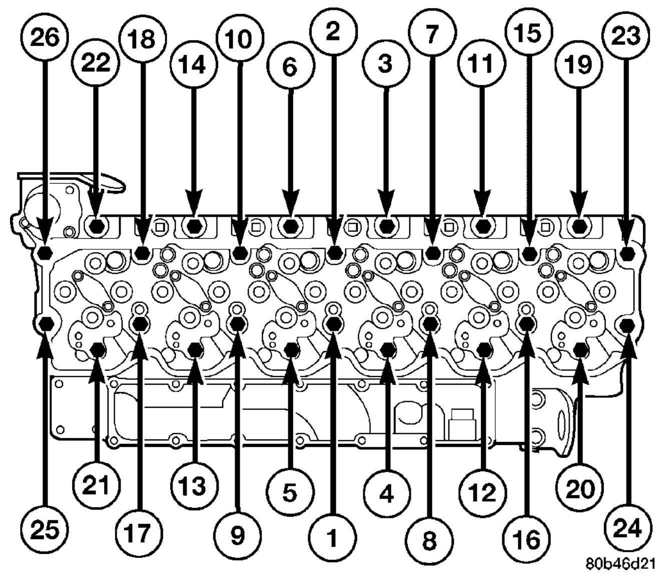


Fig. 18 Cylinder Head Bolt Torque Sequence

(4) Install push rods into their original locations (Fig. 19). **Verify that they are seated in the tappets**.

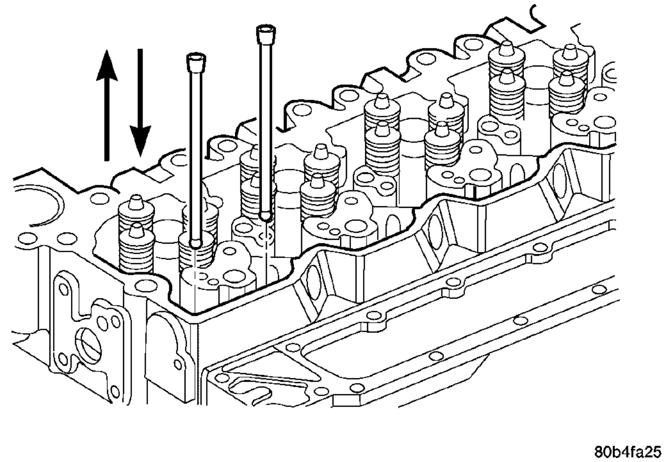


Fig. 19 Push Rod Installation

(5) Lubricate valve stem tips and install the crossheads in their original locations.

(6) Lubricate the rocker arms and pedestals and install them in their original locations (Fig. 20). Install the bolts and torque them to 36 N·m (27 ft. lbs.).

(7) Verify that the valve lash settings are maintained (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).

(8) Inspect rocker housing gasket for cuts and proper installation into groove. Replace if damaged.

CYLINDER HEAD (Continued)

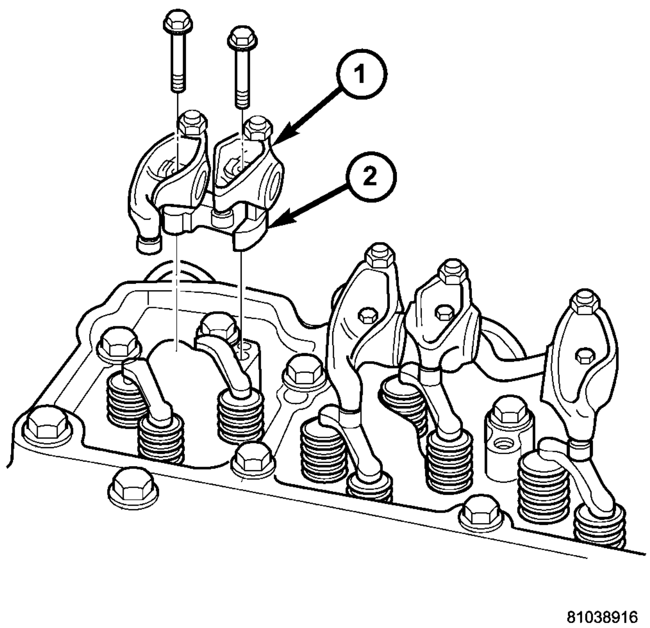


Fig. 20 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

(9) Install rocker housing and bolts. Tighten to 24 Nm (18 lb. ft.).

(10) Install fuel injector(Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION).

(11) Install fuel injector tube and fuel injector tube nut. Torqu to 50 N·m (37 ft. lbs.).

(12) Install injector harness nuts. Tighten to 1.5 Nm (13 lb. in.).

(13) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(14) Install wire harness P-clip to cylinder head behind filter housing 24 N·m (18 ft. lbs.).

(15) Connect the IAT and MAP sensor connector.

(16) Install the fuel filter canister assembly and torque mounting bolts to 24 N·m (18 ft. lbs.).

(17) Connect fuel lift pump, WIF sensor, and fuel heater.

(18) Remove the engine lift bracket at rear of cylinder head.

CAUTION: Failure to follow procedure will result in fuel leaks and/or fuel system failure.

(19) **Install the fuel rail and high pressure fuel lines as follows:**

(a) Hand tighten fuel rail bolts.

(b) Hand tighten fuel drain line to pressure limiting valve. Hand tighten at fuel filter housing.

(c) Hand tighten fuel rail-to-cylinder head lines.

(d) Install fuel line brace bolts-to-intake manifold finger tight.

(e) Hand tighten fuel pump to fuel rail line.

(f) Torque fuel line nuts at cylinder head to 30 Nm (22 ft. lbs.).

(g) Torque fuel line nuts at fuel rail to 30 Nm (22 ft. lbs.)

(h) Torque fuel pump to fuel rail line to 30 Nm (22 ft. lbs.).

(i) Torque fuel drain banjo bolt at pressure limiting valve and front of fuel filter housing to 24 Nm (18 ft. lbs.).

(j) Torque fuel line brace bolts to 24 N·m (18 ft. lbs.).

(k) Torque rail bolts to 24 Nm (18 ft. lbs.).

(l) Connect fuel pressure sensor.

(20) Install the engine lift bracket at the rear of cylinder head. Torque to 77 N·m (57 ft. lbs.).

(21) Reposition number 6 fuel line shield and torque to 43 N·m (32 ft. lbs.).

(22) Install the fuel filter to injection pump low pressure line. Inspect and replace sealing washers if necessary. Torque banjo bolts to 24 N·m (18 ft. lbs.).

(23) Connect fuel return line at back of cylinder head hand tight.

(24) Connect fuel return line at filter housing hand tight.

(25) Torque banjo connections at cylinder head and fuel filter housing to 24 Nm (18 ft. lbs.)

(26) Install bracket to rear of filter housing. Torque to 24 Nm (18 ft. lbs.).

(27) Using new gaskets, install the intake grid heater and air inlet housing. Torque bolts to 24 N·m (18 ft. lbs.).

(28) Install wire harness P-clip and push on clip to air inlet housing.

(29) Connect engine oil level indicator tube at fuel filter housing and at air inlet housing.

(30) Connect the APPS connector.

(31) Install the APPS assembly to the cylinder head bracket and torque bolts to 24 N·m (18 ft. lbs.).

(32) Install the throttle linkage cover.

(33) Install the charge air cooler-to-air inlet housing duct assembly. Torque all clamps to 11 N·m (100 in. lbs.).

(34) Connect intake grid heater wires.

(35) Secure engine harness to front of cylinder head with bolt at four locations.

(36) Connect engine coolant temperature sensor connector.

(37) Connect radiator upper hose to thermostat housing.

(38) Rotate generator into position. Install upper bolt and torque upper and lower bolts.

(39) Install wire harness push-on clip below bracket.

CYLINDER HEAD (Continued)

(40) Install wire harness P-clip to top of bracket.

(41) Install fan support and torque to 32 N·m (24 ft. lbs.).

(42) Install cooling fan/drive and torque to 33 N·m (24 ft. lbs.).

(43) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(44) Install exhaust manifold/turbocharger assembly, using new gaskets. Start all bolts/spacers by hand. Torque bolts to 43 N·m (32 ft. lbs.).

(45) Install exhaust manifold heat shield. Torque to 24 N·m (18 ft. lbs.).

(46) Install exhaust bolt retention straps across cylinders 5 & 6.

(47) Connect turbocharger oil drain tube. Torque to 8 N·m (71 in. lbs.).

(48) Perform the turbocharger pre-lube procedure. Refer to Group 11, Exhaust System and Turbocharger for the correct procedure.

(49) Connect the turbocharger oil supply line. Torque to 24 N·m (18 ft. lbs.).

(50) Install air cleaner housing and duct.

(51) Connect air inlet temperature/pressure sensor.

(52) Raise vehicle on hoist.

(53) Install exhaust pipe to turbocharger elbow. Torque bolts to 8 N·m (72 in. lbs.).

(54) Lower vehicle.

(55) Fill engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(56) Start engine and check for leaks.

CYLINDER HEAD COVER(S)

REMOVAL

REMOVAL—CYLINDER HEAD COVER

(1) Disconnect both battery negative cables.

(2) Remove oil fill cap.

(3) Remove the breather cover.

(4) Disconnect the breather hose and breather drain tube from the breather housing.

(5) Remove cylinder head cover bolts.

(6) Remove the cylinder head cover.

REMOVAL—ROCKER HOUSING

(1) Remove cylinder head cover as outlined in this section.

(2) Disconnect rocker housing injector harness connectors.

(3) Remove injector harness nuts from injectors.

(4) Remove rocker housing bolts.

(5) Remove rocker housing and gasket.

CLEANING

Using a suitable solvent, Clean and dry gasket mating surfaces on cylinder head and rocker housing. Wipe gasket dry and inspect for re-use.

INSPECTION

The cylinder head cover gasket, rocker housing gasket, are reusable. However, should cracks, nicks, or tears be present in the rubber/silicone construction, the defective components should be replaced. Also replace gasket if it is no longer flexible. Inspect o-rings on cylinder head cover bolts.

INSTALLATION

INSTALLATION—CYLINDER HEAD COVER

(1) Inspect cylinder head cover gasket for cuts and proper installation in groove. Replace if damaged.

(2) Position cylinder cover on top of rocker housing.

(3) Install bolts.

(4) Starting with the center bolt, torque to 24 N·m (18 ft. lbs.).

(5) Install breather hose to breather.

(6) Install breather drain hose to breather.

(7) Install breather cover and wire harness clip. Torque to 24 N·m (18 ft. lbs.).

INSTALLATION—ROCKER HOUSING

(1) Inspect rocker housing gasket for cuts, nicks, or tears. Replace if damaged or if gasket has come out of groove.

(2) Inspect rocker housing gasket for proper installation in groove. Gasket bead must be centered in groove. A gasket bead that is tilted to the side will cause an oil leak.

(3) Install Tool **XXXX** guide pins (or equivalent) into the cylinder head at rocker housing bolt locations #1 and #5.

(4) Install the rocker hoiusing over the guide pins. Carefully gyide the rocker housing evenly down onto the cylinder head.

(5) With guide pins in place, install remaining rocker housing bolts and tighten finger tight.

(6) Remove guide pins and install remaining rocker housing bolts finger tight.

(7) Install rocker housing and bolts. Torque bolts, working from center out, to 24 Nm (18ft. lbs.).

(8) Install injector harness nuts to injector solenoid. Torque to 1.5 Nm (13 in. lbs.).

(9) Connect rocker housing injector harness connections.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves are made of heat resistant steel, and have chrome plated stems to prevent scuffing. The intake and exhaust valves are both similar in head diameter and overall length, but they have unique face angles which makes them non-interchangeable. The valves are distinguished by unique dimples on the exhaust valve head (Fig. 21).

The exhaust valve springs are made from high strength, chrome silicon steel. The exhaust valve springs are also exhaust brake compatible.

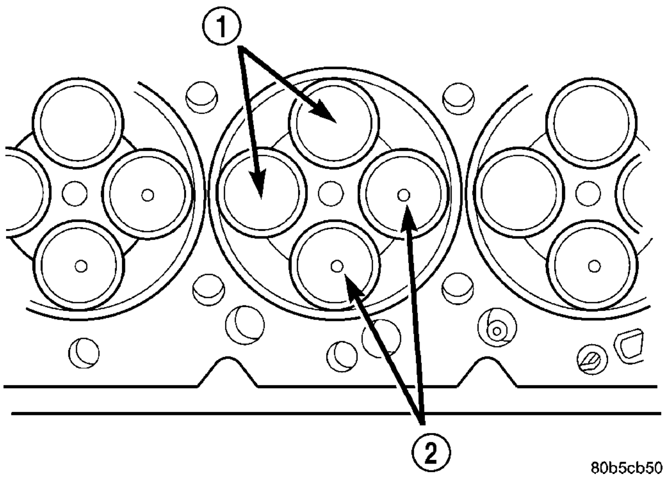


Fig. 21 Valve Identification

1 - INTAKE VALVES
2 - EXHAUST VALVES

STANDARD PROCEDURE

STANDARD PROCEDURE - VALVES, GUIDES AND SPRINGS

REMOVAL

(1) Remove cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - REMOVAL).

(2) Support cylinder head on stands, or install head bolts upside down (through combustion surface side) to protect injector tips from damage from work bench.

(3) Install the valve spring compressor mounting base as shown in (Fig. 22).

(4) Install the compressor top plate, washer, and nut. Using a suitable wrench, tighten the nut (clockwise) to compress the valve springs (Fig. 23) and remove the locks.

(5) Rotate the compressor nut counter-clockwise to relieve tension on the springs. Remove the spring compressor.

(6) Remove the retainers, springs, valve seals (if necessary), and valves (Fig. 24). Arrange or number all components so they can be installed in their original locations.

(7) Repeat the procedure on all cylinders to be serviced.

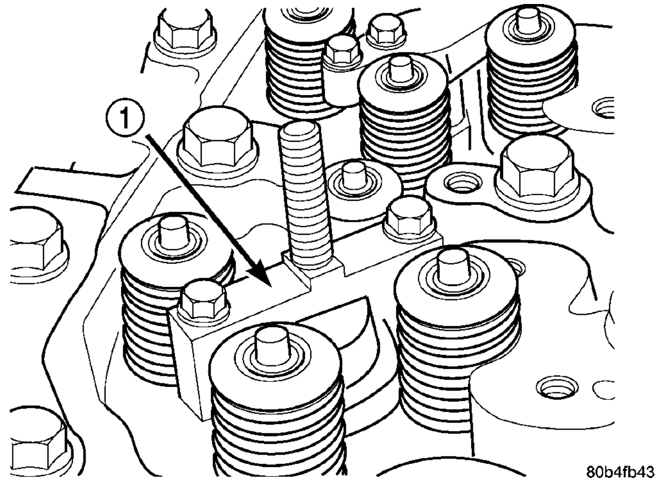


Fig. 22 Spring Compressor Mounting Base—Part of Tool 8319–A

1 - COMPRESSOR MOUNTING BASE

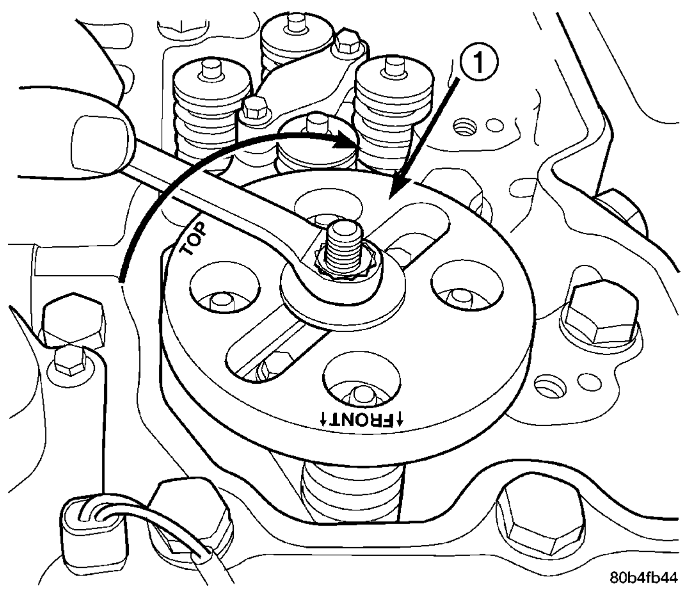


Fig. 23 Compressing Valve Springs with Tool 8319–A

1 - SPECIAL TOOL 8319

CLEANING

Clean the valve stems with crocus cloth or a Scotch-Brite™ pad. Remove carbon with a soft wire brush. Clean valves, springs, retainers, and valve retaining locks in a suitable solvent. Rinse in hot water and blow dry with compressed air.

INTAKE/EXHAUST VALVES & SEATS (Continued)

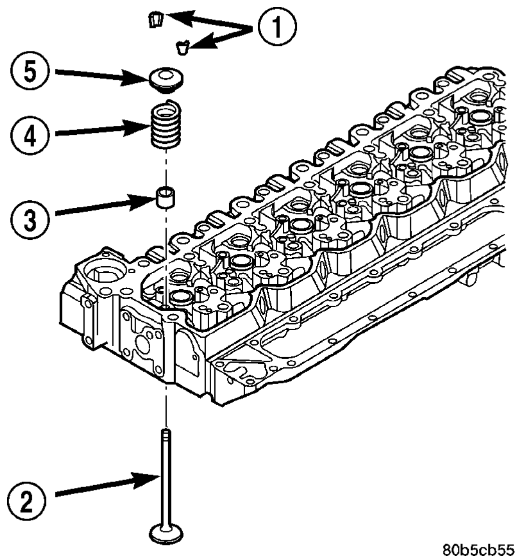


Fig. 24 Valve Spring, Seal, and Retainers

1 - VALVE RETAINING LOCKS
2 - VALVE
3 - SEAL
4 - SPRING
5 - RETAINER

INSPECTION

Visually inspect the valves for abnormal wear on the heads, stems, and tips. Replace any valve that is worn out or bent (Fig. 25).

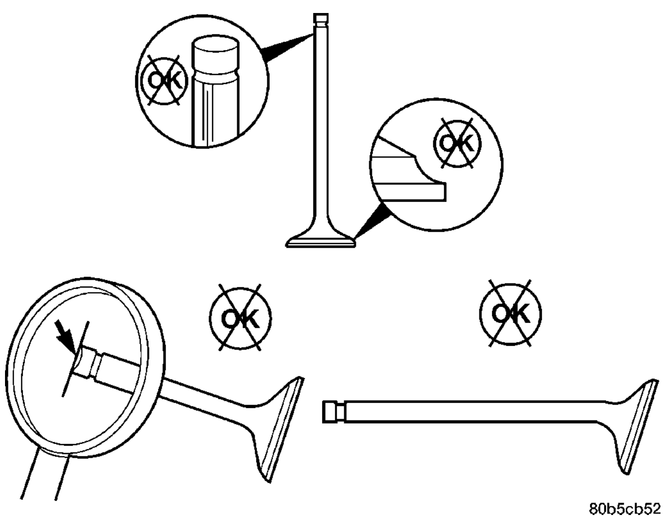


Fig. 25 Visually Inspect Valves for Abnormal Wear

Measure the valve stem diameter in three places as shown in (Fig. 26).

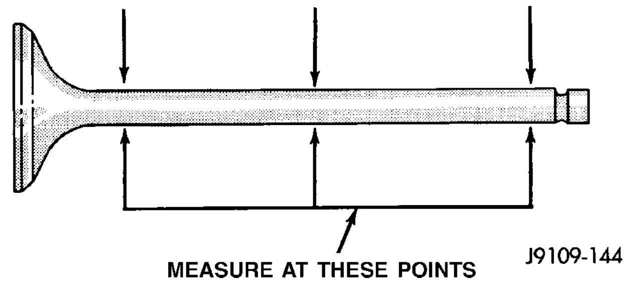


Fig. 26 Measure Valve Stem Diameter

VALVE STEM DIAMETER
6.96 mm (0.2740 in.) MIN

7.010 mm (0.2760 in.) MAX

Measure the cylinder head valve guide bore (Fig. 27).

VALVE GUIDE BORE SPECIFICATIONS

VALVE GUIDE BORE SPECIFICATIONS	
Valve guide bore diameter	
Min.	7.027 mm (0.2767 in.)
Max.	7.077 mm (0.2786 in.)
Installed valve guide depth	
Intake	
Min.	0.584 mm (0.023 in.)
Max.	1.092 mm (0.043 in.)
Exhaust	
Min.	0.965 mm (0.028 in.)
Max.	1.473 mm (0.058 in.)

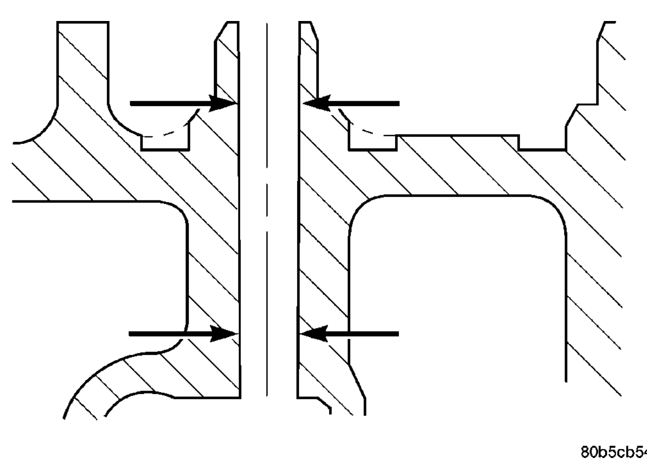


Fig. 27 Measure Valve Guide Bore

INTAKE/EXHAUST VALVES & SEATS (Continued)

Measure valve margin (rim thickness) (Fig. 28).

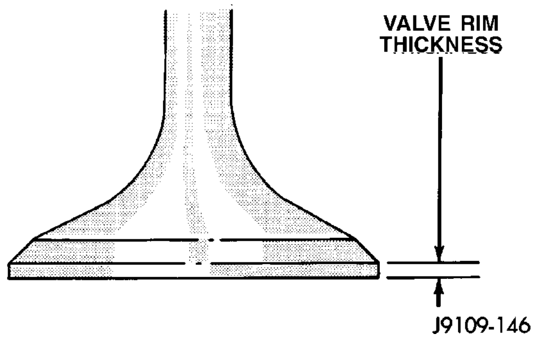


Fig. 28 Measure Valve Margin (Rim Thickness)

VALVE MARGIN (RIM THICKNESS)
0.79 mm (0.031 in.) MIN.

Measure the valve spring free length and maximum inclination (Fig. 29).

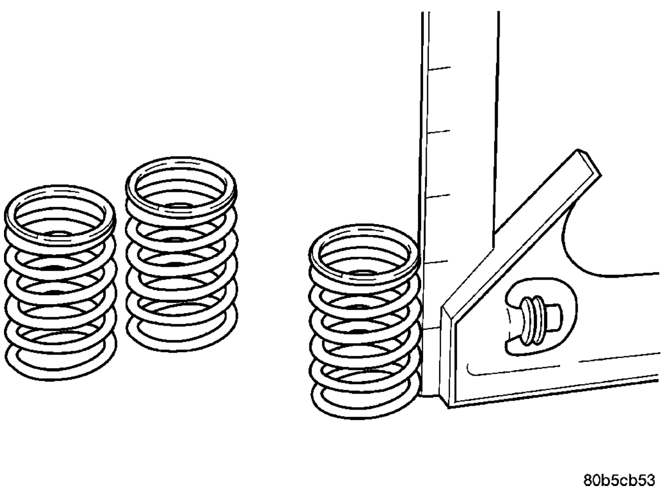


Fig. 29 Measure Valve Spring Free Length and Max. Inclination

APPROXIMATE VALVE SPRING FREE LENGTH
47.75 mm (1.88 in.)

MAX INCLINATION
1.5 mm (.059 in.)

Test valve spring force with tool C-647 (Fig. 30). Specification 72.0 — 80.7 lbs. when compressed to 35.33 mm (1.39 in.).

INSTALLATION

(1) Install new valve seals. The yellow seals are for the intake valves and the green seals are for the exhaust valves.

(2) Install the valves in their original postion. The exhaust valves are identified by a dimple on the valve head (Fig. 31).

(3) Install the valve springs and retainer.

(4) Install the valve spring compressor tool 8319–A as shown in (Fig. 22) and (Fig. 23).

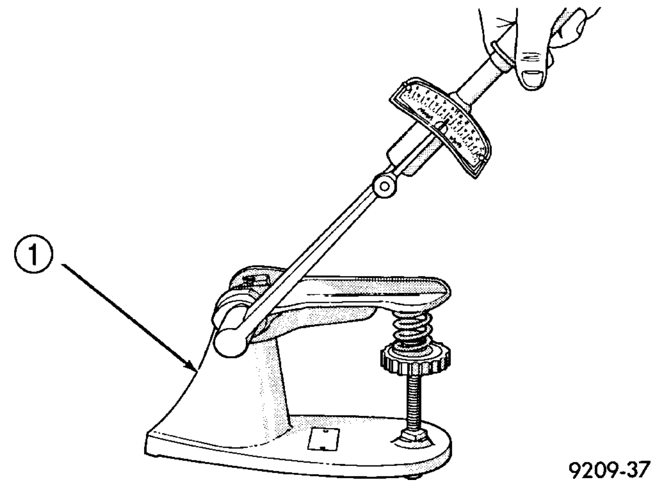


Fig. 30 Testing Valve Spring with Tool C-647

1 - SPECIAL TOOL C-647

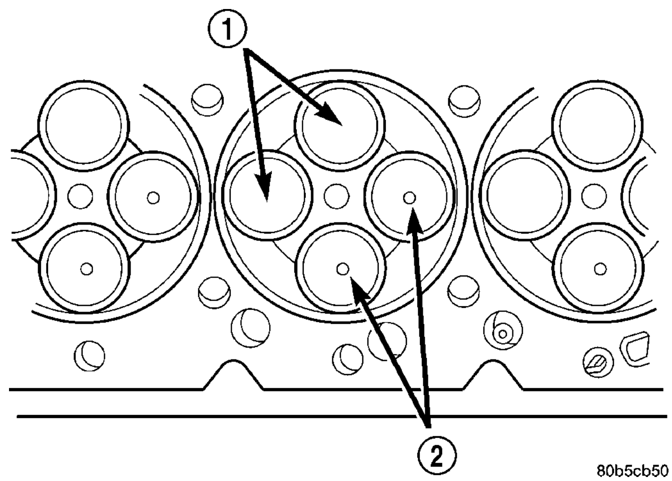


Fig. 31 Valve Identification

1 - INTAKE VALVES
2 - EXHAUST VALVES

(5) Compress the valve springs and install the valve retaining locks (Fig. 24).

(6) Remove the compressor and repeat the procedure on the remaining cylinders.

(7) Install new o-ring and sealing washer on injector.

(8) Lubricate o-ring and injector bore.

(9) Verify sealing washer (shim) was removed with old injector.

(10) Install injector with fuel injector connector port facing intake manifold.

(11) Install hold-down bolt. Torque to 10 Nm (89 in. lbs.).

(12) Install fuel injector connector and connector nut. Torque nut to 50 Nm (36.8 ft. lbs.).

(13) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

INTAKE/EXHAUST VALVES & SEATS (Continued)

STANDARD PROCEDURE - VALVE LASH ADJUSTMENT AND VERIFICATION

NOTE: To obtain accurate readings, valve lash measurements AND adjustments should only be performed when the engine coolant temperature is less than 60° C (140° F).

The 24–valve overhead system is a “low-maintenance” design. Routine adjustments are no longer necessary, however, measurement should still take place when trouble-shooting performance problems, or upon completion of a repair that includes removal and installation of the valve train components or injectors.

(1) Disconnect battery negative cables.

(2) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Using the crankshaft barring tool #7471–B, rotate crankshaft to align damper TDC mark to 12:00 o’clock position.

(a) If both number one cylinder rocker levers are loose, continue to next step.

(b) If both number one clylinder rocker levers are not loose, rotate crankshaft 360 degrees.

(4) With the engine in this position, valve lash can be measured at the following rocker arms: **INTAKE 1–2–4 / EXHAUST 1–3–5**. Measure the valve lash by inserting a feeler gauge between the rocker arm socket and crosshead (Fig. 32). Refer to VALVE LASH LIMIT CHART for the correct specifications. If the measurement falls **within** the limits, adjustment/resetting **is not** necessary. If measurement finds the lash **outside** of the limits, adjustment/resetting **is** required.

VALVE LASH LIMIT CHART

INTAKE	EXHAUST
0.152 mm (0.006 in.) MIN.	0.381 mm (0.015 in.) MIN.
0.381 mm (0.015 in.) MAX.	0.762 mm (0.030 in.) MAX.
note: If measured valve lash falls within these specifications, no adjustment/reset is necessary. Engine operation within these ranges has no adverse affect on performance, emissions, fuel economy or level of engine noise.	

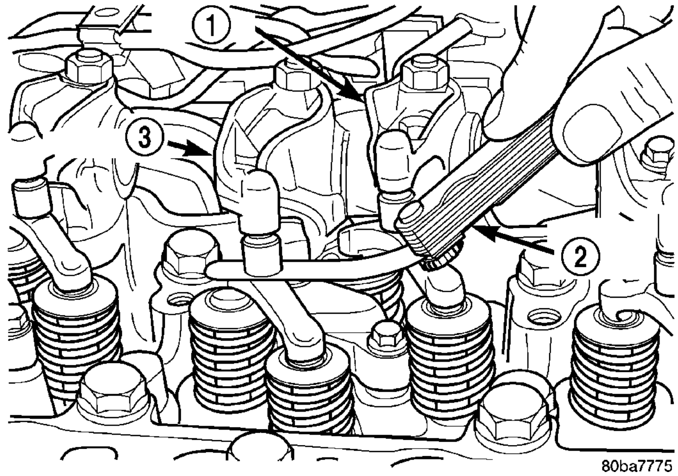


Fig. 32 Measuring Valve Lash - Typical

1 - INTAKE
2 - FEELER GAUGE
3 - EXHAUST

(5) If adjustment/resetting is required, loosen the lock nut on rocker arms and turn the adjusting screw until the desired lash is obtained:

- **INTAKE** 0.254 mm (0.010 in.)
- **EXHAUST** 0.508 mm (0.020 in.) Tighten the lock nut to 24 Nm (18 ft. lbs.) and re-check the valve lash.

(6) Using the crankshaft barring tool, rotate the **crankshaft** one revolution (360°) to align the damper TDC mark to the 12 o’clock position.

(7) With the engine in this position, valve lash can be measured at the remaining rocker arms: **INTAKE 3–5–6 / EXHAUST 2–4–6**. Use the same method as above for determining whether adjustment is necessary, and adjust those that are found to be outside of the limits.

(8) Install the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(9) Connect the battery negative cables.

REMOVAL - VALVE SPRINGS AND SEALS

(1) Disconnect the battery negative cables.

(2) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Disconnect rocker housing injector harness connector. Remove all injector harness solenoid nuts.

(4) Remove injector(s) for cylinder(s) to be serviced. Refer to Group 14 for injector removal.

(5) Remove the rocker housing.

(6) Remove the rocker arms and crossheads from the cylinder(s) to be serviced. Mark each component so they can be installed in their original position.

(7) Using the crankshaft barring tool #7471–B (Fig. 33), rotate the engine to position the damper

INTAKE/EXHAUST VALVES & SEATS (Continued)

mark in the 12 o'clock position. **At this engine position, cylinders #1 and #6 can be serviced.**

(8) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(9) With the damper TDC mark in the 12 o'clock position, add a paint mark anywhere on the gear housing cover next to the crankshaft damper. Place another mark on the vibration damper in alignment with the mark you just made on the cover.

(10) Divide the crankshaft damper into three equally sized segments as follows:

(a) Using a tape measure, measure the circumference of the crankshaft damper and divide the measurement by three (3).

(b) Measure that distance in a counter-clockwise direction from the first balancer mark and place another mark on the balancer.

(c) From the second damper mark, again measure in a counter-clockwise direction and place a mark on the damper at the same distance you measured when placing the second damper mark. The damper should now be marked in three equally spaced locations and the damper TDC mark should be in the 12 o'clock position.

(d) Remove injectors, fuel lines, and high pressure connectors for every cylinder that requires repair.

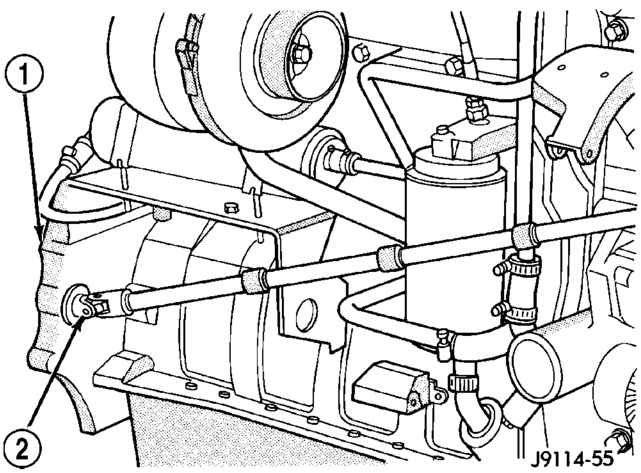


Fig. 33 Rotating Engine with Barring Tool - Typical

1 - REAR FLANGE
2 - BARRING TOOL

(11) Compress the valve springs at cyls. #1 and #6 as follows:

(a) Remove bolts and injector hold-down clamp.

(b) Using miller special tool #9010, remove injector.

(c) Install the valve spring compressor mounting base as shown in (Fig. 34).

(d) Install the top plate, washer, and nut. Using a suitable wrench tighten the nut (clock-wise) (Fig. 35) to compress the valve springs and remove the collets.

(e) Rotate the compressor nut counter-clockwise to relieve tension on springs. Remove spring compressor.

(f) Remove and replace retainers, springs, and seals as necessary.

(g) **Do not rotate the engine until the springs and retainers are re-installed.**

(h) Install seals, springs and retainers. Install spring compressor, compress valve springs and install the collets.

(i) Release the spring tension and remove the compressor. Verify that the collets are seated by tapping on the valve stem with a plastic hammer.

(12) Using the crankshaft barring tool, rotate the engine until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #2 and #5 can be serviced.**

(13) Repeat the valve spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

(14) Using the crankshaft barring tool, rotate the engine until the next crankshaft damper paint mark aligns with the mark you placed on the cover. **In this position, cylinders #3 and #4 can be serviced.**

(15) Repeat the spring compressing procedure previously performed and service the retainers, springs, and seals as necessary.

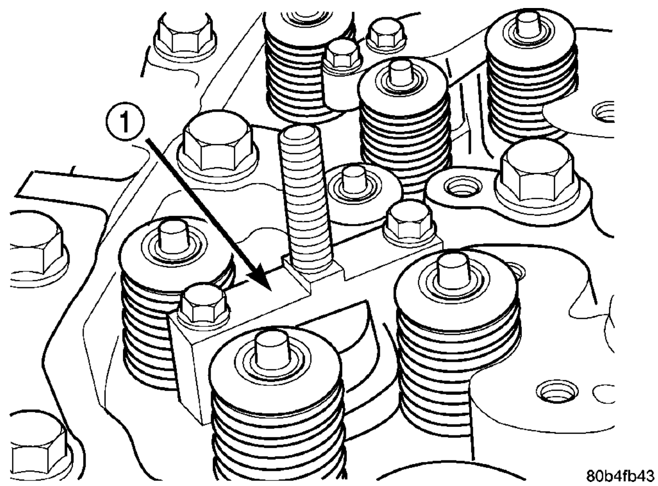


Fig. 34 Spring Compressor Mounting Base—Part of Tool 8319–A

1 - COMPRESSOR MOUNTING BASE

INSTALLATION

(1) Install rocker housing.

(2) Install fuel injectors and high pressure fuel lines.

(3) Lubricate the valve tips and install the crossheads in their original locations.

INTAKE/EXHAUST VALVES & SEATS (Continued)

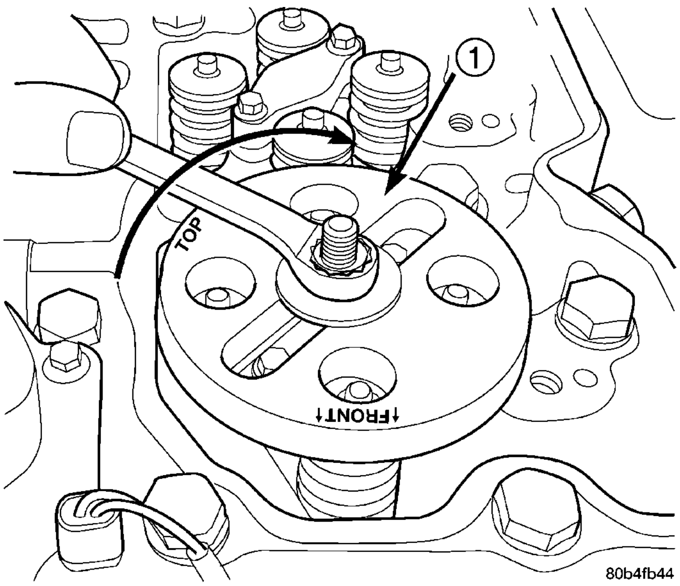


Fig. 35 Compressing Valve Springs with Tool 8319–A

1 - SPECIAL TOOL 8319

(4) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(5) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

(6) Install cylinder head cover and reusable gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(7) Connect battery negative cables.

ROCKER ARM / ADJUSTER ASSY

DESCRIPTION

The unique intake and exhaust rocker arms have their own rocker shafts and are lubricated by passages intersecting the cylinder block main oil rifle. Crossheads are used, which allow each rocker arm to operate two valves.

The solid push rods are hardened at the rocker arm and tappet contact areas for superior strength and durability.

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Remove the rocker arm/pedestal fasteners (Fig. 36) and remove rocker arm and pedestal from cylinder head. Mark the arms and pedestals so they can be installed in their original position.

CAUTION: When removing the rocker arms, the sockets (Fig. 37) may come loose and fall into the engine. Make sure they stay with the arm upon removal/installation.

(4) Lift the push rod(s) up and out of the engine (Fig. 38). Mark them so they can be installed in their original position.

NOTE: The #5 cyl. intake and exhaust and #6 cyl. intake and exhaust push rods must be raised through the provided cowl panel access holes.

(5) Lift the crosshead(s) off of the valve stems. Mark them so they can be installed in their original position.

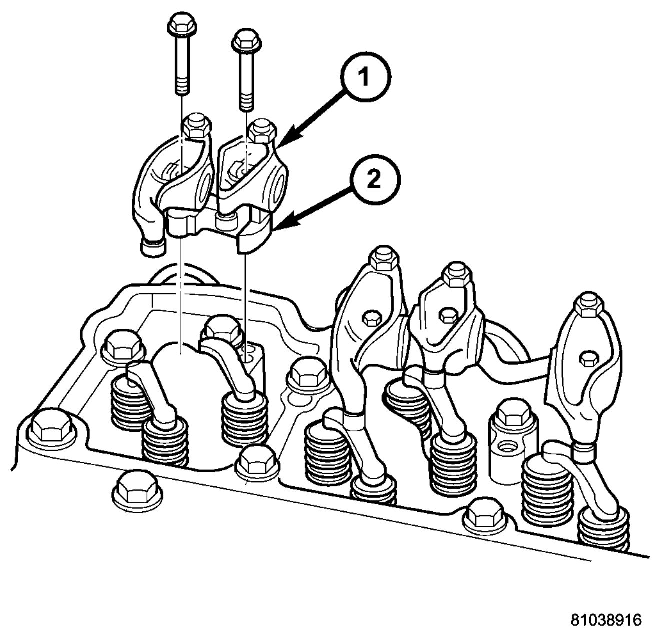


Fig. 36 Rocker Arm and Pedestal Removal

1 - ROCKER ARM
2 - PEDESTAL

CLEANING

Clean all components in a suitable solvent. If necessary, use a wire brush or wheel to remove stubborn deposits. Rinse in hot water and blow dry with compressed air. Inspect oil passages in rocker arms and pedestals. Apply compressed air to lubrication orifices to purge contaminants.

ROCKER ARM / ADJUSTER ASSY (Continued)

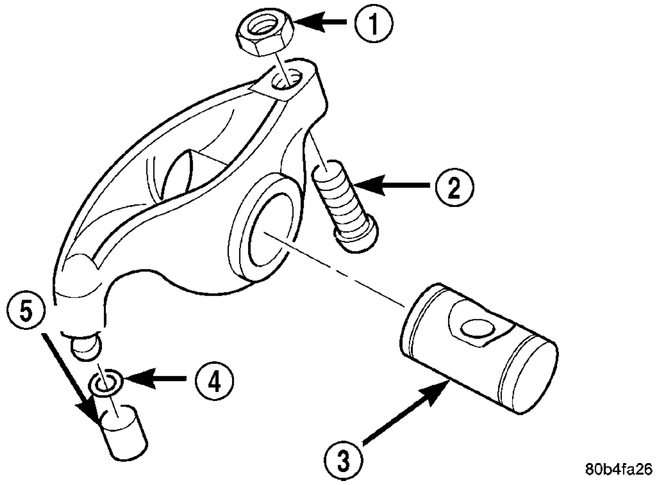


Fig. 37 Rocker Arm Assembly Identification

1 - NUT
2 - ADJUSTING SCREW
3 - ROCKER SHAFT
4 - RETAINER
5 - SOCKET

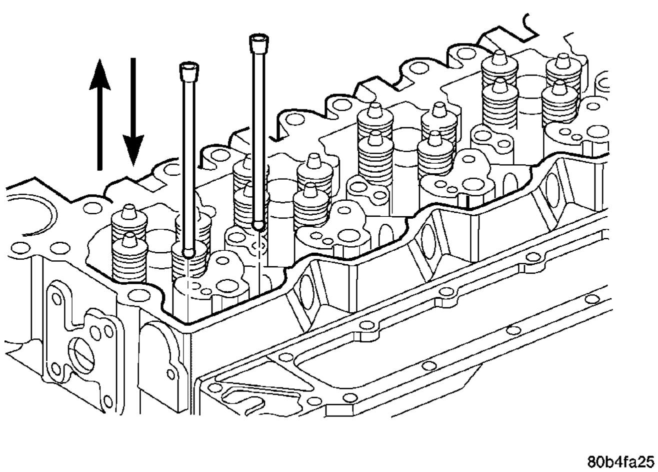


Fig. 38 Push Rod Removal/Installation

INSPECTION

Rocker Arms

(1) Remove rocker shaft and inspect for cracks and excessive wear in the bore or shaft. Remove socket and inspect ball insert and socket for signs of wear. Replace retainer if necessary.

Measure the rocker arm bore and shaft (Fig. 39) (Fig. 40).

Push Rods

Inspect the push rod ball and socket for signs of scoring. Check for cracks where the ball and the socket are pressed into the tube (Fig. 41).

Roll the push rod on a flat work surface with the socket end hanging off the edge (Fig. 42). Replace any push rod that appears to be bent.

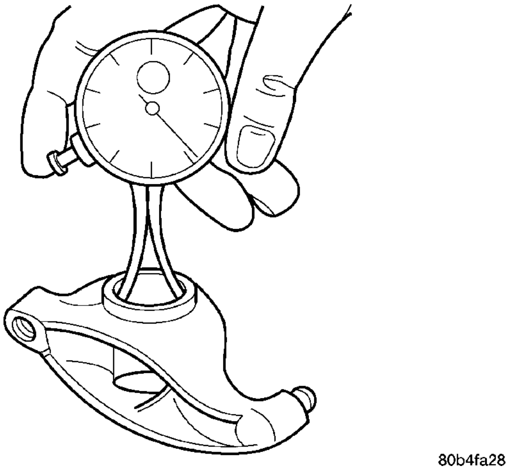


Fig. 39 Measuring Rocker Arm Bore

ROCKER ARM BORE (MAX.)
22.027 mm (.867 in.)

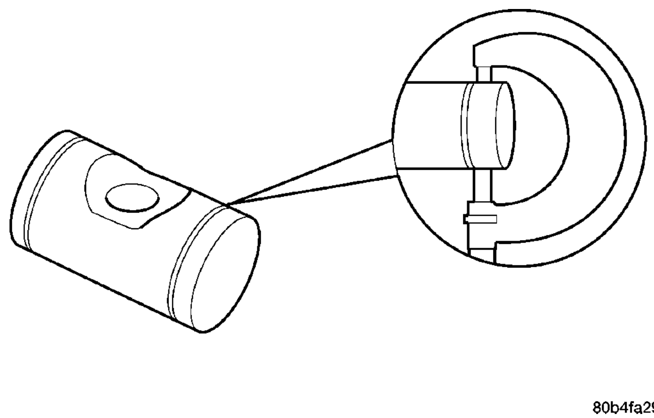


Fig. 40 Measuring Rocker Arm Shaft

ROCKER ARM SHAFT (MIN.)
21.965 mm (.865 in.)

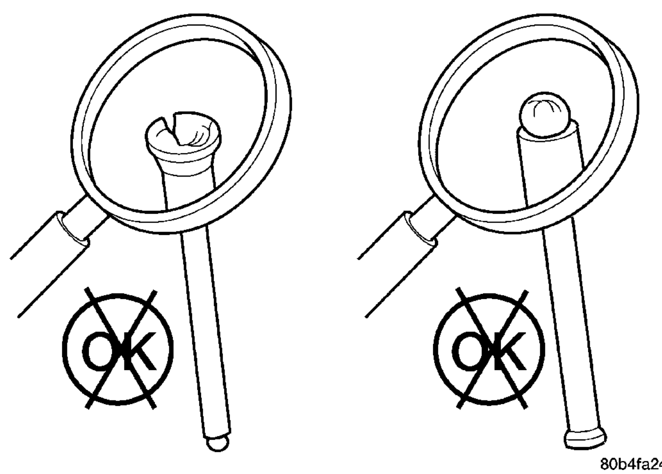


Fig. 41 Inspecting Push Rod for Cracks

ROCKER ARM / ADJUSTER ASSY (Continued)

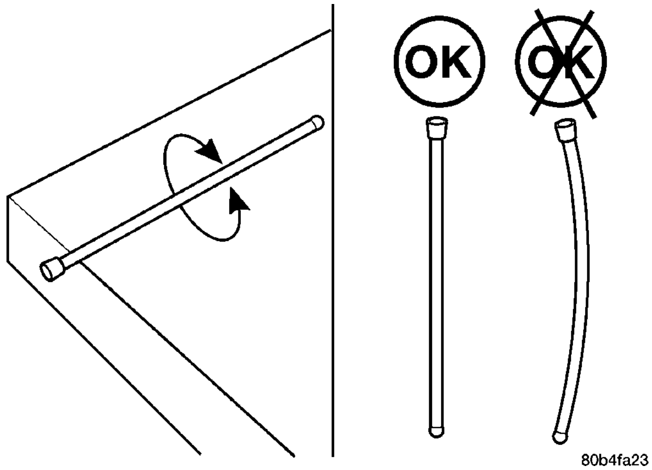


Fig. 42 Inspecting Push Rod for Flatness

Crossheads

Inspect the crossheads for cracks and/or excessive wear on rocker lever and valve tip mating surfaces (Fig. 43).

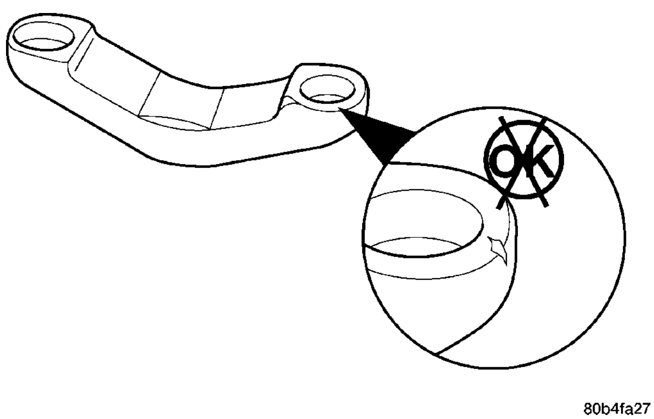


Fig. 43 Inspecting Crosshead for Cracks

INSTALLATION

(1) If previously removed, install the push rods in their original location. **Verify that they are seated in the tappets.**

(2) Lubricate the valve tips and install the crossheads in their original locations.

(3) Lubricate the crossheads and push rod sockets and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(4) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

(5) Install cylinder head cover and reusable gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(6) Connect battery negative cables.

ENGINE BLOCK

STANDARD PROCEDURE

STANDARD PROCEDURE - CYLINDER BLOCK REFACING

(1) The combustion deck can be refaced twice. The first reface should be 0.25 mm (0.0098 inch). If additional refacing is required, an additional 0.25 mm (0.0098 inch) can be removed. Total allowed refacing is 0.50 mm (0.0197 inch) - (Fig. 44).

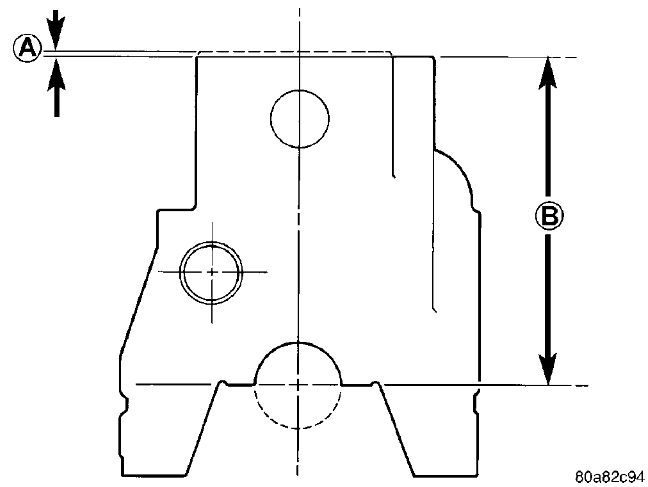


Fig. 44 Refacing Dimensions of the Cylinder Block

CYLINDER BLOCK REFACING DIMENSIONS

DIMENSION ″A″		
1st Reface	0.25mm	(0.0098 in.)
2nd Reface	0.25mm	(0.0098 in.)
Dim (A) Total	0.50 mm	(0.0197 in.)
		DIMENSION ″B″
Dim. ″B″ (STD.)	323.00 mm ± 0.10 mm	(12.7165 in. ± 0.0039 in.)
1st Reface	322.75 mm ± 0.10 mm	(12.7067 in. ± 0.0039 in.)
2nd Reface	322.50 mm ± 0.10 mm	(12.6968 in. ± 0.0039 in.)

(2) The upper right corner of the rear face of the block must be stamped with a X when the block is refaced to 0.25 mm (0.0098 inch). A second X must be stamped beside the first when the block is refaced to 0.50 mm (0.0197 inch) - (Fig. 45).

ENGINE BLOCK (Continued)

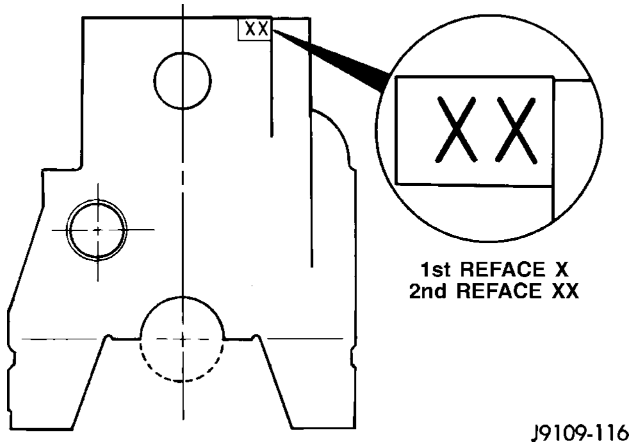


Fig. 45 Stamp Block after Reface

(3) Consult the parts catalog for the proper head gaskets which must be used with refaced blocks to ensure proper piston-to-valve clearance.

STANDARD PROCEDURE - CYLINDER BORE - DE-GLAZE

(1) New piston rings may not seat in glazed cylinder bores.

(2) De-glazing gives the bore the correct surface finish required to seat the rings. The size of the bore is not changed by proper de-glazing.

(3) Cover the lube and tappet holes in the top of the block with waterproof tape.

(4) It crankshaft is installed, wrap connecting rod journals with clean cloth. Cover cloth with waterproof tape.

(5) A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles (Fig. 46). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

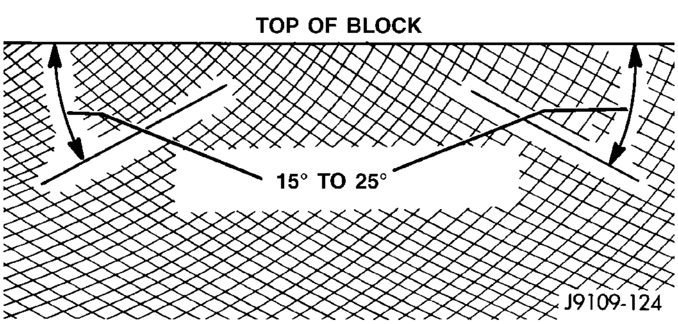


Fig. 46 Cylinder Bore Crosshatch Pattern

(6) Use a drill, a fine grit Flex-hone and a mixture of equal parts of mineral spirits and SAE 30W engine oil to de-glaze the bores.

(7) The crosshatch angle is a function of drill speed and how fast the hone is moved vertically (Fig. 47).

(8) Vertical strokes MUST be smooth continuous passes along the full length of the bore (Fig. 47).

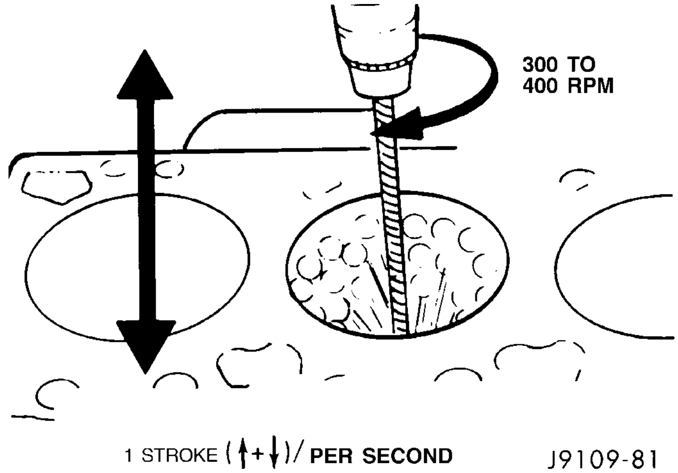


Fig. 47 De-Glazing Drill Speed and Vertical Speed

(9) Inspect the bore after 10 strokes.

(10) Use a strong solution of hot water and laundry detergent to clean the bores. Clean the cylinder bores immediately after de-glazing.

(11) Rinse the bores until the detergent is removed and blow the block dry with compressed air.

(12) Check the bore cleanliness by wiping with a white, lint free, lightly oiled cloth. If grit residue is still present, repeat the cleaning process until all residue is removed. Wash the bores and the complete block assembly with solvent and dry with compressed air. Place a clean shop towel around the top main bearing saddle to deflect water and residue from piston cooling nozzels. Remove directed piston cooling nozzles if installed.

(13) Be sure to remove the tape covering the lube holes, rod journals, and piston cooling nozzles after the cleaning process is complete.

STANDARD PROCEDURE—CYLINDER BORE REPAIR

Cylinder bore(s) can be repaired by one of two methods:

- Method 1:—Over boring and using oversize pistons and rings.
- Method 2:—Boring and installing a repair sleeve to return the bore to standard dimensions.

METHOD 1—OVERSIZE BORE

Cylinder bore(s) can be repaired by one of two methods:

Oversize pistons and rings are available in two sizes - 0.50 mm (0.0197 inch) and 1.00 mm (0.0393 inch).

Any combination of standard, 0.50 mm (0.0197 inch) or 1.00 mm (0.0393 inch) overbore may be used in the same engine.

ENGINE BLOCK (Continued)

If more than 1.00 mm (0.0393 inch) overbore is needed, a repair sleeve can be installed (refer to Method 2—Repair Sleeve).

Cylinder block bores may be bored twice before use of a repair sleeve is required. The first bore is 0.50 mm (0.0197 inch) oversize. The second bore is 1.00 mm (0.0393 inch) oversize.

After boring to size, use a honing stone to chamfer the edge of the bore.

CYLINDER BORE DIMENSION CHART

DESCRIPTION	MEASUREMENT
BORING DIAMETER DIMENSION	1st. REBORE - 102.469 mm (4.0342 in.)
	2nd. REBORE - 102.969 mm (4.0539 in.)
HONING DIAMETER DIMENSIONS	STANDARD - 102.020 ± 0.020 mm (4.0165 ± 0.0008 in.)
	1st. REBORE - 102.520 ± 0.020 mm (4.0362 ± 0.0008 in.)
	2nd. REBORE - 103.020 ± 0.020 mm 4.0559 ± 0.0008 in.)
CHAMFER DIMENSIONS	Approx. 1.25 mm (0.049 in.) by 15°

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block (Fig. 48). For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

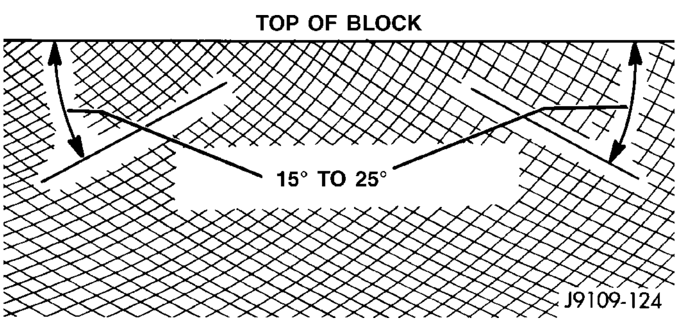


Fig. 48 Crosshatch Pattern of Repaired Sleeve(s)

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry.

Check the bore cleanliness by wiping with a white, lint-free, lightly- oiled cloth. There should be no grit residue present.

If the block is not to be used right away, coat it with a rust- preventing compound.

METHOD 2—REPAIR SLEEVE

If more than a 1.00 mm (0.03937 inch) diameter oversize bore is required, the block must be bored and a repair sleeve installed.

Bore the block cylinder bore to 104.500-104.515 mm (4.1142-4.1148 inch) - (Fig. 49).

Repair sleeves can be replaced by using a boring bar to bore out the old sleeve. DO NOT cut the cylinder bore beyond the oversize limit.

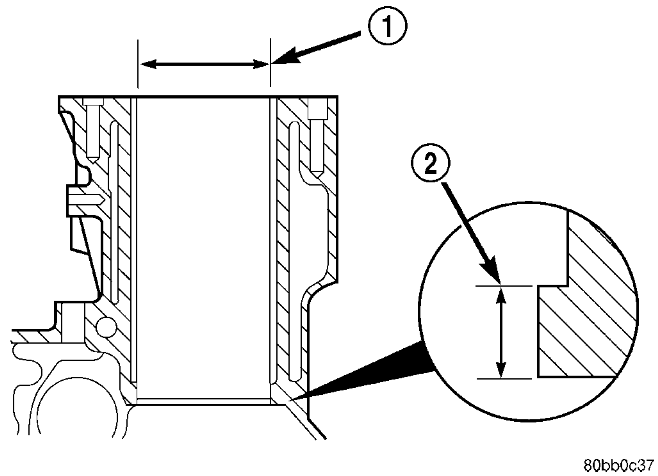


Fig. 49 Block Bore for Repair Sleeve Dimensions

1 - BORE DIAMETER
2 - STEP DIMENSION

REPAIR SLEEVE BLOCK REBORE DIMENSIONS CHART

BORE DIAMETER	STEP DIMENSION
104.500 + 0.015 mm (4.1142 + 0.0006 in.)	6.35 mm (0.25 in.)

After machining the block for the new repair sleeve, thoroughly clean the bore of all metal chips, debris and oil residue before installing the sleeve.

Cool the repair sleeve(s) to a temperature of -12°C (10°F) or below for a minimum of one hour. Be ready to install the sleeve immediately after removing it from the freezer.

Apply a coat of Loctite 620, or equivalent to the bore that is to be sleeved.

Wear protective gloves to push the cold sleeve into the bore as far as possible.

ENGINE BLOCK (Continued)

Using a sleeve driver, drive the sleeve downward until it contacts the step at the bottom of the bore (Fig. 50).

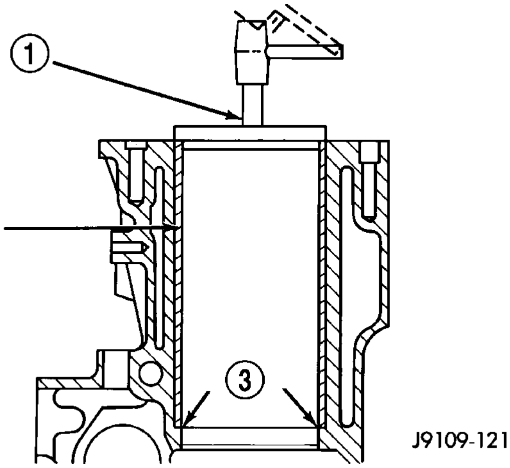


Fig. 50 Sleeve Installation

1 - SLEEVE DRIVER
2 - SLEEVE
3 - CONTACT

A sleeve driver can be constructed as follows (Fig. 51).

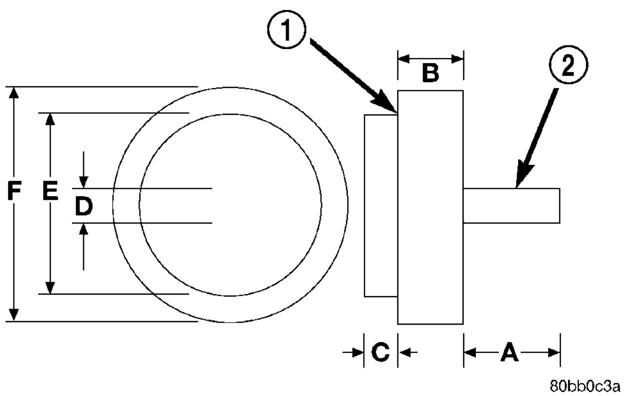


Fig. 51 Sleeve Driver Construction

1 - DRIVE
2 - HANDLE

SLEEVE DRIVER CONSTRUCTION SPECIFICATION CHART

ITEM	MEASUREMENT
A	127 mm (5 in.)
B	38 mm (1.5 in.)
C	6.35 mm (0.25 in.)
D	25.4 mm (1 in.)
E	101 mm (3.976 in.)
F	107.343 mm (4.226 in.)

Set up a boring bar and machine the sleeve to 101.956 mm (4.014 inch).

After removing the boring bar, use a honing stone to chamfer the corner of the repair sleeve(s).

SLEEVE MACHINING DIMENSIONS CHART

ITEM	MEASUREMENT
SLEEVE PROTRUSION	MIN. - FLUSH WITH BLOCK
	MAX. - 0.050 mm (0.0019 in.)
SLEEVE DIAMETER	101.956 mm (4.014 in.)
SLEEVE CHAMFER	APPROX. 1.25 mm (0.049 in.) by 15°

A correctly honed surface will have a crosshatch appearance with the lines at 15° to 25° angles with the top of the cylinder block. For the rough hone, use 80 grit honing stones. To finish hone, use 280 grit honing stones.

Finished bore inside dimension is 102.020 ±0.020 mm (4.0165 ±0.0008 inch).

A maximum of 1.2 micrometer (48 microinch) surface finish must be obtained.

After finish honing is complete, immediately clean the cylinder bores with a strong solution of laundry detergent and hot water.

After rinsing, blow the block dry with compressed air.

Wipe the bore with a white, lint-free, lightly oiled cloth. Make sure there is no grit residue present.

Apply a rust-preventing compound if the block will not be used immediately.

A standard diameter piston and a piston ring set must be used with a sleeved cylinder bore.

STANDARD PROCEDURE—CAM BORE REPAIR

For standard bushings, not oversized, maximum front and rear cam bushing bore diameter is 59.248 mm. (2.3326 in.). DO NOT bore the intermediate cam bore to the front cam bore oversize dimensions. Maximum front and rear camshaft bushing installed diameter is 54.147 mm. (2.1318 in.). Minimum installed diameter is 54.083 mm. (2.1293 in.). Maximum intermediate camshaft bore diameter is 54.164 mm. (2.1324 in.).

A surface finish of 2.3 micrometers (92 microinch) must be maintained. Not more than 20% of an area of any one bore may be 3.2 micrometers (126 microinch).

Camshaft bores can be repaired individually. It is not necessary to repair undamaged cam bores in order to repair individually damaged cam bores. The

ENGINE BLOCK (Continued)

standard front bushing cannot be used to repair intermediate bores.

Install all cam bushings flush or below the front and rear cam bore surface. The front camshaft bushing should be installed flush with front face of block. The rear camshaft bushing should be installed flush with rear face of block. The oil hole must align to allow a 3.2 mm (0.125 inch) rod to pass through freely (Fig. 52).

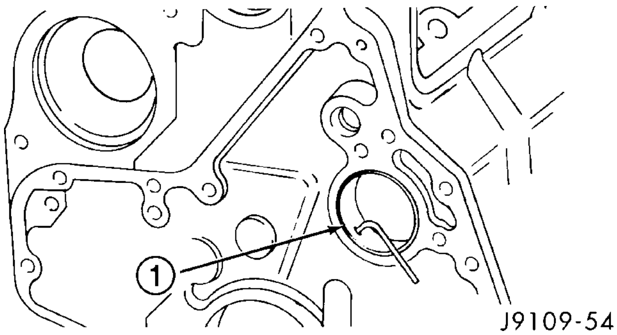


Fig. 52 Oil Hole Alignment

1 - CAMSHAFT BUSHING

INSPECTION

Measure the combustion deck face using a straight edge and a feeler gauge (Fig. 53). Cylinder block flatness: End-to-end 0.076 mm (.003 in.). Maximum variation side-to-side 0.051 mm (.002 in.).

Inspect for any localized dips or imperfections.

If the surface exceeds the limit, (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).

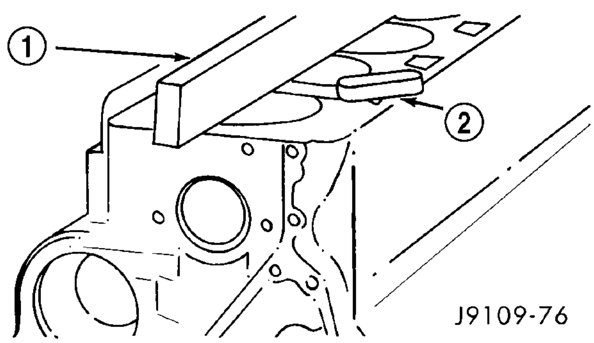


Fig. 53 Combustion Deck Face Measurement

1 - STRAIGHT EDGE
2 - FEELER GAUGE

Inspect the cylinder bores for damage or excessive wear.

Measure the cylinder bores (Fig. 54). If the cylinder bores exceed the limit, (Refer to 9 - ENGINE/ENGINE BLOCK - STANDARD PROCEDURE).

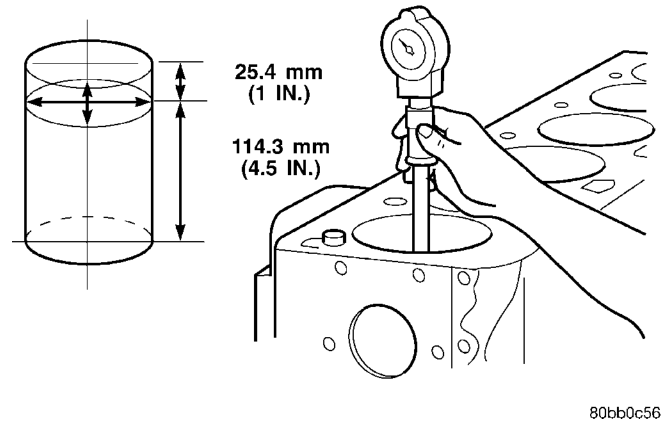


Fig. 54 Cylinder Bore Diameter

BORE SPECIFICATIONS

BORE DIAMETER	
Min.	102.000 mm (4.0157 in.)
Max.	102.116 mm (4.0203 in.)
OUT OF ROUNDNESS	
Max.	0.038 mm (0.0015 in.)
TAPER	
Max.	0.076 mm (.003 in.)

Inspect the camshaft bores for scoring or excessive wear.

Measure the camshaft bores (Refer to 9 - ENGINE - SPECIFICATIONS).

If a bore exceeds the limit, (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - STANDARD PROCEDURE).

Inspect the tappet bores for scoring or excessive wear.

Measure tappet bore from bottom of block. Minimum tappet bore diameter 16.000 mm (0.0630 in.). Maximum tappet bore 16.055 mm. (0.632 in.).

If out of limits, replace the cylinder block.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL—CAMSHAFT BEARINGS

NOTE: Measure the diameter of each bore. If the camshaft bore for the first or rear cam bushing is worn beyond the limit, install a new service bushing. Inspect the rest of the camshaft bores for damage or excessive wear.If the bores without a bushing are worn beyond the limit, the engine must be removed for machining and installation of service bushings. If badly worn, replace the cylinder block.

(1) Remove the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(2) Remove the bushing from the No.1 bore and No.7 using a universal cam bushing tool.

(3) Mark the cylinder block so you can align the oil hole in the cylinder block with the oil hole in the bushing.

REMOVAL - CAMSHAFT

(1) Disconnect both battery negative cables.

(2) Recover A/C refrigerant (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(3) Raise vehicle on hoist.

(4) Drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(5) Lower vehicle.

(6) Remove radiator upper hose.

(7) Remove viscous fan/drive assembly and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(8) Disconnect the coolant recovery bottle hose from the radiator filler neck.

(9) Disconnect lower radiator hose from radiator outlet.

(10) **Automatic Transmission models:** Disconnect transmission oil cooler lines from front of radiator using Special Tool 6931 (unless equipped with finger-release disconnect).

(11) Remove radiator mounting screws and lift radiator out of engine compartment.

(12) Remove upper radiator support panel.

(13) If A/C equipped, disconnect A/C condenser refrigerant lines.

(14) Disconnect charge air cooler piping from the cooler inlet and outlet.

(15) Remove the two charge air cooler mounting bolts.

(16) Remove charge air cooler (and A/C condenser if equipped) from vehicle.

(17) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(18) Remove accessory drive belt tensioner.

(19) Remove the fan support/hub assembly.

(20) Remove crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(21) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the sealing surfaces. Remove dust seal with cover.

(22) Using Special Tool 7471–B Crankshaft Barring Tool, rotate the crankshaft to align the timing marks on the crankshaft and the camshaft gears.

(23) Remove the cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(24) Remove the rocker arms, cross heads, and push rods (Fig. 55). Mark each component so they can be installed in their original positions.

NOTE: The #5 cylinder intake and the #6 cylinder intake and exhaust pushrods are removed by lifting them up and through the provided cowl panel access holes. Remove the rubber plugs to expose these relief holes.

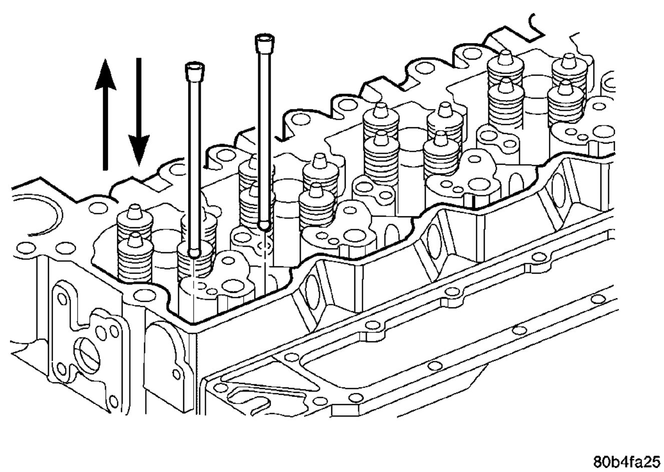


Fig. 55 Push Rod Removal/Installation

(25) Raise the tappets as follows, using the wooden dowel rods (Fig. 57)provided with the Miller Tool Kit 8502.

(a) Insert the slotted end of the dowel rod into the tappet. **The dowel rods for the rear two cylinders will have to be cut for cowl panel clearance.** Press firmly to ensure that it is seated in the tappet.

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(b) Raise the dowel rod to bring the tappet to the top of its travel, and wrap a rubber band around the dowel rods (Fig. 57) to prevent the tappets from dropping into the crankcase.

(c) Repeat this procedure for the remaining cylinders.

(26) Verify that the camshaft timing marks are aligned with the crankshaft mark (Fig. 56).

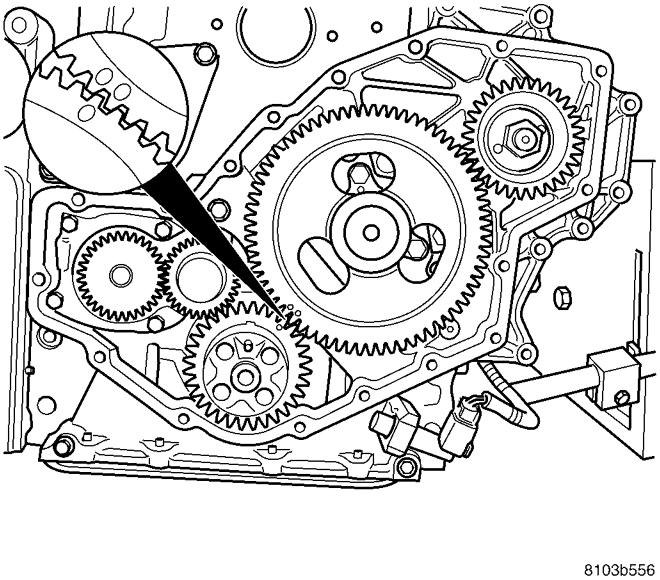


Fig. 56 Timing Mark Alignment

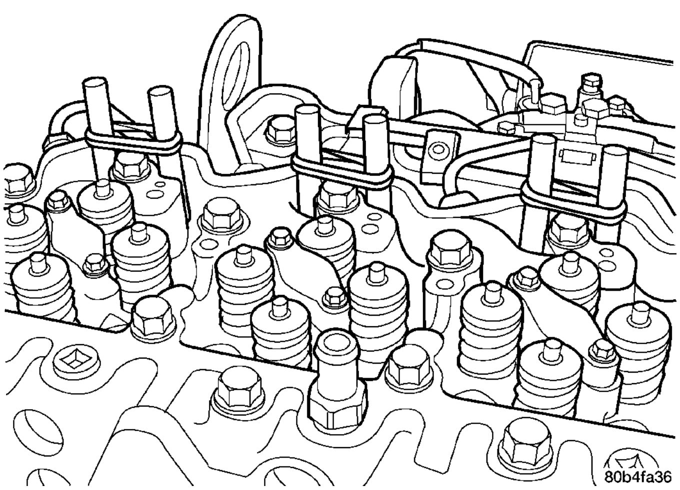


Fig. 57 Use Wooden Dowel Rods to Secure Tappets in Place - Typical

(27) Remove the bolts from the thrust plate.

(28) Remove engine mount through bolts.

(29) Install engine support fixture special tool # 8534, **and steel bracket/wing nut special tool # 8534A**.

(30) Raise engine enough to allow camshaft removal.

(31) Remove the camshaft, gear and thrust plate.

INSPECTION

Camshaft

(1) Inspect the valve lobes and bearing journals for cracks, pitting, scoring, or generally excessive wear. Replace any camshaft that exceeds the allowable limits.

(2) Measure the bearing journals and lobes (Fig. 58).

CAUTION: If Camshaft lobes are worn, requiring camshaft replacement, it is necessary to replace the tappets also. (Refer to 9 - ENGINE/ENGINE BLOCK/ SOLID LIFTERS - REMOVAL).

CAMSHAFT DIMENSIONS

CAMSHAFT DIMENSIONS	
Journal diameter (No.1 and No.7)	
Min.	54.028 mm. (2.127 in.)
Max.	54.048 mm. (2.128 in.)
Journal diameter (No.2 through No.6)	
Min.	53.962 mm. (2.1245 in.)
Max.	54.013 mm. (2.1265 in.)
Diameter of peak of lobe	
Intake	
Min.	47.175 mm (1.857 in.)
Max	47.855 mm.
Exhaust	
Min.	45.632 mm. (1.797 in.)
Max.	46.312 mm. (1.823 in.)

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

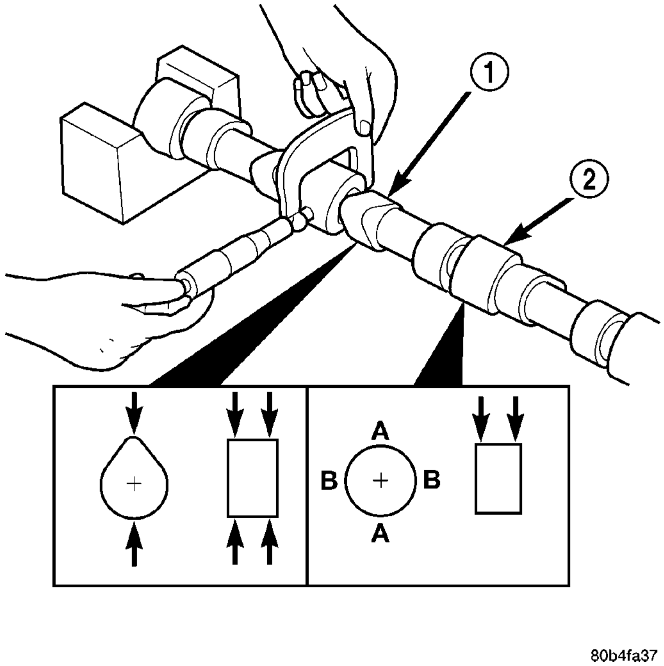


Fig. 58 Measuring

1 - VALVE LOBE
2 - CAMSHAFT JOURNAL

Camshaft Bushing/Bores

Camshaft bores No. 2–6 **do not** use a bushing.

(1) Inspect the camshaft bushing and bores for signs of excessive wear.

(2) Measure the camshaft bushing and bores (Fig. 59) with a telescoping bore gauge and micrometer. If out of specification, (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(3) Inspect the camshaft bushing oil holes for alignment with cylinder block (Fig. 60).

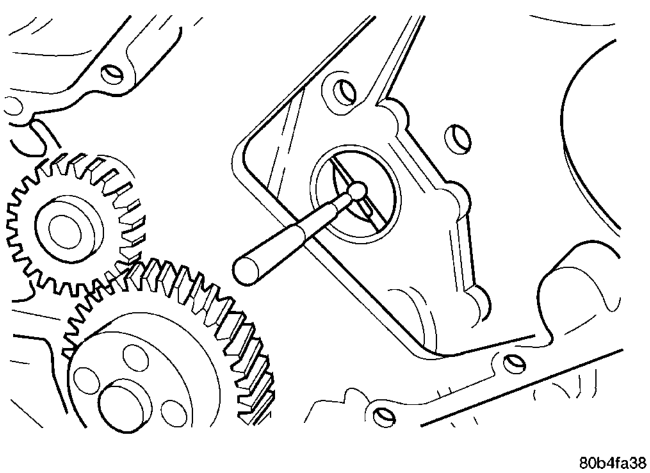


Fig. 59 Measuring Camshaft Bushing and Bores

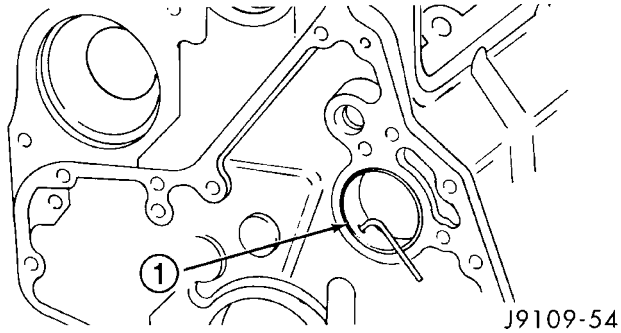


Fig. 60 Inspecting Oil Hole Alignment

1 - CAMSHAFT BUSHING

Camshaft Gear

Inspect the camshaft gear for cracks (gear and hub) (Fig. 61), and chipped/broken/fretted teeth (Fig. 62). If replacement is necessary, camshaft and gear are replaced as an assembly. (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

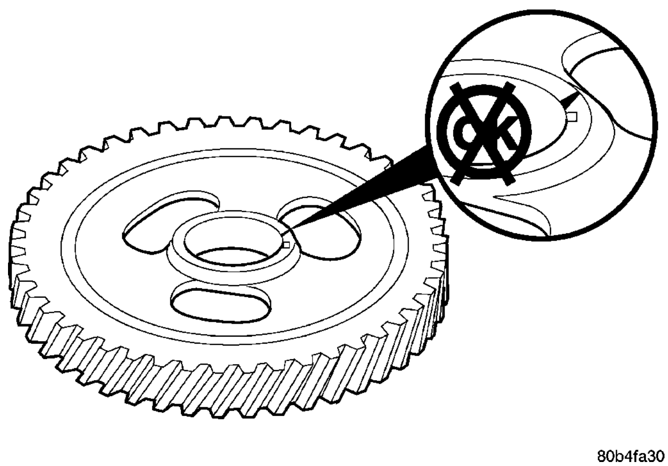


Fig. 61 Inspect Camshaft Gear Hub for Cracks - Typical

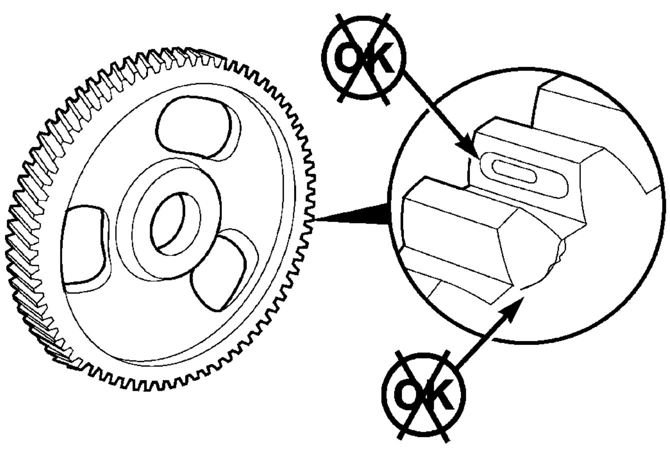


Fig. 62 Inspect Camshaft Gear for Cracks and Fretting - Typical

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

Thrust Plate

Inspect the camshaft thrust plate for excessive wear in the camshaft contact area. Measure thrust plate thickness using the CAMSHAFT THRUST PLATE THICKNESS CHART. Replace any thrust plate that falls outside of these specifications:

CAMSHAFT THRUST PLATE THICKNESS CHART

MIN. 9.34 mm (0.368 in.)
MAX. 9.60 mm (0.378 in.)

INSTALLATION

INSTALLATION - CAMSHAFT BEARINGS

(1) Apply a coating of Loctite® 640 Adhesive to the backside of the new bushing. Avoid getting adhesive in the oil hole.

(2) Use a universal cam bushing installation tool and install the front bushing so that it is even with the front face of the cylinder block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole. (Fig. 63).

(3) Install the rear camshaft bushing is flush with the rear face of the block. The oil hole must be aligned. A 3.2 mm (0.128 inch) diameter rod must be able to pass through the hole.

(4) Measure the installed bushings at the front and rear bores. The minimum inside diameter is 54.083 mm (2.1293 inch), and the maximum inside diameter is is 54.147 mm. (2.1318 in.).

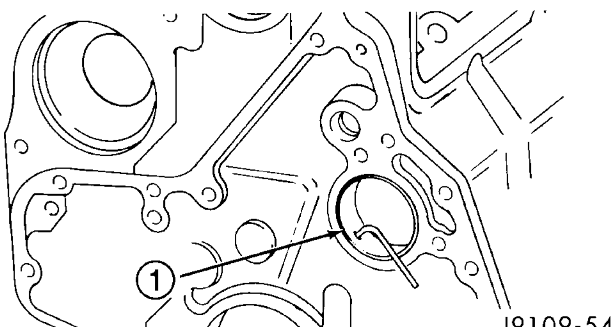


Fig. 63 Oil Hole Alignment

1 - CAMSHAFT BUSHING

INSTALLATION - CAMSHAFT

(1) Lubricate the camshaft bushing and bores with fresh engine oil or suitable equivalent.

(2) Liberally coat the camshaft lobes, journals, and thrust washer with fresh engine oil or suitable equivalent.

CAUTION: When installing the camshaft, DO NOT push it in farther than it will go with the thrust washer in place.

(3) Install the camshaft and thrust plate. Align the timing marks as shown (Fig. 64).

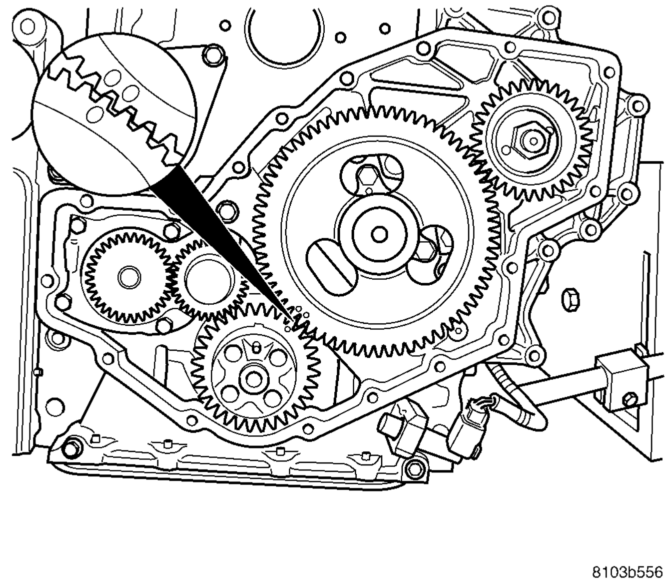


Fig. 64 Timing Mark Alignment

(4) Install the thrust plate bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(5) Measure camshaft back lash and end clearance.

BACKLASH — 0.075—0.250 mm (0.003—0.013 inch)
CLEARANCE — 0.025—0.500 mm (0.001—0.020 inch)

(6) Remove the wooden dowel rods and rubber bands from the tappets.

(7) Lubricate the push rods with engine oil and install in their original location. **Verify that they are seated in the tappets.**

(8) Lubricate the valve tips with engine oil and install the crossheads in their original locations.

(9) Lubricate the crossheads and push rod sockets with engine oil and install the rocker arms and pedestals in their original locations. Tighten bolts to 36 N·m (27 ft. lbs.) torque.

(10) **Verify valve lash adjustment (Refer to 9 - ENGINE/CYLINDER HEAD/INTAKE/EXHAUST VALVES & SEATS - STANDARD PROCEDURE).**

(11) Install the cylinder head cover and reusable gasket (Refer to 9 - ENGINE/CYLINDER HEAD/ CYLINDER HEAD COVER(S) - INSTALLATION).

(12) Install gear housing cover (Refer to 9 - ENGINE/ VALVE TIMING/GEAR HOUSING COVER - INSTALLATION). Install front crankshaft dust seal.

(13) Install the crankshaft damper with the speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(14) Install the fan support/hub assembly and tighten bolts to 33 N·m (24 ft. lbs.) torque.

(15) Install the power steering pump.

(16) Install accessory drive belt tensioner. Torque bolt to 43 Nm (43 ft. lbs.).

(17) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(18) Install the charge air cooler (with a/c condenser and auxiliary transmission oil cooler, if equipped) and tighten the mounting bolts to 2 N·m (17 in. lbs.) torque.

(19) Connect charge air cooler inlet and outlet pipes. Tighten clamps to 11 N·m (95 in. lbs.) torque.

(20) Install the radiator upper support panel.

(21) Close radiator petcock and lower the radiator into the engine compartment. Tighten the mounting bolts to 11 N·m (95 in. lbs.) torque.

(22) Raise vehicle on hoist.

(23) Connect radiator lower hose and install clamp.

(24) Connect transmission auxiliary oil cooler lines (if equipped).

(25) Lower vehicle.

(26) Install the fan shroud and tighten the mounting screws to 6 N·m (50 in. lbs.) torque.

(27) Install the electronically controlled viscous fan/drive assembly. Connect harness connector.(Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(28) Install the coolant recovery and windshield washer fluid reservoirs to the fan shroud.

(29) Connect the coolant recovery hose to the radiator filler neck.

(30) Add engine coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(31) Charge A/C system with refrigerant (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(32) Connect the battery negative cables.

(33) Start engine and check for engine oil and coolant leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING AND CRANKSHAFT JOURNAL CLEARANCE

(1) Measure the connecting rod bore with bearings **removed** and the bolts tightened to 100 N·m (73 ft. lbs.) torque..

(2) Measure the connecting rod bore with the bearings **installed** and the bolts tightened to 100 N·m (73 ft. lbs.) torque.

Measure within 20° arc from each side of the parting line. Also measure 90° from parting line.

Record the smallest and largest diameter.

Measure the diameter of the rod journal at the location shown (Fig. 65). Calculate the average diameter for each side of the journal.

Determine minimum bearing clearance by calculating the differance between the smallest connecting rod bore diameter with the bearing installed and the average diameter for each side of the crankshaft journal.

Determine the maximum bearing clearance by calculating the difference between the largest connecting rod bore diameter and the average diameter with the bearing installed for each side of the crankshaft journal.

DESCRIPTION	MEASUREMENT
CONNECTING ROD BORE, BEARINGS REMOVED	MIN. 72.99 mm (2.874 in.) MAX. 73.01 mm (2.875 in.)
CONNECTING ROD BORE, BEARINGS INSTALLED	MIN. 69.05 mm (2.719 in.) MAX. 69.10 mm (2.720 in.)

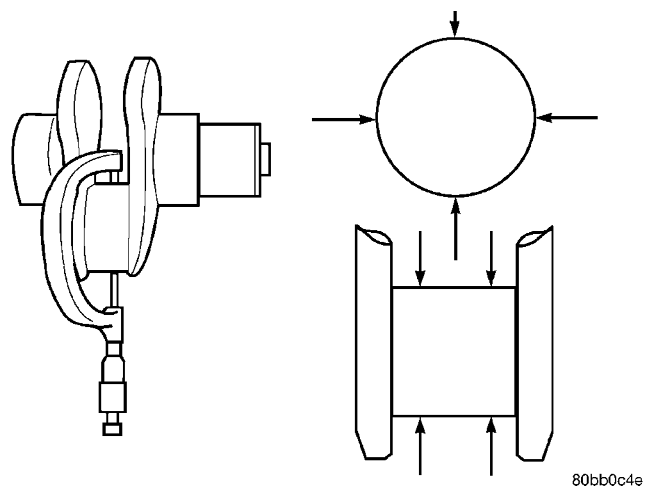


Fig. 65 Connecting Rod Journal Diameter Limits

CONNECTING ROD JOURNAL DIAMETER LIMITS CHART

DESCRIPTION	MEASUREMENT
CRANKSHAFT ROD JOURNAL DIAMETER	Min. 68.96 mm (2.715 in.) Max. 69.01 mm (2.717 in.)
BEARING CLEARANCE	Min. 0.04 mm (.002 in.) Max. 0.12 mm (0.005 in.)

If the crankshaft is within limits, replace the bearing. If the crankshaft is out of limits, grind the crankshaft to the next smaller size and use oversize rod bearings.

CRANKSHAFT AND GEAR

DESCRIPTION

The crankshaft (Fig. 66) is a forged steel, integrally balanced unit. It is supported by seven main bearings, with position number six designated as the thrust journal. The crankshaft is held in place by main caps and 12 mm capscrews. The crankshaft also has internal cross drillings to supply the connecting rods with engine oil.

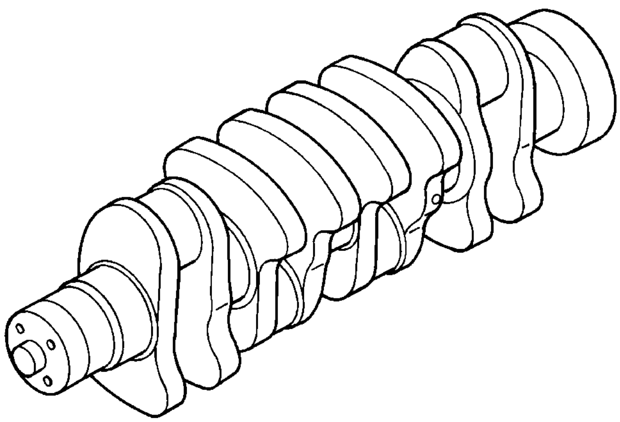


Fig. 66 Crankshaft

REMOVAL—GEAR

(1) Remove the gear housing cover. (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - REMOVAL)

(2) Remove the crank gear using a heavy duty puller.

(3) Split the gear and remove it from the crankshaft.

INSTALLATION - GEAR

(1) Remove all burrs and make sure the gear surface on the end of the crankshaft is smooth.

(2) If removed, install a new alignment pin. Drive the pin in using a ball- peen hammer, leaving it protruding 1.0 mm (0.039 inch) to 1.5 mm (0.059 inch) above the crankshaft (Fig. 67).

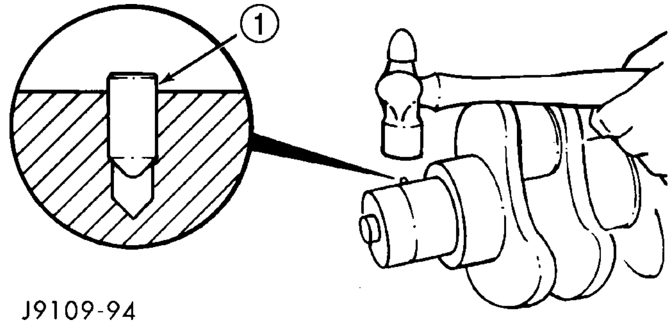


Fig. 67 Installing Alignment Pin

1 - ALIGNMENT PIN

WARNING: WEAR PROTECTIVE GLOVES TO PREVENT INJURY.

CAUTION: DO NOT heat the gear longer than 45 minutes.

(3) Heat the crankshaft gear for 45 minutes at a temperature of 149°C (300°F). **Do not use torch, gear failure will occur.**

(4) Apply a thin coat of lubricant to the nose of the crankshaft.

(5) Position the gear with the timing mark out and install it on the crankshaft using the alignment pin. Make sure the gear contacts the shoulder.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - MAIN BEARING CLEARANCE

Inspect the main bearing bores for damage or abnormal wear.

(1) Remove bearings and measure main bearing bore diameter after torquing main bearing cap bolts to 176 Nm (130 ft. lbs.).

(2) Install the crankshaft main bearings and measure main bearing bore diameter with the main bolts tightened to 176 N·m (130 ft. lbs.) torque (Fig. 68).

CRANKSHAFT MAIN BEARINGS (Continued)

(3) Measure the diameter of the main journal at the locations shown (Fig. 69). Calculate the average diameter for each side of the journal.

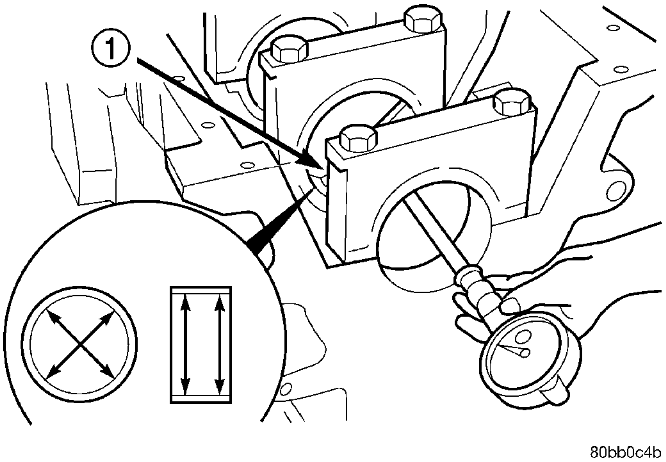


Fig. 68 Crankshaft Main Bearing Bore Diameter

1 - MAIN BEARING CAPS

MAIN BEARING BORE DIAMETER CHART

ITEM	MAIN BEARING BORE DIAMETER (MAXIMUM)
BEARINGS INSTALLED	83.106 mm (3.2719 in.)
BEARINGS REMOVED	Min 87.983 mm (3.4639 in.) Max. 88.019 mm (3.4653 in.)

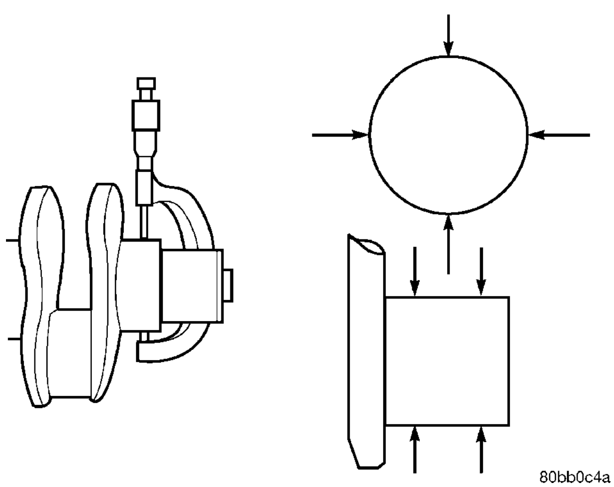


Fig. 69 Crankshaft Main Journal Diameter

CRANKSHAFT MAIN JOURNAL DIAMETER CHART

ITEM	SPECIFICATION
Minimum diameter	82.962 mm (3.2662 in.)
Maximum diameter	83.013 mm (3.2682 in.)
Maximum out of roundness	0.050 mm (.002 in.)
Maximum taper	0.013 mm (.0005 in.)
Thrust distance (at No.6 position)	Min. 0.065 mm (.003 in.) Max. 0.432 mm (.017 in.)

(4) Calculate the main bearing journal to bearing clearance. Maximum clearance is 0.119 mm (0.00475 inch). If the crankshaft journal is within limits, replace the main bearings. If not within specifications, grind the crankshaft to next size and use oversize bearings.

(5) Measure thrust distance at the No.6 position.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect both battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove the fan shroud-to-radiator mounting bolts.

(9) Remove viscous fan/drive assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(10) Remove cooling fan shroud and fan assembly from the vehicle.

(11) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(12) Remove the cooling fan support/hub from the front of the engine.

(13) Raise the vehicle on hoist.

(14) Remove the crankshaft damper and speed indicator ring.

(15) Remove hydraulic pump.

(16) Remove accessory drive belt tensioner.

CRANKSHAFT OIL SEAL - FRONT (Continued)

(17) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces. Remove crank seal dust shield with cover.

(18) Support the cover on a flat work surface with wooden blocks (Fig. 70), and using a suitable punch and hammer, drive the old seal out of the cover from the back side of the cover to the front side (Fig. 70).

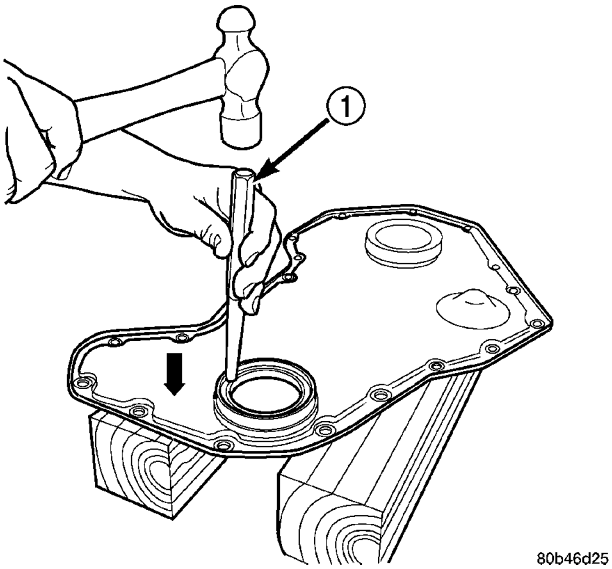


Fig. 70 Removing Seal from Cover

1 - PUNCH

INSTALLATION

(1) Clean cover and housing gasket mating surfaces. Use a suitable scraper and be careful not to damage the gear housing surface. Remove any old sealer from the oil seal bore. Thoroughly clean the front seal area of the crankshaft. The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks.

(2) Inspect the gear housing and cover for cracks and replace if necessary. Carefully straighten any bends or imperfections in the gear cover with a ball-peen hammer on a flat surface. Inspect the crankshaft front journal for any grooves or nicks that would affect the integrity of the new seal.

(3) Apply a bead of Mopar® Stud & Bearing Mount to the outside diameter of the seal. Do not lubricate the inside diameter of the new seal.

(4) With the cover supported by wood blocks, install the seal into the rear of the cover using crankshaft seal installer Special Tool 8281 and driver handle C-4171 (Fig. 71). Strike the driver handle until the installation tool bottoms out on the inside of the cover.

CAUTION: Do not distort or damage seal.

(5) Install the plastic seal pilot (provided with seal kit) into the crankshaft seal.

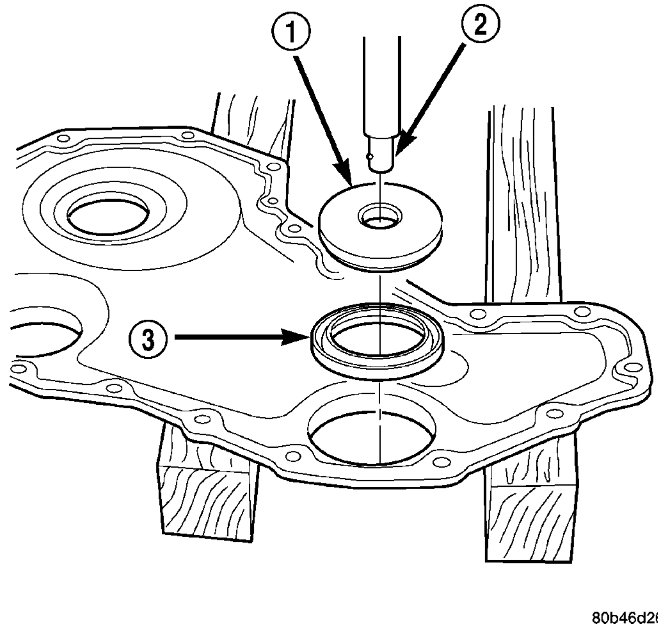


Fig. 71 Installing Seal Into Cover With Tool 8281

1 - SEAL INSTALLER 8281
2 - DRIVER HANDLE C4171
3 - SEAL

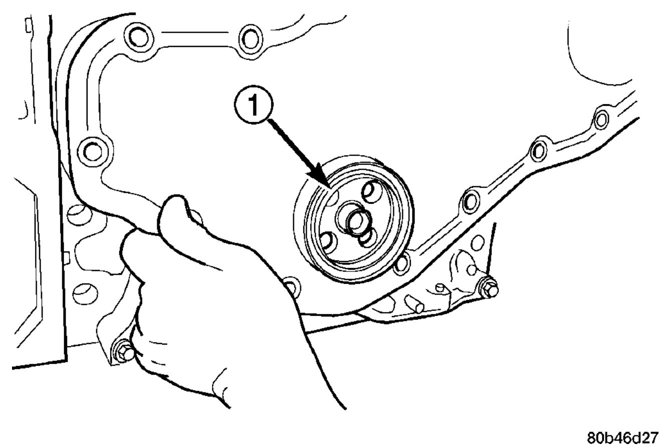


Fig. 72 Installing Front Cover with Seal Pilot

1 - SEAL PILOT

(6) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover sealing surface.

(7) Install the cover to the gear housing, aligning the seal pilot with the nose of the crankshaft (Fig. 72).

(8) Install the cover bolts and tighten to 24 N·m (18 ft. lbs.) torque. Remove pilot tool.

(9) Install dust shield over nose of crankshaft.

(10) Install the crankshaft damper and speed indicator ring. Torque the bolts to 40 N·m (30 ft. lbs.). Then rotate an additional 60°. Use the engine bar-

ring tool to keep the engine from rotating during tightening operation.

(11) Install the fan support/hub assembly and torque bolts to 32 N·m (24 ft. lbs.).

(12) Install hydraulic pump.

(13) Install accessory drive belt tensioner. Torque bolt to 43 Nm (32 ft.lbs.).

(14) Install cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(15) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(16) Refill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(17) Connect battery negative cables.

(18) Start engine and check for oil leaks.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the transmission and transfer case (if equipped).

(3) Remove the clutch cover and disc (if manual transmission equipped) (Refer to 6 - CLUTCH/CLUTCH DISC - REMOVAL).

(4) Remove the flywheel or converter drive plate.

(5) Drill holes 180° apart into the seal. Be careful not to contact the drill against the crankshaft.

(6) Install #10 sheet metal screws in the drilled holes and remove the rear seal with a slide hammer (Fig. 73).

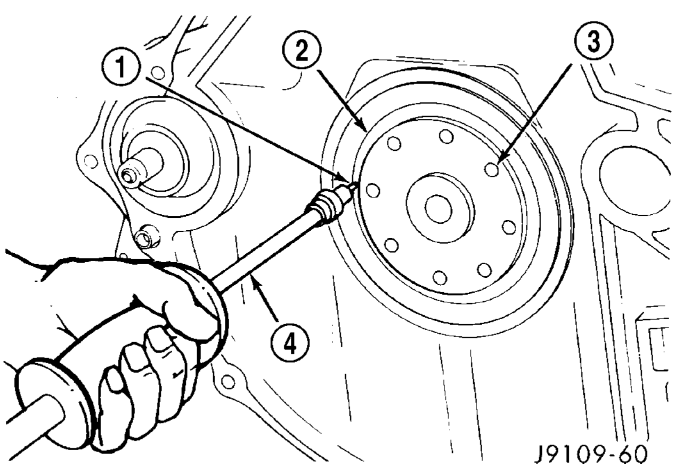


Fig. 73 Crankshaft Rear Seal Removal

1 - NO. 10 SCREW
2 - REAR SEAL
3 - CRANKSHAFT
4 - SLIDE HAMMER

INSTALLATION

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks. The crankshaft and seal surfaces must be completely dry when the seal is installed. Use a soap and water solution on outside diameter of seal to ease assembly.

(1) Clean the crankshaft journal with a suitable solvent and dry with a clean shop towel or compressed air. Wipe the inside bore of the crankshaft seal retainer with a clean shop towel.

(2) Inspect the crankshaft journal for gouges, nicks, or other imperfections. If the seal groove in the crankshaft is excessively deep, install the new seal 1/8” deeper into the retainer bore, or obtain a crankshaft wear sleeve that is available in the aftermarket.

(3) Install the seal pilot and new seal, provided in the replacement kit, onto the crankshaft.

(4) Remove the seal pilot.

(5) Install the installation tool over crankshaft.

(6) Using a ball peen hammer, strike the tool at the 12, 3, 6, and 9 o'clock positions until the alignment tool bottoms out on the retainer (Fig. 74).

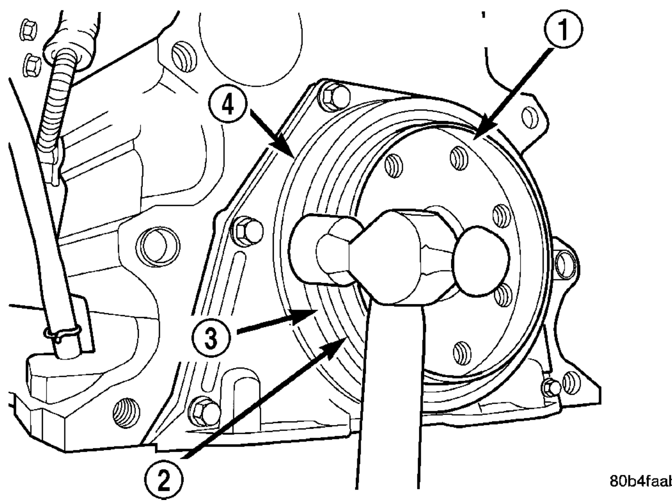


Fig. 74 Seal Installation Using Alignment Tool and Hammer

1 - SEAL PILOT TOOL
2 - INSTALLATION TOOL
3 - SEAL
4 - RETAINER

(7) Install the flywheel or converter drive plate. Tighten the bolts to 137 N·m (101 ft. lbs.) torque.

(8) Install the clutch cover and disc (if equipped) (Refer to 6 - CLUTCH/CLUTCH DISC - INSTALLATION).

(9) Install the transmission and transfer case (if equipped).

(10) Lower vehicle.

CRANKSHAFT OIL SEAL - REAR (Continued)

(11) Connect battery negative cables.

(12) Check engine oil level and adjust, if necessary.

(13) Start engine and check for oil leaks.

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Remove the oil pan drain plug and drain the engine oil. Re-install plug and torque to 50 N·m (44 ft. lbs.) torque.

(4) Remove transmission and transfer case (if equipped) from vehicle.

(5) Remove flywheel or torque converter drive plate.

(6) Disconnect starter cables from starter motor.

(7) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL) and transmission adapter plate assembly.

(8) Remove four (4) oil pan rear bolts. Slide a feeler guage between the seal retainer and oil pan gasket to break the seal.

(9) Remove the six (6) retainer-to-block bolts (Fig. 75).

(10) Remove the rear seal retainer and gasket (Fig. 75).

(11) Support the seal retainer and drive out the crankshaft seal with a hammer and suitable punch.

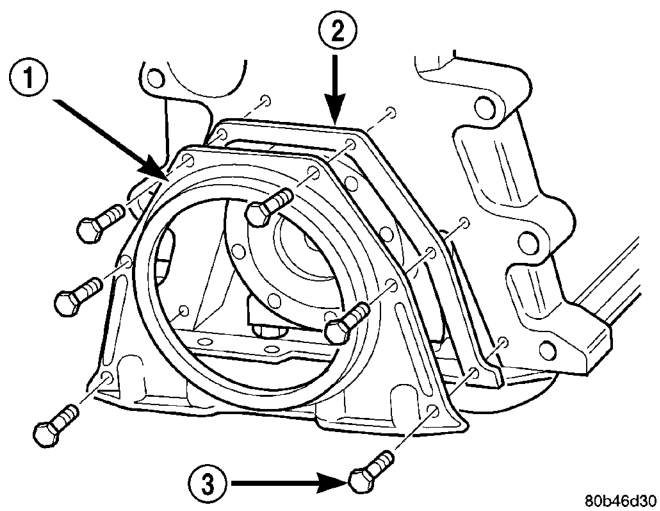


Fig. 75 Crankshaft Rear Seal Retainer and Gasket

1 - RETAINER
2 - GASKET
3 - BOLT

INSTALLATION

(1) If using the old seal retainer, the crankshaft seal must be replaced.

(2) Inspect oil pan gasket for nickes or cuts. If gasket is damaged, the oil pan must be removed and gasket must be replaced. Wipe oil pan gasket dry and apply light coating of RTV.

(3) Using the retainer alignment/seal installation tool provided in the seal service kit, install the alignment tool into the retainer and install to the cylinder block (Fig. 76), using a new gasket. Tighten the six (6) mounting bolts by hand.

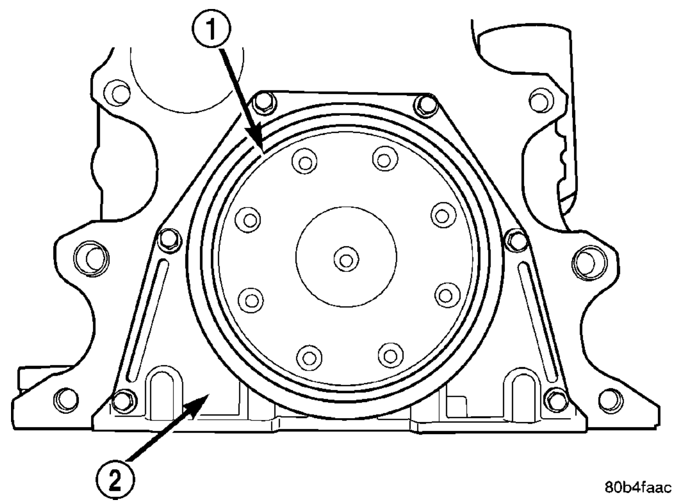


Fig. 76 Aligning Seal Retainer with Alignment/ Installation Tool

1 - ALIGNMENT / INSTALLATION TOOL
2 - SEAL RETAINER

(4) The seal alignment tool is used to align rear cover properly. Starting with the center two bolts, tighten the retainer in a circular pattern to 10 N·m (89 in. lbs.). Remove the alignment tool.

CAUTION: The seal lip and the sealing surface on the crankshaft must be free from all oil residue to prevent seal leaks. The crankshaft and seal surfaces must be completely dry when the seal is installed. Use a soap and water solution on outside diameter of seal to ease assembly.

(5) Make sure the provided seal pilot is installed into the new crankshaft seal. Use the alignment/installation tool and press the seal onto the crankshaft (Fig. 77). Alternately drive the seal at the 12, 3, 6 and 9 o'clock positions.

(6) Remove the alignment tool and trim the retainer gasket even with the oil pan mounting surface (Fig. 78).

(7) Remove the seal pilot.

(8) Apply a small amount of Mopar® Silicone Rubber Adhesive Sealant to the oil pan rail T-joints.

(9) Install the four (4) oil pan rear mounting bolts and torque to 28 N·m (21 ft. lbs.).

(10) Install new rectangular ring seal for cam bore.

CRANKSHAFT REAR OIL SEAL RETAINER (Continued)

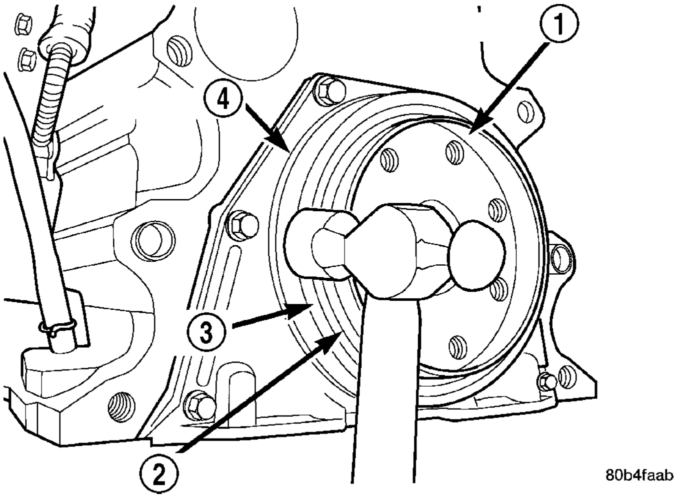


Fig. 77 Installing Seal Using Alignment Tool and Hammer

1 - SEAL PILOT TOOL
2 - INSTALLATION TOOL
3 - SEAL
4 - RETAINER

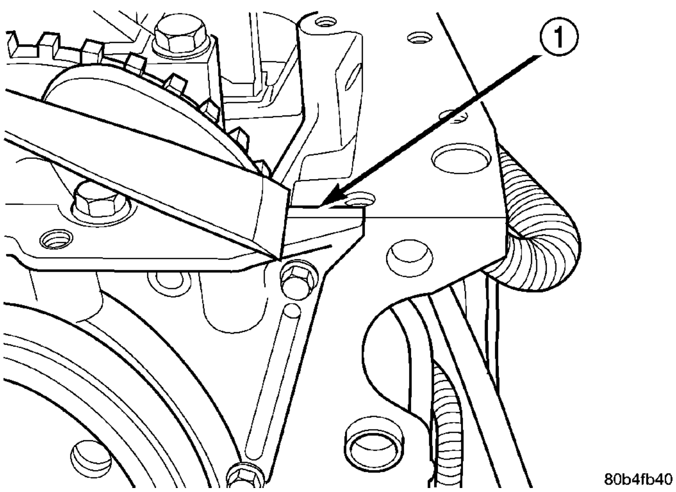


Fig. 78 Trimming Excess Gasket Material

1 - GASKET

(11) Install the flywheel housing and bolts. Torque bolts to 77 N·m (57 ft. lbs.).

(12) Install the flywheel or converter drive plate. Tighten bolts to 137 N·m (101 ft. lbs.).

(13) Install the starter motor and torque to 43 N·m (21 ft. lbs.)(Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(14) Install the transmission and transfer case (if equipped).

(15) Lower vehicle.

(16) Fill the crankcase with new engine oil.

(17) Connect the battery negative cables.

(18) Start engine and check for oil leaks.

SOLID LIFTERS/TAPPETS

REMOVAL

NOTE: This procedure requires use of Miller Tool 8502 Tappet Replacement Kit.

(1) Remove camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(2) Insert the trough (provided with tool kit) the full length of the camshaft bore (Fig. 79). Make sure the cap end goes in first and the open side faces up (towards tappets).

(3) **Remove only one tappet at a time.** Remove rubber band from one cylinder pair and attach tappet dowel not being removed to the next cylinder pair (Fig. 80).

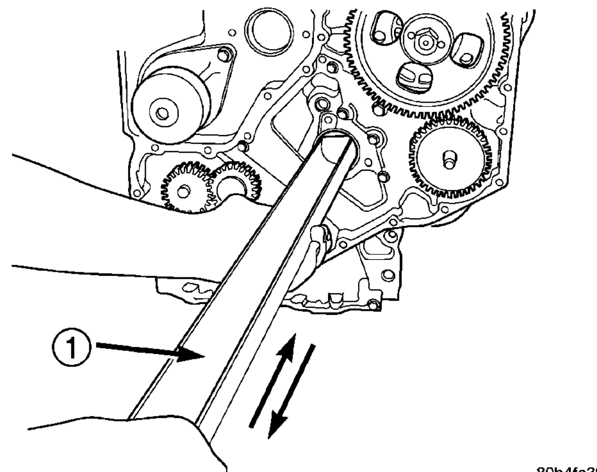


Fig. 79 Inserting the Trough - Typical

1 - TROUGH

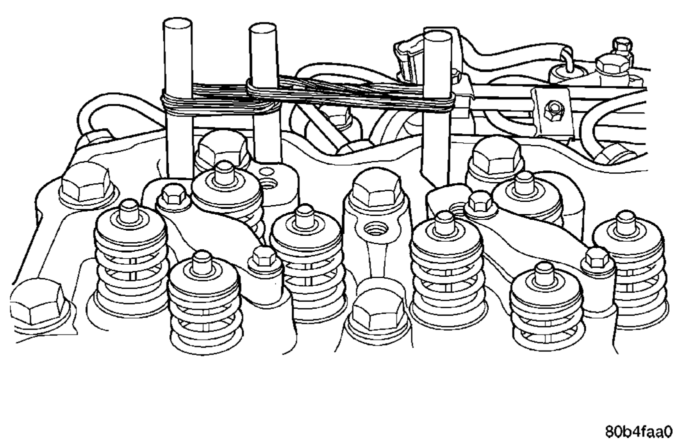


Fig. 80 Secure Dowel/Tappet to Adjacent Cylinder - typical

SOLID LIFTERS/TAPPETS (Continued)

(4) Raise dowel rod (disengage from tappet) and allow tappet to fall into trough (Fig. 81).

(5) Carefully remove trough **(do not rotate)** and tappet. If the tappet is not being replaced, mark it so it can be installed in its original location.

(6) Re-install trough and repeat procedure on remaining tappets.

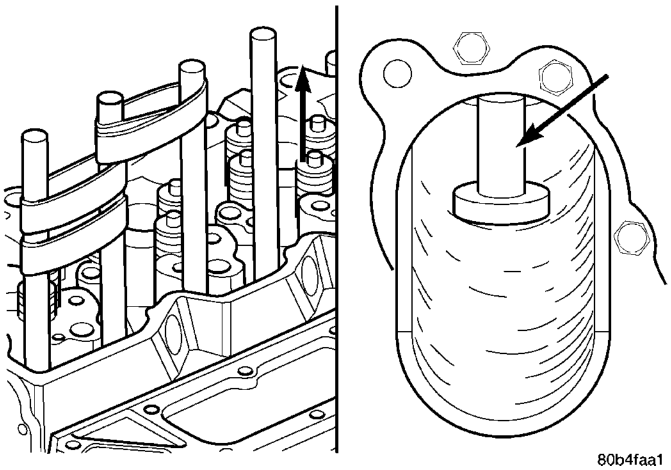


Fig. 81 Lift Dowel Rod to Disengage from Tappet - typical

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSPECTION

(1) Visually inspect the tappet the tappet socket, stem, and face for excessive wear, cracks, or obvious damage (Fig. 82).

(2) Measure the tappet stem diameter. Replace the tappet if it falls below the minimum size (Fig. 82).

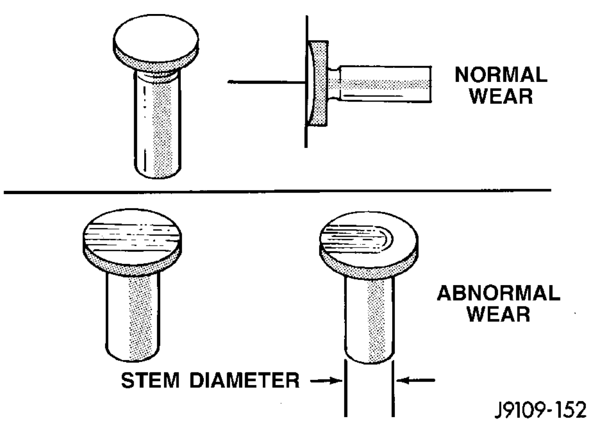


Fig. 82 Tappet Inspection

TAPPET STEM DIAMETER
15.936 mm (0.627 in.) MIN.

15.977 mm (0.629 in.) MAX.

INSTALLATION

(1) Insert the trough the full length of the camshaft bore. Again, make sure the cap end goes in first and the open side faces up (towards tappets).

(2) Lower the tappet installation tool through the push rod hole (Fig. 83) and into the trough.

(3) Retrieve the tappet installation tool using the hooked rod provided with the tool kit (Fig. 84).

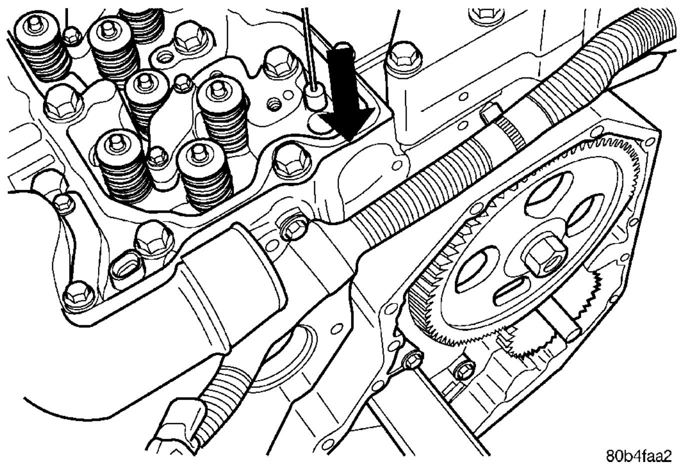


Fig. 83 Insert Installation Tool through Push Rod Hole - Typical

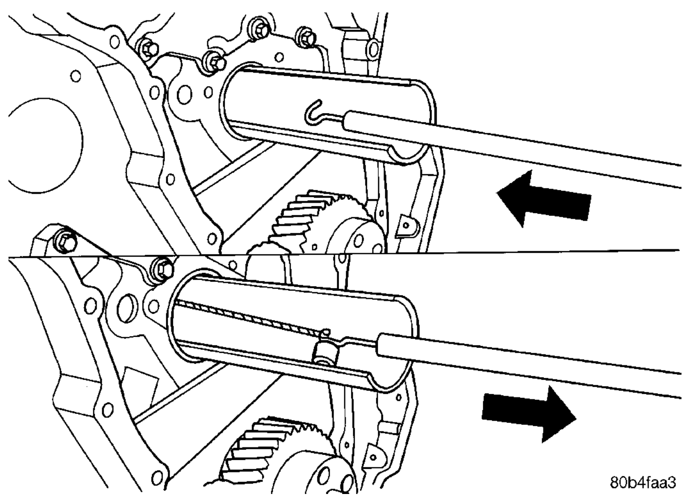


Fig. 84 Retrieve Tappet Installation Tool through Cam Bore - Typical

SOLID LIFTERS/TAPPETS (Continued)

(4) Lubricate the tappet with clean engine oil or suitable equivalent and install the tappet to the installation tool (Fig. 85).

(5) Pull the tappet up and into position (Fig. 85). If difficulty is experienced getting the tappet to make the turn into the tappet bore, wiggle the trough while **gently** pulling up on the tappet.

(6) With the tappet in place, rotate the trough one half turn so the open side is down (toward crankshaft) (Fig. 86).

(7) Remove the tappet installation tool from the tappet.

(8) Re-install a dowel rod and secure the rod with a rubber band.

(9) Rotate the trough one half turn and repeat the procedure for the remaining tappets.

(10) Install the camshaft (Refer to 9 - ENGINE/ ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - INSTALLATION).

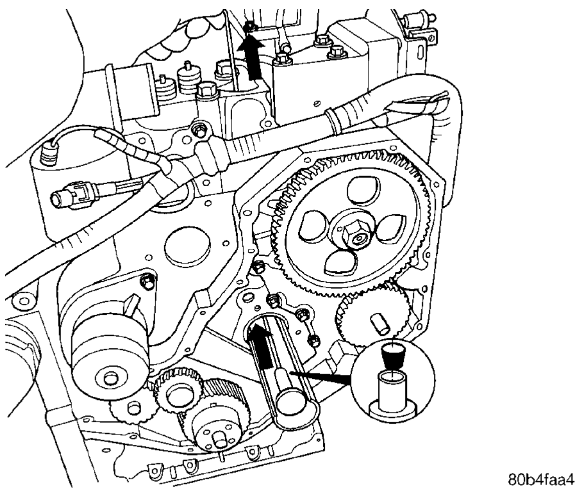


Fig. 85 Insert Tool and Pull Tappet Into Place - Typical

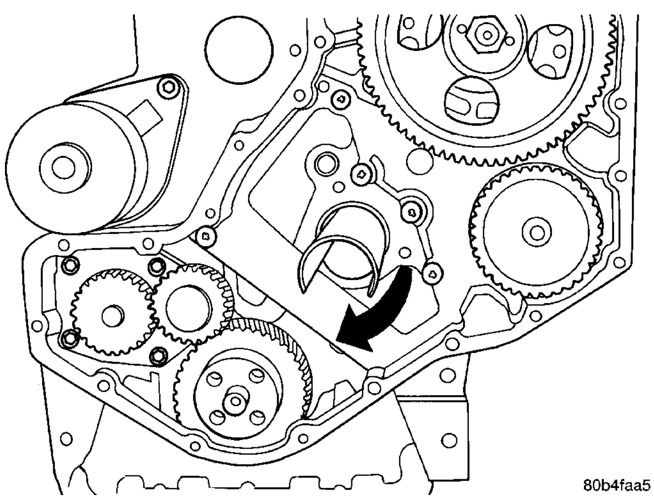


Fig. 86 Rotate Trough One Half Turn (180°) - Typical

PISTON & CONNECTING ROD

DESCRIPTION

PISTONS

The piston (Fig. 87) is constructed of aluminum and is gravity cast, free floating design. The piston incorporates a centrally located high swirl combustion bowl, and utilizes a "keystone" style top compression ring (Fig. 88), and a "Tapered Face" intermediate ring (Fig. 88), for superior cylinder wall scraping. Piston cooling nozzles cool the piston and pin with engine oil supplied by the crankshaft main journals. High horsepower pistons are gallery cooled and utilize J-jet piston cooling nozzles.

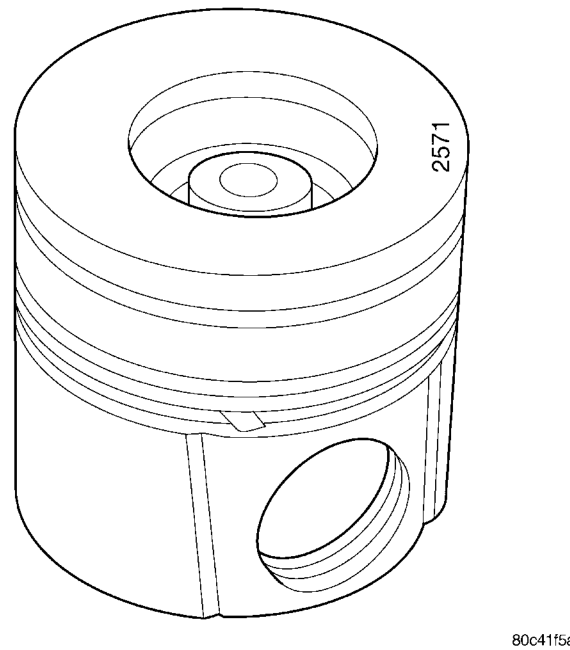


Fig. 87 Piston - Typical

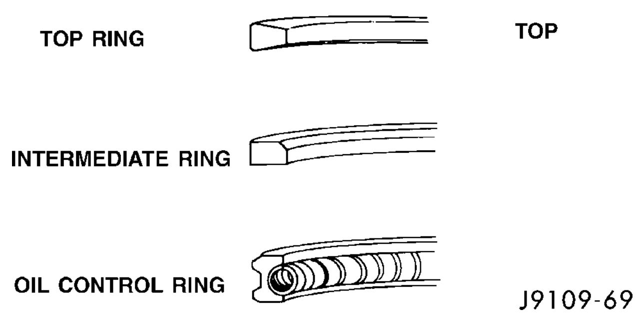


Fig. 88 Piston Ring Identification

PISTON & CONNECTING ROD (Continued)

CONNECTING RODS

The connecting rods are a split angle design (Fig. 89). They have a pressed-in-place wrist pin bushing that is lubricated by piston cooling nozzle oil spray.

There are two different types of connecting rods: machined and fractured split. The main different between the two styles is the surface finish on the connecting rod split face.

Machined connecting rods can be identified by a machined surface at the connecting rod and cap split face. Machined connecting rods have numbers stamped on the rod cap and connecting rod near the parting line. The number stamped on the connecting rod must match the number stamped on the rod cap and be installed on the camshaft or intake side of the engine.

Fractured split connecting rods are first manufactured as a single piece and then fractured into two pieces. Fractured split connecting rods can be identified by a rough and irregular surface at the connecting rod split face. To properly assemble the rod cap to the connecting rod, the bearing tangs on the connecting rod and cap must be located on the same side of the rod. The long end of the connecting rod must be assembled on the intake or camshaft side of the engine.

Measuring methods and specifications are common between fractured split and machined connecting rods.

Both fractures split and machined connecting rods and caps are machined as an assembly and are not interchangeable. If a connecting rod or cap is damaged, the entire assembly must be replaced. Machined and fractured split connecting rods cannot be used in the same engine.

STANDARD PROCEDURE - HEAD GASKET SELECTION

(1) Measure piston protrusion for all six pistons.

(2) Calculate the average piston protrusion. Maximum allowable protrusion is 0.516 mm (0.020 inch).

NOTE: There are two different head gaskets available. One gasket is for Average piston protrusion less than 0.30 mm (0.011 inch). The other gasket is for Average piston protrusion greater than 0.30 mm (0.011 inch)

REMOVAL

(1) Disconnect the battery cables.

(2) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan and suction tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove bolts and the block stiffener.

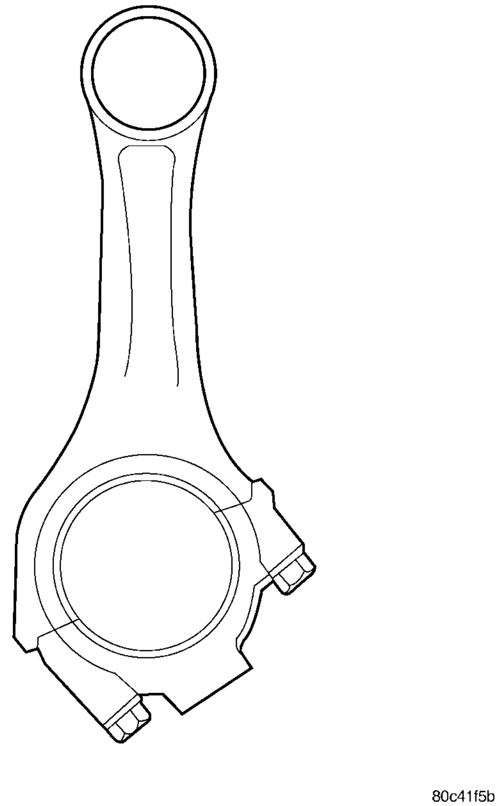


Fig. 89 Connecting Rod

(5) Using Miller Tool 7471-B crankshaft barring tool, rotate the crankshaft so all of the pistons are below TDC.

(6) Before removing the piston(s) from the bore(s):

(a) Remove any carbon ridge formations or deposits at the top of the bore with a dull scraper or soft wire brush.

(b) If cylinder bore wear ridges are found, use a ridge reamer to cut the ridge from the bore. DO NOT remove more metal than necessary to remove the ridge.

(7) Remove the J-jet cooling nozzels, if equipped.

NOTE: If cylinders have ridges, the cylinders are oversize and will more than likely need boring.

(8) Using a hammer and steel stamp, stamp the cylinder number in the top of each piston. The front of the piston is identified by a stamping on the top of the piston. DO NOT stamp in the outside 5 mm (.197 in.) of the piston diameter. DO NOT stamp over the piston pin.

(9) Mark the connecting rod and cap with the corresponding cylinder numbers.

(10) Remove the connecting rod bolts and rod caps. Use care so the cylinder bores and connecting rods are not damaged.

PISTON & CONNECTING ROD (Continued)

(11) Use a hammer handle or similar object to push the piston and connecting rod through the cylinder bore.

(12) Store the piston/rod assemblies in a rack.

CLEANING—PISTON AND CONNECTING ROD

CAUTION: DO NOT use bead blast to clean the pistons. DO NOT clean the pistons and rods in an acid tank.

PISTON

Clean the pistons and pins in a suitable solvent, rinse in hot water and blow dry with compressed air. Soaking the pistons over night will loosen most of the carbon build up. De-carbon the ring grooves with a broken piston ring and again clean the pistons in solvent. Rinse in hot water and blow dry with compressed air.

CONNECTING ROD

Clean the connecting rods in a suitable solvent, rinse in hot water and blow dry with compressed air.

INSPECTION

INSPECTION—PISTONS

Inspect the pistons for damage and excessive wear. Check top of the piston, ring grooves, skirt and pin bore. Measure the piston skirt diameter (Fig. 90). If the piston is out of limits, replace the piston.

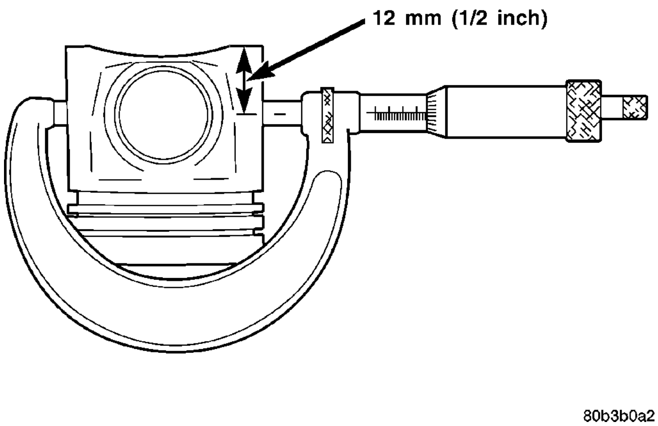


Fig. 90 Piston Skirt Diameter

PISTON SKIRT DIAMETER (MIN.)
101.887 mm (4.011 in.)

The upper groove only needs to be inspected for damage. Use a new piston ring to measure the clearance in the intermediate ring groove (Fig. 91). Minimum clearance is 0.045 mm (0.0018 inch), maximum clearance is 0.095 mm (.0037 inch). If the clearance of the intermediate ring exceeds specifications, replace the piston.

Use a new oil ring to measure the clearance in the oil groove (Fig. 91). Minimum clearance is 0.040 mm (0.0016 inch), maximum clearance is 0.085 mm (.0033 inch). If the clearance exceeds specifications, replace the piston.

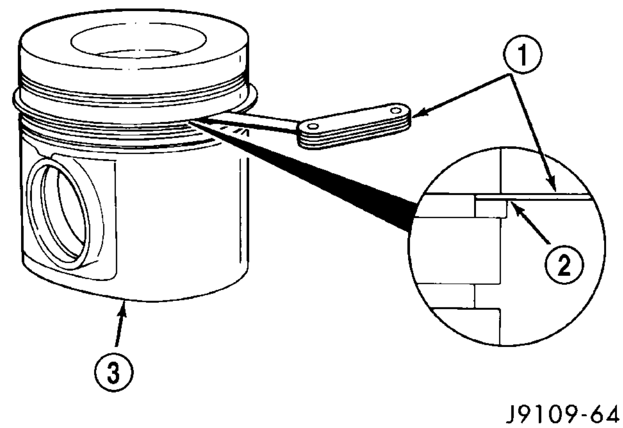


Fig. 91 Intermediate and Oil Ring Clearances

1 - FEELER GAUGE
2 - RING
3 - PISTON

Measure the pin bore (Fig. 92). The maximum diameter is 40.012 mm (1.5753 inch), Minimum is 40.006 mm (1.575 inch). If the bore is over limits, replace the piston.

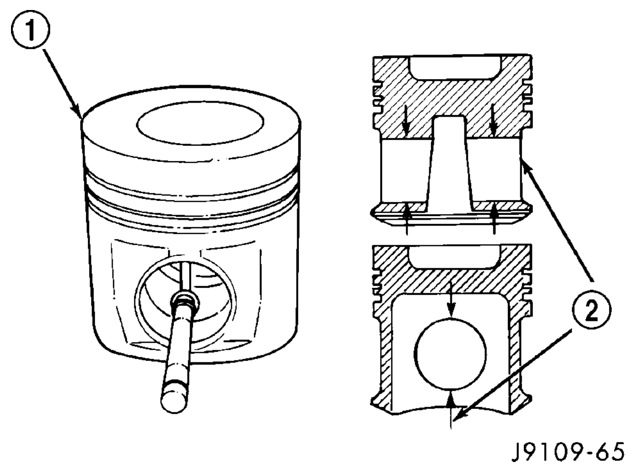


Fig. 92 Piston Pin Bore

1 - PISTON
2 - PIN BORE

PISTON & CONNECTING ROD (Continued)

Inspect the piston pin for nicks, gouges and excessive wear. Measure the pin diameter (Fig. 93). The minimum diameter is 39.990 mm (1.5744 inch), maximum 40.003 mm (1.5749 inch). If the diameter is out of limits, replace the pin.

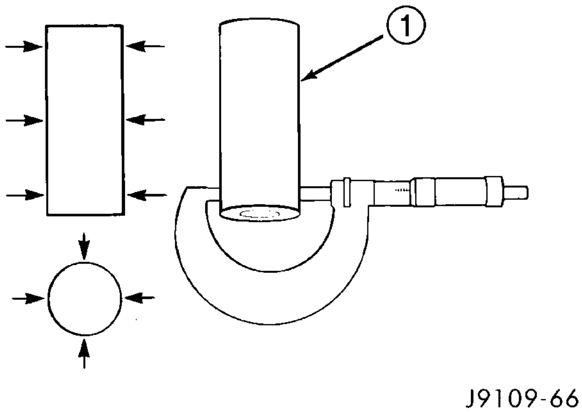


Fig. 93 Piston Pin Diameter

1 - PISTON PIN

INSPECTION—CONNECTING ROD

Inspect the connecting rod for damage and wear. The I-Beam section of the connecting rod cannot have dents or other damage. Damage to this part can cause stress risers which will progress to breakage.

Measure the connecting rod pin bore (Fig. 94). The maximum diameter is 40.042 mm (1.5765 inch), minimum diameter is 40.019 mm (1.5756 inch). If out of limits, replace the connecting rod.

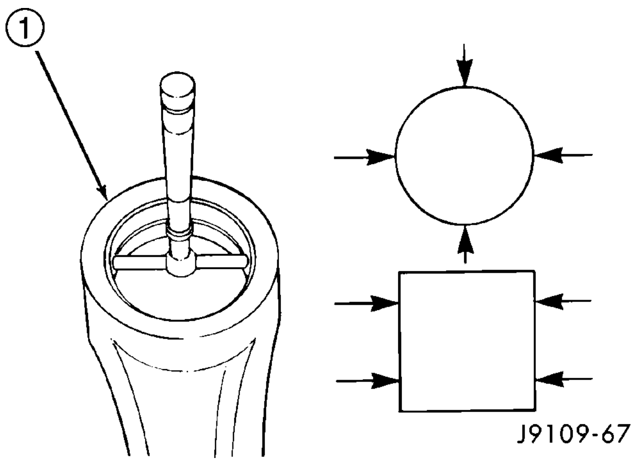


Fig. 94 Connecting Rod Pin Bore

1 - CONNECTING ROD

INSTALLATION

(1) Lubricate the cylinder bores with clean engine oil.

(2) Generously lubricate the rings and piston skirts with clean engine oil.

(3) Compress the rings using a piston ring compressor tool (Fig. 95). If using a strap-type ring compressor, make sure the inside end of the strap does not hook on a ring gap and break the ring.

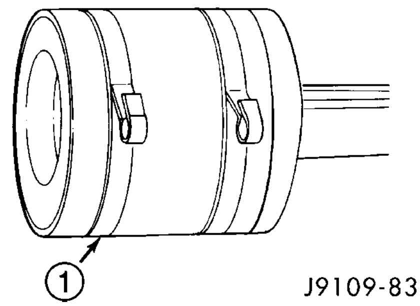


Fig. 95 Piston Ring Compressor Tool

1 - PISTON RING COMPRESSOR TOOL

(4) Bar the crankshaft so the rod journal for the piston to be installed is at BDC (Bottom Dead Center) - (Fig. 96).

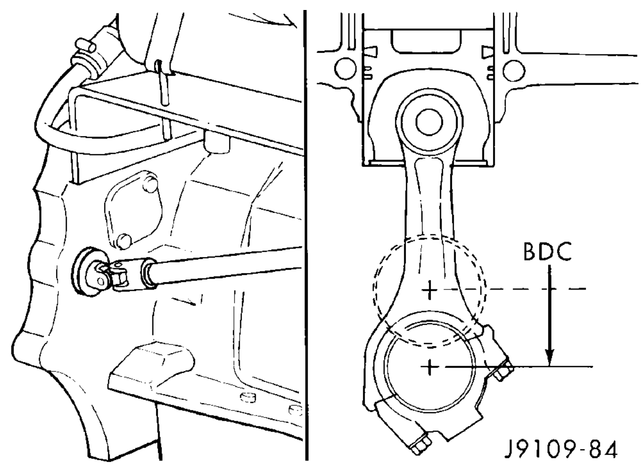


Fig. 96 Piston/Rod Assembly at BDC

(5) Make sure the front of the piston is oriented properly according to the marking on the top of the piston and the numbers on the rod and cap are oriented as illustrated.

(6) Position the piston and rod assembly into the cylinder bore with the front of the piston oriented properly according to the stamping in the top of the piston. In this position the numbers on the connecting rod should be facing the intake or camshaft side of the engine, and the rod bolt hex heads toward the oil cooler. Use care when you install the piston and connecting rod so the cylinder bore is not damaged. If a fractured split connecting rod is being installed, the long side of the connecting rod must be installed on the intake side of the engine.

(7) Push the piston into the bore until the top of the piston is approximately 50 mm (2 inch) below the top of the block. Carefully pull the connecting rod onto the crankshaft journal.

PISTON & CONNECTING ROD (Continued)

(8) Use clean engine oil to lubricate the threads and under the heads of the connecting rod bolts.

(9) **For machined connecting rods,** the number stamped on the rod cap at the parting line must match and be installed towards the intake or camshaft side of the engine (Fig. 97). **For fractured/ split type connecting rods,** the long end of the rod must be installed towards the intake side of the engine.

(a) The connecting rod split/face must face toward the same side as the piston notch feature on the skirt. The split face will face toward the oil cooler side of the engine if properly installed.

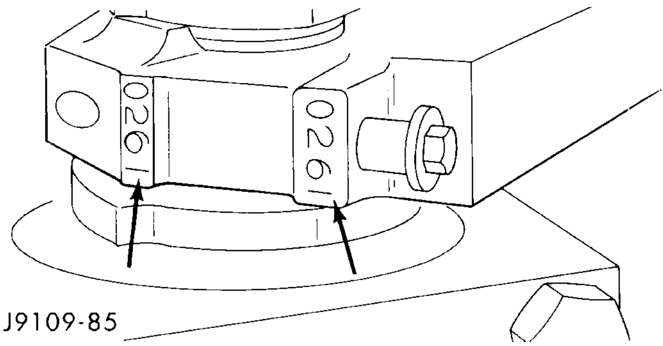


Fig. 97 Correct Rod Cap Installation

(10) Install the rod cap and bolts to the connecting rod. Tighten the connecting rod bolts evenly in 3 steps.

- Tighten the bolts to 30 N·m (22 ft. lbs.) torque.
- Tighten the bolts to 60 N·m (44 ft. lbs.) torque.
- Rotate 60° clockwise.

(11) The crankshaft must rotate freely. Check for freedom of rotation as the caps are installed. If the crankshaft does not rotate freely, check the installation of the rod bearing and the bearing size.

(12) Measure the side clearance between the connecting rod and the crankshaft (Fig. 98). DO NOT measure the clearance between the cap and crankshaft.

(13) Install J-jet piston cooling nozzles if equipped.

(14) Install block stiffener. Torque to 43 N·m (32 ft. lbs.).

(15) Install the suction tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

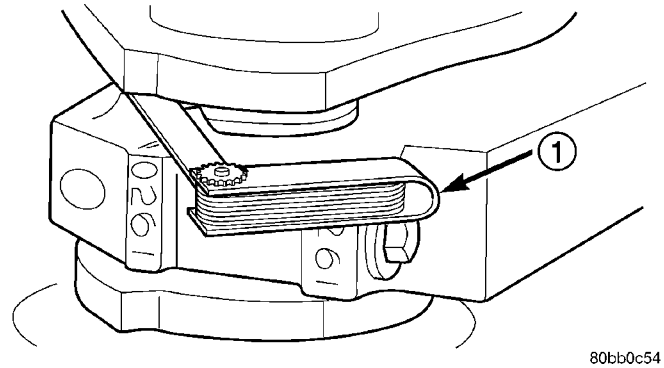


Fig. 98 Side Clearance between Connecting Rod/Crankshaft

1 - FEELER GAUGE
·Minimum 0.33 mm (.013 inch)
·MAX. 0.10mm (.004 inch)

(16) Install the cylinder head onto the engine (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(17) Install a new filter and fill the crankcase with new engine oil.

(18) Connect the battery negative cables and start engine.

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Determine the piston diameter and obtain the appropriate ring set. The piston rings can be identified as shown in (Fig. 99).

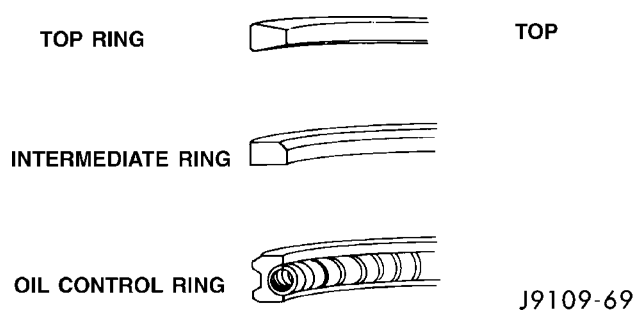


Fig. 99 Piston Ring Identification

PISTON RINGS (Continued)

(2) Position each ring in the cylinder and use a piston to square it with the bore at a depth of 89.0 mm (3.5 inch) - (Fig. 100).

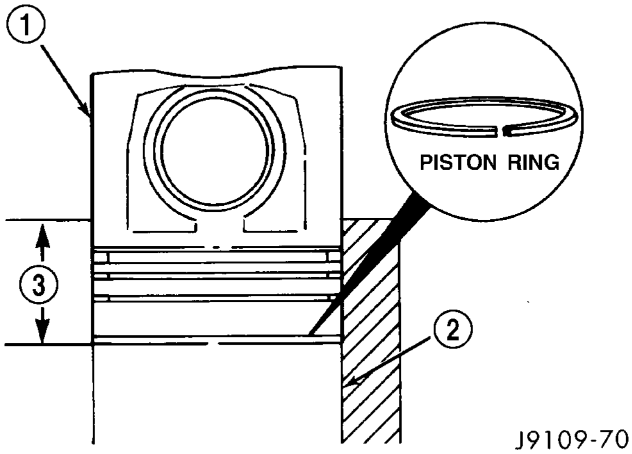


Fig. 100 Position of Ring in Cylinder Bore

1 - PISTON
2 - CYLINDER BORE
3 - DEPTH

(3) Use a feeler gauge to measure the piston ring gap.

PISTON RING GAP CHART		
TOP RING	0.26 - 0.36 mm	(0.010 - 0.014 in.)
INTERMEDIATE RING	0.85-1.15 mm	(0.033 - 0.045 in.)
OIL CONTROL RING	0.25-0.55 mm	(0.010 - 0.022 in.)

(4) The top surface of all of the rings are identified with the word TOP or the supplier's MARK. Assemble the rings with the word TOP or the supplier's MARK up.

(5) Position the oil ring expander in the oil control ring groove (bottom groove).

(6) Install the oil control ring with the end gap OPPOSITE the ends on the expander (Fig. 101).

(7) Install the intermediate piston ring in the second groove.

(8) Install the top piston ring in the top groove (Fig. 102).

(9) Position the rings as shown in (Fig. 103).

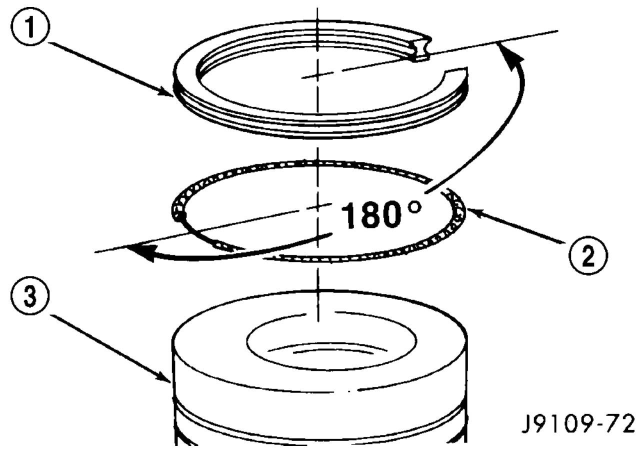


Fig. 101 Oil Control Ring/Expander Location in Groove

1 - OIL CONTROL RING
2 - EXPANDER
3 - PISTON

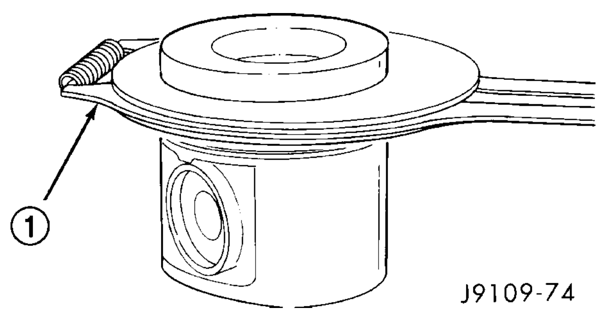


Fig. 102 Piston Ring Installation Tool

1 - PISTON RING INSTALLATION TOOL

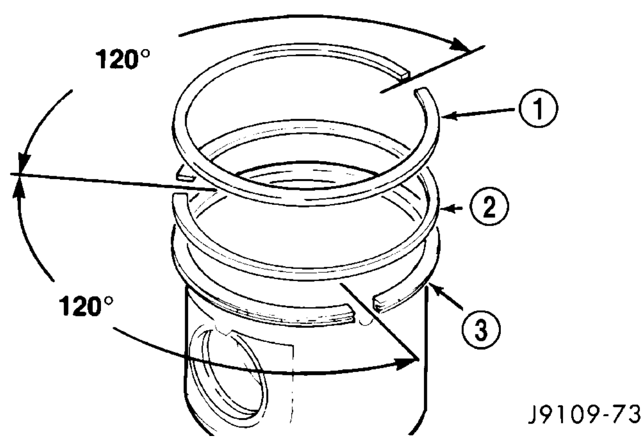


Fig. 103 Piston Ring Orientation

1 - TOP RING
2 - INTERMEDIATE RING
3 - OIL CONTROL RING

VIBRATION DAMPER

REMOVAL

(1) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove the four (4) damper to crankshaft bolts and remove damper and speed indicator ring.

INSPECTION

(1) Inspect the damper hub for cracks and replace if any are found.

(2) Inspect the index lines on the damper hub and the inertia member (Fig. 104). If the lines are more than 1.59 mm (1/16 in.) out of alignment, replace the damper.

(3) Inspect the rubber member for deterioration or missing segments (Fig. 105).

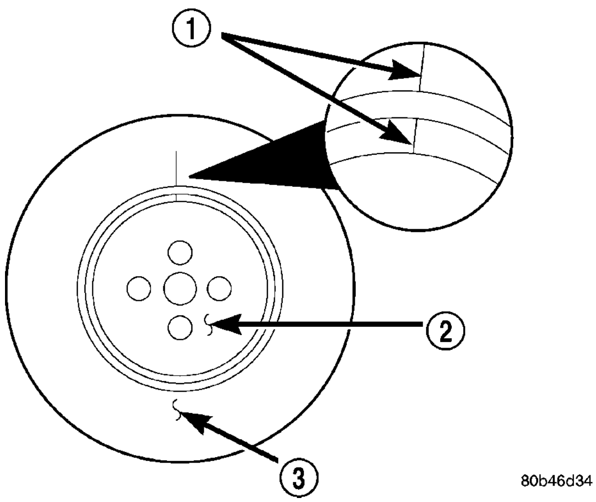


Fig. 104 Inspect Index Lines for Alignment

1 - INDEX LINES
2 - HUB
3 - INERTIA MEMBER

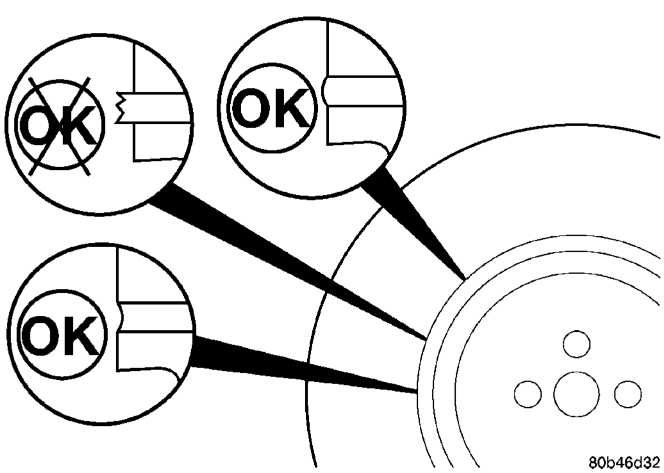


Fig. 105 Inspect Damper Rubber Member

INSTALLATION

(1) Install speed indicator ring.

NOTE: The speed indicator ring is located over a dowel pin.

(2) Install the crankshaft damper and bolts. Tighten bolts to 40 N·m (30 ft. lbs.) torque, plus an additional 60°.

NOTE: The damper must be installed so the hole is located over the dowel pin.

(3) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

FRONT MOUNT

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(3) Raise vehicle on hoist.

(4) Install engine support fixture tool# 8534 and steel bracket tool # 8534A

(5) Loosen the thru-bolt and nut.

(6) Lift the engine SLIGHTLY and remove the insulator to block bolts (Fig. 107) (Fig. 106).

(7) Remove the insulator from the vehicle.

INSTALLATION

(1) With engine raised SLIGHTLY, position the insualtor to the mount (Fig. 108) (Fig. 109). Install the bolts and torque to specification.

(2)

(3) Lower the engine using tool # 8534, while guiding the mount and thru-bolt into the frame mounted support cushion brackets.

(4) Install the thru-bolt nut and tighten the nut to 88 N·m (65 ft. lbs.) torque.

(5) Remove the engine support fixture tool #8534.

(6) Lower the vehicle.

(7) Install the viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(8) Connect the battery negative cables.

FRONT MOUNT (Continued)

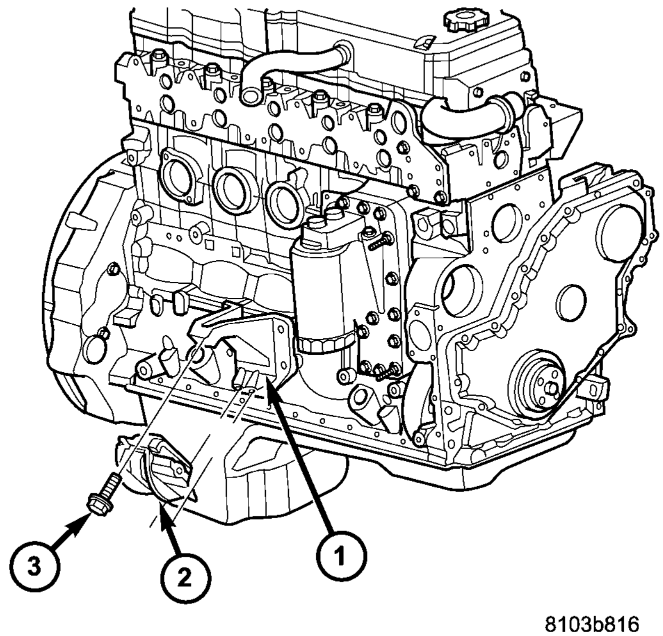


Fig. 106 RH Insulator

1 - Mount
2 - Insulator
3 - Bolt

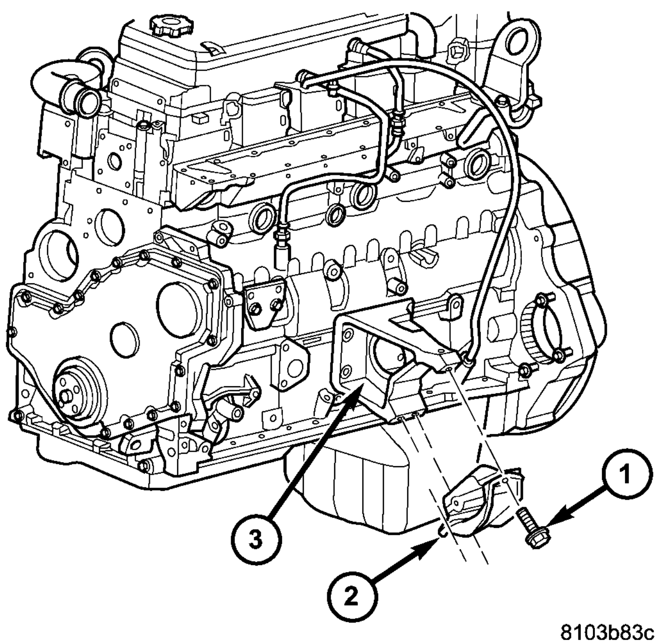


Fig. 107 LH Insulator

1 - Bolt
2 - Insulator
3 - Mount

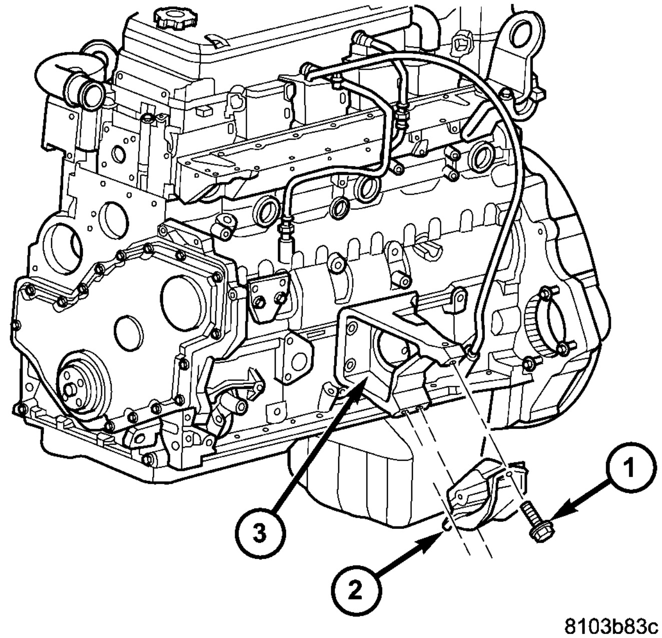


Fig. 108 LH Insulator

1 - Bolt
2 - Insulator
3 - Mount

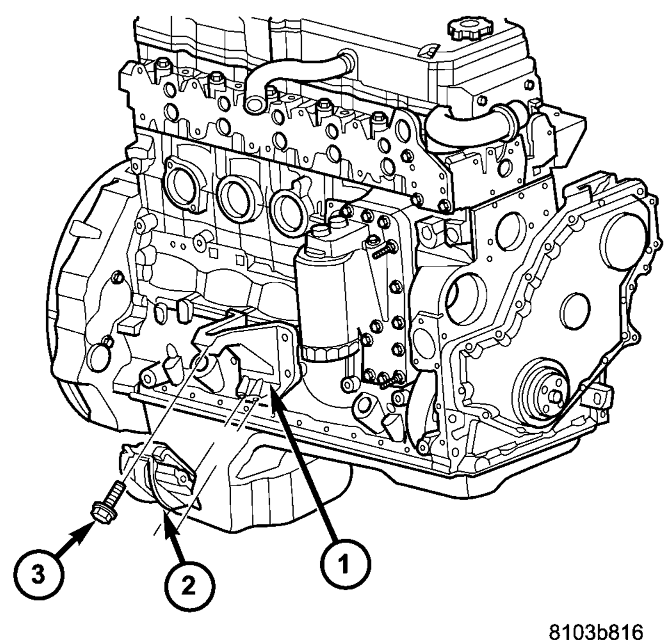


Fig. 109 RH Insulator

1 - Mount
2 - Insulator
3 - Bolt

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 110).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 110).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

LUBRICATION

DESCRIPTION

NOTE: Refer to (Fig. 111) and (Fig. 112) for circuit illustrations.

A gear driven gerotor type oil pump is mounted behind the front gear cover in the lower right portion on the engine.

OPERATION

A gerotor style oil pump draws oil from the crankcase through the suction tube and delivers it through the block where it enters the oil cooler cover and pressure regulator valve. When oil pressure exceeds 517 kPa (75 PSI), the valve opens exposing the dump port, which routes excess oil back to the oil pump.

At the same time, oil is directed to a cast in passage in the oil cooler cover, leading to the oil cooler element. As the oil travels through the element plates, it is cooled by engine coolant traveling past the outside of the plates. It is then routed to the oil filter head and through a full flow oil filter. If a plugged filter is encountered, the filter by-pass valve opens, allowing unfiltered oil to lubricate the engine. This condition can be avoided by frequent oil and filter changes, per the maintenance schedules found in

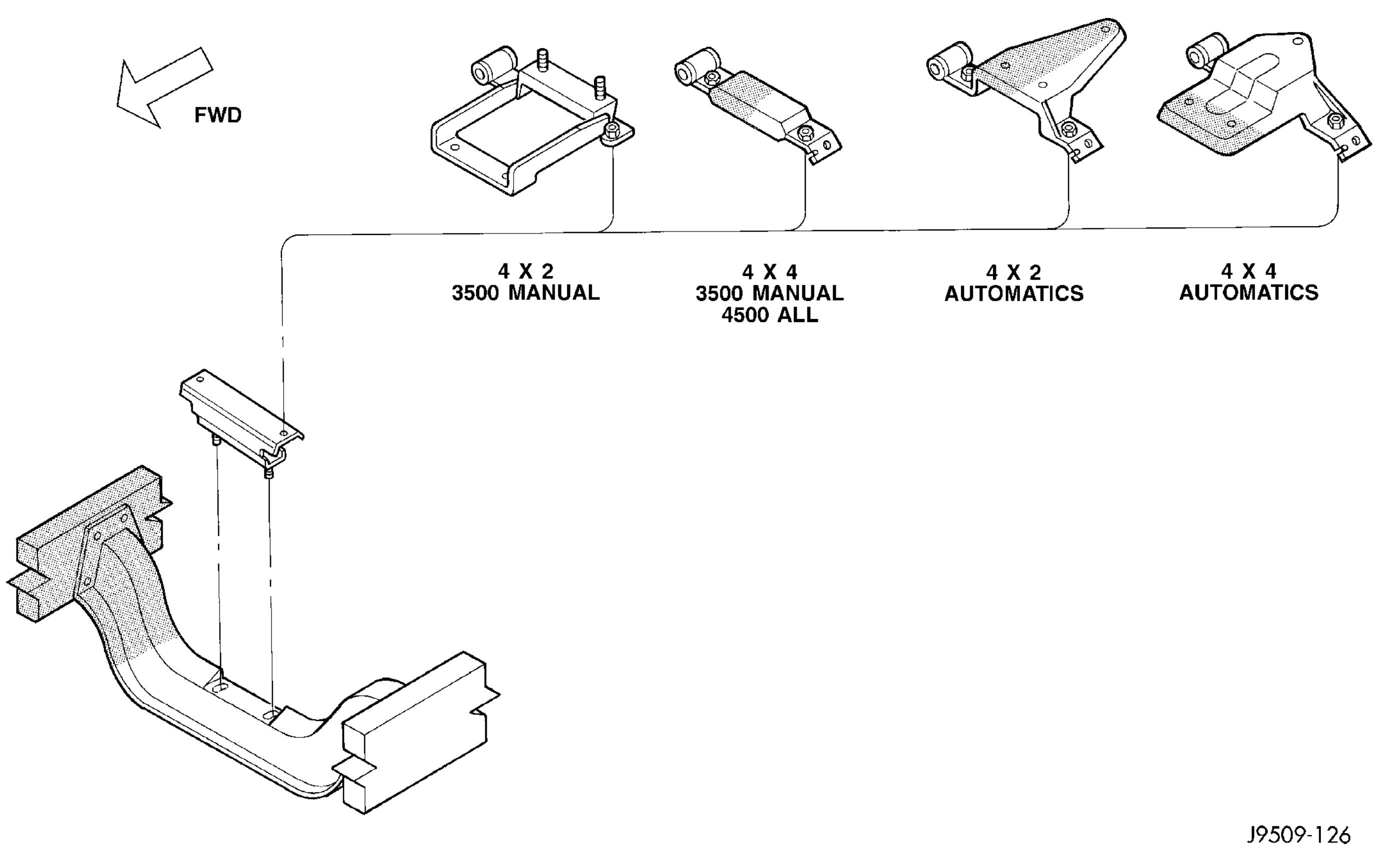


Fig. 110 Engine Rear Support Cushion Assembly

LUBRICATION (Continued)

the owners manual. The by-pass valve is calibrated to open when it sees a pressure drop of more than 345 kPa (50 psi) across the oil filter.

The oil filter head then divides the oil between the engine and the turbocharger. The turbocharger receives filtered, cooled and pressurized oil through a supply line from the filter head. The oil lubricates the turbocharger and returns to the pan by way of a drain tube connecting the bottom of the turbocharger to a pressed in tube in the cylinder block.

Oil is then carried across the block to an angle drilling which intersects the main oil rifle. The main oil rifle runs the length of the block and delivers oil to the crankshaft main journals and valve train. Oil travels to the crankshaft through a series of transfer drillings (one for each main bearing) and lubricates a groove in the main bearing upper shell. From there another drilling feeds the camshaft main journals. The saddle jet piston cooling nozzles are also supplied by the main bearing upper shell. J-jet piston cooling nozzles are supplied by a separate oil rifle. Plugs are used in place of saddle jets when J-jets are used. J-jet hole locations are plugged when saddle jet cooling nozzles are used. Crankshaft internal cross-drillings supply oil to the connecting rod journals.

Another series of transfer drillings intersecting the main oil rifle supply the valve train components. Oil travels up the drilling, through a hole in the head gasket, and through a drilling in the cylinder head (one per cylinder), where it enters the rocker arm pedestal and is divided between the intake and exhaust rocker arm. Oil travels up and around the rocker arm mounting bolt, and lubricates the rocker shaft by cross drillings that intersect the mounting bolt hole. Grooves at both ends of the rocker shaft supply oil through the rocker arm where the oil travels to the push rod and socket balls (Fig. 111) and (Fig. 112).

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove the 1/8 npt plug from the top of the oil filter housing.

(2) Install Oil Pressure Line and Gauge Tool C-3292 with a suitable adapter.

(3) Start engine and warm to operating temperature.

(4) Record engine oil pressure and compare with engine oil pressure chart.

CAUTION: If engine oil pressure is zero at idle, DO NOT RUN THE ENGINE.

Engine Oil Pressure (MIN)

At Idle	68.9 kPa (10 psi)
At 2500 rpm	206.9 kPa (30 psi)

If minimum engine oil pressure is below these ranges, (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).

(5) Remove oil pressure gauge and install the 1/8 npt plug.

LUBRICATION (Continued)

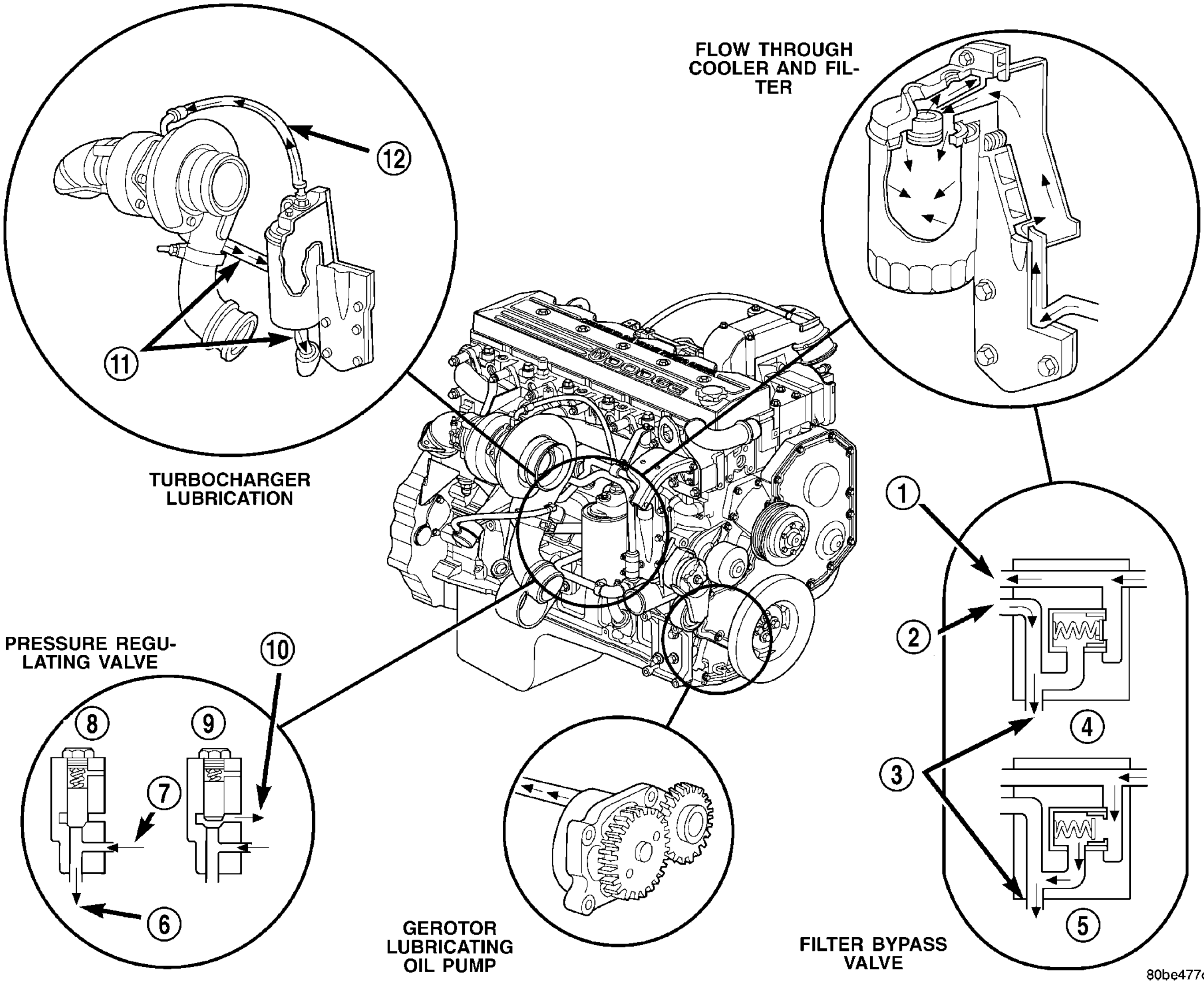


Fig. 111 Lubrication System Circulation

1 - TO FILTER
2 - FROM FILTER
3 - TO MAIN OIL RIFLE
4 - CLOSED
5 - OPEN
6 - TO COOLER
7 - FROM PUMP
8 - CLOSED
9 - OPEN
10 - OIL DRAINS BACK TO THE PUMP
11 - OIL DRAIN
12 - OIL SUPPLY

LUBRICATION (Continued)

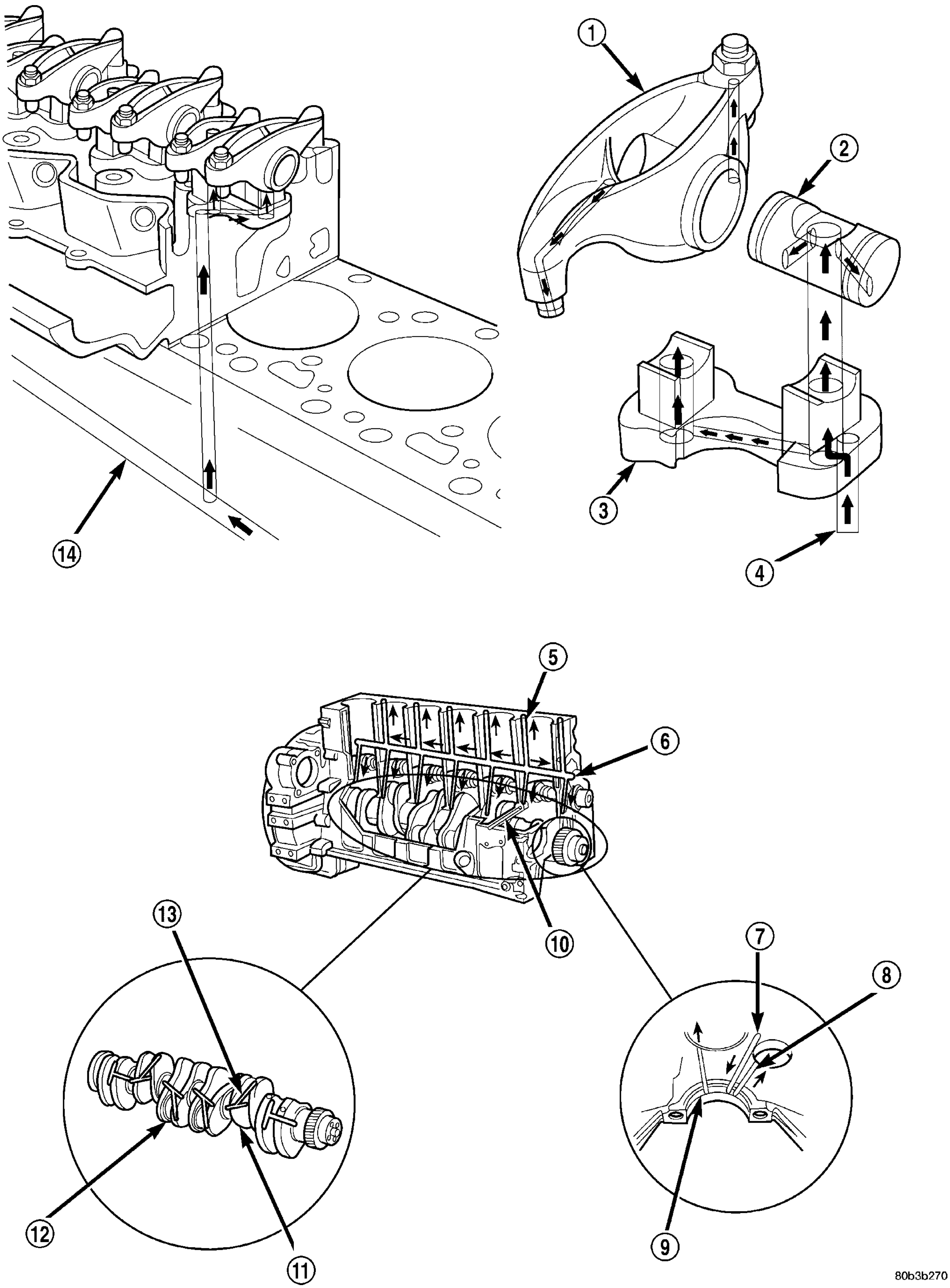


Fig. 112 Lubrication System Circulation—Cont'd

OIL (Continued)

1 - ROCKER ARM
2 - ROCKER SHAFT
3 - PEDESTAL
4 - FROM MAIN OIL RIFLE
5 - TO VALVE TRAIN
6 - MAIN OIL RIFLE
7 - FROM MAIN OIL RIFLE
8 - TO CAMSHAFT
9 - TO PISTON COOLING NOZZLE
10 - FROM OIL COOLER
11 - CRANKSHAFT MAIN JOURNAL
12 - ROD JOURNAL
13 - TO ROD BEARING
14 - MAIN OIL RIFLE

OIL

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE OIL LEVEL

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable oil level is in the SAFE RANGE on the engine oil dipstick (Fig. 113).

Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level of a cold engine is not accurate.

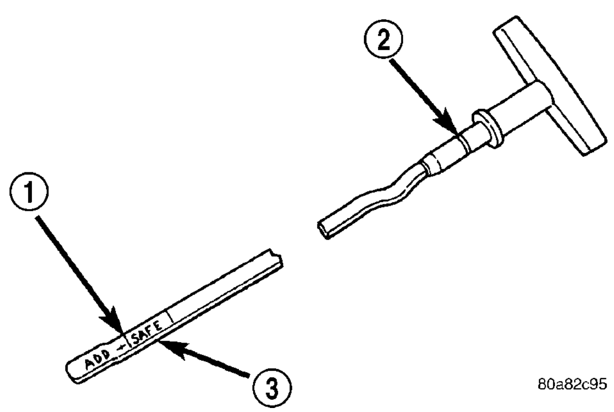


Fig. 113 Oil Level Indicator (Dipstick)

1 - ADD OIL MARK
2 - O-RING
3 - SAFE RANGE

(1) Position vehicle on level surface.
(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.
(3) Wipe dipstick clean.
(4) Replace dipstick and verify it is seated in the tube.
(5) Remove dipstick, with handle held above the tip, take oil level reading.
(6) Add oil only if level is below the SAFE RANGE area on the dipstick.
(7) Replace dipstick

STANDARD PROCEDURE - ENGINE OIL SERVICE

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

NOTE: Change engine oil and filter at intervals specified in the owner's manual.

(1) Operate the engine until the water temperature reaches 60°C (140°F). Shut the engine off.
(2) Use a container that can hold at least 14 liters (15 quarts) to hold the used oil. Remove the oil drain plug and drain the used engine oil into the container.
(3) Always check the condition of the used oil. This can give you an indication of engine problems that might exist.
- Thin, black oil indicates fuel dilution.
- Milky discoloration indicates coolant dilution.

(4) Clean the area around the oil filter head. Remove the filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
(5) Install new oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).
(6) Clean the drain plug and the sealing surface of the pan. Check the condition of the threads and sealing surface on the oil pan and drain plug.
(7) Install the drain plug. Tighten the plug to 50 N·m (37 ft. lbs.) torque.
(8) Use only High-Quality Multi-Viscosity lubricating oil in the Cummins Turbo Diesel engine. Choose the correct oil for the operating conditions (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION).
(9) Fill the engine with the correct grade of new oil (Refer to LUBRICATION & MAINTENANCE/FLUID CAPACITIES - SPECIFICATIONS).
(10) Start the engine and operate it at idle for several minutes. Check for leaks at the filter and drain plug.
(11) Stop engine. Wait several minutes to allow the oil to drain back to the pan and check the level again.

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing of used engine oil after it has been drained from a vehicle's engine.

OIL COOLER & LINES

CLEANING

CLEANING AND INSPECTION

Clean the sealing surfaces.

Apply 483 kPa (70 psi) air pressure to the element to check for leaks. If the element leaks, replace the element.

OIL FILTER

REMOVAL

(1) Clean the area around the oil filter head. Remove the filter from below using a cap-style filter wrench.

(2) Clean the gasket surface of the filter head. The filter canister O-Ring seal can stick on the filter head. Make sure it is removed.

INSTALLATION

(1) Fill the oil filter element with clean oil before installation. Use the same type oil that will be used in the engine.

(2) Apply a light film of lubricating oil to the sealing surface before installing the filter.

CAUTION: Mechanical over-tightening may distort the threads or damage the filter element seal.

(3) Install the filter until it contacts the sealing surface of the oil filter adapter. Tighten filter an additional ½ turn.

OIL PAN

REMOVAL

(1) Disconnect the battery negative cables.

(2) Install engine support fixture # 8534.

(3) Raise vehicle on hoist.

(4) Disconnect starter cables from starter motor.

(5) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL) and transmission adapter plate assembly.

(6) Remove transmission and transfer case (if equipped).

(7) Remove flywheel or flexplate.

(8) Remove the transmission adapter plate.

WARNING: HOT OIL CAN CAUSE PERSONAL INJURY.

(9) Drain the engine oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

(10) Install the oil pan drain plug if sealing surface is not damaged and tighten to 50 N·m (57 ft. lbs.) torque.

(11) Remove oil pan bolts, break the pan to block seal, and lower pan slightly and remove oil suction tube fasteners.

(12) Remove oil pan and suction tube.

CLEANING

Remove all gasket material from the oil pan and cylinder block sealing surfaces. Extra effort may be required around T-joint areas. Clean oil pan and flush suction tube with a suitable solvent.

INSPECTION

Inspect the oil pan, suction tube, and tube braces for cracks and damage. Replace any defective component. Inspect the oil drain plug and drain hole threads. Inspect the oil pan sealing surface for straightness. Repair any minor imperfections with a ball-peen hammer. Do not attempt to repair an oil pan by welding.

INSTALLATION

(1) Fill the T-joint between the pan rail/gear housing and pan rail/rear seal retainer with sealant. Use Mopar® Silicone Rubber Adhesive Sealant or equivalent.

(2) Place suction tube in oil pan and guide them into place. Using a new tube to block gasket, install and tighten the suction tube bolts by hand. Starting with the oil pump inlet bolts, tighten the bolts to 24 N·m (18 ft. lbs.) torque. Tighten the remaining tube brace bolts to 43 N·m (32 ft. lbs.) torque.

(3) Starting in the center and working outward, tighten the oil pan bolts to 28 N·m (21 ft. lbs.) torque.

(4) Install the flywheel housing assembly with the starter motor attached and tighten bolts to 77 N·m (57 ft. lbs.) torque.

(5) Connect starter motor cables.

(6) Install the flywheel or flexplate. Torque to 137 N·m (101 ft. lbs.).

(7) Install transmission and transfer case (if equipped).

(8) Lower vehicle.

(9) Remove the engine support fixture # 8534.

(10) Install battery negative cables.

(11) Fill the crankcase with new engine oil.

(12) Start engine and check for leaks. Stop engine, check oil level, and adjust, if necessary.

OIL PRESSURE RELIEF VALVE

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the threaded plug, spring and plunger (Fig. 114). Insert a finger or a seal pick to lift the plunger from the bore.

NOTE: If the plunger is stuck in the bore, it will be necessary to remove the filter head.

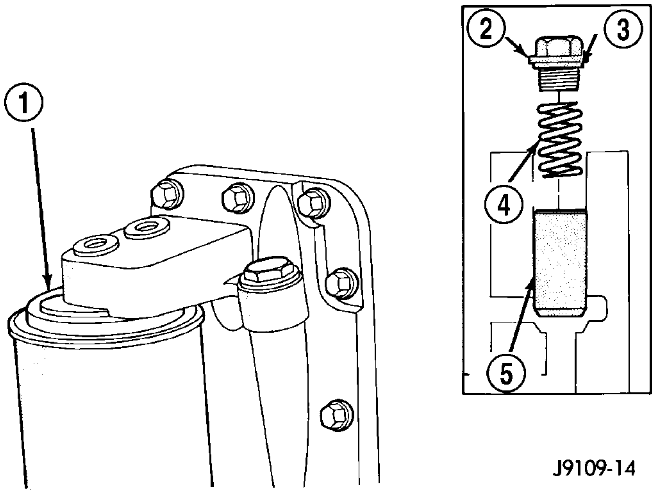


Fig. 114 Oil Pressure Regulator

1 - OIL FILTER
2 - PLUG
3 - GASKET
4 - SPRING
5 - VALVE

CLEANING

(1) Clean the regulator spring and plunger with a suitable solvent and blow dry with compressed air. If the plunger bore requires cleaning, it is necessary to remove the oil filter head to avoid getting debris into the engine.

INSPECTION

Inspect the plunger and plunger bore for cracks and excessive wear. Polished surfaces are acceptable. Verify that the plunger moves freely in the bore.

Check the spring for height and load limitations (Fig. 115). Replace the spring if out of limits shown in the figure.

INSTALLATION

(1) Install the plunger, spring, and plug as shown in (Fig. 114). Tighten the plug to 80 N·m (60 ft. lbs.) torque.

(2) Connect the battery negative cables.

(3) Start the engine and verify that it has oil pressure.

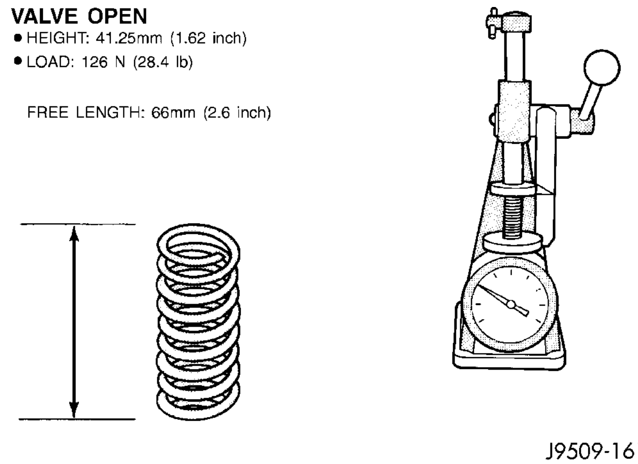


Fig. 115 Oil Pressure Regulator Spring Check

OIL PRESSURE SENSOR/ SWITCH

REMOVAL

(1) Disconnect the battery negative cables.

(2) Disconnect the oil pressure switch connector.

(3) Using a suitable socket, remove the oil pressure switch from the block (counter-clockwise).

INSTALLATION

(1) If the switch is not being replaced, replace and lubricate the o-ring.

(2) Install the oil pressure switch and tighten to 18 N·m (159 in. lbs.) torque.

(3) Connect oil pressure switch connector.

(4) Connect the battery negative cables.

(5) Start engine and check for oil leaks at the switch.

OIL PUMP

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the fan support/hub assembly.

(5) Remove crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and speed indicator ring.

(6) Remove hydraulic pump.

(7) Remove accessory drive belt tensioner.

(8) Remove the gear housing cover (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - REMOVAL).

OIL PUMP (Continued)

(9) Remove the four mounting bolts and pull the oil pump from the bore in the cylinder block (Fig. 116).

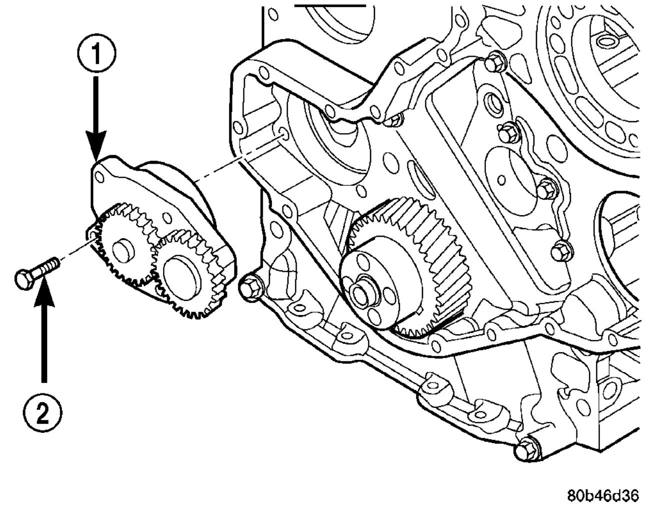


Fig. 116 Oil Pump Removal/Installation

1 - OIL PUMP
2 - BOLT (4)

CLEANING

Clean all parts in solvent and dry with compressed air. Clean the old sealer residue from the back of the gear housing cover and front of the gear housing.

INSPECTION

Disassemble and inspect the oil pump as follows:

(1) Visually inspect the lube pump gears for chips, cracks or excessive wear.

(2) Remove the back plate (Fig. 117).

(3) Mark TOP on the gerotor planetary using a felt tip pen (Fig. 117).

(4) Remove the gerotor planetary (Fig. 117). Inspect for excessive wear or damage. Inspect the pump housing and gerotor drive for damaged and excessive wear.

(5) Install the gerotor planetary in the original position.

(6) Measure the tip clearance (Fig. 118). Maximum clearance is 0.1778 mm (0.007 inch). If the oil pump is out of limits, replace the pump.

(7) Measure the clearance of the gerotor drive/ gerotor planetary to port plate (Fig. 119). Maximum clearance is 0.127 mm (0.005 inch). If the oil pump is out of limits, replace the pump.

(8) Measure the clearance of the gerotor planetary to the body bore (Fig. 120). Maximum clearance is 0.381 mm (0.015 inch). If the oil pump is out of limits, replace the pump.

(9) Measure the gears backlash (Fig. 121). The limits of a used pump is 0.15- 0.25 mm (0.006-0.010 inch). If the backlash is out of limits, replace the oil pump.

(10) Install the back plate.

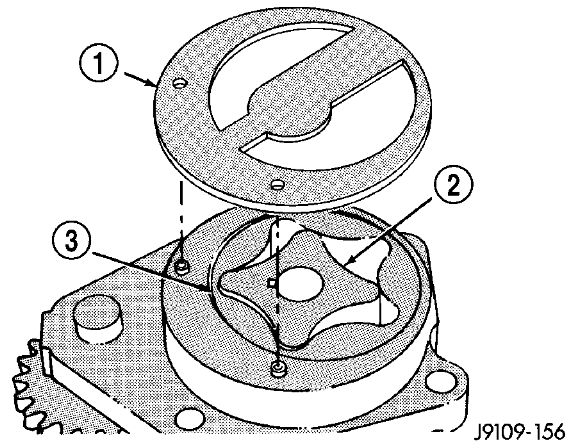


Fig. 117 Gerotor Planetary and Gerotor

1 - OIL PUMP BACK PLATE
2 - GEROTOR
3 - GEROTOR PLANETARY

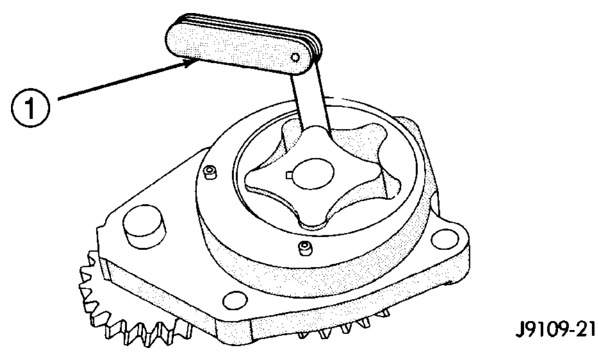


Fig. 118 Measuring Tip Clearance

1 - FEELER GAUGE

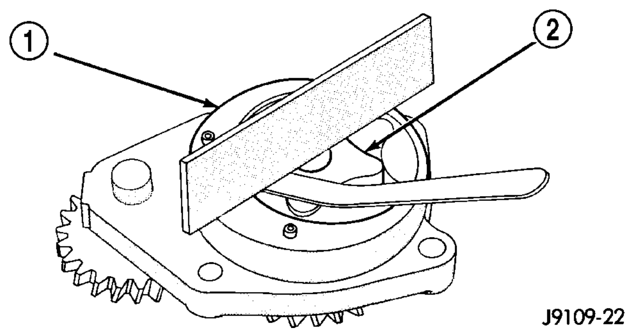


Fig. 119 Measuring Gerotor to Port Plate Clearance

1 - PORT PLATE
2 - GEROTOR

INSTALLATION

(1) Lubricate the pump with clean engine oil. Filling the pump with clean engine oil during installation will help to prime the pump at engine start up.

OIL PUMP (Continued)

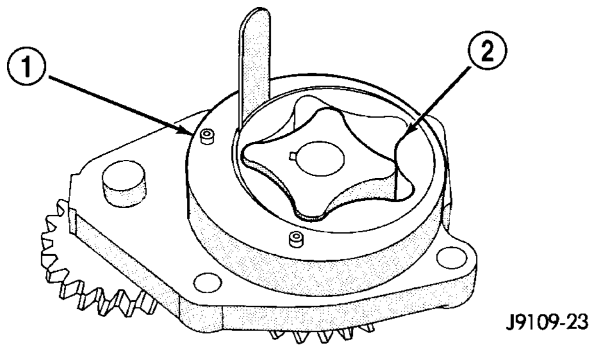


Fig. 120 Measuring Gerotor Planetary to Body Bore Clearance

1 - BODY BORE
2 - GEROTOR PLANETARY

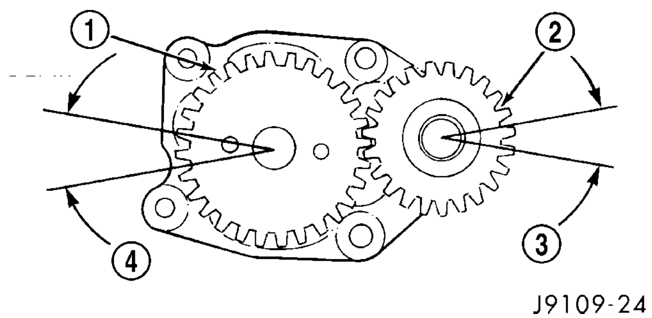


Fig. 121 Measure Gear Backlash

1 - OIL PUMP DRIVE GEAR
2 - IDLER GEAR
3 - BACKLASH
4 - BACKLASH

(2) Install the pump (Fig. 116). Verify the idler gear pin is installed in the locating bore in the cylinder block. Tighten the oil pump mounting bolts in two steps, in the sequence shown in (Fig. 122).

- Step 1—Tighten to 8 N·m (71 in. lbs.) torque.
- Step 2—Tighten to 24 N·m (18 ft. lbs.) torque.

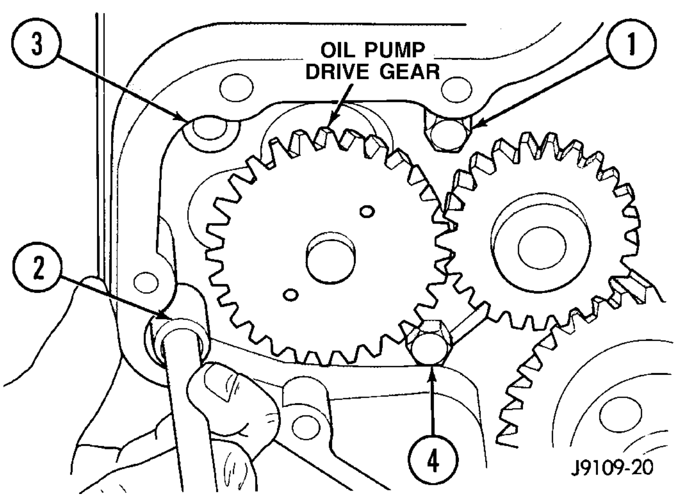


Fig. 122 Oil Pump Mounting Bolt Torque Sequence

(3) The back plate on the pump seats against the bottom of the bore in the cylinder block. When the pump is correctly installed, the flange on the pump will not touch the cylinder block.

(4) Measure the idler gear to pump drive gear backlash and the idler gear to crankshaft gear backlash (Fig. 123). The backlash should be 0.15- 0.25 mm (0.006-0.010 inch). If the backlash is out of limits, replace the oil pump.

(5) If the adjoining gear moves when you measure the backlash, the reading will be incorrect.

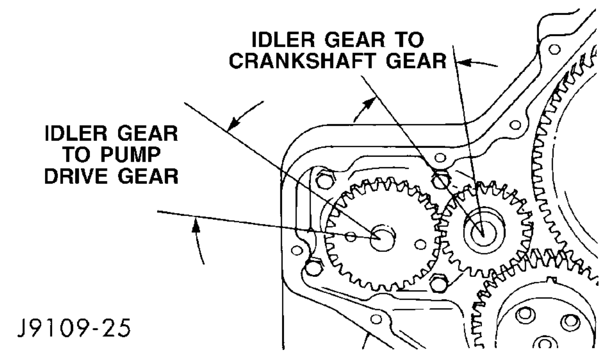


Fig. 123 Idler Gear to Pump Drive Gear and Crankshaft Gear Backlash

(6) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover sealing surface.

(7) Install the gear housing cover (Refer to 9 - ENGINE/VALVE TIMING/GEAR HOUSING COVER - INSTALLATION).

(8) Install the vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION) and speed indicator ring.

(9) Install the fan support/hub assembly and torque bolts to 32 N·m (24 ft. lbs.).

(10) Install hydraulic pump.

(11) Install accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.).

(12) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Install the cooling fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(14) Connect battery negative cables.

(15) Start engine and check for oil leaks.

INTAKE MANIFOLD

REMOVAL

(1) Disconnect the battery negative cables.

(2) Remove the charge air cooler outlet tube from the air inlet housing (Fig. 124).

(3) Remove the engine oil dipstick tube mounting bolt (Fig. 124).

INTAKE MANIFOLD (Continued)

(4) Remove dipstick support at fuel filter housing. Position dipstick tube to the side.

(5) Disconnect the air grid heater power cables at the cable mounting studs.

(6) Disconnect the ground strap at the intake cover.

(7) Remove the engine wiring harness connections at the air inlet housing elbow.

(8) Remove the four (4) air inlet housing mounting bolts and remove the housing from top of the heater elements.

(9) Remove the intake air grid heater from the manifold (Fig. 125).

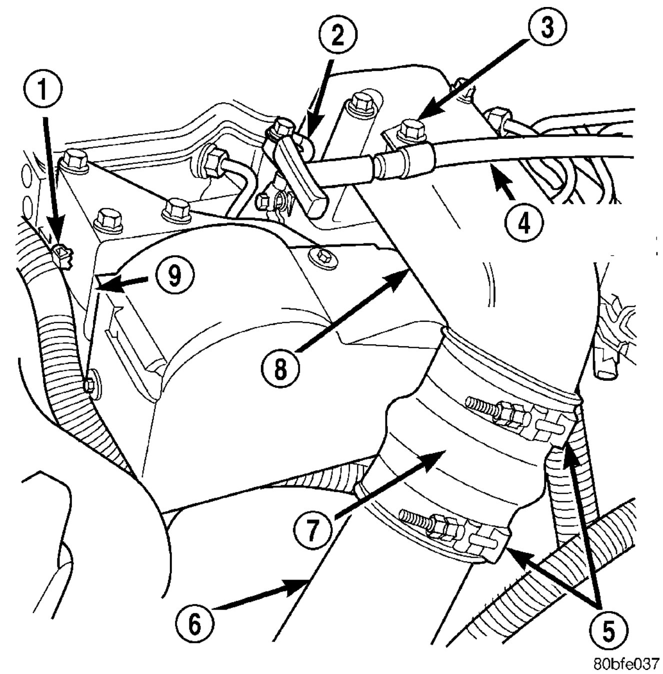


Fig. 124 Charge Air Cooler Air Tube

1 - FRONT WIRING CLIP
2 - GROUND CABLE
3 - TUBE BOLT
4 - ENGINE OIL DIPSTICK TUBE
5 - CLAMPS
6 - AIR TUBE (INT. MAN.-TO-INTERCOOLER)
7 - RUBBER HOSE
8 - AIR INTAKE HOUSING
9 - CABLE BRACKET HOUSING

(10) Remove the high pressure fuel lines and fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL LINES - REMOVAL).

(11) Remove APPS bracket from cylinder head to gain access to front intake manifold cover bolts.

(12) Disconnect manifold air temperature/pressure sensor connector.

(13) Remove the remaining intake manifold cover-to-cylinder head bolts.

(14) Remove the intake manifold cover and gasket. Keep the gasket material and any other material out of the air intake.

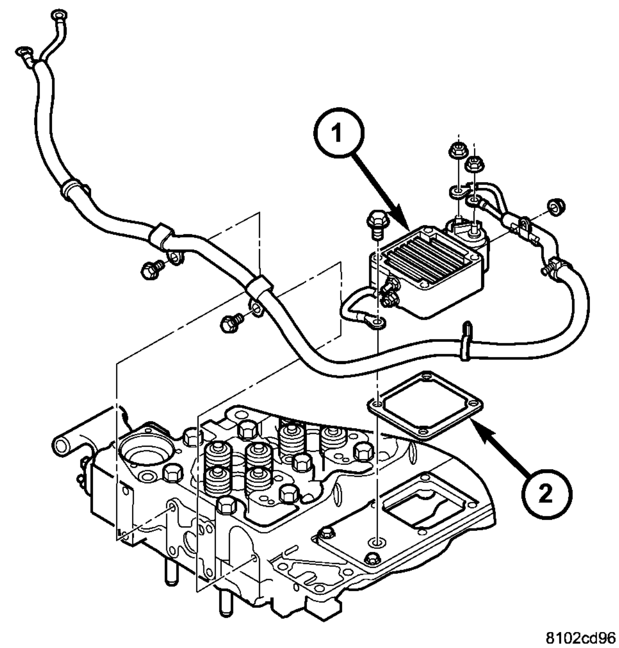


Fig. 125 Intake Air Grid Heater

1 - INTAKE AIR GRID HEATER
2 - GASKET

(15) Clean the intake manifold cover and cylinder head sealing surface.

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block gasket surfaces using a suitable solvent.

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) Using a new gasket, install the intake manifold cover.

(2) Install the cover-to-cylinder head bolts that do not hold down the fuel rail. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(3) Install the high pressure rail and fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL LINES - INSTALLATION).

(4) Using two (2) new gaskets, install the intake air grid heater and air inlet housing. Position the ground cable and install and tighten the bolts to 24 N·m (18 ft. lbs.) torque.

INTAKE MANIFOLD (Continued)

(5) Connect the manifold air temperature/pressure sensor connector.

(6) Install and tighten the air intake heater power supply nuts to 14 N·m (120 in. lbs.) torque.

(7) Install the APPS bracket. Torque fasteners to 43 N·m (32ft lbs.) torque.

(8) Install oil dipstick tube support at fuel filter housing.

(9) Install the engine oil dipstick tube and mounting bolt.

(10) Position the charge air cooler outlet tube onto the air inlet housing. Tighten the clamps to 8 N·m (72 in. lbs.) torque.

(11) Attach the engine wire harness to the air inlet housing at two locations.

(12) Prime the fuel system. Refer to the fuel priming procedure in Group 14, Fuel System.

(13) Connect the battery negative cables.

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Disconnect the exhaust pipe from the turbocharger elbow.

(4) Lower vehicle.

(5) Disconnect the turbocharger air inlet hose.

(6) Remove air cleaner assembly.

(7) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger.

(8) Disconnect the charge air cooler inlet pipe from the turbocharger.

(9) Remove the turbocharger and gasket from the exhaust manifold.

(10) Remove the cab heater return pipe nuts from the exhaust manifold stud. Position the tube out of the way.

(11) Remove heat shield.

(12) Remove exhaust manifold bolt lockplates.

(13) Remove the exhaust manifold-to-cylinder head bolts and spacers (Fig. 126).

(14) Remove the exhaust manifold and gaskets (Fig. 126).

CLEANING

Clean the cylinder head and exhaust manifold sealing surfaces with a suitable scraper. Use a Scotch-Brite™ pad or equivalent.

INSPECTION

Inspect the exhaust manifold for cracks. Measure the exhaust manifold for flatness. Place a ruler over all of the exhaust ports and insert a feeler gauge

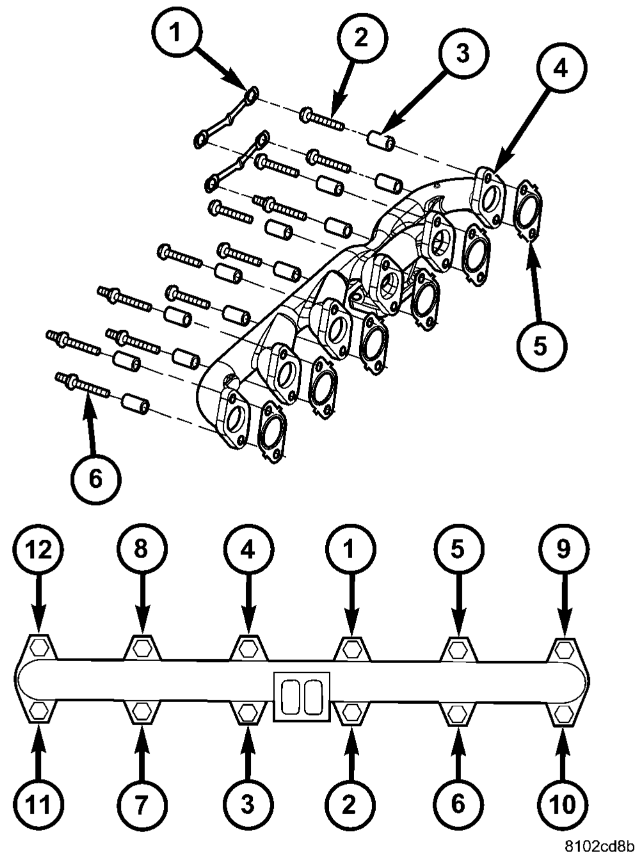


Fig. 126 Exhaust Manifold and Gaskets

1 - RETAINING STRAP
2 - BOLT (7)
3 - SPACER
4 - MANIFOLD, EXHAUST
5 - GASKET
6 - BOLT (5)

between the port flange and the ruler. Maximum deviation from flat is 0.20 mm (.008 inch).

INSTALLATION

(1) Using new gaskets, install the exhaust manifold and gaskets. Install the bolts and spacers and tighten the bolts in the sequence shown in to 43 N·m (32 ft. lbs.) torque.

(2) Retorque the four center bolts.

(3) Install heat shield and torque bolts to 24 Nm (18 ft. lbs.).

(4) Install cab heater tube.

(5) Install exhaust manifold bolt retention straps.

(6) Install the cab heater return hose to the manifold bolt stud. Tighten the nut to 24 N·m (18 ft. lbs.) torque.

(7) Install the turbocharger and a new gasket. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 43 N·m (32 ft. lbs.) torque.

EXHAUST MANIFOLD (Continued)

(8) Install the oil drain tube and a new gasket to the turbocharger. Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.

(9) **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting on the turbo. Rotate the turbocharger impeller by hand to distrubute the oil thoroughly.

(10) Install and tighten the oil supply line fitting nut to 24 N·m (18 ft. lbs.) torque.

(11) Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N·m (72 in. lbs.) torque.

(12) Position the air inlet hose to the turbocharger. Tighten the clamp to 8 N·m (72 in. lbs.) torque.

(13) Raise vehicle on hoist.

(14) Connect the exhaust pipe to the turbocharger and tighten the bolts to 34 N·m (25 ft. lbs.) torque.

(15) Lower the vehicle.

(16) Connect the battery negative cables.

(17) Start the engine to check for leaks.

VALVE TIMING

STANDARD PROCEDURE - TIMING VERIFICATION

(1) Remove the cylinder head cover(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(2) Remove fuel injector from cylinder number 1(Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

(3) Using Special Tool 7471B rotate the engine until the TDC mark on the damper is at 12 o'clock.

(4) Using a 8 in.x 1/4 in. dowel rod inserted into cylinder number 1, rock the crankshaft back and forth to verify piston number 1 is at TDC.

(5) With cylinder number still at TDC, inspect the keyway on the crankshaft gear for proper alignment (12 o'clock position).

(6) If the keyway is not at 12 o'clock position replace the crankshaft gear assembly.

(7) If the keyway is at 12 o'clock position, remove front gear cover and verify timing mark alignment between the camshaft gear and crankshaft gear, if not aligned inspect keyway on camshaft gear.

(8) Inspect keyway on camshaft gear for proper alignment with the key in the camshaft, if alignment is off replace the camshaft/gear assembly.

(9) If timing marks alignment is off and no damage is found at either the crankshaft or camshaft gear keyways, realign timing marks as necessary.

GEAR HOUSING

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove lower fan shroud fasteners. Disconnect fan drive wire harness.

(9) Remove the upper fan shroud-to-radiator mounting bolts.

(10) Remove viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(11) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(12) Remove the cooling fan support/hub from the front of the engine.

(13) Raise the vehicle on hoist.

(14) Remove the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL) and speed indicator ring.

(15) Lower the vehicle.

(16) Remove the hydraulic pump.

(17) Remove the accessory drive belt tensioner.

(18) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

(19) Remove the fuel injection pump (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - REMOVAL).

(20) Disconnect the camshaft position sensor connector.

(21) Disconnect and remove engine speed sensor.

(22) Remove the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - REMOVAL).

(23) Remove the six front oil pan fasteners.

(24) Remove the gear housing fasteners.

NOTE: Use care when removing the gear housing, to avoid damage to the oil pan gasket, as the gasket will be reused if it is not damaged.

(25) Slide a feeler gauge between the gear housing and oil pan gasket, to break the gasket seal.

(26) Remove the gear housing and gasket.

GEAR HOUSING (Continued)

(27) Clean the gasket material from the cylinder block and gear housing.

INSTALLATION

(1) Inspect oil pan gasket. If torn, gasket must be replaced.

(2) Install a new gasket and the gear housing. Torque bolts to 24 N·m (18 ft. lbs.). Follow torque sequence.

(3) If a new housing is installed, the camshaft position sensor, and engine speed sensor must be transferred to the new housing.

(4) Connect the camshaft position sensor connector.

(5) Install and connect engine speed sensor.

(6) Install the injection pump (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - INSTALLATION).

(7) Install the camshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CAMSHAFT & BEARINGS (IN BLOCK) - INSTALLATION). Align the crankshaft and camshaft gear marks as shown in.

(8) Install a new front crankshaft seal into the gear cover.

(9) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.

(10) Using the seal pilot to align the cover, install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

(11) Remove the seal pilot. Install front seal dust shield.

(12) Raise the vehicle.

(13) Trim any excess gear housing gasket to make it flush with the oil pan rail.

(14) Install the crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION). Torque bolts to 40 Nm (30 ft. lbs.), plus an additional 60°.

(15) Lower vehicle.

(16) Install the fan support/hub assembly and tighten bolts to 32 N·m (24 ft. lbs.) torque.

(17) Install the hydraulic pump.

(18) Install the accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.) torque.

(19) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(20) Install the upper cooling fan and shroud together (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(21) Install lower shroud and connect fan drive harness connector.

(22) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.

(23) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.

(24) Install the radiator upper hose and clamps.

(25) Add engine oil.

(26) Add coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(27) Connect the battery cables.

(28) Start engine and inspect for leaks.

GEAR HOUSING COVER

REMOVAL

(1) Disconnect both battery negative cables.

(2) Raise vehicle on hoist.

(3) Partially drain engine coolant into container suitable for re-use (Refer to 7 - COOLING - STANDARD PROCEDURE).

(4) Lower vehicle.

(5) Remove radiator upper hose.

(6) Disconnect coolant recovery bottle hose from radiator filler neck and lift bottle off of fan shroud.

(7) Disconnect windshield washer pump supply hose and electrical connections and lift washer bottle off of fan shroud.

(8) Remove viscous fan/drive assembly (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(9) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(10) Remove the cooling fan support/hub from the front of the engine.

(11) Raise the vehicle on hoist.

(12) Remove power steering pump.

(13) Remove accessory drive belt tensioner.

(14) Remove the crankshaft damper and speed indicator ring (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(15) Lower the vehicle.

(16) Remove the gear cover-to-housing bolts and gently pry the cover away from the housing, taking care not to mar the gasket surfaces.

GEAR HOUSING COVER (Continued)

INSTALLATION

(1) Install a new front crankshaft oil seal.

(2) Obtain a seal pilot/installation tool from a crankshaft front seal service kit and install the pilot into the seal.

(3) Apply a bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent to the gear housing cover. Be sure to surround all through holes.

(4) Using the seal pilot to align the cover (Fig. 127), install the cover to the housing and install the bolts. Tighten the bolts to 24 N·m (18 ft. lbs.) torque.

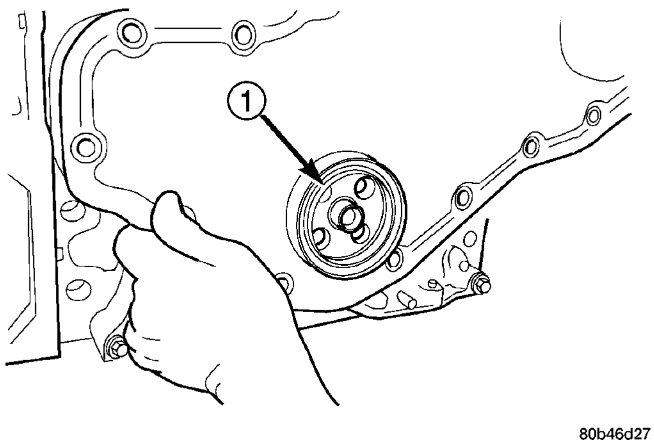


Fig. 127 Installing Cover with Seal Pilot

1 - SEAL PILOT

(5) Remove the seal pilot. Install front seal dust shield.

(6) Raise the vehicle.

(7) Install the speed indicator ring and the crankshaft damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Lower vehicle.

(9) Install the fan support/hub assy, and tighten bolts to 32 N·m (24 ft. lbs.) torque.

(10) Install power steering pump.

(11) Install accessory drive belt tensioner. Torque bolt to 43 N·m (32 ft. lbs.) torque.

(12) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Install the cooling fan and shroud together (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(14) Install the windshield washer reservoir to the fan shroud and connect the washer pump supply hose and electrical connection.

(15) Install the coolant recovery bottle to the fan shroud and connect the hose to the radiator filler neck.

(16) Install the radiator upper hose and clamps.

(17) Add coolant (Refer to 7 - COOLING - STANDARD PROCEDURE).

(18) Connect the battery cables.

(19) Start engine and inspect for leaks.

ENGINE 8.0L

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ENGINE 8.0L

DESCRIPTION

The 8.0 Liter (488 CID) ten-cylinder engine is a V-Type lightweight, single cam, overhead valve engine with hydraulic roller tappets. This engine is designed for unleaded fuel.

Engine lubrication system consists of a gerotor type oil pump mounted in the timing chain cover and driven by the crankshaft. The V-10 uses a full flow oil filter.

The cylinders are numbered from front to rear; 1, 3, 5, 7, 9 on the left bank and 2, 4, 6, 8, 10 on the right bank. The firing order is 1-10-9-4-3-6-5-8-7-2 (Fig. 1).

The engine serial number is located on the lower left front of the cylinder block in front of the engine mount (Fig. 2). When component part replacement is necessary, use the engine type and serial number for reference.

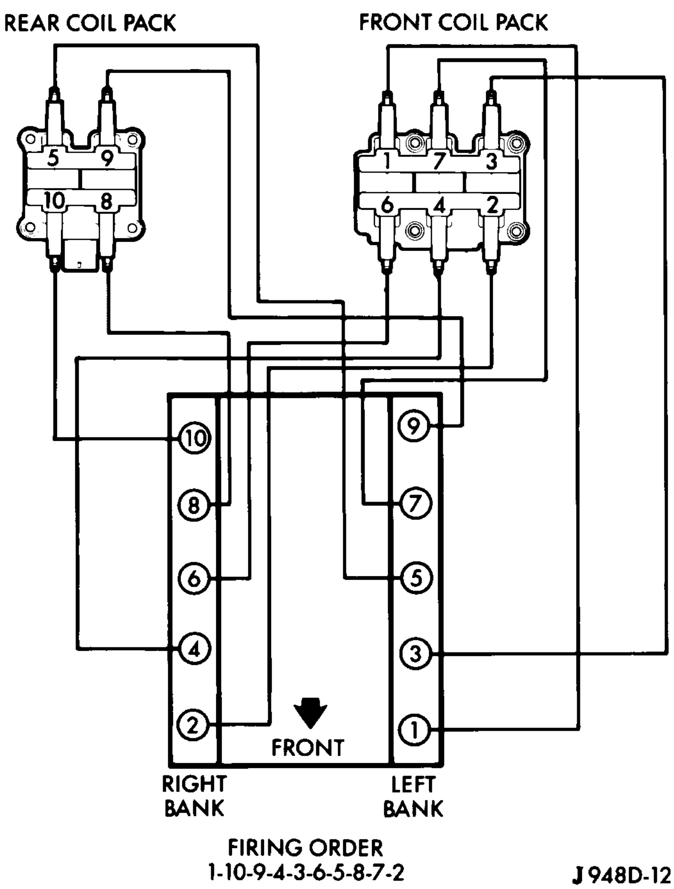


Fig. 1 Firing Order

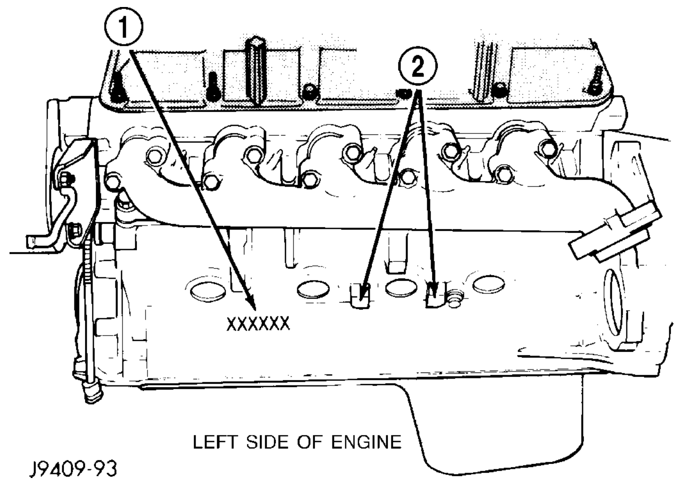


Fig. 2 Engine Identification—(Serial Number)

1 - ENGINE SERIAL NO.
2 - ENGINE MOUNT LOCATION

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

(Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Preformance) or (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - Mechanical). Refer to 14 - FUEL SYSTEM for fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Combustion Pressure Leakage Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
- Cylinder Head Gasket Failure Diagnosis (Refer to 9 - ENGINE/CYLINDER HEAD - DIAGNOSIS AND TESTING)
- Intake Manifold Leakage Diagnosis (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING)
- Lash Adjuster (Tappet) Noise Diagnosis (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - DIAGNOSIS AND TESTING)
- Engine Oil Leak Inspection (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - PERFORMANCE

PERFORMANCE DIAGNOSIS CHART—GASOLINE ENGINES

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/ BATTERY - STANDARD PROCEDURE). Check charging system. (Refer to 8 - ELECTRICAL/CHARGING - DIAGNOSIS AND TESTING).
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Seized accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/replace seized component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING)
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - DESCRIPTION)
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL PUMP - DIAGNOSIS AND TESTING).
	3. Low or no engine compression	3. Perform cylinder compression pressure test. (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ DISTRIBUTOR - REMOVAL).
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG - CLEANING).
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING).
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables

ENGINE 8.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL).
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/ IDLE AIR CONTROL MOTOR - DESCRIPTION)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - CLEANING)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ SPARK PLUG CABLE - DIAGNOSIS AND TESTING)
	6. Faulty coil	6. Test and replace, if necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - DIAGNOSIS AND TESTING).
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - CLEANING)
	2. Spark plug cables defective or crossed	2. Replace or rewire secondary ignition cables. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG CABLE - REMOVAL)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (Refer to 8 - ELECTRICAL/IGNITION CONTROL/ IGNITION COIL - REMOVAL)

ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil. (Refer to 9 - ENGINE/ LUBRICATION/OIL - STANDARD PROCEDURE)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING) for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING) engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE) for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	4. Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level.
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. (Refer to 9 - ENGINE/ LUBRICATION - DIAGNOSIS AND TESTING)
	3. Thin or diluted oil	3. Change oil to correct viscosity.

ENGINE 8.0L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace oil pump assembly.
	5. Thin or diluted oil	5. Change oil to correct viscosity.
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pickup tube loose, broken, bent or clogged	8. Inspect oil pickup tube and pump, and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. CCV System malfunction	1. (Refer to 25 - EMISSIONS CONTROL/EVAPORATIVE EMISSIONS - DESCRIPTION) for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING—ENGINE DIAGNOSIS - LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings.	1.
	(a) Misaligned or damaged.	(a) Replace as necessary.
	(b) Loose fasteners, broken or porous metal parts.	(b) Tighten fasteners, Repair or replace metal parts.
	2. Crankshaft rear seal	2. Replace as necessary.
	3. Crankshaft seal flange. Scratched, nicked or grooved.	3. Polish or replace crankshaft.
	4. Oil pan flange cracked.	4. Replace oil pan.
	5.Front cover seal, damaged or misaligned.	5. Replace seal.
	6. Scratched or damaged vibration damper hub.	6. Polish or replace damper.
OIL PRESSURE DROP	1. Low oil level.	1. Check and correct oil level.
	2. Faulty oil pressure sending unit.	2. Replace sending unit.
	3. Low oil pressure.	3. Check pump and bearing clearance.
	4. Clogged oil filter.	4. Replace oil filter.
	5. Worn oil pump.	5. Replace as necessary.
	6. Thin or diluted oil.	6. Change oil and filter.
	7. Excessive bearing clearance.	7. Replace as necessary.
	8. Oil pump relief valve stuck.	8. Replace oil pump.
	9. Oil pickup tube loose or damaged.	9. Replace as necessary.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn or damaged rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in oil ring slots.	2. Replace rings.
	3. Incorrect ring size installed.	3. Replace rings.
	4. Worn valve guides.	4. Ream guides and replace valves.
	5. Leaking intake gasket.	5. Replace intake gaskets.
	6. Leaking valve guide seals.	6. Replace valve guide seals.

ENGINE 8.0L (Continued)

DIAGNOSIS AND TESTING—CYLINDER COMPRESSION PRESSURE

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise, the indicated compression pressures may not be valid for diagnosis purposes.

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(3) Secure the throttle in the wide-open position.

(4) Disconnect the ignition coil.

(5) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(6) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.

(Refer to 9 - ENGINE - SPECIFICATIONS) for the correct engine compression pressures.

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating)
- Leaks between adjacent cylinders or into water jacket
- Any causes for combustion/compression pressure loss

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE. SERIOUS BURNS FROM HOT COOLANT CAN OCCUR.

Check the coolant level and fill as required. DO NOT install the radiator cap.

Start and operate the engine until it attains normal operating temperature, then turn OFF the engine.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

Perform the test procedure on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe or oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

ENGINE 8.0L (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE—CYLINDER BORE HONING

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round, as well as removing light scuffing, scoring and scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). about 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880, or a light honing oil, available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits, or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 3).

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

STANDARD PROCEDURE - FORM-IN-PLACE GASKETS AND SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

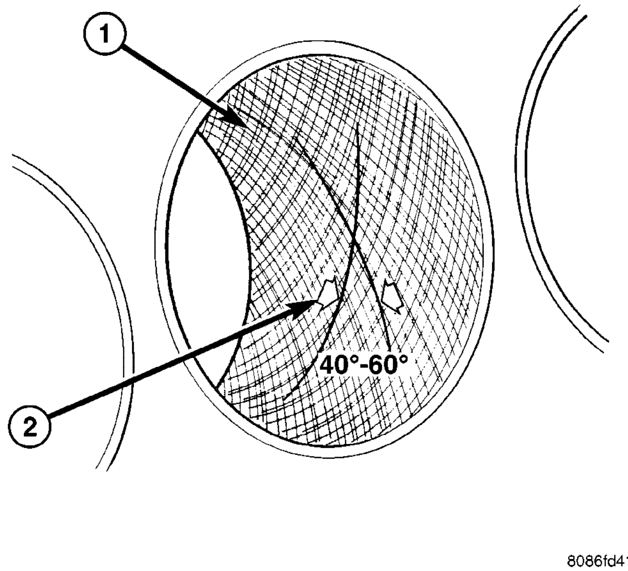


Fig. 3 Cylinder Bore Crosshatch Pattern

1 - CROSSHATCH PATTERN
2 - INTERSECT ANGLE

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

ENGINE 8.0L (Continued)

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets.

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - REPAIR DAMAGED OR WORN THREADS

CAUTION: Be sure that the tapped holes maintain the original center line.

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

STANDARD PROCEDURE—HYDROSTATIC LOCK

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect the negative cable(s) from the battery.

(3) Inspect air cleaner, induction system, and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the spark plugs.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (coolant, fuel, oil, etc.).

(7) Be sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt a small amount of engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the spark plugs to 41 N·m (30 ft. lbs.) torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil. (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(15) Connect the negative cable(s) to the battery.

(16) Start the engine and check for any leaks.

REMOVAL

(1) Remove the battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

ENGINE 8.0L (Continued)

(3) Discharge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(4) Remove the upper crossmember.

(5) Remove the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).

(6) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) Remove the A/C compressor with the lines attached (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL). Set aside.

(8) If equipped, remove the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL).

(9) Remove the washer fluid reservoir bottle (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - REMOVAL AND INSTALLATION).

(10) Disconnect the top radiator hose.

(11) Remove the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(12) Remove the fan shroud.

(13) Disconnect the lower radiator hose.

(14) Disconnect the transmission cooler lines.

(15) Remove radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

(16) Remove the generator with the wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(17) Remove the air cleaner.

(18) Disconnect the throttle linkage.

(19) Remove throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - REMOVAL).

(20) Remove the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(21) Remove the coil assemblies with the ignition cables.

(22) Disconnect the heater hoses.

(23) Disconnect the power steering hoses, if equipped.

(24) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(25) On Manual Transmission vehicles, remove the shift lever.

(26) Raise and support the vehicle on a hoist.

(27) Remove the drain plug and drain the engine oil.

(28) Loosen front engine mount thru-bolt nuts.

(29) Remove the transmission cooler line brackets from oil pan.

(30) Disconnect exhaust pipe at manifold.

(31) Disconnect the starter wires. Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

(32) Remove transmission.

(33) Lower vehicle.

CAUTION: DO NOT lift the engine by the intake manifold.

(34) Install an engine lifting fixture.

(35) Remove engine from vehicle and install engine assembly on a repair stand.

INSTALLATION

(1) Remove engine from the repair stand and position in the engine compartment. Position the thru-bolt into the support cushion brackets.

(2) Install an engine support fixture.

(3) Raise and support the vehicle on a hoist.

(4) Install Transmission.

(5) Install the starter and connect the starter wires (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(6) Install exhaust pipe to manifold.

(7) Install the transmission cooler line brackets from oil pan.

(8) Tighten the Front mount thru-bolts and nuts to 102N·m (75 ft. lbs.).

(9) Install the drain plug and tighten to 34 N·m (25 ft. lbs.) torque.

(10) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(11) Lower the vehicle.

(12) Remove engine lifting fixture.

(13) On Manual Transmission vehicles, install the shift lever.

(14) Connect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(15) Connect the heater hoses.

(16) Install the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(17) Install the coil assemblies with the ignition cables.

(18) Using a new gasket, install throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE BODY - INSTALLATION).

(19) Connect the throttle linkage.

(20) Install the air cleaner box.

ENGINE 8.0L (Continued)

(21) Install the generator and wire connections (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(22) Install the upper crossmember.

(23) Install radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION).

(24) Connect the lower radiator hose.

(25) Install the transmission oil cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).

(26) Connect the transmission cooler lines.

(27) Connect the power steering hoses, if equipped.

(28) Install the fan shroud.

(29) Install the fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(30) Connect the top radiator hose.

(31) Install the washer fluid reservoir bottle (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - INSTALLATION).

(32) If equipped, install the condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION).

(33) Install the A/C compressor with the lines attached (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(34) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(35) Evacuate (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and charge the air conditioning system, if equipped (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(36) Add coolant to the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(37) Install the battery.

(38) Warm engine and adjust as required.

(39) Road test vehicle.

SPECIFICATIONS

TORQUE

TORQUE CHART 8.0L ENGINE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	75	55	—
Camshaft Thrust Plate—Bolts	22	16	—
Coil Pack Bracket—Bolts	21	—	190
Connecting Rod Cap—Bolts	61	45	—
Main Bearing—Bolts			
Step 1	27	20	—
Step 2	115	85	—
Crankshaft Pulley/Damper—Bolt	312	230	—
Crankshaft Rear Seal Retainer—Bolts	22	16	—
Cylinder Head—Bolts			
Step 1	58	43	—
Step 2	143	105	—
Cylinder Head Cover—Bolts	16	—	144
Drive Plate to Crankshaft—Bolts	75	55	—
Drive Plate to Torque Converter—Bolts	47	35	—
EGR Tube—Nut	34	25	—
EGR Valve—Bolts	20	—	174
Engine Support Bracket/Insulator—Through Bolt	68	50	—
Engine Support Bracket/Insulator to Block—Bolts	47	35	—
Exhaust Manifold to Cylinder Head—Bolt	22	16	—
Generator Mounting—Bolt	41	30	—
Generator to Intake Manifold Bracket—Bolts	41	30	—

ENGINE 8.0L (Continued)

DESCRIPTION	N·m	Ft.	In.
Heat Shield—Nuts	20	—	175
Hydraulic Tappet Yoke Retaining Spider—Bolts	22	16	—
Intake Manifold (Lower)—Bolts	54	40	—
Intake Manifold (Upper)—Bolts	22	16	—
Oil Filter	9	—	80 + 45°
Oil Filter Connector	46	34	—
Oil Pan			
—1/4 - 20 Bolts	11	—	96
—5/16 - 18 Bolts	16	—	144
—Stud Bolts	16	—	144
—Drain Plug	34	25	—
Oil Pan Pick Up Tube—Bolts	16	—	144
Oil Pump Attaching—Bolts	41	30	—
Oil Pump Cover—Bolts	14	—	125
Oil Pump Pressure Relief—Plug	20	15	—
Rocker Arm—Bolts	54	40	—
Spark Plugs	41	30	—
Starter Mounting—Bolts	68	50	—
Timing Chain Cover—Bolts	47	35	—
Thermostat Housing—Bolts	25	—	220
Throttle Body—Nuts	11	—	96
Transfer Case to Insulator Mounting Plate—Nuts	204	150	—
Transmission Support Bracket—Bolts	102	75	—
Transmission Support Cushion—Bolts	47	35	—
Transmission Support Cushion Stud—Nuts	47	35	—
Water Pump to Chain Case Cover—Bolts	41	30	—

8.0L ENGINE

DESCRIPTION	SPECIFICATION
CAMSHAFT	
Bearing Diameter	
No. 1	53.16 – 53.19 mm (2.093 – 2.094 in.)
No. 2	52.76 – 52.78 mm (2.077 – 2.078 in.)
No. 3	52.35 – 52.37 mm (2.061 – 2.062 in.)
No. 4	51.94 – 51.97 mm (2.045 – 2.046 in.)
No. 5	51.54 – 51.56 mm (2.029 – 2.030 in.)
No. 6	48.74 – 48.77 mm (1.919 – 1.920 in.)
Bearing Journal Diameter	
No. 1	53.11 – 53.14 mm (2.091 – 2.092 in.)
No. 2	52.69 – 52.72 mm (2.0745 – 2.0755 in.)
No. 3	52.30 – 52.32 mm (2.059 – 2.060 in.)
No. 4	51.89 – 51.92 mm (2.043 – 2.044 in.)
No. 5	51.49 – 51.51 mm (2.027 – 2.028 in.)
No. 6	48.69 – 48.72 mm (1.917 – 1.918 in.)
Bearing to Journal Clearance	
No. 1,3,4,5,6	0.0254 – 0.0762 mm (0.001 – 0.003 in.)
No. 2	0.0381 – 0.0889 mm (0.0005 – 0.0035 in.)
Service Limit	0.127 mm (0.005 in.)
End Play	0.127 – 0.381 mm (0.005 – 0.015 in.)

ENGINE 8.0L (Continued)

DESCRIPTION	SPECIFICATION
CONNECTING RODS	
Piston Pin bore Diameter	24.940 – 24.978 mm (0.9819 – 0.9834 in.)
Side Clearance	0.25 – 0.46 mm (0.010 – 0.018 in.)
Total Weight (Less Bearing)	744 gms. (26.24 oz.)
CRANKSHAFT	
Rod Journal Diameter	53.950 – 53.975 mm (2.124 – 2.125 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.005 – 0.074 mm (0.0002 – 0.0029 in.)
Service Limit	0.0762 mm (0.003 in.)
Main Bearing Journal Diameter	76.187 – 76.213 mm (2.8995 – 3.0005 in.)
Out of Round (Max.)	0.0254 mm (0.001 in.)
Taper (Max.)	0.0254 mm (0.001 in.)
Bearing Clearance	0.0051 – 0.058 mm (0.0002 – 0.0023 in.)
Service Limit	0.071 mm (0.0028 in.)
End Play	0.076 – 0.305 mm (0.003 – 0.012 in.)
Service Limit—End Play	0.381 mm (0.015 in.)
CYLINDER BLOCK	
Cylinder Bore Diameter	101.60 – 101.65 mm (4.0003 – 4.0008 in.)
Out of Round (Max.)	0.0762 mm (0.003 in.)
Taper (Max.)	0.127 mm (0.005 in.)
Lifter Bore Diameter	22.982 – 23.010 mm (0.9048 – 0.9059 in.)

DESCRIPTION	SPECIFICATION
CYLINDER HEAD AND VALVES	
Valve Seat Angle	44.5°
Runout (Max.)	0.0762 mm (0.003 in.)
Width (Finish) – Intake	1.016 – 1.524 mm (0.040 – 0.060 in.)
Valve Face Angle	45°
Valve Head Diameter	
Intake	48.640 – 48.900 mm (1.915 – 1.925 in.)
Exhaust	41.123 – 41.377 mm (1.619 – 1.629 in.)
Overall Length	
Intake	145.19 – 145.82 mm (5.716 – 5.741 in.)
Exhaust	145.54 – 146.18 mm (5.730 – 5.755 in.)
Lift (@ zero lash)	
Intake	9.91 mm (0.390 in.)
Exhaust	10.34 mm (0.407 in.)
Stem Diameter	7.900 – 7.920 mm (0.311 – 0.312 in.)
Guide Bore	9.500 – 9.525 mm (0.374 – 0.375 on.)
Stem to Guide Clearance	0.025 – 0.076 mm (0.001 – 0..003 in.)
Service Limit (Runout)	0.4318 (0.017 in.)
Valve Spring Free Length	49.962 mm (1.967 in.)
Spring Tension	
Valve Closed	378 N @ 41.66 mm (85 lbs. @ 1.64 in.)
Valve Open	890 N @ 30.89 mm (200 lbs. @ 1.212 in.)
Number of Coils	6.8
Installed Height	41.66 mm (1.64 in.)
Wire Diameter	4.50 mm (0.177 in.)

ENGINE 8.0L (Continued)

DESCRIPTION	SPECIFICATION
HYDRAULIC TAPPETS	
Body Diameter	22.949 – 22.962 mm (0.9035 – 0.9040 in.)
Clearance (to bore)	0.0203 – 0.0610 mm (0.0008 – 0.0024 in.)
Dry Lash	1.524 – 5.334 mm (0.060 – 0.210 in.)
Push Rod Length	195.52 – 196.02 mm (7.698 – 7.717 in.)
OIL PRESSURE	
Curb Idle (Min.*)	83 kPa (12 psi)
@ 3000 rpm	345 – 414 kPa (50 – 60 psi)
* If oil pressure is zero at curb idle, DO NOT RUN ENGINE.	
OIL PUMP	
Clearance over Rotors (Max.)	0.1906 mm (0.0075 in.)
Cover Out of Flat (Max.)	0.051 mm (0.002 in.)
Inner Rotor Thickness (Min.)	14.925 – 14.950 mm (0.5876 – 0.5886 in.)
Outer Rotor	
Clearance (Max.)	0.1626 mm (0.006 in.)
Diameter (Min.)	82.461 mm (3.246 in.)
Thickness (Min.)	14.925 mm (0.5876 in.)
Tip Clearance between Rotors (Max.)	0.584 mm (0.0230 in.)
PISTONS	
Clearance at Top of Skirt	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Piston Length	82.5 mm (3.25 in.)
Piston Ring Groove Depth	
#1&2	91.30 – 91.55 mm (3.594 – 3.604 in.)
#3	92.90 – 93.15 mm

DESCRIPTION	SPECIFICATION
	(3.657 – 3.667 in.)
Weight	463 – 473 grams (16.33 – 16.68 oz.)
Piston to Bore Clearance	0.013 – 0.038 mm (0.0005 – 0.0015 in.)
Service Limit	0.0762 mm (0.003 in.)
PISTON PINS	
Clearance in Piston	0.010 – 0.020 mm (0.0004 – 0.0008 in.)
Diameter	24.996 – 25.001 mm (0.9841 – 0.9843 in.)
End Play	NONE
Length	67.8 – 68.3 mm (2.67 – 2.69 in.)
PISTON RINGS	
Ring Gap	
Compression Rings	0.254 – 0.508 mm (0.010 – 0.020 in.)
Oil Control (Steel Rails)	0.381 – 1.397 mm (0.015 – 0.055 in.)
Ring Side Clearance	
Compression Rings	0.074 – 0.097 mm (0.0029 – 0.0038 in.)
Oil Ring (Steel Rails)	2.591 – 2.743 mm (0.102 – 0.108 in.)
VALVE TIMING	
Exhaust Valve	
Closes (ATDC)	25°
Opens (BBDC)	60°
Duration	265°
Intake Valve	
Closes (ATDC)	61°
Opens (BBDC)	6°
Duration	246°
Valve Overlap	31°

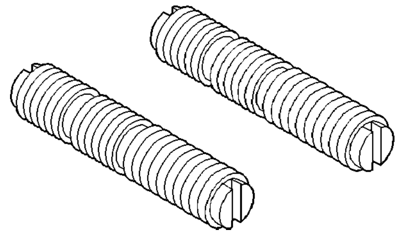
ENGINE 8.0L (Continued)

CRANKSHAFT JOURNAL MARKING LOCATION

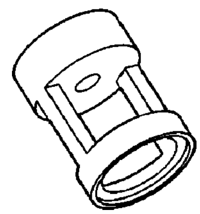
MEASURE-MENT	ITEM	IDENTIFI-CATION	LOCATION OF IDENTIFI-CATION
0.0254 mm (0.001 in.) U/S	Crankshaft Journals	R or M M-2-3 ect. (indicating No. 2 and 3 main bearing journal) and/or R-1-4 ect. (indicating No. 1 and 4 connecting rod journal)	Milled flat on No. 8 crankshaft counter-weight.
0.508 mm (0.020 in.) O/S	Cylinder Bores	A	Following engine serial number.
0.2032 mm (0.008 in.) O/S	Hydraulic Tappets	◊	Diamond-shaped stamp top pad - front of engine and flat ground on outside surface of each O/S tappet bore.
0.127 mm (0.005 in.)	Valve Stems	X	Milled pad adjacent to two tapped holes 3/8″ on each end of cylinder head.

SPECIAL TOOLS

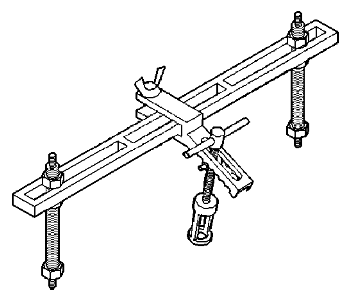
8.0L ENGINE



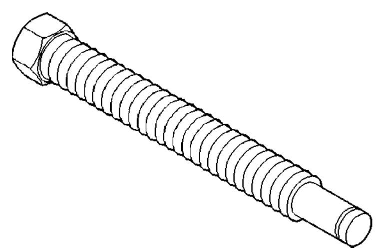
Valve Compressor Adapting Stud Tool 6715



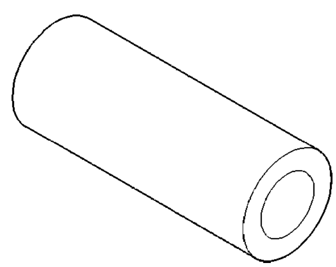
Valve Spring Compressor Adapter Tool 6716A



Valve Spring Compressor Tool MD-998772A

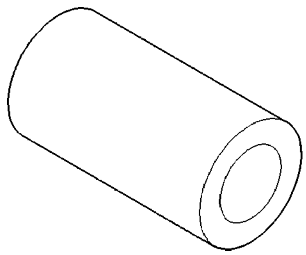


Valve Spring Compressor Screw Tool 6756

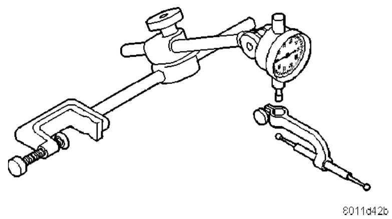


Black Valve Guide Sleeve Tool C6819

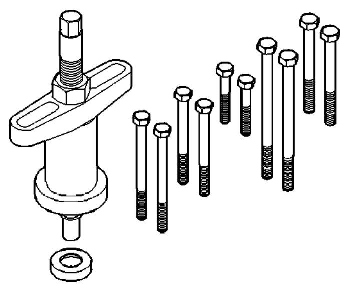
ENGINE 8.0L (Continued)



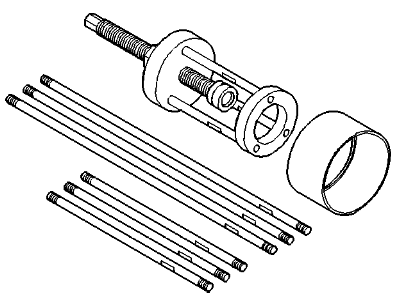
Silver Valve Guide Sleeve Tool C6818



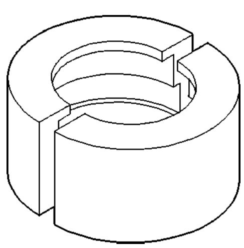
Dial Indicator Tool C3339



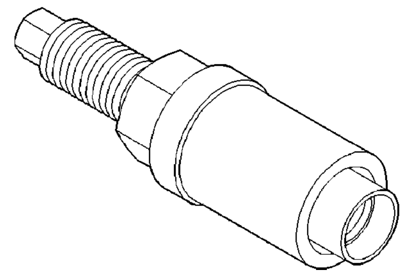
Crankshaft Pulley/Damper Installer Tool C3688



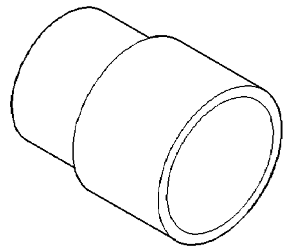
Crankshaft Sprocket Puller Tool 6444



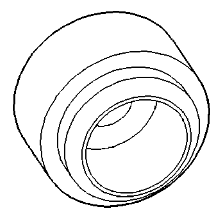
Crankshaft Sprocket Puller Jaws Tool 6820



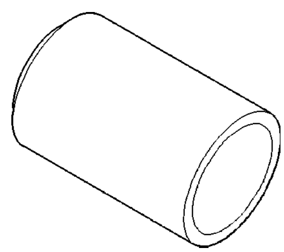
Crankshaft Sprocket Installer Tool 3718



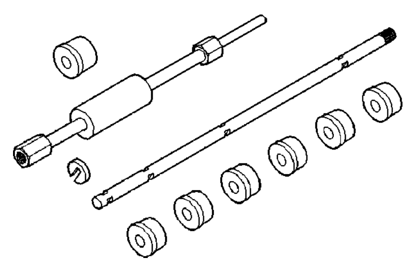
Crankshaft Sprocket Installer Tool MD990799



Front Oil Seal Installer Tool 6806

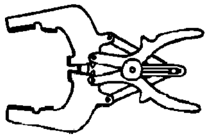


Front Oil Seal Installer Tool 6761

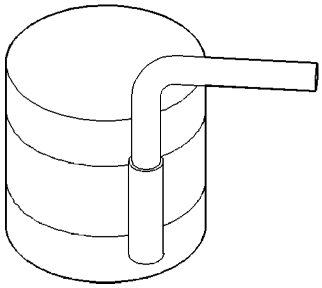


Camshaft Bearing Installer Tool C3132A

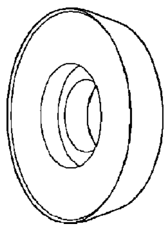
ENGINE 8.0L (Continued)



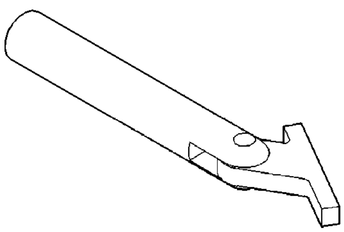
Compression Ring Installer Tool C4184



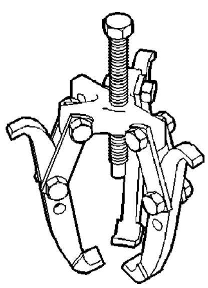
Piston Ring Compressor Tool C385



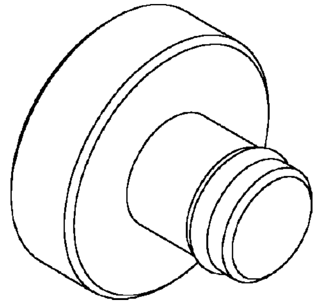
Seal Installer Tool 6687



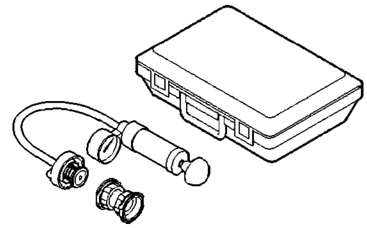
Crankshaft Main Bearing Remover/Installer Tool C3059



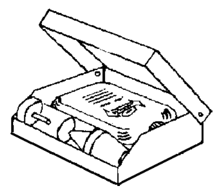
Puller 1026



Crankshaft Damper Removal Insert 8513



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A

AIR CLEANER ELEMENT

REMOVAL

Filter Element Only

Housing removal is not necessary for element (filter) replacement.

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Pry over 4 spring clips (Fig. 4) from housing cover (spring clips retain cover to housing).

(3) Release housing cover from locating tabs on housing (Fig. 4) and remove cover.

(4) Remove air cleaner element (filter) from housing.

(5) Clean inside of housing before replacing element.

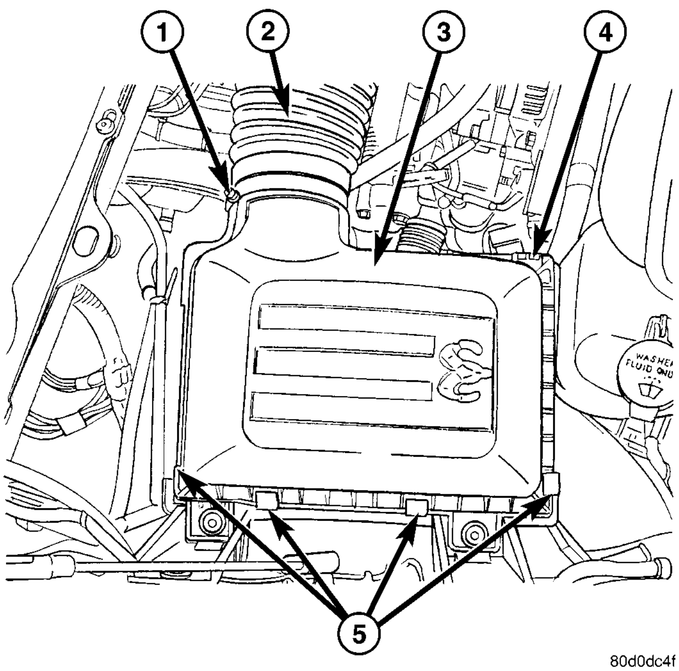


Fig. 4 AIR CLEANER HOUSING COVER

1 - CLAMP
2 - AIR DUCT
3 - AIR CLEANER COVER
4 - LOCATING TABS
5 - CLIPS (4)

Housing Assembly

(1) Loosen clamp (Fig. 4) and disconnect air duct at air cleaner cover.

(2) Lift entire housing assembly from 4 locating pins (Fig. 5).

INSTALLATION

(1) Install filter element into housing.

(2) Position housing cover into housing locating tabs (Fig. 4).

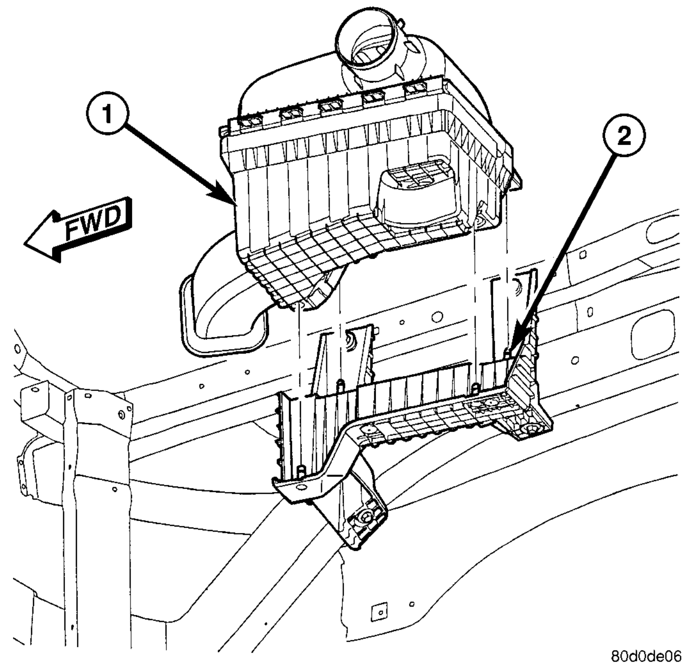


Fig. 5 AIR CLEANER HOUSING

1 - AIR CLEANER HOUSING ASSEMBLY
2 - LOCATING PINS (4)

(3) Pry up 4 spring clips (Fig. 4) and lock cover to housing.

(4) Install air duct to air cleaner cover and tighten hose clamp to 3 N·m (30 in. lbs.) torque.

(5) If any other hose clamps were removed from air intake system, tighten them to 3.4 N·m (30 in. lbs.) torque.

(6) If any bolts were removed from air resonator housing or air intake tubing, tighten them to 4.5 N·m (40 in. lbs.) torque.

CYLINDER HEAD

DESCRIPTION

The alloy cast iron cylinder heads (Fig. 6) are held in place by 12 bolts. The spark plugs are located in the peak of the wedge between the valves.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET FAILURE

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

• Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
  - Loss of engine power
  - Engine misfiring
  - Poor fuel economy

CYLINDER HEAD (Continued)

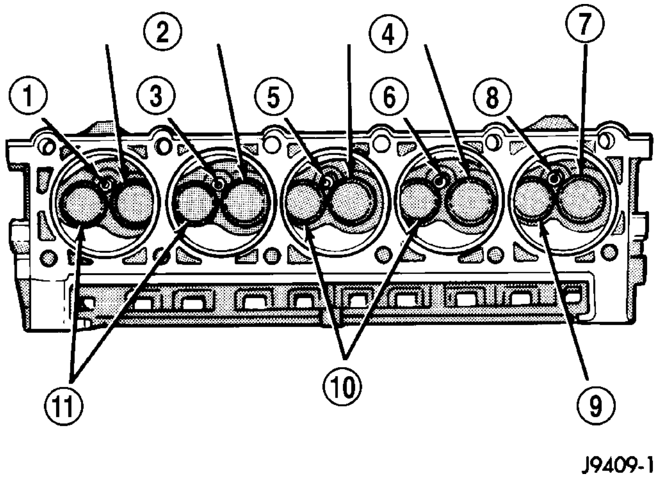


Fig. 6 Cylinder Head Assembly

1 - SPARK PLUG
2 - INTAKE VALVES
3 - SPARK PLUG
4 - INTAKE VALVES
5 - SPARK PLUG
6 - SPARK PLUG
7 - INTAKE VALVE
8 - SPARK PLUG
9 - EXHAUST VALVE
10 - EXHAUST VALVES
11 - EXHAUST VALVES

• Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test in this section. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50–70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).
(3) Remove the heat shields (Fig. 7).

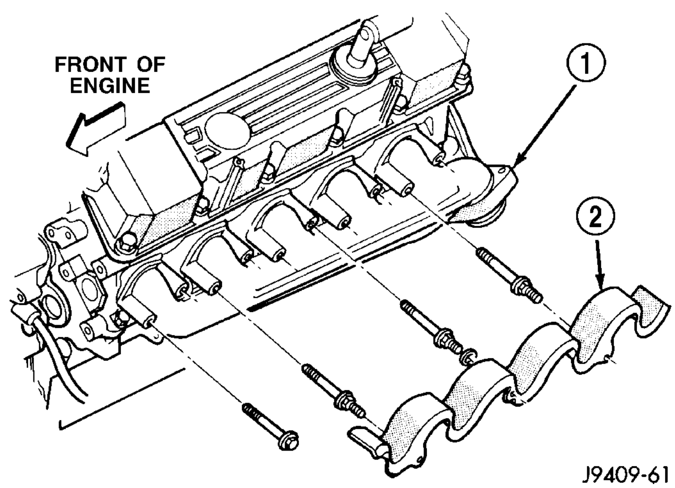


Fig. 7 Spark Plug Wire Heat Shields (Left Side Shown)

1 - EXHAUST MANIFOLD
2 - HEAT SHIELD

(4) Remove the intake manifold-to-generator bracket support rod. Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(5) Remove closed crankcase ventilation system.
(6) Disconnect the evaporation control system.
(7) Remove the air cleaner.
(8) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the

CYLINDER HEAD (Continued)

fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(9) Disconnect accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(10) Remove coil pack and bracket (Fig. 8).

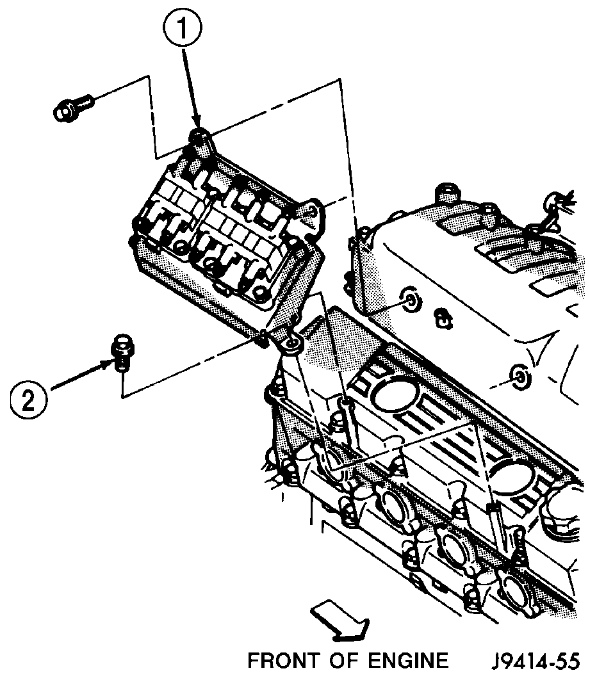


Fig. 8 Coil Pack and Bracket

1 - COIL PACKS AND BRACKET
2 - MOUNTING BOLTS (4)

(11) Disconnect the coil wires.

(12) Disconnect heat indicator sending unit wire.

(13) Disconnect heater hoses and bypass hose.

(14) Remove upper intake manifold and throttle body as an assembly (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(15) Remove cylinder head covers and gaskets (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(16) Remove the EGR tube. Discard the gasket, for right side only.

(17) Remove lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL). Discard the flange side gaskets and the front and rear cross-over gaskets.

(18) Disconnect exhaust pipe from exhaust manifold.

(19) Remove exhaust manifolds and gaskets (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL).

(20) Remove rocker arm assemblies and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify to ensure installation in original locations.

(21) Remove the head bolts from each cylinder head and remove cylinder heads. Discard the cylinder head gasket.

(22) Remove spark plugs.

CLEANING

Clean all surfaces of cylinder block and cylinder heads. Be sure material does not fall into the lifters and surrounding valley.

Clean cylinder block front and rear gasket surfaces using a suitable solvent.

Clean the exhaust manifold to cylinder head mating areas.

INSPECTION

Inspect all surfaces with a straightedge if there is any reason to suspect leakage. The out-of-flatness specifications are 0.0007 mm/mm (0.0004 inch/inch), 0.127 mm/152 mm (0.005 inch/6 inches) any direction or 0.254 mm (0.010 inch) overall across head. If exceeded, either replace head or lightly machine the head surface.

The cylinder head surface finish should be 1.78-4.57 microns (15-80 microinches).

Inspect push rods. Replace worn or bent rods.

Inspect rocker arms. Replace if worn or scored.

INSTALLATION

(1) Position the new cylinder head gaskets onto the cylinder block.

(2) Position the cylinder heads onto head gaskets and cylinder block.

(3) Tighten the cylinder head bolts in two steps (Fig. 9):

- Step 1—Tighten all cylinder head bolts, in sequence, to 58 N·m (43 ft. lbs.) torque.
- Step 2—Tighten all cylinder head bolts, in sequence, to 143 N·m (105 ft. lbs.) torque.
-

CAUTION: When tightening the rocker arm bolts, make sure the piston in that cylinder is NOT at TDC. Contact between the valves and piston could occur.

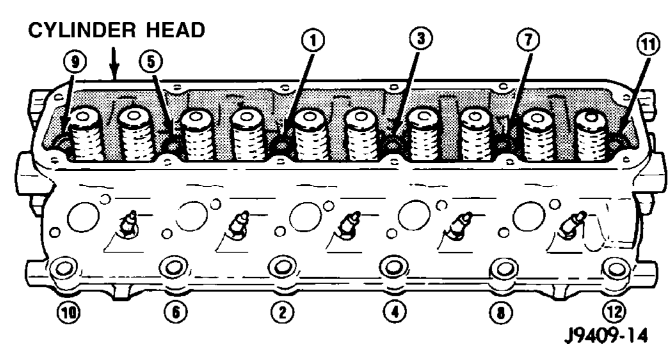


Fig. 9 Cylinder Head Bolt Tightening Sequence

CYLINDER HEAD (Continued)

(4) Install push rods and rocker arm assemblies in their original position (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(5) Install lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(6) Install the upper intake manifold onto the lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(7) Install the exhaust manifolds and new gaskets (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION).

(8) Install exhaust pipe to the exhaust manifold. Tighten the bolts to 34 n·m (25 ft. lbs.) torque.

(9) Using a new gasket, position the EGR tube to the intake manifold and the exhaust manifold. Tighten the EGR tube nut to 34 N·m (25 ft. lbs.) torque. Tighten the bolts to 20 N·m (174 in. lbs.) torque.

(10) Install the heat shields and the washers. **Make sure that heat shields tabs hook over the exhaust gasket.** Tighten the nuts to 15 N·m (132 in. lbs.) torque.

(11) Adjust and Install the spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - INSTALLATION).

(12) Install coil packs and bracket. Tighten the bracket bolts to 21 N·m (190 in. lbs.) torque. Connect the coil wires.

(13) Connect heat indicator sending unit wire.

(14) Connect the heater hoses and bypass hose.

(15) Connect the accelerator linkage and if so equipped, the speed control and transmission kick-down cables.

(16) Install the fuel line (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(17) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION) and drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(18) Install the intake manifold-to-generator bracket support rod. Tighten the bolts to 41 N·m (30 ft. lbs.) torque.

(19) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(20) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(21) Install closed crankcase ventilation system.

(22) Connect the evaporation control system.

(23) Install the air cleaner.

(24) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(25) Connect the negative cable to the battery.

(26) Check for leaks (fuel, oil, antifreeze, etc.).

CYLINDER HEAD COVER(S)

DESCRIPTION

Die-cast magnesium cylinder head covers (Fig. 10) reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover. This gasket can be used again.

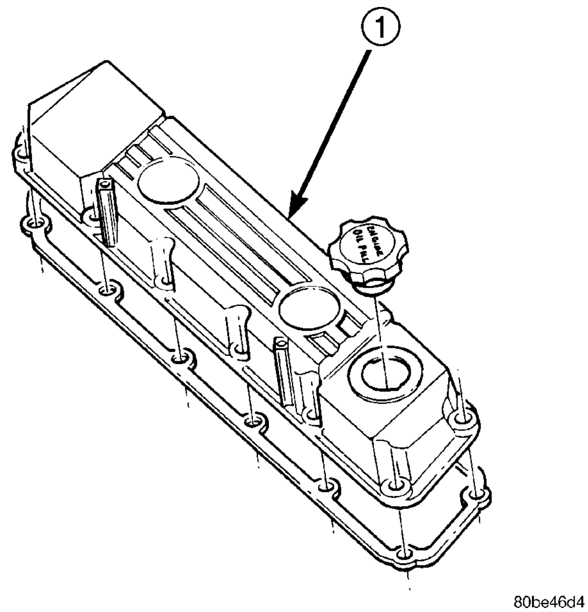


Fig. 10 Cylinder Head Cover

1 - CYLINDER HEAD COVER

REMOVAL

Die-cast magnesium cylinder head covers (Fig. 12) reduce noise and provide a good sealing surface. A steel backed silicon gasket is used with the cylinder head cover (Fig. 11).

(1) Disconnect the negative cable from the battery.

(2) Disconnect closed ventilation system and evaporation control system from cylinder head cover. Identify each system for installation.

(3) Remove the upper intake manifold to remove the right side head cover (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

CYLINDER HEAD COVER(S) (Continued)

(4) Remove cylinder head cover bolts and stud bolts. Remove the covers and gaskets (Fig. 11). The gasket may be used again.

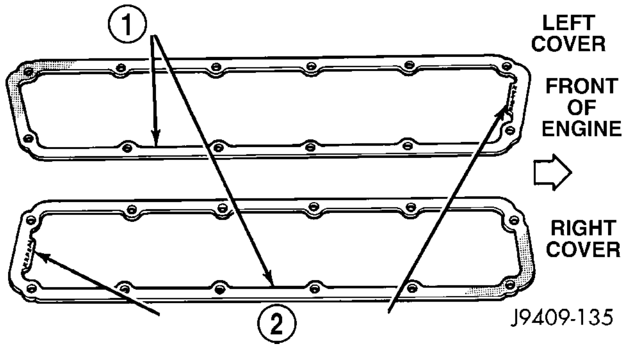


Fig. 11 Cylinder Head Cover Gaskets

1 - CYLINDER HEAD COVER GASKETS
2 - TAB WITH NUMBER UP

CLEANING

Clean cylinder head cover gasket surface.

Clean head rail, if necessary.

INSPECTION

Inspect cover for distortion and straighten, if necessary.

Check the gasket for use in head cover installation. If damaged, use a new gasket.

INSTALLATION

(1) Check the gasket for use in head cover installation. If damaged, use a new gasket.

(2) Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(3) Position the cylinder head cover onto the gasket. Install the stud bolts and hex head bolts in the proper positions (Fig. 12). Tighten the stud bolts and the bolts to 16 N·m (144 in. lbs.) torque.

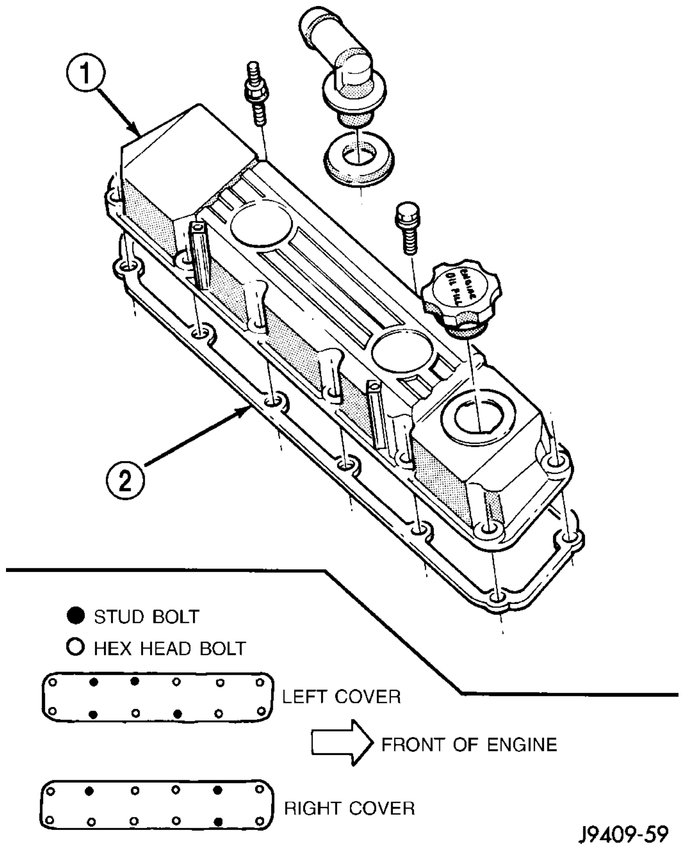


Fig. 12 Cylinder Head Covers

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

(4) If removed, install the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(5) Install closed crankcase ventilation system and evaporation control system onto the proper head cover. DO NOT switch the systems.

(6) Connect the negative cable to the battery.

(7) Start engine and check for leaks.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves (Fig. 13) are arranged in-line and inclined 18°. The rocker pivot support and the valve guides are cast integral with the heads.

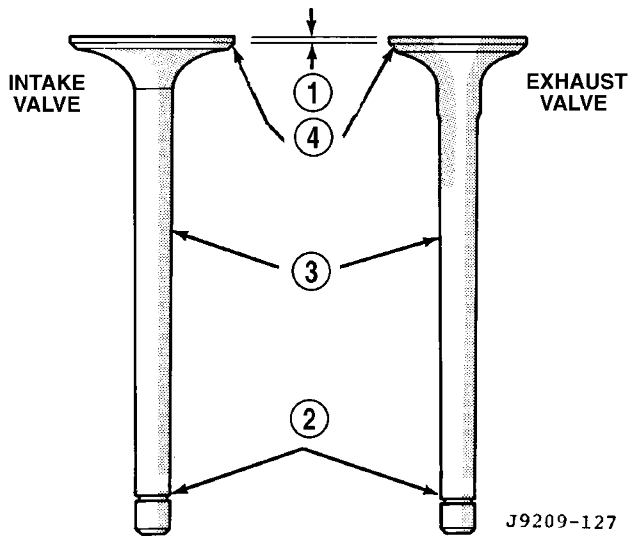


Fig. 13 Intake and Exhaust Valves—8.0L Engine

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

STANDARD PROCEDURE

VALVE SERVICE

VALVE GUIDES

Measure valve stem guide clearance as follows:

(1) Install Black Valve Guide Sleeve Tool C-6819 over valve stem for the **INTAKE** valve and install valve (Fig. 14). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Install Silver Valve Guide Sleeve Tool C-6818 over valve stem for the **EXHAUST** valve and install valve. The special sleeve places the valve at the correct height for checking with a dial indicator.

(3) Attach Dial Indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 15).

(4) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 inch). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available as shown below

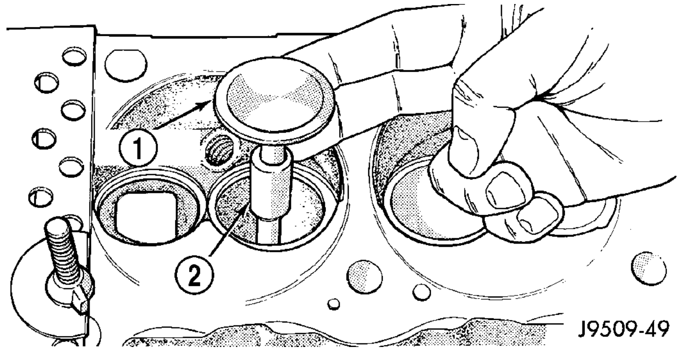


Fig. 14 Positioning Valve Spacer Tool (Typical)

1 - VALVE
2 - SPACER TOOL

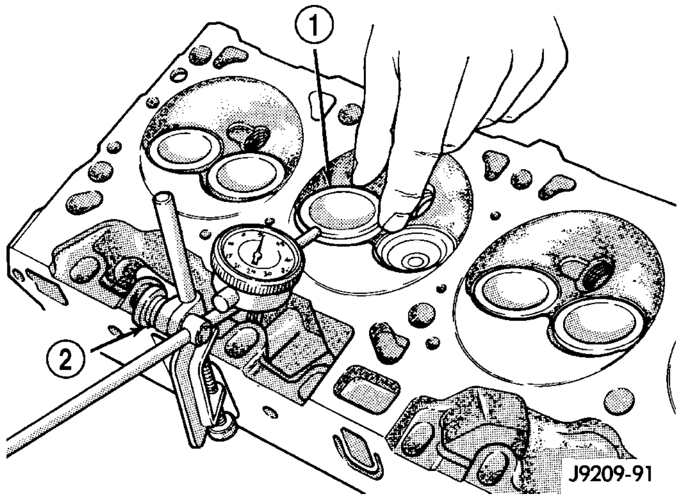


Fig. 15 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

REAMER SIZE CHART

REAMER O/S	VALVE GUIDE SIZE
0.076 mm (0.003 in.)	8.026 - 8.052 mm (0.316 - 0.317 in.)
0.381 mm (0.015 in.)	8.331 - 8.357 mm (0.316 - 0.329 in.)

(5) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Ream the valve guides from standard to 0.381 mm (0.015 inch). Use a 2 step procedure so the valve guides are reamed true in relation to the valve seat:**

- Step 1—Ream to 0.0763 mm (0.003 inch).
- Step 2—Ream to 0.381 mm (0.015 inch).

INTAKE/EXHAUST VALVES & SEATS (Continued)

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 45° face angle and a 45° to 44 1/2° seat angle (Fig. 16).

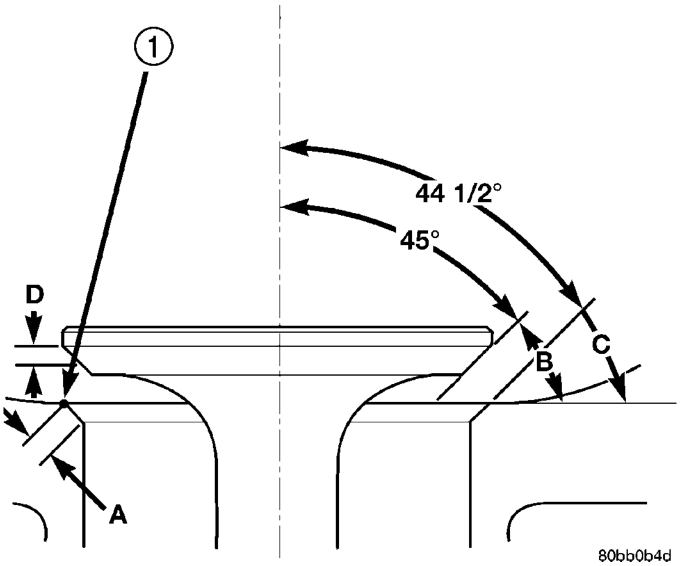


Fig. 16 Valve Face and Seat Angles

1 - CONTACT POINT

VALVE FACE AND SEAT ANGLES CHART

ITEM	DESCRIPTION	SPECIFICATION
A	SEAT WIDTH INTAKE	1.016 - 1.524 mm (0.040 - 0.060 in.)
	SEAT WIDTH EXHAUST	1.016 - 1.524 mm (0.040 - 0.060 in.)
B	FACE ANGLE (INT. and EXT.)	45°
C	SEAT ANGLE (INT. and EXT.)	44½°
D	CONTACT SURFACE	—

VALVES

Inspect the remaining margin after the valves are refaced (Fig. 17). Valves with less than 1.190 mm (0.047 inch) margin should be discarded.

VALVE SEATS

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

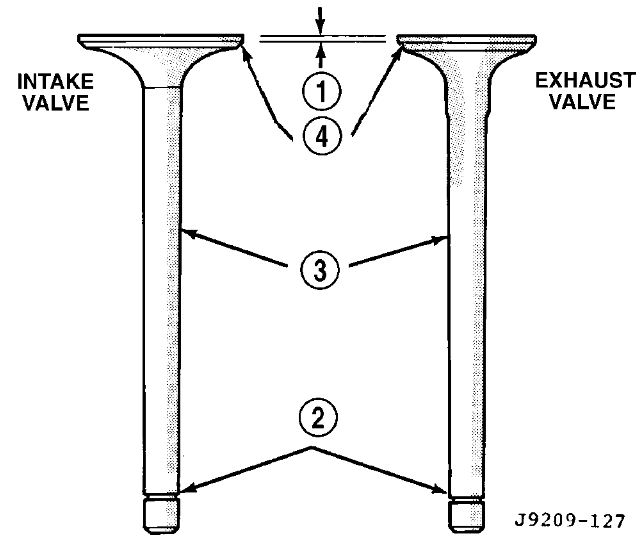


Fig. 17 Intake and Exhaust Valves

1 - MARGIN
2 - VALVE SPRING RETAINER LOCK GROOVE
3 - STEM
4 - FACE

(2) Measure the concentricity of valve seat using a dial indicator. Total runout should not exceed 0.038 mm (0.0015 inch) total indicator reading.

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to the top edge of valve face, lower valve seat with a 15° stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60° stone.

(4) When seat is properly positioned the width of valve seats should be 1.016-1.524 mm (0.040-0.060 inch).

VALVE SPRING INSPECTION

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inch. Turn table of Universal Valve Spring Tester Tool until surface is in line with the 1-5/16 inch mark on the threaded stud. Be sure the zero mark is to the front (Fig. 18). Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by 2. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

INTAKE/EXHAUST VALVES & SEATS (Continued)

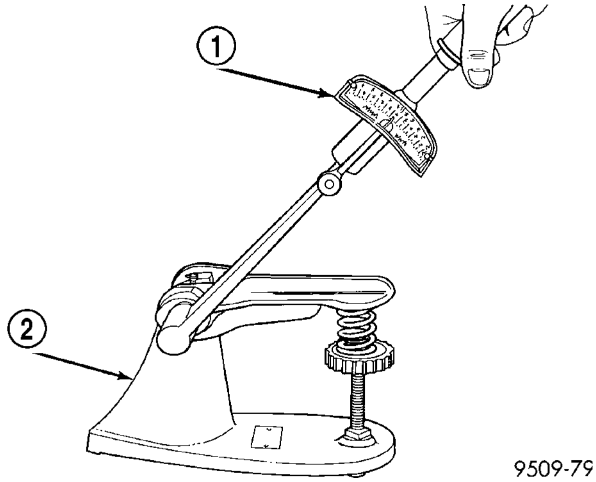


Fig. 18 Testing Valve Spring for Compressed

1 - TORQUE WRENCH
2 - VALVE SPRING TESTER

REMOVAL

REMOVAL—VALVE STEM SEALS

NOTE: This procedure is done with the cylinder head installed.

(1) Disconnect the negative cable from the battery.

(2) Set engine basic timing to Top Dead Center (TDC) and remove air cleaner.

(3) Remove cylinder head covers (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL) and spark plugs (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL).

(4) Using suitable socket and flex handle at crankshaft retaining bolt, turn engine so that the piston of the cylinder to be worked on, is at TDC on the compression stroke.

(5) Remove rocker arms (Refer to 9 - ENGINE/ CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL).

(6) With air hose attached to an adapter installed in the spark plug hole, apply 620-689 kPa (90-100 psi) air pressure.

(7) Using Valve Spring Compressor Tool MD-998772A with adapter 6716A (Fig. 19), compress valve spring and remove retainer valve locks and valve spring.

(8) Remove the valve stem seal.

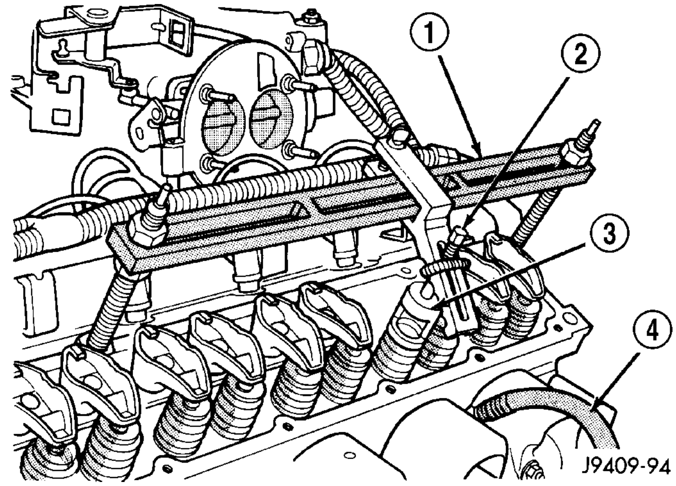


Fig. 19 Valve Spring Compressor MD-998772A with Adaptor 6716-A and Screw 6765

1 - SPECIAL TOOL MD 998772A
2 - SPECIAL TOOL 6765
3 - SPECIAL TOOL 6716A
4 - AIR HOSE

REMOVAL—VALVES AND VALVE SPRINGS

(1) Remove the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(2) Special studs must be used to adapt the Valve Spring Compressor Tool to the V-10 cylinder head (Fig. 20). Install the metric end into the Special Tool MD998772A and the 5/16 end into the cylinder head.

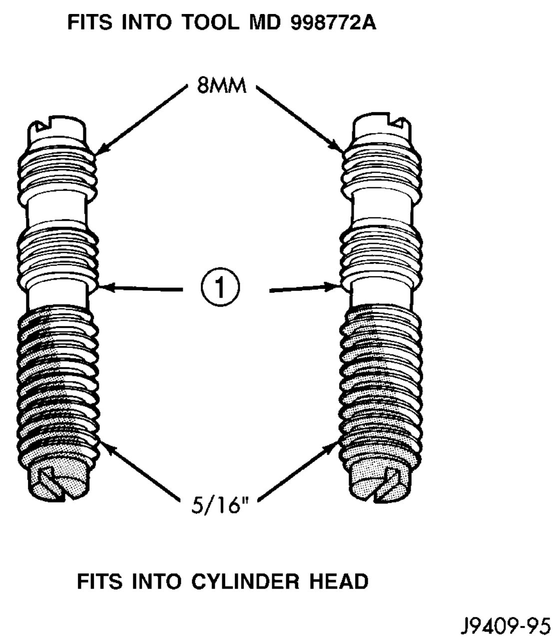


Fig. 20 Special Studs 6715 for V-10 Engine

1 - SPECIAL TOOL 6715

INTAKE/EXHAUST VALVES & SEATS (Continued)

(3) Compress valve springs using Valve Spring Compressor Tool MD-998772A with Adapter 6716A and Screw 6765 (Fig. 21). Tap the retainer using a brass drift and ball peen hammer to loosen locks away from retainer.

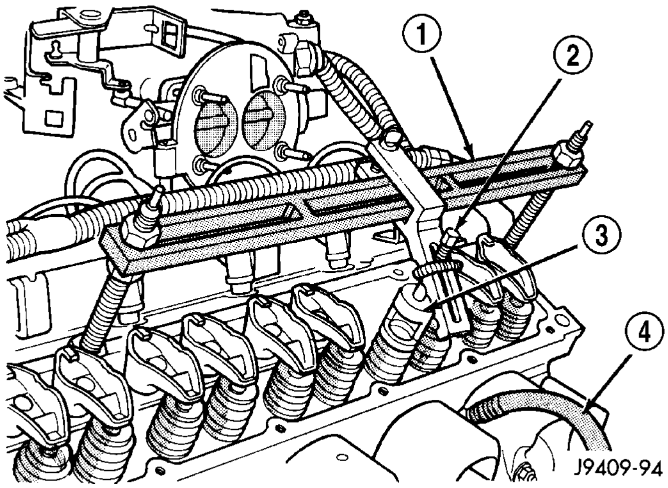


Fig. 21 Valve Spring Compressor MD-998772A with Adaptor 6716-A and Screw 6765

1 - SPECIAL TOOL MD 998772A
2 - SPECIAL TOOL 6765
3 - SPECIAL TOOL 6716A
4 - AIR HOSE

(4) Remove valve retaining locks, valve spring retainers and valve springs. Check for abnormal wear, replace as required.

(5) Remove the valve stem seals.

(6) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to ensure installation in original location.

CLEANING

Clean valves thoroughly. Discard burned, warped, or cracked valves.

Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

INSPECTION

Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 in.), replace the valve.

Measure valve stem guide clearance as follows:

(1) Install Valve Guide Sleeve Tool C-3973 over valve stem and install valve (Fig. 22). The special sleeve places the valve at the correct height for checking with a dial indicator.

(2) Attach dial indicator Tool C-3339 to cylinder head and set it at right angles to valve stem being measured (Fig. 23).

(3) Move valve to and from the indicator. The total dial indicator reading should not exceed 0.432 mm (0.017 in.). Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

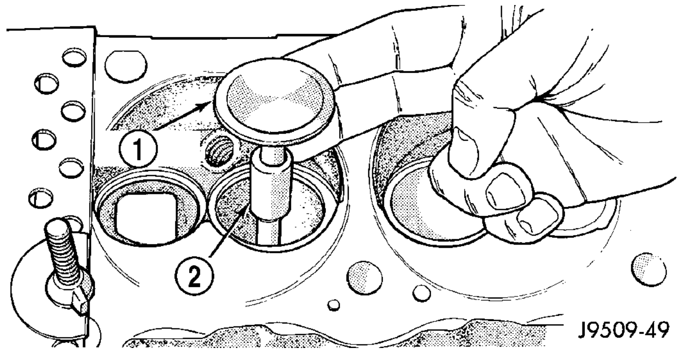


Fig. 22 Positioning Valve with Tool C-3973

1 - VALVE
2 - SPACER TOOL

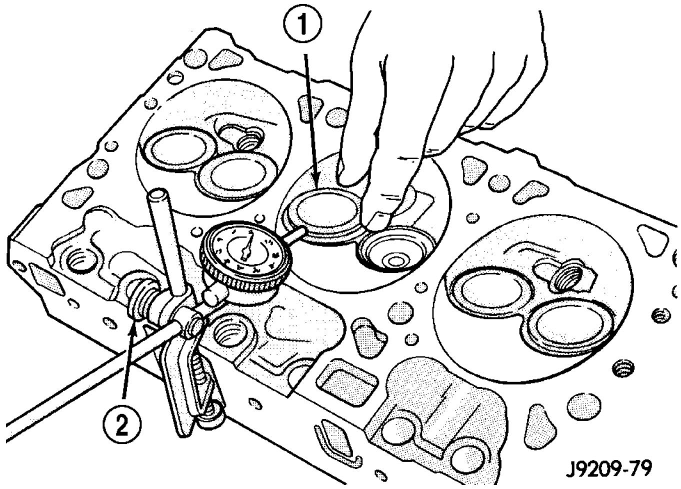


Fig. 23 Measuring Valve Guide Wear

1 - VALVE
2 - SPECIAL TOOL C-3339

INSTALLATION

INSTALLATION—VALVE STEM SEAL

(1) Install new seal onto valve stem.

(2) Position valve spring onto valve stem.

(3) Position Valve Spring Compressor with Adapter Studs onto cylinder head

(4) Compress valve spring and install retainer valve locks.

(5) Remove air hose and adapter from spark plug hole.

(6) Remove Valve Spring Compressor and Adapter Studs.

(7) Install rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

INTAKE/EXHAUST VALVES & SEATS (Continued)

(8) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(9) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION) (Fig. 24).

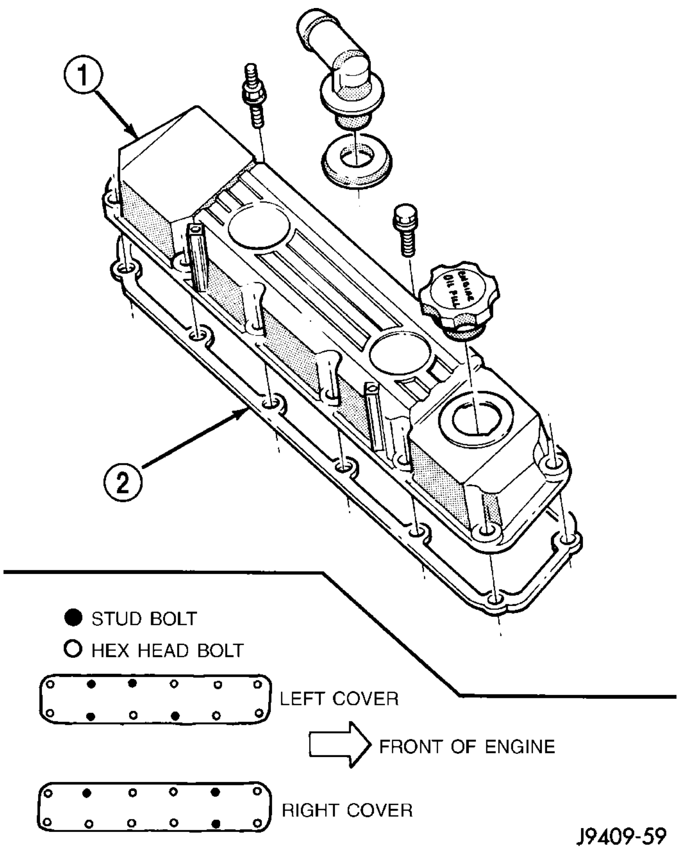


Fig. 24 Cylinder Head Covers

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

(10) Install closed crankcase ventilation system.
(11) Connect the evaporation control system.
(12) Install air cleaner.
(13) Connect the negative cable to the battery.
(14) Road test vehicle and check for leaks.

INSTALLATION—VALVES AND VALVE SPRINGS

(1) Clean valves thoroughly. Discard burned, warped and cracked valves.

(2) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(3) Measure valve stems for wear. If wear exceeds 0.051 mm (0.002 inch), replace the valve.

(4) Make sure there are no burrs on valve stems.

(5) Coat valve stems with lubrication oil. Insert valves into valve guides in cylinder head.

(6) Install new seals on all valve guides **(BLACK on intake and BROWN on exhaust)**. Install valve springs and valve retainers.

(7) Compress valve springs with Valve Spring Compressor Tool MD-998772A and adapter 6716A, install locks and release tool. Tap the retainer with a brass or heavy plastic hammer to ensure locks have been seated.

(8) If valves and/or seats were ground, measure the installed height of springs. Make sure the measurement is taken from bottom of spring seat in cylinder head to the bottom surface of spring retainer. If spacers are installed, measure from the top of spacer. If height is greater than 42.86 mm (1-11/16 inches), install a 1.587 mm (1/16 inch) spacer in head counterbore. Ensure this brings spring height back to normal, 41.27 to 42.86 mm (1-5/8 to 1-11/16 inch).

(9) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

ROCKER ARM / ADJUSTER ASSY

REMOVAL

(1) Disconnect spark plug wires by pulling the boot straight out in line with plug.

(2) Remove cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(3) Remove the rocker arm bolts and the rocker arm assembly (Fig. 25). Place rocker arm assemblies on a bench in the same order as removed.

(4) Remove the push rods and place them on a bench in the same order as removed.

INSTALLATION

CAUTION: DO NOT rotate or crank the engine during or immediately after rocker arm installation. Allow the hydraulic roller tappets adequate time to bleed down (about 5 minutes).

ROCKER ARM / ADJUSTER ASSY (Continued)

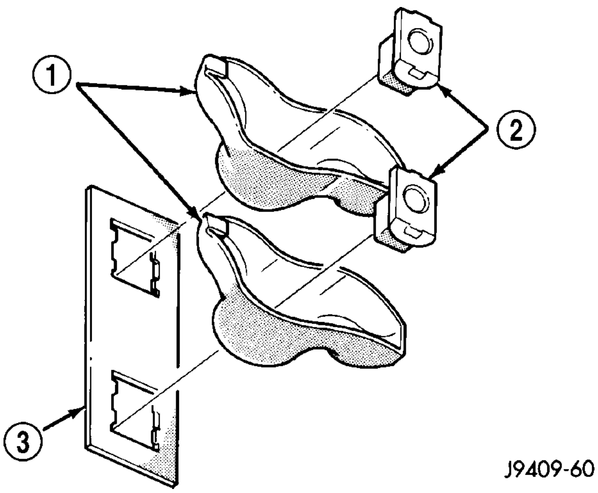


Fig. 25 Rocker Arm - Typical

1 - ROCKER ARMS
2 - ROCKER ARM PEDESTALS
3 - RETAINER

(1) Install the push rods in the same order as removed.

(2) Install rocker arm assemblies in the same order as removed. Tighten the rocker arm bolts to 53 N·m (40 ft. lbs.) torque.

(3) Install cylinder head cover and gasket (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(4) Connect spark plug wires.

ENGINE BLOCK

CLEANING

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

INSPECTION

Examine block for cracks or fractures.

The cylinder walls should be checked for out-of-round and taper with Cylinder Bore Indicator Tool, Special tool 6879 or equivalent. The cylinder block should be bored and honed with new pistons and rings fitted if:

- The cylinder bores show more than 0.127 mm (0.005 inch) out-of-round.
- The cylinder bores show a taper of more than 0.254 mm (0.010 inch).
- The cylinder walls are badly scuffed or scored.

Boring and honing operation should be closely coordinated with the fitting of pistons and rings so specified clearances may be maintained.

CAMSHAFT & BEARINGS (IN BLOCK)

REMOVAL

REMOVAL—CAMSHAFT BEARINGS

This procedure requires that the engine is removed from the vehicle.

(1) With engine completely disassembled, drive out rear cam bearing core hole plug.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available, such as recommended tool 8544 Camshaft Bushing Remover Installer.

(2) Using recommended tool 8544 Camshaft Bushing Remover Installer, Drive out bearing shells.

REMOVAL—CAMSHAFT

(1) Remove rocker arms and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify each part so it can be installed in its original location.

NOTE: The 4 corner tappets can not be removed without removing the cylinder heads and gaskets. However, they can be lifted and retained for camshaft removal.

(2) Remove the Bolts retaining the yoke retaining spider. Remove the yoke retaining spider, tappet aligning yokes and tappets.

(3) Remove upper and lower intake manifolds (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

(4) Remove timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL) and timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(5) Remove camshaft thrust plate (Fig. 26).

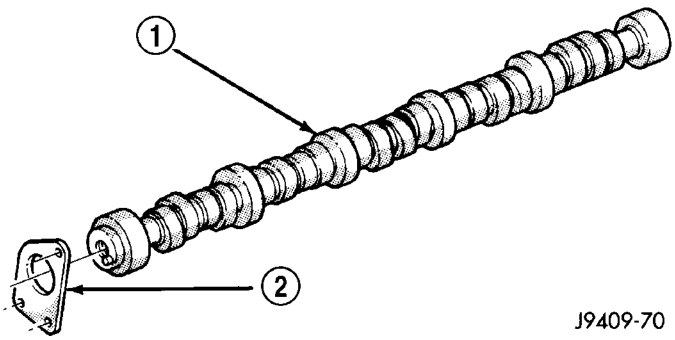


Fig. 26 Camshaft

1 - CAMSHAFT
2 - THRUST PLATE

(6) Install a long bolt into front of camshaft to aid in removal of the camshaft. Remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

INSTALLATION—CAMSHAFT BEARINGS

(1) Install new camshaft bearings using recommended Tool 8544 Camshaft Bushing Remover Installer, by sliding the new camshaft bearing shell over proper adapter.

(2) Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

INSTALLATION—CAMSHAFT

(1) Lubricate camshaft lobes and camshaft bearing journals. Using a long bolt, insert the camshaft into the cylinder block.

NOTE: Whenever an engine has been rebuilt, a new camshaft and/or new tappets installed, add 1 pint of Mopar® Crankcase Conditioner, or equivalent. The oil mixture should be left in engine for a minimum of 805 km (500 miles). Drain at the next normal oil change.

(2) Install camshaft thrust plate. Tighten the torx bolts to 22 N·m (16 ft. lbs.) torque.

(3) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(4) Line up key with keyway in sprocket, then using Special Tools C-3688, C-3718 and MB990799 install crankshaft timing sprocket. Make sure the sprocket seats against the crankshaft shoulder (Fig. 27).

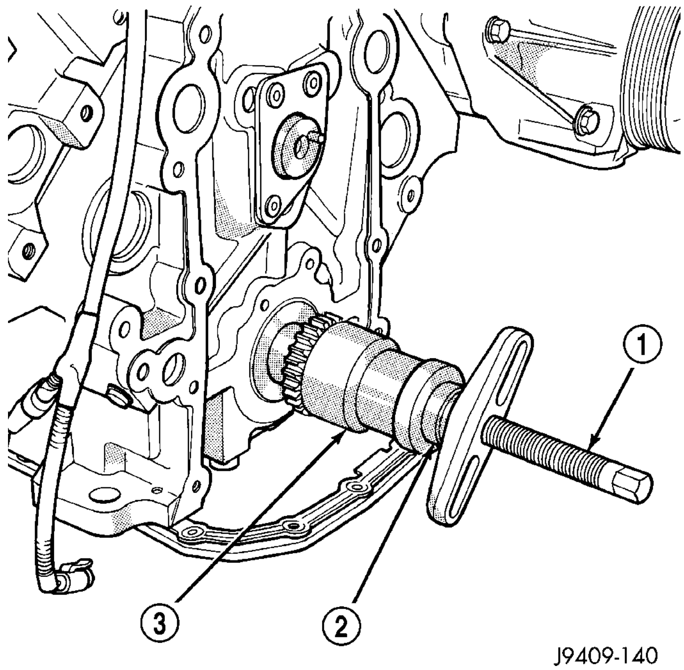


Fig. 27 Crankshaft Sprocket Installation

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL C-3718
3 - SPECIAL TOOL MD990799

(5) Install timing chain and sprocket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(7) Install the crankshaft pulley/damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(9) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced.**

(10) Install tappets and push rods in their original location.

(11) Position the tappet aligning yokes and yoke retaing spider.

(12) Install the retaining spider mounting bolts. Tighten bolts to 22 N·m (16 ft. lbs.).

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

(13) Install the rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(14) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

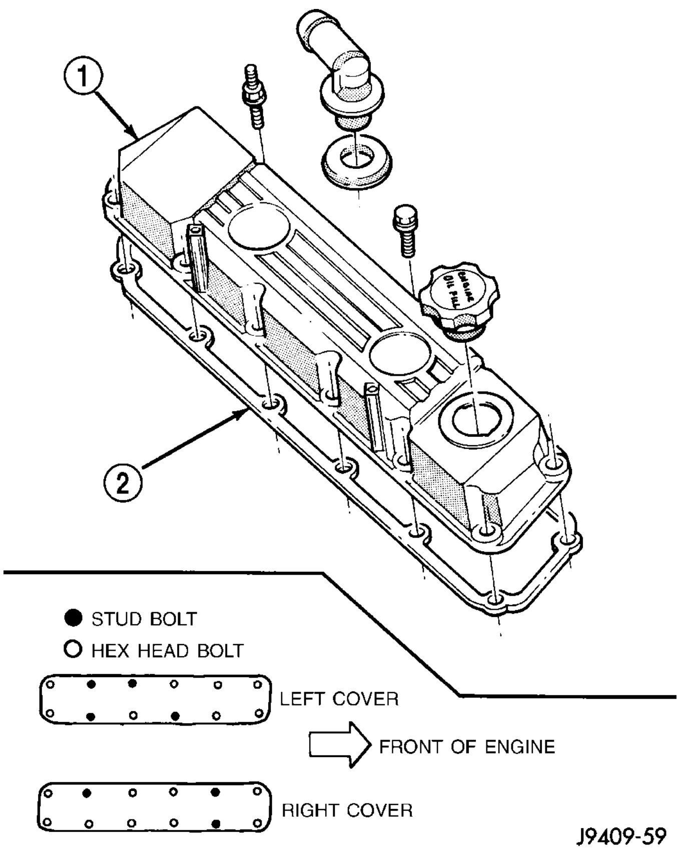


Fig. 28 Cylinder Head Cover

1 - CYLINDER HEAD COVER
2 - CYLINDER HEAD COVER GASKET

CAUTION: The cylinder head cover fasteners have a special plating. DO NOT use alternative fasteners.

(15) Install cylinder head cover (Fig. 28) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(16) Install the intake manifolds (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(17) Start engine and check for leaks.

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING ROD BEARING FITTING

Fit all rods on a bank until completed. DO NOT alternate from one bank to another, because connecting rods and pistons are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly.

Each bearing cap has a small V-groove across the parting face. When installing the lower bearing shell, be certain that the V-groove in the shell is in line with the V-groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined grooves in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.), 0.051 mm (0.002 in.), 0.076 mm (0.003 in.), 0.254 mm (0.010 in.) and 0.305 mm (0.012 in.) undersize. **Install the bearings in pairs. DO NOT use a new bearing half with an old bearing half. DO NOT file the rods or bearing caps.**

CRANKSHAFT

REMOVAL

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

(1) Remove the oil pan and oil pickup tube (refer to Oil Pan in this section for correct procedure).

(2) Remove the timing chain cover and gasket. Remove and discard the front crankshaft oil seal and cover gasket.

(3) Remove Transmission (refer to Group 21, Transmission).

(4) Remove the rear seal retainer (refer to Crankshaft Rear Seal Retainer in this section for correct procedure).

(5) Identify main bearing caps before removal (Fig. 29). Remove bearing caps and lower bearings one at a time.

(6) Remove the connecting rod bearing caps.

(7) Lift the crankshaft straight out of the block.

(8) Remove the upper main bearings from the block.

CRANKSHAFT (Continued)

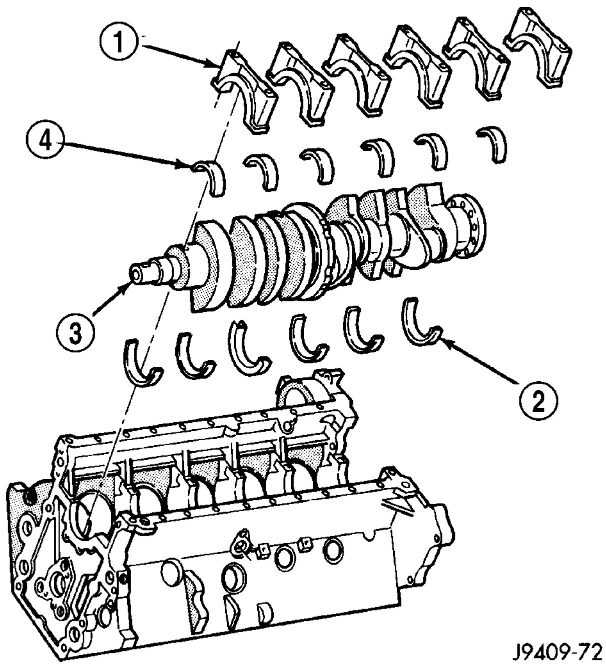


Fig. 29 Main Bearing Identification

1 - MAIN BEARING CAP
2 - UPPER MAIN BEARINGS
3 - CRANKSHAFT
4 - LOWER MAIN BEARINGS

INSTALLATION

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

NOTE: Lubricate crankshaft main bearings with clean engine oil.

(1) Position upper main bearings into block.

(2) Position the crankshaft into the cylinder block.

(3) Lubricate the main journals with clean engine oil. Install upper main bearings, caps and bolts. Follow the 2 step tightening sequence, starting with main bearing cap 1.

(4) Lubricate the connecting rod bearings and journals with clean engine oil. Carefully install connecting rods to the crankshaft.

(5) Using Special Tool 8359 Seal Installer install new oil into oil seal retainer.

(6) Using Special Tool 6687 Guide, install the rear seal retainer with a new gasket.

(7) Install the timing chain cover with a new gasket and oil seal.

(8) Prime oil pump by squirt oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(9) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.

(10) Install the oil pickup tube. Tighten the bolts to 16 N·m (144 in. lbs.) torque.

(11) Install the oil pan.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE—FITTING CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. Upper and lower bearing halves are NOT interchangeable. All lower main bearing halves are interchangeable. Upper main bearing halves of No. 2, 4, and 5 are interchangeable. Upper main bearing halves of No. 1 and 6 are interchangeable, this also applies to the lower bearing halves.

The No.3 main bearing is flanged to carry the crankshaft thrust loads. This bearing is NOT interchangeable with any other bearing halves in the engine. Bearing shells are available in standard and the following undersizes: 0.25 mm (0.001 inch), 0.051 mm (0.002 inch), 0.076 mm (0.003 inch), 0.254 mm (0.010 inch) and 0.305 mm (0.012 inch). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove the oil pan and oil pump pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Identify bearing caps before removal. Remove bearing caps one at a time.

(3) Remove upper half of bearing by inserting Crankshaft Main Bearing Remover/Installer Tool C-3059 into the oil hole of crankshaft (Fig. 30).

(4) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

INSTALLATION

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened. All bearing capbolts removed during service procedures are to be cleaned and oiled before installation.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

CRANKSHAFT MAIN BEARINGS (Continued)

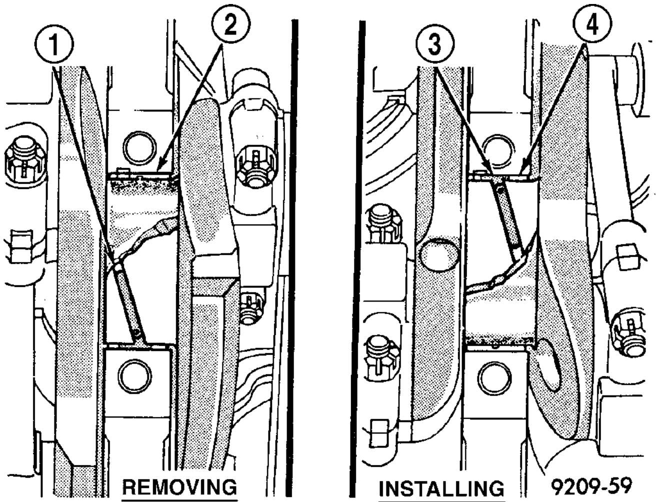


Fig. 30 Upper Main Bearing Removal and Installation with Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

(1) Start bearing in place, and insert Crankshaft Main Bearing Remover/Installer Tool C-3059 into oil hole of crankshaft (Fig. 30).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

(3) Lubricate the main journals with clean engine oil. Install main bearing caps and bolts. Follow the 2 step tightening sequence, starting with No. 1 main bearing cap.

(4) Apply a rearward axial load of 667 N (150 lbs-f) on crankshaft centerline, driving No.3 main cap and thrust bearing against No.3 bulkhead. Repeat procedure, driving crankshaft forward to align rear flange of thrust bearings in a common plane. Front face of No.1 main cap must not extend forward in front of face of No.1 bulkhead.

(5) Install the oil pump pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

REMOVAL—FRONT OIL SEAL - FRONT COVER INSTALLED

(1) Disconnect the negative cable from the battery.

(2) Remove vibration damper from the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(3) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover (Fig. 31).

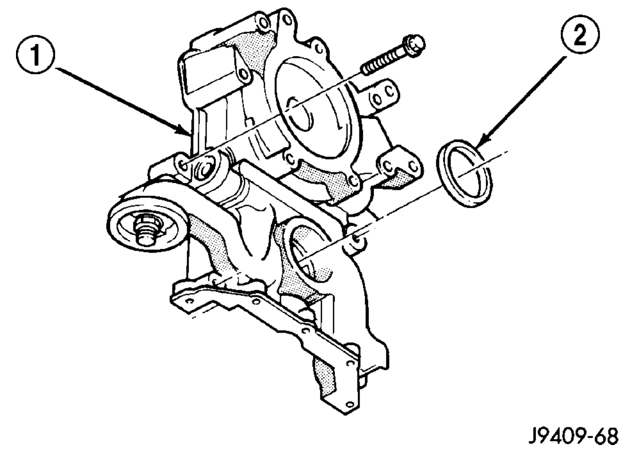


Fig. 31 Timing Chain Cover and Oil Seal

1 - TIMING CHAIN COVER
2 - OIL SEAL

REMOVAL—FRONT OIL SEAL - FRONT COVER REMOVED

(1) Remove engine front cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Place a suitable tool behind the lips of the oil seal to pry the oil seal outward. Be careful not to damage the crankshaft seal surface of the cover.

INSTALLATION

INSTALLATION—FRONT OIL SEAL – FRONT COVER INSTALLED

(1) Position the crankshaft front oil seal onto seal installer special tool 6806 and C-3688 (Fig. 32). Install seal.

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Install cooling fan and shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(5) Connect negative cable to the battery.

(6) Start engine and check for leaks.

INSTALLATION—FRONT OIL SEAL - FRONT COVER REMOVED

(1) Position the crankshaft front oil seal onto seal installer special tool 6806.

CRANKSHAFT OIL SEAL - FRONT (Continued)

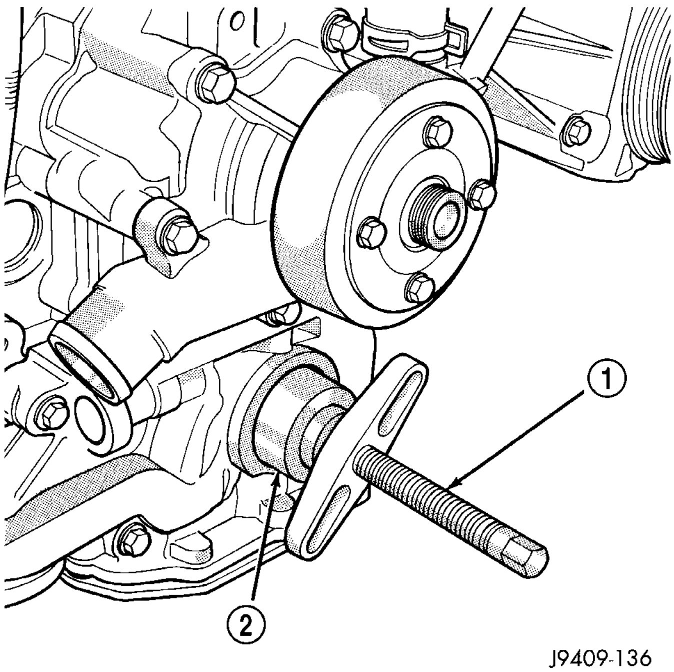


Fig. 32 Timing Chain Cover and Oil Seal

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL 6806

(2) Use tool 6761 to support timing chain cover when installing oil seal with tool 6806 (Fig. 33), install seal (Fig. 34).

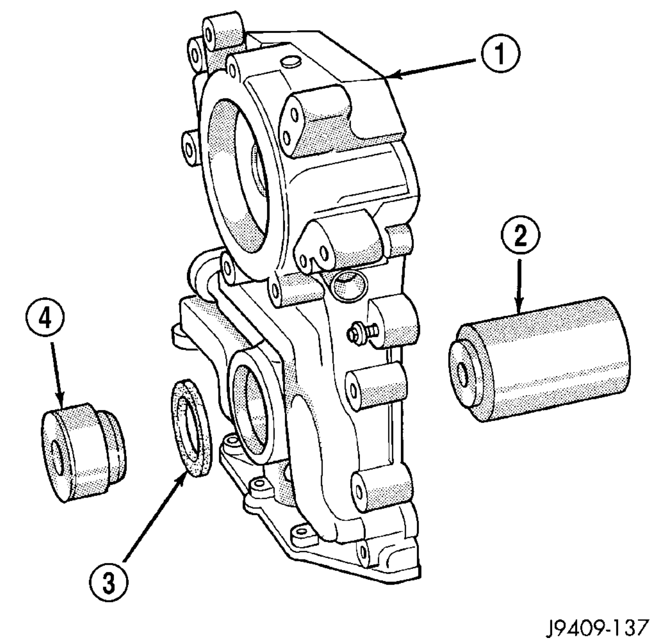


Fig. 33 Oil Seal, Tools—6806 and 6761

1 - FRONT COVER
2 - SPECIAL TOOL 6761
3 - FRONT OIL SEAL
4 - SPECIAL TOOL 6806

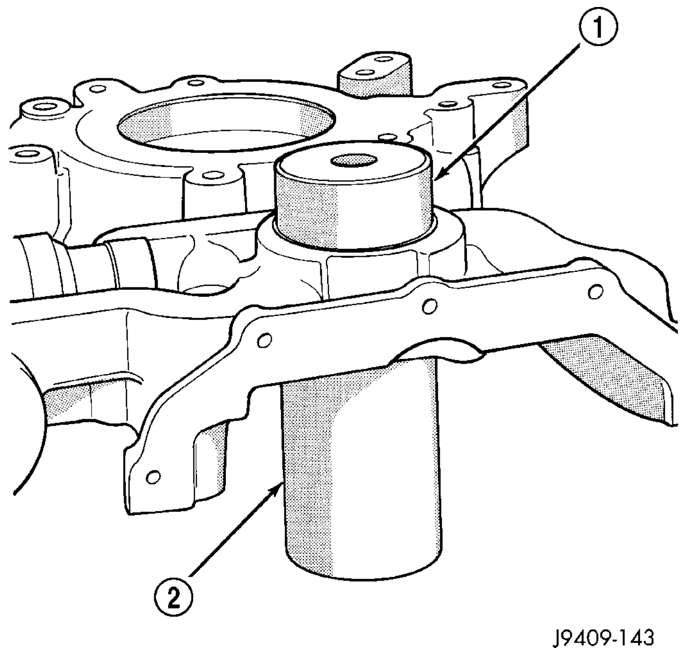


Fig. 34 Oil Seal Installed

1 - SPECIAL TOOL 6806
2 - SPECIAL TOOL 6761

(3) Install engine front cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

CRANKSHAFT OIL SEAL - REAR

REMOVAL

NOTE: This procedure does not require the removal of the seal retainer from the engine block.

(1) Remove the transmission.
(2) Carefully, remove the rear seal from the retainer. Discard the oil seal.

INSTALLATION

(1) Wash all parts in a suitable solvent and inspect carefully for damage or wear.
(2) Position Special Tool 6687 Seal Guide, onto the crankshaft.
(3) Position the oil seal onto the Seal guide, then using Special Tool 8359 Seal Installer and C–4171 Driver Handle, Install the oil seal.
(4) The seal face surface must be countersunk into the retainer .762–1.27mm (0.030–0.050 in.).
(5) Install the transmission.
(6) Check and verify engine oil is at correct level.
(7) Start engine and check for leaks.

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the transmission.
(3) Remove the drive plate / flywheel.
(4) Remove the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(5) Remove the rear oil seal retainer mounting bolts.
(6) Carefully remove the retainer from the engine block.

INSTALLATION

(1) Throughly clean all gasket resdue from the engine block.
(2) Use extream care and clean all gasket resdue from the retainer.
(3) Apply a small amount of Mopar® Silicone Rubber Adhesive Sealant to the retainer gasket. Position the gasket onto the retainer.
(4) Position Special Tool 6687 Seal Guide onto the crankshaft.
(5) Position the retainer and seal over the guide and onto the engine block.
(6) Install the retainer mounting bolts. Tighten the bolts to 22 N·m (16 ft. lbs.).
(7) Install the oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(8) Install the drive plate / flywheel.
(9) Install the transmission.
(10) Check and verify engine oil level.
(11) Start engine and check for leaks.

HYDRAULIC LIFTERS

DIAGNOSIS AND TESTING—HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.
(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

HYDRAULIC LIFTERS (Continued)

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 35).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Universal Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Remove the air cleaner.

(3) Remove cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(4) Remove rocker arm assembly and push rods (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL). Identify push rods to ensure installation in original location.

(5) Remove upper and lower intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL).

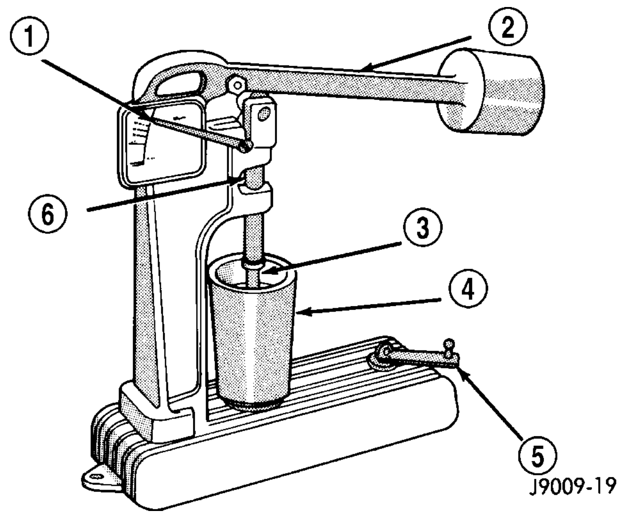


Fig. 35 Leak-Down Tester

1 - POINTER
2 - WEIGHTED ARM
3 - RAM
4 - CUP
5 - HANDLE
6 - PUSH ROD

(6) Cut the cylinder head gasket for accessibility if the end tappets are to be removed.

(7) Remove yoke retainer spider and tappet aligning yokes (Fig. 36).

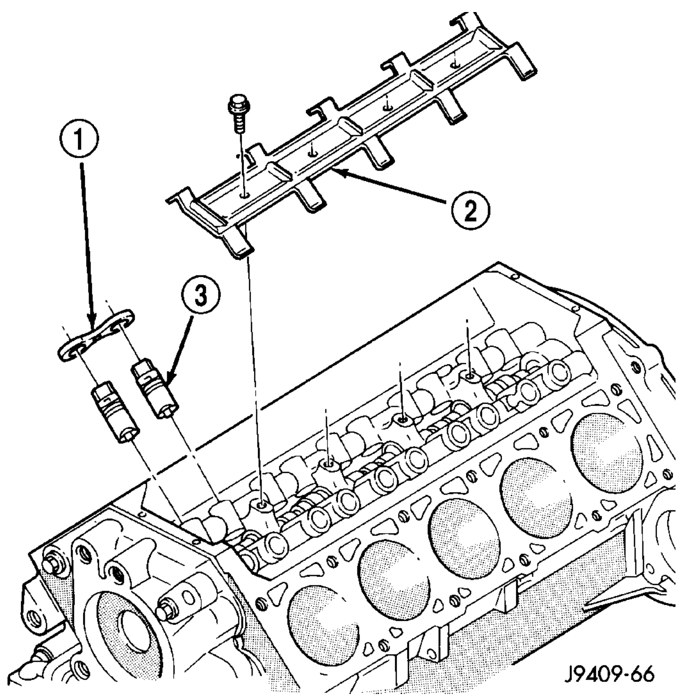


Fig. 36 Tappets, Aligning Yoke and Yoke Retaining Spider

1 - TAPPET ALIGNING YOLK
2 - YOKE RETAINING SPIDER
3 - TAPPET

HYDRAULIC LIFTERS (Continued)

(8) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, identify tappets to ensure installation in original location.

(9) If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize. Replace with oversize tappet.

(10) Check camshaft lobes for abnormal wear.

CLEANING

Clean tappet with a suitable solvent. Rinse in hot water and blow dry with a clean shop rag or compressed air.

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions. **Ensure that the oil bleed hole (if so equipped) faces forward.**

(3) Install tappet aligning yokes. Position the yoke retainer spider over the tappet aligning yokes (Fig. 36)Install the yoke retaining spider bolts and tighten to 22 N·m (16 ft. lbs.) torque.

(4) Install the push rods in their original location.

(5) Install the rocker arms (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION).

(6) Install lower and upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(7) The cylinder head cover gasket can be used again. Install the gasket onto the head rail. **For the left side the number tab is at the front of engine with the number up. For the right side the number tab is at the rear of engine with the number up.**

(8) Install cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(9) Install the air cleaner.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

(10) Connect the negative cable to the battery.

(11) Road test vehicle and check for leaks.

PISTON & CONNECTING ROD

DESCRIPTION

The pistons (Fig. 37) are elliptically turned so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, causing the piston to assume a more nearly round shape.

All pistons are machined to the same weight, regardless of size, to maintain piston balance.

The piston pin rotates in the piston only and is retained by the press interference fit of the piston pin in the connecting rod.

The pistons have a unique dry-film lubricant coating baked onto the skirts to reduce friction. The lubricant is particularly effective during engine break-in, but with time, the material becomes embedded into cylinder bore walls and continues to reduce friction.

The pistons are LH and RH bank specific.

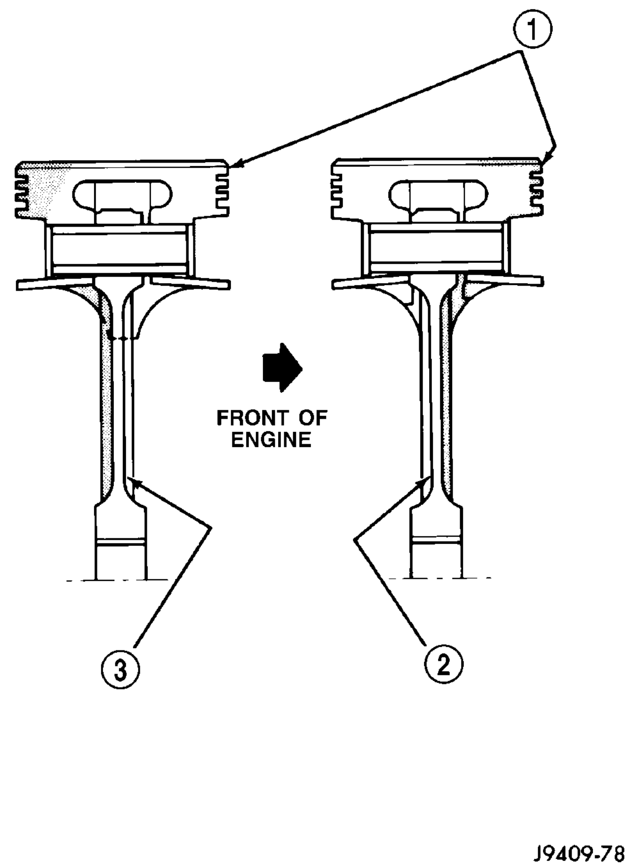


Fig. 37 Piston and Connecting Rod—8.0L Engine

1 - FRONT I.D. TOWARDS THIS SIDE
2 - ORIENTATION BUTTON TOWARDS REAR (R.H. ONLY) 2, 4, 6, 8, 10
3 - ORIENTATION BUTTON TOWARDS FRONT (L.H. ONLY) 1, 3, 5, 7, 9

PISTON & CONNECTING ROD (Continued)

STANDARD PROCEDURE—PISTON FITTING

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is 0.013-0.038 mm (0.0005-0.0015 inch). The max. allowable clearance is 0.0762 mm (0.003 in.).

Piston diameter should be measured at the top of skirt, 90° to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in .0001″ INCREMENTS is required (Fig. 38). If a bore gauge is not available, do not use an inside micrometer.The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results. Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY.** . To correctly select the proper size piston, a cylinder bore gauge capable of reading in .0001″ increments is required.Piston installation into the cylinder bore require slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

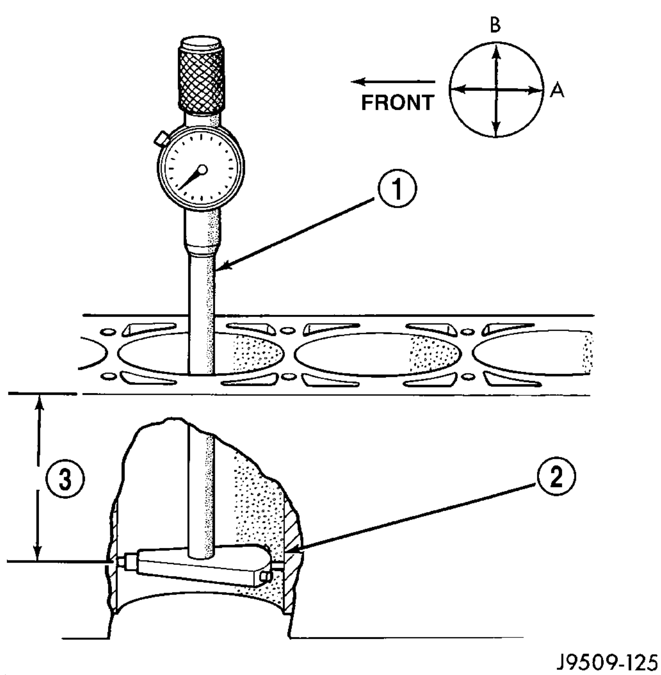


Fig. 38 Bore Gauge

1 - BORE GAUGE
2 - CYLINDER BORE
3 - 2-5/16 in.

REMOVAL

(1) Remove the engine from the vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the oil pan and oil pump pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(4) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation.

(5) Be sure the connecting rod and connecting rod cap are identified with the cylinder number. Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts.

(6) Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies, rotate crankshaft center the connecting rod in the cylinder bore and at BDC. **Be careful not to nick crankshaft journals. DO NOT try to remove black coating on skirt. This is the dry film lubricant.**

(7) After removal, install bearing cap on the mating rod.

CLEANING

Clean the piston and connecting rod assembly using a suitable solvent.

INSPECTION

Check the connecting rod journal for excessive wear, taper and scoring (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

Check the connecting rod for signs of twist or bending.

Check the piston for taper and elliptical shape before it is fitted into the cylinder bore (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - STANDARD PROCEDURE).

Check the piston for scoring, or scraping marks in the piston skirts. Check the ring lands for cracks and/or deterioration.

INSTALLATION

(1) Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

(2) Check the cylinder block bore for out-of-round, taper, scoring and scuffing.

(3) Be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(4) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located properly (Fig. 39).

PISTON & CONNECTING ROD (Continued)

NOTE: Be sure position of rings does not change during the following step.

(5) Immerse the piston head and rings in clean engine oil. Slide Piston Ring Compressor Tool C-385 over the piston and tighten with the special wrench (part of Tool C-385).

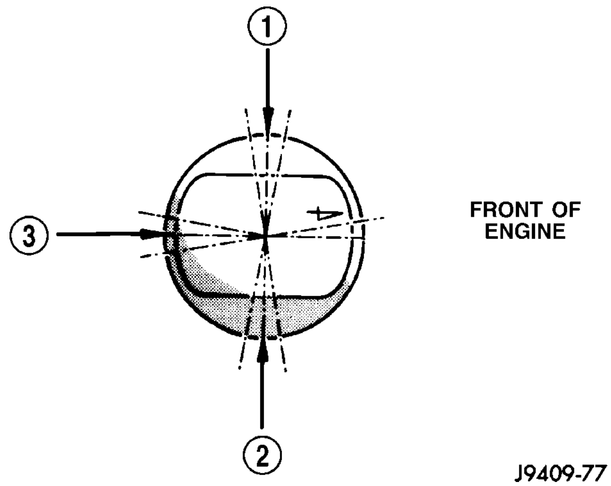


Fig. 39 Proper Ring Installation

1 - TOP COMPRESSION RING GAP
UPPER OIL RING GAP
2 - 2ND COMPRESSION RING GAP
LOWER OIL RAIL GAP
3 - SPACER GAP

(6) Install connecting rod bolt protectors on rod bolts, a long protector should be installed on the numbered side of the connecting rod.

(7) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore in the bottom dead center (BDC) position. Be sure connecting rod and cylinder bore number are the same. Insert rod and piston into cylinder bore. Be sure the piston and rod assemblies are installed in the proper orientation (Fig. 40).

(8) The notch, groove or arrow on top of piston must be pointing toward front of engine. The larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(9) While tapping the piston down in cylinder bore with the handle of a hammer, guide the connecting rod over the crankshaft journal.

(10) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 61 N·m (45 ft. lbs.) torque.

(11) Install the oil pump pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(12) Install the cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION) and cylinder head cover (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

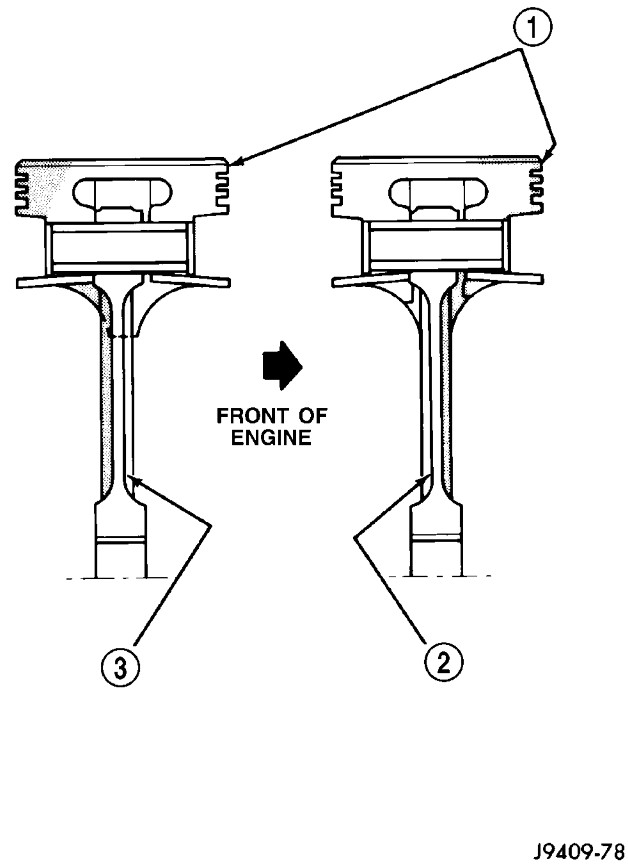


Fig. 40 Piston and Rod Orientation

1 - FRONT I.D. TOWARDS THIS SIDE
2 - ORIENTATION BUTTON TOWARDS REAR
(R.H. ONLY)
2, 4, 6, 8, 10
3 - ORIENTATION BUTTON TOWARDS FRONT
(L.H. ONLY)
1, 3, 5, 7, 9

(13) Install intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION).

(14) Install the engine into the vehicle (Refer to 9 - ENGINE - INSTALLATION).

PISTON RINGS

STANDARD PROCEDURE—FITTING PISTON RINGS

(1) Measurement of end gaps:

(a) Measure piston ring gap 2 inches from bottom of cylinder bore. An inverted piston can be used to push the rings down to ensure positioning rings squarely in the cylinder bore before measuring.

(b) Insert feeler stock in the gap. Gap for compression rings should be between 0.254-0.508 mm (0.010-0.020 inch). The oil ring gap should be 0.381- 1.397 mm (0.015-0.055 inch).

PISTON RINGS (Continued)

(c) Rings with insufficient end gap may be properly filed to the correct dimension. Ends should be stoned smooth after filing with Arkansas White Stone. Rings with excess gaps should not be used.

(2) Install rings and confirm ring side clearance:

(a) Install oil rings being careful not to nick or scratch the piston. Install the oil control rings according to instructions in the package. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(b) Install the second compression rings using Installation Tool C-4184. The compression rings must be installed with the identification mark face up (toward top of piston) and chamfer facing down. An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP (Fig. 41) (Fig. 43).

(c) Using a ring installer, install the top compression ring with the chamfer facing up (Fig. 43). An identification mark on the ring is a drill point, a stamped letter O, an oval depression or the word TOP facing up (Fig. 42).

(d) Measure side clearance between piston ring and ring land. Clearance should be 0.074-0.097 mm (0.0029-0.0038 inch) for the compression rings. The steel rail oil ring should be free in groove, but should not exceed 0.246 mm (0.0097 inch) side clearance.

(e) Pistons with insufficient or excessive side clearance should be replaced.

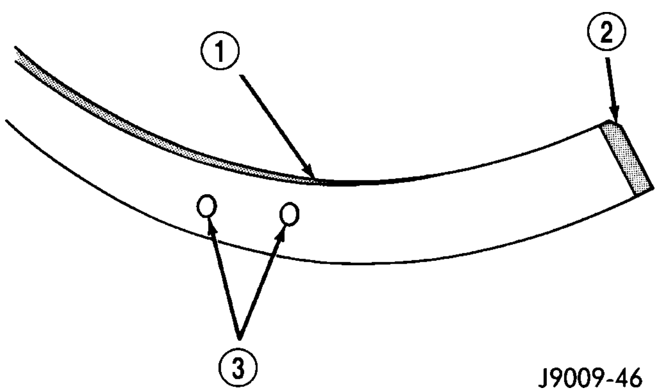


Fig. 41 Second Compression Ring Identification—Typical

1 - SECOND COMPRESSION RING (BLACK CAST IRON)
2 - CHAMFER
3 - TWO DOTS

(3) Arrange ring gaps 180° apart as shown in (Fig. 44).

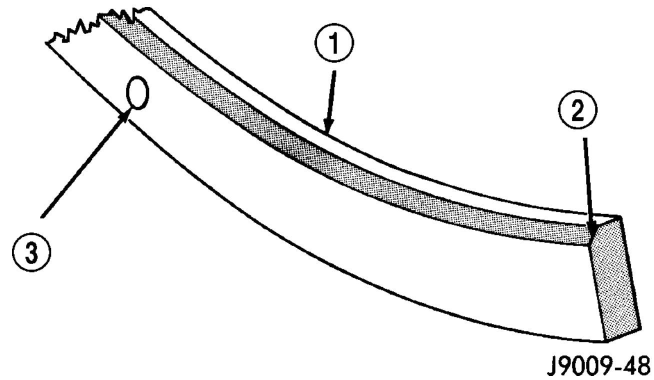


Fig. 42 Top Compression Ring Identification—Typical

1 - TOP COMPRESSION RING (GRAY IN COLOR)
2 - CHAMFER
3 - ONE DOT

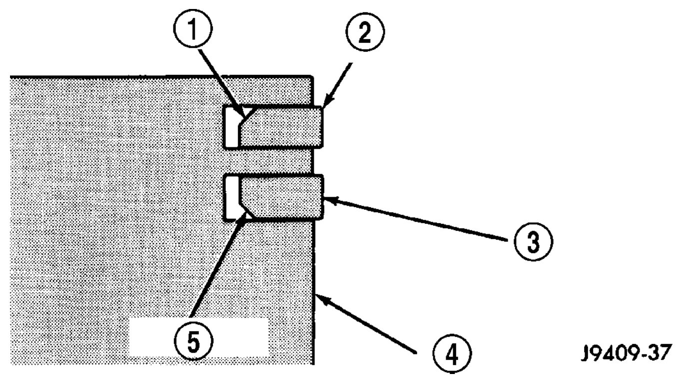


Fig. 43 Compression Ring Chamfer Location—Typical

1 - CHAMFER
2 - TOP COMPRESSION RING
3 - SECOND COMPRESSION RING
4 - PISTON
5 - CHAMFER

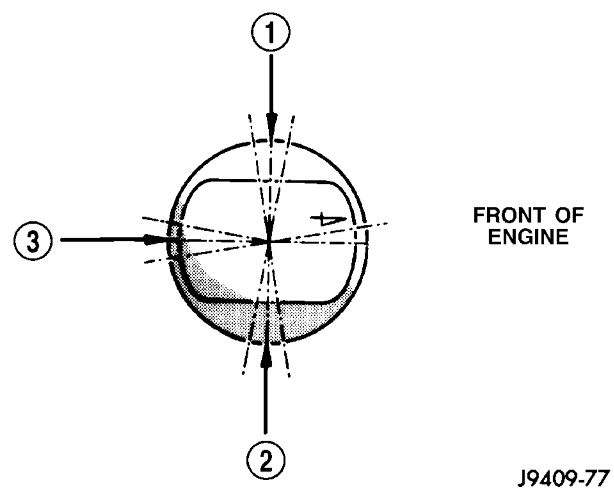


Fig. 44 Proper Ring Installation

1 - TOP COMPRESSION RING GAP UPPER OIL RING GAP
2 - 2ND COMPRESSION RING GAP LOWER OIL RAIL GAP
3 - SPACER GAP

VIBRATION DAMPER

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Remove the following:
• Radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)
• Accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)
• Radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL)
(3) Remove crankshaft pulley/damper bolt and washer from end of crankshaft.
(4) Using Special Tool, 1026 3 Jaw Puller and Special Tool 8513 Insert, remove pulley—damper from the crankshaft (Fig. 45).

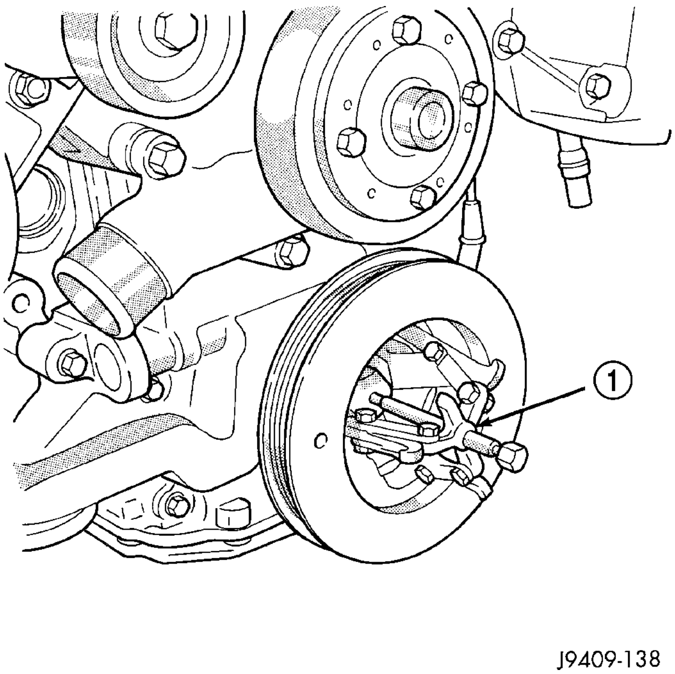


Fig. 45 Crankshaft Pulley—Damper Removal
1 - 3 JAW PULLER

(5) Inspect crankshaft oil seal. If damaged or worn, replace the front oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - REMOVAL).

INSTALLATION

(1) Position the crankshaft pulley/damper onto the crankshaft.
(2) Use Special Tool, C-3688 Crankshaft Pulley/Damper Installer to press the pulley—damper onto the crankshaft. Install crankshaft bolt and washer and tighten to 312 N·m (230 ft. lbs.) torque (Fig. 46).
(3) Install the following:
• Radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION)
• Accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)
• Radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION)
(4) Connect the negative cable to the battery.

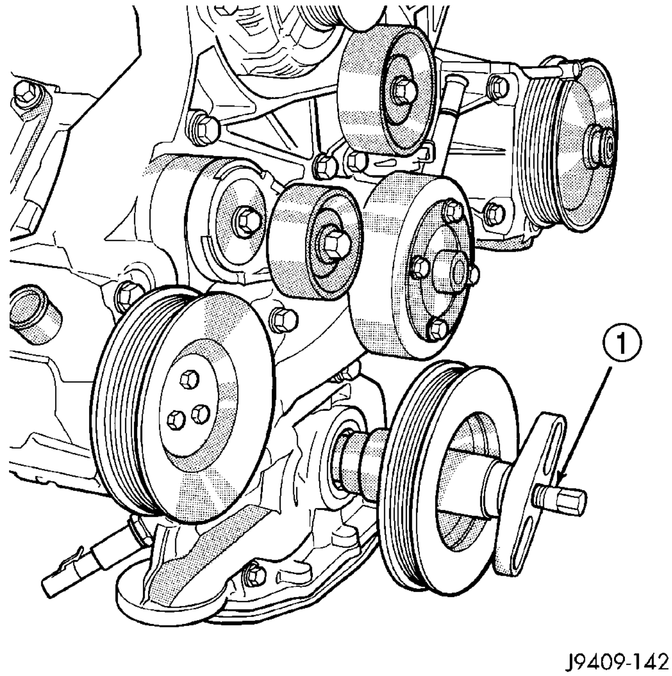


Fig. 46 Installing Crankshaft Pulley—Damper
1 - SPECIAL TOOL C-3688

FRONT MOUNT

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Position fan to assure clearance for radiator top tank and hose.

CAUTION: DO NOT lift the engine by the intake manifold.

(3) Install engine support/lifting fixture.
(4) Raise vehicle on hoist.
(5) Lift the engine SLIGHTLY and remove the thru-bolt and nut.
(6) Remove engine support bracket/cushion bolts. Remove the support bracket/cushion and heat shields.

INSTALLATION

(1) With engine raised SLIGHTLY, position the engine support bracket/cushion and heat shields to the block. Install new bolts and tighten to 81 N·m (60 ft. lbs.) torque.
(2) Install the thru-bolt and 2 piece rubber engine rubber restrictors onto the engine support bracket/cushion.

FRONT MOUNT (Continued)

(3) Lower engine with support/lifting fixture while guiding the engine bracket/cushion and thru-bolt into support cushion brackets.

(4) Install thru-bolt nuts and tighten the nuts to 68 N·m (50 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Remove lifting fixture.

REAR MOUNT

REMOVAL

(1) Raise the vehicle on a hoist.

(2) Position a transmission jack in place.

(3) Remove support cushion stud nuts (Fig. 47).

(4) Raise rear of transmission and engine SLIGHTLY.

(5) Remove the bolts holding the support cushion to the transmission support bracket. Remove the support cushion.

(6) If necessary, remove the bolts holding the transmission support bracket to the transmission.

INSTALLATION

(1) If removed, position the transmission support bracket to the transmission. Install new attaching bolts and tighten to 102 N·m (75 ft. lbs.) torque.

(2) Position support cushion to transmission support bracket. Install stud nuts and tighten to 47 N·m (35 ft. lbs.) torque.

(3) Using the transmission jack, lower the transmission and support cushion onto the crossmember (Fig. 110).

(4) Install the support cushion bolts and tighten to 47 N·m (35 ft. lbs.) torque.

(5) Remove the transmission jack.

(6) Lower the vehicle.

LUBRICATION

DESCRIPTION

A pressure feed type (gerotor) oil pump is located in the engine front cover. The pump uses a pick-up tube and screen assembly to gather engine oil from the oil pan (Fig. 48).

OPERATION

The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the inner and outer gears of the oil pump, then forced through the outlet in the engine front cover. An oil gallery in the front cover channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes

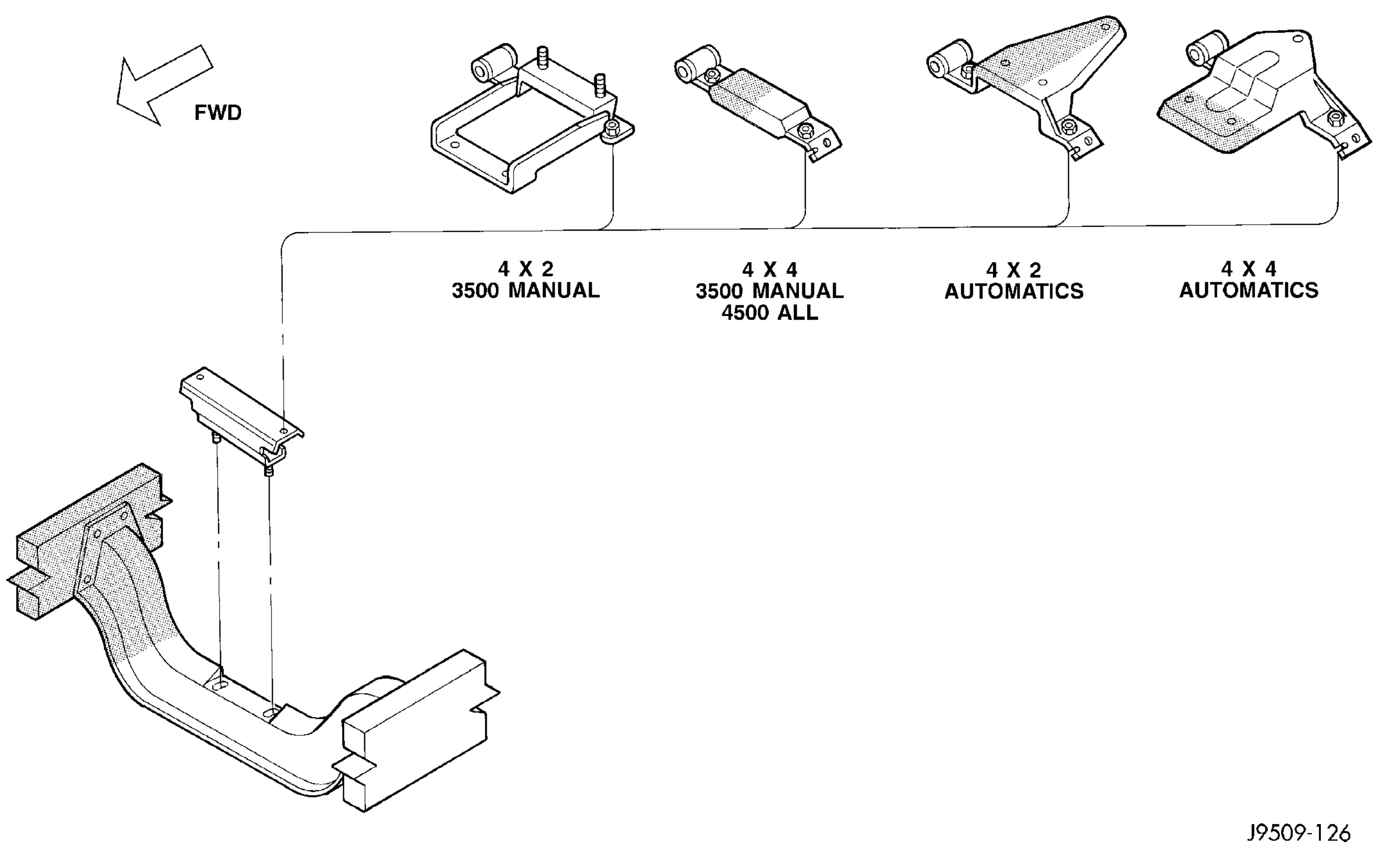


Fig. 47 Engine Rear Support Cushion Asse

LUBRICATION (Continued)

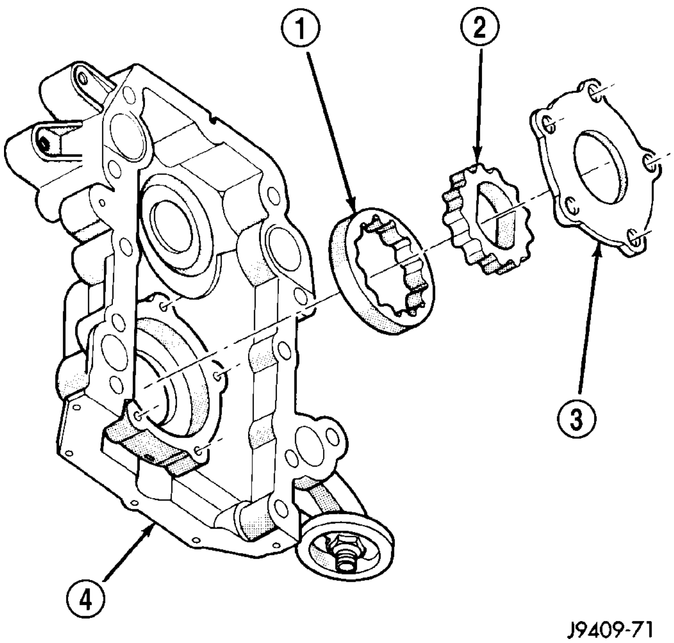


Fig. 48 Pressure Feed Type (Gerotor) Oil Pump—Typical

1 - OUTER ROTOR
2 - INNER ROTOR
3 - OIL PUMP COVER
4 - TIMING CHAIN COVER

from the center outlet of the filter through an oil gallery that channels the oil up to the tappet galleries, which extends the entire length of block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing has half a hole in it, oil passes through the hole when the rods rotate and the hole lines up, oil is then thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. The camshaft bearings receive oil from the main bearing galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets, which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components. The oil then passes down through the push rod guide holes and the oil drain-back passages in the cylinder head, past the valve tappet area, and then returns to the oil pan (Fig. 49).

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING—ENGINE OIL LEAKS

Begin with a through visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil-soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to be sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light source.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat previous step.

(5) If the oil leak source is not positively identified at this time, proceed with the air leak detection test method as follows:

(6) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(7) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(8) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(9) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(10) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(11) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose. Proceed to next step.

(12) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

LUBRICATION (Continued)

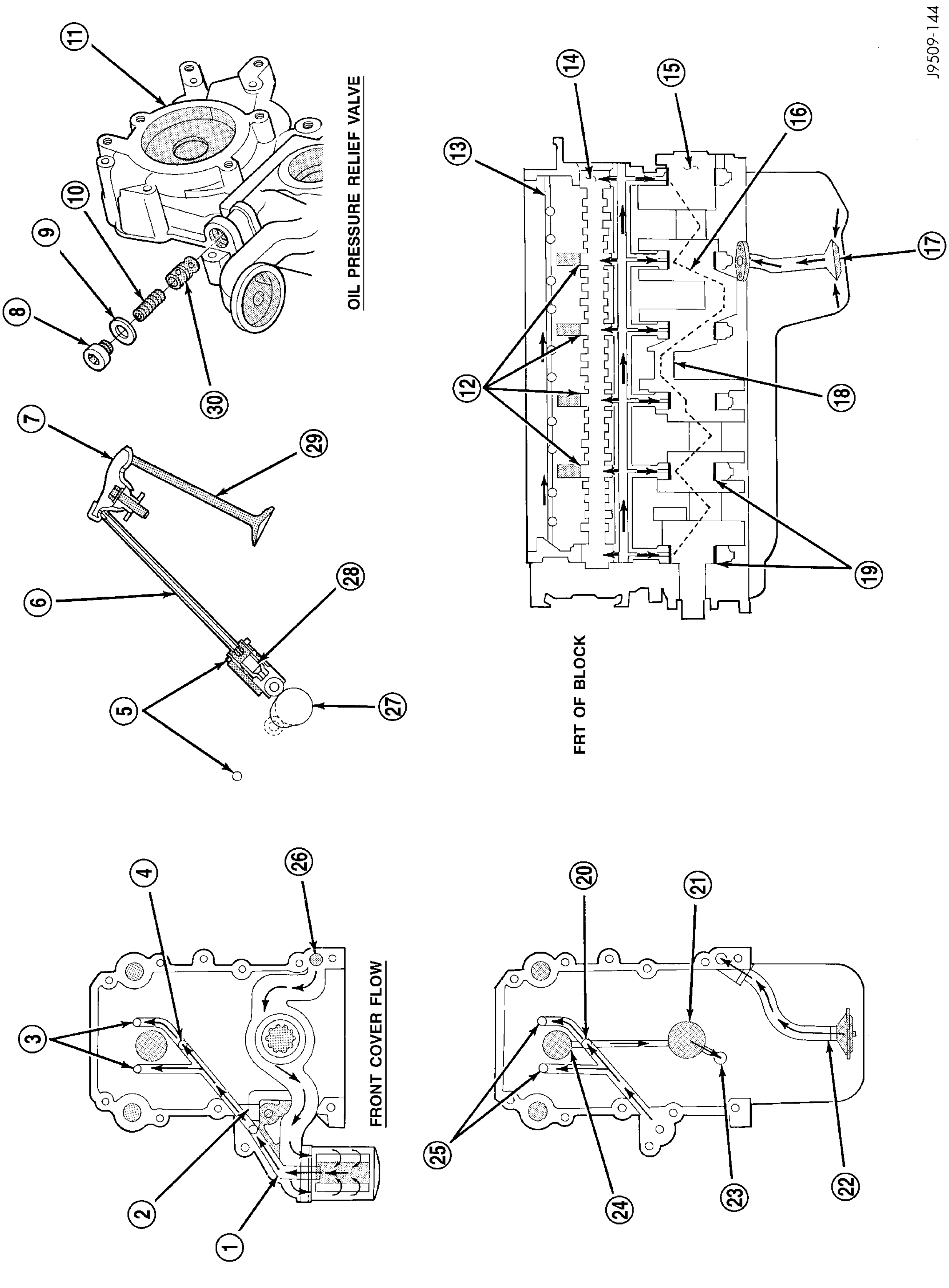


Fig. 49 Engine Lubrication System

LUBRICATION (Continued)

1 - OIL TO MAIN OIL GALLERIES
2 - RELIEF VALVE
3 - OIL GALLERY FOR TAPPETS
4 - MAIN OIL GALLERY
5 - TAPPET OIL GALLERY
6 - HOLLOW PUSH ROD
7 - ROCKER ARM
8 - PLUG
9 - GASKET
10 - SPRING
11 - TIMING CHAIN COVER
12 - CAM BEARINGS
13 - HYDRAULIC TAPPET GALLERIES
14 - CAMSHAFT
15 - CRANKSHAFT
16 - OIL PASSAGE TO CONNECTING ROD JOURNALS
17 - OIL PICKUP
18 - CONNECTING ROD JOURNALS
19 - CRANKSHAFT BEARINGS
20 - MAIN OIL GALLERY
21 - CRANKSHAFT
22 - OIL PICKUP TUBE
23 - CONNECT ROD JOURNALS
24 - CAMSHAFT BEARINGS
25 - TAPPET OIL GALLERY
26 - OIL FROM PICKUP TUBE
27 - CAMSHAFT
28 - TAPPET
29 - VALVE
30 - OIL PUMP RELIEF VALVE

DIAGNOSIS AND TESTING—ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292. Start engine and record pressure. (Refer to 9 - ENGINE - SPECIFICATIONS).

OIL

STANDARD PROCEDURE - ENGINE OIL

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right front of the engine, left of the generator (Fig. 50).

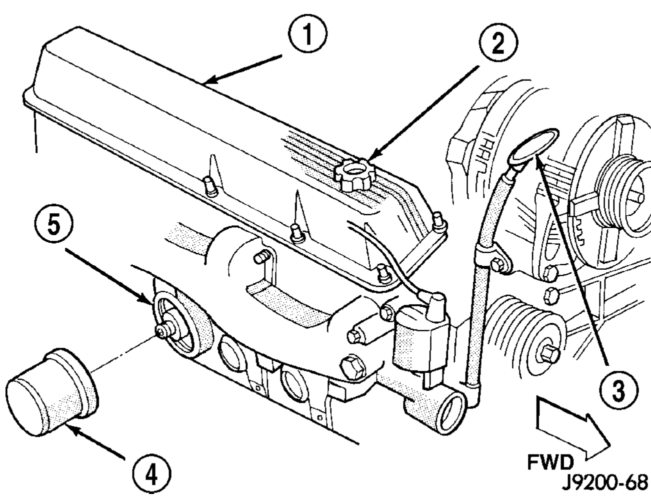


Fig. 50 Oil Level Indicator Location

1 - CYLINDER HEAD COVER
2 - ENGINE OIL FILL CAP
3 - DIPSTICK
4 - ENGINE OIL FILTER
5 - FILTER BOSS

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, oil foaming and oil pressure loss can result.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. This information can be found in the owner's manual.

TO CHANGE ENGINE OIL

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist vehicle.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

(6) Install drain plug in crankcase.

(7) Change oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).

(8) Lower vehicle and fill crankcase with specified type (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) and amount of engine oil (Refer to LUBRICATION & MAINTENANCE - SPECIFICATIONS).

(9) Install oil fill cap.

(10) Start engine and inspect for leaks.

(11) Stop engine and inspect oil level.

OIL FILTER

REMOVAL

All engines are equipped with a high quality full-flow, disposable type oil filter. DaimlerChrysler Corporation recommends a Mopar® or equivalent oil filter be used.

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise to remove it from the cylinder block oil filter boss (Fig. 51).

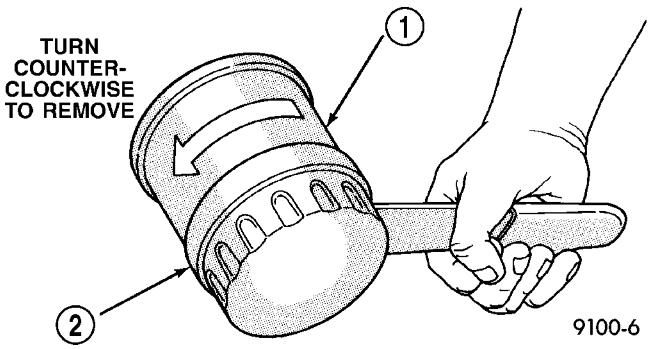


Fig. 51 Oil Filter Removal—Typical

1 - ENGINE OIL FILTER
2 - OIL FILTER WRENCH

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 52) of oil and grime.

(6) Install new filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION).

INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 52) hand tighten filter one full turn, do not over tighten.

(3) Add oil (Refer to 9 - ENGINE/LUBRICATION/OIL - STANDARD PROCEDURE).

OIL PAN

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle.

(3) Drain engine oil.

(4) Remove left engine to transmission strut.

(5) Remove oil pan mounting bolts, pan and one-piece gasket. The engine may have to be raised slightly on 2WD vehicles.

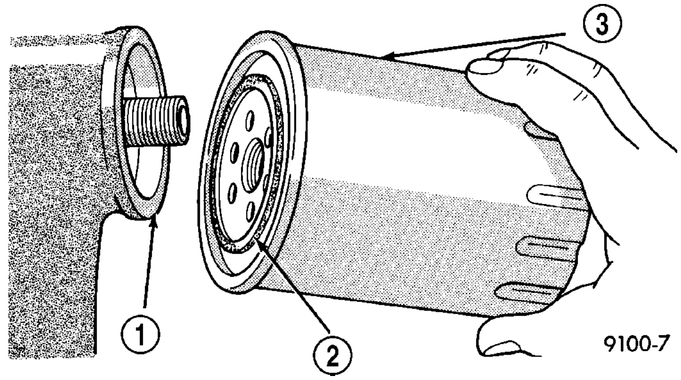


Fig. 52 Oil Filter Sealing Surface—Typical

1 - SEALING SURFACE
2 - RUBBER GASKET
3 - OIL FILTER

(6) Remove the oil pick-up tube assembly (Fig. 53). Discard the gasket.

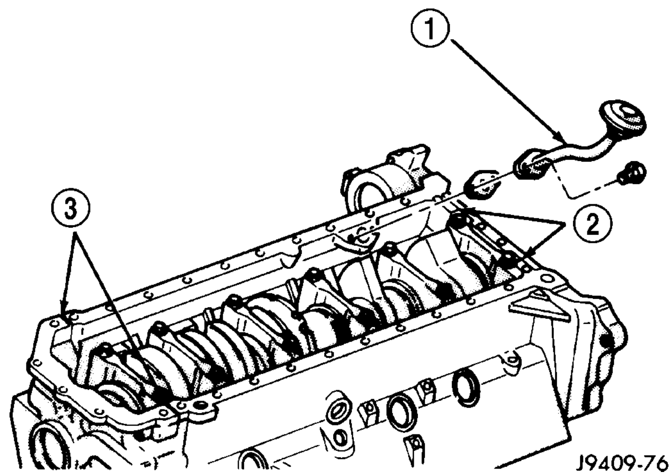


Fig. 53 Oil Pick-Up Tube

1 - PICK—UP TUBE
2 - SEALANT AT SPLIT-LINES
3 - SEALANT AT SPLIT-LINE

CLEANING

Clean the block and pan gasket surfaces.

If present, trim excess sealant from inside the engine.

Clean oil pan in solvent and wipe dry with a clean cloth.

Clean oil screen and pipe thoroughly in clean solvent. Inspect condition of screen.

INSPECTION

Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

Inspect oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PAN (Continued)

INSTALLATION

(1) Fabricate 4 alignment dowels from 5/16 x 1 1/2 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 54).

(2) Install the dowels in the cylinder block at the four corners.

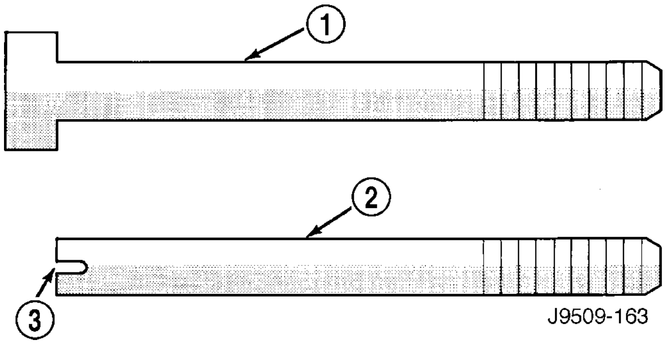


Fig. 54 Fabrication of Alignment Dowels

1 - 5/16" X 1½" BOLT
2 - DOWEL
3 - SLOT

(3) Apply small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent at the split lines. The split lines are between the cylinder block, the timing chain cover and the rear crankshaft seal assembly (Fig. 53). **After the sealant is applied you have 3 minutes to install the gasket and oil pan.**

(4) Slide the one-piece gasket over the dowels and onto the block.

(5) Position the oil pan over the dowels and onto the gasket. The engine may have to be slightly raised on 2WD vehicles.

(6) Install the oil pan bolts (Fig. 55). Tighten the bolts to as shown in Oil Pan Bolts Torque Chart.

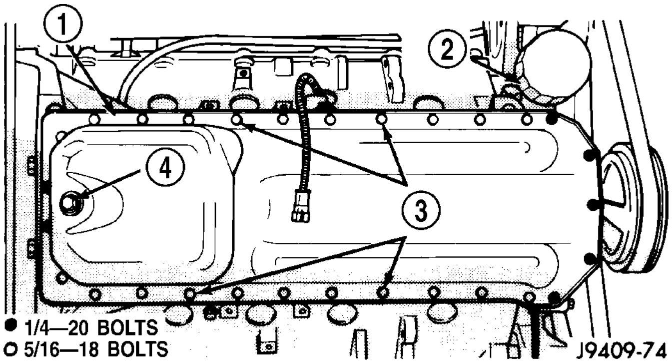


Fig. 55 Oil Pan Bolt Location

1 - OIL PAN
2 - OIL FILTER
3 - STUD BOLTS
4 - DRAIN PLUG

(7) Remove the dowels. Install the remaining 5/16 inch oil pan bolts. Torque these bolts as shown in Oil Pan Bolts Torque Chart.

(8) Install the drain plug. Tighten drain plug to 34 N·m (25 ft. lbs.) torque.

(9) Install the engine to transmission strut.

(10) Lower vehicle.

(11) Connect the negative cable to the battery.

(12) Fill crankcase with oil to proper level.

(13) Start engine and check for leaks.

OIL PUMP

REMOVAL

(1) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Remove the relief valve plug, gasket, spring and valve (Fig. 56). Discard the gasket.

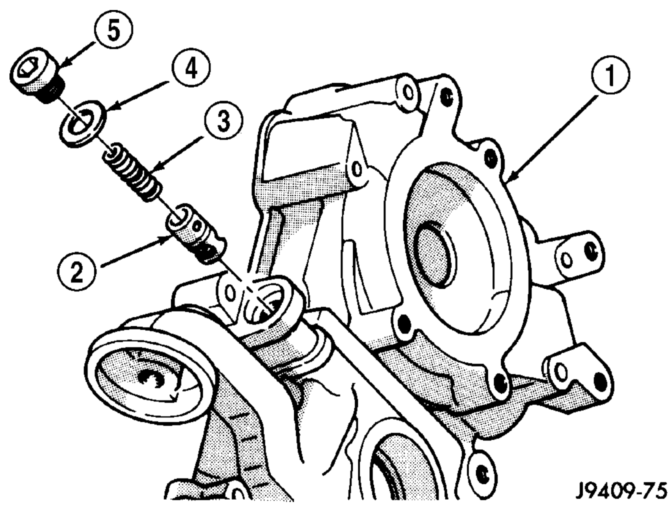


Fig. 56 Oil Pressure Relief Valve

1 - TIMING CHAIN COVER
2 - OIL PUMP RELIEF VALVE
3 - SPRING
4 - GASKET
5 - PLUG

(3) Remove mounting screws and oil pump cover (Fig. 57).

(4) Remove oil pump inner and outer rotors (Fig. 57).

(5) Inspect oil pump for wear (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSPECTION).

CLEANING

Wash all parts in a suitable solvent and inspect carefully for damage or wear.

OIL PUMP (Continued)

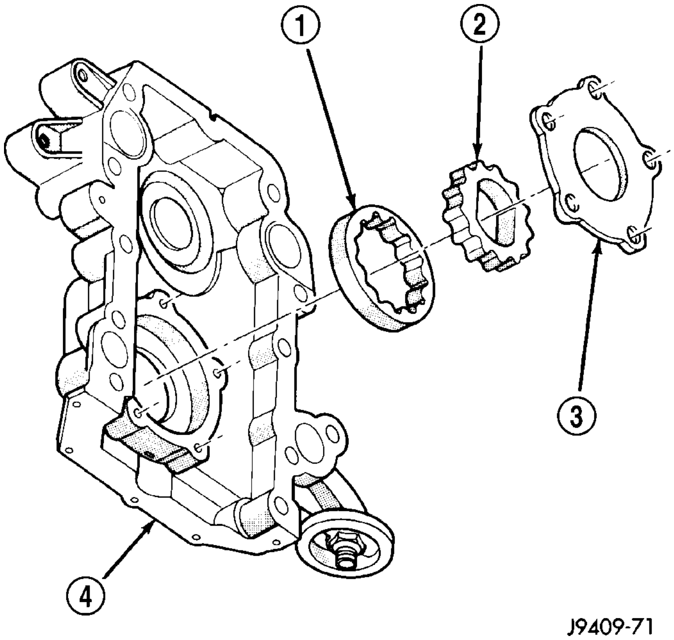


Fig. 57 Oil Pump

1 - OUTER ROTOR
2 - INNER ROTOR
3 - OIL PUMP COVER
4 - TIMING CHAIN COVER

INSPECTION

Mating surface of the oil pump cover should be smooth. Replace pump cover if scratched or grooved.

Lay a straightedge across the pump cover surface (Fig. 58). If a 0.076 mm (0.003 inch) feeler gauge can be inserted between cover and straightedge, cover should be replaced.

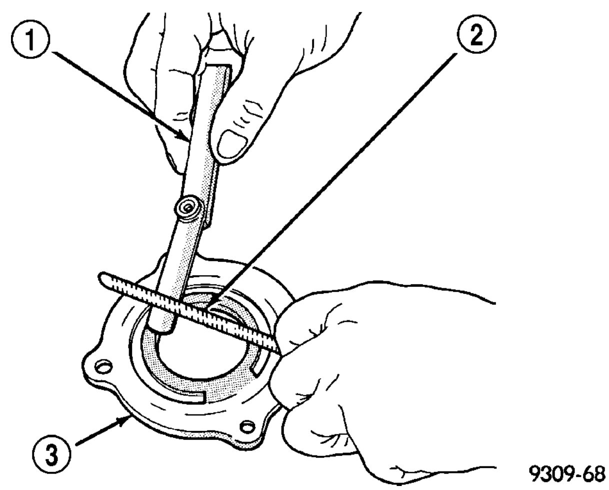


Fig. 58 Checking Oil Pump Cover Flatness

1 - FEELER GAUGE
2 - STRAIGHT EDGE
3 - OIL PUMP COVER

Measure thickness (Fig. 59) (Fig. 60) and diameter of rotors. If either rotor thickness measures 14.956 mm (0.5876 inch) or less, or if the diameter is 82.45 mm (3.246 inches) or less, replace rotor set.

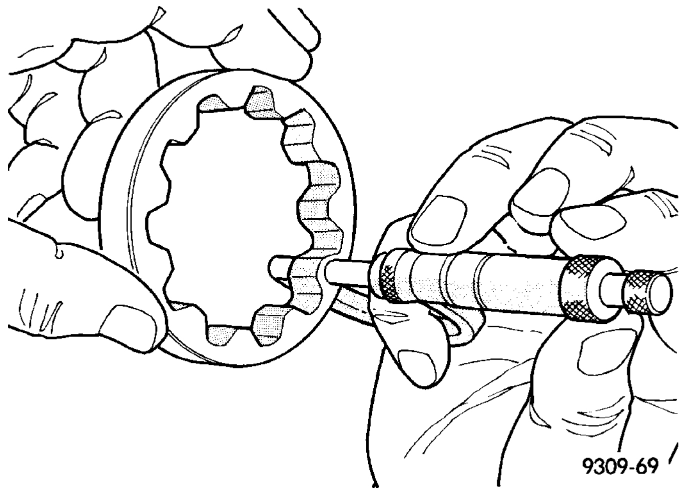


Fig. 59 Measuring Outer Rotor Thickness

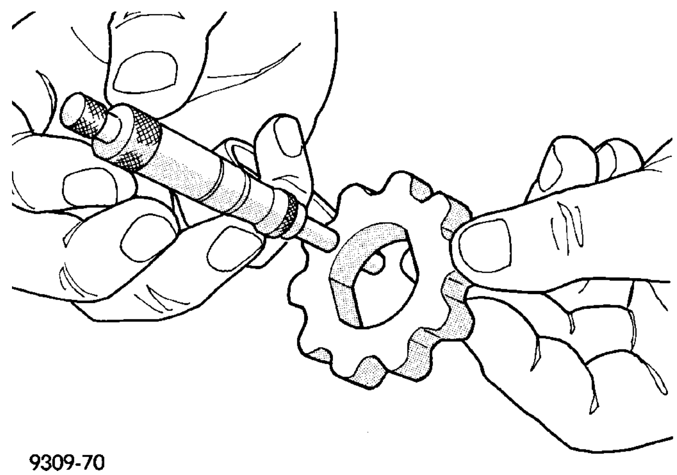


Fig. 60 Measuring Inner Rotor Thickness

Slide outer rotor into timing chain cover pump body. Press rotor to the side with your fingers and measure clearance between rotor and pump body (Fig. 61). If clearance is 0.19 mm (0.007 inch) or more, and outer rotor is within specifications, replace timing chain cover.

Install inner rotor into timing chain cover pump body (Fig. 62). Inner rotor should be positioned with chamfer up or toward engine when cover is installed. This allows easy installation over crankshaft. If clearance between inner and outer rotors is 0.150 mm (0.006 inch) or more, replace both rotors.

Place a straightedge across the face of the timing chain cover pump body, between bolt holes (Fig. 63). If a feeler gauge of 0.077 mm (0.003 inch) or more can be inserted between rotors and the straightedge, and the rotors are within specifications, replace timing chain cover.

OIL PUMP (Continued)

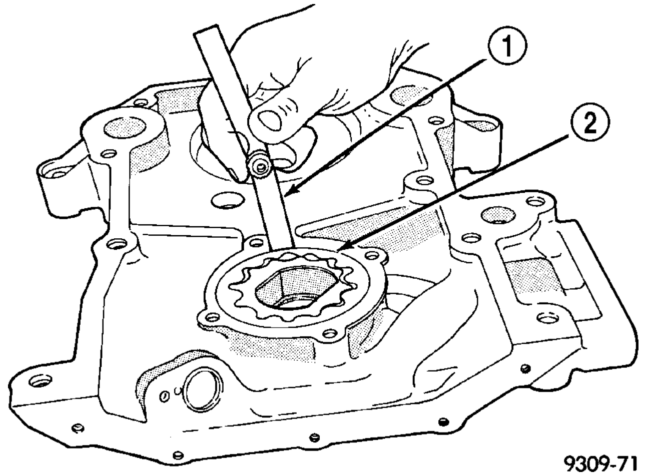


Fig. 61 Measuring Outer Rotor Clearance in Cover

1 - FEELER GAUGE
2 - OUTER ROTOR

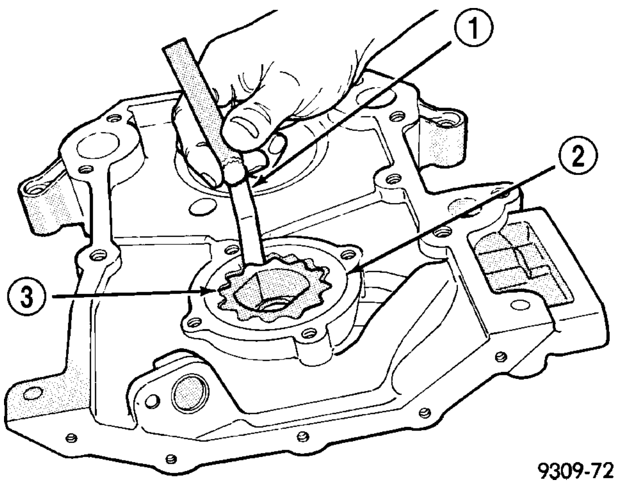


Fig. 62 Measuring Inner Rotor Clearance in Cover

1 - FEELER GAUGE
2 - OUTER ROTOR
3 - INNER ROTOR

Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

The relief valve spring has a free length of approximately 49.5 mm (1.95 inches). The spring should test between 100 and 109 N (22.5 and 24.5 pounds) when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet these specifications.

If oil pressure was low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

INSTALLATION

(1) Lubricate both oil pump rotors using petroleum jelly or lubriplate and install in the timing chain cover. Use new parts as required (Fig. 64).

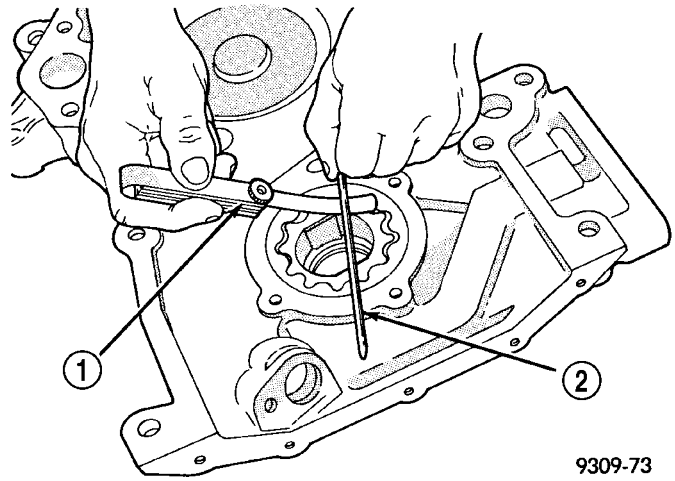


Fig. 63 Measuring Clearance Over Rotors

1 - FEELER GAUGE
2 - STRAIGHT EDGE

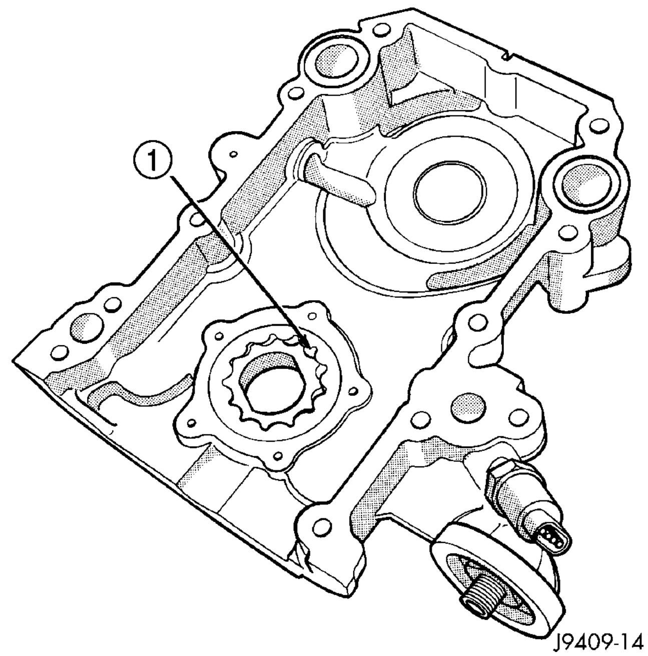


Fig. 64 Priming Oil Pump.

1 - FILL WITH PETROLEUM JELLY OR LUBER PLATE

(2) Position the oil pump cover onto the timing chain cover. Tighten cover screws to 14 N·m (125 in. lbs.) torque.

(3) Make sure that inner ring moves freely after cover is installed.

(4) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(5) Squirt oil into relief valve hole until oil runs out.

(6) Install the relief valve and spring.

OIL PUMP (Continued)

(7) Using a new pressure relief valve gasket, install the relief valve plug. Tighten the plug to 20 N·m (15 ft. lbs.) torque.

(8) Install oil filter that has been filled with oil.

INTAKE MANIFOLD

DESCRIPTION

The aluminum intake manifold (Fig. 65) has two plenum chambers an upper and lower which supply air to five runners each. Passages across the longitudinal center of the manifold feed air from the throttle body to the plenum chambers.

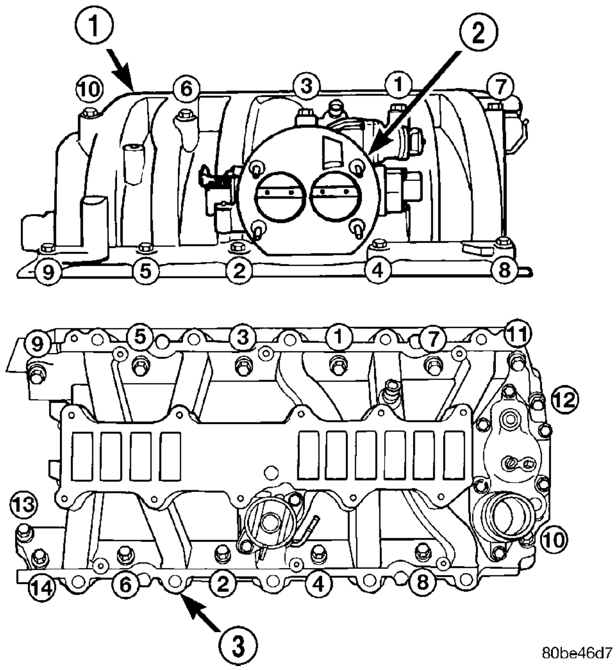


Fig. 65 Upper and Lower Intake Manifold—8.0L Engine

1 - UPPER INTAKE MANIFOLD
2 - THROTTLE BODY (MPI)
3 - LOWER INTAKE MANIFOLD

DIAGNOSIS AND TESTING—INTAKE MANIFOLD LEAKAGE

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS, OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPMs occur, the area of the suspected leak has been found.

(4) Repair as required.

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove the generator brace and generator (Fig. 66).

(5) Remove the A/C compressor brace (Fig. 66). Remove the compressor and set aside.

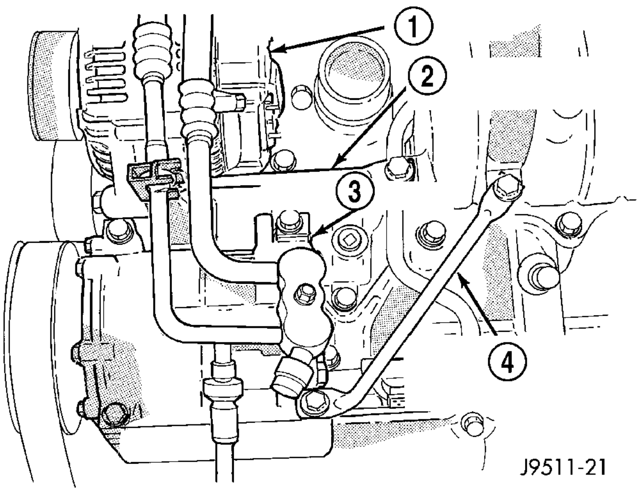


Fig. 66 Generator and A/C Compressor Braces

1 - GENERATOR
2 - INTAKE MANIFOLD TO GENERATOR BRACE
3 - A/C COMPRESSOR
4 - INTAKE MANIFOLD TO A/C COMPRESSOR BRACE

(6) Remove the air cleaner cover and filter. Remove the air cleaner housing (Fig. 67). Discard the gasket.

(7) Perform the Fuel System Pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE). Disconnect the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(8) Disconnect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(9) Remove the coil assemblies with the ignition wires.

(10) Disconnect the vacuum lines.

(11) Disconnect the heater hoses and bypass hose.

(12) Remove the closed crankcase ventilation and evaporation control systems.

INTAKE MANIFOLD (Continued)

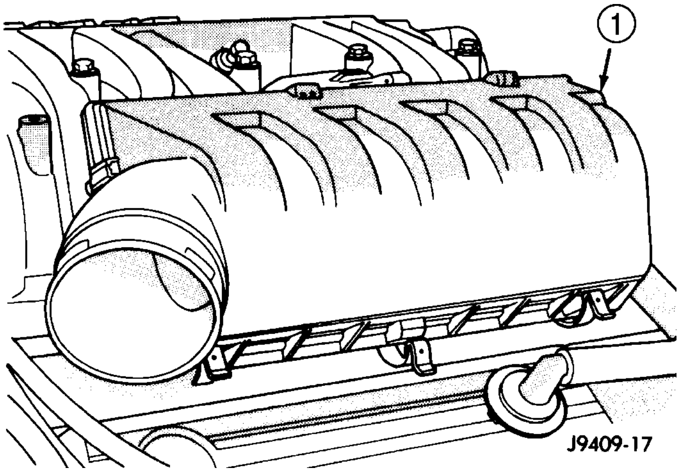


Fig. 67 Air Intake Housing

1 - AIR INTAKE HOUSING

(13) Remove the throttle body bolts and lift the throttle body off the upper intake manifold (Fig. 68). Discard the gasket.

(14) Remove upper intake manifold bolts.

(15) Lift the upper intake manifold out of the engine compartment (Fig. 68). Discard the gasket.

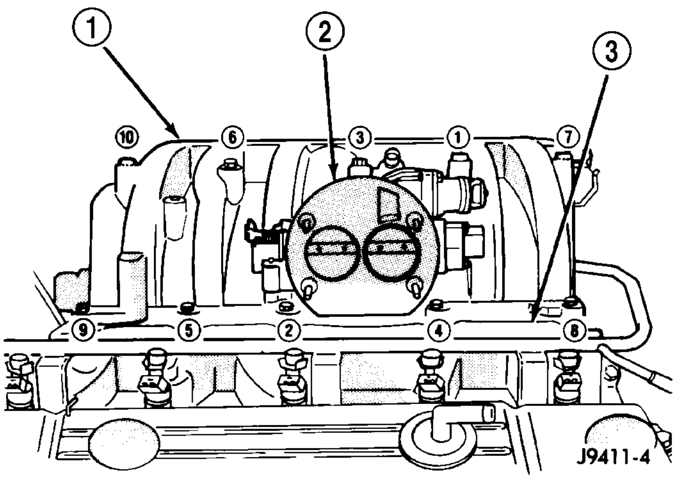


Fig. 68 Upper Intake Manifold and Throttle Body

1 - UPPER INTAKE MANIFOLD
2 - THROTTLE BODY (MPI)
3 - LOWER INTAKE MANIFOLD

(16) Remove the lower intake manifold bolts and remove the manifold (Fig. 69).

(17) Discard the lower intake manifold gaskets (Fig. 70).

CLEANING

Clean manifold in solvent and blow dry with compressed air.

Clean cylinder block gasket surfaces using a suitable solvent.

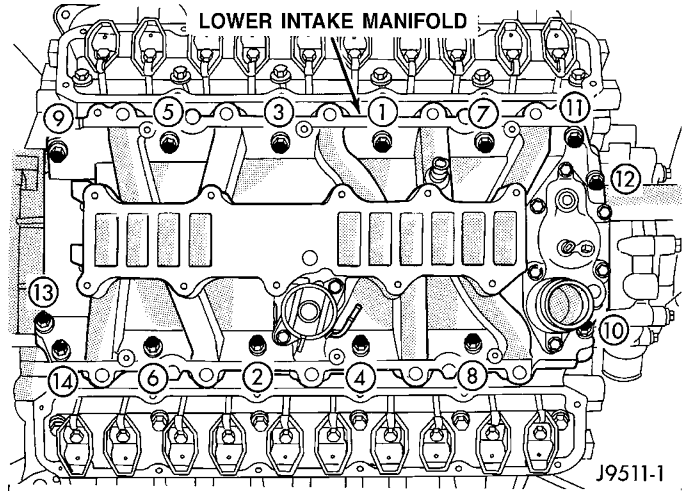


Fig. 69 Lower Intake Manifold

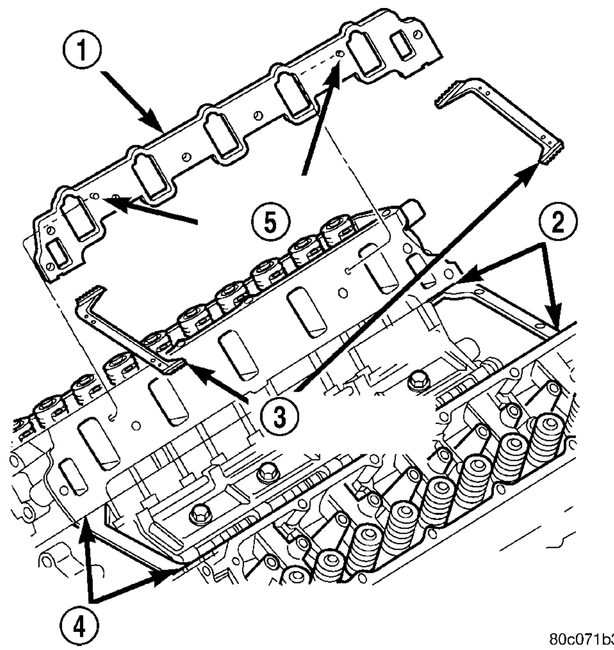


Fig. 70 Lower Intake Manifold Gaskets

1 - INTAKE MANIFOLD GASKET
2 - SEALANT
3 - CROSS-OVER GASKETS
4 - SEALANT
5 - LOCATOR DOWELS

The plenum pan rail must be clean and dry (free of all foreign material).

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straightedge.

INSTALLATION

(1) Install the intake manifold side gaskets. Be sure that the locator dowels are positioned in the head (Fig. 71).

INTAKE MANIFOLD (Continued)

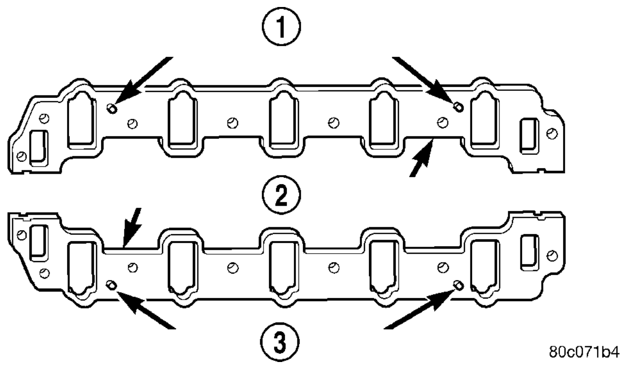


Fig. 71 Intake Manifold Flange

1 - LOCATOR DOWELS
2 - INTAKE MANIFOLD GASKETS
3 - LOCATOR DOWELS

(2) Insert Mopar® GEN II Silicone Rubber Adhesive Sealant, or equivalent, into the four corner joints an excessive amount of sealant is not required to ensure a leak proof seal. However, an excessive amount of sealant may reduce the effectiveness of the flange gasket. The sealant should be approximately 5 mm (0.2 in.) in diameter. (Fig. 70).

(3) Position the cross-over gaskets and press firmly onto the block (Fig. 70). **BE SURE THE BLOCK IS OIL FREE.**.

(4) The lower intake manifold MUST be installed within 3 minutes of sealant application. Carefully lower intake manifold into position on the cylinder block and heads. After intake manifold is in place, inspect to make sure seals and gaskets are in place. Finger start all the lower intake bolts.

(5) Tighten the lower intake manifold bolts in sequence to 54 N·m (40 ft. lbs.) torque (Fig. 69). Recheck all bolts are tightened to 54 N·m (40 ft. lbs.) torque.

(6) Using a new gasket, position the upper intake manifold onto the lower intake manifold.

(7) Finger start all bolts, alternate one side to the other.

(8) Tighten upper intake manifold bolts in sequence to 22 N·m (16 ft. lbs.) torque (Fig. 68).

(9) Using a new gasket, install the throttle body onto the upper intake manifold. Tighten the bolts to 23 N·m (200 in. lbs.) torque.

(10) Install closed crankcase ventilation and evaporation control systems.

(11) Connect the heater hoses and bypass hose.

(12) Connect the vacuum lines.

(13) Install the coil assemblies and the ignition wires.

(14) Connect the accelerator linkage and if so equipped, the speed control and transmission kickdown cables.

(15) Install the fuel lines (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(16) Using a new gasket, install the air cleaner housing. Tighten the nuts to 11 N·m (96 in. lbs.) torque. Install the air cleaner filter and cover.

(17) Install the A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION). Position the compressor brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(18) Install the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION). Position the generator brace and install the bolts. Tighten the brace bolts to 41 N·m (30 ft. lbs.) torque.

(19) Install the accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(20) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(21) Connect the negative cable to the battery.

(22) Start engine check for leaks.

EXHAUST MANIFOLD

DESCRIPTION

Engine exhaust manifolds (Fig. 72) are made of high molybdenum ductile cast iron. A special ribbed design helps control permanent dimensional changes during heat cycles.

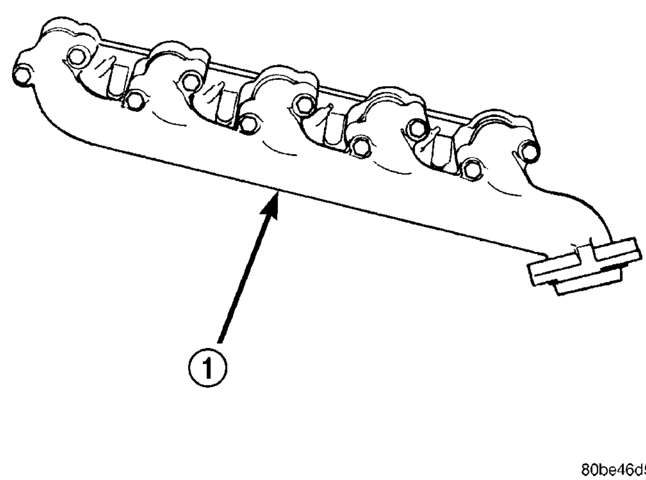


Fig. 72 Exhaust Manifold—8.0L Engine

1 - EXHAUST MANIFOLD

OPERATION

The exhaust manifolds collect the engine exhaust exiting the combustion chambers, then channels the exhaust gases to the exhaust pipes attached to the manifolds.

EXHAUST MANIFOLD (Continued)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise and support the vehicle.

(3) Remove the bolts and nuts attaching the exhaust pipe to the engine exhaust manifold..

(4) Lower the vehicle.

(5) Remove the exhaust heat shields (Fig. 73).

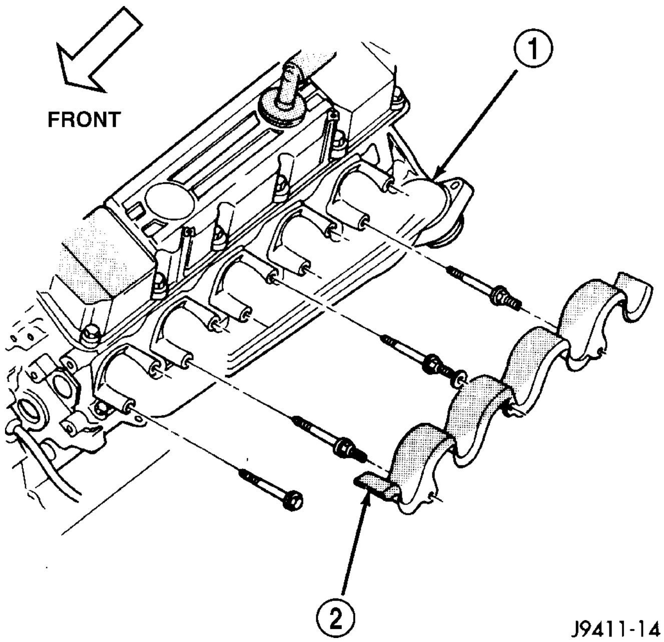


Fig. 73 8.0L Engine Exhaust Manifold—Typical

1 - EXHAUST MANIFOLD
2 - HEAT SHIELD

(6) Remove the dipstick bracket from the exhaust manifold (right side only).

(7) Remove bolts attaching manifold to cylinder head.

(8) Remove manifold from the cylinder head. Discard the gasket.

CLEANING

Clean mating surfaces on cylinder head and manifold. Wash with solvent and blow dry with compressed air.

INSPECTION

Inspect manifold for cracks.

Inspect mating surfaces of manifold for flatness with a straight edge. Gasket surfaces must be flat within 0.2 mm per 300 mm (0.008 inch per foot).

INSTALLATION

(1) Using a new gasket position the engine exhaust manifold onto the cylinder head. Install bolts and stud bolts in the proper position. (Fig. 73) Tighten the bolts to 22 N·m (16 ft. lbs.) torque.

(2) Install the dipstick bracket on to the exhaust manifold (right side only).

(3) Position washers and exhaust heat shields onto the manifold stud bolts (Fig. 73). Be sure the tabs on the heat shields are hooked over the top of the exhaust gasket. Install the nuts and tighten to 20 N·m (175 in. lbs.) torque.

(4) Raise and support the vehicle.

(5) Assemble exhaust pipe to manifold.

(6) Lower the vehicle.

(7) Connect the negative cable to the battery.

(8) Start engine check for leaks.

TIMING BELT / CHAIN COVER(S)

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(3) Remove the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove fan and fan shroud (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(5) Unbolt A/C compressor and set on top of engine.

(6) Remove generator, air pump, and bracket assembly.

(7) Remove water pump (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL).

(8) Remove damper bolt and washer.

(9) Using Special Tool 1026 3-Jaw Puller remove pulley/damper from the crankshaft. (Fig. 74)

(10) Loosen oil pan bolts and remove the front oil pan bolts that mount the pan to the timing chain cover.

(11) Remove the cover bolts.

(12) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket.

(13) Inspect surface of cover. Remove any burrs or high spots.

INSTALLATION

(1) Be sure mating surfaces of timing chain cover and cylinder block are clean and free from burrs.

(2) Lubricate the pump rotors using petroleum jelly or lubriplate (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(3) Using a new cover gasket, carefully install timing chain cover to avoid damaging oil pan gasket. Use a small amount of Mopar® Silicone Rubber Adhesive Sealant, or equivalent, at the joint between timing chain cover gasket and the oil pan gasket. Finger tighten the timing chain cover bolts at this time.

(4) Tighten timing chain cover bolts to 47 N·m (35 ft. lbs.) torque. Tighten oil pan bolts to 24 N·m (215 in. lbs.) torque.

TIMING BELT / CHAIN COVER(S) (Continued)

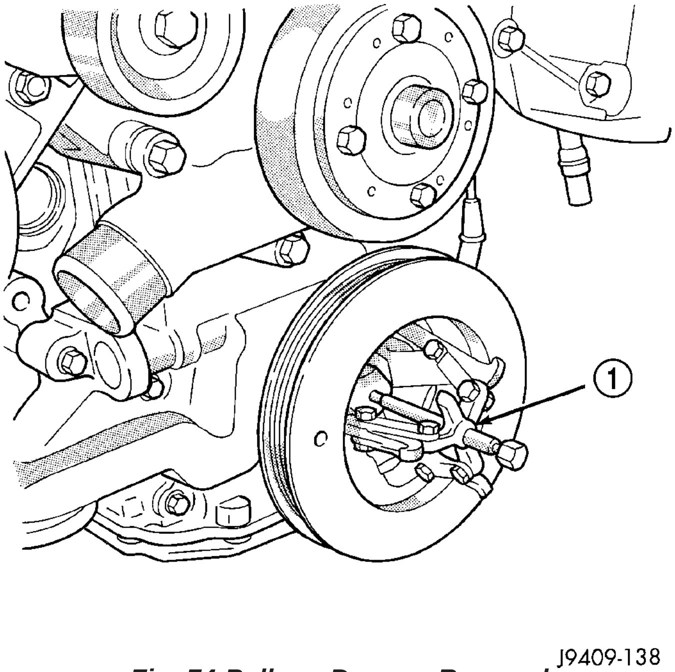


Fig. 74 Pulley—Damper Removal

1 - 3 JAW PULLER

(5) Using Special Tool C-3688 Crankshaft Pulley/ Damper Installer Install pulley/vibration damper (Fig. 75)

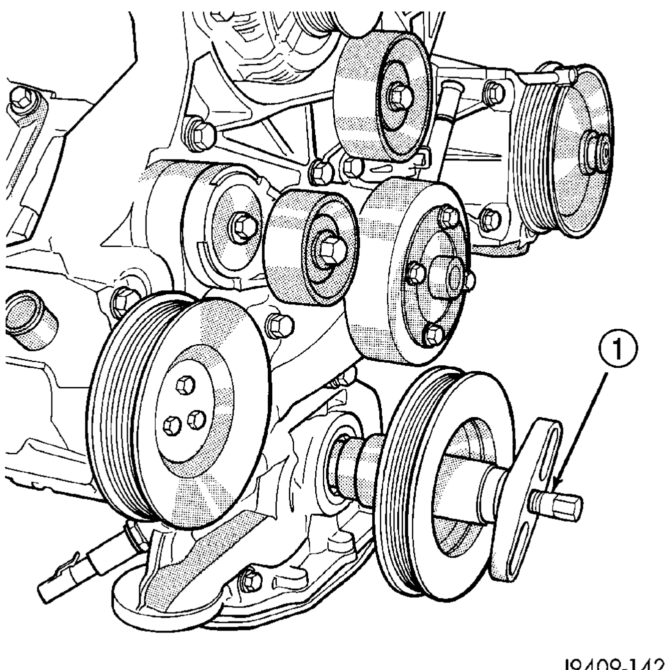


Fig. 75 Installing Crankshaft

1 - SPECIAL TOOL C-3688

(6) Prime oil pump by squirting oil in the oil filter mounting hole and filling the J-trap of the front timing cover. When oil is running out, install oil filter that has been filled with oil.

(7) Install water pump and housing assembly using new o-ring (Refer to 7 - COOLING/ENGINE/ WATER PUMP - INSTALLATION).

(8) Install generator, air pump, and bracket assembly.

(9) Install A/C compressor (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

(10) (10) Install the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(11) Position the fan shroud and install the bolts. Tighten the bolts to 11 N·m (95 in. lbs.) torque.

(12) Install the serpentine belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(14) Connect the negative cable to the battery.

(15) Road test vehicle and check for leaks.

TIMING BELT/CHAIN AND SPROCKETS

REMOVAL

(1) Remove timing chain cover and gasket using extreme caution to avoid damaging oil pan gasket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(2) Aline camshaft and crankshaft centerline. Remove camshaft sprocket attaching bolt and remove timing chain and camshaft sprockets.

(3) Use puller 6444 and jaws 6820 to remove crankshaft sprocket (Fig. 76).

INSPECTION—MEASURING TIMING CHAIN STRETCH

(1) Place a scale next to the timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt. Apply torque in the direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lbs.) torque with cylinder head installed or 20 N·m (15 ft. lbs.) torque with cylinder head removed. With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

(3) Hold a scale with dimensional reading even with the edge of a chain link. With cylinder heads installed, apply 14 N·m (30 ft. lbs.) torque in the reverse direction. With the cylinder heads removed, apply 20 N·m (15 ft. lbs.) torque in the reverse direction. Note the amount of chain movement (Fig. 77).

TIMING BELT/CHAIN AND SPROCKETS (Continued)

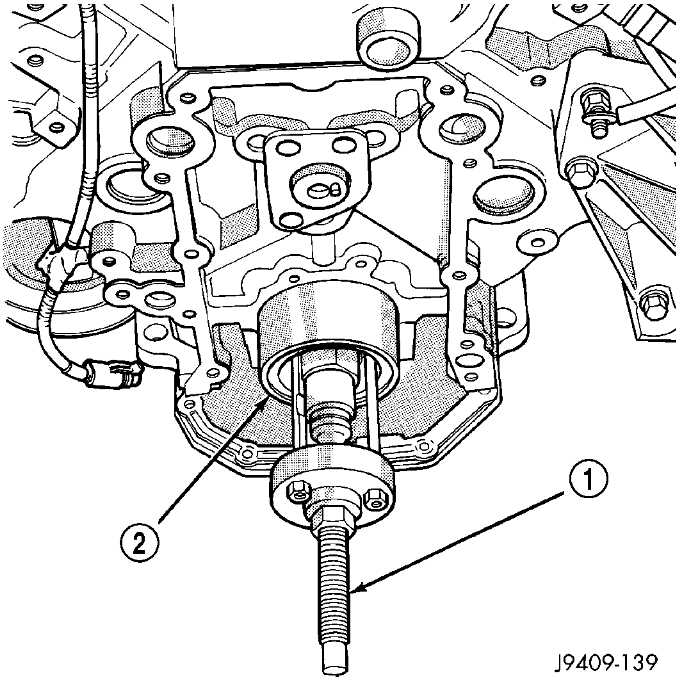


Fig. 76 Crankshaft Sprocket Removal.

1 - SPECIAL TOOL 6444
2 - SPECIAL TOOL 6820

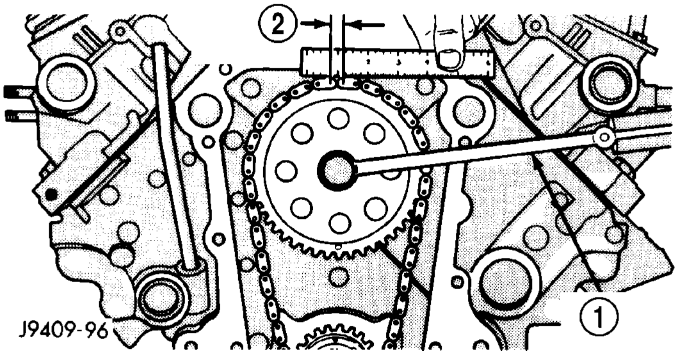


Fig. 77 Measuring Timing Chain Stretch

1 - TORQUE WRENCH
2 - 3.175 MM
(0.125 IN.)

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

INSTALLATION

(1) Line up key in crankshaft with keyway in sprocket, press on crankshaft timing sprocket, use tools C-3688, C-3718 and MB-990799, seat sprocket against crankshaft shoulder (Fig. 78).

(2) Turn crankshaft to line up the timing mark with the crankshaft and camshaft centerline.

(3) Put chain on camshaft sprocket.

(4) Align timing marks and install chain and camshaft sprocket onto crankshaft sprocket. Check to see that timing marks are on the centerline of the crankshaft and camshaft centerline (Fig. 79).

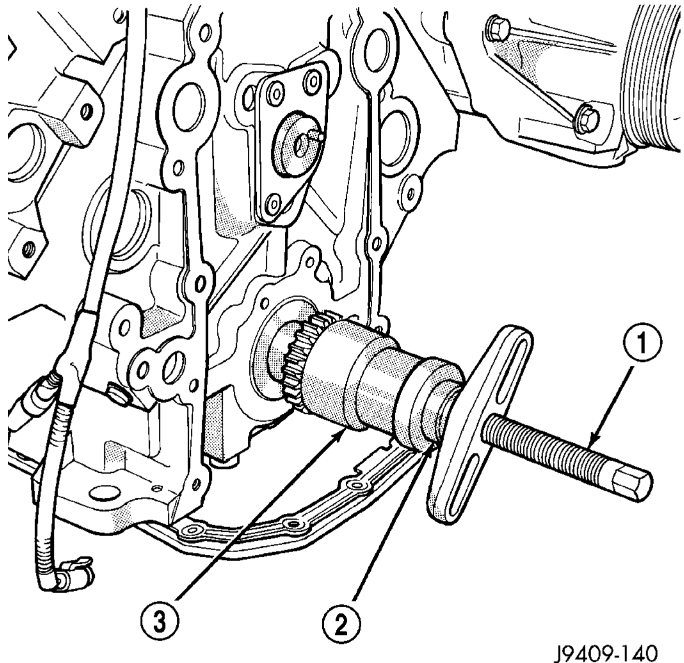


Fig. 78 Crankshaft Sprocket Installation

1 - SPECIAL TOOL C-3688
2 - SPECIAL TOOL C-3718
3 - SPECIAL TOOL MD990799

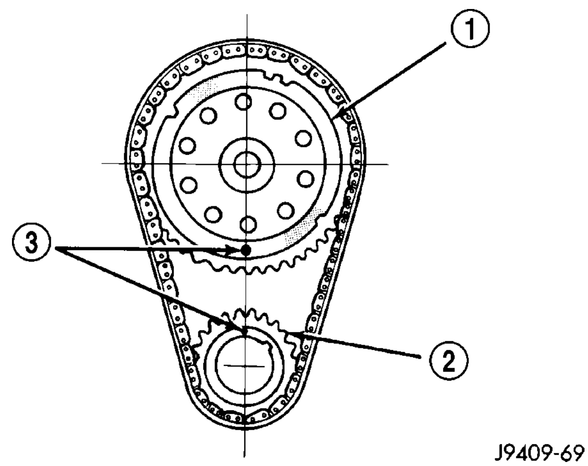


Fig. 79 Alignment of Timing Marks

1 - CAMSHAFT SPROCKET
2 - CRANKSHAFT SPROCKET
3 - TIMING MARKS

(5) Install the camshaft bolt. Tighten the bolt to 61 N·m (45 ft. lbs.) torque.

(6) Check camshaft end play. The end play should be 0.051-0.152 mm (0.002-0.006 inch) with a new thrust plate and up to 0.254 mm (0.010 inch) with a used thrust plate. If not within these limits install a new thrust plate.

(7) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

EXHAUST SYSTEM

TABLE OF CONTENTS

EXHAUST SYSTEM

DESCRIPTION

DESCRIPTION

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

The federal gasoline engine exhaust system consists of engine exhaust manifolds, exhaust pipes, catalytic converter(s), extension pipe (if needed), exhaust heat shields, muffler and exhaust tailpipe.

The California emission vehicles exhaust system also contains the above components as well as mini catalytic converters added to the exhaust pipe.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. Minimum clearance between any exhaust component and the body or frame is 25.4 mm (1.0 in.). If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

EXHAUST SYSTEM (Continued)

DESCRIPTION – 5.9L DIESEL

CAUTION: Avoid application of rust prevention compounds or undercoating materials to exhaust system floor pan exhaust heat shields. Light overspray near the edges is permitted. Application of coating will result in excessive floor pan temperatures and objectionable fumes.

The diesel engine exhaust system consists of an engine exhaust manifold, turbocharger, exhaust pipe, resonator, extension pipe (if needed), muffler and exhaust tailpipe.

California emission vehicales include a catalytic converter.

The exhaust system must be properly aligned to prevent stress, leakage and body contact. The exhaust components should be kept a minimum of 25.4 mm (1.0 in.) away from the body and frame. If the system contacts any body panel, it may amplify objectionable noises from the engine or body.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - GAS ENGINE

EXHAUST SYSTEM DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten clamps/bolts at leaking joints.
	2. Rusted or blown out muffler.	2. Replace muffler. Inspect exhaust system.
	3. Broken or rusted out exhaust pipe.	3. Replace exhaust pipe.
	4. Exhaust pipe leaking at manifold flange.	4. Tighten/replace flange attaching nuts/bolts.
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold.
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head bolts.
	7. Catalytic converter rusted or blown out.	7. Replace catalytic converter assy.
	8. Restriction in exhaust system.	8. Remove restriction, if possible. Replace restricted part if necessary.
CAUTION: When servicing and replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness and/or sensor.		

EXHAUST SYSTEM (Continued)

DIAGNOSIS AND TESTING - DIESEL ENGINE

EXHAUST SYSTEM DIAGNOSIS CHART

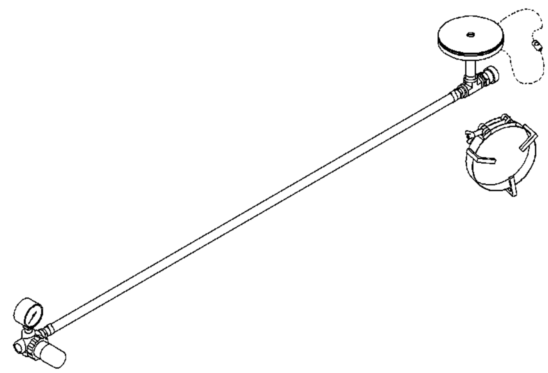
CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE EXHAUST NOISE OR LEAKING EXHAUST GASES	1. Leaks at pipe joints.	1. Tighten clamps/bolts at leaking joints.
	2. Rusted or blown out muffler.	2. Replace muffler. Inspect exhaust system.
	3. Broken or rusted out exhaust pipe.	3. Replace exhaust pipe.
	4. Exhaust pipe leaking at manifold flange.	4. Tighten/replace flange attaching nuts/bolts.
	5. Exhaust manifold cracked or broken.	5. Replace exhaust manifold.
	6. Leak between exhaust manifold and cylinder head.	6. Tighten exhaust manifold to cylinder head bolts. Replace gasket if necessary.
	7. Turbocharger mounting flange cracked.	7. Remove turbocharger and inspect. (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - REMOVAL).
	8. Restriction in exhaust system.	8. Remove restriction, if possible. Replace restricted part if necessary.

EXHAUST SYSTEM (Continued)

SPECIFICATIONS - TORQUE

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Adjusting Strap—Bolt	23	—	200
Air Heater Power Supply—Nuts	14	—	124
Air Inlet Housing—Bolts	24	18	—
Cab Heater Supply/Return Line—Nuts	24	18	—
Exhaust Clamp—Nuts	48	35	—
Exhaust Manifold to Cylinder Head—Bolts (Diesel Engine)	43	32	—
Exhaust Manifold to Cylinder Head—Bolts (5.9L)	31	23	—
Exhaust Manifold to Cylinder Head—Bolts (8.0L)	22	—	195
Exhaust Pipe to Manifold—Bolts	31	23	—
Generator Mounting—Bolts	41	30	—
Charge Air Cooler Mounting—Bolts	2	—	17
Charge Air Cooler Duct—Nuts	11	—	95
Heat Shield—Nuts and Bolts	11	—	95
Turbocharger flange studs	24	18	—
Turbocharger Mounting—Nuts	43	32	—
Turbocharger Oil Drain Tube—Bolts	24	18	—
Turbocharger Oil Supply Line—Fitting	24	18	—
Turbocharger V-Band Clamp—Nut	9	—	75
Turbocharger Oil Supply fitting (at Turbocharger)	36	27	—
Turbocharger Oil Supply fitting (at lube filter head)	24	18	—
Turbocharger Drain Hose Clamps	8	—	71

SPECIAL TOOLS



TURBOCHARGER TESTER 9022

CATALYTIC CONVERTER

DESCRIPTION - CATALYTIC CONVERTER

WARNING: THE NORMAL OPERATING TEMPERATURE OF THE EXHAUST SYSTEM IS VERY HIGH. THEREFORE, NEVER WORK AROUND OR ATTEMPT TO SERVICE ANY PART OF THE EXHAUST SYSTEM UNTIL IT IS COOLED. SPECIAL CARE SHOULD BE TAKEN WHEN WORKING NEAR THE CATALYTIC CONVERTER. THE TEMPERATURE OF THE CONVERTER RISES TO A HIGH LEVEL AFTER A SHORT PERIOD OF ENGINE OPERATION TIME.

CAUTION: DO NOT remove spark plug wires from plugs or by any other means short out cylinders. Failure of the catalytic converter can occur due to a temperature increase caused by unburned fuel passing through the converter.

The stainless steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the converter. If unburned fuel enters the converter, overheating may occur. If a converter is heat-damaged, correct the cause of the damage at the same time the converter is replaced. Also, inspect all other components of the exhaust system for heat damage.

Unleaded gasoline must be used to avoid contaminating the catalyst core.

50 State emission vehicles incorporate two mini catalytic converters located after the exhaust manifolds and before the inline catalytic converter.

OPERATION

The catalytic converter captures and burns any unburned fuel mixture exiting the combustion chambers during the exhaust stroke of the engine. This process aids in reducing emissions output.

CATALYTIC CONVERTER (Continued)

REMOVAL

REMOVAL

WARNING: IF TORCHES ARE USED WHEN WORKING ON THE EXHAUST SYSTEM, DO NOT ALLOW THE FLAME NEAR THE FUEL LINES.

(1) Raise and support the vehicle.
(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(3) Remove the bolts from the crossover pipe to the catalytic converter connection.
(4) Disconnect oxygen sensor wiring.
(5) Loosen the nuts from the clamp that hold the catalytic converter to the exhaust pipe flange connection.

NOTE: Do not remove nut from T-Bolt. Only remove nut far enough, so that the T end can be removed from the clamp.

(6) Remove the T bolt end of the fastener, from the clamp.
(7) Spread the clamp, and remove the catalytic converter from the vehicle.
(8) Discard the clamp.

NOTE: The catalytic converter to exhaust manifold clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.

REMOVAL

(1) Raise and support vehicle.
(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(3) Remove clamps and nuts.
(4) Remove the catalytic converter.

INSPECTION

Look at the stainless steel body of the converter, inspect for bulging or other distortion that could be a result of overheating. If the converter has a heat shield attached make sure it is not bent or loose.

If you suspect internal damage to the catalyst, tapping the bottom of the catalyst with a rubber mallet may indicate a damaged core.

INSTALLATION

INSTALLATION

NOTE: The catalytic converter to exhaust manifold clamp is not reusable. Always use a new clamp when reinstalling the catalytic converter.

(1) Position the catalytic converter onto the exhaust pipe flange connection. Tighten the nuts to 28 N·m (250 in. lbs.) torque.
(2) Install the muffler onto the catalytic converter until the alignment tab is inserted into the alignment slot.
(3) Install the exhaust clamp at the muffler and catalytic converter connection. Tighten the clamp nuts to 47 N·m (35 ft. lbs.) torque.
(4) Connect oxygen sensor wiring.
(5) Lower the vehicle.
(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

INSTALLATION

(1) Assemble converter and clamps loosely in place.
(2) Install the exhaust pipe onto exhaust manifolds, tighten 31 N·m (23 ft. lbs.).
(3) Tighten all clamp nuts to 48 N·m (35 ft. lbs.) torque.
(4) Lower the vehicle.
(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between exhaust system components and body/frame parts. Adjust the alignment, if needed.

EXHAUST PIPE

REMOVAL

REMOVAL — 5.9L

(1) Raise and support the vehicle.
(2) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.
(3) Remove exhaust pipe to manifold bolts, retainers and nuts.
(4) Remove the clamp nuts.
(5) Remove the exhaust pipe (Fig. 1).

REMOVAL

CAUTION: When servicing or replacing exhaust system components, disconnect the oxygen sensor connector(s). Allowing the exhaust to hang by the oxygen sensor wires will damage the harness and/or sensor.

(1) Raise and support the vehicle.
(2) Saturate the bolts and nuts with Mopar® Rust Penetrant. Allow 5 minutes for penetration.
(3) Disconnect the oxygen sensor(s).

EXHAUST PIPE (Continued)

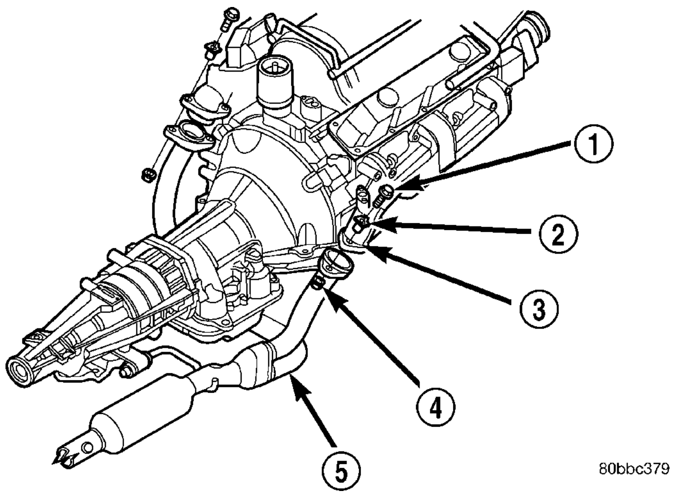


Fig. 1 Exhaust Pipe to Manifold Connection – 5.9L

1 - BOLT
2 - RETAINER
3 - EXHAUST MANIFOLD
4 - NUT
5 - EXHAUST PIPE

(4) Remove the exhaust manifold-to-exhaust pipe nuts (Fig. 2).

(5) Remove exhaust pipe to converter exhaust clamp.

(6) Disconnect the exhaust pipe from the catalytic converter front flange.

(7) Remove the exhaust pipe.

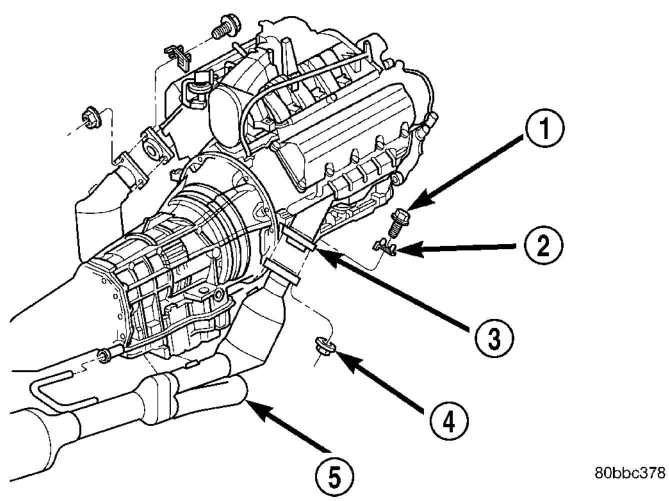


Fig. 2 Exhaust Pipe(s) to Manifold Connection

1 - BOLT
2 - RETAINER
3 - EXHAUST MANIFOLD
4 - NUT
5 - EXHAUST PIPE

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

INSTALLATION — 5.9L

(1) Position the exhaust pipe for proper clearance with the frame and underbody parts. A minimum clearance of 25.4 mm (1.0 in.) is required.

(2) Position the exhaust pipe to manifold. Install the bolts, retainers and nuts. Tighten the nuts to 31 N·m (23 ft. lbs.) torque.

(3) Tighten the clamp nuts to 48 N·m (35 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed (Fig. 1) and (Fig. 3).

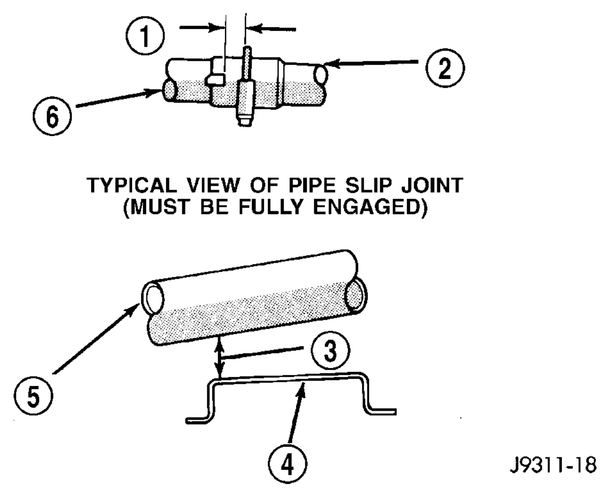


Fig. 3 Exhaust Pipe-to-Catalytic Converter Flange Alignment — Typical

1 - 7.874–17.526 mm (0.31–0.69 in.)
2 - CATALYTIC CONVERTER FLANGE
3 - 20 mm (0.79 in.) MIN.
4 - CROSSMEMBER
5 - EXHAUST PIPE
6 - EXHAUST PIPE

EXHAUST PIPE (Continued)

INSTALLATION

(1) Connect the exhaust pipe(s) to the exhaust manifold. Tighten the nuts to 34 N·m (25 ft. lbs.) torque.

(2) Align and connect the exhaust pipe to the catalytic converter flange (Fig. 4). Install exhaust clamp and tighten clamp nuts to 47 N·m (35 ft. lbs.) torque.

(3) Connect oxygen sensor connector(s).

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

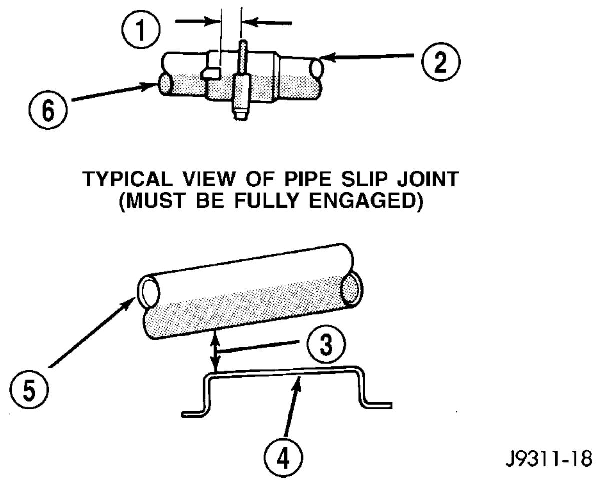


Fig. 4 Exhaust Pipe-to-Catalytic Converter Flange Alignment—Typical

1 - 7.874–17.526 mm (0.31–0.69 in.)
2 - CATALYTIC CONVERTER FLANGE
3 - 20 mm (0.79 in.) MIN.
4 - CROSSMEMBER
5 - EXHAUST PIPE
6 - EXHAUST PIPE

EXHAUST PIPE

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise and support the vehicle on a hoist.

(3) Saturate the bolts and nuts with heat valve lubricant. Allow 5 minutes for penetration.

(4) Remove the exhaust pipe-to-extension pipe clamp. Separate the exhaust pipe and extension pipe.

(5) Remove the exhaust pipe-to-turbocharger elbow clamp (Fig. 5).

(6) Remove the exhaust pipe from the transmission support (Fig. 5).

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

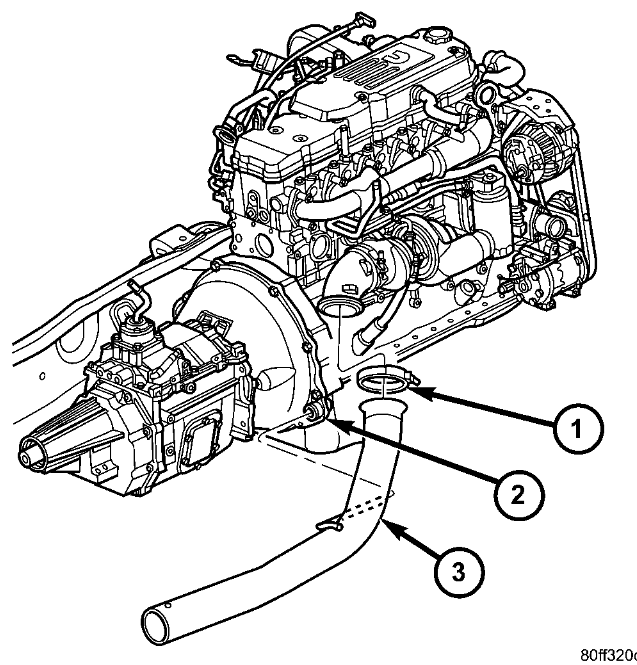


Fig. 5 Exhaust Pipe

1 - Clamp
2 - Support
3 - EXHAUST PIPE

INSTALLATION

(1) Install the exhaust pipe into the transmission support and onto the turbocharger flange.

(2) Install the exhaust pipe-to-turbocharger elbow clamp and tighten to 31 N·m (23 ft. lbs.) torque.

(3) Install the extension pipe and clamp to the exhaust pipe using a new clamp and tighten the clamp nuts to 48 N·m (35 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Connect the battery negative cables.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required. Adjust the alignment, if needed.

HEAT SHIELDS

DESCRIPTION

There are two types of heat shields used. One is stamped steel the other is molded foil sheets. The shields attach to the vehicle around the exhaust system to prevent heat from the exhaust system from entering the passenger area and other areas where the heat can cause damage to other components.

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the nuts or bolts holding the exhaust heat shield to the floor pan (Fig. 6) (Fig. 7) (Fig. 8), crossmember or bracket.

HEAT SHIELDS (Continued)

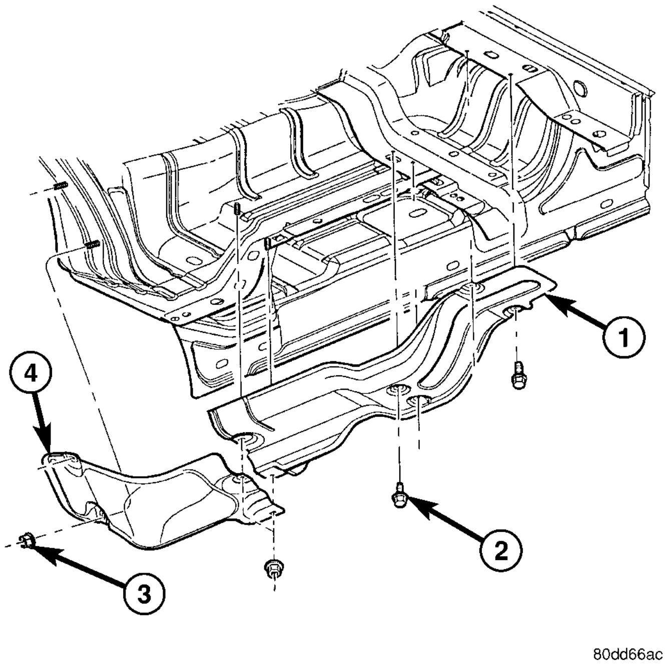


Fig. 6 HEAT SHIELDS - RH - REG CAB

1 - HEAT SHIELD
2 - FASTENER
3 - NUT
4 - HEAT SHIELD

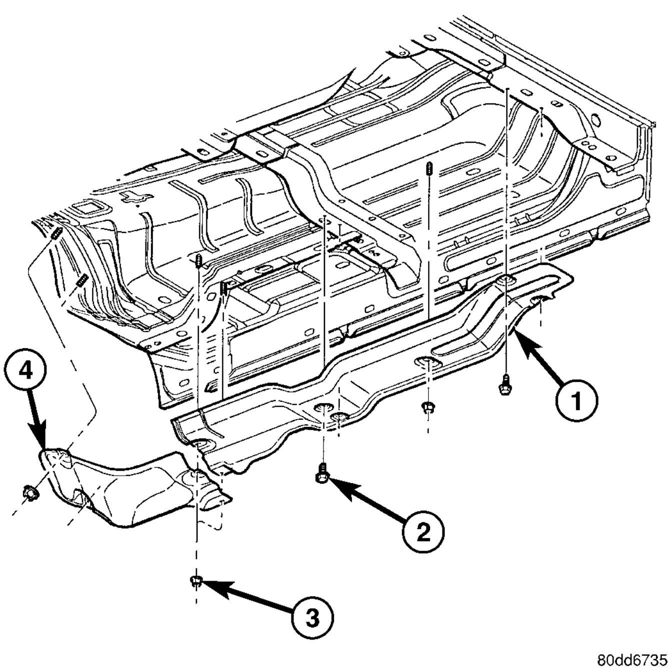


Fig. 7 HEAT SHIELDS - RH - QUAD CAB

1 - HEAT SHIELD
2 - FASTENER
3 - NUT
4 - HEAT SHIELD

(3) Slide the shield out around the exhaust system.

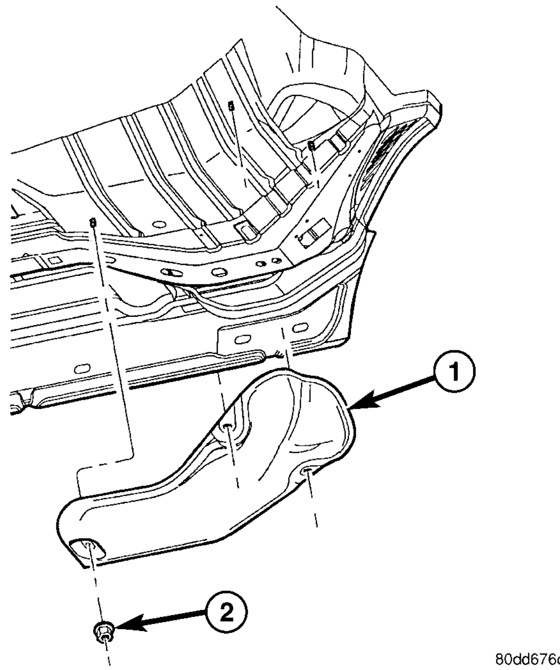


Fig. 8 HEAT SHIELD LH

1 - HEAT SHIELD
2 - NUT

INSTALLATION

(1) Position the exhaust heat shield to the floor pan, crossmember or bracket and install the nuts or bolts.

(2) Tighten the nuts and bolts 11 N·m (100 in. lbs.).

(3) Lower the vehicle.

MUFFLER

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect the muffler hangers (Fig. 9).

(4) Remove clamps and nuts.

(5) Remove the muffler.

INSTALLATION

(1) Assemble muffler and clamps loosely to permit proper alignment of all parts.

(2) Connect the muffler hangers.

(3) Tighten the clamp nuts to 48 N·m (35 ft. lbs.) torque.

(4) Lower the vehicle.

(5) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between exhaust system components and body/frame parts. Adjust the alignment, if needed.

MUFFLER (Continued)

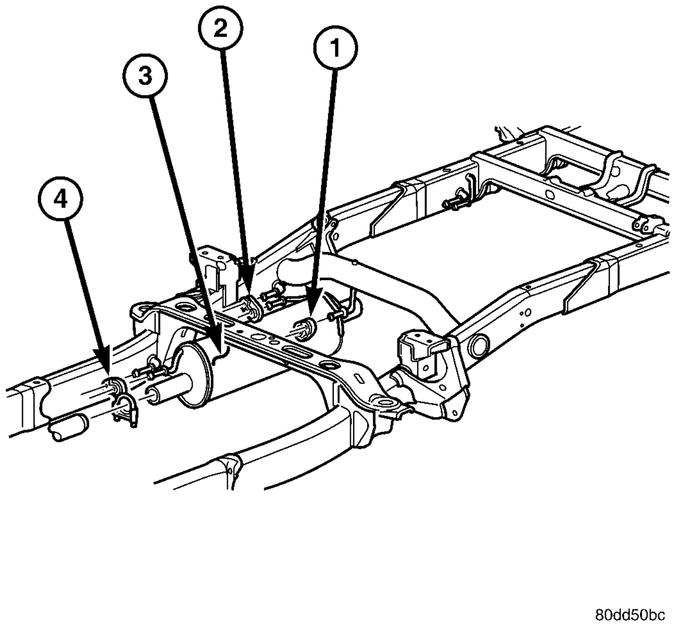


Fig. 9 MUFFLER

1 - INSULATOR
2 - INSULATOR
3 - MUFFLER
4 - INSULATOR

MUFFLER - 5.9L DIESEL

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise and support the vehicle.

(3) Remove the muffler to tail pipe and extension pipe clamps (Fig. 10).

(4) Disconnect the muffler from the hanger isolators (Fig. 10).

(5) Disconnect the muffler from the tailpipe.

(6) Disconnect the muffler from the extension pipe and remove from the vehicle.

INSTALLATION

(1) Install the muffler hanger rods into the isolators (Fig. 10).

(2) Install the muffler into the extension pipe.

(3) Install the muffler into the tail pipe.

(4) Install the exhaust clamps, align the exhaust system, and tighten the exhaust clamps to 48 N·m (35 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Connect the battery negative cables.

(7) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between exhaust system components and body/frame parts. Adjust the alignment, if needed.

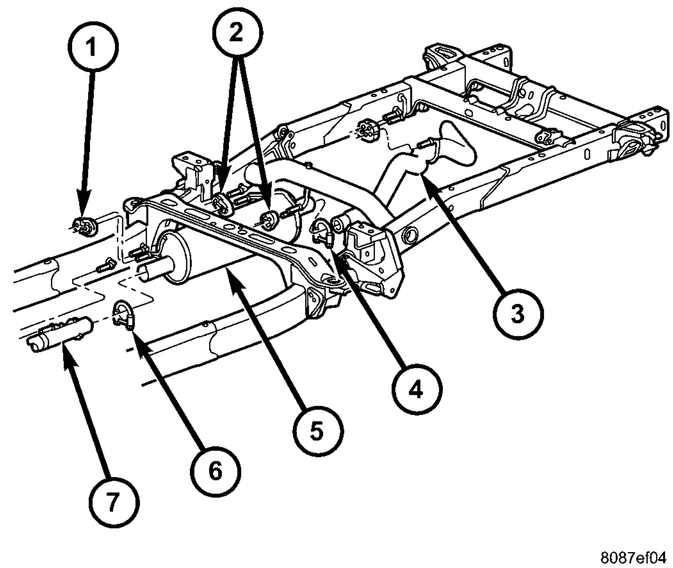


Fig. 10 Muffler Removal/Installation

1 - INSULATOR
2 - ISOLATOR
3 - TAILPIPE
4 - CLAMP
5 - MUFFLER
6 - CLAMP
7 - EXTENSION PIPE

TAILPIPE - 5.9L DIESEL

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise and support the vehicle.

(3) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(4) Disconnect the exhaust tailpipe support hanger isolators (Fig. 11).

(5) Remove the muffler-to-tailpipe clamps (Fig. 11).

(6) Remove the tailpipe from the vehicle.

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

(1) Install the tailpipe into the muffler.

(2) Install the tailpipe hanger rods into the isolators (Fig. 11)

(3) Install the exhaust clamp, align the exhaust system, and tighten the clamp 48 N·m (35 ft. lbs.) torque.

TAILPIPE - 5.9L DIESEL (Continued)

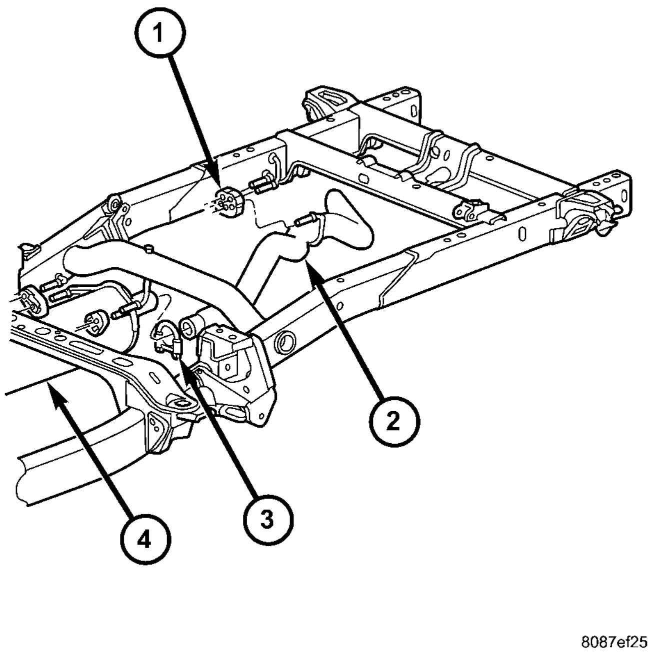


Fig. 11 Tailpipe Removal/Installation

1 - ISOLATOR
2 - TAILPIPRE
3 - CLAMP
4 - MUFFLER

(4) Lower the vehicle.

(5) Connect the battery negative cables.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. Adjust the alignment, if needed.

TAILPIPE

REMOVAL

(1) Raise and support the vehicle.

(2) Saturate the clamp nuts with heat valve lubricant. Allow 5 minutes for penetration.

(3) Disconnect the exhaust tailpipe support hanger (Fig. 12).

(4) Remove clamps and nuts.

(5) Remove the exhaust tailpipe.

INSPECTION

Discard rusted clamps, broken or worn supports and attaching parts. Replace a component with original equipment parts, or equivalent. This will assure proper alignment with other parts in the system and provide acceptable exhaust noise levels.

INSTALLATION

(1) Loosely assemble exhaust tailpipe to permit proper alignment of all parts.

(2) Connect the support hangers.

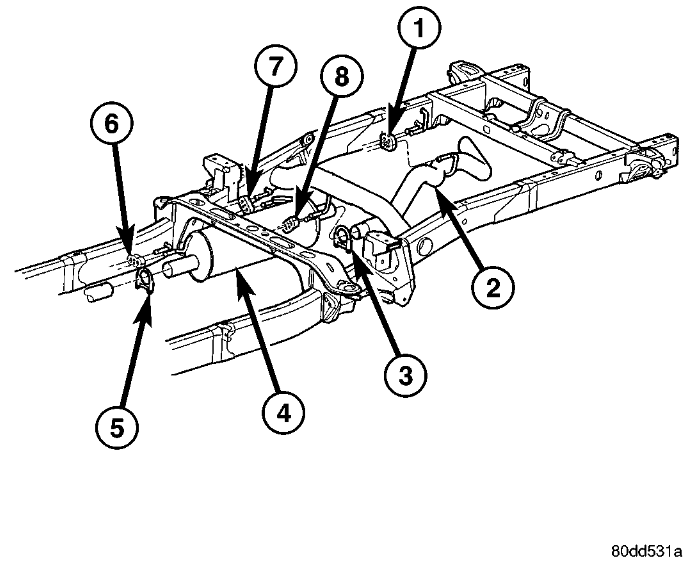


Fig. 12 TAILPIPE

1 - INSULATOR
2 - TAILPIPE
3 - CLAMP
4 - MUFFLER
5 - CLAMP
6 - INSULATOR
7 - INSULATOR
8 - INSULATOR

(3) Position the exhaust tailpipe for proper clearance with the underbody parts.

(4) Tighten all clamp nuts to 48 N·m (35 ft. lbs.) torque.

(5) Lower the vehicle.

(6) Start the engine and inspect for exhaust leaks and exhaust system contact with the body panels. A minimum of 25.4 mm (1.0 in.) is required between the exhaust system components and body/frame parts. Adjust the alignment, if needed.

TURBOCHARGER SYSTEM

DIAGNOSIS AND TESTING - TURBOCHARGER BOOST PRESSURE

NOTE: This diagnostic procedure is to be used with the DRB III® while test driving the vehicle under normal load and driving conditions.

Low turbocharger boost pressure can cause poor engine performance and driveability concerns. The following procedure will test the turbocharger boost pressure.

TURBOCHARGER SYSTEM (Continued)

(1) Loosen clamps holding air inlet duct rubber sleeve to the intake manifold and air inlet duct. Remove rubber sleeve (Fig. 13).

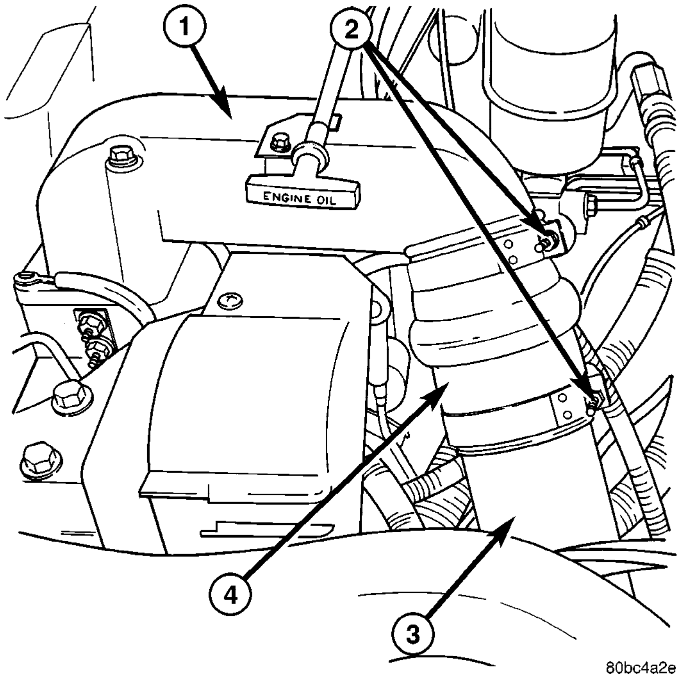


Fig. 13 INTAKE MANIFOLD TO AIR INLET DUCT RUBBER SLEEVE

1 - INTAKE MANIFOLD AIR INLET
2 - CLAMPS
3 - AIR INLET DUCT
4 - AIR INLET DUCT RUBBER SLEEVE

(2) Position Special Tool 8462 onto air inlet duct and intake manifold. Using the existing clamps tighten to 8 N·m (72 in. lbs.).

(3) Install the 3447.5 kPa 500 psi (gray) Pressure Transducer (part of OT-CH8520 Transducer Kit) into Special Tool 8462.

(4) Connect the DRB III® to the pressure transducer following the instructions supplied with the DRB III®.

(5) Enter DRB III® into pressure reading mode and test drive vehicle.

(6) Full laod boost pressure at rated speed will be 158 - 186 kPa (23 - 27 psi.) depending on engine hp rating.. If pressure readings are are not within this range inspect for the following:

- Restricted air inlet system
- Leak in the charge air cooler system (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/ CHARGE AIR COOLER AND PLUMBING - DIAGNOSIS AND TESTING)
- Turbocharger wastegate broken or misadjusted
- Restricted/high pressure drop across charge air cooler
- Turbocharger damaged (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/TURBOCHARGER - INSPECTION)

TURBOCHARGER

DESCRIPTION

The turbocharger is an exhaust-driven supercharger which increases the pressure and density of the air entering the engine. With the increase of air entering the engine, more fuel can be injected into the cylinders, which creates more power during combustion.

The turbocharger assembly consists of four (4) major component systems (Fig. 14) (Fig. 15) :

- Turbine section
- Compressor section
- Bearing housing
- Wastegate

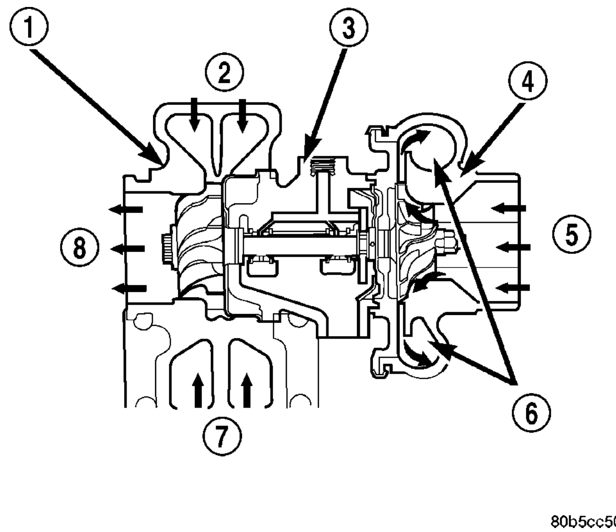


Fig. 14 Turbocharger Operation

1 - TURBINE SECTION
2 - EXHAUST GAS
3 - BEARING HOUSING
4 - COMPRESSOR SECTION
5 - INLET AIR
6 - COMPRESSED AIR TO ENGINE
7 - EXHAUST GAS
8 - EXHAUST GAS TO EXHAUST PIPE

OPERATION

Exhaust gas pressure and energy drive the turbine, which in turn drives a centrifugal compressor that compresses the inlet air, and forces the air into the engine through the charge air cooler and plumbing. Since heat is a by-product of this compression, the air must pass through a charge air cooler to cool the incoming air and maintain power and efficiency.

Increasing air flow to the engine provides:

- Improved engine performance
- Lower exhaust smoke density

TURBOCHARGER (Continued)

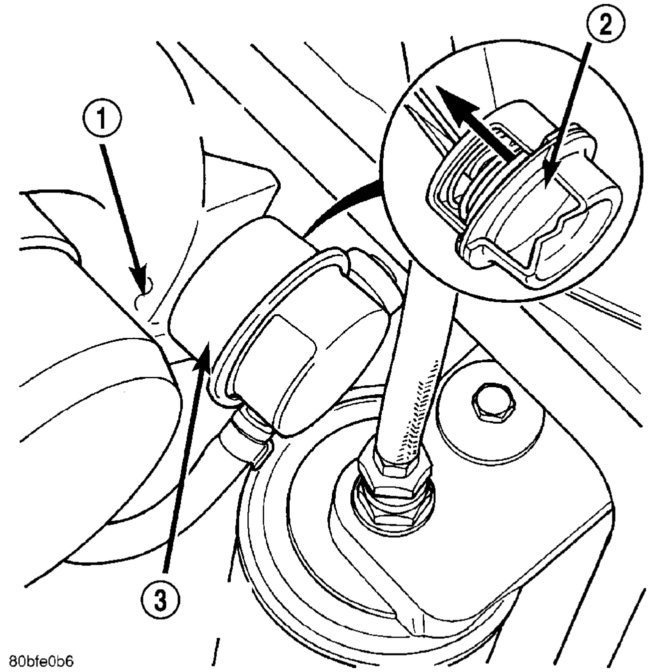


Fig. 15 Turbocharger Wastegate Actuator

1 - TURBOCHARGER
2 - DIAPHRAGM
3 - WASTE GATE ACTUATOR

- Improved operating economy
- Altitude compensation
- Noise reduction.

The turbocharger also uses a wastegate (Fig. 16), which regulates intake manifold air pressure and prevents over boosting at high engine speeds. When the wastegate valve is closed, all of the exhaust gases flow through the turbine wheel. As the intake manifold pressure increases, the wastegate actuator opens the valve, diverting some of the exhaust gases away from the turbine wheel. This limits turbine shaft speed and air output from the impeller.

The turbocharger is lubricated by engine oil that is pressurized, cooled, and filtered. The oil is delivered to the turbocharger by a supply line that is tapped into the oil filter head. The oil travels into the bearing housing, where it lubricates the shaft and bearings (Fig. 17). A return pipe at the bottom of the bearing housing, routes the engine oil back to the crankcase.

The most common turbocharger failure is bearing failure related to repeated hot shutdowns with inadequate "cool-down" periods. A sudden engine shut down after prolonged operation will result in the transfer of heat from the turbine section of the turbocharger to the bearing housing. This causes the oil to overheat and break down, which causes bearing and shaft damage the next time the vehicle is started.

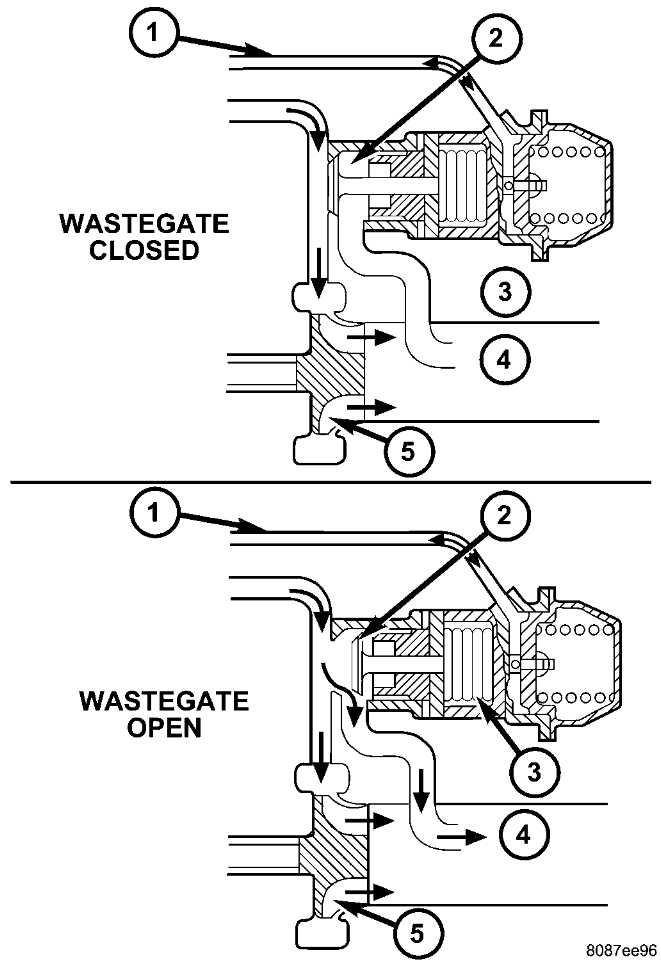


Fig. 16 Wastegate Operation

1 - SIGNAL LINE
2 - EXHAUST BYPASS VALVE
3 - WASTEGATE
4 - EXHAUST
5 - TURBINE

Letting the engine idle after extended operation allows the turbine housing to cool to normal operating temperature. The following chart should be used as a guide in determining the amount of engine idle time required to sufficiently cool down the turbocharger before shut down, depending upon the type of driving and the amount of cargo.

TURBOCHARGER (Continued)

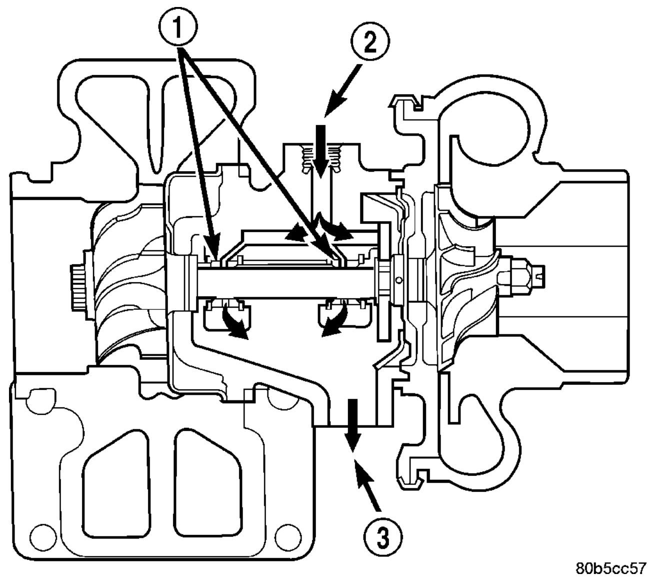


Fig. 17 Turbocharger Oil Supply and Drain

1 - BEARINGS
2 - OIL SUPPLY (FROM FILTER HEAD)
3 - OIL RETURN (TO SUMP)

TURBOCHARGER ″COOL DOWN″ CHART			
Driving Condition	Load	Turbocharger Temperature	Idle Time (in minuetes) Before Shut Down
Stop & Go	Empty	Cool	Less than 1
Stop & Go	Medium	Warm	1
Highway Speeds	Medium	Warm	2
City Traffic	Max. GCWR	Warm	3
Highway Speeds	Max. GCWR	Warm	4
Uphill Grade	Max. GCWR	Hot	5

REMOVAL

(1) Disconnect the battery negative cables.

(2) Raise vehicle on hoist.

(3) Disconnect the exhaust pipe from the turbocharger elbow(Refer to 11 - EXHAUST SYSTEM/EXHAUST PIPE - REMOVAL).

(4) Lower vehicle.

(5) Disconnect the turbocharger air inlet hose (Fig. 18).

(6) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger (Fig. 19).

(7) Disconnect the charge air cooler inlet pipe from the turbocharger compressor outlet (Fig. 19).

(8) Remove the turbocharger and gasket from the exhaust manifold.

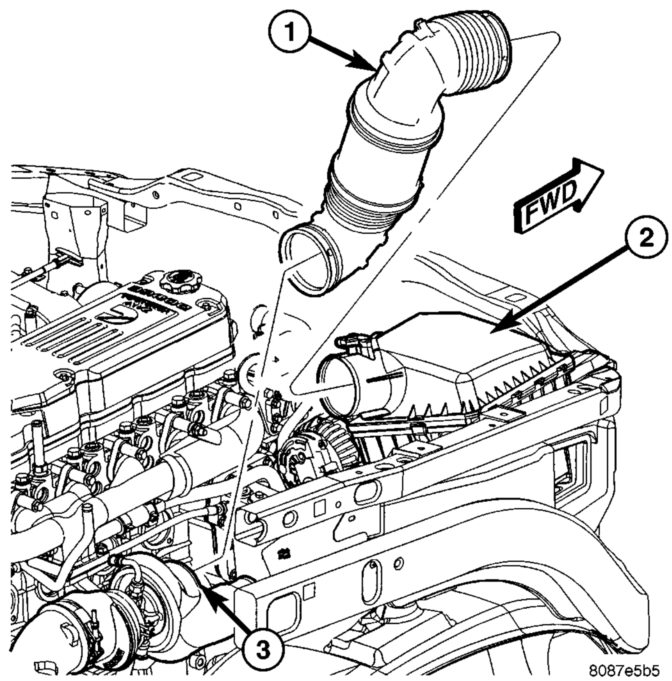


Fig. 18 Turbocharger Air Inlet Hose

1 - AIR INLET TUBE
2 - AIR FILTER HOUSING
3 - TURBOCHARGER

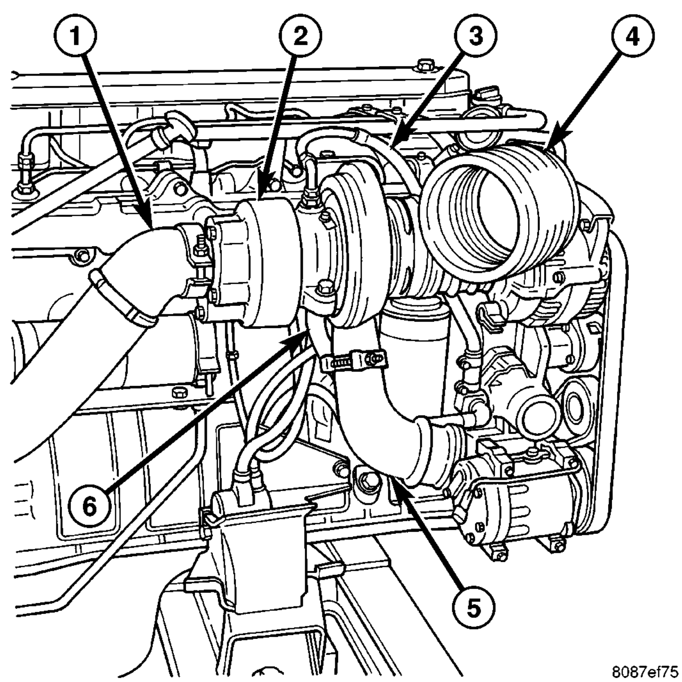


Fig. 19 Oil Supply Line and Charge Air Cooler Inlet Duct

1 - TURBOCHARGERR EXHAUST ELBOW
2 - TURBOCHARGER
3 - OIL SUPPLY LINE
4 - AIR INLET TUBE
5 - TURBOCHARGER COMPRESSOR OUTLET
6 - OIL DRAIN LINE

TURBOCHARGER (Continued)

(9) If the turbocharger is not to be installed immediately, cover the opening to prevent material from entering into the manifold.

(10) If replacing the turbocharger, transfer the compressor outlet and clamp to the new assembly.

(11) Clean and inspect the sealing surface.

CAUTION: The turbocharger is only serviced as an assembly. Do not attempt to repair the turbocharger as turbocharger and/or engine damage can result.

CLEANING

Clean the turbocharger and exhaust manifold mounting surfaces with a suitable scraper.

INSPECTION

Visually inspect the turbocharger and exhaust manifold gasket surfaces. Replace stripped or eroded mounting studs.

(1) Visually inspect the turbocharger for cracks. The following cracks are NOT acceptable:

- Cracks in the turbine and compressor housing that go completely through.
- Cracks in the mounting flange that are longer than 15 mm (0.6 in.).
- Cracks in the mounting flange that intersect bolt through-holes.
- Two (2) Cracks in the mounting flange that are closer than 6.4 mm (0.25 in.) together.

(2) Visually inspect the impeller and compressor wheel fins for nicks, cracks, or chips. Note: Some impellers may have a factory placed paint mark which, after normal operation, appears to be a crack. Remove this mark with a suitable solvent to verify that it is not a crack.

(3) Visually inspect the turbocharger compressor housing for an impeller rubbing condition (Fig. 20). Replace the turbocharger if the condition exists.

(4) Measure the turbocharger axial end play:

(a) Install a dial indicator as shown in (Fig. 21). Zero the indicator at one end of travel.

(b) Move the impeller shaft fore and aft and record the measurement. Allowable end play is 0.026 mm (0.0001 in.) MIN. and 0.127 mm (0.005 in.) MAX. If the recorded measurement falls outside these parameters, replace the turbocharger assembly.

(5) Measure the turbocharger bearing radial clearance:

(a) Insert a narrow blade or wire style feeler gauge between the compressor wheel and the housing (Fig. 22).

(b) Gently push the compressor wheel toward the housing and record the clearance.

(c) With the feeler gauge in the same location, gently push the compressor wheel away from the housing and again record the clearance.

(d) Subtract the smaller clearance from the larger clearance. This is the radial bearing clearance.

(e) Allowable radial bearing clearance is 0.33 mm (0.013 in.) MIN. and 0.50 mm (0.020 in.) MAX. If the recorded measurement falls outside these specifications, replace the turbocharger assembly.

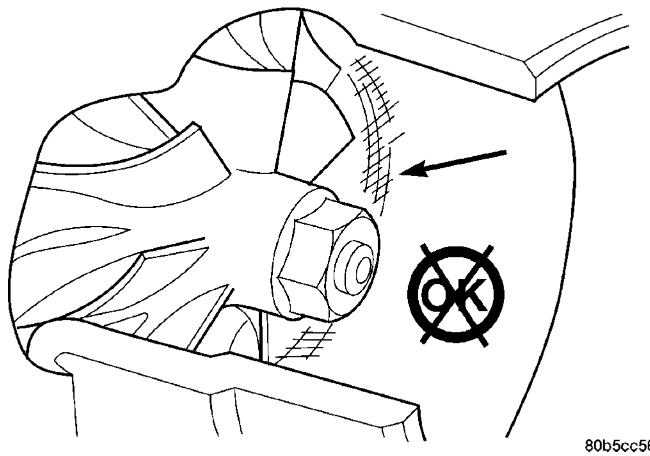


Fig. 20 Inspect Compressor Housing for Impeller Rubbing Condition

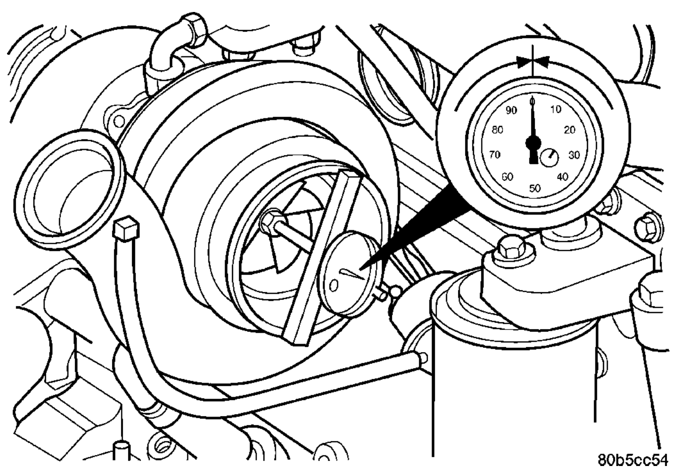


Fig. 21 Measure Turbocharger Axial End Play

INSTALLATION

(1) Install the turbocharger. Apply anti-seize to the studs and then tighten the turbocharger mounting nuts to 43 N·m (32 ft. lbs.) torque.

(2) Install the oil drain tube to the turbocharger (Fig. 19). Tighten the drain tube bolts to 24 N·m (18 ft. lbs.) torque.

TURBOCHARGER (Continued)

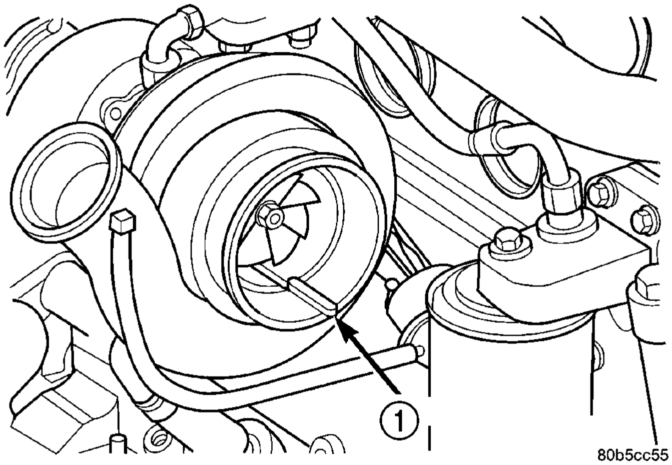


Fig. 22 Measure Turbocharger Bearing Radial Clearance

1 - FEELER GAUGE

(3) **Pre-lube the turbocharger.** Pour 50 to 60 cc (2 to 3 oz.) clean engine oil in the oil supply line fitting. Carefully rotate the turbocharger impeller by hand to distribute the oil thoroughly.

(4) Install and tighten the oil supply line to 24 N·m (18 ft. lbs.) torque.

(5) Position the charge air cooler inlet pipe to the turbocharger. With the clamp in position, tighten the clamp nut to 11 N·m (95 in. lbs.) torque.

(6) Position the air inlet hose to the turbocharger (Fig. 18). Tighten the clamp to 11 N·m (95 in. lbs.) torque.

(7) Raise vehicle on hoist.

(8) Connect the exhaust pipe to the turbocharger and tighten the bolts to 34 N·m (25 ft. lbs.) torque.

(9) Lower the vehicle.

(10) Connect the battery negative cables.

(11) Start the engine to check for leaks.

CHARGE AIR COOLER AND PLUMBING

DESCRIPTION

The charge air system (Fig. 23) consists of the charge air cooler piping, charge air cooler and intake air grid heater.

The charge air cooler is a heat exchanger that uses air flow from vehicle motion to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.

OPERATION

Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressur-

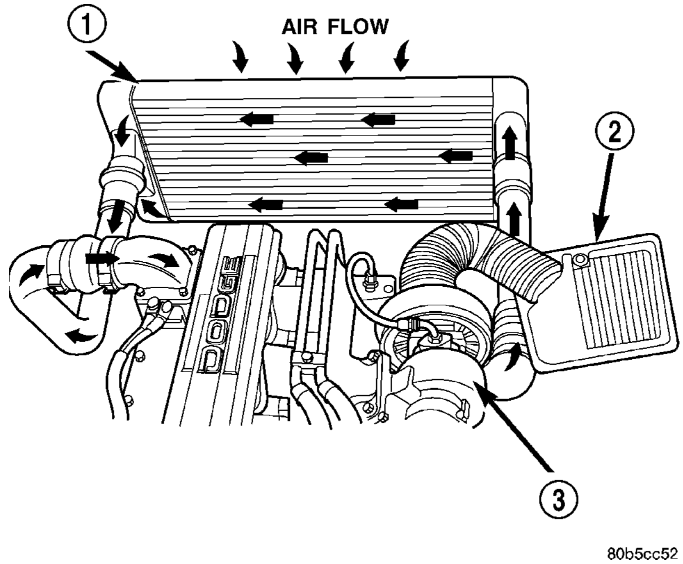


Fig. 23 Intake Air Circulation

1 - CHARGE AIR COOLER
2 - AIRFILTER
3 - TURBOCHARGER

ized air from the turbocharger then flows forward through the charge air cooler located in front of the radiator. From the charge air cooler the air flows back into the intake manifold.

DIAGNOSIS AND TESTING - CHARGE AIR COOLER SYSTEM - LEAKS

Low turbocharger boost pressure and low engine performance can be caused by leaks in the charge air cooler or it's plumbing. Fuel staining on the exhaust manifold can also be an indication that there are leaks in the air system.The following procedure outlines how to check for leaks in the charge air cooler system.

(1) Loosen clamp and remove air inlet hose from turbocharger.

(2) Insert Special Tool 9022 Adapter into the turbocharger inlet. Tighten tool clamp to 8 N·m (72 in. lbs.).

CAUTION: Do not apply more than 138 kPa (20 psi) air pressure to the charge air cooler system, sever damage to the charge air cooler system may occur.

(3) Connect a regulated air supply to air fitting on Special Tool 9022 Adapter. Set air pressure to a Maximum of 138 kPa (20 psi).

(4) Using soapy water check the rubber sleeves, charge air cooler and intake manifold for leaks.

REMOVAL

WARNING: IF THE ENGINE WAS JUST TURNED OFF, THE AIR INTAKE SYSTEM TUBES MAY BE HOT.

CHARGE AIR COOLER AND PLUMBING (Continued)

(1) Disconnect the battery negative cables.

(2) Discharge the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) and remove the A/C condenser (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL) (if A/C equipped).

(3) Remove the transmission auxiliary cooler (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - REMOVAL).

(4) Remove the boost tubes from the charge air cooler (Fig. 24).

(5) Remove the charge air cooler bolts. Pivot the charge air cooler forward and up to remove.

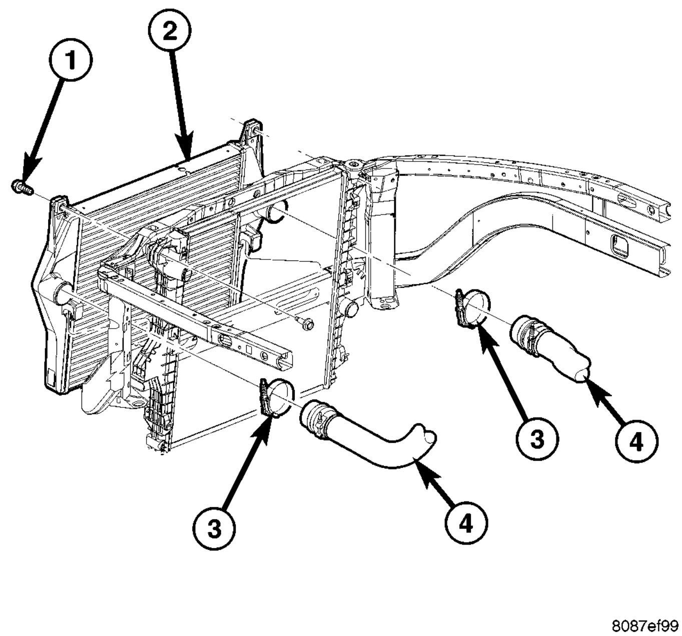


Fig. 24 Air Intake System Tubes

1 - BOLT
2 - CHARGE AIR COOLER
3 - CLAMP
4 - BOOST TUBE

CLEANING

CAUTION: Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

NOTE: If internal debris cannot be removed from the cooler, the charge air cooler MUST be replaced.

(1) If the engine experiences a turbocharger failure or any other situation where oil or debris get into the charge air cooler, the charge air cooler must be cleaned internally.

(2) Position the charge air cooler so the inlet and outlet tubes are vertical.

(3) Flush the cooler internally with solvent in the direction opposite of normal air flow.

(4) Shake the cooler and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris.

(5) Continue flushing until all debris or oil are removed.

(6) Rinse the cooler with hot soapy water to remove any remaining solvent.

(7) Rinse thoroughly with clean water and blow dry with compressed air.

INSPECTION

Visually inspect the charge air cooler for cracks, holes, or damage. Inspect the tubes, fins, and welds for tears, breaks, or other damage. Replace the charge air cooler if damage is found.

Pressure test the charge air cooler, using Charge Air Cooler Tester Kit #3824556. This kit is available through Cummins® Service Products. Instructions are provided with the kit.

INSTALLATION

(1) Position the charge air cooler. Install the bolts and tighten to 2 N·m (17 in. lbs.) torque.

(2) Install the air intake system tubes to the charge air cooler. With the clamps in position, tighten the clamps to 11 N·m (95 in. lbs.) torque.

(3) Install the transmission auxiliary cooler (if equipped) (Refer to 7 - COOLING/TRANSMISSION/TRANS COOLER - INSTALLATION).

(4) Install the A/C condenser (if A/C equipped) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION). Recharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(5) Connect the battery negative cables.

(6) Start engine and check for boost system leaks.

FRAMES & BUMPERS

TABLE OF CONTENTS

BUMPERS

SPECIFICATIONS - TORQUE

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Front bumper center bracket nuts	95	70	—
Front bumper stud plate nuts	95	70	—
License plate hitch reinforcement bolts	54	40	—
Rear bumper support bracket stud plate nuts	54	40	—
Rear bumper support bracket to hitch bolts	54	40	—
Rear bumper to hitch bolts	54	40	—

FRONT AIR DAM

REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove the fog lamp trim bezels. (Fig. 1)

(2) Remove the air dam screws through the fog lamp opening (1 per side).

(3) Remove the two outboard screws.

(4) Remove the three middle screws and remove the air dam.

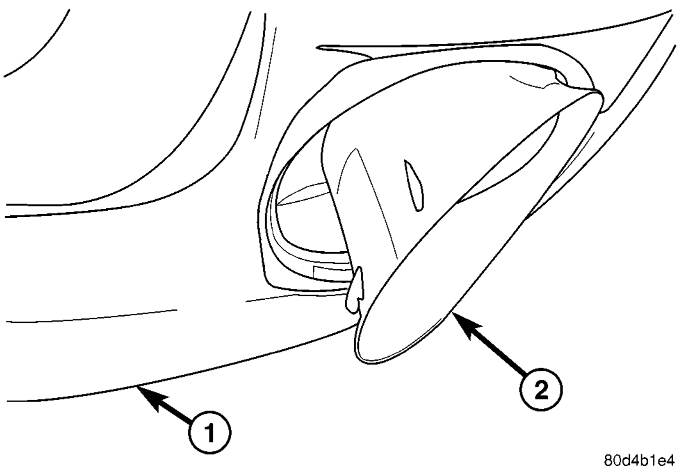


Fig. 1 FOG LAMP BEZEL

1 - BUMPER
2 - BEZEL

INSTALLATION

(1) Position the air dam onto the bumper and seat the carrot type fasteners fully.

(2) Starting at the center screw install the three middle screws.

(3) Install the screws through the fog lamp opening.

(4) Install the two outboard screws.

(5) Position the fog lamp trim bezels into the bumper and seat fully.

FRONT BUMPER

REMOVAL

(1) Using a grease pencil or equivalent, mark the position of the bumper on the frame rail tip to aid installation.

(2) Disconnect the fog lamp electrical connector at the left frame rail.

(3) Support the bumper with a suitable lifting device.

(4) Remove the center bracket nuts and bolts and remove bumper. (Fig. 2)

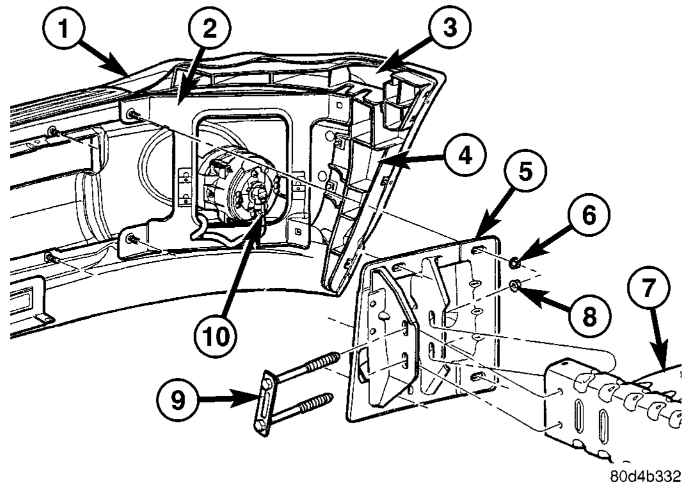


Fig. 2 BUMPER SUPPORT BRACKET - TYPICAL

1 - FASCIA - SPORT MODEL
2 - SUPPORT BRACKET
3 - FASCIA SUPPORT BRACKET
4 - WHEELHOUSE SPLASH SHIELD SUPPORT BRACKET
5 - BUMPER CENTER BRACKET
6 - NUTS (4 PER SIDE)
7 - FRAME RAIL TIP
8 - CENTER BRACKET NUTS (2 PER SIDE)
9 - CENTER BRACKET BOLTS ASSEMBLY (1 PER SIDE)
10 - FOG LAMP

INSTALLATION

(1) Install the bumper onto the frame rails and position the wheelhouse splash shield into the support brackets.

(2) Install the bolts and nuts.

(3) Line up the bumper with the marks made previously and tighten the bolts and nuts to 95 N·m (70 ft. lbs.).

(4) Check and adjust the bumper alignment as necessary. (Refer to 23 - BODY/BODY STRUCTURE/ GAP AND FLUSH - SPECIFICATIONS)

FRONT FASCIA

REMOVAL

ST/SLT/SLT+ - FASCIA REMOVAL

(1) Remove the two screws at each trailing edge of the fascia. (Fig. 3)

(2) Using a trim stick C-4755 or equivalent, carefully release the six lower clips and remove the close out panel.

(3) Using a trim stick C-4755 or equivalent, carefully remove the step pad.

(4) Remove and discard the four push pin fasteners and remove the fascia.

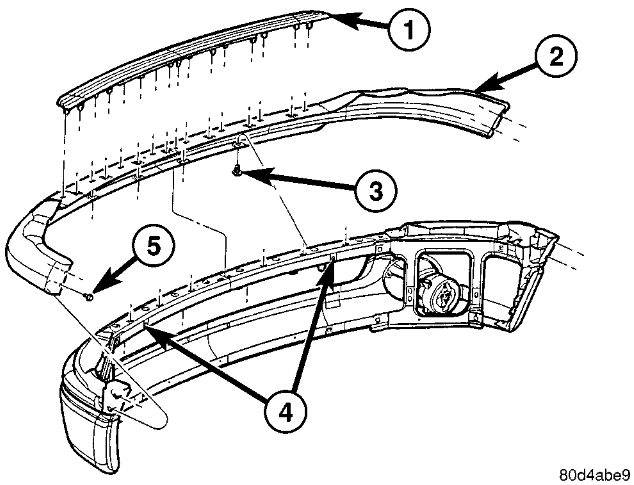


Fig. 3 UPPER FASCIA - ST/SLT/SLT+

1 - STEP PAD
2 - UPPER FASCIA (ST/SLT/SLT+ MODEL ONLY)
3 - INBOARD BUMPER BRACKET ATTACHMENTS
4 - SCREWS (4)
5 - PUSH PIN FASTENERS (4)

SPORT FASCIA REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Remove the three screws at each trailing edge of the fascia. (Fig. 4)

(3) Remove the five lower screws.

(4) Remove and discard the four upper push pins.

(5) Using a trim stick C-4755 or equivalent, carefully release the six lower clips and remove the close out panel.

(6) Using a trim stick C-4755 or equivalent, carefully remove the step pad.

(7) Spread the fascia out at the wheels and remove from the vehicle.

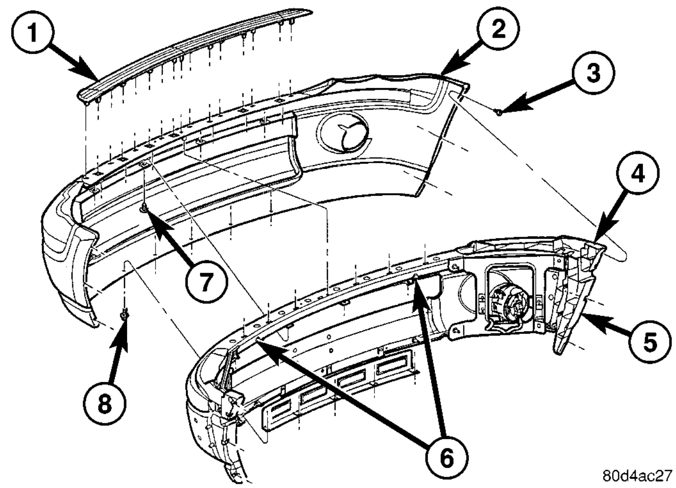


Fig. 4 SPORT FASCIA

1 - STEP PAD
2 - FASCIA (SPORT MODEL ONLY)
3 - SCREWS (3 PER SIDE)
4 - UPPER FASCIA SUPPORT BRACKET
5 - WHEELHOUSE SPLASH SHIELD BRACKET
6 - INBOARD BUMPER BRACKET ATTACHMENTS
7 - PUSH PIN FASTENERS (4)
8 - LOWER SCREWS (5)

INSTALLATION

NOTE: The left and right inboard bumper to bracket attachments must be secured before installing the fascia and step pad.

ST/SLT/SLT+ FASCIA INSTALLATION

(1) Install the fascia.

(2) Position the close out panel and seat the 6 lower clips fully.

(3) Install four new upper push pin fasteners.

(4) Position the step pad onto the fascia and fully seat the attachment clips.

(5) Align the fascia to the fender with a 19 mm (0.75 inch) gap and install the two screws at each trailing edge of the fascia.

SPORT FASCIA INSTALLATION

(1) Position the fascia onto the bumper.

(2) Position the step pad onto the fascia and fully seat the attachment clips.

(3) Install four new upper push pin fasteners.

(4) Install the five lower screws.

(5) Install the three screws at each trailing edge of the fascia.

REAR BUMPER

REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Remove the license plate.

(3) Remove the bolts behind the plate.

(4) Disconnect the license plate light electrical connectors.

(5) Disconnect the trailer light connector electrical connection, if equipped.

(6) Remove the two bolts along the front upper edge of the bumper near the frame tips.

(7) Support the bumper with a suitable lifting device.

(8) Remove the bolts attaching the bumper support brackets to the trailer hitch. (Fig. 5)

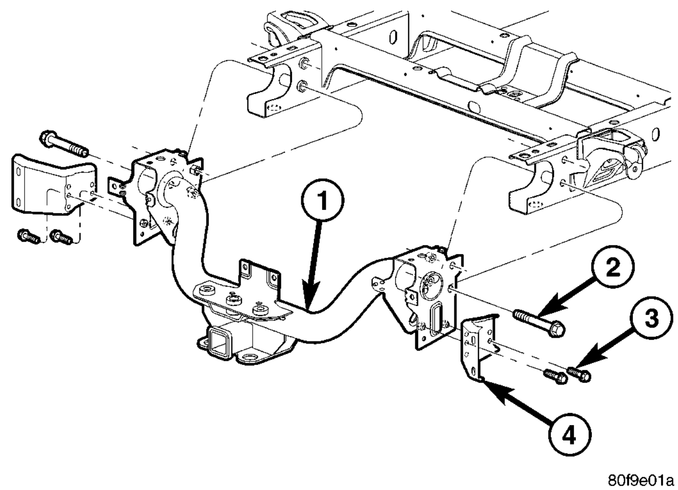


Fig. 5 TRAILER HITCH

1 - HITCH
2 - HITCH BOLTS (4)
3 - BUMPER BRACKET BOLTS (4)
4 - BUMPER SUPPORT BRACKETS

INSTALLATION

(1) Align the holes in the bumpers to the trailer hitch pins and install the bumper.

(2) Install the support bracket to the hitch bolts, loosely.

(3) Install the front upper edge to the trailer hitch bolts and tighten to 54 N·m (40 ft. lbs.).

(4) Install the license plate reinforcement to hitch bolts and tighten to 54 N·m (40 ft. lbs.).

(5) Tighten the left bumper bracket bolts to 54 N·m (40 ft. lbs.).

(6) Tighten the right bumper bracket bolts to 54 N·m (40 ft. lbs.).

(7) Connect the trailer light connector electrical connection, if equipped.

(8) Connect the license plate light electrical connectors.

(9) Install the license plate.

FRAME

STANDARD PROCEDURE

STANDARD PROCEDURE - LIGHT DUTY FRONT FRAME RAIL TIP REPLACEMENT

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT.

- **BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT.**
- **DO NOT ALLOW OPEN FLAME OR HEAT AND METAL SPATTER FROM ARC WELDING, TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT.**
- **WHEN WELDED FRAME COMPONENTS ARE REPLACED, ENSURE COMPLETE PENETRATION WELD IS ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT.**
- **STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT.**
- **DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.**

CAUTION: 1500 series Dodge Ram Trucks (2002 and later) are not designed for snow plow equipment. The front collision repair tips must not be installed on any truck equipped with a snow plow, or even intended to be equipped with a snow plow.

CAUTION: This procedure is designed to replace the front frame rail tips that have been damaged in the crush initiator zones. Prior to any cutting, the vehicle must be mounted on the appropriate frame repair equipment (“frame rack”), checked with three dimensional measuring equipment, and the necessary pull corrections made. If damage remains in the frame beyond the area covered by this service part after the pull, the frame must be replaced in its entirety.

FRAME (Continued)

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Failure to use only production fasteners or fasteners of equivalent hardness can result in loosening or failure. Do not drill any holes in the frame that are not specifically outlined in this or other, DaimlerChrysler procedure as frame rail failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result.

NOTE: Procedures for 4X2 and 4X4 are common except as noted in this procedure.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the front wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL)

(3) Remove the bolts and position aside the wire harness and grounds, if required.

(4) Remove the front bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT BUMPER - REMOVAL)

(5) Loosen and lower the stabilizer bar mount and bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - REMOVAL)

(6) Remove the front cab mount bolt to the Front End Sheet Metal (FESM) bracket. (Fig. 6)

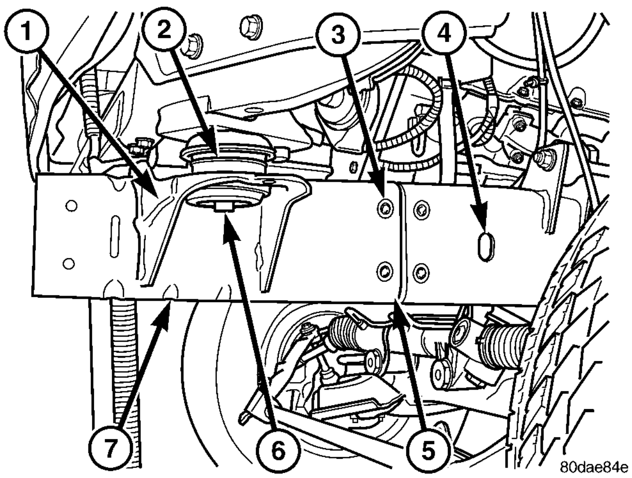


Fig. 6 REPLACEMENT FRAME TIP

1 - FRONT END SHEET METAL (FESM) BRACKET
2 - CAB INSULATOR
3 - RING-FILLET WELD/HOLE
4 - PRINCIPLE LOCATING POINT (PLP)
5 - WELD ROOT GAP 4 mm - 6 mm (0.16 in. - 0.24 in.)
6 - FRONT CAB MOUNT BOLT
7 - REPLACEMENT FRAME TIP

(7) Make a vertical mark on the inside and outside face of the frame rail 112 mm (4.5 in.) from the forward edge of the PLP hole in the sides of the rail. (Fig. 8)

(8) Using a straightedge, connect the two lines on the top and bottom of the rail.

(9) Using the service tip as a guide, re-check your cut lines to ensure the service tip will fit when the cut is made.

CAUTION: Do not use any flame or plasma cutting equipment to cut the frame in this procedure. This is due to the inaccurate nature of the cut-line and the fact that the high temperatures achieved during flame or plasma cutting will change the metal characteristics and may weaken the frame and/or repair location.

(10) Using a reciprocating saw or equivalent, carefully cut and remove the damaged frame rail tip. (Fig. 7)

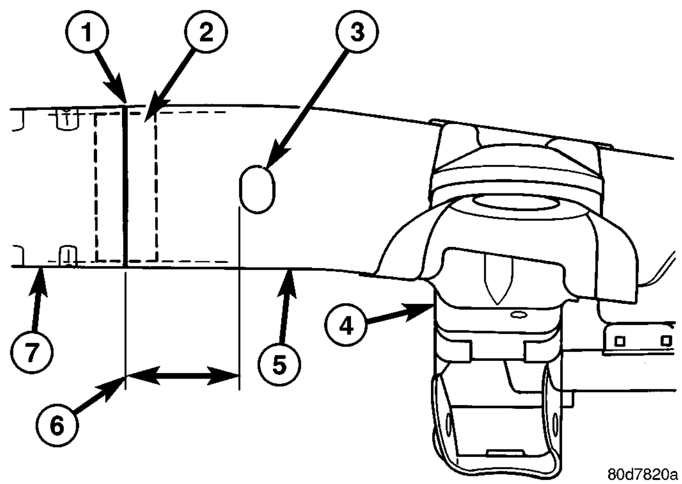


Fig. 7 FRAME CUT LOCATION

1 - REPAIR ROOT OPENING
2 - SERVICE SLEEVE
3 - PRINCIPLE LOCATING POINT (PLP)
4 - SUSPENSION BRACKETS
5 - FRAME
6 - FRAME CUTOFF LOCATION - 112 mm (4.5 in.)
7 - FRAME SERVICE TIP

FRAME (Continued)

(11) Assemble the service sleeve. Refer to SERVICE SLEEVE ASSEMBLY at the end of this procedure.

NOTE: Any burned surface coatings will need to be removed from the sleeve prior to installation and application of corrosion preventative coatings.

(12) Smooth and square the cut edges of the original frame. (Fig. 7)

(13) Dress the cut edge of the existing frame in preparation for the new rail tip.

(a) Drill four 13 mm (0.5 in.) diameter holes in the new tip and four more in the existing frame to accommodate ring-fillet welds. Center these holes 19 mm (0.75 in.) from the cut face of the rail and 38 mm (1.5 in.) from the top and bottom of the rail. (Fig. 8)

(b) Bevel the edges of the new tip, existing frame, and ring-fillet holes 25° - 30°. Scribing a line 2 mm from the cut edge and then grinding back to the mark will simplify the bevel creation process and accuracy. (Fig. 9)

(c) Remove any burrs at the holes and beveled edges.

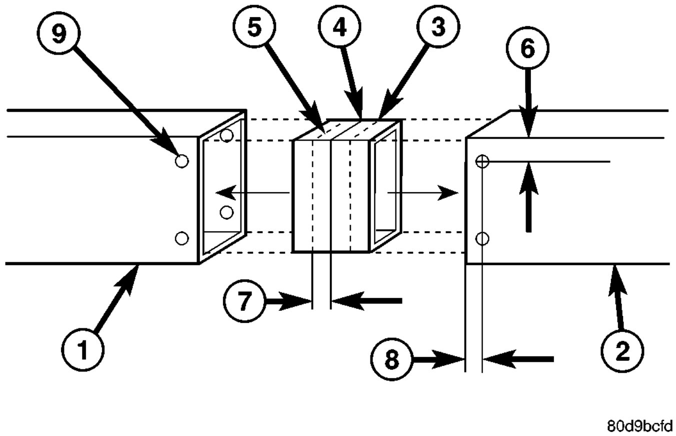


Fig. 8 REPAIR SLEEVE INSTALLATION (TYPICAL)

1 - REPLACEMENT FRAME TIP
2 - FRAME RAIL
3 - SERVICE SLEEVE
4 - CENTER LINE
5 - LOCATOR LINES (2)
6 - HORIZONTAL WELD HOLE LOCATION - 38 mm (1.5 in.)(BOTH FRAME SECTIONS)
7 - LOCATOR LINE DIMENSION - 2 mm (0.08 in.)
8 - VERTICAL WELD HOLE LOCATION - 19 mm (0.75 in.)(BOTH FRAME SECTIONS)
9 - RING FILLET WELD HOLES

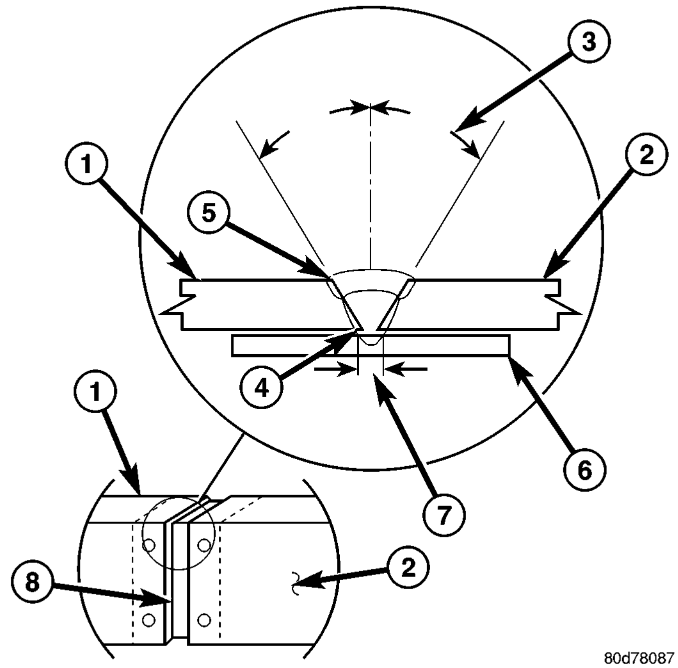


Fig. 9 WELD DIMENSIONS

1 - FRAME REPLACEMENT TIP
2 - FRAME RAIL
3 - FRAME DRESS ANGLE 25°-30°
4 - ROOT PASS
5 - COVER PASS
6 - SERVICE SLEEVE
7 - WELD ROOT GAP 4 mm - 6 mm (0.16 in. - 0.24 in.)
8 - SERVICE SLEEVE

(14) Dry fit the new rail to ensure alignment and fit and make any adjustments as necessary.

(15) Remove all internal and external OEM e-coat within 51 mm (2.0 in.) of the weld joint on the replacement tip and the existing frame rail.

NOTE: Any burned surface coatings will need to be removed prior to application of corrosion preventative coatings.

CAUTION: Shield the surrounding area and components from exposure to the welding spatter and heat.

FRAME (Continued)

(16) On 4X4 models use the service sleeve as a template to drill a hole in the frame tip to accommodate the sway bar mounting bolt. (Fig. 12)

(17) Slide the service sleeve into the replacement frame tip and align to the 2 mm (0.08 in.) off center line made previously during the sleeve assembly and tack the ring fillet welds to hold them in place. (Fig. 10) (Fig. 11) (Fig. 12) (Fig. 13)

(18) On 4X4 models, install the sway bar tapping plate and secure with tack welds. (Fig. 12) (Fig. 13)

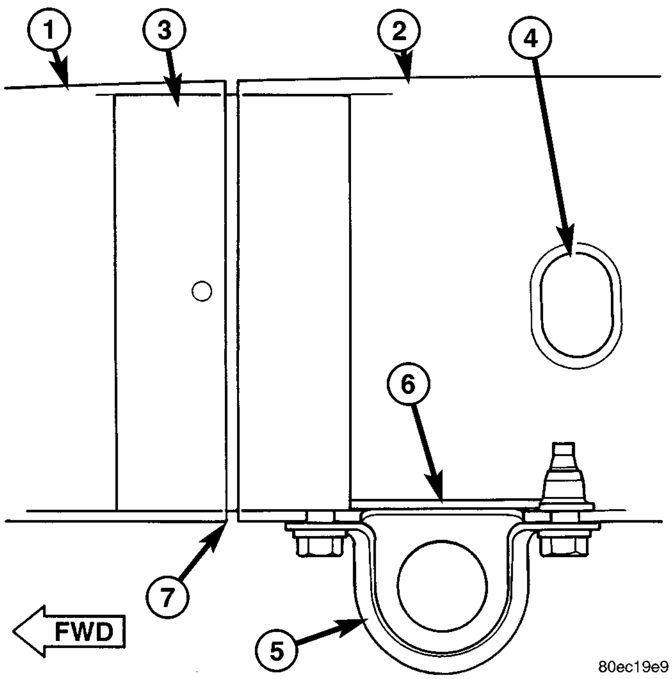


Fig. 10 4X2 SLEEVE INSTALLATION

1 - REPLACEMENT FRAME TIP
2 - FRAME RAIL
3 - SERVICE SLEEVE
4 - PLP
5 - SWAY BAR MOUNTING BRACKET
6 - TAPPING PLATE
7 - ROOT WELD GAP

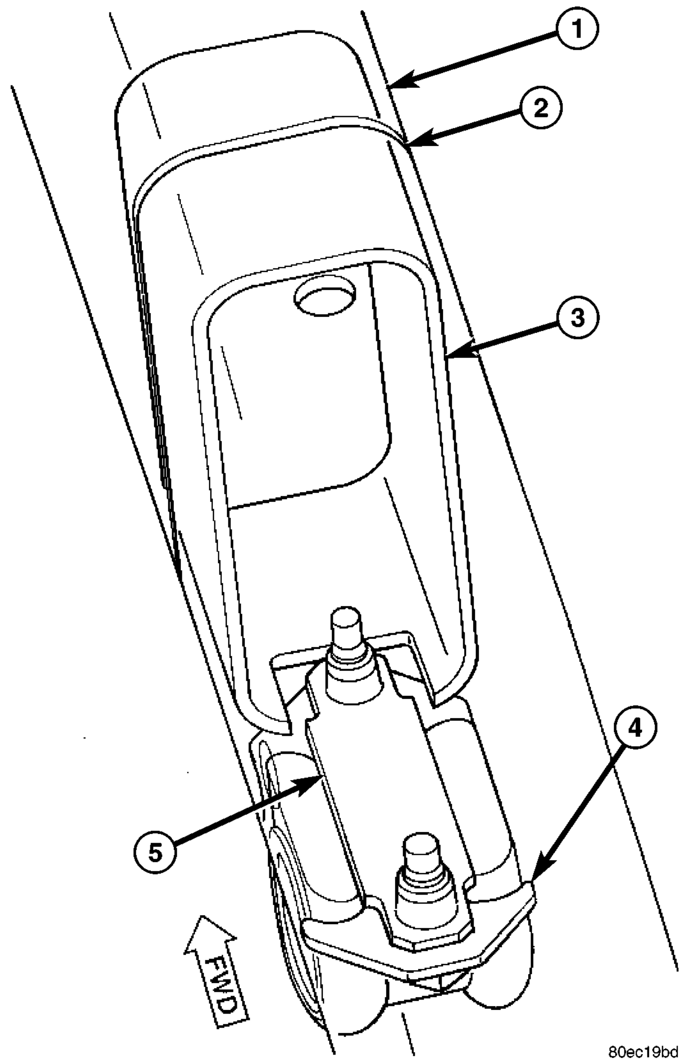


Fig. 11 4X2 SLEEVE INSTALLATION

1 - REPLACEMENT FRAME TIP
2 - ROOT WELD GAP
3 - SERVICE SLEEVE
4 - SWAY BAR MOUNTING BRACKET
5 - TAPPING PLATE

FRAME (Continued)

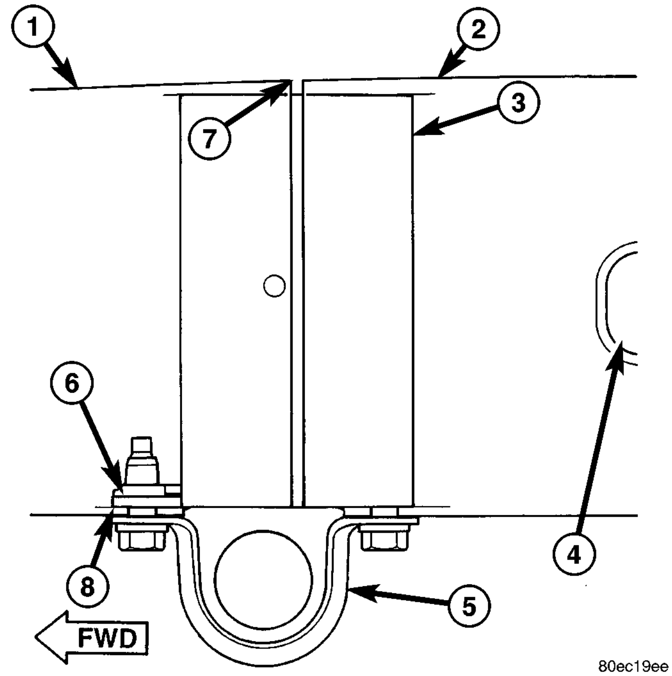


Fig. 12 4X4 TAPPING PLATE/SLEEVE INSTALLATION

1 - REPLACEMENT FRAME TIP
2 - FRAME RAIL
3 - SERVICE SLEEVE
4 - PLP
5 - SWAY BAR MOUNTING BRACKET
6 - TAPPING PLATE
7 - ROOT WELD GAP
8 - SLEEVE TAB

(19) Apply ring-fillet welds into the ring-fillet weld holes on the replacement frame tip, using the Weld Process Specifications table. (Fig. 14)

(20) Install the upper FESM insulator onto the replacement tip and position the service sleeve/replacement tip into the existing frame rail.

(21) Loosely install the lower FESM insulator and cab mounting bolt.

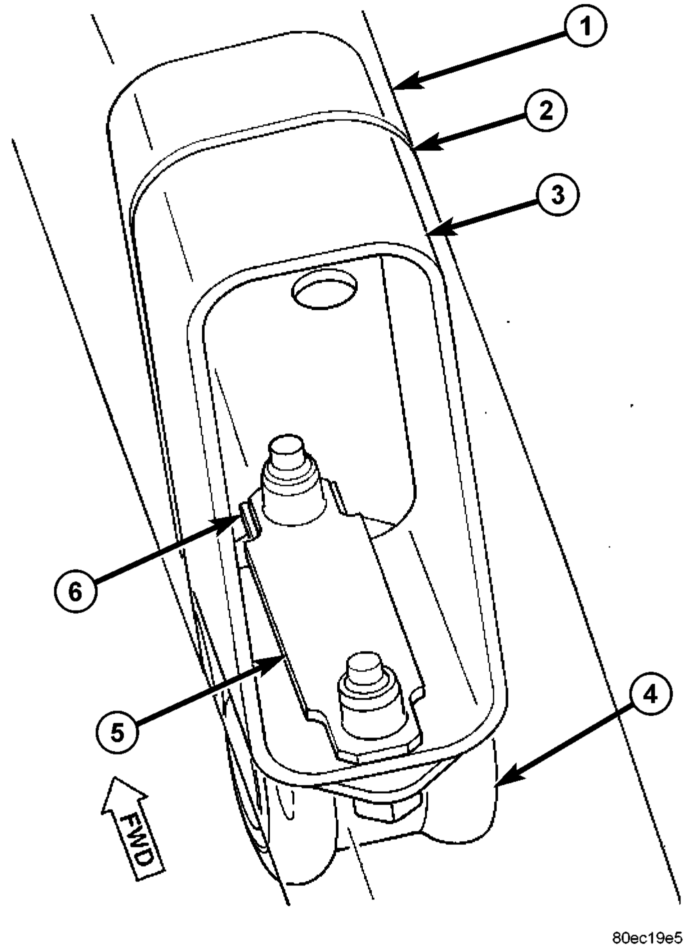


Fig. 13 4X4 TAPPING PLATE/SLEEVE INSTALLATION

1 - REPLACEMENT FRAME TIP
2 - ROOT WELD GAP
3 - SERVICE SLEEVE
4 - SWAY BAR MOUNTING BRACKET
5 - TAPPING PLATE
6 - SLEEVE TAB

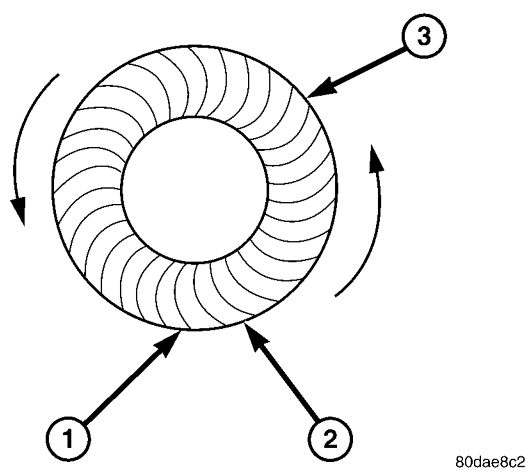


Fig. 14 RING FILLET WELD

1 - WELD START LOCATION
2 - WELD END LOCATION
3 - RING-FILLET WELD

FRAME (Continued)

(22) Using the appropriate measuring equipment, verify the front end sheet metal bracket's location in all three (X,Y, and Z) planes of space, and adjust if required. (Fig. 15)

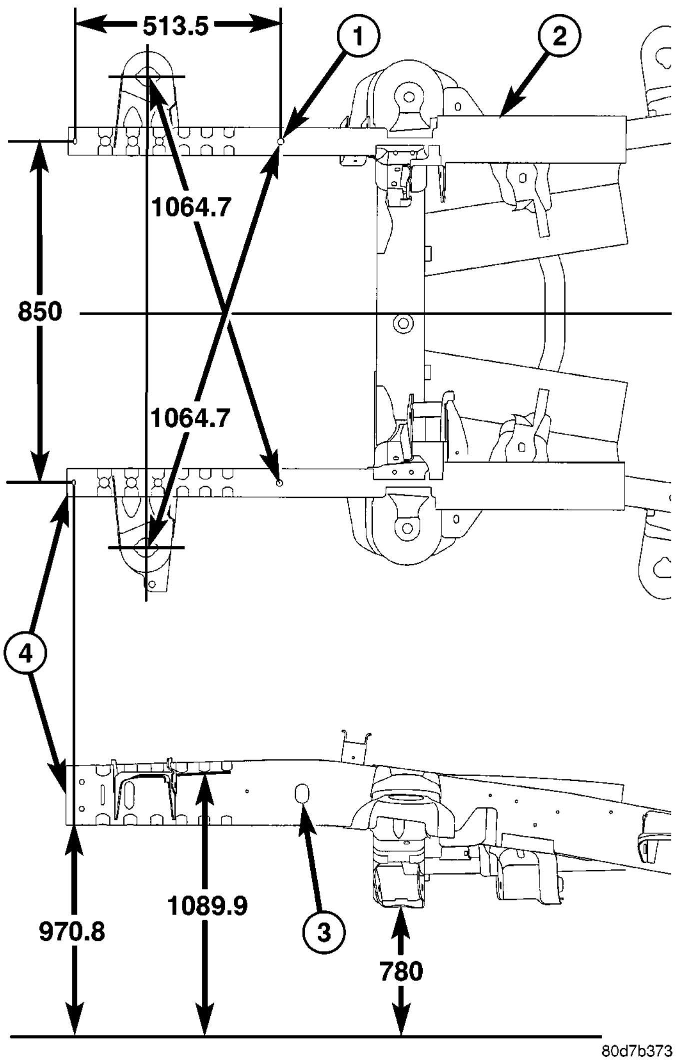


Fig. 15 FRAME TIP DIMENSIONS

NOTE:
All measurements are in mm.

1 - PLP POINT
2 - FRAME
3 - PLP POINT
4 - REPLACEMENT FRAME TIP

CAUTION: Shield the surrounding area and components from exposure to the welding spatter and heat.

(23) When correctly fitted and a weld root gap of 4 mm minimum to 6 mm maximum (0.16 in - 0.24 in) is established, tack the ring fillet welds to hold the tip in position, then complete the ring fillet welds.

NOTE: Ring-fillet welds may be filled in with weld material if an improved cosmetic appearance is desired.

(24) Confirm alignment of the replacement frame rail tip. (Fig. 15)

(25) Final welding should be performed in a skip (stitch) type method to minimize the heat buildup and frame distortion, utilizing the Weld Process Specifications at the end of this section. The preferred method is GMAW (MIG).

(a) Apply root pass welds to the root joint one quadrant at a time, switching to the opposite side of the frame for each quadrant. (Fig. 9)

(b) Clean the welds of any flux and other impurities before proceeding with the cover pass welds.

(c) Apply the cover pass welds in the same manner as described above.

(26) Confirm alignment of the replacement frame rail tip. (Fig. 15)

NOTE: Any burned surface coatings will need to be removed prior to application of corrosion preventative coatings.

(27) Dress the welded area and apply corrosion resistant coatings inside and out.

(a) Apply etch-primer to the inside of the frame rail repair area.

(b) Inside the rail, inject a creeping wax based rust inhibitor compound through the existing holes in the frame ensuring 100% coverage including the space between the original frame rail and the reinforcing sleeve.

FRAME (Continued)

(c) Apply a durable top coat to the outside of the repair area.

(28) Tighten the front cab mounting bolt to the FESM bracket to 81 N·m (60 ft. lbs.).

(29) Install the stabilizer bar. (Refer to 2 - SUSPENSION/FRONT/STABILIZER BAR - INSTALLATION)

(30) Install the front bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT BUMPER - INSTALLATION)

(31) Install the wire harness and ground strap if previously removed and install the bolt.

(a) If necessary, re-drill and tap the ground strap mounting hole

(32) Install the front wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION)

CAUTION:
All welds should conform to DaimlerChrysler vehicle engineering process standard “PS 9472”.

WELD PROCESS SPECIFICATIONS

WELDING PROCESS	FLUX CORED ARC	GAS METAL ARC (MIG)*	SHIELDED METAL ARC (STICK)
Material Thickness	3.7 mm to 4.2 mm	3.7 mm to 4.2 mm	3.7 mm to 4.2 mm
Electrode Type	Lincoln Electrical Co. Product #: NR-211 MP **(Do Not Substitute)**	AWS ER70S-3 **(Do Not Substitute)**	** AWS E 7018
Electrodes Size Inches	0.045 Tubular	0.035 Solid	3/32″
Electrode Stick Out	3/8″ - 1/2″	1/2″ - 5/8″	N/A
Polarity	Electrode ″-″ Work Piece ″+″	Electrode ″+″ Work Piece ″-″	Electrode ″+″ Work Piece ″-″
Shielding Gas	Self Shielded	75% Ar 25% CO2	Self Shielded
Gas Flow Rate	N/A	25 - 35 CFM	N/A
Wire Feed Speed (inches per minute)	110 - 130 Vertical Down 70 - 90 Flat & Overhead	245 - 250 Vertical Down 210 - 225 Flat & Overhead	N/A
Approximate Amperage			
Vertical	110 - 130	175	85 (3/32″ Diameter)
Flat & Overhead	70 - 90	155	90 (3/32″ Diameter)
Voltage	15 - 18	19 - 20	N/A
Direction of Welding			
Vertical	Vertical Down Hill (only)	Vertical Down Hill (only)	Vertical - Up Hill (only)
Flat & Overhead	Flat - Push or Drag	Flat - Push or Drag	Flat - Drag

***First choice - Gas Metal Arc Welding Process:** Butt joints - apply two layers (passes) of weld metal. First pass should only fill approximately ½ the thickness. Vertical position welds - maintain electrode wire at leading edge of weld puddle while traveling down hill to produce maximum penetration into the sleeve. These techniques work for FCAW as well.

****E7018** new electrodes may be exposed to the atmosphere for up to ten hours with no harmful effect. Reconditioning schedules should come from the manufacturer.

FRAME (Continued)

SERVICE SLEEVE ASSEMBLY

NOTE: Two sleeve halves are included with each kit. Modifications as follow, are necessary to create the correct sleeve assembly for each application.

(1) On 4X2 models, the ″lower″ sleeve is made by cutting off the tab and cutting out a notch in the bottom sleeve portion. Round the corners of the cut out to keep stress cracks from forming. On 4X4 models the ″lower″ sleeve is used as provided. (Fig. 16)

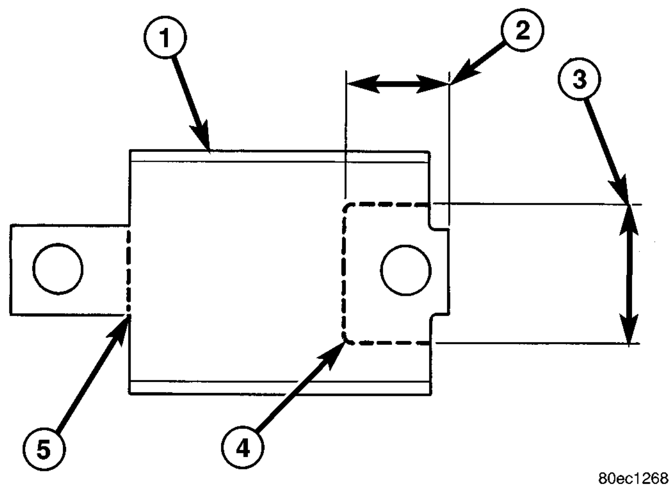


Fig. 16 4X2 LOWER SLEEVE CUT LOCATION

1 - SERVICE SLEEVE LOWER HALF
2 - CUT DIMENSION 27 mm (1.06 in.)
3 - CUT DIMENSION 36.1 mm (1.42 in)
4 - 4X2 CUTOUT
5 - FRONT TAB CUT LINE (4X2 ONLY)

(2) On both 4X2 and 4X4 models cut off the front tab on the upper sleeve portion. (Fig. 17)

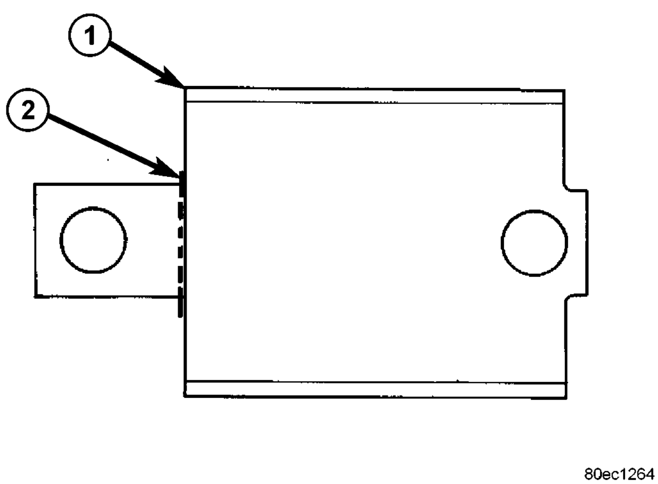


Fig. 17 UPPER SLEEVE CUT LOCATION

1 - SERVICE SLEEVE UPPER HALF
2 - CUT LOCATION

(3) The sleeve halves are shipped slightly oversized to allow custom fitting to each replacement frame rail tip. It is necessary to grind the mating surfaces to achieve the desired snug fit into the replacement tip (rail tube has increasing height rearward of the cut line). Once the two sleeve halves are fitted, bevel the edges 25° - 30°.

NOTE: Scribing a line 2 mm from the cut edge and then grinding back to the mark will simplify the bevel creation process and accuracy.

(4) Remove any burrs at the beveled edges.

(5) Using the Weld Process Specifications table, weld the two halves of the repair sleeve together. (Fig. 18)

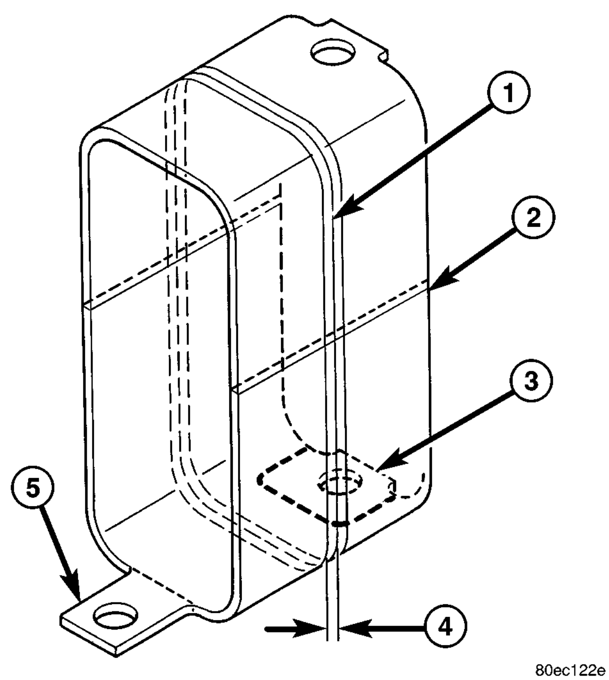


Fig. 18 SERVICE SLEEVE ASSEMBLY

1 - CENTERLINE SCRIBE MARK
2 - WELD SEAM
3 - REAR TAB (4X4 ONLY)
4 - SCRIBE LINE LOCATION 2 mm (0.08 in.)
5 - FRONT TAB (4X4 ONLY)

(6) Clean the welds of any flux and other impurities and grind smooth before proceeding with the installation of the sleeve.

(7) Find the centerline of the sleeve and scribe a centerline mark. Mark two additional lines 2 mm (0.08 in.) on either side of the centerline mark to help ensure the required 4 mm - 6 mm (0.16 in. - 0.24 in.) weld root gap. (Fig. 18)

FRAME (Continued)

STANDARD PROCEDURE - HYDROFORM FENDER RAIL REPAIR

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT.

- **BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT.**
- **DO NOT ALLOW OPEN FLAME OR HEAT AND METAL SPATTER FROM ARC WELDING, TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT.**
- **WHEN WELDED FRAME COMPONENTS ARE REPLACED, ENSURE COMPLETE PENETRATION WELD IS ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT.**
- **STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT.**
- **DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.**

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Failure to use only production fasteners or fasteners of equivalent hardness can result in loosening or failure. Do not drill holes in top or bottom frame rail flanges, frame rail failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result.

CAUTION: This repair procedure assumes damage to the right or left hydroform fender rail (Fig. 19). Prior to any repairs, the vehicle must be mounted on the appropriate frame repair equipment ("frame rack"), checked with three dimensional measuring equipment, and necessary pull corrections made. If damage exists in the hydroform fender rail, or cab beyond the area covered by this service procedure after dimensional corrections are made, the hydroform must be replaced in its entirety. Refer to 23 - BODY/BODY STRUCTURE/WELD LOCATIONS - SPECIFICATIONS, when replacing the entire hydroform.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the front wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL)

(3) Remove the fender. (Refer to 23 - BODY/EXTERIOR/FRONT FENDER - REMOVAL)

(4) Remove the A/C condenser, if required. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL)

(5) Remove the A/C lines, if required. Refer to the Heating and Air Conditioning section of the manual for recommended procedures.

(6) Remove the radiator assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL)

(7) Remove the air cleaner and support bracket, if required. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - REMOVAL)

(8) Remove the integrated power module. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - REMOVAL)

(9) Remove the bolts and position aside the wire harness and grounds, if required.

(10) Remove the upper radiator crossmember. (Refer to 23 - BODY/EXTERIOR/UPPER RADIATOR CROSSMEMBER - REMOVAL)

(11) Remove the headlamp unit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL)

(12) Remove the front cab mount to the Front End Sheet Metal bracket (FESM) bolt.

(13) Remove the bolts attaching the lower radiator crossmember to the hydroform fender rail. (Fig. 19)

CAUTION: Do not use any flame or plasma cutting equipment to cut the frame in this procedure. The inaccurate and high temperatures achieved during flame or plasma cutting will change the metal characteristics and may weaken the frame and/or repair location.

(14) Using a reciprocating saw or equivalent, cut the fender rail and shotgun at a straight and square section of the hydroform and remove.

(15) Smooth and square the cut edges.

(16) Using the damaged structure as a reference cut the service part at the same location as the first cut. Smooth and square the cut edges.

NOTE: The repair structure should butt up to the remaining structure and provide the same overall vehicle geometry.

FRAME (Continued)

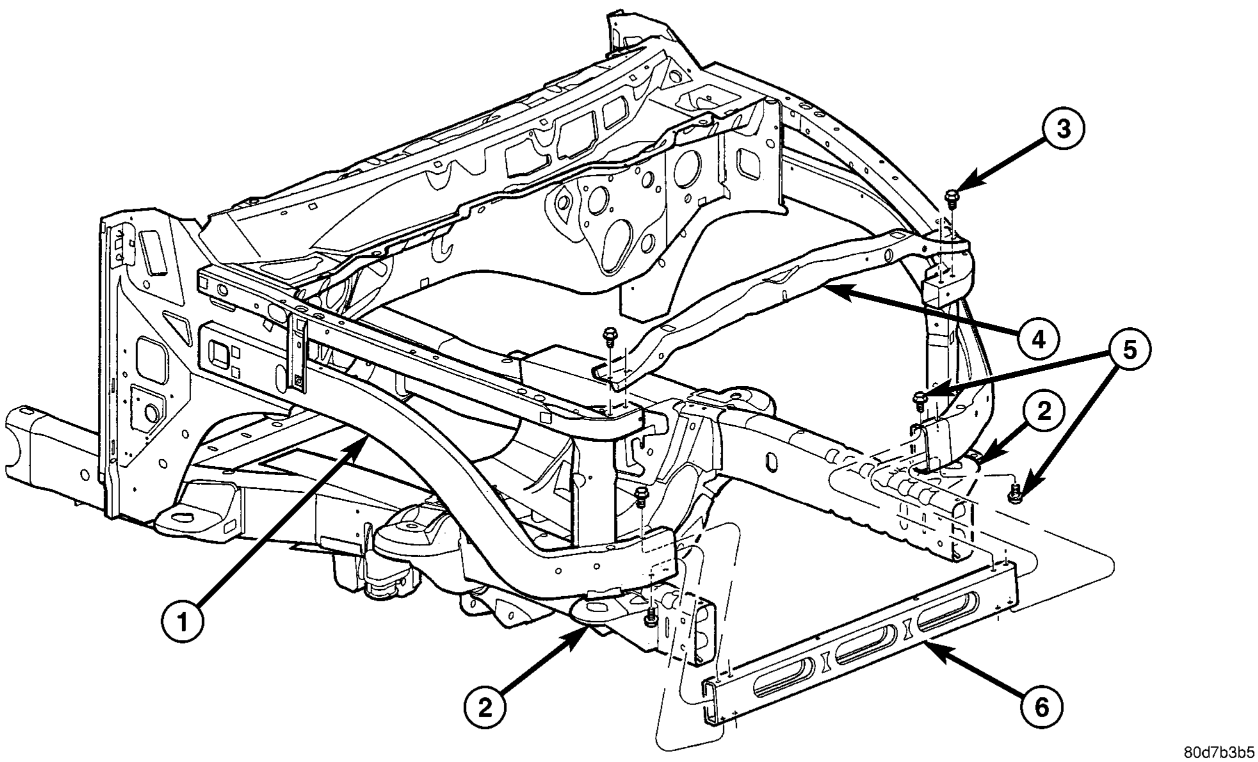


Fig. 19 HYDROFORM FENDER RAILS

1 - HYDROFORM FENDER RAIL
2 - FRONT END SHEET METAL BRACKET
3 - UPPER RADIATOR CROSSMEMBER BOLTS (4)
4 - UPPER RADIATOR CROSSMEMBER
5 - LOWER RADIATOR CROSSMEMBER BOLTS (8)
6 - LOWER RADIATOR CROSSMEMBER

(17) Fabricate 51 mm (2.0 in.) long repair inserts using scrap from the old structure or the replacement part. It will be necessary to split the inserts on each of their four sides to fit into the hydroform.

(18) Remove any paint or e-coat from the inserts and also to the interior and exterior of the hydroforms.

(19) Cut plug weld holes as described below.

- On the upper rail, cut one 13 mm (0.5 in.) hole on each side of the rail, 25 mm (1.0 in.) from the butt joint of the tubes.
- On the lower rail, cut one 13 mm (0.5 in.) hole on the top and bottom sides of the rail 25 mm (1.0 in.) from the butt joint of the tube.
- On the lower rail, cut two 13 mm (0.5 in.) holes on the inner and outer sides of the rail 25 mm (1.0 in.) from the butt joint of the tube.

CAUTION: Shield the surrounding area and components from exposure to the welding spatter and heat.

(20) Install the insert 1” into the replacement part and tack into place with a weld.

(21) Insert the service part into place and using the appropriate measuring equipment, verify the front end sheet metal bracket’s location in all three (X,Y, and Z) planes of space. (Fig. 20)

(22) Complete all 360° plug welds.

NOTE: Before the final welding, use three dimensional measuring equipment to ensure the part is in the correct location. Verify that tap plate extrusion at the bottom of the vertical post lines up with the isolator and hole in the frame perch mount. Also ensure the lower radiator closure tube is bolted into the forward shotgun ends.

(23) Complete welding by making a 360° butt weld around the fender rails.

(24) Metal finish the exposed welds on the hydroforms.

(25) Dress the welded area and apply corrosion resistant coatings inside and out.

(a) Inside the rail, inject a creeping wax based rust inhibitor compound to the inside of the hydroforms ensuring 100% coverage including the mating face between the fender rail sections and insert such that corrosion protection is restored in the internal cavity.

(b) Apply a durable top coat to the outside of the repair area.

FRAME (Continued)

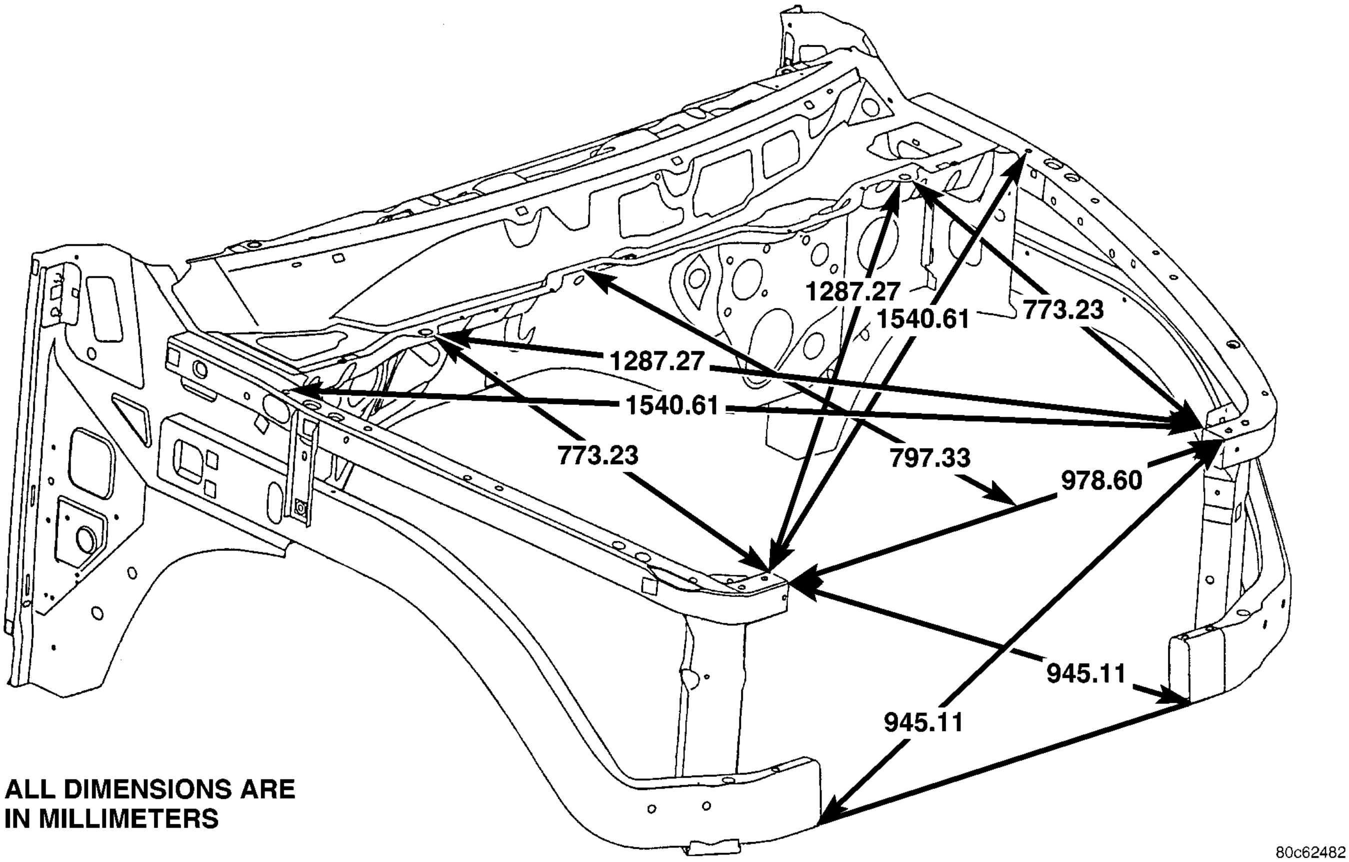


Fig. 20 ENGINE COMPARTMENT/FRONT STRUCTURE

(26) Install the front cab mount bolt if previously removed and tighten to 81 N·m (60 ft. lbs.).

(27) Install the lower radiator crossmember bolts and tighten to 28 N·m (21 ft. lbs.).

(28) Install the headlamp unit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION)

(29) Install the upper radiator crossmember. (Refer to 23 - BODY/EXTERIOR/UPPER RADIATOR CROSSMEMBER - INSTALLATION)

(30) Install the wire harness and ground if previously removed and install the bolts.

(31) Install the integrated power module, if previously removed. (Refer to 8 - ELECTRICAL/POWER DISTRIBUTION/INTEGRATED POWER MODULE - INSTALLATION)

(32) Install the air cleaner bracket and air cleaner, if previously removed. (Refer to 9 - ENGINE/AIR INTAKE SYSTEM/AIR CLEANER ELEMENT - INSTALLATION)

(33) Install the radiator assembly. (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION)

(34) Install the A/C lines, if previously removed. Refer to the Heating and Air Conditioning section of the manual for the recommended procedures.

(35) Install the A/C condenser, if previously removed. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION)

(36) Install the fender. (Refer to 23 - BODY/EXTERIOR/FRONT FENDER - INSTALLATION)

(37) Install the front wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION)

(38) Reconnect the battery ground.

FRAME (Continued)

STANDARD PROCEDURE - REAR FRAME H-SECTION REPLACEMENT

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE EYE PROTECTION WHEN GRINDING OR WELDING METAL, SERIOUS EYE INJURY CAN RESULT.

- **BEFORE PROCEEDING WITH FRAME REPAIR INVOLVING GRINDING OR WELDING, VERIFY THAT VEHICLE FUEL SYSTEM IS NOT LEAKING OR IN CONTACT WITH REPAIR AREA, PERSONAL INJURY CAN RESULT.**
- **DO NOT ALLOW OPEN FLAME OR HEAT AND METAL SPATTER FROM ARC WELDING, TO CONTACT PLASTIC BODY PANELS. FIRE OR EXPLOSION CAN RESULT.**
- **WHEN WELDED FRAME COMPONENTS ARE REPLACED, ENSURE COMPLETE PENETRATION WELD IS ACHIEVED DURING INSTALLATION. IF NOT, DANGEROUS OPERATING CONDITIONS CAN RESULT.**
- **STAND CLEAR OF CABLES OR CHAINS ON PULLING EQUIPMENT DURING FRAME STRAIGHTENING OPERATIONS, PERSONAL INJURY CAN RESULT.**
- **DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT SUPPORTED ON SAFETY STANDS, PERSONAL INJURY CAN RESULT.**

CAUTION: Do not reuse damaged fasteners, quality of repair would be suspect. Failure to use only production fasteners or fasteners of equivalent hardness can result in loosening or failure. Do not drill holes in top or bottom frame rail flanges, frame rail failure can result. When using heat to straighten frame components do not exceed 566°C (1050°F), metal fatigue can result.

CAUTION: This procedure is designed to replace the H-section/spare tire support located at the rear of the frame assembly. Prior to any cutting, the vehicle must be mounted on the appropriate frame repair equipment ("frame rack"), checked with three dimensional measuring equipment, and the necessary pull corrections made. If damage remains in the frame beyond the area covered by this service part after the pull, the frame must be replaced in its entirety.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cargo box. (Refer to 23 - BODY/EXTERIOR/CARGO BOX - REMOVAL)

(3) Remove the trailer hitch. (Refer to 13 - FRAME & BUMPERS/FRAME/TRAILER HITCH - REMOVAL)

(4) Raise and support the frame so the tires are off floor.

(5) Remove the shock absorbers. (Refer to 2 - SUSPENSION/REAR/SHOCK - REMOVAL)

(6) Remove the rear leaf spring shackle bolts and let the axle rest on the ground. (Fig. 21)

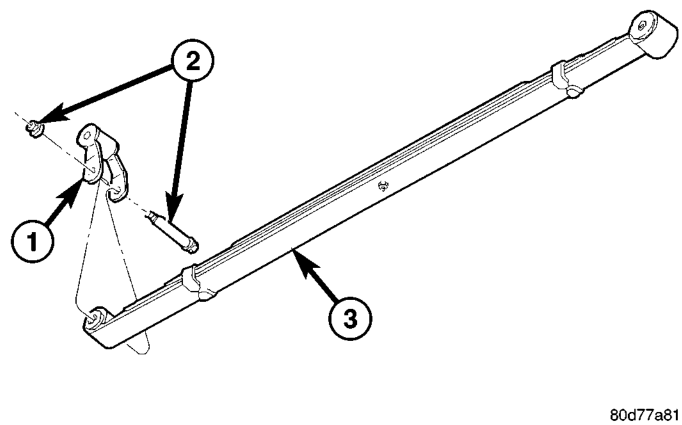


Fig. 21 REAR SPRING

1 - SPRING SHACKLE
2 - LEAF SPRING EYE BOLT/NUT
3 - REAR LEAF SPRING

(7) Remove the spare wheel.

(8) Remove the clip and remove the spare tire winch tube. (Fig. 22)

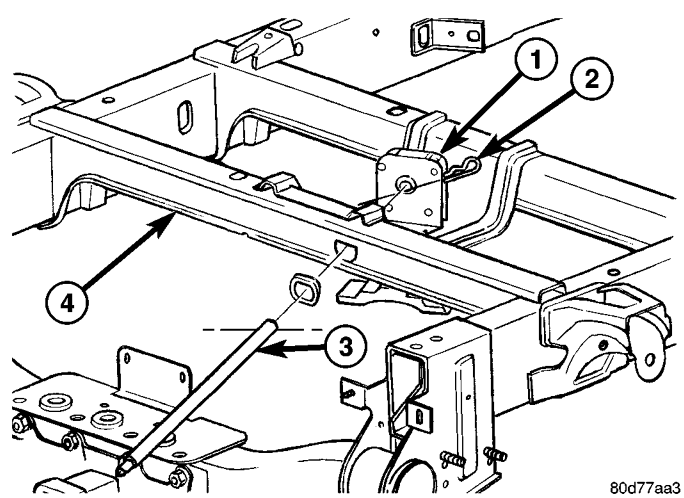


Fig. 22 SPARE TIRE WINCH TUBE

1 - SPARE TIRE WINCH ASSEMBLY
2 - HAIR PIN CLIP
3 - WINCH TUBE
4 - H-SECTION/SPARE WHEEL SUPPORT

FRAME (Continued)

(9) Remove the bolts and remove the spare tire winch. (Fig. 23)

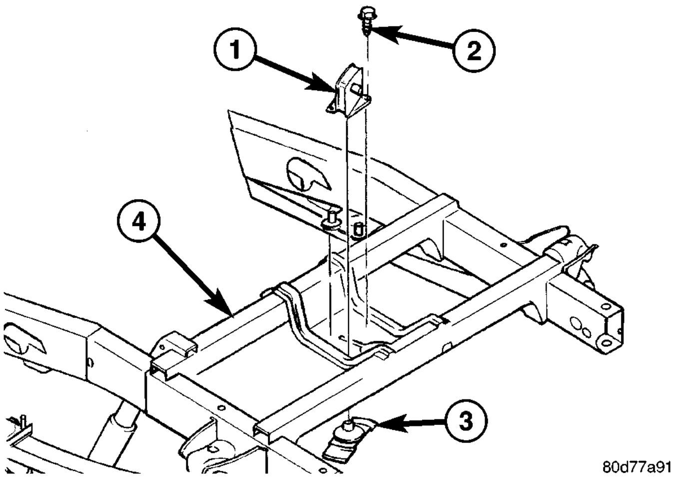


Fig. 23 SPARE TIRE WINCH ASSEMBLY

1 - SPARE TIRE WINCH ASSEMBLY
2 - BOLTS
3 - RETAINER BRACKET
4 - H-SECTION/SPARE WHEEL SUPPORT

(10) Position the wire harness forward of the work area.

CAUTION: Do not use any flame or plasma cutting equipment to cut the frame in this procedure. The inaccurate and high temperatures achieved during flame or plasma cutting will change the metal characteristics and may weaken the frame and/or repair location.

(11) Carefully remove the H-section welds using a grinder or equivalent tool.

(12) Remove the H-section and clean any remaining welds from the frame.

(13) Trial fit the replacement part.

(14) Remove all e-coat from within 25 mm (1.0 in.) of the weld area.

(15) Using the appropriate measuring equipment, position the replacement part and verify correct positioning in all three (X,Y, and Z) planes of space. (Refer to 13 - FRAME & BUMPERS/FRAME - SPECIFICATIONS - FRAME DIMENSIONS)

CAUTION: Shield the surrounding area and components from exposure to the welding spatter and heat.

(16) Weld the replacement H-section into position. The welding should be performed in a skip (stitch) type method to minimize the heat buildup following I-CAR or the American Welding Society welding procedures and utilizing the process specifications at the end of this section. Refer to the Weld Process Specifications welding schedule below.

(17) Dress the welded area and apply corrosion resistant coatings inside and out.

(a) Inside the rail, inject a creeping wax based rust inhibitor compound through the existing holes in the frame ensuring 100% coverage including the mating face between the frame and replacement H-section.

(b) Apply a durable top coat to the outside of the repair area.

(18) Position the wiring harness back.

(19) Install the spare tire winch and install the bolts. (Fig. 23)

(20) Tighten the bolts to 41 N·m (30 ft. lbs.).

(21) Install the spare tire winch tube and install the clip. (Fig. 22)

(22) Install the spare tire.

(23) Lift the axle into position and install the rear shackle bolts. (Fig. 21)

(24) Tighten the bolts to 163 N·m (120 ft. lbs.).

(25) Install the lower shock absorber bolts. (Refer to 2 - SUSPENSION/REAR/SHOCK - INSTALLATION)

(26) Install the trailer hitch. (Refer to 13 - FRAME & BUMPERS/FRAME/TRAILER HITCH - INSTALLATION)

(27) Install the cargo box. (Refer to 23 - BODY/EXTERIOR/CARGO BOX - INSTALLATION)

(28) Reconnect the battery ground.

FRAME (Continued)

CAUTION:
All welds should conform to DaimlerChrysler vehicle engineering process standard “ps 9472”.

WELD PROCESS SPECIFICATIONS

WELDING PROCESS	FLUX CORED ARC	GAS METAL ARC (MIG)*	SHIELDED METAL ARC (STICK)
Material Thickness	3.7 mm to 4.2 mm	3.7 mm to 4.2 mm	3.7 mm to 4.2 mm
Electrode Type	Lincoln Electrical Co. Product #: NR-211 MP **(Do Not Substitute)**	AWS ER70S-3 **(Do Not Substitute)**	** AWS E 7018
Electrodes Size Inches	.045 Tubular	.035 Solid	3/32″
Electrode Stick Out	3/8″ - 1/2″	1/2″ - 5/8″	N/A
Polarity	Electrode ″-″ Work Piece ″+″	Electrode ″+″ Work Piece ″-″	Electrode ″+″ Work Piece ″-″
Shielding Gas	Self Shielded	75% Ar 25% CO_2	Self Shielded
Gas Flow Rate	N/A	25 - 35 CFM	N/A
Wire Feed Speed (inches per minute)	110 - 130 Vertical Down 70 - 90 Flat & Overhead	245 - 250 Vertical Down 210 - 225 Flat & Overhead	N/A
Approximate Amperage			
Vertical	110 - 130	175	85 (3/32″ Diameter)
Flat & Overhead	70 - 90	155	90 (3/32″ Diameter)
Voltage	15 - 18	19 - 20	N/A
Direction of Welding			
Vertical	Vertical Down Hill (only)	Vertical Down Hill (only)	Vertical - Up Hill (only)
Flat & Overhead	Flat - Push or Drag	Flat - Push or Drag	Flat - Drag

***First choice - Gas Metal Arc Welding Process:** Butt joints - apply two layers (passes) of weld metal. First pass should only fill approximately ½ the thickness. Vertical position welds - maintain electrode wire at leading edge of weld puddle while traveling down hill to produce maximum penetration into the sleeve. These techniques work for FCAW as well.

****E7018** new electrodes may be exposed to the atmosphere for up to ten hours with no harmful effect. Reconditioning schedules should come from the manufacturer.

SPECIFICATIONS

SPECIFICATIONS - FRAME DIMENSIONS

NOTE: Frame dimensions are listed in metric scale. All dimensions are from center to center of Principal Locating Point (PLP), or from center to center of PLP and fastener location.

VEHICLE PREPARATION

Position the vehicle on a level work surface. Using screw or bottle jacks, adjust the vehicle PLP heights to the specified dimension above a level work surface. Vertical dimensions can be taken from the work surface to the locations indicated were applicable.

INDEX

DESCRIPTION	FIGURE
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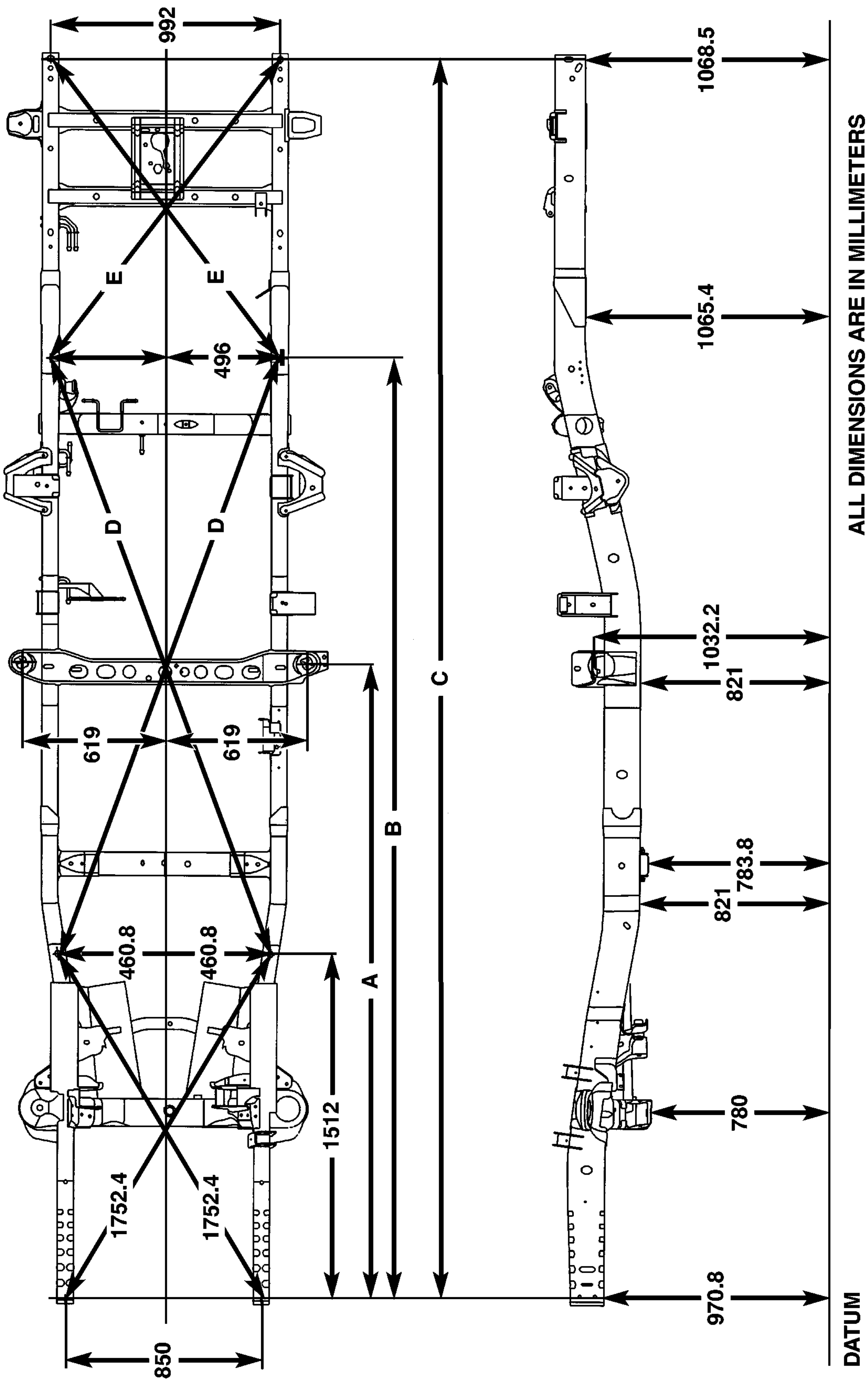
160.5 In Wheelbase - Heavy Duty - 4 Wheel Drive	28

FRAME (Continued)



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ALL DIMENSIONS ARE IN MILLIMETERS

CAB	BOX	WHEELBASE	LENGTH A	LENGTH B	LENGTH C	MEASUREMENT D	MEASUREMENT E
STD	SHORT	120.5	2791.7	3619.5	4870	2314.5	1596.2
STD	LONG	140.5	2791.7	4127.5	5428.8	2785	1636.3
QUAD	SHORT	140.5	3299.7	4127.5	5378.0	2785	1596.2
QUAD	LONG	160.5	3299.7	4635.5	5936.8	3266.7	1636.3

Fig. 24 FRAME DIMENSIONS

FRAME (Continued)

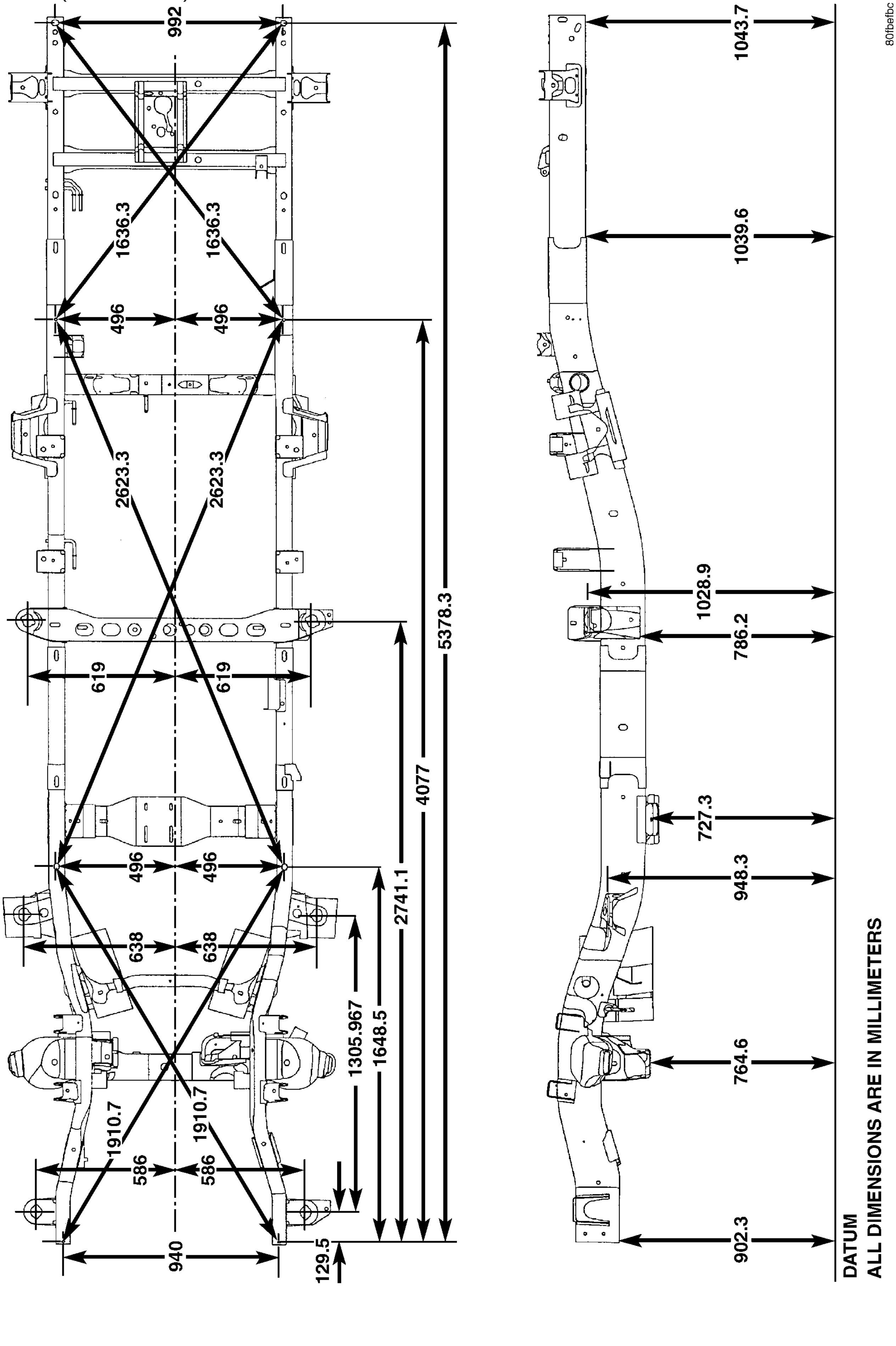

Fig. 25 140.5 IN WHEELBASE - HEAVY DUTY - 2 WHEEL DRIVE

FRAME (Continued)

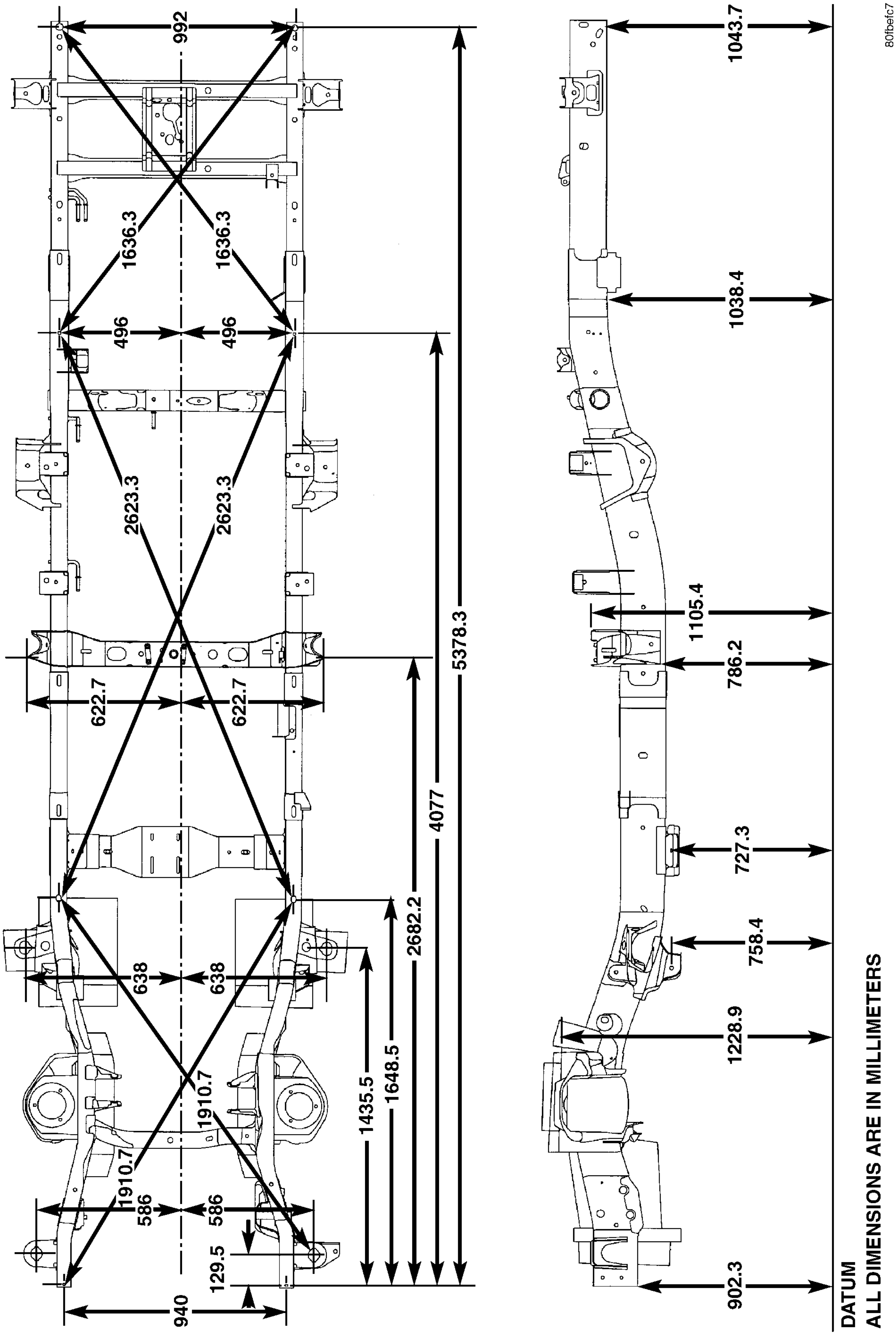

Fig. 26 140.5 IN WHEELBASE - HEAVY DUTY - 4 WHEEL DRIVE

FRAME (Continued)

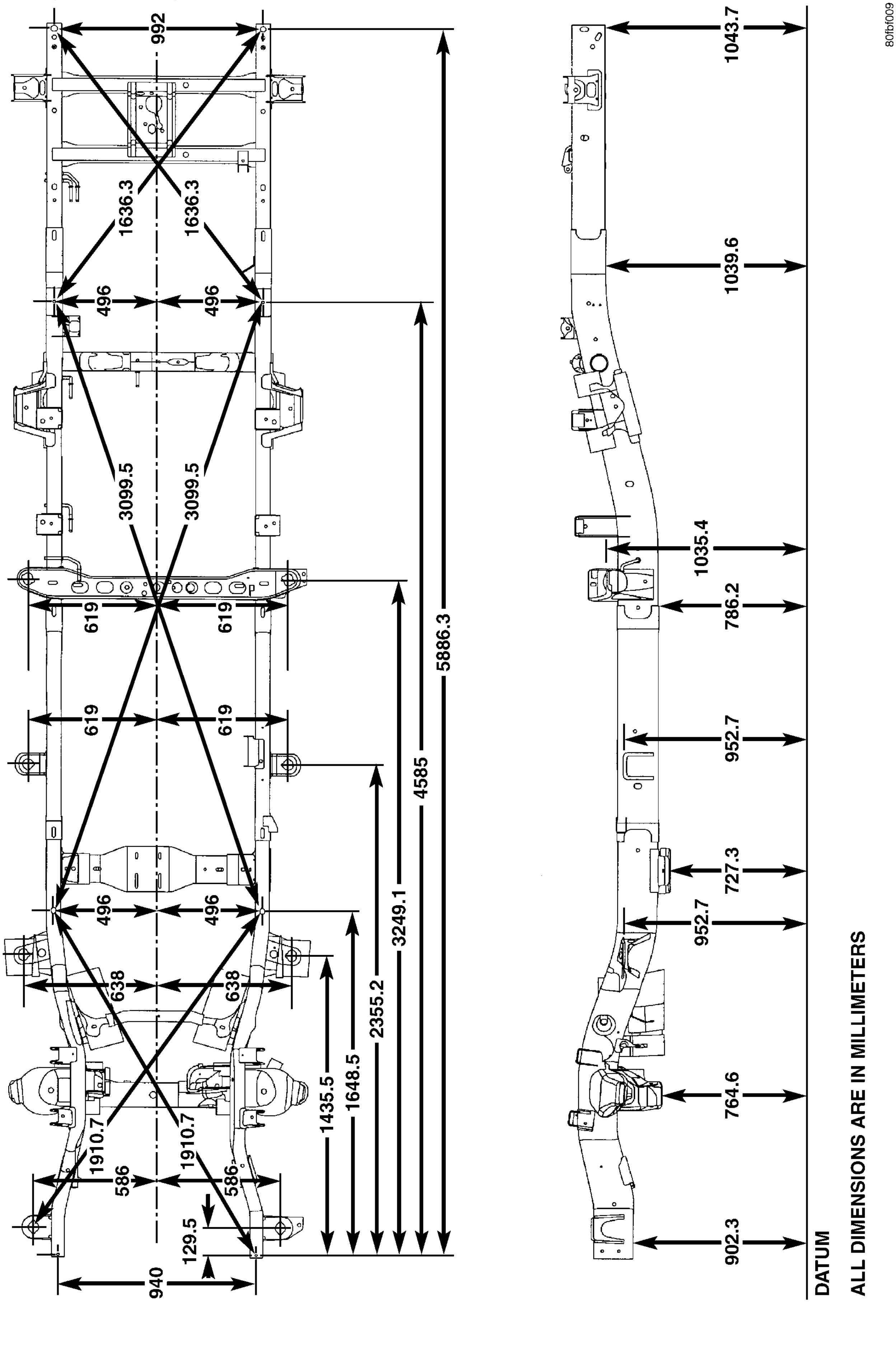

Fig. 27 160.5 IN WHEELBASE - HEAVY DUTY - 2 WHEEL DRIVE

FRAME (Continued)

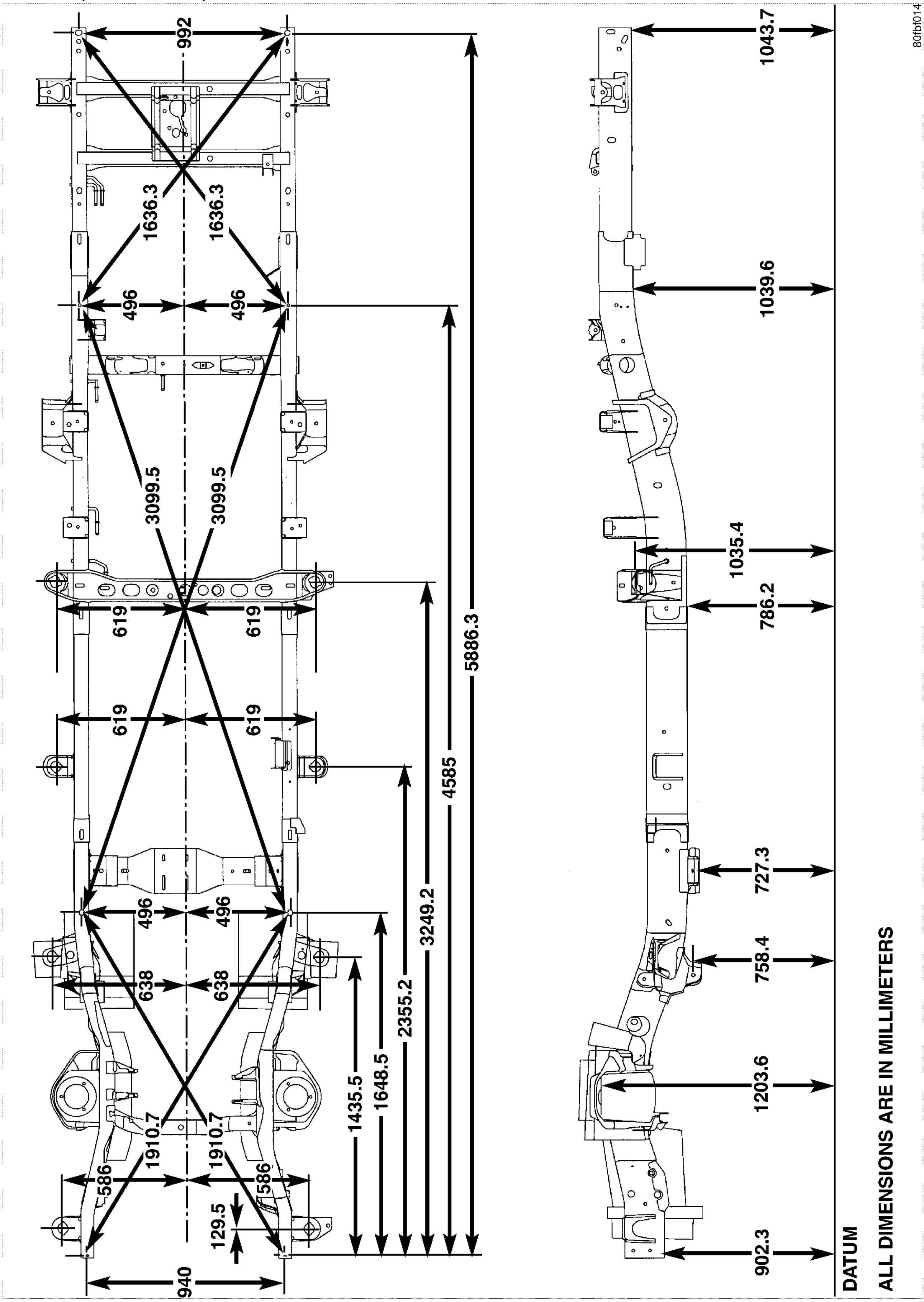

Fig. 28 160.5 IN WHEELBASE - HEAVY DUTY - 4 WHEEL DRIVE

FRAME (Continued)

SPECIFICATIONS - TORQUE

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Cab mount bolts	81	60	—
Cargo box bolts	108	80	—
Front crossmember bolts - 2WD	61	45	—
Front crossmember bolts - 4WD	102	75	—
Front skid plate bolts	34	25	—
Lower bumper support bracket bolt	54	40	—
Radiator crossmember bolts - lower	28	21	—
Radiator crossmember bolts - upper	28	21	—
Rear crossmember - 2WD	102	75	—
Rear crossmember - 4WD	102	75	—
Rear spring shackle bolts	163	120	—
Spare tire winch bolts	41	30	—
Trailer hitch reinforcement bracket bolt	170	125	—
Transfercase skid plate bolts	34	25	—
Transercase skid plate crossmember bolts	34	25	—
Transmission mount to crossmember nuts	61	45	—

FRONT CROSSMEMBER

REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Remove the front skid plate, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL)

(3) Remove the bolts and remove the crossmember. (Fig. 29) or (Fig. 30)

INSTALLATION

(1) Install the crossmember.

(2) Install the bolts;

- On 2WD vehicles, tighten the bolts to 61 N·m (45 ft. lbs.).
- On 4WD vehicles, tighten the bolts to 102 N·m (75 ft. lbs.).

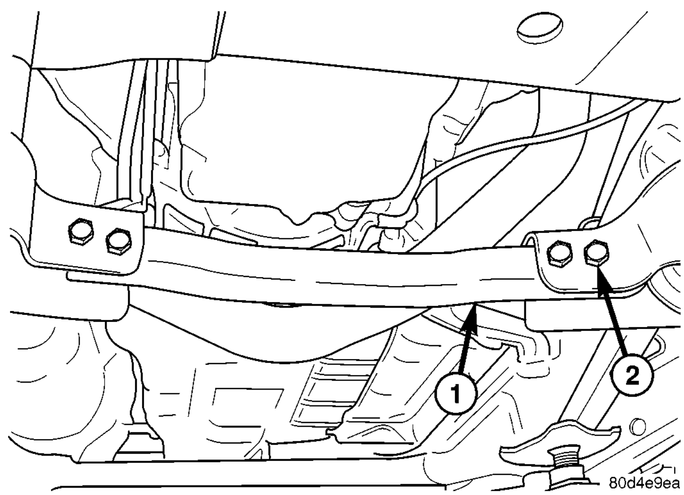

Fig. 29 FRONT CROSSMEMBER - 2WD

1 - CROSSMEMBER
2 - BOLTS (2 PER SIDE)

FRONT CROSSMEMBER (Continued)

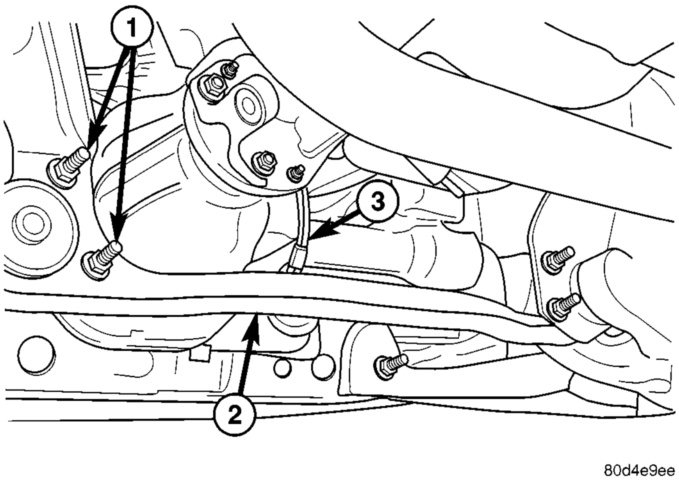

Fig. 30 FRONT CROSSMEMBER - 4WD

1 - BOLTS (2 PER SIDE)
2 - CROSSMEMBER

(3) Install the front skid plate, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - INSTALLATION)

FRONT SKID PLATE

REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Remove the bolts. (Fig. 31)

(3) Slide skid plate back off of the crossmember and remove.

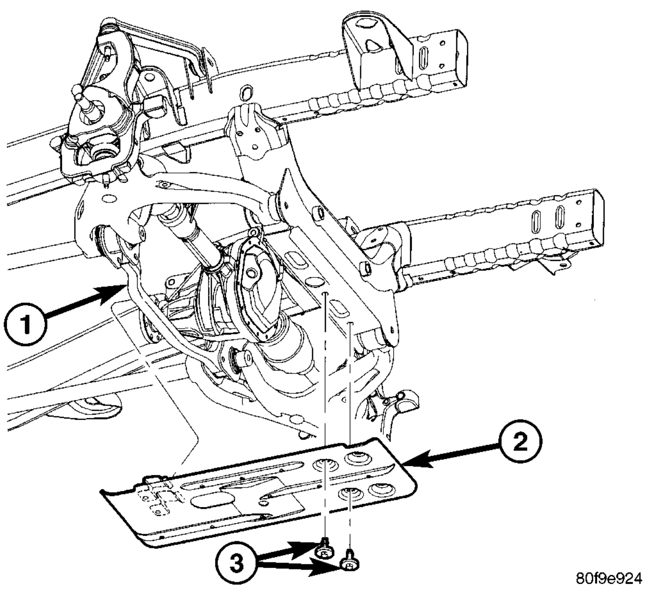

Fig. 31 FRONT SKID PLATE

1 - FRONT CROSSMEMBER
2 - FRONT SKID PLATE
3 - BOLTS (2)

INSTALLATION

(1) Snap the rear tabs over the front crossmember and install the skid plate.

(2) Install the bolts and tighten to 34 N·m (25 ft. lbs.).

TRANSMISSION CROSSMEMBER

REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Remove the transfercase skid plate, if equipped. (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)

(3) Support the transmission with a suitable lifting device.

(4) Remove the transmission mount nuts. (Fig. 32) or (Fig. 33)

(5) Remove the bolts and remove the crossmember.

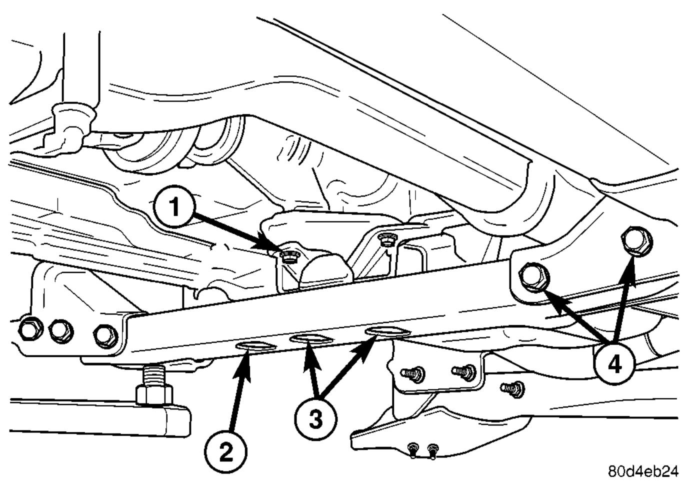

Fig. 32 REAR CROSSMEMBER - 2WD

1 - TRANSMISSION MOUNT
2 - REAR CROSSMEMBER
3 - TRANSMISSION MOUNT NUTS (2)
4 - CROSSMEMBER BOLTS (2 PER SIDE)

TRANSMISSION CROSSMEMBER (Continued)

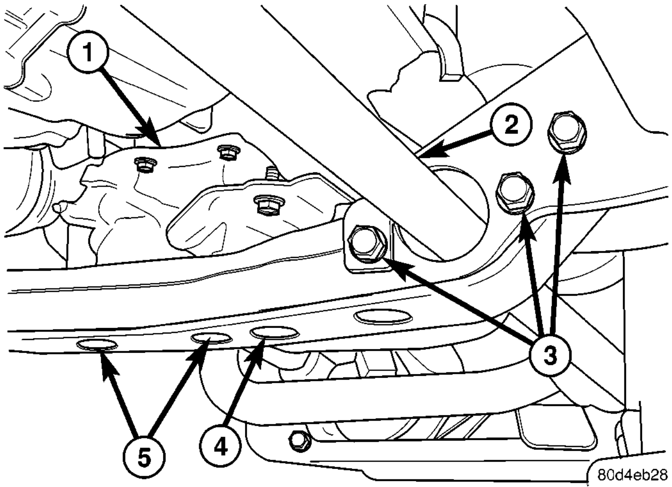

Fig. 33 REAR CROSSMEMBER - 4WD

1 - TRANSMISSION MOUNT
2 - TORSION BAR
3 - CROSSMEMBER BOLTS (3 PER SIDE)
4 - REAR CROSSMEMBER
5 - TRANSMISSION MOUNT NUTS (2)

INSTALLATION

(1) Install the crossmember and install the bolts.

(2) Tighten the bolts to 102 N·m (75 ft. lbs.).

(3) Install the transmission mount nuts and tighten to 61 N·m (45 ft. lbs.).

(4) Remove the transmission support.

(5) Install the transfercase skid plate. (Refer to 13 - FRAME & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)

TRAILER HITCH

REMOVAL

(1) Remove the rear bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/REAR BUMPER - REMOVAL)

(2) Remove the hitch bolts. (Fig. 34)

(3) Disconnect all wire harness support push pins.

(4) Remove the rear two cargo box bolts and loosen the remaining bolts. (Refer to 23 - BODY/EXTERIOR/CARGO BOX - REMOVAL)

(5) Using a suitable lifting device, lift and support the rear of the cargo box and remove the hitch.

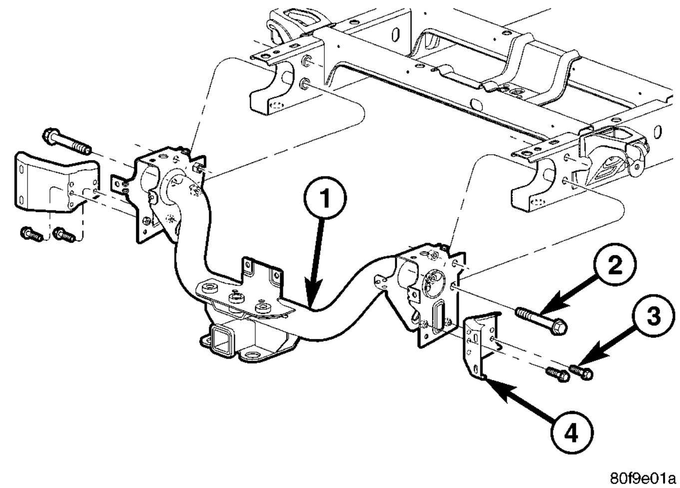

Fig. 34 TRAILER HITCH

1 - HITCH
2 - HITCH BOLTS (4)
3 - BUMPER BRACKET BOLTS (4)
4 - BUMPER SUPPORT BRACKETS

INSTALLATION

(1) Install the hitch onto the frame rails and make sure the locators on the inside of the hitch brackets are engaged with the holes in the top of the frame rails properly.

(2) Lower the cargo box and install the rear bolts. (Refer to 23 - BODY/EXTERIOR/CARGO BOX - INSTALLATION)

(3) Install the hitch bolts and tighten to 170 N·m (125 ft. lbs.).

(4) Connect all wire harness support push pins.

(5) Install the rear bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/REAR BUMPER - INSTALLATION)

TRANSFER CASE SKID PLATE

REMOVAL

(1) Raise and support the vehicle. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(2) Support the skid plate and remove the bolts. (Fig. 35)

(3) Remove the skid plate.

(4) Support the skid plate crossmember and remove the bolts.

(5) Remove the skid plate crossmember.

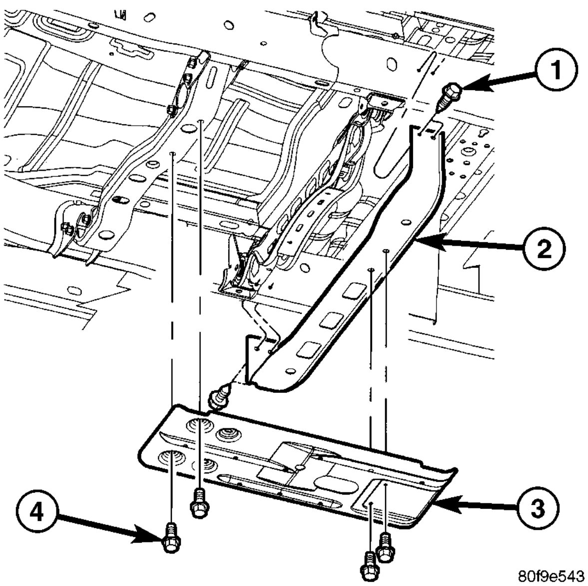

Fig. 35 TRANSFER CASE SKID PLATE

1 - CROSSMEMBER BOLTS (4)
2 - SKID PLATE CROSSMEMBER
3 - SKID PLATE
4 - SKID PLATE BOLTS (4)

INSTALLATION

(1) Install the skid plate crossmember and install the bolts.

(2) Tighten the bolts to 34 N·m (25 ft. lbs.).

(3) Install the skid plate and install the bolts.

(4) Tighten the bolts to 34 N·m (25 ft. lbs.).

FRONT TOW HOOK ASSEMBLY

REMOVAL

(1) Remove front bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT BUMPER - REMOVAL)

(2) Remove the bolts and remove the tow hook assembly. (Fig. 36)

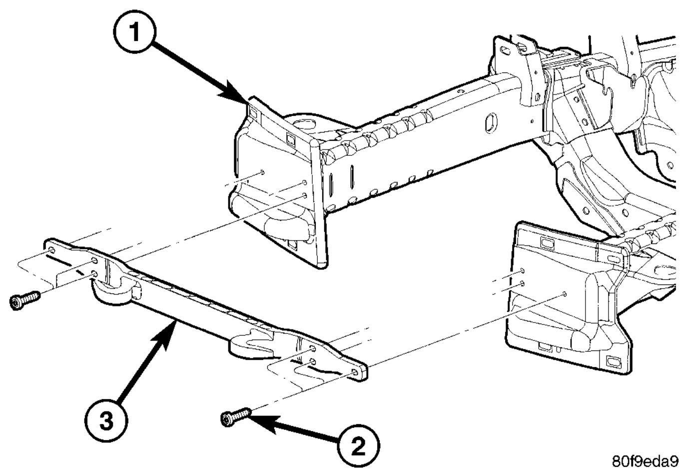

Fig. 36 FRONT TOW HOOK ASSEMBLY

1 - BUMPER CENTER SUPPORT BRACKET
2 - BOLTS (6)
3 - TOW HOOK ASSEMBLY

INSTALLATION

(1) Install the tow hook assembly and bolts hand tight.

(2) Install the front bumper. (Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT BUMPER - INSTALLATION)

(3) Tighten the tow hook bolts to 68 N·m (50 ft. lbs.).

FUEL SYSTEM

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FUEL DELIVERY - GAS

TABLE OF CONTENTS

FUEL DELIVERY - GAS

DESCRIPTION

The fuel delivery system consists of:

- a fuel pump module containing the electric fuel pump, fuel filter/fuel pressure regulator, fuel gauge sending unit (fuel level sensor) and a secondary fuel filter located at the bottom of the pump module
- fuel tubes/lines/hoses
- a combination fuel filter/fuel pressure regulator
- quick-connect fittings
- fuel injector rail
- fuel tank
- fuel tank filler/vent tube assembly
- fuel tank filler tube cap
- accelerator pedal
- throttle cable

Certain fuel delivery components can be found in (Fig. 1).

FUEL DELIVERY - GAS (Continued)

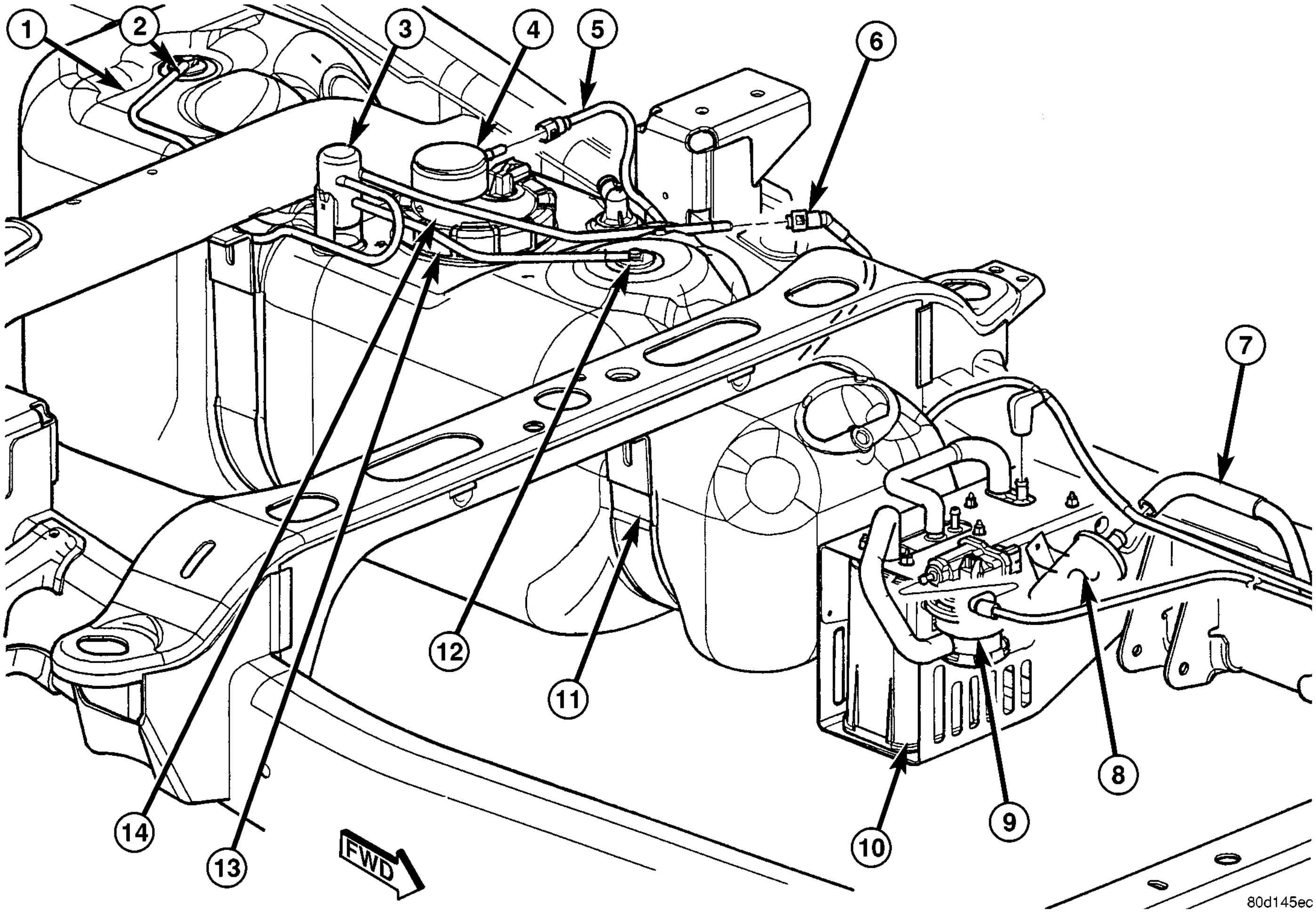


Fig. 1 FUEL DELIVERY COMPONENTS

1 - FUEL TANK
2 - CHECK VALVE
3 - LIQUID EXPANSION CHAMBER
4 - FUEL FILTER / FUEL PRESSURE REGULATOR
5 - QUICK-CONNECT FITTING AND FUEL LINE (TO ENGINE)
6 - EVAP LINE CONNECTION
7 - LEAK DETECTION PUMP FRESH AIR LINE
8 - LDP FRESH AIR FILTER
9 - LEAK DETECTION PUMP
10 - EVAP CANISTERS (2)
11 - FUEL TANK STRAPS (2)
12 - CHECK VALVE
13 - FUEL PUMP MODULE LOCK RING
14 - FUEL PUMP MODULE

OPERATION

Fuel is returned through the fuel pump module and back into the fuel tank through the fuel filter/fuel pressure regulator. A separate fuel return line from the engine to the tank is not used.

The fuel tank assembly consists of: the fuel tank, fuel pump module assembly, fuel pump module lock-nut/gasket, and fuel tank check valve (refer to Fuel Tank Check Valve for information).

A fuel filler/vent tube assembly using a pressure/vacuum, 1/4 turn fuel filler cap is used. The fuel filler tube contains a flap door located below the fuel fill cap.

Also to be considered part of the fuel system is the evaporation control system. This is designed to reduce the emission of fuel vapors into the atmosphere. The description and function of the Evaporative Control System is found in Emission Control Systems.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE

Use following procedure if the fuel injector rail is, or is not equipped with a fuel pressure test port.

(1) Remove fuel fill cap.

FUEL DELIVERY - GAS (Continued)

(2) Remove fuel pump relay from Power Distribution Center (PDC). For location of relay, refer to label on underside of PDC cover.

(3) Start and run engine until it stalls.

(4) Attempt restarting engine until it will no longer run.

(5) Turn ignition key to OFF position.

CAUTION: Steps 1, 2, 3 and 4 must be performed to relieve high pressure fuel from within fuel rail. Do not attempt to use following steps to relieve this pressure as excessive fuel will be forced into a cylinder chamber.

(6) Unplug connector from any fuel injector.

(7) Attach one end of a jumper wire with alligator clips (18 gauge or smaller) to either injector terminal.

(8) Connect other end of jumper wire to positive side of battery.

(9) Connect one end of a second jumper wire to remaining injector terminal.

CAUTION: Powering an injector for more than a few seconds will permanently damage the injector.

(10) Momentarily touch other end of jumper wire to negative terminal of battery for no more than a few seconds.

(11) Place a rag or towel below fuel line quick-connect fitting at fuel rail.

(12) Disconnect quick-connect fitting at fuel rail. Refer to Quick-Connect Fittings.

(13) Return fuel pump relay to PDC.

(14) One or more Diagnostic Trouble Codes (DTC's) may have been stored in PCM memory due to fuel pump relay removal. The DRB® scan tool must be used to erase a DTC.

SPECIFICATIONS

FUEL SYSTEM PRESSURE

339 kPa +/- 34 kPa (49.2 psi +/- 2 psi).

TORQUE - FUEL SYSTEM

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Accelerator Pedal Bracket Mounting	12	-	105
Accelerator Pedal Position Sensor Bracket-to-Battery Tray Bolts	3	-	30
Crankshaft Position Sensor - 3.7L	28	21	-
Crankshaft Position Sensor - 4.7L	28	21	-
Crankshaft Position Sensor - 5.7L	12	-	105 (+/-20)
Crankshaft Position Sensor - 5.9L	8	-	70
Crankshaft Position Sensor - 8.0L	8	-	70
Camshaft Position Sensor - 3.7L	12	-	106
Camshaft Position Sensor - 4.7L	12	-	106
Camshaft Position Sensor - 5.7L	12	9	105 (+/-) 20
Camshaft Position Sensor - 8.0L	6	-	50

FUEL DELIVERY - GAS (Continued)

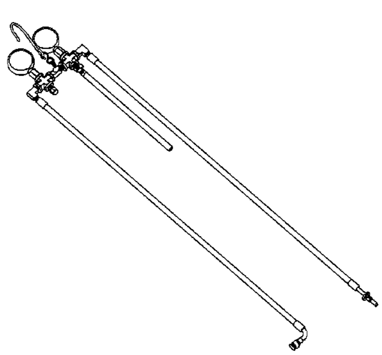
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Engine Coolant Temperature Sensor - 3.7L	11	-	96
Engine Coolant Temperature Sensor - 4.7L	11	-	96
Engine Coolant Temperature Sensor - 5.7L	11	-	96
Engine Coolant Temperature Sensor - 5.9L	11	-	96
Engine Coolant Temperature Sensor - 8.0L	11	-	96
EVAP Canister- to-Bracket Nuts	8.5	-	75
EVAP Canister-to-frame bolts	34	25	
Fuel Filler Hose Clamp at Tank	3	-	30
Fuel Filler Housing-to-Body Screws	2	-	17
Fuel Pump Module Lock Ring	54	40	-
Fuel Rail Mounting Bolts - 3.7L	11	-	100
Fuel Rail Mounting Bolts - 4.7L	11	-	100
Fuel Rail Mounting Bolts - 5.7L	11	-	100
Fuel Rail Mounting Bolts - 5.9L	23	-	200
Fuel Rail Mounting Bolts - 8.0L	15	-	136
Fuel Tank Mounting Straps	41	30	-
IAC Motor Mounting Screws - 3.7L	7	-	60
IAC Motor Mounting Screws - 4.7L	7	-	60
IAC Motor Mounting Screws - 5.9L	7	-	60
IAC Motor Mounting Screws - 8.0L	7	-	60
Leak Detection Pump Mounting Bolt	8.5	-	75
Map Sensor Mounting Screws - 3.7L	3	-	25

FUEL DELIVERY - GAS (Continued)

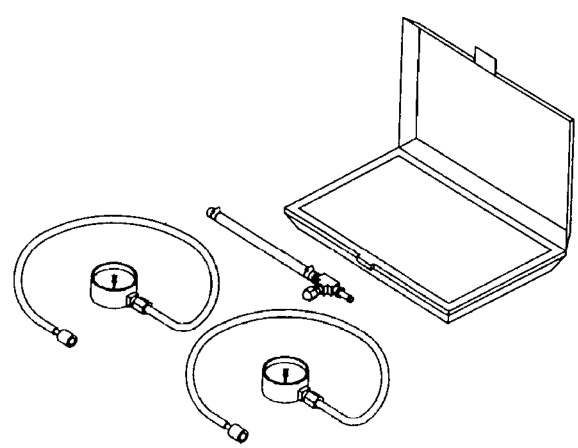
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Map Sensor Mounting Screws - 4.7L	3	-	25
Map Sensor Mounting Screws - 5.9L	3	-	25
Map Sensor Mounting Screws - 8.0L	2	-	20
PCM-to-Mounting Bracket Mounting Screws	4	-	35
Power Steering Pressure Switch - 3.7L	14-22	-	124-195
Power Steering Pressure Switch - 4.7L	14-22	-	124-195
TPS Mounting Screws - 3.7L	7	-	60
TPS Mounting Screws - 4.7L	7	-	60
TPS Mounting Screws - 5.9L	7	-	60
TPS Mounting Screws - 8.0L	7	-	60
Throttle Body Mounting Bolts - 3.7L	11	-	100
Throttle Body Mounting Bolts - 4.7L	12	-	105
Throttle Body Mounting Bolts - 5.7L	12	-	105
Throttle Body Mounting Bolts - 5.9L	23	-	200
Throttle Body Mounting Bolts - 8.0L	22	-	192
Oxygen Sensors	30	22	-

SPECIAL TOOLS

FUEL SYSTEM

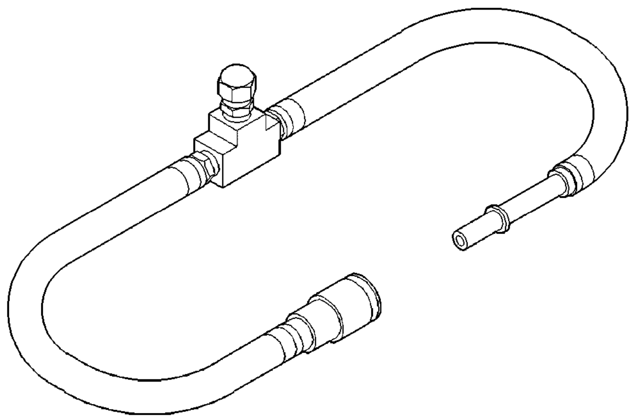


FUEL PRESSURE TESTER - #8978

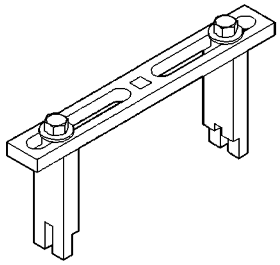


TEST KIT, FUEL PRESSURE, 8.0L ENGINE - #5069

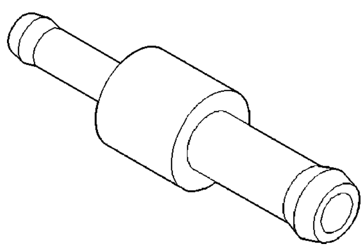
FUEL DELIVERY - GAS (Continued)



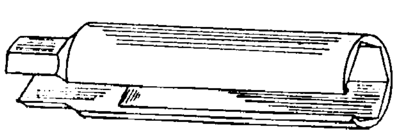
ADAPTERS, FUEL PRESSURE TEST, 8.0L - #6539 AND/OR #6631



SPANNER WRENCH - #6856



FITTING, AIR METERING - #6714



O2S (OXYGEN SENSOR) REMOVER/INSTALLER - #C-4907

FUEL FILTER/PRESSURE REGULATOR

DESCRIPTION

A combination fuel filter and fuel pressure regulator (Fig. 2) is used on all engines. It is located on the top of the fuel pump module. A separate frame mounted fuel filter is not used with any engine.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

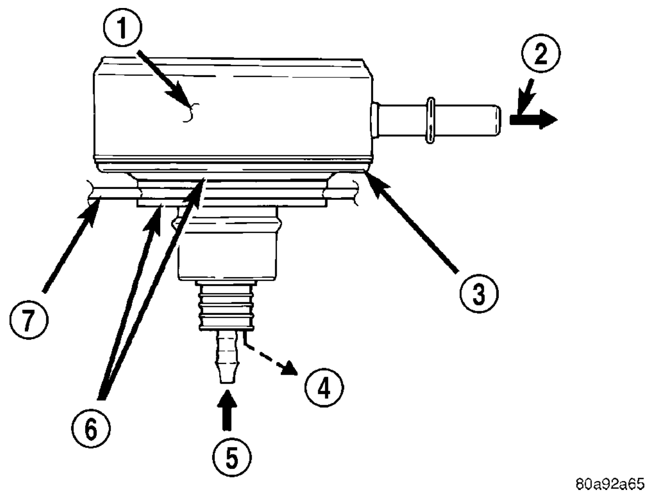


Fig. 2 SIDE VIEW - FILTER/REGULATOR

1 - INTERNAL FUEL FILTER
2 - FUEL FLOW TO FUEL INJECTORS
3 - FUEL FILTER/FUEL PRESSURE REGULATOR
4 - EXCESS FUEL BACK TO TANK
5 - FUEL INLET
6 - RUBBER GROMMET
7 - TOP OF PUMP MODULE

OPERATION

Fuel Pressure Regulator Operation: The pressure regulator is a mechanical device that is not controlled by engine vacuum or the Powertrain Control Module (PCM).

The regulator is calibrated to maintain fuel system operating pressure of approximately 339 kPa ± 34 kPa (49.2 psi ± 5 psi) at the fuel injectors. It contains a diaphragm, calibrated springs and a fuel return valve. The internal fuel filter (Fig. 2) is also part of the assembly.

Fuel is supplied to the filter/regulator by the electric fuel pump through an opening tube at the bottom of filter/regulator (Fig. 2).

The regulator acts as a check valve to maintain some fuel pressure when the engine is not operating. This will help to start the engine. A second check valve is located at the outlet end of the electric fuel

FUEL FILTER/PRESSURE REGULATOR (Continued)

pump. **Refer to Fuel Pump - Description and Operation for more information.**

If fuel pressure at the pressure regulator exceeds approximately 49.2 psi, an internal diaphragm opens and excess fuel pressure is routed back into the tank through the bottom of pressure regulator.

Both fuel filters (at bottom of fuel pump module and within fuel pressure regulator) are designed for extended service. They do not require normal scheduled maintenance. Filters should only be replaced if a diagnostic procedure indicates to do so.

FUEL LEVEL SENDING UNIT / SENSOR

DESCRIPTION

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel pump module. The sending unit consists of a float, an arm, and a variable resistor track (card).

OPERATION

The fuel pump module has 4 different circuits (wires). Two of these circuits are used for the fuel gauge sending unit for fuel gauge operation, and for certain OBD II emission requirements. The other 2 wires are used for electric fuel pump operation.

For Fuel Gauge Operation: A constant current source is supplied to the resistor track on the fuel gauge sending unit. This is fed directly from the Powertrain Control Module (PCM). **NOTE: For diagnostic purposes, this 12V power source can only be verified with the circuit opened (fuel pump module electrical connector unplugged). With the connectors plugged, output voltages will vary from about 0.6 volts at FULL, to about 8.6 volts at EMPTY (about 8.6 volts at EMPTY for Jeep models, and about 7.0 volts at EMPTY for Dodge Truck models).** The resistor track is used to vary the voltage (resistance) depending on fuel tank float level. As fuel level increases, the float and arm move up, which decreases voltage. As fuel level decreases, the float and arm move down, which increases voltage. The varied voltage signal is returned back to the PCM through the sensor return circuit.

Both of the electrical circuits between the fuel gauge sending unit and the PCM are hard-wired (not multi-plexed). After the voltage signal is sent from the resistor track, and back to the PCM, the PCM will interpret the resistance (voltage) data and send a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

For OBD II Emission Monitor Requirements: The PCM will monitor the voltage output sent from the resistor track on the sending unit to indicate fuel level. The purpose of this feature is to prevent the OBD II system from recording/setting false misfire and fuel system monitor diagnostic trouble codes. The feature is activated if the fuel level in the tank is less than approximately 15 percent of its rated capacity. If equipped with a Leak Detection Pump (EVAP system monitor), this feature will also be activated if the fuel level in the tank is more than approximately 85 percent of its rated capacity.

REMOVAL

The fuel level sending unit (fuel level sensor) and float assembly is located on the side of the fuel pump module (Fig. 3).

(1) Remove fuel pump module from fuel tank. Refer to Fuel Pump Module Removal/Installation.

(2) To remove sending unit from pump module, lift on plastic locking tab (Fig. 4) while sliding sending unit tracks.

(3) Disconnect 4–wire electrical connector (Fig. 3) from fuel pump module. Separate necessary sending unit wiring from connector using terminal pick / removal tool. Refer to Special Tools in 8W Wiring for tool part numbers.

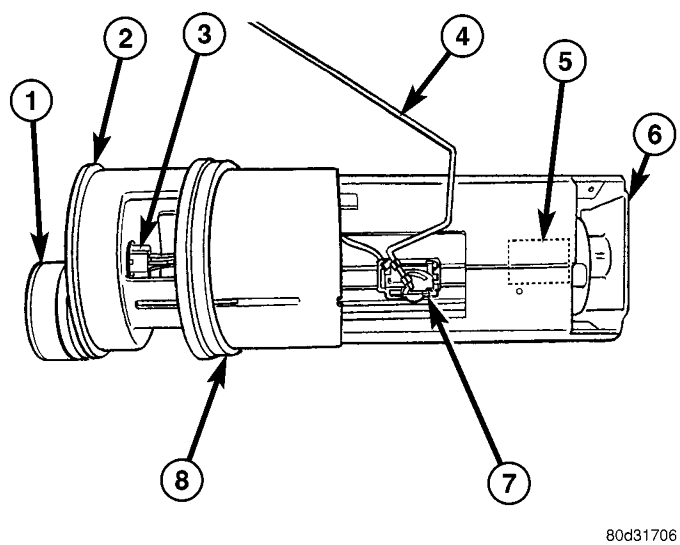


Fig. 3 LOCATION - FUEL GAUGE SENDING UNIT

1 - FUEL FILTER / FUEL PRESSURE REGULATOR
2 - FUEL PUMP MODULE ASSEMBLY
3 - 4-WAY ELEC. CONNECT.
4 - FLOAT ARM
5 - ELEC. FUEL PUMP
6 - INLET FILTER
7 - FUEL GAUGE SENDING UNIT
8 - GASKET (SEAL)

FUEL LEVEL SENDING UNIT / SENSOR (Continued)

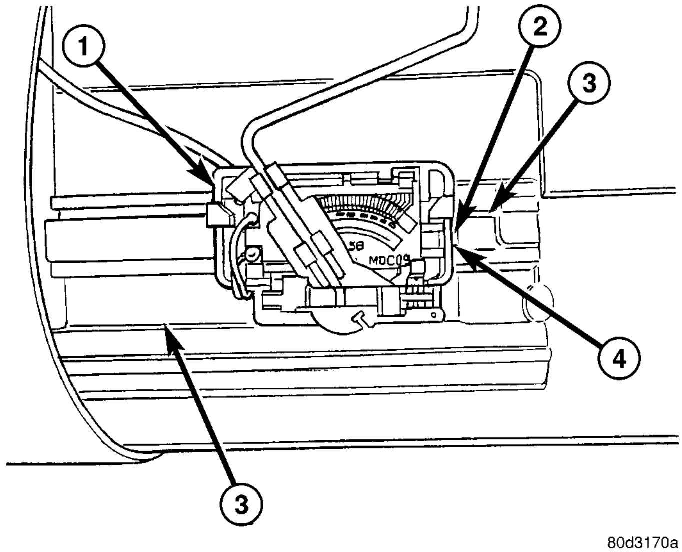


Fig. 4 FUEL GAUGE SENDING UNIT - R/I

1 - SENDING UNIT
2 - LOCK TAB
3 - TRACKS
4 - NOTCH

INSTALLATION

(1) Connect necessary wiring into electrical connectors. Connect 4–wire electrical connector to pump module.

(2) Position sending unit to pump module. Slide and snap into place.

(3) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

FUEL LINES

DESCRIPTION

Also refer to Quick-Connect Fittings.

WARNING: THE FUEL SYSTEM MAY BE UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSES, FITTINGS, LINES, OR MOST COMPONENTS, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO THE FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

The lines/tubes/hoses used on fuel injected vehicles are of a special construction. This is due to the higher fuel pressures and the possibility of contaminated fuel in this system. If it is necessary to replace these lines/tubes/hoses, only those marked EFM/EFI may be used.

If equipped: The hose clamps used to secure rubber hoses on fuel injected vehicles are of a special rolled edge construction. This construction is used to prevent the edge of the clamp from cutting into the hose. Only these rolled edge type clamps may be used in this system. All other types of clamps may cut into the hoses and cause high-pressure fuel leaks.

Use new original equipment type hose clamps.

QUICK CONNECT FITTING

DESCRIPTION

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Some are equipped with safety latch clips. Some may require the use of a special tool for disconnection and removal. Refer to Quick-Connect Fittings Removal/Installation for more information.

CAUTION: The interior components (o-rings, clips) of quick-connect fittings are not serviced separately, but new plastic spacers are available for some types. If service parts are not available, do not attempt to repair the damaged fitting or fuel line (tube). If repair is necessary, replace the complete fuel line (tube) assembly.

STANDARD PROCEDURE - QUICK-CONNECT FITTINGS

Also refer to Fuel Tubes/Lines/Hoses and Clamps.

Different types of quick-connect fittings are used to attach various fuel system components, lines and tubes. These are: a single-tab type, a two-tab type or a plastic retainer ring type. Safety latch clips are used on certain components/lines. Certain fittings may require use of a special tool for disconnection.

DISCONNECTING

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE OFF). BEFORE SERVICING ANY FUEL SYSTEM HOSE, FITTING OR LINE, FUEL SYSTEM PRESSURE MUST BE RELEASED. REFER TO FUEL SYSTEM PRESSURE RELEASE PROCEDURE.

CAUTION: The interior components (o-rings, spacers) of some types of quick-connect fitting are not serviced separately. If service parts are not available, do not attempt to repair a damaged fitting or fuel line. If repair is necessary, replace complete fuel line assembly.

(1) Perform fuel pressure release procedure. Refer to Fuel Pressure Release Procedure.

QUICK CONNECT FITTING (Continued)

(2) Disconnect negative battery cable from battery.

(3) Clean fitting of any foreign material before disassembly.

(4) **2–Button Type Fitting:** This type of fitting is equipped with a push-button located on each side of quick-connect fitting (Fig. 5). Press on both buttons simultaneously for removal. Special tools are not required for disconnection.

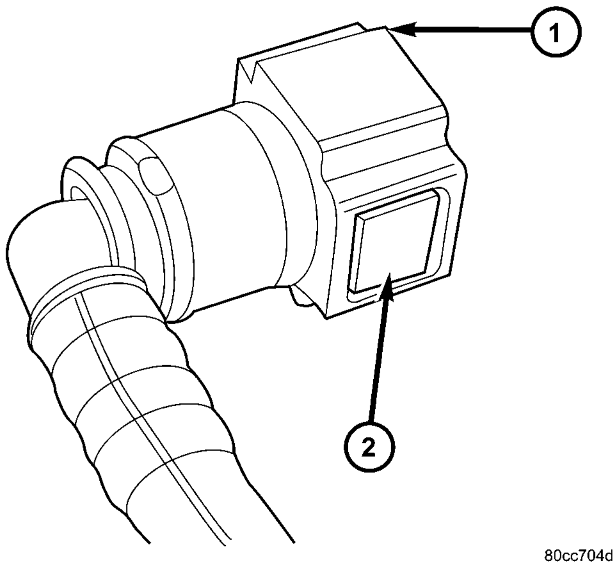


Fig. 5 2-BUTTON TYPE FITTING

1 - QUICK-CONNECT FITTING
2 - PUSH-BUTTONS (2)

(5) **Pinch-Type Fitting:** This fitting is equipped with two finger tabs. Pinch both tabs together while removing fitting (Fig. 6). Special tools are not required for disconnection.

(6) **Single-Tab Type Fitting:** This type of fitting is equipped with a single pull tab (Fig. 7). The tab is removable. After tab is removed, quick-connect fitting can be separated from fuel system component. Special tools are not required for disconnection.

(a) Press release tab on side of fitting to release pull tab (Fig. 8). **If release tab is not pressed prior to releasing pull tab, pull tab will be damaged.**

(b) While pressing release tab on side of fitting, use screwdriver to pry up pull tab (Fig. 8).

(c) Raise pull tab until it separates from quick-connect fitting (Fig. 9).

(7) **Two-Tab Type Fitting:** This type of fitting is equipped with tabs located on both sides of fitting (Fig. 10). The tabs are supplied for disconnecting quick-connect fitting from component being serviced.

(a) To disconnect quick-connect fitting, squeeze plastic retainer tabs (Fig. 10) against sides of quick-connect fitting with your fingers. Tool use is not required for removal and may damage plastic retainer.

(b) Pull fitting from fuel system component being serviced.

(c) The plastic retainer will remain on component being serviced after fitting is disconnected. The o-rings and spacer will remain in quick-connect fitting connector body.

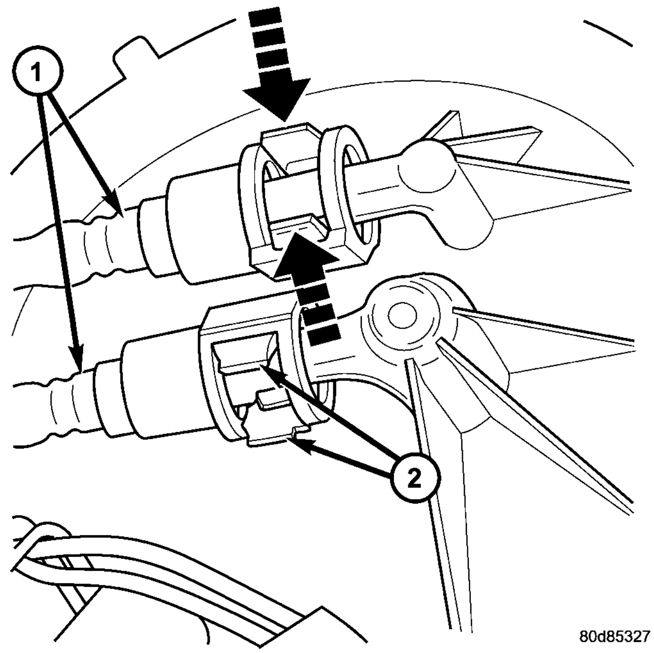


Fig. 6 PINCH TYPE QUICK-CONNECT FITTING

1 - QUICK-CONNECT FITTINGS
2 - PINCH TABS

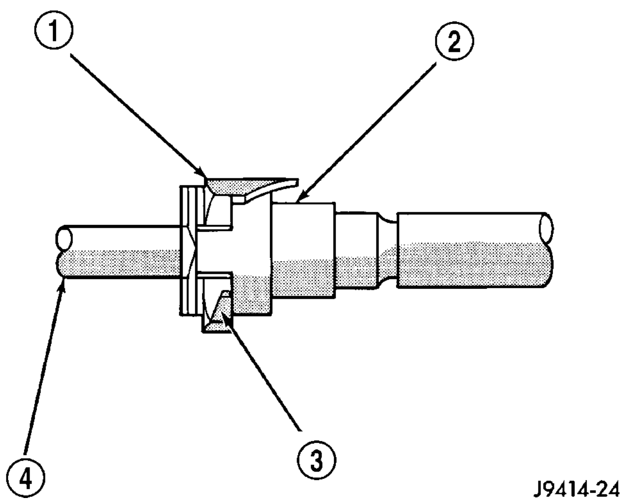


Fig. 7 SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - QUICK-CONNECT FITTING
3 - PRESS HERE TO REMOVE PULL TAB
4 - INSERTED TUBE END

QUICK CONNECT FITTING (Continued)

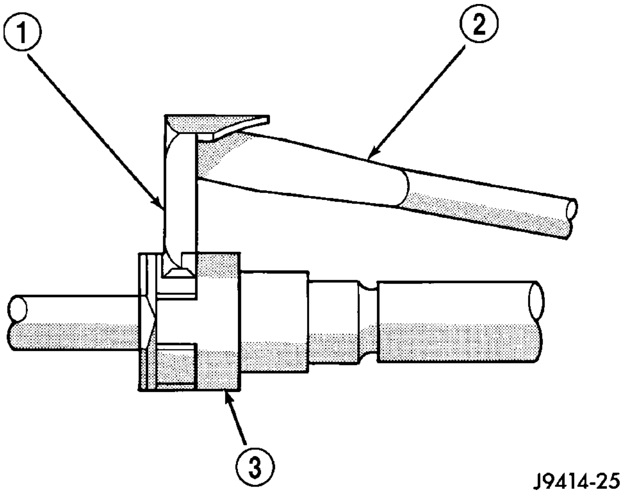


Fig. 8 DISCONNECTING SINGLE-TAB TYPE FITTING

1 - PULL TAB
2 - SCREWDRIVER
3 - QUICK-CONNECT FITTING

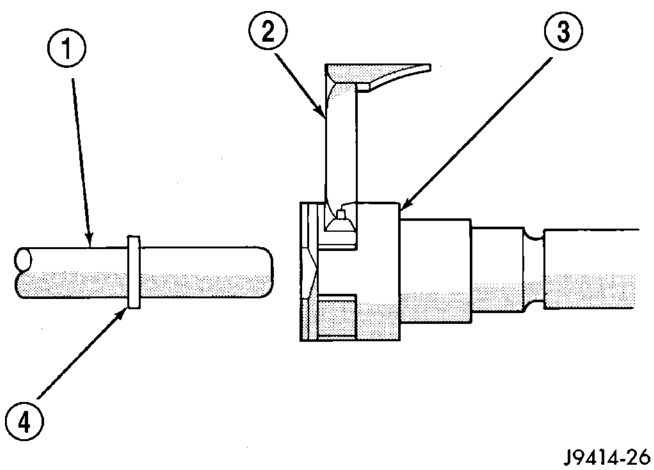


Fig. 9 REMOVING PULL TAB

1 - FUEL TUBE OR FUEL SYSTEM COMPONENT
2 - PULL TAB
3 - QUICK-CONNECT FITTING
4 - FUEL TUBE STOP

(8) **Plastic Retainer Ring Type Fitting:** This type of fitting can be identified by the use of a full-round plastic retainer ring (Fig. 11) usually black in color.

(a) To release fuel system component from quick-connect fitting, firmly push fitting towards component being serviced while firmly pushing plastic retainer ring into fitting (Fig. 11). With plastic ring depressed, pull fitting from component. **The plastic retainer ring must be pressed squarely into fitting body. If this retainer is cocked during removal, it may be difficult to disconnect fitting. Use an open-end wrench on shoulder of plastic retainer ring to aid in disconnection.**

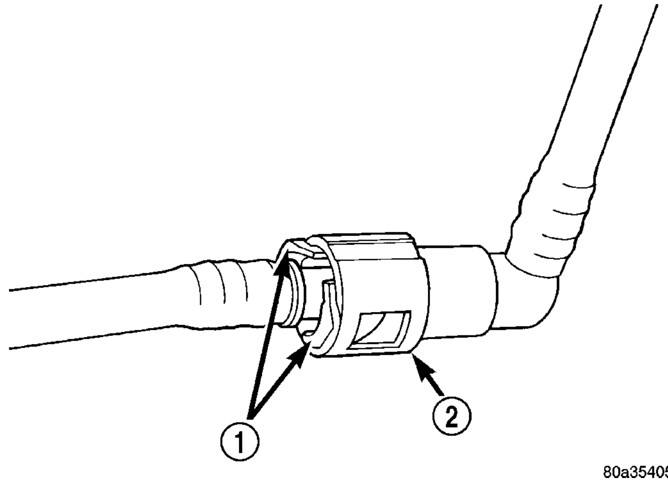


Fig. 10 TYPICAL 2–TAB TYPE FITTING

1 - TAB(S)
2 - QUICK-CONNECT FITTING

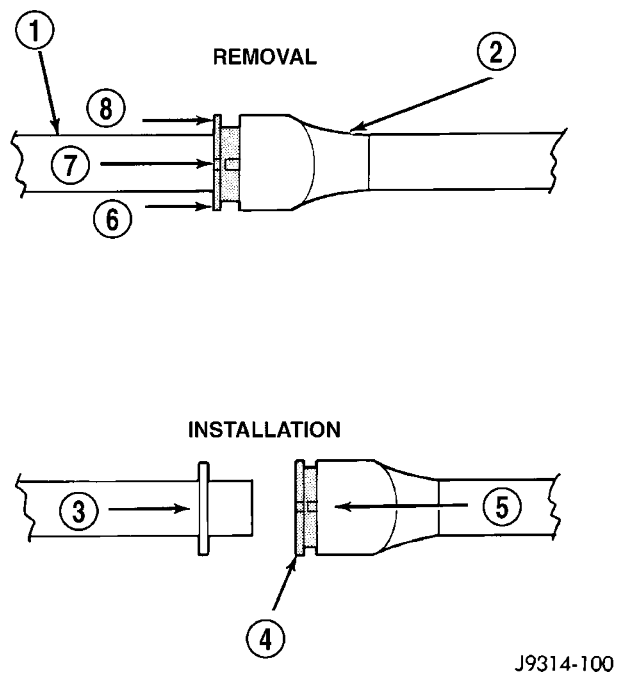


Fig. 11 PLASTIC RETAINER RING TYPE FITTING

1 - FUEL TUBE
2 - QUICK CONNECT FITTING
3 - PUSH
4 - PLASTIC RETAINER
5 - PUSH
6 - PUSH
7 - PUSH
8 - PUSH

(b) After disconnection, plastic retainer ring will remain with quick-connect fitting connector body.

(c) Inspect fitting connector body, plastic retainer ring and fuel system component for damage. Replace as necessary.

(9) **Latch Clips:** Depending on vehicle model and engine, 2 different types of safety latch clips are used

QUICK CONNECT FITTING (Continued)

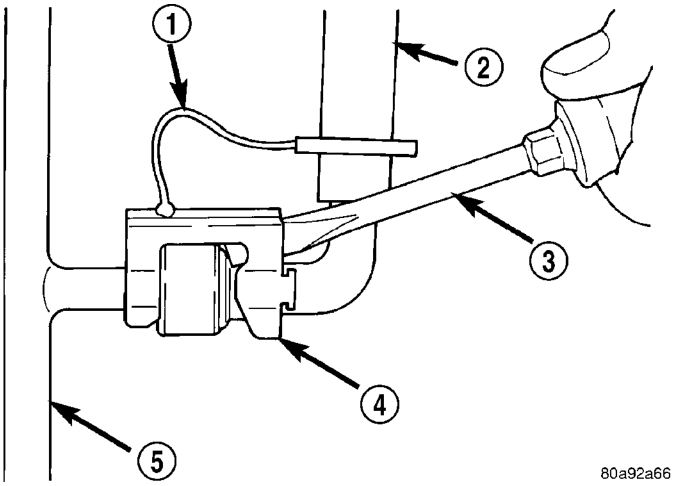


Fig. 12 LATCH CLIP-TYPE 1

1 - TETHER STRAP
2 - FUEL LINE
3 - SCREWDRIVER
4 - LATCH CLIP
5 - FUEL RAIL

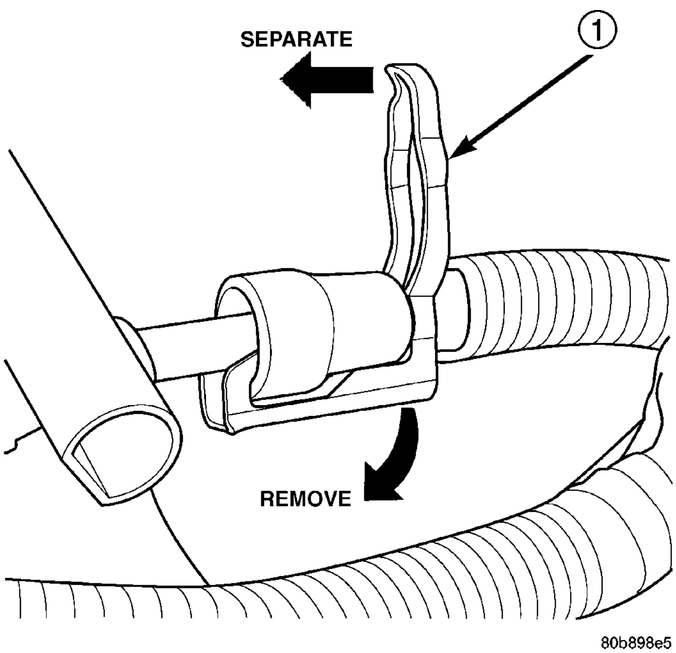


Fig. 13 LATCH CLIP-TYPE 2

1 - LATCH CLIP

(Fig. 12) or (Fig. 13). Type-1 is tethered to fuel line and type-2 is not. A special tool will be necessary to disconnect fuel line after latch clip is removed. The latch clip may be used on certain fuel line/fuel rail connection, or to join fuel lines together.

(a) Type 1: Pry up on latch clip with a screwdriver (Fig. 12).

(b) Type 2: Separate and unlatch 2 small arms on end of clip (Fig. 13) and swing away from fuel line.

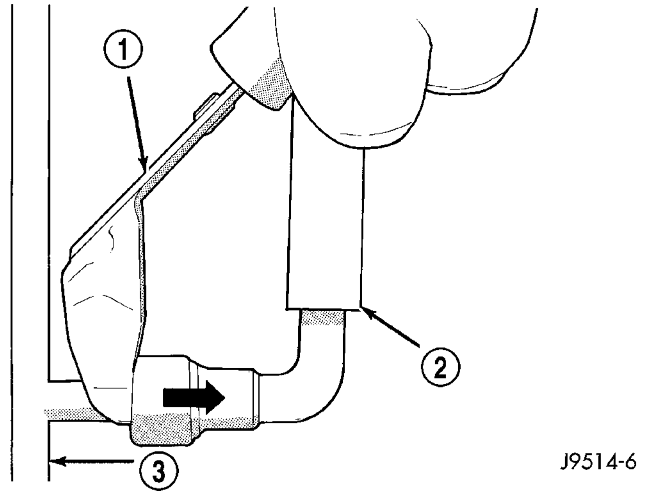


Fig. 14 FUEL LINE DISCONNECTION USING SPECIAL TOOL

1 - SPECIAL FUEL LINE TOOL
2 - FUEL LINE
3 - FUEL RAIL

(c) Slide latch clip toward fuel rail while lifting with screwdriver.

(d) Insert special fuel line removal tool (Snap-On number FIH 9055-1 or equivalent) into fuel line (Fig. 14). Use tool to release locking fingers in end of line.

(e) With special tool still inserted, pull fuel line from fuel rail.

(f) After disconnection, locking fingers will remain within quick-connect fitting at end of fuel line.

(10) Disconnect quick-connect fitting from fuel system component being serviced.

CONNECTING

(1) Inspect quick-connect fitting body and fuel system component for damage. Replace as necessary.

(2) Prior to connecting quick-connect fitting to component being serviced, check condition of fitting and component. Clean parts with a lint-free cloth. Lubricate with clean engine oil.

(3) Insert quick-connect fitting into fuel tube or fuel system component until built-on stop on fuel tube or component rests against back of fitting.

(4) Continue pushing until a click is felt.

(5) Single-tab type fitting: Push new tab down until it locks into place in quick-connect fitting.

(6) Verify a locked condition by firmly pulling on fuel tube and fitting (15-30 lbs.).

(7) Latch Clip Equipped: Install latch clip (snaps into position). **If latch clip will not fit, this indicates fuel line is not properly installed to fuel rail (or other fuel line). Recheck fuel line connection.**

(8) Connect negative cable to battery.

(9) Start engine and check for leaks.

FUEL PUMP

DESCRIPTION

The electric fuel pump is located inside of the fuel pump module. A 12 volt, permanent magnet, electric motor powers the fuel pump. The electric fuel pump is not a separate, serviceable component.

OPERATION

Voltage to operate the electric pump is supplied through the fuel pump relay.

Fuel is drawn in through a filter at the bottom of the module and pushed through the electric motor gearset to the pump outlet.

Check Valve Operation: The bottom section of the fuel pump module contains a one-way check valve to prevent fuel flow back into the tank and to maintain fuel supply line pressure (engine warm) when pump is not operational. It is also used to keep the fuel supply line full of gasoline when pump is not operational. After the vehicle has cooled down, fuel pressure may drop to 0 psi (cold fluid contracts), but liquid gasoline will remain in fuel supply line between the check valve and fuel injectors. **Fuel pressure that has dropped to 0 psi on a cooled down vehicle (engine off) is a normal condition.**

The electric fuel pump is not a separate, serviceable component.

FUEL PUMP MODULE

DESCRIPTION

The fuel pump module assembly is located on the top of the fuel tank (Fig. 1). The complete assembly contains the following components:

- A combination fuel filter/fuel pressure regulator
- A separate fuel pick-up, or inlet filter
- An electric fuel pump
- A lockring to retain pump module to tank
- A soft gasket between tank flange and module
- A fuel gauge sending unit (fuel level sensor)
- Fuel line connection

The fuel gauge sending unit may be serviced separately. If the electrical fuel pump, primary inlet filter, fuel filter or fuel pressure regulator require service, the fuel pump module must be replaced.

OPERATION

Refer to Fuel Pump, Inlet Filter, Fuel Filter / Fuel Pressure Regulator and Fuel Gauge Sending Unit.

REMOVAL

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE OFF). BEFORE SERVICING THE FUEL PUMP MODULE, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Drain and remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) The plastic fuel pump module locknut (Fig. 15) is threaded onto fuel tank. Install Special Tool 6856 to locknut and remove locknut (Fig. 16). The fuel pump module will spring up slightly when locknut is removed.

(3) Remove module from fuel tank.

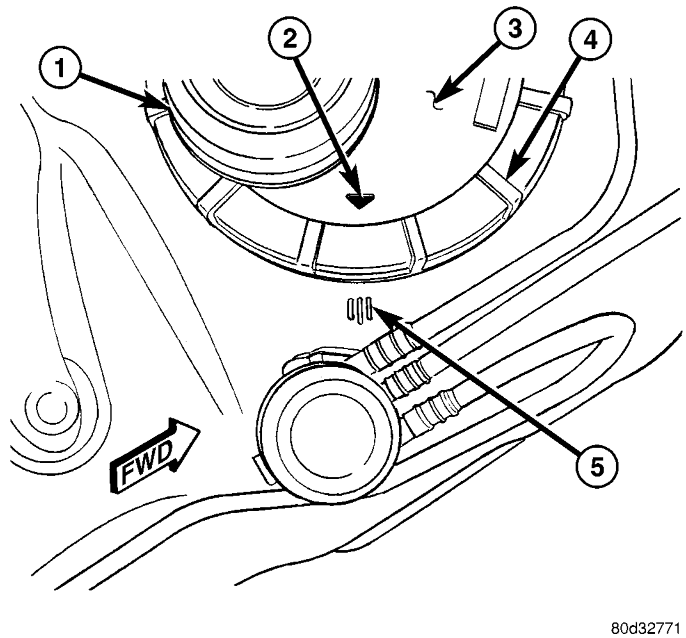


Fig. 15 FUEL PUMP MODULE (TOP)

1 - FUEL FILTER / FUEL PRESSURE REGULATOR
2 - ALIGNMENT ARROW
3 - TOP OF PUMP MODULE
4 - LOCKNUT
5 - ALIGNMENT MARKS

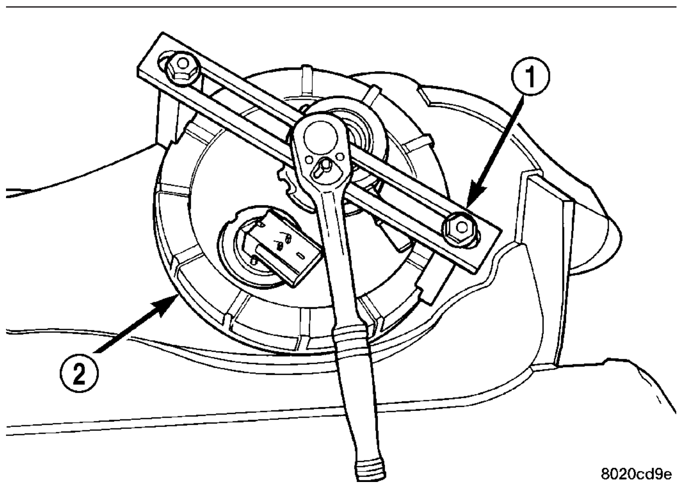


Fig. 16 LOCKNUT REMOVAL/INSTALLATION - TYPICAL

1 - SPECIAL TOOL 6856
2 - LOCKNUT

INSTALLATION

CAUTION: Whenever the fuel pump module is serviced, the rubber gasket must be replaced.

(1) Using a new gasket, position fuel pump module into opening in fuel tank.
(2) Position locknut over top of fuel pump module. Install locknut finger tight.
(3) Rotate module until embossed alignment arrow (Fig. 15) points to center alignment mark. This step must be performed to prevent float from contacting side of fuel tank. Also be sure fitting on fuel filter/ fuel pressure regulator is pointed to drivers side of vehicle.
(4) Install Special Tool 6856 (Fig. 16) to locknut.
(5) Tighten locknut. Refer to Torque Specifications.
(6) Install fuel tank. Refer to Fuel Tank Removal/ Installation.

FUEL RAIL

DESCRIPTION

The fuel injector rail is used to mount the fuel injectors to the engine.

OPERATION

High pressure from the fuel pump is routed to the fuel rail. The fuel rail then supplies the necessary fuel to each individual fuel injector.

A quick-connect fitting with a safety latch clip is used to attach the fuel line to the fuel rail.

The fuel rail is not repairable.

CAUTION: The left and right sections of the fuel rail are connected with either a flexible connecting hose, or joints. Do not attempt to separate the rail halves at these connecting hose or joints. Due to the design of the connecting hose or joint, it does not use any clamps. Never attempt to install a clamping device of any kind to the hose or joint. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose or joint.

REMOVAL

3.7L V-6

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tubes (Fig. 18). Due to design of tubes, it does not use any clamps. Never attempt to install a clamping device of any kind to tubes. When removing fuel rail assembly for any reason, be careful not to bend or kink tubes.

(1) Remove fuel tank filler tube cap.
(2) Perform Fuel System Pressure Release Procedure.
(3) Remove negative battery cable at battery.
(4) Remove air duct at throttle body air box.
(5) Remove air box at throttle body.
(6) Remove air resonator mounting bracket at front of throttle body (2 bolts).
(7) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.
(8) Remove necessary vacuum lines at throttle body.
(9) Disconnect electrical connectors at all 6 fuel injectors. To remove connector refer to (Fig. 17). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.
(10) Disconnect electrical connectors at all throttle body sensors.
(11) Remove 6 ignition coils. Refer to Ignition Coil Removal/Installation.
(12) Remove 4 fuel rail mounting bolts (Fig. 18).
(13) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.
(14) Remove fuel rail (with injectors attached) from engine.
(15) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

4.7L V-8

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

FUEL RAIL (Continued)

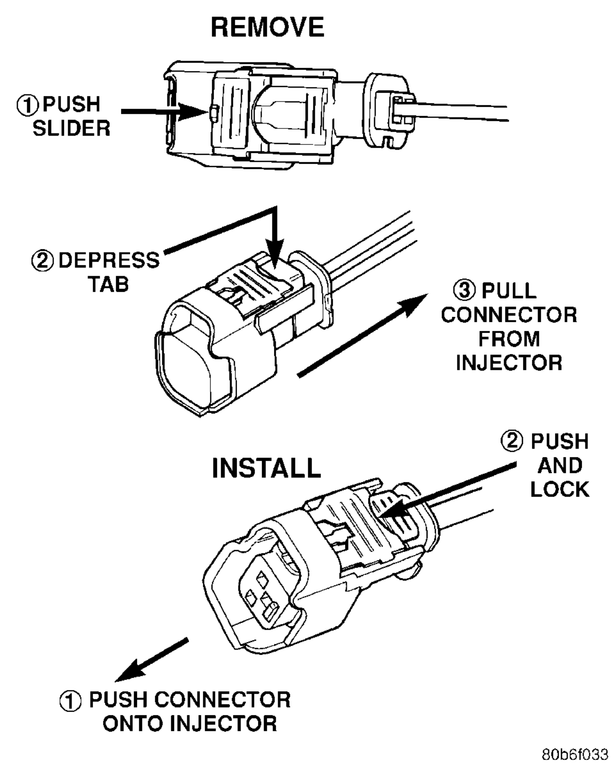


Fig. 17 REMOVE/INSTALL INJECTOR CONNECTOR

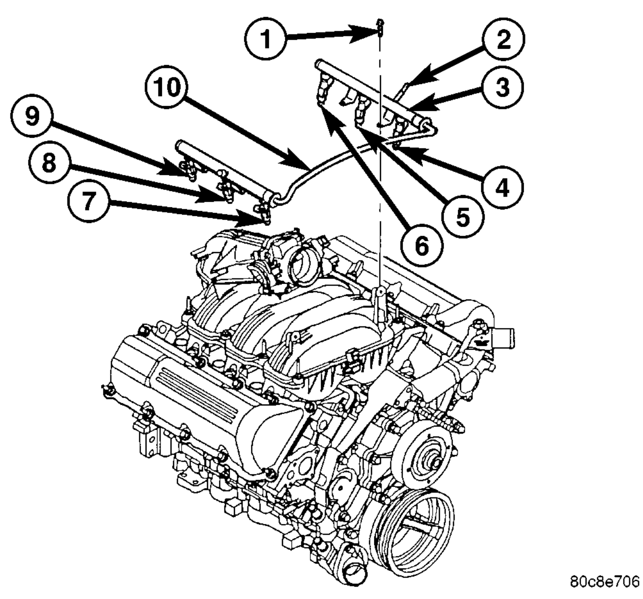


Fig. 18 FUEL RAIL REMOVE/INSTALL - 3.7L V-6

1 - MOUNTING BOLTS (4)
2 - QUICK-CONNECT FITTING
3 - FUEL RAIL
4 - INJ. #1
5 - INJ. #3
6 - INJ. #5
7 - INJ. #2
8 - INJ. #4
9 - INJ. #6
10 - CONNECTOR TUBE

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tubes (Fig. 19). Due to design of tubes, it does not use any clamps. Never attempt to install a clamping device of any kind to tubes. When removing fuel rail assembly for any reason, be careful not to bend or kink tubes.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove air duct at throttle body air box.

(5) Remove air box at throttle body.

(6) Remove air resonator mounting bracket at front of throttle body (2 bolts).

(7) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(8) Remove necessary vacuum lines at throttle body.

(9) Disconnect electrical connectors at all 8 fuel injectors. To remove connector refer to (Fig. 17). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(10) Disconnect electrical connectors at all throttle body sensors.

(11) Remove 8 ignition coils. Refer to Ignition Coil Removal/Installation.

(12) Remove 4 fuel rail mounting bolts (Fig. 19).

(13) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in cylinder head. Gently rock and pull **right** side of rail until injectors just start to clear cylinder head holes. Repeat this procedure (left/right) until all injectors have cleared cylinder head holes.

(14) Remove fuel rail (with injectors attached) from engine.

(15) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

5.7L V-8

WARNING: THE FUEL SYSTEM IS UNDER CONSTANT PRESSURE EVEN WITH ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

FUEL RAIL (Continued)

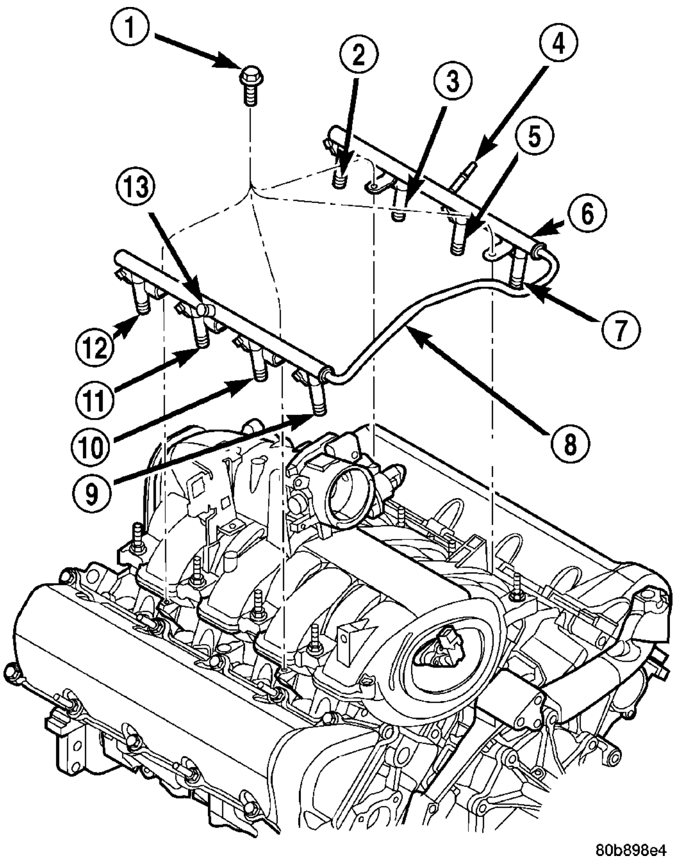


Fig. 19 FUEL RAIL REMOVE/INSTALL - 4.7L V-8

1 - MOUNTING BOLTS (4)
2 - INJ.#7
3 - INJ.#5
4 - QUICK-CONNECT FITTING
5 - INJ.#3
6 - FUEL INJECTOR RAIL
7 - INJ.#1
8 - CONNECTOR TUBE
9 - INJ.#2
10 - INJ.#4
11 - INJ.#6
12 - INJ.#8
13 - PRESSURE TEST PORT CAP

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate rail halves at connector tube (Fig. 20). Due to design of tube, it does not use any clamps. Never attempt to install a clamping device of any kind to tube. When removing fuel rail assembly for any reason, be careful not to bend or kink tube.

(1) Remove fuel tank filler tube cap.

(2) Perform Fuel System Pressure Release Procedure.

(3) Remove negative battery cable at battery.

(4) Remove flex tube (air cleaner housing to engine).

(5) Remove air resonator box at throttle body.

(6) Disconnect all spark plug cables from all spark plugs and ignition coils. Do not remove cables from cable routing tray. Note original cable positions while removing (Fig. 22).

(7) Remove spark plug cable tray from engine by releasing 4 retaining clips (Fig. 21). Remove tray and cables from engine as an assembly.

(8) Disconnect electrical connectors at all 8 ignition coils. Refer to Ignition Coil Removal/Installation.

(9) Disconnect fuel line latch clip and fuel line at fuel rail. A special tool will be necessary for fuel line disconnection. Refer to Quick-Connect Fittings.

(10) Disconnect electrical connectors at all 8 fuel injectors. To remove connector refer to (Fig. 17). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(11) Disconnect electrical connectors at all throttle body sensors.

(12) Remove 4 fuel rail mounting bolts and holdown clamps (Fig. 20).

(13) Gently rock and pull **left** side of fuel rail until fuel injectors just start to clear machined holes in intake manifold. Gently rock and pull **right** side of rail until injectors just start to clear intake manifold head holes. Repeat this procedure (left/right) until all injectors have cleared machined holes.

(14) Remove fuel rail (with injectors attached) from engine.

(15) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

5.9L V-8

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH ENGINE TURNED OFF). BEFORE SERVICING FUEL RAIL ASSEMBLY, FUEL SYSTEM PRESSURE MUST BE RELEASED.

To release fuel pressure, refer to Fuel System Pressure Release Procedure found in this group.

CAUTION: The left and right fuel rails are replaced as an assembly. Do not attempt to separate the rail halves at the connecting hose (Fig. 24). Due to the design of this connecting hose, it does use any clamps. Never attempt to install a clamping device of any kind to the hose. When removing the fuel rail assembly for any reason, be careful not to bend or kink the connecting hose.

(1) Remove negative battery cable at battery.

(2) Remove air cleaner.

(3) Perform fuel pressure release procedure.

(4) Remove throttle body from intake manifold. Refer to Throttle Body Removal/Installation.

FUEL RAIL (Continued)

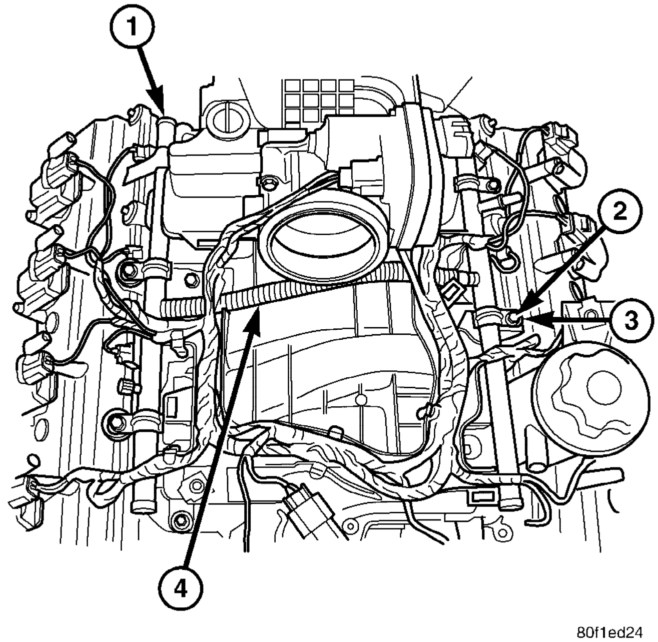


Fig. 20 5.7L FUEL RAIL

1 - FUEL RAIL
2 - MOUNTING BOLT
3 - HOLDOWN CLAMPS
4 - CONNECTOR TUBE

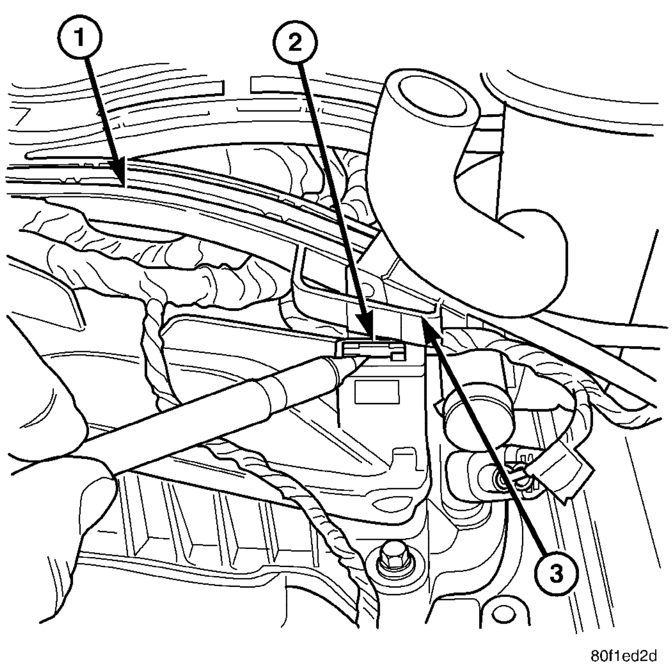


Fig. 21 5.7L SPARK PLUG CABLE ROUTING TRAY

1 - SPARK PLUG CABLES
2 - RETAINING CLIP
3 - SPARK PLUG CABLE ROUTING TRAY

(5) If equipped with air conditioning, remove the A-shaped A/C compressor-to-intake manifold support bracket (three bolts) (Fig. 23).

(6) Disconnect electrical connectors at all fuel injectors. To remove connector refer to (Fig. 17). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification. If harness is not tagged, note wiring location before removal.

(7) Disconnect fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures,

(8) Remove the remaining fuel rail mounting bolts.

(9) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

(10) Remove fuel rail (with injectors attached) from engine.

8.0L V-10

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE EVEN WITH THE ENGINE OFF. BEFORE SERVICING FUEL RAIL, FUEL SYSTEM PRESSURE MUST BE RELEASED.

(1) Remove negative battery cable at battery.

(2) Remove air cleaner housing and tube.

(3) Perform fuel pressure release procedure. Refer to Fuel Delivery System section of this group.

(4) Disconnect throttle body linkage and remove throttle body from intake manifold. Refer to Throttle Body removal in this group.

(5) Remove ignition coil pack and bracket assembly (Fig. 25) at intake manifold and right engine valve cover (four bolts).

(6) Remove upper half of intake manifold. Refer to Engines for procedures.

(7) Disconnect electrical connectors at all fuel injectors. To remove connector refer to (Fig. 26). Push red colored slider away from injector (1). While pushing slider, depress tab (2) and remove connector (3) from injector. The factory fuel injection wiring harness is numerically tagged (INJ 1, INJ 2, etc.) for injector position identification.

(8) Disconnect fuel line quick-connect fitting at left-rear end of fuel rail. A special 3/8 inch fuel line disconnection tool will be necessary.

(9) Remove the six fuel rail mounting bolts from the lower half of intake manifold (Fig. 27).

(10) Gently rock and pull the **left** fuel rail until the fuel injectors just start to clear the intake manifold. Gently rock and pull the **right** fuel rail until the fuel injectors just start to clear the intake manifold. Repeat this procedure (left/right) until all fuel injectors have cleared the intake manifold.

FUEL RAIL (Continued)

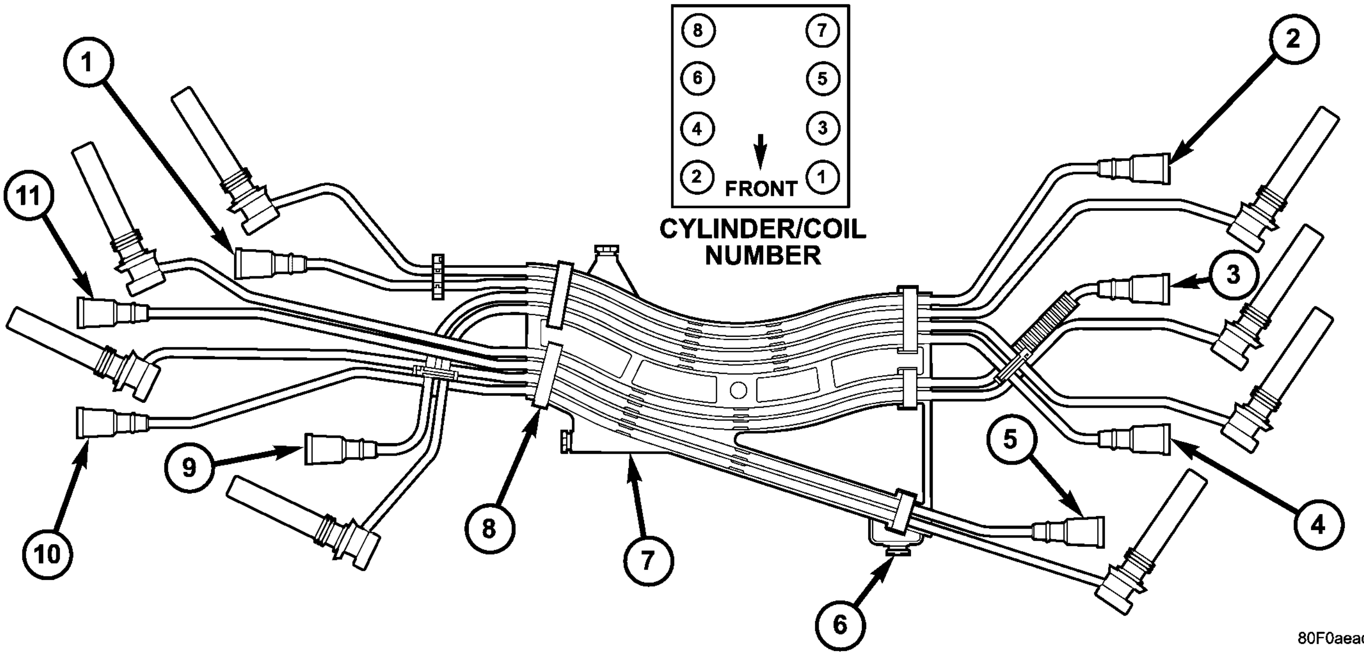


Fig. 22 5.7L SPARK PLUG CABLE ROUTING

1 - #8 COIL-TO- #5 SPARK PLUG (MARKED 5/8)
2 - #5 COIL-TO- #8 SPARK PLUG (MARKED 5/8)
3 - #7 COIL-TO- #4 SPARK PLUG (MARKED 4/7)
4 - #3 COIL-TO- #2 SPARK PLUG (MARKED 2/3)
5 - #1 COIL-TO- #6 SPARK PLUG (MARKED 1/6)
6 - CLIPS (TRAY-TO-MANIFOLD RETENTION)
7 - CABLE TRAY
8 - CLIPS (SPARK PLUG CABLE-TO-TRAY- RETENTION)
9 - #2 COIL-TO- #3 SPARK PLUG (MARKED 2/3)
10 - #6 COIL-TO- #1 SPARK PLUG (MARKED 1/6)
11 - #4 COIL-TO- #7 SPARK PLUG (MARKED 4/7)

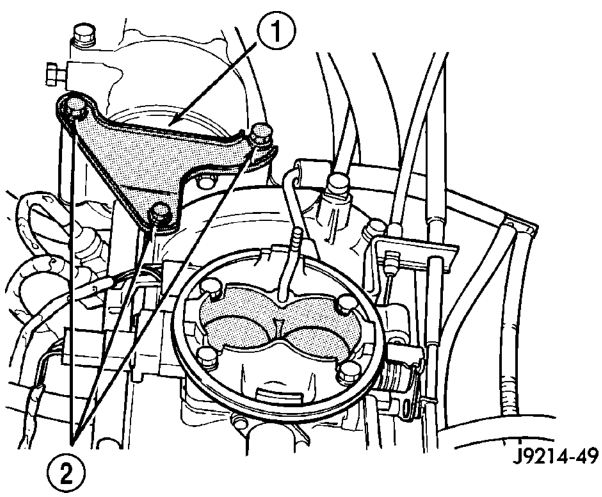


Fig. 23 A/C COMPRESSOR SUPPORT BRACKET - 5.9L V-8

1 - AIR CONDITIONING COMPRESSOR SUPPORT BRACKET
2 - MOUNTING BOLTS

(11) Remove fuel rail (with injectors attached) from engine.

(12) If fuel injectors are to be removed, refer to Fuel Injector Removal/Installation.

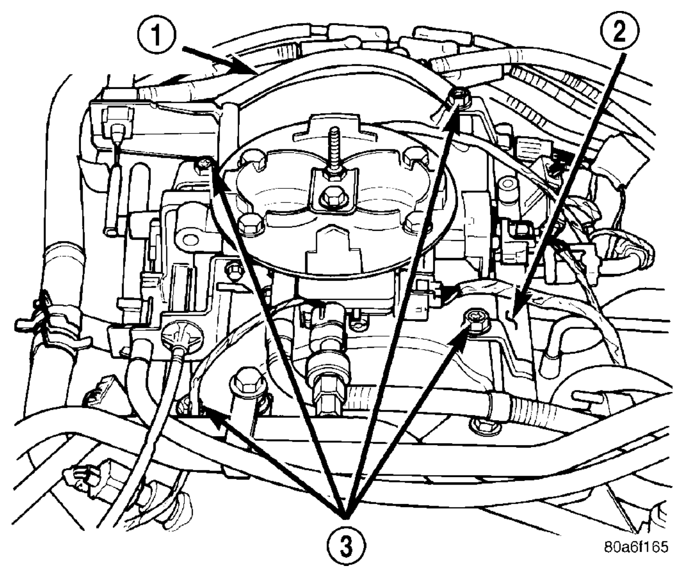


Fig. 24 FUEL RAIL REMOVE/INSTALL - 5.9L V-8

1 - FUEL RAIL CONNECTING HOSE
2 - FUEL RAIL
3 - MOUNTING BOLTS (4)

FUEL RAIL (Continued)

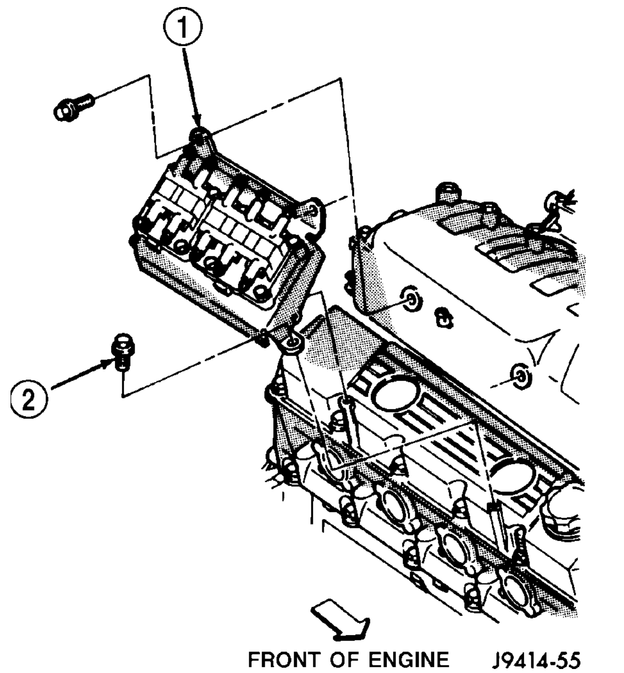


Fig. 25 IGNITION COIL PACK AND MOUNTING BRACKET - 8.0L V-10

1 - COIL PACKS AND BRACKET
2 - MOUNTING BOLTS (4)

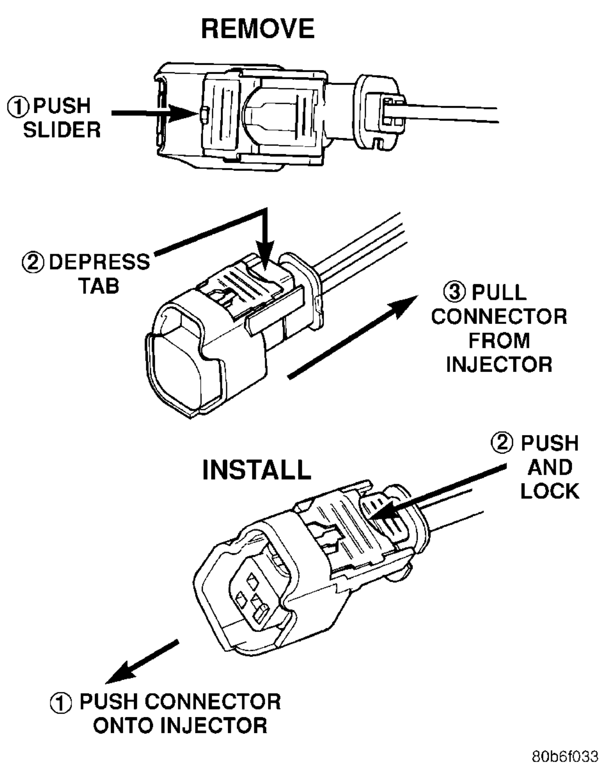


Fig. 26 REMOVE/INSTALL FUEL INJECTOR CONNECTOR

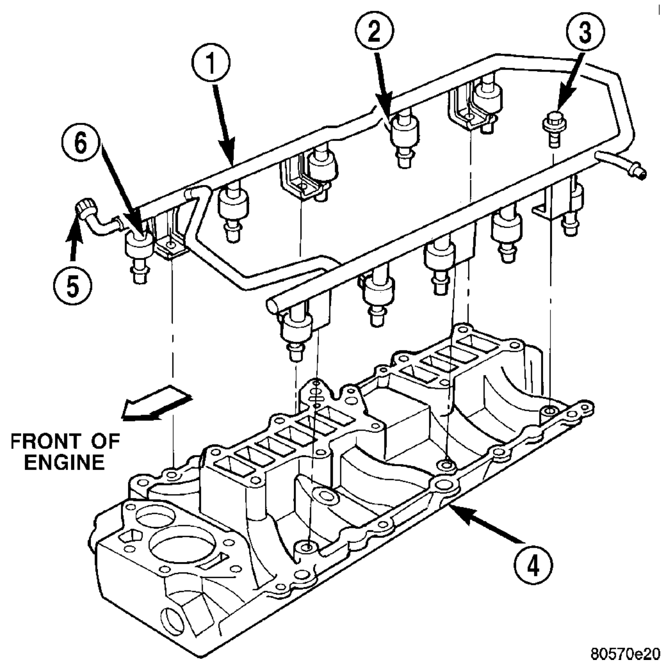


Fig. 27 FUEL RAIL MOUNTING BOLTS - 8.0L V-10 - TYPICAL

1 - FUEL RAIL
2 - ELECTRICAL CONNECTOR
3 - MOUNTING BOLTS (6)
4 - INTAKE MANIFOLD LOWER HALF
5 - FUEL PRESSURE TEST PORT
6 - FUEL INJECTORS (10)

INSTALLATION

3.7L V-6

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder. Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(7) Install 4 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Install 6 ignition coils. Refer to Ignition Coil Removal/Installation.

(9) Connect electrical connectors to throttle body.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 17). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

FUEL RAIL (Continued)

(11) Connect necessary vacuum lines to throttle body.

(12) Install air resonator mounting bracket near front of throttle body (2 bolts).

(13) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(14) Install air box to throttle body.

(15) Install air duct to air box.

(16) Connect battery cable to battery.

(17) Start engine and check for leaks.

4.7L V-8

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in cylinder head.

(5) Guide each injector into cylinder head. Be careful not to tear injector o-rings.

(6) Push **right** side of fuel rail down until fuel injectors have bottomed on cylinder head shoulder. Push **left** fuel rail down until injectors have bottomed on cylinder head shoulder.

(7) Install 4 fuel rail mounting bolts and tighten. Refer to torque specifications.

(8) Install 8 ignition coils. Refer to Ignition Coil Removal/Installation.

(9) Connect electrical connectors to throttle body.

(10) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 17). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(11) Connect necessary vacuum lines to throttle body.

(12) Install air resonator mounting bracket near front of throttle body (2 bolts).

(13) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(14) Install air box to throttle body.

(15) Install air duct to air box.

(16) Connect battery cable to battery.

(17) Start engine and check for leaks.

5.7L V-8

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Clean out fuel injector machined bores in intake manifold.

(3) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(4) Position fuel rail/fuel injector assembly to machined injector openings in intake manifold.

(5) Guide each injector into intake manifold. Be careful not to tear injector o-rings.

(6) Push **right** side of fuel rail down until fuel injectors have bottomed on shoulders. Push **left** fuel rail down until injectors have bottomed on shoulders.

(7) Install 4 fuel rail holdown clamps and 4 mounting bolts. Refer to Torque Specifications.

(8) Position spark plug cable tray and cable assembly to intake manifold. Snap 4 cable tray retaining clips into intake manifold.

(9) Install all cables to spark plugs and ignition coils.

(10) Connect electrical connector to throttle body.

(11) Install electrical connectors to all 8 ignition coils. Refer to Ignition Coil Removal/Installation.

(12) Connect electrical connector to throttle body.

(13) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 17). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(14) Connect fuel line latch clip and fuel line to fuel rail. Refer to Quick-Connect Fittings.

(15) Install air resonator to throttle body (2 bolts).

(16) Install flexible air duct to air box.

(17) Connect battery cable to battery.

(18) Start engine and check for leaks.

5.9L V-8

(1) If fuel injectors are to be installed, refer to Fuel Injector Removal/Installation.

(2) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(3) Clean out fuel injector machined bores in intake manifold.

(4) Position fuel rail/fuel injector assembly to injector openings on intake manifold.

(5) Guide each injector into intake manifold. Be careful not to tear injector o-ring.

(6) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(7) Install fuel rail mounting bolts. Refer to Torque Specifications.

(8) Connect electrical connector to intake manifold air temperature sensor.

(9) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 17). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector.

(10) Install fuel tube (line) at side of fuel rail. Refer to Quick-Connect Fittings for procedures.

(11) Install air cleaner resonator to throttle body.

(12) Connect battery cable to battery.

FUEL RAIL (Continued)

(13) Start engine and check for leaks.

8.0L V-10

(1) Apply a small amount of engine oil to each fuel injector o-ring. This will help in fuel rail installation.

(2) Install injector(s) and injector clip(s) to fuel rail.

NOTE: The fuel injector electrical connectors on all 10 injectors should be facing to right (passenger) side of vehicle (Fig. 27).

(3) Position fuel rail/fuel injector assembly to injector openings on intake manifold.

(4) Guide each injector into intake manifold. Be careful not to tear injector o-ring.

(5) Push the **right** fuel rail down until fuel injectors have bottomed on injector shoulder. Push the **left** fuel rail down until fuel injectors have bottomed on injector shoulder.

(6) Install six fuel rail mounting bolts into lower half of intake manifold. Tighten bolts to 15 N·m (136 in. lbs.) torque.

(7) Connect electrical connectors at all fuel injectors. To install connector, refer to (Fig. 26). Push connector onto injector (1) and then push and lock red colored slider (2). Verify connector is locked to injector by lightly tugging on connector. The injector wiring harness is numerically tagged.

(8) Install upper half of intake manifold. Refer to Engines for procedures.

(9) Connect main fuel line at fuel rail. Refer to Quick-Connect Fittings for procedures.

(10) Install ignition coil pack and bracket assembly at intake manifold and right engine valve cover (four bolts).

(11) Install throttle body to intake manifold. Refer to Throttle Body Removal / Installation.

(12) Install throttle body linkage to throttle body.

(13) Install air cleaner tube and housing.

(14) Install negative battery cable at battery.

(15) Start engine and check for leaks.

FUEL TANK

DESCRIPTION

The fuel tank is constructed of a plastic material. Its main functions are for fuel storage and for placement of the fuel pump module, and (if equipped) certain ORVR components.

OPERATION

All models pass a full 360 degree rollover test without fuel leakage. To accomplish this, fuel and vapor flow controls are required for all fuel tank connections.

Two check (control) valves are mounted into the top of the fuel tank. Refer to Fuel Tank Check Valve for additional information.

An evaporation control system is connected to the fuel tank to reduce emissions of fuel vapors into the atmosphere. When fuel evaporates from the fuel tank, vapors pass through vent hoses or tubes to a charcoal canister where they are temporarily held. When the engine is running, the vapors are drawn into the intake manifold. Certain models are also equipped with a self-diagnosing system using a Leak Detection Pump (LDP) and/or an On-Board Refueling Vapor Recovery (ORVR) system. Refer to Emission Control System for additional information.

REMOVAL- EXCEPT DIESEL

Fuel Tank Draining

WARNING: THE FUEL SYSTEM MAY BE UNDER CONSTANT FUEL PRESSURE EVEN WITH THE ENGINE OFF. THIS PRESSURE MUST BE RELEASED BEFORE SERVICING FUEL TANK.

Two different procedures may be used to drain fuel tank: through the fuel fill fitting on tank, or using the DRB® scan tool. Due to a one-way check valve installed into the fuel fill opening fitting at the tank, the tank cannot be drained conventionally at the fill cap.

The quickest draining procedure involves removing the rubber fuel fill hose.

As an alternative procedure, the electric fuel pump may be activated allowing tank to be drained at fuel rail connection. Refer to DRB scan tool for fuel pump activation procedures. Before disconnecting fuel line at fuel rail, release fuel pressure. Refer to the Fuel System Pressure Release Procedure for procedures. Attach end of special test hose tool number 6541, 6539, 6631 or 6923 at fuel rail disconnection (tool number will depend on model and/or engine application). Position opposite end of this hose tool to an approved gasoline draining station. Activate fuel pump and drain tank until empty.

If electric fuel pump is not operating, fuel must be drained through fuel fill fitting at tank. Refer to following procedures.

(1) Release fuel system pressure.

(2) Raise vehicle.

(3) Thoroughly clean area around fuel fill fitting and rubber fuel fill hose at tank.

(4) If vehicle is equipped with 4 doors and a 6 foot (short) box, remove left-rear tire/wheel.

(5) Loosen clamp (Fig. 28) and disconnect rubber fuel fill hose at tank fitting. Using an approved gas holding tank, drain fuel tank through this fitting.

FUEL TANK (Continued)

Tank Removal

(1) Loosen clamp and disconnect rubber fuel vent hose (Fig. 28) at tank fitting.

(2) Support tank with a hydraulic jack.

(3) Remove 2 fuel tank strap nuts (Fig. 29) and remove both tank support straps.

(4) Carefully lower tank a few inches and disconnect fuel pump module electrical connector (Fig. 30) at top of tank. To disconnect electrical connector: Push upward on red colored tab to unlock. Push on black colored tab while removing connector.

(5) Disconnect fuel line at fuel filter / fuel pressure regulator (Fig. 30) by pressing on tabs at side of quick-connect fitting.

(6) Disconnect EVAP line at top of tank (Fig. 1).

(7) Continue to lower tank for removal.

(8) If fuel tank is to be replaced, remove fuel pump module from tank. Refer to Fuel Pump Module Removal/Installation procedures.

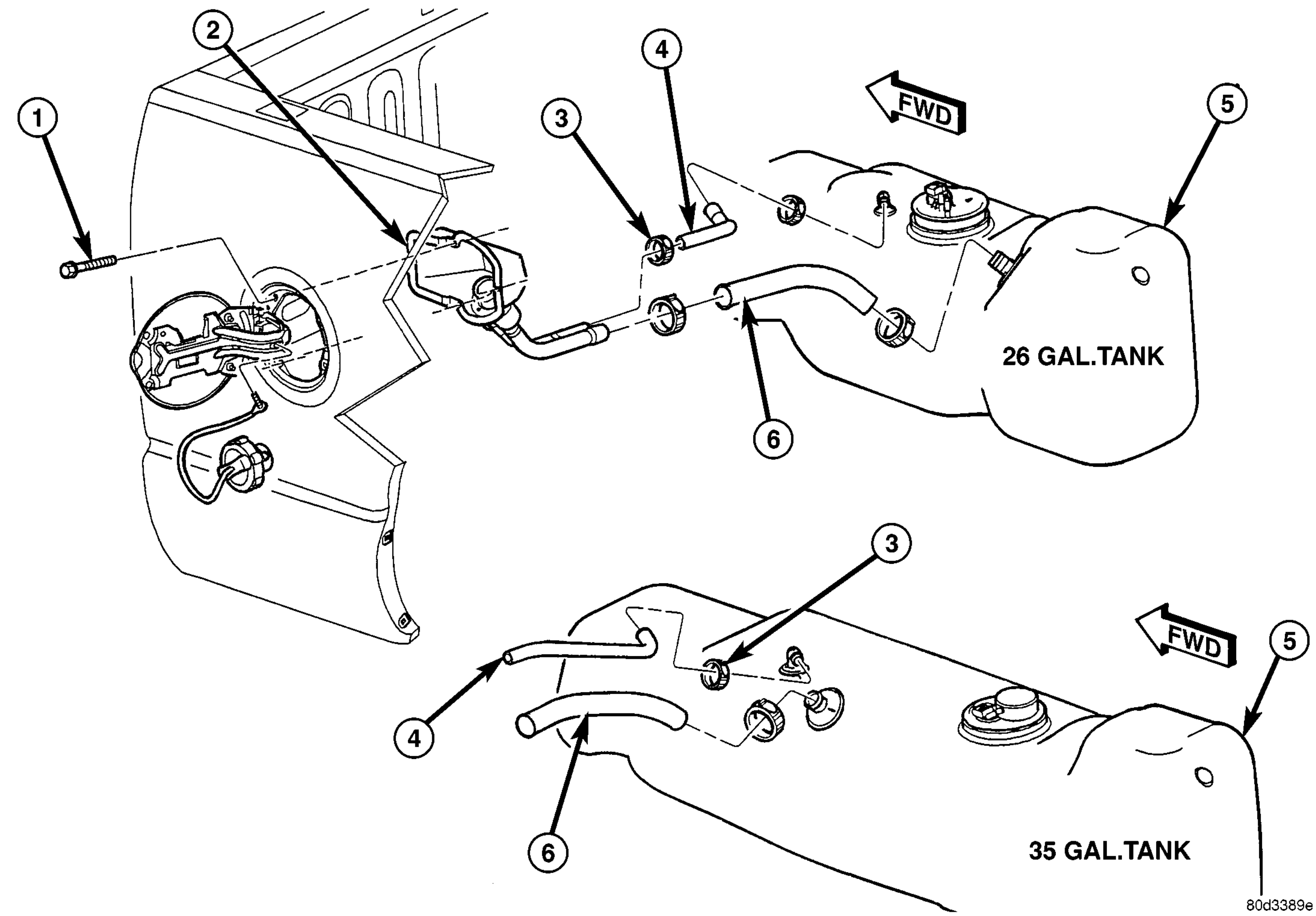


Fig. 28 FUEL TANK FILL / VENT HOSES

1 - BEZEL SCREWS
2 - FUEL FILL BEZEL
3 - HOSE CLAMPS
4 - VENT HOSE
5 - FUEL TANK
6 - FILL HOSE

FUEL TANK (Continued)

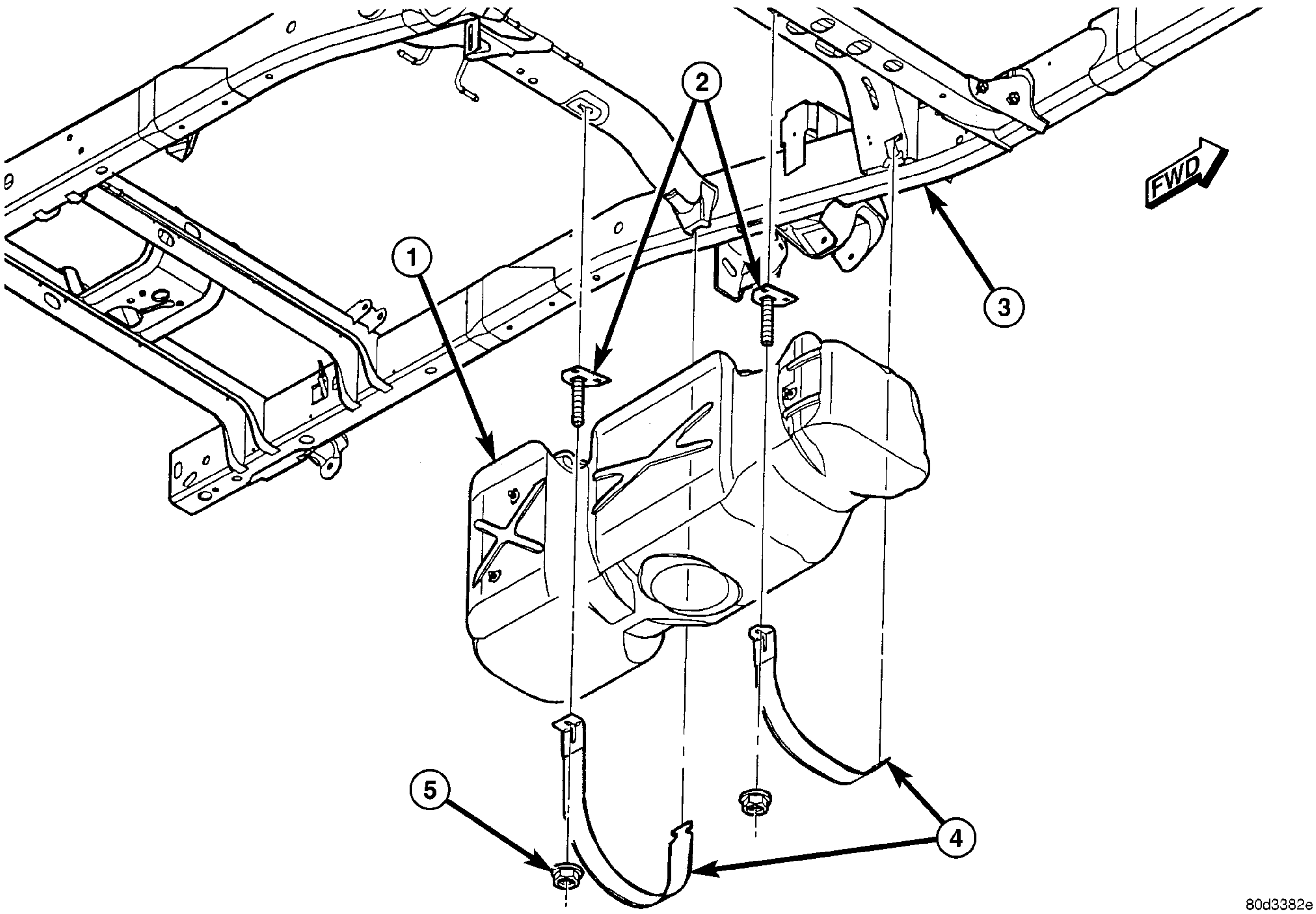


Fig. 29 FUEL TANK MOUNTING

1 - FUEL TANK
2 - STRAP MOUNTING STUDS
3 - VEHICLE FRAME
4 - MOUNTING STRAPS
5 - STRAP NUTS

INSTALLATION - EXCEPT DIESEL

(1) If fuel tank is to be replaced, install fuel pump module into tank. Refer to Fuel Pump Module Removal/Installation procedures.

(2) Disconnect clamps and remove rubber fuel fill hose and fuel vent hose at fuel fill tube. Install these 2 hoses to 2 fuel tank fittings. Rotate hoses until paint marks on hoses line up with alignment marks (Fig. 31). Tighten both clamps.

(3) Position fuel tank to hydraulic jack.

(4) Raise tank until positioned near body.

(5) Connect EVAP line at tank (Fig. 1).

(6) Connect fuel pump module electrical connector (Fig. 30) at top of tank.

(7) Connect fuel line quick-connect fitting to fuel filter / fuel pressure regulator (Fig. 1) or (Fig. 30).

(8) Continue raising tank until positioned snug to body.

(9) Install and position both tank support straps. Install 2 fuel tank strap nuts (Fig. 29) and tighten. **Tighten rear strap nut first.** Refer to Torque Specifications.

(10) Connect rubber fill and vent hoses to fuel fill tube and tighten clamps.

(11) Lower vehicle.

(12) Fill fuel tank with fuel.

FUEL TANK (Continued)

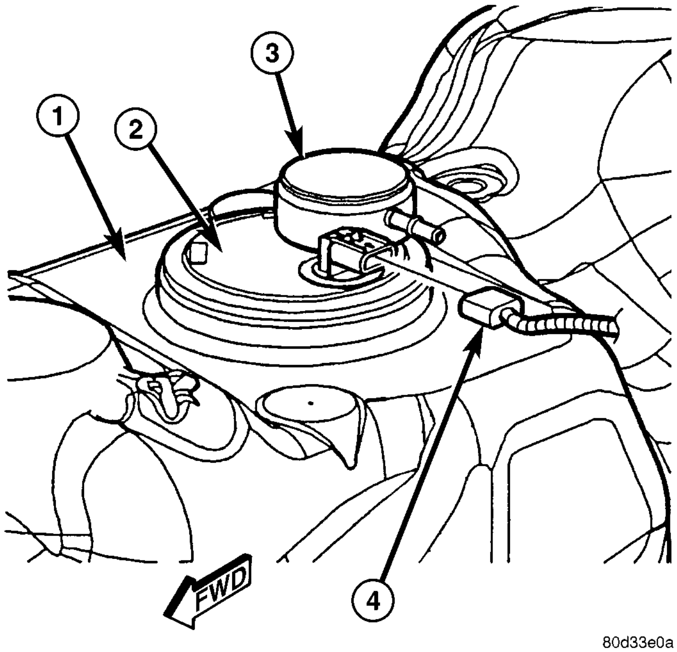


Fig. 30 FUEL PUMP MODULE CONNECTIONS

1 - TOP OF FUEL TANK
2 - FUEL PUMP MODULE
3 - FUEL FILTER / FUEL PRESSURE REGULATOR
4 - ELEC. CONNECT.

(13) Start engine and check for fuel leaks near top of module.

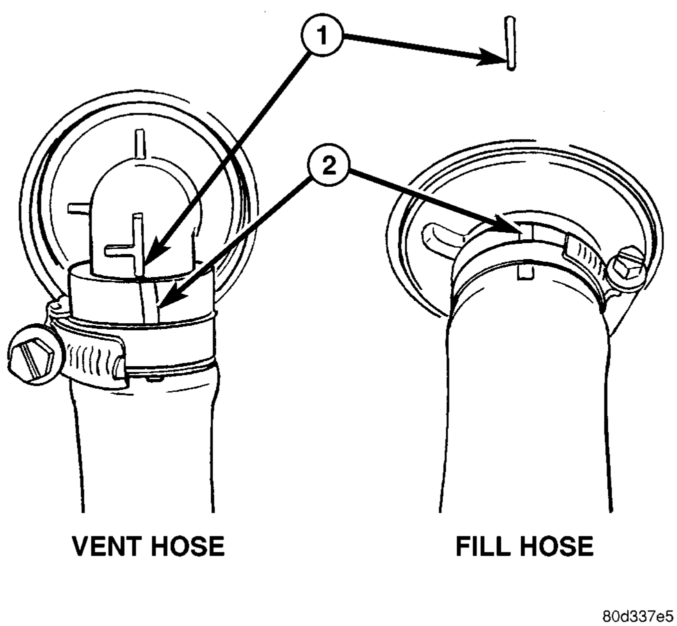


Fig. 31 HOSE ALIGNMENT MARKS

1 - ALIGNMENT MARKS (MARK FOR FILL HOSE IS LOCATED ON FUEL TANK - MARK FOR VENT HOSE IS LOCATED ON FITTING)
2 - PAINT MARKS ON RUBBER HOSES

INLET FILTER

REMOVAL

The fuel pump inlet filter (strainer) is located on the bottom of the fuel pump module (Fig. 32). The fuel pump module is located inside of fuel tank.

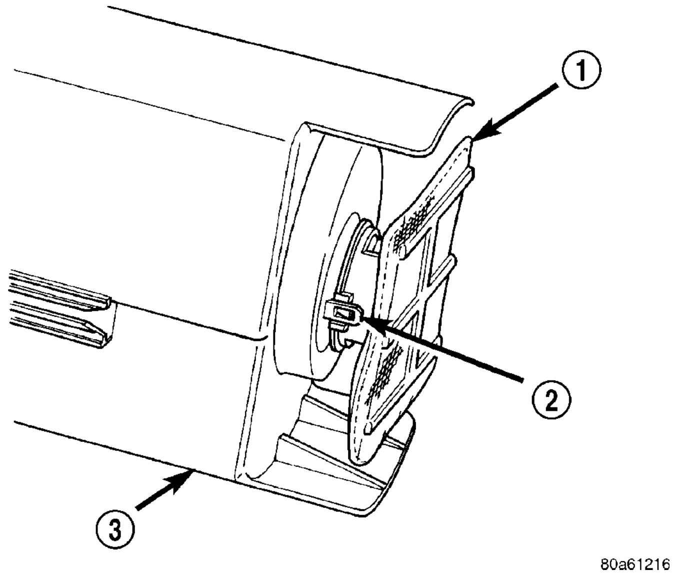


Fig. 32 FUEL PUMP INLET FILTER

1 - FUEL PUMP INLET FILTER
2 - LOCK TABS (2)
3 - FUEL PUMP MODULE (BOTTOM)

(1) Remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) Remove fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Remove filter by carefully prying 2 lock tabs at bottom of module with 2 screwdrivers. Filter is snapped to module.

(4) Clean bottom of pump module.

INSTALLATION

The fuel pump inlet filter (strainer) is located on the bottom of the fuel pump module (Fig. 32). The fuel pump module is located inside of fuel tank.

(1) Snap new filter to bottom of module. Be sure o-ring is in correct position.

(2) Install fuel pump module. Refer to Fuel Pump Module Removal/Installation.

(3) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL INJECTION - GAS

TABLE OF CONTENTS

ACCELERATOR PEDAL

REMOVAL

The following procedure applies only to vehicles without the Adjustable Pedal Package (code XAP).

The accelerator pedal is serviced as a complete assembly including the bracket.

The accelerator cable is connected to the upper part of the accelerator pedal arm by a plastic retainer (clip) (Fig. 1). This plastic retainer snaps into the top of the accelerator pedal arm.

(1) From inside the vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of accelerator pedal arm (Fig. 1). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove 2 accelerator pedal mounting bracket nuts. Remove accelerator pedal assembly.

INSTALLATION

(1) Place accelerator pedal assembly over 2 studs.

(2) Install and tighten 2 mounting nuts. Refer to Torque Specifications.

(3) Slide throttle cable into opening slot in top of pedal arm.

(4) Push plastic cable retainer (clip) into accelerator pedal arm opening until it snaps into place.

(5) Before starting engine, operate accelerator pedal to check for any binding.

ACCELERATOR PEDAL (Continued)

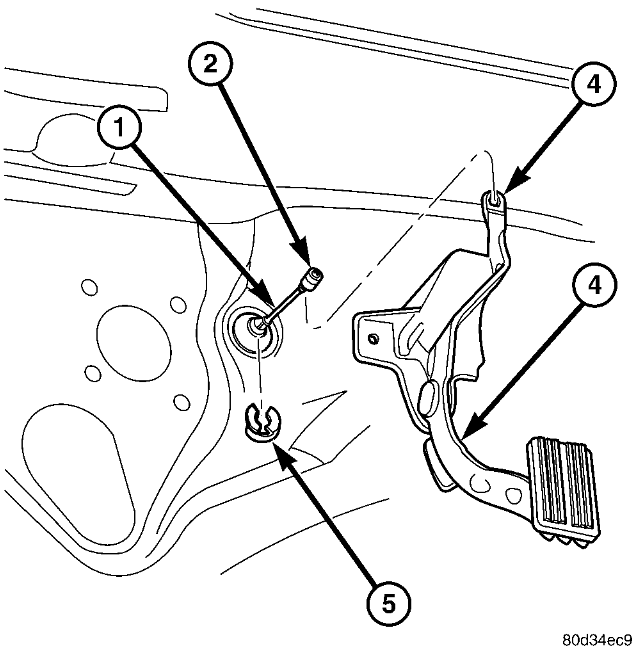


Fig. 1 ACCELERATOR PEDAL MOUNTING

1 - ACCELERATOR CABLE
2 - PLASTIC RETAINER (CLIP)
3 - THROTTLE PEDAL ARM
4 - PEDAL / BRACKET ASSEMBLY
5 - CABLE CLIP

ACCELERATOR PEDAL POSITION SENSOR

DESCRIPTION

The Accelerator Pedal Position Sensor (APPS) assembly is located under the vehicle battery tray. A cable connects the assembly to the accelerator pedal. A plastic cover with a movable door is used to cover the assembly.

The APPS is used only with the 5.7L V-8 engine.

OPERATION

The Accelerator Pedal Position Sensor (APPS) is a linear potentiometer. It provides the Powertrain Control Module (PCM) with a DC voltage signal proportional to the angle, or position of the accelerator pedal. The APPS signal is translated (along with other sensors) to place the throttle plate (within the throttle body) to a pre-determined position.

A mechanical cable is used between the accelerator pedal and the APPS assembly. Although a cable is used between the pedal and APPS, a mechanical cable is not used at the throttle body. Throttle plate position is electrically determined.

REMOVAL

The APPS is serviced (replaced) as one assembly including the sensor, plastic housing and cable. The APPS assembly is located under the vehicle battery tray (Fig. 2). Access to APPS is gained from over top of left / front tire.

(1) Disconnect negative battery cable at battery.

(2) Disconnect APPS cable at accelerator pedal. Refer to Accelerator Pedal Removal / Installation.

(3) Remove wheel house liner at left / front wheel. Refer to Body.

(4) Gain access to APPS electrical connector by opening swing-down door (Fig. 3). Disconnect electrical connector.

(5) Remove 3 mounting bolts (Fig. 3).

(6) Remove APPS assembly from battery tray.

(7) If cable is to be separated at APPS, unsnap cable clip from ball socket (Fig. 4). Release cable from plastic housing by pressing on small cable release tab (Fig. 3).

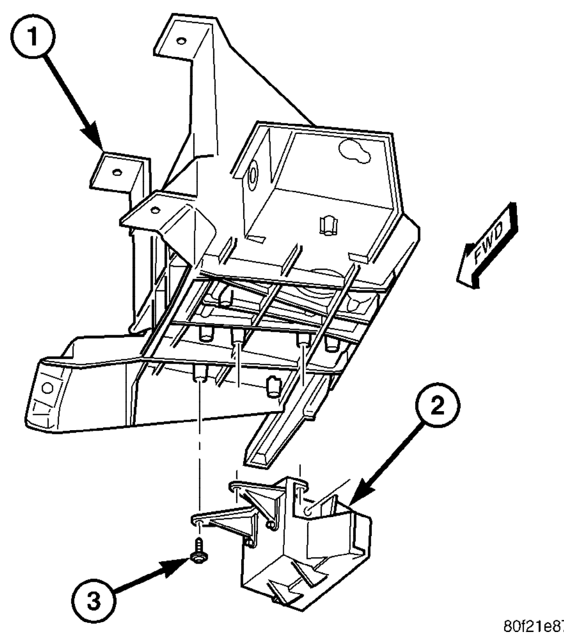


Fig. 2 APPS LOCATION

1 - BATTERY TRAY
2 - APPS LOCATION
3 - APPS MOUNTING BOLTS

INSTALLATION

(1) Install Accelerator Pedal Position Sensor (APPS) cable to accelerator pedal. Refer to Accelerator Pedal Removal / Installation.

(2) Connect electrical connector to APPS.

(3) If necessary, connect cable to APPS lever ball socket (snaps on).

(4) Snap APPS cable cover closed.

ACCELERATOR PEDAL POSITION SENSOR (Continued)

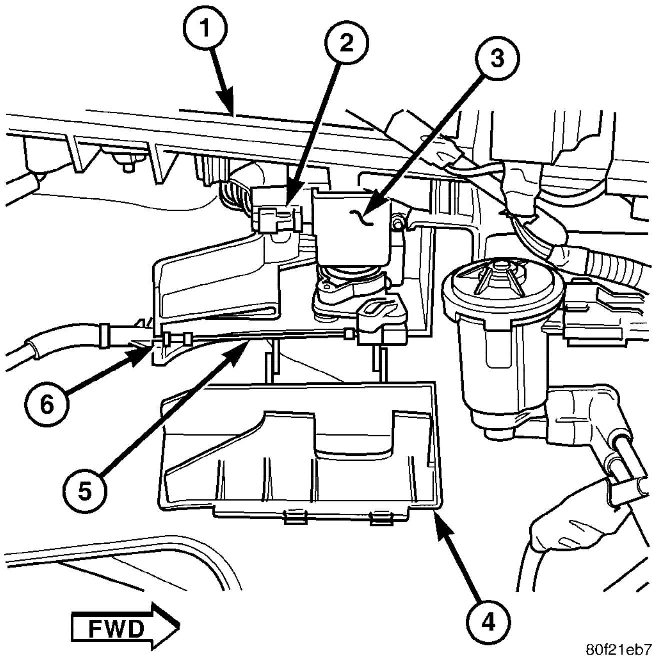


Fig. 3 APPS REMOVE / INSTALL

1 - BOTTOM OF BATTERY TRAY
2 - ELECTRICAL CONNECTOR
3 - APPS
4 - SWING-DOWN DOOR
5 - CABLE (TO PEDAL)
6 - CABLE RELEASE TAB

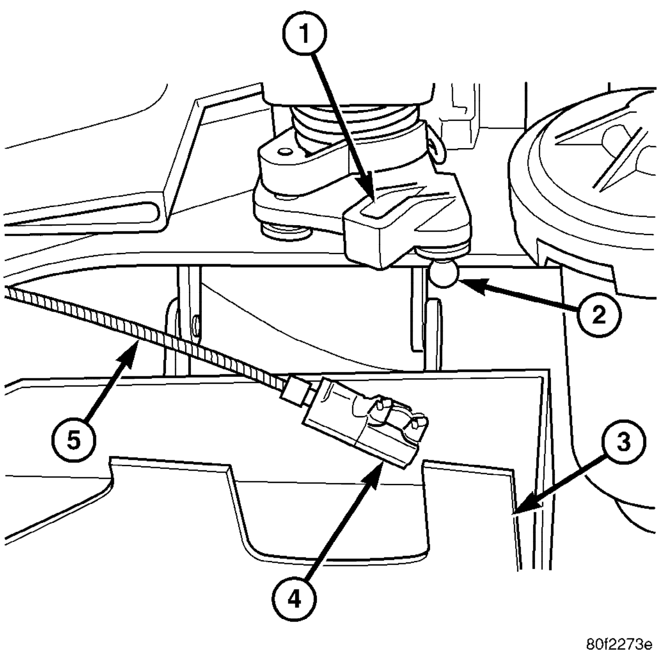


Fig. 4 APPS CABLE

1 - APPS LEVER
2 - BALL SOCKET
3 - SWING-DOWN DOOR
4 - CABLE CLIP
5 - CABLE

(5) Position APPS assembly to bottom of battery tray and install 3 bolts. Refer to Torque Specifications.

(6) Install wheelhouse liner. Refer to Body.

(7) Perform the following procedure:

(a) Connect negative battery cable to battery.

(b) Turn ignition switch ON, but do not crank engine.

(c) Leave ignition switch ON for a minimum of 10 seconds. This will allow PCM to learn electrical parameters.

(8) If the previous step is not performed, a Diagnostic Trouble Code (DTC) will be set.

(9) If necessary, use DRB III® Scan Tool to erase any Diagnostic Trouble Codes (DTC's) from PCM.

CRANKSHAFT POSITION SENSOR

DESCRIPTION

3.7L V-6

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block. It is positioned and bolted into a machined hole.

4.7L V-8

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block. It is positioned and bolted into a machined hole.

5.7L V-8

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block. It is positioned and bolted into a machined hole.

5.9L V-8 Gas

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear). It is bolted to the rear of the engine.

8.0L V-10

The Crankshaft Position (CKP) sensor is located on the right-lower side of the cylinder block, forward of the right engine mount, just above the oil pan rail.

OPERATION

3.7L V-6

Engine speed and crankshaft position are provided through the CKP (Crankshaft Position) sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with

CRANKSHAFT POSITION SENSOR (Continued)

other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

A tonewheel (targetwheel) is bolted to the engine crankshaft (Fig. 5). This tonewheel has sets of notches at its outer edge (Fig. 5).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

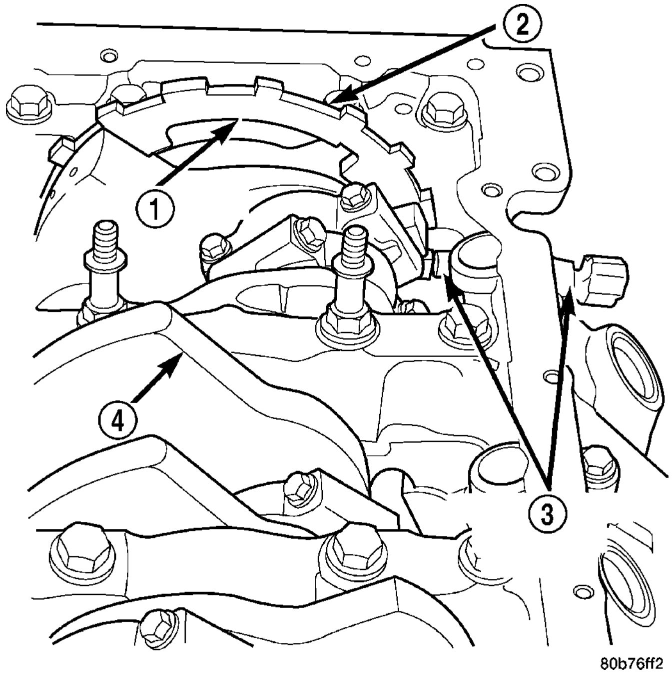


Fig. 5 CKP OPERATION - 3.7L V-6

1 - TONEWHEEL
2 - NOTCHES
3 - CRANKSHAFT POSITION SENSOR
4 - CRANKSHAFT

4.7L V-8

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On the 4.7L V–8 engine, a tonewheel is bolted to the engine crankshaft (Fig. 6). This tonewheel has sets of notches at its outer edge (Fig. 6).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

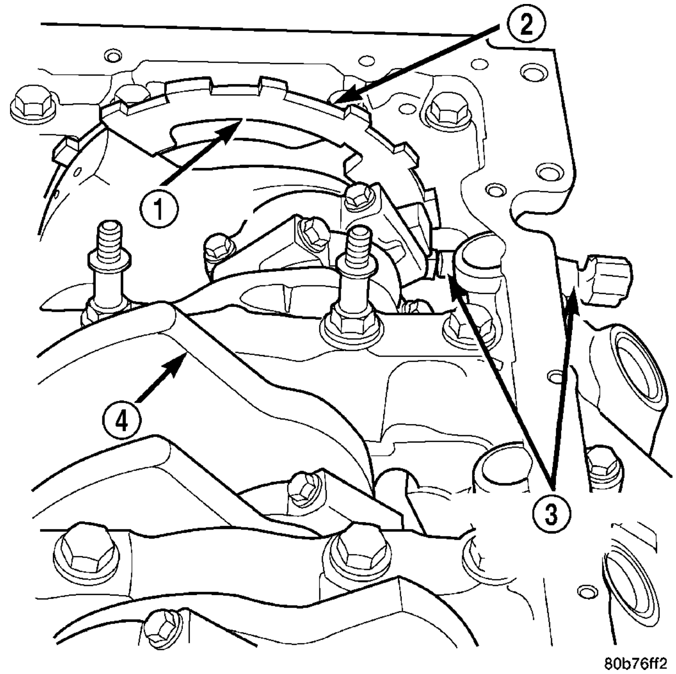


Fig. 6 CKP SENSOR OPERATION AND TONEWHEEL - 4.7L V-8

1 - TONEWHEEL
2 - NOTCHES
3 - CRANKSHAFT POSITION SENSOR
4 - CRANKSHAFT

5.7L V-8

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On the 5.7L V–8 engine, a tonewheel is bolted to the engine crankshaft. This tonewheel has sets of notches at its outer edge (Fig. 7).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

5.9L V-8 Gas

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

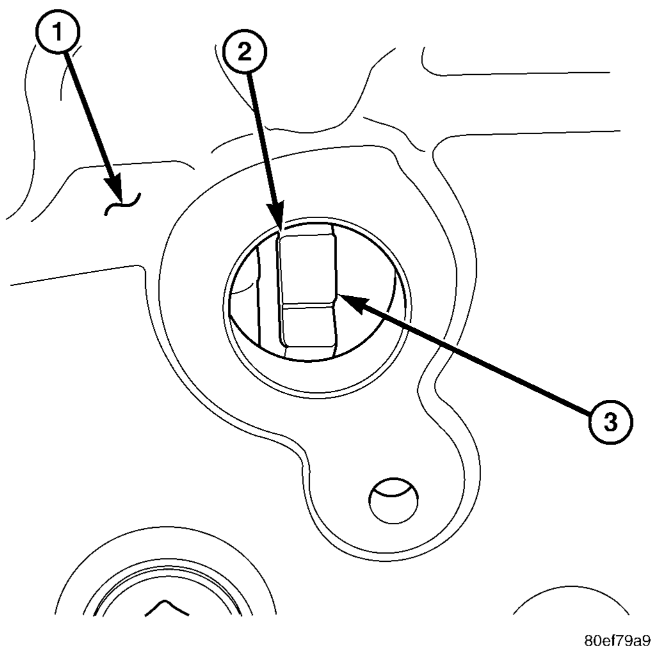


Fig. 7 CKP SENSOR OPERATION AND NOTCHES - 5.7L V-8

1 - RIGHT / REAR SIDE OF CYLINDER BLOCK
2 - MACHINED HOLE
3 - NOTCHES

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On 5.9L V-8 engines, the flywheel/drive plate has 8 single notches, spaced every 45 degrees, at its outer edge (Fig. 8).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution, there are 8 pulses generated on V-8 engines.

The engine will not operate if the PCM does not receive a CKP sensor input.

8.0L V-10

The Crankshaft Position (CKP) sensor detects notches machined into the middle of the crankshaft (Fig. 9).

There are five sets of notches. Each set contains two notches. Basic ignition timing is determined by the position of the last notch in each set of notches. Once the Powertrain Control Module (PCM) senses the last notch, it will determine crankshaft position (which piston will next be at Top Dead Center). An input from the camshaft position sensor is also needed. It may take the module up to one complete engine revolution to determine crankshaft position during engine cranking.

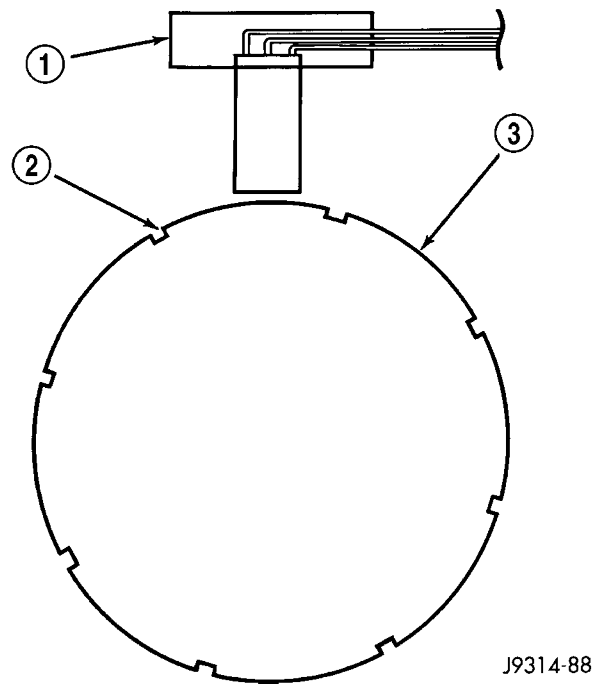


Fig. 8 CKP SENSOR OPERATION – 5.9L V-8

1 - CRANKSHAFT POSITION SENSOR
2 - NOTCHES
3 - FLYWHEEL

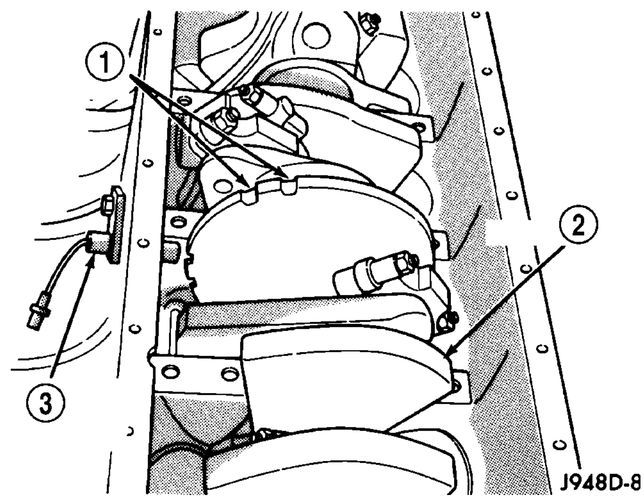


Fig. 9 CKP SENSOR OPERATION – 8.0L V-10 ENGINE

1 - CRANKSHAFT NOTCHES
2 - CRANKSHAFT
3 - CRANKSHAFT POSITION SENSOR

The PCM uses the signal from the camshaft position sensor to determine fuel injector sequence. Once crankshaft position has been determined, the PCM begins energizing a ground circuit to each fuel injector to provide injector operation.

CRANKSHAFT POSITION SENSOR (Continued)

REMOVAL

3.7L V-6

The Crankshaft Position (CKP) sensor is mounted into the right rear side of the cylinder block (Fig. 10). It is positioned and bolted into a machined hole.

(1) Raise vehicle.
(2) Disconnect sensor electrical connector.
(3) Remove sensor mounting bolt (Fig. 10).
(4) Carefully twist sensor from cylinder block.
(5) Check condition of sensor o-ring.

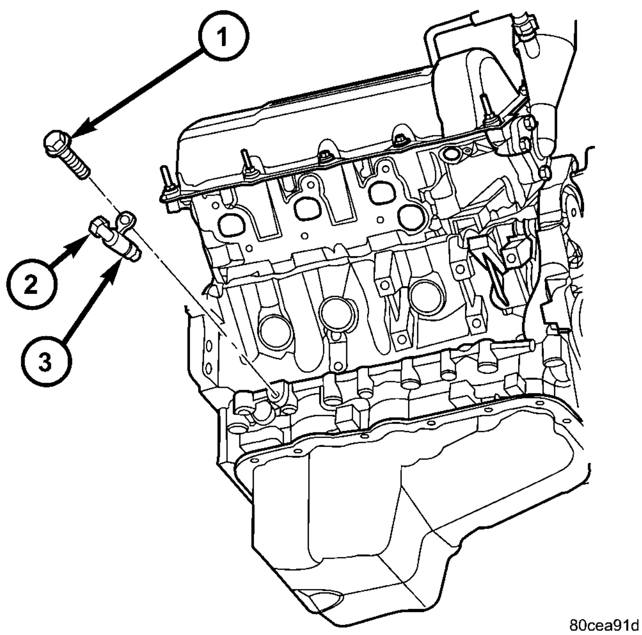


Fig. 10 CKP REMOVAL / INSTALLATION - 3.7L

1 - MOUNTING BOLT
2 - CKP SENSOR
3 - O-RING

4.7L V-8

The Crankshaft Position (CKP) sensor is located at the right-rear side of the engine cylinder block (Fig. 11). It is positioned and bolted into a machined hole in the engine block.

(1) Raise vehicle.

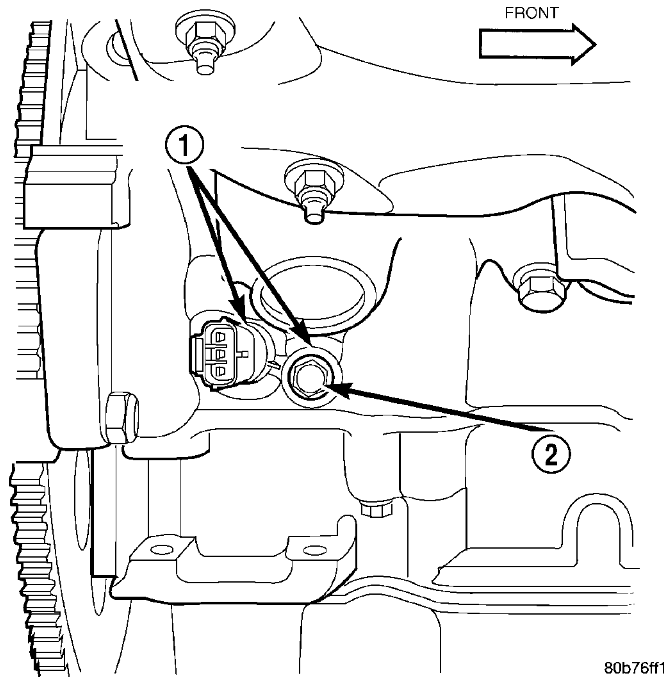


Fig. 11 CKP REMOVAL / INSTALLATION - 4.7L

1 - CRANKSHAFT POSITION SENSOR
2 - MOUNTING BOLT

(2) Disconnect CKP electrical connector at sensor.
(3) Remove CKP mounting bolt (Fig. 11).
(4) Carefully twist sensor from cylinder block.
(5) Remove sensor from vehicle.
(6) Check condition of sensor o-ring.

5.7L V-8

The Crankshaft Position (CKP) sensor is located at the right-rear side of the engine cylinder block (Fig. 12). It is positioned and bolted into a machined hole in the engine block.

(1) Raise vehicle.
(2) Disconnect CKP electrical connector at sensor (Fig. 12).
(3) Remove CKP mounting bolt (Fig. 12).
(4) Carefully twist sensor from cylinder block.
(5) Remove sensor from vehicle.
(6) Check condition of sensor o-ring.

CRANKSHAFT POSITION SENSOR (Continued)

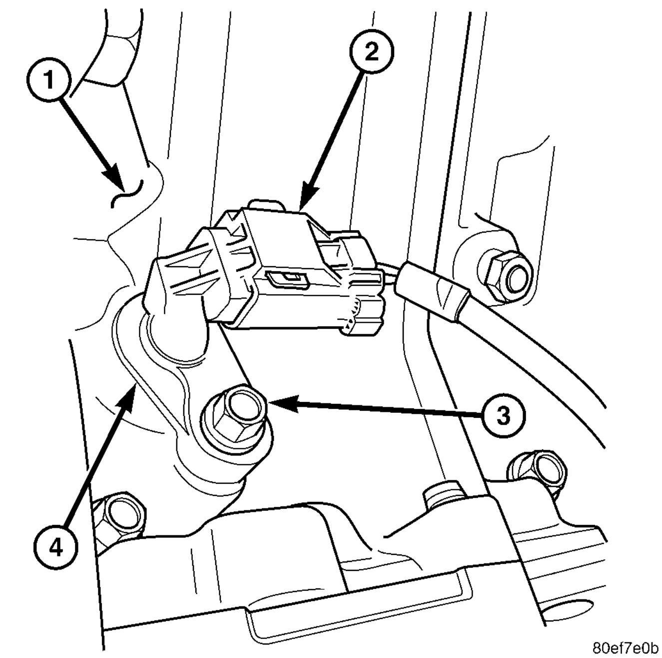


Fig. 12 CKP REMOVAL / INSTALLATION - 5.7L V-8

1 - CYLINDER BLOCK - RIGHT / REAR
2 - ELEC. CONNECTOR
3 - MOUNTING BOLT
4 - CKP SENSOR

5.9L Gas

The sensor is bolted to the top of the cylinder block near the rear of right cylinder head (Fig. 13).

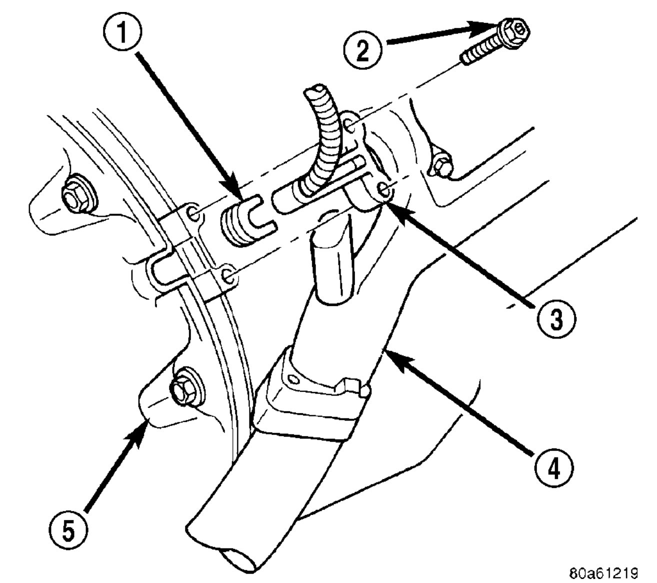


Fig. 13 CKP REMOVAL / INSTALLATION - 5.9L V-8

1 - GROMMET
2 - MOUNTING BOLTS (2)
3 - CRANKSHAFT POSITION SENSOR
4 - RIGHT EXHAUST MANIFOLD
5 - TRANSMISSION BELL HOUSING

(1) Raise vehicle.

(2) Disconnect crankshaft position sensor pigtail harness from main wiring harness.

(3) Remove two sensor (recessed hex head) mounting bolts (Fig. 13).

(4) Remove sensor from engine.

8.0L V–10

The crankshaft position sensor is located on the right-lower side of the cylinder block, forward of the right engine mount, just above the oil pan rail (Fig. 14).

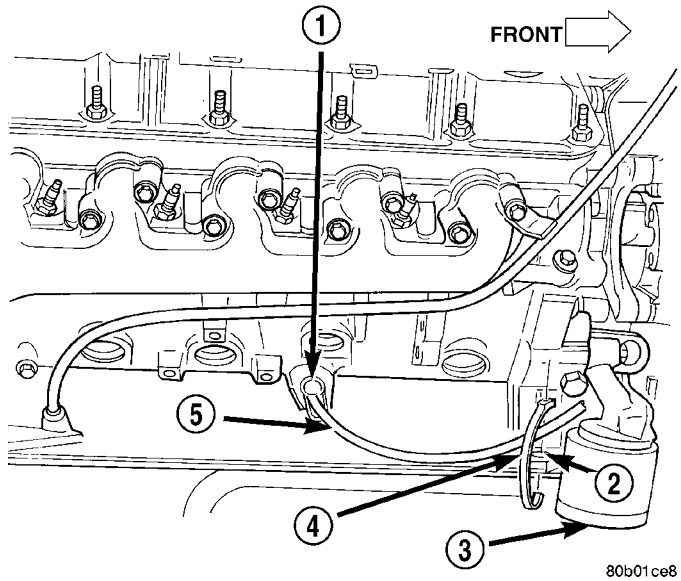


Fig. 14 CKP SENSOR LOCATION – 8.0L V-10

1 - CRANKSHAFT POSITION SENSOR
2 - HOLE
3 - OIL FILTER
4 - PLASTIC TIE STRAP
5 - PIGTAIL HARNESS

(1) Raise and support vehicle.

(2) Disconnect sensor pigtail harness from main engine wiring harness.

(3) Remove sensor mounting bolt (Fig. 15).

(4) Cut plastic tie strap (Fig. 14) securing sensor pigtail harness to side of engine block.

(5) Carefully pry sensor from cylinder block in a rocking action with two small screwdrivers.

(6) Remove sensor from vehicle.

(7) Check condition of sensor o-ring (Fig. 16).

INSTALLATION

3.7L V-6

(1) Clean out machined hole in engine block.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into engine block with a slight rocking and twisting action.

CRANKSHAFT POSITION SENSOR (Continued)

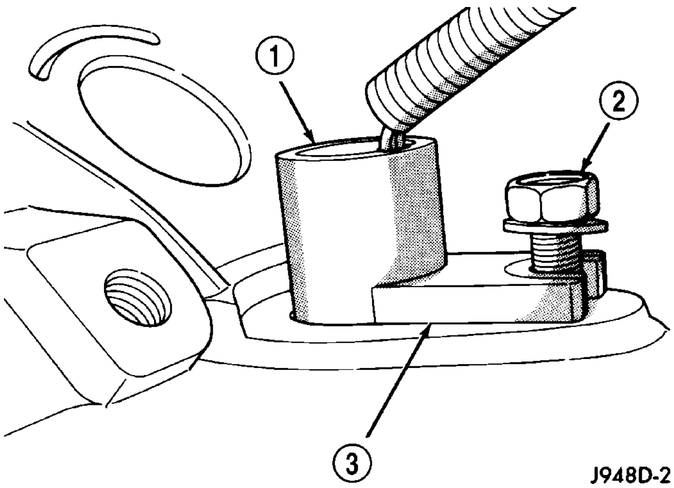


Fig. 15 CKP SENSOR R/I – 8.0L V-10

1 - CRANKSHAFT POSITION SENSOR
2 - MOUNTING BOLT
3 - SENSOR POSITIONED FLUSH TO CYLINDER BLOCK

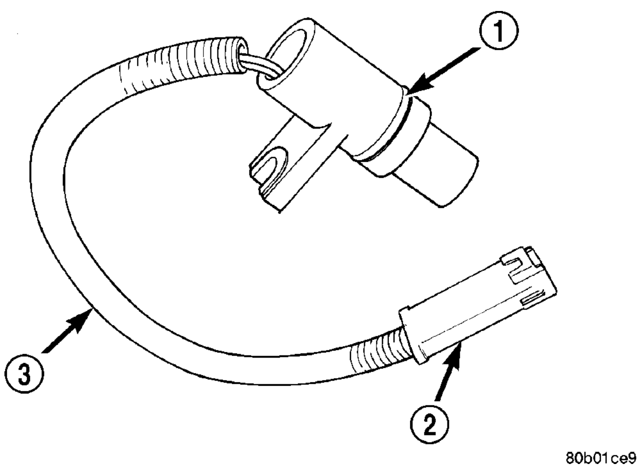


Fig. 16 SENSOR O-RING – 8.0L V-10

1 - CRANKSHAFT POSITION SENSOR O-RING
2 - ELECTRICAL CONNECTOR
3 - PIGTAIL HARNESS

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.
(6) Lower vehicle.

4.7L V-8

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into engine block with a slight rocking and twisting action.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.
(6) Lower vehicle.

5.7L V-8

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into engine block with a slight rocking and twisting action.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.
(6) Lower vehicle.

5.9L V-8 Gas

(1) Position crankshaft position sensor to engine.
(2) Install mounting bolts and tighten to 8 N·m (70 in. lbs.) torque.
(3) Connect main harness electrical connector to sensor.
(4) Lower vehicle.

8.0L V-10

(1) Apply a small amount of engine oil to sensor o-ring.
(2) Install sensor into cylinder block with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(3) Install mounting bolt and tighten to 8 N·m (70 in. lbs.) torque.
(4) Connect sensor pigtail harness to main engine wiring harness
(5) Install new plastic tie strap (Fig. 14) to secure sensor pigtail harness to side of engine block. Thread tie strap through casting hole on cylinder block.

FUEL INJECTOR

DESCRIPTION

An individual fuel injector (Fig. 17) is used for each individual cylinder.

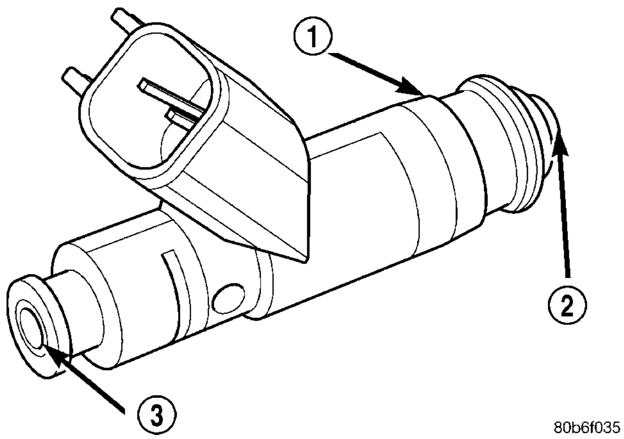


Fig. 17 FUEL INJECTOR

1 - FUEL INJECTOR
2 - NOZZLE
3 - TOP (FUEL ENTRY)

OPERATION

OPERATION - FUEL INJECTOR

The top (fuel entry) end of the injector (Fig. 17) is attached into an opening on the fuel rail.

The fuel injectors are electrical solenoids. The injector contains a pintle that closes off an orifice at the nozzle end. When electric current is supplied to the injector, the armature and needle move a short distance against a spring, allowing fuel to flow out the orifice. Because the fuel is under high pressure, a fine spray is developed in the shape of a pencil stream. The spraying action atomizes the fuel, adding it to the air entering the combustion chamber.

The nozzle (outlet) ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector.

The injectors are energized individually in a sequential order by the Powertrain Control Module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage is supplied to the injectors through the ASD relay.

The PCM determines injector pulse width based on various inputs.

OPERATION - PCM OUTPUT

The nozzle ends of the injectors are positioned into openings in the intake manifold just above the intake valve ports of the cylinder head. The engine wiring harness connector for each fuel injector is equipped with an attached numerical tag (INJ 1, INJ 2 etc.). This is used to identify each fuel injector with its respective cylinder number.

The injectors are energized individually in a sequential order by the Powertrain Control Module (PCM). The PCM will adjust injector pulse width by switching the ground path to each individual injector on and off. Injector pulse width is the period of time that the injector is energized. The PCM will adjust injector pulse width based on various inputs it receives.

Battery voltage (12 volts +) is supplied to the injectors through the ASD relay. The ASD relay will shutdown the 12 volt power source to the fuel injectors if the PCM senses the ignition is on, but the engine is not running. This occurs after the engine has not been running for approximately 1.8 seconds.

The PCM determines injector on-time (pulse width) based on various inputs.

REMOVAL

(1) Remove fuel rail. Refer to Fuel Injector Rail Removal.

(2) Disconnect clip(s) that retain fuel injector(s) to fuel rail (Fig. 18).

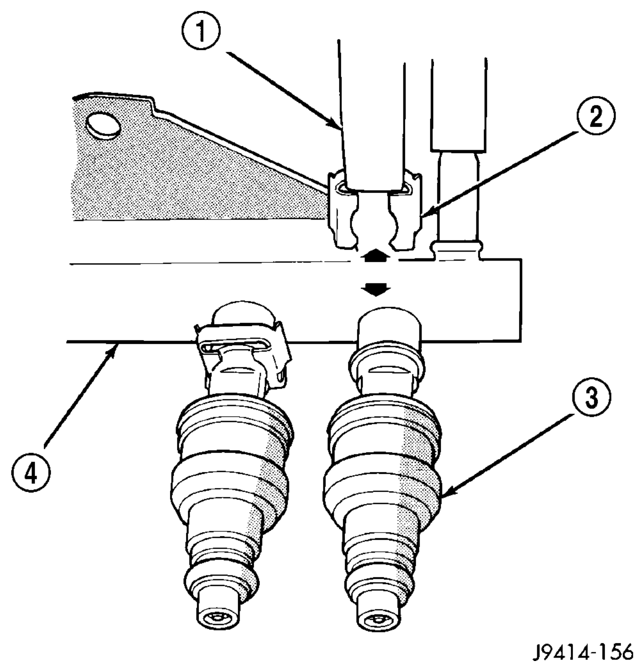


Fig. 18 INJECTOR RETAINING CLIP

1 - PLIERS
2 - INJECTOR CLIP
3 - FUEL INJECTOR - TYPICAL
4 - FUEL RAIL - TYPICAL

FUEL INJECTOR (Continued)

INSTALLATION

(1) Install fuel injector(s) into fuel rail assembly and install retaining clip(s).

(2) If same injector(s) is being reinstalled, install new o-ring(s).

(3) Apply a small amount of clean engine oil to each injector o-ring. This will aid in installation.

(4) Install fuel rail. Refer to Fuel Rail Installation.

(5) Start engine and check for fuel leaks.

FUEL PUMP RELAY

DESCRIPTION

The 5–pin, 12–volt, fuel pump relay is located in the Power Distribution Center (PDC). Refer to the label on the PDC cover for relay location.

OPERATION

The Powertrain Control Module (PCM) energizes the electric fuel pump through the fuel pump relay. The fuel pump relay is energized by first applying battery voltage to it when the ignition key is turned ON, and then applying a ground signal to the relay from the PCM.

Whenever the ignition key is turned ON, the electric fuel pump will operate. But, the PCM will shutdown the ground circuit to the fuel pump relay in approximately 1–3 seconds unless the engine is operating or the starter motor is engaged.

REMOVAL

The fuel pump relay is located in the Power Distribution Center (PDC) (Fig. 19). Refer to label on PDC cover for relay location.

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

INSTALLATION

The fuel pump relay is located in the Power Distribution Center (PDC). Refer to label on PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

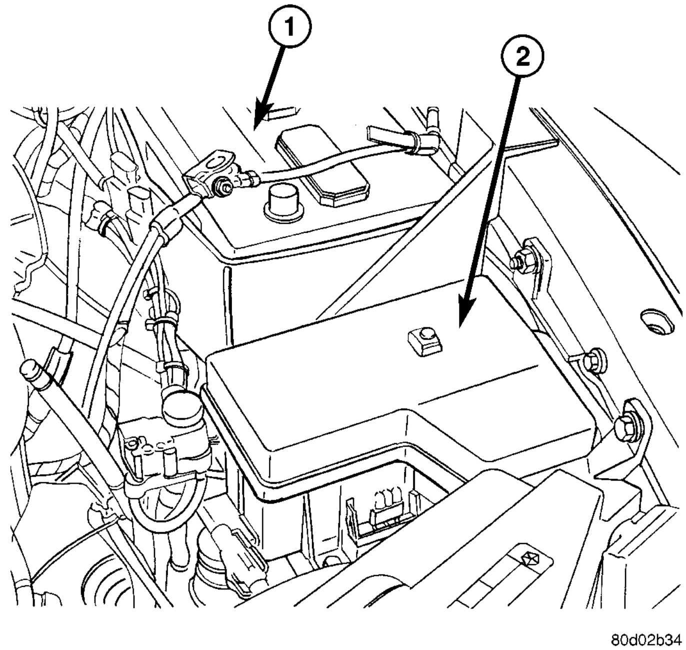


Fig. 19 PDC LOCATION

1 - BATTERY
2 - PDC (POWER DISTRIBUTION CENTER)

IDLE AIR CONTROL MOTOR

DESCRIPTION

A separate IAC motor is not used with the 5.7L V-8 engine.

The IAC stepper motor is mounted to the throttle body, and regulates the amount of air bypassing the control of the throttle plate. As engine loads and ambient temperatures change, engine rpm changes. A pintle on the IAC stepper motor protrudes into a passage in the throttle body, controlling air flow through the passage. The IAC is controlled by the Powertrain Control Module (PCM) to maintain the target engine idle speed.

OPERATION

A separate IAC motor is not used with the 5.7L V-8 engine.

At idle, engine speed can be increased by retracting the IAC motor pintle and allowing more air to pass through the port, or it can be decreased by restricting the passage with the pintle and diminishing the amount of air bypassing the throttle plate.

The IAC is called a stepper motor because it is moved (rotated) in steps, or increments. Opening the IAC opens an air passage around the throttle blade which increases RPM.

The PCM uses the IAC motor to control idle speed (along with timing) and to reach a desired MAP during decel (keep engine from stalling).

IDLE AIR CONTROL MOTOR (Continued)

The IAC motor has 4 wires with 4 circuits. Two of the wires are for 12 volts and ground to supply electrical current to the motor windings to operate the stepper motor in one direction. The other 2 wires are also for 12 volts and ground to supply electrical current to operate the stepper motor in the opposite direction.

To make the IAC go in the opposite direction, the PCM just reverses polarity on both windings. If only 1 wire is open, the IAC can only be moved 1 step (increment) in either direction. To keep the IAC motor in position when no movement is needed, the PCM will energize both windings at the same time. This locks the IAC motor in place.

In the IAC motor system, the PCM will count every step that the motor is moved. This allows the PCM to determine the motor pintle position. If the memory is cleared, the PCM no longer knows the position of the pintle. So at the first key ON, the PCM drives the IAC motor closed, regardless of where it was before. This zeros the counter. From this point the PCM will back out the IAC motor and keep track of its position again.

When engine rpm is above idle speed, the IAC is used for the following:

- Off-idle dashpot (throttle blade will close quickly but idle speed will not stop quickly)
- Deceleration air flow control
- A/C compressor load control (also opens the passage slightly before the compressor is engaged so that the engine rpm does not dip down when the compressor engages)
- Power steering load control

The PCM can control polarity of the circuit to control direction of the stepper motor.

IAC Stepper Motor Program: The PCM is also equipped with a memory program that records the number of steps the IAC stepper motor most recently advanced to during a certain set of parameters. For example: The PCM was attempting to maintain a 1000 rpm target during a cold start-up cycle. The last recorded number of steps for that may have been 125. That value would be recorded in the memory cell so that the next time the PCM recognizes the identical conditions, the PCM recalls that 125 steps were required to maintain the target. This program allows for greater customer satisfaction due to greater control of engine idle.

Another function of the memory program, which occurs when the power steering switch (if equipped), or the A/C request circuit, requires that the IAC stepper motor control engine rpm, is the recording of the last targeted steps into the memory cell. The PCM can anticipate A/C compressor loads. This is accomplished by delaying compressor operation for approximately 0.5 seconds until the PCM moves the IAC stepper motor to the recorded steps that were loaded into the memory cell. Using this program helps eliminate idle-quality changes as loads change. Finally, the PCM incorporates a ″No-Load″ engine speed limiter of approximately 1800 - 2000 rpm, when it recognizes that the TPS is indicating an idle signal and IAC motor cannot maintain engine idle.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the IAC motor through the PCM.

REMOVAL

3.7L V-6

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 20).

(1) Remove air resonator box at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws).
(4) Remove IAC motor from throttle body.

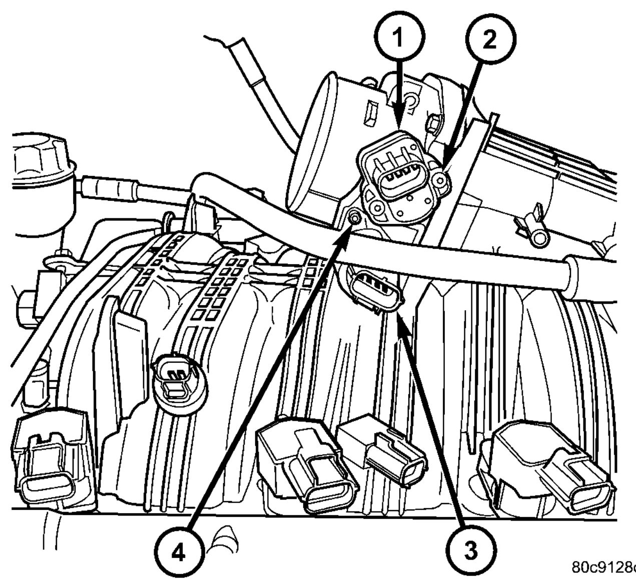


Fig. 20 IDLE AIR CONTROL MOTOR - 3.7L V-6

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

4.7L V-8

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 21).

(1) Remove air resonator box at throttle body.
(2) Disconnect electrical connector from IAC motor.
(3) Remove two mounting bolts (screws).
(4) Remove IAC motor from throttle body.

IDLE AIR CONTROL MOTOR (Continued)

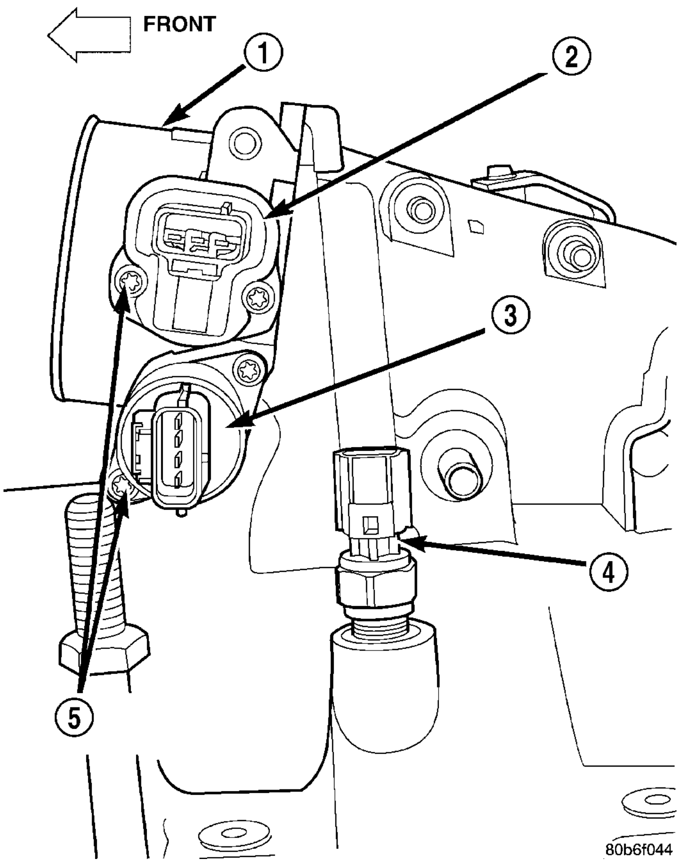


Fig. 21 IDLE AIR CONTROL MOTOR - 4.7L V-8

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

5.7L V-8

The IAC motor is not serviceable on the 5.7L V-8 engine.

5.9L V-8

The IAC motor is located on the back of the throttle body (Fig. 22).

(1) Remove air resonator box at throttle body.

(2) Disconnect electrical connector from IAC motor.

(3) Remove two mounting bolts (screws) (Fig. 22).

(4) Remove IAC motor from throttle body.

8.0L V-10

The IAC motor is located on the back of the throttle body (Fig. 23).

(1) Remove the air cleaner cover.

(2) Remove the 4 air cleaner housing mounting nuts and remove housing from throttle body.

(3) Disconnect electrical connector from IAC motor.

(4) Remove two mounting bolts (screw).

(5) Remove IAC motor from throttle body.

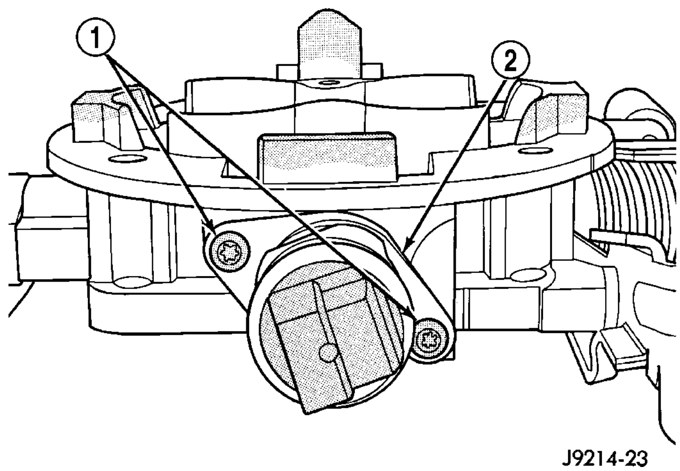


Fig. 22 IDLE AIR CONTROL MOTOR - 5.9L V-8

1 - MOUNTING SCREWS
2 - IDLE AIR CONTROL MOTOR

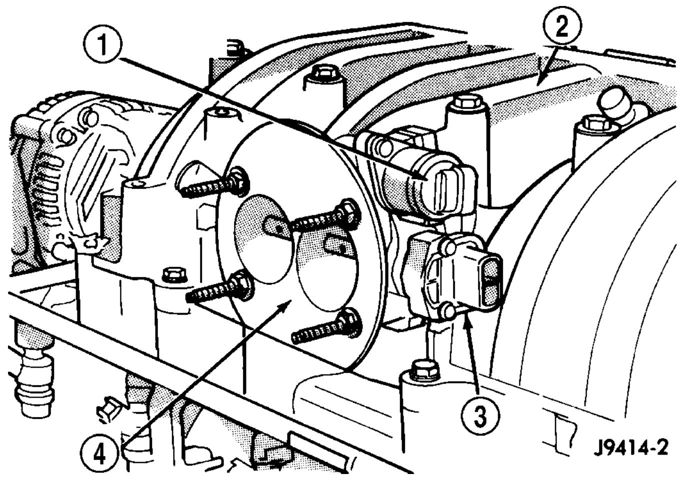


Fig. 23 IAC MOTOR - 8.0L V-10

1 - IDLE AIR CONTROL MOTOR
2 - INTAKE MANIFOLD (UPPER HALF)
3 - THROTTLE POSITION SENSOR
4 - THROTTLE BODY

INSTALLATION

3.7L V-6

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 20).

(1) Install IAC motor to throttle body.

(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.

(3) Install electrical connector.

(4) Install air resonator to throttle body.

4.7L V-8

The Idle Air Control (IAC) motor is located on the side of the throttle body (Fig. 21).

(1) Install IAC motor to throttle body.

IDLE AIR CONTROL MOTOR (Continued)

(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air resonator to throttle body.

5.7L V-8

The IAC motor is not serviceable on the 5.7L V-8 engine.

5.9L V-8

The IAC motor is located on the back of the throttle body (Fig. 22).
(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air resonator to throttle body.

8.0L V-10

The IAC motor is located on the back of the throttle body (Fig. 23).
(1) Install IAC motor to throttle body.
(2) Install and tighten two mounting bolts (screws) to 7 N·m (60 in. lbs.) torque.
(3) Install electrical connector.
(4) Install air cleaner housing to throttle body.
(5) Install 4 air cleaner housing mounting nuts. Tighten nuts to 11 N·m (96 in. lbs.) torque.
(6) Install air cleaner housing cover.

INTAKE AIR TEMPERATURE SENSOR

DESCRIPTION

The 2–wire Intake Manifold Air Temperature (IAT) sensor is installed in the intake manifold with the sensor element extending into the air stream.

The IAT sensor is a two-wire Negative Thermal Coefficient (NTC) sensor. Meaning, as intake manifold temperature increases, resistance (voltage) in the sensor decreases. As temperature decreases, resistance (voltage) in the sensor increases.

OPERATION

The IAT sensor provides an input voltage to the Powertrain Control Module (PCM) indicating the density of the air entering the intake manifold based upon intake manifold temperature. At key-on, a 5–volt power circuit is supplied to the sensor from the PCM. The sensor is grounded at the PCM through a low-noise, sensor-return circuit.

The PCM uses this input to calculate the following:

- Injector pulse-width
- Adjustment of spark timing (to help prevent spark knock with high intake manifold air-charge temperatures)

The resistance values of the IAT sensor is the same as for the Engine Coolant Temperature (ECT) sensor.

REMOVAL

3.7L V-6

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 24).
(1) Disconnect electrical connector from IAT sensor.
(2) Clean dirt from intake manifold at sensor base.
(3) Gently lift on small plastic release tab (Fig. 24) or (Fig. 25) and rotate sensor about 1/4 turn counterclockwise for removal.
(4) Check condition of sensor o-ring.

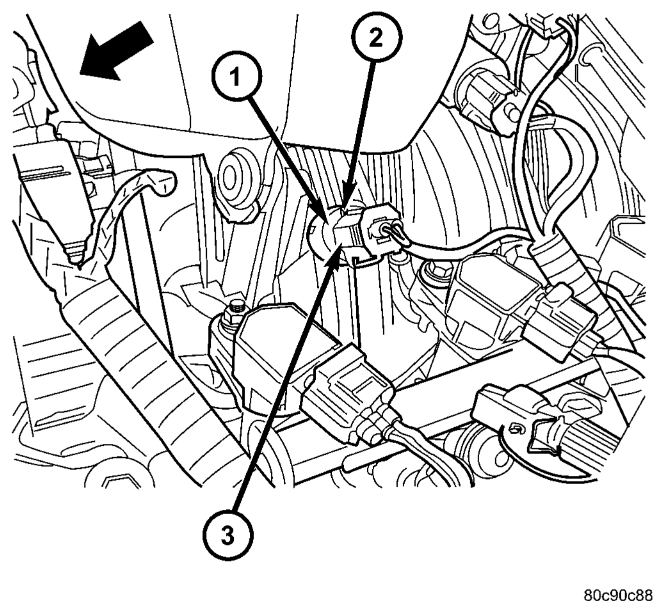


Fig. 24 IAT SENSOR LOCATION - 3.7L V-6

1 - IAT SENSOR
2 - RELEASE TAB
3 - ELECTRICAL CONNECTOR

4.7L V-8

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 26).
(1) Disconnect electrical connector from IAT sensor.
(2) Clean dirt from intake manifold at sensor base.
(3) Gently lift on small plastic release tab (Fig. 25) or (Fig. 26) and rotate sensor about 1/4 turn counterclockwise for removal.

INTAKE AIR TEMPERATURE SENSOR (Continued)

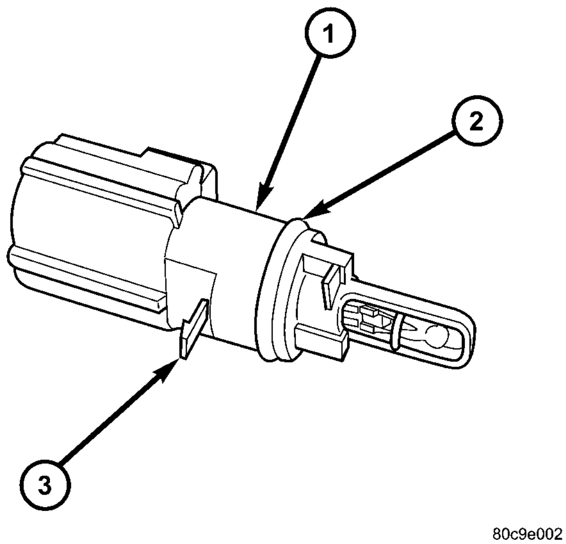


Fig. 25 IAT SENSOR TAB / O-RING - 3.7L V-6/4.7L V-8/5.7L V-8

1 - IAT SENSOR
2 - SENSOR O-RING
3 - RELEASE TAB

(4) Check condition of sensor o-ring.

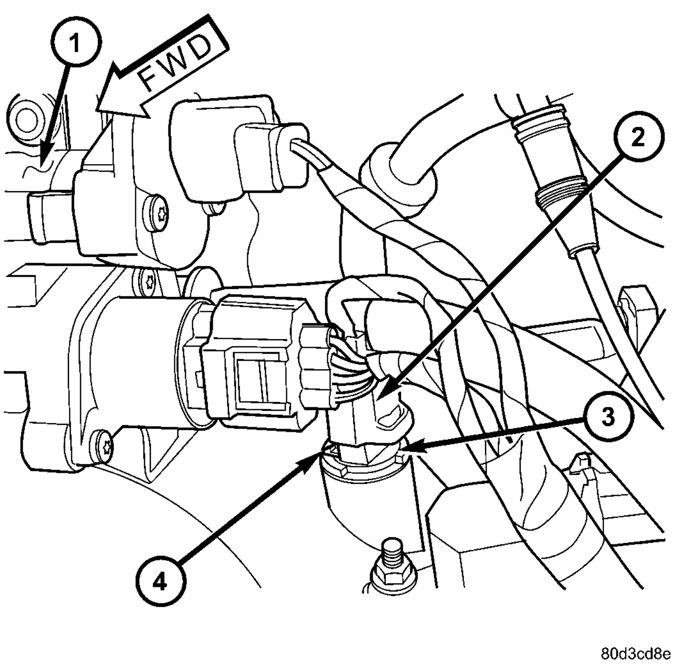


Fig. 26 IAT SENSOR - 4.7L V-8

1 - LEFT SIDE OF THROTTLE BODY
2 - ELEC. CONNECT.
3 - IAT SENSOR
4 - RELEASE TAB

5.7L V-8

The intake manifold air temperature (IAT) sensor is installed into the front of the intake manifold air box plenum (Fig. 27).

(1) Disconnect electrical connector from IAT sensor (Fig. 27).

(2) Clean dirt from intake manifold at sensor base.

(3) Gently lift on small plastic release tab (Fig. 25) or (Fig. 28) and rotate sensor about 1/4 turn counter-clockwise for removal.

(4) Check condition of sensor o-ring.

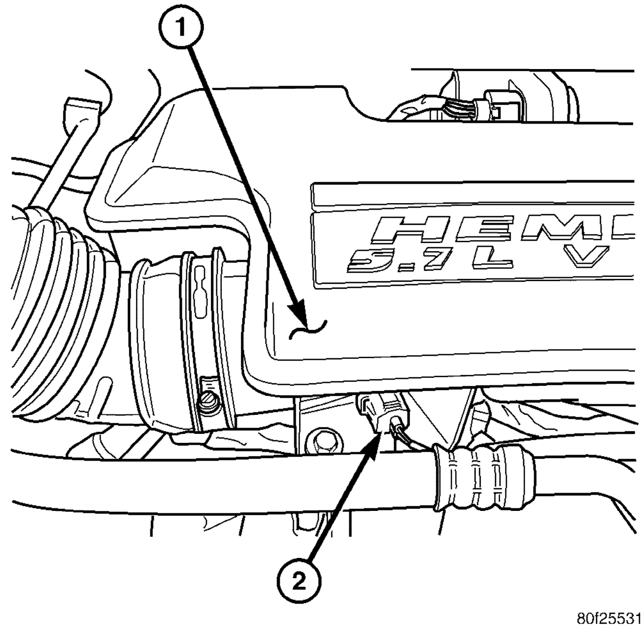


Fig. 27 5.7L IAT SENSOR LOCATION

1 - FRONT OF INTAKE MANIFOLD PLENUM
2 - IAT ELECTRICAL CONNECTOR

5.9L

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 29).

(1) Clean dirt from intake manifold at sensor base.

(2) Disconnect electrical connector at sensor (Fig. 29).

(3) Remove sensor from intake manifold.

8.0L V-10

The intake manifold air temperature sensor is located in the side of the intake manifold near the front of throttle body (Fig. 30).

(1) Disconnect electrical connector at sensor.

(2) Remove sensor from intake manifold.

INTAKE AIR TEMPERATURE SENSOR (Continued)

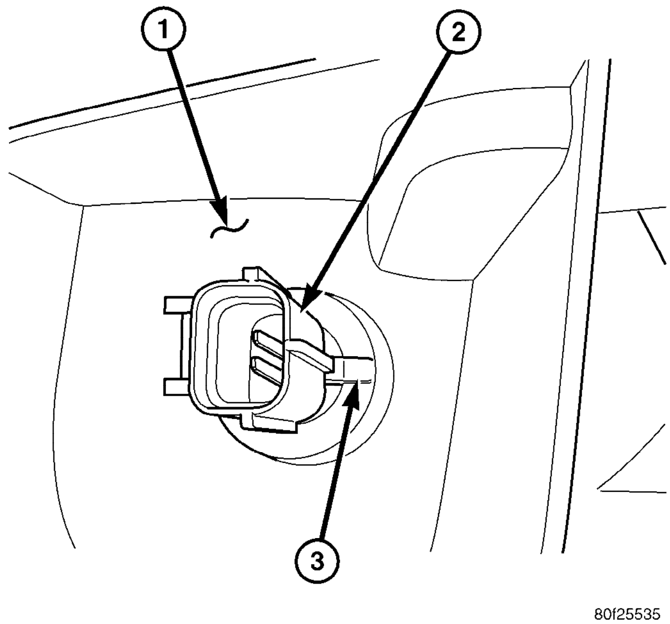


Fig. 28 5.7L IAT SENSOR R/I

1 - FRONT OF INTAKE MANIFOLD PLENUM
2 - IAT SENSOR
3 - RELEASE TAB

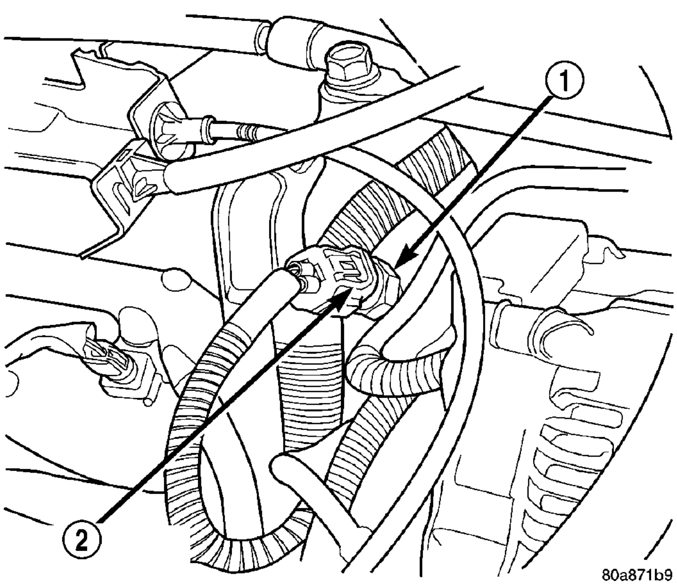


Fig. 29 IAT SENSOR LOCATION - 5.9L

1 - INTAKE MANIFOLD AIR TEMPERATURE SENSOR
2 - ELECTRICAL CONNECTOR

INSTALLATION

3.7L V-6

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 24).

(1) Check condition of sensor o-ring.

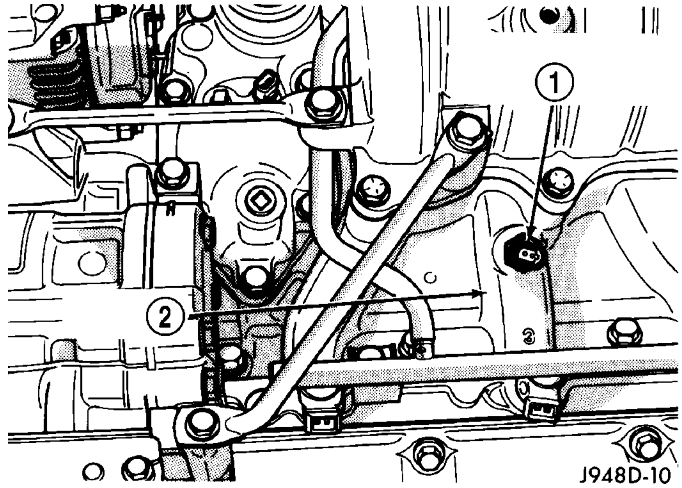


Fig. 30 AIR TEMPERATURE SENSOR - 8.0L V-10

1 - INTAKE MANIFOLD AIR TEMP. SENSOR
2 - INTAKE MANIFOLD

(2) Clean sensor mounting hole in intake manifold.
(3) Position sensor into intake manifold and rotate clockwise until past release tab (Fig. 24).
(4) Install electrical connector.

4.7L V-8

The intake manifold air temperature (IAT) sensor is installed into the left side of intake manifold plenum (Fig. 26).

(1) Check condition of sensor o-ring.
(2) Clean sensor mounting hole in intake manifold.
(3) Position sensor into intake manifold and rotate clockwise until past release tab.
(4) Install electrical connector.

5.7L V-8

The intake manifold air temperature (IAT) sensor is installed into the front of the intake manifold air box plenum (Fig. 27).

(1) Check condition of sensor o-ring.
(2) Clean sensor mounting hole in intake manifold.
(3) Position sensor into intake manifold and rotate clockwise until past release tab.
(4) Install electrical connector.

5.9L V-8

The intake manifold air temperature sensor is located in the front/side of the intake manifold (Fig. 29).

(1) Install sensor to intake manifold. Tighten to 12–15 N·m (110–130 in. lbs.) torque.
(2) Install electrical connector.

8.0L V-10

The intake manifold air temperature sensor is located in the side of the intake manifold near the front of throttle body (Fig. 30).

INTAKE AIR TEMPERATURE SENSOR (Continued)

(1) Install sensor to intake manifold. Tighten to 12–15 N·m (110–130 in. lbs.) torque.

(2) Install electrical connector.

MAP SENSOR

DESCRIPTION

3.7L V-6

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold with 2 screws.

4.7L V-8

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold with 2 screws.

5.7L V-8

The Manifold Absolute Pressure (MAP) sensor is mounted to the front of the intake manifold air plenum box.

5.9L V-8

The Manifold Absolute Pressure (MAP) sensor is mounted to the front of the throttle body with 2 screws.

8.0L V-10

The Manifold Absolute Pressure (MAP) sensor is mounted into the right side of the intake manifold.

OPERATION

The MAP sensor is used as an input to the Powertrain Control Module (PCM). It contains a silicon based sensing unit to provide data on the manifold vacuum that draws the air/fuel mixture into the combustion chamber. The PCM requires this information to determine injector pulse width and spark advance. When manifold absolute pressure (MAP) equals Barometric pressure, the pulse width will be at maximum.

A 5 volt reference is supplied from the PCM and returns a voltage signal to the PCM that reflects manifold pressure. The zero pressure reading is 0.5V and full scale is 4.5V. For a pressure swing of 0–15 psi, the voltage changes 4.0V. To operate the sensor, it is supplied a regulated 4.8 to 5.1 volts. Ground is provided through the low-noise, sensor return circuit at the PCM.

The MAP sensor input is the number one contributor to fuel injector pulse width. The most important function of the MAP sensor is to determine barometric pressure. The PCM needs to know if the vehicle is at sea level or at a higher altitude, because the air density changes with altitude. It will also help to correct for varying barometric pressure. Barometric pressure and altitude have a direct inverse correlation; as altitude goes up, barometric goes down. At key-on, the PCM powers up and looks at MAP voltage, and based upon the voltage it sees, it knows the current barometric pressure (relative to altitude). Once the engine starts, the PCM looks at the voltage again, continuously every 12 milliseconds, and compares the current voltage to what it was at key-on. The difference between current voltage and what it was at key-on, is manifold vacuum.

During key-on (engine not running) the sensor reads (updates) barometric pressure. A normal range can be obtained by monitoring a known good sensor.

As the altitude increases, the air becomes thinner (less oxygen). If a vehicle is started and driven to a very different altitude than where it was at key-on, the barometric pressure needs to be updated. Any time the PCM sees Wide Open Throttle (WOT), based upon Throttle Position Sensor (TPS) angle and RPM, it will update barometric pressure in the MAP memory cell. With periodic updates, the PCM can make its calculations more effectively.

The PCM uses the MAP sensor input to aid in calculating the following:

- Manifold pressure
- Barometric pressure
- Engine load
- Injector pulse-width
- Spark-advance programs
- Shift-point strategies (certain automatic transmissions only)
- Idle speed
- Decel fuel shutoff

The MAP sensor signal is provided from a single piezoresistive element located in the center of a diaphragm. The element and diaphragm are both made of silicone. As manifold pressure changes, the diaphragm moves causing the element to deflect, which stresses the silicone. When silicone is exposed to stress, its resistance changes. As manifold vacuum increases, the MAP sensor input voltage decreases proportionally. The sensor also contains electronics that condition the signal and provide temperature compensation.

The PCM recognizes a decrease in manifold pressure by monitoring a decrease in voltage from the reading stored in the barometric pressure memory cell. The MAP sensor is a linear sensor; meaning as pressure changes, voltage changes proportionately. The range of voltage output from the sensor is usually between 4.6 volts at sea level to as low as 0.3 volts at 26 in. of Hg. Barometric pressure is the pressure exerted by the atmosphere upon an object. At sea level on a standard day, no storm, barometric

MAP SENSOR (Continued)

pressure is approximately 29.92 in Hg. For every 100 feet of altitude, barometric pressure drops 0.10 in. Hg. If a storm goes through, it can change barometric pressure from what should be present for that altitude. You should know what the average pressure and corresponding barometric pressure is for your area.

REMOVAL

3.7L V-6

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 31). An o-ring is used to seal the sensor to the intake manifold (Fig. 32).

(1) Disconnect electrical connector at sensor.
(2) Clean area around MAP sensor.
(3) Remove 2 sensor mounting screws.
(4) Remove MAP sensor from intake manifold.
(5) Check condition of sensor o-ring (Fig. 32).

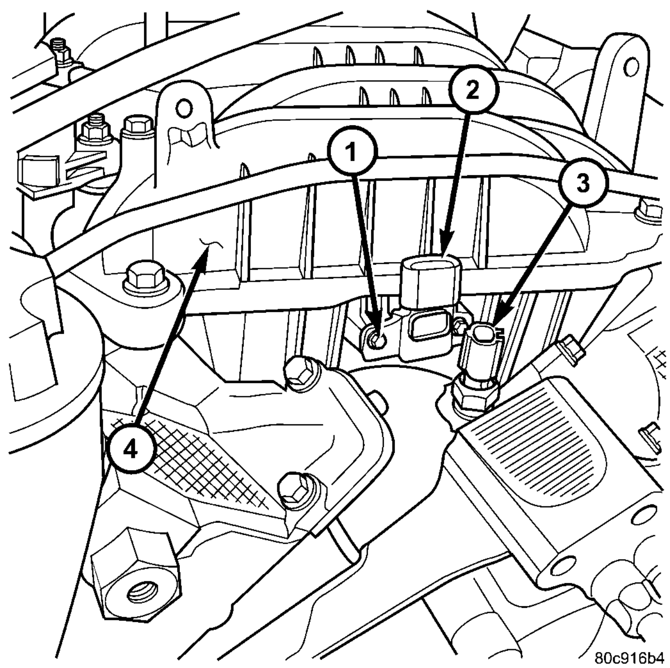


Fig. 31 MAP SENSOR - 3.7L V-6

1 - MOUNTING SCREWS
2 - MAP SENSOR
3 - ECT SENSOR
4 - FRONT OF INTAKE MANIFOLD

4.7L V-8

The MAP sensor is located on the front of the intake manifold (Fig. 33). An o-ring seals the sensor to the intake manifold.

(1) Disconnect electrical connector at sensor.
(2) Clean area around MAP sensor.
(3) Remove 2 sensor mounting bolts (Fig. 33).
(4) Remove MAP sensor from intake manifold.

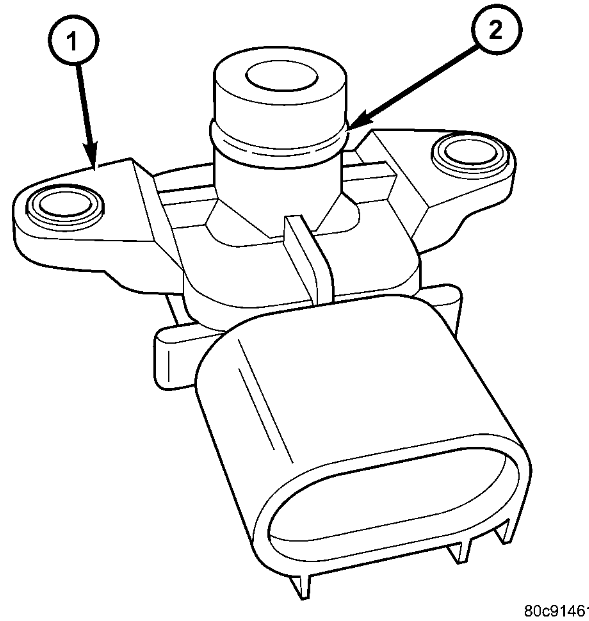


Fig. 32 MAP SENSOR O-RING 3.7L / 4.7L

1 - MAP SENSOR
2 - O-RING

(5) Check condition of sensor o-ring (Fig. 32).

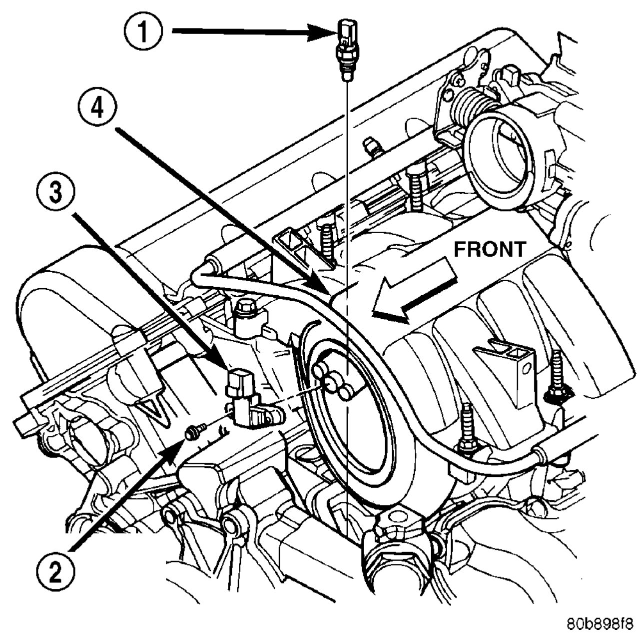


Fig. 33 MAP SENSOR - 4.7L V-8

1 - ECT SENSOR
2 - MOUNTING BOLTS (2)
3 - MAP SENSOR
4 - INTAKE MANIFOLD

MAP SENSOR (Continued)

5.7L V-8

The Manifold Absolute Pressure (MAP) sensor is mounted to the front of the intake manifold air plenum box (Fig. 34).

(1) Disconnect electrical connector at sensor by sliding release lock out (Fig. 35). Press down on lock tab for removal.

(2) Rotate sensor 1/4 turn counter-clockwise for removal.

(3) Check condition of sensor o-ring.

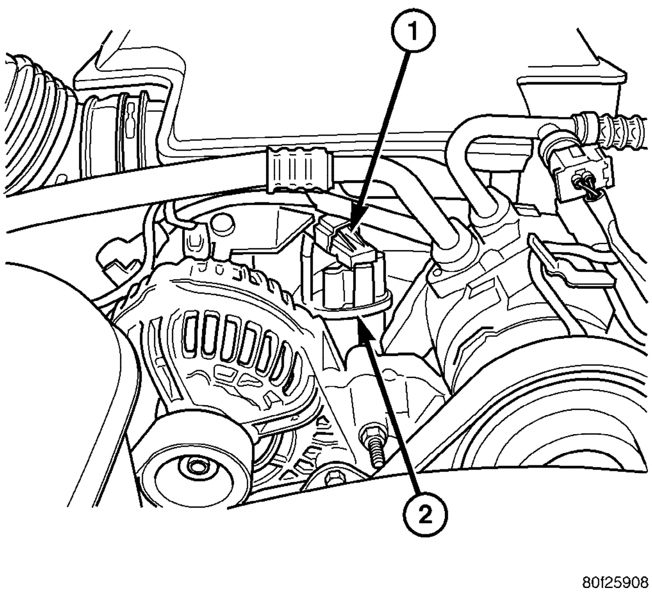


Fig. 34 5.7L MAP SENSOR LOCATION

1 - MAP SENSOR
2 - FRONT OF INTAKE MANIFOLD

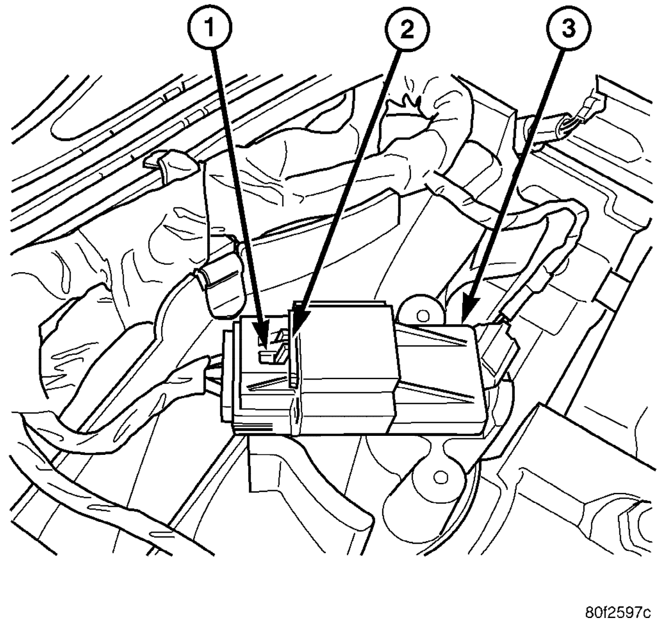


Fig. 35 5.7L MAP SENSOR R/I

1 - PRESS DOWN
2 - SLIDE RELEASE LOCK
3 - MAP SENSOR

5.9L V-8

The MAP sensor is located on the front of the throttle body (Fig. 36). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 37).

(1) Clean area around MAP sensor.

(2) Remove two MAP sensor mounting bolts (screws) (Fig. 36).

(3) While removing MAP sensor, slide the vacuum rubber L-shaped fitting (Fig. 37) from the throttle body.

(4) Remove rubber L-shaped fitting from MAP sensor.

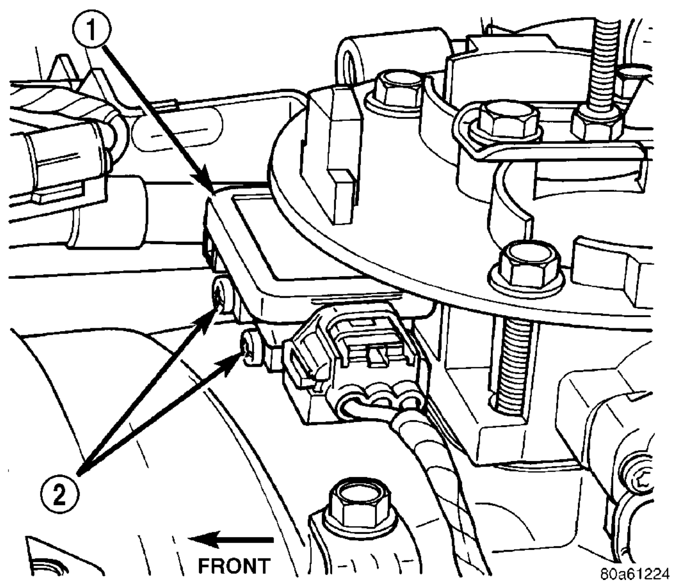


Fig. 36 MAP SENSOR - 5.9L V-8

1 - MAP SENSOR
2 - MOUNTING SCREWS (2)

8.0L V-10

The MAP sensor is mounted into the right upper side of intake manifold (Fig. 38). A rubber gasket is used to seal sensor to intake manifold. The rubber gasket is part of sensor and is not serviced separately.

(1) Remove electrical connector at sensor.

(2) Clean area around sensor before removal.

(3) Remove two sensor mounting bolts.

(4) Remove sensor from intake manifold.

MAP SENSOR (Continued)

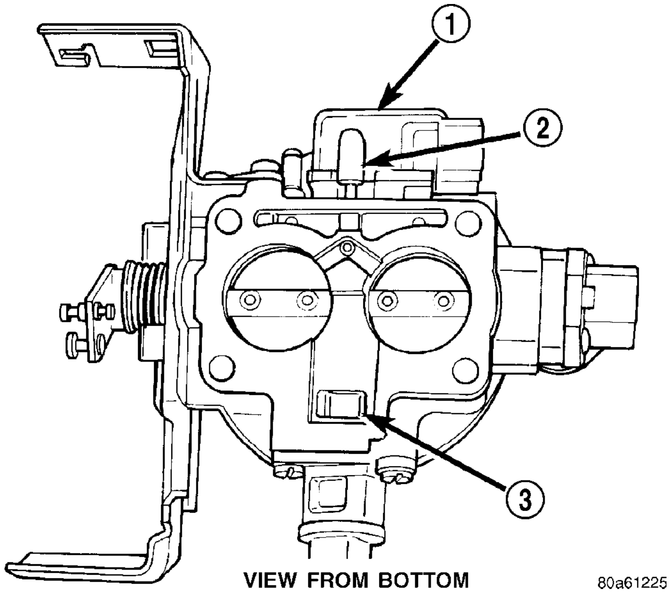


Fig. 37 MAP SENSOR L-SHAPED RUBBER FITTING - 5.9L V-8

1 - MAP SENSOR
2 - RUBBER FITTING
3 - IDLE AIR PASSAGE

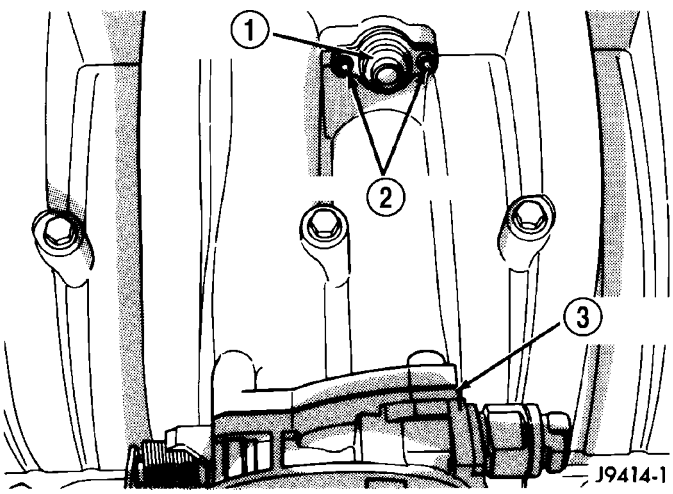


Fig. 38 MAP SENSOR LOCATION - 8.0L V-10

1 - MAP SENSOR
2 - MOUNTING BOLTS
3 - THROTTLE BODY

INSTALLATION

3.7L V-6

The Manifold Absolute Pressure (MAP) sensor is mounted into the front of the intake manifold (Fig. 31). An o-ring is used to seal the sensor to the intake manifold (Fig. 32).

(1) Clean MAP sensor mounting hole at intake manifold.

(2) Check MAP sensor o-ring seal for cuts or tears.

(3) Position sensor into manifold.

(4) Install MAP sensor mounting bolts (screws). Refer to Torque Specifications.

(5) Connect electrical connector.

4.7L V-8

The MAP sensor is located on the front of the intake manifold (Fig. 33). An o-ring seals the sensor to the intake manifold (Fig. 32).

(1) Clean MAP sensor mounting hole at intake manifold.

(2) Check MAP sensor o-ring seal for cuts or tears.

(3) Position sensor into manifold.

(4) Install MAP sensor mounting bolts (screws). Refer to Torque Specifications.

(5) Connect electrical connector.

5.7L V-8

The Manifold Absolute Pressure (MAP) sensor is mounted to the front of the intake manifold air plenum box (Fig. 34).

(1) Clean MAP sensor mounting hole at intake manifold.

(2) Check MAP sensor o-ring seal for cuts or tears.

(3) Position sensor into manifold.

(4) Rotate sensor 1/4 turn clockwise for installation.

(5) Connect electrical connector.

5.9L V-8

The MAP sensor is located on the front of the throttle body (Fig. 36). An L-shaped rubber fitting is used to connect the MAP sensor to throttle body (Fig. 37).

(1) Install rubber L-shaped fitting to MAP sensor.

(2) Position sensor to throttle body while guiding rubber fitting over throttle body vacuum nipple.

(3) Install MAP sensor mounting bolts (screws). Refer to Torque Specifications.

(4) Install air resonator box.

8.0L V-10

The MAP sensor is mounted into the right upper side of intake manifold (Fig. 38). A rubber gasket is used to seal sensor to intake manifold. The rubber gasket is part of sensor and is not serviced separately.

(1) Check condition of sensor seal. Clean sensor and lubricate rubber gasket with clean engine oil.

(2) Clean sensor opening in intake manifold.

(3) Install sensor into intake manifold.

(4) Install sensor mounting bolts. Refer to Torque Specifications.

(5) Install electrical connector to sensor.

OXYGEN SENSOR

DESCRIPTION

The Oxygen Sensors (O2S) are attached to, and protrude into the vehicle exhaust system. Depending on the engine or emission package, the vehicle may use a total of either 2 or 4 sensors.

Federal Emission Packages : Two sensors are used: upstream (referred to as 1/1) and downstream (referred to as 1/2). With this emission package, the upstream sensor (1/1) is located just before the main catalytic convertor. The downstream sensor (1/2) is located just after the main catalytic convertor.

California Emission Packages: On this emissions package, 4 sensors are used: 2 upstream (referred to as 1/1 and 2/1) and 2 downstream (referred to as 1/2 and 2/2). With this emission package, the right upstream sensor (2/1) is located in the right exhaust downpipe just before the mini-catalytic convertor. The left upstream sensor (1/1) is located in the left exhaust downpipe just before the mini-catalytic convertor. The right downstream sensor (2/2) is located in the right exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor. The left downstream sensor (1/2) is located in the left exhaust downpipe just after the mini-catalytic convertor, and before the main catalytic convertor.

OPERATION

An O2 sensor is a galvanic battery that provides the PCM with a voltage signal (0-1 volt) inversely proportional to the amount of oxygen in the exhaust. In other words, if the oxygen content is low, the voltage output is high; if the oxygen content is high the output voltage is low. The PCM uses this information to adjust injector pulse-width to achieve the 14.7–to–1 air/fuel ratio necessary for proper engine operation and to control emissions.

The O2 sensor must have a source of oxygen from outside of the exhaust stream for comparison. Current O2 sensors receive their fresh oxygen (outside air) supply through the O2 sensor case housing.

Four wires (circuits) are used on each O2 sensor: a 12–volt feed circuit for the sensor heating element; a ground circuit for the heater element; a low-noise sensor return circuit to the PCM, and an input circuit from the sensor back to the PCM to detect sensor operation.

Oxygen Sensor Heater Relay - 5.9L/8.0L: If 4 oxygen sensors are used, a separate heater relay is used to supply voltage to the sensors heating elements for only the 1/2 and 2/2 downstream sensors. Voltage for the other 2 sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through a Pulse Width Module (PWM) method.

Pulse Width Module (PWM) - 5.9L/8.0L: Voltage to the O2 sensor heating elements is supplied directly from the Powertrain Control Module (PCM) through two separate Pulse Width Module (PWM) low side drivers. PWM is used on both the upstream and downstream O2 sensors if equipped with a Federal Emissions Package, and only on the 2 upstream sensors (1/1 and 2/1) if equipped with a California Emissions Package. The main objective for a PWM driver is to avoid overheating of the O2 sensor heater element. With exhaust temperatures increasing with time and engine speed, it's not required to have a full-voltage duty-cycle on the O2 heater elements.

To avoid the large simultaneous current surge needed to operate all 4 sensors, power is delayed to the 2 downstream heater elements by the PCM for approximately 2 seconds.

Oxygen Sensor Heater Elements:

The O2 sensor uses a Positive Thermal Co-efficient (PTC) heater element. As temperature increases, resistance increases. At ambient temperatures around 70°F, the resistance of the heating element is approximately 13 ohms. As the sensor's temperature increases, resistance in the heater element increases. This allows the heater to maintain the optimum operating temperature of approximately 930°-1100°F (500°-600° C). Although the sensors operate the same, there are physical differences, due to the environment that they operate in, that keep them from being interchangeable.

Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation sooner. Also, it allows the system to remain in closed loop operation during periods of extended idle.

In Closed Loop operation, the PCM monitors certain O2 sensor input(s) along with other inputs, and adjusts the injector pulse width accordingly. During Open Loop operation, the PCM ignores the O2 sensor input. The PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

Upstream Sensor - Federal Emissions Package : The upstream sensor (1/1) provides an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensor. The PCM will change the air/fuel ratio until the upstream sensor inputs a voltage that the PCM has determined will make the downstream sensor output (oxygen content) correct.

The upstream oxygen sensor also provides an input to determine catalytic convertor efficiency.

OXYGEN SENSOR (Continued)

Downstream Sensor - Federal Emissions Package : The downstream oxygen sensor (1/2) is also used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, the PCM calculates how much air-fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensor also provides an input to determine catalytic convertor efficiency.

Upstream Sensors - California Emissions Package : Two upstream sensors are used (1/1 and 2/1). The 1/1 sensor is the first sensor to receive exhaust gases from the #1 cylinder. They provide an input voltage to the PCM. The input tells the PCM the oxygen content of the exhaust gas. The PCM uses this information to fine tune fuel delivery to maintain the correct oxygen content at the downstream oxygen sensors. The PCM will change the air/fuel ratio until the upstream sensors input a voltage that the PCM has determined will make the downstream sensors output (oxygen content) correct.

The upstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

Downstream Sensors - California Emissions Package : Two downstream sensors are used (1/2 and 2/2). The downstream sensors are used to determine the correct air-fuel ratio. As the oxygen content changes at the downstream sensor, the PCM calculates how much air-fuel ratio change is required. The PCM then looks at the upstream oxygen sensor voltage, and changes fuel delivery until the upstream sensor voltage changes enough to correct the downstream sensor voltage (oxygen content).

The downstream oxygen sensors also provide an input to determine mini-catalyst efficiency. Main catalytic convertor efficiency is not calculated with this package.

Engines equipped with either a downstream sensor(s), or a post-catalytic sensor, will monitor catalytic convertor efficiency. If efficiency is below emission standards, the Malfunction Indicator Lamp (MIL) will be illuminated and a Diagnostic Trouble Code (DTC) will be set. Refer to Monitored Systems in Emission Control Systems for additional information.

REMOVAL

CAUTION: Never apply any type of grease to the oxygen sensor electrical connector, or attempt any soldering of the sensor wiring harness.

Refer to (Fig. 39) or (Fig. 40) for typical O2S (oxygen sensor) locations.

WARNING: THE EXHAUST MANIFOLD, EXHAUST PIPES AND CATALYTIC CONVERTER BECOME VERY HOT DURING ENGINE OPERATION. ALLOW ENGINE TO COOL BEFORE REMOVING OXYGEN SENSOR.

(1) Raise and support vehicle.
(2) Disconnect wire connector from O2S sensor.

CAUTION: When disconnecting sensor electrical connector, do not pull directly on wire going into sensor.

(3) Remove O2S sensor with an oxygen sensor removal and installation tool.
(4) Clean threads in exhaust pipe using appropriate tap.

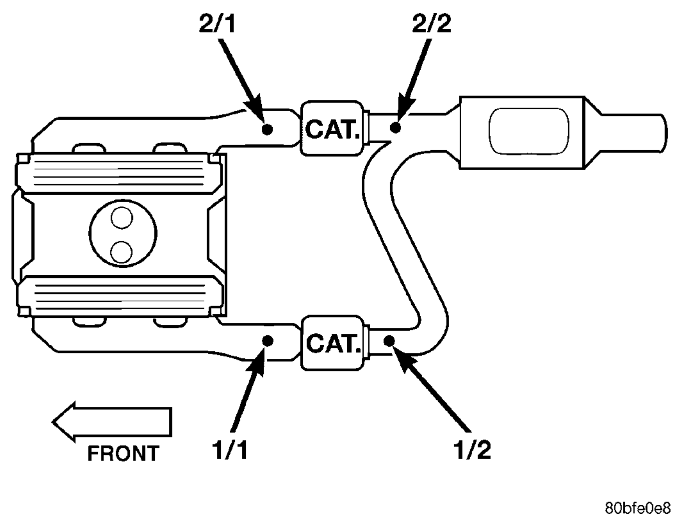


Fig. 39 O2 SENSOR SYSTEM - WITH 4 SENSORS

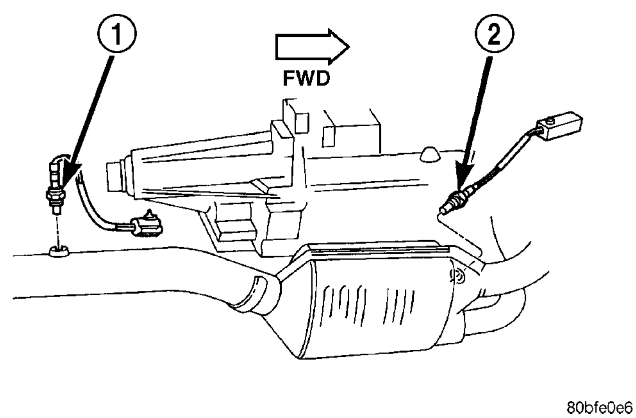


Fig. 40 O2 SENSOR SYSTEM - WITH 2 SENSORS

1 - POST CATALYST OXYGEN SENSOR (1/3)
2 - PRE-CATALYST OXYGEN SENSOR (1/2)

OXYGEN SENSOR (Continued)

INSTALLATION

Threads of new oxygen sensors are factory coated with anti-seize compound to aid in removal. **DO NOT add any additional anti-seize compound to threads of a new oxygen sensor.**

(1) Install O2S sensor. Tighten to 30 N·m (22 ft. lbs.) torque.

(2) Connect O2S sensor wire connector.

(3) Lower vehicle.

THROTTLE BODY

DESCRIPTION

The throttle body is located on the intake manifold. Fuel does not enter the intake manifold through the throttle body. Fuel is sprayed into the manifold by the fuel injectors.

OPERATION

Filtered air from the air cleaner enters the intake manifold through the throttle body. The throttle body contains an air control passage controlled by an Idle Air Control (IAC) motor. The air control passage is used to supply air for idle conditions. A throttle valve (plate) is used to supply air for above idle conditions.

5.7L V-8 Engine:

The throttle body on the 5.7L engine is an electrically controlled unit. A mechanical cable is not used to connect the throttle body to the accelerator pedal. The Accelerator Pedal Position Sensor (APPS) along with inputs from other sensors sets the throttle blade to pre-determined positions.

Except 5.7L V-8 Engine:

Certain sensors are attached to the throttle body. The accelerator pedal cable, speed control cable and transmission control cable (when equipped) are connected to the throttle body linkage arm.

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the PCM.

REMOVAL

3.7L V-6

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the Powertrain Control Module (PCM).

(1) Remove air cleaner tube at throttle body.

(2) Disconnect throttle body electrical connectors at IAC motor and TPS.

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section for removal/installation procedures.

(4) Disconnect necessary vacuum lines at throttle body.

(5) Remove 3 throttle body mounting bolts (Fig. 41).

(6) Remove throttle body from intake manifold.

(7) Check condition of old throttle body-to-intake manifold o-ring (Fig. 42).

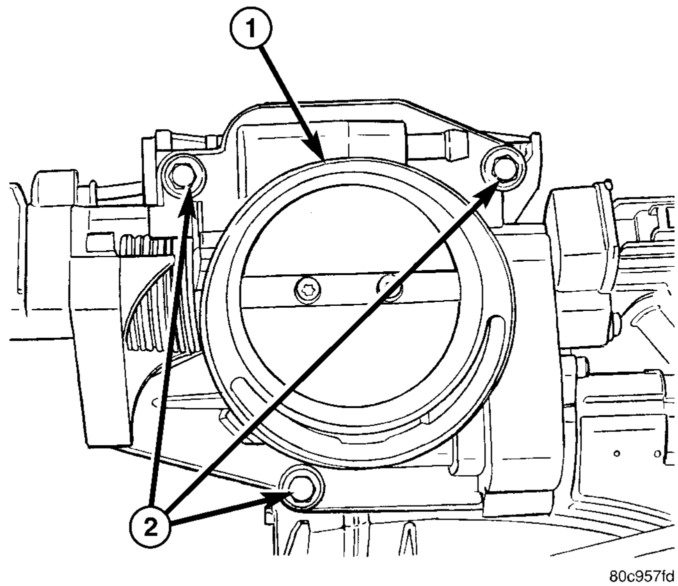


Fig. 41 THROTTLE BODY MOUNTING BOLTS - 3.7L V-6

1 - THROTTLE BODY
2 - MOUNTING BOLTS (3)

4.7L V-8

(1) Remove air duct and air resonator box at throttle body.

(2) Disconnect throttle body electrical connectors at IAC motor and TPS (Fig. 43).

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to Accelerator Pedal and Throttle Cable.

(5) Remove three throttle body mounting bolts (Fig. 43).

(6) Remove throttle body from intake manifold.

5.7L V-8

CAUTION: Do not use spray (carb) cleaners on any part of the throttle body. Do not apply silicone lubricants to any part of the throttle body.

THROTTLE BODY (Continued)

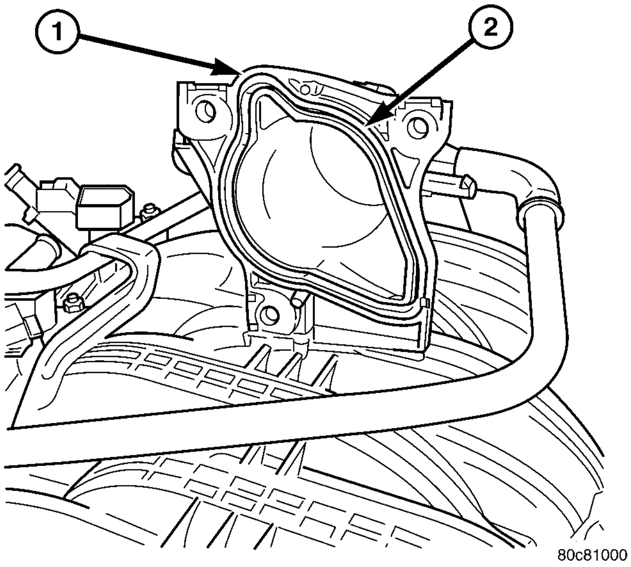


Fig. 42 THROTTLE BODY O-RING - 3.7L V-6

1 - INTAKE MANIFOLD
2 - THROTTLE BODY O-RING

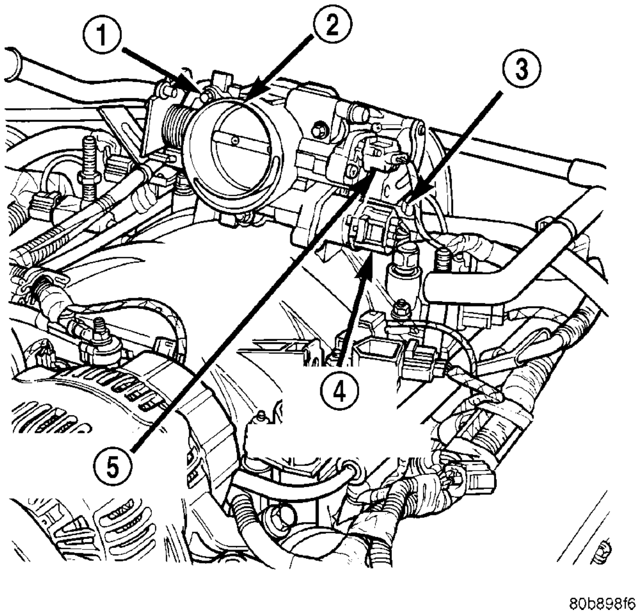


Fig. 43 THROTTLE BODY MOUNTING BOLTS - 4.7L V-8

1 - MOUNTING BOLTS (3)
2 - THROTTLE BODY
3 - IAT SENSOR CONNECTOR
4 - IAC MOTOR CONNECTOR
5 - TPS CONNECTOR

(1) Remove air duct and air resonator box at throttle body.

(2) Disconnect electrical connector at throttle body (Fig. 44).

(3) Remove 4 throttle body mounting bolts (Fig. 44).

(4) Remove throttle body from intake manifold.

(5) Check condition of throttle body o-ring (Fig. 45).

(6) If the throttle body has been changed, the following procedure must be performed:

(a) Disconnect negative battery cable from battery. Leave cable disconnected for approximately 90 seconds.

(b) Reconnect cable to battery.

(c) Turn ignition switch ON, but do not crank engine.

(d) Leave ignition switch ON for a minimum of 10 seconds. This will allow PCM to learn throttle body electrical parameters.

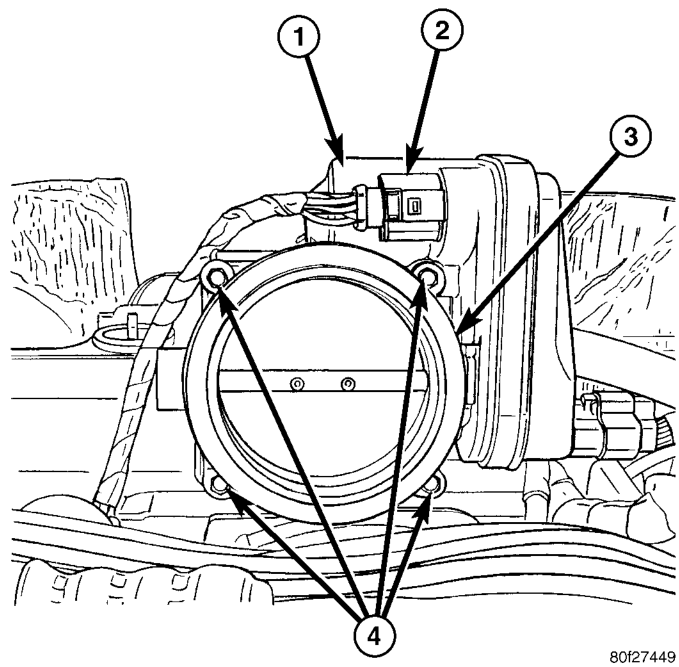


Fig. 44 5.7L V-8 THROTTLE BODY

1 - THROTTLE BODY
2 - ELECTRICAL CONNECTOR
3 - SILICONE SEAL
4 - MOUNTING BOLTS (4)

5.9L V-8

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

(1) Remove the air cleaner resonator tube.

(2) Disconnect throttle body electrical connectors at MAP sensor, IAC motor and TPS (Fig. 46).

(3) Remove vacuum line at throttle body.

(4) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

THROTTLE BODY (Continued)

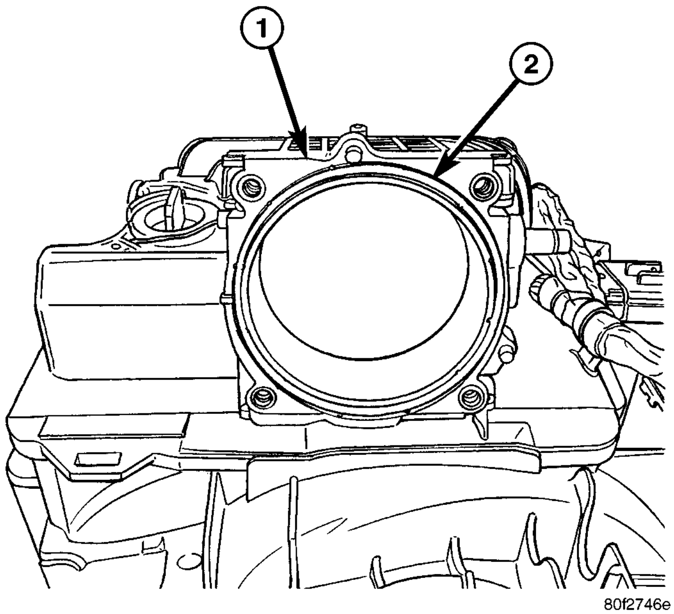


Fig. 45 5.7L V-8 THROTTLE BODY O-RING

1 - INTAKE MANIFOLD
2 - THROTTLE BODY O-RING

(5) Remove four throttle body mounting bolts (Fig. 47).

(6) Remove throttle body from intake manifold.

(7) Discard old throttle body-to-intake manifold gasket.

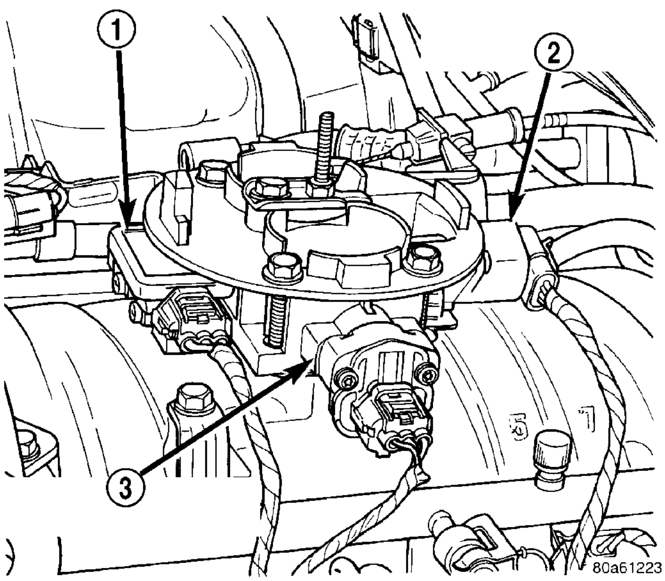


Fig. 46 SENSOR ELECTRICAL CONNECTORS - 5.9L V-8

1 - MAP SENSOR
2 - IDLE AIR CONTROL MOTOR
3 - THROTTLE POSITION SENSOR

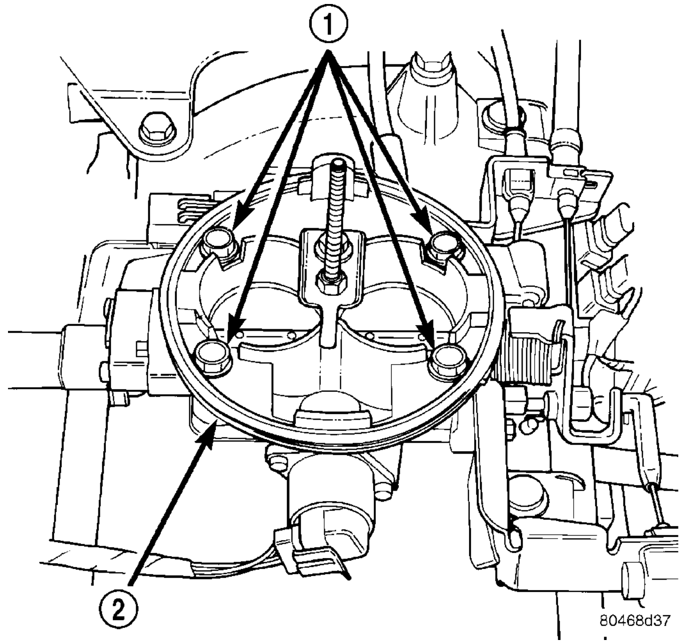


Fig. 47 THROTTLE BODY MOUNTING BOLTS - 5.9L V-8

1 - THROTTLE BODY MOUNTING BOLTS (4)
2 - THROTTLE BODY

8.0L V-10

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).

(1) Remove air plenum resonator.

(2) Disconnect throttle body electrical connectors at the IAC motor and TPS.

(3) Remove all control cables from throttle body (lever) arm. Refer to the Accelerator Pedal and Throttle Cable section of this group for additional information.

(4) Remove four throttle body mounting nuts (Fig. 48).

(5) Remove throttle body from intake manifold.

(6) Discard old throttle body-to-intake manifold gasket.

INSTALLATION

3.7L V-6

(1) Check condition of throttle body-to-intake manifold o-ring. Replace as necessary.

(2) Clean mating surfaces of throttle body and intake manifold.

(3) Install throttle body-to-intake manifold o-ring.

(4) Install throttle body to intake manifold.

(5) Install 3 mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.

THROTTLE BODY (Continued)

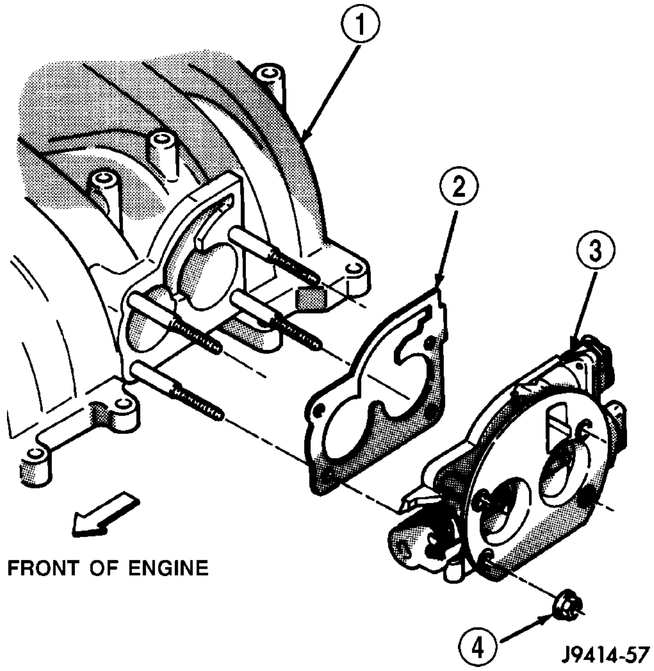


Fig. 48 THROTTLE BODY MOUNTING NUTS - 8.0L V-10

1 - INTAKE MANIFOLD UPPER HALF
2 - GASKET
3 - THROTTLE BODY
4 - MOUNTING NUTS (4)

(6) Install control cables.
(7) Install electrical connectors.
(8) Install necessary vacuum lines.
(9) Install air plenum.

4.7L V-8

(1) Clean throttle body-to-intake manifold o-ring.
(2) Clean mating surfaces of throttle body and intake manifold.
(3) Install throttle body to intake manifold by positioning throttle body to manifold alignment pins.
(4) Install three mounting bolts. Tighten bolts to 12 N·m (105 in. lbs.) torque.
(5) Install control cables.
(6) Install vacuum line to throttle body.
(7) Install electrical connectors.
(8) Install air plenum.

5.7L V-8

CAUTION: Do not use spray (carb) cleaners on any part of the throttle body. Do not apply silicone lubricants to any part of the throttle body.

(1) Clean and check condition of throttle body-to-intake manifold o-ring.
(2) Clean mating surfaces of throttle body and intake manifold.
(3) Install throttle body to intake manifold by positioning throttle body to manifold alignment pins.
(4) Install 4 mounting bolts. Refer to Torque Specifications.
(5) Install electrical connector.
(6) Install air plenum.
(7) **If the throttle body has been changed, the following procedure must be performed:**

(a) Disconnect negative battery cable from battery. Leave cable disconnected for approximately 90 seconds.
(b) Reconnect cable to battery.
(c) Turn ignition switch ON, but do not crank engine.
(d) Leave ignition switch ON for a minimum of 10 seconds. This will allow PCM to learn throttle body electrical parameters.

5.9L V-8

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).
(1) Clean the mating surfaces of the throttle body and the intake manifold.
(2) Install new throttle body-to-intake manifold gasket.
(3) Install throttle body to intake manifold.
(4) Install four mounting bolts. Tighten bolts to 23 N·m (200 in. lbs.) torque.
(5) Install control cables.
(6) Install vacuum line to throttle body.
(7) Install electrical connectors.
(8) Install air plenum.

8.0L V-10

A (factory adjusted) set screw is used to mechanically limit the position of the throttle body throttle plate. **Never attempt to adjust the engine idle speed using this screw.** All idle speed functions are controlled by the powertrain control module (PCM).
(1) Clean mating surfaces of throttle body and intake manifold.
(2) Install new throttle body-to-intake manifold gasket.
(3) Install throttle body to intake manifold.
(4) Install four mounting nuts (Fig. 48). Refer to Torque Specifications.
(5) Install control cables.
(6) Install electrical connectors.
(7) Install air plenum and hoses.

THROTTLE CONTROL CABLE

REMOVAL

3.7L V-6

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or throttle cable.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 1). Plastic cable retainer snaps into top of pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove metal clip holding cable to dashpanel (Fig. 1).

(4) Remove air resonator box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 49) from throttle body bellcrank.

(8) Using a pick or small screwdriver, press release tab (Fig. 50) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 50) towards right side of vehicle to remove throttle cable from throttle body bracket.

(9) Remove throttle cable from vehicle.

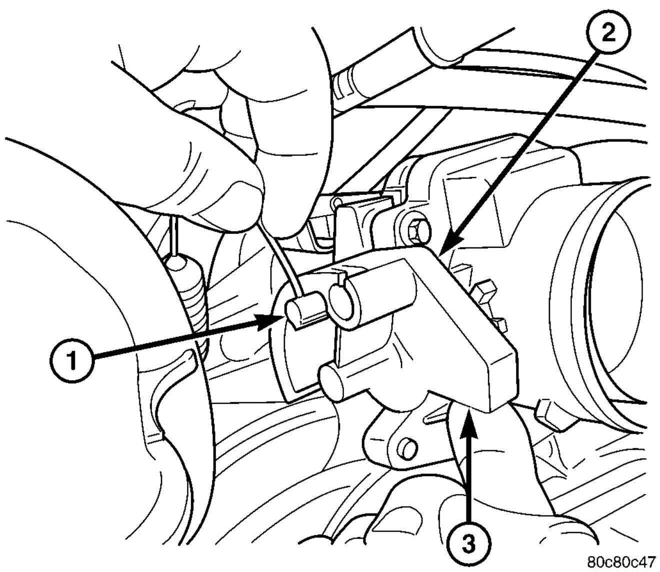


Fig. 49 THROTTLE CABLE PIN - 3.7L V-6

1 - THROTTLE CABLE PIN
2 - THROTTLE BODY BELLCRANK
3 - PUSH UP HERE

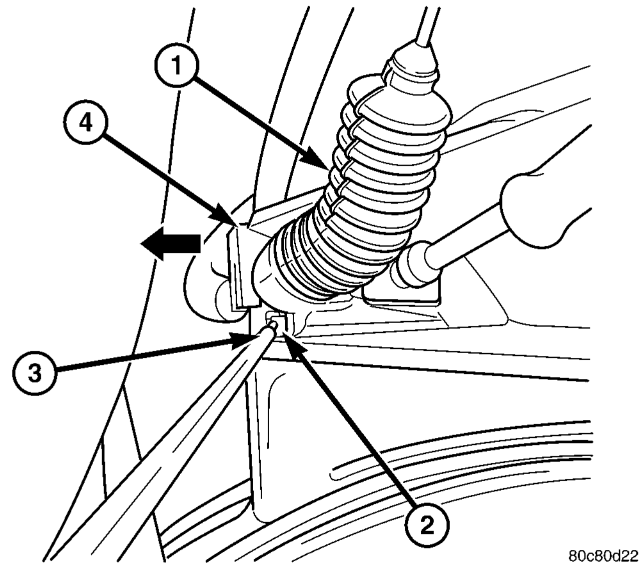


Fig. 50 THROTTLE CABLE RELEASE TAB - 3.7L V-6

1 - THROTTLE CABLE
2 - RELEASE TAB
3 - PICK OR SCREWDRIVER
4 - PLASTIC CABLE MOUNT

4.7L V-8

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or throttle cable.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer (clip) and throttle cable core wire from upper end of pedal arm (Fig. 1). Plastic cable retainer (clip) snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) From inside vehicle, remove cable clip holding cable to dashpanel (Fig. 1).

(4) Remove air box at throttle body.

(5) Unsnap cable from dashpanel routing clip.

(6) Remove cable housing from dash panel and pull into engine compartment.

(7) Using finger pressure only, disconnect accelerator cable connector at throttle body bellcrank pin by pushing connector off bellcrank pin towards front of vehicle (Fig. 51). **DO NOT try to pull connector off perpendicular to bellcrank pin. Connector will be broken.**

(8) Lift accelerator cable from top of cable cam (Fig. 51).

(9) Press tab (Fig. 52) to release plastic cable mount from bracket. **Press on tab only enough to release cable from bracket. If tab is pressed too much, it will be broken.** Slide plastic mount (Fig. 52) towards passenger side of vehicle to remove cable from bracket.

(10) Remove throttle cable from vehicle.

THROTTLE CONTROL CABLE (Continued)

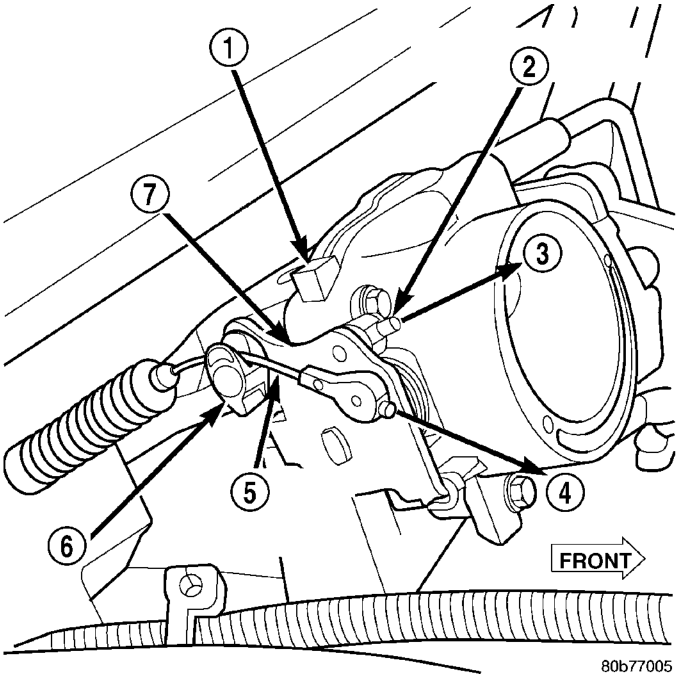


Fig. 51 ACCELERATOR CABLE AT BELL CRANK - 4.7L V-8

1 - THROTTLE BODY
2 - SPEED CONTROL CABLE CONNECTOR
3 - OFF
4 - OFF
5 - ACCELERATOR CABLE CONNECTOR
6 - CABLE CAM
7 - BELLCRANK

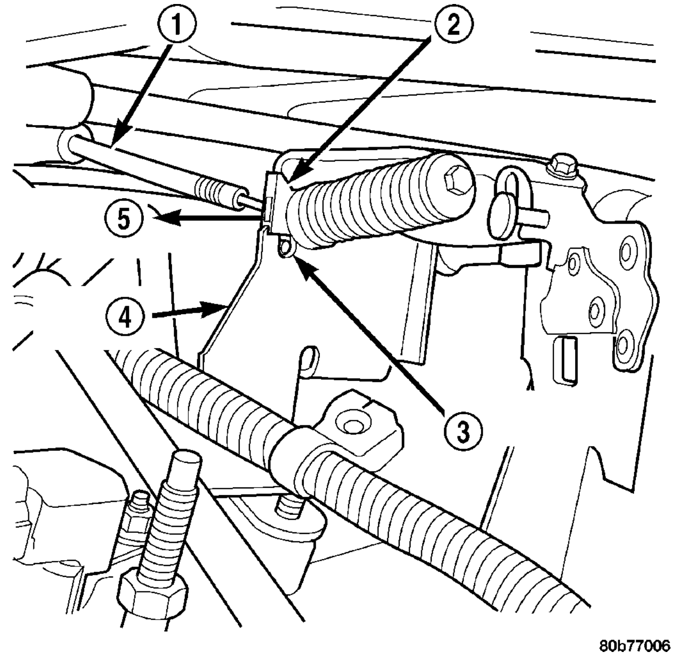


Fig. 52 ACCELERATOR CABLE RELEASE TAB - 4.7L V-8

1 - ACCELERATOR CABLE
2 - PLASTIC CABLE MOUNT
3 - PRESS TAB FOR REMOVAL
4 - CABLE BRACKET
5 - SLIDE FOR REMOVAL

5.7L V-8

The Throttle Control Cable on the 5.7L V-8 engine connects the accelerator pedal to the Accelerator Pedal Position Sensor (APPS). A separate mechanical cable is not routed to the throttle body.

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal, cables or APPS.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 1). The plastic cable retainer snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) Remove APPS. Refer to Accelerator Pedal Position Sensor (APPS) Removal / Installation.

(4) From inside vehicle, remove cable clip (Fig. 1).

(5) Remove cable housing from dash panel and pull cable into engine compartment.

(6) Remove cable housing at APPS bracket by pressing on release tab with a small screwdriver. **To prevent cable housing breakage, press on tab only enough to release cable from APPS bracket.**

5.9L V-8

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or cables.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 1). The plastic cable retainer snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) Remove air resonator at throttle body.

(4) From inside vehicle, remove cable clip (Fig. 1).

(5) Remove cable housing from dash panel and pull cable into engine compartment.

(6) Disconnect cable from routing/holddown clip.

(7) Slip cable end rearward from pin on throttle body (Fig. 53).

(8) Remove cable housing at throttle body mounting bracket by pressing on release tab with a small screwdriver (Fig. 54). **To prevent cable housing breakage, press on tab only enough to release cable from bracket.** Lift cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

THROTTLE CONTROL CABLE (Continued)

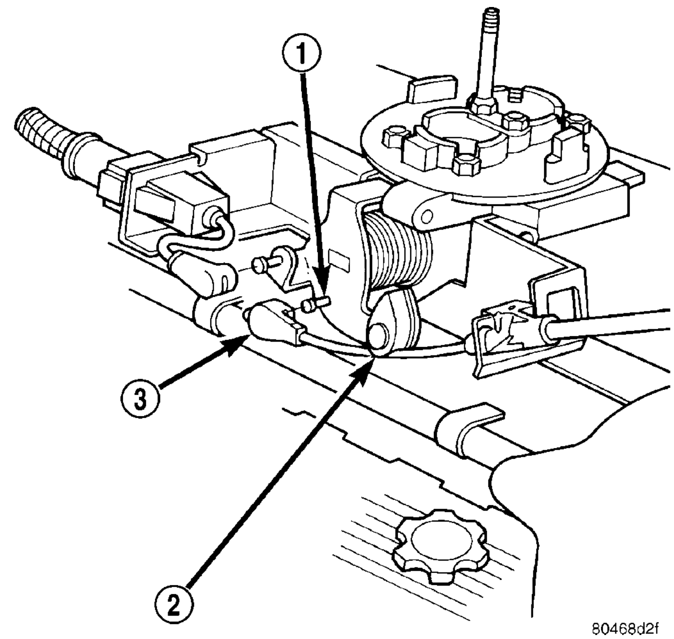


Fig. 53 THROTTLE CABLE AT THROTTLE BODY - 5.9L

1 - THROTTLE LEVER PIN
2 - CAM (V-8 ENGINE ONLY)
3 - THROTTLE CABLE END

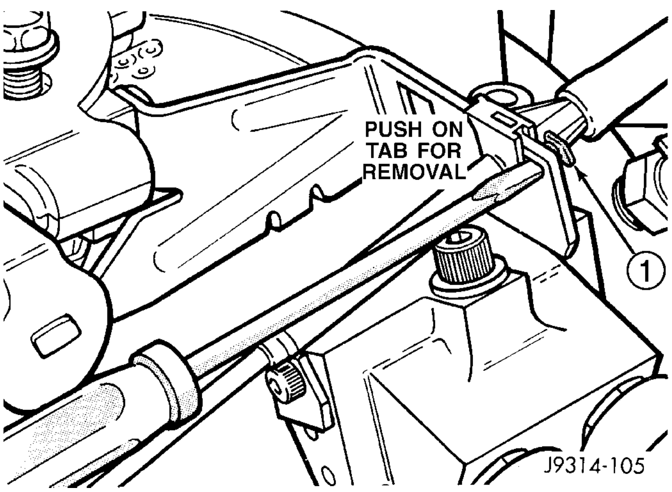


Fig. 54 CABLE RELEASE - 5.9L V-8

1 - TAB

8.0L V-10

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal or cables.

(1) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 1). The plastic cable retainer snaps into pedal arm.

(2) Remove cable core wire at pedal arm.

(3) Remove necessary air intake tubes and resonator housing.

(4) From inside vehicle, pinch both sides of plastic cable housing retainer tabs at dash panel (Fig. 1).

(5) Remove cable housing from dash panel and pull cable into engine compartment.

(6) Remove throttle cable socket at throttle lever ball (Fig. 55) (snaps off).

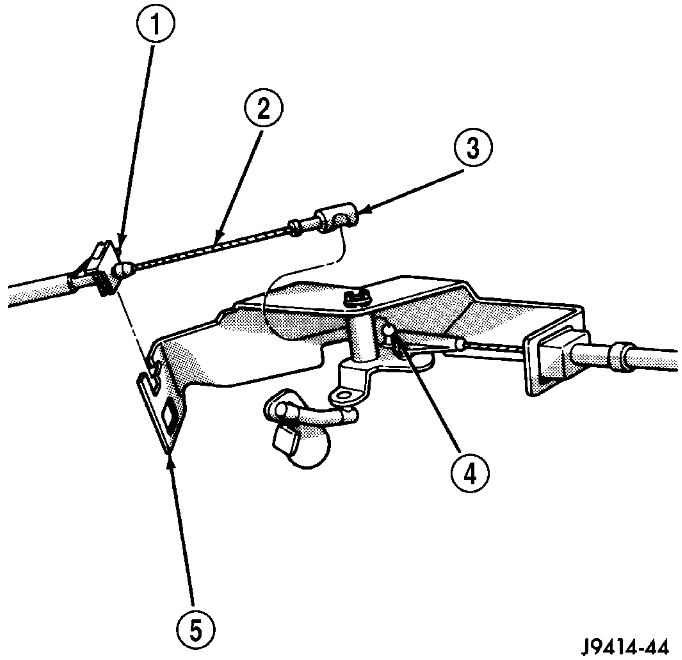


Fig. 55 THROTTLE CABLE AT THROTTLE BODY - 8.0L V-10

1 - PRESS TAB FOR CABLE REMOVAL
2 - THROTTLE CABLE
3 - CABLE SOCKET
4 - LEVER BALL
5 - MOUNTING BRACKET

(7) Remove cable housing at throttle body mounting bracket by pressing on release tab with a small screwdriver (Fig. 55). **To prevent cable housing breakage, press on tab only enough to release cable from bracket.** Lift cable housing straight up from bracket while pressing on release tab. Remove throttle cable from vehicle.

INSTALLATION

3.7L V-6

(1) Slide accelerator cable plastic mount into throttle body mounting bracket. Continue sliding until release tab (Fig. 50) is aligned to hole in mounting bracket.

(2) Hold throttle in wide open position. While held in this position, slide throttle cable pin (Fig. 49) into throttle body bellcrank.

(3) Push cable housing into rubber grommet and through opening in dash panel.

THROTTLE CONTROL CABLE (Continued)

(4) From inside vehicle, install metal clip holding cable to dashpanel (Fig. 1).

(5) From inside vehicle, slide throttle cable core wire into opening (slot) in top of pedal arm.

(6) Push plastic cable retainer (clip) into pedal arm opening until it snaps in place.

(7) Install air resonator tube to throttle body.

(8) Before starting engine, operate accelerator pedal to check for any binding.

4.7L V-8

(1) Slide accelerator cable plastic mount into bracket. Continue sliding until tab (Fig. 52) is aligned to hole in mounting bracket.

(2) Route accelerator cable over top of cable cam.

(3) Connect cable end to throttle body bellcrank pin (snaps on rearward).

(4) Slide rubber grommet away from plastic cable housing.

(5) Install rubber grommet into dash panel until seated.

(6) Push cable housing into rubber grommet and through opening in dash panel.

(7) From inside vehicle, install clip holding cable to dashpanel (Fig. 1).

(8) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(9) Push cable retainer (clip) into pedal arm opening until it snaps in place.

(10) Snap cable into dashpanel routing clip.

(11) Install air resonator tube to throttle body.

(12) Before starting engine, operate accelerator pedal to check for any binding.

5.7L V-8

(1) Attach cable to Accelerator Pedal Position Sensor (APPS). Refer to APPS Removal / Installation.

(2) Push cable housing into rubber grommet and through opening in dash panel.

(3) From inside vehicle, install clip holding cable to dashpanel (Fig. 1).

(4) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(5) Push cable retainer (clip) into pedal arm opening until it snaps in place.

(6) Before starting engine, operate accelerator pedal to check for any binding.

(7) If necessary, use DRB III® Scan Tool to erase any APPS Diagnostic Trouble Codes (DTC's) from PCM.

5.9L V-8

(1) Slide accelerator cable plastic mount into throttle body mounting bracket. Continue sliding until release tab (Fig. 54) is aligned to hole in mounting bracket.

(2) Hold throttle in wide open position. While held in this position, slide throttle cable pin into throttle body bellcrank.

(3) Push cable housing into rubber grommet and through opening in dash panel.

(4) From inside vehicle, install metal clip holding cable to dashpanel (Fig. 1).

(5) From inside vehicle, slide throttle cable core wire into opening (slot) in top of pedal arm.

(6) Push plastic cable retainer (clip) into pedal arm opening until it snaps in place.

(7) Install air resonator tube to throttle body.

(8) Before starting engine, operate accelerator pedal to check for any binding.

8.0L V-10

(1) Connect cable end socket to throttle body lever ball (snaps on) (Fig. 55).

(2) Connect cable to throttle body mounting bracket (push down and lock)

(3) Install the remaining cable housing end into and through the dash panel opening (snaps into position). The two plastic pinch tabs (Fig. 1) should lock the cable to dash panel.

(4) From inside the vehicle, hold up the accelerator pedal. Install the throttle cable core wire and plastic cable retainer into and through the upper end of the pedal arm (the plastic retainer is snapped into the pedal arm). When installing the plastic retainer to the accelerator pedal arm, note the index tab on the pedal arm (Fig. 1). Align the index slot on the plastic cable retainer to this index tab.

(5) Install air resonator tube to throttle body.

(6) Before starting engine, operate accelerator pedal to check for any binding.

THROTTLE POSITION SENSOR

DESCRIPTION

The 3-wire Throttle Position Sensor (TPS) is mounted on the throttle body and is connected to the throttle blade shaft.

The 5.7L V-8 engine does not use a separate TPS on the throttle body.

OPERATION

The 5.7L V-8 engine does not use a separate Throttle Position Sensor (TPS) on the throttle body.

The 3–wire TPS provides the Powertrain Control Module (PCM) with an input signal (voltage) that represents the throttle blade position of the throttle body. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the output voltage of the TPS changes.

THROTTLE POSITION SENSOR (Continued)

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the PCM) represents the throttle blade position. The PCM receives an input signal voltage from the TPS. This will vary in an approximate range of from .26 volts at minimum throttle opening (idle), to 4.49 volts at wide open throttle. Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. In response to engine operating conditions, the PCM will adjust fuel injector pulse width and ignition timing.

The PCM needs to identify the actions and position of the throttle blade at all times. This information is needed to assist in performing the following calculations:

- Ignition timing advance
- Fuel injection pulse-width
- Idle (learned value or minimum TPS)
- Off-idle (0.06 volt)
- Wide Open Throttle (WOT) open loop (2.608 volts above learned idle voltage)
- Deceleration fuel lean out
- Fuel cutoff during cranking at WOT (2.608 volts above learned idle voltage)
- A/C WOT cutoff (certain automatic transmissions only)

REMOVAL

3.7L V6

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 56), or (Fig. 57).

(1) Remove air resonator tube at throttle body.
(2) Disconnect TPS electrical connector.
(3) Remove 2 TPS mounting screws.
(4) Remove TPS.

4.7L V-8

The TPS is located on the throttle body (Fig. 58).

(1) Remove air duct and tube at throttle body.
(2) Disconnect TPS electrical connector.
(3) Remove two TPS mounting bolts (screws) (Fig. 58).
(4) Remove TPS from throttle body.

5.7L V-8

The 5.7L V-8 engine does not use a separate Throttle Position Sensor (TPS) on the throttle body.

5.9L V-8

The TPS is located on the side of the throttle body (Fig. 59).

(1) Remove air intake tube at throttle body.
(2) Disconnect TPS electrical connector.
(3) Remove two TPS mounting bolts (Fig. 59).
(4) Remove TPS from throttle body.

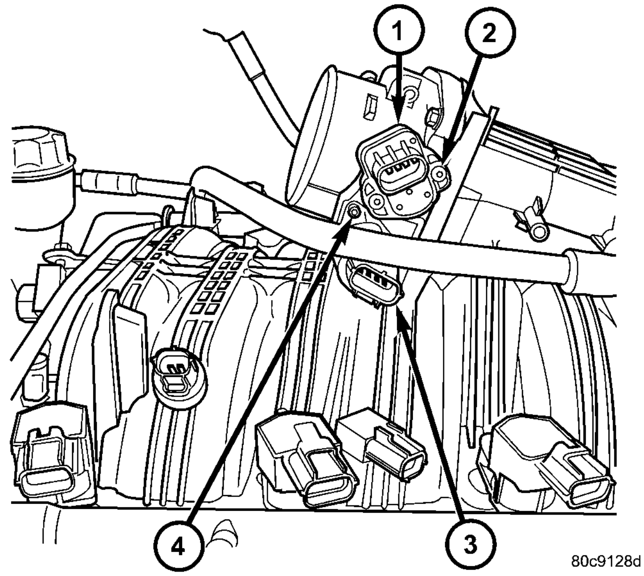


Fig. 56 TPS LOCATION - 3.7L V-6

1 - THROTTLE POSITION SENSOR (TPS)
2 - MOUNTING SCREWS
3 - IDLE AIR CONTROL MOTOR (IAC)
4 - MOUNTING SCREWS

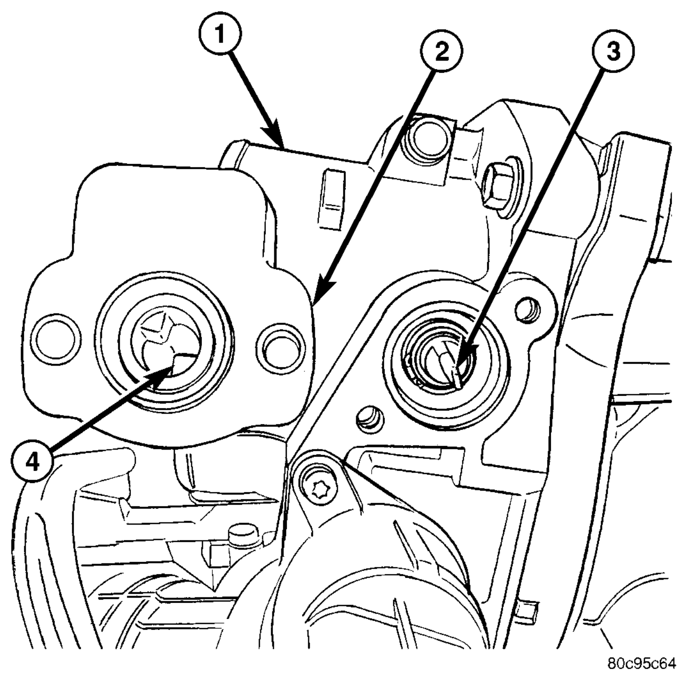


Fig. 57 TPS INSTALLATION - 3.7 V-6

1 - THROTTLE BODY
2 - TPS
3 - THROTTLE BODY SHAFT
4 - SOCKET LOCATING TANGS

8.0L V-10

The TPS is located on the side of the throttle body (Fig. 60).

(1) Remove air plenum.
(2) Disconnect TPS electrical connector.

THROTTLE POSITION SENSOR (Continued)

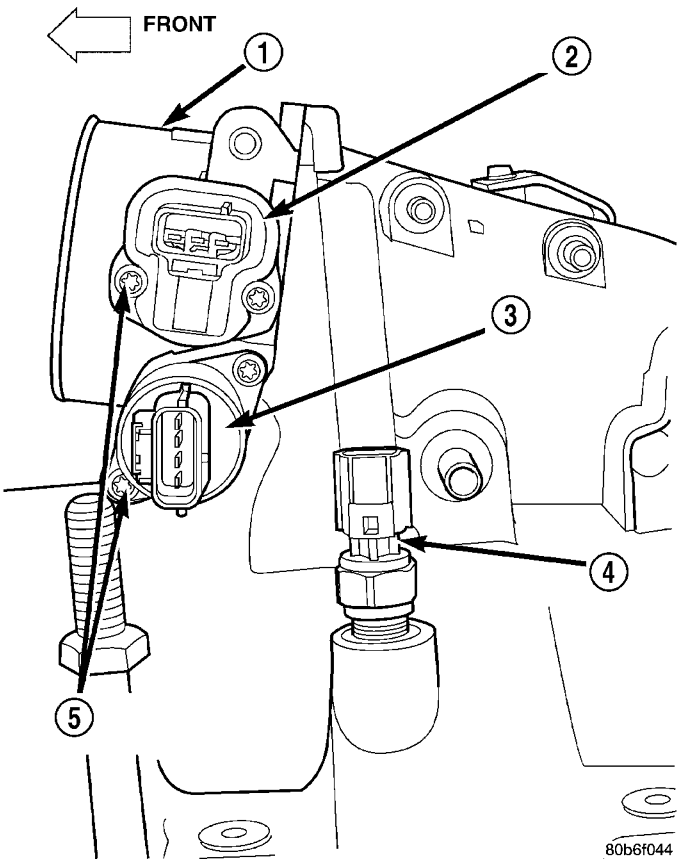


Fig. 58 TPS LOCATION - 4.7L

1 - THROTTLE BODY
2 - TPS
3 - IAC MOTOR
4 - IAT SENSOR
5 - MOUNTING SCREWS

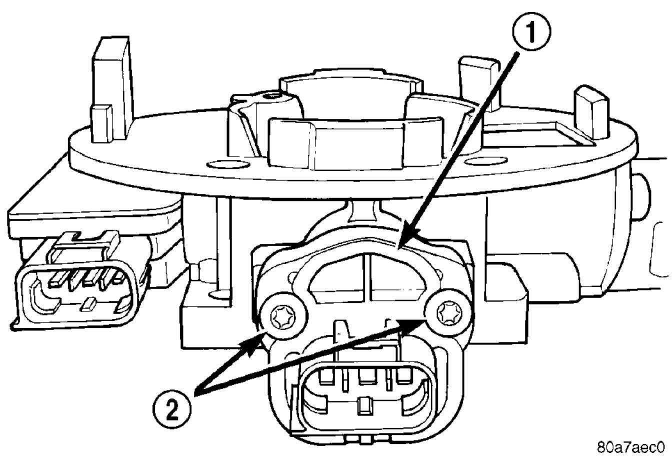


Fig. 59 TPS LOCATION - 5.9L V-8

1 - THROTTLE POSITION SENSOR
2 - MOUNTING SCREWS

(3) Remove two TPS mounting bolts (Fig. 60).

(4) Remove TPS from throttle body.

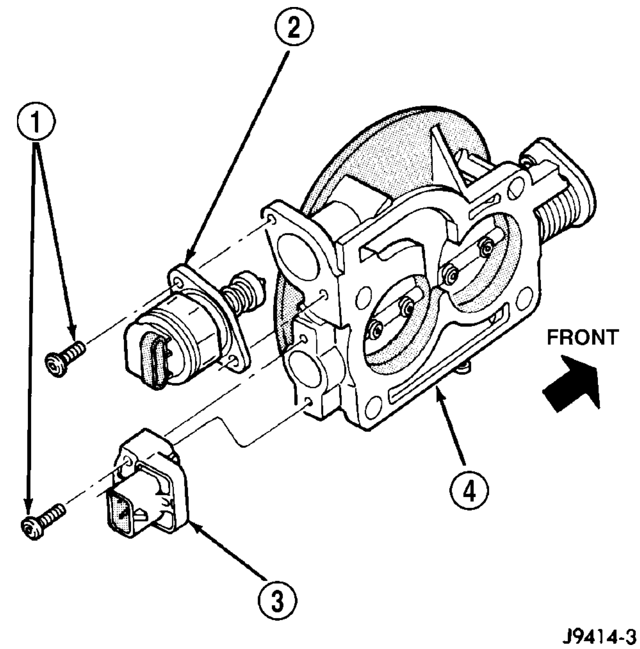


Fig. 60 TPS MOUNTING BOLTS - 8.0L V-10

1 - MOUNTING BOLTS (2)
2 - IDLE AIR CONTROL MOTOR
3 - THROTTLE POSITION SENSOR
4 - THROTTLE BODY

INSTALLATION

3.7L V-6

The Throttle Position Sensor (TPS) is mounted to the throttle body (Fig. 56).

The throttle shaft end of throttle body slides into a socket in TPS (Fig. 61). The TPS must be installed so that it can be rotated a few degrees. (If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs). The TPS will be under slight tension when rotated.

(1) Install TPS and retaining screws.

(2) Tighten screws to 7 N·m (60 in. lbs.) torque.

(3) Connect TPS electrical connector to TPS.

(4) Manually operate throttle (by hand) to check for any TPS binding before starting engine.

(5) Install air cleaner tube to throttle body.

4.7L V-8

The throttle shaft end of throttle body slides into a socket in TPS (Fig. 62). The TPS must be installed so that it can be rotated a few degrees. If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs. The TPS will be under slight tension when rotated.

(1) Install TPS and two retaining bolts.

(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.

(3) Manually operate throttle control lever by hand to check for any binding of TPS.

(4) Connect TPS electrical connector to TPS.

THROTTLE POSITION SENSOR (Continued)

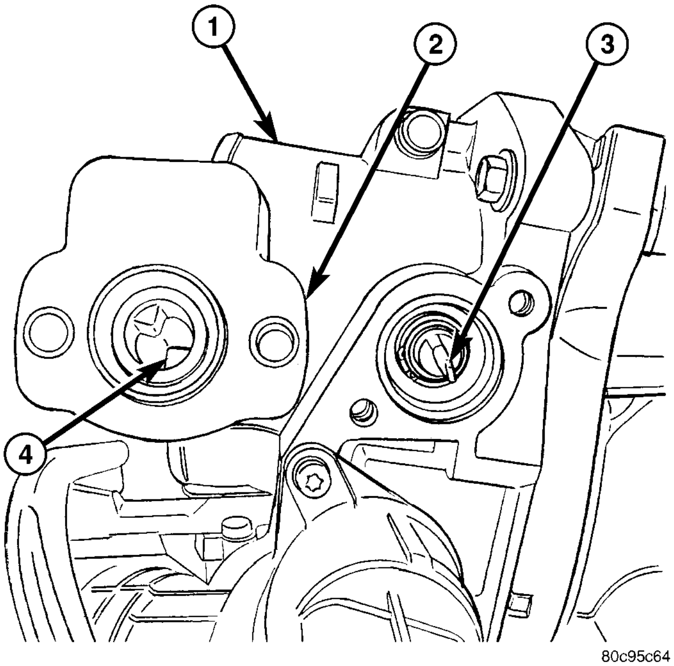


Fig. 61 TPS INSTALLATION - 3.7L

1 - THROTTLE BODY
2 - TPS
3 - THROTTLE BODY SHAFT
4 - SOCKET LOCATING TANGS

(5) Install air duct/air box to throttle body.

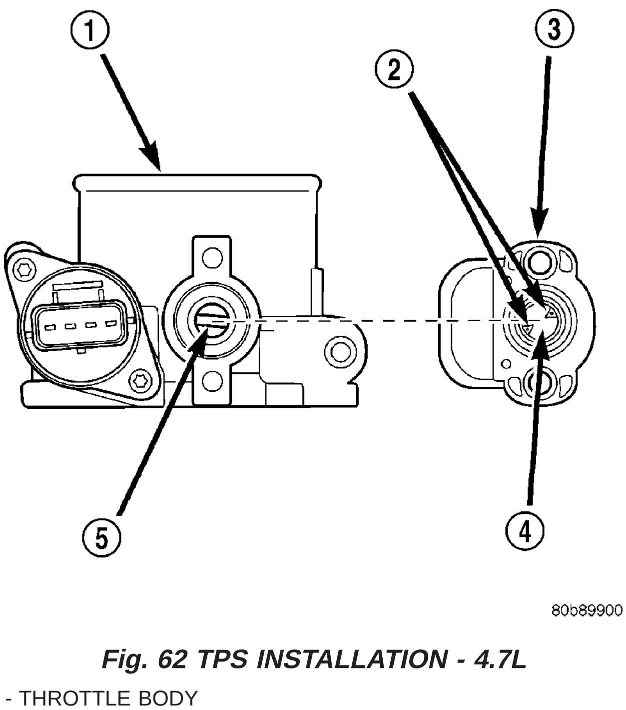


Fig. 62 TPS INSTALLATION - 4.7L

1 - THROTTLE BODY
2 - LOCATING TANGS
3 - THROTTLE POSITION SENSOR
4 - SOCKET
5 - THROTTLE SHAFT

5.9L V-8

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 63). The TPS must be installed so that it can be rotated a few degrees. If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs. The TPS will be under slight tension when rotated.

(1) Install TPS and two retaining bolts.

(2) Tighten bolts to 7 N·m (60 in. lbs.) torque.

(3) Manually operate throttle control lever by hand to check for any binding of TPS.

(4) Connect TPS electrical connector to TPS.

(5) Install air intake tube.

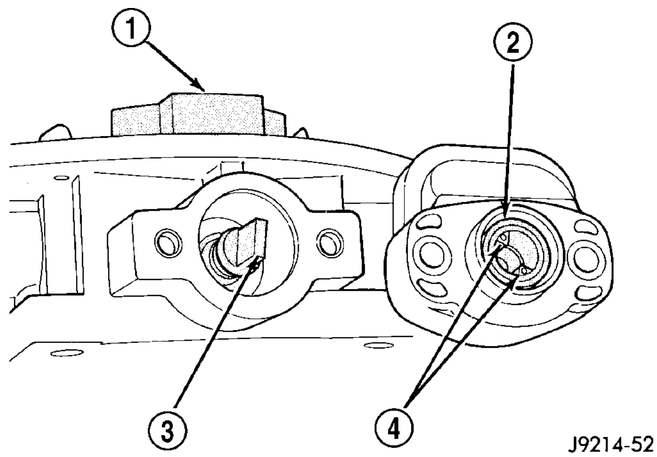


Fig. 63 TPS INSTALLATION - 5.9L V-8 AND 8.0L V-10

1 - THROTTLE BODY
2 - THROTTLE POSITION SENSOR
3 - THROTTLE SHAFT
4 - SOCKET LOCATING TANGS

8.0L V-10

The throttle shaft end of the throttle body slides into a socket in the TPS (Fig. 63). The TPS must be installed so that it can be rotated a few degrees. If sensor will not rotate, install sensor with throttle shaft on other side of socket tangs. The TPS will be under slight tension when rotated.

(1) Install TPS and two retaining bolts. Refer to Torque Specifications.

(2) Manually operate throttle control lever by hand to check for any binding of TPS.

(3) Connect TPS electrical connector to TPS.

(4) Install air plenum.

FUEL DELIVERY - DIESEL

TABLE OF CONTENTS

FUEL DELIVERY - DIESEL

DESCRIPTION - DIESEL FUEL SYSTEM

The fuel system used on the Cummins engine is an electronically controlled, Bosch HPCR (High-Pressure Common Rail) system. The HPCR system consists of five main components:

- Electric Fuel Transfer (lift) Pump
- Fuel Pump/Gear Pump (attached to fuel injection pump)
- High-Pressure Fuel Injection Pump
- Fuel Injection Rail
- Fuel Injectors

Also to be considered as part of the overall fuel system are:

- Accelerator Pedal
- Air Cleaner Housing/Element
- Fuel Drain Manifold (passage)
- Fuel Drain Valve (at filter)
- Fuel Filter/Water Separator
- Fuel Heater
- Fuel Heater Relay
- Fuel Level (gauge) Sending Unit
- Fuel Tank
- Fuel Tank Module (containing fuel gauge sending unit and separate fuel filter located at bottom of tank module)
- Fuel Tank Filler/Vent Tube Assembly
- Fuel Tank Filler Tube Cap
- Fuel Tubes/Lines/Hoses
- High-Pressure Fuel Injector Lines
- In-Tank Fuel Filter (at bottom of fuel tank module)
- Low-Pressure Fuel Supply Lines
- Low-Pressure Fuel Return Line
- Overflow Valve
- Quick-Connect Fuel Line Fittings
- Throttle Cable
- Water Draining (maintenance)
- Water-In-Fuel (WIF) Sensor

The fuel injection pump supplies high pressure to the fuel rail independent of engine speed. This high pressure is then accumulated in the fuel rail. High pressure fuel is constantly supplied to the injectors by the fuel rail. The Engine Control Module (ECM) controls the fueling and timing of the engine by actuating the injectors.

Fuel enters the system from the electric fuel transfer (lift) pump, which is attached to the fuel filter assembly. Fuel is forced through the fuel filter element and then enters the Fuel Pump/Gear Pump, which is attached to the rear of the fuel injection pump. The Fuel Pump/Gear Pump is a low-pressure pump and produce pressures ranging from 551.5 kpa (80 psi) to 1241 kpa (180) psi. Fuel then enters the fuel injection pump. Low pressure fuel is then supplied to the FCA (Fuel Control Actuator).

The FCA is an electronically controlled solenoid valve. The ECM controls the amount of fuel that enters the high-pressure pumping chambers by opening and closing the FCA based on a demanded fuel pressure. The FPS (Fuel Pressure Sensor) on the fuel rail provides the actual fuel pressure. When the actuator is opened, the maximum amount of fuel is being supplied to the fuel injection pump. Any fuel that does not enter the injection pump is directed to the overflow valve. The overflow valve regulates how much excess fuel is used for lubrication of the pump and how much is returned to the tank through the drain manifold.

Fuel entering the injection pump is pressurized to between 300 - 1600 bar by three radial pumping chambers. The pressurized fuel is then supplied to the fuel rail.

Some fuel system components are shown in.

WARNING: HIGH-PRESSURE FUEL LINES DELIVER DIESEL FUEL UNDER EXTREME PRESSURE FROM THE INJECTION PUMP TO THE FUEL INJECTORS. THIS MAY BE AS HIGH AS 160,000 KPA (23,206 PSI). USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

Certain fuel system components can be found in (Fig. 1), or (Fig. 2).

STANDARD PROCEDURE

STANDARD PROCEDURES - WATER DRAINING AT FUEL FILTER

Refer to Fuel Filter/Water Separator removal/installation for procedures.

FUEL DELIVERY - DIESEL (Continued)

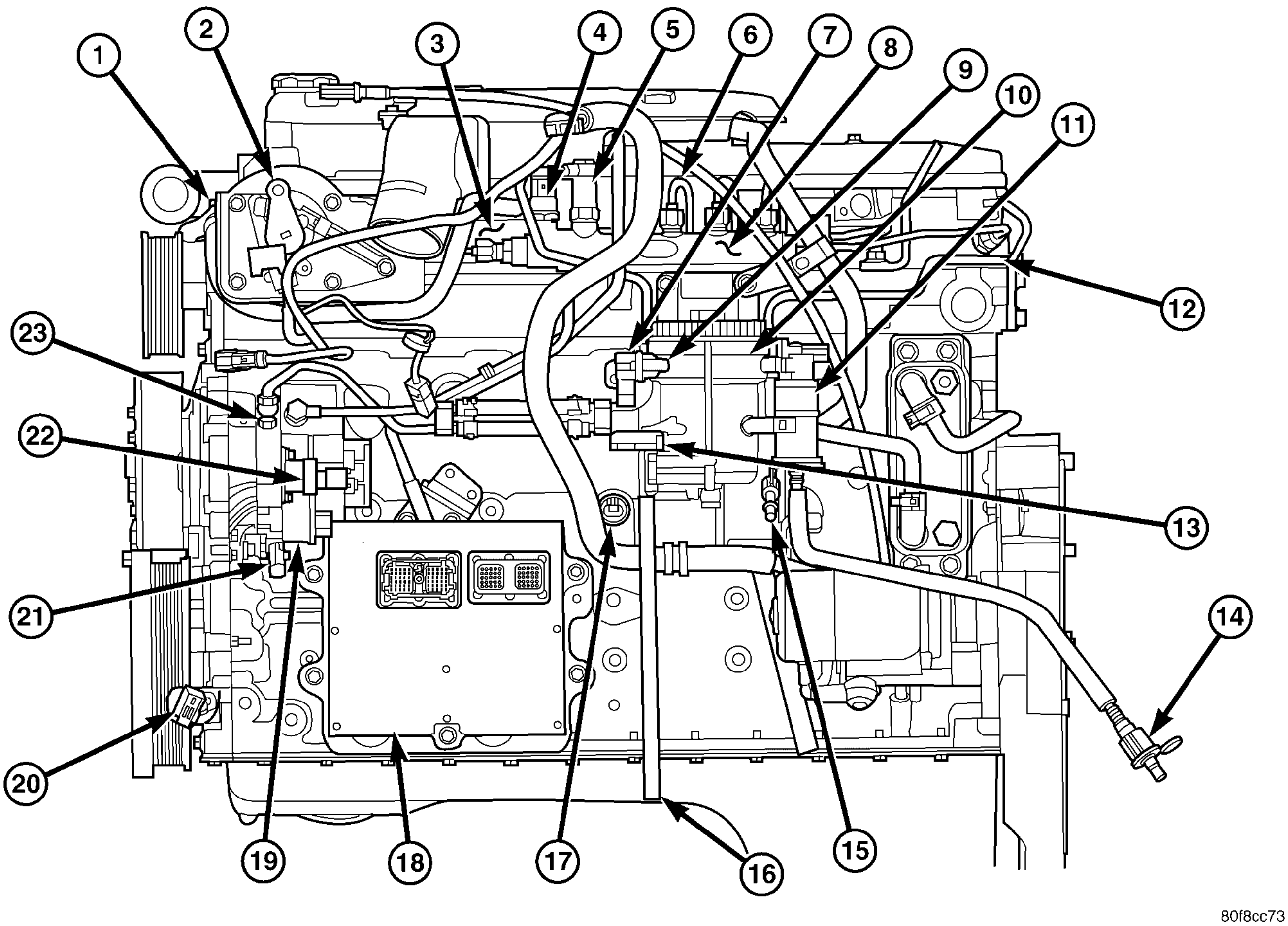


Fig. 1 DIESEL FUEL SYSTEM COMPONENTS

1 - ENGINE COOLANT TEMPERATURE (ECT) SENSOR
2 - THROTTLE LEVER BELLCRANK AND APPS (ACCELERATOR PEDAL POSITION SENSOR)
3 - INTAKE MANIFOLD AIR HEATER/ELEMENTS
4 - FUEL PRESSURE SENSOR
5 - FUEL LIMITING VALVE
6 - HIGH-PRESSURE FUEL LINES
7 - FUEL HEATER
8 - HIGH-PRESSURE FUEL INJECTOR RAIL
9 - FUEL HEATER TEMPERATURE SENSOR (THERMOSTAT)
10 - FUEL FILTER/WATER SEPARATOR
11 - FUEL TRANSFER (LIFT) PUMP
12 - FUEL DRAIN MANIFOLD
13 - DRAIN VALVE
14 - FUEL SUPPLY LINE (LOW-PRESSURE, TO ENGINE)
15 - FUEL RETURN LINE CONNECTION (TO FUEL TANK)
16 - FUEL DRAIN TUBE
17 - OIL PRESSURE SENSOR
18 - ENGINE CONTROL MODULE (ECM)
19 - FUEL INJECTION PUMP
20 - CRANKSHAFT POSITION (ENGINE SPEED) SENSOR
21 - CAMSHAFT POSITION SENSOR (CMP)
22 - FUEL CONTROL ACTUATOR (FCA)
23 - CASCADE OVERFLOW VALVE

STANDARD PROCEDURES - CLEANING FUEL SYSTEM PARTS

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

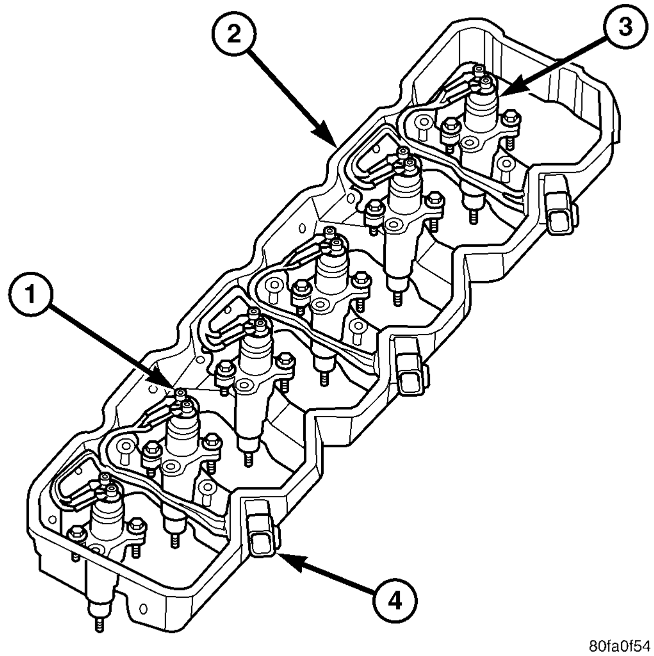


Fig. 2 FUEL INJECTORS

1 - SOLENOID CONNECTIONS
2 - ROCKER HOUSING
3 - FUEL INJECTOR
4 - PASSTHROUGH CONNECTOR

STANDARD PROCEDURE - FUEL SYSTEM PRIMING

A certain amount of air becomes trapped in the fuel system when fuel system components on the supply and/or high-pressure side are serviced or replaced. Fuel system priming is accomplished using the electric fuel transfer (lift) pump.

Servicing or replacing fuel system components usually will not require fuel system priming.

The fuel transfer (lift) pump is self-priming: When the key is first turned on (without cranking engine), the pump operates for approximately 2 seconds and then shuts off. The pump will also operate for up to 25 seconds after the starter is quickly engaged, and then disengaged without allowing the engine to start. The pump shuts off immediately if the key is on and the engine stops running.

(1) Turn key to CRANK position and quickly release key to ON position before engine starts. This will operate fuel transfer pump for approximately 25 seconds.

(2) If the engine does not start after 25 seconds, turn key OFF. Repeat previous step until engine starts.

(3) Fuel system priming is now completed.

(4) Attempt to start engine. If engine will not start, proceed to following steps. **When engine does start, it may run erratically and be noisy for a few minutes. This is a normal condition.**

CAUTION: Do not engage the starter motor for more than 30 seconds at a time. Allow two minutes between cranking intervals.

(5) Perform previous fuel priming procedure steps using fuel transfer pump. Be sure fuel is present at fuel tank.

(6) Crank the engine for 30 seconds at a time to allow fuel system to prime.

WARNING: THE FUEL INJECTION PUMP SUPPLIES EXTREMELY HIGH FUEL PRESSURE TO EACH INDIVIDUAL INJECTOR THROUGH THE HIGH-PRESSURE LINES. FUEL UNDER THIS AMOUNT OF PRESSURE CAN PENETRATE THE SKIN AND CAUSE PERSONAL INJURY. WEAR SAFETY GOGGLES AND ADEQUATE PROTECTIVE CLOTHING. DO NOT LOOSEN FUEL FITTINGS WHILE ENGINE IS RUNNING.

WARNING: ENGINE MAY START WHILE CRANKING STARTER MOTOR.

FUEL DELIVERY - DIESEL (Continued)

SPECIFICATIONS

FUEL SYSTEM PRESSURE - DIESEL

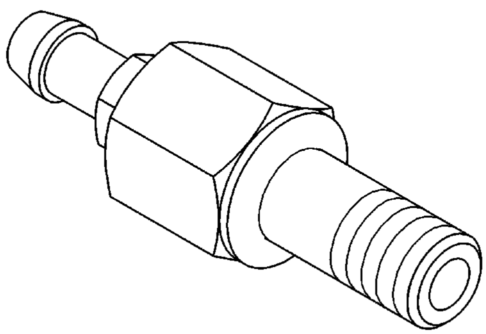
DESCRIPTION	PRESSURE
Fuel Transfer (Lift) Pump Pressure	Minimum 9.5 psi

FUEL INJECTOR FIRING ORDER - DIESEL

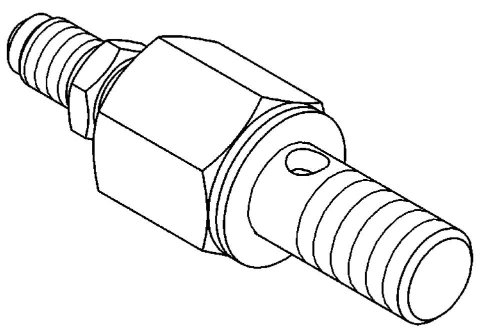
1–5–3–6–2–4

SPECIAL TOOLS

DIESEL FUEL SYSTEM



FUEL PRESSURE TEST ADAPTER - # 9012



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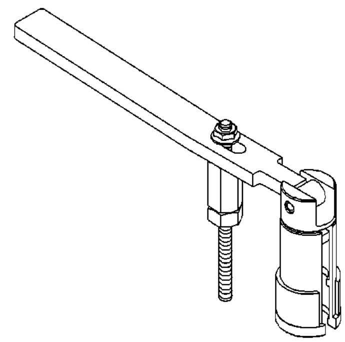
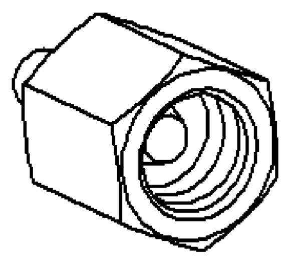
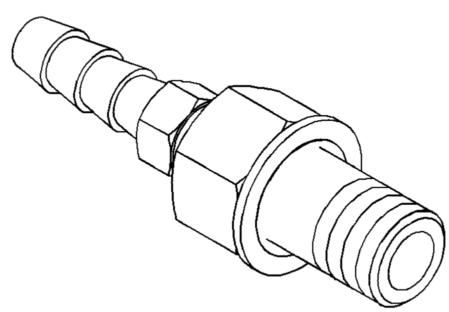


FUEL INJECTOR REMOVER - #9010

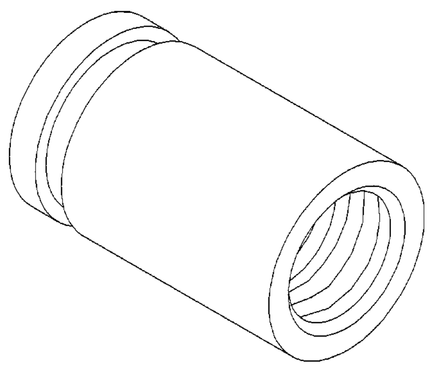


PRESSURE CAP - #9011

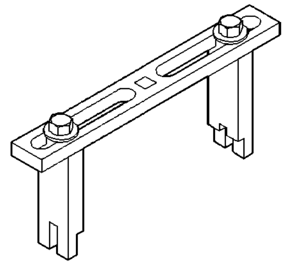


FUEL PRESSURE TEST ADAPTER - #9013

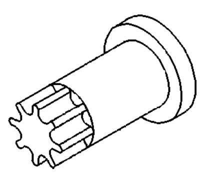
FUEL DELIVERY - DIESEL (Continued)



FUEL INJECTOR TUBE (CONNECTOR) REMOVER - #9015



SPANNER WRENCH (FUEL TANK MODULE REMOVAL/INSTALLATION) - #6856



ENGINE ROTATING (BARRING) TOOL - #7471B (ALSO PART OF KIT #6860)

FUEL FILTER / WATER SEPARATOR

DESCRIPTION

The fuel filter/water separator assembly is located on left side of engine above starter motor. The assembly also includes the fuel heater and Water-In-Fuel (WIF) sensor, and fuel transfer pump.

OPERATION

The fuel filter/water separator protects the fuel injection pump by removing water and contaminants from the fuel. The construction of the filter/separator allows fuel to pass through it, but helps prevent moisture (water) from doing so. Moisture collects at the bottom of the canister.

Refer to the maintenance schedules for the recommended fuel filter replacement intervals.

For draining of water from canister, refer to Fuel Filter/Water Separator Removal/Installation section.

A Water-In-Fuel (WIF) sensor is attached to side of canister. Refer to Water-In-Fuel Sensor Description/Operation.

The fuel heater is installed into the top of the filter/separator housing. Refer to Fuel Heater Description/Operation.

REMOVAL

Refer to maintenance schedules in this manual for recommended fuel filter replacement intervals.

Draining water from fuel filter/water separator housing:

The housing drain valve (Fig. 3) or (Fig. 4) serves two purposes. One is to **partially** drain filter housing of excess water. The other is to **completely** drain housing for fuel filter, drain valve, heater element, , water-in-fuel sensor replacement or transfer pump replacement.

The filter housing should be partially drained whenever water-in-fuel warning lamp remains illuminated. (Note that lamp will be illuminated for approximately two seconds when ignition key is initially placed in ON position for a bulb check).

(1) A drain hose (Fig. 3) or (Fig. 4) is located at bottom of drain valve. Place drain pan under drain.

(2) **With engine not running,** rotate drain valve handle rearward to OPEN (DRAIN) position. Hold drain valve open until all water and contaminants have been removed and clean fuel exits.

(3) If drain valve, fuel heater element or Water-In-Fuel (WIF) sensor is being replaced, drain housing completely. Dispose of mixture in drain pan according to applicable regulations.

(4) After draining operation, push valve handle forward to CLOSE position.

(5) **Fuel Filter Replacement:** The fuel filter is located inside of the fuel filter housing.

(a) Clean all debris from around canister.

(b) Remove filter lid (Fig. 5) using a socket. Attach socket to large hex on top of lid (Fig. 5). Rotate counter-clockwise for removal. Remove o-ring.

(c) Remove filter element by twisting element sideways from filter lid.

(6) **Water-In-Fuel (WIF) Sensor Replacement:** The WIF sensor is located on the side of the fuel filter housing (Fig. 3) or (Fig. 4).

(a) Disconnect electrical connector at sensor.

(b) Clean area around sensor.

(c) Remove sensor by rotating counter-clockwise.

(d) Check condition of sensor o-ring. Replace if damaged.

(7) **Fuel Heater Element Replacement:** The heater element is located in the fuel filter housing (Fig. 3) or (Fig. 4).

(a) Remove fuel filter. See previous steps.

FUEL FILTER / WATER SEPARATOR (Continued)

(b) Disconnect electrical connector.

(c) Remove two T-15 Torx head mounting screws from fuel heater element.

(d) Remove fuel filter cover and filter element.

(e) Remove fuel heater.

(8) **Drain Valve Replacement:** The drain valve assembly is located on the side of the fuel filter housing (Fig. 3) or (Fig. 4).

(a) Disconnect drain hose from the fuel drain valve.

(b) Remove 4 drain valve mounting screws (T-15 Torx head).

(c) Remove drain valve from filter housing.

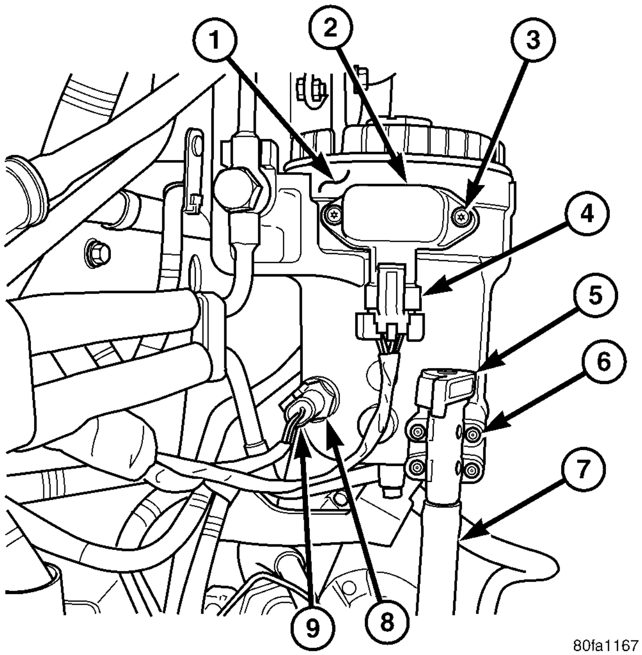


Fig. 3 FILTER HOUSING (EARLY)

1 - FILTER HOUSING
2 - FUEL HEATER AND THERMOSTAT
3 - FUEL HEATER MOUNTING SCREWS
4 - FUEL HEATER ELEC. CONNECTOR
5 - DRAIN VALVE
6 - DRAIN VALVE MOUNTING SCREWS
7 - DRAIN HOSE
8 - WIF SENSOR
9 - WIF SENSOR ELEC. CONNECTOR

INSTALLATION

Refer to maintenance schedules for recommended fuel filter replacement intervals.

(1) Thoroughly clean inside of filter housing, filter cap and all related components.

(2) **Fuel Filter:**

(a) **The engine has a self-priming low-pressure fuel system. Refer to Standard Procedures-Fuel System Priming.**

(b) Install new o-ring to canister lid and lubricate o-ring with 30W oil.

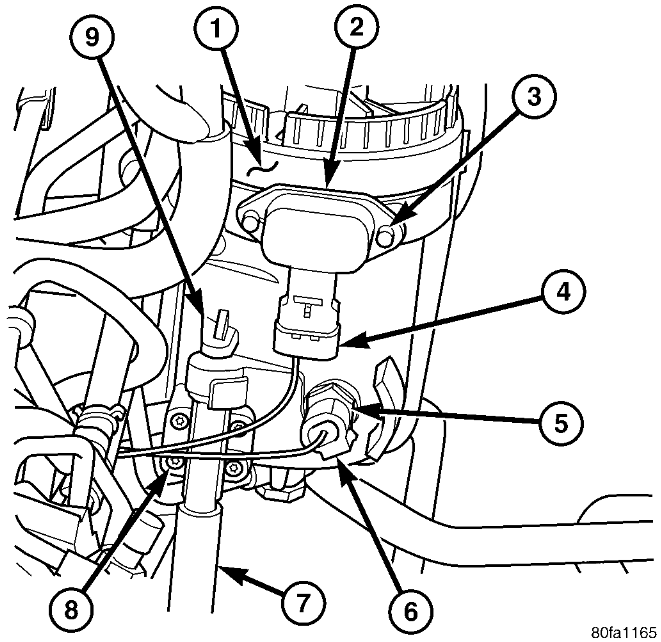


Fig. 4 FILTER HOUSING (LATE)

1 - FILTER HOUSING
2 - FUEL HEATER AND THERMOSTAT
3 - FUEL HEATER MOUNTING SCREWS
4 - FUEL HEATER ELEC. CONNECTOR
5 - WIF SENSOR
6 - WIF SENSOR ELEC. CONNECTOR
7 - DRAIN HOSE
8 - DRAIN VALVE MOUNTING SCREWS
9 - DRAIN VALVE

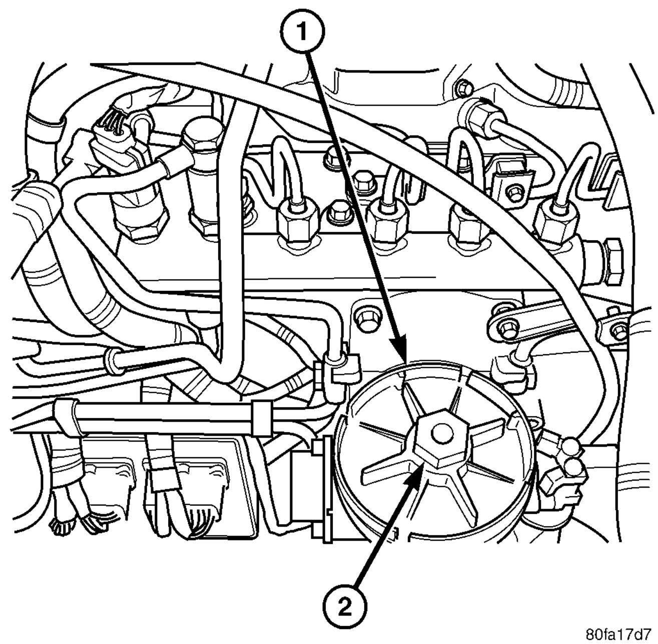


Fig. 5 FILTER COVER (LID)

1 - FILTER COVER
2 - ATTACH SOCKET HERE

(c) Position new element to canister lid. Place this assembly into canister by rotating clockwise.

(d) Tighten cap to 34 N·m (25 ft. lbs.) torque. Do not overtighten cap.

(3) **Water-In-Fuel (WIF) Sensor:**

(a) Install new o-ring seal to WIF sensor.

(b) Apply a light film of clean diesel oil to o-ring seal.

(c) Install sensor into housing.

(d) Tighten sensor to 4.5 N·m (39 in. lbs.) torque.

(e) Connect electrical connector to WIF sensor.

(4) **Fuel Heater Element:**

(a) Install fuel heater into fuel filter housing.

(b) Install fuel heater thermostat into fuel filter housing.

(c) Install fuel heater mounting screws and tighten to 1-1.5 N·m torque.

(d) Connect electrical connector to fuel heater thermostat.

(e) Install new filter cover O-ring onto fuel filter housing cover and lubricate with 30W oil.

(f) Tighten fuel filter housing cover (lid) to 34 N·m (25 ft. lbs.).

(5) **Drain Valve:**

(a) Install 2 new o-rings to valve and filter housing.

(b) Lubricate with silicon grease.

(c) Install fuel drain valve.

(d) Install 4 mounting screws and tighten to 1–1.5 N·m (8–13 in. lbs.) torque.

(e) Connect drain hose to drain valve.

(6) Start engine and check for leaks.

FUEL HEATER

DESCRIPTION

The fuel heater assembly is located on the side of the fuel filter housing (Fig. 3) or (Fig. 4).

The heater/element assembly is equipped with a temperature sensor (thermostat) that senses fuel temperature. This sensor is attached to the fuel heater/element assembly.

OPERATION

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation.

When the temperature is below 45 ±8 degrees F, the temperature sensor allows current to flow to the heater element warming the fuel. When the temperature is above 75 ±8 degrees F, the sensor stops current flow to the heater element.

Battery voltage to operate the fuel heater element is supplied from the ignition switch and through the fuel heater relay. Also refer to Fuel Heater Relay. **The fuel heater element and fuel heater relay are not computer controlled.**

The heater element operates on 12 volts, 300 watts at 0 degrees F.

DIAGNOSIS AND TESTING - FUEL HEATER

The fuel heater is used to prevent diesel fuel from waxing during cold weather operation.

NOTE: The fuel heater element, fuel heater relay and fuel heater temperature sensor are not controlled by the Engine Control Module (ECM), or the Powertrain Control Module (PCM).

A malfunctioning fuel heater can cause a wax build-up in the fuel filter/water separator. Wax build-up in the filter/separator can cause engine starting problems and prevent the engine from revving up. It can also cause blue or white fog-like exhaust. If the heater is not operating in cold temperatures, the engine may not operate due to fuel waxing.

The fuel heater assembly is located on the side of fuel filter housing.

The heater assembly is equipped with a built-in fuel temperature sensor (thermostat) that senses fuel temperature. When fuel temperature drops below 45 degrees ± 8 degrees F, the sensor allows current to flow to built-in heater element to warm fuel. When fuel temperature rises above 75 degrees ± 8 degrees F, the sensor stops current flow to heater element (circuit is open).

Voltage to operate fuel heater element is supplied from ignition switch, through fuel heater relay (also refer to Fuel Heater Relay), to fuel temperature sensor and on to fuel heater element.

The heater element operates on 12 volts, 300 watts at 0 degrees F. As temperature increases, power requirements decrease.

A minimum of 7 volts is required to operate fuel heater. The resistance value of heater element is less than 1 ohm (cold) and up to 1000 ohms warm.

TESTING

(1) Disconnect electrical connector from thermostat (Fig. 3) or (Fig. 4).

Ambient temperature must be below circuit close temperature, If necessary, induce this ambient temperature by placing ice packs on thermostat to produce an effective ambient temperature below circuit close temperature. For first check of thermostat you can hear click of thermostat when circuit closes.

Measure resistance across two pins. Operating range is 0.3 — 0.45 Ohms.

(2) If resistance is out of range, remove thermostat and check resistance across terminal connections of

FUEL HEATER (Continued)

heater. The heater can be check at room temperature. Operating range is 0.3 — 0.45 Ohms.

(3) Replace heater if resistance is not within operating range.

(4) If heater is within operating range, replace heater thermostat.

REMOVAL

REMOVAL/INSTALLATION

The fuel heater/element/sensor assembly is located inside of the fuel filter housing. Refer to Fuel Filter/ Water Separator Removal/Installation for procedures.

FUEL HEATER RELAY

DESCRIPTION

The fuel heater relay is located in Power Distribution Center (PDC) (Fig. 6). Refer to label on inside of PDC cover for relay location.

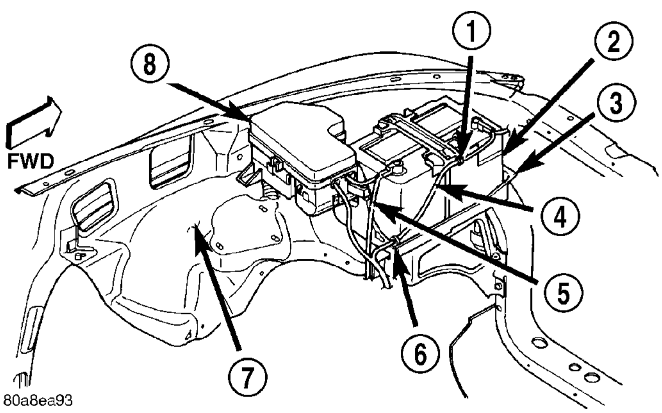


Fig. 6 POWER DISTRIBUTION CENTER LOCATION

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

OPERATION

Battery voltage to operate the fuel heater element is supplied from the ignition switch through the fuel heater relay. **The fuel heater element and fuel heater relay are not computer controlled.**

REMOVAL

The fuel heater relay is located in the Power Distribution Center (PDC) (Fig. 7). Refer to label under PDC cover for relay location.

(1) Remove PDC cover.

(2) Remove relay from PDC.

(3) Check condition of relay terminals and PDC connector terminals for damage or corrosion. Repair if necessary before installing relay.

(4) Check for pin height (pin height should be the same for all terminals within the PDC connector). Repair if necessary before installing relay.

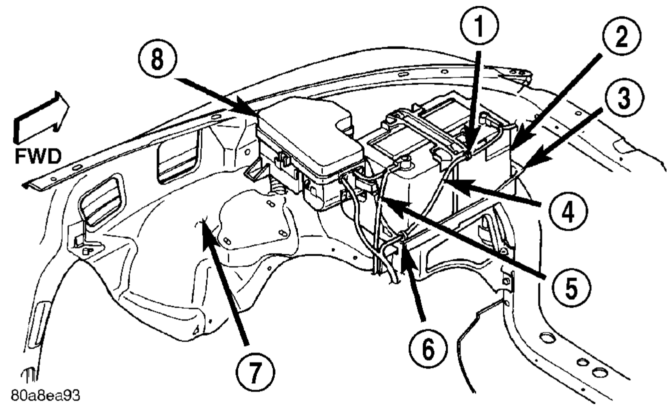


Fig. 7 POWER DISTRIBUTION CENTER LOCATION

1 - CLIP
2 - BATTERY
3 - TRAY
4 - NEGATIVE CABLE
5 - POSITIVE CABLE
6 - CLIP
7 - FENDER INNER SHIELD
8 - POWER DISTRIBUTION CENTER

INSTALLATION

The fuel heater relay is located in the Power Distribution Center (PDC) (Fig. 7). Refer to label under PDC cover for relay location.

(1) Install relay to PDC.

(2) Install cover to PDC.

FUEL INJECTION PUMP

DESCRIPTION

A Robert Bosch high-pressure fuel injection pump is used. The pump is attached to the back of the timing gear cover at the left / rear side of the engine.

OPERATION

The fuel injection pump supplies high pressure to the fuel rail independent of engine speed. This high pressure is then accumulated in the fuel rail. High pressure fuel is constantly supplied to the injectors by the fuel rail. The Engine Control Module (ECM) controls the fueling and timing of the engine by actuating the injectors.

Fuel enters the system from the electric fuel transfer (lift) pump, which is attached to the fuel filter assembly. Fuel is forced through the fuel filter element and then enters the Fuel Pump/Gear Pump, which is attached to the rear of the fuel injection

FUEL INJECTION PUMP (Continued)

pump. The Fuel Pump/Gear Pump is a low-pressure pump and produce pressures ranging from 551.5 kpa (80 psi) to 1241 kpa (180) psi. Fuel then enters the fuel injection pump. Low pressure fuel is then supplied to the FAC (Fuel Control Actuator).

The FAC is an electronically controlled solenoid valve. The ECM controls the amount of fuel that enters the high-pressure pumping chambers by opening and closing the FAC based on a demanded fuel pressure. The FPS (Fuel Pressure Sensor) on the fuel rail provides the actual fuel pressure. When the actuator is opened, the maximum amount of fuel is being supplied to the fuel injection pump. Any fuel that does not enter the injection pump is directed to the overflow valve. The overflow valve regulates how much excess fuel is used for lubrication of the pump and how much is returned to the tank through the drain manifold.

Fuel entering the injection pump is pressurized to between 300 - 1600 bar by three radial pumping chambers. The pressurized fuel is then supplied to the fuel rail.

DIAGNOSIS AND TESTING - FUEL INJECTION PUMP TIMING

With the Bosch injection pump, there are no mechanical adjustments needed or necessary to accomplish fuel injection timing. All timing and fuel adjustments are electrically made by the engine mounted Engine Control Module (ECM).

REMOVAL

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

(1) Disconnect both negative battery cables at both batteries. Cover and isolate ends of both cables.

(2) Remove intake manifold air intake tube (above injection pump) and its rubber connector hose (Fig. 8).

(3) The Engine Control Module (ECM) is mounted to left side of engine (Fig. 9). Remove 5 ECM mounting bolts and position ECM for injection pump removal. **Do not disconnect wiring connectors from ECM.**

(4) Remove cooling fan shroud.

(5) Remove cooling fan assembly.

(6) Remove accessory drive belt.

(7) Thoroughly clean the rear of injection pump, and attachment points for its 3 fuel lines (Fig. 10). Also clean the opposite ends of these same 3 lines at their attachment points.

(8) Disconnect Fuel Control Actuator (FCA) electrical connector at rear of injection pump (Fig. 11).

(9) Remove fuel line (injection pump-to-overflow valve).

(10) Remove fuel line (injection pump-to-fuel rail).

(11) Remove fuel line (injection pump-to-fuel filter housing).

(12) Remove fuel pump drive gear access cover (plate) with a 1/2 inch drive ratchet. Plate is threaded to timing gear cover (Fig. 12).

(13) Remove fuel pump drive gear mounting nut and washer.

(14) Attach C3428B, or L4407A (or equivalent) gear puller (Fig. 13) to pump drive gear with 2 bolts, and separate gear from pump (a keyway is not used on this particular injection pump). Leave drive gear hanging loose within timing gear cover.

(15) Remove 3 injection pump mounting nuts (Fig. 14), and remove pump from engine.

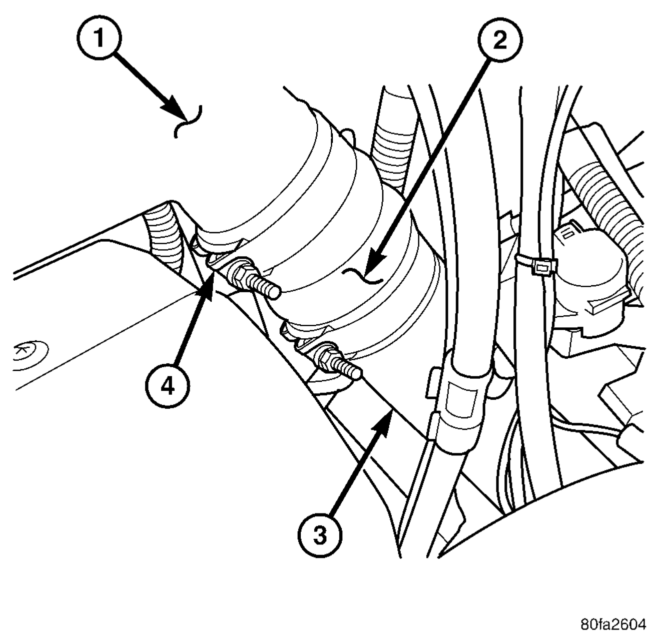


Fig. 8 INTAKE TUBE AND CONNECTING HOSE

1 - MANIFOLD ABOVE HEATERS
2 - RUBBER CONNECTING HOSE
3 - METAL INTAKE TUBE
4 - CLAMPS (2)

FUEL INJECTION PUMP (Continued)

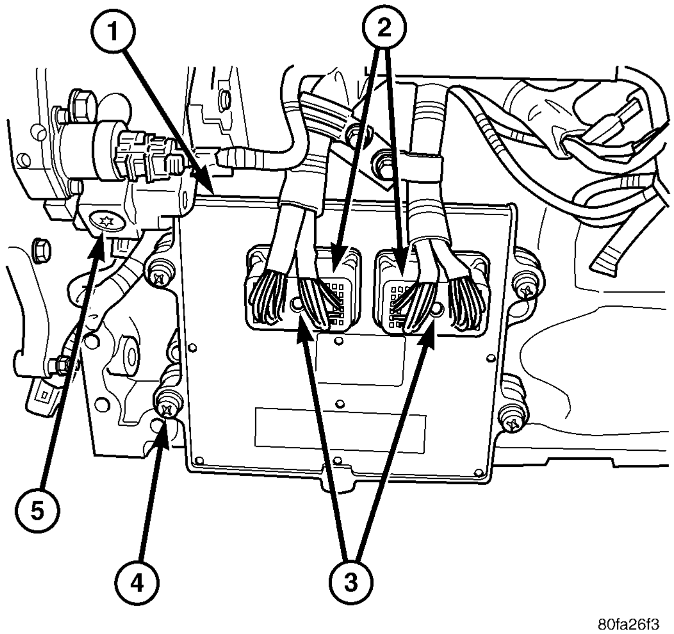


Fig. 9 ECM REMOVAL/INSTALLATION

1 - ECM LOCATION
2 - ELECTRICAL CONNECTORS (2)
3 - CONNECTOR BOLTS
4 - ECM MOUNTING BOLTS (5)
5 - BOTTOM OF INJECTION PUMP

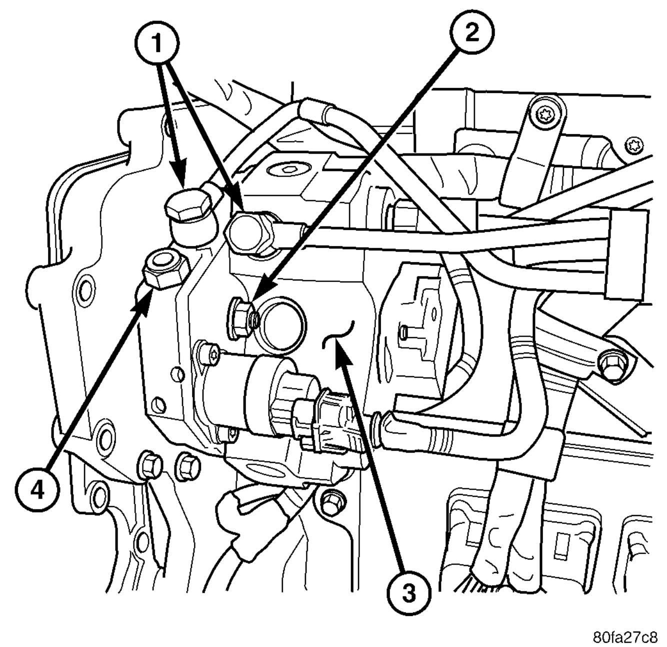


Fig. 10 OVERFLOW VALVE

1 - BANJO BOLTS
2 - PUMP MOUNTING NUTS (3)
3 - FUEL INJECTION PUMP
4 - CASCADE OVERFLOW VALVE

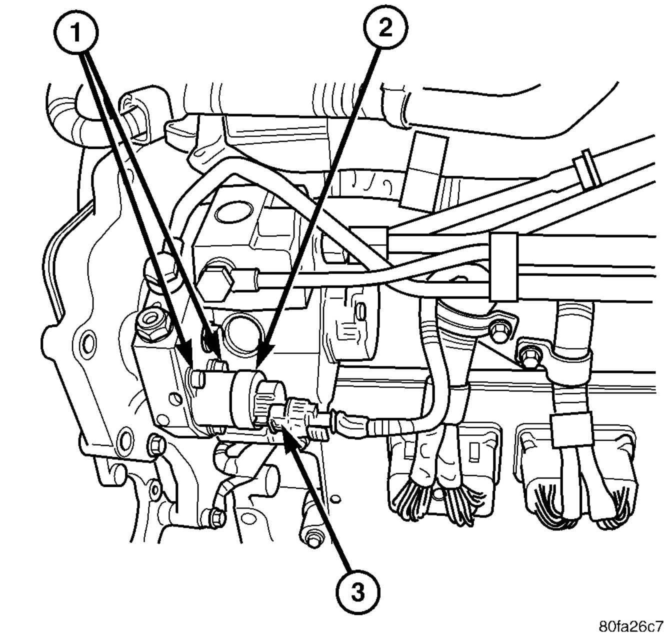


Fig. 11 FUEL CONTROL ACTUATOR

1 - ACTUATOR MOUNTING BOLTS
2 - FCA (FUEL CONTROL ACTUATOR)
3 - ACTUATOR ELECTRICAL CONNECTOR

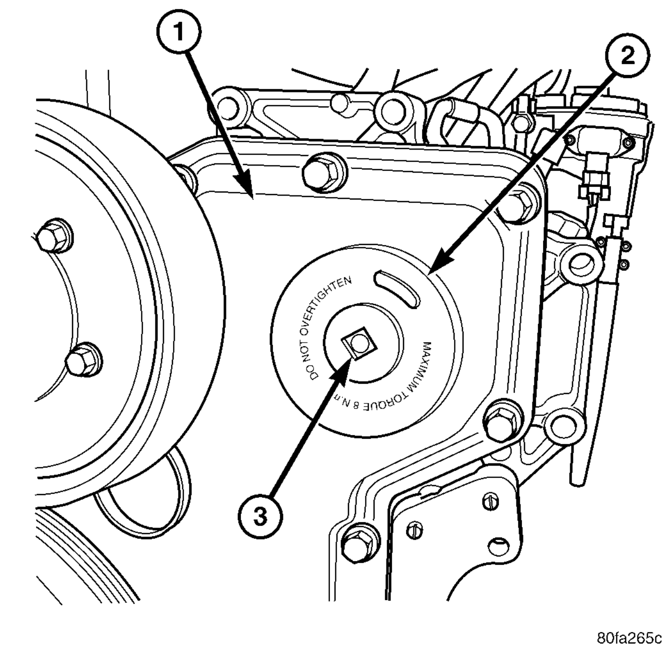


Fig. 12 PUMP DRIVE GEAR ACCESS COVER

1 - FRONT TIMING GEAR COVER
2 - GEAR ACCESS PLATE (COVER)
3 - HEX DRIVE (FOR COVER REMOVAL/INSTALLATION)

FUEL INJECTION PUMP (Continued)

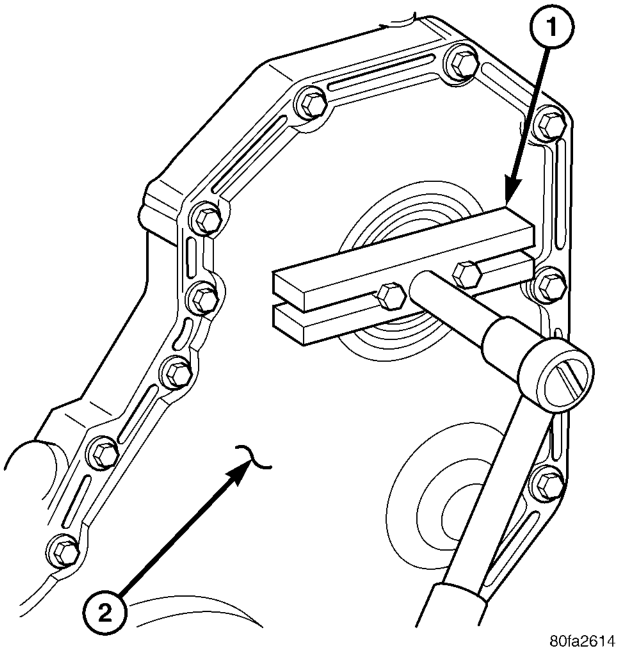


Fig. 13 DRIVE GEAR REMOVAL

1 - FRONT TIMING GEAR COVER
2 - GEAR PULLER TOOL

INSTALLATION

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

(1) Inspect pump mounting surfaces at pump and mounting flange for nicks, cuts or damage. Inspect o-ring surfaces for nicks, cuts or damage.

(2) Clean injection pump mounting flange at gear housing. Also clean front of injection pump.

(3) Install new rubber o-ring into machined groove (Fig. 14) at pump mounting area.

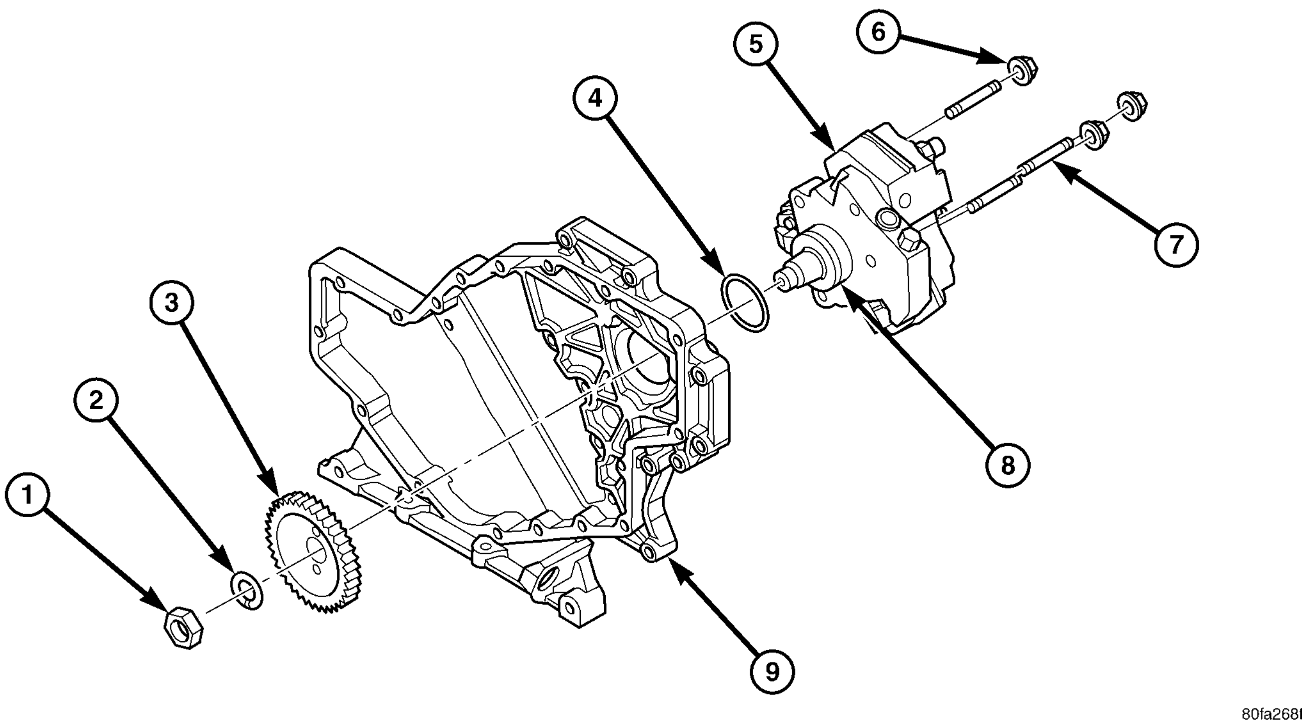


Fig. 14 FUEL INJECTION PUMP REMOVAL/INSTALLATION

1 - PUMP DRIVE GEAR NUT
2 - WASHER
3 - PUMP DRIVE GEAR
4 - RUBBER O-RING
5 - FUEL INJECTION PUMP
6 - PUMP MOUNTING NUTS (3)
7 - PUMP MOUNTING STUDS (3)
8 - O-RING MACHINED GROOVE
9 - FRONT TIMING GEAR COVER

FUEL INJECTION PUMP (Continued)

(4) Apply clean engine oil **to injection pump o-ring only.**

The machined tapers on both injection pump shaft and injection pump gear must be absolutely dry, clean and free of any dirt or oil film. This will ensure proper gear-to-shaft tightening.

(5) Clean pump gear and pump shaft at machined tapers with an evaporative type cleaner such as brake cleaner.

(6) Position injection pump to mounting flange on gear cover while aligning injection pump shaft through back of injection pump gear.

(7) After pump is positioned flat to mounting flange, install 3 pump mounting nuts and tighten **finger tight only.** Do not attempt a final tightening at this time. **Do not attempt to tighten (pull) pump to gear cover using mounting nuts. Damage to pump or gear cover may occur. The pump must be positioned flat to its mounting flange before attempting to tighten 3 mounting nuts.**

(8) To prevent damage or cracking of components, install and tighten nuts in the following sequence:

(a) Install injection pump shaft washer and nut to pump shaft. Tighten nut **finger tight only.**

(b) Do preliminary (light) tightening of injection pump shaft nut.

(c) Tighten 3 injection pump mounting nuts to 8 N·m (70.8 in. lbs.).

(d) Do a final tightening of pump shaft nut to 105 N·m (77 ft. lbs.).

(9) Install drive gear access cover (plate) using a 1/2 inch drive ratchet. Plate is threaded to timing gear cover.

(10) Install Engine Control Module (ECM) to left side of engine.

(11) Install fuel line (injection pump-to-overflow valve). Tighten bolts to 24 N·m (17 ft. lbs.) torque.

(12) Install fuel line (injection pump-to-fuel rail). Tighten to 24 N·m (17 ft. lbs.) torque.

(13) Install fuel line (injection pump-to-fuel filter housing). Tighten to 24 N·m (17 ft. lbs.) torque.

(14) Connect Fuel Control Actuator (FCA) electrical connector to rear of injection pump.

(15) Install intake manifold air intake tube (above injection pump). Tighten clamps.

(16) Install accessory drive belt.

(17) Install cooling fan shroud.

(18) Install cooling fan assembly.

(19) Connect both negative battery cables to both batteries.

(20) Check system for fuel or engine oil leaks.

FUEL LEVEL SENDING UNIT / SENSOR

DESCRIPTION

The fuel gauge sending unit (fuel level sensor) is attached to the side of the fuel tank module. The sending unit consists of a float, an arm, and a variable resistor track (card).

OPERATION

The fuel tank module on diesel powered models has 3 different circuits (wires). Two of these circuits are used at the fuel gauge sending unit for fuel gauge operation. The other wire is used for a ground. The diesel engine does not have a fuel tank module mounted electric fuel pump. The electric fuel pump (fuel transfer pump) is mounted to the engine.

For Fuel Gauge Operation: A constant input voltage source of about 12 volts (battery voltage) is supplied to the resistor track on the fuel gauge sending unit. This is fed directly from the Powertrain Control Module (PCM). **NOTE: For diagnostic purposes, this 12V power source can only be verified with the circuit opened (fuel tank module electrical connector unplugged). With the connectors plugged, output voltages will vary from about .6 volts at FULL, to about 7.0 volts at EMPTY.** The resistor track is used to vary the voltage (resistance) depending on fuel tank float level. As fuel level increases, the float and arm move up, which decreases voltage. As fuel level decreases, the float and arm move down, which increases voltage. The varied voltage signal is returned back to the ECM through the sensor return circuit.

Both of the electrical circuits between the fuel gauge sending unit and the ECM are hard-wired (not multi-plexed). After the voltage signal is sent from the resistor track, and back to the ECM, the ECM will interpret the resistance (voltage) data and send a message across the multi-plex bus circuits to the instrument panel cluster. Here it is translated into the appropriate fuel gauge level reading. Refer to Instrument Panel for additional information.

REMOVAL

REMOVAL/INSTALLATION

For diesel removal and installation procedures, refer to the gas section of Fuel System/Fuel Delivery. See Fuel Level Sending Unit/Sensor Removal/Installation.

FUEL LINES

DESCRIPTION

Low-Pressure Lines

- the fuel supply line from fuel tank to fuel transfer (lift) pump.
- the fuel return line back to fuel tank.
- the fuel drain manifold line at rear of cylinder head.
- the fuel supply line from fuel filter to fuel injection pump.

High-Pressure Lines

- the fuel line from fuel injection pump to overflow valve.
- the fuel line from fuel injection pump to fuel rail.
- the 6 fuel lines from fuel rail up to injector connector tubes

WARNING: HIGH-PRESSURE FUEL LINES DELIVER DIESEL FUEL UNDER EXTREME PRESSURE FROM THE INJECTION PUMP TO THE FUEL INJECTORS. THIS MAY BE AS HIGH AS 160,000 KPA (23,206 PSI). USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

OPERATION

High-Pressure Lines

CAUTION: The high-pressure fuel lines must be held securely in place in their holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. If lines are ever kinked or bent, they must be replaced. Use only the recommended lines when replacement of high-pressure fuel line is necessary.

High-pressure fuel lines deliver fuel (under pressure) of up to approximately 160,000 kPa (23,206 PSI) from the injection pump to the fuel injectors. The lines expand and contract from the high-pressure fuel pulses generated during the injection process. All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

WARNING: USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

DIAGNOSIS AND TESTING - HIGH-PRESSURE FUEL LINE LEAKS

High-pressure fuel line leaks can cause starting problems and poor engine performance.

WARNING: DUE TO EXTREME FUEL PRESSURES OF UP TO 160,000 kPa (23,206 PSI), USE EXTREME CAUTION WHEN INSPECTING FOR HIGH-PRESSURE FUEL LEAKS. DO NOT GET YOUR HAND OR A FINGER NEAR A SUSPECTED LEAK. INSPECT FOR HIGH-PRESSURE FUEL LEAKS WITH A SHEET OF CARDBOARD. HIGH FUEL INJECTION PRESSURE CAN CAUSE PERSONAL INJURY IF CONTACT IS MADE WITH THE SKIN.

Start the engine. Move the cardboard (Fig. 15) over the suspected high-pressure fuel line leak, and check for fuel spray onto the cardboard. If line is leaking, retorque line. Replace damaged, restricted or leaking high-pressure fuel lines with the correct replacement line.

CAUTION: The high-pressure fuel lines must be clamped securely in place in the holders. The lines cannot contact each other or other components. Do not attempt to weld high-pressure fuel lines or to repair lines that are damaged. Only use the recommended lines when replacement of high-pressure fuel line is necessary.

REMOVAL

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

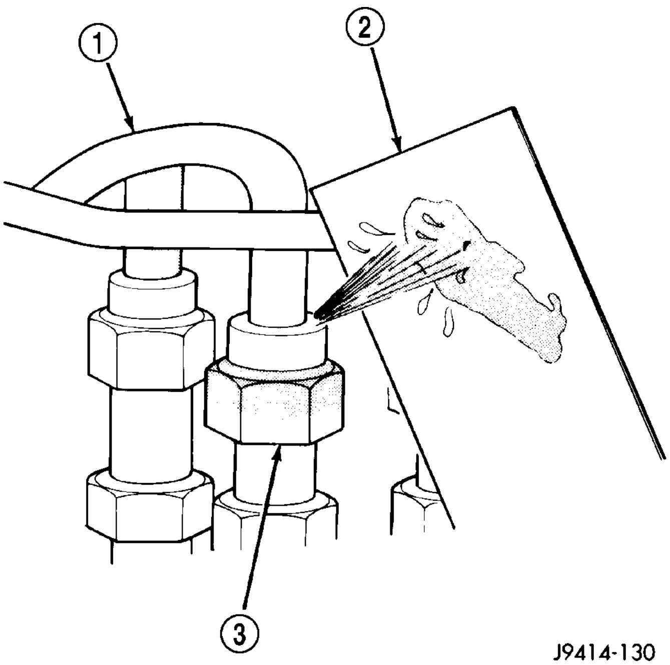


Fig. 15 TYPICAL TEST FOR LEAKS USING CARDBOARD

1 - HIGH-PRESSURE LINE
2 - CARDBOARD
3 - TYPICAL HIGH-PRESSURE FITTING

(1) Disconnect both negative battery cables from both batteries. Cover and isolate ends of cables.

(2) Thoroughly clean fuel lines at both the cylinder head and injection pump ends.

(3) If removing fuel line at either #1 or #2 cylinder, the intake manifold air heater elements must first be removed from top of intake manifold. Refer to Intake Air Heater Removal / Installation for procedures.

(4) If removing fuel line at #6 cylinder, a bracket (Fig. 16) is located above fuel line connection at cylinder head. Two bolts secure this bracket to rear of cylinder head. The upper bolt hole is slotted. Loosen (but do not remove) these 2 bracket bolts. Tilt bracket down to gain access to #6 fuel line connection.

(5) Remove necessary insulated fuel line support clamps (Fig. 17) and bracket bolts at intake manifold.

(6) Place shop towels around fuel lines at fuel rail and injectors. If possible, do not allow fuel to drip down side of engine.

CAUTION: WHEN LOOSENING OR TIGHTENING HIGH-PRESSURE LINES ATTACHED TO A SEPARATE FITTING (Fig. 18) , USE A BACK-UP WRENCH ON FITTING. DO NOT ALLOW FITTING TO ROTATE. DAMAGE TO BOTH FUEL LINE AND FITTING WILL RESULT.

(7) Carefully remove each fuel line from engine. Note position of each while removing. **Do not bend lines while removing.**

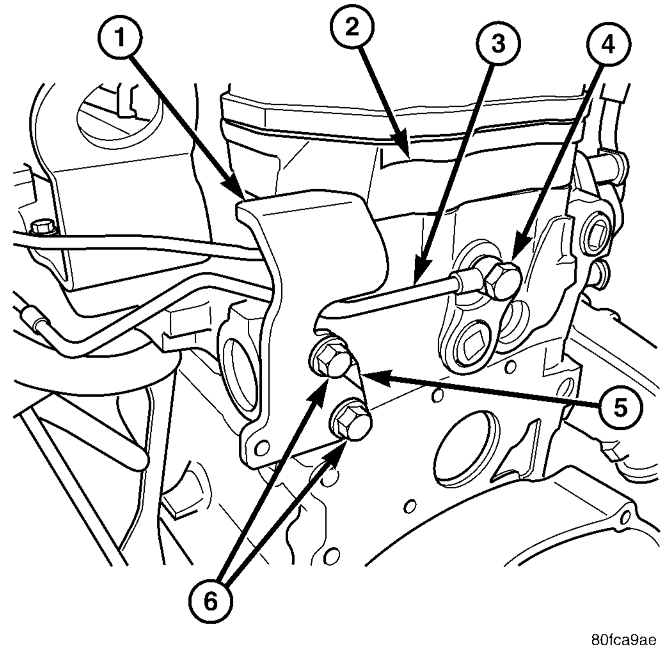


Fig. 16 BRACKET - #6 INJECTOR

1 - BRACKET
2 - REAR OF CYLINDER HEAD
3 - FUEL DRAIN MANIFOLD LINE (TO FUEL TANK)
4 - BANJO BOLT
5 - SLOTTED HOLE
6 - BRACKET BOLTS (2)

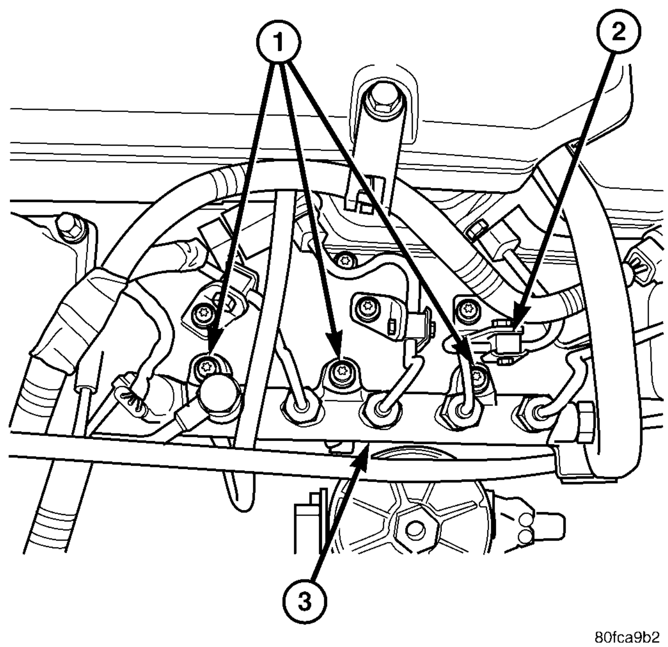


Fig. 17 FUEL INJECTOR RAIL

1 - FUEL RAIL MOUNTING BOLTS (3)
2 - INSULATED CLAMPS
3 - FUEL INJECTOR RAIL

FUEL LINES (Continued)

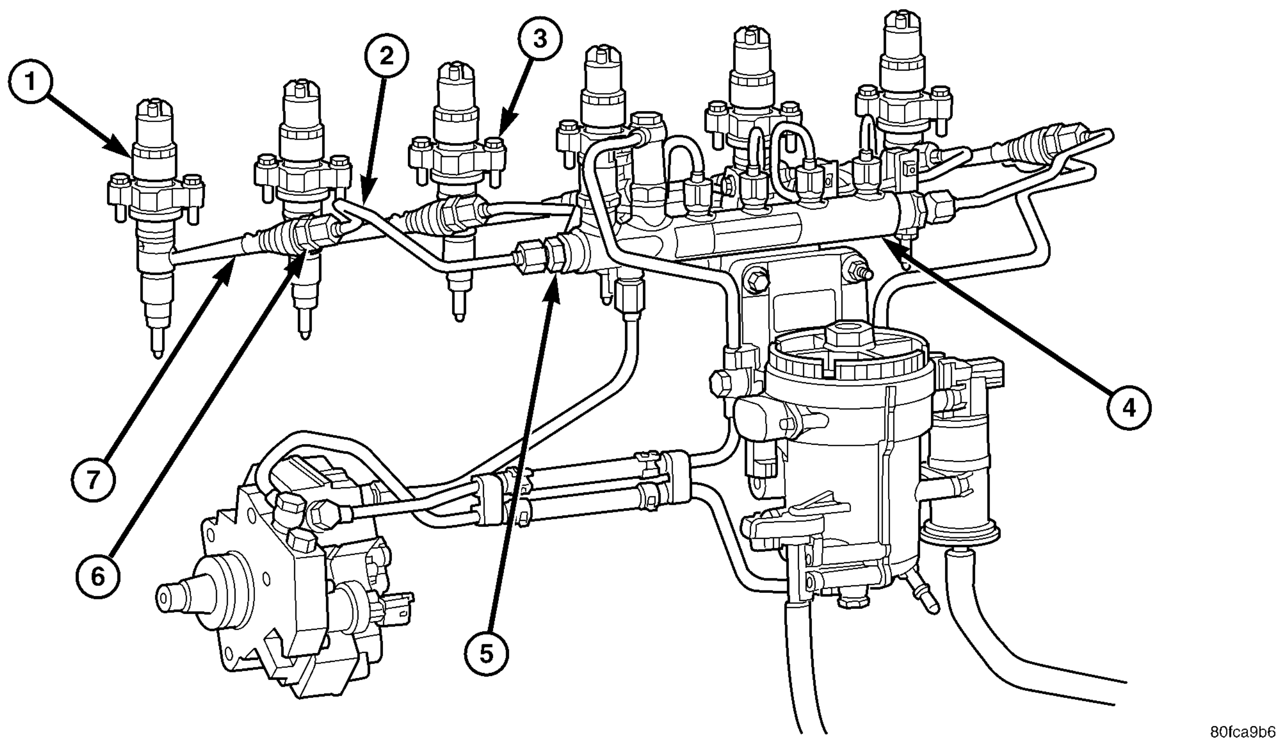


Fig. 18 HIGH PRESSURE FUEL LINES

1 - FUEL INJECTOR
2 - HIGH-PRESSURE LINE
3 - INJECTOR MOUNTING BOLTS
4 - FUEL INJECTOR RAIL
5 - SEPARATE FITTING (TYPICAL)
6 - CONNECTOR TUBE RETAINER (FITTING)
7 - CONNECTOR TUBE

INSTALLATION

All high-pressure fuel lines are of the same length and inside diameter. Correct high-pressure fuel line usage and installation is critical to smooth engine operation.

(1) Position fuel line support clamp to fuel line. Install clamp nuts/bolts and tighten finger tight.

(2) Position proper fuel line to proper injector on engine. Tighten fittings hand tight at both ends of line.

(3) Tighten fuel lines at high pressure injector connector to 30 N·m (22 lb. ft.).

(4) Tighten fuel lines at fuel rail to 30 N·m (22 lb. ft.).

(5) Tighten clamp/support nuts and bolts.

(6) Install engine lifting bracket and bolt. Tighten bolt to 77 N·m (56 lb.ft.).

(7) If fuel line at either #1 or #2 cylinder has been replaced, install intake manifold air heater elements to top of intake manifold. Refer to Intake Air Heater Removal / Installation for procedures.

(8) If fuel line at #6 cylinder has been replaced, tilt metal bracket upward and tighten 2 bolts at rear of cylinder head.

(9) Install remaining fuel line support clamps and bracket bolts at intake manifold.

(10) Connect both negative battery cables to both batteries.

(11) Prime fuel system. Refer to Fuel System Priming.

(12) Check lines/fittings for leaks.

FUEL PRESSURE SENSOR

DESCRIPTION

The fuel pressure sensor is mounted vertically near the top/center of the fuel rail.

OPERATION

The fuel pressure sensor monitors actual high-pressure within the fuel rail. An output signal from this sensor (relating to fuel pressure) is sent to the Engine Control Module (ECM).

REMOVAL

The fuel pressure sensor is mounted vertically near the top/center of the fuel rail (Fig. 19).

(1) Disconnect electrical connector at sensor.

(2) Remove sensor from fuel rail.

(3) Inspect sensor o-ring.

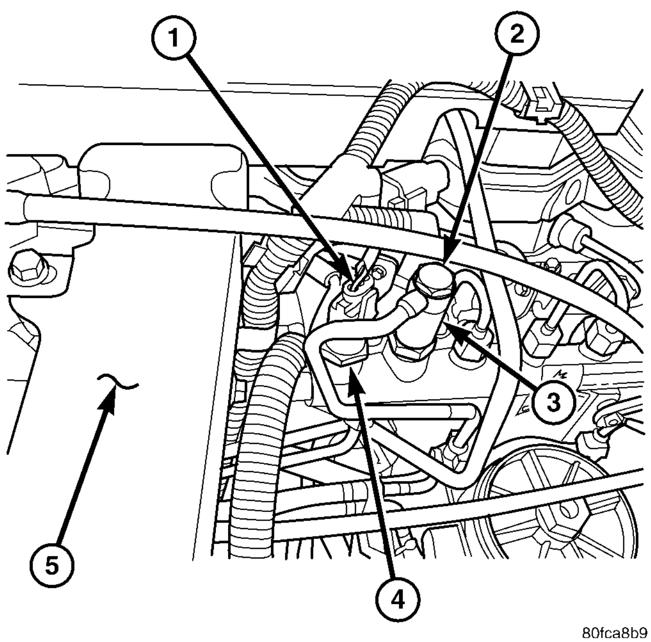


Fig. 19 FUEL PRESSURE SENSOR/FUEL PRES. LIMIT. VALVE

1 - ELEC. CONNECTOR
2 - BANJO BOLT
3 - FUEL PRESSURE LIMITING VALVE
4 - FUEL PRESSURE SENSOR
5 - TOP OF INTAKE HEATER MANIFOLD

INSTALLATION

(1) Inspect fuel pressure sensor o-ring.

(2) Lubricate sensor o-ring with clean diesel fuel.

(3) Install sensor into fuel rail.

(4) To prevent leaks, sensor **must** be tightened to prescribed torque. Tighten sensor to 101 N·m (75 ft. lbs.) torque.

(5) Connect electrical connector to sensor.

(6) Start engine and check for fuel leaks.

FUEL PRESSURE LIMITING VALVE

DESCRIPTION

The fuel pressure limiting valve is located on the top of the fuel rail.

OPERATION

Fuel pressure at the fuel rail is monitered by the fuel rail pressure sensor. If fuel pressure becomes excessive, the pressure limiting valve opens and vents excess pressure into the fuel drain circuit.

REMOVAL

The fuel pressure limiting valve is located on the top of the fuel rail (Fig. 20).

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

(1) Thoroughly clean area at pressure limiting valve.

(2) Remove banjo bolt (Fig. 20) at banjo fitting.

(3) Remove pressure limiting valve from intake manifold.

FUEL PRESSURE LIMITING VALVE (Continued)

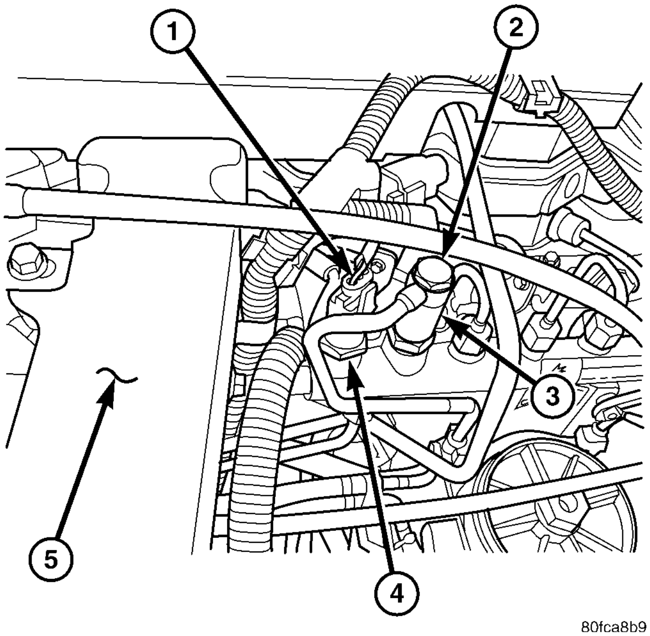


Fig. 20 FUEL PRESSURE SENSOR/FUEL PRESSURE LIMITING VALVE

1 - ELEC. CONNECTOR
2 - BANJO BOLT
3 - FUEL PRESSURE LIMITING VALVE
4 - FUEL PRESSURE SENSOR
5 - TOP OF INTAKE HEATER MANIFOLD

INSTALLATION

(1) Be sure both top of manifold and limiting valve are clean.

(2) Assemble banjo bolt and new sealing washers to limiting valve.

(3) Tighten banjo bolt to 24 N·M (17 ft. lbs.) torque.

FUEL TANK

DESCRIPTION - DIESEL

The fuel tank is similar to the tank used with gasoline powered models. The tank is equipped with a separate fuel return line and a different fuel tank module for diesel powered models. A fuel tank mounted, electric fuel pump is not used with diesel powered models. Refer to Fuel Tank Module for additional information.

REMOVAL - DIESEL

Fuel Tank Draining

Due to a one-way check valve installed into the fuel fill opening fitting at the tank, the tank cannot be drained conventionally at the fill cap.

(1) Raise vehicle.

(2) If vehicle is equipped with 4 doors and a 6 foot (short) box, remove left-rear tire/wheel.

(3) Thoroughly clean area at top of fuel tank around fuel tank module.

(4) Remove rubber cap from auxiliary fitting on top of tank module (Fig. 21).

(5) Drain fuel tank by attaching drain hose from an approved draining station to auxiliary fitting on top of tank module (Fig. 21).

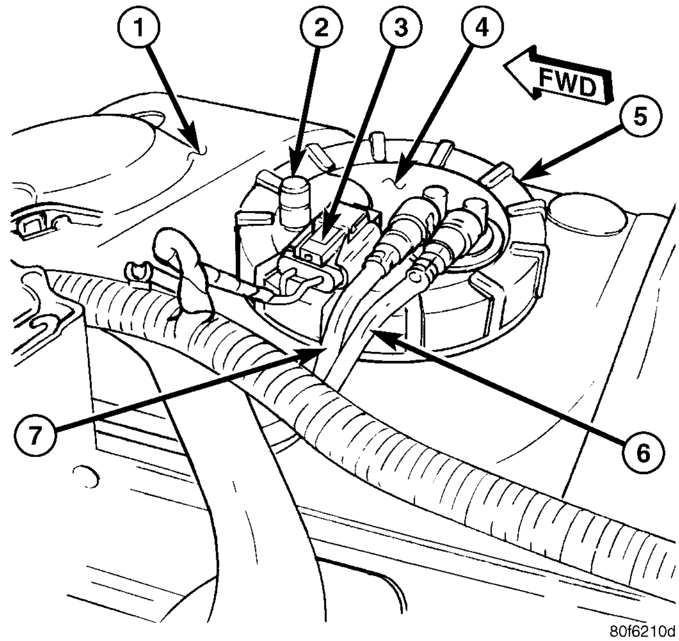


Fig. 21 FUEL TANK MODULE - DIESEL

1 - TOP OF FUEL TANK
2 - AUX. FITTING
3 - ELEC. CONNECTOR
4 - FUEL TANK MODULE (TOP)
5 - LOCKNUT
6 - FUEL SUPPLY LINE
7 - FUEL RETURN LINE

Tank Removal

(1) Loosen clamp and disconnect rubber fuel fill hose at tank.

(2) Support tank with a hydraulic jack.

(3) Remove 2 fuel tank strap nuts (Fig. 22) and remove both tank support straps.

(4) Carefully lower tank a few inches and disconnect fuel pump module electrical connector (Fig. 21) at top of tank. To disconnect electrical connector: Push upward on red colored tab to unlock. Push on black colored tab while removing connector.

(5) Disconnect fuel supply and return lines at fuel tank module (Fig. 21). Refer to Quick-Connect Fittings for procedures.

(6) Continue to lower tank for removal.

FUEL TANK (Continued)

(7) If fuel tank is to be replaced, remove fuel tank module from tank. Refer to Fuel Tank Module Removal/Installation procedures.

INSTALLATION - DIESEL

(1) If fuel tank is to be replaced, install fuel tank module into tank. Refer to Fuel Tank Module Removal/Installation procedures.

(2) Position fuel tank to hydraulic jack.

(3) Raise tank until positioned near body.

(4) Connect fuel tank module electrical connector at top of tank.

(5) Connect fuel supply and return lines to tank module.

(6) Continue raising tank until positioned snug to body.

(7) Install and position both tank support straps. Install 2 fuel tank strap nuts and tighten. **Tighten rear strap nut first.** Refer to Torque Specifications.

(8) Remove hydraulic jack.

(9) Connect rubber fill hose to fuel fill tube and tighten clamp.

(10) Install tire / wheel (if necessary).

(11) Lower vehicle.

(12) Fill fuel tank with fuel.

(13) Start engine and check for fuel leaks near top of module.

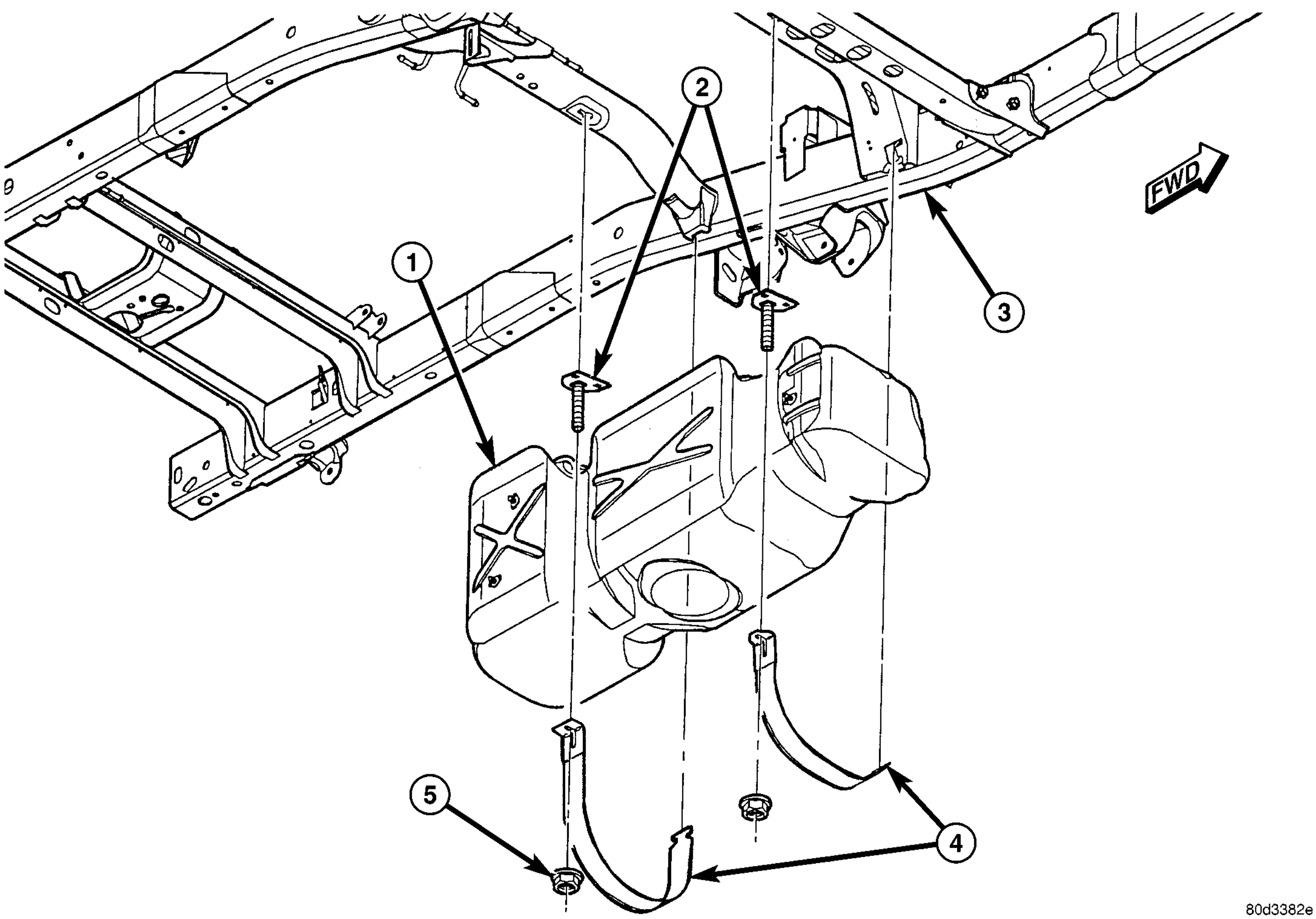


Fig. 22 FUEL TANK MOUNTING

1 - FUEL TANK
2 - STRAP MOUNTING STUDS
3 - VEHICLE FRAME
4 - MOUNTING STRAPS
5 - STRAP NUTS

FUEL TANK MODULE

DESCRIPTION

An electric fuel pump is **not used** in the fuel tank module for diesel powered engines. Fuel is supplied by the engine mounted fuel transfer (lift) pump.

The fuel tank module is installed in the top of the fuel tank (Fig. 23). The fuel tank module contains the following components:

- Fuel reservoir
- A separate in-tank fuel filter
- Fuel gauge sending unit (fuel level sensor)
- Fuel supply line connection
- Fuel return line connection
- Auxiliary non-pressurized fitting

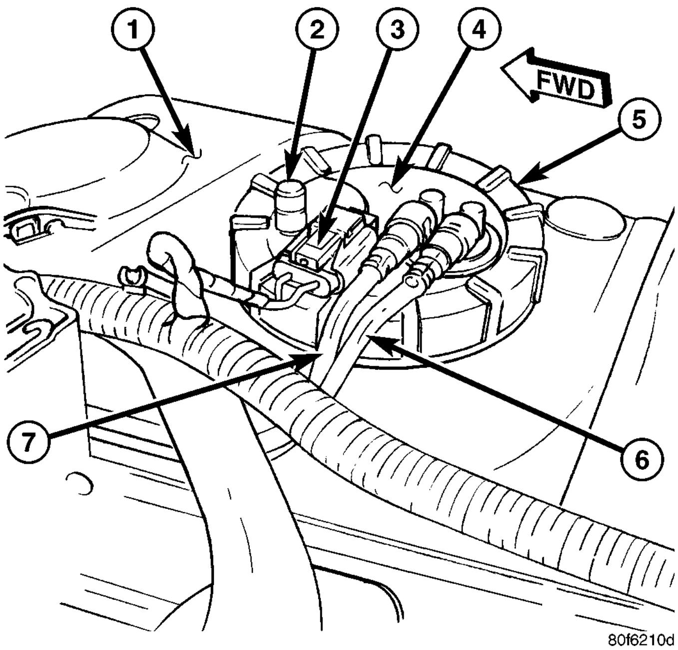


Fig. 23 FUEL TANK MODULE - DIESEL

1 - TOP OF FUEL TANK
2 - AUX. FITTING
3 - ELEC. CONNECTOR
4 - FUEL TANK MODULE (TOP)
5 - LOCKNUT
6 - FUEL SUPPLY LINE
7 - FUEL RETURN LINE

OPERATION

Refer to Fuel Gauge Sending Unit.

REMOVAL

(1) Drain and remove fuel tank. Refer to Fuel Tank Removal/Installation.

(2) Thoroughly clean area around tank module at top of tank.

(3) The plastic fuel tank module locknut is threaded onto fuel tank. Install Special Tool 6856 to locknut and remove locknut (Fig. 24). The fuel tank module will spring up when locknut is removed.

(4) Remove module from fuel tank.

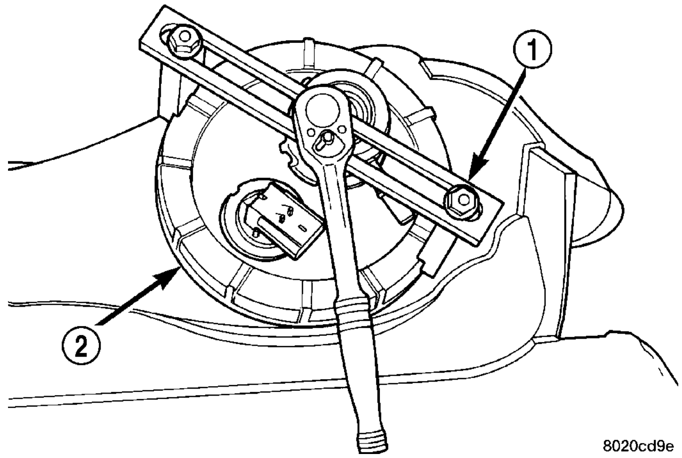


Fig. 24 LOCKNUT REMOVAL/INSTALLATION - TYPICAL MODULE

1 - SPECIAL TOOL 6856
2 - LOCKNUT

INSTALLATION

CAUTION: Whenever the fuel tank module is serviced, the rubber gasket must be replaced.

(1) Thoroughly clean locknut and locknut threads at top of tank.

(2) Using new gasket, carefully position fuel tank module into opening in fuel tank.

(3) Position locknut over top of fuel tank module. Install locknut finger tight.

(4) When looking down at tank from drivers side of tank, the fuel line connectors and fuel gauge electrical connector should all be pointed to drivers side of vehicle. Rotate and align if necessary before tightening locknut. **This step must be performed to prevent the module's float from contacting side of fuel tank.**

(5) Tighten locknut to 24 - 44 N·m (18 - 32 ft. lbs.) torque.

(6) Install fuel tank. Refer to Fuel Tank Removal/Installation.

FUEL TRANSFER PUMP

DESCRIPTION

The fuel transfer pump (fuel lift pump) is attached to the rear of the fuel filter/water separator housing. The 12–volt electric pump is operated and controlled by the Engine Control Module (ECM).

FUEL TRANSFER PUMP (Continued)

OPERATION

The purpose of the fuel transfer pump is to supply (transfer) a low-pressure fuel source: **from** the fuel tank, **through** the fuel filter/water separator and **to** the fuel injection pump. Here, the low-pressure is raised to a high-pressure by the fuel injection pump for operation of the high-pressure fuel injectors. Check valves within the pump, control direction of fuel flow and prevent fuel bleed-back during engine shut down.

Maximum current flow to the pump is 5 amperes.

With the engine running, the pump has a 100 percent duty-cycle with a minimum pressure of 11.5 psi.

The transfer pump is self-priming: When the key is first turned on (without cranking engine), the pump will operate for approximately 1/2 second and then shut off. The pump will also operate for up to 25 seconds after the starter is engaged, and then disengaged and the engine is not running. The pump shuts off immediately if the key is on and the engine stops running.

The fuel volume of the transfer pump will always provide more fuel than the fuel injection pump requires. Excess fuel is returned from the injection pump through an overflow valve, and then back to the fuel tank.

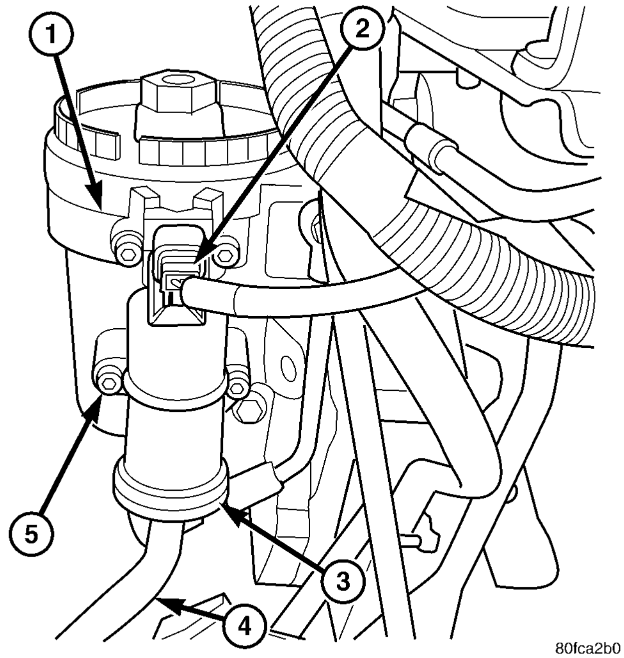


Fig. 25 FUEL TRANSFER (LIFT) PUMP

1 - FILTER HOUSING
2 - ELEC. CONNECTOR
3 - FUEL TRANSFER (LIFT) PUMP
4 - FUEL LINE EXTENTION
5 - MOUNTING BOLTS (4)

REMOVAL

The fuel transfer pump (fuel lift pump) is attached to the rear of the fuel filter/water separator housing (Fig. 25).

(1) Drain fuel from fuel filter housing. Refer to Fuel Filter/Water Separator - Removal. See Draining.

(2) Disconnect electrical connector (Fig. 25) from fuel transfer pump.

(3) Disconnect fuel tank supply line from fuel transfer pump extension line. Do this at disconnection point at inside of left inner frame rail (Fig. 26). Refer to quick-connect fittings for procedures. **The fuel line extension is permanently attached to the transfer pump. Do not attempt to disconnect fuel line at transfer pump.**

(4) Remove 4 pump mounting bolts (hex-allen), and remove pump from fuel filter housing.

(5) Confirm that transfer pump o-ring is also removed from fuel filter housing.

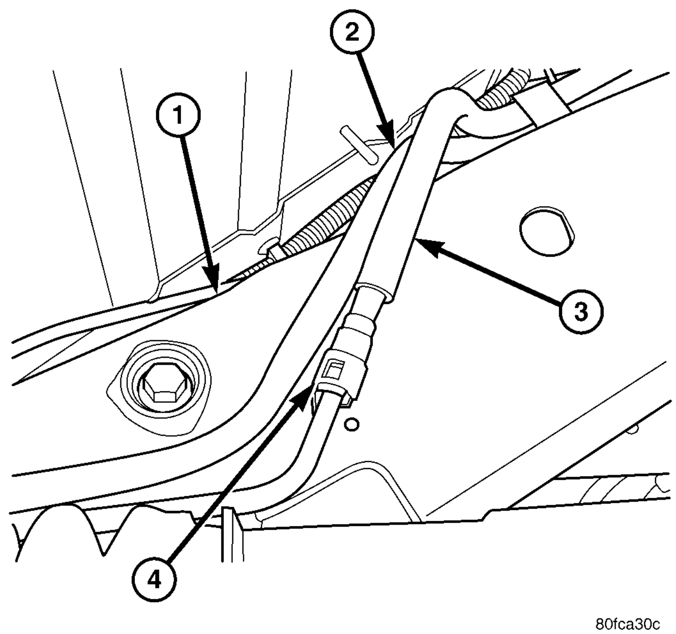


Fig. 26 TRANSFER PUMP FUEL LINE CONNECT

1 - LEFT INNER FRAME RAIL
2 - FUEL RETURN LINE
3 - FUEL SUPPLY LINE
4 - QUICK-CONNECT FITTING

INSTALLATION

(1) Install a new o-ring to fuel transfer pump.

(2) Lubricate o-ring and OD of transfer pump inlet connector.

(3) Position fuel transfer pump onto fuel filter housing. **Do not use mounting bolts to draw transfer pump to filter housing.**

FUEL TRANSFER PUMP (Continued)

(4) Be sure pump is positioned flat to fuel filter housing. Install mounting bolts and evenly tighten to 7 N·m (61 in. lbs.).

(5) Connect fuel line extension at fuel supply line.

(6) Connect electrical connector to pump.

(7) **Prime System:** Cycle key to actuate transfer pump or use DRB II Scan Tool to actuate transfer pump. Check for leaks.

(8) Operate engine and check for fuel leaks.

CASCADE OVERFLOW VALVE

DESCRIPTION

The cascade overflow valve is located on the top/rear side of the fuel injection pump (Fig. 27).

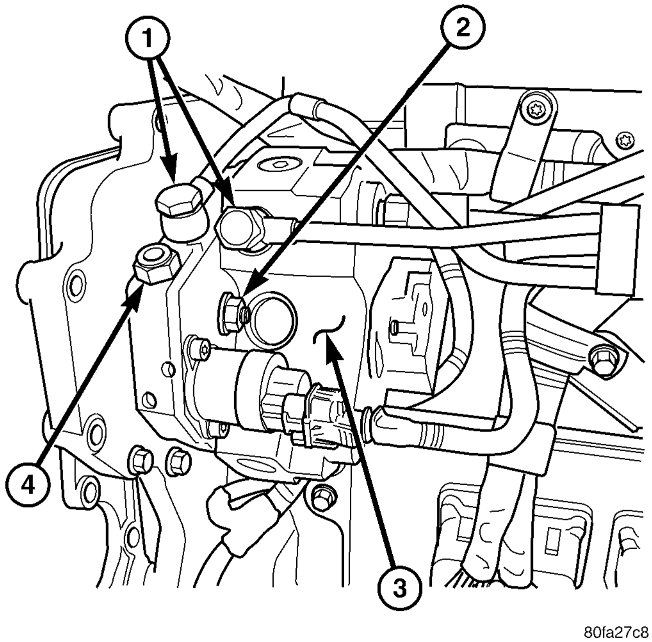


Fig. 27 OVERFLOW VALVE

1 - BANJO BOLTS
2 - PUMP MOUNTING NUTS (3)
3 - FUEL INJECTION PUMP
4 - CASCADE OVERFLOW VALVE

OPERATION

When the fuel control actuator (FCA) is opened, the maximum amount of fuel is being delivered to the fuel injection pump. Any fuel that does not enter the injection pump is directed to the cascade overflow valve. The cascade valve regulates how much excess fuel is used for lubrication of the injection pump, and is also used to route excess fuel through the drain circuit and back into the fuel tank.

REMOVAL

REMOVAL/INSTALLATION

The cascade overflow valve is not serviced separately.

WATER IN FUEL SENSOR

DESCRIPTION

The Water-In-Fuel (WIF) sensor is located on the side of the fuel filter/water separator canister (Fig. 28), or (Fig. 29).

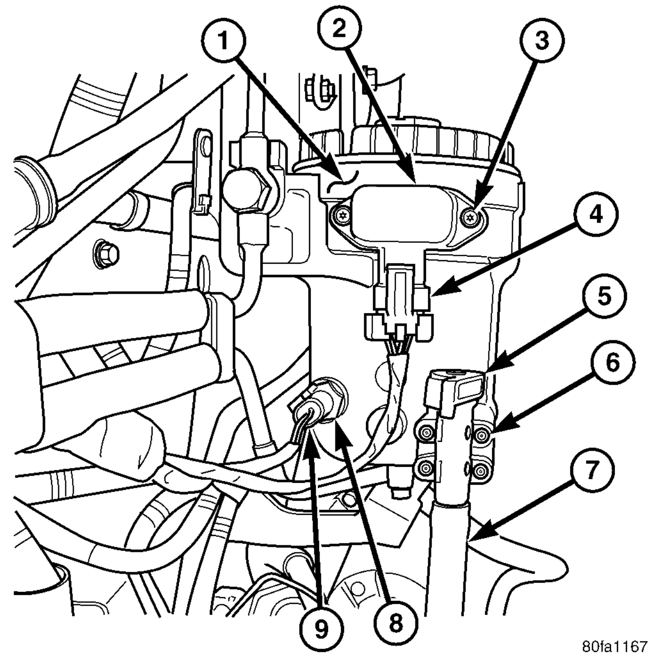


Fig. 28 FILTER HOUSING (EARLY)

1 - FILTER HOUSING
2 - FUEL HEATER AND THERMOSTAT
3 - FUEL HEATER MOUNTING SCREWS
4 - FUEL HEATER ELEC. CONNECTOR
5 - DRAIN VALVE
6 - DRAIN VALVE MOUNTING SCREWS
7 - DRAIN HOSE
8 - WIF SENSOR
9 - WIF SENSOR ELEC. CONNECTOR

WATER IN FUEL SENSOR (Continued)

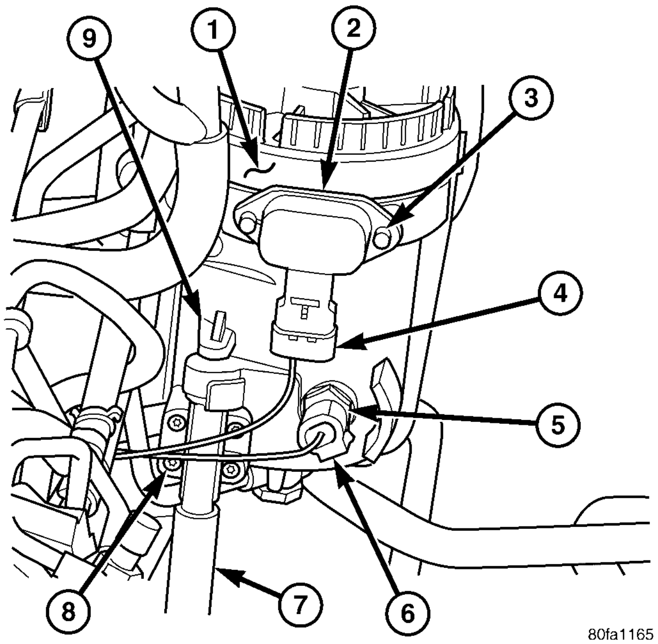


Fig. 29 FILTER HOUSING (LATE)

1 - FILTER HOUSING
2 - FUEL HEATER AND THERMOSTAT
3 - FUEL HEATER MOUNTING SCREWS
4 - FUEL HEATER ELEC. CONNECTOR
5 - WIF SENSOR
6 - WIF SENSOR ELEC. CONNECTOR
7 - DRAIN HOSE
8 - DRAIN VALVE MOUNTING SCREWS
9 - DRAIN VALVE

OPERATION

The sensor sends an input to the Engine Control Module (ECM) when it senses water in the fuel filter/ water separator. As the water level in the filter/separator increases, the resistance across the WIF sensor decreases. This decrease in resistance is sent as a signal to the ECM and compared to a high water standard value. Once the value reaches 30 to 40 kilohms, the ECM will activate the water-in-fuel warning lamp through CCD bus circuits. This all takes place when the ignition key is initially put in the ON position. The ECM continues to monitor the input at the end of the intake manifold air heater post-heat cycle.

REMOVAL

The Water-In-Fuel (WIF) sensor is located at the side of fuel filter/water separator canister. Refer to Fuel Filter/Water Separator Removal/Installation for WIF sensor removal/installation procedures.

FUEL DRAIN CIRCUIT

OPERATION

The Fuel Drain Circuit incorporates several sources of fuel return. Fuel travels from the fuel tank to the fuel transfer pump and is forced through the fuel filter. A portion of that fuel travels through the fuel filter and into the fuel injection pump, while the rest of the fuel flows through a passage in the fuel filter housing. It then goes to a fuel drain line and returns back to the fuel tank.

The fuel that flows to the fuel pump is pressurized and sent into a passage in the fuel pump. At this point the fuel is channeled into two passages. One passage sends fuel to the FCA (Fuel Control Actuator). The other passage sends fuel to the cascade overflow valve. The overflow valve sends some fuel to a lubrication passage. The rest of the fuel is sent to a drain passage which connects to an external fuel line. This fuel line is connected to the same fuel filter housing passage that the fuel transfer pump is connected to.

Fuel that travels through the FCA is pressurized by the fuel injection pump and sent through an external high pressure fuel line to the fuel rail. At the fuel rail, fuel is sent to the fuel injectors. If fuel pressure in the fuel rail becomes excessive, the pressure limiting valve opens and sends fuel through an external fuel line. This line is connected to the fuel filter housing at the fuel pump drain.

At the fuel injector, fuel that is not injected is used for lubrication of the fuel injectors. This fuel then travels through an internal passage in the rear of the cylinder head, an then into an external fuel line. This line is connected to the vehicles fuel return line, and returns excess fuel back to the fuel tank.

FUEL INJECTION - DIESEL

TABLE OF CONTENTS

ACCELERATOR PEDAL POSITION SENSOR

DESCRIPTION

DESCRIPTION (EARLY)

The APPS assembly is located at the top-left-front of the engine. A plastic cover is used to cover the assembly. The actual sensor is located behind its mounting bracket.

DESCRIPTION (LATE)

The Accelerator Pedal Position Sensor (APPS) assembly is located under the vehicle battery tray. A cable connects the assembly to the accelerator pedal. A plastic cover with a movable door is used to cover the assembly.

OPERATION

The Accelerator Pedal Position Sensor (APPS) is a linear potentiometer. It provides the Engine Control Module (ECM) with a DC voltage signal proportional to the angle, or position of the accelerator pedal.

REMOVAL

Early Diesel Engines

The APPS is serviced (replaced) as one assembly including the lever, brackets and sensor. The APPS is calibrated to its mounting bracket. The APPS assembly is located at left-front of engine below plastic cable/lever/linkage cover (Fig. 1).

ACCELERATOR PEDAL POSITION SENSOR (Continued)

CAUTION: Do not attempt to remove sensor from its mounting bracket as electronic calibration will be destroyed (sensor-to-bracket mounting screws are permanently attached). Two accelerator lever set screws (Fig. 3) are used to position lever. Do not attempt to alter positions of these set screws as electronic calibration will be destroyed.

(1) Disconnect both negative battery cables at both batteries.

(2) Remove cable cover (Fig. 1). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 1). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal.

(3) Using finger pressure only, disconnect end of speed control servo cable from throttle lever pin by pulling forward on connector while holding lever rearward (Fig. 2). **DO NOT try to pull connector off perpendicular to lever pin. Connector will be broken.**

(4) Using two small screwdrivers, pry throttle cable connector socket from throttle lever ball (Fig. 2). **Be very careful not to bend throttle lever arm.**

(5) Disconnect transmission control cable at lever arm (if equipped). Refer to 21, Transmission.

(6) Squeeze pinch tabs on speed control cable (Fig. 2) and pull cable rearward to remove from cable mounting bracket.

(7) Squeeze pinch tabs on throttle cable (Fig. 2) and pull cable rearward to remove from cable mounting bracket.

(8) If equipped with an automatic transmission, refer to 21, Transmission for transmission control cable removal procedures.

(9) Disconnect wiring harness clip (Fig. 3) at bottom of bracket.

(10) Remove 6 mounting bolts (Fig. 3) and partially remove APPS assembly from engine. After assembly is partially removed, disconnect electrical connector from bottom of sensor by pushing on connector tab (Fig. 4).

(11) Remove APPS assembly from engine.

Late Diesel Engines

The APPS is serviced (replaced) as one assembly including the sensor, plastic housing and cable. The APPS assembly is located under the left vehicle battery tray (Fig. 5). Access to APPS is gained from over top of left / front tire.

(1) Disconnect negative battery cable at battery.

(2) Disconnect APPS cable at accelerator pedal. Refer to Accelerator Pedal Removal / Installation.

(3) Remove wheel house liner at left / front wheel. Refer to Body.

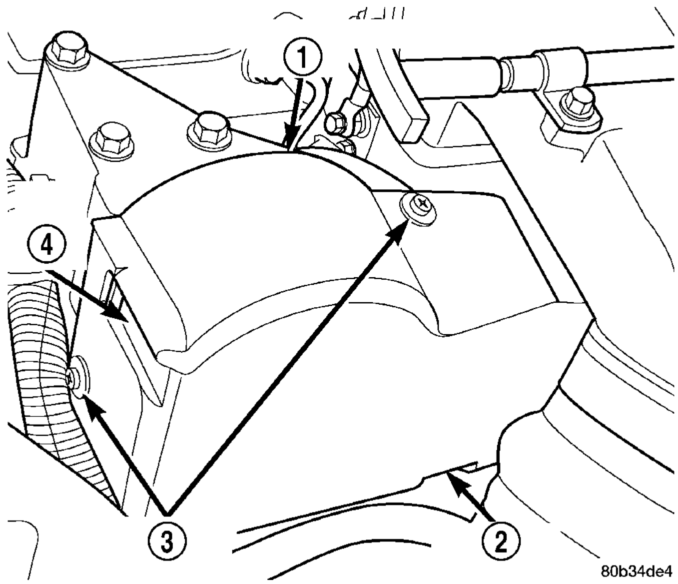


Fig. 1 CABLE/LEVER/THROTTLE LINKAGE COVER

1 - CABLE/LEVER/LINKAGE COVER
2 - PUSH UP LOWER TAB
3 - SCREWS/CLIPS (2)
4 - TAB PUSH HERE

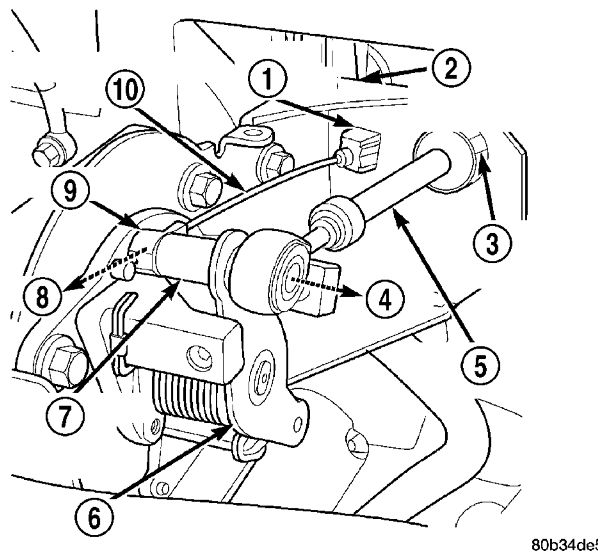


Fig. 2 SERVO CABLE AT THROTTLE LEVER

1 - PINCH (2) TABS
2 - CABLE MOUNTING BRACKET
3 - PINCH TABS (2)
4 - OFF
5 - THROTTLE CABLE
6 - THROTTLE LEVER
7 - THROTTLE LEVER PIN
8 - OFF
9 - CONNECTOR
10 - SPEED CONTROL CABLE

(4) Gain access to APPS electrical connector by opening swing-down door (Fig. 6). Disconnect electrical connector.

(5) Remove 3 mounting bolts (Fig. 6).

(6) Remove APPS assembly from battery tray.

ACCELERATOR PEDAL POSITION SENSOR (Continued)

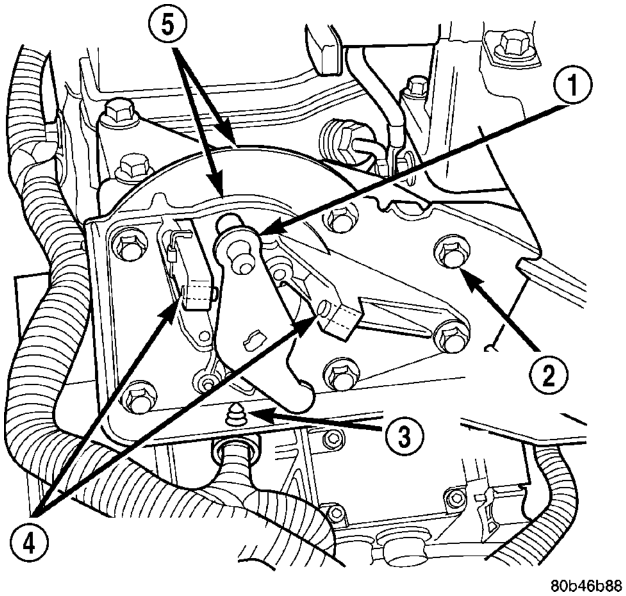


Fig. 3 APPS ASSEMBLY

1 - LEVER
2 - MOUNTING BOLTS (6)
3 - WIRE HARNESS CLIP
4 - CALIBRATION SCREWS (NO ADJUSTMENT)
5 - APPS ASSEMBLY

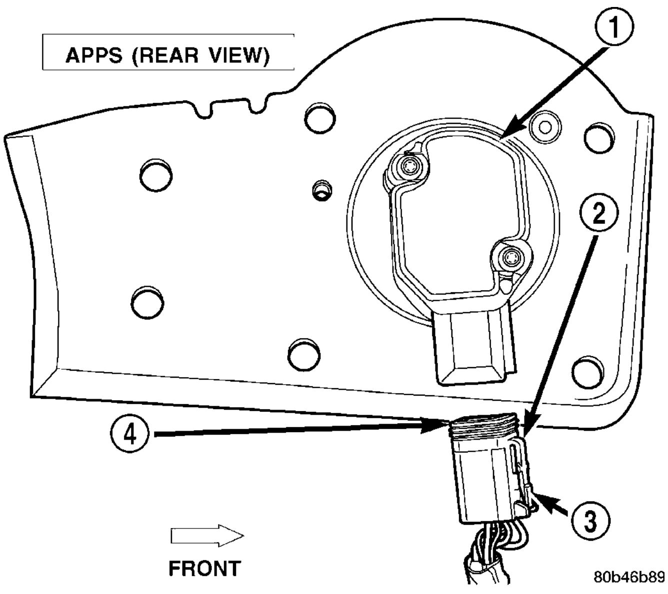


Fig. 4 APPS CONNECTOR

1 - APPS
2 - TAB
3 - PUSH FOR REMOVAL
4 - APPS CONNECTOR

(7) If cable is to be separated at APPS, unsnap cable clip from ball socket (Fig. 7). Release cable from plastic housing by pressing on small cable release tab (Fig. 6).

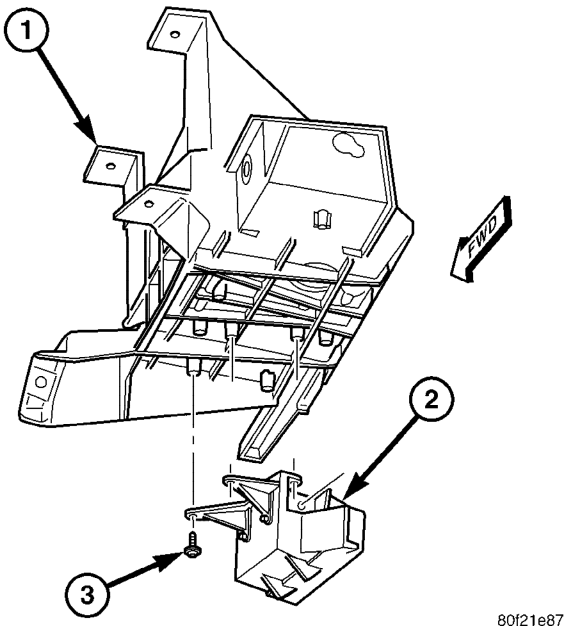


Fig. 5 APPS LOCATION (LATE)

1 - BATTERY TRAY
2 - APPS LOCATION
3 - APPS MOUNTING BOLTS

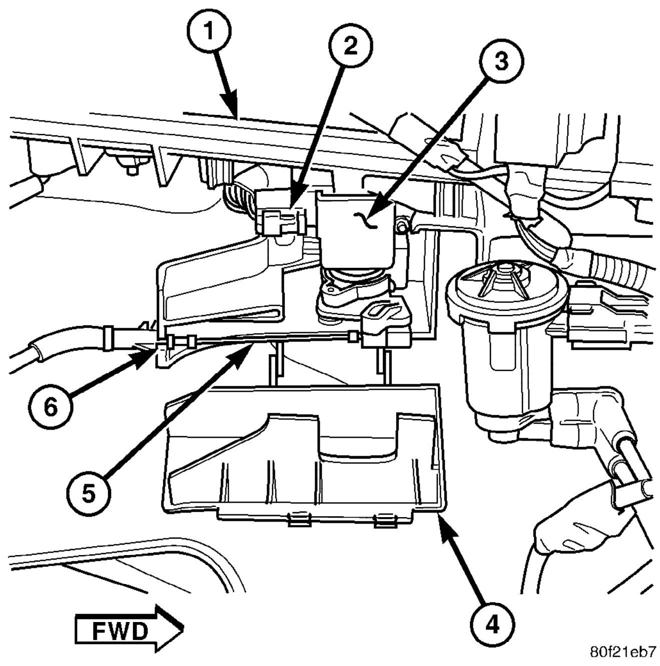


Fig. 6 APPS REMOVE / INSTALL (LATE)

1 - BOTTOM OF BATTERY TRAY
2 - ELECTRICAL CONNECTOR
3 - APPS
4 - SWING-DOWN DOOR
5 - CABLE (TO PEDAL)
6 - CABLE RELEASE TAB

ACCELERATOR PEDAL POSITION SENSOR (Continued)

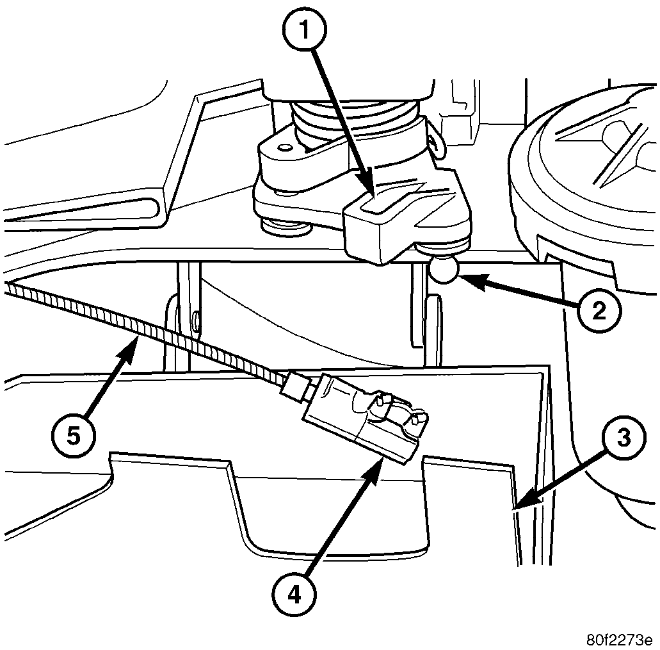


Fig. 7 APPS CABLE (LATE)

1 - APPS LEVER
2 - BALL SOCKET
3 - SWING-DOWN DOOR
4 - CABLE CLIP
5 - CABLE

INSTALLATION

Early Diesel Engines

The APPS is serviced (replaced) as one assembly including the lever, brackets and sensor. The APPS is calibrated to its mounting bracket.

(1) Snap electrical connector into bottom of sensor.

(2) Position APPS assembly to engine and install 6 bolts. Tighten bolts to 24 N·m (18 ft. lbs.) torque.

(3) Connect wiring harness clip at bottom of bracket.

(4) If equipped with an automatic transmission, refer to Group 21, Transmission for transmission control cable installation procedures.

(5) Install speed control cable into mounting bracket. Be sure pinch tabs have secured cable.

(6) Install throttle cable into mounting bracket. Be sure pinch tabs have secured cable.

(7) Connect throttle cable at lever (snaps on).

(8) Connect speed control cable to lever by pushing cable connector rearward onto lever pin while holding lever forward.

(9) Install cable cover.

(10) Connect both negative battery cables to both batteries.

(11) **ECM Calibration:** Turn key to ON position. Without starting engine, slowly press throttle pedal to floor and then slowly release. This step must be done (one time) to ensure accelerator pedal position sensor calibration has been learned by ECM. If not done, possible DTC's may be set.

(12) Use DRB III scan tool to erase any DTC's from ECM.

Late Diesel Engines

(1) Install Accelerator Pedal Position Sensor (APPS) cable to accelerator pedal. Refer to Accelerator Pedal Removal / Installation.

(2) Connect electrical connector to APPS.

(3) If necessary, connect cable to APPS lever ball socket (snaps on).

(4) Snap APPS cable cover closed.

(5) Position APPS assembly to bottom of battery tray and install 3 bolts. Refer to Torque Specifications.

(6) Install wheelhouse liner. Refer to Body.

(7) Perform the following procedure:

(a) Connect negative battery cables to both batteries.

(b) Turn key switch ON, but do not crank engine.

(c) Leave key switch ON for a minimum of 10 seconds. This will allow ECM to learn electrical parameters.

(8) If necessary, use DRB III® Scan Tool to erase any Diagnostic Trouble Codes (DTC's) from PCM.

CAMSHAFT POSITION SENSOR

DESCRIPTION

The Camshaft Position Sensor (CMP) on the 5.9L diesel engine is located below the fuel injection pump. It is bolted to the back of the timing gear cover.

OPERATION

The diesel Camshaft Position Sensor (CMP) contains a hall effect device. A rotating target wheel (tonewheel) for the CMP is located on the front timing gear. This hall effect device detects notches located on the tonewheel. As the tonewheel rotates, the notches pass the tip of the CMP.

When the leading edge of the tonewheel notch passes the tip of the CMP, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a signal of approximately 5 volts.

When the trailing edge of the tonewheel notch passes the tip of the CMP, the following occurs: The change of the magnetic field causes the signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR (Continued)

The CMP (Fig. 8) provides a signal to the Engine Control Module (ECM) at all times when the engine is running. The ECM uses the CMP information primarily on engine start-up. Once the engine is running, the ECM uses the CMP as a backup sensor for engine speed. The Crankshaft Position Sensor (CKP) is the primary engine speed indicator for the engine after the engine is running.

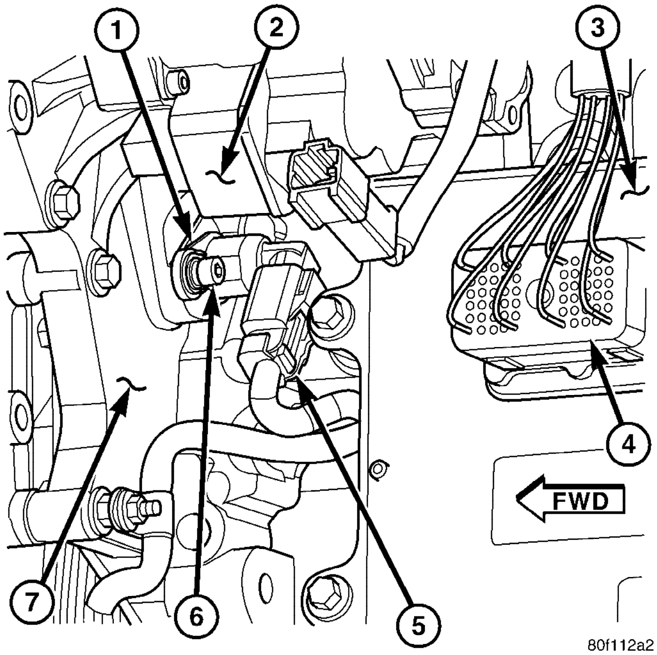


Fig. 8 5.9L DIESEL CMP

1 - CMP
2 - FUEL INJECTION PUMP (BOTTOM)
3 - ELECTRONIC CONTROL MODULE (ECM)
4 - ECM ELEC. CONNECTOR
5 - CMP ELEC. CONNECTOR
6 - CMP MOUNTING BOLT
7 - BACK OF TIMING GEAR COVER

REMOVAL

The Camshaft Position Sensor (CMP) on the 5.9L diesel engine is located below the fuel injection pump. It is bolted to the back of the timing gear cover (Fig. 9).

(1) Disconnect electrical connector at CMP sensor (Fig. 9).

(2) Remove sensor mounting bolt.

(3) Carefully twist sensor from timing gear cover.

(4) Check condition of sensor o-ring.

INSTALLATION

(1) Clean out machined hole in back of timing gear cover.

(2) Apply a small amount of engine oil to sensor o-ring.

(3) Install sensor into timing gear cover with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

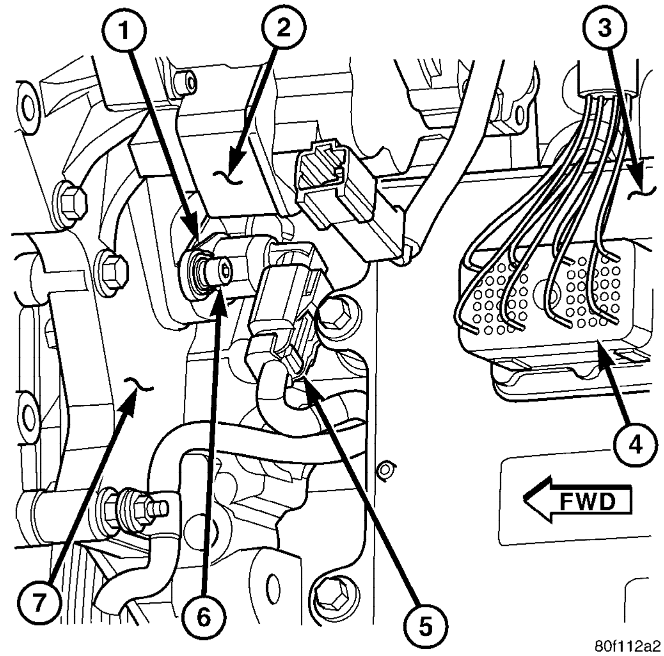


Fig. 9 5.9L DIESEL CMP

1 - CMP
2 - FUEL INJECTION PUMP (BOTTOM)
3 - ELECTRONIC CONTROL MODULE (ECM)
4 - ECM ELEC. CONNECTOR
5 - CMP ELEC. CONNECTOR
6 - CMP MOUNTING BOLT
7 - BACK OF TIMING GEAR COVER

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to back of timing chain cover. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten. Refer to Torque Specifications.

(5) Connect electrical connector to sensor.

CRANKSHAFT POSITION SENSOR

DESCRIPTION

The Crankshaft Position Sensor (CKP) on the diesel engine is attached at the front / left side of the engine next to the engine harmonic balancer.

OPERATION

The Crankshaft Position Sensor (CKP) is the primary engine speed indicator for the engine after the engine is running (Fig. 10). The CKP contains a hall effect device. A rotating, notched target wheel (tonewheel) for the CMP is located on the engine harmonic balancer (Fig. 11). This hall effect device detects notches located on the tonewheel. As the

CRANKSHAFT POSITION SENSOR (Continued)

tonewheel rotates, the notches pass the tip of the CKP.

When the leading edge of the tonewheel notch passes the tip of the CKP, the following occurs: The interruption of magnetic field causes the voltage to switch high resulting in a signal of approximately 5 volts.

When the trailing edge of the tonewheel notch passes the tip of the CKP, the following occurs: The change of the magnetic field causes the signal voltage to switch low to 0 volts.

The Camshaft Position Sensor (CMP) also provides a signal to the Engine Control Module (ECM) at all times when the engine is running. The ECM uses this CMP information primarily on engine start-up. Once the engine is running, the ECM uses the CMP as a backup sensor for engine speed.

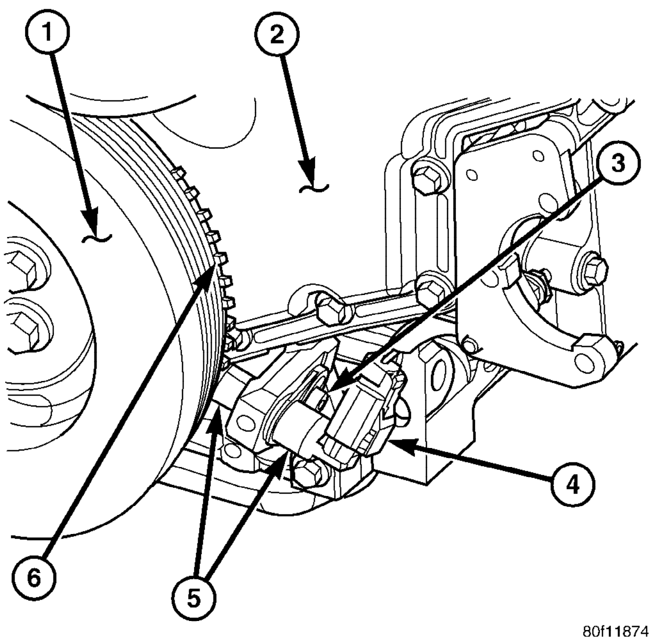


Fig. 10 5.9L DIESEL CKP

1 - ENGINE HARMONIC BALANCER
2 - FRONT OF TIMING GEAR COVER
3 - CKP MOUNTING BOLT
4 - ELEC. CONNECTOR
5 - CKP SENSOR
6 - NOTCHES

REMOVAL

(1) Raise and support vehicle

(2) Disconnect electrical connector at CKP sensor (Fig. 12).

(3) Remove 1 sensor mounting bolt.

(4) Remove CKP sensor.

INSTALLATION

(1) Position and install CKP sensor to engine.

(2) Install 1 sensor mounting bolt. Refer to Torque Specifications.

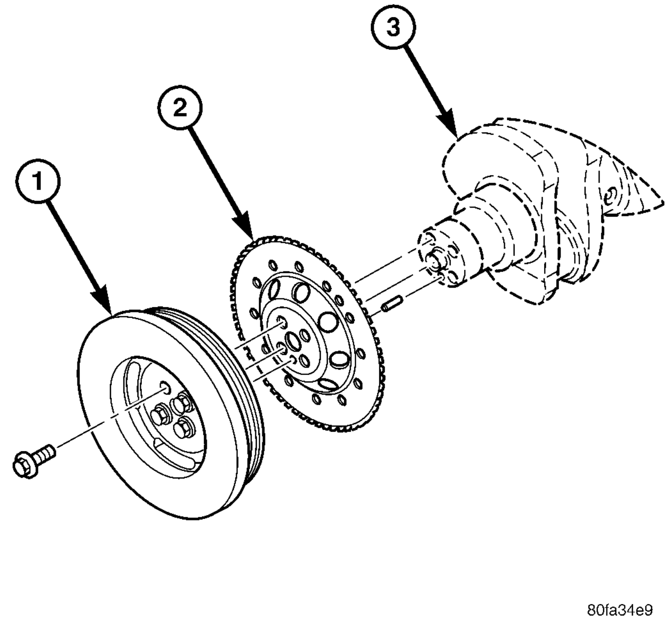


Fig. 11 CKP NOTCHED TONEWHEEL

1 - ENGINE HARMONIC BALANCER
2 - NOTCHED TONEWHEEL
3 - FRONT OF CRANKSHAFT

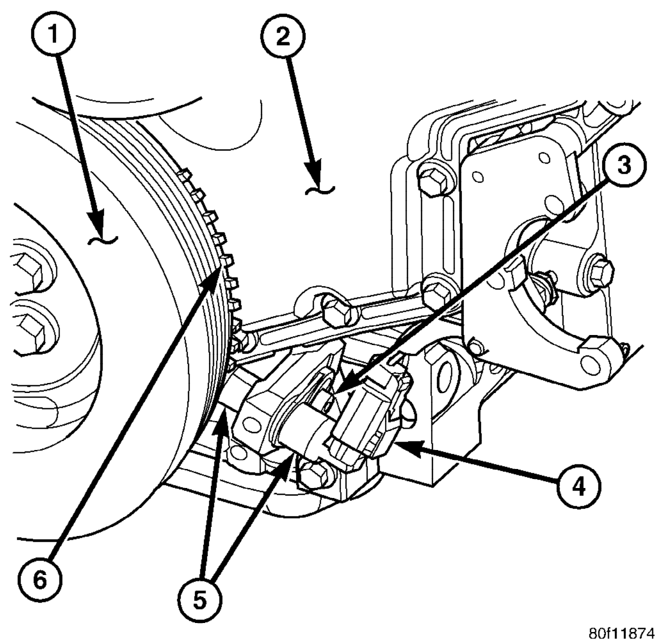


Fig. 12 5.9L DIESEL CKP

1 - ENGINE HARMONIC BALANCER
2 - FRONT OF TIMING GEAR COVER
3 - CKP MOUNTING BOLT
4 - ELEC. CONNECTOR
5 - CKP SENSOR
6 - NOTCHES

(3) Install electrical connector to CKP sensor (Fig. 12).

FUEL CONTROL ACTUATOR

DESCRIPTION

The Fuel Control Actuator (FCA) is located at the rear of the high-pressure, fuel injection pump.

OPERATION

The Fuel Control Actuator (FCA) is an electronically controlled solenoid valve. The ECM controls the amount of fuel that enters the high-pressure pumping chambers by opening and closing the FCA based on a demanded fuel pressure. When the FCA is opened, the maximum amount of fuel is being supplied to the fuel injection pump. Any fuel that does not enter the injection pump is directed to the overflow valve. The overflow valve regulates how much excess fuel is used for lubrication of the pump and how much is returned to the fuel tank through the drain manifold.

An audible click from the FCA is normal when operating the key to either the ON or OFF positions.

REMOVAL

The Fuel Control Actuator (FCA) is located at the rear of the high-pressure, fuel injection pump (Fig. 13).

(1) Clean FCA mounting area at rear of fuel injection pump with an evaporative-type cleaner.

(2) Disconnect electrical connector at FCA.

(3) Remove 2 FCA mounting bolts.

(4) Remove FCA from injection pump.

(5) After removal, inspect FCA for corrosion or damage. Shake the FCA and listen for a rattle. If FCA does not rattle, replace it.

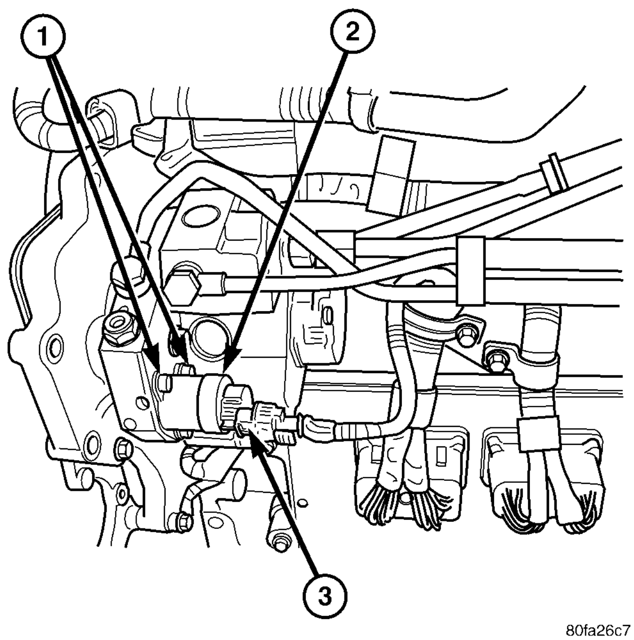


Fig. 13 FUEL CONTROL ACTUATOR

1 - ACTUATOR MOUNTING BOLTS
2 - FCA (FUEL CONTROL ACTUATOR)
3 - ACTUATOR ELECTRICAL CONNECTOR

INSTALLATION

(1) Install new o-rings to the Fuel Control Actuator (FCA).

(2) Lubricate o-rings with clean, light grease.

(3) Using new mounting bolts, install FCA into injection pump. Tighten the micro-encapsulated bolts in two stages. First to 3 N·m (27 in. lbs.), and then to 7 N·m (62 in. lbs.) torque. Do not pause more than two minutes between tightening stages as bolts may lose their ability to retain torque.

(4) Ensure FCA is mounted flush to injection pump.

(5) Connect electrical connector to FCA.

(6) Start engine and observe for leaks.

FUEL INJECTOR

DESCRIPTION

Six individual, solenoid actuated high-pressure fuel injectors are used (Fig. 14). The injectors are vertically mounted into a bored hole in the top of the cylinder head. This bored hole is located between the intake/exhaust valves. High-pressure connectors (Fig. 15), mounted into the side of the cylinder head, connect each fuel injector to each high-pressure fuel line.

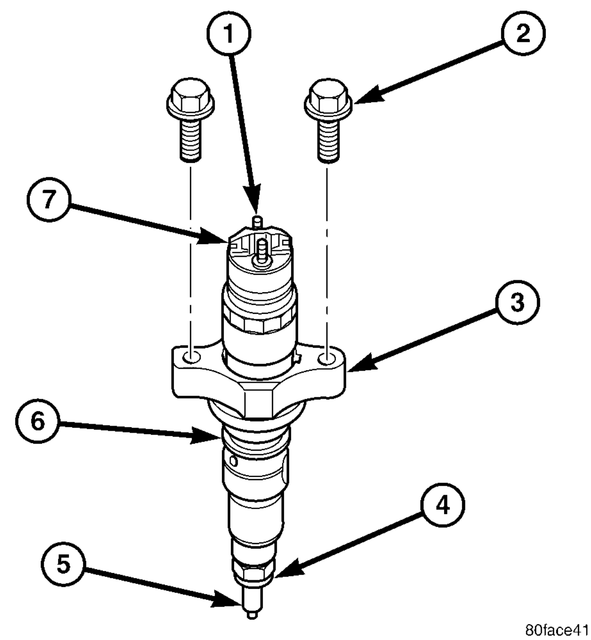


Fig. 14 FUEL INJECTOR - DIESEL

1 - SOLENOID ELECTRICAL CONNECTOR STUDS
2 - MOUNTING BOLTS
3 - MOUNTING PLATES
4- COPPER SEALING WASHER
5 - INJECTOR TIP
6 - INJECTOR O-RING
7 - INJECTOR ELECTRICAL SOLENOID

FUEL INJECTOR (Continued)

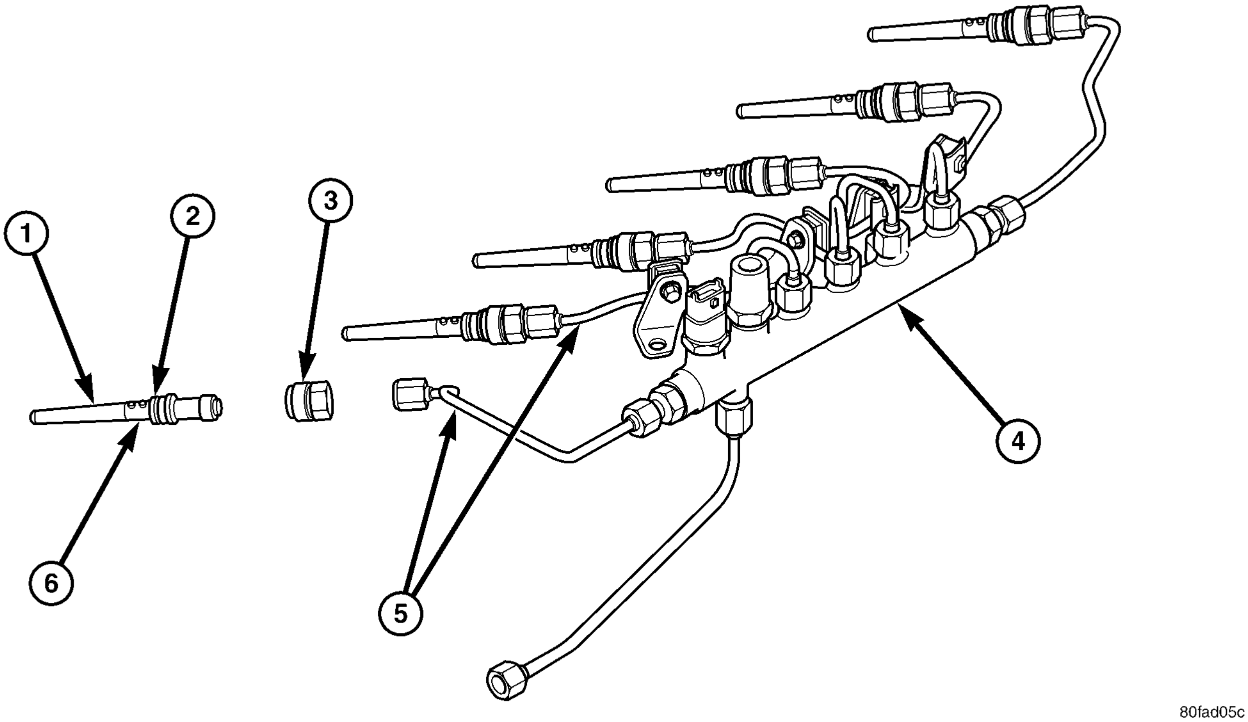


Fig. 15 HIGH-PRESSURE CONNECTOR

1 - HIGH-PRESSURE CONNECTOR (TO FUEL INJECTOR)
2 - O-RING
3 - CONNECTOR RETAINER
4 - FUEL RAIL
5 - HIGH-PRESSURE FUEL LINES
6 - LOCATING PINS

OPERATION

High-pressure fuel is supplied from the injection pump, through a high-pressure fuel line, through a fuel pressure limiting valve, into a fuel rail, through high-pressure lines, through steel connectors and into the solenoid actuated fuel injector. The ECM actuates the solenoid causing the needle valve to rise and fuel flows through the spray holes in the nozzle tip into the combustion chamber.

Each fuel injector is connected to the fuel rail by a high-pressure fuel line with a steel connector. This steel connector is positioned into the cylinder head and sealed with an o-ring. The connectors are sealed to the high-pressure fuel lines with fittings. The ferrule on the end of the high-pressure fuel line pushes against the steel connector when the fuel line fitting is torqued into the cylinder head. This torquing force provides a sealing pressure between both the fuel line-to-connector and the fuel connector-to-fuel injector. **The fitting torque is very critical.** If the fitting is under torqued, the mating surfaces will not seal and a high-pressure fuel leak will result. If the fitting is over torqued, the connector and injector will deform and also cause a high-pressure fuel leak. This leak will be inside the cylinder head and will not be visible. The result will be a possible fuel injector miss-fire and low power.

The fuel injectors use hole type nozzles. High-pressure flows into the side of the injector, the ECM activates the solenoid causing the injector needle to lift and fuel to be injected. The clearances in the nozzle bore are extremely small and any sort of dirt or contaminants will cause the injector to stick. Because of this, it is very important to do a thorough cleaning of any lines before opening up any fuel system component. Always cover or cap any open fuel connections before a fuel system repair is performed.

Each fuel injector connector tube contains an edge filter that breaks up small contaminants that enter the injector. The edge filter uses the injectors pulsating high-pressure to break up most particles so they are small enough to pass through the injector. **The edge filters are not a substitute for proper cleaning and covering of all fuel system components during repair.**

The bottom of each fuel injector is sealed to the cylinder head with a **1.5mm** thick copper shim (gasket). The correct thickness shim must always be reinstalled after removing an injector.

Fuel pressure in the injector circuit decreases after injection. The injector needle valve is immediately

FUEL INJECTOR (Continued)

closed and fuel flow into the combustion chamber is stopped. Exhaust gases are prevented from entering the injector nozzle by the needle valve.

REMOVAL

CAUTION: Refer to Cleaning Fuel System Parts.

Six individual, solenoid actuated high-pressure fuel injectors are used (Fig. 14). The injectors are vertically mounted into a bored hole in the top of the cylinder head. This bored hole is located between the intake/exhaust valves. High-pressure connectors (Fig. 15), mounted into the side of the cylinder head, connect each fuel injector to each high-pressure fuel line.

(1) Disconnect both negative battery cables from both batteries. Cover and isolate ends of cables.

(2) Remove breather assembly.

(3) Remove valve cover. Refer to Engines for procedures.

(4) Remove necessary high pressure fuel line connecting necessary fuel injector rail to high pressure connector. Refer to Fuel Line Removal for procedures.

(5) A connector retainer (nut) (Fig. 15) is used on each connector tube. Remove this nut(s) by unthreading from cylinder head.

(6) Using special high-pressure connector removal tool #9015 (Fig. 16), or (Fig. 17) remove necessary high-pressure connector(s) from cylinder head. Tool #9015 threads onto connector tube. Use tool to pry connector tube(s) from cylinder head.

(7) Remove necessary exhaust rocker arm assembly(s).

(8) Disconnect injector solenoid wire nuts at top of injectors (Fig. 18).

(9) Remove 2 fuel injector hold-down clamp bolts at each injector being removed.

(10) **USING TOOL #9010:**

(a) Special Tool #9010 (Fig. 19) is equipped with 2 clamshell clamps, a sliding retainer sleeve to retain the clamshell clamps, a 2–piece mounting stud, and a pivoting handle. **Do not attempt to remove the fuel injector with any other device. Damage to injector will occur.**

(b) The rocker housing (Fig. 18) is bolted to the top of cylinder head. The mounting stud from tool #9010 was meant to temporarily replace a rocker housing mounting bolt. Remove the necessary rocker housing mounting bolt. These mounting bolts are located at the center of each of the 3 rocker housing support bridges.

(c) Install and tighten 2–piece mounting stud to rocker housing. If removing the #6 fuel injector, separate the 2–piece mounting stud. Install lower half of mounting stud to center of rocker housing bridge. Install upper half of mounting stud to lower half.

(d) Position tool handle to mounting stud and install handle nut. Leave handle nut loose to allow a pivoting action.

(e) Position lower part of clamshell halves to sides of fuel injector (wider shoulder to bottom). The upper part of clamshell halves should also be positioned into machined shoulder on the handles pivoting head.

(f) Slide the retainer sleeve over pivoting handle head to lock clamshell halves together.

(g) Be sure handle pivot nut is loose.

(h) Depress handle downward to remove fuel injector straight up from cylinder head bore.

(11) Remove and discard injector sealing washer. This should be located on tip of injector (Fig. 20) or (Fig. 21).

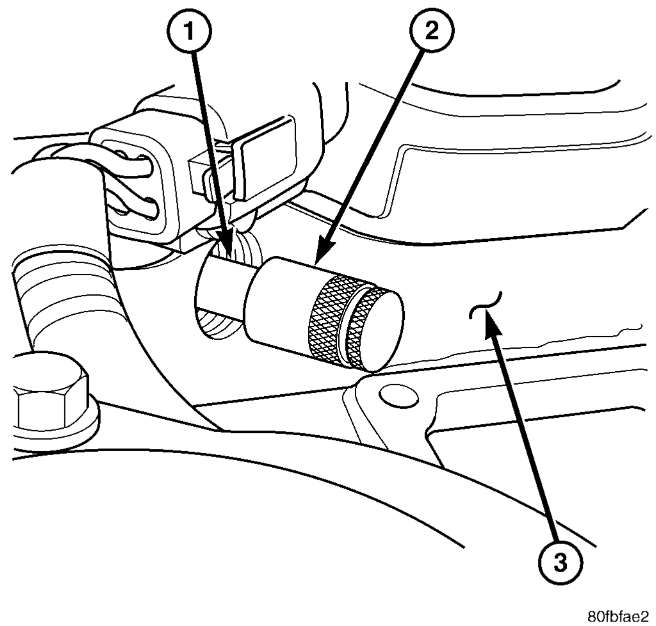


Fig. 16 CONNECTOR TUBE REMOVAL

1 - CONNECTOR TUBE
2 - TOOL #9015
3 - CYLINDER HEAD (LEFT SIDE)

INSTALLATION

(1) Inspect fuel injector.

(a) Look for burrs on injector inlet.

(b) Check nozzle holes for hole erosion or plugging.

(c) Inspect end of nozzle for burrs or rough machine marks.

(d) Look for cracks at nozzle end.

(e) Check nozzle color for signs of overheating. Overheating will cause nozzle to turn a dark yellow/tan or blue (depending on overheating temperature).

(f) If any of these conditions occur, replace injector.

(2) Thoroughly clean fuel injector cylinder head bore with special Cummins wire brush tool or equivalent (Fig. 22). Blow out bore hole with compressed air.

FUEL INJECTOR (Continued)

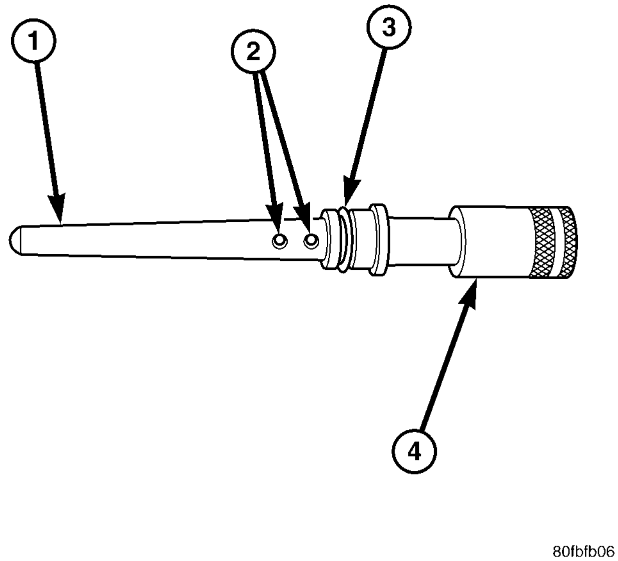


Fig. 17 TOOL #9015 AND CONNECTOR TUBE

1 - CONNECTOR TUBE
2 - LOCATING PINS
3 - RUBBER O-RING
4 - TOOL #9015

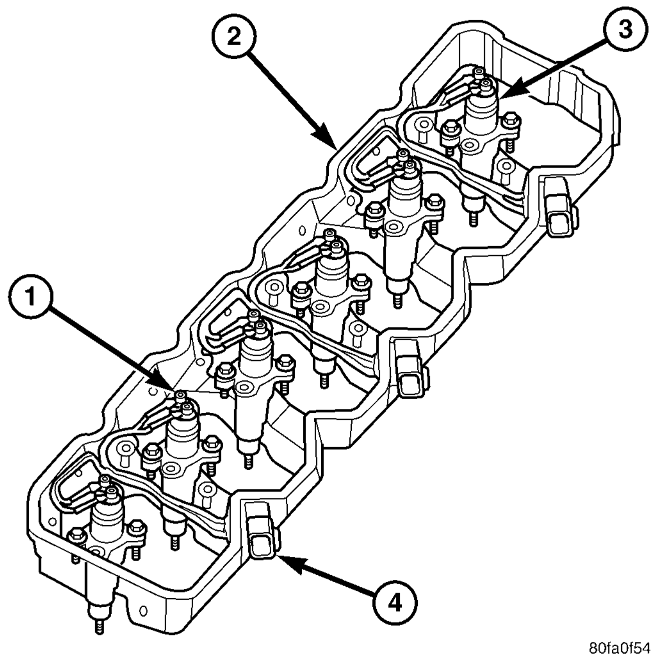


Fig. 18 FUEL INJECTORS

1 - SOLENOID CONNECTIONS
2 - ROCKER HOUSING
3 - FUEL INJECTOR
4 - PASSTHROUGH CONNECTOR

(3) The bottom of fuel injector is sealed to cylinder head bore with a copper sealing washer (shim) of a

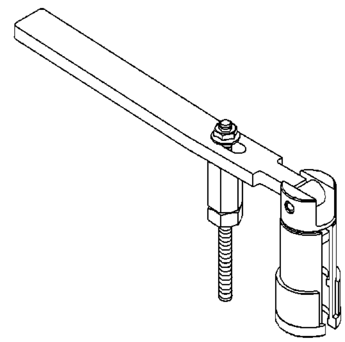


Fig. 19 FUEL INJECTOR REMOVER - #9010

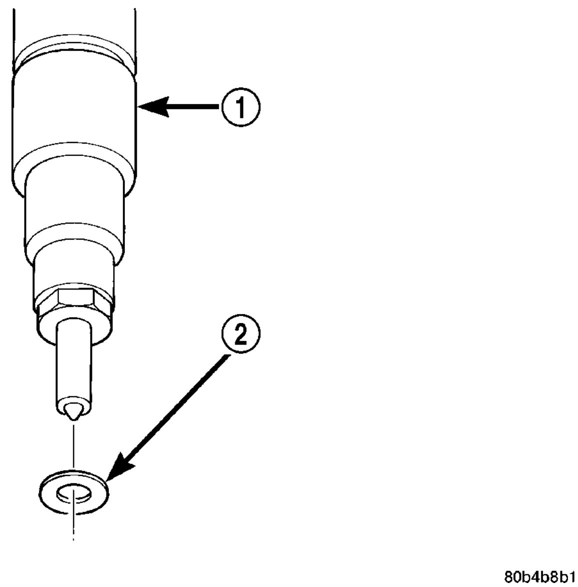


Fig. 20 FUEL INJECTOR SEALING WASHER (SHIM) LOCATION

1 - FUEL INJECTOR
2 - COPPER SEALING WASHER (SHIM)

certain thickness (Fig. 20). A new shim with correct thickness must always be re-installed after removing injector. Measure thickness of injector shim (Fig. 21). **Shim Thickness: 1.5 mm (.060”)**

(4) Install new shim (washer) to bottom of injector. Apply light coating of clean engine oil to washer. This will keep washer in place during installation.

(5) Install new o-ring to fuel injector. Apply small amount of clean engine oil to o-ring.

(6) Note fuel inlet port on high pressure connector. This must be positioned towards intake manifold. Position injector into cylinder head bore being extremely careful not to allow injector tip to touch sides of bore. Press fuel injector into cylinder head with finger pressure only.

(7) Install fuel injector hold down clamp and hold down bolts. Alternately tighten clamp bolts to 10 N·m (89 in. lbs.) torque.

(8) Connect injector solenoid wires and nuts to top of injectors (Fig. 18). Tighten connector nuts to 1.5

FUEL INJECTOR (Continued)

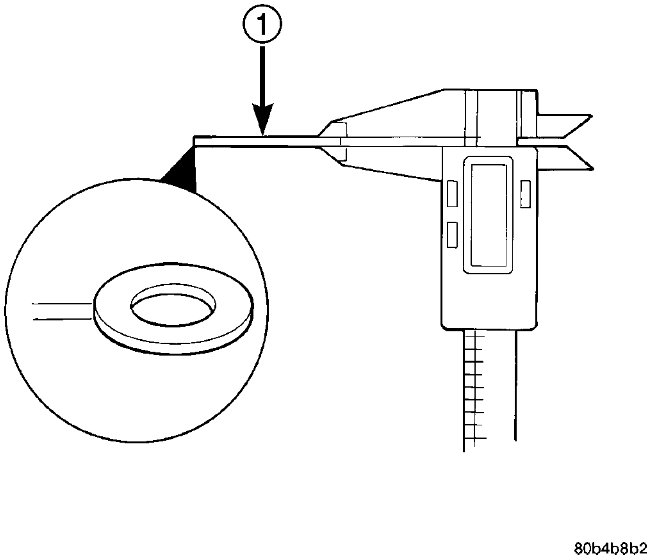


Fig. 21 MEASURING INJECTOR SEALING WASHER (SHIM)

1 - SHIM

N·m (14 in. lbs.). **Be very careful not to over-tighten these nuts as damage to fuel injector will occur.**

(9) Install exhaust rocker arm assembly.

(10) Set exhaust valve lash. Refer to Engine.

(11) Install high pressure connector and its retainer nut. Tighten nut to 50 N·m (37 ft. lbs.) torque.

(12) Install high pressure fuel line. Refer to Fuel Line Installation.

(13) Install valve cover. Refer to Engine.

(14) Install breather assembly.

(15) Connect negative battery cables to both batteries.

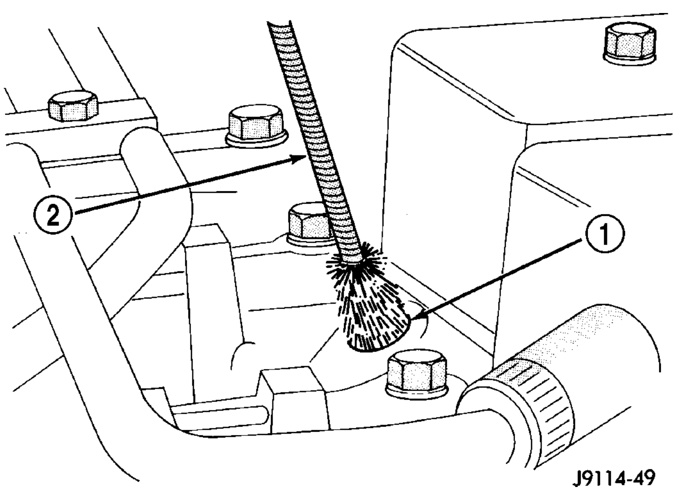


Fig. 22 CLEANING CYLINDER HEAD INJECTOR BORE - TYPICAL BORE

1 - TYPICAL INJECTOR BORE
2 - WIRE BRUSH

FUEL INJECTOR RAIL

DESCRIPTION

The fuel injector rail is bolted to the top of the intake manifold.

OPERATION

The fuel rail is used as a distribution device to supply high-pressure fuel to the high-pressure fuel lines.

REMOVAL

CAUTION: Cleanliness cannot be overemphasized when handling or replacing diesel fuel system components. This especially includes the fuel injectors, high-pressure fuel lines and fuel injection pump. Very tight tolerances are used with these parts. Dirt contamination could cause rapid part wear and possible plugging of fuel injector nozzle tip holes. This in turn could lead to possible engine misfire. Always wash/clean any fuel system component thoroughly before disassembly and then air dry. Cap or cover any open part after disassembly. Before assembly, examine each part for dirt, grease or other contaminants and clean if necessary. When installing new parts, lubricate them with clean engine oil or clean diesel fuel only.

(1) Disconnect both negative battery cables at both batteries. Isolate ends of both cables.

(2) Disconnect electrical connector at fuel pressure sensor.

(3) Remove banjo bolt at fuel limiting valve and remove fuel limiting valve.

(4) Disconnect necessary wiring harness retention clips from intake manifold.

(5) Lift 2 rubber covers to gain access to positive (+), intake heater cable nuts. Remove 2 nuts and remove 2 cables from studs.

(6) Carefully remove 4 high-pressure fuel lines from top of injector rail engine. Note position of each line while removing. **Do not bend lines while removing.**

CAUTION: WHEN LOOSENING OR TIGHTENING HIGH-PRESSURE LINES ATTACHED TO A SEPARATE FITTING, USE A BACK-UP WRENCH ON FITTING. DO NOT ALLOW FITTING TO ROTATE. DAMAGE TO BOTH FUEL LINE AND FITTING WILL RESULT.

(7) Carefully remove 2 high-pressure fuel lines at each end of injector rail. Note position of each line while removing. **Do not bend lines while removing.**

FUEL INJECTOR RAIL (Continued)

(8) Remove 3 injector rail mounting bolts (Fig. 23).
(9) Remove rail from top of intake manifold.

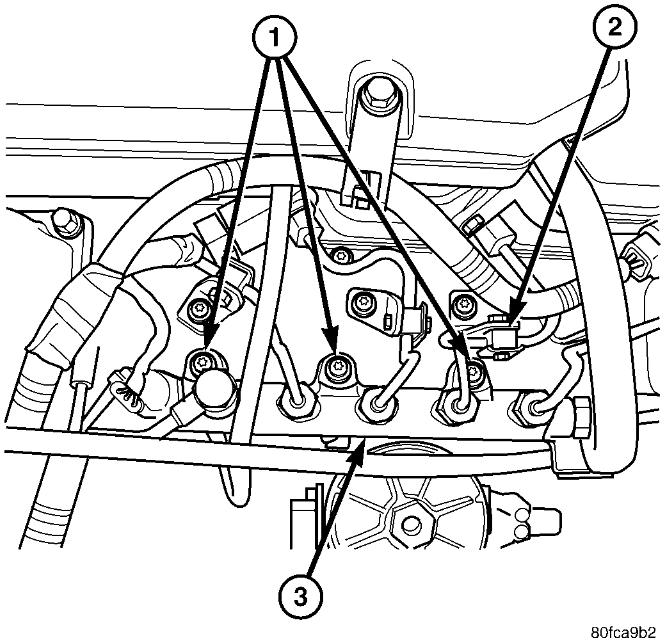


Fig. 23 FUEL INJECTOR RAIL

1 - FUEL RAIL MOUNTING BOLTS (3)
2 - INSULATED CLAMPS
3 - FUEL INJECTOR RAIL

INSTALLATION

(1) Clean any dirt/debris from top of intake manifold and bottom of fuel rail.
(2) Position fuel rail to top of manifold and install 3 mounting bolts. Tighten 3 bolts to 24 N·m (18 ft. lbs.) torque.
(3) Install all high-pressure lines to rail. Refer to Fuel Lines for procedures.
(4) Reposition wiring harness to intake manifold and install new tie wraps.
(5) Position fuel limiting valve and install banjo bolt. Tighten bolt to 30 N·m (22 ft. lbs.) torque.
(6) Connect electrical connector to fuel pressure sensor.
(7) Position 2 positive (+) cables to intake heater studs. Install 2 nuts.
(8) Connect battery cables to both batteries.
(9) Start engine and check for leaks.

INLET AIR TEMPERATURE SENSOR/PRESSURE SENSOR

DESCRIPTION

The combination, dual function Inlet Air Temperature/Pressure Sensor is located on the air cleaner (filter) cover.

OPERATION

The Inlet Air Temperature/Pressure Sensor is a combination dual-function sensor. The sensor element extends into the intake air stream at the top of the air filter housing. Ambient air temperature as well as barometric pressure is monitored by this sensor. The Engine Control Module (ECM) monitors signals from this sensor.

REMOVAL

The Inlet Air Temperature/Pressure Sensor is located on the air cleaner cover (Fig. 24).
(1) Disconnect electrical connector at sensor (Fig. 25).
(2) Remove two Torx-type mounting screws.
(3) Remove sensor from air cleaner cover.
(4) Check condition of sensor o-ring (Fig. 26).

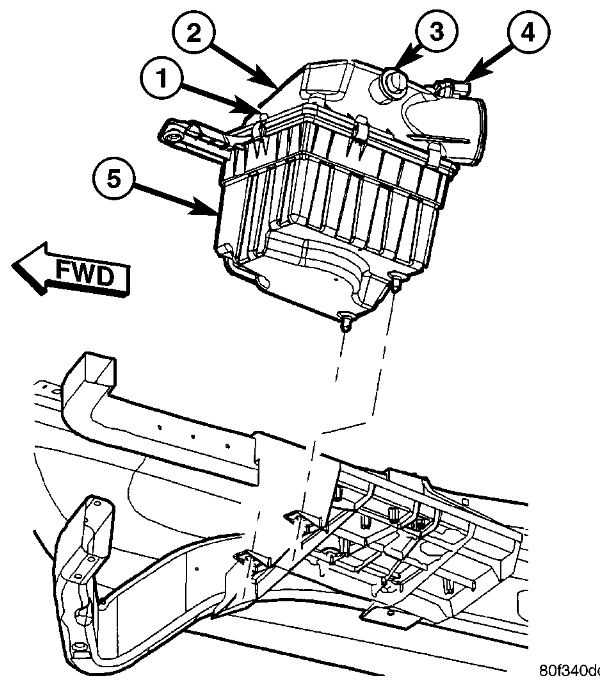


Fig. 24 IAT/PRESSURE SENSOR LOCATION - 5.9L DIESEL

1 - CLIPS
2 - FILTER COVER
3 - FILTER MINDER™
4 - INLET AIR TEMPERATURE/ PRESSURE SENSOR
5 - FILTER HOUSING

INSTALLATION

(1) Check condition of sensor o-ring.
(2) Position sensor into top of air cleaner cover with a slight twisting action.
(3) Install 2 mounting screws.
(4) Install electrical connector.

INLET AIR TEMPERATURE SENSOR/PRESSURE SENSOR (Continued)

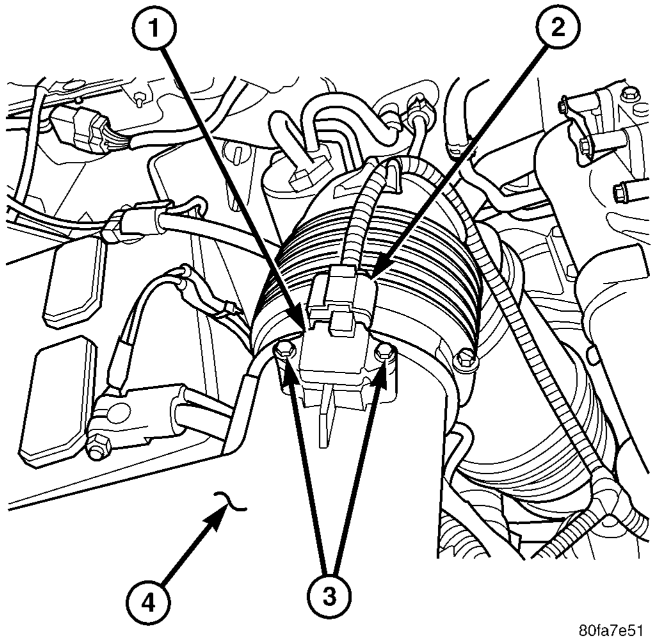


Fig. 25 INLET/PRESSURE SENSOR REMOVAL/ INSTALLATION

1 - INLET/PRESSURE SENSOR
2 - ELEC. CONNECTOR
3 - SENSOR MOUNTING SCREWS (2)
4 - TOP OF AIR FILTER COVER

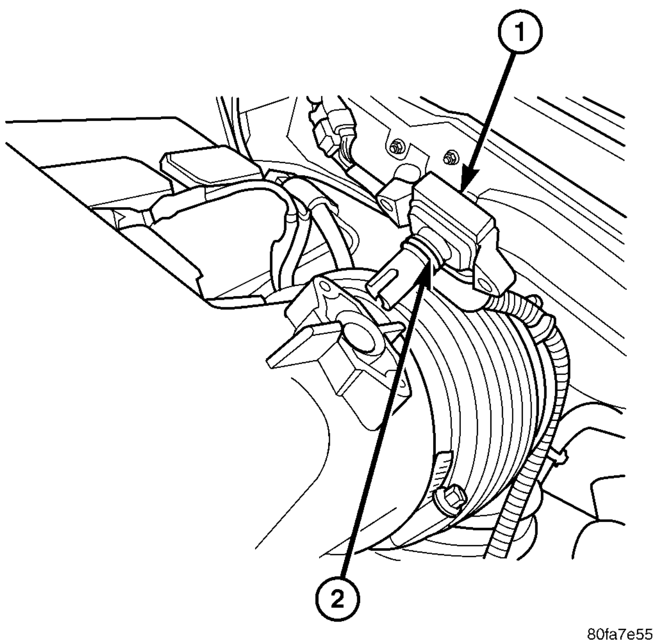


Fig. 26 SENSOR O-RING

1 - IAT/PRESSURE SENSOR
2 - O-RING

INTAKE AIR HEATER

DESCRIPTION

The intake manifold air heater element assembly is located in the top of the intake manifold.

OPERATION

The air heater elements are used to heat incoming air to the intake manifold. This is done to help engine starting and improve driveability with cool or cold outside temperatures.

Electrical supply for the 2 air heater elements is controlled by the Engine Control Module (ECM) through the 2 air heater relays. Refer to Intake Manifold Air Heater Relays for more information.

Two heavy-duty cables connect the 2 air heater elements to the 2 air heater relays. Each of these cables will supply approximately 95 amps at 12 volts to an individual heating element within the heater block assembly.

Refer to the Powertrain Diagnostic Procedures manual for an electrical operation and complete description of the intake heaters, including pre-heat and post-heat cycles.

REMOVAL

If servicing either of the heater elements, the entire block/element assembly must be replaced.

(1) Disconnect both negative battery cables at both batteries. Cover and isolate ends of both cables.

(2) Remove both the intake manifold air intake tube (above injection pump), and its rubber connector hose (Fig. 27).

(3) Lift 2 rubber covers (Fig. 28) to gain access to 2 positive (+) cable nuts. Remove these 2 nuts (Fig. 29) and remove 2 cables from studs.

(4) Disconnect ground strap (Fig. 28) at heater element stud.

(5) Remove wiring harness clips.

(6) Remove engine oil dipstick tube bracket from air inlet connection and fuel filter housing.

(7) Remove 4 housing mounting bolts (Fig. 28) and remove heater element assembly.

INSTALLATION

If servicing either of the heater elements, the entire block/element assembly must be replaced.

(1) Using 2 new gaskets, position element assembly and air housing to intake manifold.

(2) Position ground cable to air housing.

(3) Install 4 housing bolts and tighten to 24 N·m (18 ft. lbs.) torque.

(4) Connect 2 positive (+) heater cables at cable mounting studs. **Do not allow either of the cable eyelets to contact any other metal source other than the cable nuts/studs.**

INTAKE AIR HEATER (Continued)

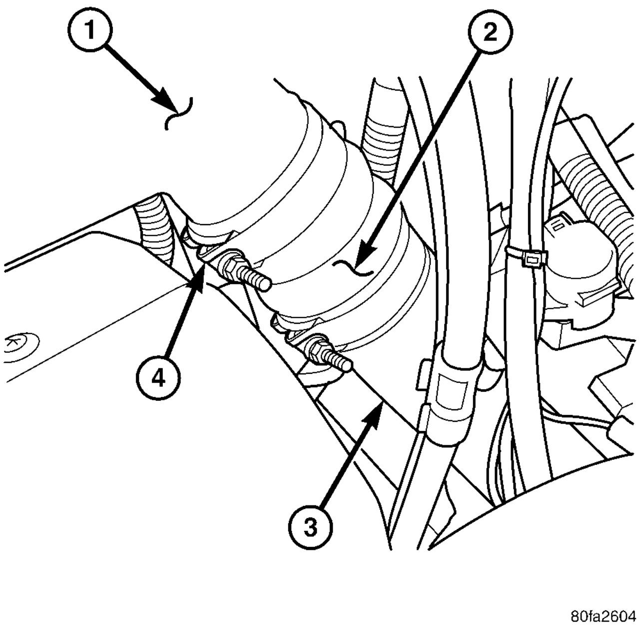


Fig. 27 INTAKE TUBE AND CONNECTING HOSE

1 - MANIFOLD ABOVE HEATERS
2 - RUBBER CONNECTING HOSE
3 - METAL INTAKE TUBE
4 - CLAMPS (2)

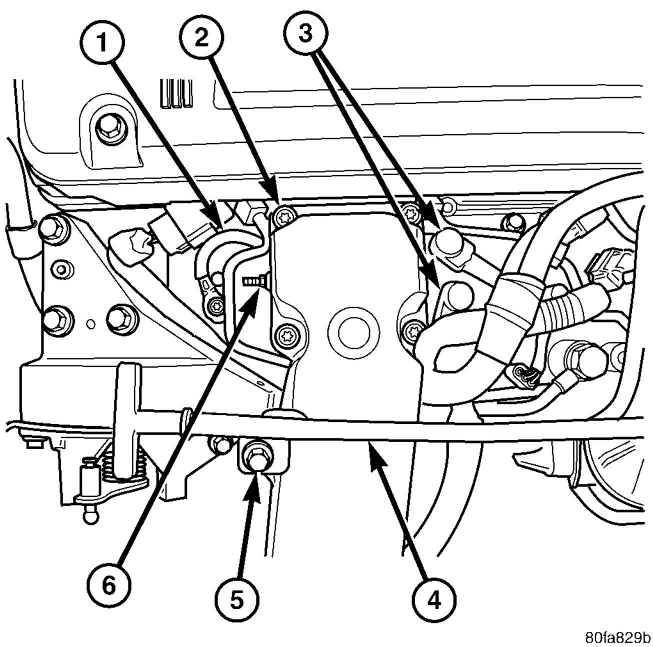


Fig. 28 AIR HEATER MANIFOLD

1 - GROUND CABLE
2 - MOUNTING BOLTS (4)
3 - RUBBER COVERS
4 - OIL DIPSTICK TUBE
5 - DIPSTICK MOUNTING BOLT
6 - NUT (GROUND CABLE)

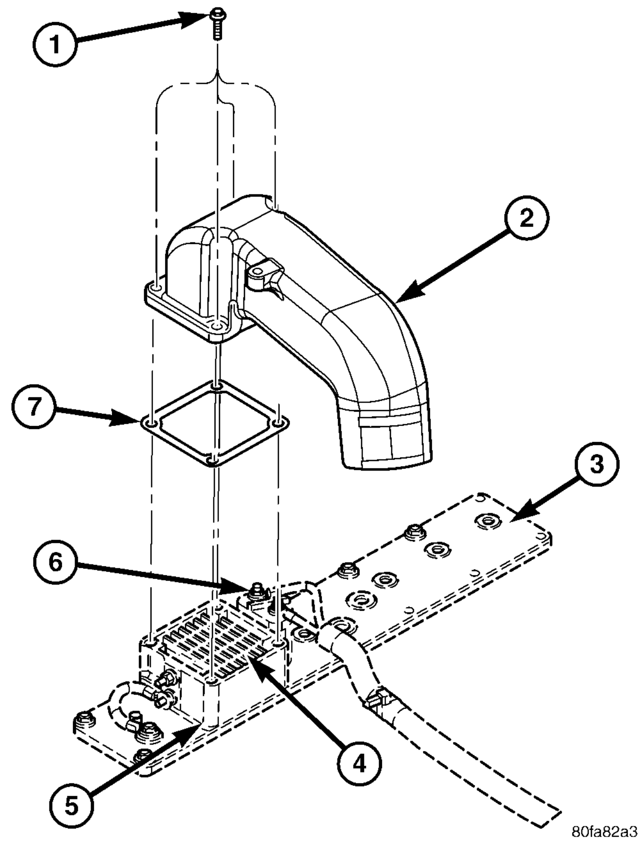


Fig. 29 AIR HEATER ELEMENTS

1 - MOUNTING BOLTS (4)
2 - AIR HEATER MANIFOLD
3 - INTAKE MANIFOLD
4 - HEATER ELEMENTS
5 - LOWER GASKET
6 - NUTS (2) POSITIVE CABLES
7 - UPER GASKET

(5) Install engine oil dipstick tube and mounting bolt.

(6) Connect rubber connector hose and intake tube to air intake housing.

(7) Connect both negative battery cables at both batteries.

INTAKE AIR HEATER RELAY

DESCRIPTION

The 2 intake manifold air heater relays are located in the engine compartment. They are attached to a common bracket. This bracket is attached to the right battery tray (Fig. 30).

OPERATION

The Engine Control Module (ECM) operates the 2 heating elements through the 2 intake manifold air heater relays.

INTAKE AIR HEATER RELAY (Continued)

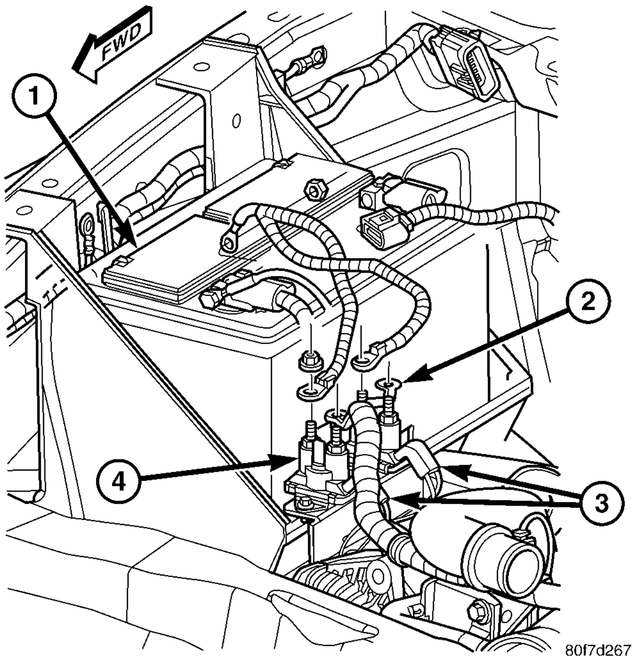


Fig. 30 INTAKE MANIFOLD AIR HEATER RELAYS

1 - BATTERY
2 - CABLES TO INTAKE HEATERS
3 - RELAY TRIGGER WIRES
4 - INTAKE AIR HEATER RELAYS (2)

Refer to Powertrain Diagnostic Procedures for an electrical operation and complete description of the intake heaters, including pre-heat and post-heat cycles.

REMOVAL

The 2 intake manifold air heater relays are located in the engine compartment. They are attached to a common bracket. This bracket is attached to the right battery tray (Fig. 30).

The mounting bracket and both relays are replaced as an assembly.

(1) Disconnect both negative battery cables at both batteries.

(2) Disconnect four relay trigger wires at both relays. Note position of wiring before removing.

(3) Lift four rubber shields from all 4 cables.

(4) Remove four nuts at cable connectors. Note position of wiring before removing.

(5) Remove relay mounting bracket bolts and remove relay assembly.

INSTALLATION

(1) Install relay assembly to battery tray. Tighten mounting bolts to 4.5 N·m (40 in. lbs.) torque.

(2) Connect eight electrical connectors to relays.

(3) Connect battery cables to both batteries.

INTAKE AIR TEMPERATURE SENSOR/MAP SENSOR

DESCRIPTION

The combination, dual function Intake Manifold Air Temperature Sensor/MAP Sensor is installed into the top of the intake manifold.

OPERATION

The combination, dual function Intake Manifold Air Temperature Sensor/MAP Sensor is installed into the top of the intake manifold with the sensor element extending into the air stream.

The IAT portion of the sensor provides an input voltage to the Engine Control Module (ECM) indicating intake manifold air temperature. The MAP portion of the sensor provides an input voltage to the ECM indicating turbocharger boost pressure.

REMOVAL

The combination, dual function Intake Manifold Air Temperature Sensor/MAP (IAT/MAP) sensor is installed into the top of the intake manifold (Fig. 31).

(1) Clean area around sensor.

(2) Disconnect electrical connector from IAT/MAP sensor.

(3) Remove two T-15 Torx headed screws.

(4) Remove sensor from intake manifold.

(5) Check condition of sensor o-ring (Fig. 32).

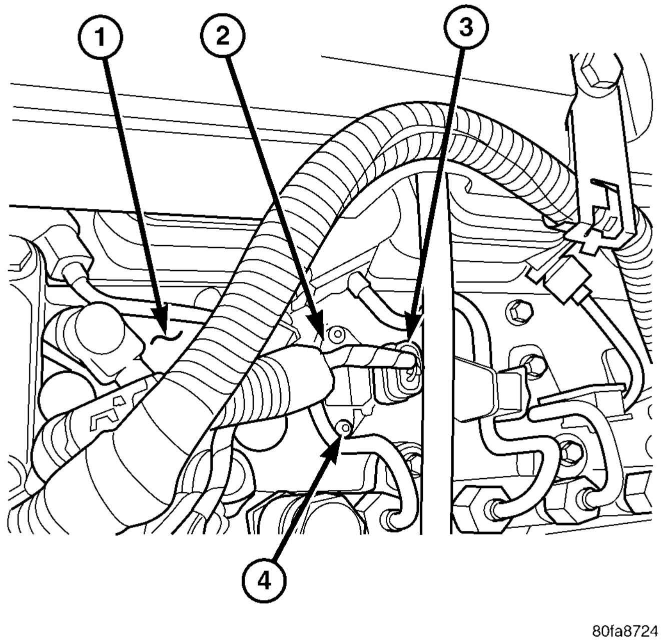


Fig. 31 INTAKE/MAP SENSOR

1 - TOP OF INTAKE MANIFOLD
2 - IAT/MAP SENSOR
3 - ELEC. CONNECTOR
4 - MOUNTING BOLTS (2)

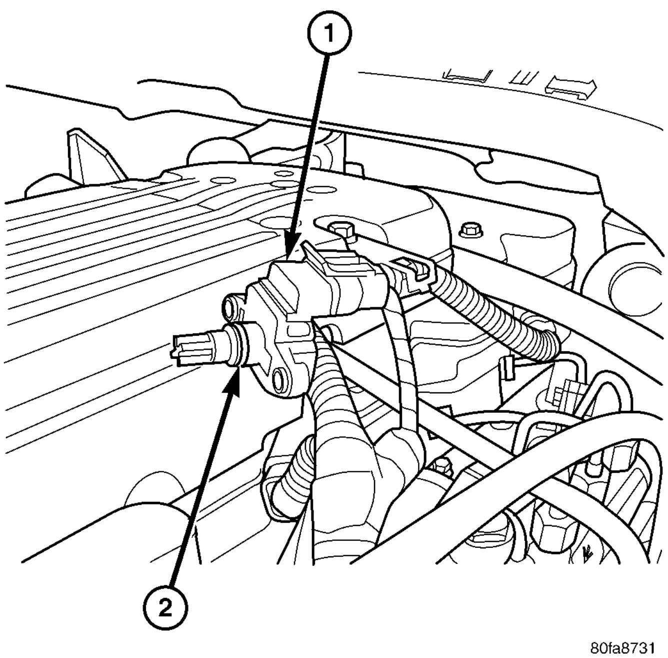


Fig. 32 SENSOR O-RING

1 - IAT/MAP SENSOR
2 - O-RING

INSTALLATION

(1) Check condition of sensor o-ring.
(2) Clean sensor mounting area at intake manifold
(3) Position sensor into intake manifold.
(4) Install and tighten 2 screws.
(5) Connect electrical connector to sensor.

MAP SENSOR

DESCRIPTION

A combination, dual function Intake Manifold Air Temperature Sensor/MAP Sensor is used. Refer to Intake Air Temperature Sensor/MAP Sensor for information.

THROTTLE CONTROL CABLE

REMOVAL

Early Diesel Engine

(1) Disconnect both negative battery cables at both batteries.
(2) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 33). The plastic cable retainer snaps into pedal arm.
(3) From inside vehicle, remove cable clip (Fig. 33).
(4) Remove cable core wire at pedal arm.
(5) Remove cable housing from dash panel and pull cable into engine compartment.
(6) Remove cable cover (Fig. 34). Cable cover is attached with 2 Phillips screws, 2 plastic retention clips and 2 push tabs (Fig. 34). Remove 2 Phillips screws and carefully pry out 2 retention clips. After clip removal, push rearward on front tab, and upward on lower tab for cover removal.
(7) Using 2 screwdrivers, pry cable connector socket from throttle lever ball (Fig. 35). **Be very careful not to bend throttle lever arm.**

THROTTLE CONTROL CABLE (Continued)

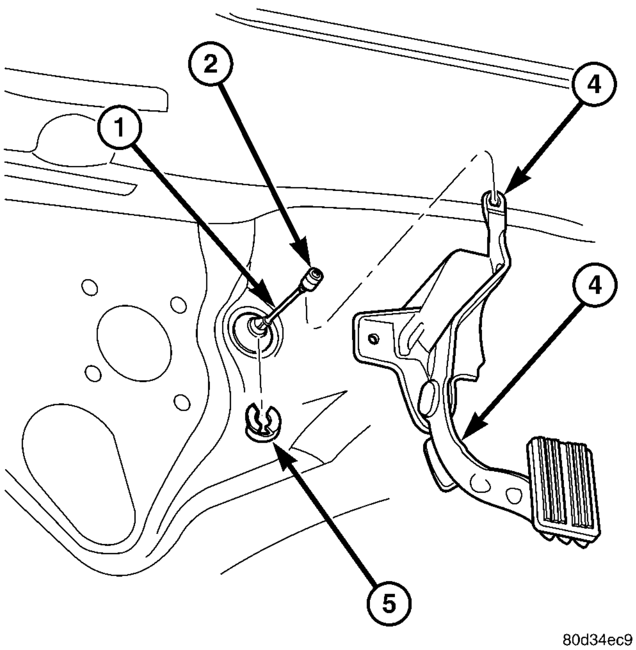


Fig. 33 ACCELERATOR PEDAL MOUNTING

1 - ACCELERATOR CABLE
2 - PLASTIC RETAINER (CLIP)
3 - THROTTLE PEDAL ARM
4 - PEDAL / BRACKET ASSEMBLY
5 - CABLE CLIP

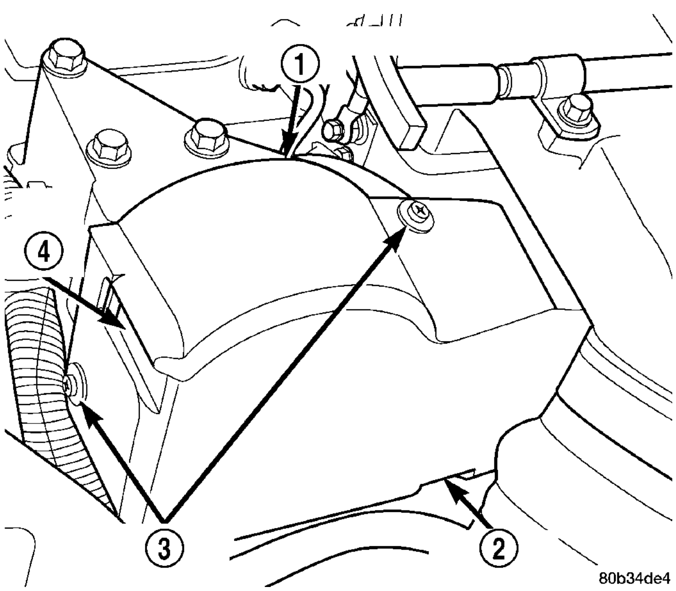


Fig. 34 CABLE/LEVER/THROTTLE LINKAGE COVER

1 - CABLE/LEVER/LINKAGE COVER
2 - PUSH UP LOWER TAB
3 - SCREWS/CLIPS (2)
4 - TAB PUSH HERE

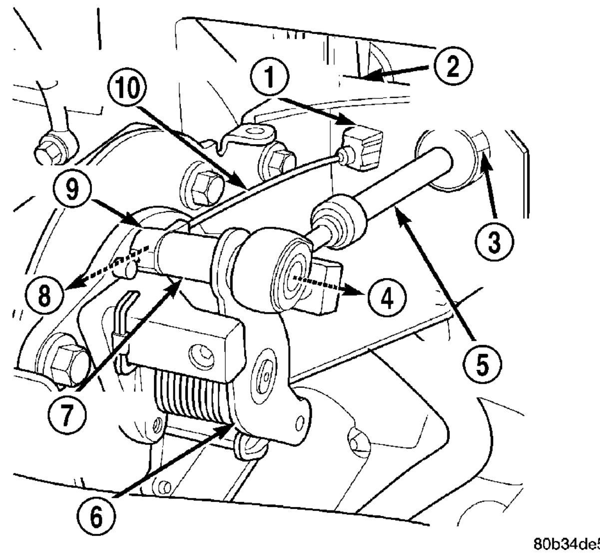


Fig. 35 SERVO CABLE AT THROTTLE LEVER

1 - PINCH (2) TABS
2 - CABLE MOUNTING BRACKET
3 - PINCH TABS (2)
4 - OFF
5 - THROTTLE CABLE
6 - THROTTLE LEVER
7 - THROTTLE LEVER PIN
8 - OFF
9 - CONNECTOR
10 - SPEED CONTROL CABLE

Late Diesel Engine

The Throttle Control Cable on the late diesel engine connects the accelerator pedal to the Accelerator Pedal Position Sensor (APPS). A separate mechanical cable is not routed to the throttle body.

CAUTION: Be careful not to damage or kink cable core wire (within cable sheathing) while servicing accelerator pedal, cables or APPS.

(1) Disconnect both negative battery cables at both batteries.

(2) From inside vehicle, hold up accelerator pedal. Remove plastic cable retainer and throttle cable core wire from upper end of pedal arm (Fig. 36). The plastic cable retainer snaps into pedal arm.

(3) Remove cable core wire at pedal arm.

(4) Remove APPS. Refer to (Diesel) Accelerator Pedal Position Sensor (APPS) Removal / Installation.

(5) From inside vehicle, remove cable clip (Fig. 36).

(6) Remove cable housing from dash panel and pull cable into engine compartment.

(7) Remove cable housing at APPS bracket by pressing on release tab with a small screwdriver. **To prevent cable housing breakage, press on tab only enough to release cable from APPS bracket.**

THROTTLE CONTROL CABLE (Continued)

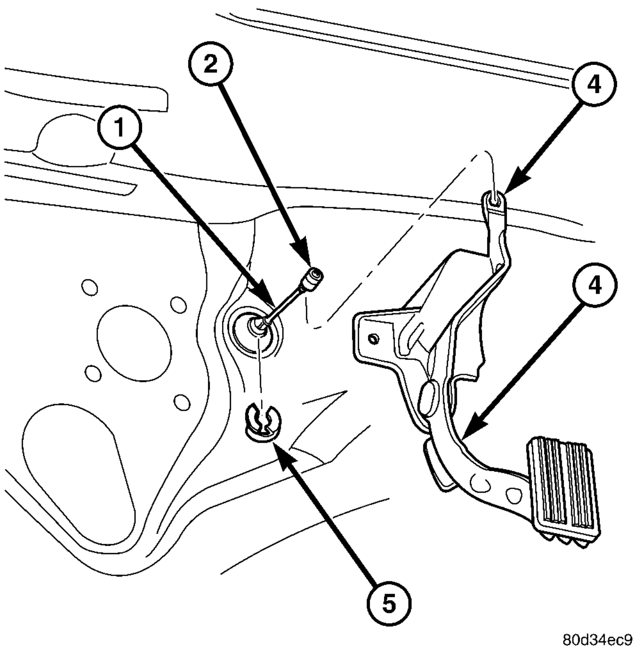


Fig. 36 ACCELERATOR PEDAL MOUNTING

1 - ACCELERATOR CABLE
2 - PLASTIC RETAINER (CLIP)
3 - THROTTLE PEDAL ARM
4 - PEDAL / BRACKET ASSEMBLY
5 - CABLE CLIP

INSTALLATION

Early Diesel Engine

(1) Install cable through mounting hole on cable mounting bracket (Fig. 35). Cable snaps into bracket. Be sure 2 pinch tabs are secure.

(2) Using large pliers, connect cable end socket to throttle lever ball (snaps on).

(3) Install remaining cable housing end into and through dash panel opening (snaps into position). The two plastic pinch tabs should lock cable to dash panel.

(4) From inside vehicle, hold up accelerator pedal. Install throttle cable core wire and plastic cable retainer into and through upper end of pedal arm (the plastic retainer is snapped into pedal arm). When installing plastic retainer to accelerator pedal arm, note index tab on pedal arm (Fig. 33). Align index slot on plastic cable retainer to this index tab.

(5) Connect negative battery cables to both batteries.

(6) Before starting engine, operate accelerator pedal to check for any binding.

(7) Install cable/lever cover.

Late Diesel Engine

(1) Attach cable to Accelerator Pedal Position Sensor (APPS). Refer to APPS (Diesel) Removal / Installation.

(2) Push cable housing into rubber grommet and through opening in dash panel.

(3) From inside vehicle, install clip holding cable to dashpanel (Fig. 36).

(4) From inside vehicle, slide throttle cable core wire into opening in top of pedal arm.

(5) Push cable retainer (clip) into pedal arm opening until it snaps in place.

(6) Before starting engine, operate accelerator pedal to check for any binding.

(7) If necessary, use DRB III® Scan Tool to erase any APPS Diagnostic Trouble Codes (DTC's) from PCM.

STEERING

TABLE OF CONTENTS

STEERING

DESCRIPTION

CAUTION: MOPAR® ATF+4 is to be used in the power steering system. No other power steering or automatic transmission fluid is to be used in the system. Damage may result to the power steering pump and system if any other fluid is used, and do not overfill.

Power steering systems consist of:
- Steering column
- Rack and pinion steering gear
- Belt driven hydraulic steering pump
- Pump pressure and return hoses
- Oil Cooler

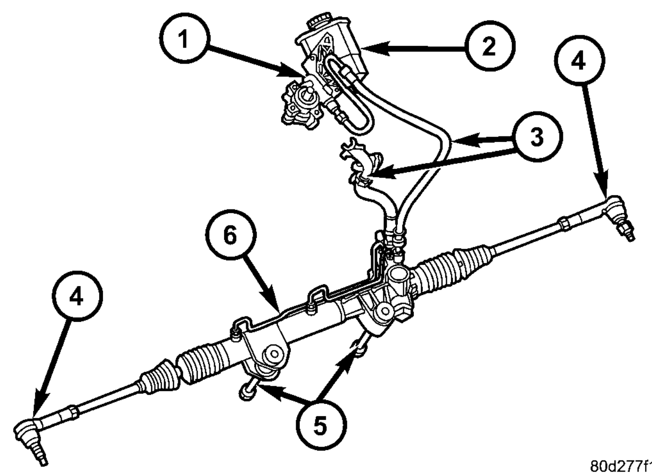


Fig. 1 STEERING COMPONENTS

1 - POWER STEERING PUMP ASSEMBLY
2 - RESERVOIR
3 - HOSES
4 - TIE ROD ENDS
5 - MOUNTING BOLTS
6 - RACK & PINION

OPERATION

The steering column shaft is attached to the gear pinion. The rotation of the pinion moves the gear rack from side-to-side. This lateral action of the rack pushes and pulls the tie rods to change the direction of the front wheels (Fig. 1).

Power assist is provided by an engine mounted hydraulic pump which supplies hydraulic fluid pressure to the steering gear.

STEERING (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - POWER STEERING SYSTEM

There is some noise in all power steering systems. One of the most common is a hissing sound evident at a standstill parking. Or when the steering wheel is at the end of it's travel. Hiss is a high frequency noise similar to that of a water tap being closed slowly. The noise is present in all valves that have a high velocity fluid passing through an orifice. There is no relationship between this noise and steering performance.

STEERING NOISE

CONDITION	POSSIBLE CAUSES	CORRECTION
OBJECTIONAL HISS OR WHISTLE	1. Steering intermediate shaft to dash panel seal.	1. Check and repair seal at dash panel.
	2. Noisy valve in power steering gear.	2. Replace steering gear.
RATTLE OR CLUNK	1. Gear mounting bolts loose.	1. Tighten bolts to specification.
	2. Loose or damaged suspension components.	2. Inspect and repair suspension.
	3. Internal gear noise.	3. Replace steering gear.
	4. Pressure hose in contact with other components.	4. Reposition hose.
	5. Loose or damaged intermediate shaft or column.	5. Inspect and repair or replace.
CHIRP OR SQUEAL	1. Loose belt.	1. Adjust or replace.
WHINE OR GROWL	1. Low fluid level.	1. Fill to proper level.
	2. Pressure hose in contact with other components.	2. Reposition hose.
	3. Internal pump noise.	3. Replace pump.
	4. Air in fluid	4. Check for lekas, Evacuate air from P/S system.
SUCKING AIR SOUND	1. Loose return line clamp.	1. Replace clamp.
	2. O-ring missing or damaged on hose fitting.	2. Replace o-ring.
	3. Low fluid level.	3. Fill to proper level.
	4. Air leak between pump and reservoir.	4. Repair as necessary.
	5. Reservoir cap not installed correctly.	5. Install reservoir cap correctly.
SCRUBBING OR KNOCKING	1. Wrong tire size.	1. Verify tire size.

STEERING (Continued)

BINDING AND STICKING

CONDITION	POSSIBLE CAUSE	CORRECTION
DIFFICULT TO TURN WHEEL STICKS OR BINDS	1. Low fluid level.	1. Fill to proper level.
	2. Tire pressure.	2. Adjust tire pressure.
	3. Steering components (ball joints/tie rod ends).	3 Inspect and repair as necessary.
	4. Loose belt.	4. Adjust or replace.
	5. Low pump pressure.	5. Pressure test and replace if necessary.
	6. Column shaft coupler binding.	6. Replace coupler.
	7. Steering gear worn.	7. Replace gear.
	8. Pump seized / Stuck valve	8. Replace pump.

INSUFFICIENT ASST. OR POOR RETURN TO CENTER

CONDITION	POSSIBLE CAUSE	CORRECTION
HARD TURNING OR MOMENTARY INCREASE IN TURNING EFFORT	1. Tire pressure.	1. Adjust tire pressure.
	2. Low fluid level.	2. Fill to proper level.
	3. Loose belt.	3. Adjust or replace.
	4. Low pump pressure.	4. Pressure test and repair as necessary.
	5. Internal gear leak.	5. Replace gear.
STEERING WHEEL DOES NOT WANT TO RETURN TO CENTER POSITION	1. Tire pressure.	1. Adjust tire pressure.
	2. Wheel alignment.	2. Align front end.
	3. Lack of lubrication.	3. Inspect and lubricate suspension compnents.
	4. High friction in steering gear.	4. Replace gear.

LOOSE STEERING AND VEHICLE LEAD

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE PLAY IN STEERING WHEEL	1. Worn or loose suspension or steering components.	1. Inspect and repair as necessary.
	2. Worn or loose wheel bearings.	2. Inspect and repair or adjust bearings.
	3. Steering gear mounting.	3. Tighten gear mounting bolts to specification.
	4. Gear out of adjustment.	4. Replace gear.
	5. Worn or loose steering coupler.	5. Inspect and replace as necessary.
VEHICLE PULLS OR LEADS TO ONE SIDE.	1. Tire Pressure.	1. Adjust tire pressure.
	2. Radial tire lead.	2. Rotate tires.
	3. Brakes dragging.	3. Repair as necessary.
	4. Wheel alignment.	4. Align front end.

STEERING (Continued)

DIAGNOSIS AND TESTING - POWER STEERING FLOW AND PRESSURE

The following procedure is used to test the operation of the power steering system on the vehicle. This test will provide the gallons per minute (GPM) or flow rate of the power steering pump along with the maximum relief pressure. Perform test any time a power steering system problem is present. This test will determine if the power steering pump or power steering gear is not functioning properly. The following pressure and flow test is performed using Power Steering Analyzer Tool kit 6815 and (Fig. 2) Adapter Kit 6893.

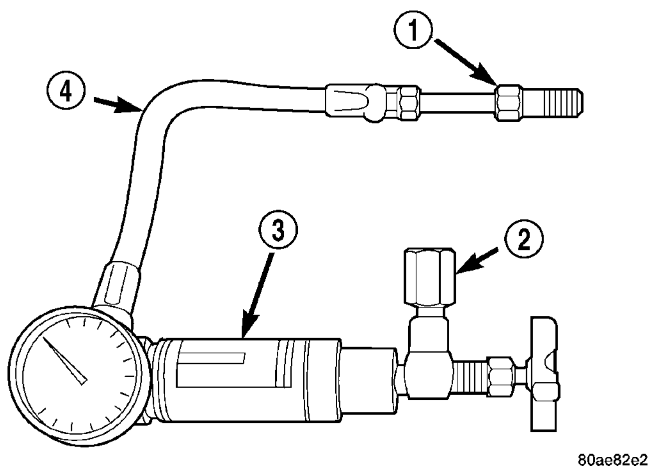


Fig. 2 Analyzer With Tube and Adapter

1 - TUBE
2 - ADAPTER FITTINGS
3 - ANALYZER
4 - GAUGE HOSE

FLOW AND PRESSURE TEST

(1) Check the power steering belt to ensure it is in good condition and adjusted properly.

(2) Connect pressure gauge hose from the Power Steering Analyzer to adapter 6826.

(3) Connect tube 6825A to Power Steering Analyzer test valve end.

(4) Disconnect the high pressure hose from the power steering pump.

(5) Connect the tube 6825A to the pump fitting.

(6) Connect the power steering hose from the steering gear to the adapter 6826.

(7) Open the test valve completely.

(8) Start engine and let idle long enough to circulate power steering fluid through flow/pressure test gauge and to get air out of the fluid. Then shut off engine.

(9) Check fluid level, add fluid as necessary. Start engine again and let idle.

(10) Gauge should read below 862 kPa (125 psi), if above, inspect the hoses for restrictions and repair as necessary. The initial pressure reading should be in the range of 345-552 kPa (50-80 psi).

(11) Increase the engine speed to 1500 RPM and read the flow meter. If the flow rate (GPM) is below specification, (refer to pump specification chart for GPM) the pump should be replaced.

CAUTION: The following test procedure involves testing maximum pump pressure output and flow control valve operation. Do not leave valve closed for more than three seconds as the pump could be damaged.

(12) Close valve fully three times and record highest pressure indicated each time. **All three readings must be above specifications and within 345 kPa (50 psi) of each other.**

- Pressures above specifications but not within 345 kPa (50 psi) of each other, replace pump.
- Pressures within 345 kPa (50 psi) of each other but below specifications, replace pump.

(13) Open the test valve and turn the steering wheel to the extreme left and right positions three times against the stops. Record the highest pressure reading at each position. Compare readings to the pump specifications chart. If pressures readings are not within 50 psi of each other, the gear is leaking internally and must be replaced.

CAUTION: Do not force the pump to operate against the stops for more than 2 to 3 seconds at a time because, pump damage will result.

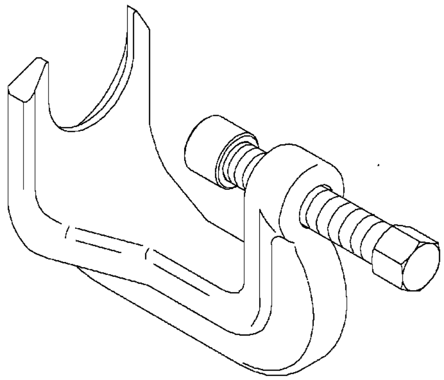
PUMP SPECIFICATION

ENGINE	RELIEF PRESSURE ± 65	FLOW RATE (GPM) AT 1500 RPM
1500 series	11032 kPa (1615 ± 65 psi)	3.1 - 3.5
2500 & 3500 series	12400 kPa (1800 ± 50 psi)	3.5 - 4.0

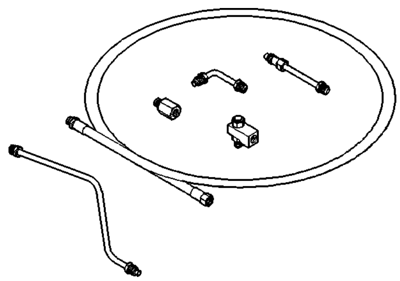
STEERING (Continued)

SPECIAL TOOLS

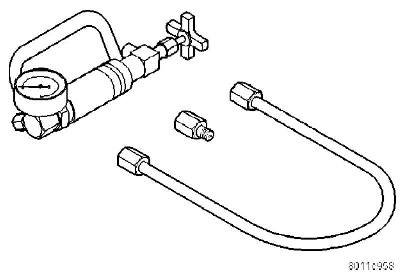
STEERING



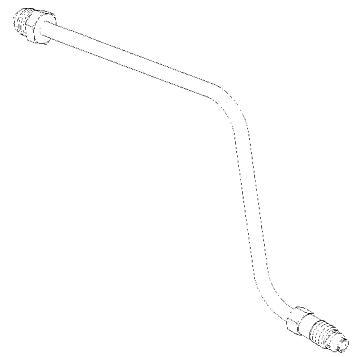
PULLER - 8677



ADAPTERS, POWER STEERING FLOW/PRESSURE TESTER - 6893



ANALYZER SET, POWER STEERING FLOW/ PRESSURE 6815



ADAPTER, POWER STEERING FLOW/PRESSURE - 6825A

COLUMN

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COLUMN

DESCRIPTION

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

The tilt and standard column (Fig. 1) has been designed to be serviced as an assembly; less wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the steering column from the vehicle.

To service the steering wheel, switches or airbag, refer to Restraints and follow all WARNINGS and CAUTIONS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY. THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.

CAUTION: Do not hammer on steering column shaft. This may cause damage to the shaft or bearing.

CAUTION: Do not attempt to remove the pivot bolts to disassemble the tilting mechanism. Do not remove shaft lock plate or plate retainer. This will damage the column.

CAUTION: Do not attempt to remove or modify the park lock slider or link.

NOTE: When servicing the steering wheel after removing the old bolt a new bolt must be used when installing.

COLUMN (Continued)

NOTE: When servicing the coupler a new bolt must be used when installing.

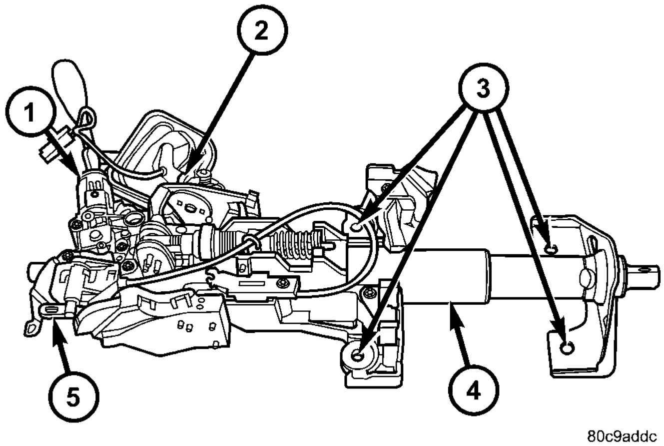

Fig. 1 STEERING COLUMN

1 - LOCK CYLINDER
2 - GEAR SHIFT LEVER
3 - MOUNTING HOLES
4 - STEERING COLUMN
5 - TILT LEVER

DIAGNOSIS AND TESTING - STEERING COLUMN

If the vehicle is involved in a front end collision/the air bag has deployed the column must be inspected. This inspection will determine if the Column has collapsed. Inspect the column mounting capsules visually and manually push and pull them to check for separation or fractures. If capsules are fractured or have moved the column MUST be replaced.

REMOVAL

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

CAUTION: All fasteners must be torqued to specification to ensure proper operation of the steering column.

(1) Position the front wheels **straight ahead**.
(2) Disconnect the negative (ground) cable from the battery.
(3) Remove the two switches from the steering wheel.
(4) Remove the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).
(5) Remove the steering wheel with special tool CJ98–1 or an appropriate steering wheel puller.

CAUTION: Ensure the puller bolts are fully engaged into the steering wheel and not into the clockspring, before attempting to remove the wheel. Failure to do so may damage the steering wheel/clockspring.

(6) Remove the steering column opening cover (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL).
(7) Remove the tilt lever.
(8) Remove the column shrouds (Fig. 2).

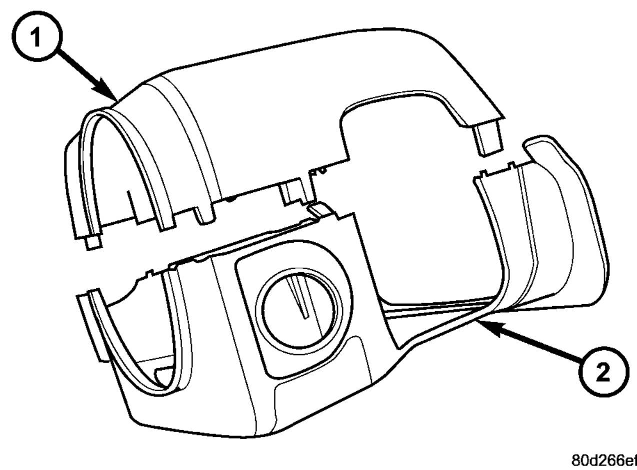

Fig. 2 UPPER & LOWER SHROUDS

1 - UPPER SHROUD
2 - LOWER SHROUD

(9) Remove the clock spring, (Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).
(10) Disconnect the wiring harness to the column.
(11) Remove the shift cable from the column shift lever actuator (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 32RH/GEAR SHIFT CABLE - REMOVAL). (Fig. 3).

COLUMN (Continued)

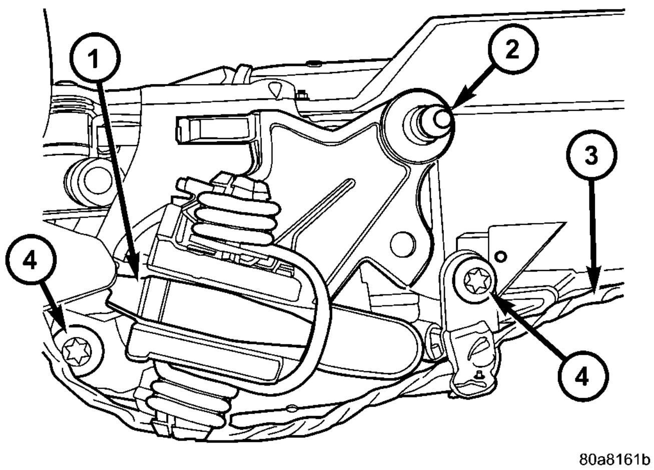

Fig. 3 SHIFT CABLE CONNECTOR

1 - Shift lever
2 - Cable Connection
3 - Overdrive Electrical Wiring
4 - Mounting Screws

(12) Release the shift cable from the column bracket and remove it from the bracket.

(13) Remove the SKIM module in order to disconnect the electrical connector.

(14) Remove the upper steering shaft coupler bolt and slide the shaft down (Fig. 4) & (Fig. 5)

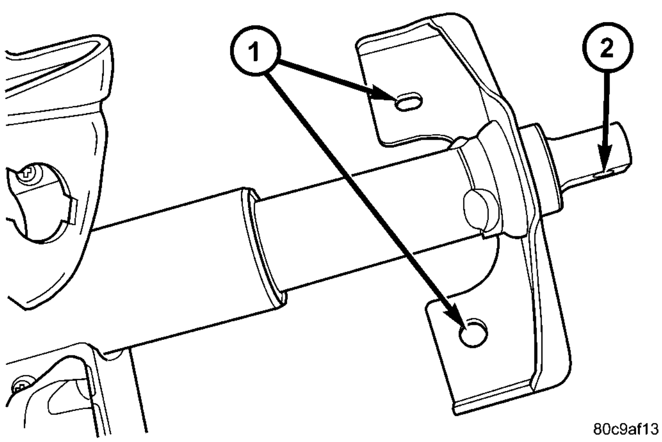

Fig. 4 COUPLER SHAFT

1 - MOUNTING HOLES
2 - COUPLER BOLT HOLE

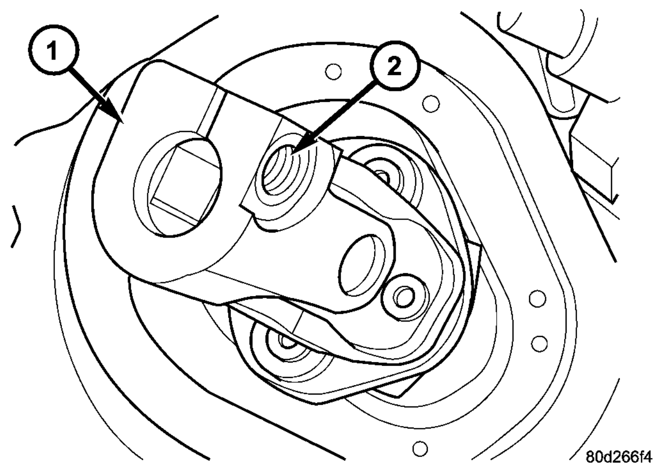

Fig. 5 UPPER STEERING COUPLER

1 - STEERING COUPLER
2 - PINCH BOLT HOLE

(15) Remove the brake light switch and discard (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(16) Remove the four steering column mounting nuts (Fig. 6).

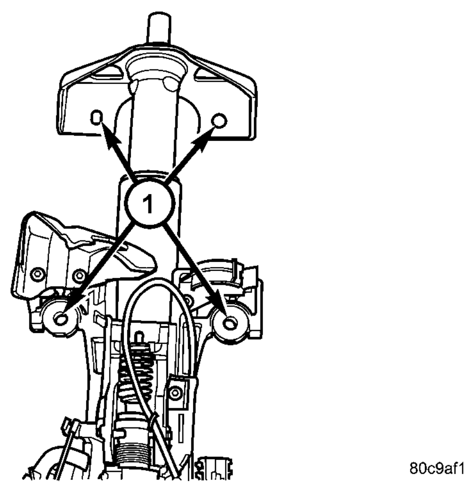

Fig. 6 MOUNTING HOLES

1 - MOUNTING HOLES

(17) Remove the steering column assembly from the vehicle. (Fig. 7)

COLUMN (Continued)

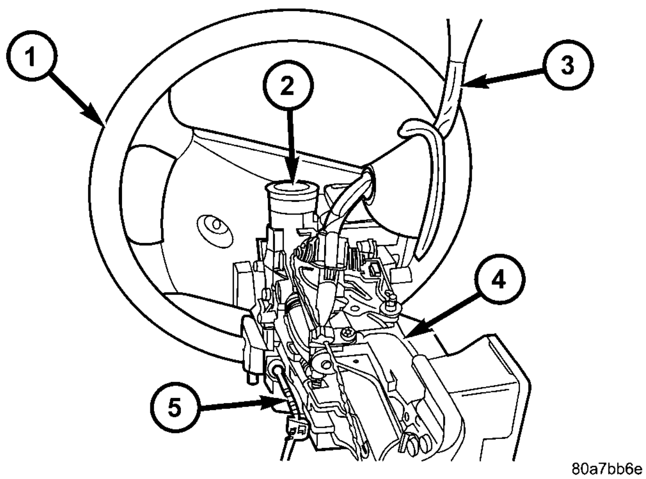

Fig. 7 STEERING COLUMN

1 - Steering Wheel
2 - Key Cylinder
3 - Gear Shift Lever
4 - Steering Column
5 - Tilt Lever Cable

INSTALLATION

WARNING: BEFORE SERVICING THE STEERING COLUMN THE AIRBAG SYSTEM MUST BE DISARMED. REFER TO ELECTRICAL RESTRAINT SYSTEM FOR SERVICE PROCEDURES. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY.

CAUTION: All fasteners must be torqued to specification to ensure proper operation of the steering column.

(1) Position the steering column on the dash panel support and loosely install the mounting nuts.

(2) Firmly slide the steering column upward against the studs in dash panel and hand tighten the nuts.

(3) Install the steering shaft coupler on the steering shaft and loosely install a **new** bolt.

(4) Center steering column in dash opening and tighten mounting nuts to 28 N·m (250 in. lbs.).

NOTE: Torque the upper left nut first then the lower right nut. Then torque the lower left nut then the upper right nut.

NOTE: A new bolt must be used for reinstallation.

(5) Tighten the coupler bolt to 57 N·m (42 ft. lbs.).

(6) Install a new brake light switch (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - REMOVAL).

(7) Install the shifter cable. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 32RH/GEAR SHIFT CABLE - INSTALLATION)

(8) Connect the wiring harness to the column.

(9) Install the SKIM module.

(10) Install the clockspring(Refer to 8 - ELECTRICAL/RESTRAINTS/CLOCKSPRING - REMOVAL).

(11) Install the shrouds.

(12) Install the steering column opening cover (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION).

(13) Align the spline on the wheel hub to shaft.

(14) Then install the steering wheel and install a **new** bolt. Tighten the bolt to 61 N·m (45 ft. lbs.).

(15) Install the airbag (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

(16) Install the two steering wheel switches.

(17) Install the tilt lever handle.

(18) Install the negative battery terminal.

(19) Test the operation of the horn, Electronic PRNDL Indicator, lights and any other functions that are steering column operated.

IGNITION SWITCH

DESCRIPTION

The ignition switch is located on the steering column. It is used as the main on/off switching device for most electrical components. The mechanical key cylinder is used to engage/disengage the electrical ignition switch.

OPERATION

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the shift cable. This interlock device is used to lock the transmission shifter in the PARK position when the key cylinder is in any position and the brake pedal is not depressed.

DIAGNOSIS AND TESTING - IGNITION SWITCH

TEST AND REPAIR

If the key removal effort is excessive on a vehicle with a automatic transmission first adjust the shift linkage, (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/GEAR SHIFT CABLE - ADJUSTMENTS).

If the ignition switch effort is excessive remove the ignition key cylinder from the steering column. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL). Check the turning effort of the key cylinder. If the ignition key cylinder effort is excessive replace the key cylinder.

IGNITION SWITCH (Continued)

REMOVAL

SERVICE PRECAUTIONS

NOTE: The steering column on vehicles equipped with an automatic transmission is not equipped with an internal locking shaft with the ignition cylinder. Alternative methods of locking the steering wheel for service will have to be used.

The tilt and standard column (Fig. 8) have been designed to be serviced as an assembly; without wiring, switches, shrouds, steering wheel, etc. Most steering column components can be serviced without removing the steering column from the vehicle.

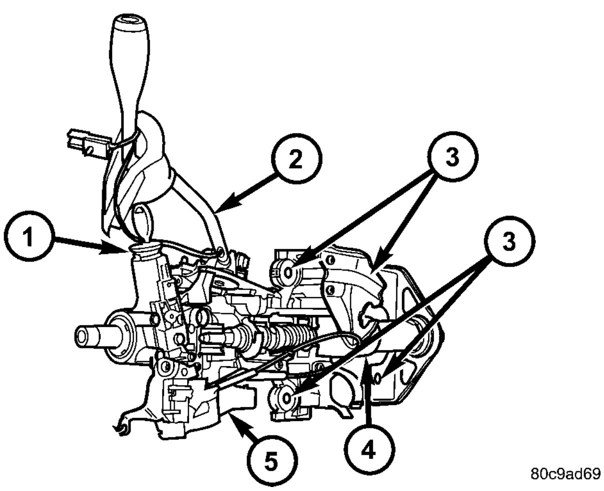

Fig. 8 STEERING COLUMN

1 - KEY CYLINDER
2 - GEAR SHIFT LEVER
3 - MOUNTING HOLES
4 - STEERING COLUMN
5 - IGNITION SWITCH

Safety goggles should be worn at all times when working on steering columns.

To service the steering wheel, switches or airbag, Refer to Electrical Restraints and follow all WARNINGS and CAUTIONS.

WARNING: THE AIRBAG SYSTEM IS A SENSITIVE, COMPLEX ELECTRO-MECHANICAL UNIT. BEFORE ATTEMPTING TO DIAGNOSE, REMOVE OR INSTALL THE AIRBAG SYSTEM COMPONENTS YOU MUST FIRST DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE. THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE. FAILURE TO DO SO COULD RESULT IN ACCIDENTAL DEPLOYMENT OF THE AIRBAG AND POSSIBLE PERSONAL INJURY. THE FASTENERS, SCREWS, AND BOLTS, ORIGINALLY USED FOR THE AIRBAG COMPONENTS, HAVE SPECIAL COATINGS AND ARE SPECIFICALLY DESIGNED FOR THE AIRBAG SYSTEM. THEY MUST NEVER BE REPLACED WITH ANY SUBSTITUTES. ANYTIME A NEW FASTENER IS NEEDED, REPLACE WITH THE CORRECT FASTENERS PROVIDED IN THE SERVICE PACKAGE OR FASTENERS LISTED IN THE PARTS BOOKS.

CAUTION: Do not hammer on steering column shaft. This may cause damage to the shaft or bearing.

CAUTION: Do not attempt to remove the pivot bolts to disassemble the tilting mechanism.

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before removing ignition switch.

(1) Remove the negative (ground) cable from the battery.

(2) Disable the airbag, (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).

(3) Remove the lower and upper shrouds.

(4) Remove key cylinder. (Refer to 19 - STEERING/COLUMN/LOCK CYLINDER HOUSING - REMOVAL).

(5) Disconnect the lower clockspring connectors.

(6) Remove the wire retainer from the tilt lever bracket.

(7) Remove the tilt lever mounting screws to gain access to the ignition switch mounting screws. (Fig. 9)

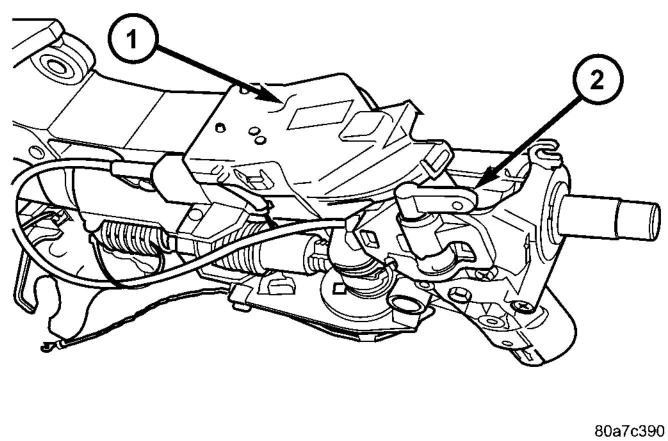

Fig. 9 IGNITION SWITCH WITH TILT

1 - IGNITION SWITCH
2 - TILT LEVER MECHANISM

(8) For columns without tilt remove the bracket to gain access to the ignition switch mounting screws. (Fig. 10)

(9) Disconnect the electrical connector at rear of ignition switch (Fig. 11).

IGNITION SWITCH (Continued)

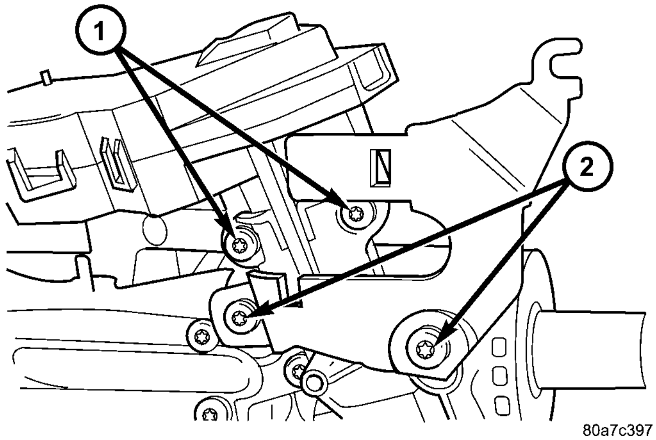

Fig. 10 IGNITION SWITCH WITHOUT TILT

1 - Ignition Switch Mounting Screws
2 - Non-Tilt Mounitng Bracket Screws

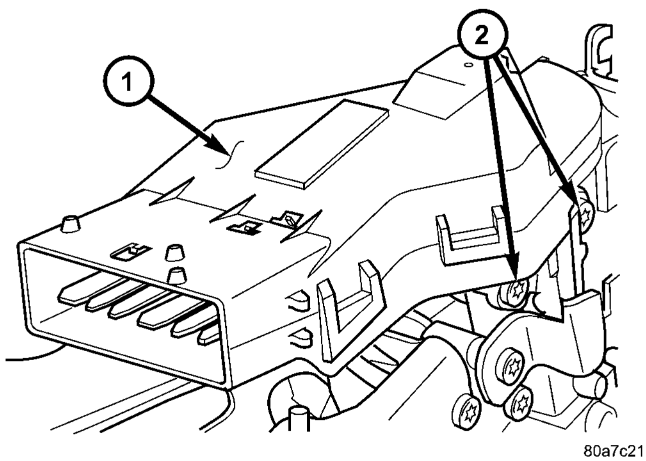

Fig. 11 IGNITION SWITCH

1 - Ignition Switch
2 - Ignition Switch Mounting Screws

(10) Remove ignition switch mounting screw.

(11) Using a small screwdriver, push on locking tab and remove switch from steering column.

INSTALLATION

The ignition key must be in the key cylinder for cylinder removal. The key cylinder must be removed first before installing ignition switch.

(1) Before installing ignition switch, rotate the slot in the switch to the ON position.

(2) Connect the electrical connector to rear of the ignition switch. Make sure that locking tabs are fully seated into wiring connector.

(3) Position switch to column and install the mounting screw. Tighten screw to 3 N·m (26 in. lbs.).

(4) Install the tilt lever bracket mounting screws. Tighten screws to 4.5 N·m (40 in. lbs.).

(5) If the column is non-tilt install the bracket. Tighten screws to 4.5 N·m (40 in. lbs.) (Fig. 10)

(6) Position the wire retainer into the tilt lever bracket.

(7) Reconnect the lower clockspring connectors.

(8) Install the key cylinder.

(9) Install steering column upper and lower shrouds.

(10) Enable the airbag system. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

KEY-IN IGNITION SWITCH

DESCRIPTION

The key-in ignition switch is integral to the ignition switch, which is mounted on the left side of the steering column. It closes a path to ground for the Central Timer Module (CTM) when the ignition key is inserted in the ignition key cylinder and the driver door ajar switch is closed (driver door is open). The key-in ignition switch opens the ground path when the key is removed from the ignition key cylinder. The ground path is also opened when the driver door ajar switch is open (driver door is closed).

The key-in ignition switch cannot be repaired and, if faulty or damaged, the entire ignition switch must be replaced, (Refer to 19 - STEERING/COLUMN/IGNITION SWITCH - REMOVAL).

DIAGNOSIS AND TESTING - IGNITION SWITCH AND KEY LOCK CYLINDER

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, refer to Ignition Switch in the appropriate section of Electrical Wiring Diagrams.

MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

(Refer to 19 - STEERING/COLUMN/IGNITION SWITCH - DIAGNOSIS AND TESTING).

KEY CYLINDER

REMOVAL

The ignition key must be in the key cylinder for cylinder removal.

(1) Disconnect negative cable from battery.

(2) Remove upper and lower covers (shrouds) from steering column.

(3) Place shifter in PARK position.

(4) A retaining pin (Fig. 12) is located at side of key cylinder assembly.

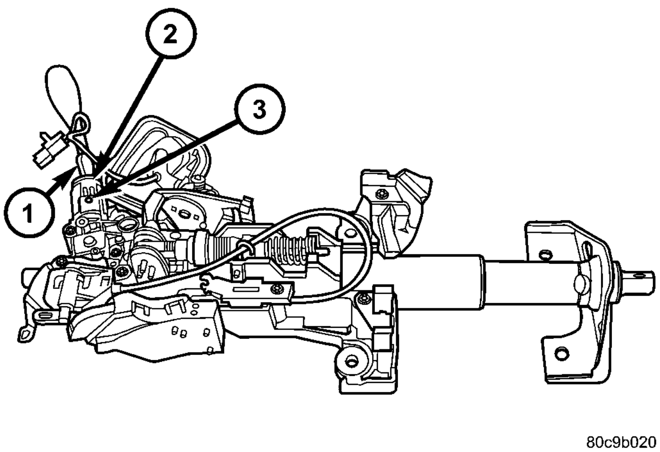

Fig. 12 KEY CYLINDER

1 - KEY
2 - KEY CYLINDER
3 - RETAINING PIN HOLE

(a) Rotate key to RUN position.

(b) Press in on retaining pin while pulling key cylinder from ignition switch (Fig. 13).

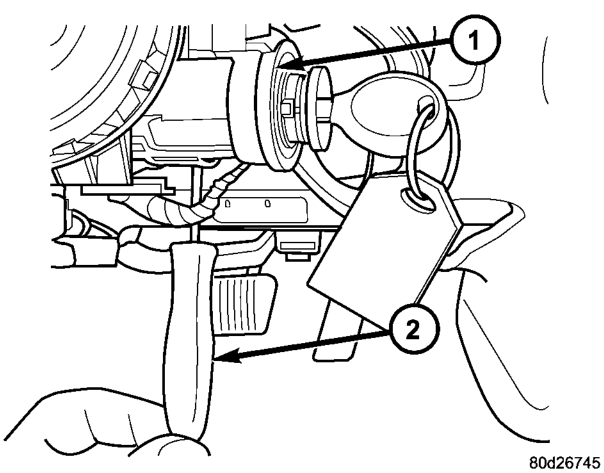

Fig. 13 KEY CYLINDER

1 - KEY CYLINDER
2 - PUNCH

INSTALLATION

The ignition key must be in the key cylinder for cylinder installation.

(1) Install the key cylinder into the housing using care to align the end of the key cylinder with the ignition switch.

(2) Push the key cylinder in until it clicks.

(3) Replace the upper and lower shrouds.

(4) Reconnect the battery.

GEAR SHIFT LEVER

REMOVAL

(1) Remove the kneeblocker. (Refer to 23 - BODY/ INSTRUMENT PANEL/KNEE BLOCKER - REMOVAL).

(2) Remove the upper and lower column shroud.

(3) Remove and discard the brake light switch.

(4) Loosen the column bolts and lower the column enough to allow clearance for the gear shift lever removal.

(5) Disconnect the overdrive switch harness (if equipped).

(6) Disconnect the shift cable from the shift lever.

(7) Remove the SKIM.

(8) Remove the gear shift lever mounting screws and remove the lever. (Fig. 14)

(9) Remove the blocker pin from the inhibit link slot (Fig. 14).

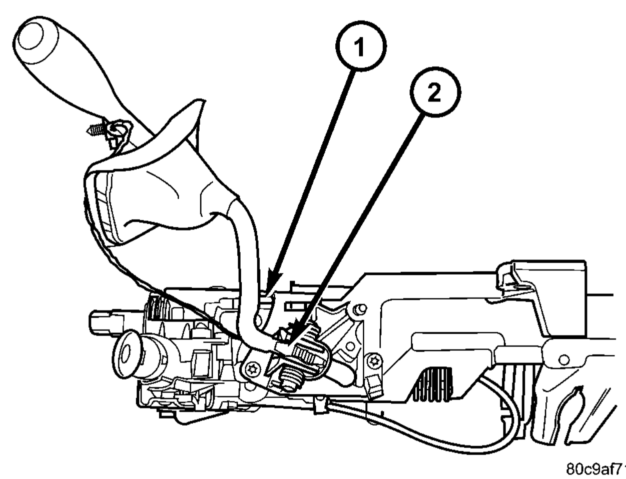

Fig. 14 GEAR SHIFT LEVER

1 - PARK INHIBIT BLOCKER SPRING
2 - GEAR SHIFT LEVER

INSTALLATION

(1) Install the lever assembly using care to install the pin in the blocker to slider slot (Fig. 15) and install the mounting screws and tighten to 12 N·m (105 in. lbs.).

GEAR SHIFT LEVER (Continued)

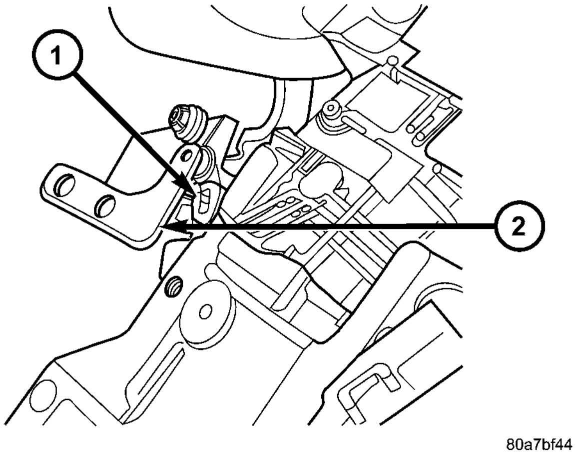

Fig. 15 GEAR SHIFT LEVER SPRING

1 - BLOCKER TO INHIBIT LINK SLOT
2 - GEAR SHIFT LEVER

(2) Cycle the key from ACC to RUN and ensure that the blocker does not stick or bind.

(3) Turn the key to the OFF position and ensure that the shifter will not pull from the PARK position.

(4) Connect the over drive switch harness (if equipped).

NOTE: Route and tie off harness to original location.

(5) Connect the shift cable to the lever.

(6) Ensure the gear shift lever and transmission are in the PARK position and snap the cable adjust clip in place.

(7) Install a new brake light switch (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/BRAKE LAMP SWITCH - INSTALLATION).

(8) Install the SKIM and halo.

(9) Install the upper and lower column shroud.

(10) Install the column back into place and tighten.

(11) Install the kneeblocker. (Refer to 23 - BODY/INSTRUMENT PANEL/KNEE BLOCKER - INSTALLATION).

UPPER STEERING COUPLING

REMOVAL

(1) Disconnect the negative battery cable.

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

(2) Lock the steering wheel with the tire in the straight position.

(3) Remove and discard the lower pinch bolt.

(4) Lower the steering coupler shaft from the column.

(5) Remove the upper steering coupling shaft seal by pushing in the four tags securing it to the panel (Fig. 16).

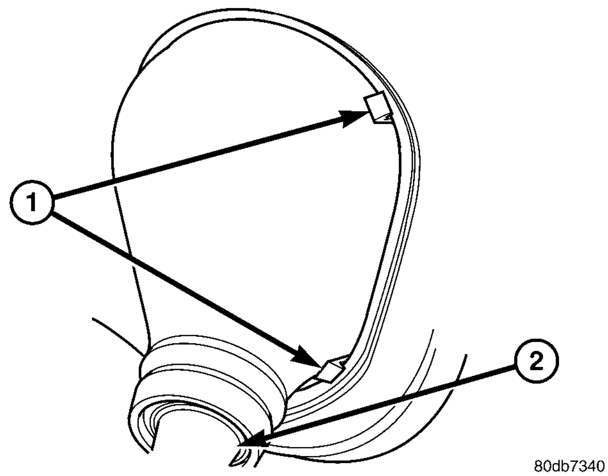

Fig. 16 RELEASE TANGS

1 - RELEASE TANGS (4)
2 - UPPER STEERING COUPLER SHAFT

(6) Remove and discard the lower coupler pinch bolt from the lower steering coupling shaft (Fig. 17).

(7) Remove the upper steering coupling shaft from the vehicle (Fig. 17).

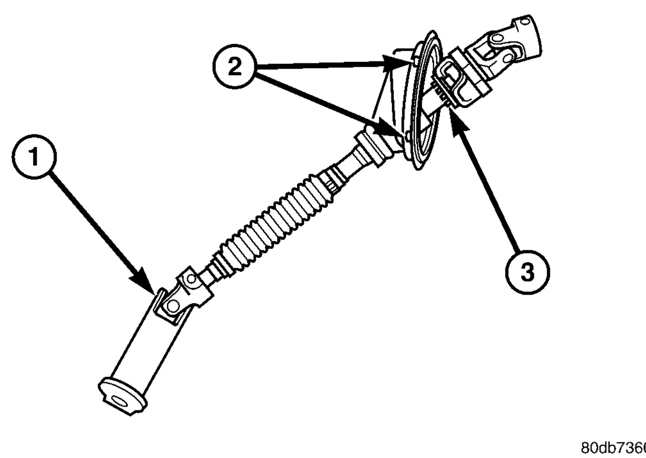

Fig. 17 UPPER STEERING COUPLER SHAFT

1 - LOWER STEERING COUPLER
2 - RELEASE TANGS (4)
3 - UPPER STEERING COUPLER SHAFT

UPPER STEERING COUPLING (Continued)

INSTALLATION

(1) Install the upper steering coupling shaft to the vehicle (Fig. 17).

(2) Install the upper steering coupling shaft seal by pushing it in securing the four tangs to the panel (Fig. 16).

NOTE: Note: A new steering coupling shaft pinch bolt for the upper and lower shafts must be used.

(3) Install the steering coupler shaft to the column (Fig. 17).

(4) Install the upper pinch bolt use new bolt and tighten to 57 N.m (42 ft.lbs).

(5) Install the shaft to the lower coupler (Fig. 17).

(6) Install the lower pinch bolt use new bolt and tighten to 57 N.m (42 ft.lbs).

(7) Unlock the steering wheel.

(8) Reconnect the negative battery cable.

LOWER STEERING COUPLING

REMOVAL

REMOVAL - ALL LD & HD EXCEPT 4X4 HD

(1) Disconnect the negative battery cable.

(2) Raise and support the vehicle.

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

(3) Lock the steering wheel with the tire in the straight position.

(4) Remove the left front tire and wheel assembly.

(5) Mark both coupler connections for proper installation.

(6) Remove and discard the upper coupler pinch bolt.

(7) Remove and discard the lower coupler pinch bolt.

(8) Remove the lower steering shaft coupler (Fig. 18).

REMOVAL - 4X4 HD

(1) Disconnect the negative battery cable.

(2) Raise and support the vehicle.

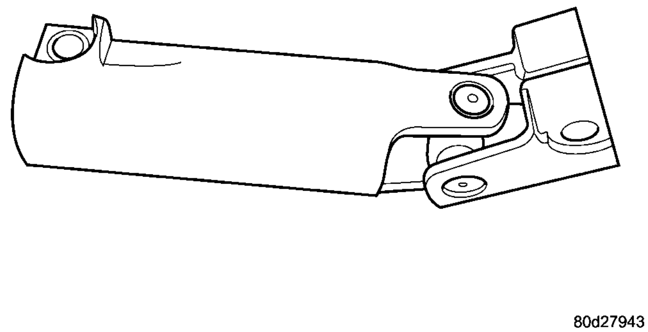

Fig. 18 LOWER STEERING COUPLER

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

(3) Lock the steering wheel with the tire in the straight position.

(4) Remove the left front tire and wheel assembly.

(5) Remove and discard the upper coupler pinch bolt (Fig. 20).

(6) Remove and discard the lower coupler pinch bolt (Fig. 19).

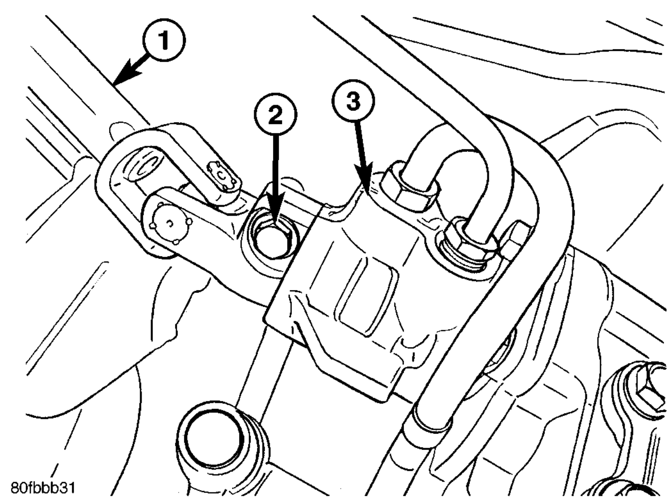

Fig. 19 LOWER COUPLER PINCH BOLT

1 - INTERMEDIATE STEERING SHAFT
2 - LOWER COUPLING BOLT
3 - STEERING GEAR

LOWER STEERING COUPLING (Continued)

(7) Remove the lower steering shaft coupler (Fig. 20).

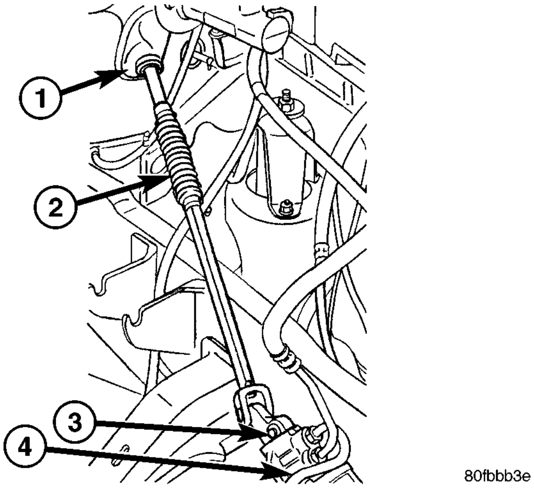

Fig. 20 INTERMEDIATE STEERING SHAFT

1 - UPPER COUPLING BOOT AND BOLT
2 - INTERMEDIATE STEERING SHAFT
3 - LOWER COUPLING BOLT
4 - STEERING GEAR

INSTALLATION

INSTALLATION - ALL LD & HD EXCEPT 4X4 HD

(1) Install the coupler to the steering rack & pinion using the marks made in the removal process.
(2) Install the coupler to the intermediate shaft using the marks made in the removal process.

NOTE: New pinch bolts must be used for reinstallation.

(3) Install the lower pinch bolt and tighten to 57 N·m (42 ft. lbs.).
(4) Install the upper pinch bolt and tighten to 57 N·m (42 ft. lbs.).
(5) Install the left front tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(6) Lower the vehicle.
(7) Reconnect the negative battery cable.
(8) Unlock the steering wheel.

INSTALLATION - 4X4 HD

(1) Install the coupler to the steering gear.
(2) Install the coupler to the intermediate shaft.

NOTE: New pinch bolts must be used for reinstallation.

(3) Install the lower pinch bolt and tighten to 28 N·m (250 in. lbs.).
(4) Install the upper pinch bolt and tighten to 57 N·m (42 ft. lbs.).
(5) Install the left front tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).
(6) Lower the vehicle.
(7) Reconnect the negative battery cable.
(8) Unlock the steering wheel.

STEERING WHEEL

REMOVAL

(1) Disable and remove the driver's side airbag.(Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - REMOVAL).
(2) Partially remove the steering wheel bolt and leave the bolt in the column.
(3) Install puller CJ98-1 or equivalent using the top of the bolt to push on. (Fig. 21)

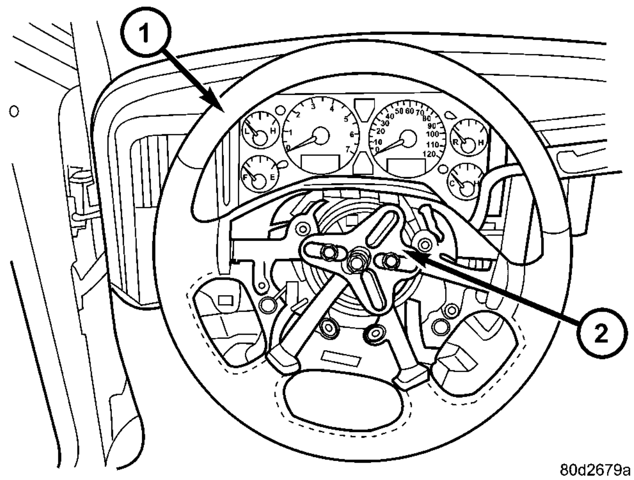

Fig. 21 STEERING WHEEL PULLER

1 - STEERING WHEEL
2 - SPECIAL TOOL CJ98-1

(4) Remove and discard the steering wheel bolt.
(5) Remove the steering wheel.

INSTALLATION

NOTE: Do not reuse the old steering wheel bolt (a new bolt must be used)

(1) Install steering wheel to the column

NOTE: Be certain that the steering wheel mounting bolt is tightened to the proper torque specification to ensure proper clockspring operation.

(2) Install the new steering wheel bolt. Tighten the bolt to 61 N·m (45 ft. lbs.).
(3) Install the driver's side air bag. (Refer to 8 - ELECTRICAL/RESTRAINTS/DRIVER AIRBAG - INSTALLATION).

GEAR - INDEPENDENT FRONT SUSPENSION

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GEAR - INDEPENDENT FRONT SUSPENSION

DESCRIPTION

A rack and pinion steering gears (Fig. 1) is made up of two main components, the pinon shaft and the rack. The gear cannot be adjusted or internally serviced. If a malfunction or a fluid leak occurs, the gear must be replaced as an assembly.

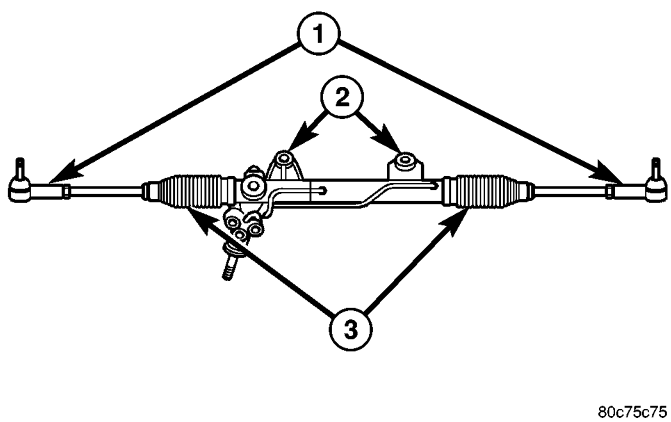

Fig. 1 STEERING GEAR

1 - OUTER TIE ROD ENDS
2 - MOUNTING BUSHINGS
3 - BELLOWS

REMOVAL

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

(1) Lock the steering wheel.

(2) Drain and siphon the power steering fluid from the reservoir.

(3) Raise the vehicle.

(4) Remove and discard the steering coupler pinch bolt.

(5) Remove the power steering hoses from the rack & pinion.

(6) Remove the tire and wheel assembly.

(7) Remove the tie rod end nuts and separate tie rod ends from the knuckles with Special tool 8677 (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).

(8) Remove the skid plate (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - REMOVAL).

(9) Remove the rack & pinion mounting bolts. (Fig. 2) & (Fig. 3)

(10) Remove the rack & pinion from the vehicle.

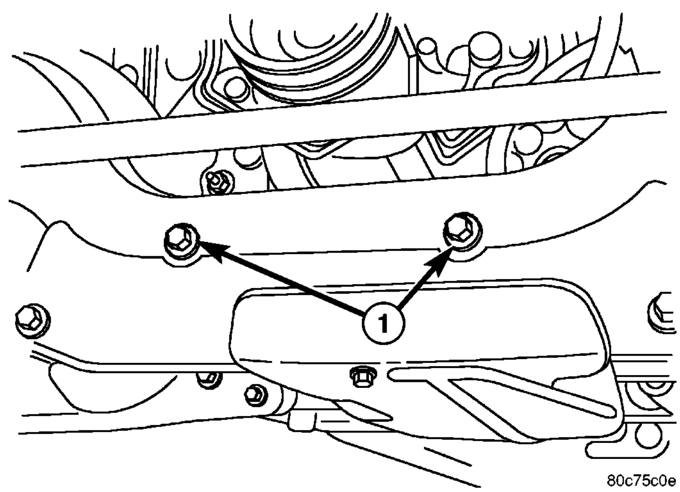

Fig. 2 STEERING GEAR MOUNTING BOLTS

1 - STEERING GEAR MOUNTING BOLTS 4X4

GEAR - INDEPENDENT FRONT SUSPENSION (Continued)

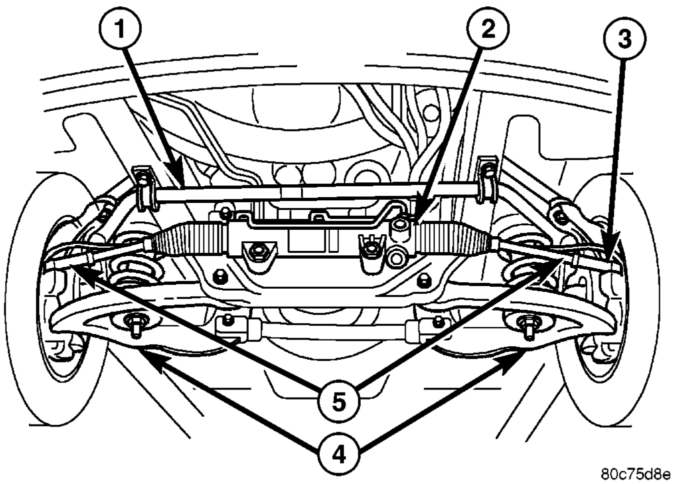

Fig. 3 STEERING GEAR 4X2

1 - SWAY BAR
2 - STEERING GEAR
3 - LEFT OUTER TIE ROD END
4 - LOWER CONTROL ARMS
5 - LEFT INNER & RIGHT OUTER (TIE ROD ENDS)

INSTALLATION

NOTE: Before installing gear inspect bushings and replace if worn or damaged.

NOTE: In the frame there is two holes for the mounting of the steering gear one is slotted and one is round, When tightening the gear to specifications make sure to tighten the mounting bolt with the hole first to avoided movement of the steering gear.

(1) Install the gear on the front crossmember and tighten the mounting bolts to 319 N·m (235 ft. lbs.). (Fig. 4) & (Fig. 3).

(2) Slide the shaft coupler onto the gear. Install **new** pinch bolt and tighten to 49 N·m (36 ft. lbs.).

(3) Clean and dry the tie rod end studs and the knuckle tapers.

(4) Install the tie rod ends into the steering knuckles and tighten the nuts to 61 N·m (45 ft. lbs.) then an additional 90°. (Refer to 19 - STEERING/LINKAGE/TIE ROD END - INSTALLATION).

(5) Install the pressure power steering hose to the steering gear and tighten to 32 N·m (23 ft. lbs.). (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION).

(6) Install the return power steering hose to the steering gear and tighten to 71 N·m (52 ft. lbs.). (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION).

(7) Install the front skid plate (Refer to 13 - FRAME & BUMPERS/FRAME/FRONT SKID PLATE - INSTALLATION).

(8) Install the tire and wheel assembly (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

(9) Remove the support and lower the vehicle.

(10) Fill the system with fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(11) Adjust the toe position. (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

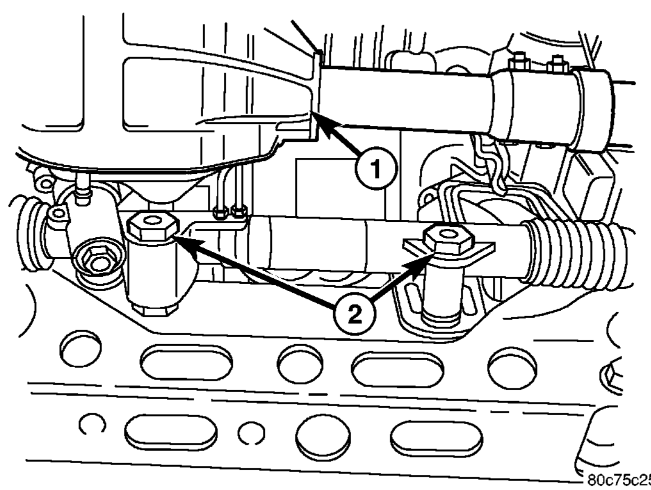

Fig. 4 STEERING GEAR 4X4

1 - FRONT AXLE
2 - STEERING GEAR MOUNTING NUTS & BUSHINGS

GEAR - INDEPENDENT FRONT SUSPENSION (Continued)

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Rack and Pinion Steering Gear Gear to Frame Bolts	319	235	—
Rack and Pinion Steering Gear Coupler Bolt	49	36	—
Tie Rod End Knuckle Nut	61 Then tighten an additional 90°	45 Then tighten an additional 90°	—
Tie Rod End Jam Nut	75	55	—
Power Steering Line Pressure Line	32	23	—
Power Steering Line Return Line	71	52	—
Power Steering Line Pressure Line To Pump	37	27	—

BUSHING

REMOVAL

(1) Remove the steering gear (Refer to 19 - STEERING/GEAR - REMOVAL).

CAUTION: Do not overtighten the vise on the gear case.

(2) Mount the steering gear in a soft jawed vise.

NOTE: If the bushings are seized a brass punch can be used to remove the bushings from the gear using care not to strike the gear.

(3) Remove the front mounting bushings.
(4) Remove the rear mounting bushings.
(5) Remove the steering gear from the vise and place it on the bench.

INSTALLATION

NOTE: Coat all bushings with a thin rubber lubricate oil prior to installation.

NOTE: A rubber mallet can be used to assist in the installation of the bushings once lubricated.

(1) Coat the rear bushings with a thin rubber lubricate oil then install the rear bushings using a rubber mallet to seat the bushings in the gear.
(2) Coat the front bushings with a thin rubber lubricate oil then install the front bushings using a rubber mallet to seat the bushings in the gear.
(3) Install the steering gear (Refer to 19 - STEERING/GEAR - INSTALLATION).
(4) Adjust the toe position (if necessary) (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

GEAR - LINK/COIL

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GEAR - LINK/COIL

DESCRIPTION

The power steering gear is a recirculating ball type gear (Fig. 1). The gear ratio's used are 12.5:1.

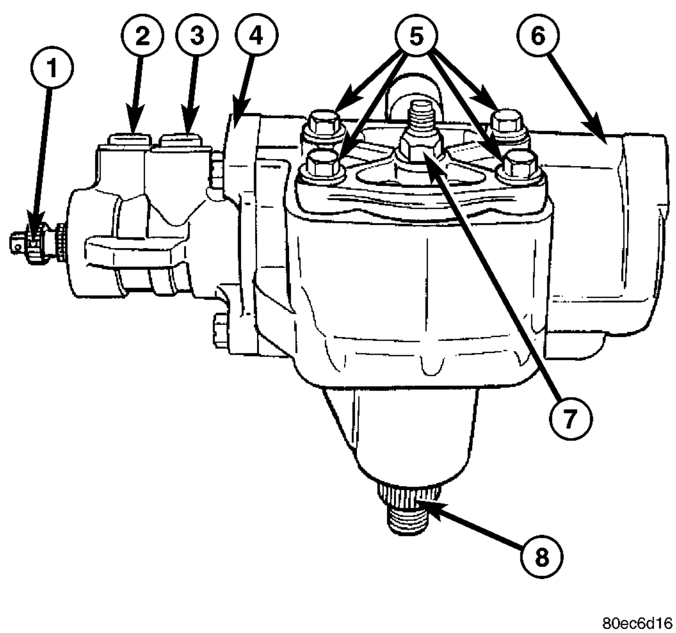


Fig. 1 STEERING GEAR

1 - INPUT SHAFT
2 - OUTLET
3 - INLET
4 - VALVE ASSEMBLY HOUSING
5 - PITMAN SHAFT COVER BOLTS
6 - STEERING GEAR
7 - MESHLOAD ADJUSTER NUT
8 - PITMAN SHAFT

OPERATION

The gear acts as a rolling thread between the worm shaft and rack piston. The worm shaft is supported by a thrust bearing at the lower end and a bearing assembly at the upper end. When the worm shaft is turned from input from the steering column the rack piston moves. The rack piston teeth mesh with the pitman shaft. Turning the worm shaft, turns the pitman shaft, which turns the steering linkage.

REMOVAL

(1) Place the front wheels in a straight-ahead position.

NOTE: The steering column on vehicles with an automatic transmission may not be equipped with an internal locking shaft that allows the ignition key cylinder to be locked with the key. Alternative methods of locking the steering wheel for service will have to be used.

(2) Lock the steering wheel.

(3) Siphon out as much power steering fluid as possible.

GEAR - LINK/COIL (Continued)

(4) Disconnect and cap the fluid hoses from steering gear (Refer to 19 - STEERING/PUMP/HOSES - REMOVAL).

(5) Remove coupler pinch bolt at the steering gear and slide shaft off gear (Fig. 2).

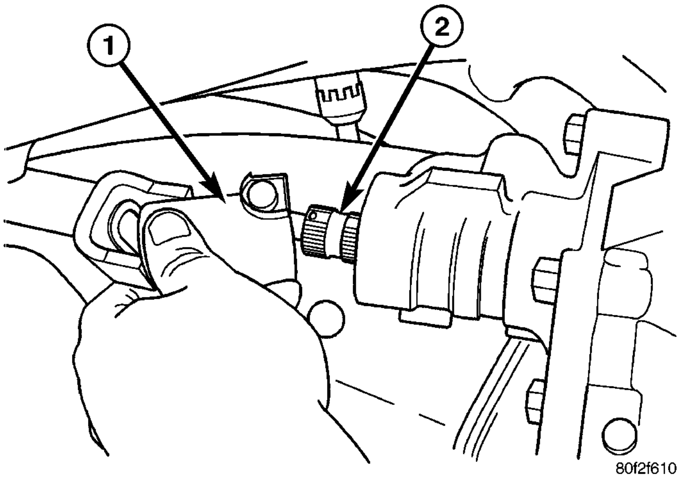


Fig. 2 COLUMN SHAFT

1 - STEERING COUPLER
2 - STEERING GEAR INPUT SHAFT

(6) Mark the pitman shaft and pitman arm for installation reference. Remove the pitman arm from the shaft with Puller C-4150A (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL), (Fig. 3).

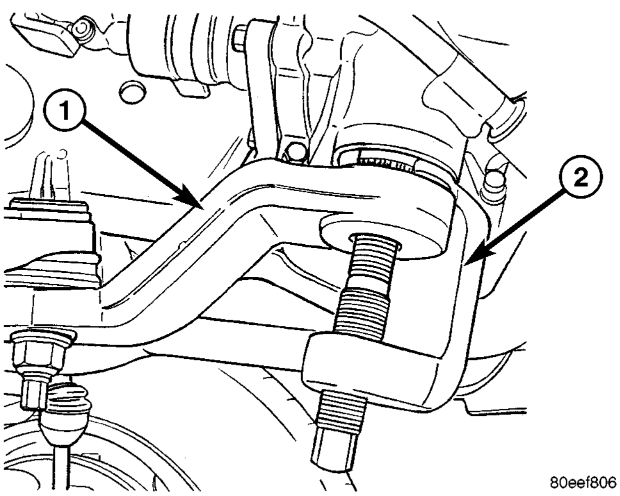


Fig. 3 PITMAN ARM REMOVAL

1 - PITMAN ARM
2 - C-4150A PULLER

(7) Remove steering gear three mounting bolts (Fig. 4). Remove the steering gear from the vehicle.

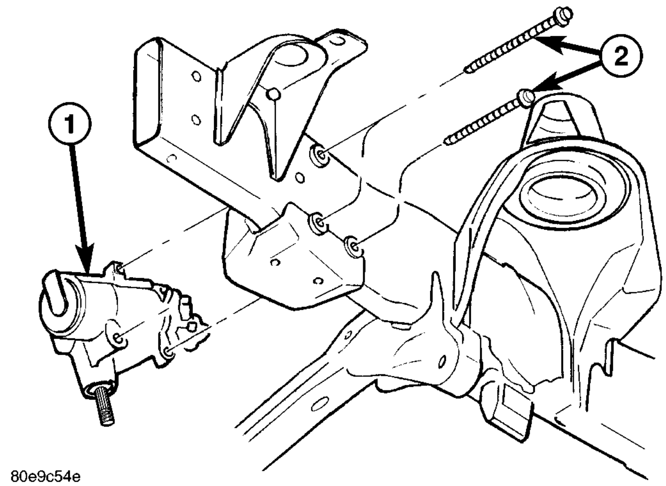


Fig. 4 STEERING GEAR REMOVAL/INSTALLATION

1 - STEERING GEAR
2 - MOUNTING BOLTS (3)

INSTALLATION

(1) Position the steering gear on the frame rail and install the three mounting bolts (Fig. 4). Tighten the mounting bolts to 196 N·m (145 ft. lbs.).

(2) Align steering coupler on gear shaft. Install pinch bolt and tighten to 49 N·m (36 ft. lbs.) torque.

(3) Align and install the pitman arm (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).

(4) Install the washer and retaining nut on the pitman shaft. Tighten the nut to 305 N·m (225 ft. lbs.).

(5) Connect fluid hoses to steering gear (Refer to 19 - STEERING/PUMP/HOSES - INSTALLATION), tighten to 31 N·m (23 ft. lbs.).

(6) Add fluid, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(7) Reset the toe and center the steering wheel (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

ADJUSTMENTS

ADJUSTMENT

CAUTION: Steering gear must be adjusted in the proper order. If adjustments are not performed in order, gear damage and improper steering response may result.

NOTE: Adjusting the steering gear in the vehicle is not recommended. Remove gear from the vehicle and drain the fluid. Then mount gear in a vise to perform adjustments.

GEAR - LINK/COIL (Continued)

(1) Remove the steering gear from the vehicle (Refer to 19 - STEERING/GEAR - REMOVAL).

(2) Mount the gear carefully into a soft-jawed vise.

CAUTION: Do not overtighten the vise on the gear case. This may affect the adjustment

(3) Hold the steering gear upside down over a drain pan and rotate the input shaft back and forth several times lock-to-lock to discharge the fluid from the steering gear

(4) Rotate the input shaft to the left stop and then back-off approximately 45 degrees. Using an inch-pound torque wrench on the input shaft, record the peak torque required to slowly and evenly rotate the input shaft clockwise ½ turn (180 degrees) starting from the 45 degree position. This peak torque reading is the preload torque. The preload torque must be within 2 - 10 in-lbs.

(5) Rotate the input shaft to its center of travel (approximately 1.5 turns from either stop). Place the torque wrench on the input shaft with the handle in the vertical position. Rotate the torque wrench slowly and evenly ¼ turn (90 degrees) each side of center and record the peak torque measure on or near center. This total on-center torque reading must be 5 - 9 in-lbs higher than the previously measured preload torque without exceeding a total of 17 in-lbs. The value of the total on-center minus the preload torque is defined as the meshload torque

(6) If required, adjust the on-center torque by loosening the adjuster screw lock nut and turning the adjuster screw until the total on-center and meshload torque readings fall within the specified values. Turn the adjuster screw clockwise to increase and counter-clockwise to decrease the torque reading. While holding the adjuster screw in place, tighten the lock nut to 31 N·m (23 ft. lbs.).

(7) Re-check the preload and on-center torque readings.

(8) Install pitman arm on the steering gear (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).

(9) Reinstall steering gear to the vehicle (Refer to 19 - STEERING/GEAR - INSTALLATION).

SPECIFICATIONS

POWER STEERING GEAR

SPECIFICATIONS

DESCRIPTION	SPECIFICATION
Steering Gear Type	Recirculating Ball
Gear Code & Ratio	12.5:1

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Preload Torque	0.23-1.13	—	2-10
Meshload Torque	0.56-1.02	—	5-9 + Preload (17 Max)

GEAR - LINK/COIL (Continued)

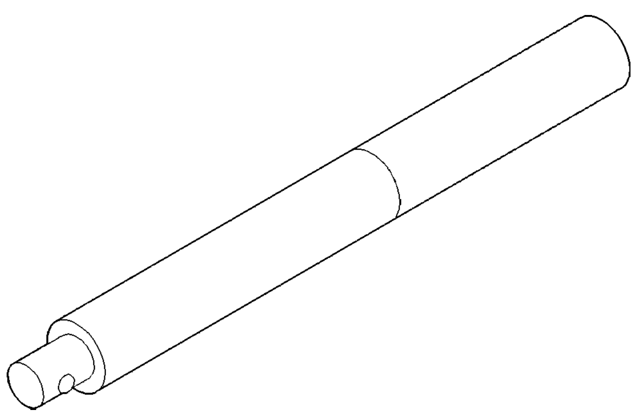
TORQUE CHART

TORQUE SPECIFICATIONS

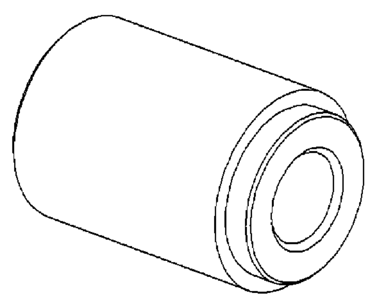
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Steering Gear Mounting Frame Bolts	196	145	—
Power Steering Line Pressure	32	23	—
Power Steering Line Return	71	52	—
Power Steering Line Pressure Line To Pump	37	27	—
Steering Gear Adjustment Screw Locknut	31	23	—
Steering Gear Pitman Shaft Nut	305	225	—
Steering Gear Pitman Shaft Cover Bolts	68	50	—
Steering Gear Valve Housing to Gear Bolts	54	40	—
Steering Gear Retainer Ring Screw	2.26	—	20
Steering Gear Retainer Ring	97	72	—

SPECIAL TOOLS

POWER STEERING GEAR

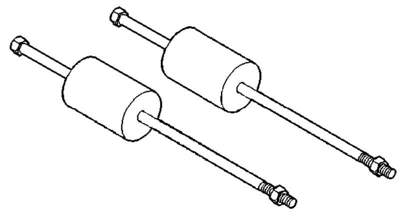


HANDLE C-4171

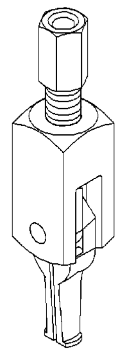


INPUT SHAFT SEAL INSTALLER - 8987

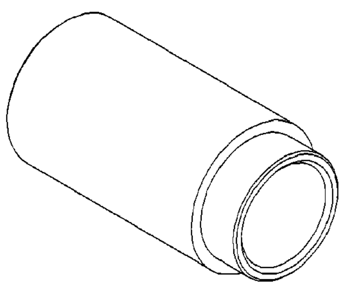
GEAR - LINK/COIL (Continued)



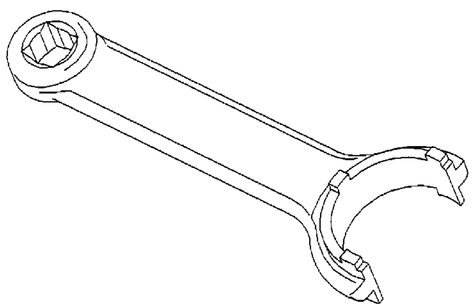
PULLER, SLIDE HAMMER - C-3752



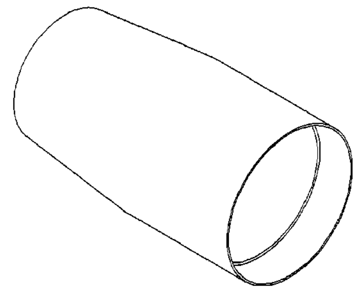
SEAL REMOVER ADAPTER - 8990



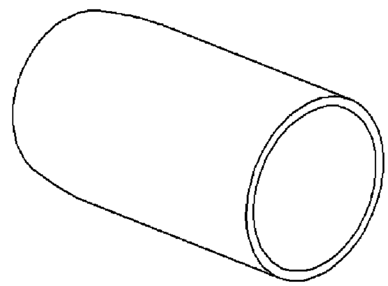
PITMAN SHAFT SEAL INSTALLER - 8989



RETAINER RING WRENCH - 8988



PITMAN SHAFT SEAL PROTECTOR - 8993



INPUT SHAFT SEAL PROTECTOR - 8986

PITMAN SHAFT SEAL

REMOVAL

REMOVAL - GAS ENGINE

(1) Seperate the pitman arm from the gear box (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL).

(2) Clean exposed end of pitman shaft and housing with a wire brush.

(3) Rotate the steering wheel from stop to stop and count the number of turns.

(4) Center the steering wheel by rotating it from the stop back 1 1/2 turns to achieve center position.

(5) Remove the pitman shaft cover bolts.

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Remove the pitman shaft from the gear.

(7) Remove dust seal from the housing with a special tool (Fig. 5).

CAUTION: Use care not to score the housing bore when prying out seals and washer.

(8) Remove retaining ring with snap ring pliers.

PITMAN SHAFT SEAL (Continued)

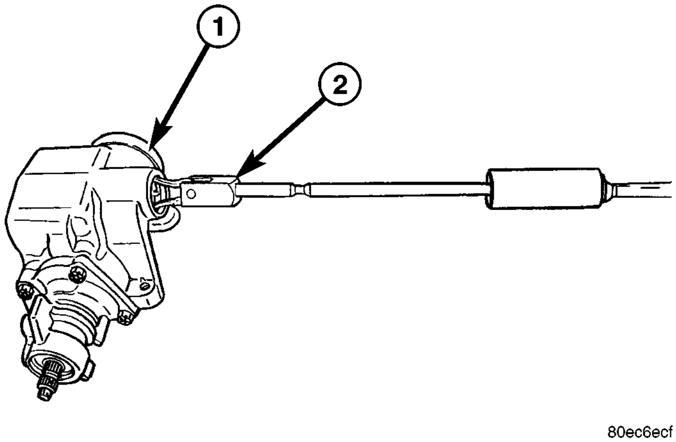


Fig. 5 SLIDE HAMMER

1 - STEERING GEAR
2 - SLIDE HAMMER C-3752 USED WITH SPECIAL TOOL ADAPTER 8990

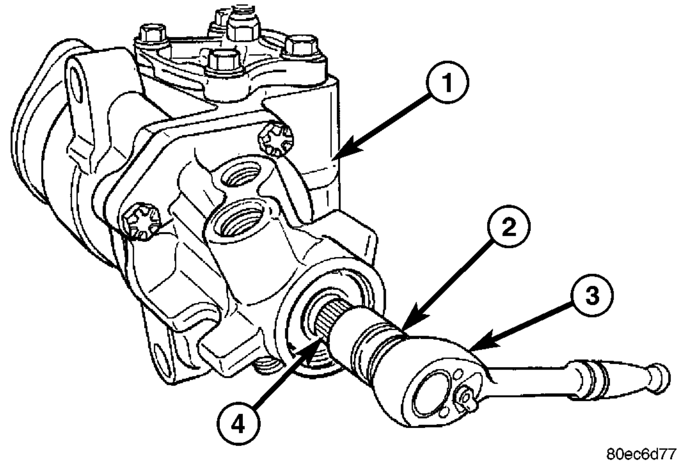


Fig. 6 CENTERING STEERING GEAR

1 - STEERING GEAR
2 - 12 POINT SOCKET
3 - RATCHET
4 - INPUT SHAFT

(9) Remove washer from the housing.

NOTE: Tighten the slide hammer adapter 8990 into the seal using wrenches, in order to make a tight fit to pull the seal out. If this is not performed the seal may tear on the removal making it difficult to remove.

(10) Remove oil seal from the housing with a special tool 8990 with slide hammer C-3752.

REMOVAL - DIESEL

(1) Seperate the pitman arm from the gear box (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL).
(2) Remove the steering gear box (Refer to 19 - STEERING/GEAR - REMOVAL).
(3) Install the steering gear in a soft jawed bench vise.
(4) Clean exposed end of pitman shaft and housing with a wire brush.
(5) Rotate the input shaft with a 12 point socket from stop to stop and count the number of turns (Fig. 6).
(6) Center the input shaft by rotating it from the stop 1/2 of the total amount of turns (Fig. 6).
(7) Remove the pitman shaft cover bolts.

NOTE: The pitman shaft will not clear the housing if it is not centered.

(8) Remove the pitman shaft from the gear.
(9) Remove dust seal from the housing with a special tool 8990 (Fig. 5).

CAUTION: Use care not to score the housing bore when prying out seals.

(10) Remove retaining ring with snap ring pliers.
(11) Remove washer from the housing.

NOTE: Tighten the slide hammer adapter 8990 into the seal using wrenches, in order to make a tight fit to pull the seal out. If this is not performed the seal may tear on the removal making it difficult to remove.

(12) Remove oil seal from the housing with a special tool 8990 with slide hammer C-3752. (Fig. 5).

INSTALLATION

INSTALLATION - GAS ENGINE

NOTE: Generous amounts of the high temperature grease from the seal kit should be applied to areas between the pitman shaft bearing and oil seals and also between the dust seals and snap ring.

(1) Coat the oil seal and washer with **high temp grease**.

NOTE: Install the oil seal with the lip facing inward. Flat side of the oil seal should be against the washer.

(2) Install the oil seal with special tool 8989 driver and C-4171 handle (Fig. 7).
(3) Install backup washer.
(4) Install the retainer ring with snap ring pliers.

PITMAN SHAFT SEAL (Continued)

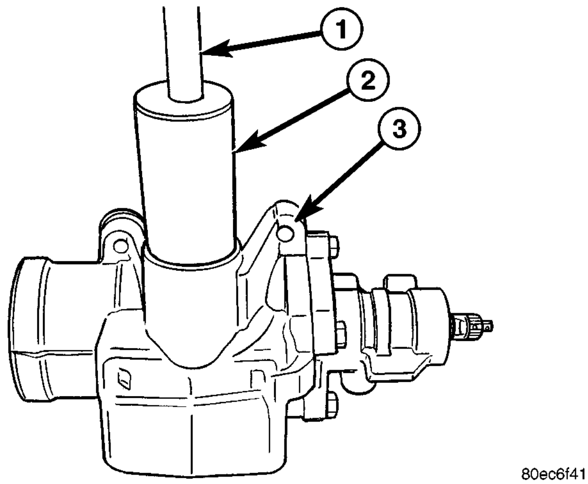


Fig. 7 SEAL INSTALLATION

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL 8989
3 - STEERING GEAR

(5) Coat the dust seal with **high temp grease**.
(6) Install the dust seal with a driver and handle (Fig. 7).
(7) Install protective seal protector 8993 over the shaft (Fig. 8).

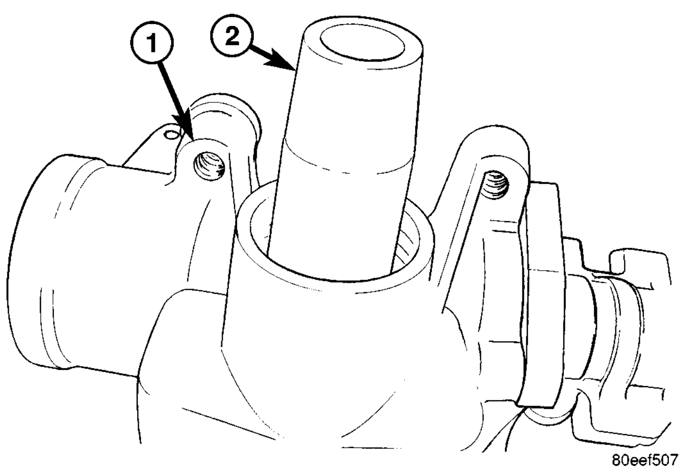


Fig. 8 PITMAN SHAFT SEAL PROTECTOR

1 - STEERING GEAR
2 - SPECIAL TOOL 8993

(8) Install the pitman shaft into the steering gear until it fully seats into the bearing.
(9) Install the new cover bolts and tighten to 68 N·m (50 ft. lbs.).
(10) Install the pitman arm (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).

INSTALLATION - DIESEL

NOTE: Generous amounts of the high temperature grease from the seal kit should be applied to areas between the pitman shaft bearing and oil seals and also between the dust seals and snap ring.

(1) Coat the oil seal and washer with **high temp grease**.

NOTE: Install the oil seal with the lip facing inward. Flat side of the oil seal should be against the washer.

(2) Install the oil seal with special tool 8989 driver and C-4171 handle (Fig. 7).
(3) Install backup washer.
(4) Install the retainer ring with snap ring pliers.
(5) Coat the dust seal with **high temp grease**.
(6) Install the dust seal with special tool 8989 driver and C-4171 handle (Fig. 7).
(7) Install protective seal protector 8993 over the shaft (Fig. 8).
(8) Install the pitman shaft into the steering gear until it fully seats into the bearing.
(9) Install the new cover bolts and tighten to 68 N·m (50 ft. lbs.).
(10) Install the steering gear (Refer to 19 - STEERING/GEAR - INSTALLATION).
(11) Install the pitman arm (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).
(12) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

STEERING GEAR INPUT SHAFT SEAL

REMOVAL

(1) Remove the steering gear from the vehicle (Refer to 19 - STEERING/GEAR - REMOVAL).

CAUTION: Do not overtighten the vise on the gear case. This may affect the adjustment

(2) Mount the steering gear upside down over a drain pan in a soft jawed vise.
(3) Place a drain pan under the gear and rotate the input shaft back and forth several times lock-to-lock to discharge the fluid from the steering gear
(4) Drain all the remaining fluid from the gear.
(5) Rotate the input shaft from stop to stop and count the number of turns using a 12 point socket (Fig. 9).

STEERING GEAR INPUT SHAFT SEAL (Continued)

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Center the input shaft by rotating it from the stop back 1 1/2 turns to achieve center position (Fig. 9).

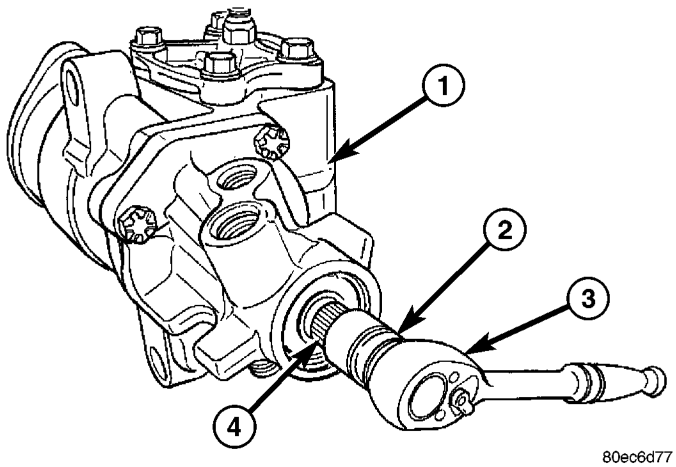


Fig. 9 CENTERING STEERING GEAR

1 - STEERING GEAR
2 - 12 POINT SOCKET
3 - RATCHET
4 - INPUT SHAFT

(7) Remove the pitman shaft (Refer to 19 - STEERING/GEAR/PITMAN SHAFT - REMOVAL).

(8) Remove the four bolts securing the valve housing.

(9) Remove the valve housing from the steering gear (Fig. 10).

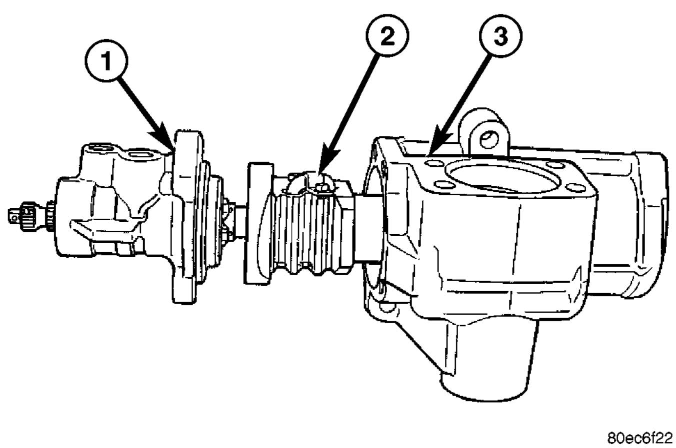


Fig. 10 VALVE ASSEMBLY

1 - VALVE HOUSING
2 - WORMSHAFT BALLS
3 - STEERING GEAR HOUSING

(10) Remove the valve housing and wormshaft assembly from the steering gear housing and place the valve housing in a soft jawed vise (Fig. 11).

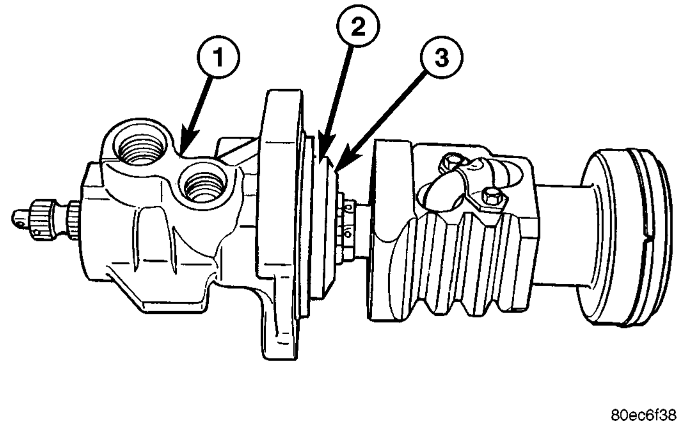


Fig. 11 VALVE HOUSING AND WORMSHAFT

1 - VALVE HOUSING
2 - SET SCREW
3 - RETAINER RING

(11) Remove the retainer ring set screw from the valve housing (Fig. 12).

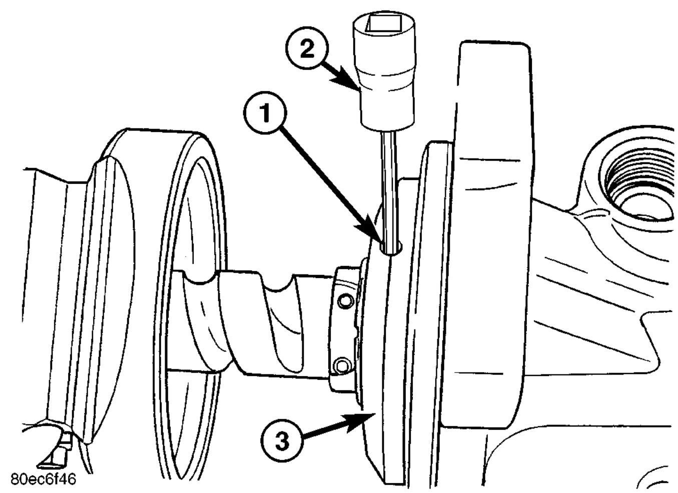


Fig. 12 SET SCREW FOR THE RETAINER RING

1 - SET SCREW
2 - 3/32 ALLEN HEAD SOCKET
3 - RETAINER RING

STEERING GEAR INPUT SHAFT SEAL (Continued)

(12) Using special tool reatainer ring wrench to remove the steering gear worm thrust bearing reatainer ring (Fig. 13).

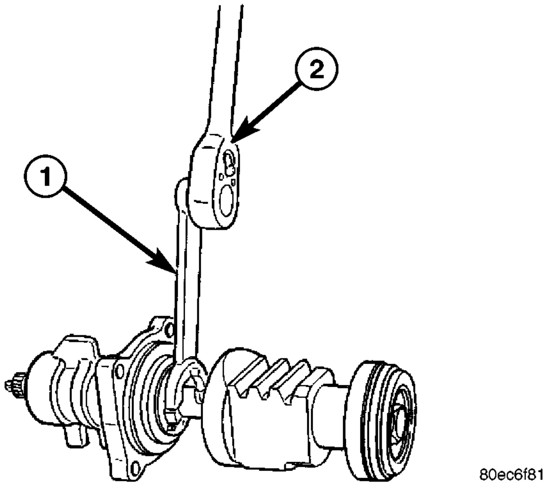


Fig. 13 REATINER RING REMOVAL

1 - SPECIAL TOOL
8988
2 - RATCHET

(13) Separate the wormshaft assembly from the valve housing, Then remove the wormshaft assembly from the vise (Fig. 14).

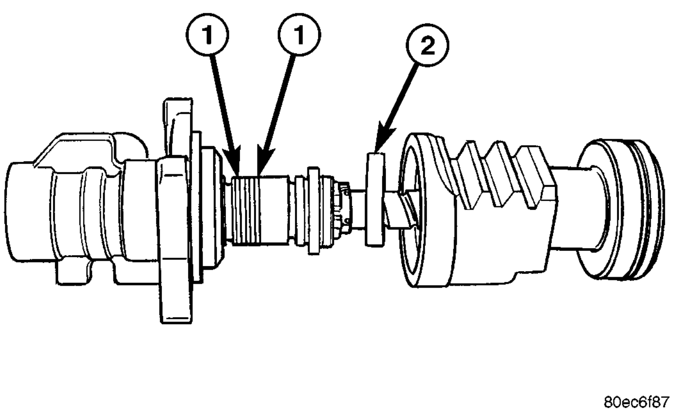


Fig. 14 WORMSHAFT AND VALVE ASSEMBLY

1 - PISTON TEFLON SEALS
2 - RETAINER RING

(14) Remove the dust seal with a pick (Fig. 15).

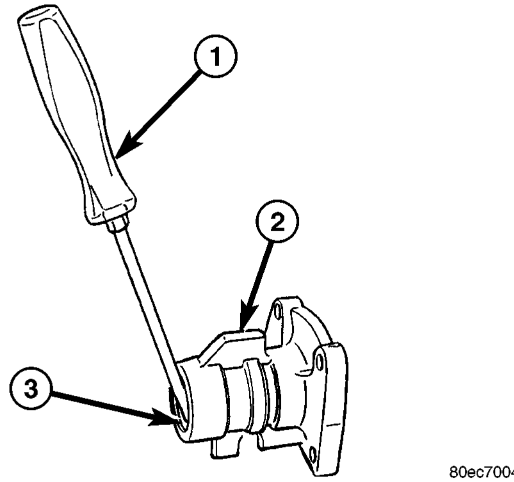


Fig. 15 DUST SEAL REMOVAL

1 - PICK
2 - VALVE HOUSING
3 - SEAL

CAUTION: Use care not to score the housing bore when removing seals.

(15) Remove the snap ring with snap ring pliers (Fig. 16).

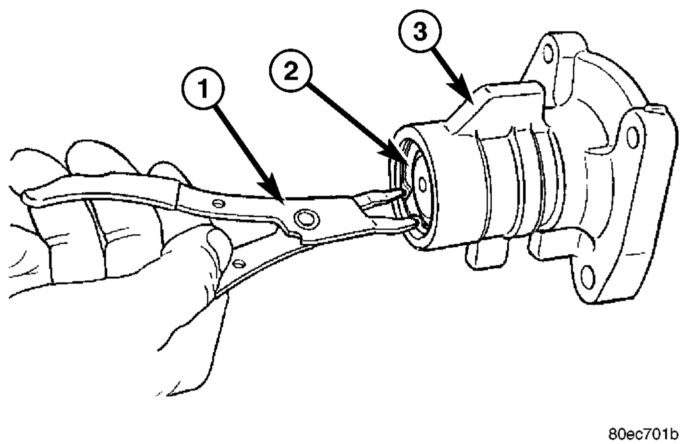


Fig. 16 SNAP RING REMOVAL

1 - SNAP RING PLIERS
2 - SNAP RING
3 - VALVE HOUSING

STEERING GEAR INPUT SHAFT SEAL (Continued)

(16) Using special tool slide hammer C-3752 with adapter 8990 remove the oil seal (Fig. 17).

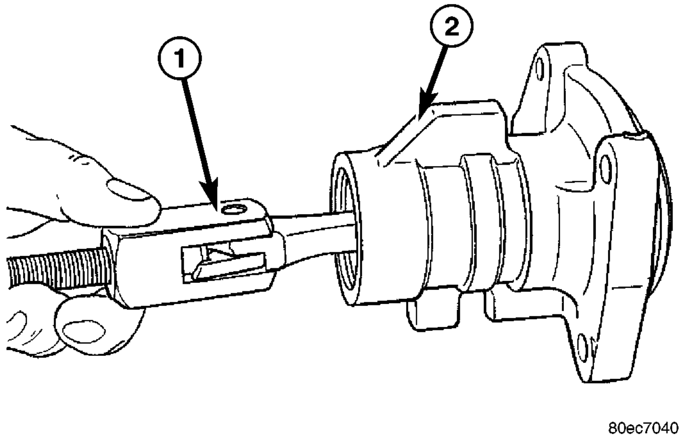


Fig. 17 OIL SEAL REMOVAL

1 - SPECIAL TOOL
8990
WITH SLIDE HAMMER C-3752
2 - VALVE HOUSING

INSTALLATION

(1) Inspect the piston teflon seals for damage. Replace if needed.

NOTE: To replace the teflon seals, use a pick to remove the teflon o-ring and the rubber o-ring underneath. Install a new rubber o-ring in the piston seal grove and a new teflon o-ring over the top of it.

(2) Install the valve into the valve housing.

(3) Thread the retainer ring into the valve housing (Fig. 18). Tighten to 97 N·m (72 ft. lbs.)

NOTE: It is very important to make sure to compensate for the added length of the torque wrench when torquing to proper specifications.

(4) Install the retainer ring set screw. Tighten to 2.26 N·m (20 in. lbs.)

(5) Clean the steering gear housing.

CAUTION: Valve assembly must be centered to the housing (Fig. 19).

(6) Install the valve assembly into the steering gear (Fig. 19). Tighten the new bolts to 54 N·m (40 ft. lbs.)

(7) Install the input shaft seal protector 8986 (Fig. 20).

(8) Coat the new seal in **high temp grease** and Install the new oil seal using special tool 8987 driver and C-4171 handle (Fig. 21).

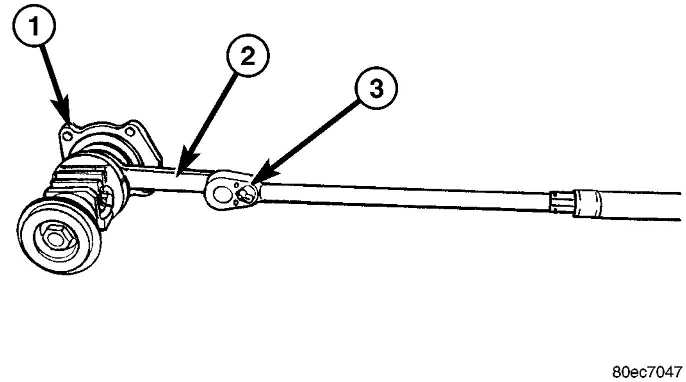


Fig. 18 RETAINER RING INSTALLATION

1 - VALVE HOUSING
2 - SPECIAL TOOL
3 - TORQUE WRENCH

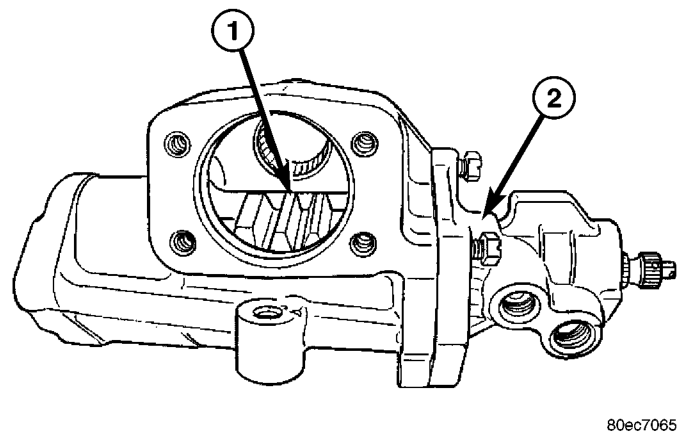


Fig. 19 CENTERED GEAR TEETH

1 - GEAR INSTALLED WITH THE CENTER TOOTH CENTERED IN HOLE
2 - VALVE HOUSING

NOTE: Drive the oil seal into the housing until the outer edge does not quite clear the snap ring groove.

(9) Insert the snap ring into the housing. Using special tool 8987 driver and C-4171 handle push the snap ring and oil seal together until the snap ring seats in the groove.

NOTE: Generous amounts of the high temperature grease from the seal kit should be applied to areas between the pitman shaft bearing and oil seals and also between the dust seals and snap ring.

STEERING GEAR INPUT SHAFT SEAL (Continued)

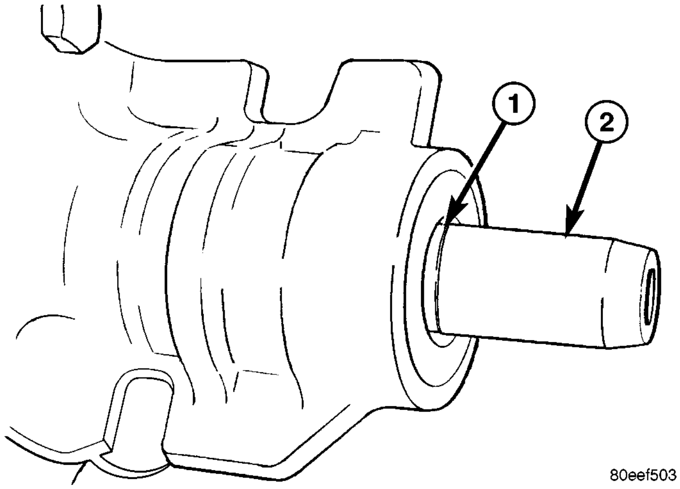


Fig. 20 INPUT SHAFT SEAL PROTECTOR

1 - INPUT SHAFT
2 - SPECIAL TOOL
8986

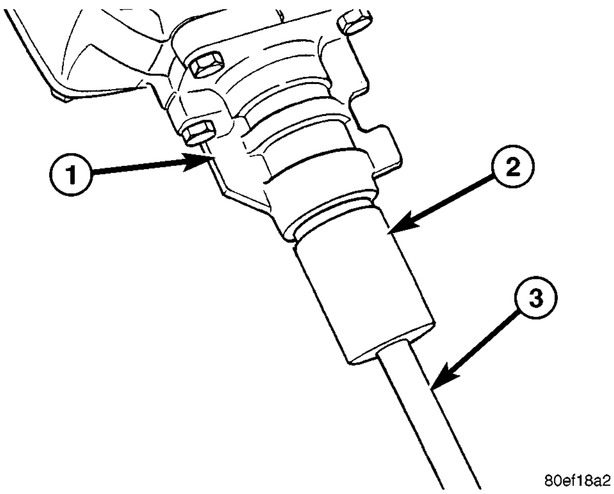


Fig. 21 INPUT SHAFT SEAL INSTALLATION

1 - VALVE HOUSING
2 - SPECIAL TOOL
8987
3 - SPECIAL TOOL
C-4171

(10) Install the new dust seal using **high temp grease**, special tool C-4171 (driver) and 8987 (handle).

(11) Check to make sure the gear is centered in the middle tooth before installing the pitman shaft (Fig. 19).

(12) Install the pitman shaft into the steering gear (Refer to 19 - STEERING/GEAR/PITMAN SHAFT - INSTALLATION).

(13) Perform over-center meshload adjustment (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

(14) Install the steering gear to the vehicle (Refer to 19 - STEERING/GEAR - INSTALLATION).

(15) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

PITMAN SHAFT

REMOVAL

REMOVAL - GAS

(1) Separate the pitman arm from the gear box (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL).

(2) Clean exposed end of pitman shaft and housing with a wire brush.

(3) Rotate the steering wheel from stop to stop and count the number of turns.

(4) Center the steering wheel by rotating it from the stop back 1 1/2 turns to achieve center position.

(5) Remove the pitman shaft cover bolts.

NOTE: The pitman shaft will not clear the housing if it is not centered.

(6) Remove the pitman shaft from the gear (Fig. 22).

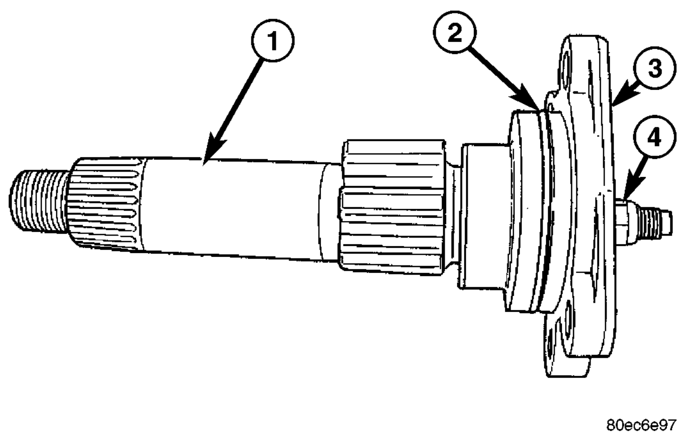


Fig. 22 PITMAN SHAFT

1 - PITMAN SHAFT
2 - O-RING SEAL
3 - COVER
4 - ADJUSTING NUT

(7) Remove the cover if needed by loosing the adjuster nut, Then removing the cover from the pitman shaft.

REMOVAL - DIESEL

(1) Separate the pitman arm from the gear box (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - REMOVAL).

(2) Remove the steering gear box (Refer to 19 - STEERING/GEAR - REMOVAL).

(3) Install the steering gear in a soft jawed bench vise.

(4) Clean exposed end of pitman shaft and housing with a wire brush.

(5) Rotate the stub shaft with a 12 point socket from stop to stop and count the number of turns (Fig. 23).

(6) Center the stub shaft by rotating it from the stop 1/2 of the total amount of turns (Fig. 23).

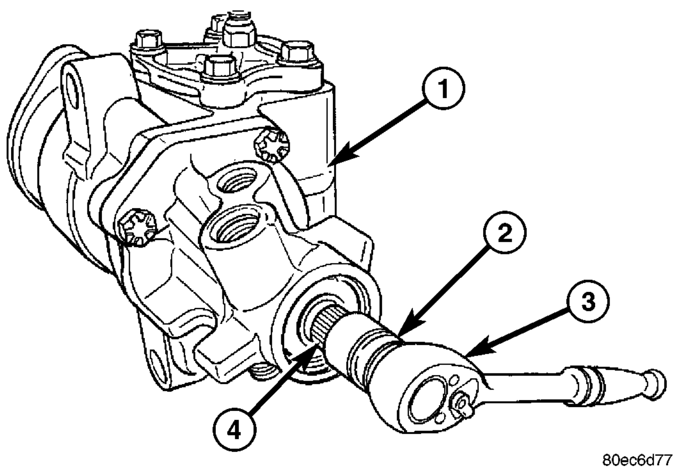


Fig. 23 CENTERING STEERING GEAR

1 - STEERING GEAR
2 - 12 POINT SOCKET
3 - RATCHET
4 - INPUT SHAFT

(7) Remove the pitman shaft cover bolts.

NOTE: The pitman shaft will not clear the housing if it is not centered.

(8) Remove the pitman shaft from the gear (Fig. 24).

(9) Remove the cover if needed by loosing the adjuster nut, Then removing the cover from the pitman shaft.

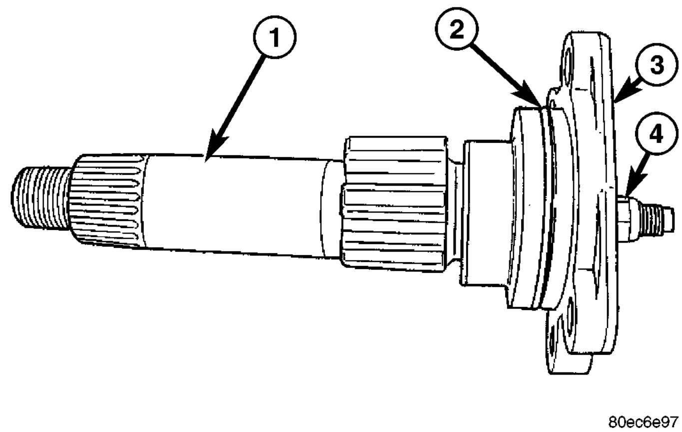


Fig. 24 PITMAN SHAFT

1 - PITMAN SHAFT
2 - O-RING SEAL
3 - COVER
4 - ADJUSTING NUT

INSTALLATION

INSTALLATION - GAS

(1) Coat the seal with **power steering fluid**.

(2) Install pitman shaft into the steering gear until it fully seats into the bearing.

(3) Install the new cover bolts and tighten to 68 N·m (50 ft. lbs.).

(4) Perform over-center meshload adjustment, (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

(5) Install the pitman arm (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).

(6) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

INSTALLATION - DIESEL

(1) Coat the seal with **power steering fluid**.

(2) Install the pitman shaft into the steering gear until it fully seats into the bearing.

(3) Install the new cover bolts and tighten to 68 N·m (50 ft. lbs.).

(4) Perform over-center meshload adjustment (Refer to 19 - STEERING/GEAR - ADJUSTMENTS).

(5) Install the steering gear (Refer to 19 - STEERING/GEAR - INSTALLATION).

(6) Install the pitman arm (Refer to 19 - STEERING/LINKAGE/PITMAN ARM - INSTALLATION).

(7) Perform a wheel alignment (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

LINKAGE - INDEPENDENT FRONT SUSPENSION

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LINKAGE - INDEPENDENT FRONT SUSPENSION

DIAGNOSIS AND TESTING - OUTER TIE ROD END

NOTE: If the outer tie rod end is equipped with a lubrication fitting, grease the joint then road test the vehicle before performing test.

(1) Raise the front of the vehicle. Place safety floor stands under both lower control arms as far outboard as possible. Lower the vehicle to allow the stands to support some or all of the vehicle weight.
(2) Remove the front tires.
(3) Mount a dial indicator solidly to the vehicle steering knuckle and then zero the dial indicator.
(4) Position indicator plunger on the topside of the outer tie rod end.

NOTE: The dial indicator plunger must be perpendicular to the machined surface of the outer tie rod end.

(5) Position a pry bar in order to pry downwards on the outer tie rod end.
(6) If the travel exceeds 0.5 mm (0.020 in.), replace the outer tie rod end (Refer to 19 - STEERING/LINKAGE/TIE ROD END - REMOVAL).
(7) If the outer tie rod end is within specs reinstall the front tires (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE).

TIE ROD END

REMOVAL - OUTER TIE ROD END

NOTE: Do not twist the boot anytime during removal or installation.

(1) Loosen the jam nut.
(2) Remove the outer tie rod end nut from the ball stud.
(3) Separate the tie rod ball stud from the knuckle with Remover 8677 (Fig. 1).
(4) Unthread the outer tie rod end from the inner tie rod.

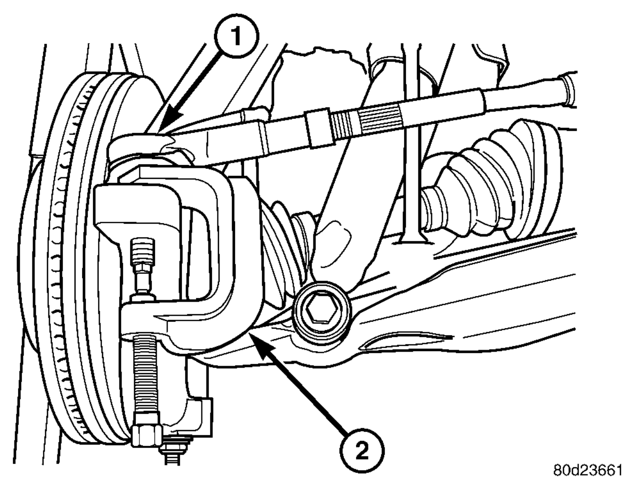

Fig. 1 TIE ROD SEPARATION

1 - TIE ROD END
2 - SPECIAL TOOL 8677

TIE ROD END (Continued)

INSTALLATION - OUTER TIE ROD END

NOTE: Do not twist the boot at anytime during removal or installation.

(1) Thread the outer tie rod end onto the inner tie rod, to it's original position (Fig. 2).

(2) Install the outer tie rod end into the steering knuckle (Fig. 2).

(3) Tighten the ball stud nut on the ball stud to 61 N·m (45 ft. lbs.) then an additional 90°.

(4) Set wheel toe pattern, (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) Tighten jam nut to 75 N·m (55 ft. lbs.) (Fig. 2).

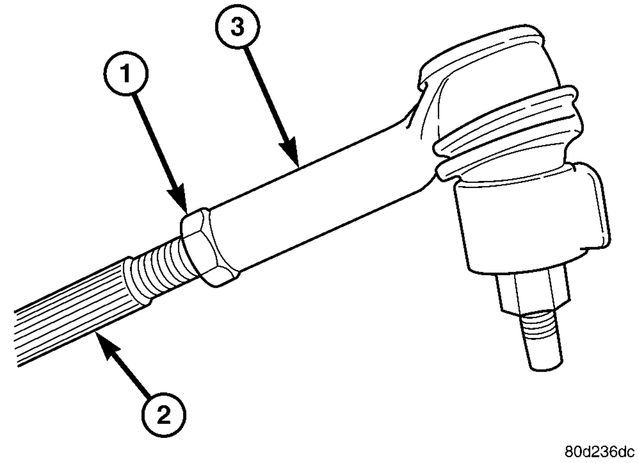

Fig. 2 TIE ROD END

1 - JAM NUT
2 - TIE ROD - INNER
3 - TIE ROD END - OUTER

LINKAGE - LINK/COIL

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LINKAGE - LINK/COIL

DESCRIPTION

The steering linkage is comprised of a tie rod end, tie rod, drag link, steering damper and pitman arm (Fig. 1).

CAUTION: If any steering components are replaced or serviced an alignment must be performed.

NOTE: To avoid damaging ball stud seals, use Puller C-3894–A or an appropriate puller to remove tie rod ends (Fig. 2).

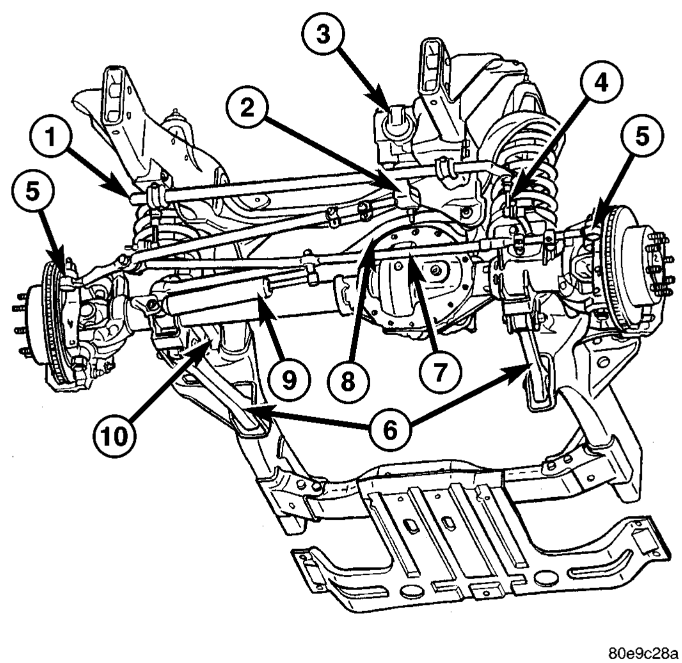


Fig. 1 LINK/COIL FRONT SUSPENSION

1 - STABILIZER BAR
2 - PITMAN ARM
3 - STEERING GEAR
4 - STABILIZER LINK
5 - TIE ROD ENDS
6 - LOWER SUSPENSION ARMS
7 - DRAG LINK
8 - TRACK BAR
9 - DAMPER
10 - UPPER SUSPENSION ARM

LINKAGE - LINK/COIL (Continued)

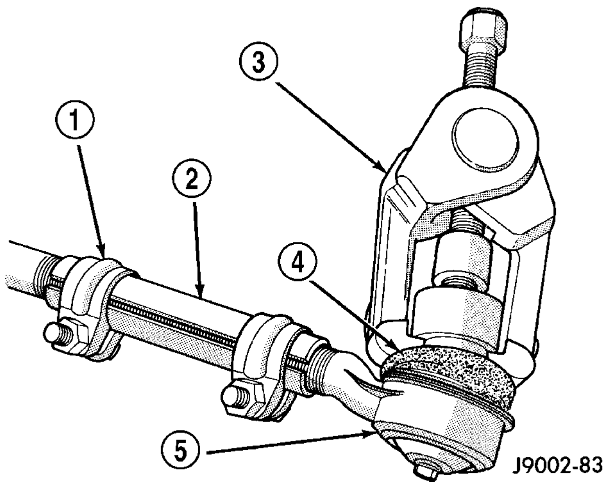


Fig. 2 Ball Stud Puller

1 - CLAMP
2 - ADJUSTMENT SLEEVE
3 - PULLER TOOL C-3894–A
4 - SEAL
5 - TIE-ROD END

STANDARD PROCEDURE - LUBRICATION

Periodic lubrication of the steering system components is required. Refer to Lubrication And Maintenance for the recommended maintenance schedule.

The following components must be lubricated:

- Tie rod
- Tie rod end
- Drag link

SPECIFICATIONS

TORQUE CHART

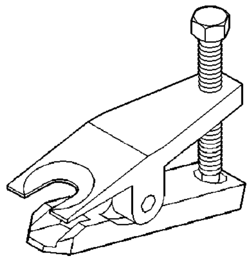
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Pitman Arm Gear Shaft Nut	300	225	—
Drag Link Pitman Arm	88	65	—
Drag Link Tie Rod	108	80	—
Drag Link Adjuster Clamp	61	45	—
Tie Rod End Knuckle	108	80	—
Tie Rod End Adjuster Clamp	61	45	—
Stabilizer Bar Link to Axle	68	50	—
Steering Damper Axle	95	70	—
Steering Damper Tie Rod	81	60	—

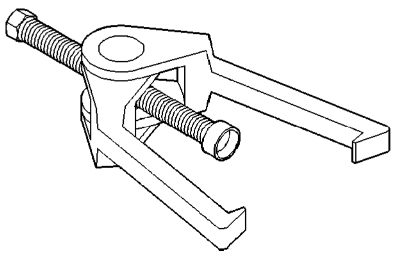
LINKAGE - LINK/COIL (Continued)

SPECIAL TOOLS

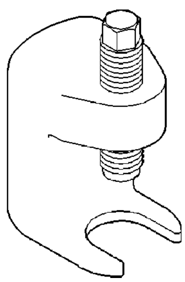
STEERING LINKAGE



Remover Ball Stud MB-991113



Puller Tie Rod C-3894-A



Remover Ball Joint C-4150A

DAMPER

REMOVAL

(1) Remove the steering damper mounting nuts and bolts.

(2) Slide the damper from the isolation bushing.

(3) Remove the damper.

INSTALLATION

(1) Install the steering damper on the axle and isolation bushing. Tighten nut to 95 N·m (75 ft. lbs.).

(2) Install the steering damper on the tie rod. Tighten nut to 81 N·m (60 ft. lbs.).

DRAG LINK

REMOVAL

(1) Remove the draglink nut from the pitman arm side.

(2) Remove the drag link nut from the knuckle side.

(3) Remove the drag link from the right knuckle and pitman arm with Puller C-3894A (Fig. 3).

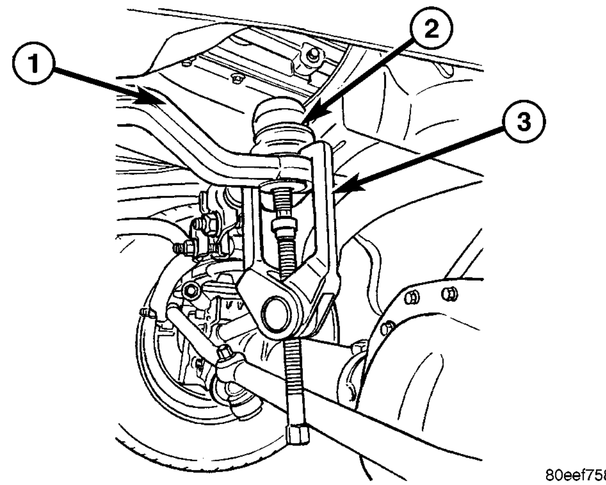


Fig. 3 DRAGLINK REMOVAL

1 - PITMAN ARM
2 - DRAGLINK
3 - C -3894-A PULLER

INSTALLATION

(1) Install the drag link to the pitman arm. Install the nut and tighten to 88 N·m (65 ft. lbs.).

(2) Install the drag link to the right steering knuckle. Install the nut and tighten to 108 N·m (80 ft. lbs.).

(3) Install tie rod to the left steering knuckle and drag link. Install the nuts and tighten to 108 N·m (80 ft. lbs.).

(4) Remove the supports and lower the vehicle to the surface. Center steering wheel and adjust toe, (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) After adjustment tighten tie rod adjustment sleeve clamp bolts to 61 N·m (45 ft. lbs.).

NOTE: Position the clamp on the sleeve so retaining bolt is located on the bottom side of the sleeve.

PITMAN ARM

REMOVAL

(1) Remove the drag link from the right knuckle and pitman arm with Puller C-4150A (Fig. 4).

(2) Mark the pitman arm and shaft positions for installation reference. Remove the nut and washer from the pitman arm (Fig. 5). Remove the pitman arm with Puller C-4150A.

PITMAN ARM (Continued)

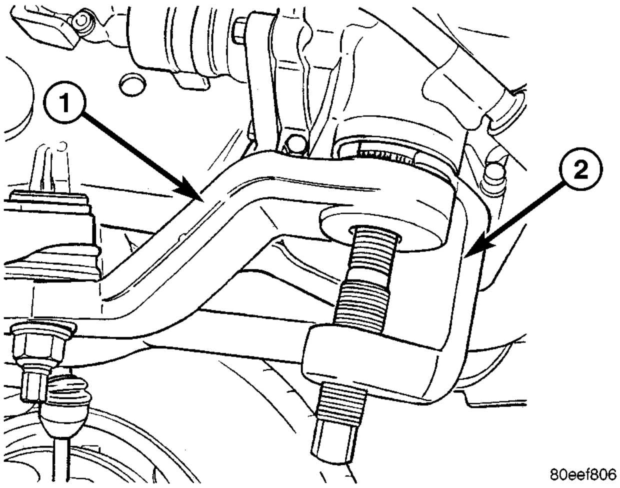


Fig. 4 PITMAN ARM REMOVAL

1 - PITMAN ARM
2 - C-4150A PULLER

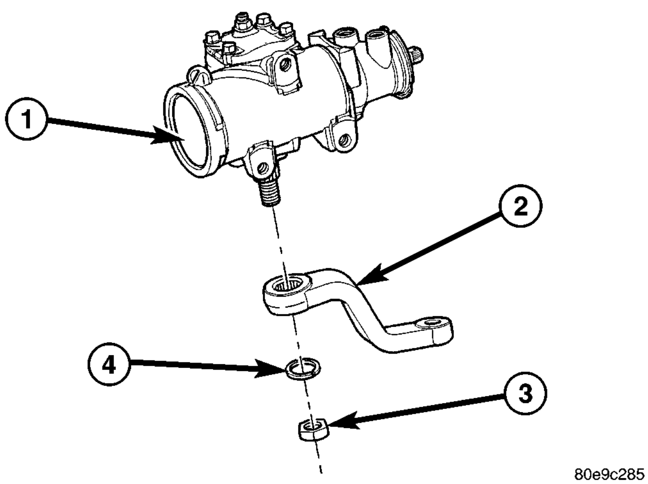


Fig. 5 PITMAN ARM REMOVAL/INSTALLATION

1 - STEERING GEAR
2 - PITMAN ARM
3 - NUT
4 - WASHER

INSTALLATION

(1) Align reference marks and install pitman arm.

(2) Install the lock washer and retaining nut on the pitman shaft and tighten nut to 251 N·m (185 ft. lbs.).

(3) Install the drag link to the pitman arm (Fig. 6). Install the nut and tighten to 108 N·m (80 ft. lbs.).

(4) Remove the supports and lower the vehicle to the surface. Center steering wheel and adjust toe, (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(5) After adjustment tighten tie rod adjustment sleeve clamp bolts to 61 N·m (45 ft. lbs.).

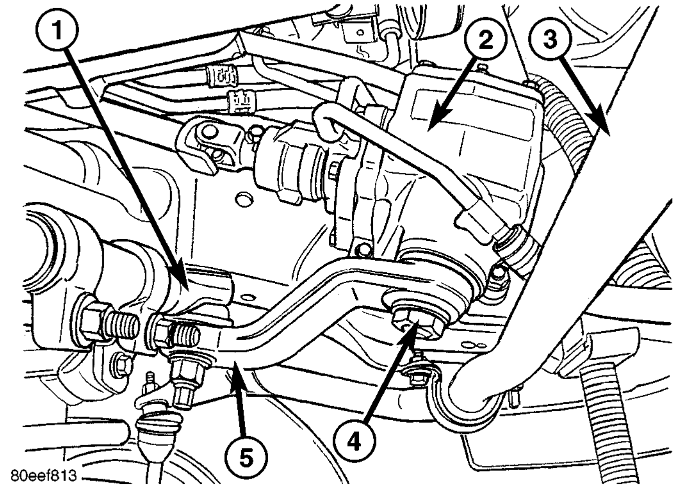


Fig. 6 PITMAN ARM INSTALLED

1 - DRAGLINK
2 - STEERING GEAR
3 - SWAYBAR
4 - NUT/WASHER
5 - PITMAN ARM

NOTE: Position the clamp on the sleeve so retaining bolt is located on the bottom side of the sleeve.

TIE ROD END

REMOVAL

(1) Remove tie rod nuts (Fig. 7).

(2) Remove tie rod from drag link and left knuckle with Puller C-4150A.

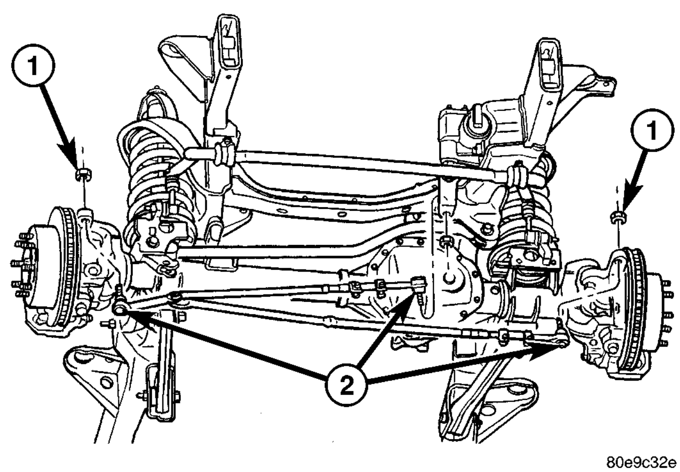


Fig. 7 TIE ROD ENDS

1 - NUT
2 - TIE ROD ENDS

TIE ROD END (Continued)

INSTALLATION

(1) Install tie rod to the left steering knuckle and drag link. Install the nuts and tighten to 108 N·m (80 ft. lbs.).

(2) Remove the supports and lower the vehicle to the surface. Center steering wheel and adjust toe, (Refer to 2 - SUSPENSION/WHEEL ALIGNMENT - STANDARD PROCEDURE).

(3) After adjustment tighten tie rod adjustment sleeve clamp bolts to 61 N·m (45 ft. lbs.).

NOTE: Position the clamp on the sleeve so retaining bolt is located on the bottom side of the sleeve.

TRACK BAR

REMOVAL

(1) Raise and support the axle.

(2) Remove the track bar bolts and nuts (Fig. 8).

(3) Remove the track bar (Fig. 8).

INSTALLATION

(1) Install the track bar.

(2) Install the new bolts and nuts. Tighten to 203 N·m (150 ft lbs.).

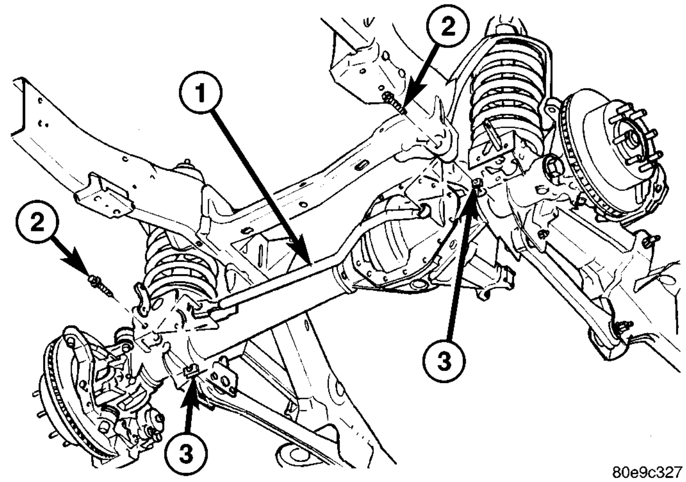


Fig. 8 TRACK BAR REMOVAL/INSTALLATION

1 - TRACK BAR
2 - BOLT
3 - NUT

(3) Remove the supports under the axle and lower the vehicle to the ground.

PUMP

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PUMP

DESCRIPTION

CAUTION: MOPAR® ATF+4 is to be used in the power steering system. No other power steering or automatic transmission fluid is to be used in the system. Damage may result to the power steering pump and system if any other fluid is used, and do not overfill.

The pump is connected to the steering gear via the pressure hose and the return hose. The pump shaft has a pressed-on pulley that is belt driven by the crankshaft pulley.

All vehicles are equipped with a power steering fluid cooler.

NOTE: Power steering pumps are not interchangeable with pumps installed on other vehicles.

OPERATION

Hydraulic pressure is provided for the power steering gear by the belt driven power steering pump (Fig. 1). The power steering pumps are constant flow rate and displacement, vane-type pumps.

PUMP (Continued)

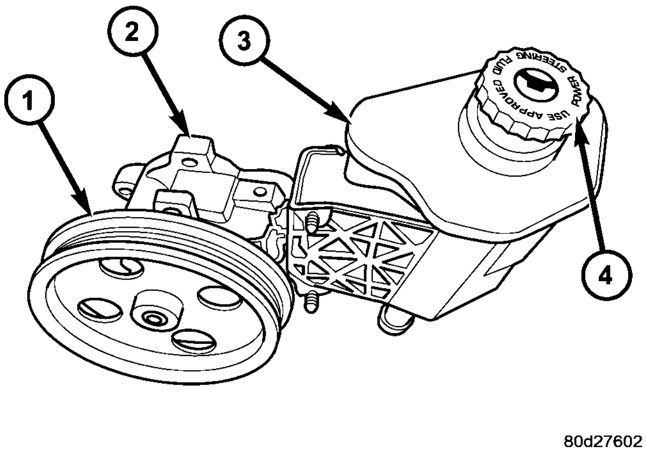

Fig. 1 POWER STEERING PUMP

1 - 3.7L & 4.7L (6 GROOVE) PHENOLIC (PLASTIC TYPE) PULLEY
1 - 5.7L,5.9L & 8.0L (7 GROOVE) PHENOLIC (PLASTIC TYPE) PULLEY
1 - 5.9L DIESEL (8 GROOVE) STEEL PULLEY
2 - PUMP ASSEMBLY
3 - RESERVOIR
4 - CAP

DIAGNOSIS AND TESTING - PUMP LEAKAGE

The pump is serviced as an assembly and should not be disassembled. The plastic pump reservoir and the reservoir o-rings can be replaced.

Check for leaks in the following areas:

- Pump shaft seal behind the pulley
- Pump to reservoir O-ring
- Reservoir cap
- Pressure and return lines
- Flow control valve fitting

STANDARD PROCEDURE

STANDARD PROCEDURE - POWER STEERING PUMP - INITIAL OPERATION

WARNING: THE FLUID LEVEL SHOULD BE CHECKED WITH ENGINE OFF TO PREVENT INJURY FROM MOVING COMPONENTS.

CAUTION: MOPAR® ATF+4 is to be used in the power steering system. No other power steering or automatic transmission fluid is to be used in the system. Damage may result to the power steering pump and system if any other fluid is used, and do not overfill.

Wipe filler cap clean, then check the fluid level. The dipstick should indicate **COLD** when the fluid is at normal temperature.

(1) Turn steering wheel all the way to the left

(2) Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two (2) minutes.

(3) Raise the front wheels off the ground.

(4) Slowly turn the steering wheel lock-to-lock 20 times with the engine off while checking the fluid level.

NOTE: For vehicles with long return lines or oil coolers turn wheel 40 times.

(5) Start the engine. With the engine idling maintain the fluid level.

(6) Lower the front wheels and let the engine idle for two minutes.

(7) Turn the steering wheel in both direction and verify power assist and quiet operation of the pump.

If the fluid is extremely foamy or milky looking, allow the vehicle to stand a few minutes and repeat the procedure.

CAUTION: Do not run a vehicle with foamy fluid for an extended period. This may cause pump damage.

STANDARD PROCEDURE - FLUSHING POWER STEERING SYSTEM

Flushing is required when the power steering/hydraulic booster system fluid has become contaminated. Contaminated fluid in the steering/booster system can cause seal deterioration and affect steering gear/booster spool valve operation.

(1) Raise the front end of the vehicle off the ground until the wheels are free to turn.

(2) Remove the return line from the pump.

NOTE: If vehicle is equipped with a hydraulic booster remove both return lines from the pump.

(3) Plug the return line port/ports at the pump.

(4) Position the return line/lines into a large container to catch the fluid.

(5) While an assistant is filling the pump reservoir start the engine.

(6) With the engine running at idle turn the wheel back and forth.

NOTE: Do not contact or hold the wheel against the steering stops.

(7) Run a quart of fluid through the system then stop the engine and install the return line/lines.

(8) Fill the system with fluid and perform Steering Pump Initial Operation, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

(9) Start the engine and run it for fifteen minutes then stop the engine.

PUMP (Continued)

(10) Remove the return line/lines from the pump and plug the pump port/ports.

(11) Pour fresh fluid into the reservoir and check the draining fluid for contamination. If the fluid is still contaminated, then flush the system again.

(12) Install the return line/lines and perform Steering Pump Initial Operation, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

REMOVAL

REMOVAL - GAS

(1) Drain and siphon the power steering fluid from the reservoir.

(2) Remove the serpentine belt.

CAUTION: Do not remove the fitting on the pump that the high pressure hose screws into. The fitting may come loose unless it is backed up using another wrench. If the fitting does come loose, it must be retightened before continuing. (57 - 67Nm, 40 - 50 lbft) If this fitting comes out of the pump body, the internal spring and valve parts will fall out of the pump and they cannot be reinstalled properly. If this occurs the pump needs to be replaced with a new pump.

(3) Disconnect the return hose. (Fig. 2)

(4) Disconnect the pressure hose. (Fig. 2)

(5) Access to remove the three bolts securing the pump to the cylinder head can be gained thru the pulley holes. (Fig. 2)

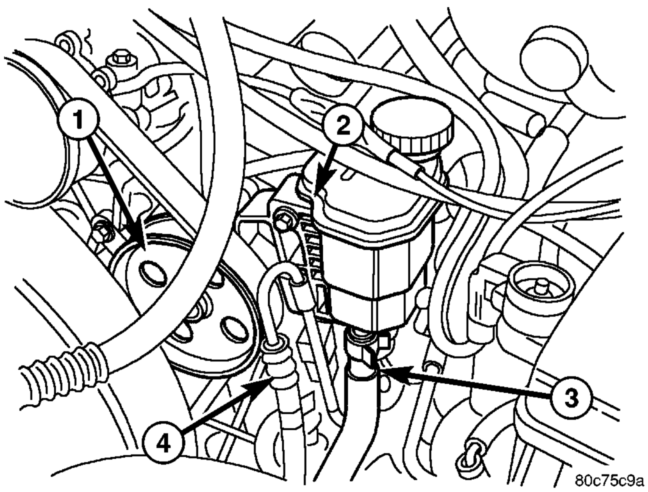

Fig. 2 POWER STEERING PUMP

1 - POWER STEERING PULLEY
2 - POWER STEERING RESERVOIR
3 - RETURN HOSE
4 - HIGH PRESSURE HOSE

REMOVAL - DIESEL

(1) Drain and siphon the power steering fluid from the reservoir.

(2) Remove the serpentine belt.

CAUTION: Do not remove the fitting on the pump that the high pressure hose screws into. The fitting may come loose unless it is backed up using another wrench. If the fitting does come loose, it must be retightened before continuing. (57 - 67Nm, 40 - 50 lbft) If this fitting comes out of the pump body, the internal spring and valve parts will fall out of the pump and they cannot be reinstalled properly. If this occurs the pump needs to be replaced with a new pump.

(3) Disconnect the return hose.

(4) Disconnect the pressure hose.

(5) Access to remove the three bolts securing the pump to the cylinder head can be gained thru the pulley holes.

(6) Loosen the pump bracket to the block.

(7) Remove the 6 intake plenum bolts (Fig. 3).

(8) loosen the inner cooler tube clamp at the intake plenum and remove the intake plenum.

(9) Loosen the inner cooler tube clamp at the radiator support side and remove the tube from the vehicle.

(10) Remove the power steering pump from the top of the engine compartment where the intake plenum was (Fig. 3).

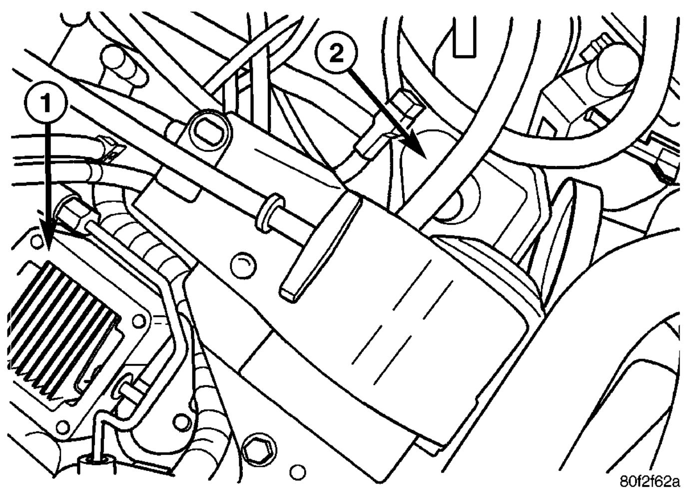

Fig. 3 POWER STEERING PUMP ACCESS

1 - INTAKE PLENUM MOUNTING
2 - POWER STEERING PUMP

PUMP (Continued)

INSTALLATION

INSTALLATION - GAS

(1) Align the pump with the mounting holes in the left cylinder head.

(2) Install 3 pump mounting bolts through the pulley access holes. Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Reconnect the pressure line and return hose to the pump and reservoir. Tighten the pressure line to 37 N·m (27 ft. lbs.).

(4) Install the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(5) Fill the power steering pump, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - DIESEL

(1) Set the power steering pump in place in the engine compartment from the top (Fig. 3).

(2) Install the inner cooler tube.

(3) Tighten the inner cooler tube clamp at the radiator support side.

(4) Install the 6 intake plenum bolts (Fig. 3).

(5) Tighten the inner cooler tube clamp at the intake plenum.

(6) Install 3 pump mounting bolts through the pulley access holes. Tighten the bolts to 28 N·m (21 ft. lbs.).

(7) Tighten the pump bracket to the block.

(8) Reconnect the pressure line and return hose to the pump and reservoir. Tighten the pressure line to 37 N·m (27 ft. lbs.).

(9) Install the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Fill the power steering pump, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Power Steering Pressure Switch	10	—	80
Power Steering Line Pressure Line	32	23	—
Power Steering Line Return Line	71	52	—
Power Steering Line Pressure Line To Pump	37	27	—
Power Steering Pump Mounting Bolts	28	27	—
Power Steering Pump Reservoir Bolts	7	5	—
Power Steering Pump Bracket Bolts	7	5	—

FLUID

DESCRIPTION

The recommended fluid for the power steering system is Mopar® ATF +4.

Mopar® ATF+4, when new is red in color. The ATF+4 is dyed red so it can be identified from other fluids used in the vehicle such as engine oil or antifreeze. The red color is not permanent and is not an indicator of fluid condition, As the vehicle is driven, the ATF+4 will begin to look darker in color and may eventually become brown. **THIS IS NORMAL.** ATF+4 also has a unique odor that may change with age. Consequently, odor and color cannot be used to indicate the fluid condition or the need for a fluid change.

STANDARD PROCEDURE - POWER STEERING FLUID LEVEL CHECKING

WARNING: FLUID LEVEL SHOULD BE CHECKED WITH THE ENGINE OFF TO PREVENT PERSONAL INJURY FROM MOVING PARTS.

CAUTION: MOPAR® ATF+4 is to be used in the power steering system. No other power steering or automatic transmission fluid is to be used in the system. Damage may result to the power steering pump and system if any other fluid is used, and do not overfill.

The power steering fluid level can be viewed on the dipstick attached to the filler cap. There are two ranges listed on the dipstick, COLD and HOT. Before opening power steering system, wipe the reservoir filler cap free of dirt and debris. Remove the cap and check the fluid level on its dipstick. When the fluid is at normal ambient temperature, approximately 21°C to 27°C (70°F to 80°F), the fluid level should read between the minimum and maximum area of the cold range. When the fluid is hot, fluid level is allowed to read up to the highest end of the HOT range. Only add fluid when the vehicle is cold.

Use only Mopar® ATF+4 Do not overfill the power steering system.

FLUID COOLER

REMOVAL

(1) Drain and siphon the power steering fluid.

(2) Disconnect the return and supply hoses connected to the power steering fluid cooler.

(3) Remove the mounting bracket bolts securing the fluid cooler to the brace. (Fig. 4)& (Fig. 5)

(4) Remove the fluid cooler from the vehicle.

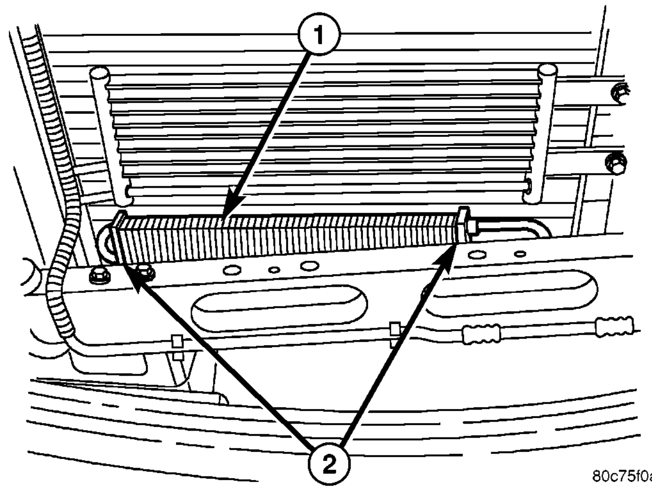

Fig. 4 V6 & V8 P/S FLUID COOLER

1 - POWER STEERING FLUID COOLER
2 - MOUNTING BOLTS

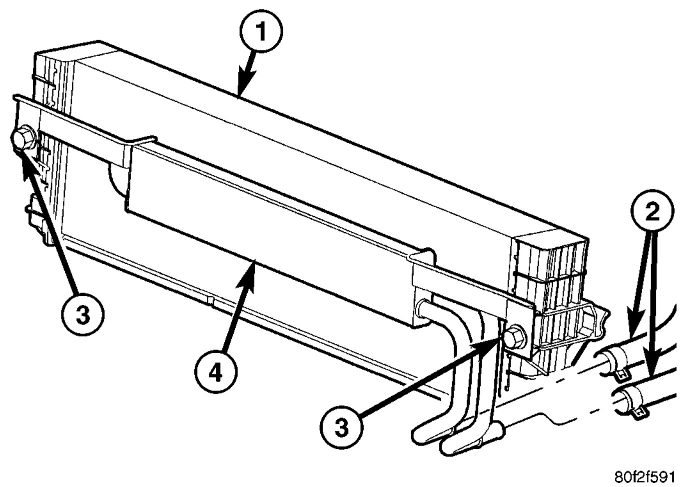

Fig. 5 V10 & DIESEL P/S FLUID COOLER

1 - RADIATOR
2 - POWER STEERING HOSES
3 - MOUNTING BOLTS
4 - P/S FLUID COOLER

INSTALLATION

(1) Install the fluid cooler to the vehicle.

(2) Install the mounting bracket bolts securing the fluid cooler to the brace (Fig. 4)& (Fig. 5).

(3) Reclamp the return and supply hoses to the power steering fluid cooler.

(4) Refill the power steering fluid (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

HOSES - I.F.S.

REMOVAL

REMOVAL - RETURN HOSE - GEAR TO COOLER

(1) Drain and siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the return hose at the cooler.
(4) Disconnect the return hose at the gear (Fig. 6).
(5) Remove the return hose from the routing clamp at the fan shroud and then remove from the vehicle.

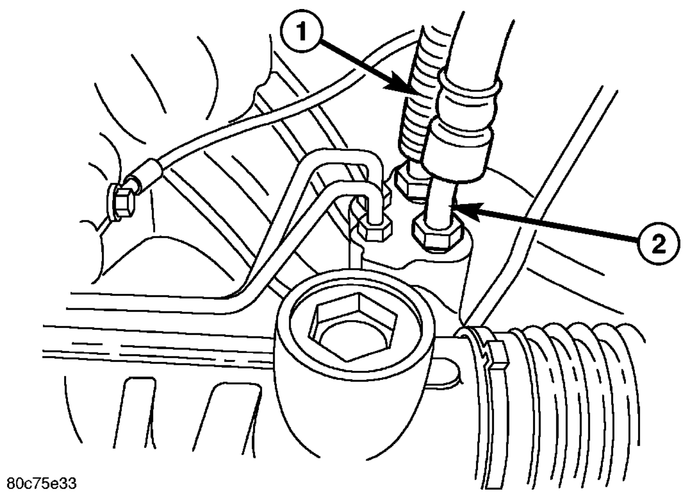

Fig. 6 HOSE CONNECTIONS

1 - RETURN HOSE
2 - PRESSURE HOSE

REMOVAL - PRESSURE HOSE

(1) Drain and siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the pressure hose at the pump.
(4) Disconnect the pressure hose at the gear (Fig. 6).
(5) Remove the pressure hose from the vehicle.

REMOVAL - RETURN HOSE - RESERVOIR TO COOLER

(1) Drain and siphon the power steering system.
(2) Disconnect the return hose at the reservoir.
(3) Raise and support the vehicle.
(4) Remove the return hose from the routing clamp at the fan shroud.
(5) Disconnect the return hose at the cooler.
(6) Remove the hose from the vehicle.

INSTALLATION

INSTALLATION - RETURN HOSE - GEAR TO COOLER

(1) Install the return hose to the vehicle.
(2) Reconnect the return hose at the cooler.
(3) Reconnect the return hose at the gear. Tighten the hose to 71 N·m (52 ft. lbs.) (Fig. 6).
(4) Reattach the hose to the routing clip at the fan shroud.
(5) Remove the support and lower the vehicle.
(6) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - PRESSURE HOSE

NOTE: Be sure to align the pressure hose so it does not contact the fan shroud or the frame rail.

(1) Install the pressure hose to the vehicle.
(2) Reconnect the pressure hose at the gear. Tighten the hose to 32 N·m (23 ft. lbs.) (Fig. 6).
(3) Reconnect the pressure hose at the pump. Tighten the hose to 36 N·m (27 ft. lbs.).
(4) Remove the support and lower the vehicle.
(5) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - RETURN HOSE - RESERVOIR TO COOLER

(1) Install the return hose to the vehicle.
(2) Reconnect the return hose at the cooler.
(3) Reattach the hose to the routing clip at the fan shroud.
(4) Remove the support and lower the vehicle.
(5) Reconnect the return hose at the reservoir.
(6) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

HOSES - LINK/COIL

REMOVAL

REMOVAL - RETURN HOSE - GEAR TO COOLER

(1) Drain and siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the return hose at the cooler.
(4) Disconnect the return hose at the gear (Fig. 7).
(5) Remove the return hose from the routing clamp at the fan shroud and then remove from the vehicle.

HOSES - LINK/COIL (Continued)

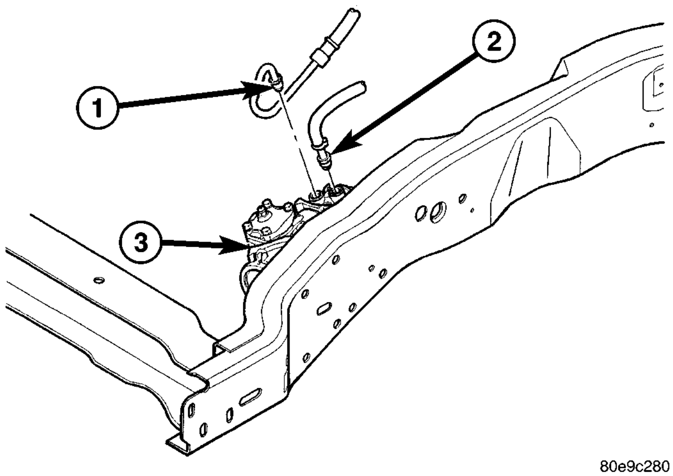

Fig. 7 POWER STEERING HOSES TO STEERING GEAR

1 - HIGH PRESSURE HOSE
2 - RETURN HOSE
3 - STEERING GEAR

REMOVAL - PRESSURE HOSE

(1) Drain and siphon the power steering system.
(2) Raise and support the vehicle.
(3) Disconnect the pressure hose at the pump.
(4) Disconnect the pressure hose at the gear (Fig. 8).

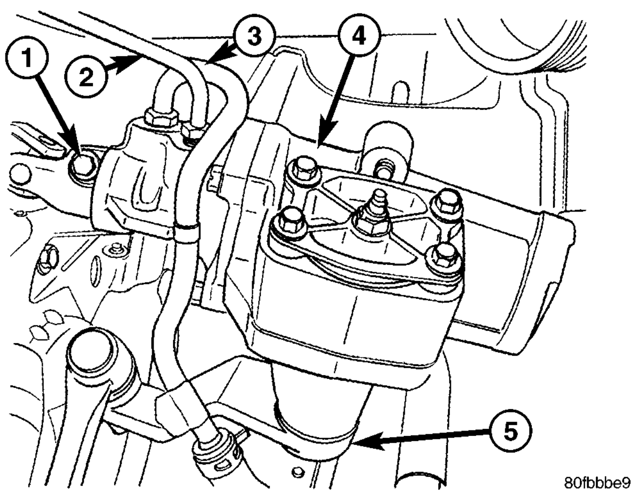

Fig. 8 HOSES INSTALLED

1 - LOWER COUPLING BOLT
2 - HIGH PRESSURE HOSE
3 - RETURN HOSE
4 - STEERING GEAR
5 - PITMAN ARM

(5) Remove the pressure hose from the vehicle.

REMOVAL - RETURN HOSE - RESERVOIR TO COOLER

(1) Drain and siphon the power steering system.
(2) Disconnect the return hose at the reservoir.
(3) Raise and support the vehicle.
(4) Remove the return hose from the routing clamp at the fan shroud.
(5) Disconnect the return hose at the cooler.
(6) Remove the hose from the vehicle.

INSTALLATION

INSTALLATION - RETURN HOSE - GEAR TO COOLER

(1) Install the return hose to the vehicle.
(2) Reconnect the return hose at the cooler.
(3) Reconnect the return hose at the gear. Tighten the hose to 71 N·m (52 ft. lbs.) (Fig. 7).
(4) Reattach the hose to the routing clip at the fan shroud.
(5) Remove the support and lower the vehicle.
(6) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - PRESSURE HOSE

NOTE: Be sure to align the pressure hose so it does not contact the fan shroud or the frame rail.

(1) Install the pressure hose to the vehicle.
(2) Reconnect the pressure hose at the gear. Tighten the hose to 32 N·m (23 ft. lbs.) (Fig. 8).
(3) Reconnect the pressure hose at the pump. Tighten the hose to 36 N·m (27 ft. lbs.).
(4) Remove the support and lower the vehicle.
(5) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

INSTALLATION - RETURN HOSE - RESERVOIR TO COOLER

(1) Install the return hose to the vehicle.
(2) Reconnect the return hose at the cooler.
(3) Reattach the hose to the routing clip at the fan shroud.
(4) Remove the support and lower the vehicle.
(5) Reconnect the return hose at the reservoir.
(6) Refill the power steering system,(Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

POWER STEERING PRESSURE SWITCH

DESCRIPTION

A pressure sensing switch is used in the power steering system. It is mounted on the high-pressure steering hose (Fig. 9). This switch will be used with both 3.7L, 4.7L and 5.7L engines. There is no pressure switch used for the 5.9L pump.

OPERATION

The switch is used on the 3.7L V-6, 4.7L & 5.7L V-8 engines.

The power steering pressure switch provides an input to the Powertrain Control Module (PCM). This input is provided during periods of high steering pump load and low engine rpm; such as during parking maneuvers. The PCM increases the idle speed through the Idle Air Control (IAC) motor. This is done to prevent the engine from stalling under the increased load.

When steering pump pressure exceeds 3275 kPa ± 690 kPa (475 psi ± 100 psi), the Normally Closed (NC) switch will open and the PCM will increase the engine idle speed. This will prevent the engine from stalling.

When pump pressure drops to approximately 1379 kPa (200 psi), the switch circuit will re-close and engine idle speed will return to its previous setting.

REMOVAL - 3.7L, 4.7L & 5.7L

The power steering pressure switch is installed in the power steering high-pressure hose (Fig. 9).

(1) Disconnect electrical connector from power steering pressure switch.

(2) Place a small container or shop towel beneath switch to collect any excess fluid.

(3) Remove switch. Use back-up wrench on power steering line to prevent line bending.

INSTALLATION - 3.7L, 4.7L & 5.7L

This switch is used only with the 3.7L V–6 and the 4.7L, 5.7L V-8 engines.

(1) Install power steering switch into power steering line.

(2) Tighten to 8–11 N·m (70–100 in. lbs.) torque.

(3) Connect electrical connector to switch.

(4) Check power steering fluid and add as necessary.

(5) Start engine and again check power steering fluid. Add fluid if necessary.

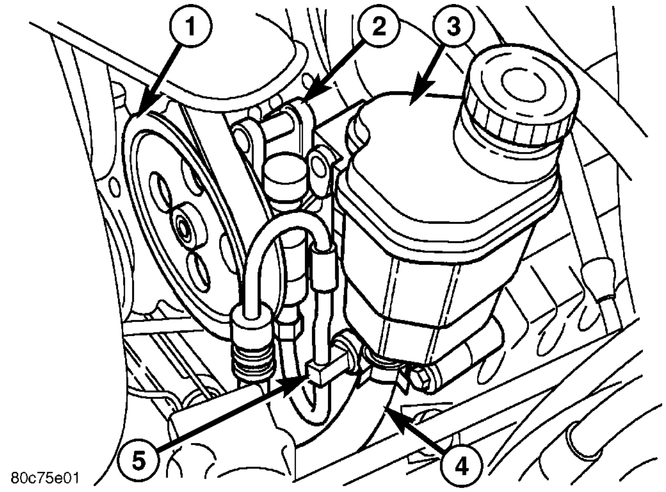

Fig. 9 PRESSURE SWITCH

1 - POWER STEERING PULLEY
2 - POWER STEERING PUMP HOUSING
3 - POWER STEERING FLUID RESERVOIR
4 - RETURN HOSE
5 - HIGH PRESSURE HOSE WITH PRESSURE SWITCH

PULLEY

REMOVAL

CAUTION: Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

(1) Remove the power steering pump assembly, (Refer to 19 - STEERING/PUMP - REMOVAL).

(2) Remove the pulley from the pump with an appropriate power steering pulley removal tool (Fig. 10).

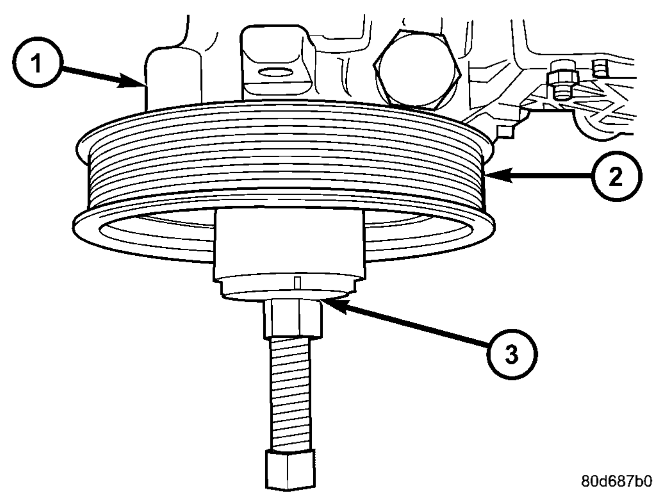

Fig. 10 PULLEY REMOVAL

1 - POWER STEERING PUMP
2 - PULLEY
3 - POWER STEERING PULLEY REMOVAL TOOL

PULLEY (Continued)

INSTALLATION

CAUTION: Do not reuse the old power steering pump pulley it is not intended for reuse. A new pulley must be installed if removed.

(1) Replace the pulley if it's bent, cracked, or loose.

(2) Install the pulley on the pump with an appropriate power steering pulley installation tool (Fig. 11) making sure it is flush with the end of the shaft. Ensure the tool and pulley remain aligned with the pump shaft.

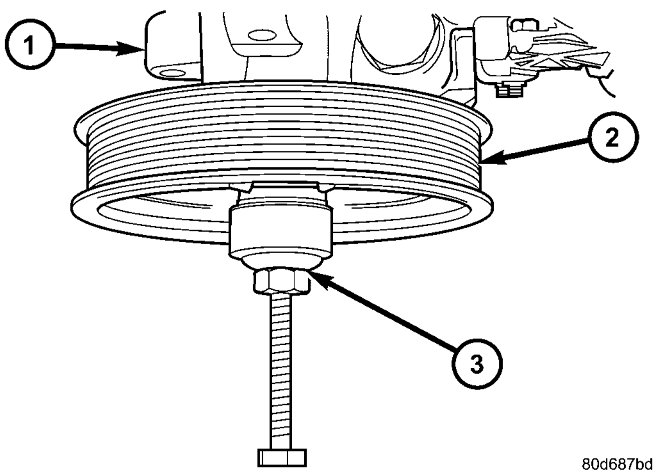

Fig. 11 PULLEY INSTALLATION

1 - POWER STEERING PUMP
2 - PULLEY
3 - POWER STEERING PUMP PULLEY INSTALLATION TOOL

(3) Install the power steering pump assembly, (Refer to 19 - STEERING/PUMP - INSTALLATION).

(4) Run engine until warm (5 min.) and note any belt chirp. If chirp exists, move pulley outward approximately 0.5 mm (0.020 in.). If noise increases, press on 1.0 mm (0.040 in.). **Be careful that pulley does not contact mounting bolts.**

RESERVOIR

REMOVAL

(1) Drain and siphon the power steering fluid from the reservoir.

(2) Remove the serpentine belt.

(3) Remove the power steering pump (Refer to 19 - STEERING/PUMP - REMOVAL).

(4) Remove the reservoir mounting bolts.

(5) Remove the reservoir.

(6) Remove the rear bracket to the pump mounting bolts.

INSTALLATION

(1) Install the reservoir bracket to the pump housing. **Do not reuse the o-rings (install new o-rings).** Tighten bolts to 7 N·m (5 ft. lbs.).

NOTE: Ensure the reservoir is fully seated onto the pump.

(2) Install the reservoir to the bracket/pump body.

(3) Install the reservoir mounting bolts. Tighten bolts to 7 N·m (5 ft. lbs.).

(4) Install the power steering pump (Refer to 19 - STEERING/PUMP - INSTALLATION).

(5) Install the serpentine drive belt, (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Fill the power steering pump, (Refer to 19 - STEERING/PUMP - STANDARD PROCEDURE).

TRANSMISSION AND TRANSFER CASE

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MANUAL TRANSMISSION - NV3500

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MANUAL TRANSMISSION - NV3500

DESCRIPTION

The transmission is a medium-duty 5-speed, constant mesh fully synchronized manual transmission with fifth gear overdrive range. The transmission is available in two and four-wheel drive configurations. The transmission gear case consists of two aluminum housings (Fig. 1). The clutch housing is an integral part of the transmission front housing.

A combination of roller and ball bearings are used to support the transmission shafts in the two housings. The transmission gears all rotate on caged type needle bearings. A roller bearing is used between the input and output shaft.

The transmission has a single shaft shift mechanism with three shift forks all mounted on the shaft. The shaft is supported in the front and rear housings by bushings and one linear ball bearing. Internal shift components consist of the forks, shaft, shift lever socket and detent components

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth countershaft gear. At this point, all the transmission gears are spinning.

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

MANUAL TRANSMISSION - NV3500 (Continued)

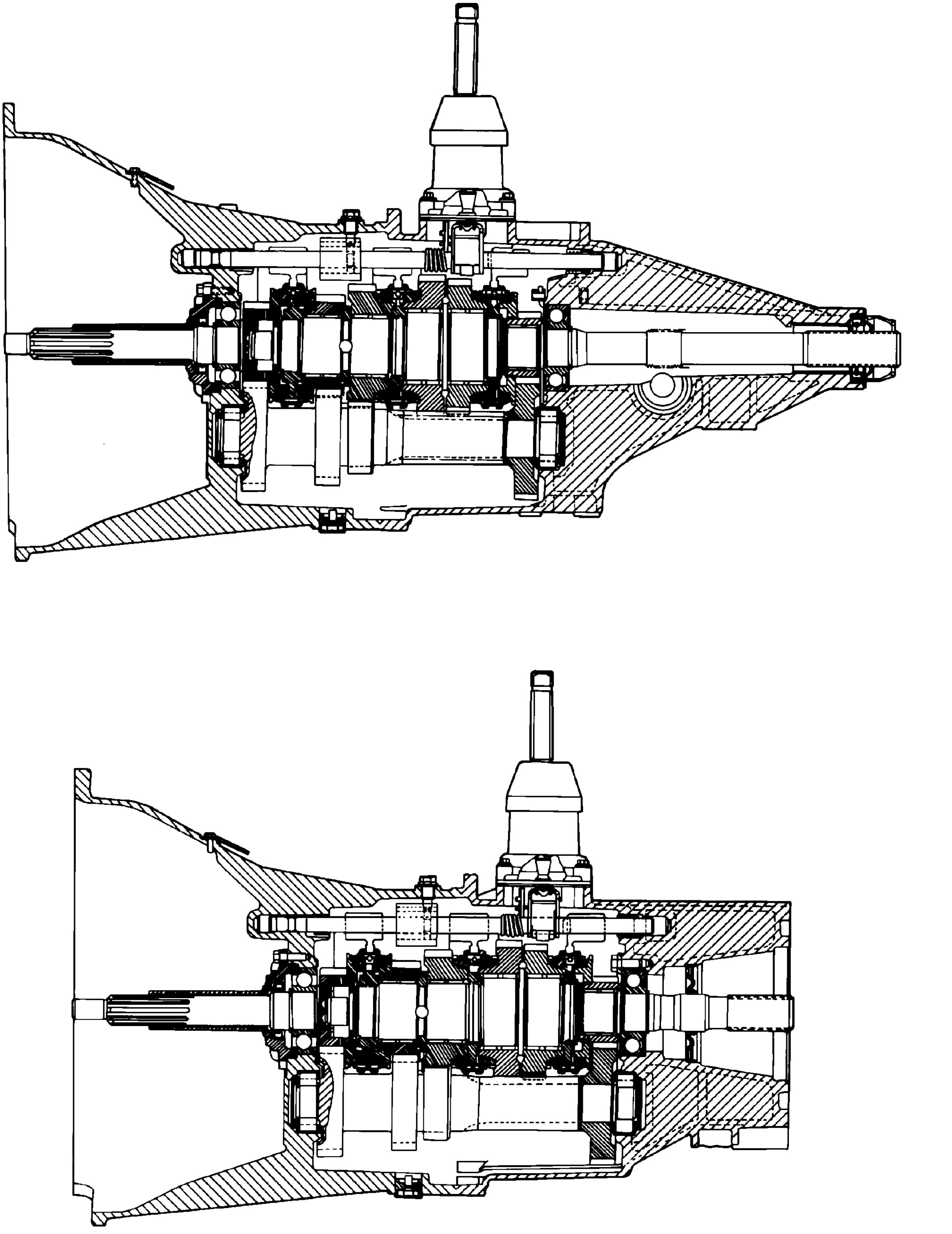


Fig. 1 NV3500 TRANSMISSION

MANUAL TRANSMISSION - NV3500 (Continued)

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill or an incorrect lubricant level check. Leaks can occur at the mating surfaces of the gear case, adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition.

Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening or use of a non-recommended sealer.

A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab and or chatter.

A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Shift component damage or damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Worn/damaged pressure plate or disc can cause incorrect release. If clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases this condition will decline as the rings wear-in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds.

Severe highly audible transmission noise is generally the initial indicator of a lubricant problem. Insufficient, improper or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear and bearing damage.

REMOVAL

(1) Disconnect battery negative cable.

(2) Shift transmission into Neutral.

(3) Remove shift boot bezel screws and slide boot upward on shift lever extension.

(4) Remove shift lever extension from the shift tower and lever assembly.

(5) Raise vehicle on hoist.

(6) Remove skid plate, if equipped.

(7) Drain lubricant if transmission will be disassembled for service.

(8) Mark propeller shaft/shafts and companion flange yoke/yokes for installation reference and remove propeller shaft/shafts.

(9) Disconnect harness from clips on transmission housing.

(10) Remove transfer case linkage if equipped.

(11) Remove transfer case mounting nuts and remove transfer case if equipped.

(12) Remove slave cylinder mounting nut and remove cylinder (Fig. 2).

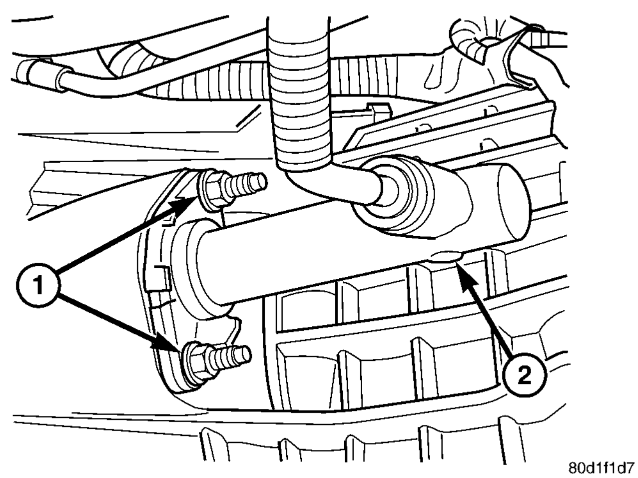


Fig. 2 SLAVE CYLINDER

1 - MOUNTING NUTS
2 - SLAVE CYLINDER

MANUAL TRANSMISSION - NV3500 (Continued)

(13) Remove starter motor, structural dust cover, dust shield and suspension crossmember (Fig. 3).

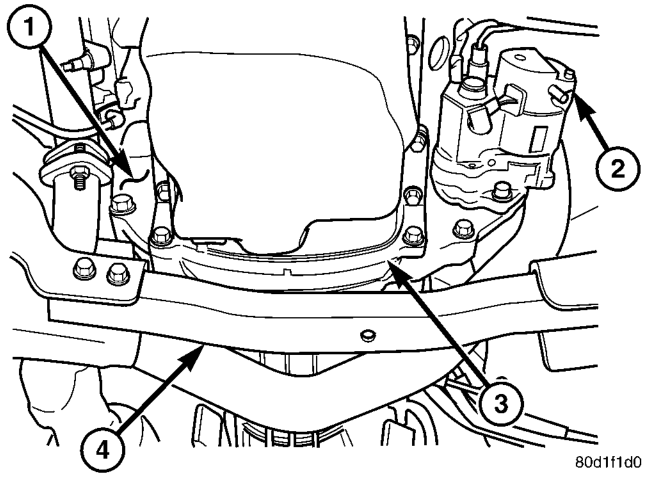


Fig. 3 DUST COVER

1 - DUST SHIELD
2 - STARTER MOTOR
3 - DUST COVER
4 - CROSSMEMBER

(14) Remove exhaust pipe from the exhaust manifolds.

(15) Support engine with adjustable jack stand and wood block.

(16) Support and secure transmission to a transmission jack with safety chains.

(17) Remove bolts from the rear transmission mount.

(18) Remove the rear crossmember and transmission mount (Fig. 4).

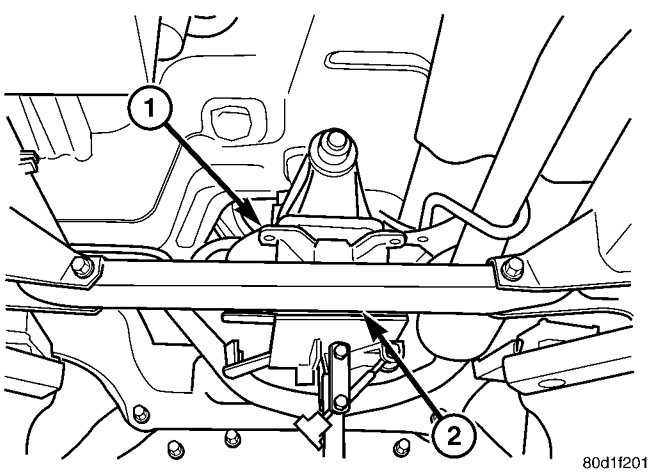


Fig. 4 CROSSMEMBER

1 - TRANSMISSION MOUNT
2 - CROSSMEMBER

(19) Remove bolts attaching transmission to the engine.

(20) Move transmission rearward until input shaft is clear of clutch disc and pressure plate. Then lower jack and remove transmission from under vehicle.

DISASSEMBLY

FRONT HOUSING

(1) Shift transmission into Neutral.

(2) If lubricant was not drained out of transmission during removal, remove drain plug and drain lubricant.

(3) Inspect drain plug magnet for debris.

(4) Remove backup light switch located on passenger side of rear housing (Fig. 5).

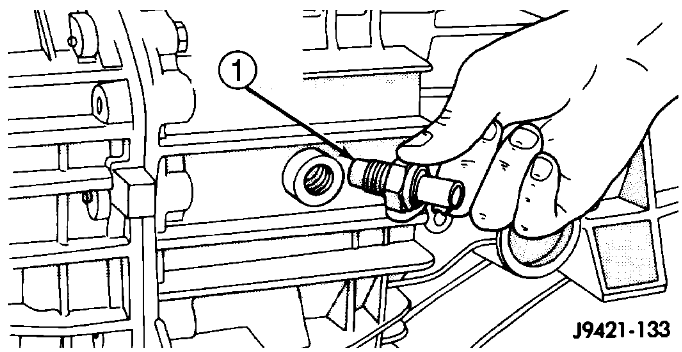


Fig. 5 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

(5) Remove shift tower bolts and remove tower and lever assembly (Fig. 6).

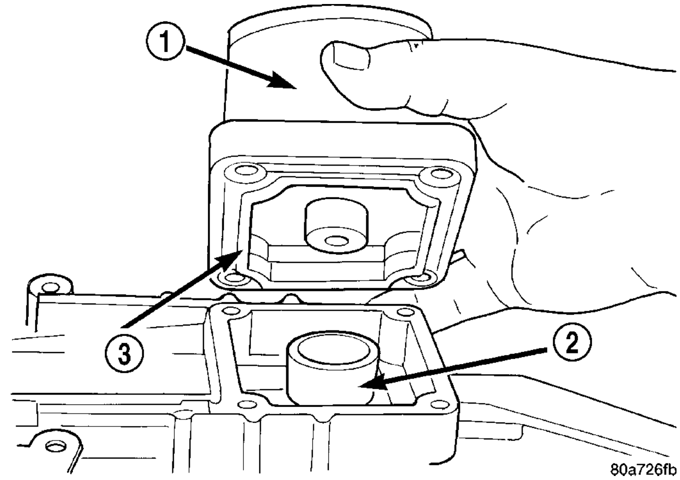


Fig. 6 SHIFT TOWER

1 - SHIFT TOWER
2 - SHIFT SOCKET
3 - SEAL

MANUAL TRANSMISSION - NV3500 (Continued)

(6) Remove shift shaft lock bolt (Fig. 7) from the top of front housing. The bolt secures the shift shaft bushing and lever.

NOTE: This is a special bolt and can not be substituted with any other bolt.

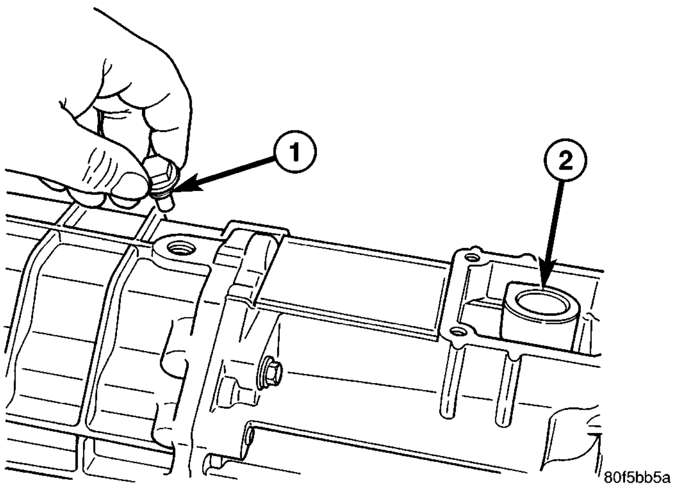


Fig. 7 SHAFT LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(7) Remove input shaft bearing retainer bolts from the front housing, then carefully pry on the retainer to break sealer bead loose (Fig. 8).

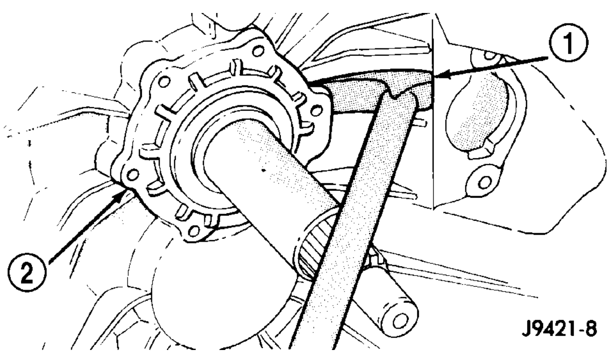


Fig. 8 BEARING RETAINER SEAL

1 - PRY TOOL
2 - INPUT SHAFT BEARING RETAINER

(8) Remove bearing retainer from input shaft (Fig. 9).

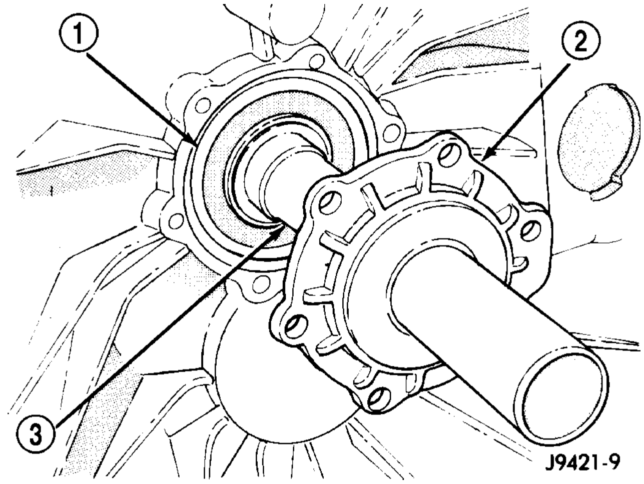


Fig. 9 INPUT SHAFT BEARING RETAINER

1 - SHAFT BEARING
2 - BEARING RETAINER
3 - INPUT SHAFT

(9) Remove input shaft snap ring (Fig. 10).

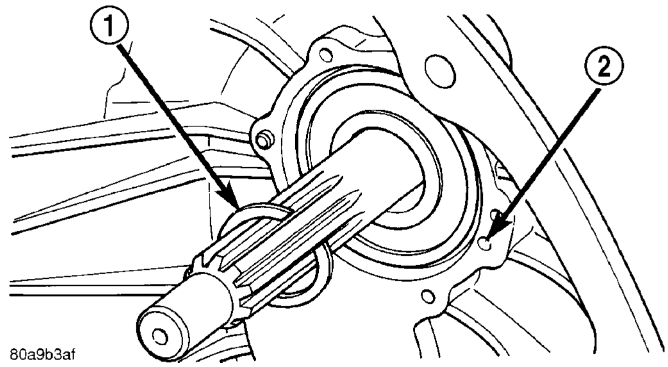


Fig. 10 INPUT SHAFT SNAP RING

1 - INPUT SHAFT SNAP RING
2 - OIL FEED

MANUAL TRANSMISSION - NV3500 (Continued)

(10) Remove shift shaft detent plug from the side of the transmission with Remover 8117A. Attach fingers of the remover to the detent plug and push the cup down till it contacts the trans. Then tighten the nut till it pulls the plug from the case.

(11) Remove shift shaft detent plunger and spring with a pencil magnet.

(12) Remove bolts that attach front housing to the rear housing (Fig. 11). Three bolts at extreme rear of housing are for the output shaft bearing retainer. Leave one bolt in place until geartrain is ready to be removed from case.

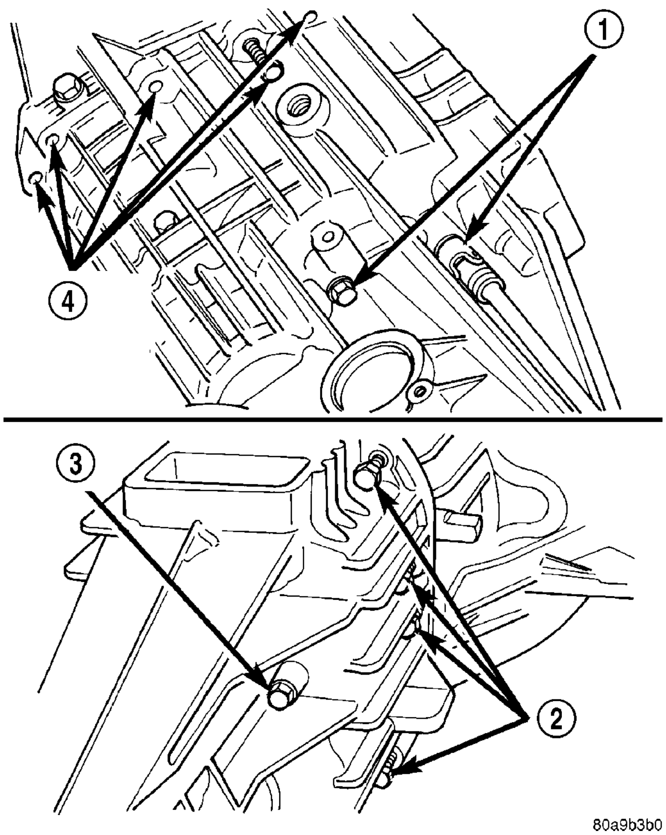


Fig. 11 HOUSING & BEARING RETAINER BOLT

1 - RETAINER BOLTS
2 - HOUSING BOLTS
3 - RETAINER BOLT
4 - HOUSING BOLT LOCATIONS

(13) Separate the housings (Fig. 12) by tapping the front housing off alignment dowels with a plastic hammer.

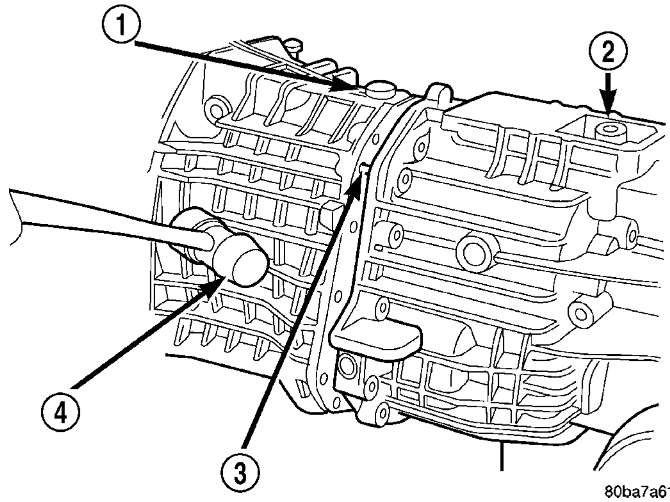


Fig. 12 FRONT HOUSING

1 - FRONT HOUSING
2 - REAR HOUSING
3 - DOWELS (2)
4 - PLASTIC MALLET

(14) Remove input shaft bearing and countershaft front bearing race (Fig. 13).

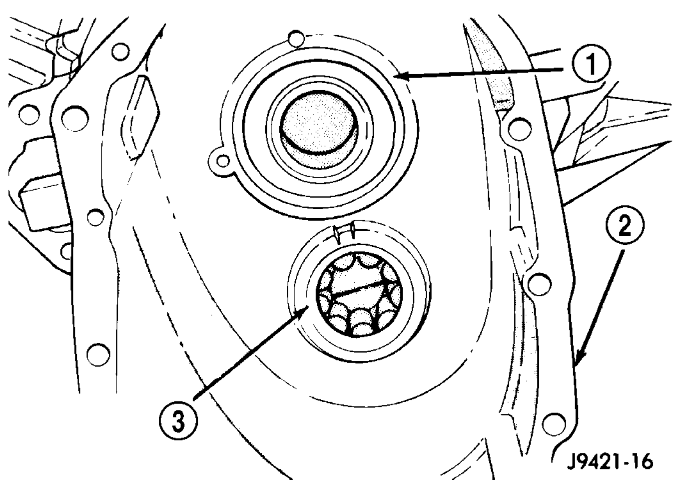


Fig. 13 Input Shaft Bearing and Countershaft Front Bearing Race

1 - INPUT SHAFT BEARING
2 - FRONT HOUSING
3 - COUNTERSHAFT FRONT BEARING

MANUAL TRANSMISSION - NV3500 (Continued)

(15) Note position of input shaft, shift shaft, forks and geartrain components in housing (Fig. 14).

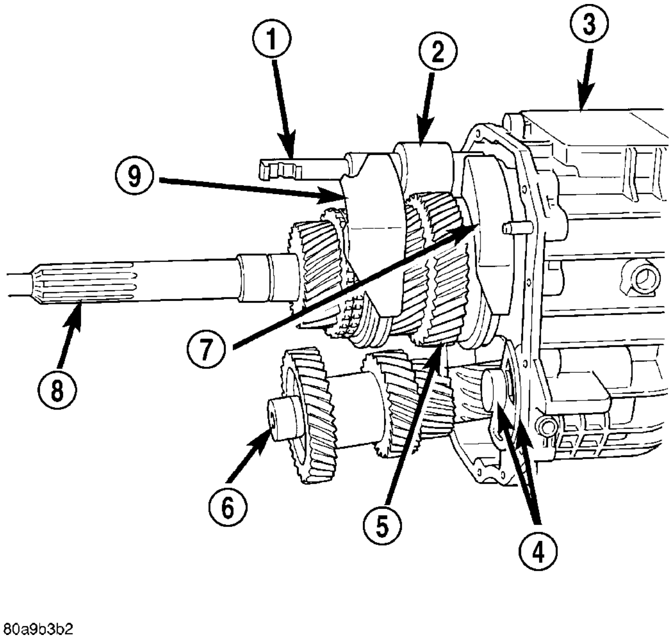


Fig. 14 GEARTRAIN AND SHIFT COMPONENT

1 - SHIFT SHAFT
2 - BUSHING
3 - REAR HOUSING
4 - REVERSE IDLER AND SUPPORT
5 - OUTPUT SHAFT AND GEARS
6 - COUNTERSHAFT
7 - 1-2 FORK
8 - INPUT SHAFT
9 - 3-4 FORK

SHIFT/FORK SHAFTS AND REVERSE IDLER SEGMENT

(1) Place a shop towel over the shaft lever to contain the lever detent ball and spring.

(2) Rotate lever and bushing upward out of the shift forks and catch ball and spring (Fig. 15).

(3) Unseat shift socket roll pin with Remover 6858. Position remover on shift shaft and center tool over the roll pin. Verify tool legs are firmly seated on the shift socket (Fig. 16).

(4) Tilt socket toward the side of the case to avoid trapping the pin between the gear teeth.

(5) Tighten remover to press the roll pin downward and out of the shift socket (Fig. 16).

NOTE: Roll pin must only clear the shift shaft. Do not push the pin into the geartrain.

(6) Drive out shift bushing and lever roll pin with a hammer and punch (Fig. 17).

NOTE: Use proper size punch to avoid bending the shift shaft.

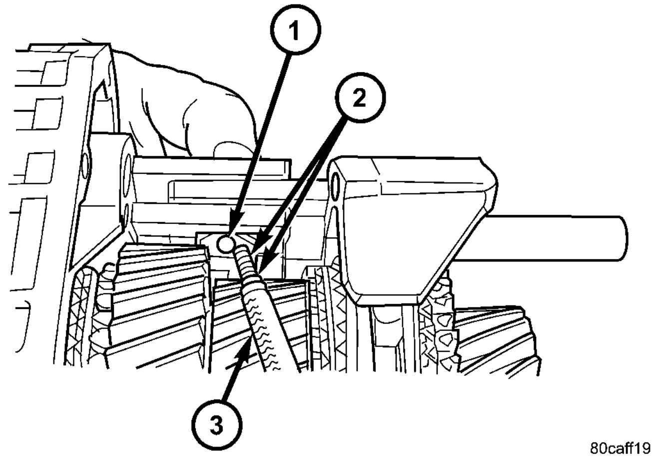


Fig. 15 DETENT SPRING AND BALL

1 - SHAFT LEVER
2 - SPRING AND BALL
3 - MAGNET

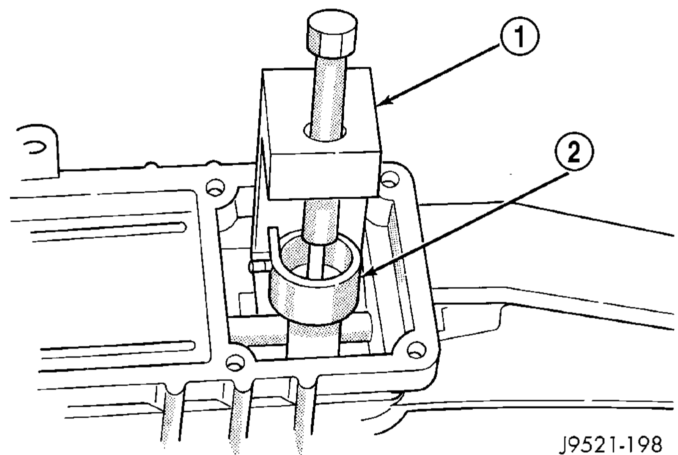


Fig. 16 SHIFT SOCKET

1 - REMOVER
2 - SHIFT SOCKET

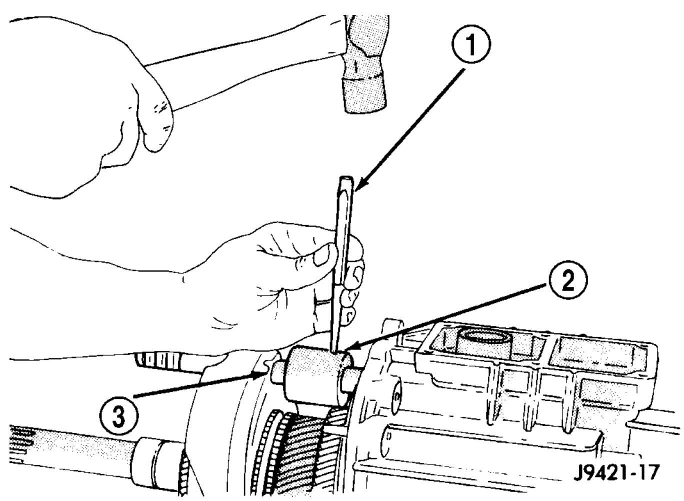


Fig. 17 SHIFT SHAFT LEVER & BUSHING ROLL PIN

1 - PIN PUNCH
2 - BUSHING AND LEVER
3 - SHIFT SHAFT

MANUAL TRANSMISSION - NV3500 (Continued)

(7) Pull shift shaft straight out of rear housing, shift socket, fifth-reverse fork and 1-2 fork (Fig. 18).

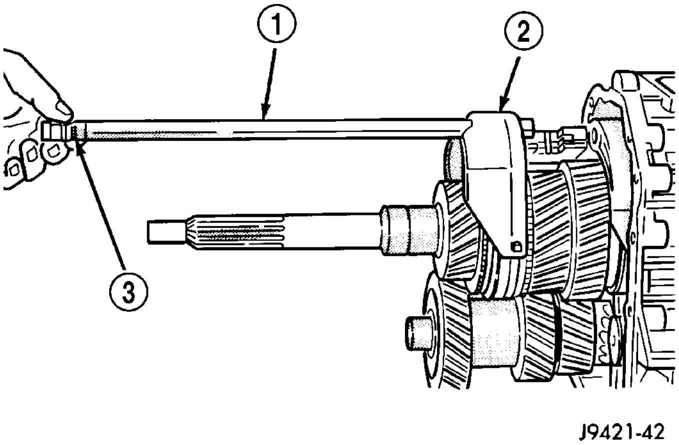


Fig. 18 SHIFT SHAFT

1 - SHIFT SHAFT
2 - 3-4 FORK
3 - SHAFT DETENT NOTCHES

(8) Remove shift socket from rear housing (Fig. 19).

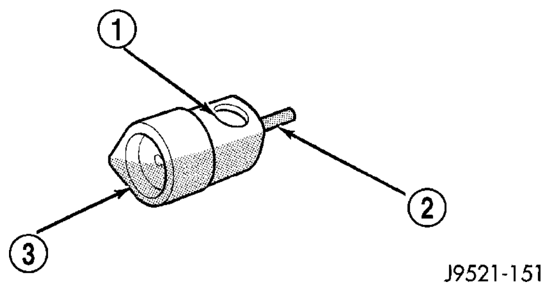


Fig. 19 SHIFT SOCKET & ROLL PIN

1 - SHAFT BORE
2 - ROLL PIN
3 - SHIFT SOCKET

(9) Remove shaft lever and bushing (Fig. 20).

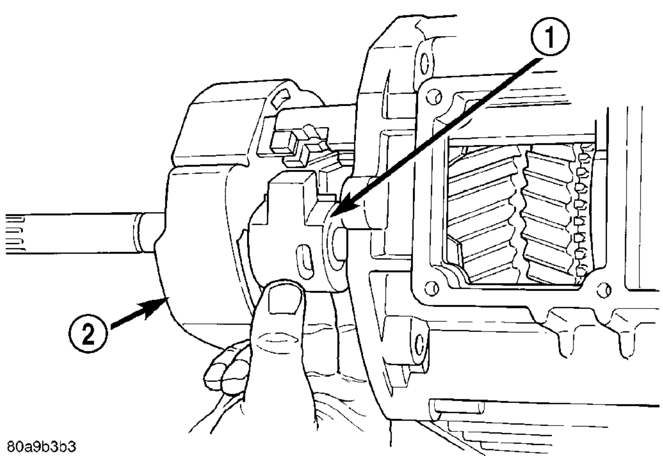


Fig. 20 SHIFT SHAFT LEVER & BUSHING

1 - SHAFT LEVER AND BUSHING
2 - 3-4 FORK

(10) Rotate 3-4 fork around synchro sleeve until fork clears shift arms on 1-2 and fifth-reverse forks, then remove 3-4 fork (Fig. 21).

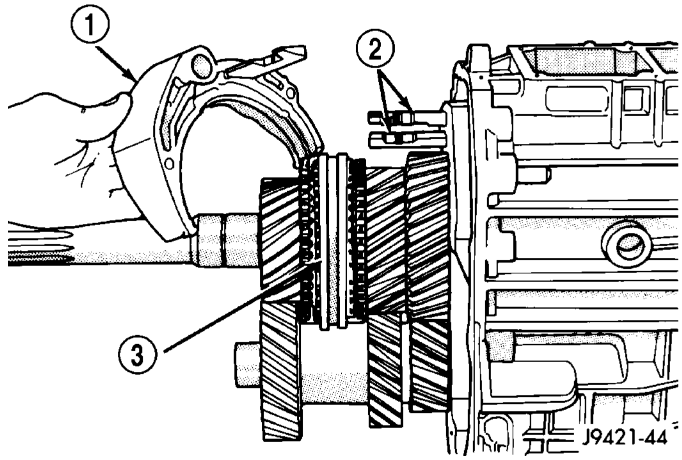


Fig. 21 3-4 SHIFT FORK

1 - 3-4 FORK
2 - 1-2 AND 5TH-REVERSE FORK ARMS
3 - 3-4 SYNCHRO SLEEVE

(11) Remove reverse idler shaft support bolt and loosen rear reverse idler shaft bolt (Fig. 22).

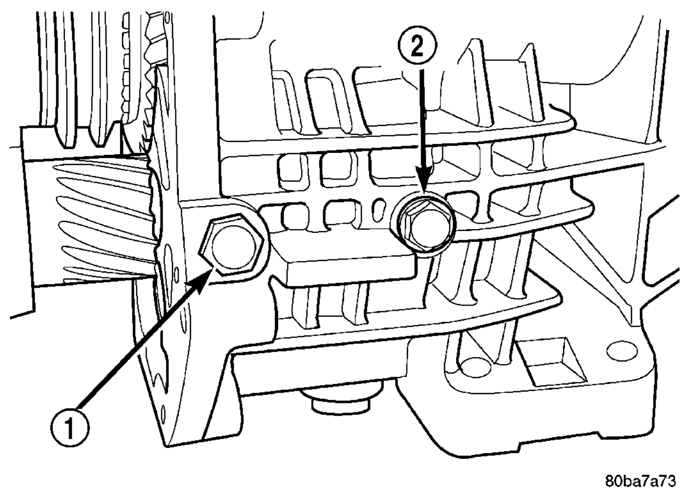


Fig. 22 REVERSE IDLER SHAFT & SUPPORT

1 - SUPPORT BOLT
2 - SHAFT BOLT

MANUAL TRANSMISSION - NV3500 (Continued)

(12) Remove reverse idler shaft support segment by sliding it straight out of housing.

(13) Support geartrain and rear housing on Fixture 6747 as follows:

(a) Adjust height of reverse idler pedestal rod until the reverse idle shaft bottoms in Cup 8115.

(b) Position Adapters 6747-1A and 6747-2A on Fixture 6747.

(c) Slide fixture tool onto input shaft, countershaft and idler gear (Fig. 23).

(d) Stand geartrain and rear housing upright on fixture (Fig. 24). Have helper hold fixture tool in place while housing and geartrain is being rotated into upright position.

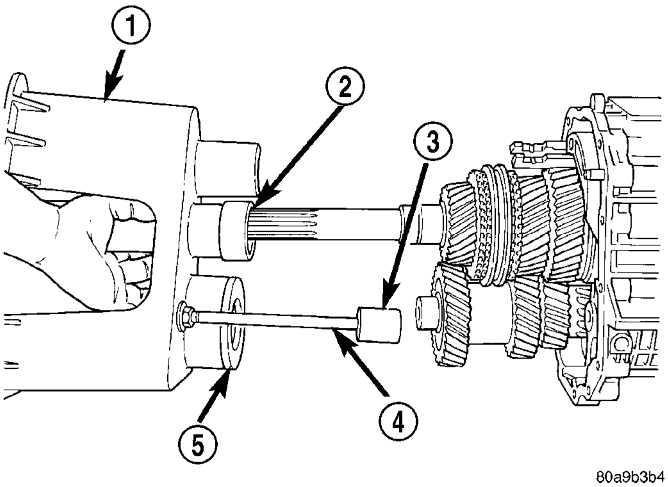


Fig. 23 FIXTURE ASSEMBLY

1 - FIXTURE 6747
2 - ADAPTER 6747-1A
3 - CUP ADAPTER 8115
4 - REVERSE IDLER PEDESTAL
5 - ADAPTER 6747-2A

(14) Remove rear bolt holding reverse idler shaft in housing.

REAR HOUSING - 2WD

(1) On 2-wheel drive transmission, remove three bolts that attach output shaft bearing retainer to rear case (Fig. 25). Bolts are rear of shift tower opening.

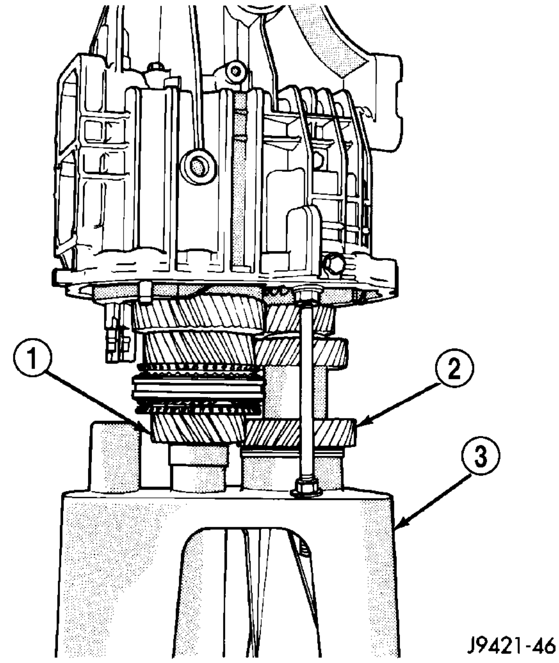


Fig. 24 GEARTRAIN & HOUSING ON FIXTURE

1 - INPUT SHAFT
2 - COUNTERSHAFT
3 - FIXTURE 6747

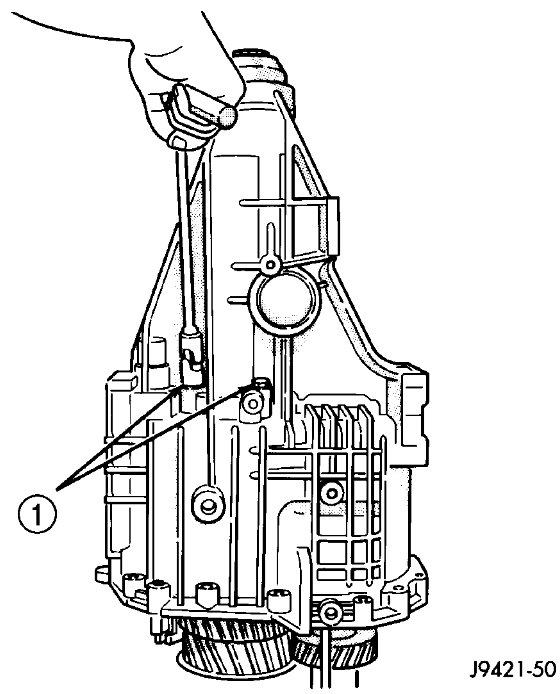


Fig. 25 OUTPUT SHAFT

1 - OUTPUT SHAFT BEARING RETAINER BOLTS (THIRD BOLT IS AT OPPOSITE SIDE OF CASE)

MANUAL TRANSMISSION - NV3500 (Continued)

(2) Tap rear housing upward and off output shaft bearing with a plastic/rawhide hammer (Fig. 26).

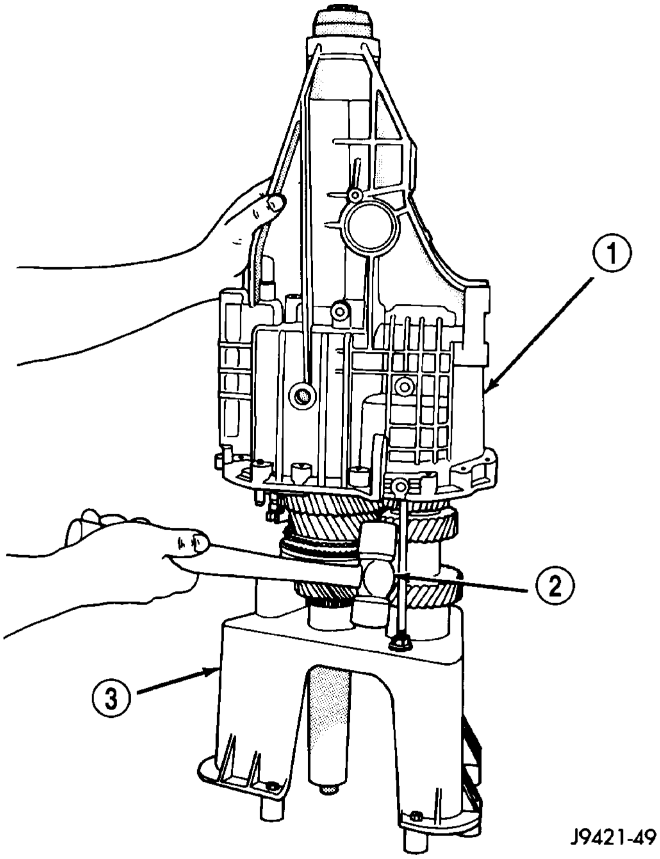


Fig. 26 SEPARATE REAR HOUSING & OUTPUT SHAFT BEARING

1 - REAR HOUSING
2 - MALLET
3 - FIXTURE

(3) Lift rear housing up and off geartrain (Fig. 27).

(4) Remove countershaft rear bearing from countershaft (Fig. 28).

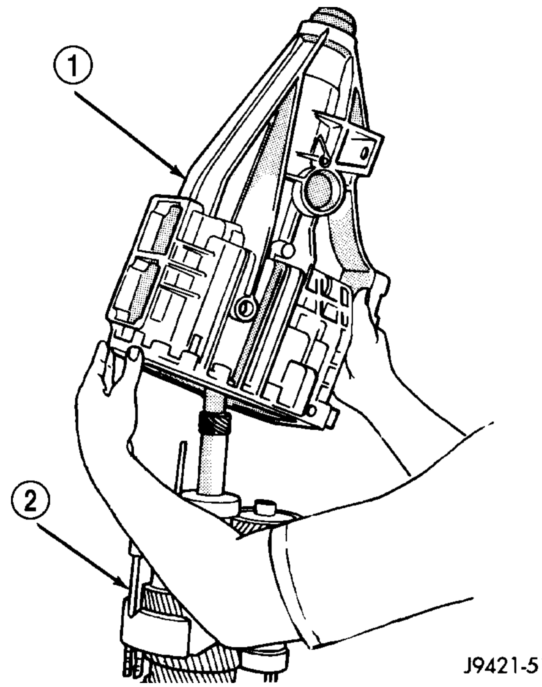


Fig. 27 REAR HOUSING - 2WD

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

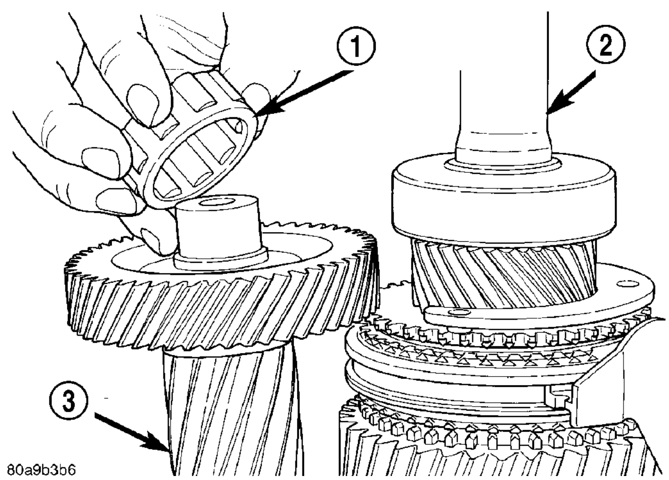


Fig. 28 COUNTERSHAFT REAR BEARING

1 - COUNTERSHAFT REAR BEARING
2 - OUTPUT SHAFT
3 - COUNTER SHAFT

MANUAL TRANSMISSION - NV3500 (Continued)

REAR ADAPTER HOUSING - 4WD

(1) Inserting screw from slide hammer (Fig. 29) into one of the dimples in face of rear seal (Fig. 30) and remove seal.

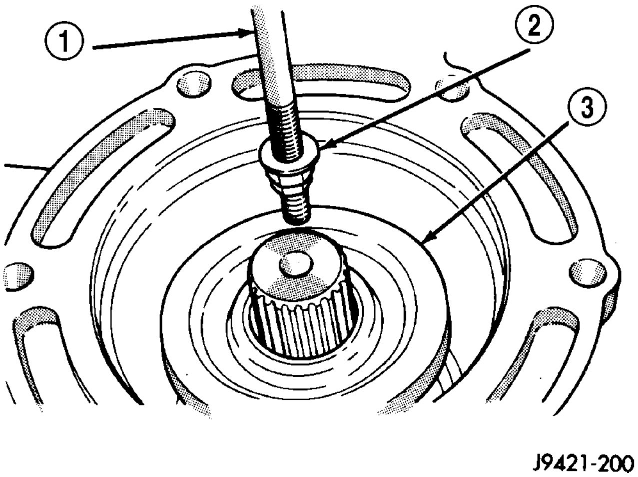


Fig. 29 REAR SEAL

1 - SLIDE HAMMER
2 - REMOVER TOOL
3 - REAR SEAL

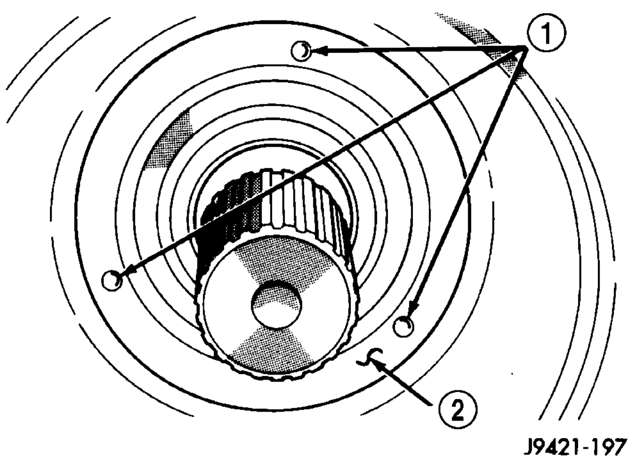


Fig. 30 REAR SEAL FACE

1 - DIMPLES
2 - SEAL FACE

(2) Remove rear bearing snap ring from output shaft (Fig. 31).

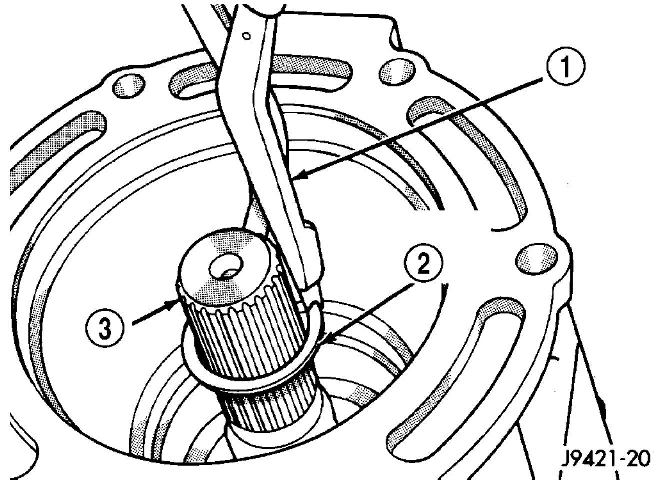


Fig. 31 REAR BEARING SNAP RING

1 - HEAVY DUTY SNAP RING PLIERS
2 - REAR BEARING SNAP RING
3 - OUTPUT SHAFT

(3) Lift rear adapter housing upward and off geartrain (Fig. 32).

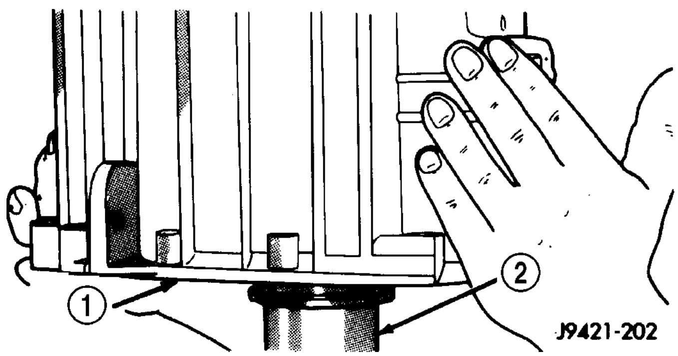


Fig. 32 REAR ADAPTER HOUSING

1 - REAR ADAPTER HOUSING
2 - OUTPUT SHAFT

MANUAL TRANSMISSION - NV3500 (Continued)

(4) Remove bearing retainer bolts and remove rear bearing retainer and rear bearing (Fig. 33). Push or tap bearing out of housing with a hammer handle if needed.

NOTE: Housing must be replaced if race, bearing bore or idler shaft notch are worn or damaged.

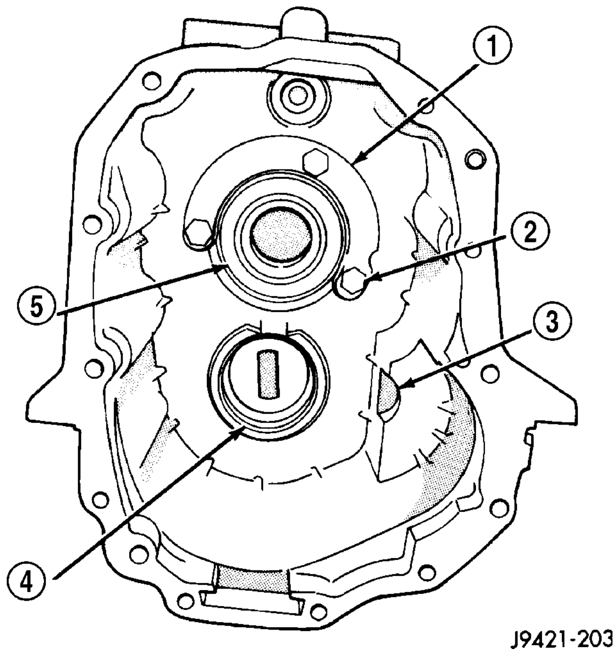


Fig. 33 REAR ADAPTER HOUSING COMPONENTS

1 - BEARING RETAINER
2 - RETAINER BOLTS (3)
3 - IDLER SHAFT NOTCH
4 - COUNTERSHAFT REAR BEARING RACE
5 - REAR BEARING

GEARTRAIN FROM FIXTURE

(1) Remove reverse idler gear assembly from assembly fixture cup.

(2) Remove 1-2 and fifth-reverse forks from synchro sleeves.

(3) Slide countershaft out of fixture tool.

(4) Remove output shaft bearing retainer from rear surface of fifth gear (retainer will drop onto gear after bolts are removed).

(5) Lift and remove output shaft and gears off input shaft.

(6) Lift and remove input shaft, pilot bearing and fourth gear synchro ring from the fixture.

OUTPUT SHAFT

NOTE: Synchronizer hubs and sleeves are different and must not be mixed. Remove each synchronizer unit as an assembly to avoid mixing parts. Mark each synchro hub and sleeve with a scriber or paint for correct assembly reference.

(1) Remove snap ring that secures 3-4 synchro hub on output shaft.

(2) Position Bearing Splitter 1130 between second and third gears and press off 3-4 synchro assembly, third gear synchro ring and third gear with a shop press.

(3) Remove third gear needle bearing (Fig. 34).

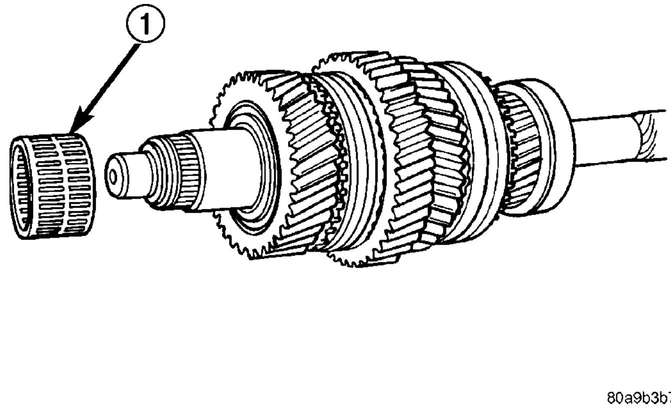


Fig. 34 THIRD GEAR NEEDLE BEARING

1 - THIRD GEAR NEEDLE BEARING

(4) Remove retaining ring that secures two-piece thrust washer on shaft with a small pry tool (Fig. 35).

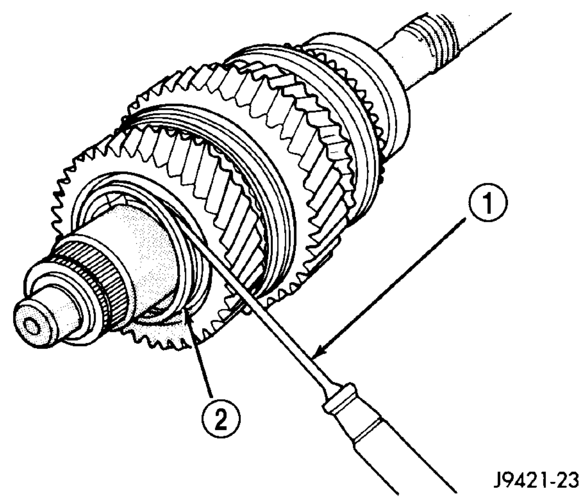


Fig. 35 THRUST WASHER

1 - PRY TOOL
2 - THRUST WASHER RETAINING RING

MANUAL TRANSMISSION - NV3500 (Continued)

(5) Remove two-piece thrust washer (Fig. 36) and note position of washer locating lugs in shaft notches for installation reference.

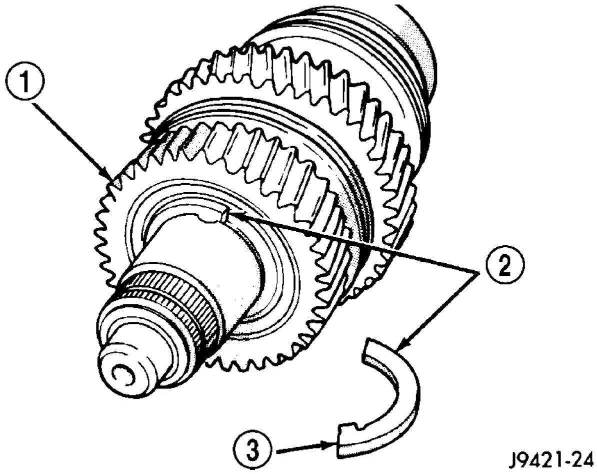


Fig. 36 TWO-PIECE THRUST WASHER

1 - SECOND GEAR
2 - THRUST WASHER (2-PIECE)
3 - WASHER LOCATING LUG

(6) Remove second gear and needle bearing (Fig. 37).

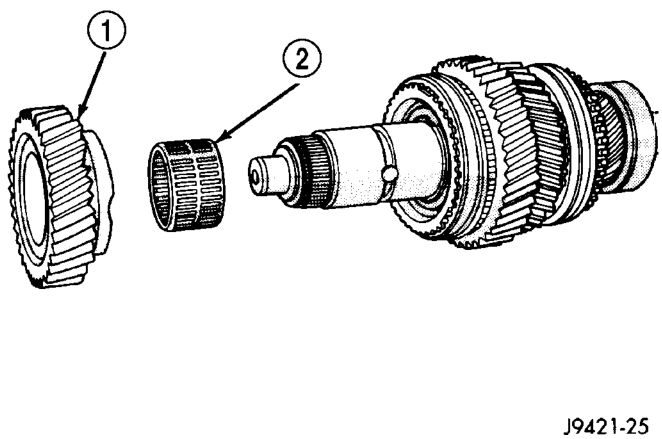


Fig. 37 SECOND GEAR

1 - SECOND GEAR
2 - SECOND GEAR NEEDLE BEARING

(7) Remove second gear synchro ring, synchro friction cone, synchro cone and interm ring (Fig. 38).

(8) Remove 1-2 synchro hub snap ring.

(9) Position Bearing Splitter 1130 between first and reverse gear. Press off 1-2 synchro hub, sleeve and first gear from output shaft with shop press (Fig. 39).

(10) Remove first gear needle bearing (Fig. 40).

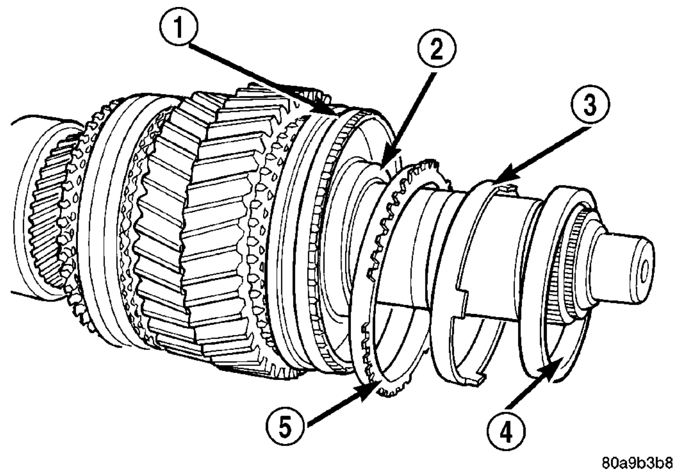


Fig. 38 SECOND GEAR SYNCHRO RING & CONES

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - INTERM RING
3 - SYNCHRO FRICTION CONE
4 - SYNCHRO CONE
5 - SYNCHRO RING

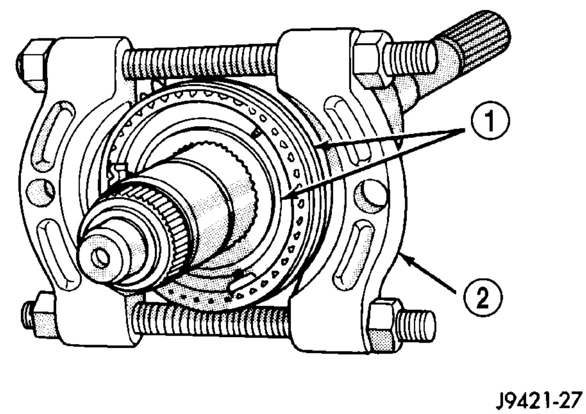


Fig. 39 HUB SLEEVE & 1-2 SYNCHRO

1 - 1-2 SYNCHRO HUB AND SLEEVE
2 - BEARING SPLITTER 1130

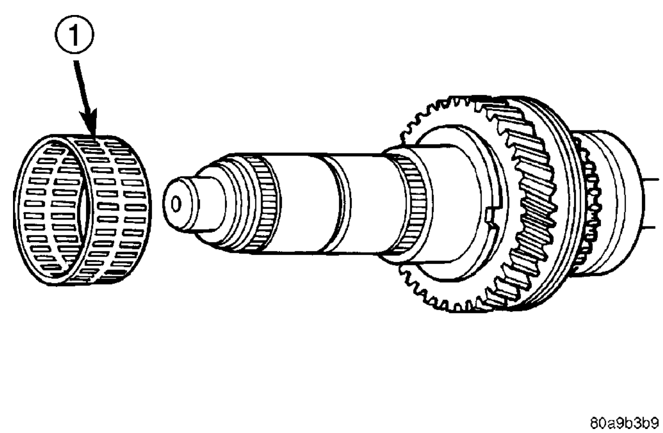


Fig. 40 FIRST GEAR NEEDLE BEARING

1 - FIRST GEAR NEEDLE BEARING

MANUAL TRANSMISSION - NV3500 (Continued)

(11) Remove output shaft bearing snap ring (Fig. 41).

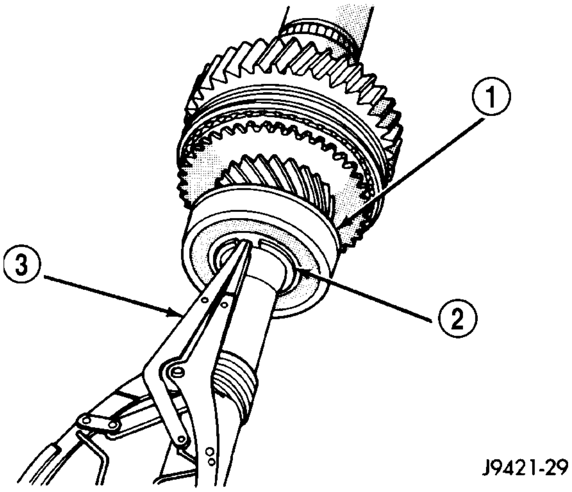


Fig. 41 OUTPUT SHAFT BEARING SNAP RING

1 - OUTPUT SHAFT BEARING
2 - BEARING SNAP RING
3 - SNAP RING PLIERS

(12) On 2-wheel drive models, remove output shaft bearing.

(13) Remove fifth gear (Fig. 42).

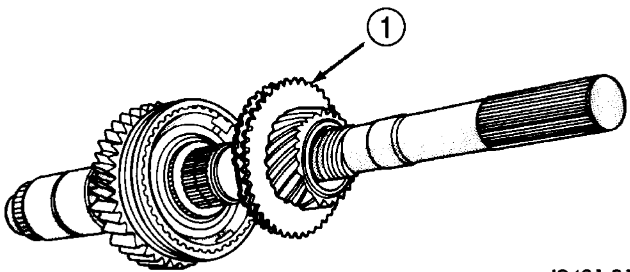


Fig. 42 FIFTH GEAR

1 - FIFTH GEAR AND SYNCHRO RING

(14) Remove fifth gear needle bearing. Spread bearing just enough to clear shoulder on output shaft (Fig. 43).

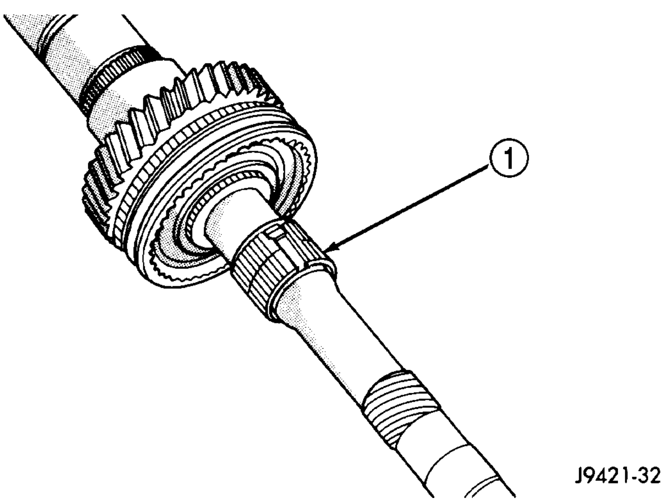


Fig. 43 FIFTH GEAR NEEDLE BEARING

1 - FIFTH GEAR NEEDLE BEARING

(15) Remove fifth-reverse synchro hub snap ring (Fig. 44).

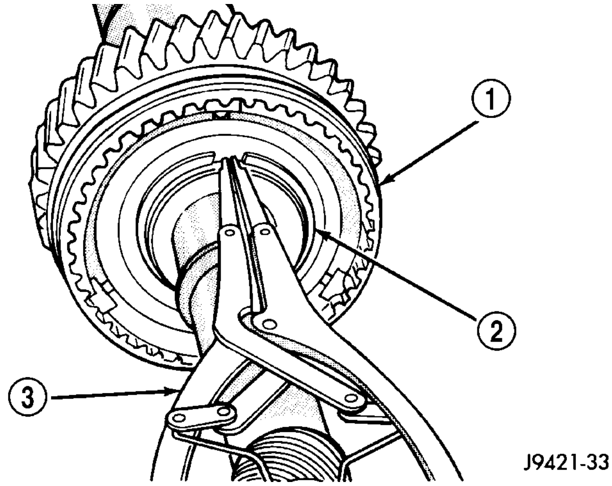


Fig. 44 FIFTH-REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
2 - SYNCHRO HUB SNAP RING
3 - SNAP RING PLIERS

(16) Remove fifth-reverse synchro hub and sleeve with shop press (Fig. 45).

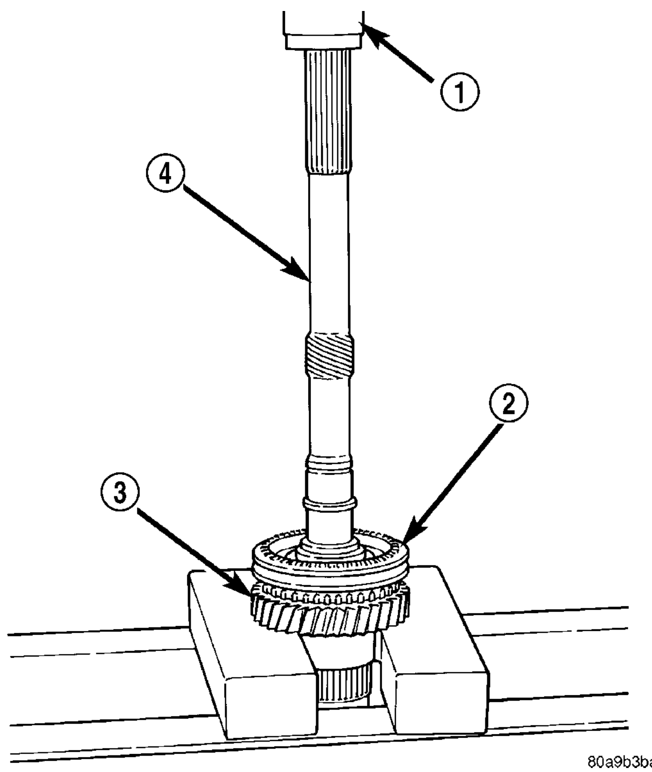


Fig. 45 FIFTH-REVERSE SYNCHRO

1 - PRESS
2 - FIFTH-REVERSE SYNCHRO HUB AND SLEEVE
3 - REVERSE GEAR
4 - OUTPUT SHAFT

MANUAL TRANSMISSION - NV3500 (Continued)

(17) Remove reverse gear and needle bearing (Fig. 46).

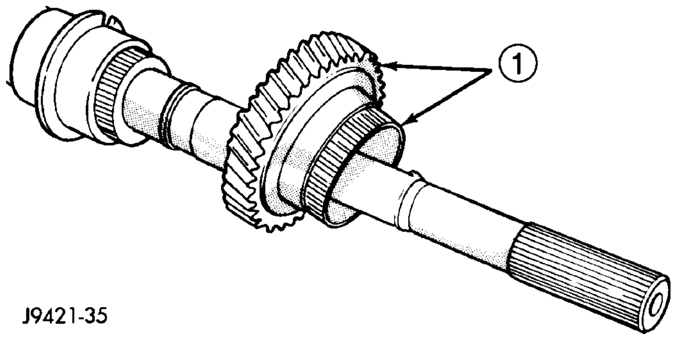


Fig. 46 REVERSE GEAR & NEEDLE BEARING

1 - REVERSE GEAR AND NEEDLE BEARING

REVERSE IDLER

(1) Remove idler gear snap rings (Fig. 47).

(2) Remove thrust washer, wave washer, thrust plate and idler gear from shaft.

(3) Remove idler gear needle bearing from shaft.

CLEANING

Clean the gears, shafts, shift components and transmission housings with a standard parts cleaning solvent. Do not use acid or corrosive base solvents. Dry all parts except bearings with compressed air.

Clean the shaft bearings with a mild solvent such as Mopar degreasing solvent, Gunk or similar solvents. Do not dry the bearings with compressed air. Allow the bearings to either air dry or wipe them dry with clean shop towels.

INSPECTION

SHIFT LEVER ASSEMBLY

The shift lever assembly is not serviceable. Replace the lever and shift tower as an assembly if the tower, lever, lever ball or internal components are worn or damaged.

SHIFT SHAFT AND FORKS

Inspect the shift fork interlock arms and synchro sleeve contact surfaces (Fig. 48). Replace any fork exhibiting wear or damage in these areas. Do not attempt to salvage shift forks.

Check condition of the shift shaft detent plunger and spring. The plunger should be smooth and free of nicks or scores. The plunger spring should be straight and not collapsed, or distorted. Minor scratches or nicks on the plunger can be smoothed with 320/400 grit emery soaked in oil. Replace the plunger and spring if in doubt about condition. Check condition of detent plunger bushings. Replace if damaged.

Inspect shift shaft, shift shaft bushing, bearing, shaft lever and lever bushing that fits over the lever. Replace shaft if bent, cracked or severely scored. Minor burrs, nicks or scratches can be smoothed off with 320/400 grit emery cloth followed by polishing with crocus cloth. Replace the shift shaft bushing or bearing if damaged.

Replace the shaft lever and bushing if either part is deformed, or worn. Do not attempt to salvage these parts as shift fork binding will occur. Replace the roll pin that secures the lever to the shaft.

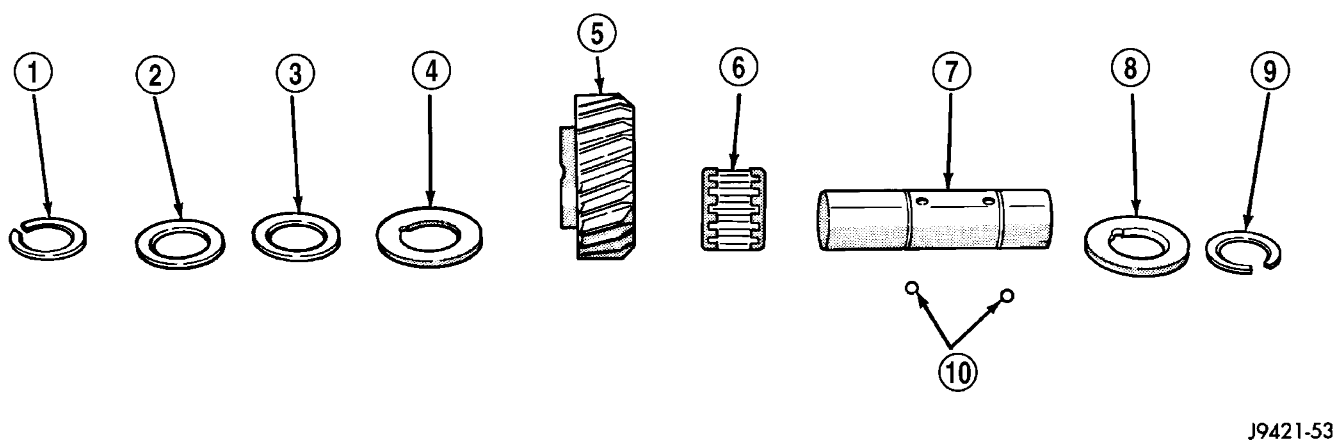


Fig. 47 Reverse Idler Components

1 - SNAP RING
2 - FLAT WASHER
3 - WAVE WASHER
4 - THRUST WASHER
5 - REVERSE IDLER GEAR
6 - IDLER GEAR BEARING
7 - IDLER SHAFT
8 - THRUST WASHER
9 - SNAP RING
10 - THRUST WASHER LOCKBALLS

MANUAL TRANSMISSION - NV3500 (Continued)

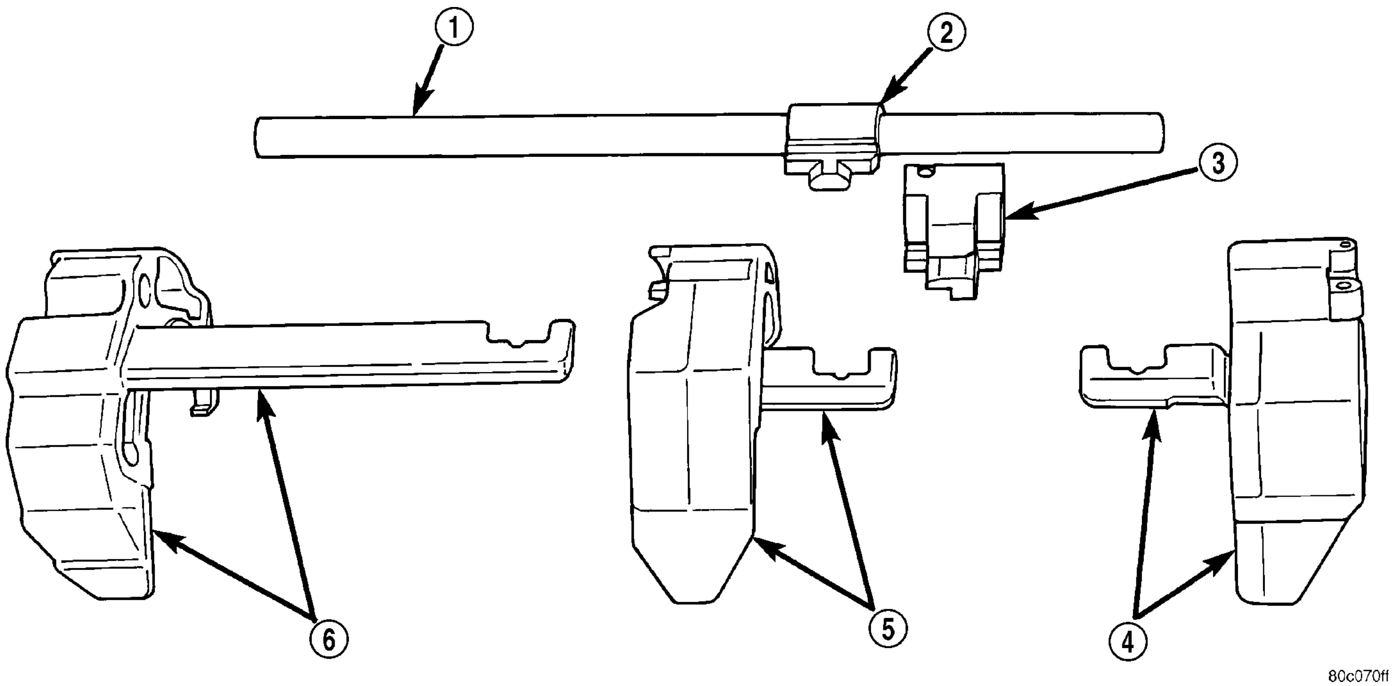


Fig. 48 Shift Forks And Shaft

1 - SHIFT SHAFT
2 - SHAFT LEVER
3 - SHAFT LEVER BUSHING
4 - 3-4 SHIFT FORK
5 - 1-2 SHIFT FORK
6 - FIFTH-REVERSE SHIFT FORK

FRONT/REAR HOUSINGS AND BEARING RETAINERS

Inspect the housings carefully. Look for cracks, stripped threads, scored mating surfaces, damaged bearing bores or worn dowel pin holes. Minor nicks on mating surfaces can be dressed off with a fine file or emery cloth. Damaged threads can be renewed by either re-tapping or installing Helicoil inserts.

NOTE: The front housing contains the countershaft front bearing race. The rear housing contains the countershaft rear bearing race. These components are NOT serviceable items. The front housing will have to be replaced if the countershaft bearing race is loose, worn or damaged. The rear housing will have to be replaced if the countershaft rear bearing race is loose, worn or damaged.

Inspect the input shaft bearing retainer. Be sure the release bearing slide surface of the retainer is in good condition. Minor nicks on the surface can be smoothed off with 320/420 grit emery cloth and final polished with oil coated crocus cloth. Replace the retainer seal if necessary.

Inspect output shaft bearing retainer, the U-shaped retainer must be flat and free of distortion. Replace the retainer if the threads are damaged or if the retainer is bent or cracked.

COUNTERSHAFT BEARINGS AND RACES

The countershaft bearings and races are machine lapped during manufacture to form matched sets. The bearings and races should not be interchanged.

NOTE: The bearing races are a permanent press fit in the housings and are NOT serviceable. If a bearing race becomes damaged, the front or rear housing must be replaced. A new countershaft bearing will be supplied with each new housing for service use.

REVERSE IDLER COMPONENTS

Inspect the idler gear, bearing, shaft, thrust washer, wave washer and thrust plate. Replace the bearing if any of the needle bearing rollers are worn, chipped, cracked, flat-spotted or brinnelled. Also replace the bearing if the plastic bearing cage is damaged or distorted.

Replace thrust washer, wave washer or thrust plate if cracked, chipped or worn. Replace idler gear if the teeth are chipped, cracked or worn thin. Replace shaft if worn, scored or the bolt threads are damaged beyond repair. Replace support segment if cracked or chipped and replace the idler attaching bolts if the threads are damaged.

MANUAL TRANSMISSION - NV3500 (Continued)

Shift Socket

Inspect the shift socket for wear or damage. Replace the socket if the roll pin or shift shaft bores are damaged. Minor nicks in the shift lever ball seat in the socket can be smoothed down with 400 grit emery or wet/dry paper. Replace the socket if the ball seat is worn or cracked. Do not reuse the original shift socket roll pin. Install a **new** pin during assembly. The socket roll pin is approximately 33 mm (1-1/4 in.) long.

Output Shaft And Geartrain

Inspect all gears for worn, cracked, chipped or broken teeth. Also check condition of the bearing bore in each gear. The bores should be smooth and free of surface damage. Discoloration of the gear bores is a normal occurrence and is not a reason for replacement. Replace gears only when tooth damage has occurred or if the bores are brinnelled or severely scored.

Inspect the shaft splines and bearings surfaces. Minor nicks on the bearing surfaces can be smoothed with 320/420 grit emery and final polished with crocus cloth. Replace the shaft if the splines are damaged or bearing surfaces are deeply scored, worn or brinnelled.

ASSEMBLY

NOTE: Sealers are used at all case joints. Use Mopar Gasket Maker or equivalent for all case joints and Mopar silicone sealer or equivalent for the input shaft bearing retainer.

SYNCHRONIZER

(1) Slide sleeve onto the hub, leaving enough room to install the spring in the hub and strut in the hub groove.

(2) Install first spring in the hub, then install a strut over the spring. Verify spring is seated in the spring bore in the strut.

(3) Slide sleeve onto the hub far enough to hold the first strut and spring in place.

(4) Place detent ball in the top of the strut, then press the ball into place with a small screwdriver. Work the sleeve over the ball to hold it in place.

(5) Repeat procedure for the remaining springs, struts and balls. Use tape or rubber bands to temporarily secure each strut and ball as they are installed.

(6) Verify the synchro three springs, struts and detent balls are all in place (Fig. 49).

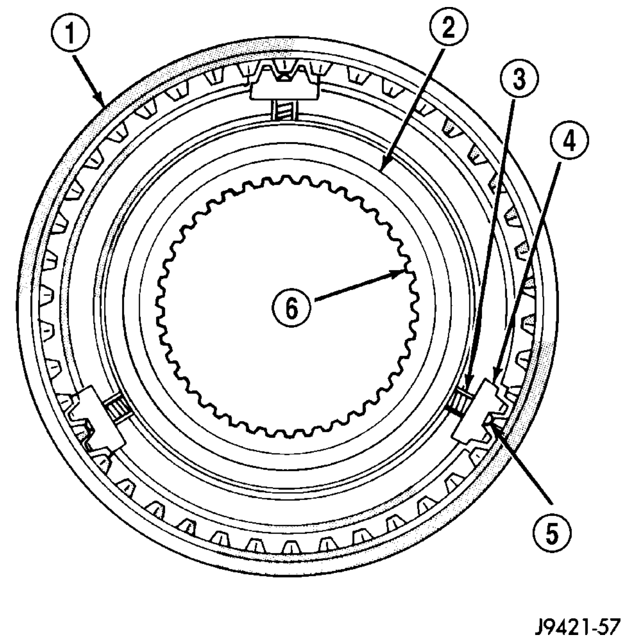


Fig. 49 SYNCHRONIZER COMPONENTS

1 - SLEEVE
2 - HUB SHOULDER
3 - SPRING (3)
4 - STRUT (3)
5 - DETENT BALL (3)
6 - HUB

OUTPUT SHAFT

NOTE: Lubricate shaft, gears, bearings and immerse each synchro ring with recommended lubricant during assembly. Petroleum jelly can be used to hold parts in place.

(1) Install reverse gear needle bearing up against shoulder on output shaft (Fig. 50).

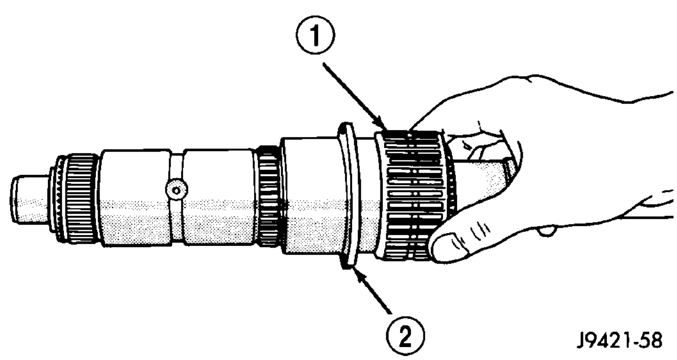


Fig. 50 REVERSE GEAR BEARING

1 - REVERSE GEAR BEARING
2 - SHOULDER

MANUAL TRANSMISSION - NV3500 (Continued)

(2) Install reverse gear over needle bearing (Fig. 51).

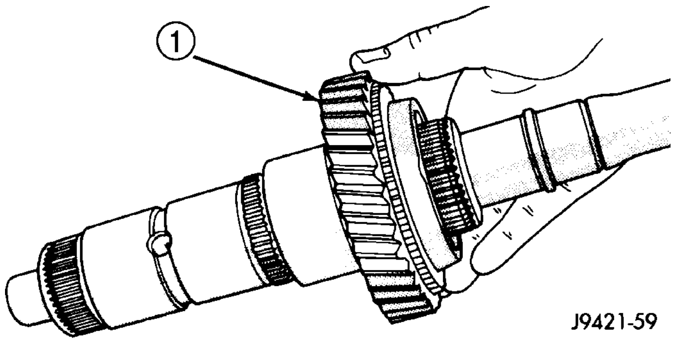


Fig. 51 REVERSE GEAR

1 - REVERSE GEAR

(3) Install brass synchro ring on reverse gear (Fig. 52).

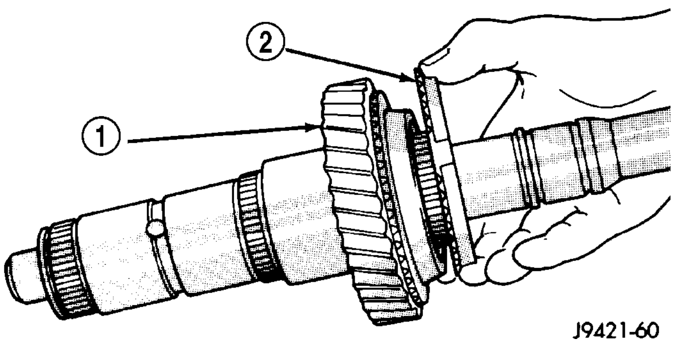


Fig. 52 REVERSE GEAR SYNCHRO

1 - REVERSE GEAR
2 - SYNCHRO RING

(4) Start fifth-reverse synchro assembly on output shaft splines by hand. Then seat synchro onto shaft with shop press and Remover 6310-1 (Fig. 53).

CAUTION: One side of the hub has shoulders around the hub bore, this side faces the front of the shaft. One side of the sleeve is tapered the tapered side faces the front of the shaft.

(5) Install **new** fifth-reverse hub snap ring (Fig. 54). Verify snap ring is seated in the groove.

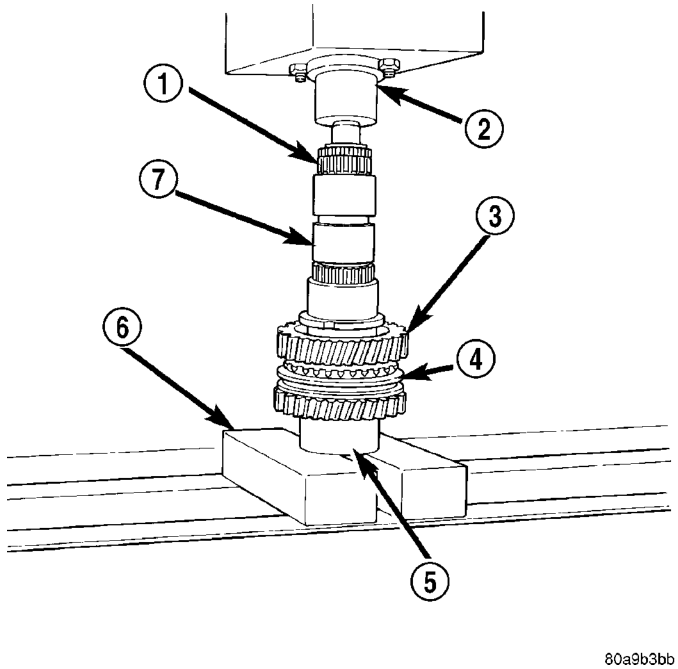


Fig. 53 FIFTH/REVERSE SYNCHRO ASSEMBLY

1 - SPACER
2 - PRESS RAM
3 - REVERSE GEAR
4 - FIFTH-REVERSE SYNCHRO ASSEMBLY
5 - REMOVER 6310-1
6 - PRESS BLOCKS
7 - OUTPUT SHAFT

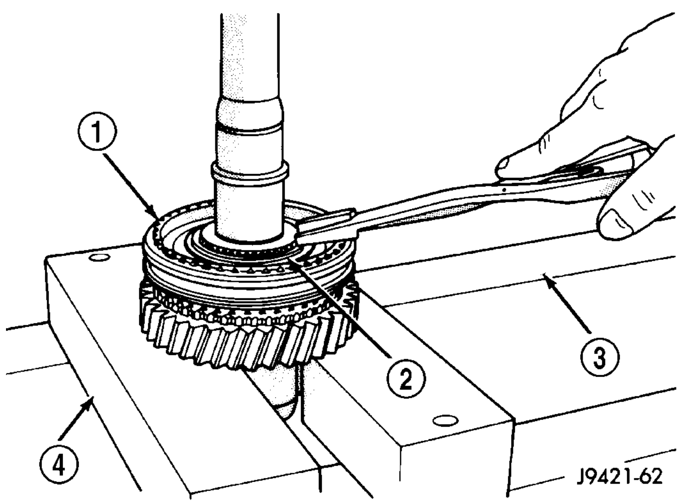


Fig. 54 FIFTH/REVERSE SYNCHRO HUB SNAP RING

1 - FIFTH-REVERSE SYNCHRO ASSEMBLY
2 - SNAP RING
3 - PRESS BED
4 - PRESS BLOCKS

MANUAL TRANSMISSION - NV3500 (Continued)

(6) Install fifth gear synchro ring in synchro hub and sleeve (Fig. 55).

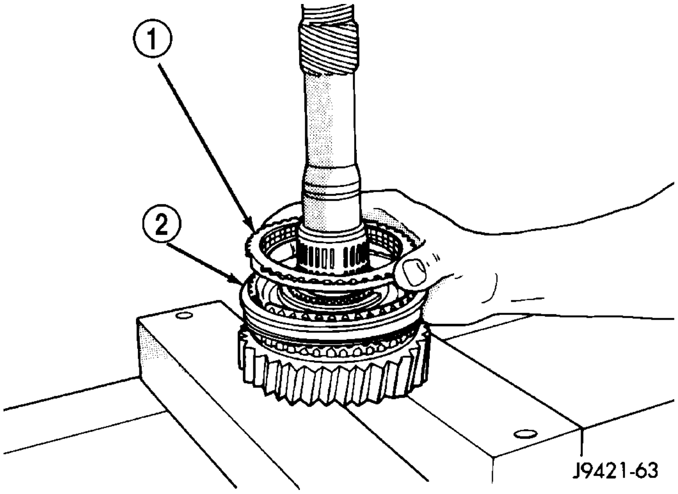


Fig. 55 FIFTH GEAR SYNCHRO RING

1 - FIFTH-SPEED SYNCHRO RING
2 - FIFTH-REVERSE SYNCHRO ASSEMBLY

(7) Install fifth gear bearing. Spread bearing only enough to clear shoulder on output shaft (Fig. 56). Verify bearing is properly seated.

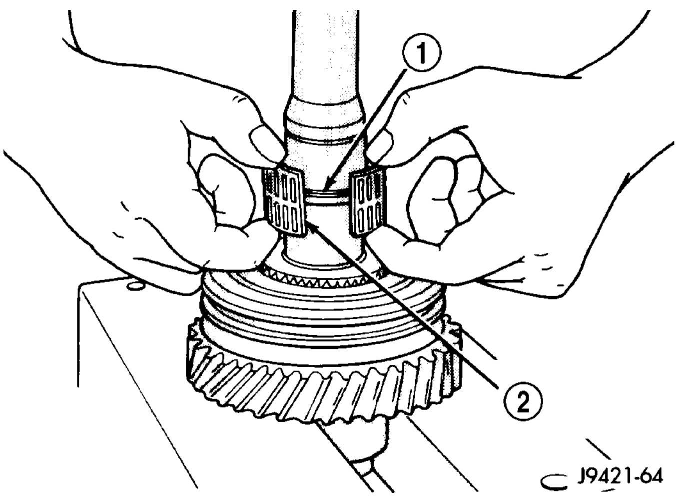


Fig. 56 FIFTH GEAR BEARING

1 - SHAFT SHOULDER
2 - FIFTH GEAR BEARING

(8) Install fifth gear on shaft and onto bearing (Fig. 57).

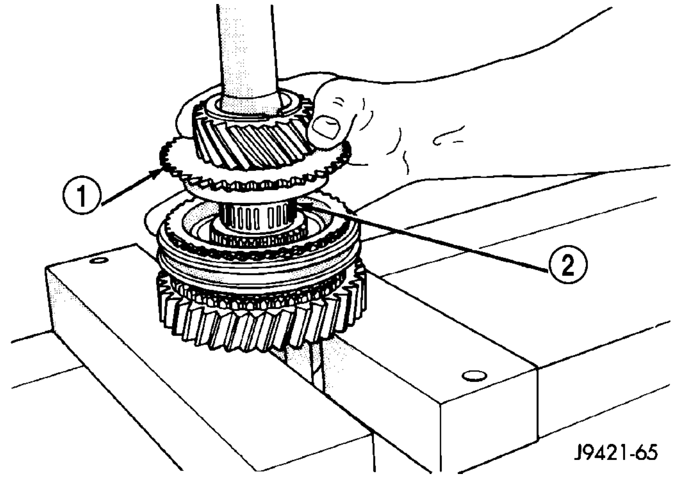


Fig. 57 FIFTH GEAR

1 - FIFTH GEAR
2 - BEARING

(9) Invert output shaft and set the shaft in Collar 6310-1 so fifth gear is seated on the tool (Fig. 58).

(10) Install first gear bearing on output shaft (Fig. 58). Verify bearing is seated on shaft shoulder and is properly joined.

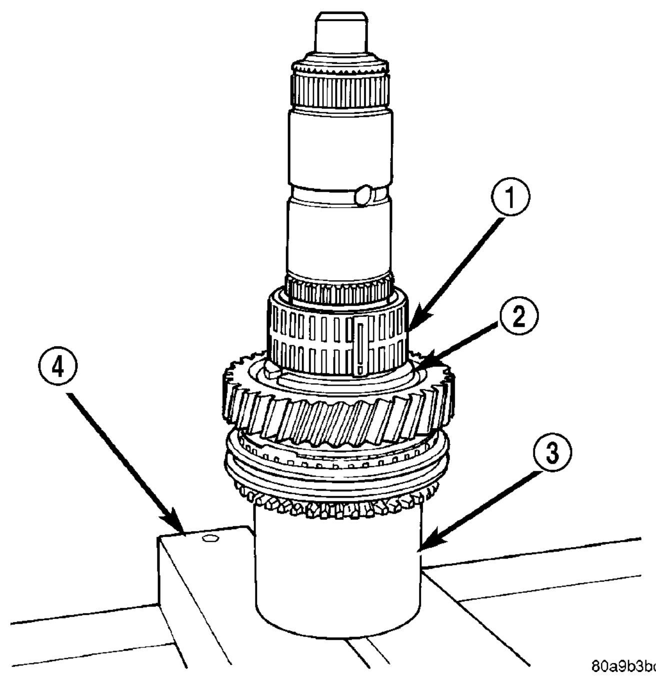


Fig. 58 FIRST GEAR

1 - FIRST GEAR BEARING
2 - SHAFT SHOULDER
3 - COLLAR
4 - PRESS BLOCKS

MANUAL TRANSMISSION - NV3500 (Continued)

(11) Install first gear on shaft and over bearing (Fig. 59) with bearing synchro cone facing up.

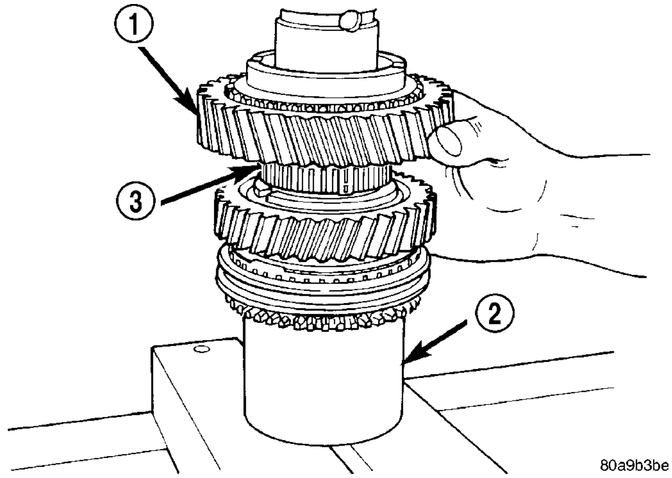


Fig. 59 FIRST GEAR

1 - FIRST GEAR
2 - COLLAR
3 - BEARING

(12) Install first gear synchro ring (Fig. 60).

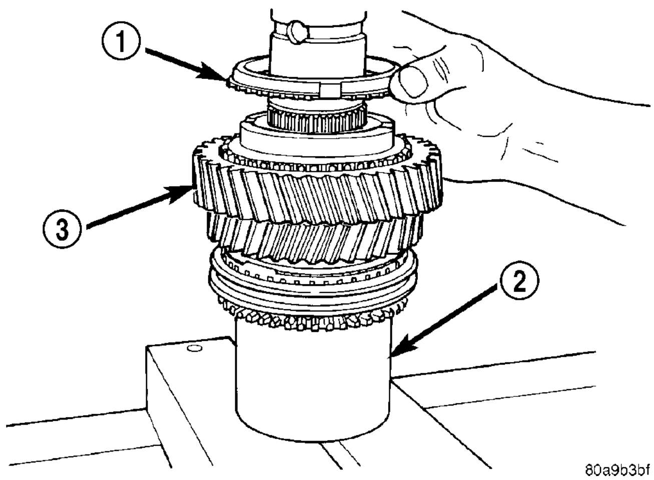


Fig. 60 FIRST GEAR SYNCHRO RING

1 - FIRST GEAR SYNCHRO RING
2 - COLLAR
3 - FIRST GEAR

(13) Start 1-2 synchro assembly on shaft by hand (Fig. 61).

CAUTION: One side of the synchro sleeve is marked First Gear Side, this side must face first gear.

(14) Press 1-2 synchro onto output shaft using suitable size pipe and shop press (Fig. 62).

CAUTION: Keep synchro ring and sleeve aligned as the hub is being pressed onto the shaft. The synchro ring can be cracked if it becomes misaligned.

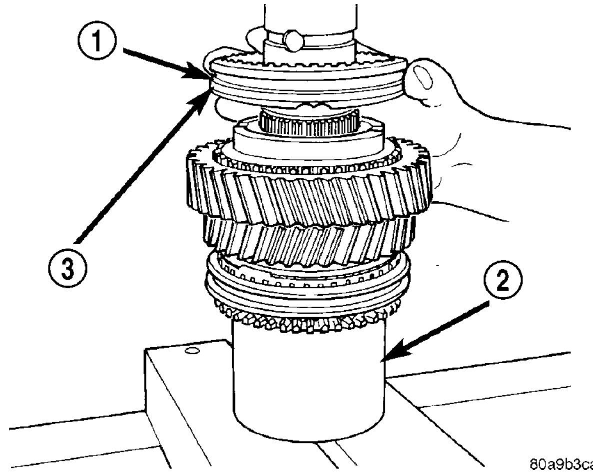


Fig. 61 STARTING 1-2 SYNCHRO

1 - 1-2 SYNCHRO ASSEMBLY
2 - COLLAR
3 - FIRST GEAR SIDE

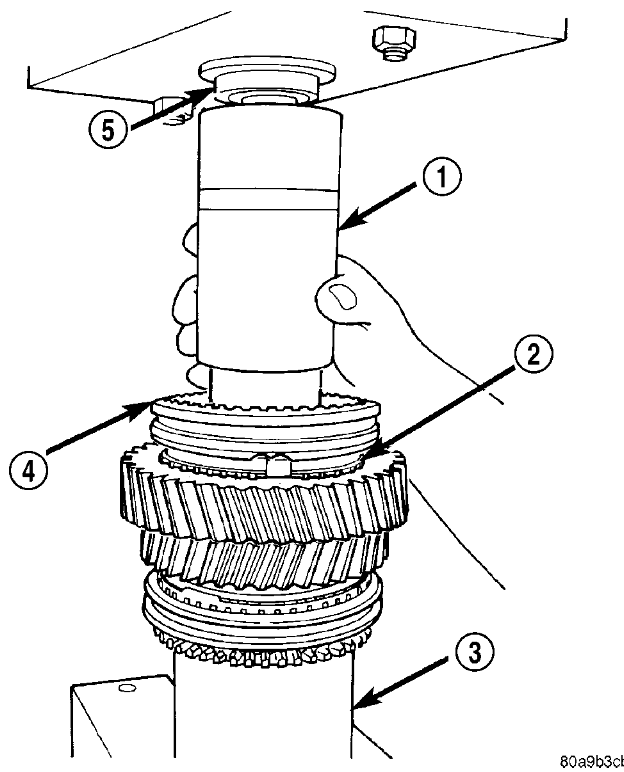


Fig. 62 1-2 SYNCHRO ON OUTPUT SHAFT

1 - PIPE TOOL
2 - SYNCHRO RING
3 - COLLAR
4 - 1-2 SYNCHRO ASSEMBLY
5 - PRESS RAM

MANUAL TRANSMISSION - NV3500 (Continued)

(15) Install interm ring.

(16) Install **new** 1-2 synchro hub snap ring (Fig. 63). Verify snap ring is seated in shaft groove.

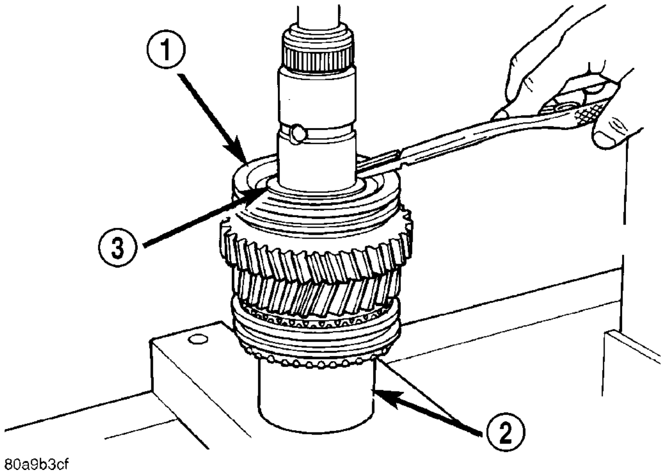


Fig. 63 1-2 SYNCHRO HUB SNAP RING

1 - 1-2 SYNCHRO
2 - COLLAR
3 - SYNCHRO SNAP RING

(17) Install second gear synchro ring in 1-2 synchro hub and sleeve (Fig. 64). Verify synchro ring is seated in sleeve.

(18) Install synchro friction cone and synchro cone in synchro ring.

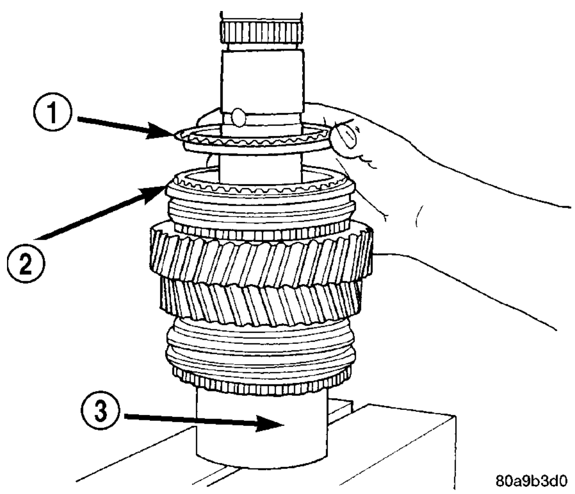


Fig. 64 SECOND GEAR SYNCHRO RING

1 - SECOND GEAR SYNCHRO RING
2 - 1-2 SYNCHRO
3 - COLLAR

(19) Install second gear needle bearing on shaft (Fig. 65).

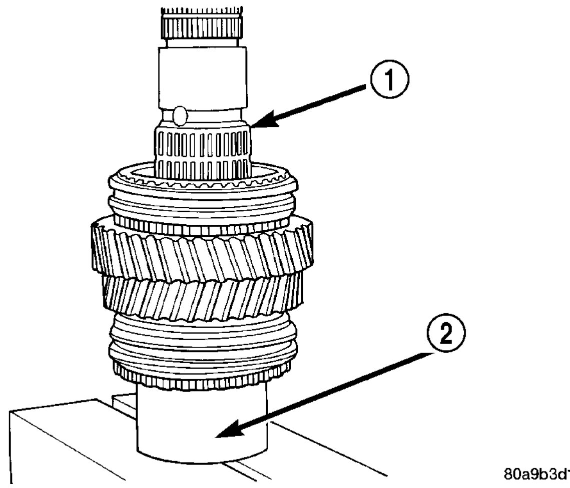


Fig. 65 SECOND GEAR BEARING

1 - SECOND GEAR BEARING
2 - COLLAR

(20) Install second gear onto shaft and bearing (Fig. 66). Verify second gear is seated on synchro components.

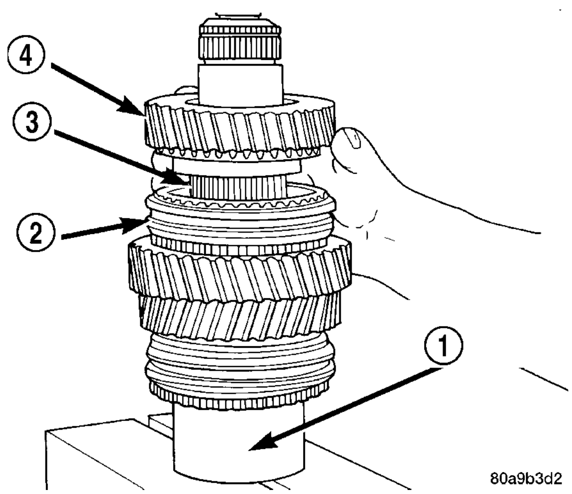


Fig. 66 SECOND GEAR

1 - COLLAR
2 - 1-2 SYNCHRO ASSEMBLY
3 - BEARING
4 - SECOND GEAR

MANUAL TRANSMISSION - NV3500 (Continued)

(21) Install two-piece thrust washer with halves seated in the shaft groove and washer lugs seated in shaft lug bores (Fig. 67). Verify i.d. grooves and markings noted during removal are facing the correct direction.

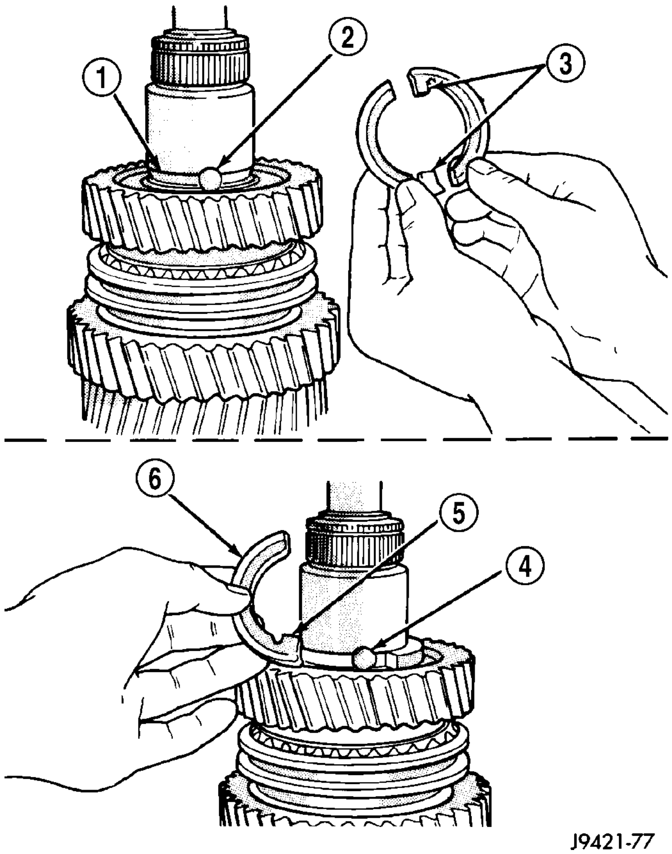


Fig. 67 TWO-PIECE THRUST WASHER

1 - WASHER GROOVE IN SHAFT
2 - LUG BORE
3 - THRUST WASHER LUGS
4 - LUG BORE
5 - LUG
6 - WASHER HALF

(22) Start retaining ring around two-piece thrust washer (Fig. 68). Verify locating dimple is between thrust washer halves.

(23) Seat thrust washer retaining ring with plastic mallet (Fig. 69).

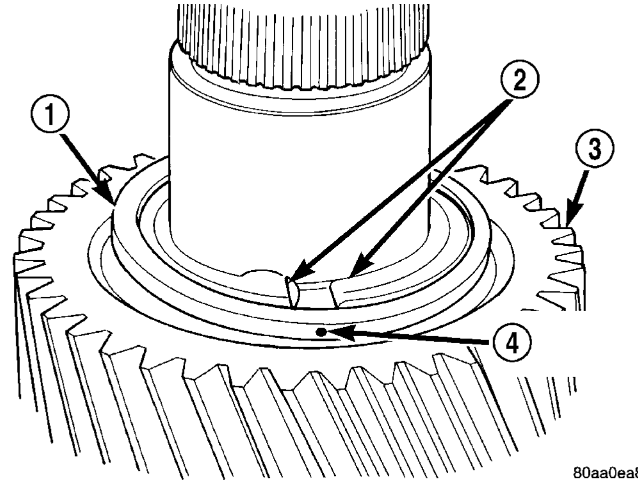


Fig. 68 RETAINING RING

1 - THRUST WASHER RETAINING RING
2 - THRUST WASHER HALVES
3 - SECOND GEAR
4 - LOCATING DIMPLE

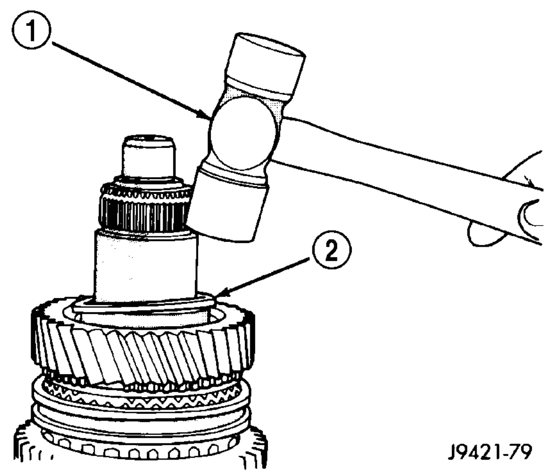


Fig. 69 THRUST RETAINER

1 - PLASTIC MALLET
2 - THRUST WASHER RETAINING RING

MANUAL TRANSMISSION - NV3500 (Continued)

(24) Install third gear needle bearing on shaft (Fig. 70).

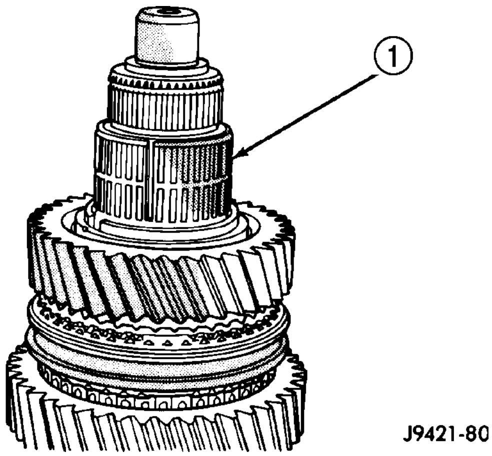


Fig. 70 THIRD GEAR BEARING

1 - THIRD GEAR BEARING

(25) Install third gear on shaft and bearing (Fig. 71).

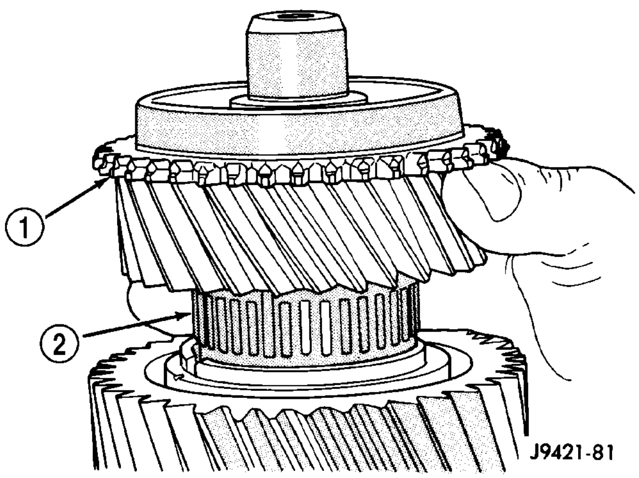


Fig. 71 THIRD GEAR

1 - THIRD GEAR
2 - BEARING

(26) Install third speed synchro ring on third gear (Fig. 72).

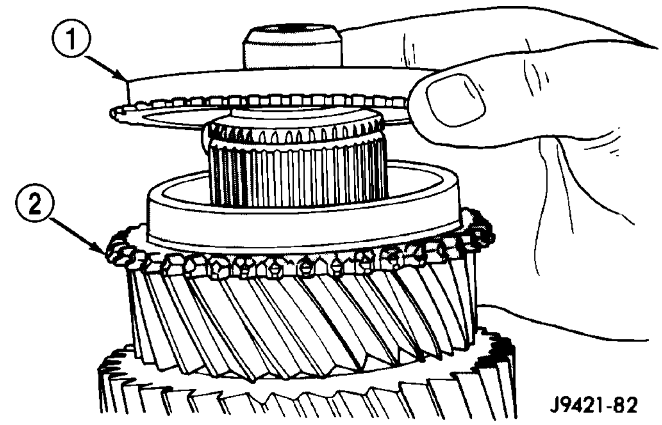


Fig. 72 THIRD GEAR SYNCHRO RING

1 - THIRD SPEED SYNCHRO RING
2 - THIRD GEAR

(27) Start 3-4 synchro hub on output shaft splines by hand (Fig. 73).

CAUTION: The 3-4 synchro hub and sleeve can be installed backwards if care is not exercised. One side of the sleeve has grooves in it, this side must faces the front of the shaft.

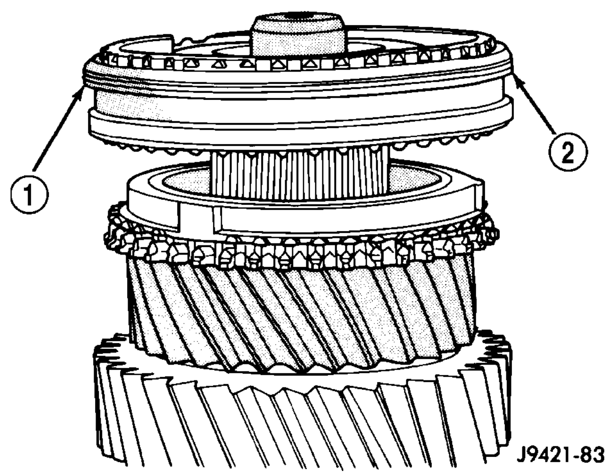


Fig. 73 3-4 SYNCHRO HUB ON OUTPUT SHAFT

1 - GROOVED SIDE OF SLEEVE
2 - 3-4 SYNCHRO ASSEMBLY

MANUAL TRANSMISSION - NV3500 (Continued)

(28) Press 3-4 synchro assembly onto output shaft with shop press and suitable size pipe (Fig. 74).

NOTE: Tool presses on hub must be as close to output shaft as possible but not contacting the shaft splines.

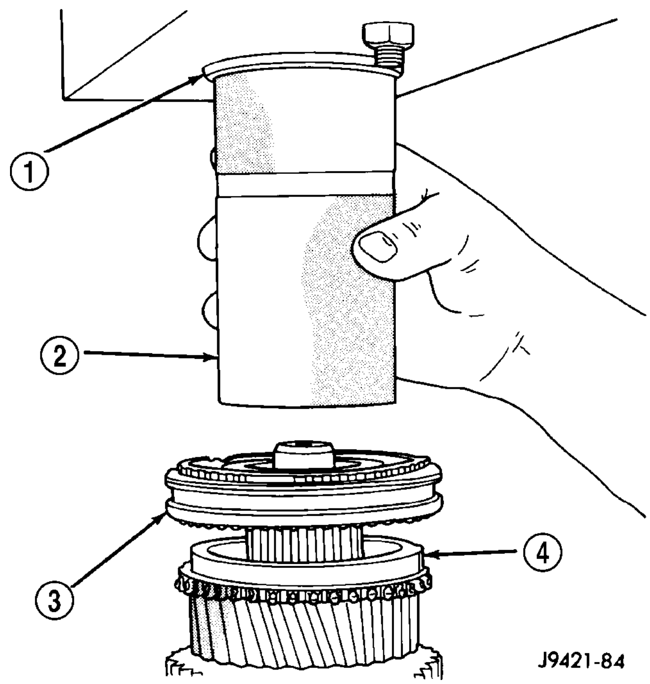


Fig. 74 3-4 SYNCHRO ON OUTPUT SHAFT

1 - PRESS RAM
2 - PIPE TOOL
3 - 3-4 SYNCHRO
4 - THIRD SPEED SYNCHRO RING

(29) Install **new** 3-4 synchro hub snap ring (Fig. 75). Verify snap ring is seated in groove.

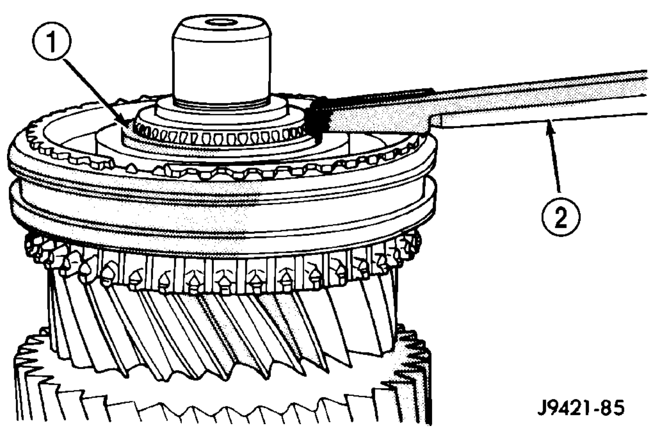


Fig. 75 3-4 SYNCHRO HUB SNAP RING

1 - 3-4 SYNCHRO HUB SNAP RING
2 - HEAVY DUTY SNAP RING PLIERS

(30) Install output shaft bearing.

(31) Install output shaft bearing snap ring with heavy duty snap ring pliers (Fig. 76). Verify snap ring is seated in shaft groove.

NOTE: Spread snap ring only enough to install it.

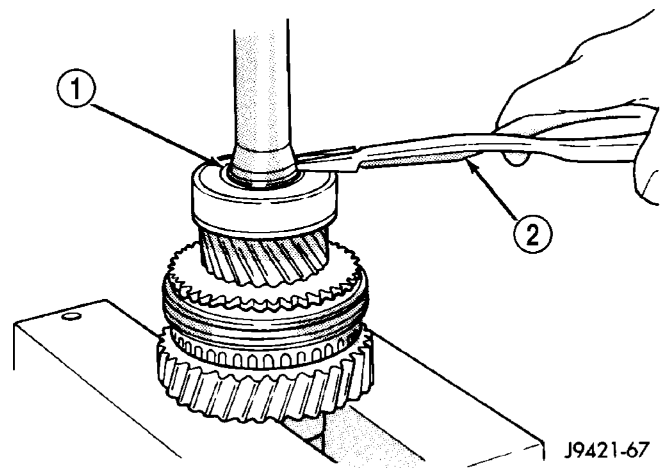


Fig. 76 OUTPUT SHAFT BEARING SNAP

1 - BEARING SNAP RING
2 - HEAVY DUTY SNAP RING PLIERS

(32) Verify position of synchro sleeves before proceeding (Fig. 77). Grooved side of 3-4 sleeve must face forward. First gear side of 1-2 sleeve must face first gear. Tapered side of fifth-reverse sleeve must face forward.

REVERSE IDLER ASSEMBLY

(1) Lubricate idler components with gear lube.

(2) Slide idler gear bearing on shaft (Fig. 78). Bearing fits either way on shaft.

(3) Slide gear onto shaft. Side of gear with recess goes to rear (Fig. 78).

(4) Place first lock ball in dimple at rear end of idler shaft (Fig. 78). Petroleum jelly can be used to hold ball in place if desired.

(5) Slide thrust rear thrust washer onto shaft and over lock ball (Fig. 79).

(6) Install snap ring in groove at rear of shaft (Fig. 79).

MANUAL TRANSMISSION - NV3500 (Continued)

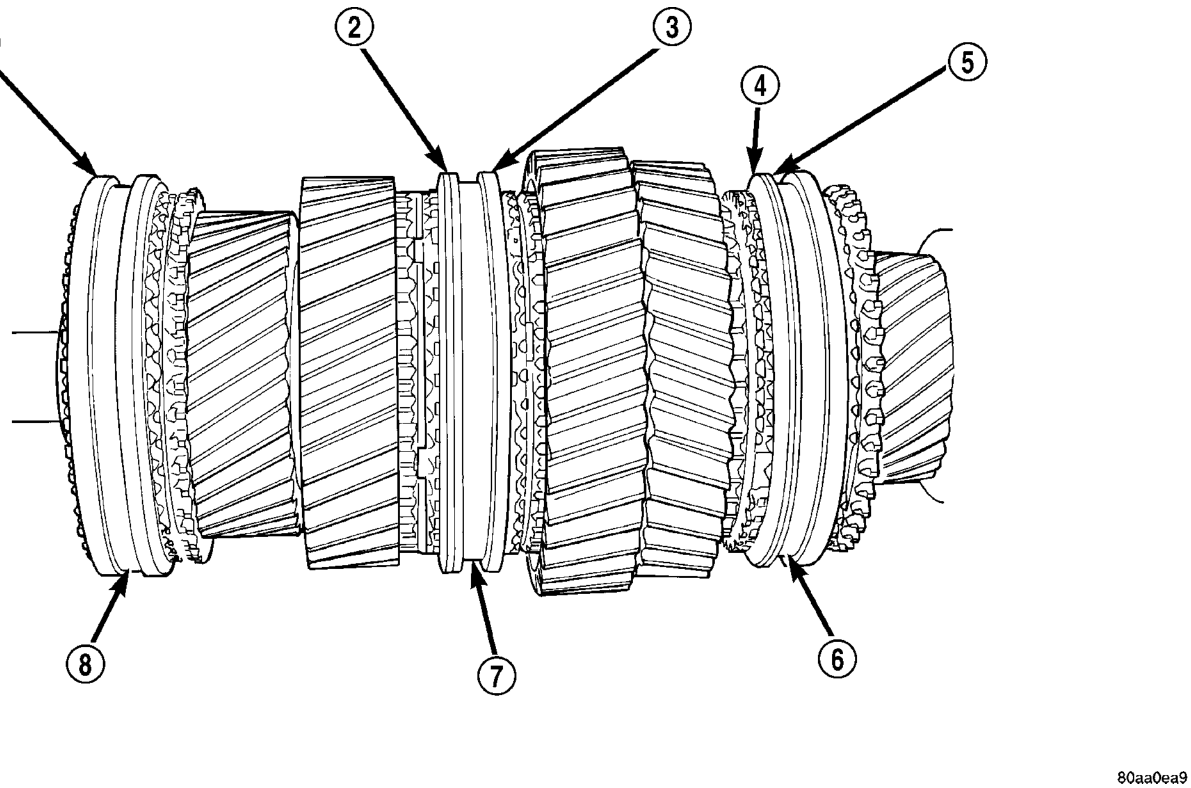


Fig. 77 SYNCHRO SLEEVE LOCATIONS

1 - DOUBLE GROOVE FORWARD
2 - GROOVE FORWARD
3 - FIRST GEAR SIDE MARKING TOWARD FIRST GEAR
4 - TAPER FORWARD
5 - GROOVE FORWARD
6 - 5TH-REV SYNCHRO SLEEVE
7 - 1-2 SYNCHRO SLEEVE
8 - 3-4 SYNCHRO SLEEVE

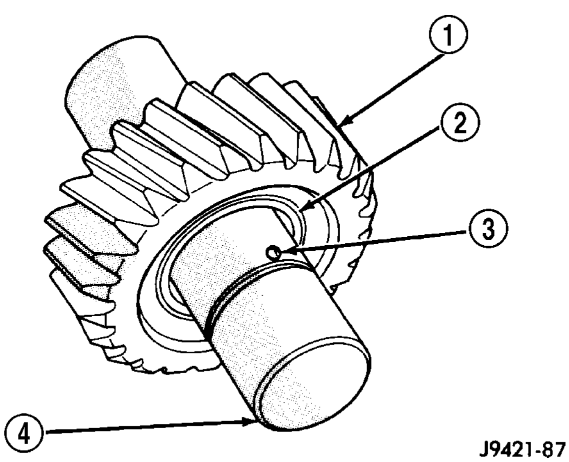


Fig. 78 IDLER GEAR & BEARING

1 - IDLER GEAR
2 - BEARING
3 - LOCK BALL
4 - REAR OF SHAFT

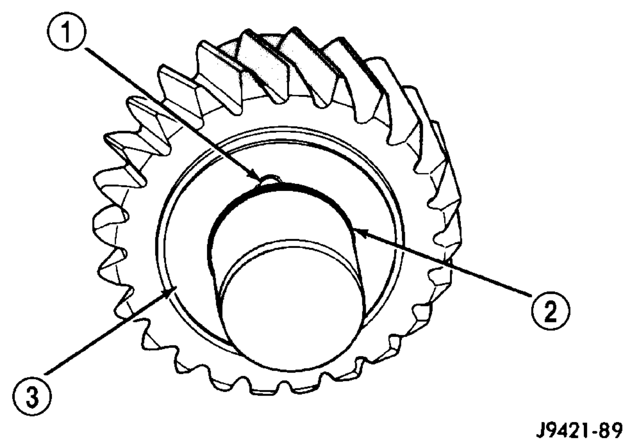


Fig. 79 IDLER GEAR REAR THRUST WASHER

1 - LOCK BALL
2 - SNAP RING GROOVE
3 - THRUST WASHER

MANUAL TRANSMISSION - NV3500 (Continued)

(7) Install lock ball in dimple at front of shaft. Hold ball in place with petroleum jelly if desired.

(8) Install front thrust washer on shaft and slide washer up against gear and over lock ball (Fig. 80).

(9) Install wave washer, flat washer and remaining snap ring on idler shaft (Fig. 80). Verify snap ring is seated.

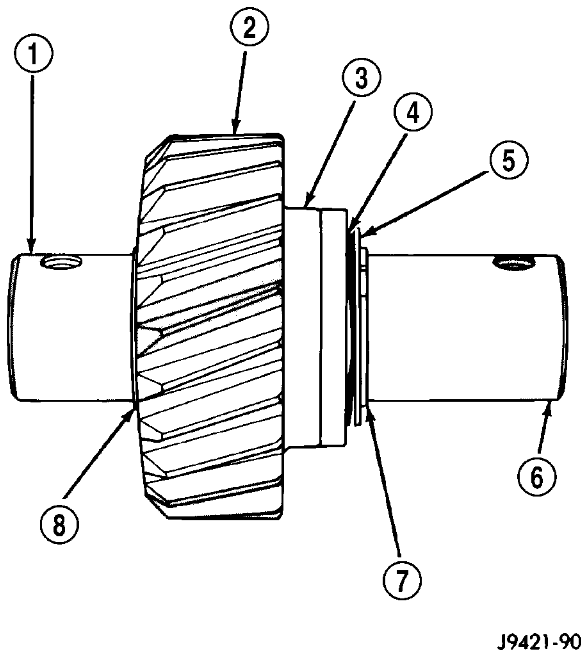


Fig. 80 IDLER GEAR & SHAFT ASSEMBLY

1 - REAR OF SHAFT
2 - GEAR
3 - THRUST WASHER AND BALL
4 - WAVE WASHER
5 - FLAT WASHER
6 - FRONT OF SHAFT
7 - SNAP RING
8 - SNAP RING

SHIFT SHAFT AND DETENT PLUNGER BUSHINGS/ BEARINGS

(1) Inspect shift shaft bushing and bearing for damage.

(2) If necessary, the shift shaft bushing can be replaced as follows:

(a) Locate a bolt that will thread into the bushing without great effort.

(b) Thread the bolt into the bushing, allowing the bolt to make its own threads in the bushing.

(c) Attach a slide hammer or suitable puller to the bolt and remove bushing.

(d) Use the short end of Installer 8119 to install the new bushing.

(e) Bushing is correctly installed if flush with the transmission case.

(3) If necessary, the shift shaft bearing can be replaced as follows:

(a) Locate a bolt that will thread into the bearing without great effort.

(b) Thread the bolt into the bearing as much as possible.

(c) Attach a slide hammer or suitable puller to the bolt and remove the bearing.

(d) Use the short end of Installer 8119 to install the new bearing.

(e) Bearing is correctly installed if flush with the transmission case.

(4) Inspect detent plunger bushings for damage.

NOTE: The detent plunger bushings are installed to a specific depth. The space between the two bushings when correctly installed contain an oil feed hole. Do not attempt to install the bushings with anything other than the specified tool or this oil hole may become restricted.

(5) If necessary, the detent plunger bushings can be replaced as follows:

(a) Using the long end of Installer 8119, drive the detent bushings through the outer case and into the shift shaft bore.

(b) Remove the bushings from the shift shaft bore.

(c) Install a new detent plunger bushing on the long end of Installer 8118.

(d) Start bushing in the detent plunger bore in the case.

(e) Drive bushing into the bore until the tool contacts the transmission case.

(f) Install a new detent plunger bushing on the short end of Installer 8118.

(g) Start the bushing in the detent plunger bore in the case.

(h) Drive bushing into the bore until the tool contacts the transmission case.

MANUAL TRANSMISSION - NV3500 (Continued)

GEARTRAIN ASSEMBLY

(1) Install Adapter 6747-1A on input shaft hub of Fixture 6747 (Fig. 81). Then install Adapter 6747-2A on front bearing hub of countershaft. Be sure the shoulder is seated against the countershaft.

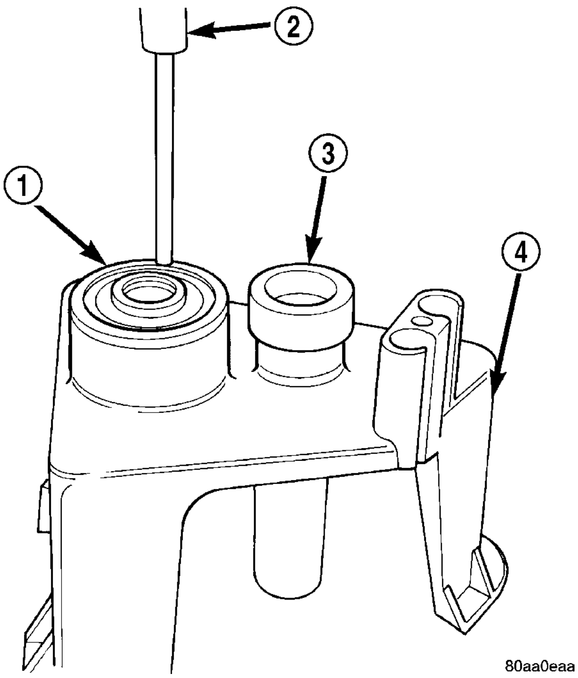


Fig. 81 FIXTURE FOR GEARTRAIN BUILD-UP

1 - ADAPTER 6747-2A
2 - CUP 8115
3 - ADAPTER 6747-1A
4 - FIXTURE 6747

(2) Install input shaft in fixture tool with Adapter Tool 6747-1A positioned under the shaft as shown (Fig. 82).

(3) Install pilot bearing in input shaft (Fig. 82).

NOTE: The side of the pilot bearing with the small diameter goes toward the input shaft.

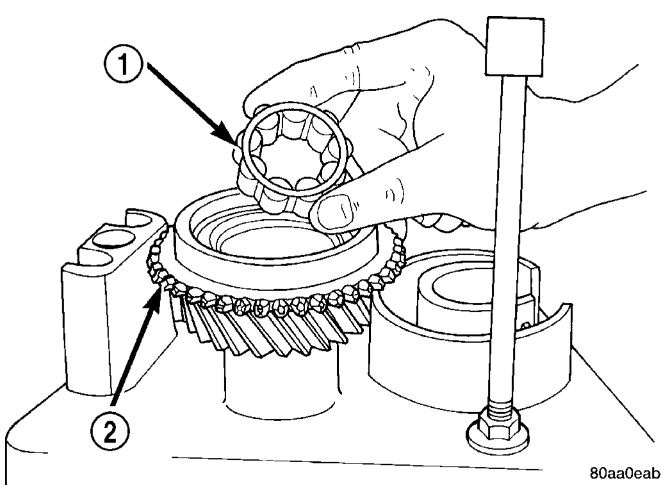


Fig. 82 PILOT BEARING & INPUT SHAFT

1 - PILOT BEARING
2 - INPUT SHAFT

(4) Install fourth gear synchro ring on input shaft (Fig. 83).

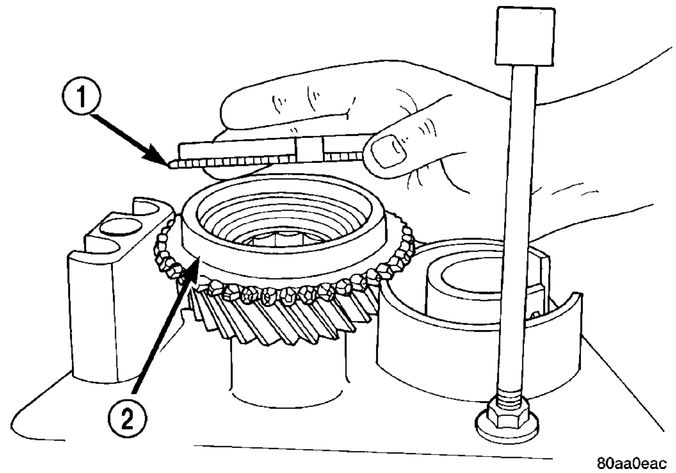


Fig. 83 FOURTH GEAR SYNCHRO

1 - FOURTH GEAR SYNCHRO RING
2 - INPUT SHAFT

(5) Adjust height of idler gear pedestal on fixture (Fig. 84). Start with a basic height of 18.4 cm (7-1/4 in.). Final adjustment can be made after gear is positioned on pedestal.

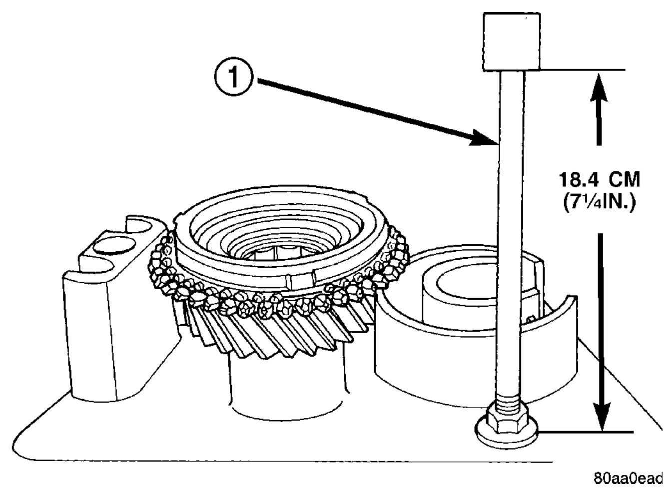


Fig. 84 IDLER PEDESTAL BASE HEIGHT

1 - REVERSE IDLER PEDESTAL

MANUAL TRANSMISSION - NV3500 (Continued)

(6) Install assembled output shaft and geartrain in input shaft (Fig. 85). Carefully rotate output shaft until the 3-4 synchro ring seats in synchro hub and sleeve.

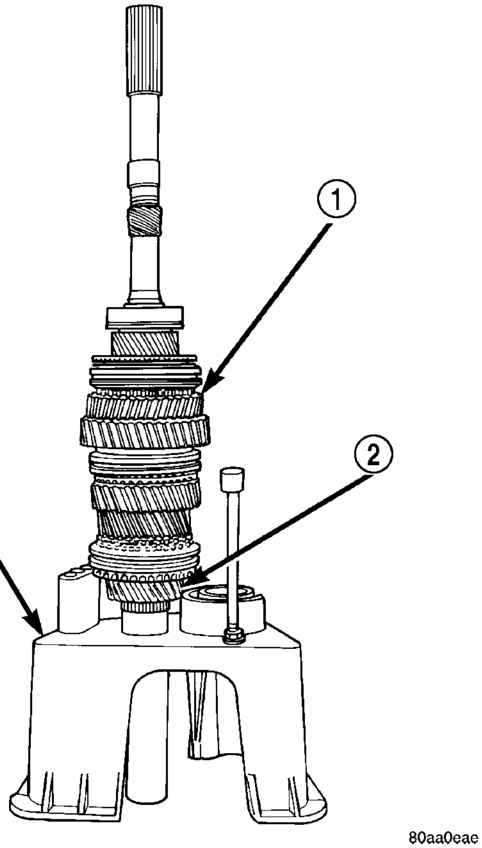


Fig. 85 OUTPUT SHAFT, GEARTRAIN & INPUT SHAFT

1 - OUTPUT SHAFT AND GEARTRAIN
2 - INPUT SHAFT
3 - FIXTURE 6747

(7) Install Adapter 6747-2A on front bearing hub of countershaft, if not previously done. The shoulder goes toward the countershaft.

(8) Slide countershaft (and adapter) into fixture slot. Verify countershaft and output shaft gears are fully meshed with the mainshaft gears before proceeding (Fig. 86).

(9) Check alignment of countershaft and output shaft gear teeth. Gears may not align perfectly a difference in height of 1.57 to 3.18 mm (1/16 to 1/8 in.) will probably exist. This will not interfere with assembly. If difference is greater than this, the countershaft adapter tool is probably upside down.

(10) Position reverse idler in support cup of fixture (Fig. 87). Verify idler gear is properly meshed and aligned with shaft gear teeth and that bolt holes are facing out from the geartrain. Adjust pedestal up or down if necessary and verify short end of idler shaft is facing up as shown.

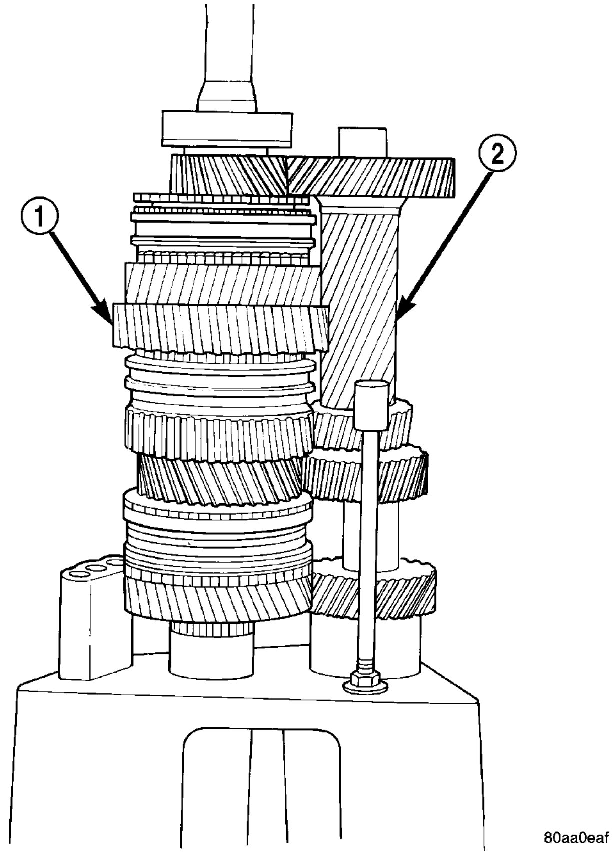


Fig. 86 COUNTERSHAFT ON FIXTURE

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT (SLIDE INTO PLACE ON FIXTURE TOOL)

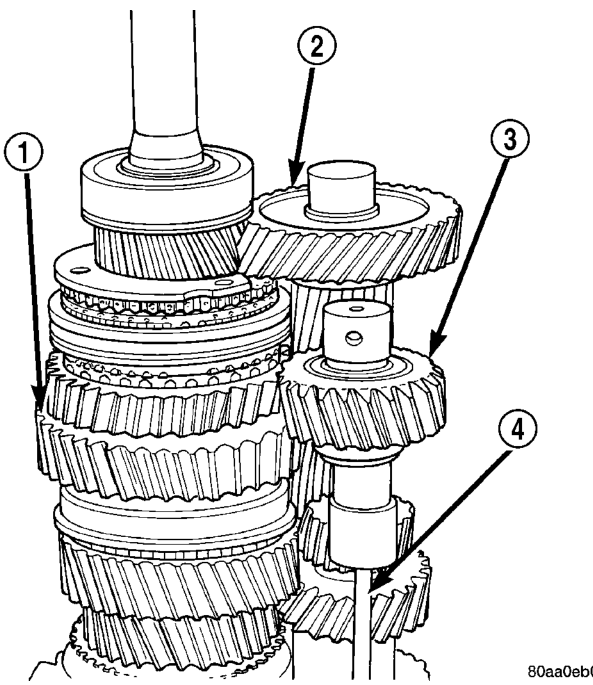


Fig. 87 REVERSE IDLER ASSEMBLY ON FIXTURE

1 - OUTPUT SHAFT AND GEARTRAIN
2 - COUNTERSHAFT
3 - REVERSE IDLER ASSEMBLY
4 - PEDESTAL

MANUAL TRANSMISSION - NV3500 (Continued)

(11) On 2-wheel drive transmission, thread one Alignment Pin 8120 in center or passenger side hole of output shaft bearing retainer. Then position retainer on fifth gear as shown (Fig. 88).

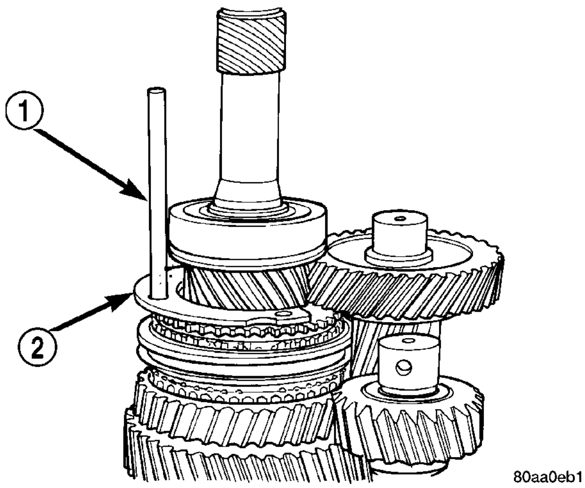


Fig. 88 ALIGN OUTPUT SHAFT BEARING RETAINER

1 - ALIGNMENT PIN
2 - OUTPUT SHAFT BEARING RETAINER

(12) Assemble 1-2 and fifth reverse-shift forks (Fig. 89). Arm of fifth-reverse fork goes through slot in 1-2 fork.

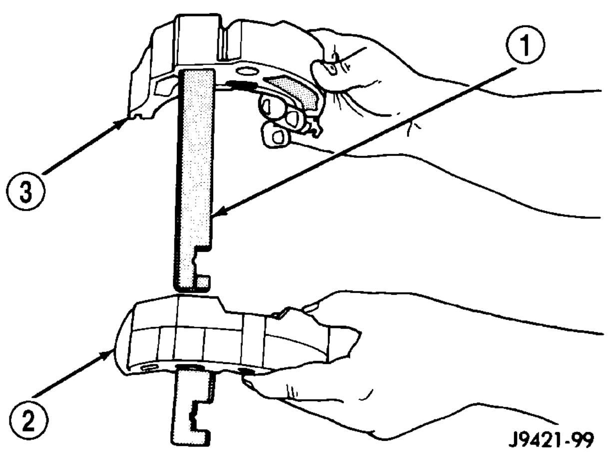


Fig. 89 1-2 & FIFTH-REVERSE SHIFT FORKS

1 - 1-2 FORK
2 - 1-2 FORK ARM
3 - FIFTH-REVERSE FORK

(13) Install assembled shift forks in synchro sleeves and verify forks are seated in sleeves (Fig. 90).

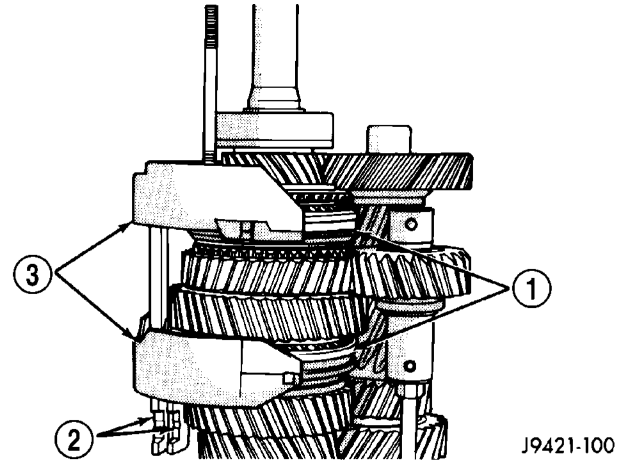


Fig. 90 SHIFT FORKS IN SYNCHRO

1 - SYNCHRO SLEEVES
2 - FORK ARMS
3 - SHIFT FORKS

REAR HOUSING - 2WD

NOTE: Transmission shift components must be in Neutral position to prevent damaging the synchro and shift components when installing the housings.

(1) Drive adapter housing alignment dowels back into housing until dowels are flush with mounting surface (Fig. 91).

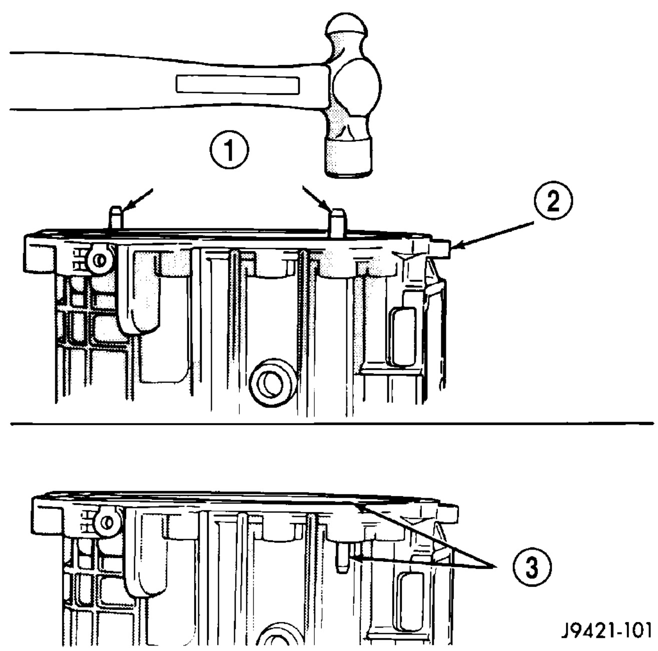


Fig. 91 REAR HOUSING DOWELS

1 - HOUSING ALIGNMENT DOWELS
2 - REAR HOUSING
3 - DOWEL FLUSH WITH SURFACE

MANUAL TRANSMISSION - NV3500 (Continued)

(2) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(3) Install countershaft rear bearing in bearing race (Fig. 92).

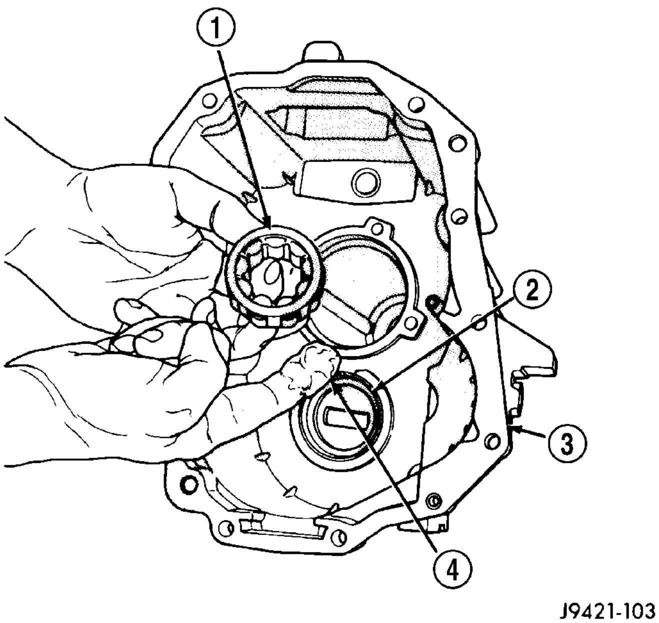


Fig. 92 COUNTERSHAFT REAR BEARING

1 - COUNTERSHAFT REAR BEARING
2 - REAR BEARING RACE
3 - REAR HOUSING
4 - PETROLEUM JELLY

NOTE: Large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 93).

(4) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(5) Apply light coat of petroleum jelly to shift shaft bushing/bearing in rear housing (Fig. 93).

(6) Reach into countershaft rear bearing with finger and push each bearing roller outward against the race. Then apply extra petroleum jelly to hold rollers in place during housing installation.

(7) Install rear housing onto geartrain (Fig. 94) and verify bearing retainer pilot stud is in correct bolt hole in housing. Verify countershaft and output shaft bearings are aligned in housing and on countershaft.

NOTE: It may be necessary to lift upward on countershaft slightly to ensure that the countershaft rear bearing engages to the countershaft before the rear output shaft bearing engages the housing.

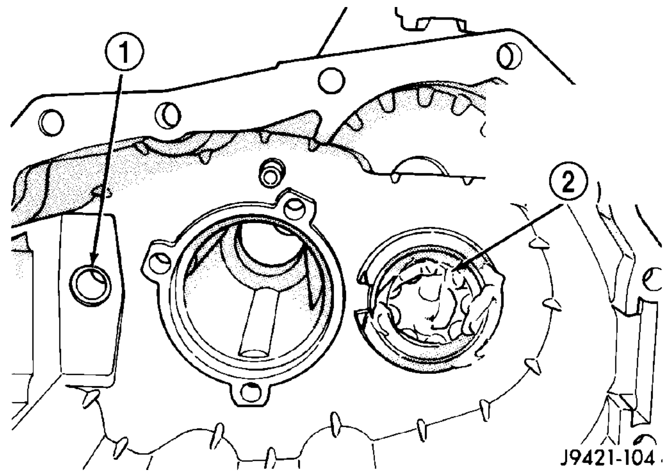


Fig. 93 COUNTERSHAFT BEARING

1 - SHIFT SHAFT BUSHING/BEARING
2 - COUNTERSHAFT REAR BEARING

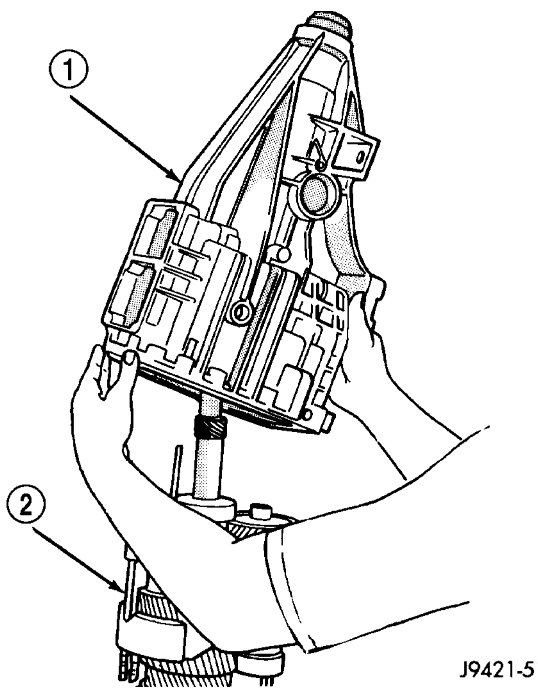


Fig. 94 REAR HOUSING

1 - REAR HOUSING
2 - SHIFT FORKS AND GEARTRAIN

(8) Seat rear housing on output shaft rear bearing and countershaft by tapping the housing with a plastic mallet.

MANUAL TRANSMISSION - NV3500 (Continued)

(9) Apply Mopar Gasket Maker or equivalent to housing bolt threads, bolt shanks and under bolt heads (Fig. 95).

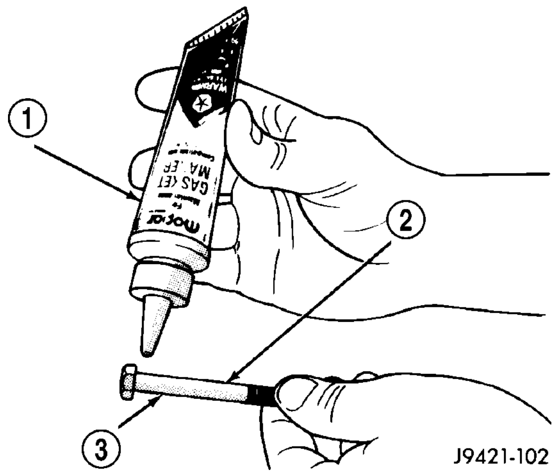


Fig. 95 HOUSING BOLTS

1 - GASKET MAKER
2 - RETAINER AND HOUSING BOLTS
3 - APPLY SEALER TO UNDERSIDE OF BOLT HEAD, SHANK AND THREADS

(10) Start first two bolts in retainer (Fig. 96). It may be necessary to move retainer rearward (with pilot stud) in order to start bolts in retainer.

(11) Remove Alignment Pin 8120 and install last retainer bolt (Fig. 96).

(12) Tighten retainer bolts to 30-35 N·m (22-26 ft. lbs.).

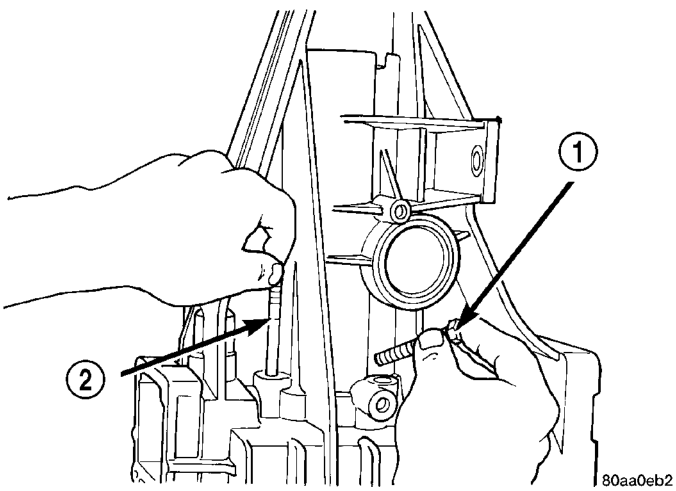


Fig. 96 Alitgnment Pin And Retainer Bolts

1 - BEARING RETAINER BOLT
2 - ALIGNMENT PIN

ADAPTER HOUSING - 4WD

NOTE: Transmission shift components must be in Neutral to prevents damaging to the synchro and shift components when installing the housings.

(1) Install rear bearing in adapter housing. Use wood hammer handle or wood dowel to tap bearing into place.

(2) Position rear bearing retainer in adapter housing (Fig. 97).

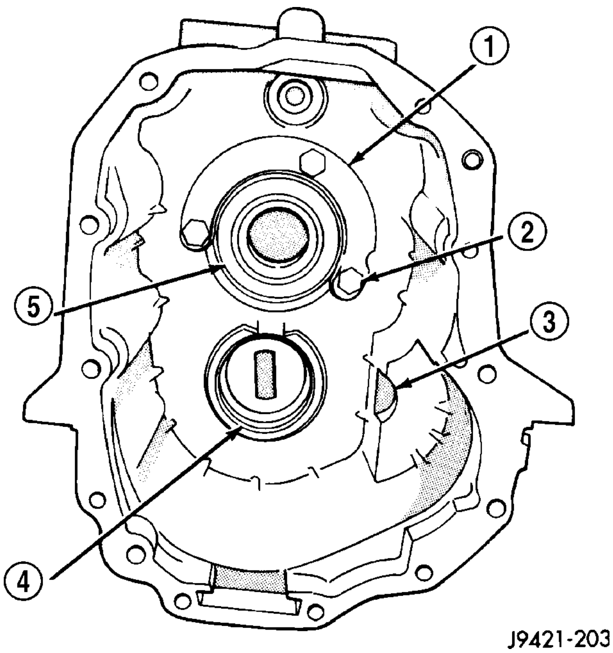


Fig. 97 ADAPTER HOUSING

1 - BEARING RETAINER
2 - RETAINER BOLT
3 - IDLER SHAFT NOTCH
4 - COUNTERSHAFT BEARING RACE
5 - REAR BEARING

(3) Apply Mopar Gasket Maker or equivalent to threads, bolt shanks and under hex heads of bearing retainer bolts (Fig. 95).

(4) Apply liberal quantity of petroleum jelly to countershaft rear bearing and bearing race.

(5) Install countershaft rear bearing in bearing race (Fig. 93).

NOTE: Large diameter side of the roller retainer faces the countershaft and the small diameter side faces the race and housing (Fig. 93).

(6) Apply extra petroleum jelly to hold countershaft rear bearing in place when housing is installed.

(7) Apply light coat of petroleum jelly to shift shaft bushing/bearing in adapter housing (Fig. 93).

MANUAL TRANSMISSION - NV3500 (Continued)

(8) Install adapter housing on geartrain.

(9) Install rear bearing snap ring on output shaft (Fig. 98).

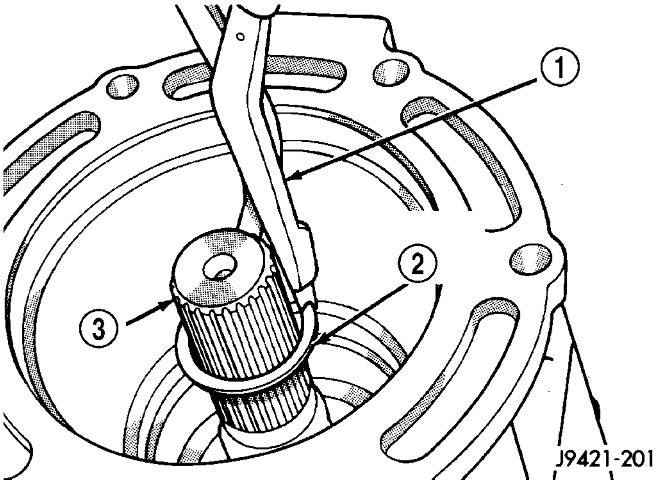


Fig. 98 REAR BEARING SNAP RING

1 - SNAP RING PLIERS
2 - SNAP RING
3 - OUTPUT SHAFT

(10) Lubricate lip of new rear seal (Fig. 99) with Mopar Door Ease, or transmission fluid.

(11) Install **new** rear seal in adapter housing bore with Installer C-3860-A. Verify seal is seated in housing bore (Fig. 99).

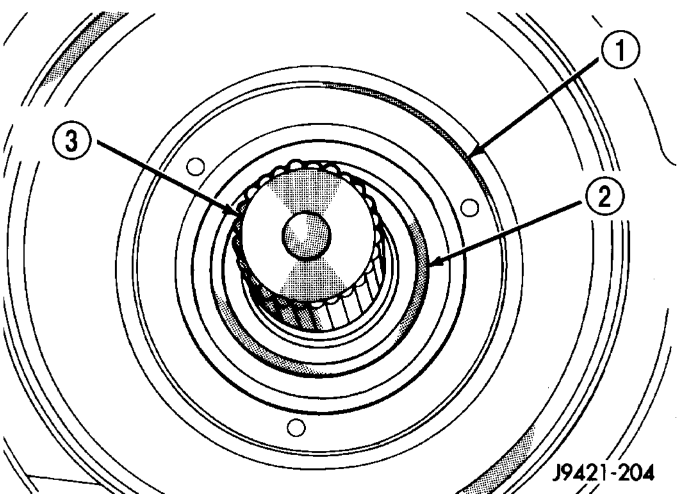


Fig. 99 ADAPTER HOUSING REAR SEAL

1 - REAR SEAL
2 - SEAL LIP
3 - OUTPUT SHAFT

SHIFT SHAFT, SHAFT LEVER AND BUSHING AND SHIFT SOCKET

(1) Verify all synchro sleeves are in Neutral position (centered on hub).

CAUTION: Transmission synchros must all be in Neutral position to prevent damaging the housings, shift forks and gears while installing the housings.

(2) Install 3-4 shift fork in synchro sleeve (Fig. 100). Verify groove in fork arm is aligned with grooves in 1-2 and fifth-reverse fork arms as shown.

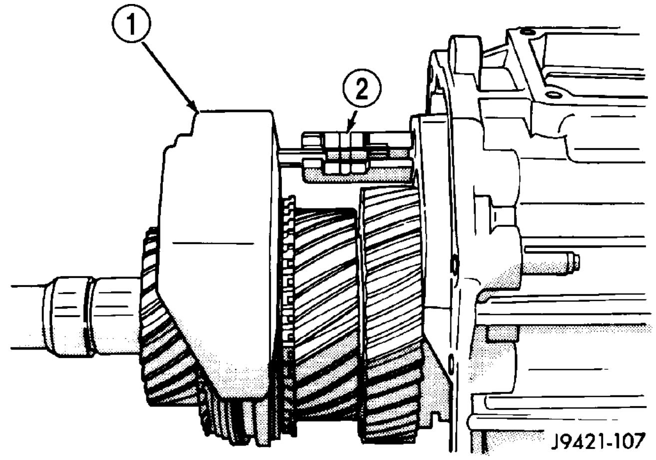


Fig. 100 3-4 SHIFT FORK

1 - 3-4 FORK
2 - ALIGN GROOVES IN FORK ARMS

(3) Slide shift shaft through 3-4 shift fork (Fig. 101).

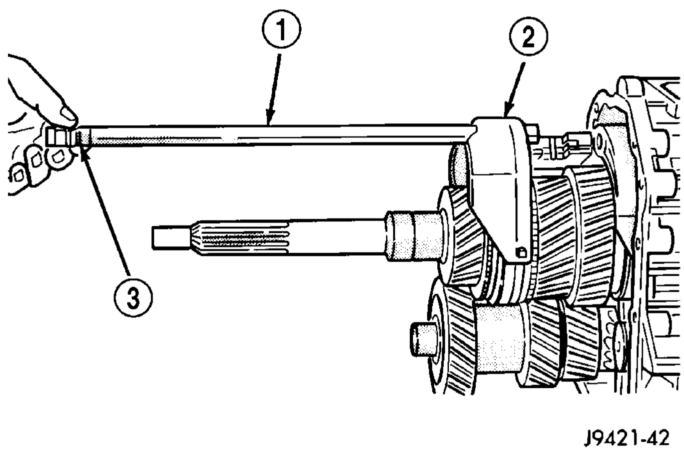


Fig. 101 SHIFT SHAFT

1 - SHIFT SHAFT
2 - 3-4 FORK
3 - SHAFT DETENT NOTCHES

MANUAL TRANSMISSION - NV3500 (Continued)

(4) Assemble shift shaft shift lever and bushing (Fig. 102). Verify slot in bushing is facing up and roll pin hole for lever is aligned with hole in shaft.

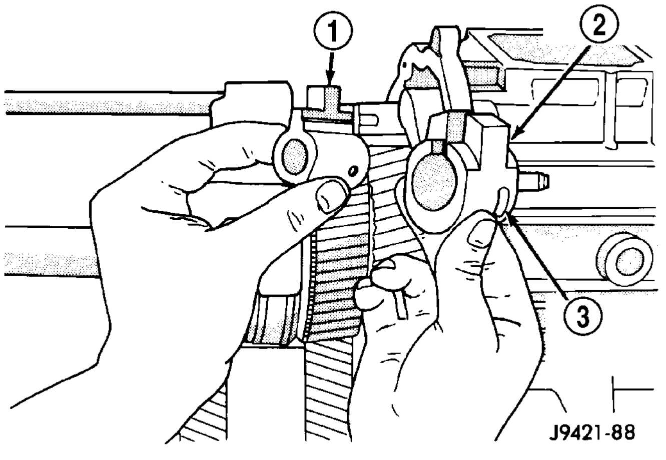


Fig. 102 SHIFT SHAFT LEVER AND BUSHING

1 - SHAFT LEVER
2 - LEVER BUSHING
3 - BUSHING LOCK PIN SLOT

(5) Install assembled lever and bushing on shift shaft (Fig. 103).

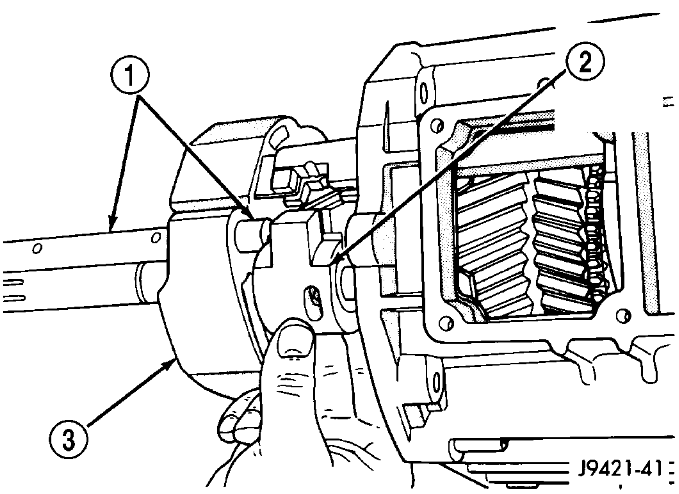


Fig. 103 SHIFT SHAFT LEVER AND BUSHING

1 - SHIFT SHAFT
2 - SHAFT LEVER AND BUSHING
3 - 3-4 FORK

(6) Slide shift shaft through 1-2 and fifth-reverse fork and into shift lever opening in rear housing (Fig. 104).

(7) Align shift socket with shaft and slide shaft through socket and into shift shaft bearing in rear housing (Fig. 105).

(8) Rotate shift shaft so detent notches in shaft are facing the TOP of the transmission housing.

CAUTION: Both shaft roll pins can be installed when the shaft is 180° off. If this occurs, the transmission will have to be disassembled again to correct shaft alignment.

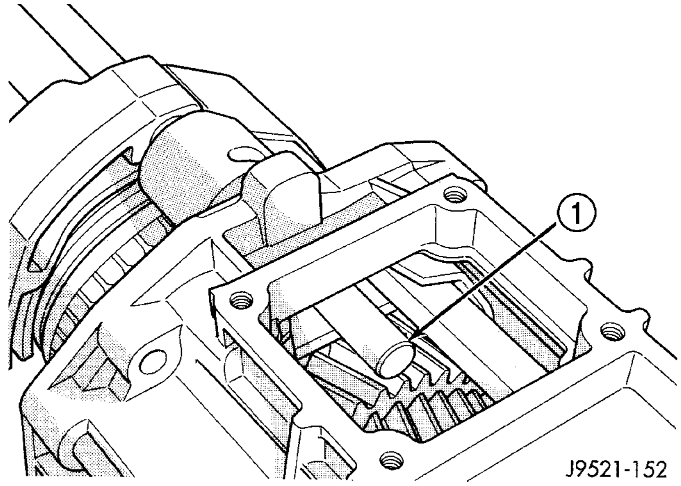


Fig. 104 SHAFT LEVER OPENING

1 - SHIFT SHAFT

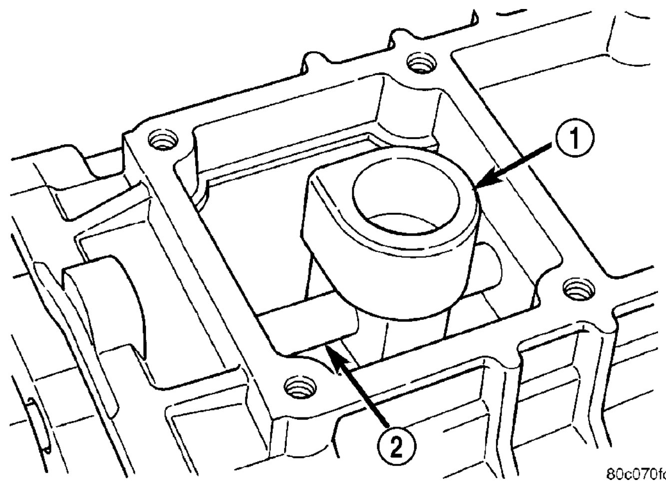


Fig. 105 SHIFT SOCKET

1 - SHIFT SOCKET
2 - SHIFT SHAFT

(9) Select correct **new** roll pin for shift shaft lever (Fig. 106). Shaft lever roll pin is approximately 22 mm (7/8 in.) long. Shift socket roll pin is approximately 33 mm (1-1/4 in.) long.

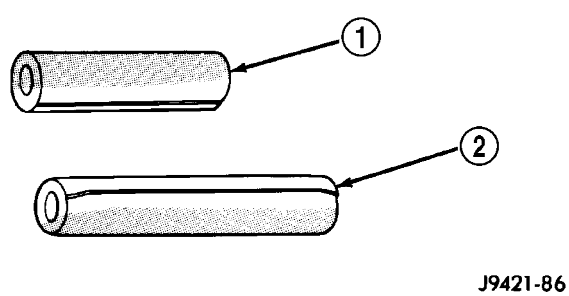


Fig. 106 ROLL PIN IDENTIFICATION

1 - SHAFT LEVER ROLL PIN
2 - SHIFT SOCKET ROLL PIN

MANUAL TRANSMISSION - NV3500 (Continued)

(10) Align roll pin holes in shift shaft, lever and bushing. Then start roll pin into shaft lever by hand (Fig. 107).

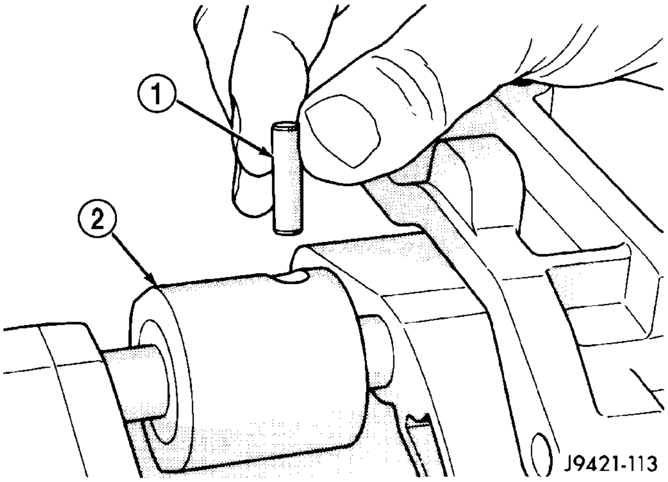


Fig. 107 SHIFT SHAFT ROLL PIN

1 - SHAFT LEVER ROLL PIN
2 - LEVER AND BUSHING

(11) Seat shaft lever roll pin with pin punch (Fig. 108).

CAUTION: Shaft lever roll pin must be flush with the surface of the lever. The lever bushing will bind on the roll pin if the pin is not seated flush.

(12) Verify that lock pin slot in lever bushing is positioned as shown (Fig. 108).

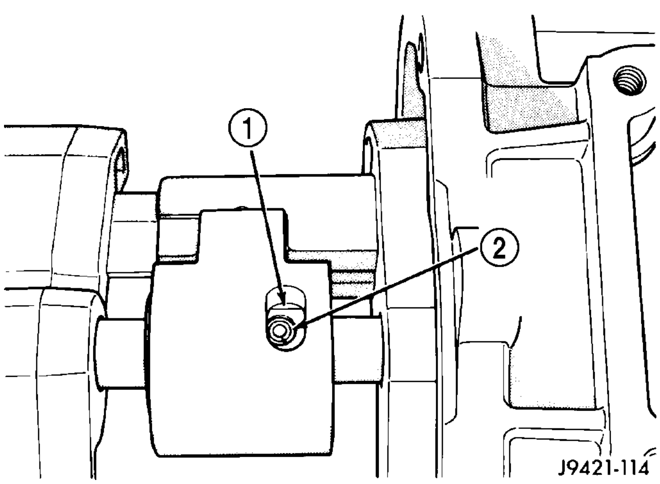


Fig. 108 SHIFT SHAFT/LEVER ROLL PIN

1 - BUSHING LOCK PIN SLOT
2 - SEAT ROLL PIN FLUSH WITH LEVER

(13) Align roll pin holes in shift socket and shift shaft. Then start roll pin into shift shaft by hand (Fig. 109).

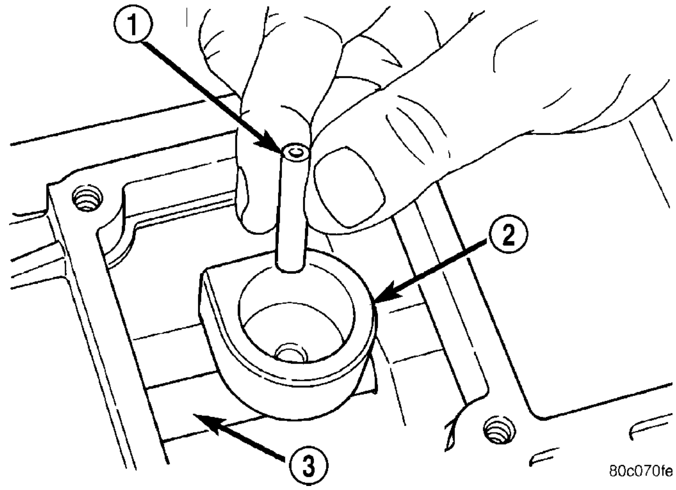


Fig. 109 SHIFT SOCKET ROLL PIN

1 - ROLL PIN
2 - SHIFT SOCKET
3 - SHIFT SHAFT

(14) Seat roll pin in shift socket with pin punch. Roll pin must be flush with socket after installation (Fig. 110).

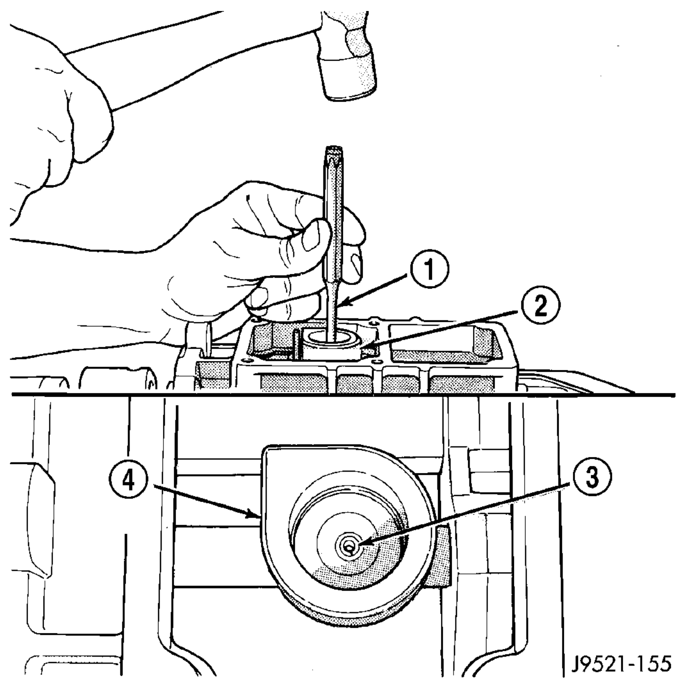


Fig. 110 SEAT SHIFT SOCKET

1 - PIN PUNCH
2 - SHIFT SOCKET
3 - SEAT ROLL PIN FLUSH
4 - SHIFT SOCKET

MANUAL TRANSMISSION - NV3500 (Continued)

(15) Verify that notches in shift fork arms are aligned (Fig. 111). Realign arms if necessary.

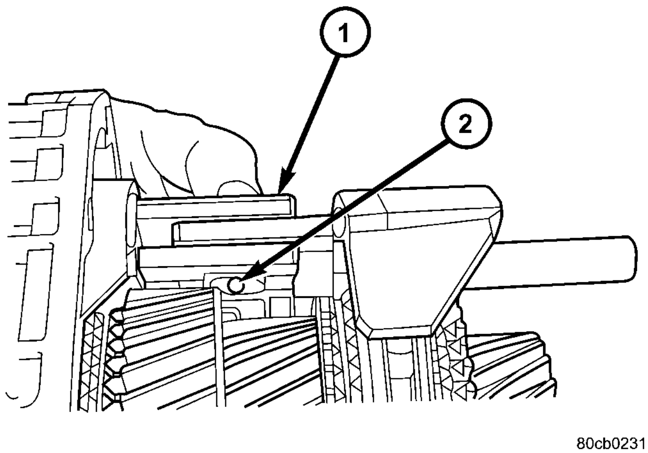


Fig. 111 SHIFT LEVER POSITION

1 - SHIFT FORK ARMS
2 - DETENT BORE

(16) Rotate shift lever and bushing downward to expose detent bore in the lever.

(17) Install detent spring then the ball into the detent bore (Fig. 112) and hold the ball in the lever. Then rotate the lever upward into the fork arm notches.

NOTE: Verify detent ball is seated in the fork arms before proceeding.

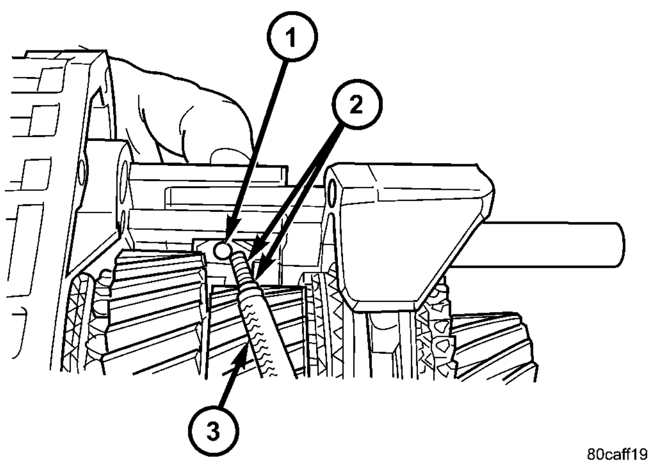


Fig. 112 DETENT SPRING AND BALL

1 - SHAFT LEVER
2 - SPRING AND BALL
3 - MAGNET

FRONT HOUSING AND INPUT SHAFT BEARING RETAINER

(1) If previously removed, install input shaft bearing in front housing bore (Fig. 113). Install snap ring and use plastic mallet to seat bearing. Bearing goes in from front side of housing only.

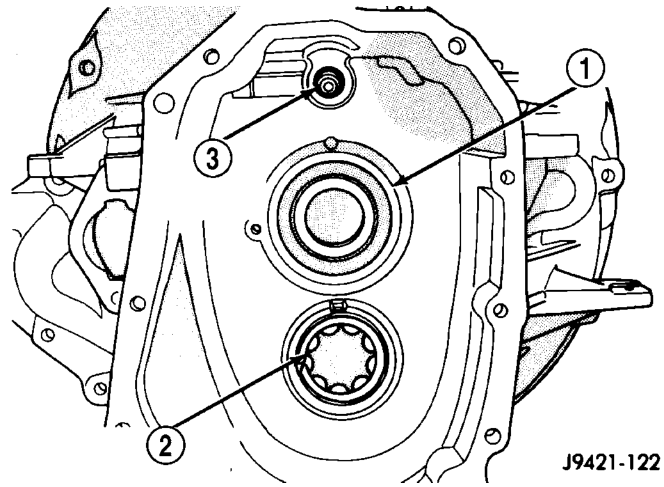


Fig. 113 INPUT SHAFT & COUNTERSHAFT BEARING

1 - INPUT SHAFT BEARING
2 - COUNTERSHAFT FRONT BEARING
3 - SHIFT SHAFT BUSHING

(2) Apply liberal quantity of petroleum jelly to countershaft front bearing. Then insert bearing in front housing race (Fig. 113). Large diameter side of bearing cage goes toward countershaft (Fig. 114). Small diameter side goes toward bearing race in housing.

(3) Reach into countershaft front bearing with finger and push each bearing roller outward against race. Then apply extra petroleum jelly to hold rollers in place during housing installation.

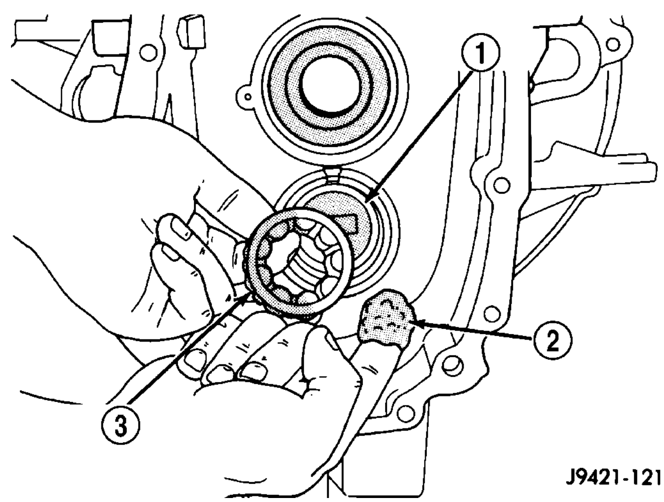


Fig. 114 COUNTERSHAFT FRONT BEARING

1 - BEARING RACE
2 - PETROLEUM JELLY
3 - COUNTERSHAFT FRONT BEARING

(4) Apply small amount of petroleum jelly to shift shaft bushing in front housing.

MANUAL TRANSMISSION - NV3500 (Continued)

(5) Apply 1/8 in. wide bead of Mopar Gasket Maker or equivalent to mating surfaces of front and rear housings (Fig. 115).

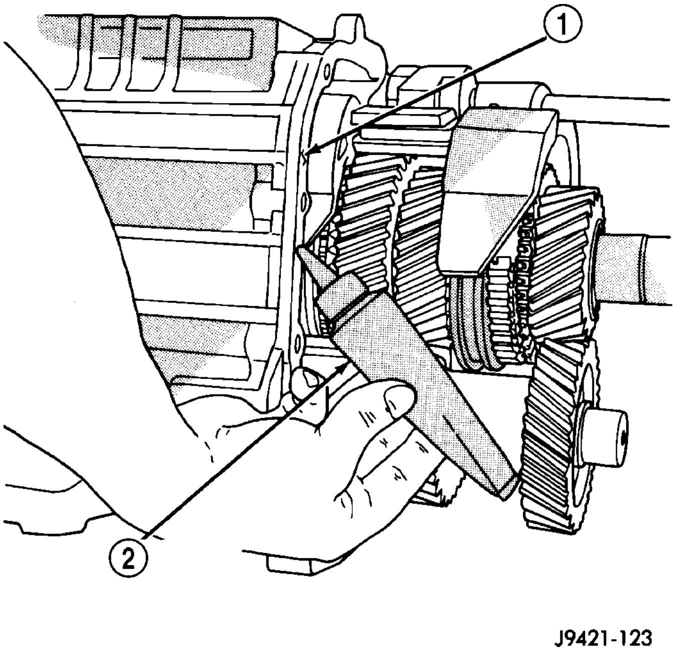


Fig. 115 SEAL HOUSINGS

1 - HOUSING FLANGE SURFACE
2 -GASKET MAKER

(6) Have helper hold rear housing and geartrain in upright position. Then install front housing on rear housing and geartrain.

(7) Work front housing downward onto geartrain until seated on rear housing.

CAUTION: Front housings will not seat if shift components are not in Neutral or one or more components are misaligned. Do not force the front housing into place.

(8) Tap rear housing alignment dowels back into place with hammer and pin punch. Both dowels should be flush fit in each housing. Have helper hold transmission upright while dowels are tapped back into place.

(9) Place transmission in horizontal position.

(10) Apply Mopar Gasket Maker or equivalent to housing attaching bolts. Apply sealer material sealer to underside of bolt heads and to bolt shanks and threads (Fig. 116).

(11) Install and start housing attaching bolts by hand (Fig. 116). Then tighten bolts to 34 N·m (25 ft. lbs.).

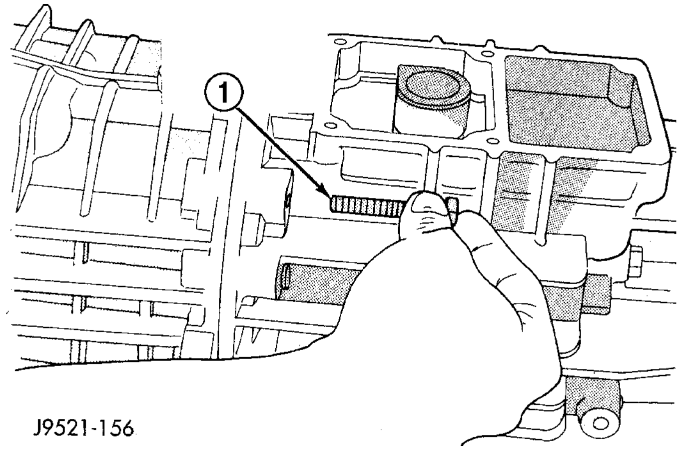


Fig. 116 HOUSING BOLTS

1 - HOUSING BOLTS

(12) Install shift shaft bushing lock bolt (Fig. 117). Apply Mopar Gasket Maker or equivalent to bolt threads, shank and underside of bolt head before installation.

CAUTION: If lock bolt cannot be fully installed the shift shaft is not in Neutral, or the shaft bushing (or lever) is misaligned.

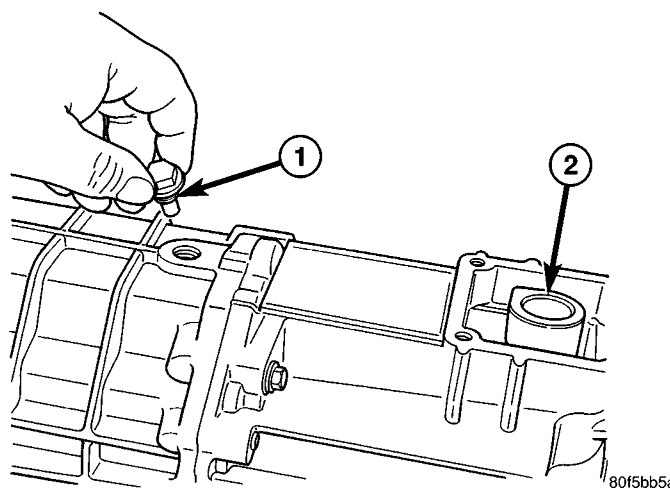


Fig. 117 SHAFT LOCK BOLT

1 - SHIFT SHAFT LOCK BOLT
2 - SHAFT SOCKET

(13) Lubricate then install shift shaft detent plunger in housing bore. Lubricate plunger with semi-synthetic/synthetic grease. Verify plunger is fully seated in detent notch in shift shaft.

(14) Install detent spring inside plunger.

(15) Install detent plug in end of Installer 8123. Position plug on detent spring and compress spring until detent plug pilots in detent plunger bore. Drive detent plug into transmission case until plug seats.

MANUAL TRANSMISSION - NV3500 (Continued)

(16) Install backup light switch (Fig. 118).

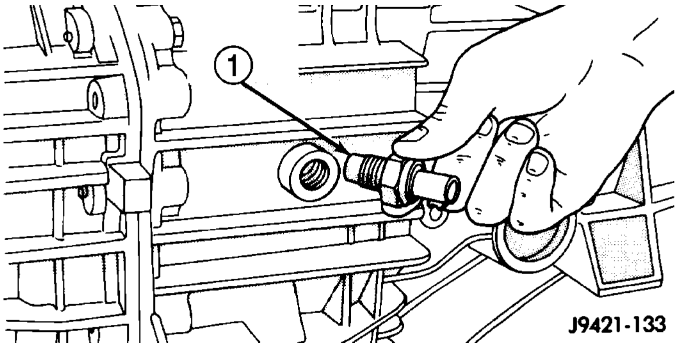


Fig. 118 BACKUP LIGHT SWITCH

1 - BACKUP LIGHT SWITCH

(17) Install input shaft snap ring (Fig. 119).

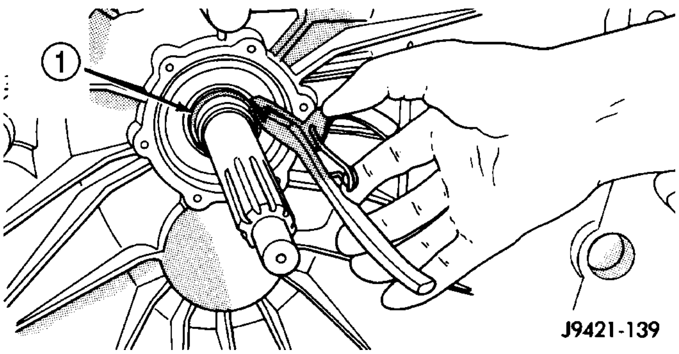


Fig. 119 SHAFT SNAP RING - TYPICAL

1 - INPUT SHAFT SNAP RING

(18) Install **new** oil seal in front bearing retainer with Installer 6448 (Fig. 120).

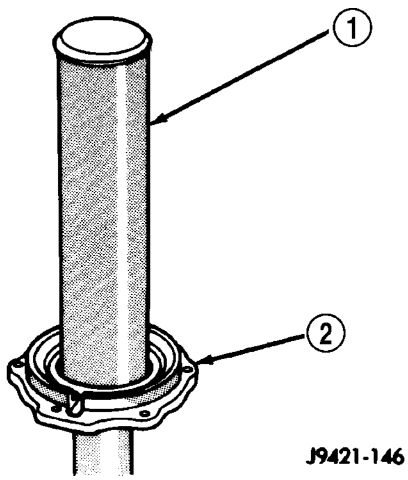


Fig. 120 BEARING RETAINER OIL SEAL

1 - INSTALLER
2 - FRONT BEARING RETAINER

(19) Apply bead of Mopar silicone sealer or equivalent to flange surface of front bearing retainer (Fig. 121).

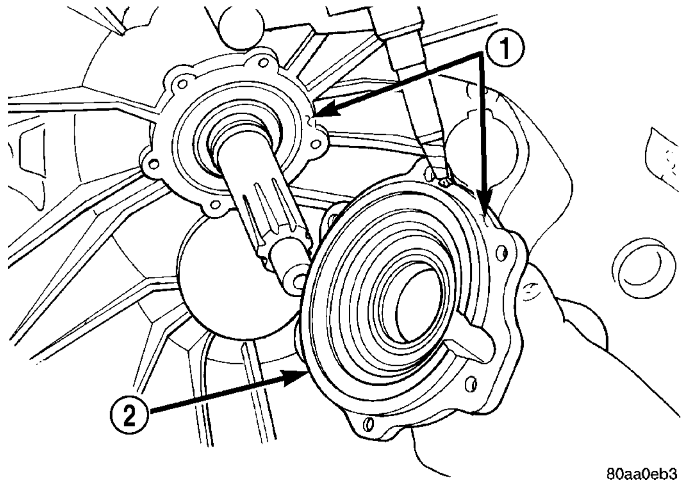


Fig. 121 SEAL BEARING RETAINER - TYPICAL

1 - APPLY SEALER BEAD
2 - INPUT SHAFT BEARING RETAINER

(20) Align and install front bearing retainer over input shaft and onto housing mounting surface (Fig. 122). Verify bolt holes are aligned before seating retainer.

CAUTION: Be sure sealer does not get into the oil feed hole in the transmission case or bearing retainer.

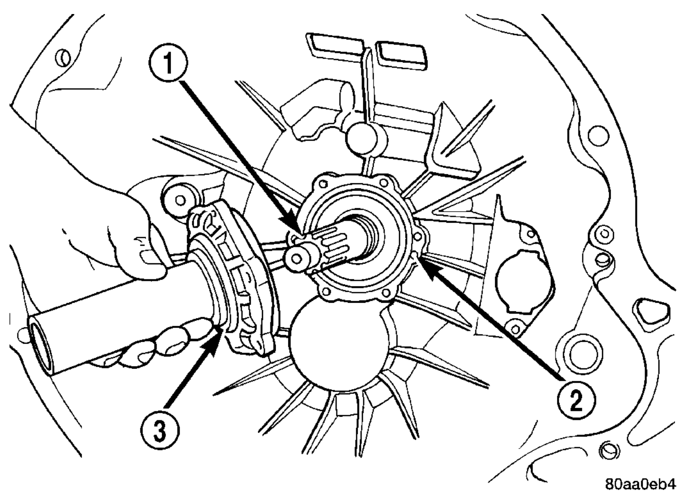


Fig. 122 INPUT SHAFT BEARING RETAINER

1 - INPUT SHAFT
2 - OIL FEED
3 - BEARING RETAINER

MANUAL TRANSMISSION - NV3500 (Continued)

(21) Install and tighten bearing retainer bolts to 7-10 N·m (5-7 ft. lbs.) (Fig. 123).

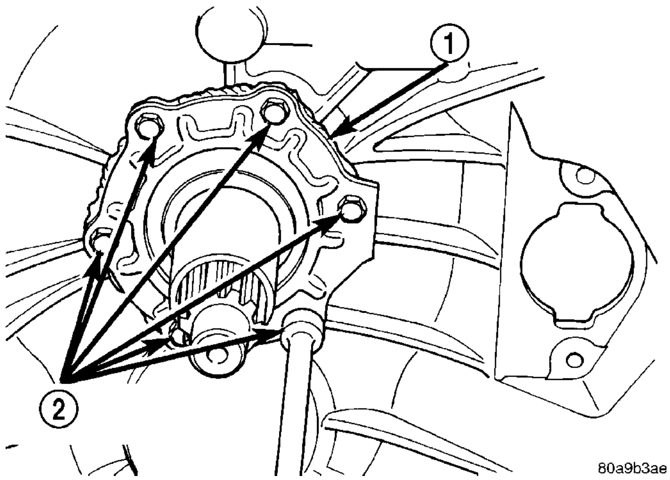


Fig. 123 BEARING RETAINER BOLTS - TYPICAL

1 - RETAINER BOLTS
2 - RETAINER

SHIFT TOWER AND LEVER

(1) Apply petroleum jelly to ball end of shift lever and interior of shift socket.

(2) Shift the transmission into third gear.

(3) Align and install shift tower and lever assembly (Fig. 124). Be sure shift ball is seated in socket and the offset in the tower is toward the passenger side of the vehicle before installing tower bolts.

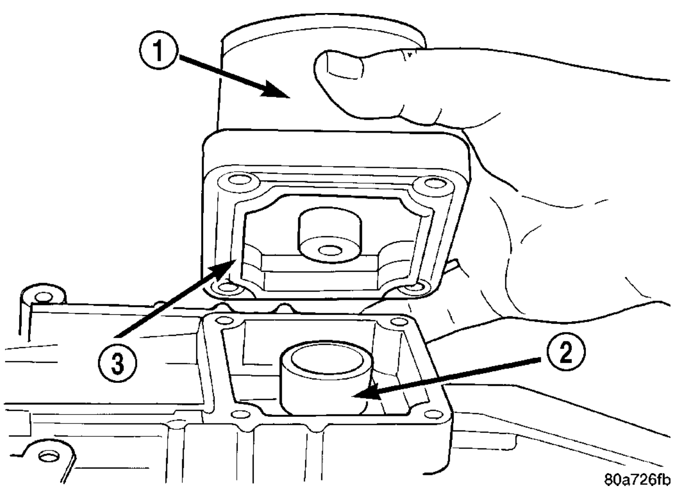


Fig. 124 SHIFT TOWER

1 - SHIFT TOWER
2 - SHAFT SOCKET
3 - SHIFT BALL

(4) Install shift tower bolts (Fig. 125) and tighten bolts to 8.5 N·m (75.2 in. lbs.).

(5) Fill transmission to bottom edge of fill plug hole with lubricant.

(6) Install and tighten fill plug to 34 N·m (25 ft. lbs.).

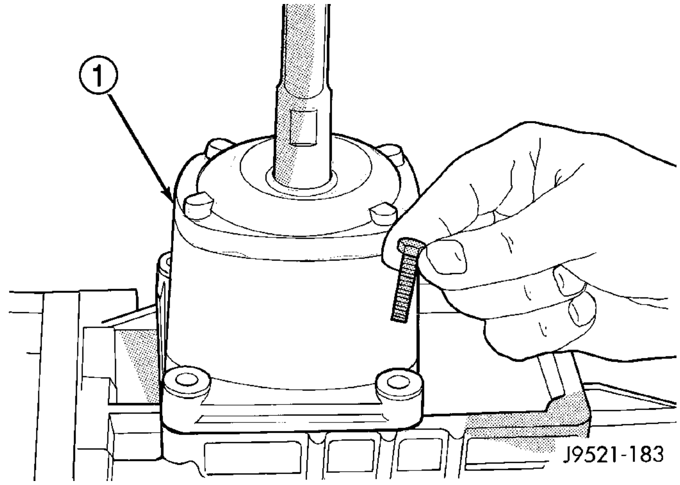


Fig. 125 SHIFT TOWER BOLTS

1 - SHIFT TOWER AND LEVER ASSEMBLY

(7) Check transmission vent. Be sure vent is open and not restricted.

INSTALLATION

NOTE: If a new transmission is being installed, use all components supplied with the new transmission. For example, if a new shift tower is supplied, do not re-use the original shift tower.

(1) Clean transmission front housing mounting surface.

(2) Apply light coat of Mopar high temperature bearing grease or equivalent to contact surfaces (Fig. 126) of following components:
- release fork ball stud.
- release bearing slide surface.
- input shaft splines.
- release bearing bore.
- propeller shaft slip yoke.

(3) Support and secure transmission to jack.

(4) Raise and align transmission input shaft with clutch disc, then slide transmission into place.

(5) Verify front housing is fully seated. Install transmission bolts without washers and tighten bolts into the engine to 41 N·m (30 ft. lbs.). Tighten the bolts with washers into the transmission to 68 N·m (50 ft. lbs.) (Fig. 127).

(6) Install rear crossmember and tighten nuts to 102 N·m (75 ft. lbs.).

(7) Install transmission rear mounting bolts and tighten to 68 N·m (50 ft. lbs.).

(8) Install front dust shield.

(9) Install structural dust cover and tighten the bolts to 73 N·m (54 ft. lbs.).

(10) Install starter motor.

(11) Install suspension crossmember and tighten nuts to 102 N·m (75 ft. lbs.).

MANUAL TRANSMISSION - NV3500 (Continued)

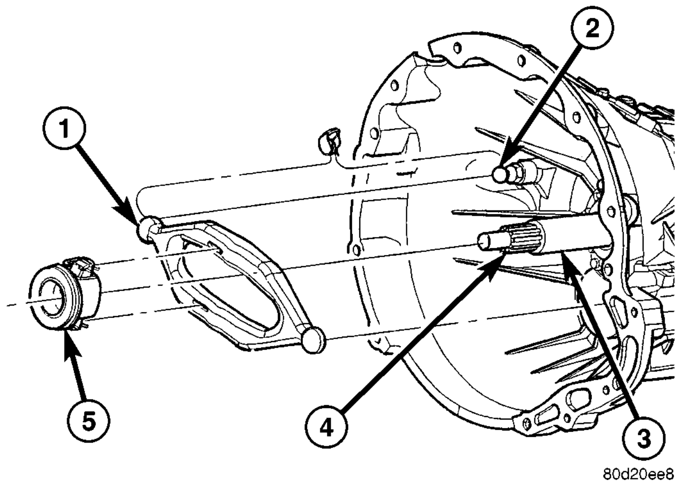


Fig. 126 LUBRICATION POINTS

1 - RELEASE FORK
2 - FORK BALL STUD
3 - BEARING SLIDE SURFACE
4 - SPLINE
5 - RELEASE BEAING

(12) Connect transmission harnesses to clips on case and connect switches.

(13) Install slave cylinder and tighten cylinder nuts to 23 N·m (200 in. lbs.).

(14) Install transfer case and transfer case linkage if equipped.

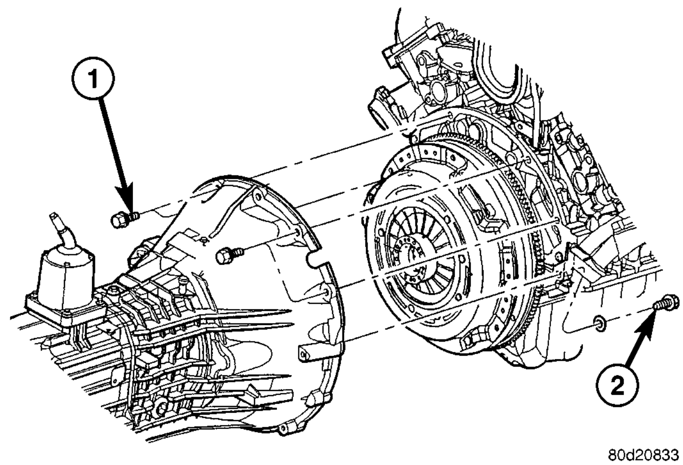


Fig. 127 TRANSMISSION

1 - BOLT WITHOUT WASHER
2 - BOLT WITH WASHER

(15) Remove transmission jack.

(16) Install propeller shaft/shafts with reference marks aligned.

(17) Install exhaust on the exhaust manifolds.

(18) Fill transmission with lubricant. Correct fill level is to bottom edge of fill plug hole.

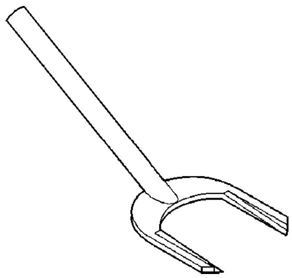
SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Crossmember Nuts	102	75	-
Transmission Mount Bolts 4WD	68	50	-
Transmission Mount Bolts 2WD	68	50	-
Structural Dust Cover Bolts	73	54	-
Drain/Fill Plug	9-27	14-20	-
Front To Rear Housing Bolts	30-35	22-26	-
Front Bearing Retainer Bolts	7-10	5-7	62-88
Idler Shaft Bolts	19-25	14-18	-
Rear Bearing Retainer Bolts	30-35	22-26	-
Shift Tower Bolts	7-10	5-7	62-88
Slave Cylinder Nuts	23	17	-
Transfer Case Nuts	47	35	-

MANUAL TRANSMISSION - NV3500 (Continued)

SPECIAL TOOLS



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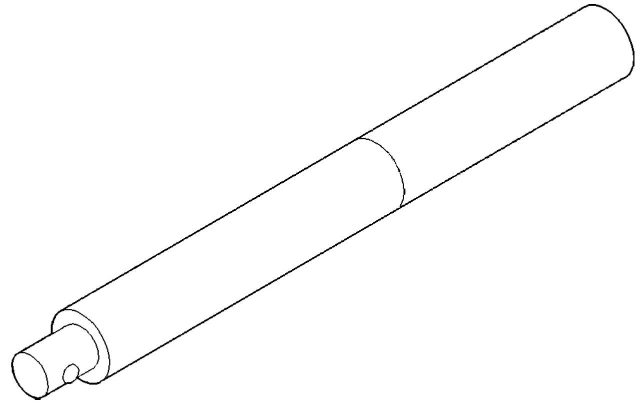
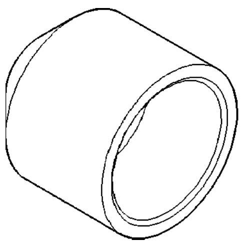
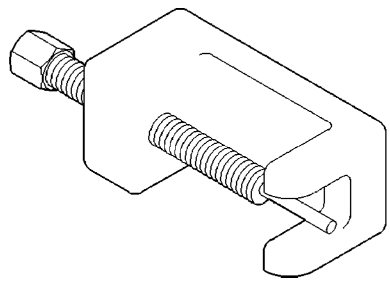


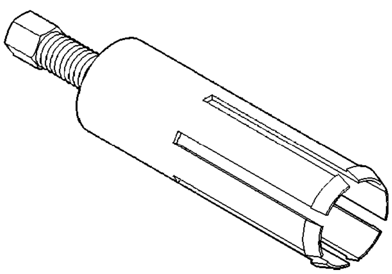
HANDLE C-4171



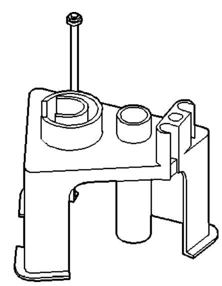
INSTALLER C-3972-A



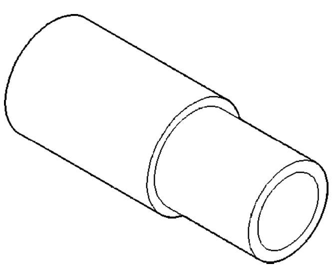
REMOVER/INSTALLER 6858



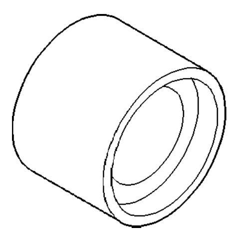
REMOVER 6957



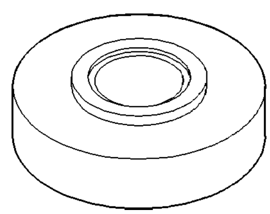
FIXTURE 6747



INSTALLER 6951

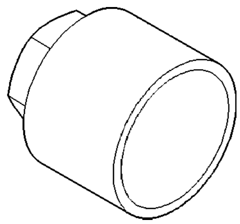


ADAPTER 6747-1A

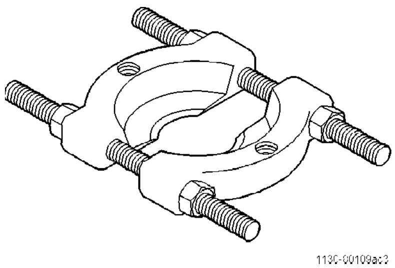


ADAPTER 6747-2A

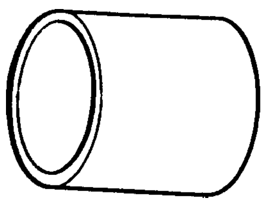
MANUAL TRANSMISSION - NV3500 (Continued)



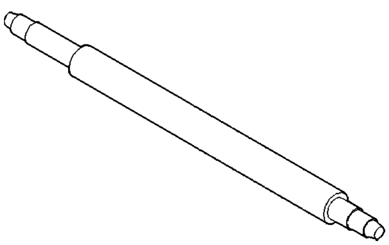
CUP 8115



BEARING SPLITTER 1130



TUBE 6310-1



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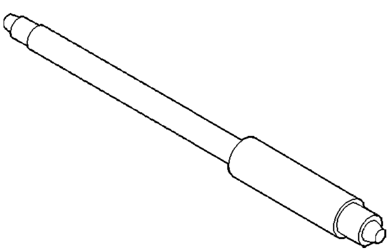
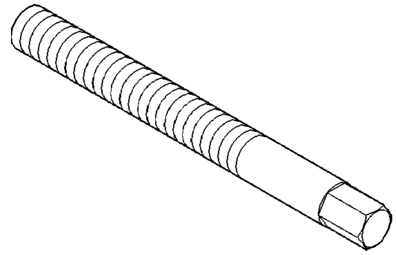
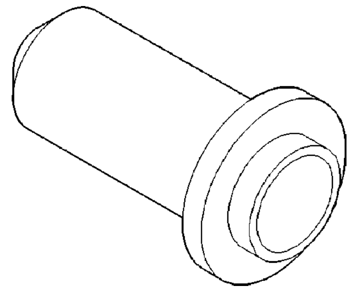


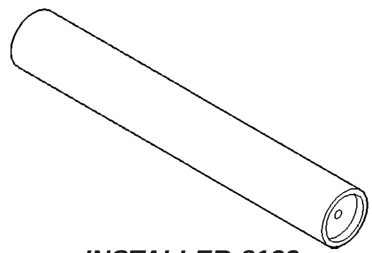
REMOVER/INSTALLER 8119



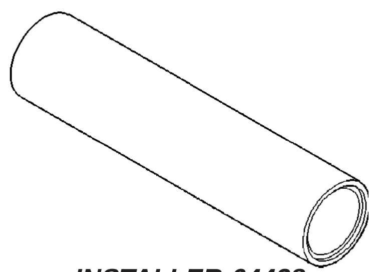
ALIGNMENT STUD 8120



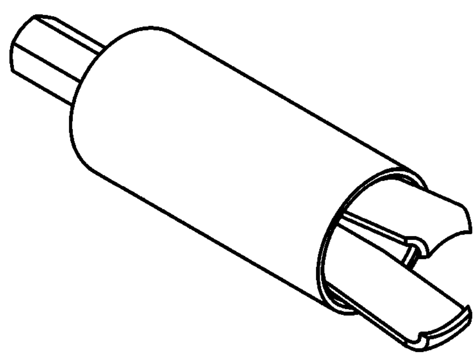
INSTALLER C-3860-A



INSTALLER 8123



INSTALLER 64428



REMOVER 8117A

MANUAL TRANSMISSION - NV4500

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MANUAL TRANSMISSION - NV4500

DESCRIPTION

The NV4500 is a five speed constant mesh manual transmission. All gear ranges including reverse are synchronized. Fifth gear is an overdrive range. The transmission has a cast iron gear case and aluminum shift cover.

Two versions are used, a standard duty for 5.7L applications and a heavy duty for V10 and Cummins diesel applications. Main difference is a larger diameter input shaft, for the heavy duty model.

Tapered roller bearings support the drive gear, mainshaft and countershaft in the gear case. Roller bearings in the drive gear support the forward end of the mainshaft. The mainshaft gears are all supported on caged type roller bearings. Drive gear thrust reaction is controlled by a needle type thrust bearing. The bearing is located at the forward end of the mainshaft.

The transmission is a top loader style. The shift lever is located in a shifter tower which is bolted to the shift cover and operates the shift forks and rails directly. The shift forks and rails are all located within the aluminum cover which is bolted to the top of the gear case.

IDENTIFICATION

The transmission identification tag is attached to the driver side PTO cover (Fig. 1).

The tag provides the transmission model number, build date and part number. Be sure to reinstall the I.D. tag if removed during service. The information on the tag is essential to correct parts ordering.

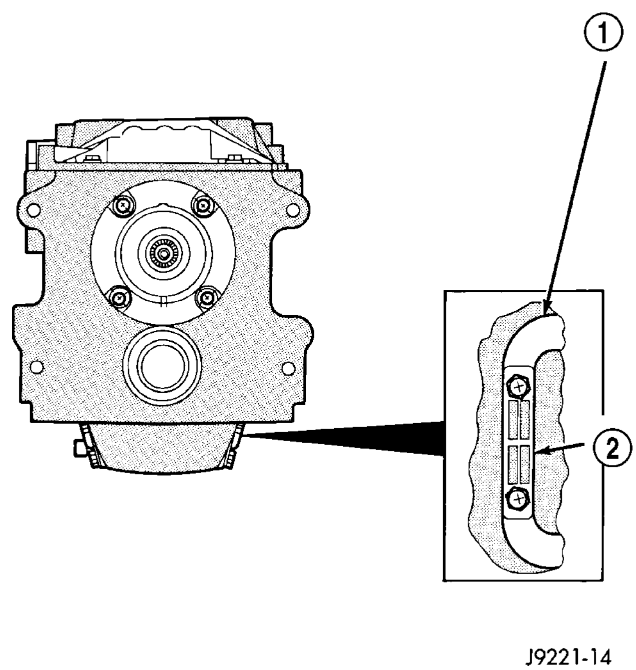


Fig. 1 IDENTIFICATION TAG LOCATION

1 - PTO COVER
2 - I.D. TAG

OPERATION

The manual transmission receives power through the clutch assembly from the engine. The clutch disc is splined to the transmission input shaft and is turned at engine speed at all times that the clutch is engaged. The input shaft is connected to the transmission countershaft through the mesh of fourth speed gear on the input shaft and the fourth countershaft gear. At this point all the transmission gears are spinning.

MANUAL TRANSMISSION - NV4500 (Continued)

The driver selects a particular gear by moving the shift lever to the desired gear position. This movement moves the internal transmission shift components to begin the shift sequence. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether the driver is up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft, or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and the friction cone and eventually will slide over the teeth, locking the gear to the mainshaft, or countershaft, through the synchronizer.

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill or an incorrect lubricant level check. A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

Leaks can occur at the mating surfaces of the gear case, adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition. Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening or use of a non-recommended sealer. A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab and or chatter.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment or damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases this condition will decline as the rings wear-in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds. Severe highly audible transmission noise is generally the initial indicator of a lubricant problem.

Insufficient, improper or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL

(1) Shift transmission into Neutral.

(2) Remove shift boot screws from floorpan and slide boot upward on the shift lever.

(3) Remove shift lever extension from shift tower and lever assembly.

(4) Remove shift tower bolts (Fig. 2).

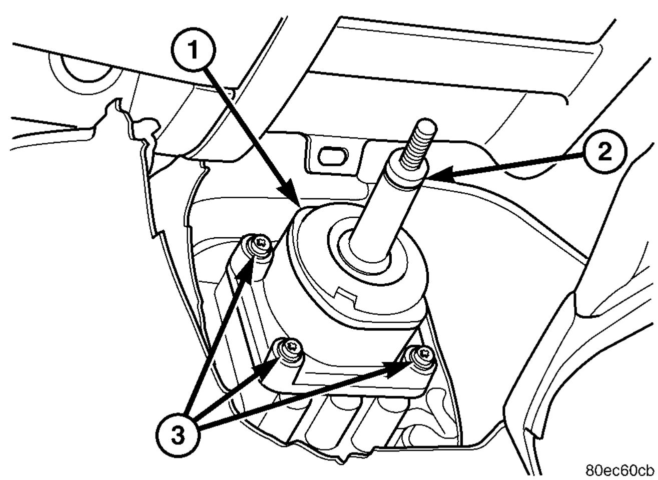


Fig. 2 SHIFT TOWER

1 - SHIFT TOWER
2 - SHIFTER
3 - BOLTS

MANUAL TRANSMISSION - NV4500 (Continued)

(5) Remove shift tower and isolator plate from transmission shift cover.

(6) Raise and support vehicle.

(7) Remove skid plate, if equipped.

(8) Mark propeller shaft and axle yokes for installation reference and remove shaft/shafts.

(9) Remove exhaust system Y-pipe.

(10) Disconnect speed sensor and backup light switch connectors.

(11) Support engine with safety stand and a wood block.

(12) If transmission is to be disassembled, remove drain bolt at bottom of PTO cover and drain lubricant (Fig. 3).

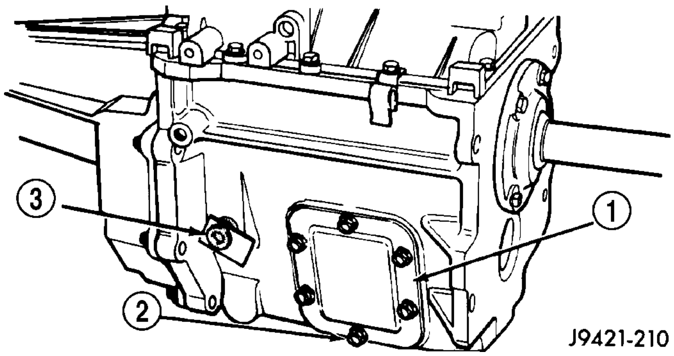


Fig. 3 FILL AND DRAIN PLUGS

1 - PTO COVER
2 - DRAIN BOLT
3 - FILL PLUG

TWO WHEEL DRIVE

(1) Remove bolts attaching transmission to rear crossmember mount.

(2) Support and secure transmission with safety chains to a transmission jack.

(3) Remove rear crossmember bolts and pry out crossmenber.

(4) Remove clutch slave cylinder bolts and move cylinder aside for clearance.

NOTE: The hydraulic linkage has a quick connect at the slave cylinder. This fitting should not be disconnected.

(5) Remove transmission harness wires from clips on transmission shift cover.

(6) Remove transmission to clutch housing bolts.

(7) Slide transmission and jack rearward until input shaft clears clutch housing.

(8) Lower transmission jack and remove transmission from under vehicle.

FOUR WHEEL DRIVE

(1) Disconnect transfer case shift linkage at transfer case range lever. Then remove transfer case shift mechanism from transmission (Fig. 4).

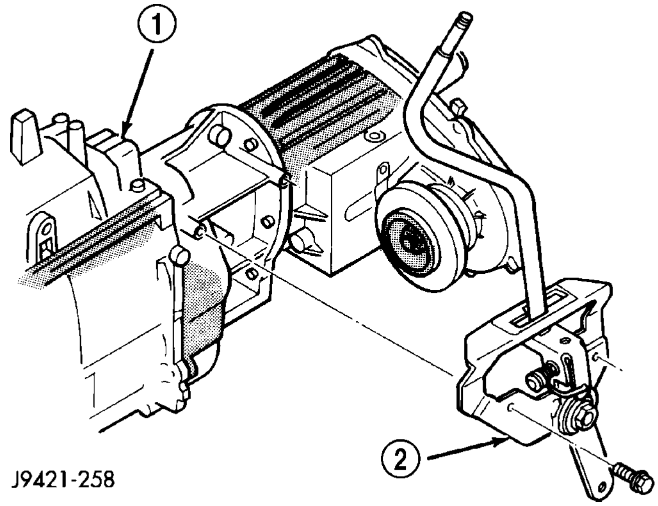


Fig. 4 TRANSFER CASE SHIFTER-TYPICAL

1 - TRANSMISSION
2 - TRANSFER CASE SHIFT MECHANISM

(2) Support and secure transfer case to transmission jack with safety chains.

(3) Remove transfer case mounting nuts.

(4) Move transfer case rearward until input gear clears transmission mainshaft.

(5) Lower transfer case assembly and move it from under vehicle.

(6) Support and secure transmission with safety chains to a transmission jack.

(7) Remove transmission harness from retaining clips on transmission shift cover.

(8) Remove bolts/nuts attaching transmission mount to rear crossmember.

(9) Remove rear crossmember bolts and pry out crossmenber.

(10) Remove clutch slave cylinder splash shield, if equipped.

(11) Remove clutch slave cylinder bolts and move cylinder aside for clearance.

NOTE: The hydraulic linkage has a quick connect at the slave cylinder. This fitting should not be disconnected.

(12) Remove transmission to clutch housing bolts.

(13) Slide transmission and jack rearward until input shaft clears clutch housing.

(14) Lower transmission jack and remove transmission from under vehicle.

DISASSEMBLY

SHIFT MECHANISM

(1) Remove bolts holding shift tower to shift mechanism cover and remove tower.

MANUAL TRANSMISSION - NV4500 (Continued)

(2) Remove bolts (Fig. 5) holding shift mechanism cover to transmission.

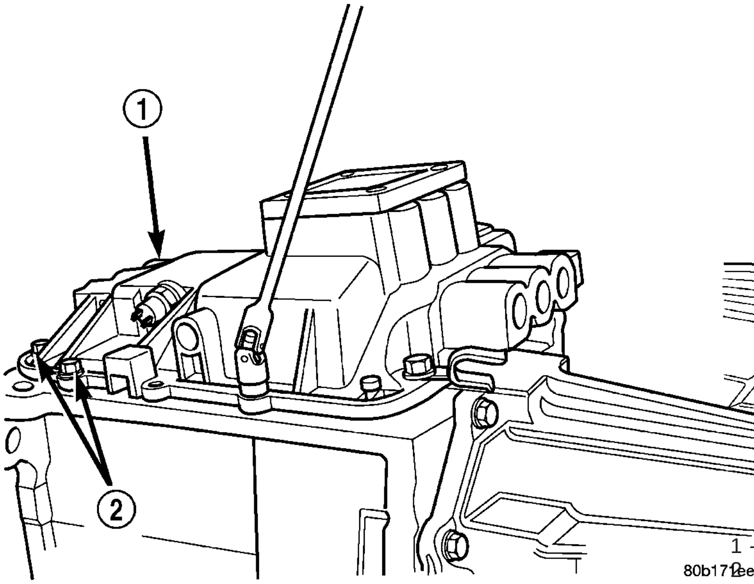


Fig. 5 SHIFT MECHANISM COVER BOLTS

1 - SHIFT MECHANISM COVER
2 - BOLTS

(3) Pry up shift mechanism cover at slot (Fig. 6) in cover.

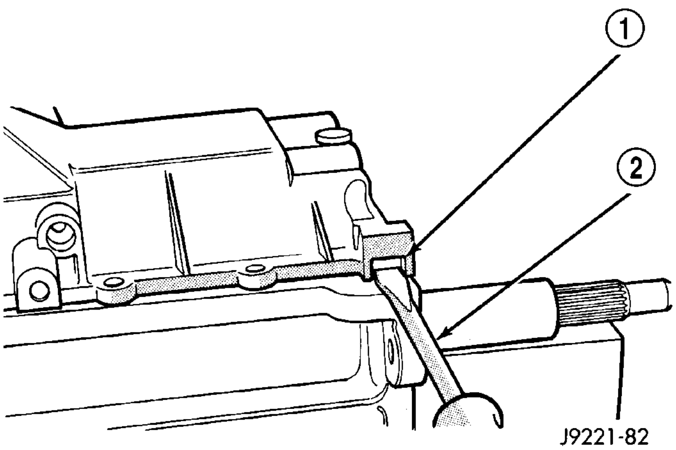


Fig. 6 LOOSEN SHIFT MECHANISM

1 - SHIFT MECHANISM COVER SLOT
2 - PRY TOOL

(4) Raise mechanism up enough to disengage it from the dowl pins (Fig. 7).

(5) Raise front of the mechanism and lift up and off the transmission.

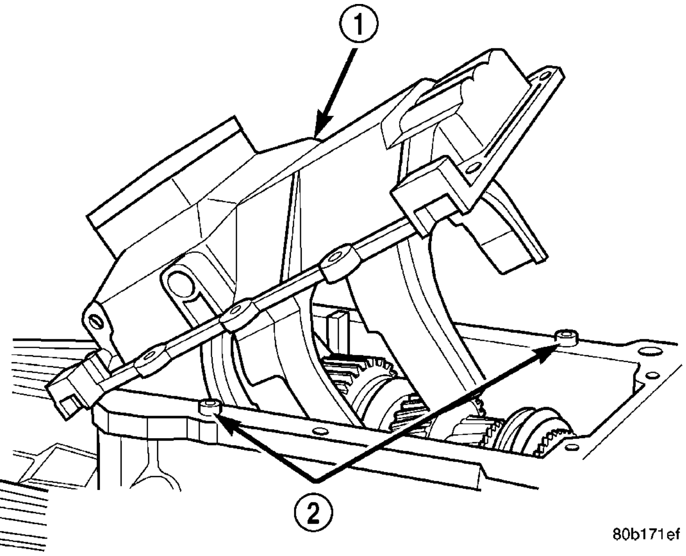


Fig. 7 SHIFT MECHANISM COVER

1 - SHIFT MECHANISM COVER
2 - ALIGNMENT DOWELS

EXTENSION/ADAPTER HOUSING

(1) Remove bolts attaching extension/adapter housing to gear case (Fig. 8).

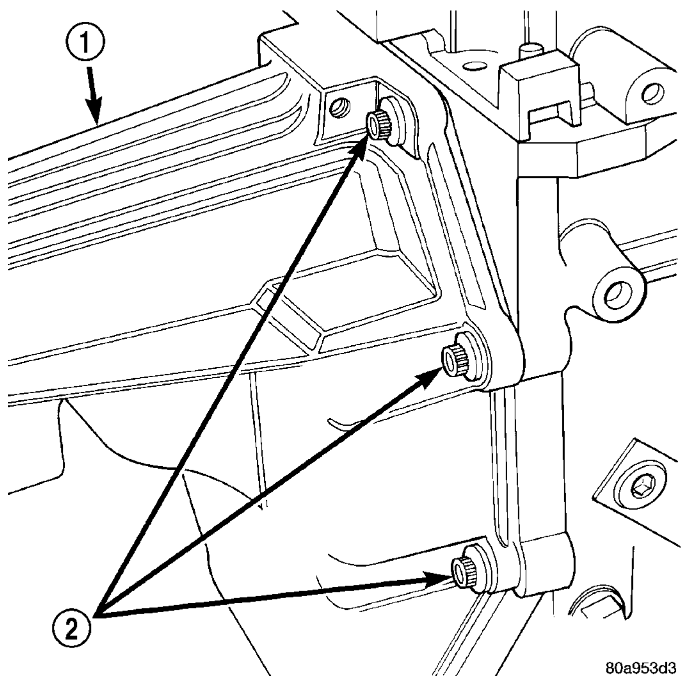


Fig. 8 EXTENSION/ADAPTER HOUSING BOLTS

1 - EXTENSION HOUSING
2 - BOLTS (8)

MANUAL TRANSMISSION - NV4500 (Continued)

(2) Remove extension/adapter housing (Fig. 9). There is one alignment dowel in the gear case and one in the extension/adapter housing.

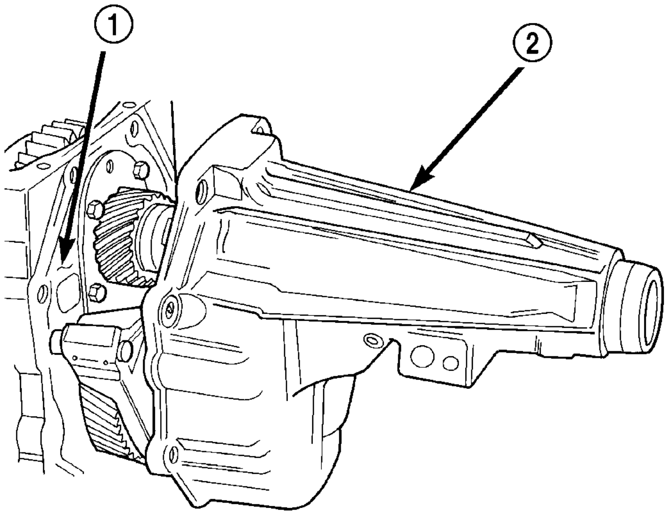


Fig. 9 EXTENSION/ADAPTER HOUSING

1 - GEAR CASE
2 - EXTENSION HOUSING

(3) Remove rubber spline seal from end of main-shaft (Fig. 10). The seal is used to prevent lubricant loss during shipping and does not have to be replaced if damaged.

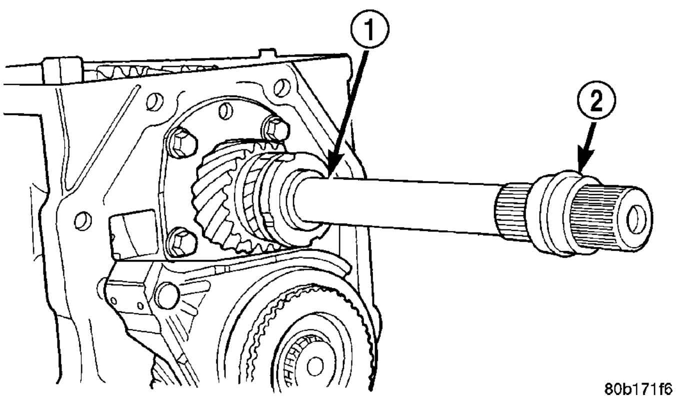


Fig. 10 MAINSHAFT SPLINE SEAL

1 - MAINSHAFT
2 - RUBBER SPLINE SEAL

FIFTH GEAR NUT

(1) Remove extension/adapter housing.
(2) Loosen fifth gear clamp nut clamping screw approximately 1 1/2 turns.
(3) Install Wrench 6743 on fifth gear nut (Fig. 11).

NOTE: Wrench only fits one way on nut. Make sure wrench is fully engaged in nut slots and is not cocked.

(4) Install Socket 6993 4X2 or Socket 6984 4X4 with breaker bar to hold mainshaft and remove fifth gear nut.

NOTE: Wedge breaker bar handle against workbench. Purpose of socket wrench and breaker bar is to prevent mainshaft from turning while nut is loosened.

(5) Remove fifth gear nut, then remove belleville washer from mainshaft.

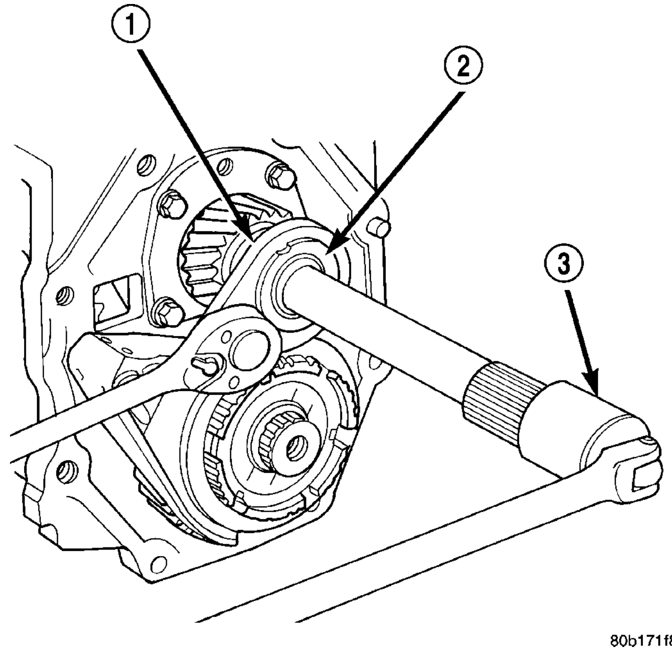


Fig. 11 FIFTH GEAR NUT

1 - WRENCH
2 - FIFTH GEAR NUT
3 - SPLINE SOCKET

FIFTH GEAR

(1) Remove fifth gear shift fork roll pins (Fig. 12). Drive roll pins out from the bottom of fork.

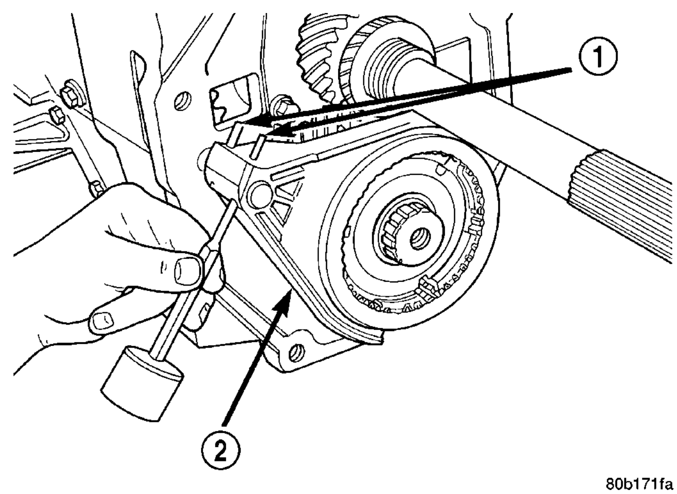


Fig. 12 FIFTH GEAR SHIFT FORK ROLL PINS

1 - ROLL PINS
2 - FIFTH GEAR SHIFT FORK

MANUAL TRANSMISSION - NV4500 (Continued)

(2) Remove fifth gear clutch hub and gear snap ring from countershaft (Fig. 13).

(3) Remove countershaft fifth gear clutch gear and stop ring.

(4) Tap off fifth gear shift fork and gear assembly off rail with plastic mallet.

(5) Remove fifth gear shift fork from sleeve.

(6) Remove sleeve, struts and strut springs from countershaft fifth gear hub, if necessary.

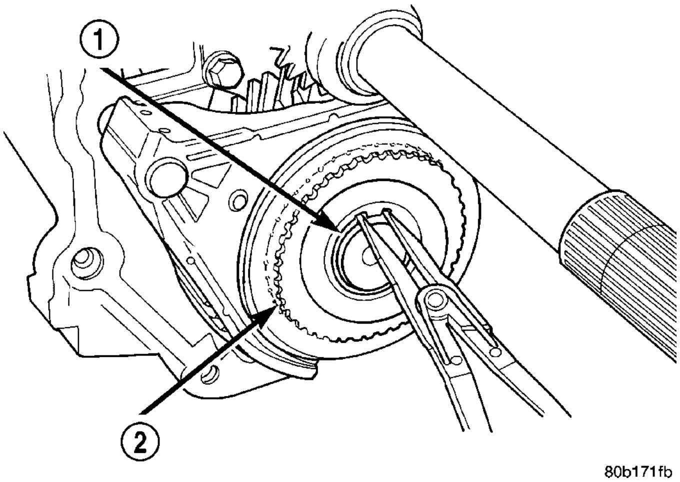


Fig. 13 FIFTH GEAR CLUTCH GEAR SNAP RING

1 - CLUTCH GEAR RING
2 - FIFTH SYNCHRO CLUTCH GEAR

(7) Remove countershaft fifth gear needle bearing assembly (Fig. 14).

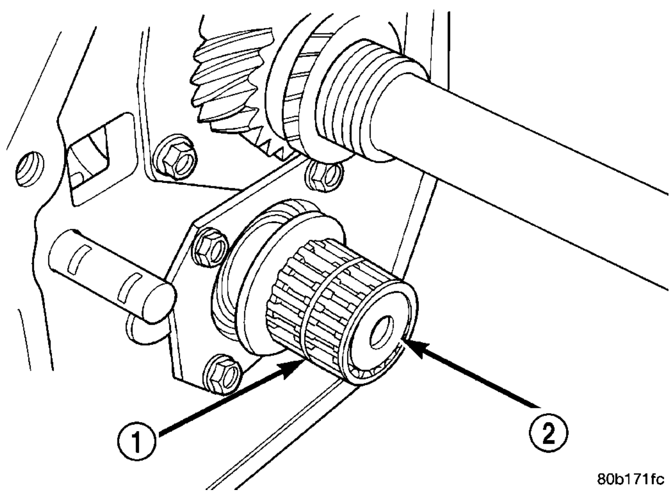


Fig. 14 COUNTERSHAFT FIFTH GEAR NEEDLE BEARING

1 - NEEDLE BEARING
2 - COUNTERSHAFT

(8) Remove coned shape rear bearing thrust washer from countershaft (Fig. 15).

NOTE: Note washer bore locating notch for assembly reference.

(9) Remove thrust washer locating pin from countershaft.

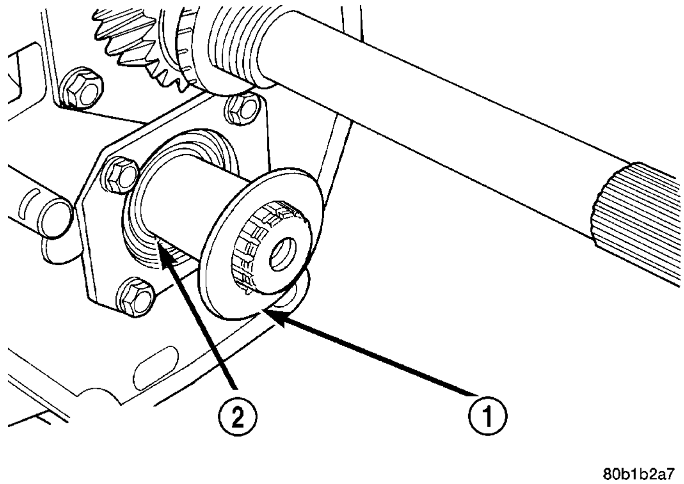


Fig. 15 COUNTERSHAFT REAR BEARING THRUST WASHER

1 - THRUST WASHER
2 - THRUST WASHER PIN

(10) Remove mainshaft fifth gear with Puller Set 6444 and Jaw 6459 or 6820. Position first Jaw on gear (Fig. 16).

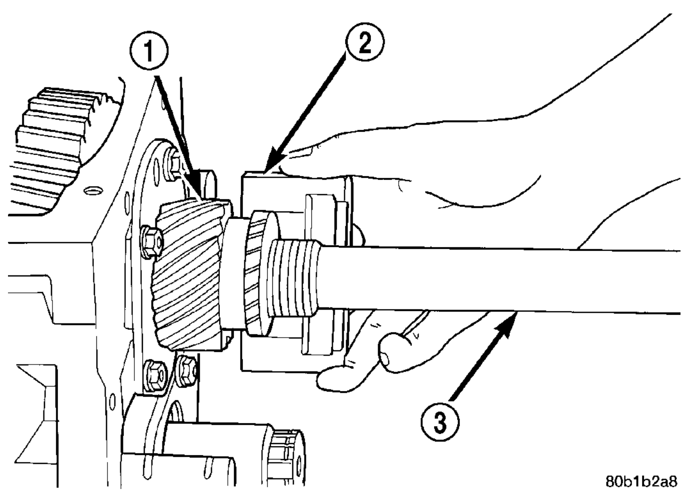


Fig. 16 JAW ON MAINSHAFT FIFTH GEAR

1 - MAINSHAFT FIFTH GEAR
2 - JAW
3 - MAINSHAFT

MANUAL TRANSMISSION - NV4500 (Continued)

(11) Assemble Puller Flange 6444-1and Puller Rods 6444-3 4X2 or 6444-4 4X4 (Fig. 17). Slide assembly onto output shaft and seat flange in notch of jaw.

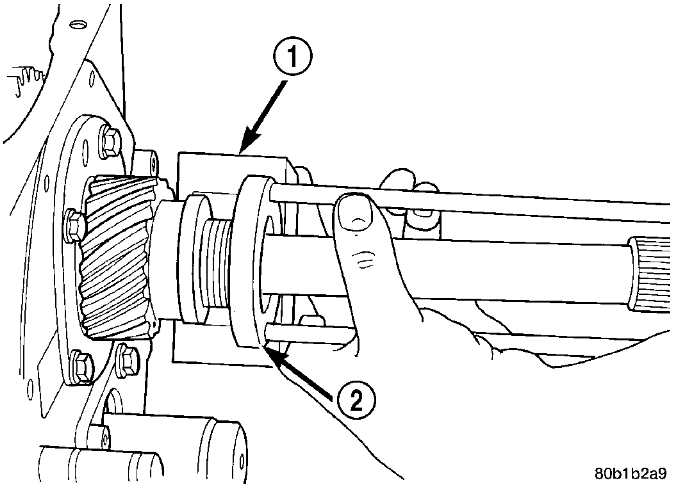


Fig. 17 PULLER FLANGE

1 - JAW
2 - PULLER FLANGE

(12) Position second puller jaw on gear and in notch of puller flange (Fig. 18). Slide Collar 6444-8 over puller jaws to hold them in place.

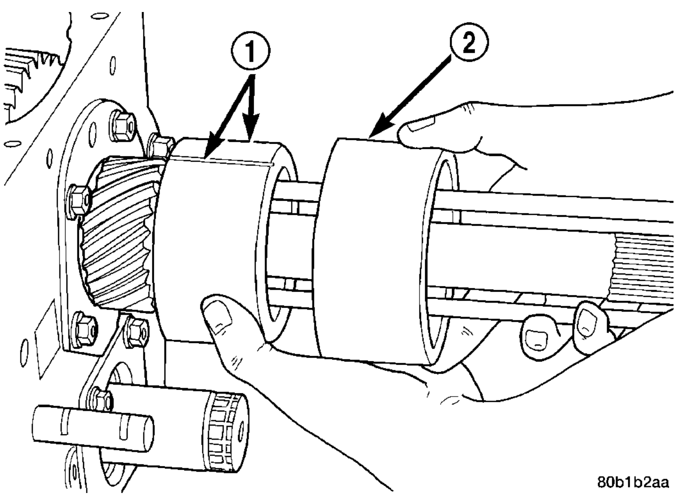


Fig. 18 PULLER COLLAR

1 - JAWS
2 - COLLAR

(13) Install Puller and Bolt 6444 on puller rods and secure puller to rods with retaining nuts (Fig. 19). Tighten puller bolt to remove gear from shaft splines.

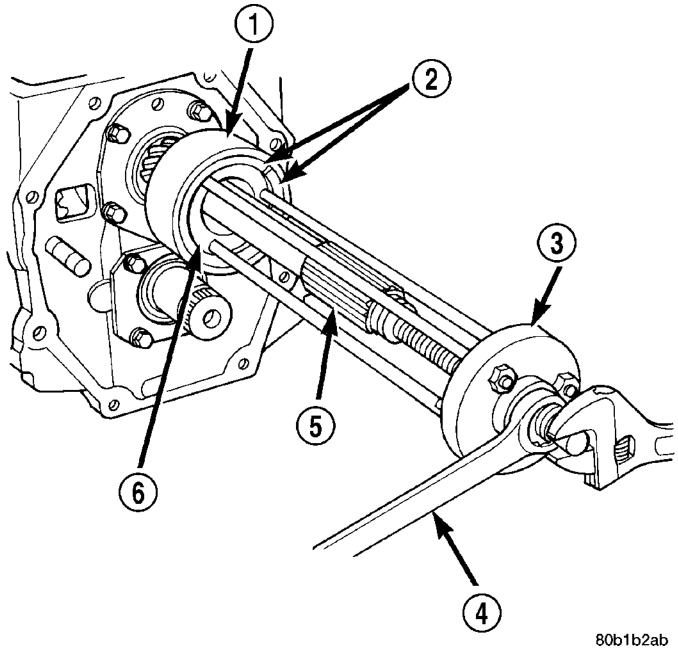


Fig. 19 PULLER ASSEMBLY

1 - COLLAR
2 - JAWS
3 - BOLT
4 - WRENCH
5 - MAINSHAFT
6 - PULLER FLANGE

(14) Remove mainshaft rear bearing plate bolts and remove fifth gear plate end play shims and bearing cup (Fig. 20).

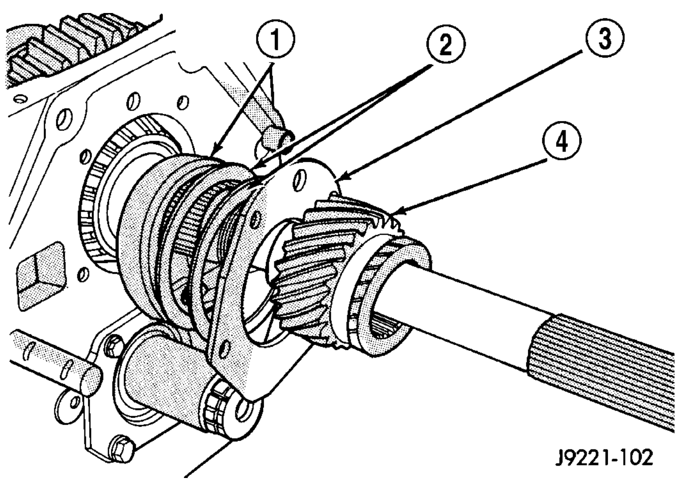


Fig. 20 FIFTH GEAR BEARING PLATE, SHIMS AND BEARING CUP

1 - MAINSHAFT REAR BEARING CUP
2 - BEARING SHIMS
3 - BEARING PLATE
4 - FIFTH GEAR

MANUAL TRANSMISSION - NV4500 (Continued)

FRONT RETAINER

(1) Remove and discard front bearing retainer bolts (Fig. 21).

CAUTION: Do not reuse retainer bolts.

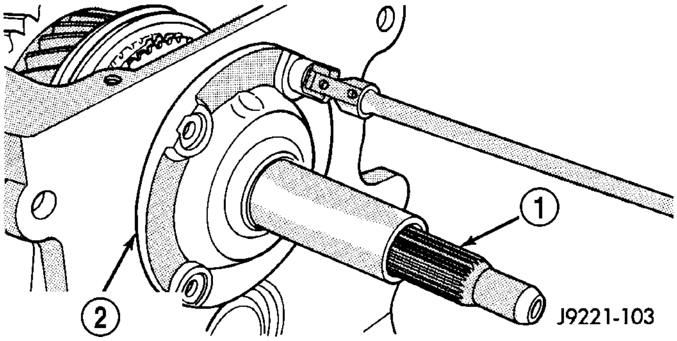


Fig. 21 FRONT BEARING RETAINER

1 - DRIVE GEAR
2 - FRONT BEARING RETAINER

(2) Lightly tap retainer back and forth with plastic mallet to work it out of gear case.

NOTE: Retainer flange extends into transmission case and is a snug fit.

(3) Remove front retainer seal by (Fig. 22) collapsing one side of seal then prying it out.

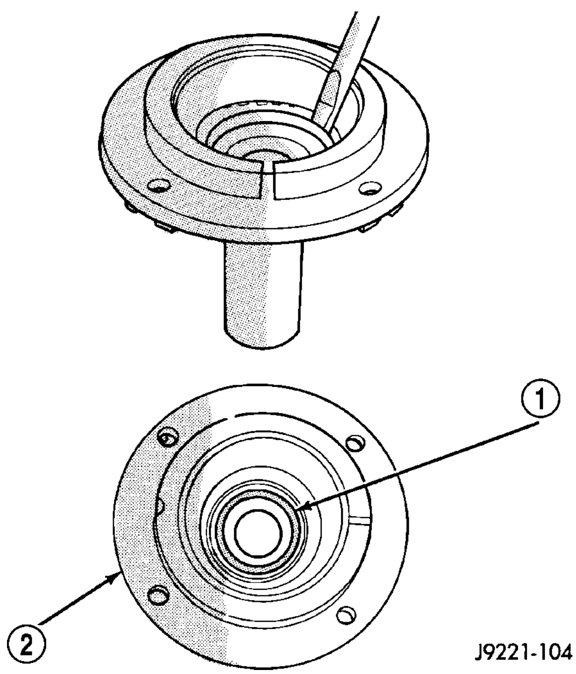


Fig. 22 BEARING RETAINER SEAL

1 - SEAL
2 - FRONT BEARING RETAINER

(4) Remove front retainer bearing cup with Puller 6444. Assemble Puller Flange 6444-1 and Puller Rods 6444-4 (Fig. 23). Insert Jaws 6453-1 in puller flange. Narrow lip of puller jaws will go under bearing cup.

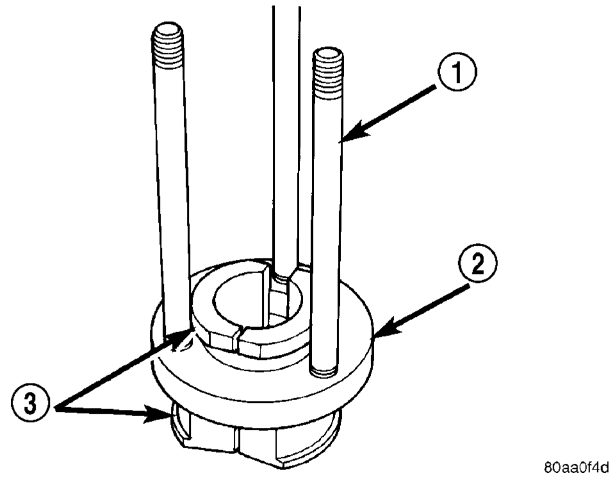


Fig. 23 PULLER RODS, FLANGE AND JAWS

1 - RODS
2 - FLANGE
3 - JAWS

(5) Install Disc C-4487-1 into bearing retainer for Insert 6453-2 to rest upon.

(6) Install assembled tools in front retainer (Fig. 24) with puller jaws seated under bearing cup. Place Insert 6453-2 in center of puller jaws, to hold puller jaws in place.

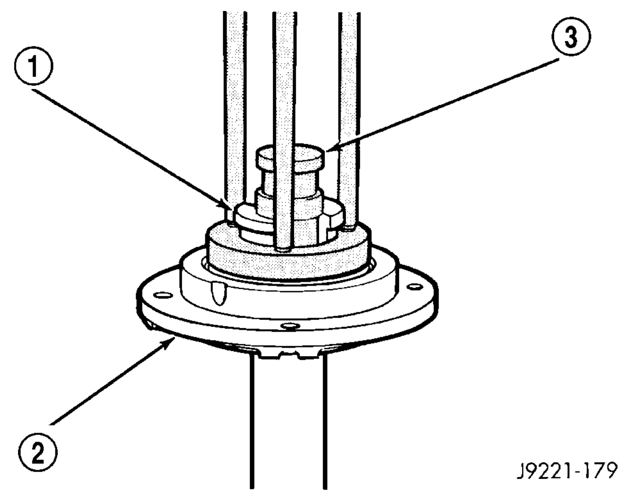


Fig. 24 INSERT AND RETAINER

1 - INSERT
2 - FRONT RETAINER
3 - JAWS

MANUAL TRANSMISSION - NV4500 (Continued)

(7) Install Puller 6444 on puller rods (Fig. 25) and install retaining nuts on puller rods. Tighten puller bolt to draw bearing cup out of retainer.

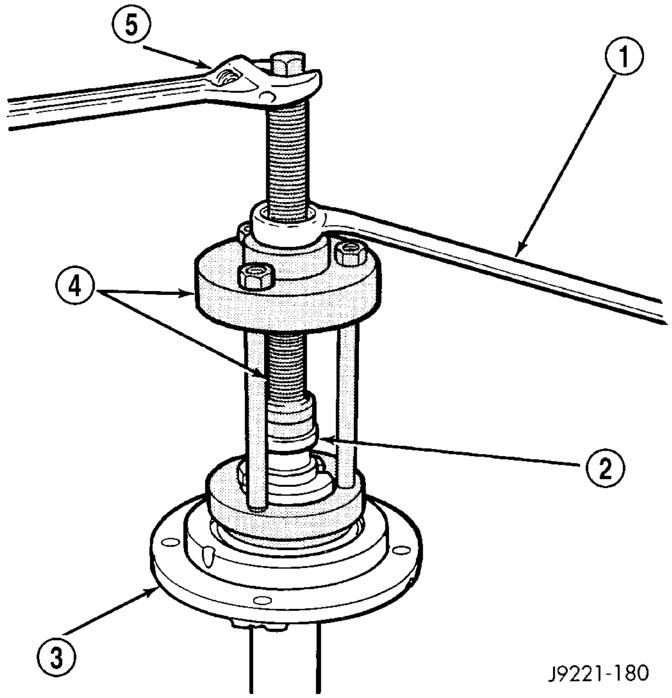


Fig. 25 BEARING CUP PULLER ASSEMBLY

1 - WRENCH
2 - INSERT
3 - FRONT RETAINER
4 - PULLER
5 - WRENCH

DRIVE GEAR

(1) Remove drive gear (Fig. 26).
(2) Remove pilot bearing from drive gear (Fig. 27).
(3) Remove tapered bearing from drive gear with Puller Flange 6444-1 and Puller Rods 6444-6 (Fig. 28).
(4) Position first Jaw 6447 on bearing. Slide assembled puller flange and rod tools onto input shaft. Then seat flange in notch of puller jaw.
(5) Position second Jaw 6447 on gear and in notch of puller flange. Slide Collar 6444-8 over puller jaws to hold them in place.
(6) Install Puller 6444 on puller rods then install retaining nuts. Tighten puller bolt to remove bearing cone from drive gear.

MAINSHAFT AND GEARTRAIN

(1) Move 1-2 and 3-4 synchro sleeves into neutral.
(2) Remove drive gear thrust bearing from forward end of mainshaft (Fig. 29).
(3) Remove fourth gear clutch gear and synchro stop ring from mainshaft (Fig. 30).
(4) Roll gear case onto left side.

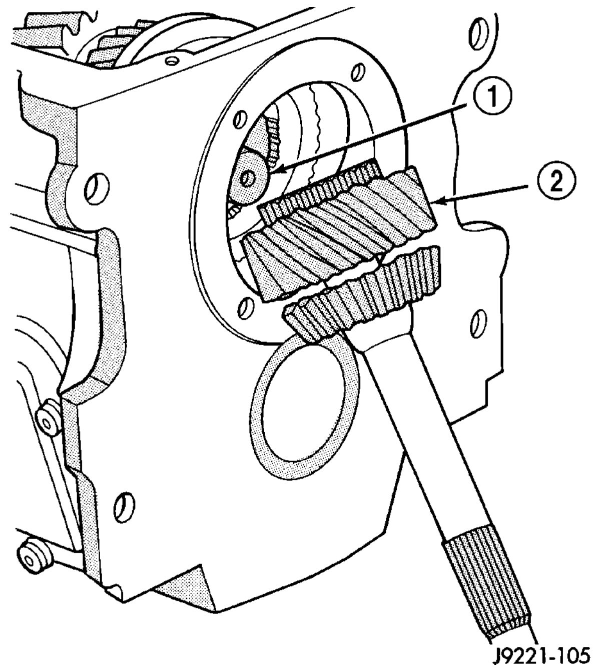


Fig. 26 DRIVE GEAR

1 - MAINSHAFT
2 - DRIVE GEAR

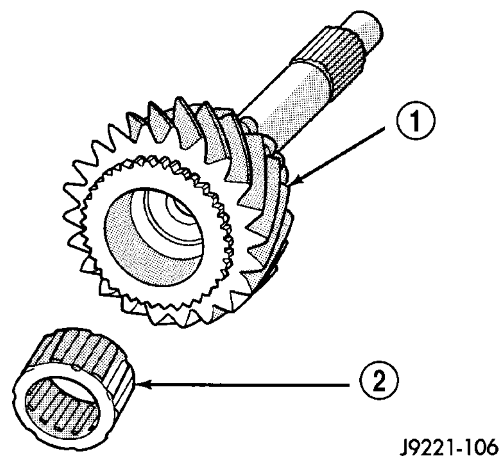


Fig. 27 PILOT BEARING

1 - DRIVE GEAR
2 - MAINSHAFT PILOT BEARING

(5) Remove mainshaft assembly (Fig. 31) by lifting front end of mainshaft slightly. Then grasp mainshaft rear splines and turn spline end of mainshaft counterclockwise to rotate shaft and geartrain out of case. Tilt mainshaft outward and removed from case.

NOTE: Handling mainshaft carefully because gears are lose on the mainshaft.

REVERSE IDLER AND COUNTERSHAFT

(1) Remove countershaft rear bearing plate (Fig. 32).

MANUAL TRANSMISSION - NV4500 (Continued)

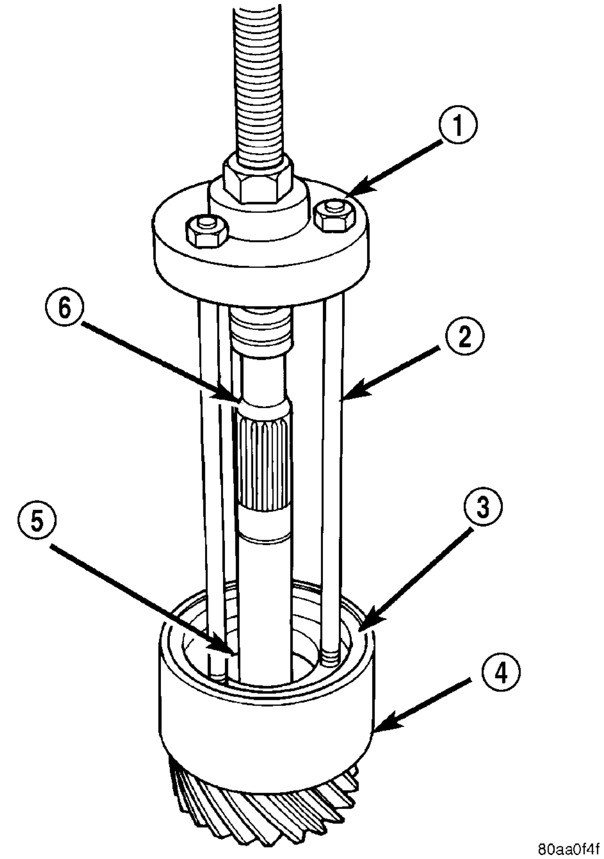


Fig. 28 FRONT BEARING PULLER

1 - PULLER
2 - RODS
3 - JAWS
4 - COLLAR
5 - FLANGE
6 - DRIVE GEAR

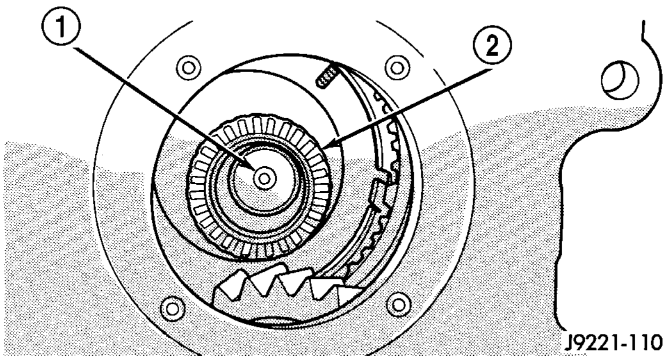


Fig. 29 DRIVE GEAR THRUST BEARING

1 - MAINSHAFT
2 - DRIVE GEAR THRUST BEARING

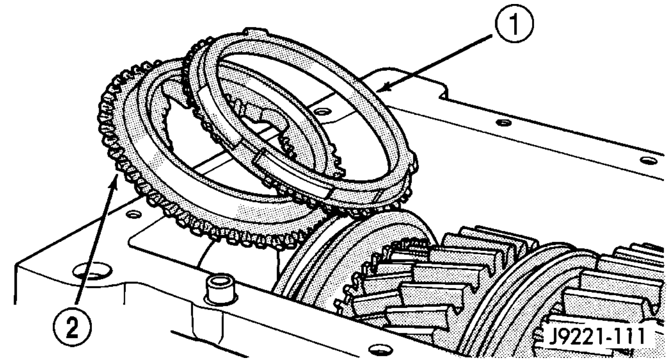


Fig. 30 FOURTH GEAR CLUTCH GEAR STOP RING

1 - FOURTH GEAR SYNCHRO STOP RING
2 - FOURTH SPEED CLUTCH GEAR

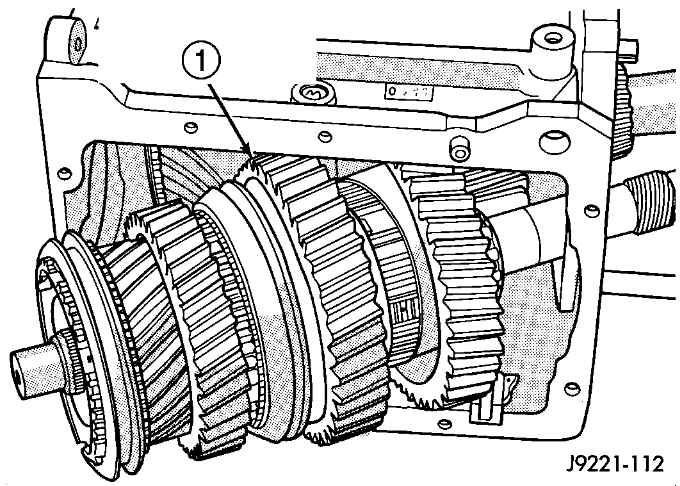


Fig. 31 MAINSHAFT AND GEARTRAIN

1 - MAINSHAFT AND CASE

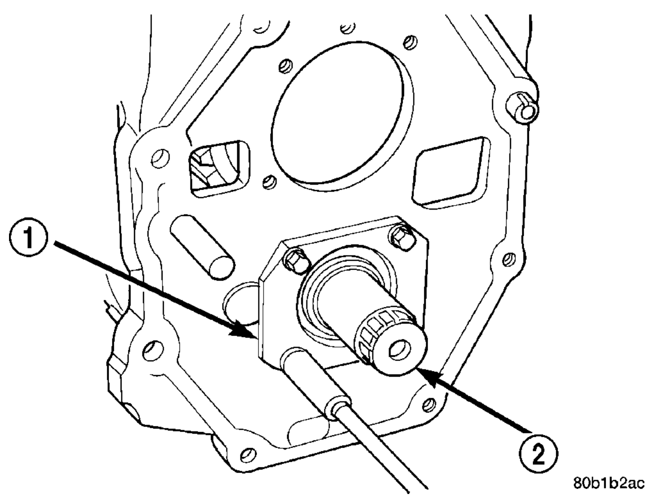


Fig. 32 COUNTERSHAFT REAR BEARING PLATE

1 - REAR BEARING PLATE
2 - COUNTERSHAFT

MANUAL TRANSMISSION - NV4500 (Continued)

(2) Remove countershaft end play shim and rear bearing cup (Fig. 33).

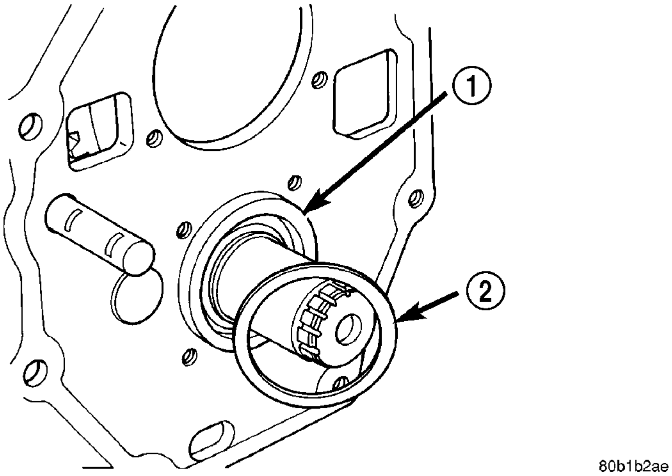


Fig. 33 END PLAY SHIM AND REAR BEARING CUP

1 - COUNTERSHAFT REAR BEARING CUP
2 - END PLAY SHIM

(3) Remove reverse idler shaft (Fig. 34).

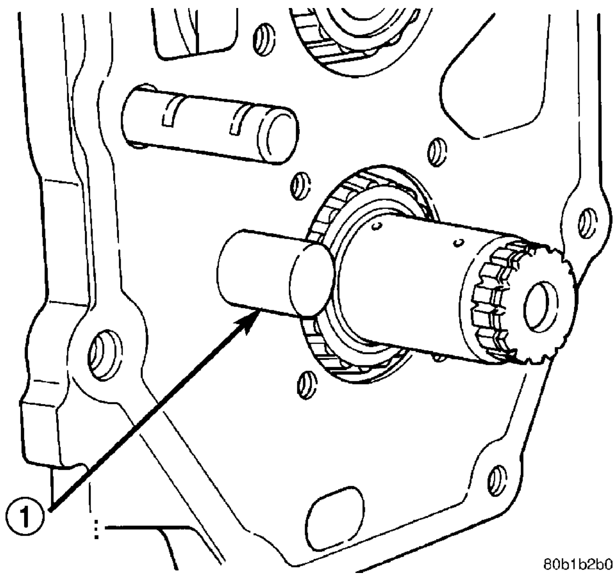


Fig. 34 REVERSE IDLER SHAFT

1 - REVERSE IDLER SHAFT

(4) Rotate countershaft outward and push reverse idler gear away from countershaft and toward front of case (Fig. 35).

(5) Remove idler gear (Fig. 36).

(6) Keep reverse idler gear bearings and spacer together (Fig. 37). Insert idler shaft through gear and bearings to keep them in place.

(7) Remove idler gear thrust washers from gear case. Install washers on idler shaft to keep them together for cleaning and inspection.

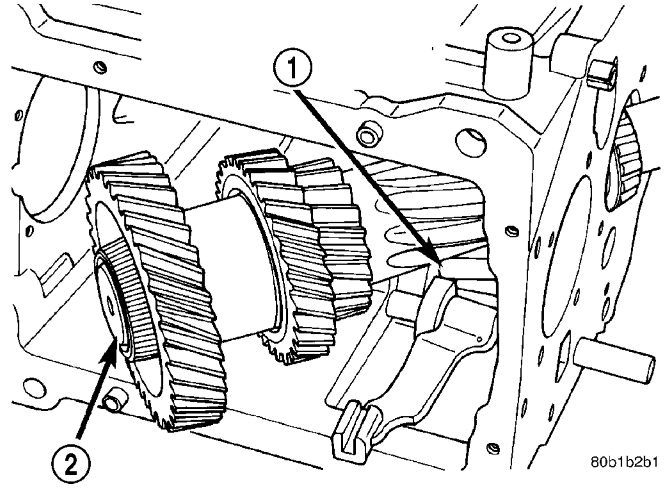


Fig. 35 IDLER GEAR AND COUNTERSHAFT

1 - REVERSE IDLER GEAR
2 - COUNTERSHAFT

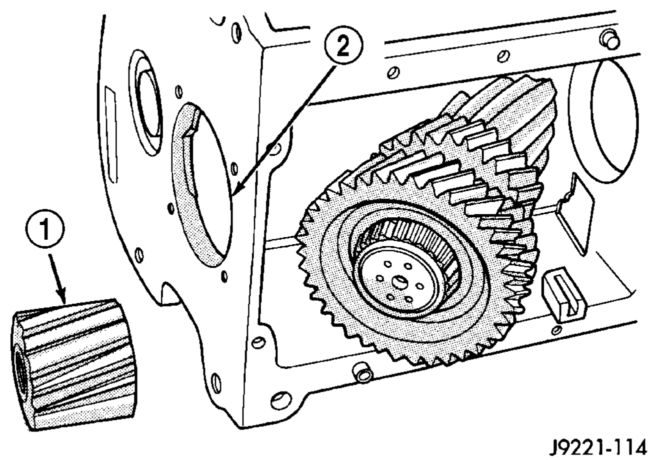


Fig. 36 REVERSE IDLER GEAR

1 - REVERSE IDLER GEAR
2 - DRIVE GEAR BORE

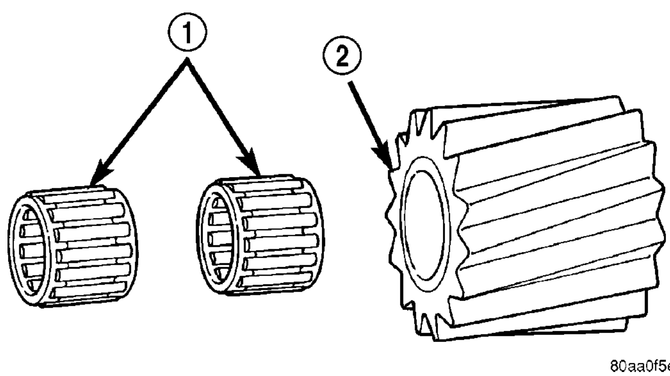


Fig. 37 IDLER GEAR COMPONENTS

1 - BEARINGS
2 - REVERSE IDLER GEAR

MANUAL TRANSMISSION - NV4500 (Continued)

(8) Remove countershaft rear bearing with Puller Flange 6444-1 and Puller Rods 6444-4 (Fig. 38).

NOTE: Shaft cannot be removed from case until rear bearing has been removed.

(9) Position first Jaw 6449 on bearing cone and seat puller flange in notch of puller.

(10) Install second Jaw 6449 on bearing and in notch of puller flange. Slide Collar 6444-8 over puller jaws to hold them in place.

NOTE: Retaining collar has small lip on one end and only fits one way over jaws.

(11) Install Puller 6444 on puller rods, then secure puller to rods with retaining nuts.Tighten puller bolt to remove bearing from shaft.

NOTE: If bearing is exceptionally tight, tap end of puller bolt with copper mallet to help loosen bearing.

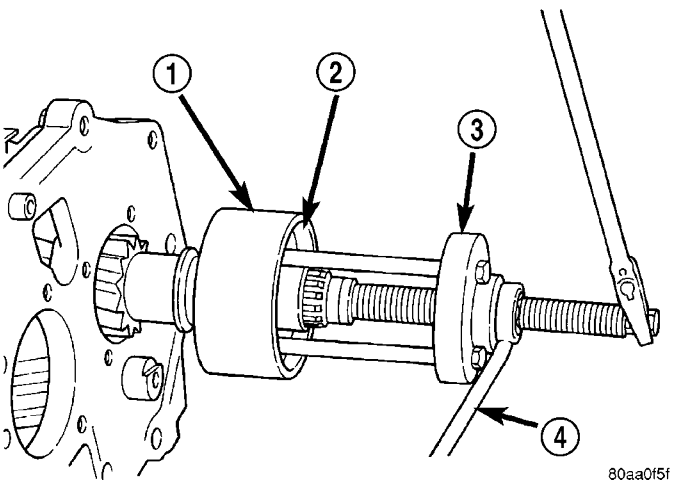


Fig. 38 COUNTERSHAFT REAR BEARING

1 - COLLAR
2 - JAWS
3 - PULLER
4 - WRENCH

(12) Remove bearing puller tools then rotate countershaft out of gear case (Fig. 39).

(13) Remove countershaft front bearing, with Puller Flange 6444-1 and Puller Bolts 6444-4 (Fig. 40).

(14) Position first Jaw 6451 on bearing and seat puller flange in notch of puller jaw.

(15) Install second Jaw 6451 on bearing and in notch of puller flange. Slide Collar 6444-8 over puller jaws to hold them in place.

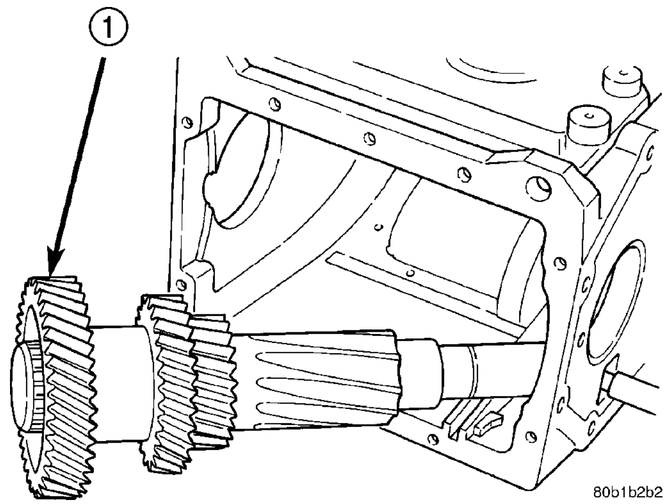


Fig. 39 COUNTERSHAFT AND CASE

1 - COUNTERSHAFT

NOTE: Retaining collar has small lip on one end and only fits one way over jaws.

(16) Install puller bridge and bolt assembly 6444 on puller bolts and install retaining nuts. Tighten puller bolt to remove bearing from shaft.

NOTE: If bearing is exceptionally tight, tap end of puller bolt with mallet to help loosen bearing.

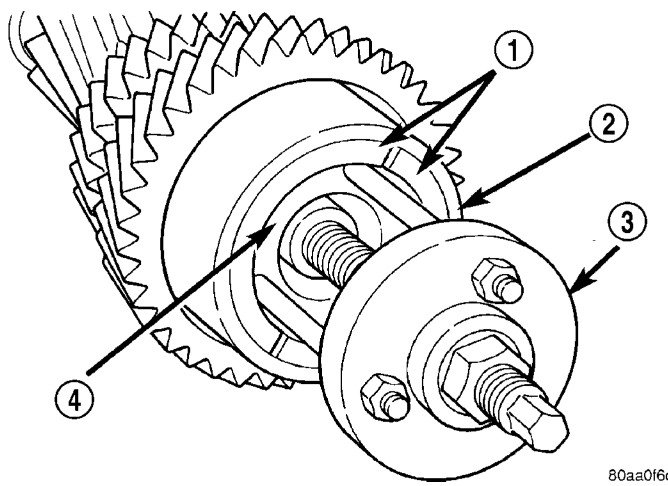


Fig. 40 Countershaft Front Bearing

1 - JAWS
2 - COLLAR
3 - PULLER
4 - FLANGE

(17) Remove bearing puller tools.

MANUAL TRANSMISSION - NV4500 (Continued)

GEAR CASE

(1) Remove countershaft front bearing cap with hammer (Fig. 41).

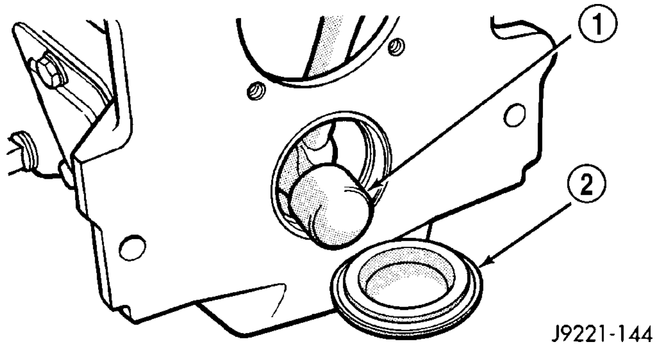


Fig. 41 COUNTERSHAFT FRONT BEARING CAP

1 - HAMMER
2 - BEARING CAP

(2) Remove countershaft front bearing cup with Remover 6454 and Handle C-4171 (Fig. 42).

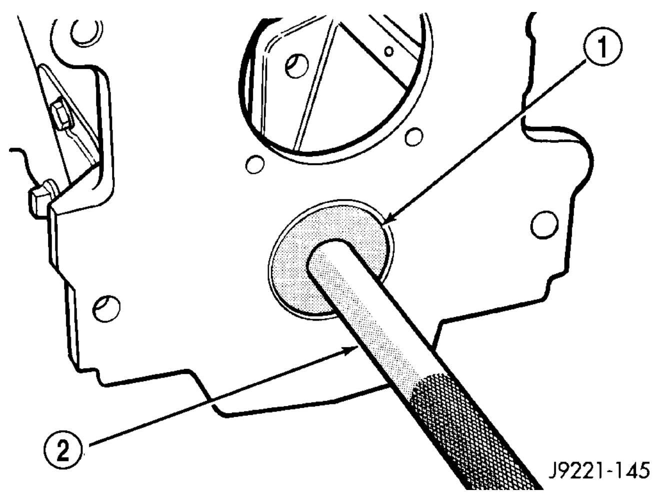


Fig. 42 COUNTERSHAFT FRONT BEARING CUP

1 - REMOVER
2 - HANDLE

(3) Remove roll pin that secures shift lug on shift rail in case (Fig. 43). A small pin punch can be modified by putting a slight bend in it to drive pin completely out of shift rail (Fig. 43).

(4) Remove shift lug rail.

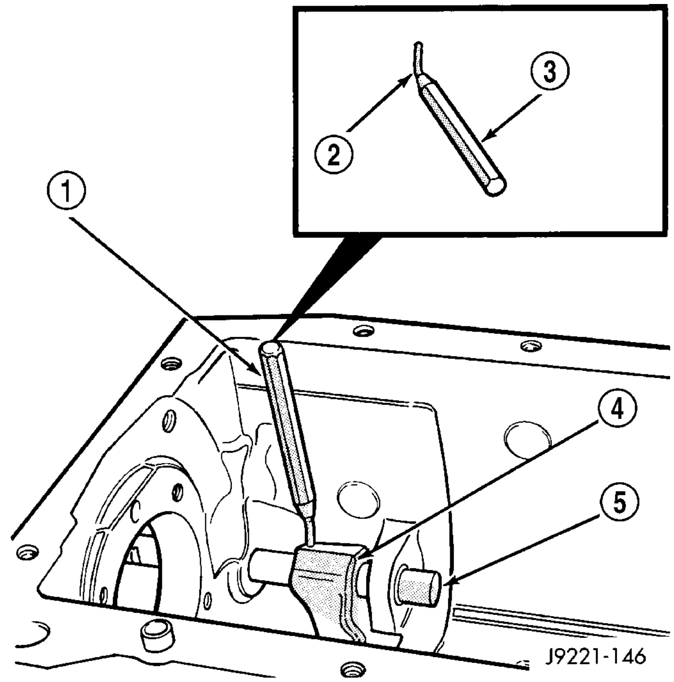


Fig. 43 SHIFT LUG ROLL PIN

1 - PUNCH
2 - 30° BEND
3 - PIN PUNCH MODIFICATION
4 - SHIFT LUG
5 - SHIFT RAIL

MAINSHAFT

NOTE: Gear and synchro components can be installed backwards. Paint or scribe gear and synchro components for installation reference. Then stack geartrain parts in order of removal.

(1) Remove drive gear thrust bearing from end of mainshaft, if not previously removed.

(2) Place 3-4 gear in a press with support under 3rd gear and Remove 3-4 synchro hub, third gear stop ring and third gear as an assembly (Fig. 44).

(3) Remove third gear bearing from mainshaft (Fig. 45).

(4) Remove third gear bearing spacer (Fig. 46).

(5) Remove second gear thrust washer snap ring from mainshaft (Fig. 46).

(6) Remove second gear thrust washer (Fig. 47). Note washer notch for locating pin.

MANUAL TRANSMISSION - NV4500 (Continued)

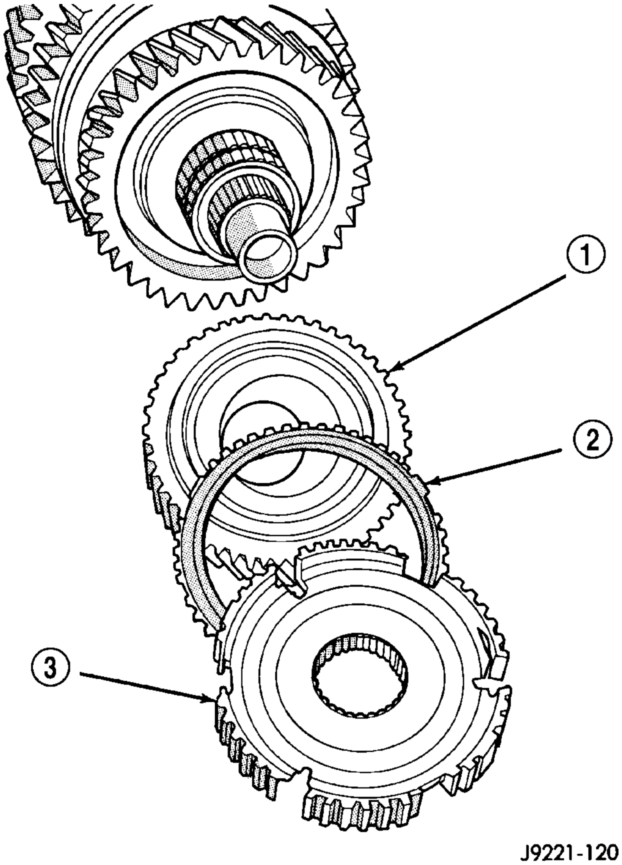


Fig. 44 THIRD GEAR, STOP RING, AND 3-4 HUB

1 - THIRD GEAR
2 - THIRD GEAR STOP RING
3 - 3-4 SYNCHRO HUB

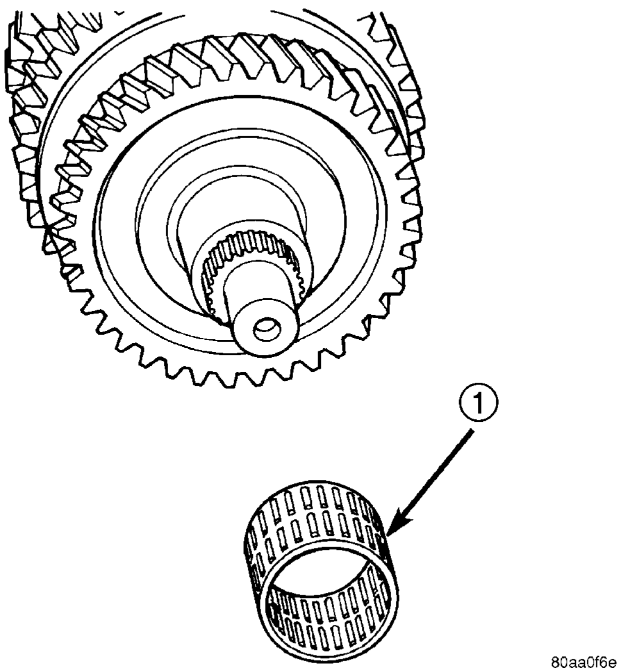


Fig. 45 THIRD GEAR BEARING

1 - THIRD GEAR NEEDLE BEARING

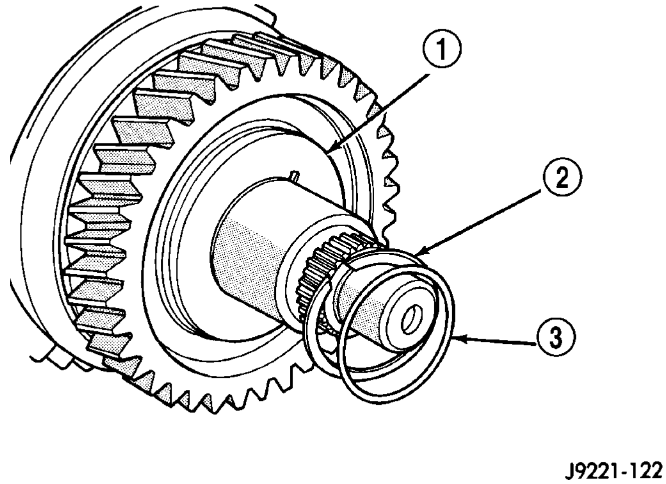


Fig. 46 SNAP RING AND THIRD GEAR BEARING SPACER

1 - SECOND GEAR THRUST WASHER
2 - THRUST WASHER SNAP RING
3 - THIRD GEAR BEARING SPACER

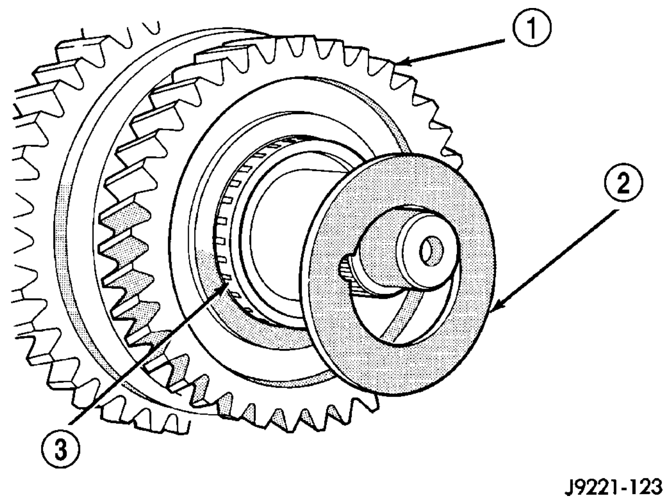


Fig. 47 SECOND GEAR THRUST WASHER

1 - SECOND GEAR
2 - THRUST WASHER
3 - SECOND GEAR BEARING

MANUAL TRANSMISSION - NV4500 (Continued)

(7) Remove thrust washer locating pin (Fig. 48) with needle nose pliers.

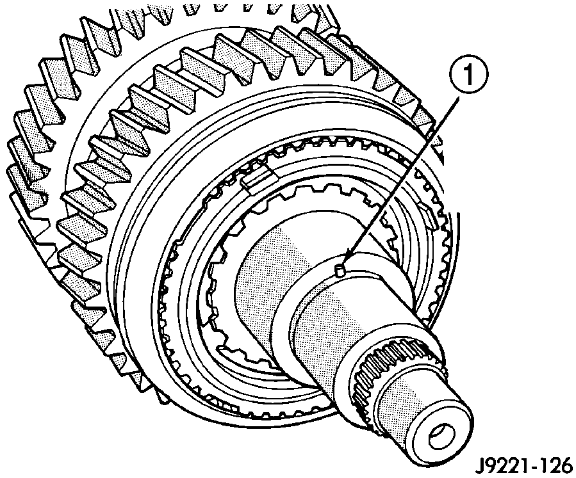


Fig. 48 THRUST WASHER LOCATING PIN

1 - THRUST WASHER LOCATING PIN

(8) Remove second gear (Fig. 49).

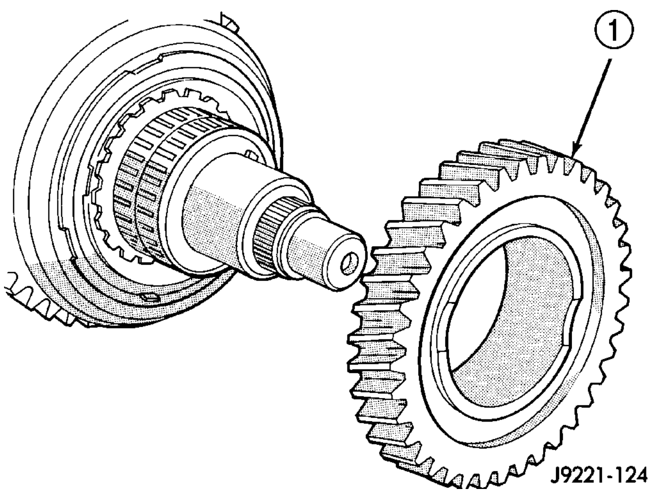


Fig. 49 SECOND GEAR

1 - SECOND GEAR

(9) Remove second gear bearing (Fig. 50).

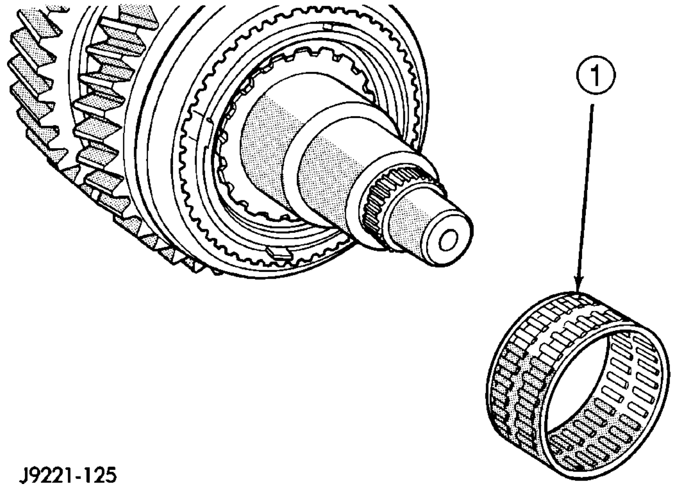


Fig. 50 SECOND GEAR BEARING

1 - SECOND GEAR NEEDLE BEARING

(10) Remove second gear clutch cone snap ring from mainshaft synchro hub groove (Fig. 51).

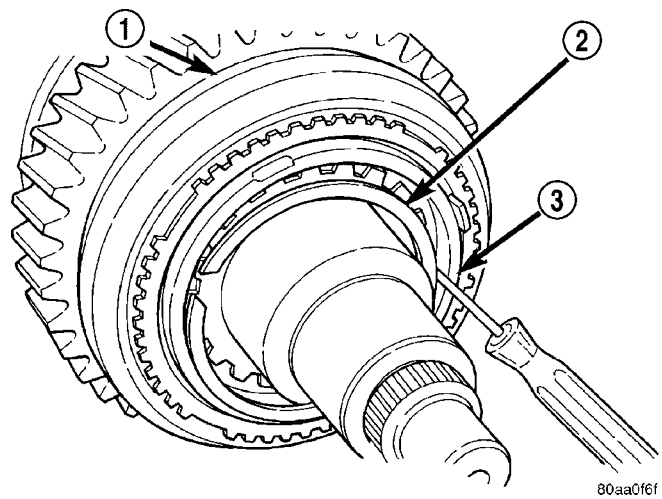


Fig. 51 SECOND GEAR CLUTCH CONE SNAP RING

1 - 1-2 SLEEVE
2 - SNAP RING
3 - SECOND GEAR CLUTCH CONE

MANUAL TRANSMISSION - NV4500 (Continued)

(11) Remove second gear clutch cone, synchro clutch ring and synchro stop ring (Fig. 52).

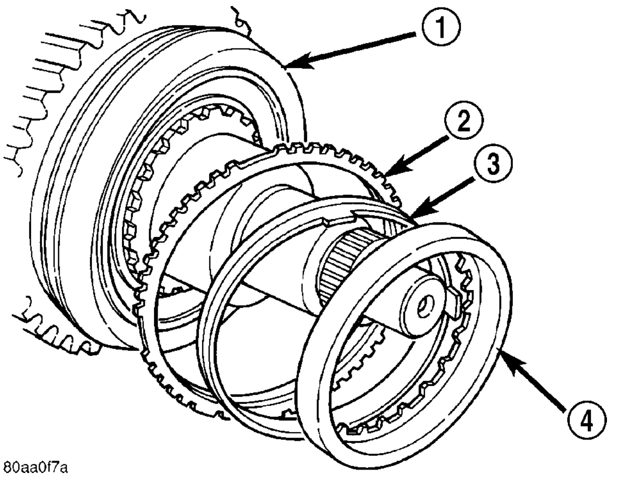


Fig. 52 SECOND GEAR CLUTCH CONE AND RING

1 - 1-2 SLEEVE AND HUB
2 - SYNCHRO STOP RING
3 - CLUTCH RING
4 - SECOND GEAR CLUTCH CONE

(12) Remove 1-2 synchro hub snap ring (Fig. 53).

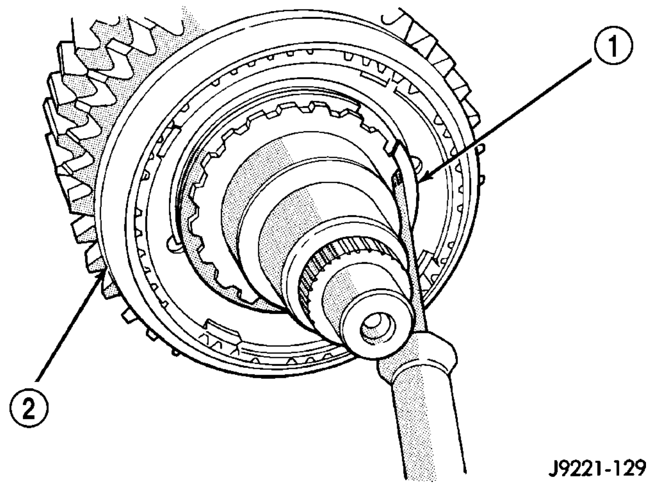


Fig. 53 1-2 SLEEVE AND HUB SNAP RING

1 - 1-2 HUB SNAP RING
2 - 1-2 SLEEVE AND HUB

(13) Remove 1-2 synchro sleeve, hub, struts and springs as an assembly (Fig. 54).

NOTE: Tapered side of sleeve also goes toward front. Do not disassemble synchro components unless worn or damaged.

(14) Remove first gear synchro stop ring and clutch ring (Fig. 55).

(15) Remove first gear clutch cone front snap ring from mainshaft hub (Fig. 56).

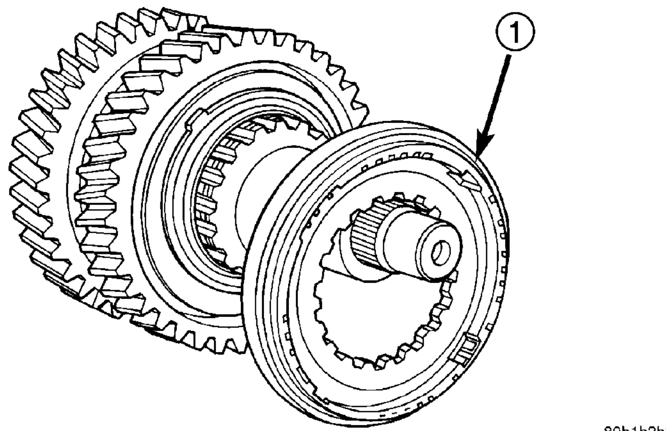


Fig. 54 1-2 SYNCHRO SLEEVE AND HUB

1 - 1-2 SLEEVE AND HUB

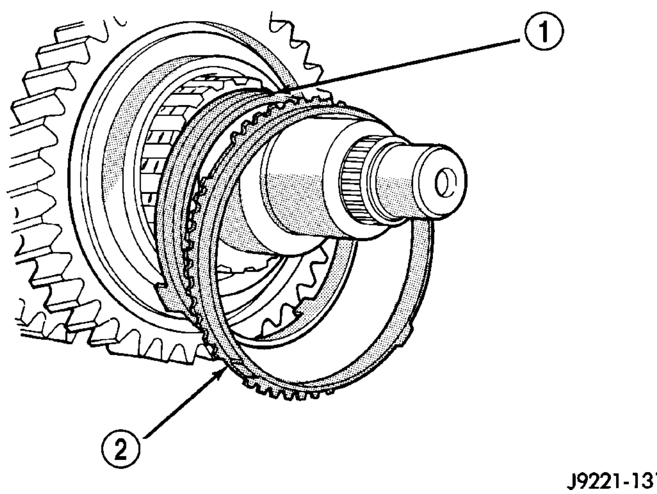


Fig. 55 FIRST GEAR STOP AND CLUTCH RING

1 - FIRST GEAR CLUTCH RING
2 - FIRST GEAR STOP RING

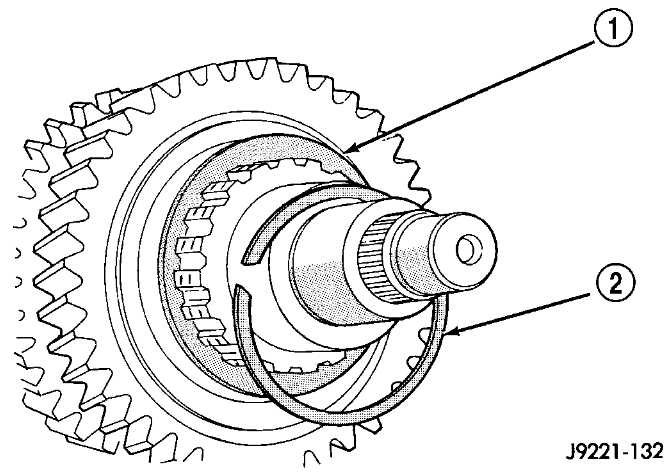


Fig. 56 FIRST GEAR CLUTCH GEAR FRONT SNAP RING

1 - FIRST SPEED CLUTCH GEAR
2 - CLUTCH GEAR SNAP RING (FRONT)

MANUAL TRANSMISSION - NV4500 (Continued)

(16) Remove first gear clutch cone (Fig. 57).

(17) Remove first gear clutch gear rear snap ring from mainshaft hub (Fig. 57).

NOTE: Do not remove this snap ring unless mainshaft is being replaced.

(18) Remove mainshaft rear bearing, with Puller Flange 6444-1 and Puller Rods 6444-3 for 4X2 or 6444-4 for 4X4.

(19) Position the first Jaw 6445 on the bearing cone and seat Puller Flange 6444-1 in notch of jaw (Fig. 58).

(20) Install second Jaw 6445 on the bearing cone and puller flange. Slide Collar 6444-8 over jaws to hold them in place.

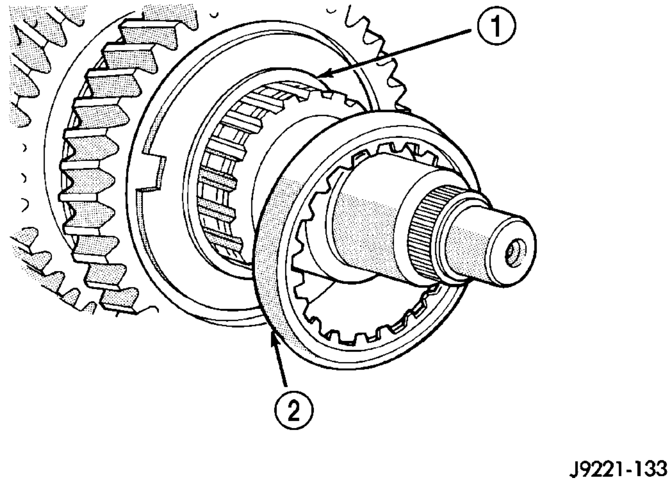


Fig. 57 FIRST GEAR CLUTCH GEAR

1 - CLUTCH GEAR SNAP RING (REAR)
2 - FIRST SPEED CLUTCH GEAR

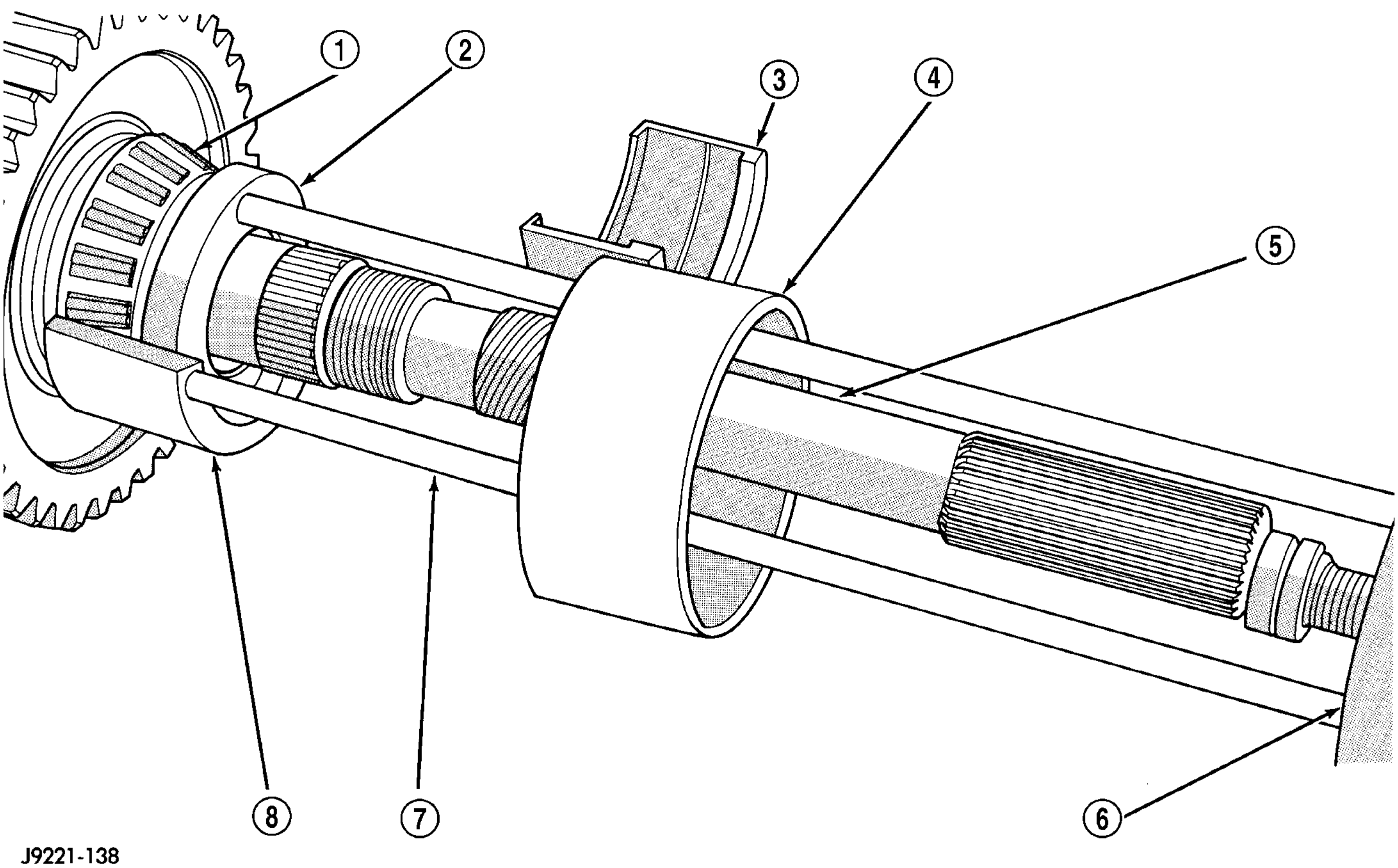


Fig. 58 MAINSHAFT REAR BEARING PULLER

1 - REAR BEARING
2 - FLANGE
3 - JAW
4 - COLLAR
5 - MAINSHAFT
6 - PULLER
7 - RODS
8 - JAW

MANUAL TRANSMISSION - NV4500 (Continued)

(21) Install Puller 6444 on the puller rods and secure with nuts (Fig. 59). Tighten puller bolt to the remove bearing.

(22) Remove bearing puller tools and rear mainshaft bearing from output shaft.

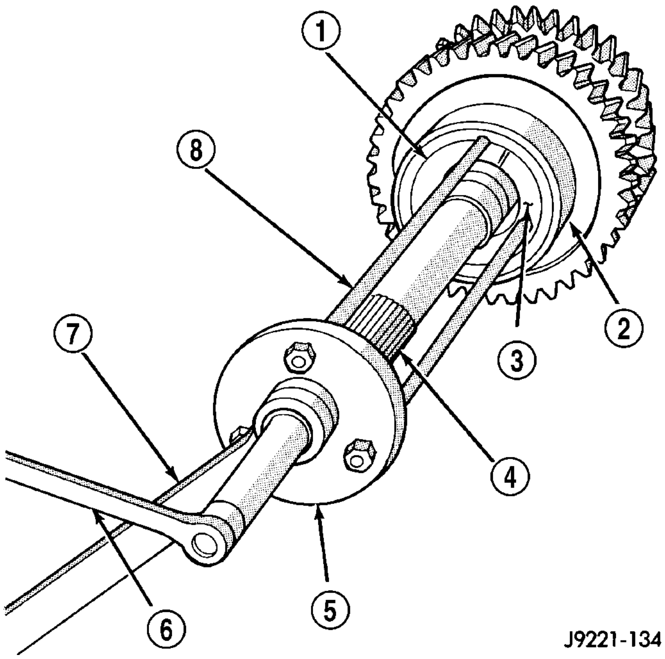


Fig. 59 MAINSHAFT REAR BEARING

1 - JAWS
2 - COLLAR
3 - FLANGE
4 - MAINSHAFT
5 - PULLER
6 - TIGHTENING WRENCH
7 - HOLDING WRENCH
8 - RODS

(23) Remove reverse gear thrust washer (Fig. 60).

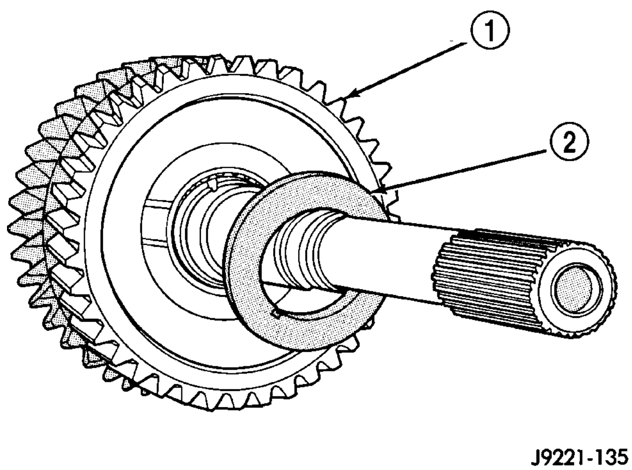


Fig. 60 REVERSE GEAR THRUST WASHER

1 - REVERSE GEAR
2 - THRUST WASHER

(24) Remove reverse gear and synchro components as assembly (Fig. 61).

CAUTION: Do not disassemble synchro components unless they are damaged. If synchro sleeve or struts require service, mark position of sleeve on hub before removal. Correct sleeve position is important as sleeve can be installed backwards causing shift problems.

(25) Remove reverse gear bearing assembly from mainshaft (Fig. 61).

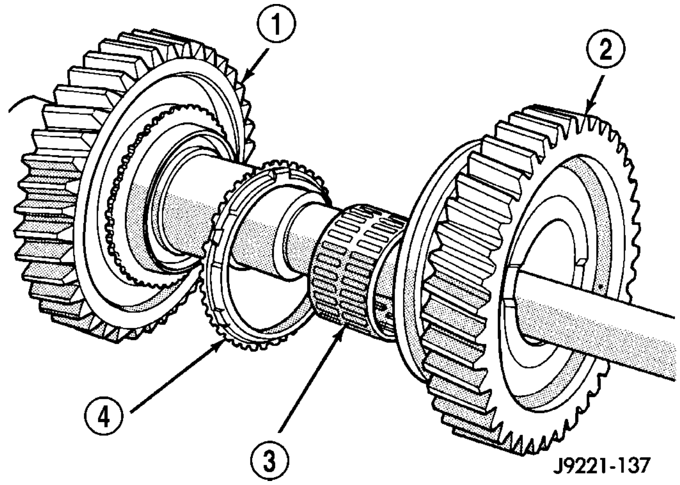


Fig. 61 REVERSE GEAR, BEARING, AND STOP RING

1 - FIRST GEAR
2 - REVERSE GEAR ASSEMBLY
3 - BEARING ASSEMBLY
4 - STOP RING

(26) Remove reverse gear bearing spacer from mainshaft (Fig. 62).

(27) Remove reverse clutch gear snap ring (Fig. 62). Heavy duty snap ring pliers will be required to spread the ring far enough to remove it.

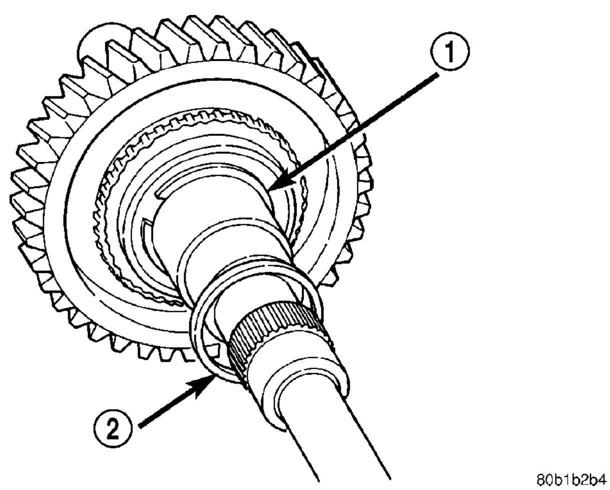


Fig. 62 REVERSE GEAR BEARING SPACER AND FIRST GEAR SNAP RING

1 - CLUTCH GEAR SNAP RING
2 - REVERSE GEAR BEARING SPACER

MANUAL TRANSMISSION - NV4500 (Continued)

(28) Remove reverse clutch gear (Fig. 63).

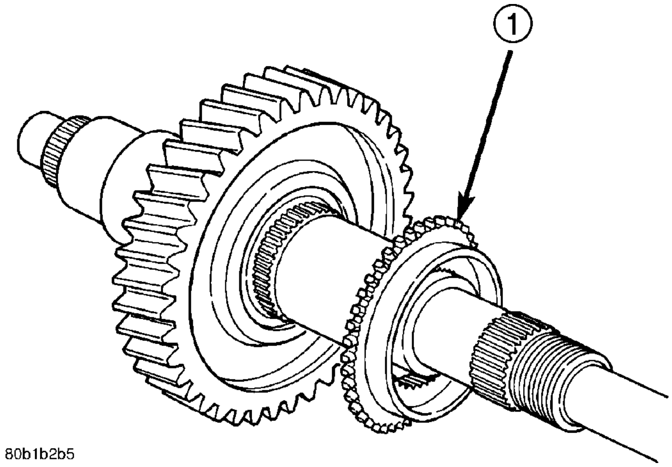


Fig. 63 Reverse Clutch Gear

1 - REVERSE CLUTCH GEAR

(29) Remove first gear from bearing and mainshaft (Fig. 64).

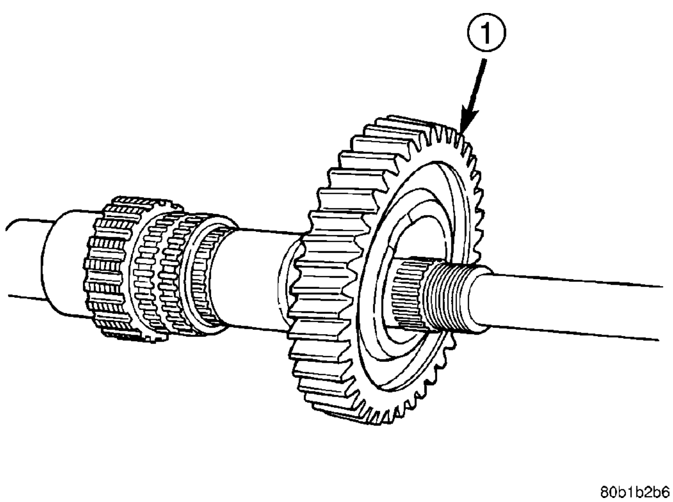


Fig. 64 FIRST GEAR

1 - FIRST GEAR

(30) Remove first gear bearing from mainshaft (Fig. 65).

CLEANING

Clean the gears, shafts, shift components and transmission housings with a standard parts cleaning solvent. Do not use acid or corrosive base solvents. Dry all parts except bearings with compressed air.

Clean the shaft bearings with a mild solvent such as Mopar degreasing solvent, Gunk or similar solvents. Do not dry the bearings with compressed air. Allow the bearings to either air dry or wipe them dry with clean shop towels.

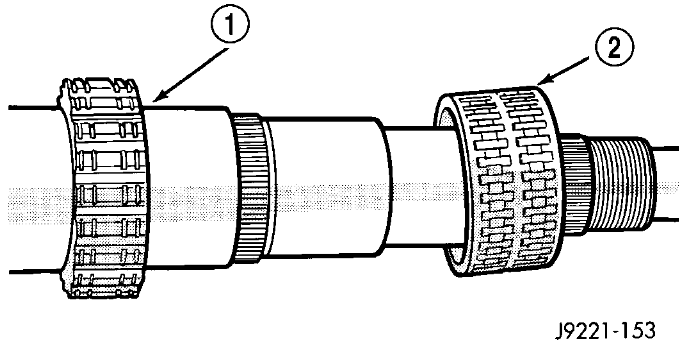


Fig. 65 FIRST GEAR BEARING

1 - MAINSHAFT
2 - FIRST GEAR BEARING

INSPECTION

NOTE: Minor corrosion, nicks, or pitting can be smoothed with 400 grit emery and polished out with crocus cloth.

Inspect the reverse idler gear, bearings, shaft and thrust washers. Replace the bearings if the rollers are worn, chipped, cracked, flat-spotted or brinnelled. Replace the gear if the teeth are chipped, cracked or worn thin.

Inspect the front bearing retainer and bearing cup. Replace the bearing cup if scored, cracked, brinnelled or rough. Check the release bearing slide surface of the retainer carefully. Replace the retainer if worn or damaged in any way.

Inspect mainshaft bearing surfaces, splines, snap ring grooves and threads. Replace the shaft if any surfaces exhibit considerable wear or damage.

Inspect the countershaft and bearings. Replace the shaft if any surfaces exhibit considerable wear or damage.

Inspect shift forks for wear and distortion. Check fit of the sleeve in the fork to be sure the two parts fit and work smoothly. Replace the fork if the roll pin holes are worn oversize or damaged. Do not attempt to salvage a worn fork. Replace shift fork roll pins if necessary or if doubt exists about their condition.

The all bearings for wear, roughness, flat spots, pitting or other damage. Replace the bearings if necessary.

Inspect the blocker rings and fiction cones. replace either part if worn or damaged in any way. Replace if the friction material is burned, flaking off or worn.

Inspect synchro components wear or damage. Replace parts if worn, cracked or distorted.

Inspect all of the thrust washers and locating pins. Replace the pins if bent or worn. Replace the washers if worn or the locating pin notches are distorted.

Inspect the case and housing/adapter sealing and mating surfaces are free of burrs and nicks. Inspcet

MANUAL TRANSMISSION - NV4500 (Continued)

the alignment dowels in the case top surface and in the housing/adapter are tight and in good condition. Replace the gear case or housing/adapter if cracked or broken.

ASSEMBLY

NOTE: Gaskets are not used in the transmission. Use Mopar Silicone Sealer or equivalent on all gear case and extension housing sealing surfaces.

COUNTERSHAFT AND REVERSE IDLER GEAR

(1) Install countershaft front bearing cup in case with Handle C-4171 and Installer 6061-1.

(2) Install front bearing on countershaft with Installer C-4340 (Fig. 66).

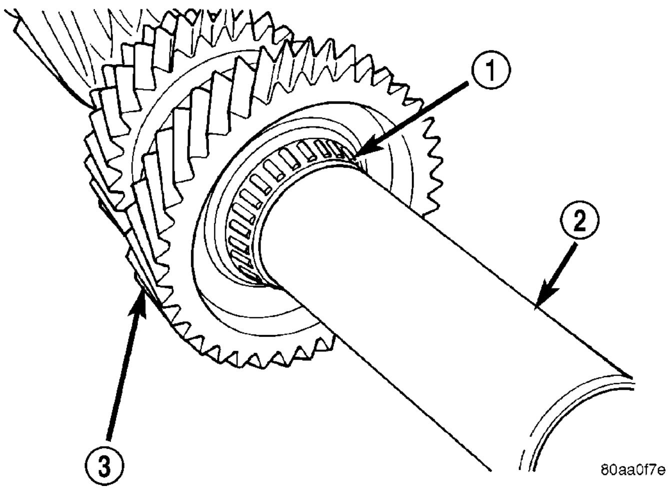


Fig. 66 COUNTERSHAFT FRONT BEARING

1 - FRONT BEARING
2 - INSTALLER
3 - COUNTERSHAFT

(3) Lubricate countershaft front bearing cup and cone with petroleum jelly.

(4) Position gear case on end with rear of case facing up (Fig. 67).

(5) Install countershaft in gear case (Fig. 67).

NOTE: Do not install rear countershaft bearing on countershaft at this time.

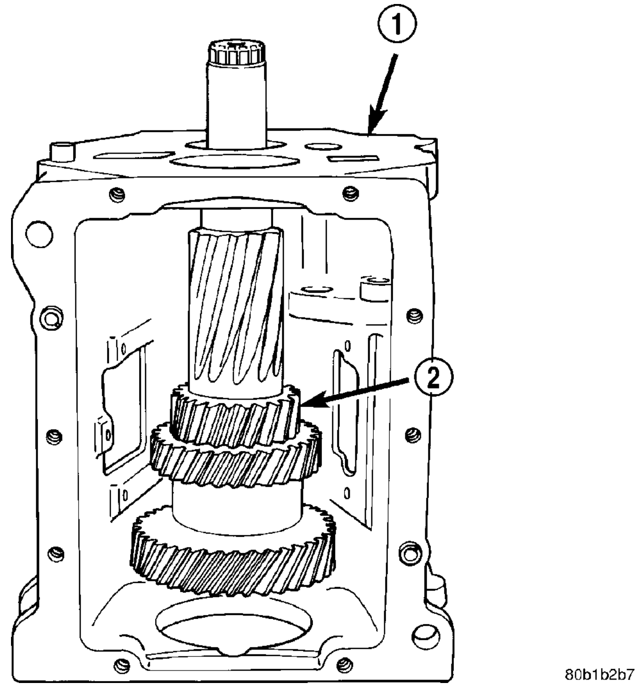


Fig. 67 COUNTERSHAFT IN GEAR CASE

1 - GEAR CASE
2 - COUNTERSHAFT

(6) Lubricate reverse idler gear bearings with petroleum jelly and install first bearing and second bearing (Fig. 68).

(7) Install idler gear front thrust washer on boss in gear case (Fig. 68). Coat thrust washer with liberal quantity of petroleum jelly to hold it in place.

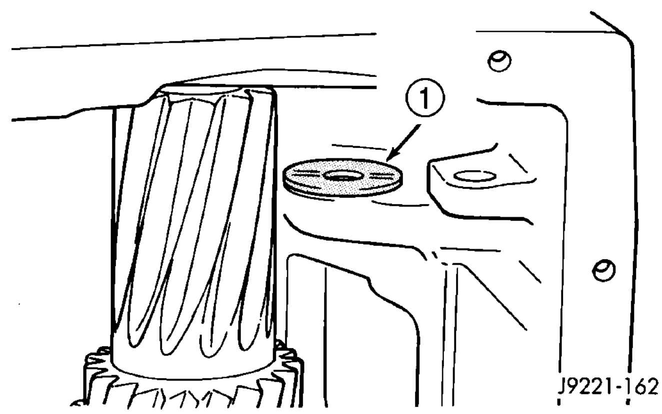


Fig. 68 IDLER GEAR FRONT THRUST WASHER

1 - IDLER GEAR FRONT THRUST WASHER ON BOSS

MANUAL TRANSMISSION - NV4500 (Continued)

(8) Install reverse idler gear in case (Fig. 69).

(9) Install idler gear rear thrust washer between idler gear and case boss (Fig. 69).

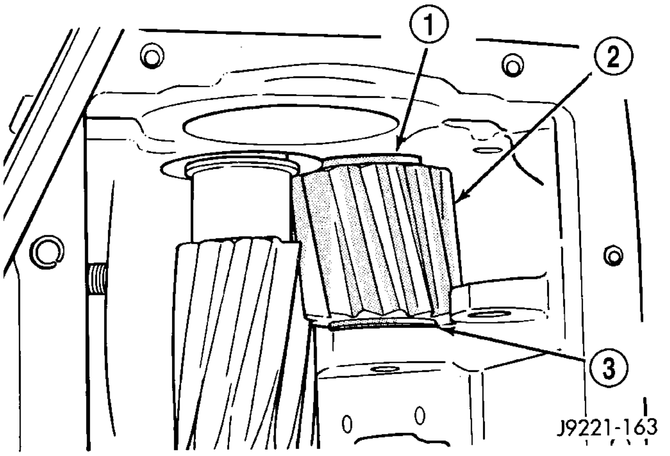


Fig. 69 IDLER GEAR

1 - REAR THRUST WASHER
2 - REVERSE IDLER GEAR
3 - FRONT THRUST WASHER

(10) Align idler gear bearings and thrust washers with a drift.

(11) Install reverse idler shaft with notched end of shaft facing countershaft (Fig. 70).

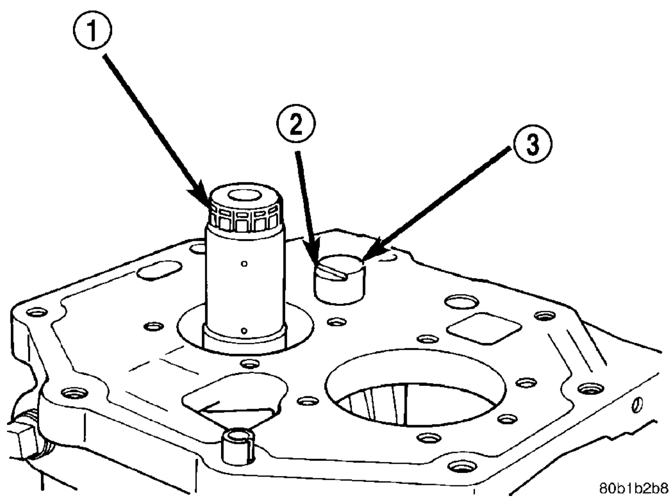


Fig. 70 REVERSE IDLER SHAFT

1 - COUNTERSHAFT
2 - SHAFT NOTCH
3 - REVERSE IDLER SHAFT

(12) Lift countershaft upward and position wood block between front of shaft and case (Fig. 71).

(13) Install rear bearing cone on countershaft with Installer C-4040 (Fig. 72).

(14) Remove wood block from under countershaft and lower countershaft front bearing into front bearing cup.

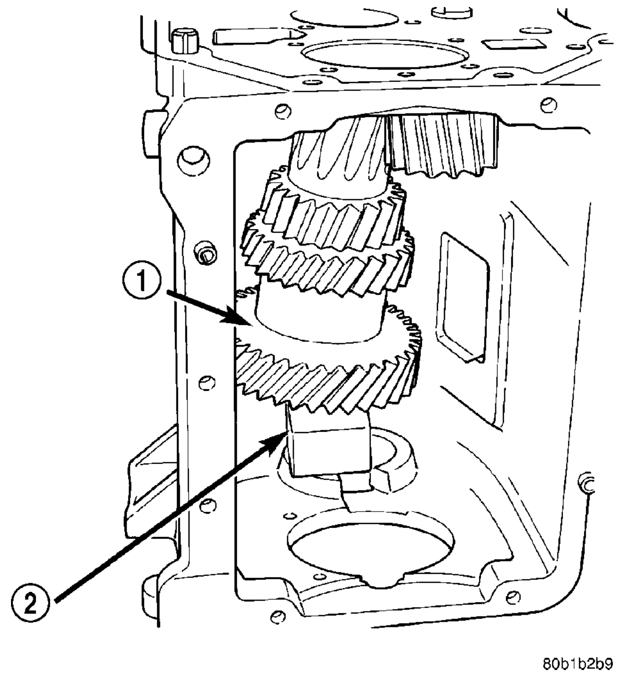


Fig. 71 SUPPORTING COUNTERSHAFT

1 - COUNTERSHAFT
2 - WOOD BLOCK

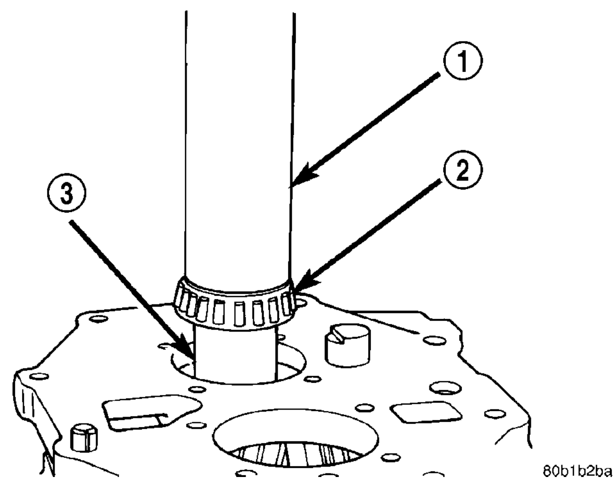


Fig. 72 COUNTERSHAFT REAR BEARING

1 - INSTALLER
2 - REAR BEARING
3 - COUNTERSHAFT

(15) Lubricate countershaft rear bearing cup and cone with petroleum jelly.

(16) Install countershaft rear bearing cup in gear case and over rear bearing (Fig. 73). Tap cup into place with plastic mallet if necessary.

(17) Install countershaft rear bearing plate (Fig. 74).

NOTE: Verify plate is seated in notch in reverse idler shaft before tightening bearing plate bolts.

MANUAL TRANSMISSION - NV4500 (Continued)

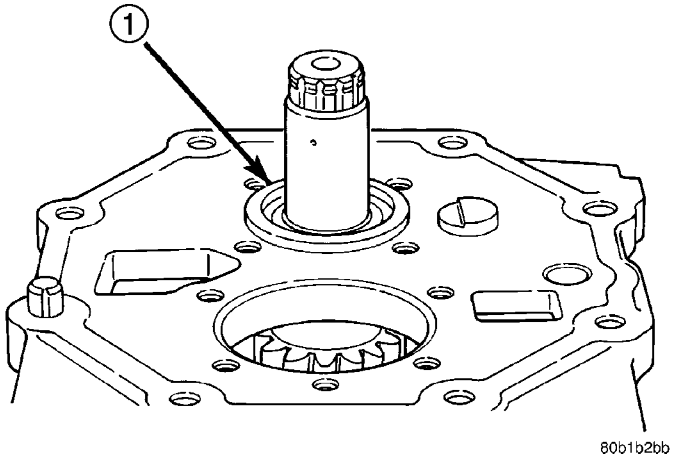


Fig. 73 COUNTERSHAFT REAR BEARING CUP

1 - COUNTERSHAFT REAR BEARING CUP

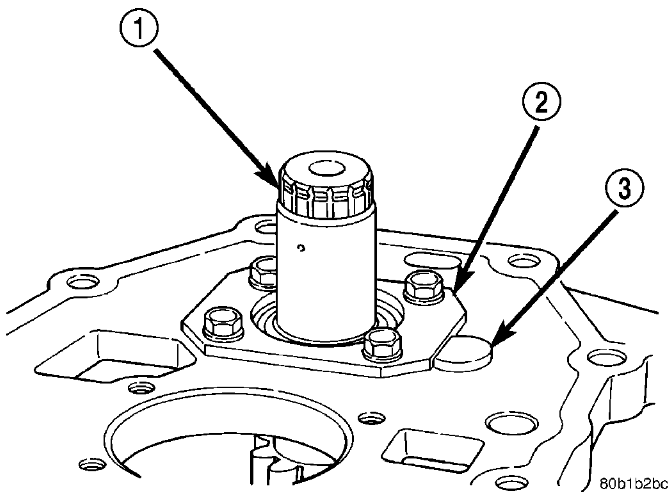


Fig. 74 COUNTERSHAFT REAR BEARING PLATE

1 - COUNTERSHAFT
2 - REAR BEARING PLATE
3 - IDLER SHAFT

(18) Apply Mopar silicone adhesive/sealer or equivalent to flange and lip of new cap. Install **new** front bearing cap in gear case (Fig. 75) with Handle C-4171 and Installer C-3972-A.

COUNTERSHAFT END PLAY

(1) Rotate countershaft 4-5 times to seat bearings.

(2) Mount dial indicator on case. Then position indicator plunger on end of countershaft and zero dial indicator (Fig. 76).

(3) Raise countershaft with screwdriver and note end play reading on dial indicator. End play should be 0.051 - 0.15 mm (0.002 - 0.006 in.).

(4) Remove countershaft rear bearing plate.

(5) Install a end play shim that will provide minimum countershaft end play. Position shim on rear bearing cup (Fig. 77).

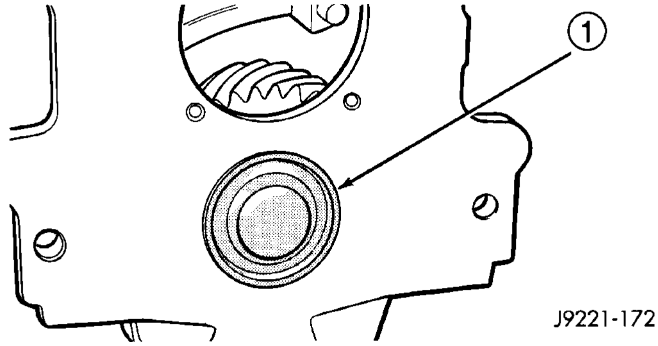


Fig. 75 COUNTERSHAFT FRONT BEARING CAP

1 - FRONT BEARING CAP

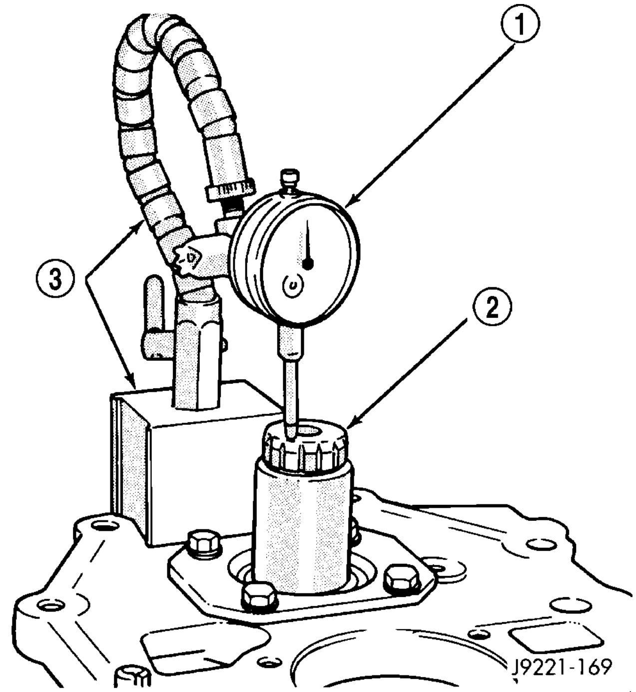


Fig. 76 MEASURING COUNTERSHAFT END PLAY

1 - DIAL INDICATOR
2 - COUNTER SHAFT
3 - INDICATOR MOUNTING ARM AND BASE

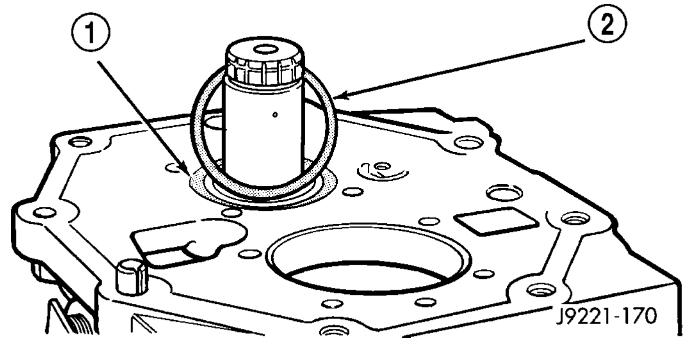


Fig. 77 COUNTERSHAFT END PLAY SHIM

1 - REAR BEARING CUP
2 - END PLAY SHIM (SELECTIVE)

MANUAL TRANSMISSION - NV4500 (Continued)

(6) Install countershaft rear bearing plate (Fig. 74).

NOTE: Verify plate is seated in reverse idler shaft notch and end play shims are still in position before installing bolts.

(7) Apply 1-2 drops Mopar Loc N' Seal or equivalent to threads of rear bearing plate bolts. Then install and tighten bearing plate bolts to 23 N·m (200 in. lbs.).

SHIFT LUG AND RAIL

(1) Lubricate shift lug and rail with Castrol® Syntorq or equivalent.

(2) Insert shift lug rail part way into case.

(3) Install shift lug on rail.

(4) Position shift rail so roll pin notches are toward outside of case (Fig. 78).

(5) Install roll pin that secures lug to rail (Fig. 78).

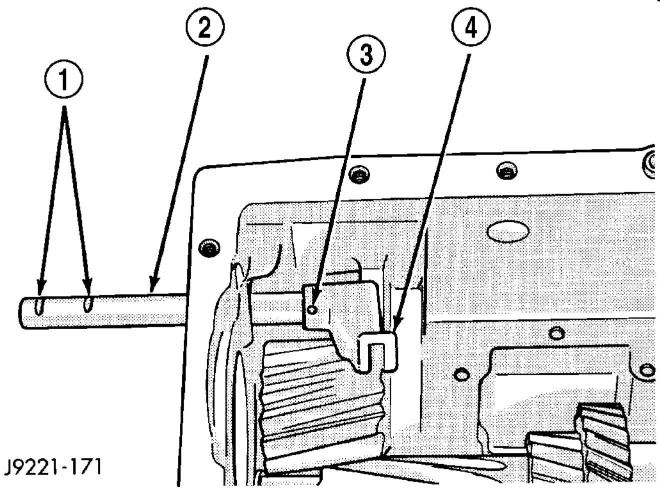


Fig. 78 SHIFT LUG AND RAIL

1 - NOTCHES (FOR 5TH GEAR SHIFT FORK ROLL PINS)
2 - LUG RAIL
3 - ROLL PIN HOLE
4 - SHIFT LUG

MAINSHAFT AND GEARTRAIN

CAUTION: The reverse, 1-2 and 3-4 synchro components can be assembled and installed incorrectly. Follow assembly procedures for component identification and location.

Lubricate mainshaft bearing surfaces and all bearing assemblies with Castrol® Syntorq or with petroleum jelly.

(1) Install first snap ring in rear most groove of mainshaft hub (Fig. 79). This snap ring locates first gear clutch gear on shaft.

NOTE: Four of these snap rings are used to secure various components on the mainshaft 1-2 synchro hub. The snap rings are all the same size and are interchangeable.

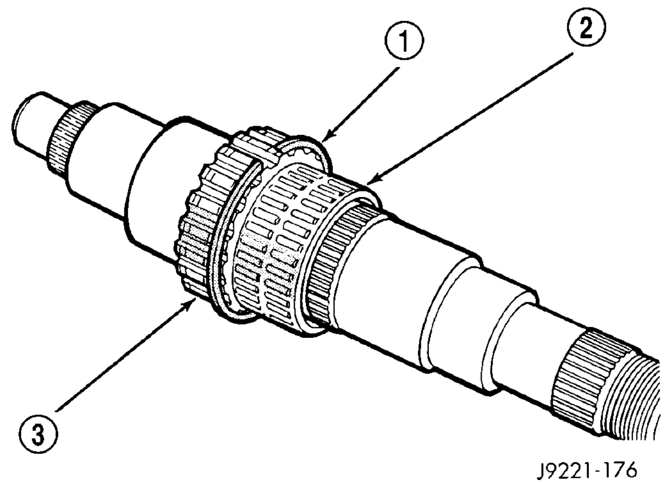


Fig. 79 FIRST GEAR BEARING AND SNAP RING

1 - SNAP RING
2 - FIRST GEAR BEARING
3 - MAINSHAFT SYNCHRO HUB

(2) Install first gear clutch cone on mainshaft 1-2 synchro hub with recessed side of cone facing front (Fig. 80). Verify cone is seated against snap ring on hub.

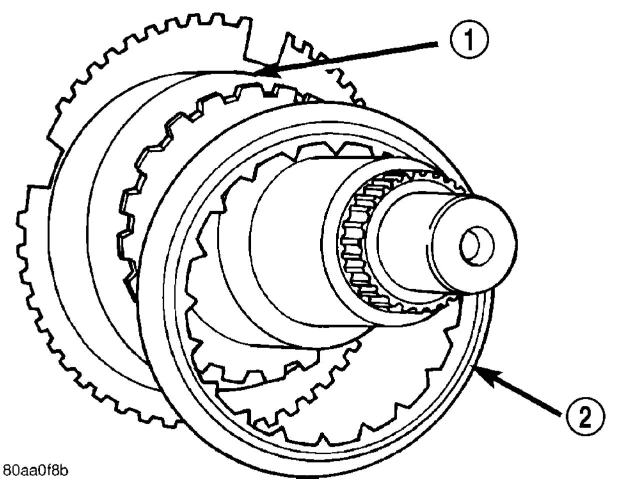


Fig. 80 FIRST GEAR CLUTCH CONE

1 - MAINSHAFT 1-2 SYNCHRO HUB
2 - FIRST GEAR CLUTCH CONE

MANUAL TRANSMISSION - NV4500 (Continued)

(3) Install snap ring on mainshaft 1-2 synchro hub to secure clutch cone (Fig. 81). Verify snap ring is seated in hub groove and against clutch cone.

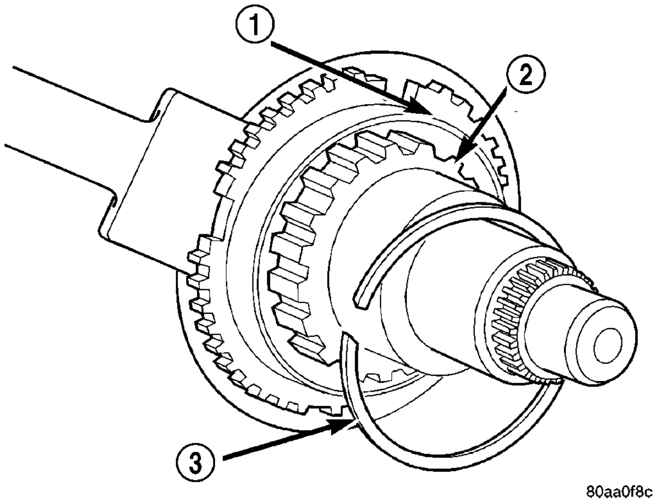


Fig. 81 FIRST GEAR CLUTCH CONE SNAP RING

1 - FIRST GEAR CLUTCH CONE
2 - MAINSHAFT 1-2 SYNCHRO HUB
3 - CLUTCH CONE SNAP RING

(4) Support mainshaft in upright position to install remaining gears, snap rings and synchro components. Shaft can be supported in gear case or hole can be cut in workbench to support shaft.

(5) If 1-2 synchro hub and sleeve were disassembled for service, reassemble hub, sleeve, struts and springs as follows:

(a) Align and install sleeve on hub. Rotate sleeve until it slides onto hub. Sleeve only fits one way and will easily slide onto hub when long slot in sleeve, aligns with long shoulder on hub (Fig. 82).

(b) Place wood blocks under hub that will raise hub about 3.5 cm (1.375 in.) above surface of workbench. Then allow sleeve to drop down on hub (Fig. 83).

(c) Install springs and struts in hub (Fig. 83). Use lots of petroleum jelly to hold them in place. Then compress struts with your fingers and move sleeve upward until struts are started in sleeve. Verify that struts are engaged in sleeve before proceeding.

(d) Turn synchro assembly upright. Then move sleeve into neutral position on hub and work struts into sleeve at same time. Be sure struts are seated and springs are not displaced during assembly.

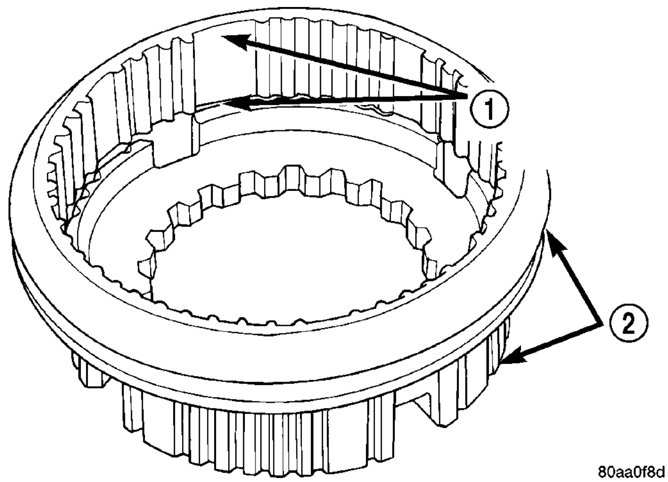


Fig. 82 1-2 SYNCHRO SLEEVE ON HUB

1 - ALIGN WIDE SLOT IN SLEEVE WITH WIDE SPLINE OF HUB
2 - 1-2 SLEEVE AND HUB

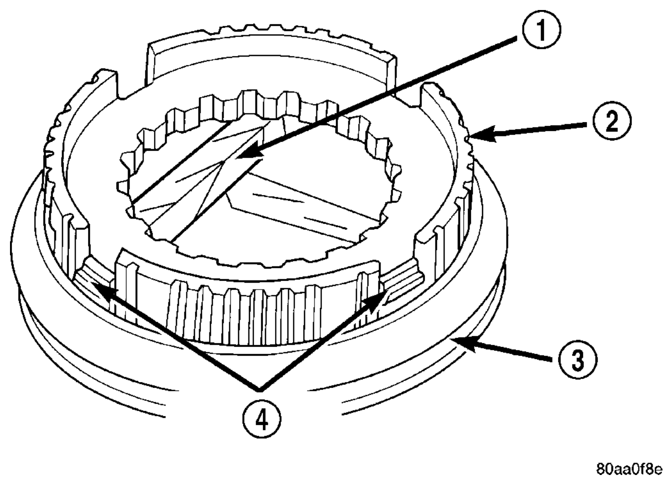


Fig. 83 1-2 SYNCHRO STRUTS AND SPRINGS

1 - WOOD BLOCKS
2 - HUB
3 - SLEEVE
4 - STRUTS AND SPRINGS (4 EACH)

MANUAL TRANSMISSION - NV4500 (Continued)

(6) Install first gear stop ring in 1-2 synchro hub and sleeve (Fig. 84). Verify stop ring is seated and engaged in hub and sleeve.

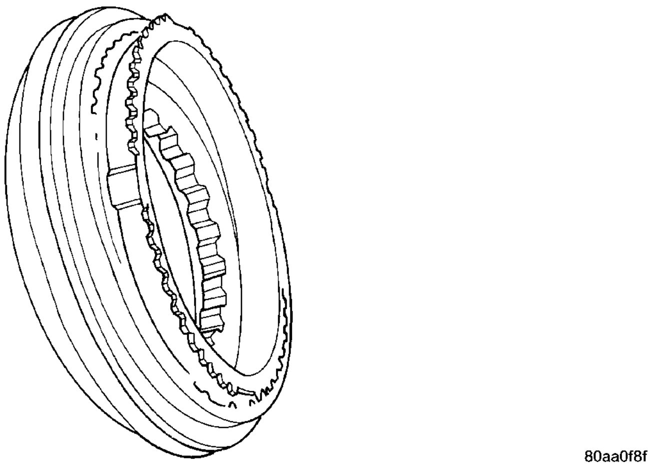


Fig. 84 FIRST GEAR STOP RING IN SYNCHRO HUB

(7) Install 1-2 synchro assembly and stop ring on mainshaft with the taper on the sleeve facing forward. (Fig. 85).

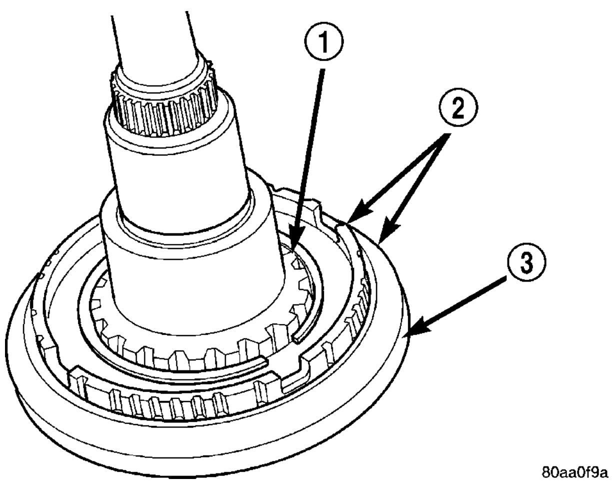


Fig. 85 1-2 SYNCHRO

1 - MAINSHAFT HUB
2 - 1-2 SYNCHRO ASSEMBLY
3 - TAPERED SIDE OF SLEEVE

(8) Install snap ring that secures 1-2 synchro on mainshaft hub (Fig. 86). Verify snap ring is seated in groove in mainshaft hub.

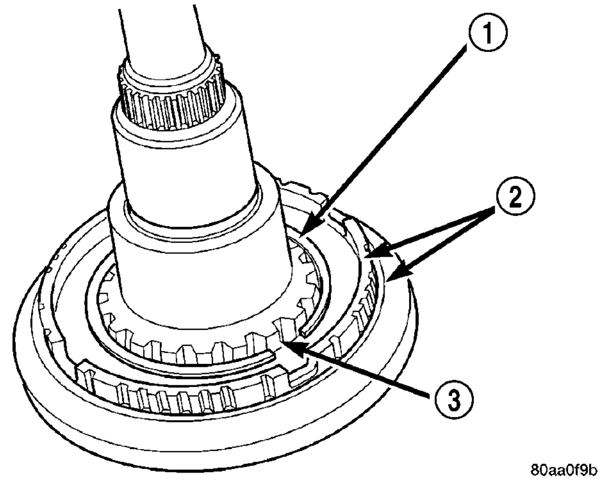


Fig. 86 1-2 SYNCHRO SNAP RING

1 - SYNCHRO SNAP RING
2 - 1-2 SYNCHRO ASSEMBLY
3 - MAINSHAFT HUB

(9) Assemble second gear clutch cone, clutch ring and stop ring (Fig. 87).

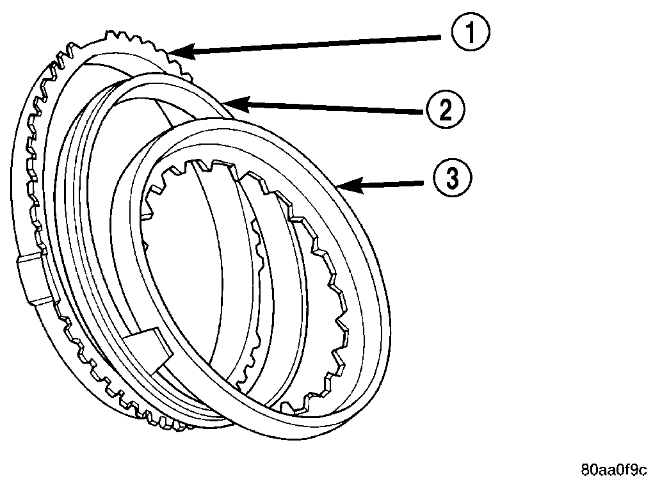


Fig. 87 SECOND GEAR CLUTCH CONE, CLUTCH RING AND STOP RING

1 - STOP RING
2 - CLUTCH RING
3 - CLUTCH CONE

MANUAL TRANSMISSION - NV4500 (Continued)

(10) Install assembled second gear clutch cone and rings on mainshaft and in 1-2 synchro hub (Fig. 88).

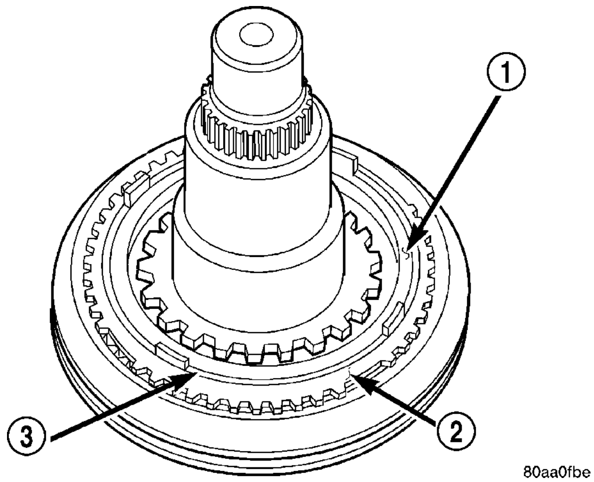


Fig. 88 SECOND GEAR CLUTCH CONE, CLUTCH RING AND STOP RING

1 - CLUTCH CONE
2 - STOP RING
3 - CLUTCH RING

(11) Install snap ring that secures second gear clutch cone on mainshaft (Fig. 89). Use narrow blade screwdriver to work snap ring into hub groove as shown. Verify snap ring is seated in mainshaft groove.

NOTE: If snap ring will not fit in groove, clutch cone is slightly misaligned.

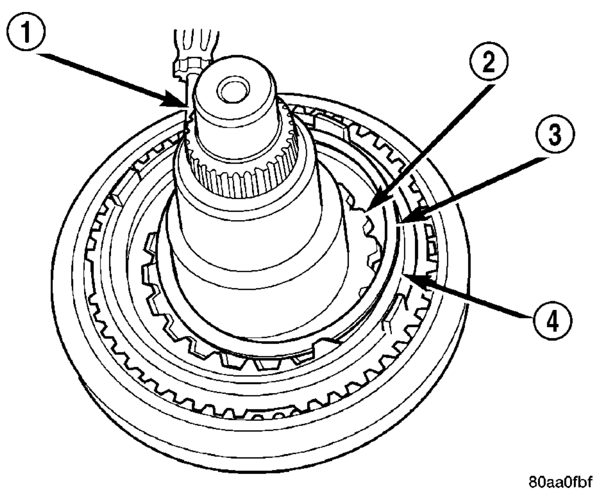


Fig. 89 SECOND GEAR CLUTCH CONE SNAP RING

1 - SCREWDRIVER
2 - MAINSHAFT HUB
3 - SNAP RING
4 - SECOND GEAR CLUTCH CONE

(12) Install second gear bearing on mainshaft (Fig. 90).

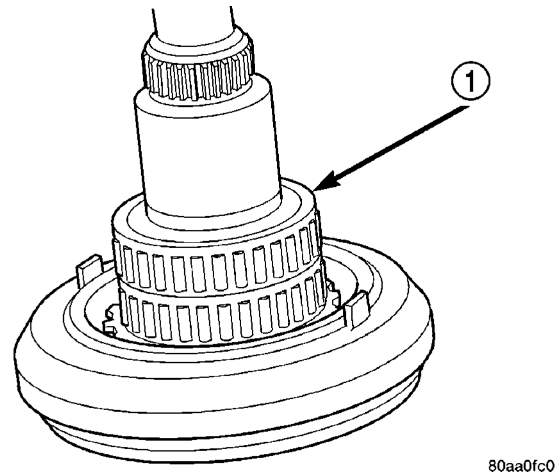


Fig. 90 SECOND GEAR BEARING

1 - SECOND GEAR BEARING

(13) Install second gear on mainshaft and bearing. Rotate gear until tabs of second gear clutch ring are seated in tab slots in gear (Fig. 91).

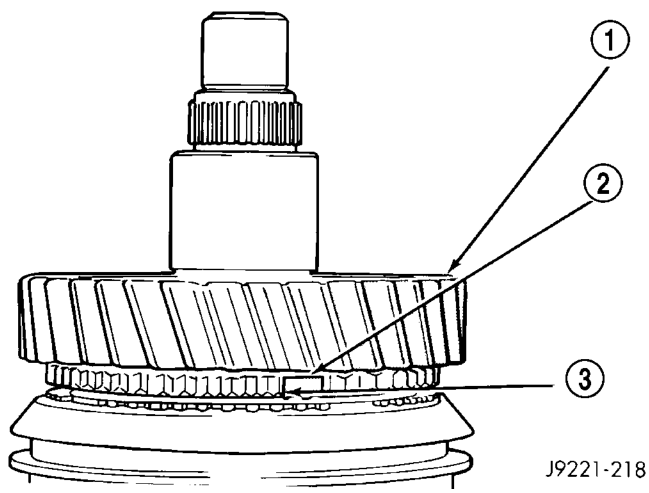


Fig. 91 SECOND GEAR

1 - SECOND GEAR
2 - CLUTCH RING TABS
3 - TAB SLOTS (IN GEAR)

MANUAL TRANSMISSION - NV4500 (Continued)

(14) Install thrust washer pin in shaft (Fig. 92).

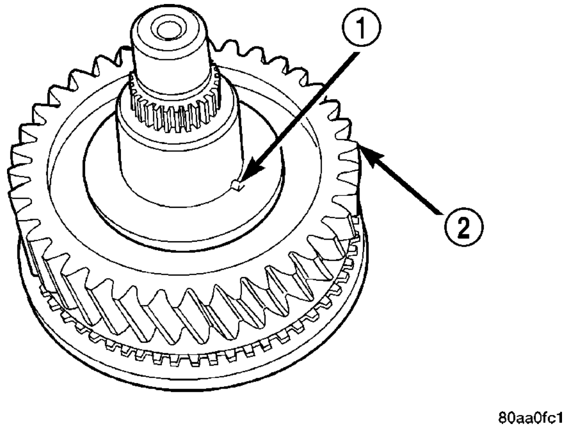


Fig. 92 THRUST WASHER PIN

1 - THRUST WASHER PIN
2 - SECOND GEAR

(15) Install second gear thrust washer. Verify washer is seated on gear and pin (Fig. 93).

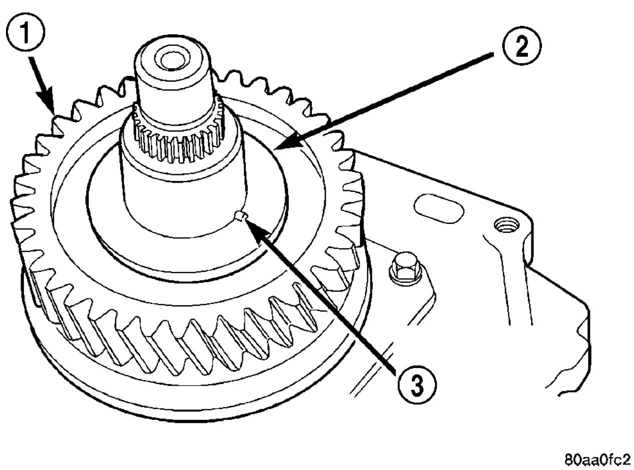


Fig. 93 SECOND GEAR THRUST WASHER

1 - SECOND GEAR
2 - SECOND GEAR THRUST WASHER
3 - LOCATING PIN IN WASHER NOTCH

(16) Install second gear thrust washer snap ring (Fig. 94). Verify snap ring is seated in mainshaft groove.

(17) Install third gear bearing spacer on shaft and seat it against thrust washer snap ring (Fig. 94).

(18) Install third gear bearing on mainshaft (Fig. 95). Bearing should be flush with mainshaft hub.

NOTE: If bearing is not flush with hub, the bearing spacer or snap ring was not installed.

(19) Install third gear over bearing and onto mainshaft (Fig. 96).

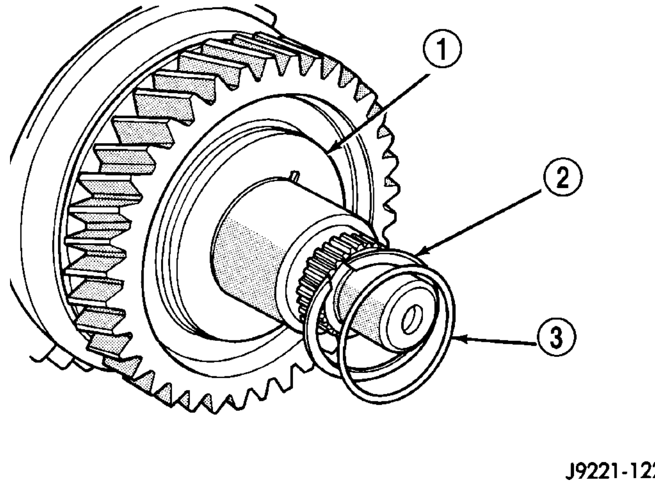


Fig. 94 SNAP RING AND THIRD

1 - SECOND GEAR THRUST WASHER
2 - THRUST WASHER SNAP RING
3 - THIRD GEAR BEARING SPACER

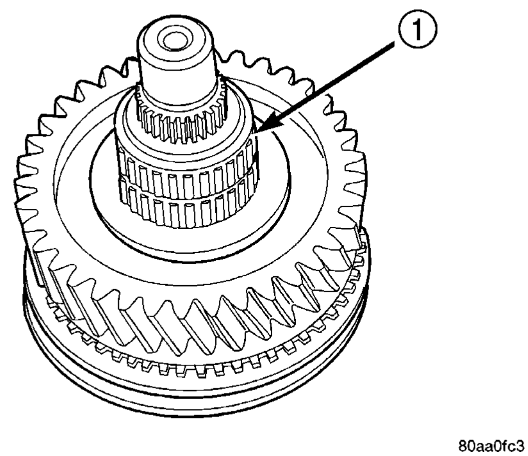


Fig. 95 THIRD GEAR BEARING

1 - THIRD GEAR BEARING

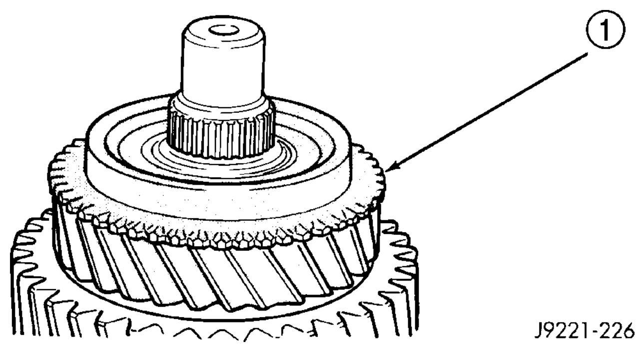


Fig. 96 THIRD GEAR

1 - THIRD GEAR

MANUAL TRANSMISSION - NV4500 (Continued)

(20) Install synchro stop ring on third gear (Fig. 97). Verify stop ring is seated on cone taper.

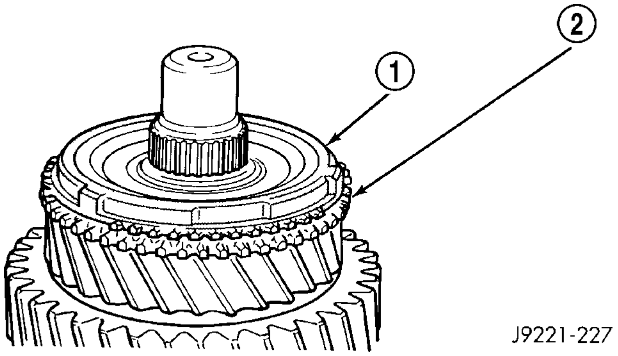


Fig. 97 THIRD GEAR STOP RING

1 - SYNCHRO STOP RING
2 - THIRD GEAR

(21) If 3-4 synchro was disassembled for service, reassemble synchro components as follows:

(a) Align and install synchro sleeve on hub (Fig. 98). **Front side of hub has a narrow groove machined in it.**

(b) Insert all three synchro struts in slots machined in sleeve and hub (Fig. 98).

(c) Install and seat synchro springs (Fig. 98). Use screwdriver to compress springs and seat them in struts and hub as shown.

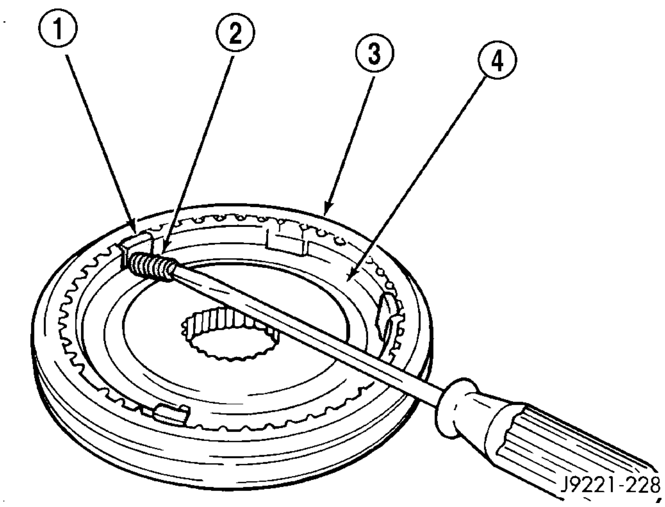


Fig. 98 SYNCHRO ASSEMBLY (3-4)

1 - STRUT (3)
2 - SPRING (3)
3 - 3-4 SLEEVE
4 - 3-4 HUB

(22) Start 3-4 synchro assembly on mainshaft with the hub groove and sleeve groove both facing forward. Tap assembly onto shaft splines until hub is about 3 mm (0.125 in.) away from third gear stop ring. Then align stop ring with synchro sleeve and hub and seat synchro assembly with Installer C-4040 (Fig. 99).

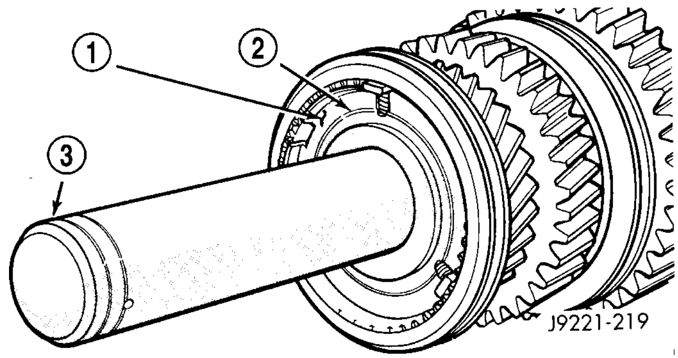


Fig. 99 SEATING 3-4 SYNCHRO ASSEMBLY ON MAINSHAFT

1 - 3-4 SYNCHRO HUB
2 - HUB GROOVE
3 - INSTALLER C-4040

(23) Verify 3-4 synchro hub is seated on shaft with approximately 3 mm (0.125 in.) of shaft spline visible.

NOTE: If hub is not seated, stop ring lugs are misaligned. Rotate ring until lugs are engaged in 3-4 hub slots.

(24) Verify that second and third gear rotate freely at this point. If not, determine the cause and correct.

(25) Invert mainshaft in case or bench.

(26) Install first gear bearing on mainshaft.

(27) Install first gear on shaft with clutch hub side of gear facing the front of shaft (Fig. 100). Verify tabs on clutch ring are aligned and seated in first gear hub.

NOTE: 1-2 synchro hub will not seat properly if clutch ring tabs are misaligned.

MANUAL TRANSMISSION - NV4500 (Continued)

(28) Install reverse clutch gear on first gear (Fig. 100). Verify clutch gear is seated on shaft splines.

(29) Install reverse clutch gear snap ring with heavy duty snap ring pliers (Fig. 100). Verify snap ring is seated in groove.

NOTE: Reverse gear will not fit properly if snap ring is not seated.

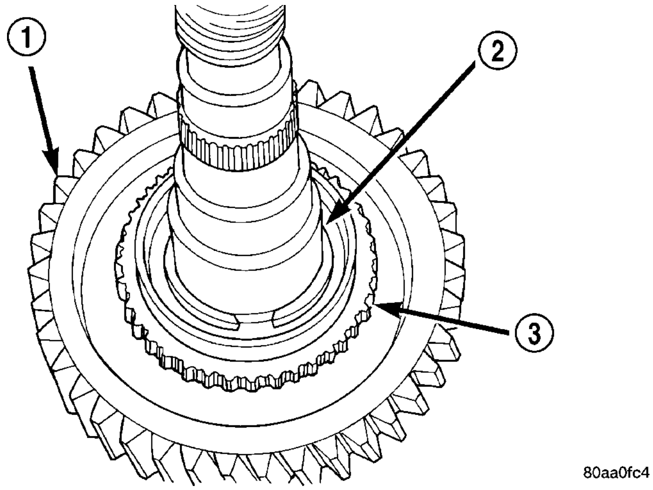


Fig. 100 FIRST GEAR AND CLUTCH GEAR

1 - FIRST GEAR
2 - REVERSE CLUTCH GEAR SNAP RING
3 - REVERSE CLUTCH GEAR

(30) Install stop ring on clutch cone (Fig. 101). Verify stop ring is seated on cone taper.

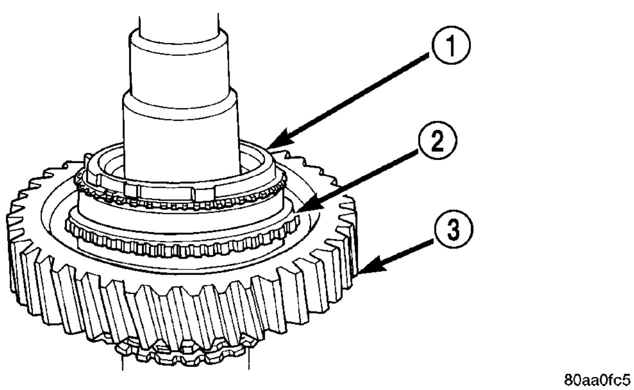


Fig. 101 CLUTCH GEAR STOP RING

1 - REVERSE GEAR STOP RING
2 - CLUTCH GEAR
3 - FIRST GEAR

(31) Install reverse gear bearing spacer on mainshaft and seat against reverse clutch gear snap ring (Fig. 102).

(32) Install reverse gear bearing on mainshaft (Fig. 102).

(33) If reverse gear sleeve and struts were disassembled for service, reassemble sleeve, struts and springs as follows:

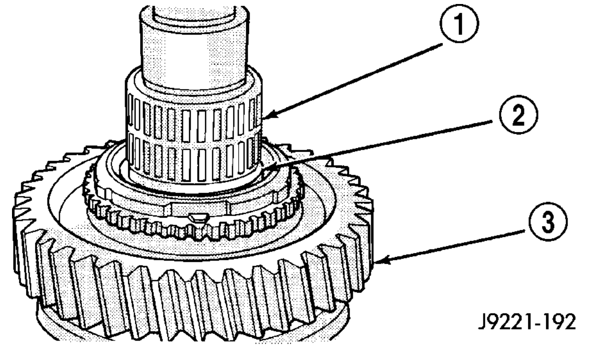


Fig. 102 REVERSE GEAR BEARING AND SPACER

1 - REVERSE GEAR BEARING
2 - BEARING SPACER
3 - FIRST GEAR

CAUTION: The reverse sleeve will fit either way on the hub. Verify tapered side of the sleeve faces rearward.

(a) Position sleeve on hub so tapered side of sleeve faces rearward. (Fig. 103).

(b) Rotate sleeve to align teeth on sleeve and hub. Sleeve will slide easily into place on hub when properly aligned.

(c) Install springs in gear hub (Fig. 103). Use petroleum jelly to hold springs in place if desired.

(d) Compress first spring with flat blade screwdriver and slide strut into position in hub slot. Then work spring into seat in strut with small hooked tool or screwdriver.

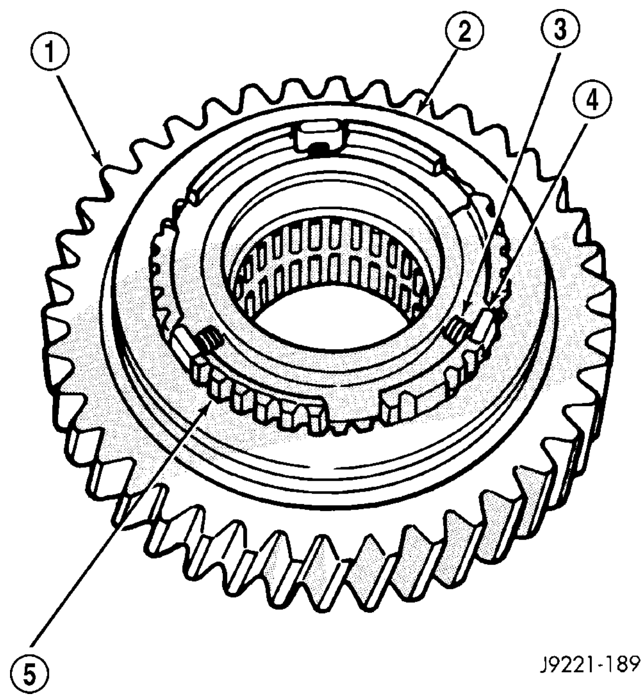


Fig. 103 REVERSE GEAR SYNCHRO ASSEMBLY

1 - REVERSE GEAR
2 - SLEEVE
3 - SPRING (3)
4 - STRUT (3)
5 - HUB

MANUAL TRANSMISSION - NV4500 (Continued)

(e) Install second and third struts in same manner as described in step (d).

(f) Work sleeve upward on hub until struts are centered and seated in sleeve. Sleeve should be in neutral position after seating struts.

(34) Install reverse gear and synchro assembly on mainshaft (Fig. 104). Rotate assembly until stop ring lugs engage in hub slots and gear drops into seated position.

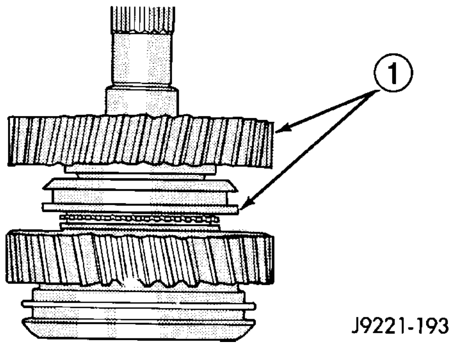


Fig. 104 REVERSE GEAR

1 - REVERSE GEAR AND SYNCHRO ASSEMBLY

(35) Install reverse gear thrust washer (Fig. 105).

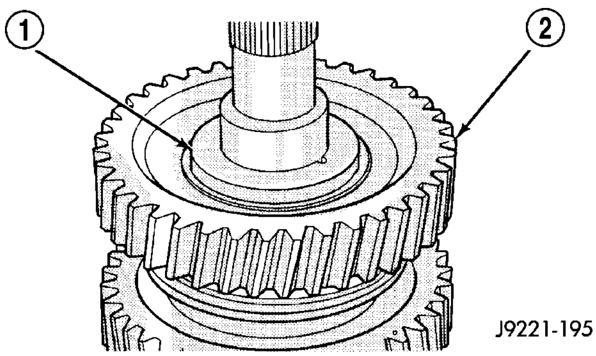


Fig. 105 REVERSE GEAR THRUST WASHER

1 - THRUST WASHER
2 - REVERSE GEAR

(36) Install rear bearing on mainshaft with Installer 6446. Seat bearing on output shaft and against thrust washer (Fig. 106).

(37) Install fourth gear stop ring in 3-4 synchro sleeve (Fig. 107).

(38) Install fourth gear clutch gear in stop ring (Fig. 108).

(39) Roll gear case onto its left side.

(40) Grip mainshaft at pilot bearing hub and just behind reverse gear. Then lift assembly and guide rear of shaft through bearing bore at rear of case.

(41) Continue holding front of shaft but switch grip at rear to shaft output splines. Lift mainshaft assembly slightly, align gears and seat assembly in case.

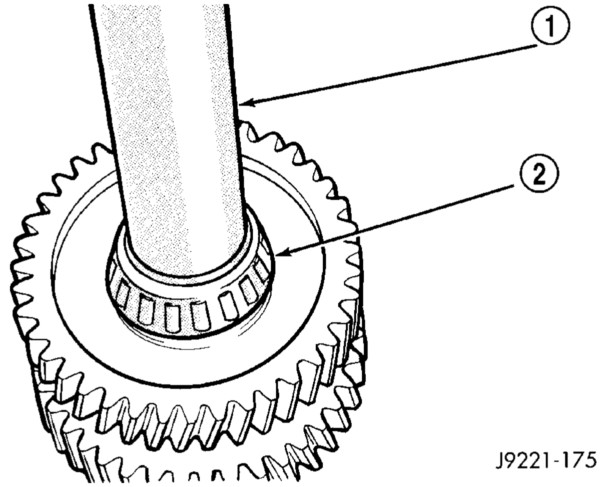


Fig. 106 MAINSHAFT REAR BEARING

1 - INSTALLER
2 - MAINSHAFT REAR BEARING

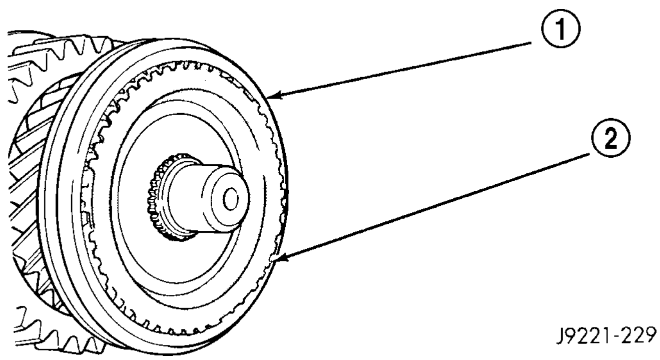


Fig. 107 FOURTH GEAR STOP RING

1 - 3-4 SYNCHRO SLEEVE
2 - FOURTH SPEED STOP RING

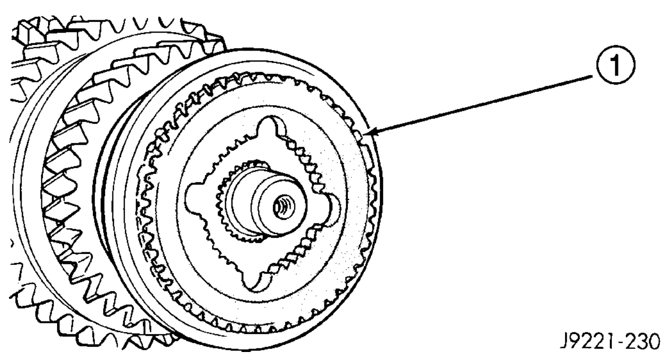


Fig. 108 FOURTH GEAR CLUTCH GEAR

1 - FOURTH SPEED CLUTCH GEAR

MANUAL TRANSMISSION - NV4500 (Continued)

(42) Set transmission case upright (Fig. 109).

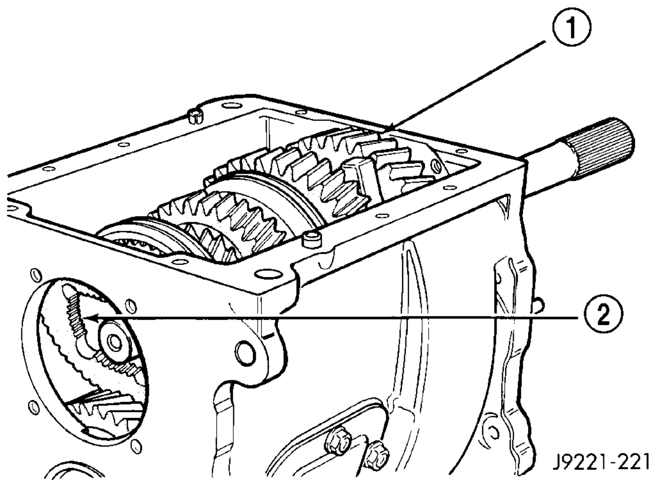


Fig. 109 MAINSHAFT AND GEARTRAIN IN CASE

1 - MAINSHAFT AND GEARTRAIN
2 - FOURTH SPEED CLUTCH GEAR

(43) Install drive gear thrust bearing on mainshaft (Fig. 110). Use plenty of petroleum jelly to hold bearing in place.

(44) Check alignment and mesh of mainshaft gears. If gears are not aligned, roll case on side and realign shaft and gears in case.

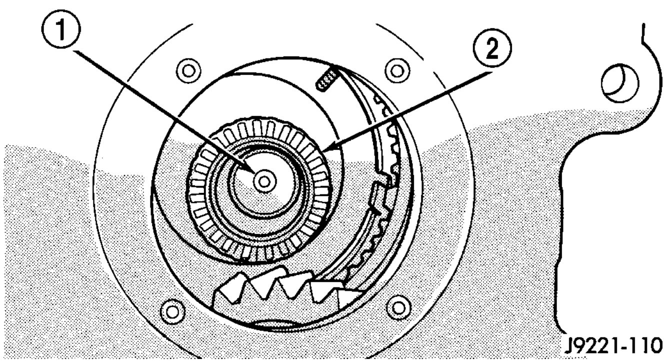


Fig. 110 DRIVE GEAR THRUST BEARING

1 - MAINSHAFT
2 - DRIVE GEAR THRUST BEARING

DRIVE GEAR AND RETAINER

(1) Install bearing on drive gear with Installer 6448 (Fig. 111).

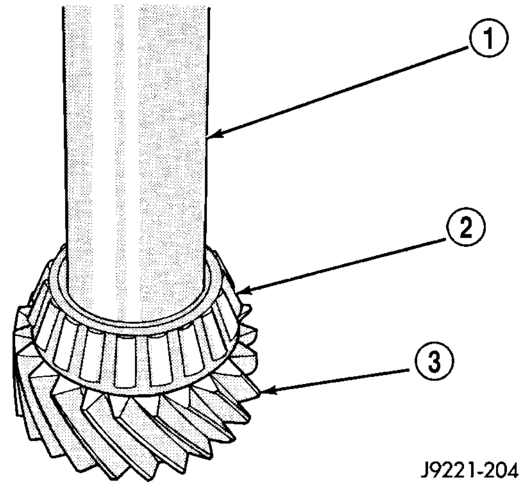


Fig. 111 FRONT BEARING ON DRIVE GEAR

1 - INSTALLER
2 - BEARING
3 - DRIVE GEAR

(2) Lubricate pilot bearing with petroleum jelly and install it in drive gear bore.

(3) Install drive gear on mainshaft. Work gear rearward until mainshaft hub is seated in pilot bearing.

(4) Install bearing cup in front retainer with Handle C-4171 and Installer C-4308 (Fig. 112).

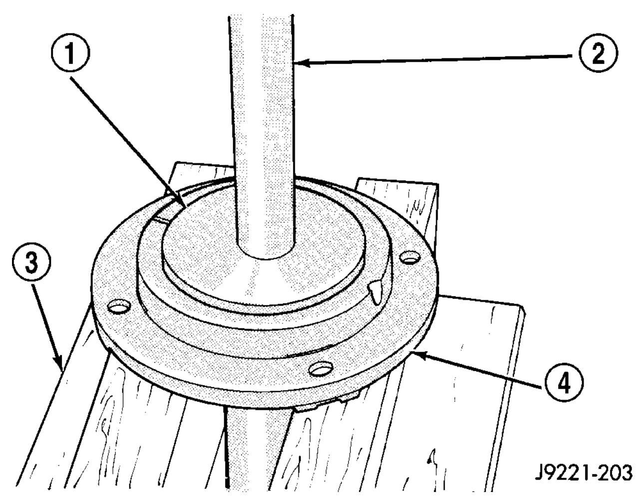


Fig. 112 FRONT BEARING CUP IN RETAINER

1 - INSTALLER
2 - HANDLE
3 - WOOD BLOCKS
4 - RETAINER

MANUAL TRANSMISSION - NV4500 (Continued)

(5) Install new oil seal in front bearing retainer with Installer 6052 (Fig. 113). Use one or two wood blocks to support retainer as shown. Lubricate seal lip with petroleum jelly after installation.

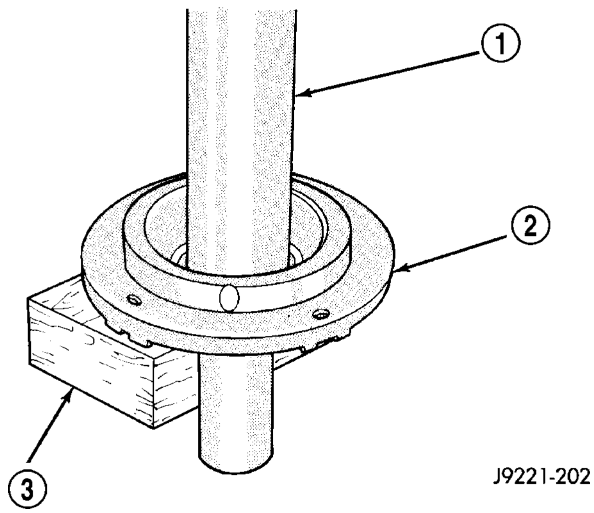


Fig. 113 BEARING RETAINER OIL SEAL

1 - INSTALLER
2 - RETAINER
3 - WOOD BLOCK

(6) Clean contact surfaces of gear case and front bearing retainer with a wax and grease remover.

(7) Apply Mopar Silicone Sealer or equivalent to flange surface of front bearing retainer (Fig. 114).

(8) Install front bearing retainer over drive gear and start it into case.

(9) Start front bearing retainer in gear case. Verify retainer lube channel is at the top-center **(12 O'clock)** position (Fig. 114).

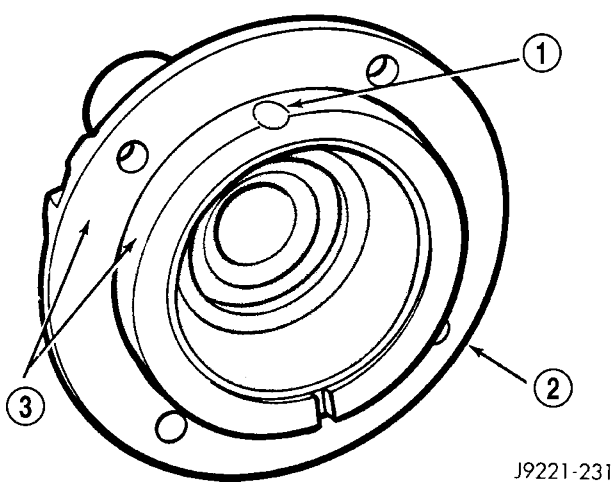


Fig. 114 LOCATION OF FRONT RETAINER LUBE CHANNEL

1 - LUBE CHANNEL
2 - FRONT RETAINER
3 - APPLY GASKET MAKER HERE

(10) Align front bearing retainer bolt holes and tap retainer into place with plastic mallet. Install **new** retainer bolts and tighten to 30 N·m (22 ft. lbs.) (Fig. 115).

NOTE: Never reuse the old bolts.

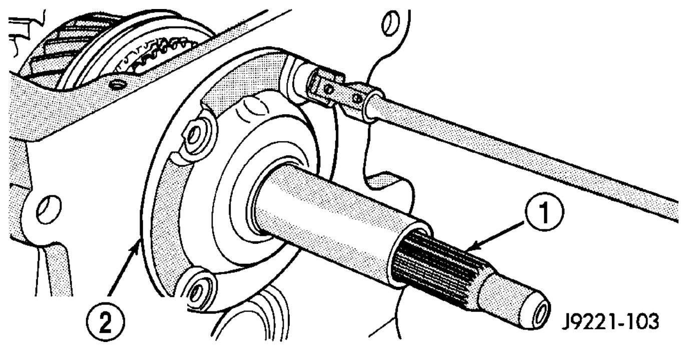


Fig. 115 FRONT BEARING RETAINER

1 - DRIVE GEAR
2 - FRONT BEARING RETAINER

MAINSHAFT END PLAY

(1) Install mainshaft rear bearing cup in case and over bearing. Tap bearing cup into place with plastic mallet.

(2) Install rear bearing plate to hold mainshaft and rear bearing in position (Fig. 116).

NOTE: Do not install any end play shims at this time.

(3) Tighten rear bearing plate bolts securely.

(4) Place gear case in upright position on bench. Either cut hole in bench to accept drive gear and front retainer or use C-clamps to secure transmission on bench.

NOTE: Do not leave transmission unsupported.

(5) Install Extension Rod 8161 into a suitable threaded hole in rear of case.

(6) Mount dial indicator on extension rod and position indicator plunger against end of mainshaft.

(7) Move mainshaft forward to remove all play then zero dial indicator.

(8) Move mainshaft upward and record dial indicator reading. Move mainshaft with pry tool positioned between drive gear and case.

(9) End play should be 0.051-0.15 mm (0.002-0.006 in.). Select fit shims are available to adjust end play. If end play adjustment is required, remove bearing plate and install necessary shim.

(10) Reinstall rear bearing plate with oil hole in bearing plate at the top (Fig. 116).

(11) Apply Mopar Lock N' Seal or equivalent to bearing plate bolt threads. Install and tighten bolts to 23 N·m (200 in. lbs.).

MANUAL TRANSMISSION - NV4500 (Continued)

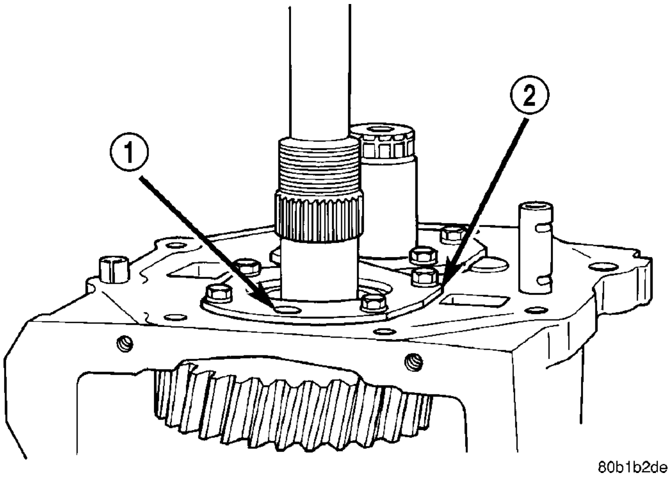


Fig. 116 REAR BEARING PLATE

1 - BEARING PLATE OIL HOLE (AT TOP)
2 - MAINSHAFT REAR BEARING PLATE

(12) Install mainshaft fifth gear with Installer 6446 (Fig. 117). Gear is seated when it contacts rear bearing.

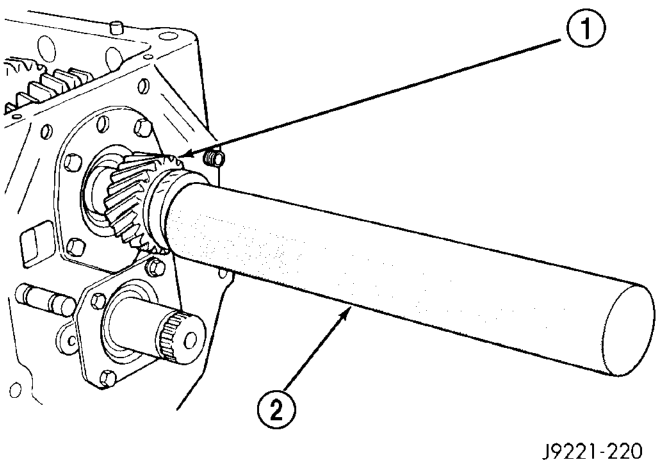


Fig. 117 MAINSHAFT FIFTH GEAR

1 - MAINSHAFT FIFTH GEAR
2 - INSTALLER

COUNTERSHAFT FIFTH GEAR SYNCHRO

(1) Install thrust washer pin in countershaft (Fig. 118).

(2) Install thrust washer on countershaft. Turn washer until pin engages in washer notch (Fig. 119).

NOTE: The flat side of washer faces the rear and cone side faces the front.

(3) Lubricate and install fifth gear bearing on countershaft (Fig. 120).

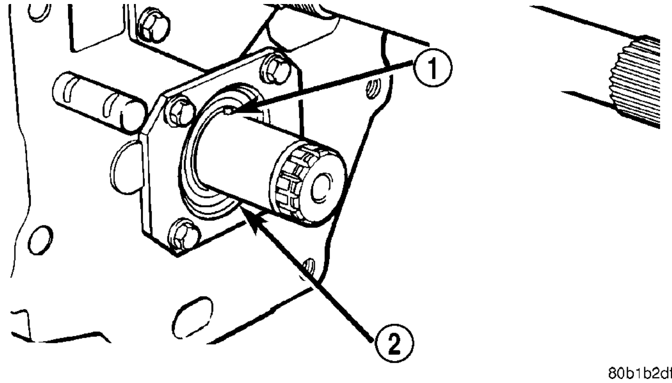


Fig. 118 FIFTH GEAR THRUST WASHER PIN

1 - THRUST WASHER PIN
2 - COUNTERSHAFT

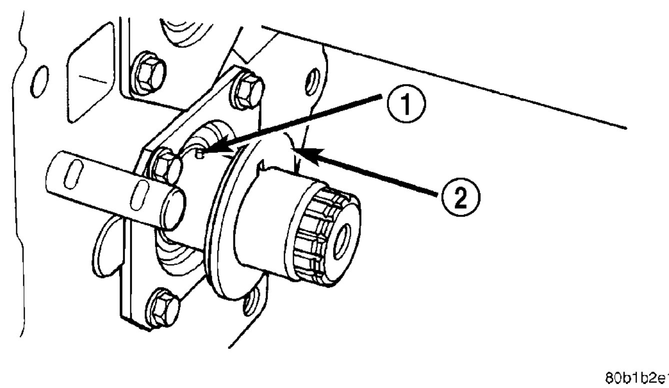


Fig. 119 FIFTH GEAR THRUST WASHER

1 - PIN
2 - THRUST WASHER

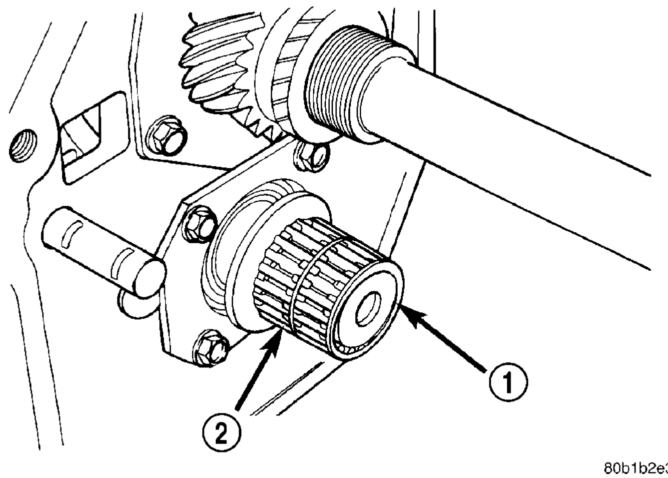


Fig. 120 COUNTERSHAFT FIFTH GEAR BEARING

1 - COUNTERSHAFT
2 - FIFTH GEAR NEEDLE BEARING

MANUAL TRANSMISSION - NV4500 (Continued)

(4) Install synchro sleeve on hub of countershaft fifth gear with tapered side of sleeve facing front and the flat side facing rear (Fig. 121).

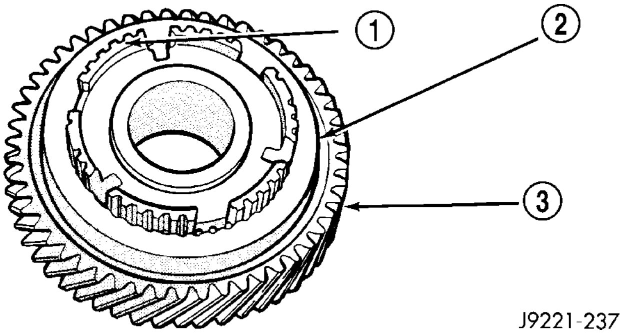


Fig. 121 SYNCHRO SLEEVE ON COUNTERSHAFT FIFTH

1 - GEAR HUB
2 - SYNCHRO SLEEVE
3 - COUNTERSHAFT FIFTH GEAR

(5) Install shift fork in synchro sleeve (Fig. 122).

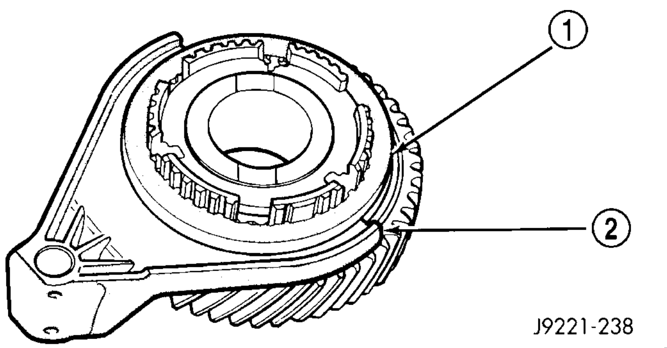


Fig. 122 FIFTH GEAR SHIFT FORK IN SYNCHRO SLEEVE

1 - SYNCHRO SLEEVE
2 - SHIFT FORK

(6) Install assembled fifth gear, synchro sleeve and shift fork (Fig. 123). Align fork with shift lug rail and align gear with bearings and countershaft. Start components onto shaft and rail, then tap gear and fork into place with plastic or rawhide mallet.

(7) Install fifth gear synchro struts and springs (Fig. 124).

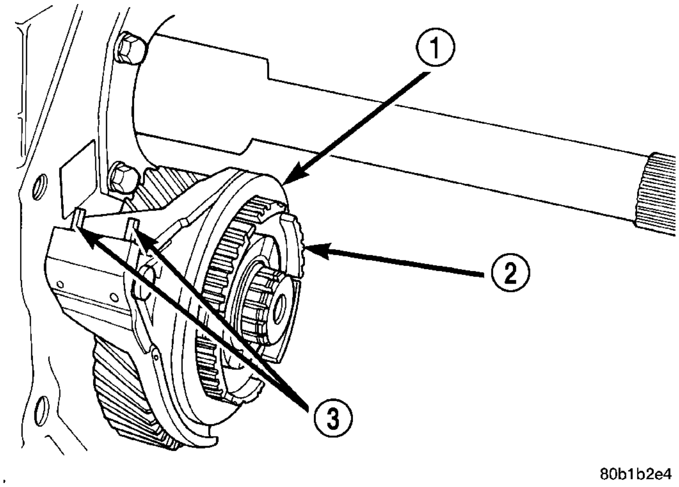


Fig. 123 COUNTERSHAFT FIFTH GEAR, SHIFT FORK AND SYNCHRO SLEEVE

1 - SHIFT FORK AND SLEEVE
2 - FIFTH GEAR HUB
3 - SHIFT FORK ROLL PINS

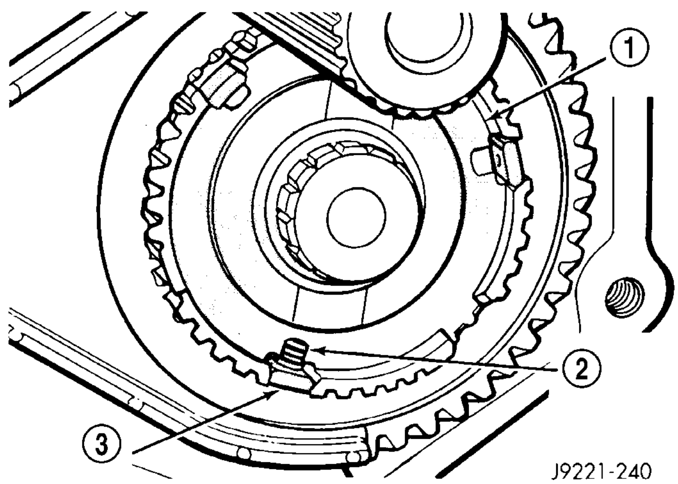


Fig. 124 FIFTH GEAR SYNCHRO STRUTS AND SPRINGS

1 - FIFTH GEAR HUB
2 - SYNCHRO SPRING (3)
3 - SYNCHRO STRUT (3)

MANUAL TRANSMISSION - NV4500 (Continued)

(8) Assemble and install fifth synchro clutch gear and stop ring in fifth gear hub (Fig. 125). Verify parts are seated in fifth gear hub.

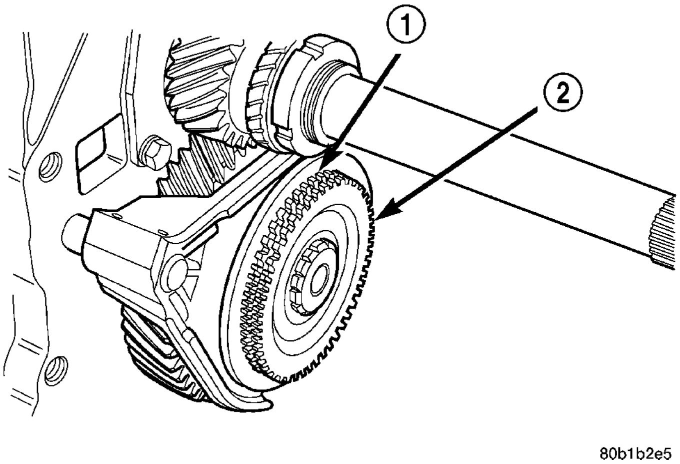


Fig. 125 FIFTH SYNCHRO CLUTCH GEAR AND STOP RING

1 - STOP RING
2 - CLUTCH GEAR

(9) Install clutch gear snap ring (Fig. 126).

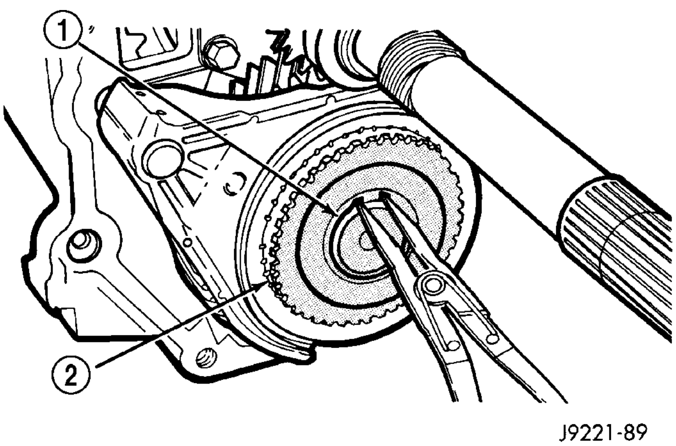


Fig. 126 FIFTH SYNCHRO CLUTCH SNAP RING

1 - CLUTCH GEAR RING
2 - FIFTH SYNCHRO CLUTCH GEAR

(10) Align roll pin holes in shift fork with notches in shift lug rail. Then install roll pins from top side of fork (Fig. 123).

NOTE: Roll pins only fit one way due to small shoulder at one end of each pin.

FIFTH GEAR NUT

(1) Install belleville washer onto the mainshaft.

(2) Install fifth gear nut over the mainshaft.

(3) Tighten the clamp bolt until the gap in the clamp nut assembly is closed.

(4) Back the clamp bolt off one full turn.

(5) Place 10-15 drops of Loctite 272 onto the mainshaft threads where the fifth gear nut will be engaged.

(6) Install fifth gear nut on mainshaft (Fig. 127).

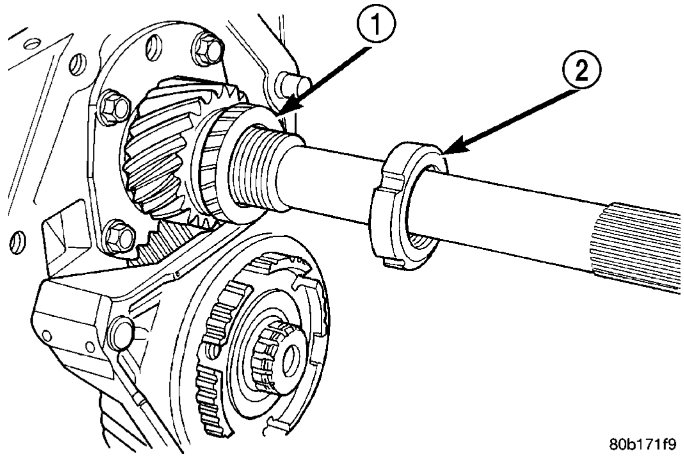


Fig. 127 FIFTH GEAR NUT

1 - FIFTH GEAR
2 - FIFTH GEAR NUT

(7) Hold mainshaft Socket 6993 4X2 or Socket 6984 4X4 while installing the fifth gear nut.

(8) Tighten fifth gear nut as much as possible with Wrench 6743, long handle ratchet, breaker bar and applicable socket wrench (Fig. 128).

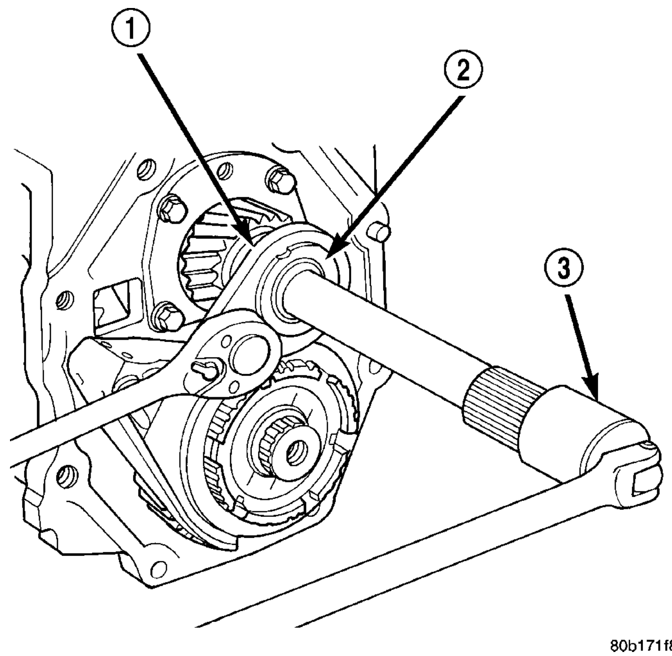


Fig. 128 FIFTH GEAR NUT

1 - WRENCH
2 - FIFTH GEAR NUT
3 - SOCKET

(9) Lock mainshaft gears by shifting all synchro sleeves into engaged position.

MANUAL TRANSMISSION - NV4500 (Continued)

(10) Tighten fifth gear nut with Nut Wrench 6743 and high capacity torque wrench. Tighten nut to 366-380 N·m (270-280 ft. lbs.). Have helper hold transmission steady if necessary.

(11) Torque the fifth gear clamp nut clamping bolt to 13.5 N·m (10 ft. lbs.).

(12) Unlock the mainshaft gears by shifting all synchro sleeves out of the engaged position.

EXTENSION/ADAPTER HOUSING

(1) Clean mating surfaces of extension/adapter housing and gear case with a wax and grease remover.

(2) Check alignment dowels in gear case and housing or adapter. Be sure dowels are in position and seated.

(3) Apply Mopar Silicone Sealer or equivalent to gear case and housing mating surfaces.

(4) Align and install extension/adapter housing on gear case (Fig. 129).

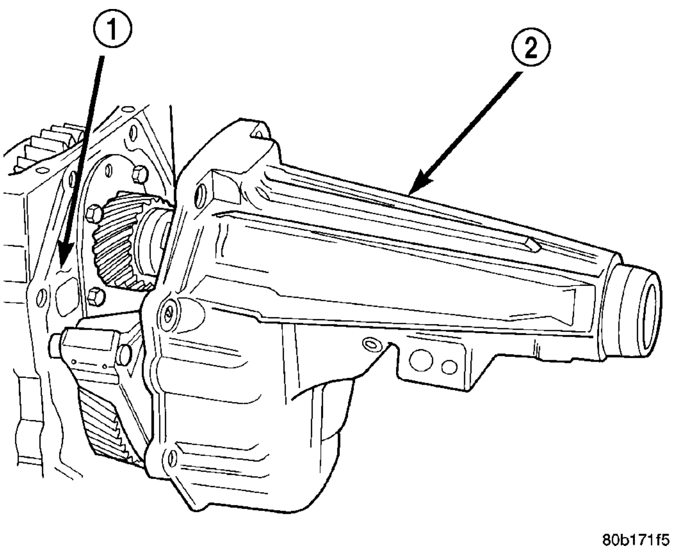


Fig. 129 INSTALLING EXTENSION/ADAPTER HOUSING

1 - GEAR CASE
2 - EXTENSION HOUSING

(5) Apply Mopar Lock N' Seal or equivalent to threads of extension/adapter housing bolts.

(6) Install and tighten housing bolts to 54 N·m (40 ft. lbs.).

SHIFT MECHANISM

(1) Clean mating surfaces of shift cover and gear case with wax and grease remover.

(2) Apply a small amount of Mopar silicone sealer or equivalent to sealing surface of shift cover.

CAUTION: Do not over-apply an excesive amount sealer. Excess can squeezed into gear case and could block lubricant feed holes in time.

(3) Lubricate synchro sleeves with Castrol® Syntorq gear lubricant or equivalent. Then apply light coat of petroleum jelly to shift fork contact surfaces.

(4) Verify shift fork pads (Fig. 130) are secure.

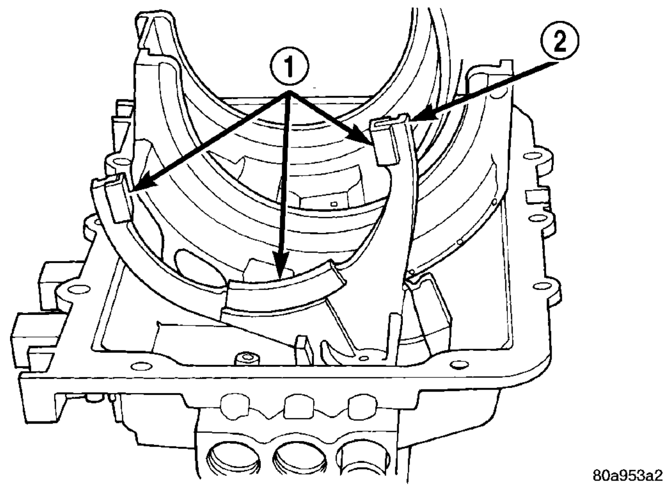


Fig. 130 SHIFT FORK PAD

1 - SHIFT FORK PADS
2 - FIFTH-REVERSE FORK

(5) Verify 1-2 and 3-4 synchro sleeves and forks in shift cover are in neutral position.

(6) Align and seat shift cover on transmission.

NOTE: If cover will not seat, it may not be aligned on gear case dowels or shift forks are not aligned with sleeves and shift lug.

(7) Apply Mopar Lock N' Seal or equivalent to threads of shift cover bolts.

(8) Install shift cover bolts and tighten to 27-31 N·m (216-276 in. lbs.).

(9) Apply sealer to backup lamp switch. Install switch into cover and tighten to 22-34 N·m (193-265 in. lbs.).

(10) Install vent assembly if removed. Apply an adhesive/sealer to vent tube to help secure it in cover.

INSTALLATION

NOTE: If a new transmission is being installed, use all components supplied with the new transmission. For example, if a new shift tower is supplied with the new transmission, do not re-use the original shift tower.

(1) Apply light coat of Mopar high temperature bearing grease or equivalent to contact surfaces of the following components:

- input shaft splines.
- release bearing slide surface of front retainer.
- release bearing bore.
- release fork.

- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of bottom PTO cover bolt and install bolt in case.

(3) Mount transmission on jack and position transmission under vehicle.

(4) Raise transmission until input shaft is centered in release bearing and clutch disc hub.

(5) Move transmission forward and start input shaft in release bearing, clutch disc and pilot bushing.

(6) Work transmission forward until seated against clutch housing. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install transmission bolts and tighten to 108 N·m (80 ft. lbs.).

(8) Install transmission mount on transmission or rear crossmember.

(9) Install rear crossmember.

(10) Remove transmission jack and engine support fixture.

(11) Position transmission harness wires in clips on shift cover.

(12) Install clutch slave cylinder and install slave cylinder shield, if equipped.

(13) Connect speed sensor and backup light switch wires.

TWO WHEEL DRIVE

(1) Fill transmission with recommended lubricant. Correct fill level is bottom edge of fill plug hole.

(2) Align and install propeller shaft.

(3) Lower vehicle.

(4) Clean the mating surfaces of shift tower, isolator plate and shift cover with suitable wax and grease remover.

(5) Apply Mopar Gasket Maker or equivalent to the sealing surface of the shift cover. Do not over apply sealant.

(6) Install the isolator plate onto the shift cover, metal side down.

(7) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(8) Verify that the shift tower, isolator plate and the shift tower bushings are properly aligned.

(9) Install the bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2-11.25 N·m (7.5-8.3 ft. lbs.).

(10) Install the shift lever extension onto the shift tower and lever assembly.

(11) Install shift boot and bezel.

(12) Connect battery negative cable.

FOUR WHEEL DRIVE

(1) Install transfer case shift mechanism on transmission.

(2) Install transfer case on transmission jack. Secure transfer case to jack with safety chains.

(3) Raise jack and align transfer case input gear with transmission mainshaft.

(4) Move transfer case forward and seat it on adapter.

(5) Install transfer case nuts and tighten to:

- If 3/8 studs 41-47 N·m (30-35 ft. lbs.).
- If 5/16 studs 30-41 N·m (22-30 ft. lbs.).

(6) Install transfer case shift mechanism to side of transfer case.

(7) Connect transfer case shift lever to range lever on transfer case.

(8) Align and connect propeller shafts.

(9) Fill transmission with required lubricant. Check lubricant level in transfer case and add lubricant if necessary.

(10) Install transfer case skid plate, if equipped and crossmember. Tighten attaching bolts/nuts to 41 N·m (30 ft. lbs.).

(11) Install exhaust system components.

(12) Lower vehicle.

(13) Clean the mating surfaces of shift tower, isolator plate and shift cover with suitable wax and grease remover.

(14) Apply Mopar Gasket Maker or equivalent to the sealing surface of the shift cover. Do not over apply sealant.

(15) Install the isolator plate onto the shift cover, metal side down.

(16) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(17) Verify that the shift tower, isolator plate and the shift tower bushings are properly aligned.

(18) Install the bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2-11.25 N·m (7.5-8.3 ft. lbs.).

(19) Install the shift lever extension onto the shift tower and lever assembly.

(20) Install shift lever boot and bezel.

(21) Connect battery negative cable.

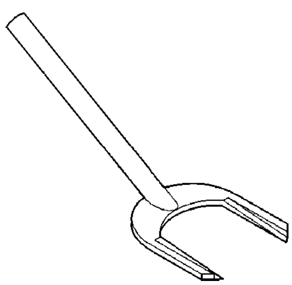
MANUAL TRANSMISSION - NV4500 (Continued)

SPECIFICATIONS

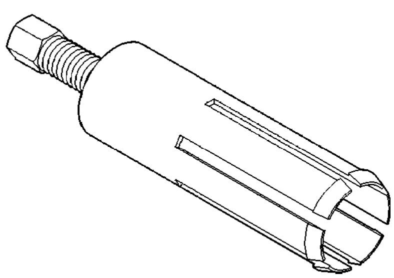
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Switch, Back-up Lamp	22-34	16-25	-
Countershaft Bearing Plate Bolts	19-26	14-19	170-230
Fifth Gear Nut	366-380	270-280	-
Fifth Gear Nut Clamp Bolt	13.5	10	-
Drain and Fill Plug	34-47	25-35	-
Front Bearing Retainer Bolts	27-34	20-25	235-305
Mainshaft Bearing Plate Bolts	19-26	14-19	170-230
PTO Cover Bolts	27-54	20-40	-
Extension/Adapter Housing Bolts	41-68	30-50	-
Shift Mechanism Cover Bolts	27-31	20-23	-
Transmission Bolts	108	80	-

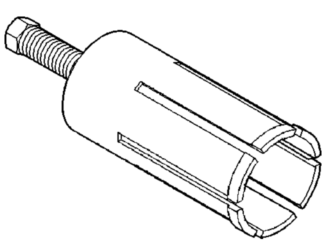
SPECIAL TOOLS



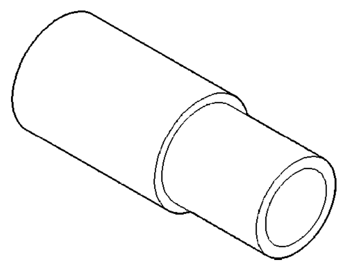
REMOVER C-3985-B



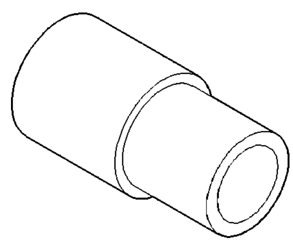
BUSHING REMOVER 6957



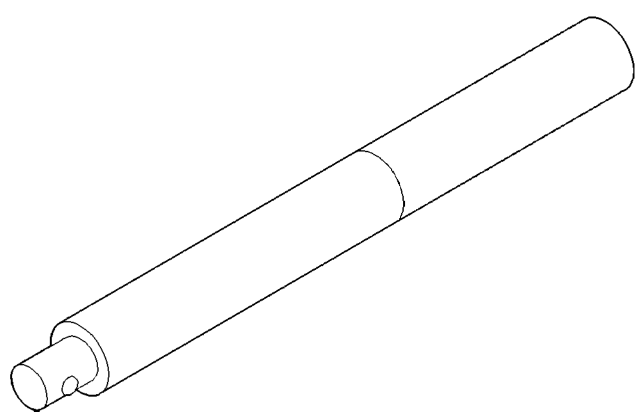
REMOVER BUSHING 8155



INSTALLER BUSHING 6951

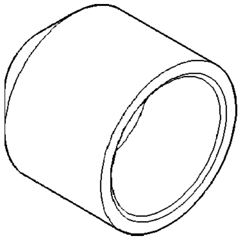


INSTALLER BUSHING 8156

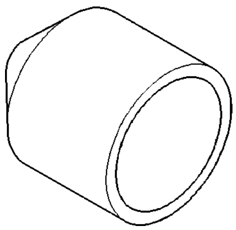


HANDLE C-4171

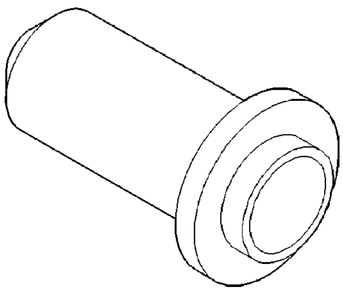
MANUAL TRANSMISSION - NV4500 (Continued)



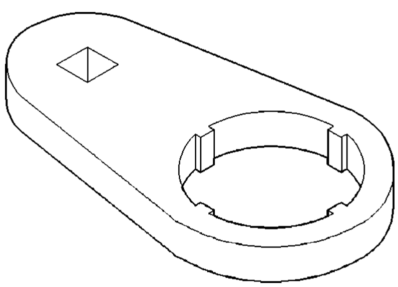
INSTALLER SEAL C-3972-A



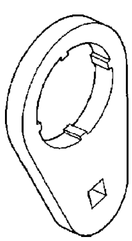
INSTALLER SEAL 8154



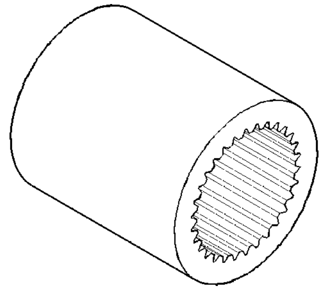
INSTALLER SEAL C-3860-A



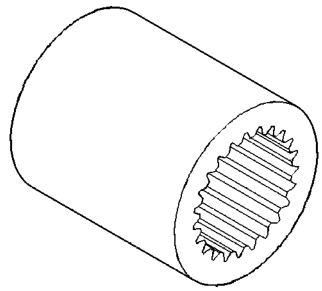
WRENCH 6443



WRENCH 6743



SOCKET 6441



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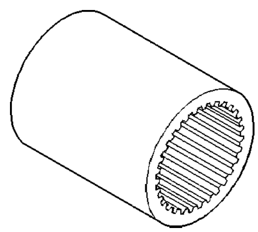
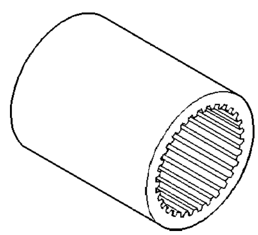
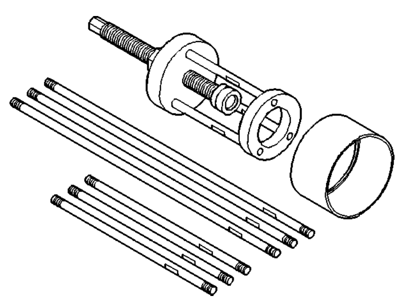


SOCKET 6993

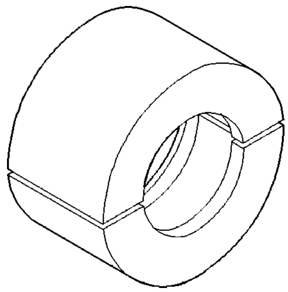


SOCKET 6984



PULLER 6444

MANUAL TRANSMISSION - NV4500 (Continued)



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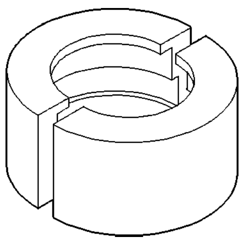

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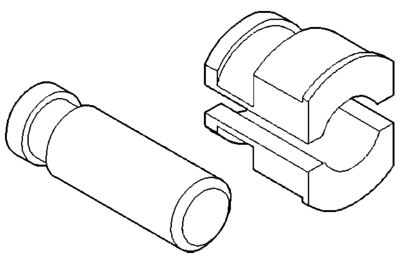
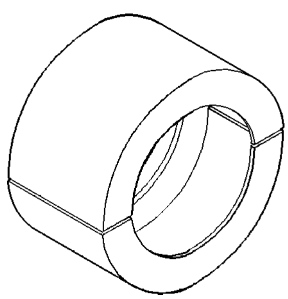


JAWS & INSERT 6453



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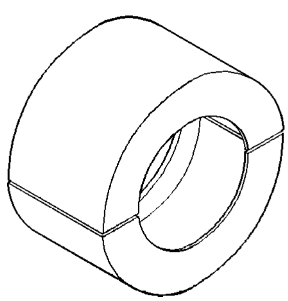
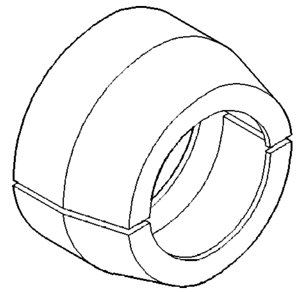


JAWS 6449



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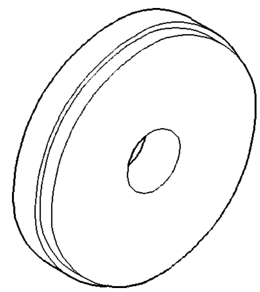
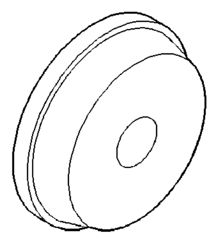
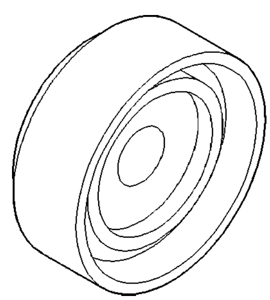


REMOVER 6454

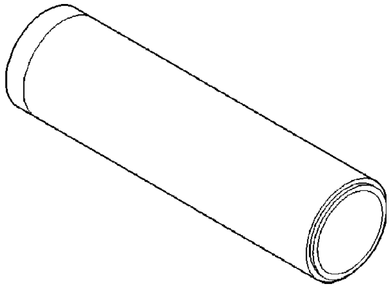


INSTALLER 6061

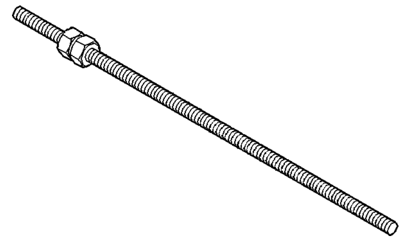


INSTALLER C-4340

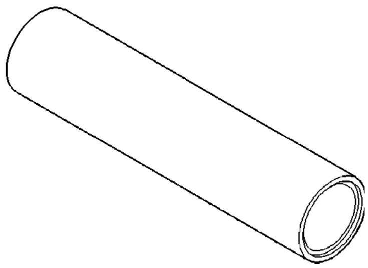
MANUAL TRANSMISSION - NV4500 (Continued)



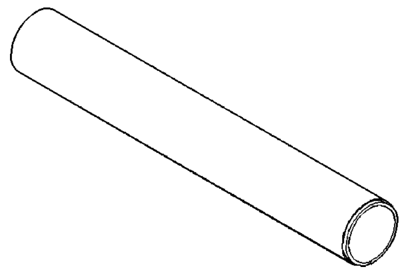
INSTALLER C-4040



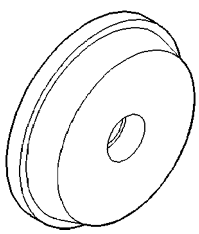
ROD EXTENSION 8161



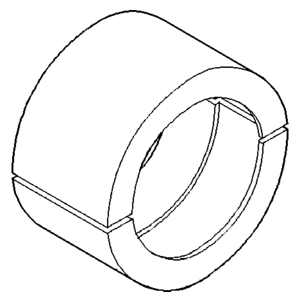
INSTALLER 6448



INSTALLER 6446



INSTALLER C-4308



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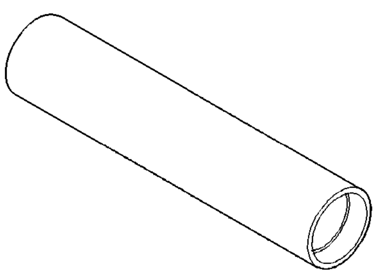


INSTALLER 6052

ADAPTER HOUSING SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Mark the propeller shafts and yokes for installation reference and remove the shafts.

(3) Support transmission with a transmission jack.

(4) Remove engine rear support.

(5) Remove transfer case.

(6) Remove adapter housing seal with a pry tool or slide hammer mounted screw (Fig. 131).

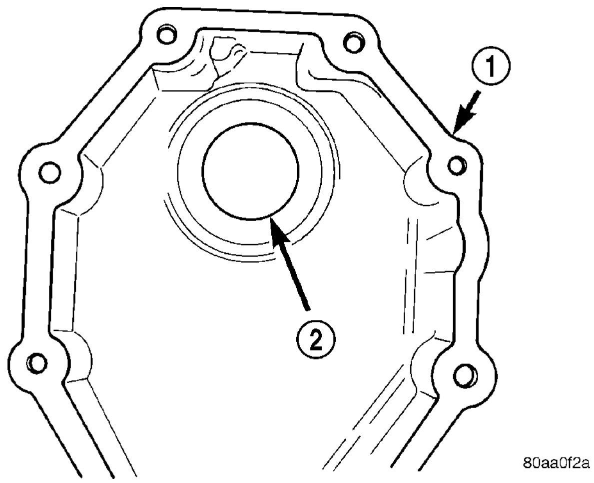


Fig. 131 Adapter Housing (4–Wheel Drive Models)

1 - ADAPTER HOUSING
2 - SEAL

INSTALLATION

(1) Install adapter housing seal with Installer C-3860-A and Handle C-4171.

(2) Install transfer case.

(3) Install propeller shafts with reference marks aligned.

(4) Fill transfer case and transmission to proper level.

(5) Remove support and lower vehicle.

EXTENSION HOUSING SEAL

REMOVAL

(1) Mark the propeller shaft and yoke for installation reference.

(2) Remove the propeller shaft.

(3) Remove extension housing seal (Fig. 132) using Remover C-3985-B.

(4) On heavy duty 4X2 vehicles, remove extension housing seal with a pry tool or a slide hammer mounted screw.

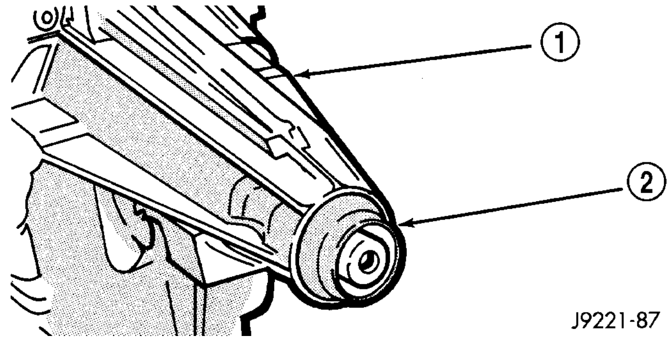


Fig. 132 EXTENSION HOUSING AND SEAL (4X2)

1 - EXTENSION HOUSING
2 - SEAL

(5) On light duty transmissions, remove the extension housing bushing with Remover 6957.

(6) On heavy duty transmissions, remove the extension housing bushing with Remover 8155.

INSTALLATION

(1) Install housing bushing with Handle C-4171 (Fig. 133) and Installer.

- Light Duty - Installer 6951
- Heavy Duty - Installer 8161

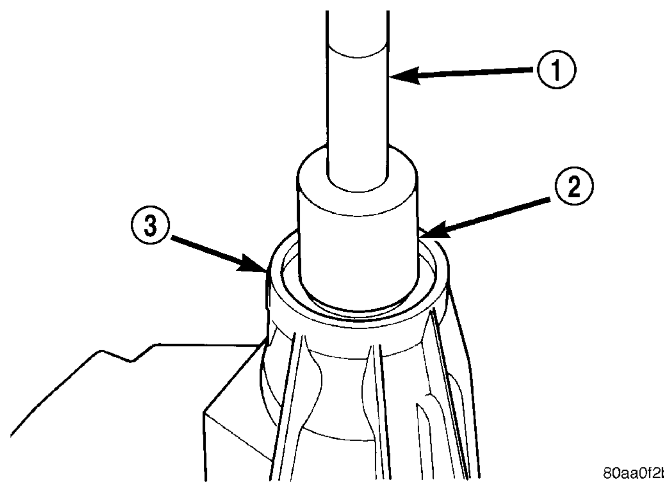


Fig. 133 Extension Housing Bushing

1 - HANDLE
2 - INSTALLER
3 - EXTENSION HOUSING

EXTENSION HOUSING SEAL (Continued)

(2) Install housing seal with Handle C-4171 (Fig. 134) and Installer.
- Light Duty - Installer C-3972-A
- Heavy Duty - Installer 8154

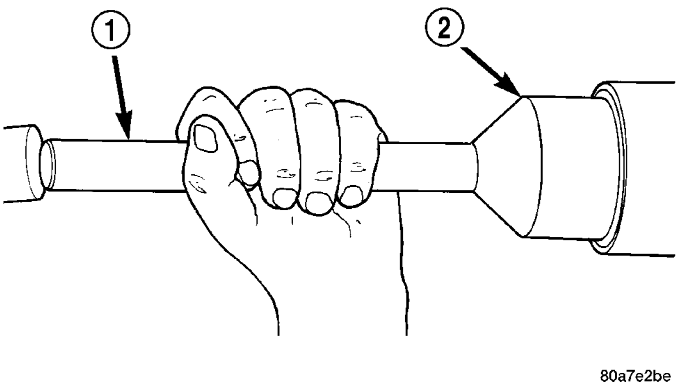


Fig. 134 Pinion Seal

1 - HANDLE
2 - INSTALLER

(3) Install propeller shaft with reference marks aligned.
(4) Check and fill transmission.

SHIFT MECHANISM

REMOVAL

(1) Remove transmission from vehicle.
(2) Remove shift mechanism cover bolts (Fig. 135).

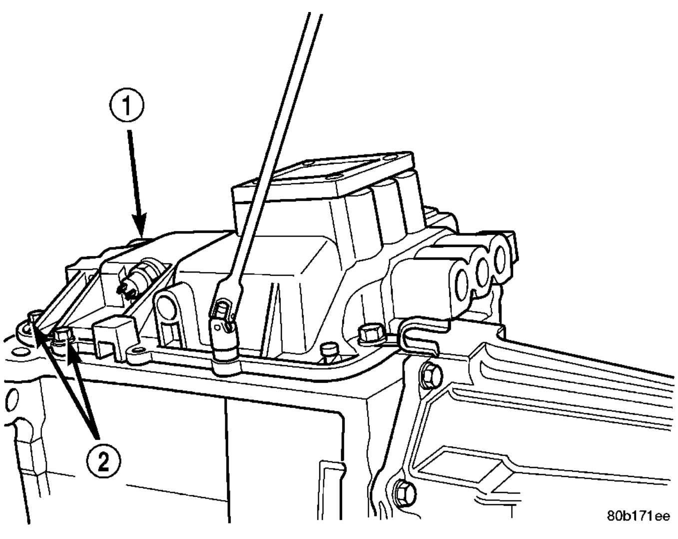


Fig. 135 SHIFT MECHANISM BOLTS

1 - SHIFT MECHANISM COVER
2 - BOLTS

(3) Pry up shift mechanism cover at slots provided in cover (Fig. 136).

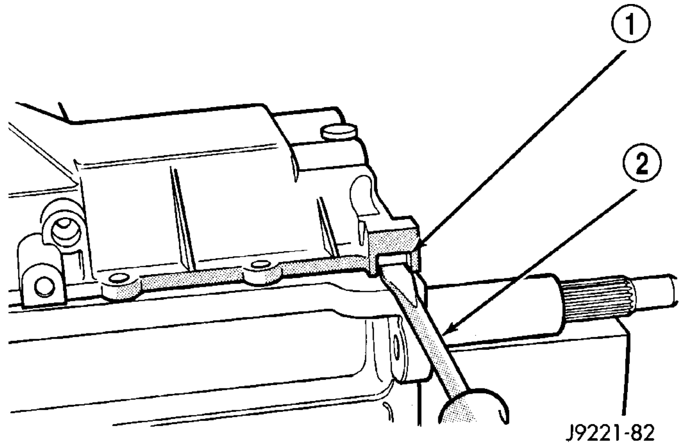


Fig. 136 LOOSEN SHIFT MECHANISM

1 - SHIFT MECHANISM COVER SLOT
2 - PRY TOOL

(4) Raise cover enough to disengage it from alignment dowels in gear case (Fig. 137).

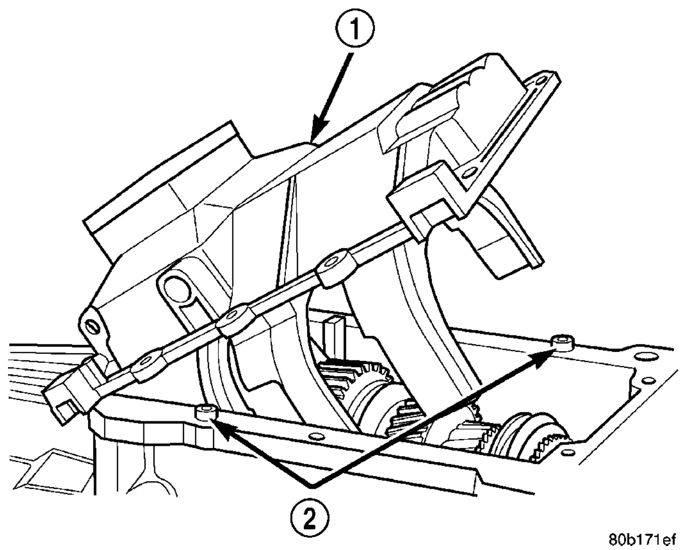


Fig. 137 SHIFT MECHANISM COVER

1 - SHIFT MECHANISM COVER
2 - ALIGNMENT DOWELS

(5) Raise front of shift mechanism cover and lift cover up and off gear case (Fig. 137).

SHIFT MECHANISM (Continued)

FIFTH-REVERSE SHIFT FORK PADS

Three shift pads on the forks are held in place by tension and a small locating tang (Fig. 138).

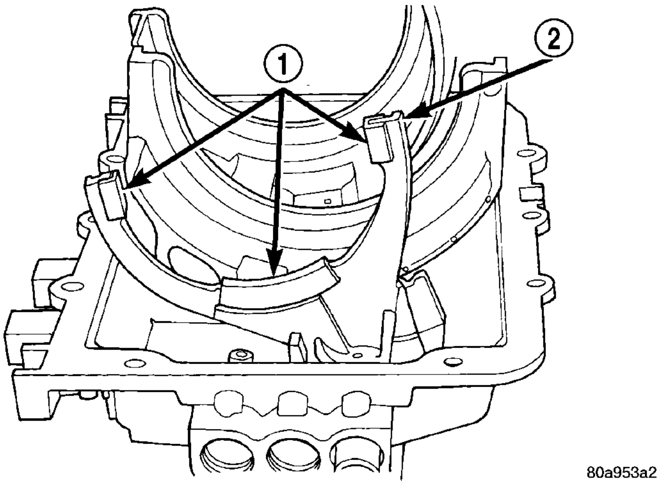


Fig. 138 SHIFT FORK PAD LOCATIONS

1 - SHIFT FORK PADS
2 - FIFTH-REVERSE FORK

To remove the pads, grasp a pad with hand and tilt it out and off the fork. If pad is difficult to remove by hand, insert a screwdriver blade between the pad and fork and pry the pad off.

EXPANSION PLUG

The expansion plugs at the rear of the shift rail bores (Fig. 139) can be replaced if loose/leaking.

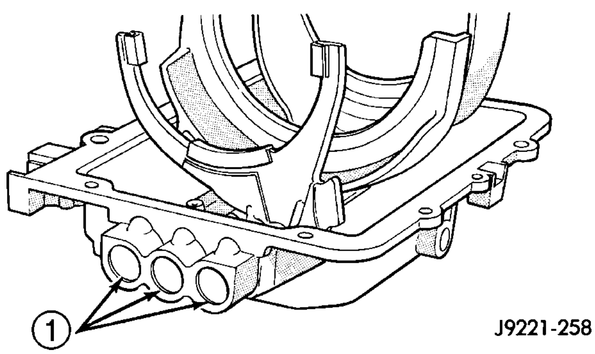


Fig. 139 EXPANSION PLUG LOCATION

1 - EXPANSION PLUGS

(1) Drill 6 mm (1/4 in.) diameter hole in center of the plug to be removed.

(2) Pry plug out of cover with tapered punch.

(3) Clean all chips from shift cover and plug bores. Then clean plug bores with solvent and dry with clean shop towel.

INSTALLATION

EXPANSION PLUG

(1) Apply small bead of Mopar silicone sealer or equivalent to outer edge of each new plug.

(2) Position each plug in bore and tap into place with hammer and punch or socket.

FIFTH-REVERSE SHIFT FORK PADS

(1) Align pad locating tab.

(2) Snap pads into place and verify locating tabs are locked-in.

SHIFT COVER

(1) Clean mating surfaces of shift mechanism cover and gear case with wax and grease remover.

(2) Apply a small amount of Mopar silicone sealer or equivalent to sealing surface of shift mechanism cover.

CAUTION: Do not use an excessive amount sealer. Excess can squeezed into gear case and could block lubricant feed holes in time.

(3) Lubricate synchro sleeves with Castrol® Syntorq gear lubricant or equivalent. Then apply light coat of petroleum jelly to shift fork contact surfaces.

(4) Verify shift fork pads (Fig. 140) are secure.

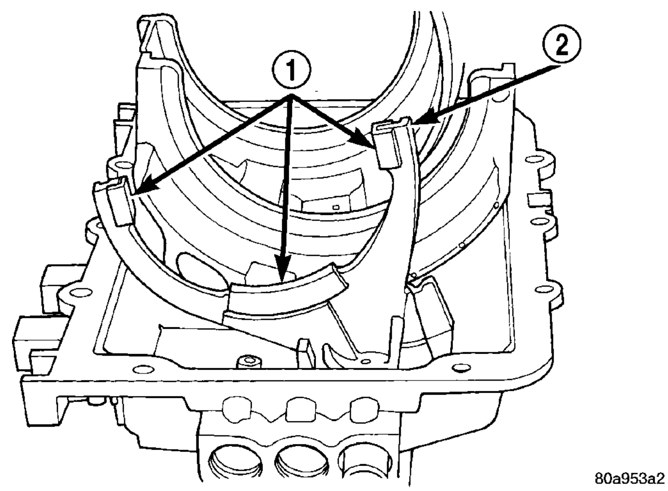


Fig. 140 SHIFT FORK PAD

1 - SHIFT FORK PADS
2 - FIFTH-REVERSE FORK

(5) Verify 1-2 and 3-4 synchro sleeves and forks in shift cover are in neutral position.

(6) Align and seat shift mechanism cover on transmission.

NOTE: If cover will not seat, it may not be aligned on gear case dowels or shift forks are not aligned with sleeves and shift lug.

SHIFT MECHANISM (Continued)

(7) Apply Mopar Lock N' Seal or equivalent to threads of shift cover bolts.

(8) Install shift cover mechanism bolts and tighten to 27-31 N·m (216-276 in. lbs.).

(9) Apply sealer to backup lamp switch. Install switch into cover and tighten to 22-34 N·m (193-265 in. lbs.).

(10) Install vent assembly if removed. Apply an adhesive/sealer to vent tube to help secure it in cover.

(11) Install transmission.

SHIFT COVER

REMOVAL

(1) Shift transmission into Neutral.

(2) Unscrew and remove the shift lever extension from the shift

(3) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.

(4) Remove the bolts holding the shift tower to the isolator plate and transmission shift cover.

(5) Remove the shift tower and isolator plate from the transmission shift cover.

INSTALLATION

(1) Clean the mating surfaces of shift tower, isolator plate and shift cover with suitable wax and grease remover.

(2) Apply Mopar Gasket Maker or equivalent to the sealing surface of the shift cover. Do not over apply sealant.

(3) Install the isolator plate onto the shift cover, metal side down.

(4) Install the shift tower onto the isolator plate. No sealant is necessary between the shift tower and the isolator plate.

(5) Verify shift tower, isolator plate and shift tower bushings are properly aligned.

(6) Install bolts to hold the shift tower to the isolator plate and the shift cover. Tighten the shift tower bolts to 10.2-11.25 N·m (7.5-8.3 ft. lbs.).

(7) Install shift lever extension, shift boot and bezel.

MANUAL TRANSMISSION - NV5600

TABLE OF CONTENTS

MANUAL TRANSMISSION - NV5600

DESCRIPTION

The NV5600 is a six speed constant mesh manual transmission (Fig. 1). All gear ranges including reverse are synchronized. First and second gears utilize dual cone synchronizers in order to aid shifting. Sixth gear is an overdrive range. The transmission uses cast iron for the gear case and extension/adapter housing and aluminum for the clutch housing.

To drain the trans remove the bottom PTO cover bolt. Fill the trans through the plug to the rear of the PTO cover (Fig. 1). Dry fill is approximately 4.5 liters (9.5 pints) or to the bottom edge of the fill plug hole.

The gear ratios are:

GEAR RATIOS

GEAR	RATIO
FIRST	5.63:1
SECOND	3.38:1
THIRD	2.04:1
FOURTH	1.39:1
FIFTH	1.00:1
SIXTH	0.73:1
REVERSE	5.63:1

MANUAL TRANSMISSION - NV5600 (Continued)

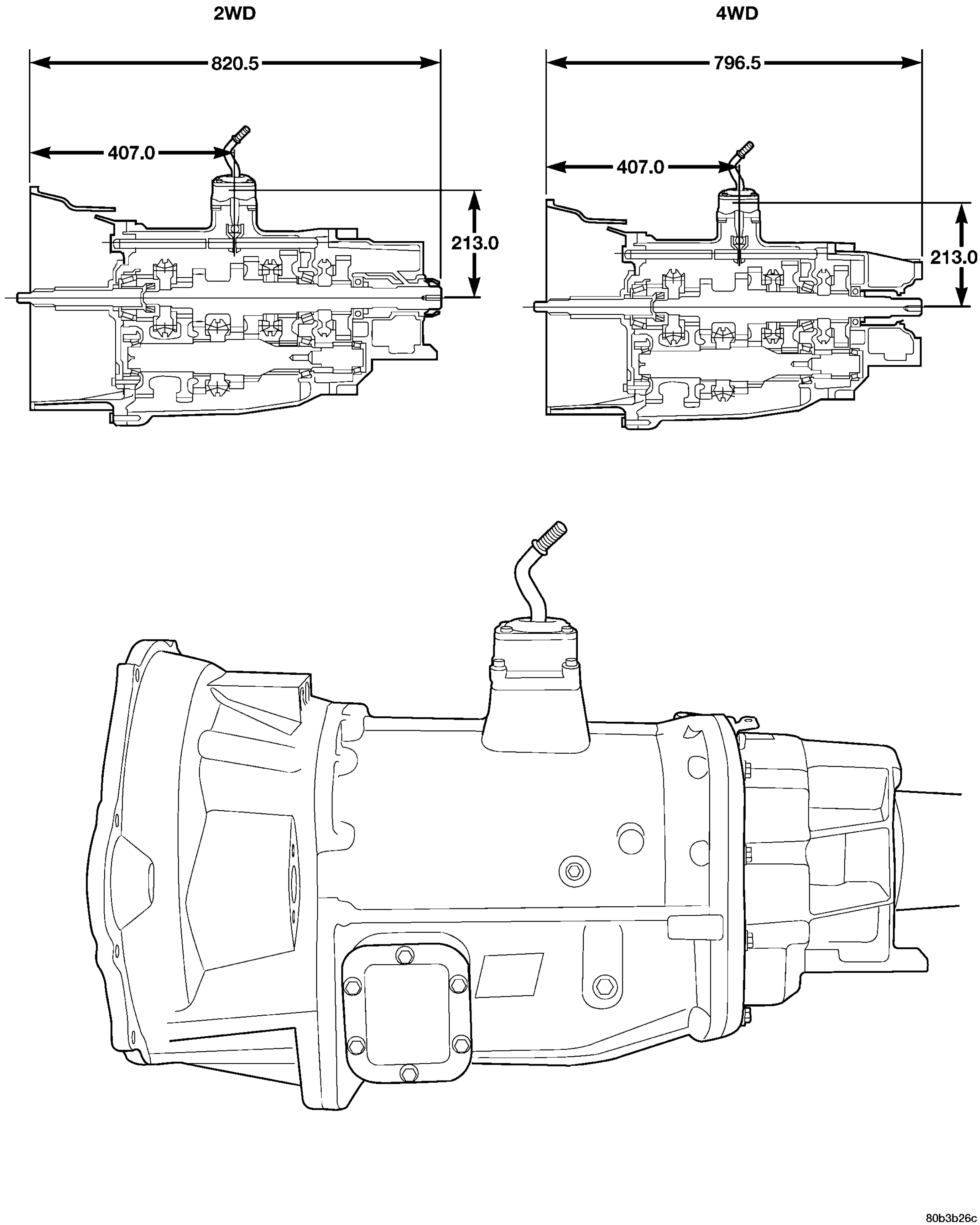


Fig. 1 NV5600 MANUAL TRANSMISSION

MANUAL TRANSMISSION - NV5600 (Continued)

IDENTIFICATION

The transmission has two identification tags attached to the driver side upper clutch housing (Fig. 2). One tag provides the transmission part number. The second tag provides sequencing and build date information. The information on the tags are essential to correct parts ordering.

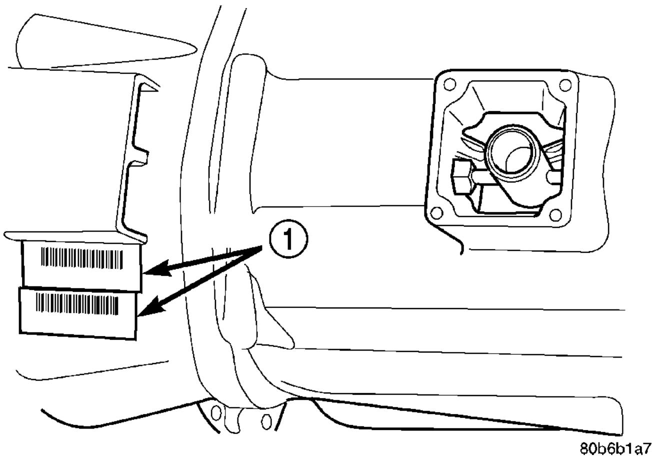


Fig. 2 IDENTIFICATION TAG LOCATION

1 - IDENTIFICATION TAGS

OPERATION

The driver selects a particular gear by moving the shift lever to the desired gear position. As the shift lever moves the selected shift rail, the shift fork attached to that rail begins to move. The fork is positioned in a groove in the outer circumference of the synchronizer sleeve. As the shift fork moves the synchronizer sleeve, the synchronizer begins to speed-up or slow down the selected gear (depending on whether we are up-shifting or down-shifting). The synchronizer does this by having the synchronizer hub splined to the mainshaft or the countershaft in some cases, and moving the blocker ring into contact with the gear's friction cone. As the blocker ring and friction cone come together, the gear speed is brought up or down to the speed of the synchronizer. As the two speeds match, the splines on the inside of the synchronizer sleeve become aligned with the teeth on the blocker ring and friction cone and eventually will slide over the teeth, locking the gear to the mainshaft or countershaft through the synchronizer.

DIAGNOSIS AND TESTING

LOW LUBRICANT LEVEL

A low transmission lubricant level is generally the result of a leak, inadequate lubricant fill or an incorrect lubricant level check. A correct lubricant level check can only be made when the vehicle is level. Also allow the lubricant to settle for a minute or so before checking. These recommendations will ensure an accurate check and avoid an underfill or overfill condition. Always check the lubricant level after any addition of fluid to avoid an incorrect lubricant level condition.

Leaks can occur at the mating surfaces of the gear case, adaptor or extension housing, or from the front/rear seals. A suspected leak could also be the result of an overfill condition. Leaks at the rear of the extension or adapter housing will be from the housing oil seals. Leaks at component mating surfaces will probably be the result of inadequate sealer, gaps in the sealer, incorrect bolt tightening or use of a non-recommended sealer. A leak at the front of the transmission will be from either the front bearing retainer or retainer seal. Lubricant may be seen dripping from the clutch housing after extended operation. If the leak is severe, it may also contaminate the clutch disc causing the disc to slip, grab and or chatter.

HARD SHIFTING

Hard shifting is usually caused by a low lubricant level, improper or contaminated lubricants. The consequence of using non-recommended lubricants is noise, excessive wear, internal bind and hard shifting. Substantial lubricant leaks can result in gear, shift rail, synchro, and bearing damage. If a leak goes undetected for an extended period, the first indications of component damage are usually hard shifting and noise.

Component damage, incorrect clutch adjustment or damaged clutch pressure plate or disc are additional probable causes of increased shift effort. Incorrect adjustment or a worn/damaged pressure plate or disc can cause incorrect release. If clutch problem is advanced, gear clash during shifts can result. Worn or damaged synchro rings can cause gear clash when shifting into any forward gear. In some new or rebuilt transmissions, new synchro rings may tend to stick slightly causing hard or noisy shifts. In most cases this condition will decline as the rings wear-in.

TRANSMISSION NOISE

Most manual transmissions make some noise during normal operation. Rotating gears generate a mild whine that is audible, but generally only at extreme speeds. Severe highly audible transmission noise is generally the initial indicator of a lubricant problem.

Insufficient, improper or contaminated lubricant will promote rapid wear of gears, synchros, shift rails, forks and bearings. The overheating caused by a lubricant problem, can also lead to gear breakage.

REMOVAL

(1) Shift transmission into Neutral.

(2) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.

(3) Remove the bolts holding the shift tower to the isolator plate and transmission gear case.

(4) Remove the shift tower and isolator plate from the transmission gear case.

(5) Raise and support vehicle.

(6) Remove skid plate, if equipped.

(7) Mark propeller shaft/shafts and axle yokes for installation reference.

(8) Remove propeller shaft.

(9) Disconnect and remove exhaust system as necessary.

(10) Disconnect wires at backup light switch.

(11) Support engine with adjustable safety stand and wood block.

(12) If transmission is to be disassembled for repair, remove drain bolt at bottom of PTO cover and drain lubricant from transmission (Fig. 3).

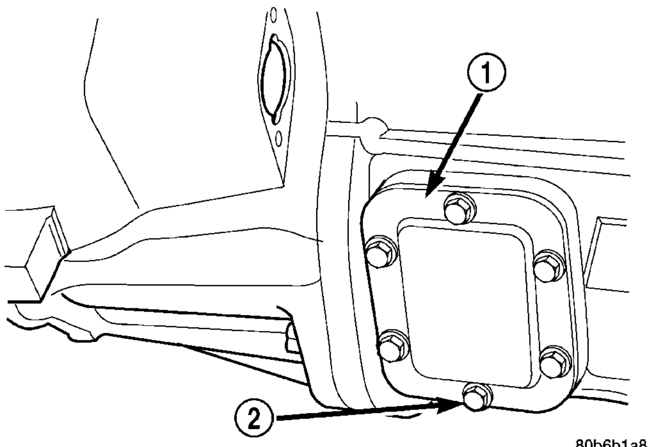


Fig. 3 NV5600 DRAIN BOLT

1 - PTO COVER
2 - DRAIN BOLT

(13) Remove clutch slave cylinder splash shield, if equipped.

(14) Remove clutch slave cylinder bolts and move cylinder aside for clearance.

(15) Remove wire harness from clips on transmission.

TWO WHEEL DRIVE

(1) Remove bolts/nuts mounting transmission to the rear mount.

(2) Support and secure transmission with safety chains to a transmission jack.

(3) Remove rear crossmember bolts and pry out crossmember.

(4) Remove transmission clutch housing bolts at the engine block.

(5) Slide transmission and jack rearward until input shaft clears clutch disc and pressure plate.

(6) Lower transmission jack and remove transmission from under vehicle.

FOUR WHEEL DRIVE

(1) Disconnect transfer case shift linkage at transfer case range lever.

(2) Support and secure transfer case with safety chains to a transmission jack.

(3) Remove transfer case mounting nuts.

(4) Move transfer case rearward until input gear clears transmission mainshaft.

(5) Lower transfer case assembly and move it from under vehicle.

(6) Support and secure transmission with safety chains to a transmission jack.

(7) Remove bolts/nuts attaching transmission mount to rear crossmember.

(8) Remove rear crossmember bolts and pry out crossmember.

(9) Remove transmission clutch housing bolts at the engine block.

(10) Move transmission rearward until input shaft clears clutch disc.

(11) Lower transmission and remove it from under vehicle.

DISASSEMBLY

NOTE: Use Fixture 8241 for moving and handling the transmission. The fixture supports the transmission at the center of gravity in order to ease mounting the transmission into the build fixture.

(1) Mount the transmission into Fixture 8230 (Fig. 4).

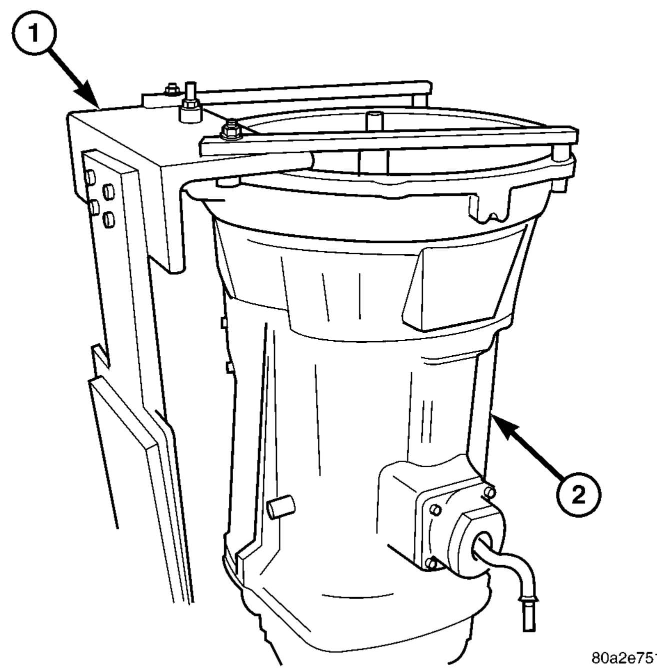


Fig. 4 TRANSMISSION FIXTURE

1 - FIXTURE
2 - TRANSMISSION

MANUAL TRANSMISSION - NV5600 (Continued)

(2) Rotate the transmission to the horizontal position, if necessary.

(3) Remove the shift tower (Fig. 5) and isolator plate (Fig. 6).

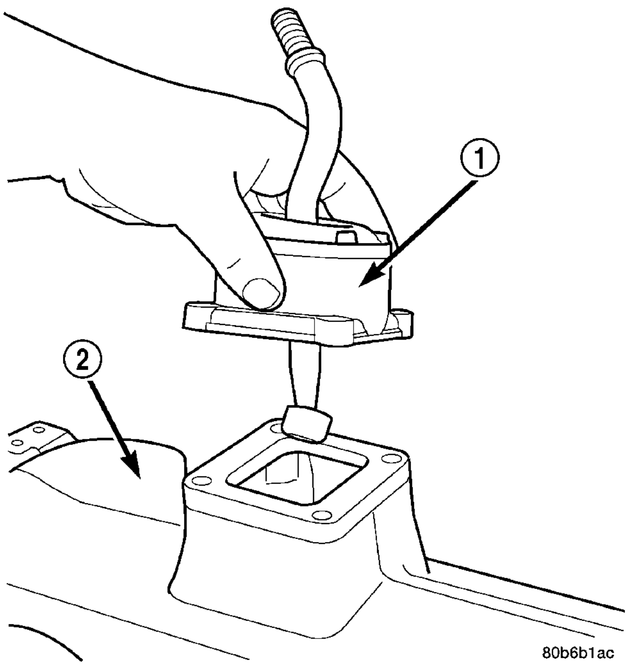


Fig. 5 REMOVE SHIFT TOWER

1 - SHIFT TOWER
2 - TRANSMISSION

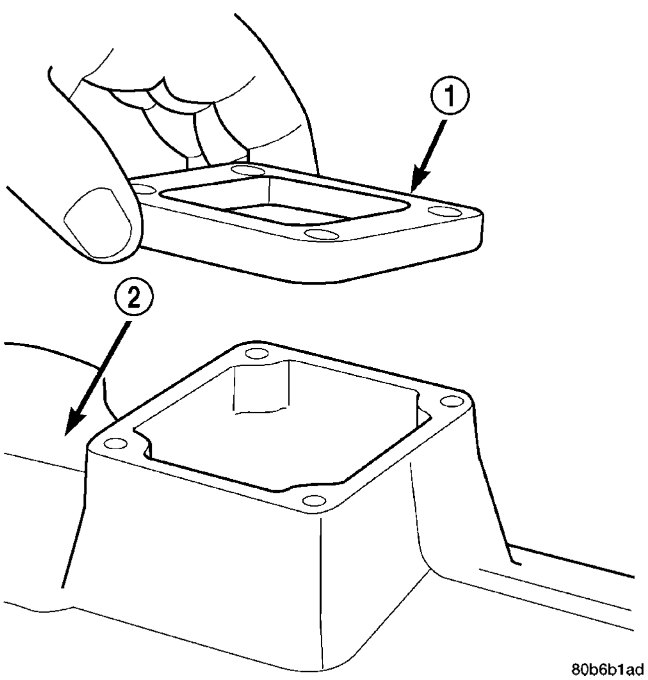


Fig. 6 SHIFT TOWER ISOLATOR PLATE

1 - ISOLATOR PLATE
2 - TRANSMISSION

(4) Remove primary shift rail detent plug (Fig. 7).

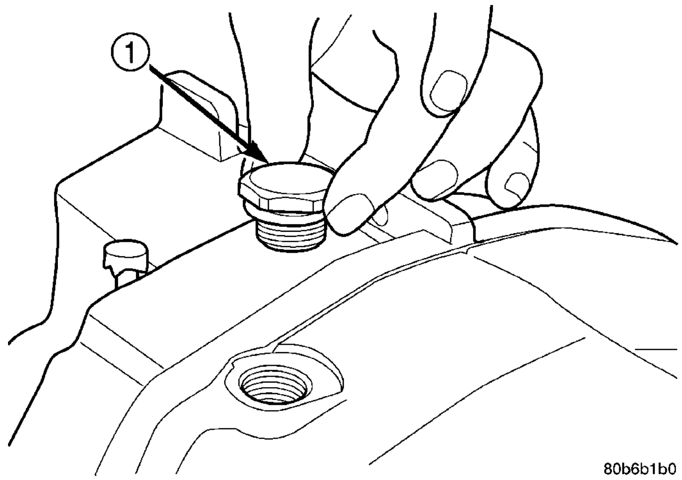


Fig. 7 PRIMARY SHIFT RAIL DETENT PLUG

1 - DETENT PLUG

(5) Remove primary shift rail detent spring (Fig. 8).

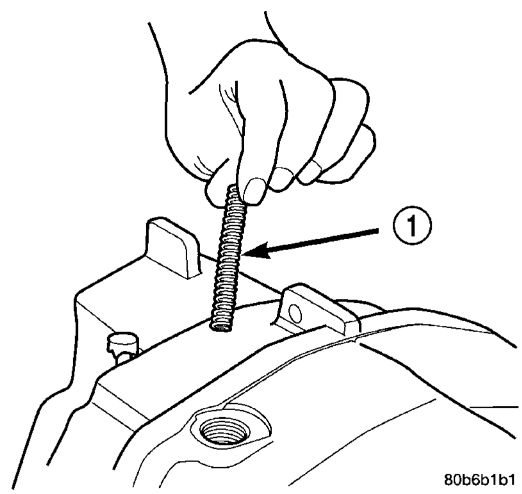


Fig. 8 PRIMARY SHIFT RAIL DETENT SPRING

1 - DETENT SPRING

MANUAL TRANSMISSION - NV5600 (Continued)

(6) Remove primary shift rail detent plunger (Fig. 9).

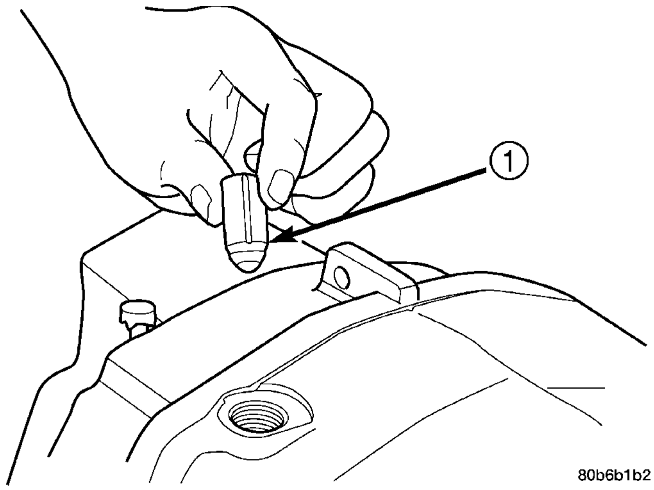


Fig. 9 PRIMARY SHIFT RAIL DETENT PLUNGER

1 - DETENT PLUNGER

(7) Remove clutch housing bolts (10) (Fig. 10) from inside the housing.

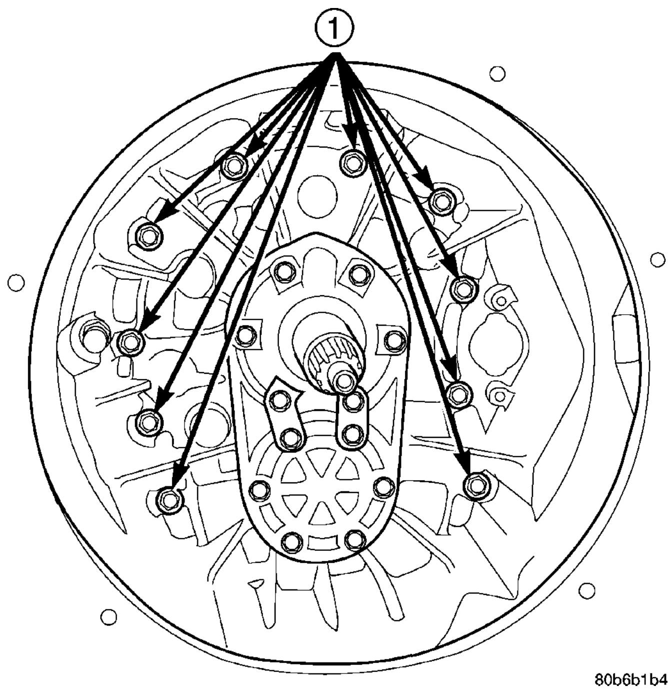


Fig. 10 CLUTCH HOUSING BOLTS

1 - BOLTS (10)

(8) Remove shift rail blocker bolt (Fig. 11) from the side of the transmission gear case.

EXTENSION/ADAPTER HOUSING

(1) Remove bolts holding the extension/adapter housing onto the transmission gear case.

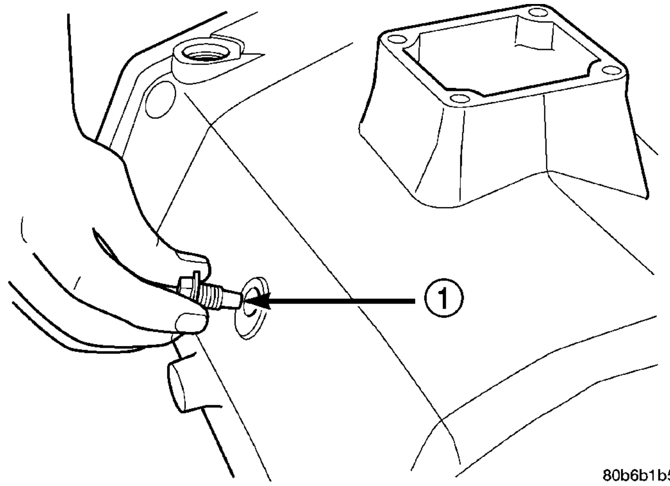


Fig. 11 SHIFT RAIL BLOCKER BOLT

1 - BLOCKER BOLT

(2) Remove extension/adapter housing from the transmission gear case with Puller 8244 (Fig. 12).

NOTE: It may be necessary to straighten the housing during removal due to the tendency for the reverse idler shaft to bind into one side of the housing.

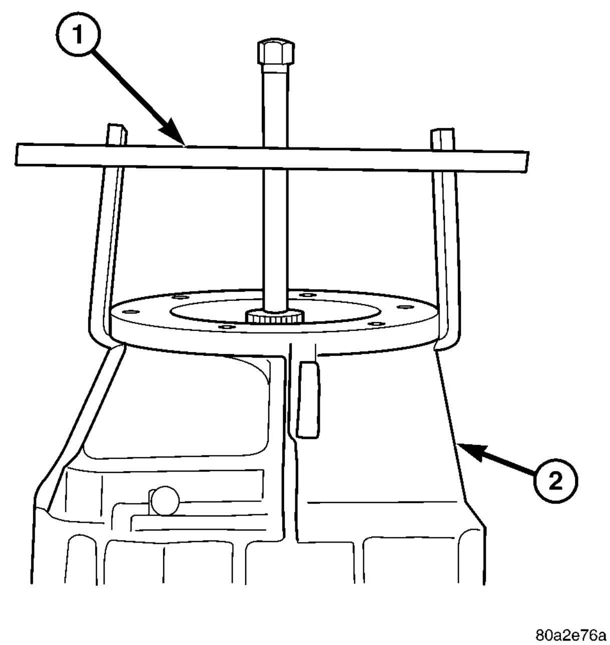


Fig. 12 TRANSMISSION CASE PULLER

1 - PULLER
2 - EXTENSION/ADAPTER HOUSING

MANUAL TRANSMISSION - NV5600 (Continued)

(3) Remove crossover detent plug, spring and plunger from the extension/adapter housing (Fig. 13).

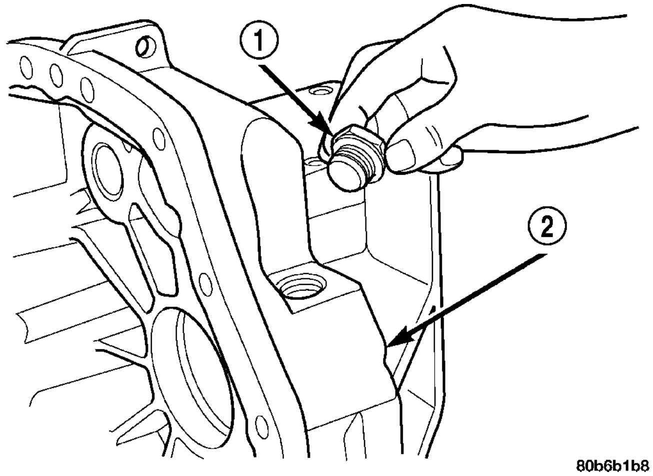


Fig. 13 CROSSOVER CAM DETENT PLUG

1 - DETENT PLUG
2 - EXTENSION HOUSING

(4) Remove bolt and washer holding the crossover cam to the extension/adapter housing (Fig. 14).

(5) Remove crossover cam from the extension/adapter housing.

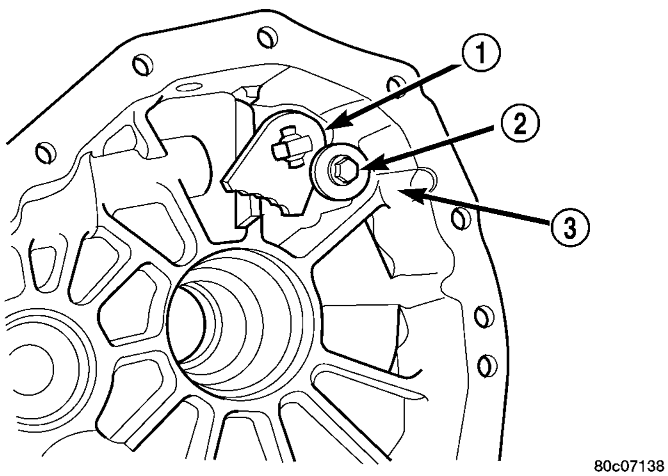


Fig. 14 CROSSOVER CAM BOLT

1 - CROSSOVER CAM
2 - BOLT
3 - EXTENSION HOUSING

(6) Remove back-up lamp switch from the extension/adapter housing.

(7) Remove countershaft rear bearing race from the extension/adapter housing with Remover L-4518 (Fig. 15).

NOTE: Tag all countershaft pre-load shims from between the bearing race and the housing (Fig. 16).

(8) Remove crossover cam bushing from the extension/adapter housing with Remover 8240.

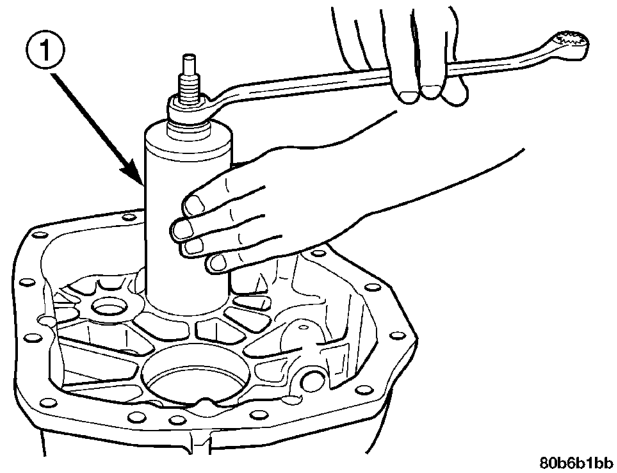


Fig. 15 COUNTERSHAFT REAR BEARING RACE

1 - REMOVER

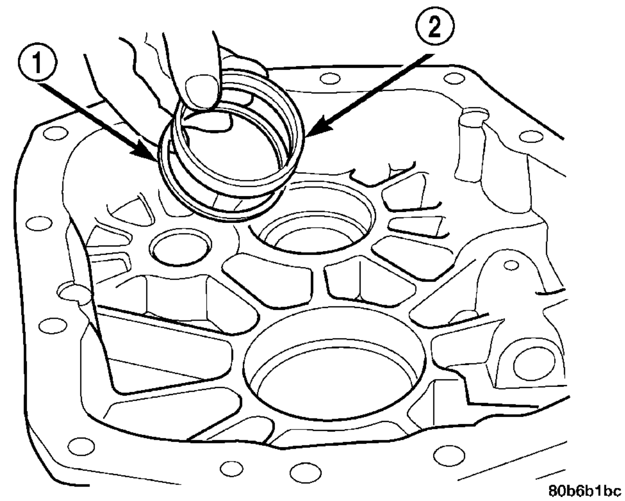


Fig. 16 COUNTERSHAFT REAR BEARING RACE AND SHIM

1 - PRE-LOAD SHIM
2 - BEARING RACE

(9) On 4X2 vehicles, remove extension housing seal with a pry tool or a slide hammer and screw.

(10) On 4X4 vehicles, remove adapter housing seal with a pry tool or a slide hammer and screw.

MANUAL TRANSMISSION - NV5600 (Continued)

REVERSE GEAR

(1) Remove crossover cam rollers and pin (Fig. 17).

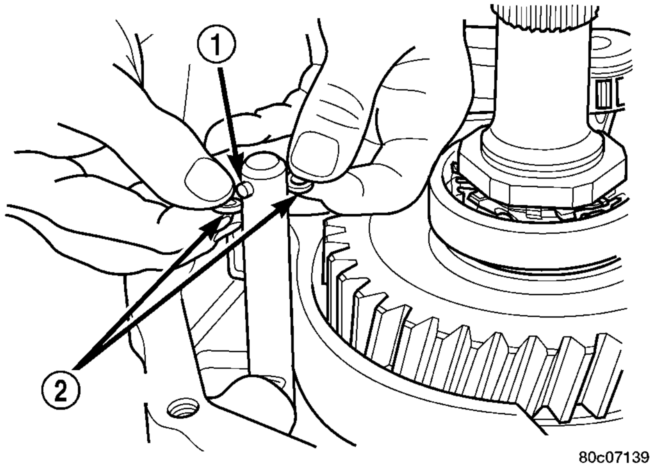


Fig. 17 CROSSOVER CAM ROLLERS AND PIN

1 - CROSSOVER CAM PIN
2 - CROSSOVER CAM ROLLERS

(2) Remove reverse idler thrust washer from the reverse idler.

(3) Remove reverse idler and reverse countershaft gears together (Fig. 18).

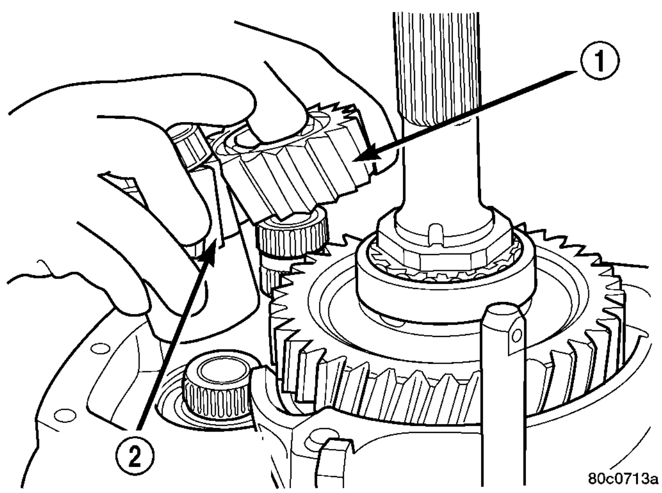


Fig. 18 REVERSE IDLER AND COUNTERSHAFT GEARS

1 - REVERSE IDLER GEAR
2 - COUNTERSHAFT REVERSE GEAR

(4) Remove reverse idler gear rear bearing, bearing spacer, front bearing and front thrust washer from the idler gear shaft.

(5) Remove reverse countershaft rear bearing from the countershaft reverse gear assembly with Puller C-293-PA and Adapters C-293-52 (Fig. 19).

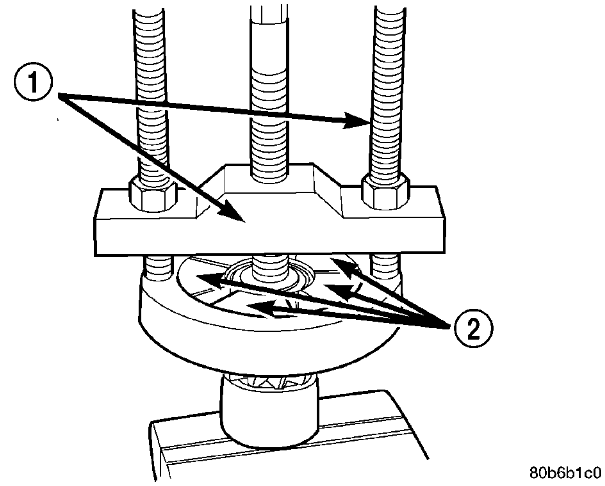


Fig. 19 COUNTERSHAFT REAR BEARING PULLER

1 - PULLER
2 - ADAPTERS

(6) Seperate countershaft reverse gear and sleeve.

(7) Remove output shaft nut with Wrench 8226 on the shaft nut and Socket 6993 or 6984 to hold the shaft (Fig. 20). Discard output shaft nut from the output shaft.

NOTE: If necessary strike the flat side area of Wrench 8226 with a hammer to break the nut loose.

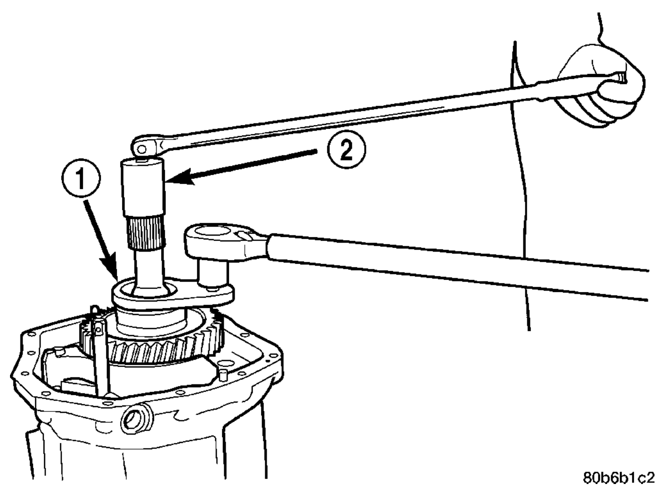


Fig. 20 LOOSEN OUTPUT SHAFT NUT

1 - WRENCH
2 - SOCKET

MANUAL TRANSMISSION - NV5600 (Continued)

(8) Remove output shaft ball bearing assembly and reverse thrust washer from the output shaft (Fig. 21).

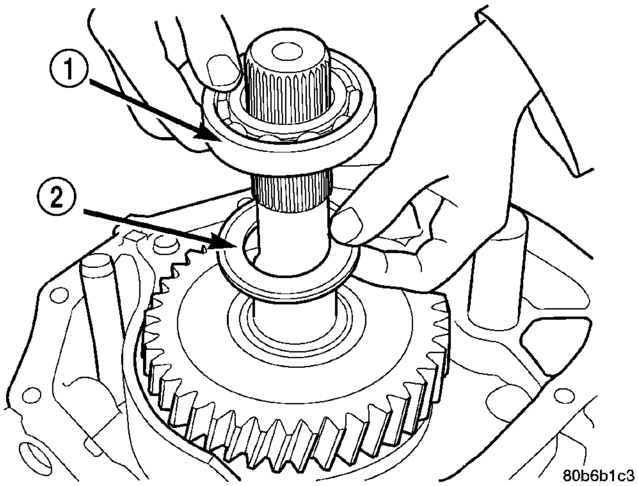


Fig. 21 OUTPUT SHAFT BEARING AND THRUST WASHER

1 - OUTPUT SHAFT BALL BEARING
2 - THRUST WASHER

(9) Remove reverse gear, reverse gear synchronizer cone, reverse gear outer blocker ring and reverse gear bearing (Fig. 22).

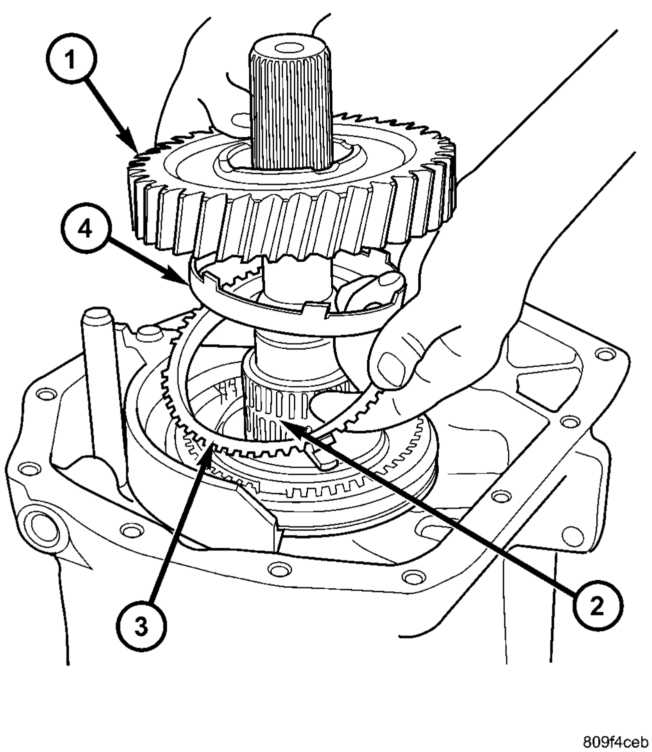


Fig. 22 REVERSE GEAR COMPONENTS

1 - REVERSE GEAR
2 - REVERSE BEARING
3 - BLOCKER RING
4 - FRICTION CONE

(10) Remove reverse gear bearing sleeve from the output shaft (Fig. 23).

NOTE: If necessary heat the sleeve slightly with a heat gun. Do not use a torch to heat the sleeve or damage to the output shaft may occur.

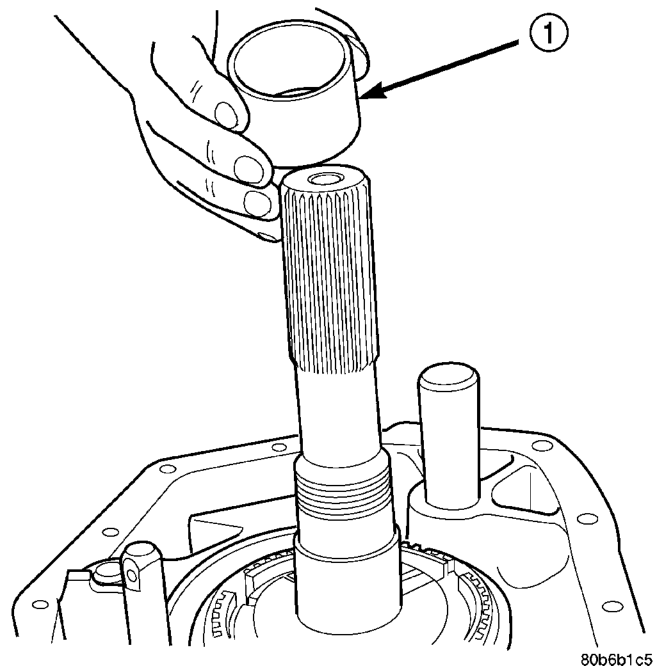


Fig. 23 REVERSE BEARING SLEEVE

1 - REVERSE GEAR BEARING SLEEVE

(11) Remove roll-pin securing the reverse shift fork to the reverse shift rail with a 6 mm (7/32 in.) punch and hammer.

MANUAL TRANSMISSION - NV5600 (Continued)

(12) Remove reverse shift fork and synchronizer as an assembly from the reverse shift rail and the output shaft (Fig. 24).

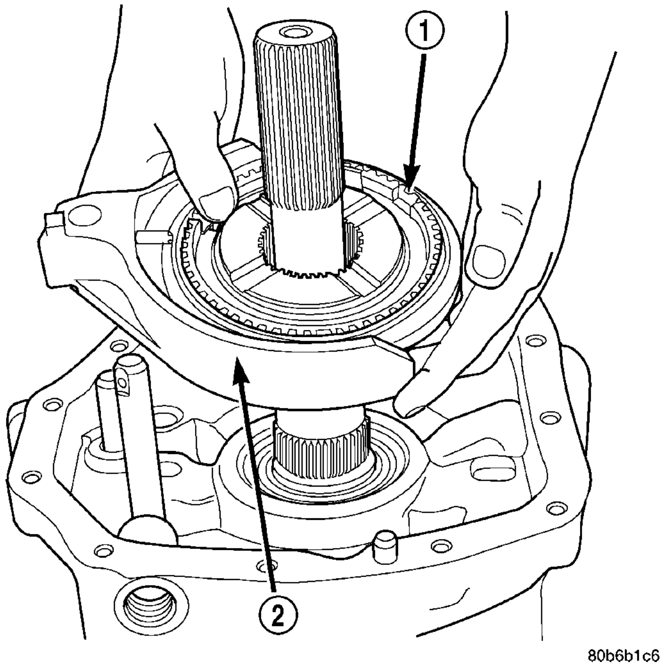


Fig. 24 REVERSE SHIFT FORK AND SYNCHRO

1 - REVERSE SYNCHRO
2 - REVERSE SHIFT FORK

TRANSMISSION GEAR CASE

(1) Remove remaining bolts holding the transmission gear case to the clutch housing.
(2) Remove the shift socket roll pin with a 6 mm (7/32 in.) punch and hammer.
(3) Turn shift socket so it won't catch the case when lifting it up.
(4) Install Fixture 8232 to the transmission gear case.
(5) Attach an engine crane or equivalent to Fixture 8232 and remove the transmission gear case from the clutch housing (Fig. 25).
(6) Remove rear output shaft and countershaft bearing races from the transmission gear case with a brass drift and hammer.

GEARTRAIN

(1) Remove bolts holding the 5-6 crossover bracket to the clutch housing (Fig. 26).

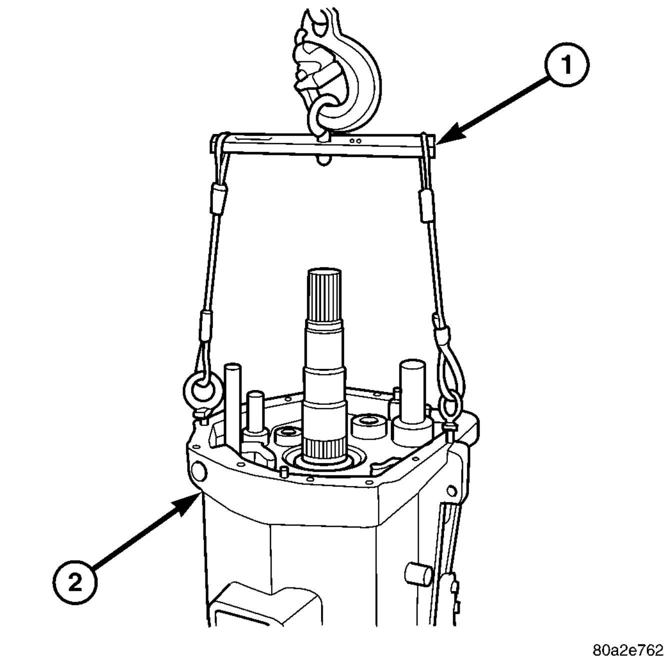


Fig. 25 TRANSMISSION CASE LIFT FIXTURE

1 - FIXTURE
2 - TRANSMISSION CASE

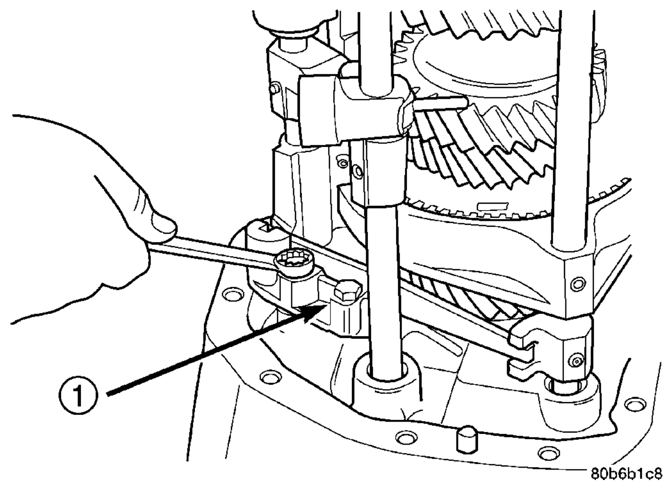


Fig. 26 5-6 CROSSOVER BRACKET BOLTS

1 - 5-6 CROSSOVER BRACKET

MANUAL TRANSMISSION - NV5600 (Continued)

(2) Attach Fixture 8232 to the output shaft and countershaft (Fig. 27).

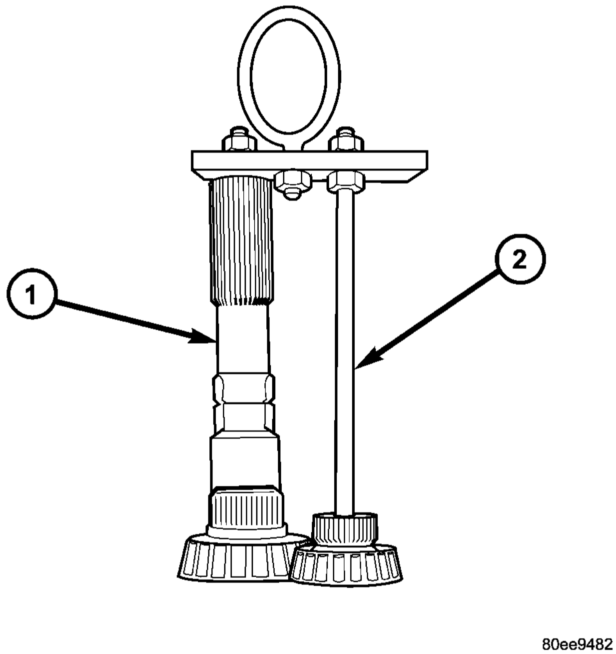


Fig. 27 FIXTURE/OUTPUT SHAFT

1 - OUTPUT SHAFT
2 - FIXTURE

(3) Attach an engine crane or equivalent to Fixture 8232 and raise the geartrain approximately 1/4 in. from the clutch housing.

(4) Remove 5-6 crossover bracket from the clutch housing.

(5) Lower the geartrain back into the clutch housing.

(6) Install Holding Tool 8242 (Fig. 28) onto the 5-6 synchro and tighten the screw to hold the 5-6 synchro together during the removal operation.

NOTE: Note the order of the shift fork arms at the primary shift rail, while in the Neutral position.

(7) Raise geartrain and shift rails until all the shift rails clear the clutch housing.

(8) Remove shift rails from the rest of the geartrain (Fig. 29).

(9) Raise the geartrain until the input shaft is clear of the clutch housing.

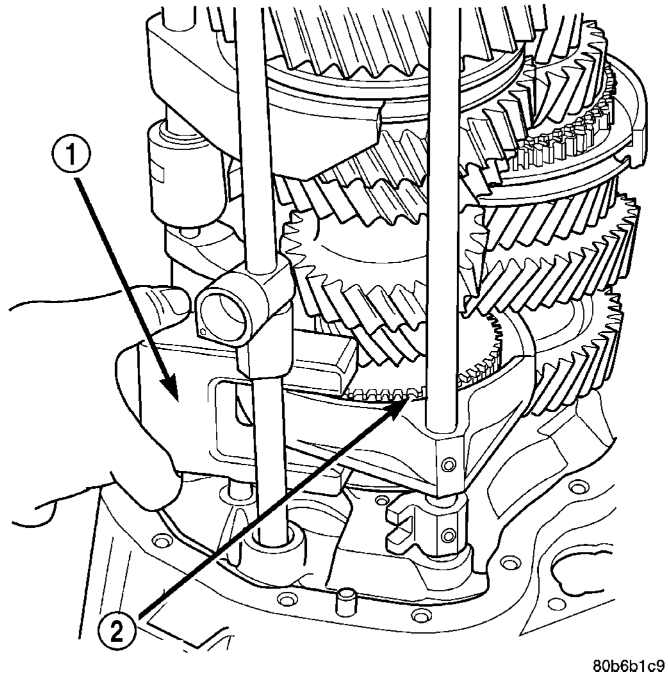


Fig. 28 Remove Holding Tool

1 - HOLDING TOOL
2 - 5-6 SYNCHRO

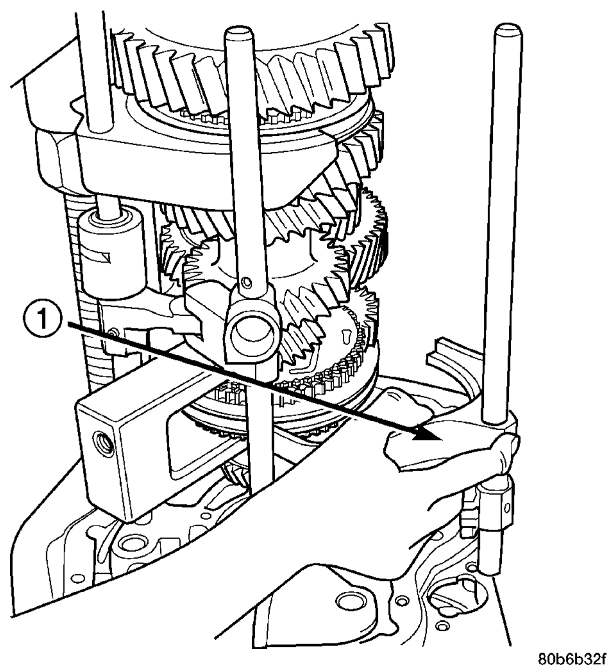


Fig. 29 SHIFT RAILS

1 - 5-6 SHIFT RAIL

MANUAL TRANSMISSION - NV5600 (Continued)

(10) Remove geartrain from the clutch housing and install the geartrain into Support Stand 8246 (Fig. 30).

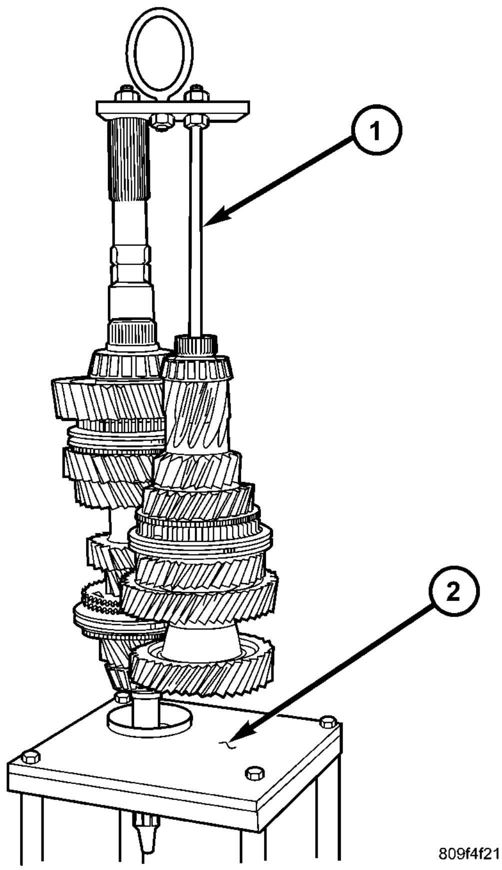


Fig. 30 GEARTRAIN FIXTURE

1 - FIXTURE
2 - SUPPORT STAND

(11) Remove Fixture 8232 from the output shaft and the countershaft.

(12) Separate the countershaft from the output shaft.

(13) Separate the output shaft from the input shaft. Hold the 5-6 synchro together while removing the output shaft to prevent the synchro sleeve from being dislodged from the synchro hub.

COUNTERSHAFT BEARINGS

(1) Remove snap-ring holding the front counter-shaft bearing onto the countershaft.

(2) Remove front countershaft bearing with Collar 6444-8, Jaws 6451, Puller Rods 6444-4 and Puller 6444 (Fig. 31).

(3) Remove rear countershaft bearing with Collar 6444-8, Jaws 6447, Puller Rods 6444-4, Puller 6444 and suitable press button (Fig. 32).

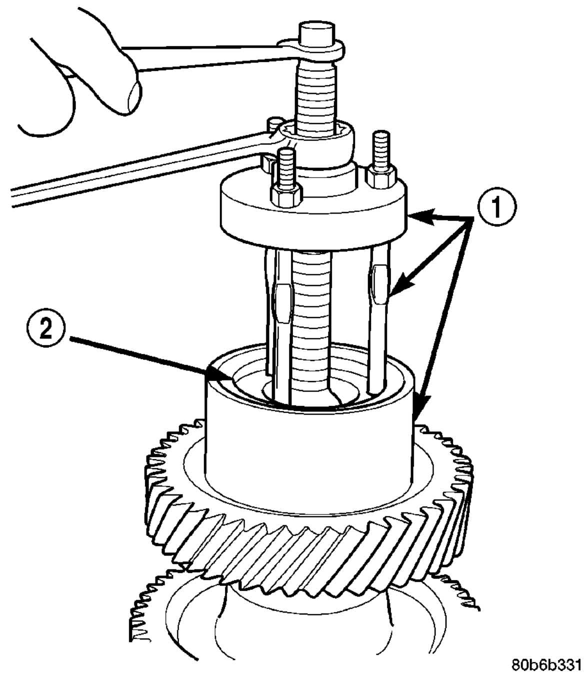


Fig. 31 FRONT COUNTERSHAFT BEARING

1 - PULLER
2 - JAWS

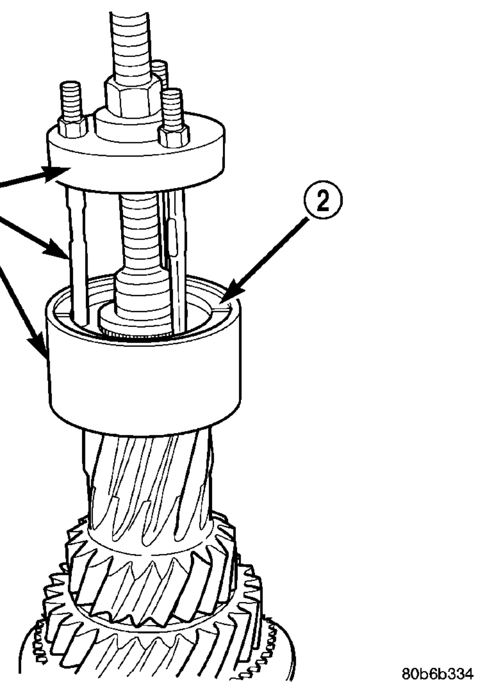


Fig. 32 REAR COUNTERSHAFT BEARING

1 - PULLER
2 - JAWS

MANUAL TRANSMISSION - NV5600 (Continued)

OUTPUT SHAFT BEARINGS

(1) Remove snap-ring holding the pocket bearing onto the output shaft.

(2) Remove pocket bearing from the output shaft with Sleeve 6444-8, Jaws 8234, Puller Rods 6444-4 and the remainder of Puller 6444 (Fig. 33).

(3) Remove snap-ring holding the rear output shaft bearing onto the output shaft.

(4) Use Collar 6444-8, Jaws 8271 and Puller Rods 6444-3 for 4X2 vehicles or Puller Rods 6444-4 for 4X4 vehicles with the remainder of Puller 6444 to remove the rear output shaft bearing from the output shaft.

(5) Remove rear output shaft thrust washer from the output shaft.

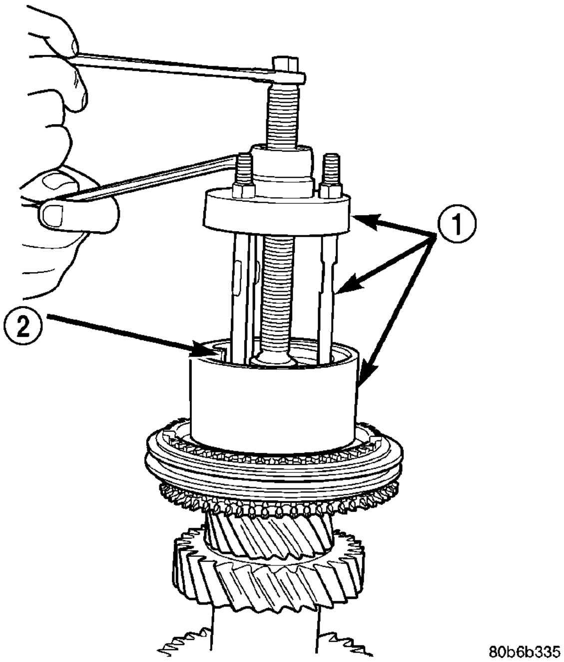


Fig. 33 OUTPUT SHAFT POCKET BEARING

1 - PULLER
2 - JAWS

INPUT SHAFT

(1) Remove fifth gear blocker ring from the input shaft (Fig. 34).

(2) Remove fifth gear friction cone from the input shaft (Fig. 35).

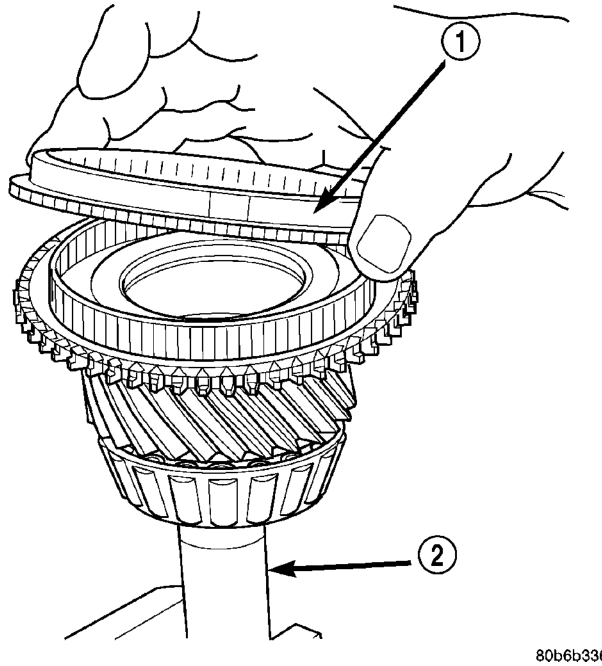


Fig. 34 FIFTH GEAR BLOCKER RING

1 - FIFTH GEAR BLOCKER RING
2 - INPUT SHAFT

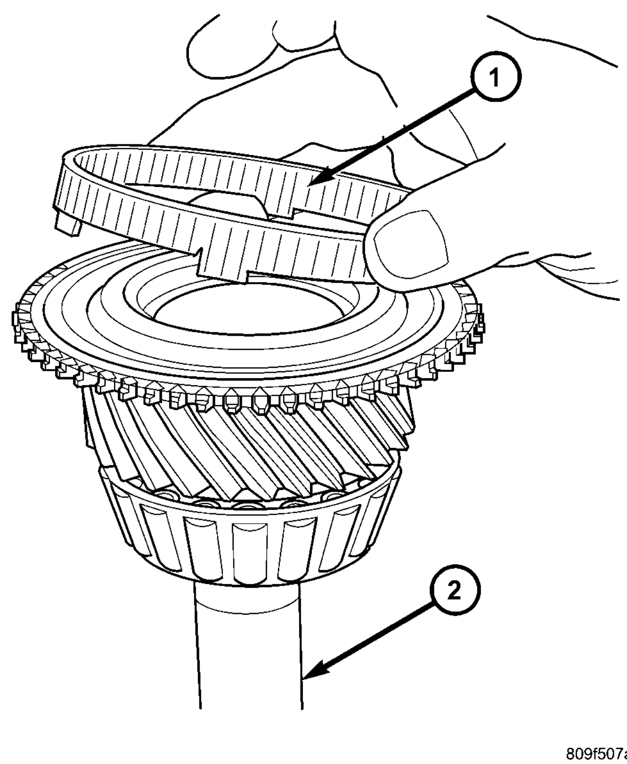


Fig. 35 FIFTH GEAR FRICTION CONE

1 - FRICTION CONE
2 - INPUT SHAFT

MANUAL TRANSMISSION - NV5600 (Continued)

(3) Remove output shaft pocket bearing race from the input shaft with Puller L-4518 (Fig. 36).

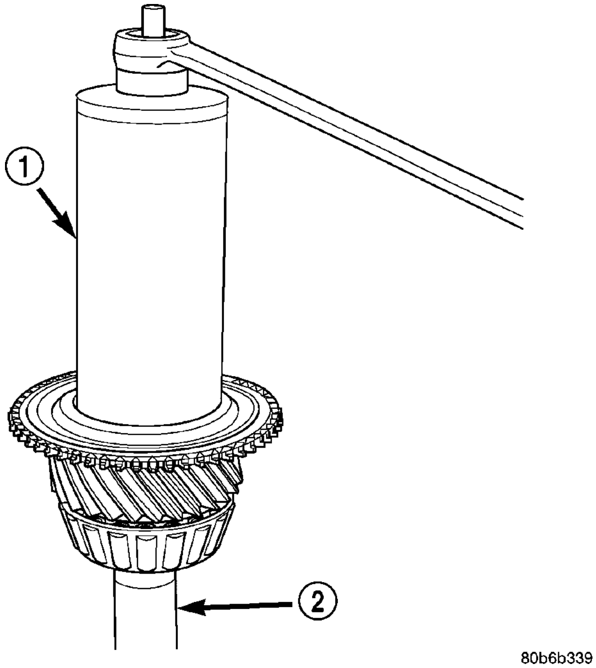


Fig. 36 OUTPUT SHAFT POCKET BEARING RACE

1 - PULLER
2 - INPUT SHAFT

(4) Remove input shaft bearing and oil guide from the input shaft with Collar 6444-8, Jaws 8243, Puller Rods 6444-6 and the remainder of Puller 6444 (Fig. 37).

OUTPUT SHAFT

NOTE: Some gear and synchro components can be installed backwards. Mark the gears, clutch gears, synchro hubs, and sleeves for installation reference during disassembly. Use paint or a scribe for marking purposes. Then stack the geartrain parts in order of removal.

(1) Remove first gear from the output shaft.
(2) Remove first gear bearing from the output shaft (Fig. 38).
(3) Remove first gear blocker rings (2) and cones from the 1-2 synchro assembly (Fig. 39).
(4) Install the remainder of the output shaft into Fixture 8227 with press blocks under second gear.
(5) Install shaft and Fixture assembly into a shop press (Fig. 40).
(6) Press second gear, 1-2 synchro assembly and first gear bearing sleeve from the output shaft.
(7) Remove second gear bearing from the output shaft.

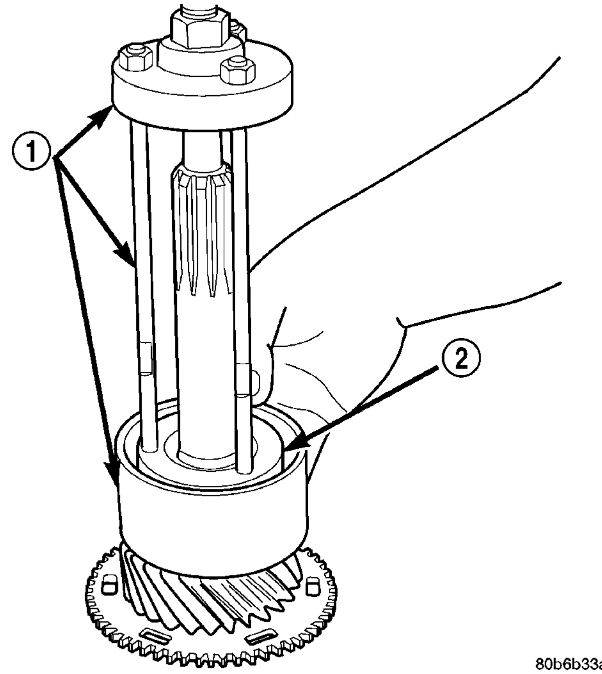


Fig. 37 INPUT SHAFT BEARING

1 - PULLER
2 - JAWS

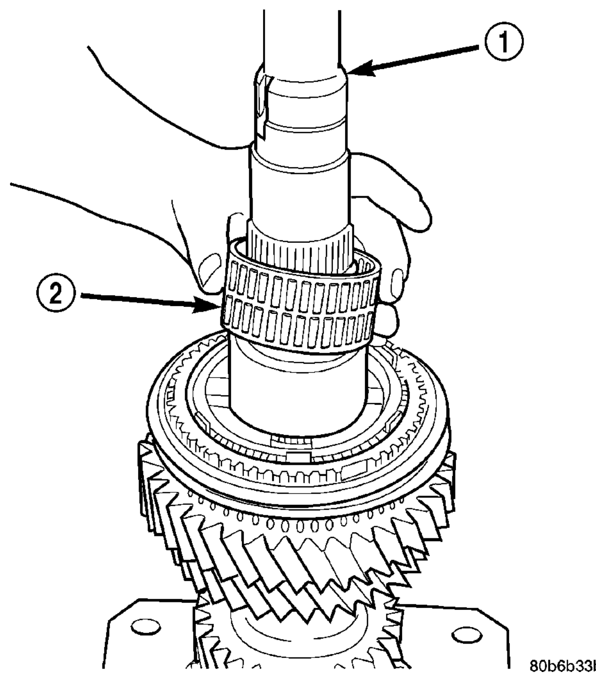


Fig. 38 FIRST GEAR BEARING

1 - OUTPUT SHAFT
2 - FIRST GEAR BEARING

(8) Reverse output shaft in the Fixture 8227 with press blocks positioned under the 5-6 synchro assembly.
(9) Press the 5-6 synchro assembly from the output shaft.

MANUAL TRANSMISSION - NV5600 (Continued)

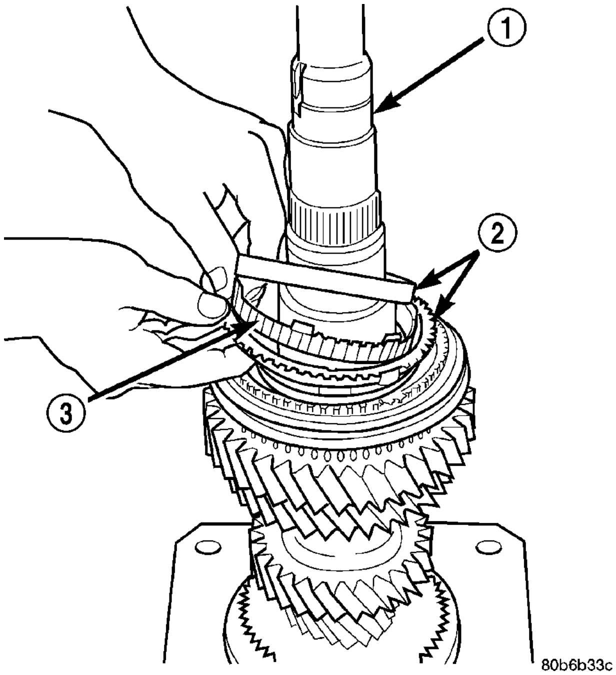


Fig. 39 FIRST GEAR BLOCKER RINGS AND FRICTION CONE

1 - OUTPUT SHAFT
2 - FIRST GEAR BLOCKER RINGS
3 - FIRST GEAR FRICTION CONE

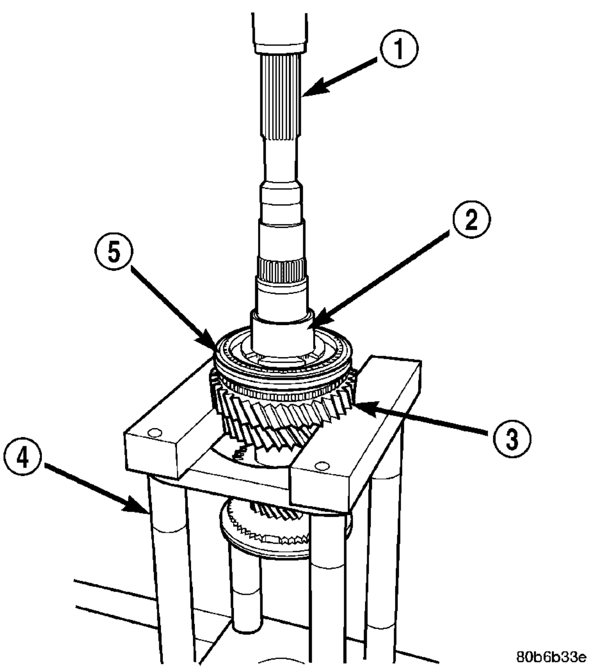


Fig. 40 SECOND GEAR, 1-2 SYNCHRO & FIRST GEAR BEARING SLEEVE

1 - OUTPUT SHAFT
2 - FIRST GEAR BEARING SLEEVE
3 - SECOND GEAR
4 - FIXTURE
5 - 1-2 SYNCHRO

(10) Remove sixth gear and the sixth gear bearing from the output shaft (Fig. 41).

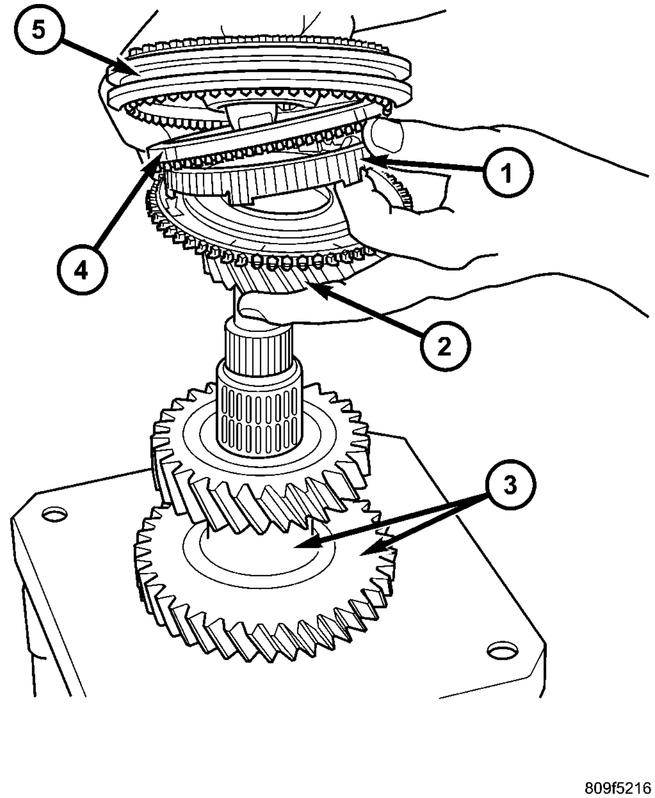


Fig. 41 SIXTH GEAR COMPONENTS

1 - SIXTH GEAR FRICTION CONE
2 - SIXTH GEAR
3 - OUTPUT SHAFT
4 - SIXTH GEAR BLOCKER RING
5 - 5-6 SYNCHRO

COUNTERSHAFT

(1) Install the countershaft into Fixture 8227 with press blocks located under the fifth countershaft gear.

(2) Place the assembly into a shop press.

(3) Use Guide 8235 on end of countershaft and press the countershaft fifth gear from the countershaft (Fig. 42).

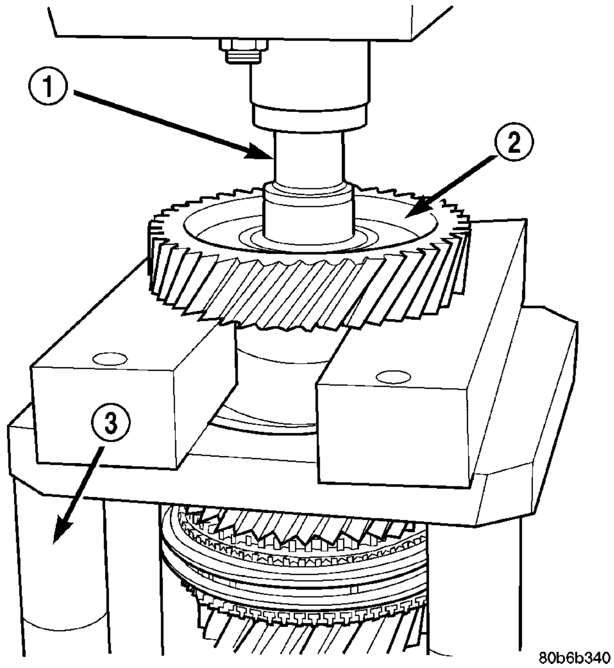


Fig. 42 FIFTH COUNTERSHAFT GEAR

1 - GUIDE
2 - FIFTH COUNTER SHAFT GEAR
3 - FIXTURE

(4) Place countershaft in Fixture 8227 with press blocks placed under the sixth countershaft gear.

(5) Use Guide 8235 on end of countershaft and press the countershaft sixth gear from the countershaft (Fig. 43).

(6) Remove countershaft from the press and Fixture 8227.

(7) Remove fourth countershaft gear, friction cone, blocker ring and bearing from the countershaft (Fig. 44).

(8) Install countershaft into Fixture 8227 with press blocks located under the third countershaft gear.

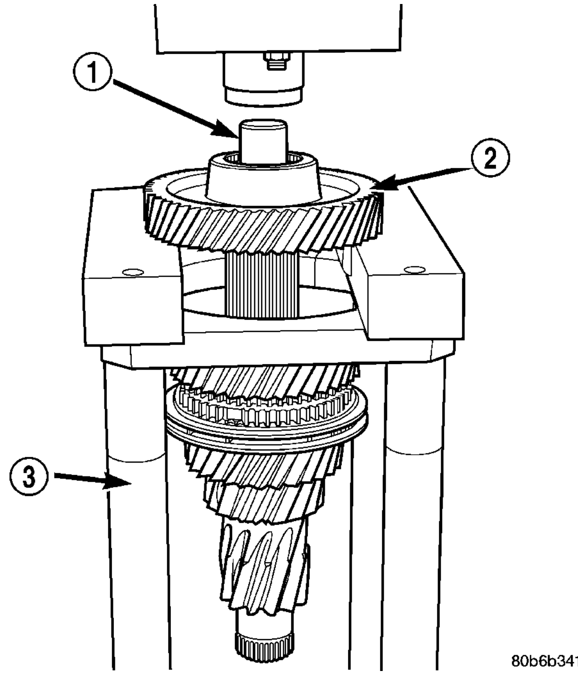


Fig. 43 SIXTH COUNTERSHAFT GEAR

1 - GUIDE
2 - SIXTH COUNTER SHAFT GEAR
3 - FIXTURE

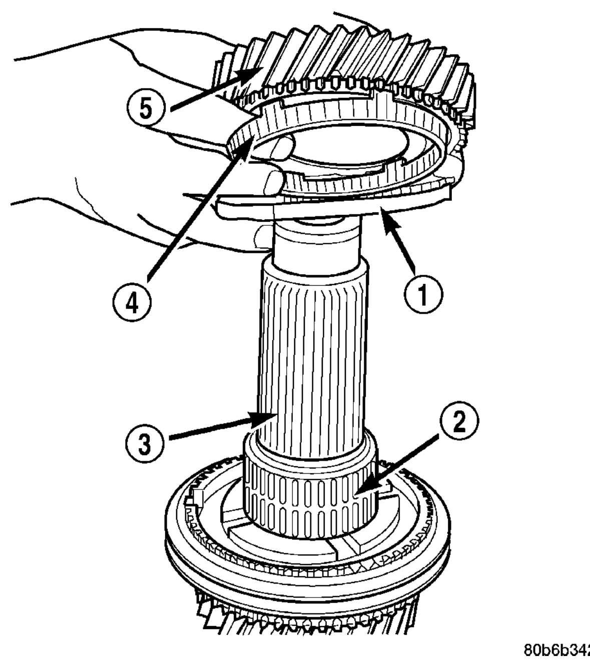


Fig. 44 FOURTH COUNTERSHAFT GEAR COMPONENTS

1 - FOURTH GEAR BLOCKER RING
2 - FOURTH GEAR BEARING
3 - COUNTERSHAFT
4 - FOURTH GEAR FRICTION CONE
5 - FOURTH COUNTERSHAFT GEAR

MANUAL TRANSMISSION - NV5600 (Continued)

(9) Place assembly into a shop press and press third countershaft gear, 3-4 synchro and fourth countershaft gear bearing sleeve from the countershaft (Fig. 45).

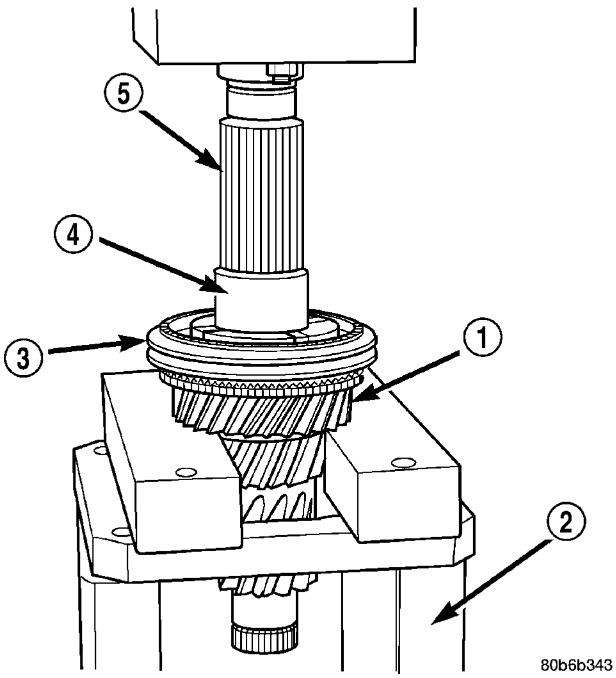


Fig. 45 THIRD COUNTERSHAFT GEAR COMPONENTS

1 - THIRD COUNTERSHAFT GEAR
2 - FIXTURE
3 - 3-4 SYNCHRO
4 - BEARING SLEEVE
5 - COUNTERSHAFT

(10) Remove countershaft from the press and Fixture 8227.

(11) Remove third countershaft gear bearing from the countershaft (Fig. 46).

(12) The 2-3 thrust washer should not normally need to be removed from the countershaft. If necessary slide 2-3 thrust washer off countershaft.

CLUTCH HOUSING

(1) Remove input shaft retainer bolts from the clutch housing and remove retainer (Fig. 47).

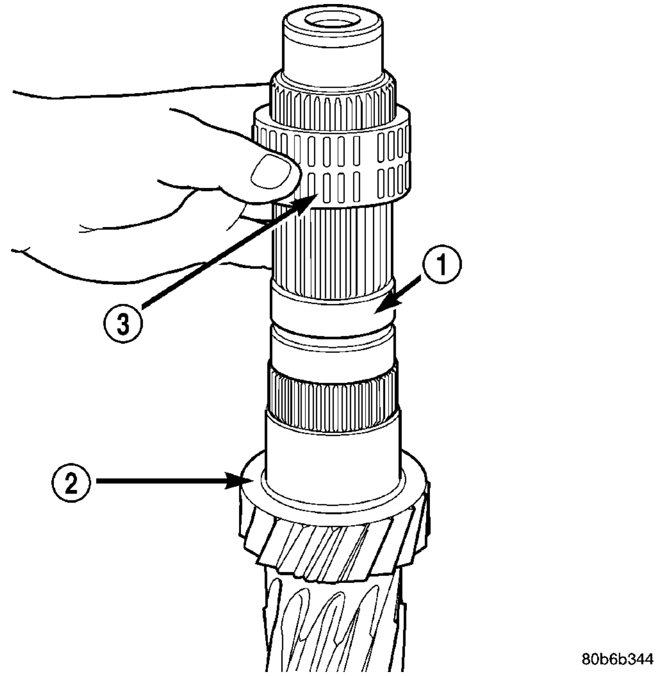


Fig. 46 THIRD GEAR BEARING

1 - COUNTERSHAFT
2 - 2-3 THRUST WASHER
3 - THIRD COUNTERSHAFT GEAR BEARING

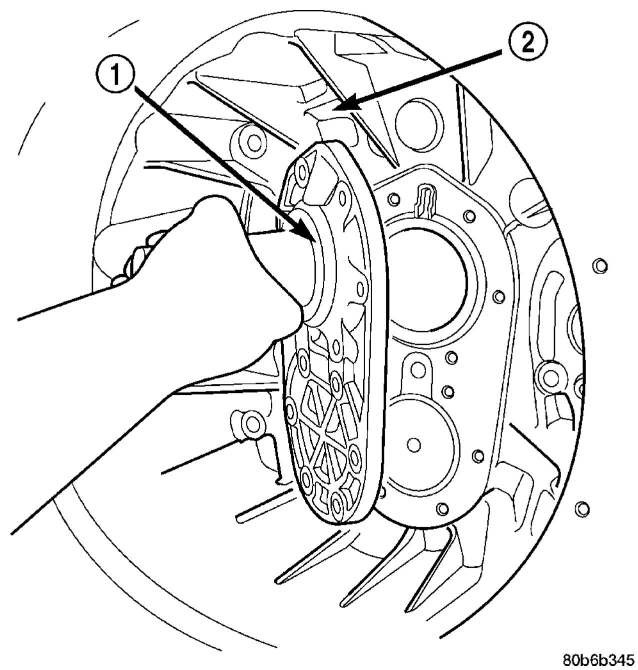


Fig. 47 INPUT SHAFT RETAINER

1 - INPUT SHAFT RETAINER
2 - CLUTCH HOUSING

(2) Remove countershaft oil guide from the countershaft front bearing bore in the clutch housing (Fig. 48).

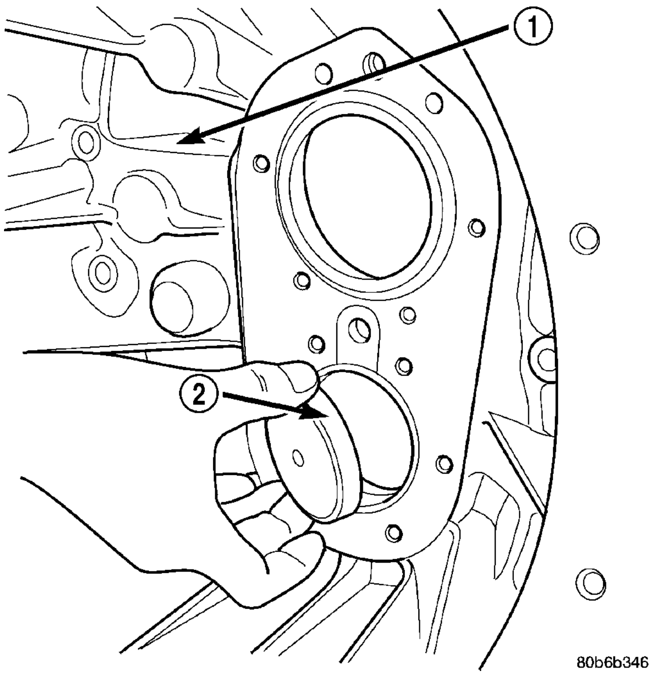


Fig. 48 COUNTERSHAFT OIL GUIDE

1 - CLUTCH HOUSING
2 - COUNTERSHAFT OIL GUIDE

(3) Remove countershaft front bearing race, endplay shims and spacer from the clutch housing with Remover 6061-1 and Handle C-4171 (Fig. 49).

(4) Remove input shaft bearing race with Remover/Installer 8237 and Handle C-4171.

(5) Remove input shaft oil guide and retainer seal (Fig. 50).

CLEANING - TRANSMISSION

Clean the gears, bearings shafts, extension/adapter housing and gear case with solvent. Dry all parts except the bearings with compressed air. Allow the bearings to either air dry or wipe them dry with clean shop towels.

INSPECTION

NOTE: Minor corrosion, nicks, or pitting can be smoothed with 400 grit emery and polished out with crocus cloth.

Inspect the reverse idler gear, bearings, shaft and thrust washers. Replace the bearings if the rollers are worn, chipped, cracked, flat-spotted or brinnelled. Replace the gear if the teeth are chipped, cracked or worn thin.

Inspect the front bearing retainer and bearing cup. Replace the bearing cup if scored, cracked, brinnelled

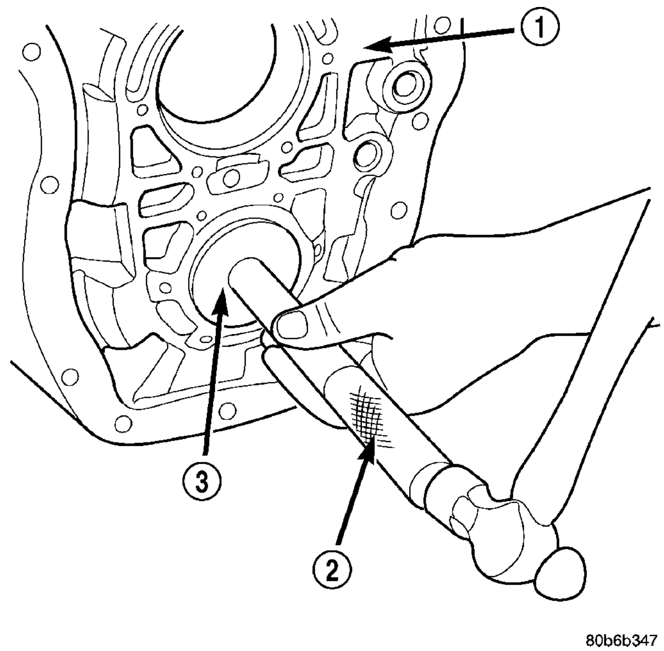


Fig. 49 FRONT COUNTERSHAFT BEARING RACE

1 - CLUTCH HOUSING
2 - HANDLE
3 - REMOVER

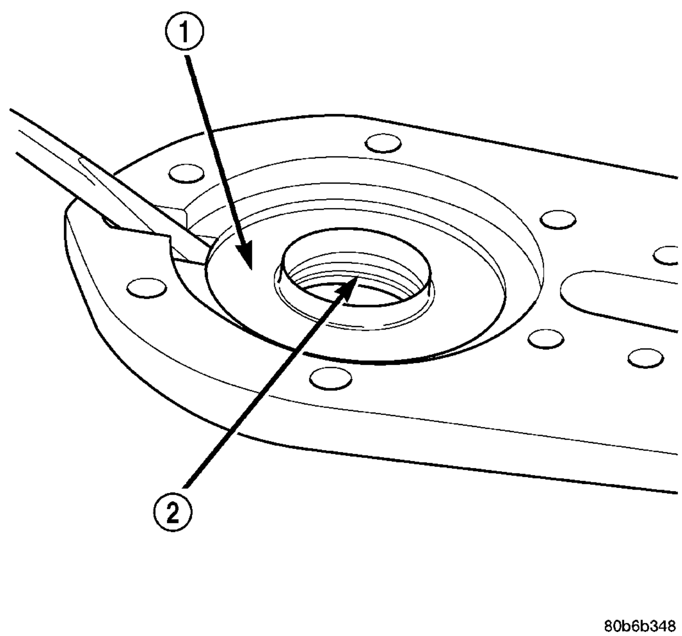


Fig. 50 OIL GUIDE AND SEAL

1 - INPUT SHAFT OIL GUIDE
2 - INPUT SHAFT OIL SEAL

or rough. Check the release bearing slide surface of the retainer carefully. Replace the retainer if worn or damaged in any way.

Inspect mainshaft bearing surfaces, splines, snap ring grooves and threads. Replace the shaft if any surfaces exhibit considerable wear or damage.

MANUAL TRANSMISSION - NV5600 (Continued)

Inspect the countershaft and bearings. Replace the shaft if any surfaces exhibit considerable wear or damage.

Inspect shift forks for wear and distortion. Check fit of the sleeve in the fork to be sure the two parts fit and work smoothly. Replace the fork if the roll pin holes are worn oversize or damaged. Do not attempt to salvage a worn fork. Replace shift fork roll pins if necessary or if doubt exists about their condition.

The all bearings for wear, roughness, flat spots, pitting or other damage. Replace the bearings if necessary.

Inspect the blocker rings and fiction cones. replace either part if worn or damaged in any way. Replace if the friction material is burned, flaking off or worn.

Inspect synchro components wear or damage. Replace parts if worn, cracked or distorted.

Inspect all of the thrust washers and locating pins. Replace the pins if bent or worn. Replace the washers if worn or the locating pin notches are distorted.

Inspect the case and housing/adapter sealing and mating surfaces are free of burrs and nicks. Inspcet the alignment dowels in the case top surface and in the housing/adapter are tight and in good condition. Replace the gear case or housing/adapter if cracked or broken.

ASSEMBLY

NOTE: Gaskets are not used in the transmission. Use Mopar Gasket Maker or equivalent on all gear case and extension housing sealing surfaces.

OUTPUT SHAFT

(1) Place second gear on bench with the synchro clutch ring up.

(2) Install second gear synchro inner blocker ring onto second gear (Fig. 51).

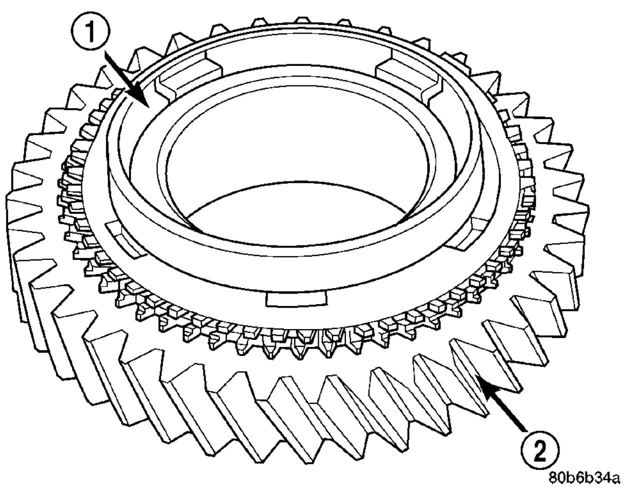


Fig. 51 INNER BLOCKER RING

1 - INNER BLOCKER RING
2 - GEAR

(3) Install second gear synchro friction cone over the blocker ring and onto second gear (Fig. 52).

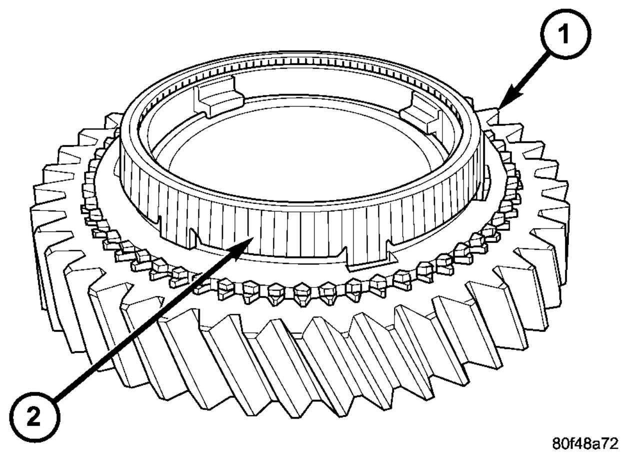


Fig. 52 FRICTION CONE

1 - GEAR
2 - FRICTION CONE

(4) Install second gear synchro outer blocker ring over the second gear synchro friction cone. Align one of the lugs on the outer ring with a lug on the inner ring (Fig. 53).

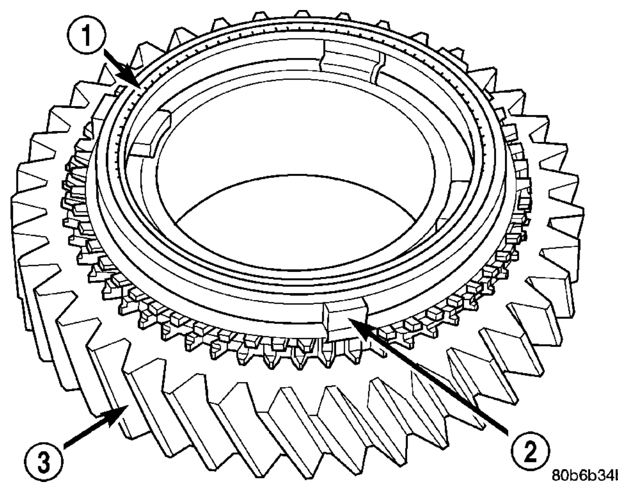


Fig. 53 OUTER BLOCKER RING

1 - OUTER BLOCKER RING
2 - LUG
3 - GEAR

MANUAL TRANSMISSION - NV5600 (Continued)

(5) Install 1-2 synchro assembly onto the second gear assembly (Fig. 54).

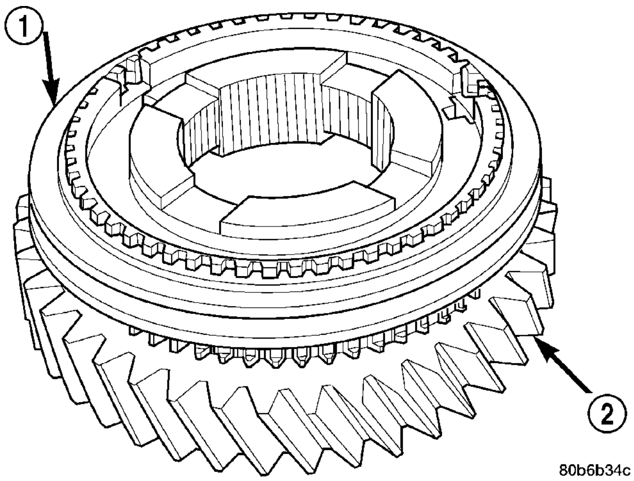


Fig. 54 3-4 SYNCHRO ASSEMBLY

1 - SYNCHRO
2 - GEAR

(6) Reverse assembly on the bench.

(7) Lubricate and install second gear bearing into second gear (Fig. 55).

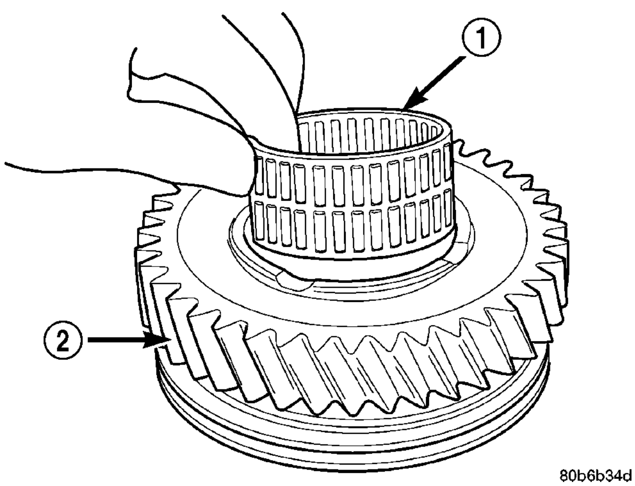


Fig. 55 SECOND GEAR AND BEARING

1 - BEARING
2 - GEAR

(8) Place 1-2 synchro, second gear and second gear bearing assembly on shop press with second gear facing upward.

(9) Install output shaft into the second gear 1-2 synchro assembly with the front of the output shaft facing upward (Fig. 56).

(10) Press the output shaft into position.

(11) Place first gear on bench with the synchro clutch ring up.

(12) Install first gear synchro inner blocker ring onto first gear (Fig. 51).

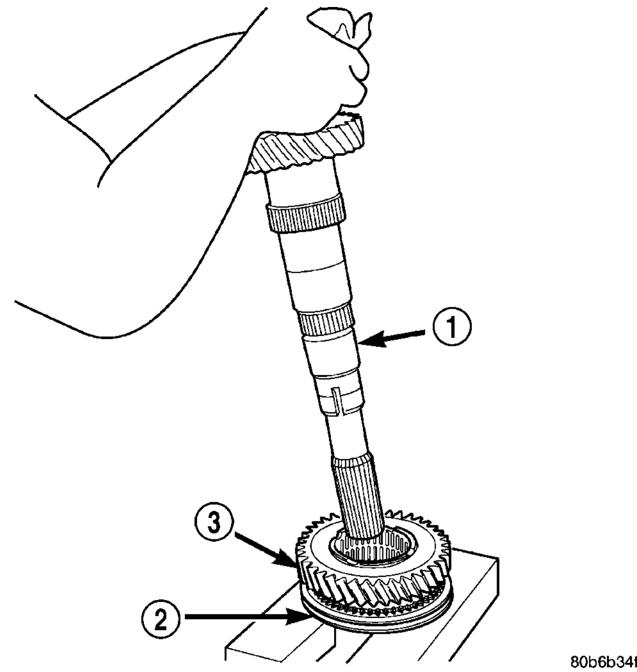


Fig. 56 OUTPUT SHAFT INTO 1-2 SYNCHRO

1 - OUTPUT SHAFT
2 - 1-2 SYNCHRO
3 - SECOND GEAR

(13) Install first gear synchro friction cone over the blocker ring and onto first gear (Fig. 52).

(14) Install first gear synchro outer blocker ring over the first gear synchro friction cone. Align one of the lugs on the outer ring with a lug on the inner ring (Fig. 53).

(15) Reverse the output shaft in the press.

(16) Install first gear bearing sleeve onto the output shaft.

MANUAL TRANSMISSION - NV5600 (Continued)

(17) Install first gear bearing sleeve the remainder of the way onto the output shaft using Installer 8228 and a shop press (Fig. 57).

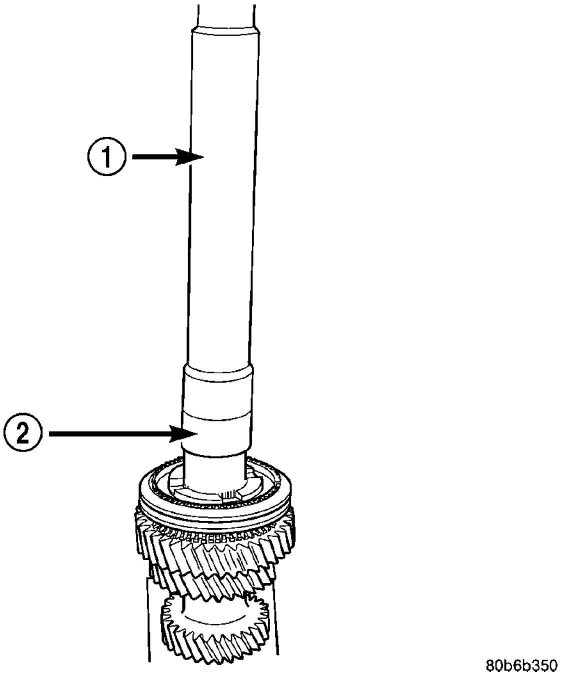


Fig. 57 FIRST GEAR BEARING SLEEVE

1 - INSTALLER
2 - FIRST GEAR BEARING SLEEVE

(18) Install first gear and blocker assembly onto the output shaft (Fig. 58).

(19) Install first gear bearing over the output shaft and into first gear.

(20) Install output shaft thrust washer onto the output shaft (Fig. 59).

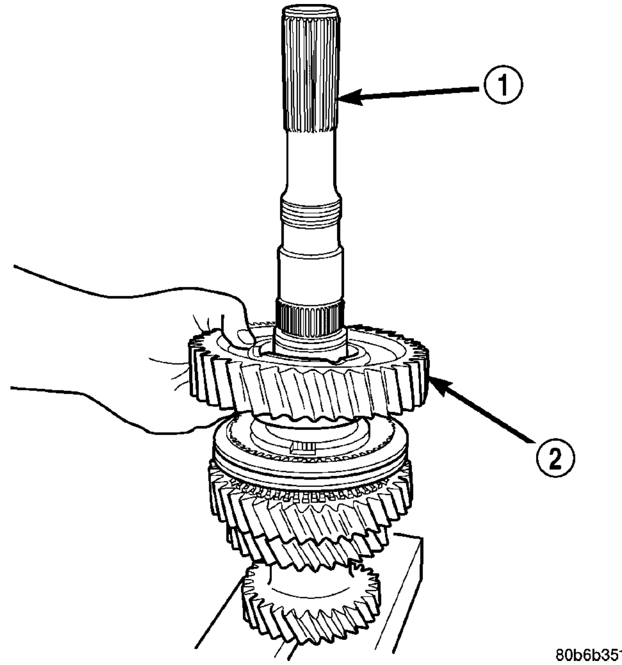


Fig. 58 FIRST GEAR AND BLOCKER ASSEMBLY

1 - OUTPUT SHAFT
2 - FIRST GEAR ASSEMBLY

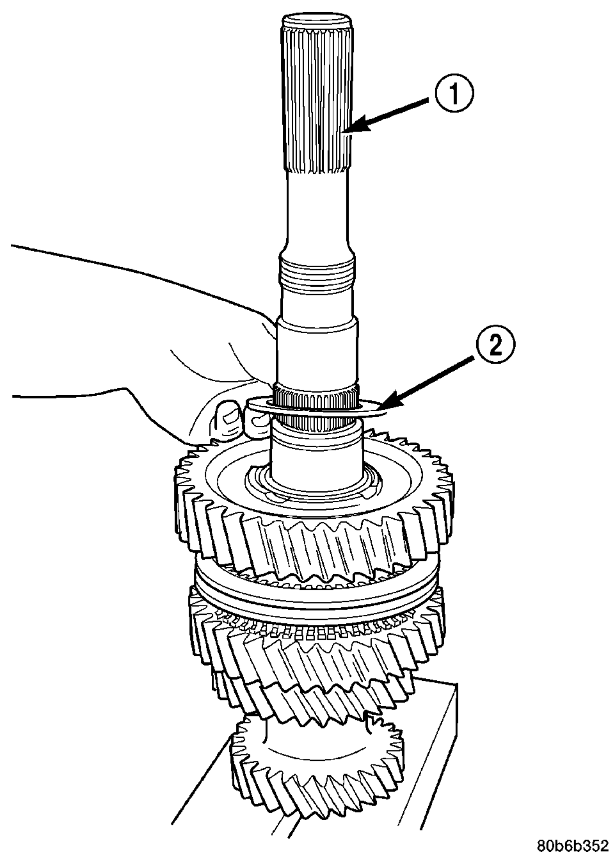


Fig. 59 OUTPUT SHAFT THRUST WASHER

1 - OUTPUT SHAFT
2 - OUTPUT SHAFT THRUST WASHER

MANUAL TRANSMISSION - NV5600 (Continued)

(21) Install rear output shaft bearing onto the output shaft with Installer 8228 and a shop press (Fig. 60).

(22) Install a **new** snap-ring to hold the rear output bearing onto the output shaft. Install the thickest snap-ring which will fit into the groove.

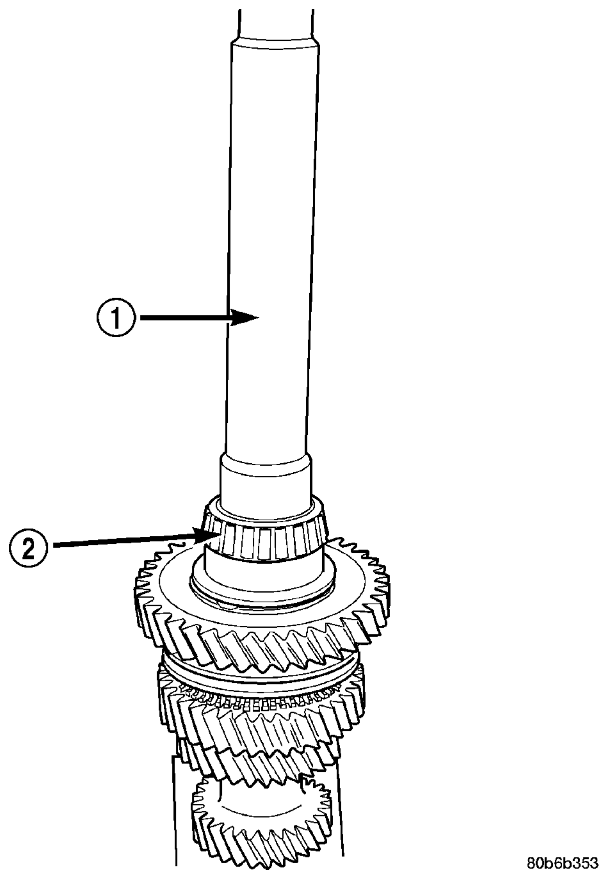


Fig. 60 REAR OUTPUT SHAFT BEARING

1 - INSTALLER
2 - REAR OUTPUT SHAFT BEARING

(23) Reverse output shaft in the Fixture 8227 and support the shaft with press blocks under first gear.

(24) Install sixth gear bearing onto the output shaft.

(25) Install sixth gear onto the output shaft and over the sixth gear bearing (Fig. 61).

(26) Install the sixth gear friction cone onto sixth gear.

(27) Install sixth gear blocker ring over the sixth gear friction cone (Fig. 62).

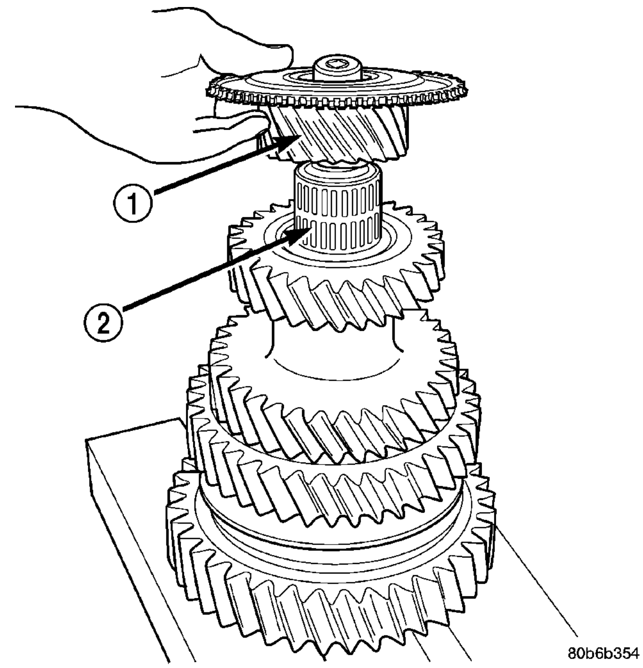


Fig. 61 SIXTH GEAR

1 - SIXTH GEAR
2 - SIXTH GEAR BEARING

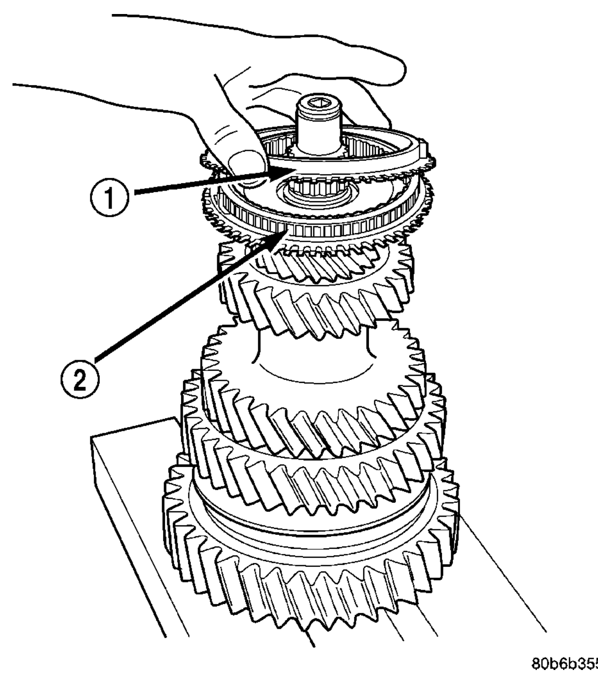


Fig. 62 SIXTH GEAR BLOCKER RING

1 - SIXTH GEAR BLOCKER RING
2 - SIXTH GEAR FRICTION CONE

MANUAL TRANSMISSION - NV5600 (Continued)

(28) Install Guide 8235 onto the end of the output shaft (Fig. 63).

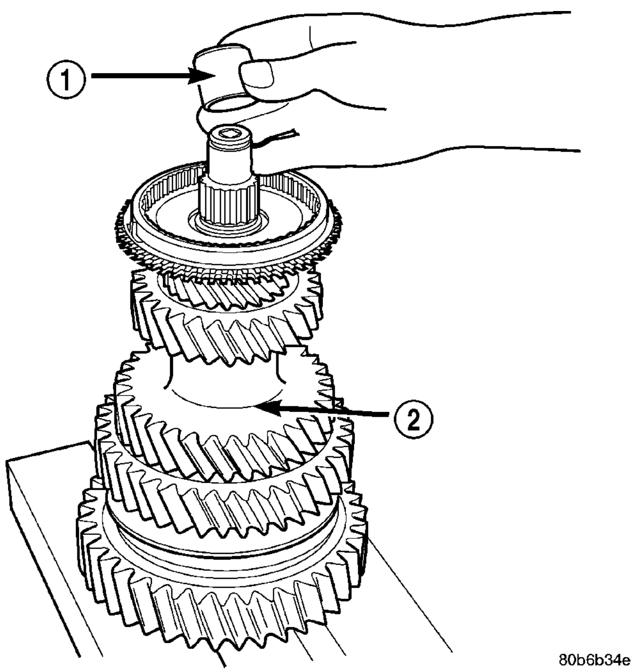


Fig. 63 OUTPUT SHAFT GUIDE

1 - GUIDE
2 - OUTPUT SHAFT

(29) Install 5-6 synchro over Guide 8235 and onto the output shaft.

(30) Press 5-6 synchro (Fig. 64) onto the output shaft with Installer 8156 and a shop press.

(31) Install output shaft pocket bearing onto the output shaft.

(32) Press pocket bearing the remainder of the way onto the output shaft using Guide 8235 and a shop press (Fig. 65).

(33) Install a **new** snap-ring to hold the output shaft pocket bearing onto the output shaft.

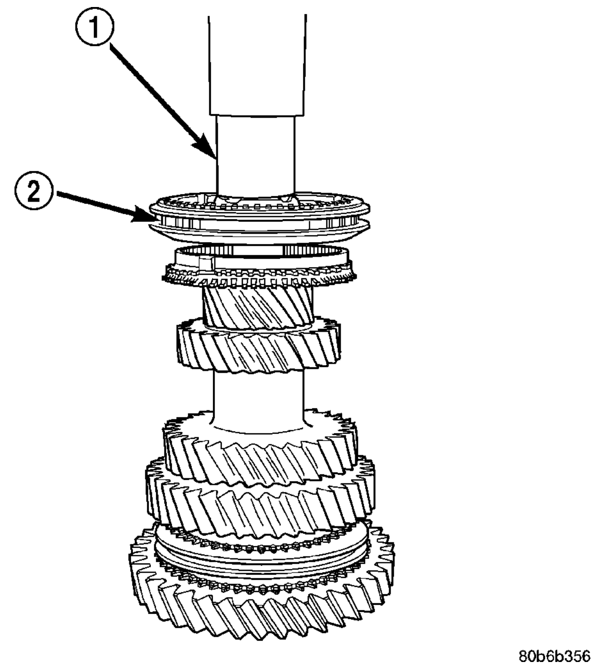


Fig. 64 5-6 SYNCHRO

1 - INSTALLER
2 - 5-6 SYNCHRO

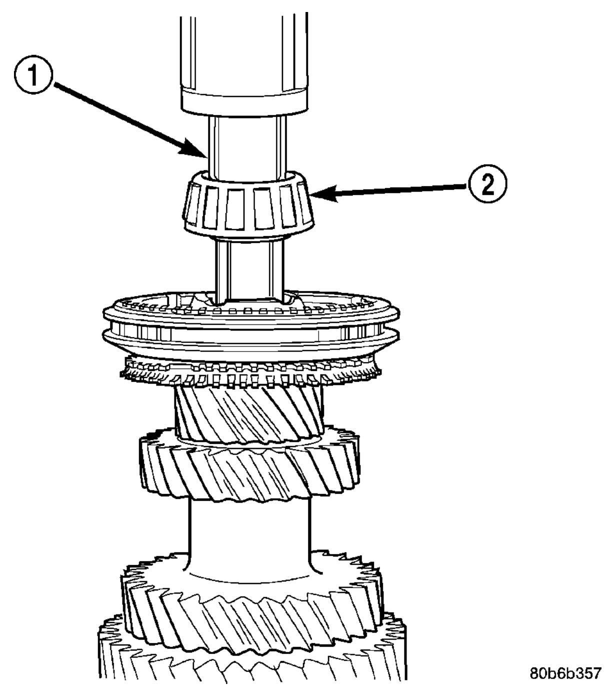


Fig. 65 OUTPUT SHAFT POCKET BEARING

1 - GUIDE
2 - POCKET BEARING

MANUAL TRANSMISSION - NV5600 (Continued)

COUNTERSHAFT

(1) Place third countershaft gear on the bench with the synchro clutch ring up.

(2) Install third countershaft gear friction cone onto third gear (Fig. 66).

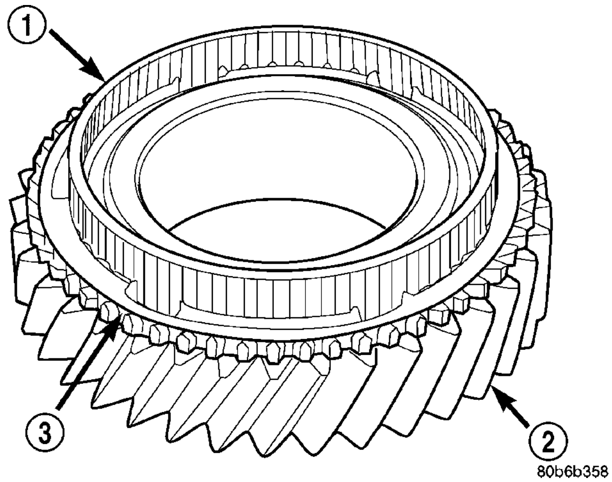


Fig. 66 FRICTION CONE AND THIRD GEAR

1 - FRICTION CONE
2 - GEAR
3 - CLUTCH RING

(3) Install third countershaft gear blocker ring onto the friction cone (Fig. 67).

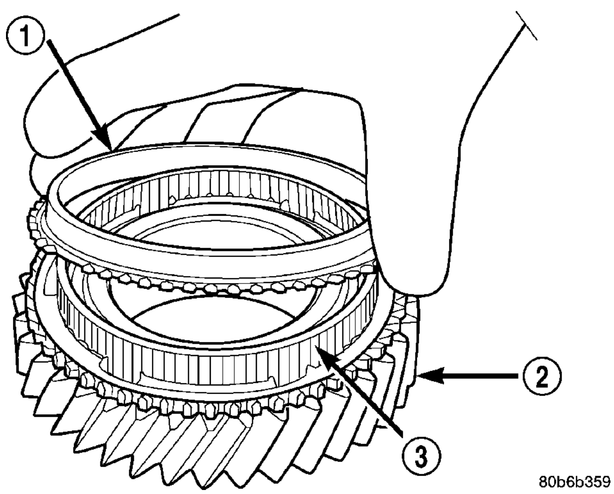


Fig. 67 BLOCKER RING ONTO FRICTION CONE

1 - BLOCKER RING
2 - GEAR
3 - FRICTION CONE

(4) Install 3-4 synchro assembly onto the blocker ring/gear assembly (Fig. 68).

(5) Reverse the assembly on the bench.

(6) Install third countershaft gear bearing into the third countershaft gear.

(7) Install 2-3 thrust washer onto the countershaft.

(8) Place third gear/3-4 synchro assembly in a shop press.

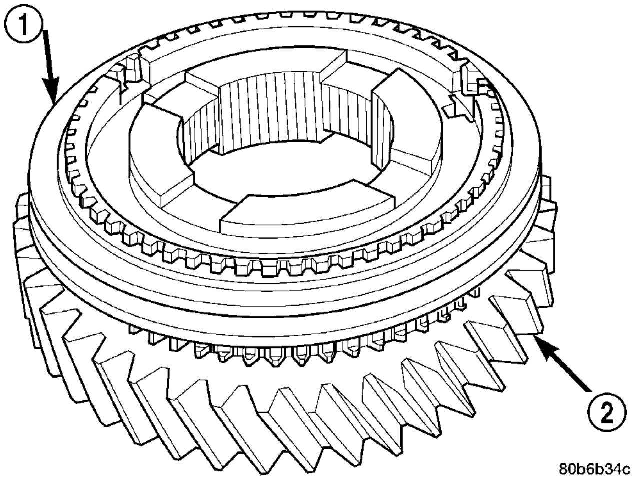


Fig. 68 3-4 SYNCHRO ASSEMBLY

1 - SYNCHRO
2 - GEAR

(9) Install countershaft through the third gear/3-4 synchro assembly.

(10) Press countershaft into the 3-4 synchro assembly (Fig. 69).

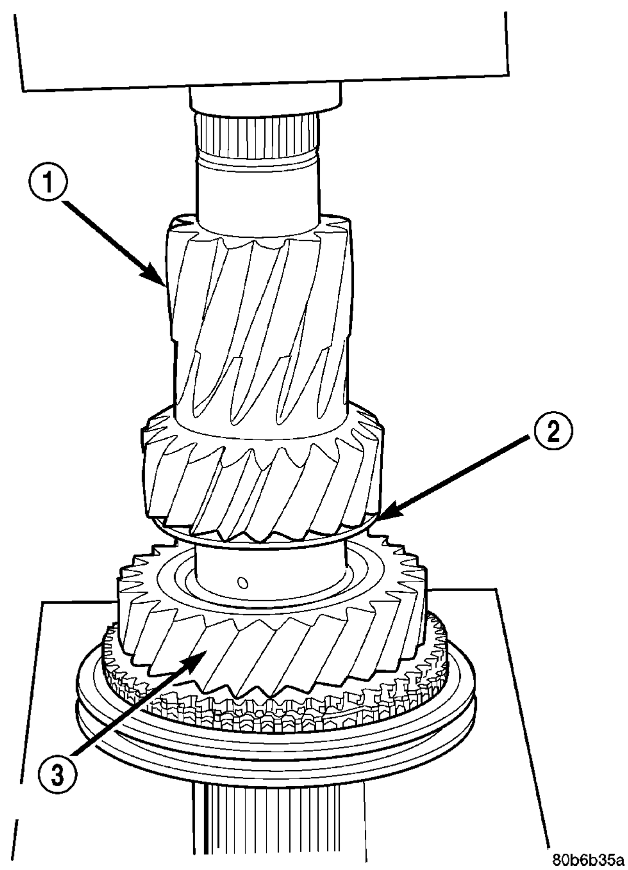


Fig. 69 COUNTERSHAFT INTO 3-4 SYNCHRO

1 - COUNTERSHAFT
2 - 2-3 THRUST WASHER
3 - THIRD COUNTERSHAFT GEAR

MANUAL TRANSMISSION - NV5600 (Continued)

(11) Install fourth countershaft gear bearing sleeve onto the output shaft.

(12) Press fourth countershaft bearing sleeve onto the countershaft with Installer 8228 and a shop press.

(13) Place fourth countershaft gear on the bench with the synchro clutch ring up.

(14) Install fourth countershaft gear friction cone onto fourth countershaft gear (Fig. 66).

(15) Install fourth countershaft gear blocker ring onto the friction cone (Fig. 67).

(16) Install fourth countershaft gear bearing into the fourth countershaft gear.

(17) Place sixth countershaft gear in the shop press.

(18) Position fourth countershaft gear assembly onto the sixth countershaft gear (Fig. 70).

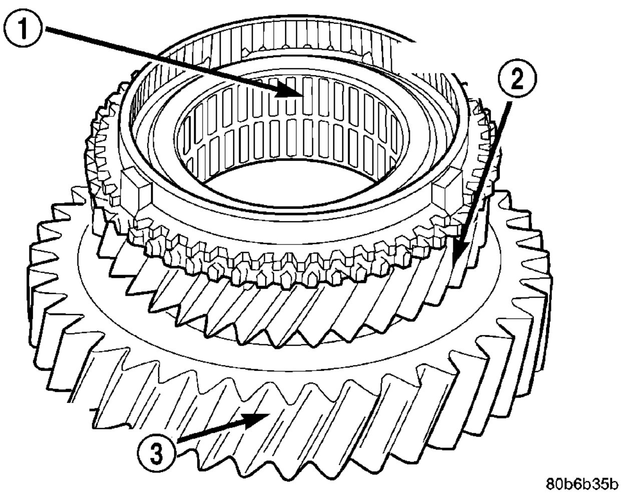


Fig. 70 FOURTH COUNTERSHAFT ONTO SIXTH COUNTERSHAFT GEAR

1 - FOURTH BEARING
2 - FOURTH COUNTERSHAFT GEAR
3 - SIXTH COUNTERSHAFT GEAR

(19) Install countershaft into the fourth/sixth countershaft gear assembly in the shop press.

(20) Press countershaft into sixth gear (Fig. 71).

CAUTION: Gear and shaft must be aligned while pressing or the gear will bind on the shaft.

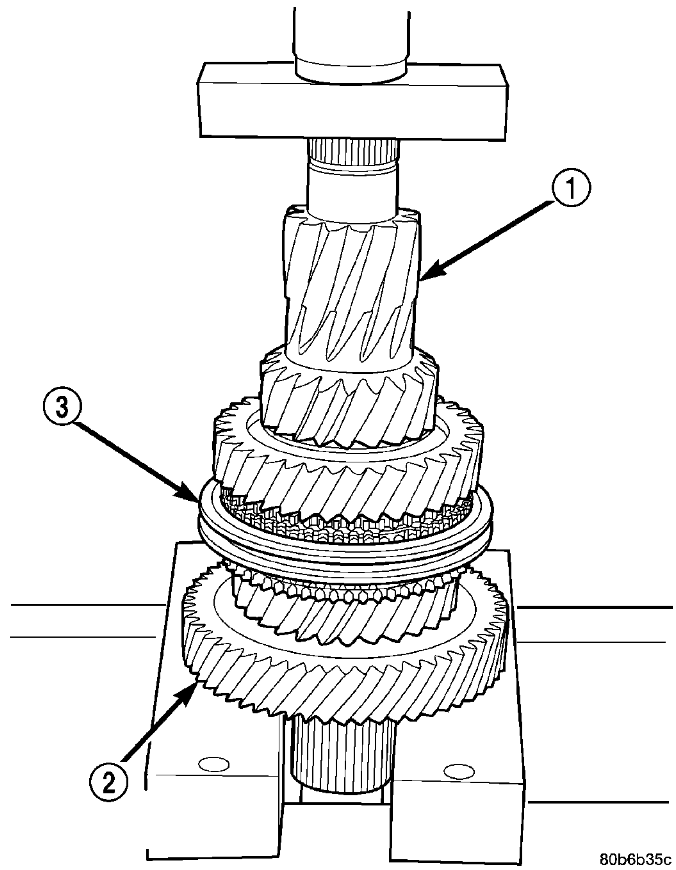


Fig. 71 COUNTERSHAFT INTO SIXTH GEAR

1 - COUNTERSHAFT
2 - SIXTH COUNTERSHAFT GEAR
3 - 3-4 SYNCHRO

(21) Place fifth countershaft gear into the shop press.

(22) Install countershaft into the fifth countershaft gear and press countershaft into fifth gear (Fig. 72).

CAUTION: Gear and shaft must be aligned while pressing or the gear will bind on the shaft.

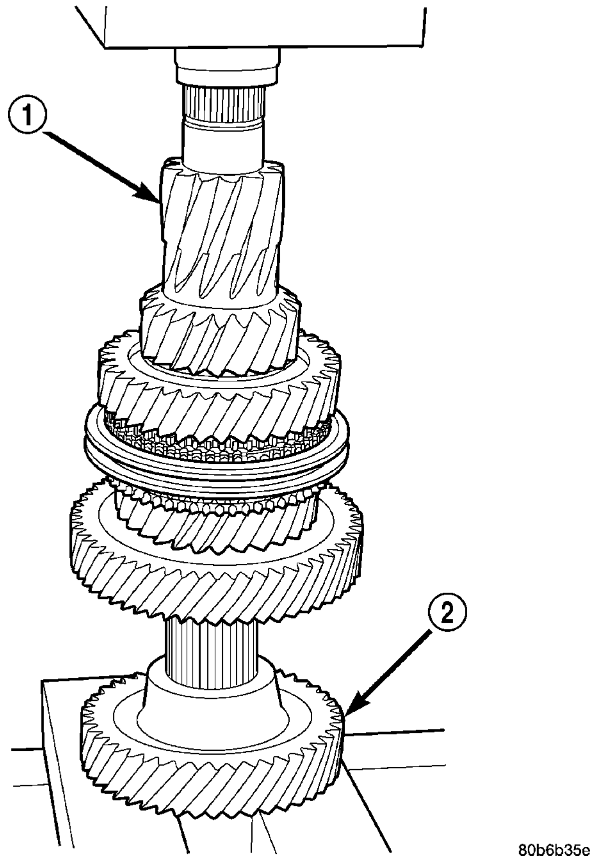


Fig. 72 COUNTERSHAFT TO FIFTH COUNTERSHAFT GEAR

1 - COUNTERSHAFT
2 - FIFTH COUNTERSHAFT GEAR

(23) Place front countershaft bearing onto the countershaft.

(24) Install front countershaft bearing onto the countershaft with Installer 8236 and Handle C-4171.

(25) Install a **new** snap-ring to hold the front countershaft bearing onto the countershaft.

(26) Place rear countershaft bearing onto the countershaft.

INPUT SHAFT

(1) Place the input shaft bearing onto the input shaft.

(2) Install input shaft bearing with Installer MD998805 (Fig. 73).

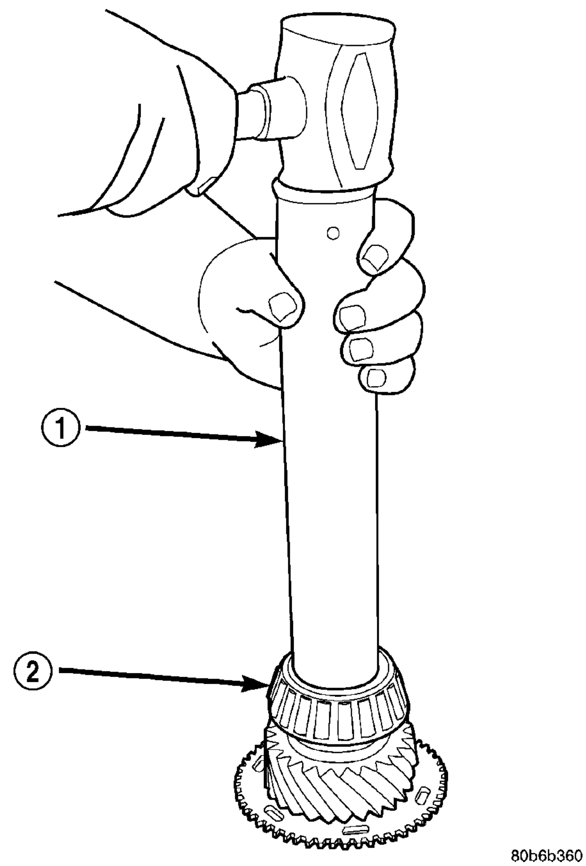


Fig. 73 INPUT SHAFT BEARING

1 - INSTALLER
2 - INPUT SHAFT BEARING

MANUAL TRANSMISSION - NV5600 (Continued)

(3) Position the input shaft bearing oil guide on the input shaft (Fig. 74).

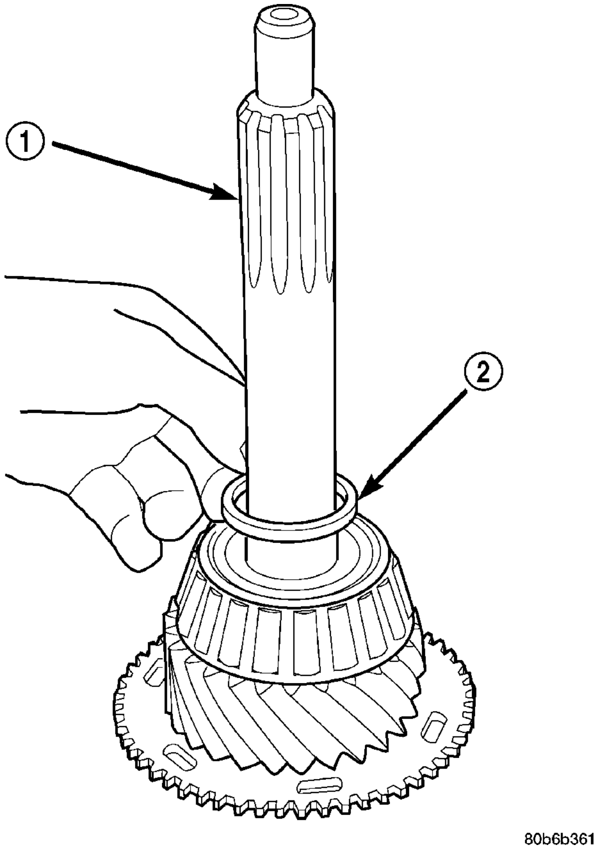


Fig. 74 INPUT SHAFT OIL GUIDE

1 - INPUT SHAFT
2 - INPUT SHAFT OIL GUIDE

(4) Install input shaft bearing oil guide with Installer MD998805.

(5) Place the output shaft pocket bearing race in the input shaft.

(6) Install output shaft pocket bearing race into the input shaft with Installer C-4628 and Handle C-4171 (Fig. 75).

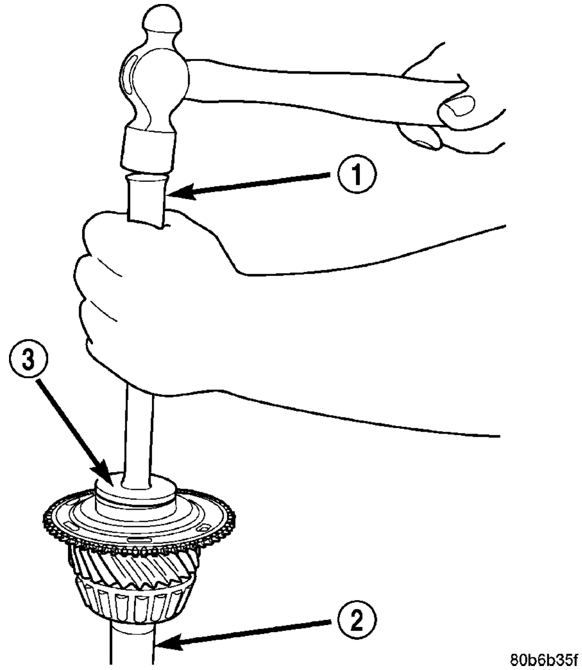


Fig. 75 OUTPUT SHAFT POCKET BEARING RACE

1 - HANDLE
2 - INPUT SHAFT
3 - INSTALLER

CLUTCH HOUSING

(1) Install input shaft bearing race so that the bearing race protrudes 0.3 in. above the front surface of the clutch housing. Install bearing race with Remover/Installer 8237 and Handle C-4171.

(2) Install countershaft front bearing race into the clutch housing so that the bearing race protrudes 0.4 in. above the front surface of the clutch housing. Install bearing race with Remover 6061-1 and Handle C-4171.

(3) Install countershaft oil guide and spacer into the countershaft front bearing bore in the clutch housing (Fig. 76).

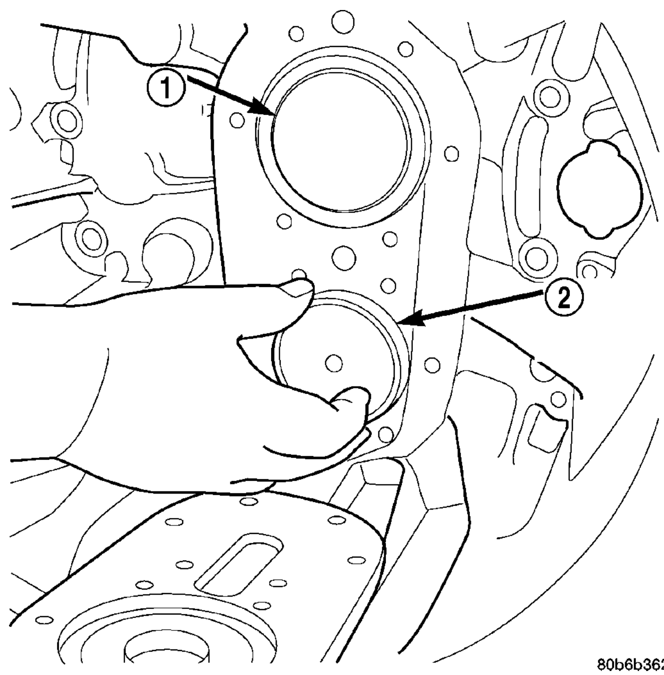


Fig. 76 OIL GUIDE AND SPACER

1 - 0.3 IN. BEYOND FLUSH
2 - 0.4 IN. BEYOND FLUSH

(4) Clean all old sealer from the input shaft retainer and the clutch housing but **DO NOT** apply new sealer at this time. New sealer will be applied after all the preload measurements are made and end-play shims are installed.

MANUAL TRANSMISSION - NV5600 (Continued)

NOTE: Do not replace the input shaft seal at this time. A new seal will be installed after all the pre-load measurements are made and endplay shims are installed.

(5) Install input shaft retainer onto the clutch housing and install bolts to hold the input shaft retainer.

GEARTRAIN

(1) Install input shaft into Support Stand 8246.
(2) Install fifth gear friction cone onto the input shaft.
(3) Install fifth gear blocker ring onto the fifth gear friction cone.
(4) Install output shaft into the input shaft (Fig. 77).

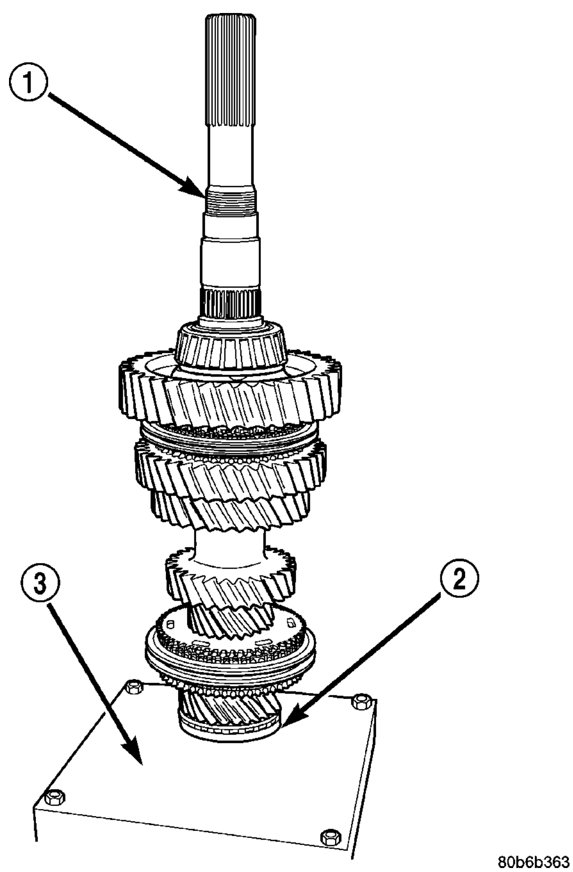


Fig. 77 OUTPUT SHAFT AND INPUT SHAFT

1 - OUTPUT SHAFT
2 - INPUT SHAFT
3 - SUPPORT STAND

(5) Install countershaft into the Support Stand 8246 and verify that all gears are meshed with their mates on the output shaft (Fig. 78).

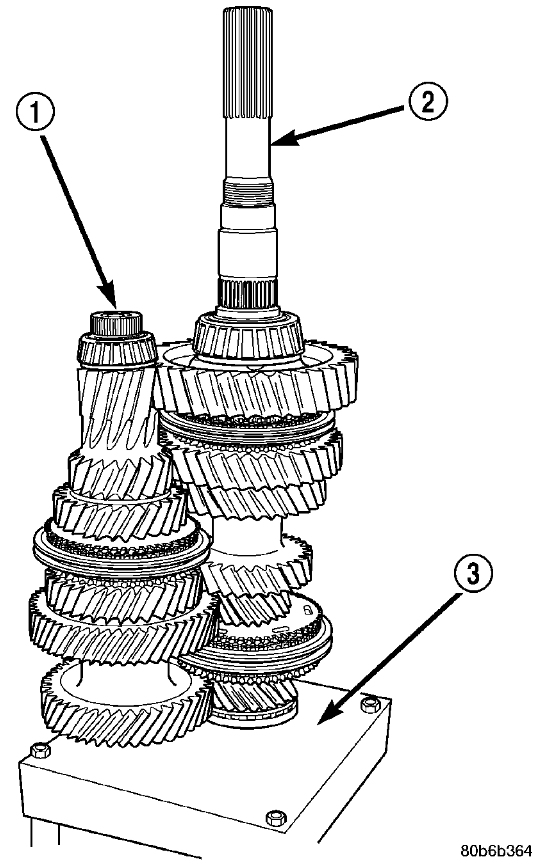


Fig. 78 COUNTERSHAFT WITH OUTPUT SHAFT

1 - COUNTERSHAFT
2 - OUTPUT SHAFT
3 - SUPPORT STAND

MANUAL TRANSMISSION - NV5600 (Continued)

(6) Install Fixture 8232 to the output shaft and countershaft.

(7) Install Holding Tool 8242 onto the 5-6 synchro and tighten the screw to hold the 5-6 synchro together during the remainder of the installation procedure.

(8) Attach a engine crane or equivalent to Fixture 8232 and move the geartrain from the Support Stand 8246 to the clutch housing (Fig. 79).

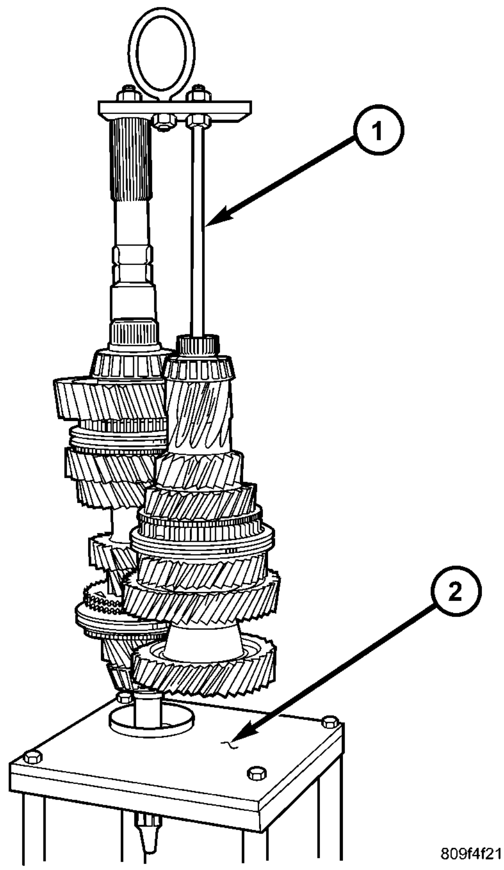


Fig. 79 GEARTRAIN FIXTURE

1 - FIXTURE
2 - SUPPORT STAND

(9) Install shift forks and rails onto the geartrain (Fig. 80).

NOTE: The closest shift arm to the geartrain is for Reverse. The next is 5-6, then 3-4 and then 1-2 when moving out from the geartrain.

(10) Install geartrain and shift rails into the clutch housing. Lower the geartrain and rails into the housing slowly while guiding input shaft through input shaft seal. Avoid any binds on the shift rails, forks and synchros as the rails enter their bushings.

CAUTION: Do not damage input shaft seal with the input shaft splines.

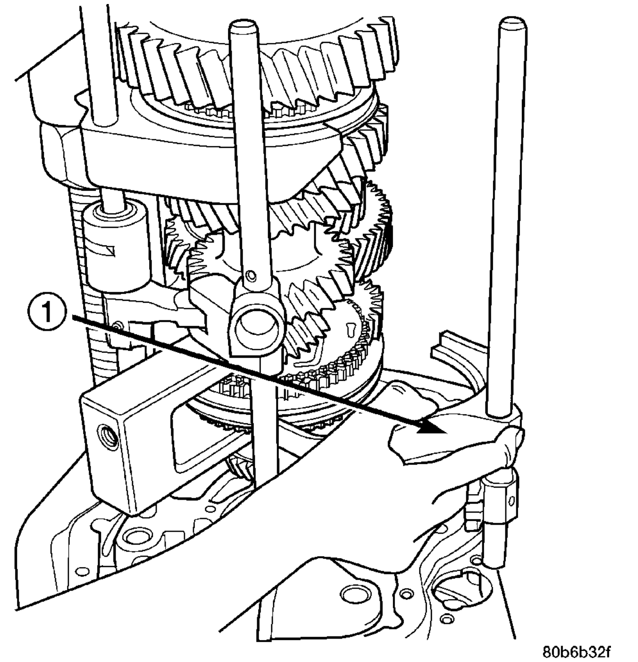


Fig. 80 SHIFT RAILS INSTALLED

1 - SHIFT RAILS

(11) With the geartrain approximately 1/4 in. from the clutch housing, remove Holding Tool 8242 from the 5-6 synchro (Fig. 81).

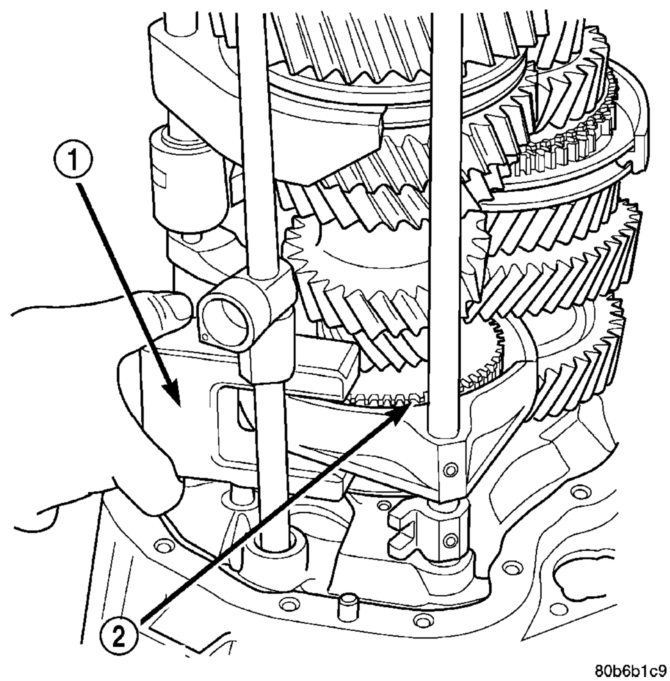


Fig. 81 HOLDING TOOL

1 - HOLDING TOOL
2 - 5-6 SYNCHRO

(12) Install 5-6 crossover bracket and arm to the shift rails and the clutch housing.

MANUAL TRANSMISSION - NV5600 (Continued)

(13) Lower geartrain the remainder of the way into the clutch housing.

(14) Install the 5-6 crossover bracket bolts and tighten to 28 N·m (20 ft. lbs.) (Fig. 82).

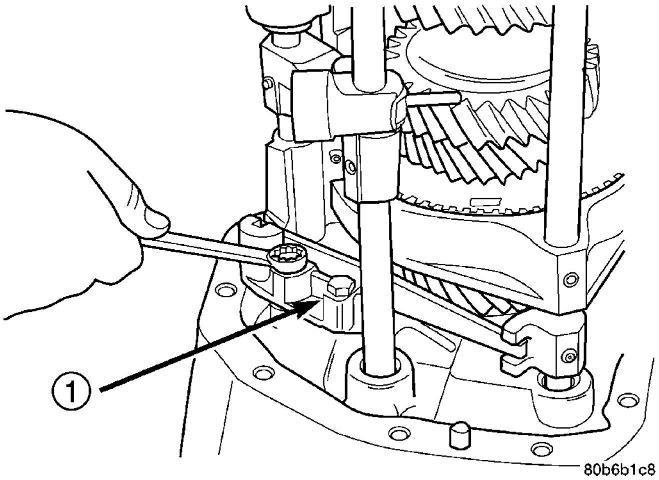


Fig. 82 5-6 CROSSOVER BRACKET BOLTS

1 - 5-6 CROSSOVER BRACKET

(15) Remove engine crane and Fixture 8232 from the output shaft and the countershaft.

TRANSMISSION GEAR CASE

(1) Install rear output shaft bearing race into the transmission gear case with Installer C-4308 and Handle C-4171.

(2) Install rear countershaft bearing race into the transmission gear case with Installer 8153 and Handle C-4171.

(3) Install Fixture 8232 to the transmission gear case.

NOTE: Shift socket must be loose on the shift shaft and is rotated a minimum of 90° from its normal position. This will ensure enough clearance to install the transmission gear case.

(4) Apply sealant to the clutch housing.

(5) Attach an engine crane or equivalent to Fixture 8232 and install the transmission gear case onto the clutch housing (Fig. 83).

(6) Install clutch housing bolts and tighten to 48 N·m (35 ft.lbs.).

(7) Install shift socket roll pin with a suitable 6 mm (7/32 in.) punch and hammer.

MAINSHAFT AND COUNTERSHAFT ENDPLAY

(1) With transmission in vertical position, use Socket 6993 to rotate the shafts and seat the bearings.

(2) Measure mainshaft endplay with Dial Indicator Set C-3339 and Extension Rod 8161 installed onto the rear of the transmission gear case (Fig. 84).

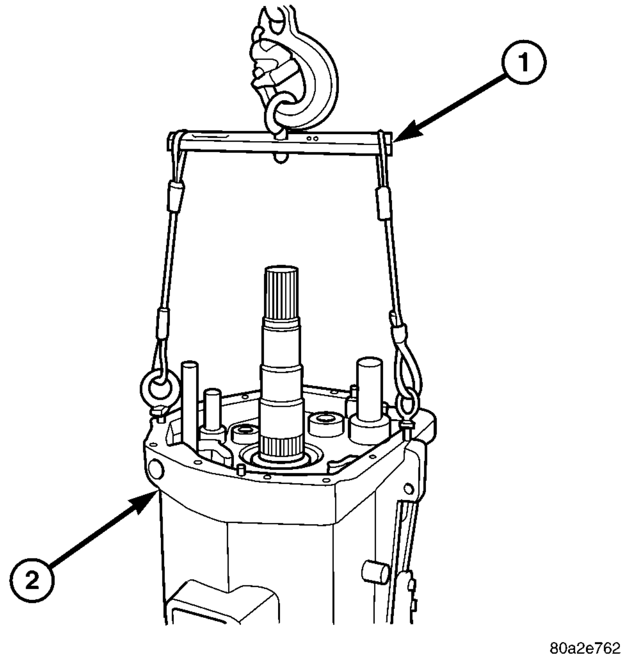


Fig. 83 LIFT FIXTURE

1 - FIXTURE
2 - TRANSMISSION CASE

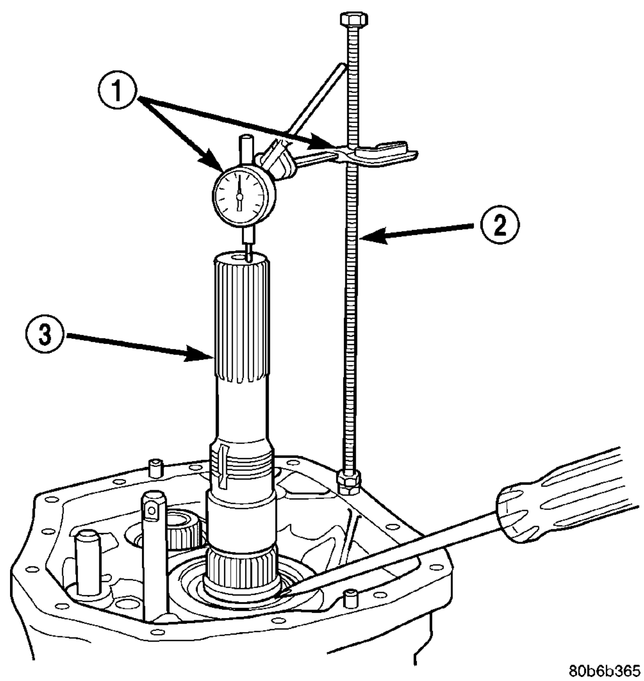


Fig. 84 MEASURE MAINSHAFT ENDPLAY

1 - DIAL INDICATOR
2 - EXTENSION ROD
3 - MAIN SHAFT

MANUAL TRANSMISSION - NV5600 (Continued)

(3) Measure countershaft end-play with Dial Indicator Set C-3339 and Extension Rod 8161 installed onto the rear of the transmission gear case (Fig. 85).

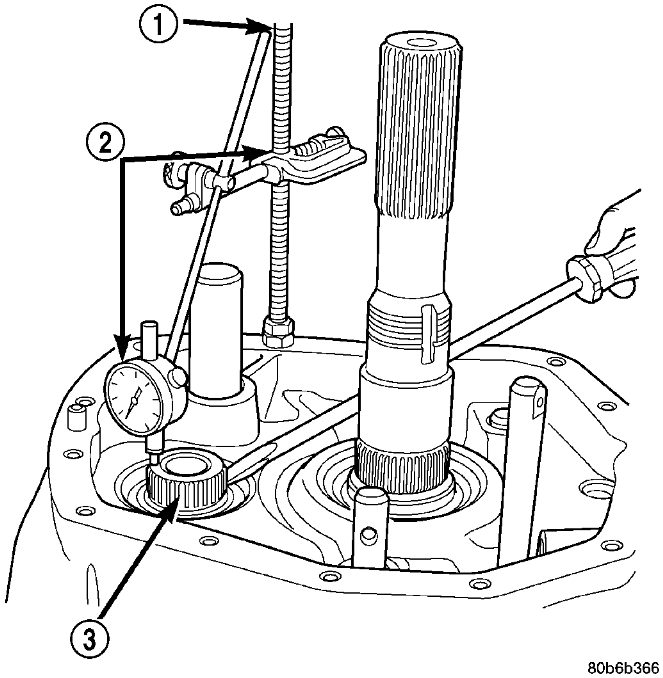


Fig. 85 MEASURE COUNTERSHAFT END-PLAY

1 - EXTENSION ROD
2 - DIAL INDICATOR
3 - COUNTERSHAFT

(4) Rotate transmission into a horizontal position and remove the input shaft retainer.

(5) Install shims necessary to achieve an end-play of 0-0.10 mm (0-0.004 in.) for the mainshaft and countershaft.

NOTE: Countershaft shims go between the bearing race and spacer. Mainshaft shims go into the input shaft retainer.

(6) Install a **new** input shaft seal into the input shaft retainer with Installer C-4965.

(7) Install input shaft oil guide with C-3972-A and Handle C-4171.

(8) Apply sealer to the input shaft retainer and install retainer onto the clutch housing. Install bolts and tighten to 28 N·m (20 ft.lbs.).

REVERSE GEAR

(1) Install reverse shift fork and synchronizer as an assembly onto the reverse shift rail and output shaft (Fig. 86).

NOTE: Raised square shoulder and snap-ring on the synchro face the case.

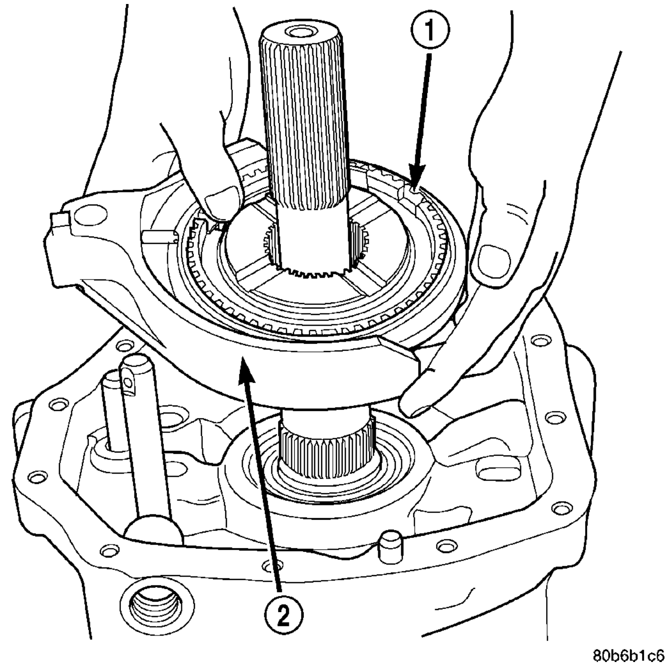


Fig. 86 REVERSE SHIFT FORK AND SYNCHRO

1 - REVERSE SYNCHRO
2 - REVERSE SHIFT FORK

(2) Install roll-pin securing the reverse shift fork to the reverse shift rail with 6 mm (7/32 in.) punch and a hammer.

(3) Install reverse gear bearing sleeve onto the output shaft with Installer 6446 if necessary (Fig. 87).

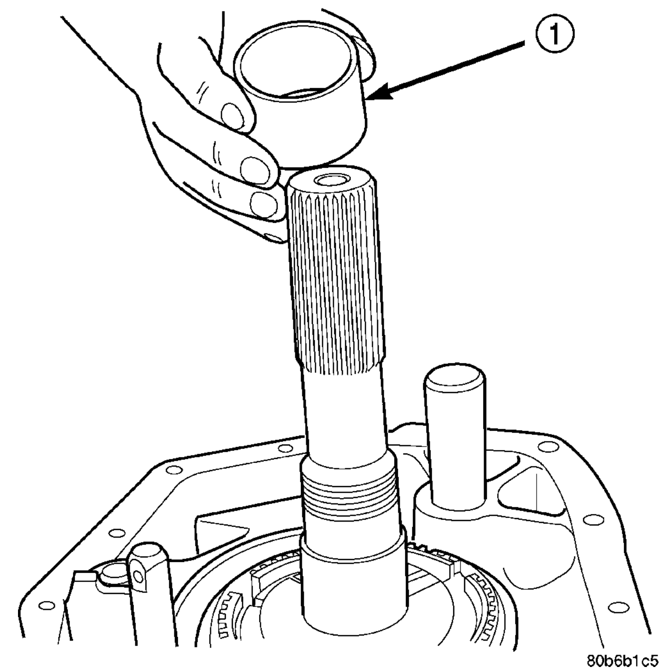


Fig. 87 REVERSE BEARING SLEEVE

1 - REVERSE GEAR BEARING SLEEVE

MANUAL TRANSMISSION - NV5600 (Continued)

(4) Install reverse gear, reverse gear synchronizer cone, reverse gear outer blocker ring and reverse gear bearing (Fig. 88).

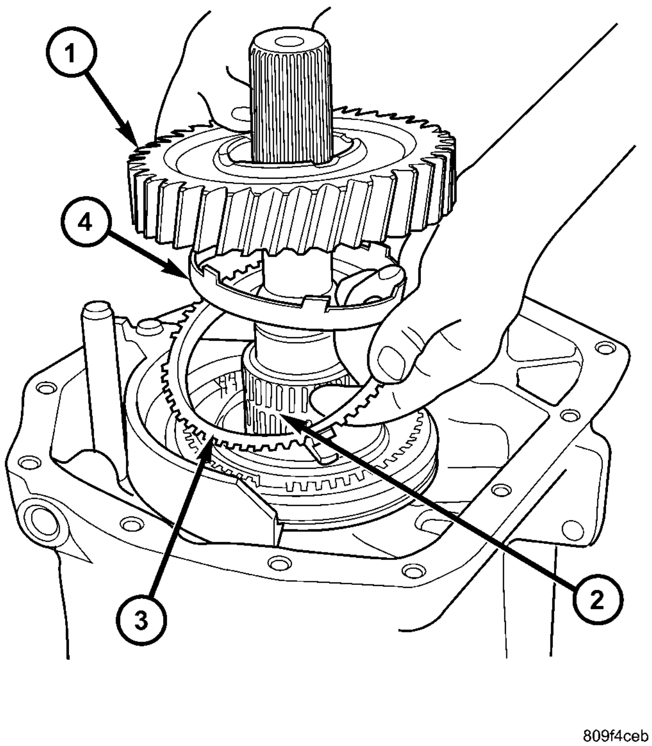


Fig. 88 REVERSE GEAR COMPONENTS

1 - REVERSE GEAR
2 - REVERSE BEARING
3 - BLOCKER RING
4 - FRICTION CONE

(5) Install output shaft ball bearing assembly and reverse thrust washer onto the output shaft (Fig. 89).

NOTE: Raised shoulder on thrust washer faces away from the reverse gear.

(6) Install a **new** output shaft nut onto the output shaft.

(7) With Wrench 8226 on the output shaft nut and Socket 6993 or 6984 holding the output shaft, tighten the nut to 339 N·m (250 ft.lbs.).

(8) Stake nut into the slot in the output shaft with a 9 mm (5/16 in.) punch.

(9) Press countershaft reverse gear into the sleeve with a shop press.

(10) Install reverse countershaft rear bearing onto the countershaft reverse gear assembly with Installer C-4652 and Handle C-4171.

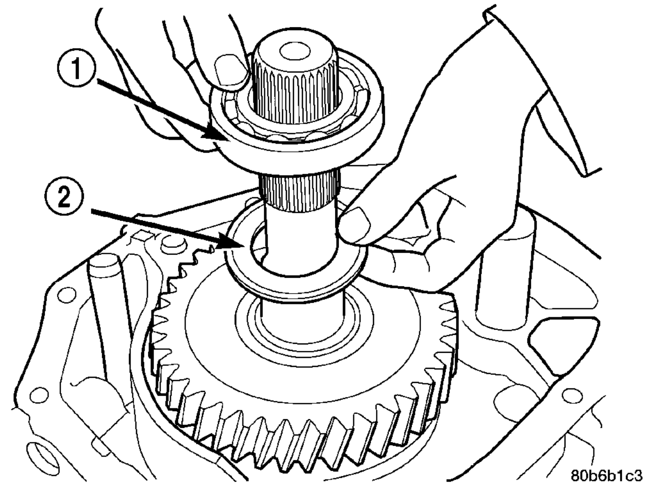


Fig. 89 OUTPUT SHAFT BEARING AND THRUST WASHER

1 - OUTPUT SHAFT BALL BEARING
2 - THRUST WASHER

(11) Install reverse idler gear rear bearing, bearing spacer, front bearing, and front thrust washer onto the idler gear shaft.

(12) Install idler and reverse countershaft gears together (Fig. 90).

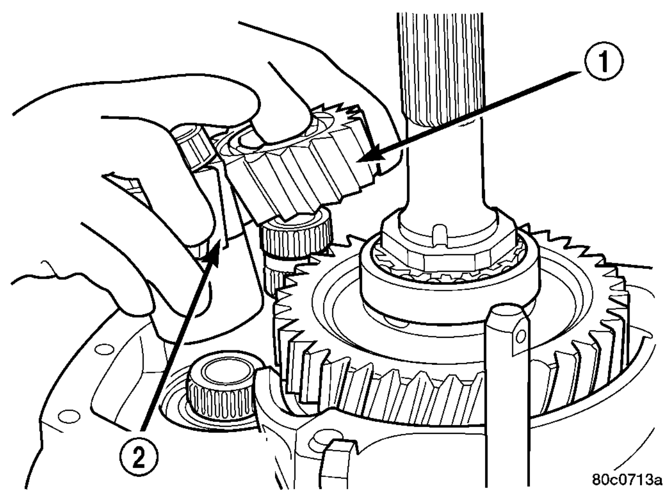


Fig. 90 REVERSE IDLER AND COUNTERSHAFT GEARS

1 - REVERSE IDLER GEAR
2 - COUNTERSHAFT REVERSE GEAR

MANUAL TRANSMISSION - NV5600 (Continued)

(13) Install reverse idler thrust washer from the reverse idler.

(14) Install crossover cam rollers and pin (Fig. 91).

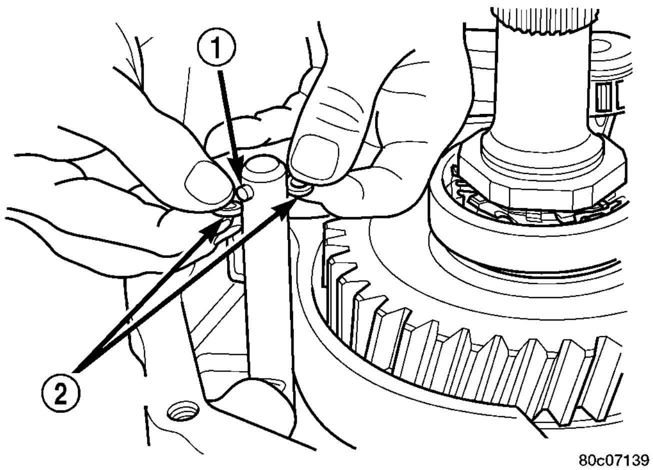


Fig. 91 CROSSOVER CAM ROLLERS AND PIN

1 - CROSSOVER CAM PIN
2 - CROSSOVER CAM ROLLERS

EXTENSION/ADAPTER HOUSING

(1) Install extension housing bushing with Installer 8156 and Handle C-4171, if necessary. The oil feed hole must be at the 12 o'clock position when installed.

(2) On 4X2 vehicles, install extension housing seal with Installer 8154 and Handle C-4171, with the weep hole at the bottom.

NOTE: Drain hole located in the dust boot portion of the seal must face downward (toward the ground) when installed.

(3) On 4X4 vehicles, install adapter housing seal with Installer C-3860-A and Handle C-4171.

(4) Install the crossover cam bushing into the extension/adapter housing with Installer 8239 and Handle C-4171.

(5) Clean the rear of the transmission case of all sealer.

(6) Install reverse countershaft gear bearing race onto the reverse countershaft gear bearing.

(7) Measure the distance from the back of the bearing race to Gauge Bar 6311 (Fig. 92).

(8) Measure thickness of the gauge bar and record the total of the two measurements.

(9) Clean all the sealer from the extension/adapter housing.

(10) Place Gauge Bar 6311 across the housing face. Measure the distance from the top of the bar to the bottom of the reverse countershaft bearing race bore (Fig. 93).

(11) Subtract thickness of the gauge bar from the measurement and record the result.

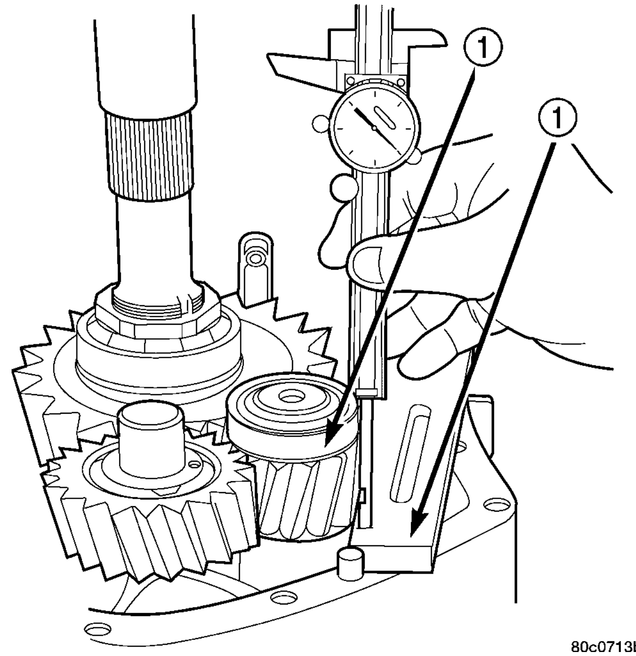


Fig. 92 Measure Height of Reverse Countershaft

1 - MEASURE DISTANCE FROM RACE TO GAUGE BAR

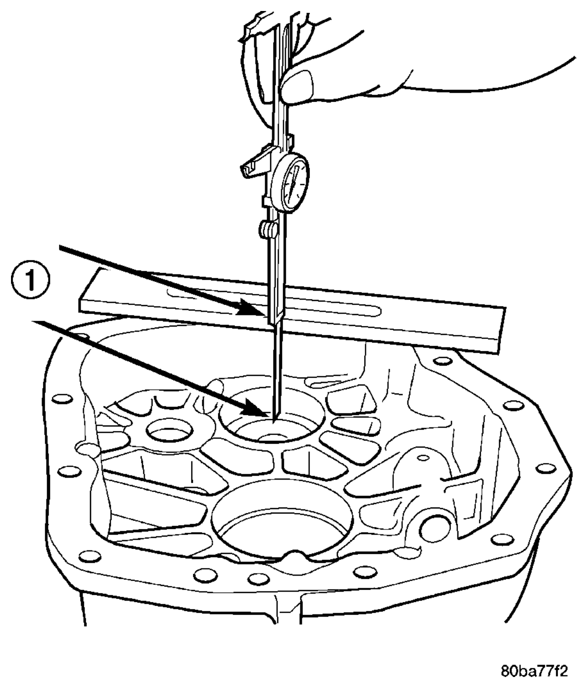


Fig. 93 MEASURE DEPTH OF REVERSE COUNTERSHAFT GEAR BEARING RACE BORE

1 - GAUGE BAR TO BEARING RACE BORE MEASUREMENT

(12) The difference between the two measurements is the end-play for the reverse countershaft gear assembly.

(13) Install shims to achieve 0.15-0.25 mm (0.006-0.010 in.) end-play for the reverse countershaft gear assembly into the reverse countershaft bearing race bore.

MANUAL TRANSMISSION - NV5600 (Continued)

(14) Use Installer to install the reverse countershaft bearing race into the extension/adapter housing.

(15) Install back-up lamp switch into the extension/adapter housing and tighten to 28 N·m (20 ft.lbs.).

(16) Install crossover cam into the extension/adapter housing.

(17) Install bolt to hold the crossover cam to the extension/adapter housing (Fig. 94).

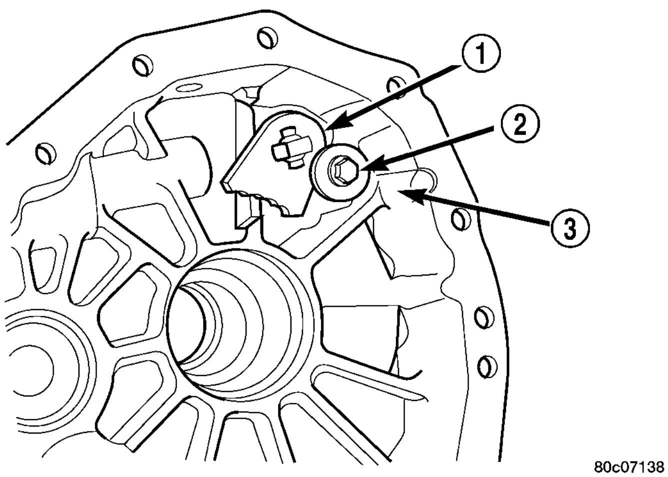


Fig. 94 CROSSOVER CAM BOLT

1 - CROSSOVER CAM
2 - BOLT
3 - EXTENSION HOUSING

(18) Install crossover detent plunger, spring and plug into the extension/adapter housing. Tighten the plug to 47.5 N·m (35 ft.lbs.) (Fig. 95).

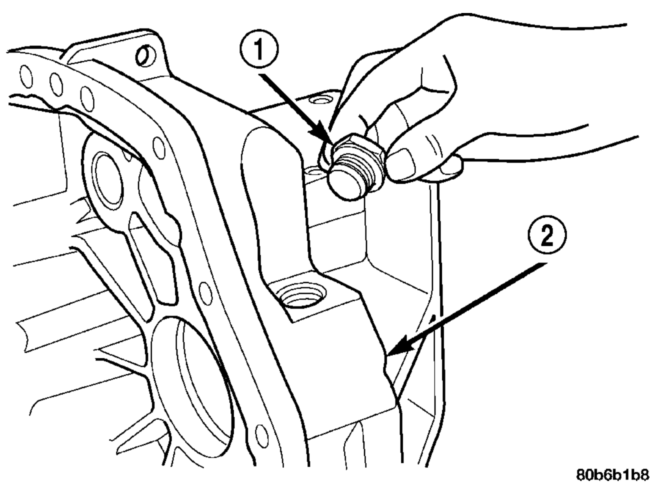


Fig. 95 CROSSOVER CAM DETENT PLUG

1 - DETENT PLUG
2 - EXTENSION HOUSING

(19) Apply sealer to the surface of the transmission case.

(20) Install extension/adapter housing onto the transmission case.

(21) Install bolts to hold the extension/adapter housing onto the transmission gear case. Tighten bolts to 48 N·m (35 ft.lbs.).

(22) Install shift rail blocker bolt and tighten bolt to 55 N·m (41 ft.lbs.).

(23) Install primary shift rail detent plunger, spring and plug into the transmission case. Tighten detent plug to 47.5 N·m (35 ft.lbs.).

(24) Install shift tower onto the transmission case and tighten bolts to 9 N·m (7 ft.lbs.).

INSTALLATION

NOTE: If installing a new transmission, use all components supplied with the transmission. If a new shift tower is supplied with the new transmission, do not re-use the original shift tower.

(1) Apply a light coat of Mopar high temperature bearing grease or equivalent to contact surfaces of following components:
- input shaft splines.
- release bearing slide surface of front retainer.
- release bearing bore.
- release fork.
- release fork ball stud.
- propeller shaft slip yoke.

(2) Apply sealer to threads of bottom PTO cover bolt and install bolt in case.

(3) Mount transmission on jack and position transmission under vehicle.

(4) Raise transmission until input shaft is centered in clutch disc hub.

(5) Move transmission forward and start input shaft in clutch disc and pilot bushing/bearing.

(6) Work transmission forward until seated against engine block. Do not allow transmission to remain unsupported after input shaft has entered clutch disc.

(7) Install and tighten transmission-to-engine block bolts.

(8) Install clutch slave cylinder.

(9) Connect backup light switch wires.

(10) Position transmission harness wires in clips on transmission.

(11) Install transmission mount on transmission or rear crossmember.

(12) Install rear crossmember.

(13) Remove transmission jack and engine support fixture.

(14) Fill transmission with required lubricant (Fig. 96). Check lubricant level in transfer case if equipped.

MANUAL TRANSMISSION - NV5600 (Continued)

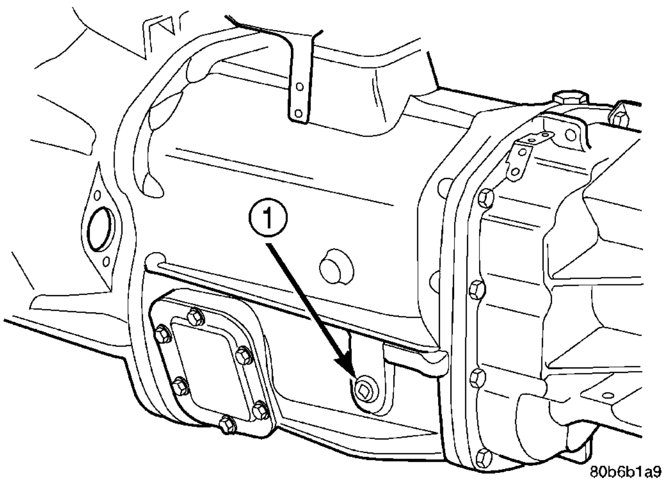


Fig. 96 FILL PLUG

1 - FILL PLUG

TWO WHEEL DRIVE

(1) Install propeller shaft with referece marks aligned.

(2) Install exhaust system components.

(3) Remove support and lower vehicle.

(4) Shift transmission into third gear.

(5) Clean the mating surfaces of shift tower and isolator plate with suitable wax and grease remover.

(6) Apply Mopar Gasket Maker or equivalent to sealing surface of the transmission case. Do not over apply sealant.

(7) Install isolator plate onto the transmission case metal side down.

(8) Install shift tower onto the isolator plate. No sealant is necessary between the shift tower and top of isolator plate.

(9) Verify shift tower, isolator plate and the shift socket are properly aligned.

(10) Install bolts to hold the shift tower to the isolator plate and the transmission case. Tighten bolts to 10.2–11.25 N·m (7.5–8.3 ft. lbs.).

(11) Install shift boot and bezel.

FOUR WHEEL DRIVE

(1) Install and secure transfer case on the transmission jack.

(2) Raise and align transfer case input gear with transmission mainshaft.

(3) Move transfer case forward and seat it on adapter.

(4) Install and tighten transfer case mounting nuts to 41-47 N·m (30-35 ft. lbs.) if case has 3/8 studs. If case has 5/16 studs tighten to 30-41 N·m (22-30 ft. lbs.).

(5) Connect transfer case shift lever to range lever on transfer case.

(6) Install propeller shafts with reference marks aligned.

(7) Install transfer case skid plate, if equipped, and crossmember. Tighten attaching bolts/nuts to 41 N·m (30 ft. lbs.).

(8) Install exhaust system components.

(9) Remove support and lower vehicle.

(10) Shift transmission into third gear.

(11) Clean the mating surfaces of shift tower, isolator plate and transmission case with suitable wax and grease remover.

(12) Apply Mopar Gasket Maker or equivalent to the sealing surface of the transmission case. Do not over apply sealant.

(13) Install isolator plate onto the transmission case, metal side down.

(14) Install shift tower onto the isolator plate. No sealant is necessary between the shift tower and top of isolator plate.

(15) Verify that the shift tower, isolator plate and the shift tower bushings are properly aligned.

(16) Install the bolts to hold the shift tower to the isolator plate and the transmission case. Tighten the shift tower bolts to 10.2-11.25 N·m (7.5-8.3 ft. lbs.).

(17) Install shift lever boot and bezel.

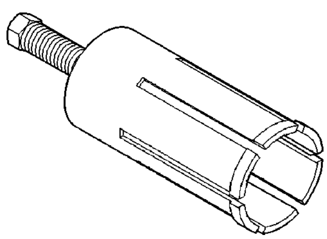
MANUAL TRANSMISSION - NV5600 (Continued)

SPECIFICATIONS - NV5600

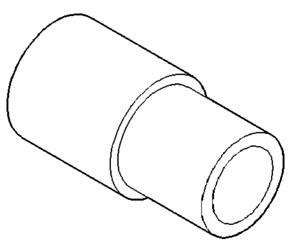
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Plug, Crossover Cam and Detent	48	35	-
Bolt, Input Retainer	28	20	-
Bolt, 5-6 Crossover Bracket	28	20	-
Bolt, Clutch Housing	48	35	-
Bolt, Extension/Adapter Housing	48	35	-
Bolt, Shift Tower	9	7	80
Switch, Back-up Lamp	28	20	-
Bolt, Shift Blocker	55	41	-
Bolt, PTO Cover	40	30	-
Pivot, Clutch Release Lever	22	16	-
Plug, Fill	30	22	-
Nut, Output Shaft	339	250	-

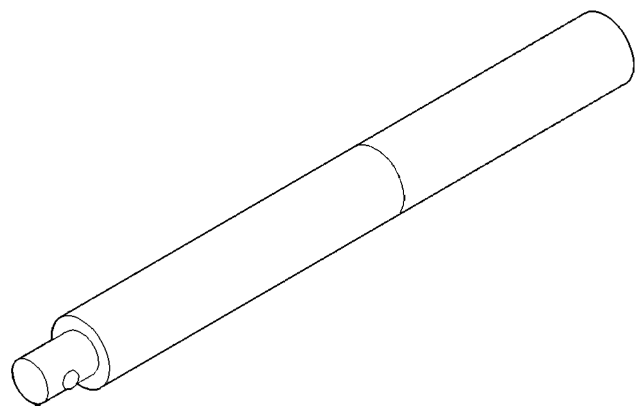
SPECIAL TOOLS



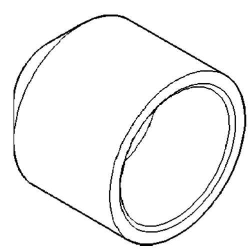
REMOVER 8155



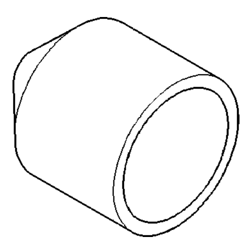
INSTALLER 8156



HANDLE C-4171

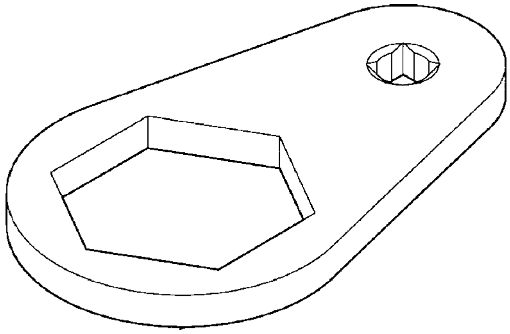


INSTALLER C-3972-A

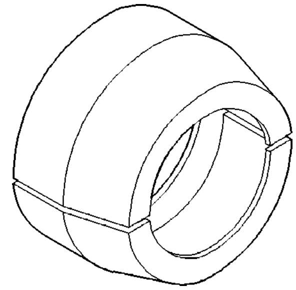


INSTALLER 8154

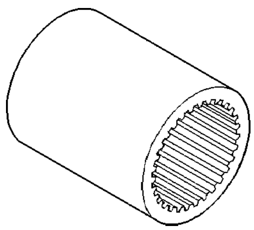
MANUAL TRANSMISSION - NV5600 (Continued)



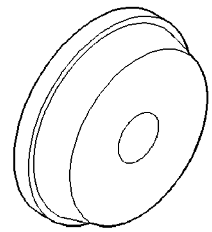
WRENCH 8226



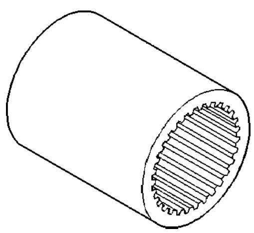
JAWS 6451



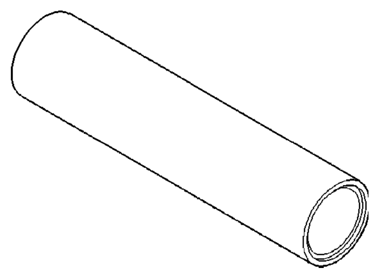
SOCKET 6984



INSTALLER 6061



SOCKET 6984



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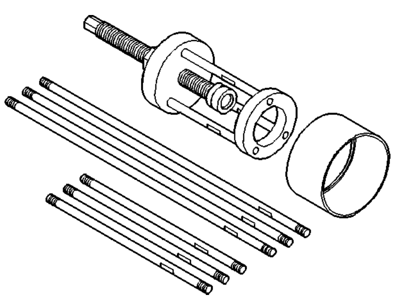

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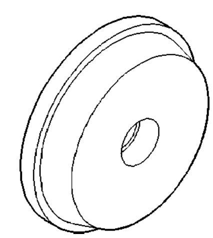

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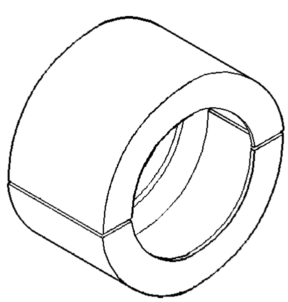

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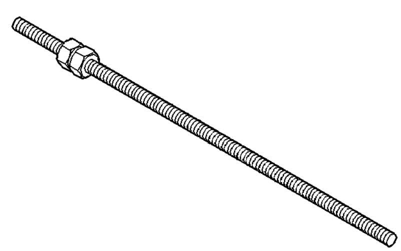

ROD EXTENSION 8161

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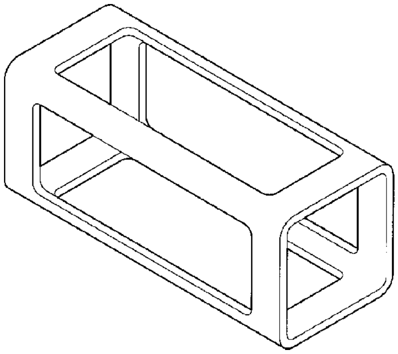

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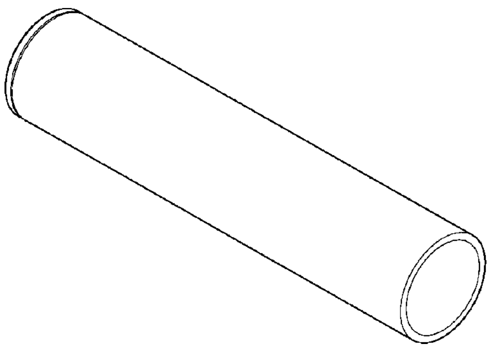

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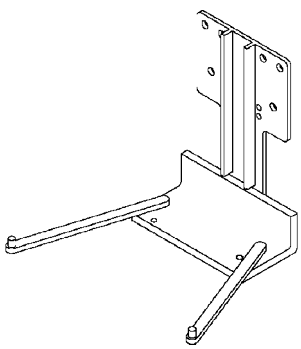

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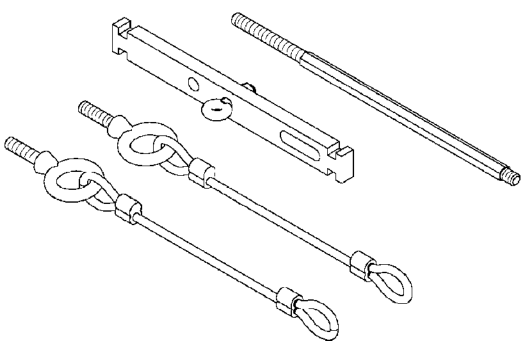

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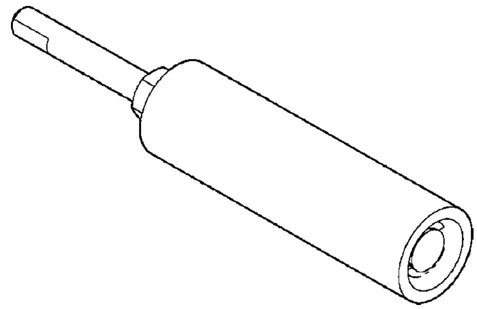

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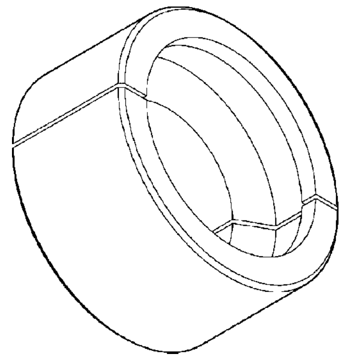

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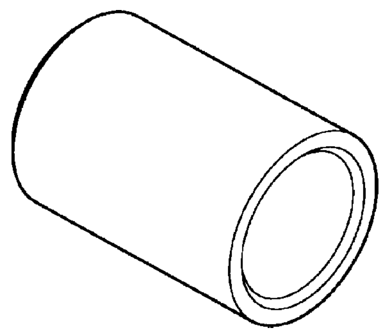

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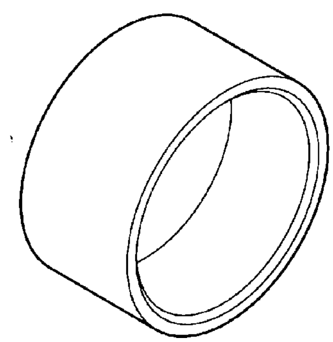

INSTALLER 8236

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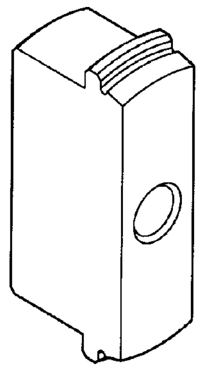

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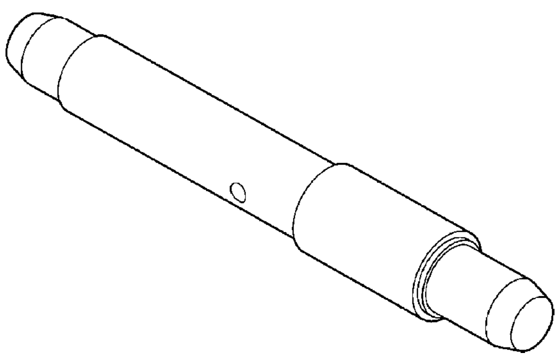

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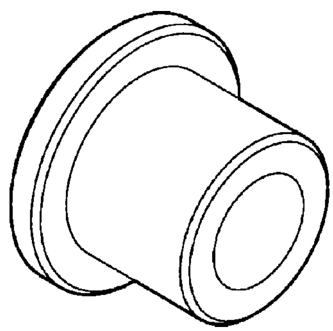

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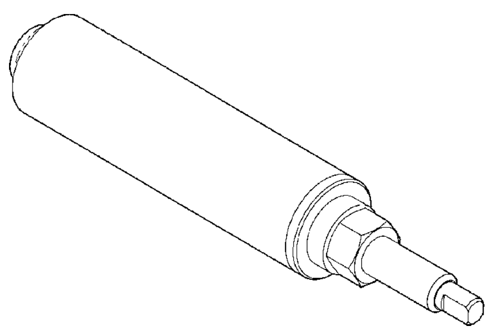

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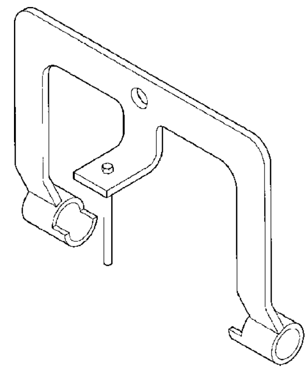

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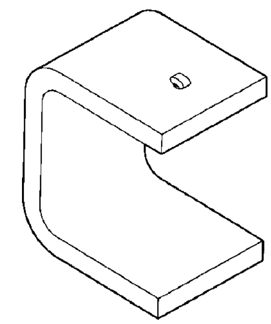

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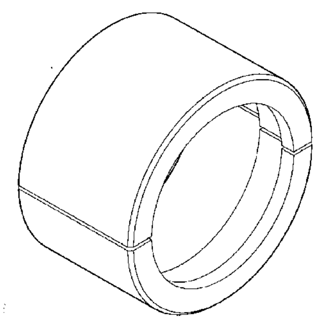
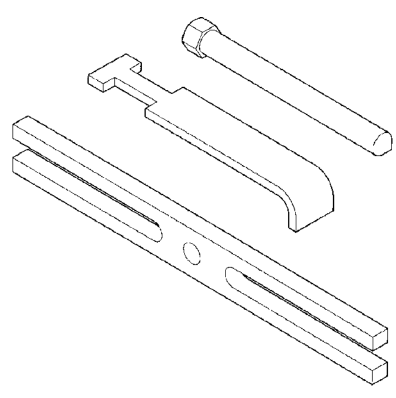


REMOVER 8243



PULLER 8244

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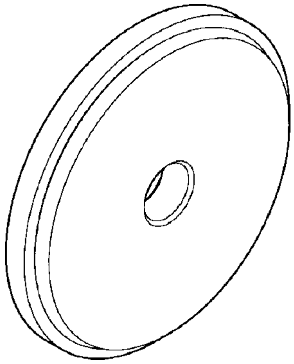
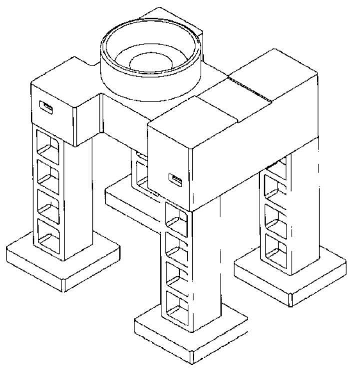
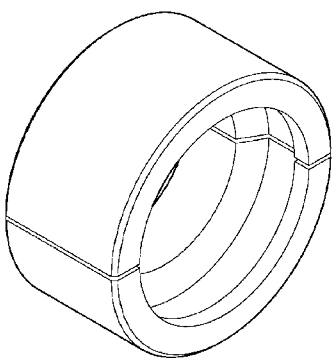


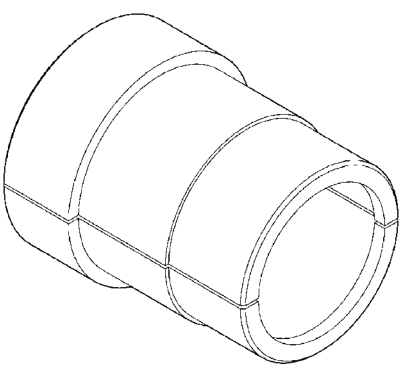
REMOVER 8245



SUPPORT STAND 8246



REMOVER 8262



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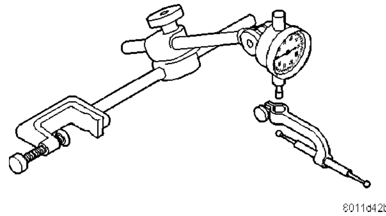

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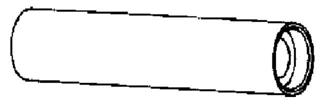
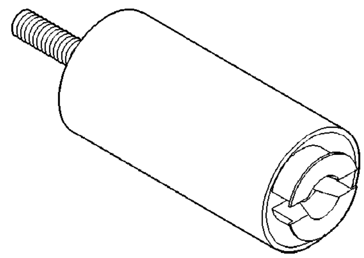


INSTALLER C-4965



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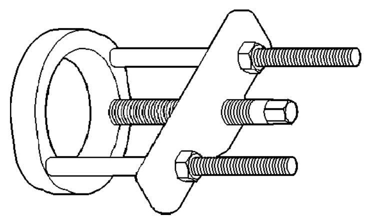
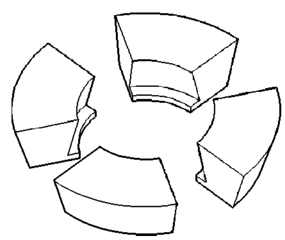
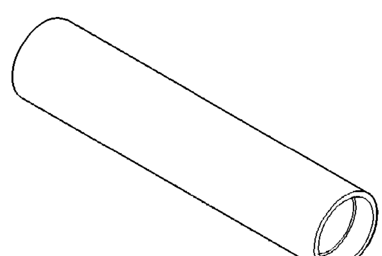


PULLER C-293-PA



ADAPTERS C-293-52



INSTALLER MD998805

ADAPTER HOUSING SEAL

REMOVAL

(1) Raise and support vehicle.
(2) Mark propeller shaft and yokes for installation reference and remove shaft.
(3) Remove the transfer case.
(4) Remove the adapter housing seal with a pry tool or slide hammer with a screw.

INSTALLATION

(1) Install adapter housing seal with Installer and Handle C-4171.
(2) Install transfer case.
(3) Install propeller shaft with reference marks aligned.
(4) Check fluid level.
(5) Remove support and lower vehicle.

EXTENSION HOUSING SEAL

REMOVAL

(1) Mark propeller shaft and pinion yoke for installation reference and remove the propeller shaft.
(2) Remove extension housing seal with a pry tool or a slide hammer and screw.
(3) Remove extension housing bushing with Remover 8155 (Fig. 97).

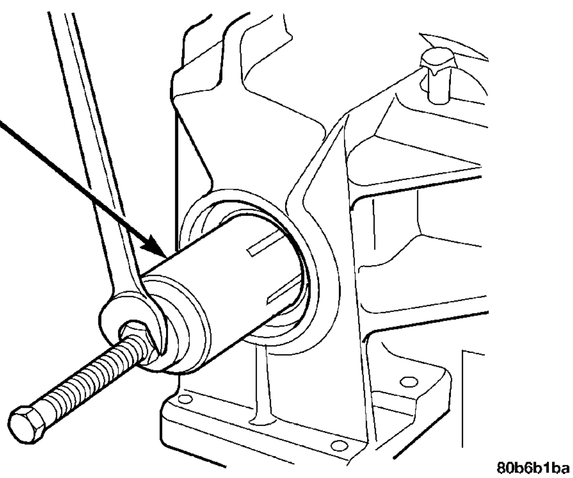


Fig. 97 EXTENSION HOUSING BUSHING REMOVAL
1 - REMOVER

INSTALLATION

(1) Install extension housing bushing with Installer 8156 and Handle C-4171 (Fig. 98).

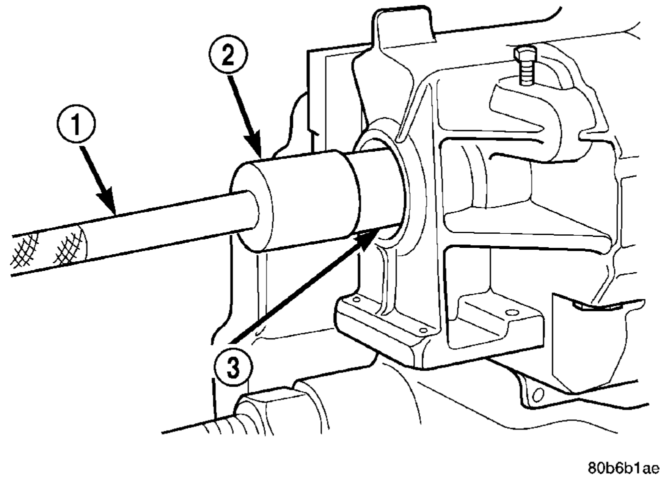


Fig. 98 Install Extension Housing Bushing
1 - HANDLE
2 - INSTALLER
3 - BUSHING

(2) Install extension housing seal with Installer 8154 and Handle C-4171 (Fig. 99).

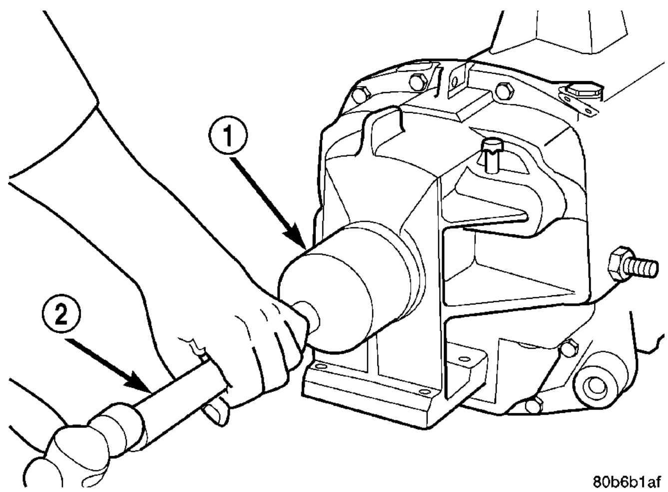


Fig. 99 EXTENSION HOUSING SEAL INSTALLER
1 - INSTALLER
2 - HANDLE

(3) Install propeller shaft with reference marks aligned.
(4) Check and fill transmission.

SHIFT COVER

REMOVAL

(1) Shift transmission into Neutral.

(2) Unscrew and remove the shift lever extension from the shift

(3) Remove screws attaching shift boot to floorpan. Then slide boot upward on the shift lever.

(4) Remove the bolts holding the shift tower to the isolator plate and transmission gear case.

(5) Remove the shift tower (Fig. 100) and isolator plate (Fig. 101) from the transmission.

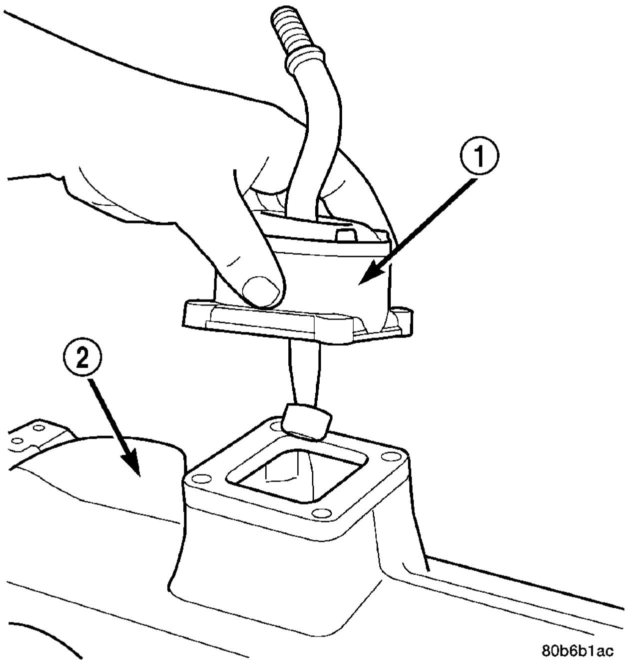


Fig. 100 SHIFT TOWER

1 - SHIFT TOWER
2 - TRANSMISSION

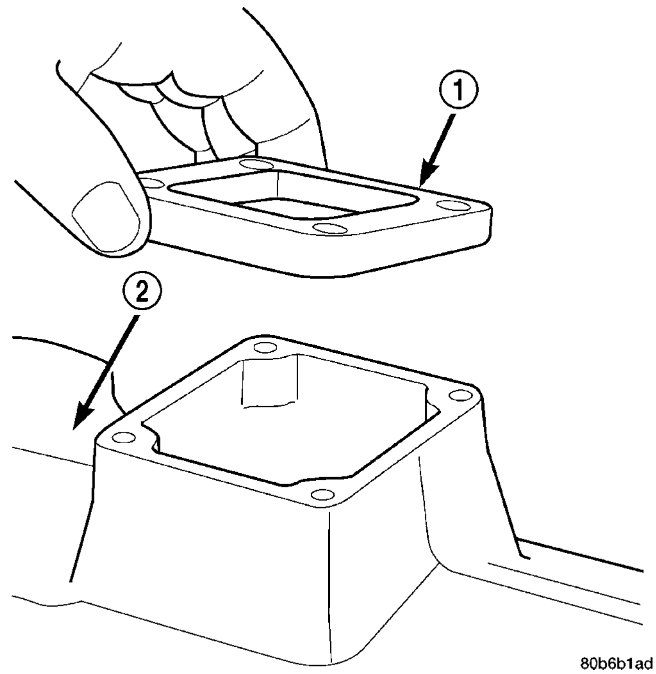


Fig. 101 SHIFT TOWER ISOLATOR PLATE

1 - ISOLATOR PLATE
2 - TRANSMISSION

INSTALLATION

(1) Shift transmission into third gear.

(2) Clean the mating surfaces of shift tower, isolator plate and transmission gear case with suitable wax and grease remover.

(3) Apply Mopar Gasket Maker or equivalent to the sealing surface of the transmission. Do not over apply sealant.

(4) Install isolator plate onto the transmission, metal side down.

(5) Install shift tower onto the isolator plate. No sealant is necessary between the shift tower and isolator plate.

(6) Verify shift tower, isolator plate and shift tower bushings are properly aligned.

(7) Install shift tower bolts and tighten the shift tower bolts to 8-10 N·m (7-9 ft. lbs.).

(8) Install shift lever extension, shift boot and bezel.

AUTOMATIC TRANSMISSION - 46RE

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AUTOMATIC TRANSMISSION - 46RE

DESCRIPTION

The 46RE (Fig. 1) is a four speed fully automatic transmissions with an electronic governor. The 46RE is equipped with a lock-up clutch in the torque converter. First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch.

The transmission contains a front, rear, and direct clutch which function as the input driving components. It also contains the kickdown (front) and the low/reverse (rear) bands which, along with the overrunning clutch and overdrive clutch, serve as the holding components. The driving and holding components combine to select the necessary planetary gear components, in the front, rear, or overdrive planetary gear set, transfer the engine power from the input shaft through to the output shaft.

The valve body is mounted to the lower side of the transmission and contains the valves to control pressure regulation, fluid flow control, and clutch/band application. The oil pump is mounted at the front of the transmission and is driven by the torque converter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

AUTOMATIC TRANSMISSION - 46RE (Continued)

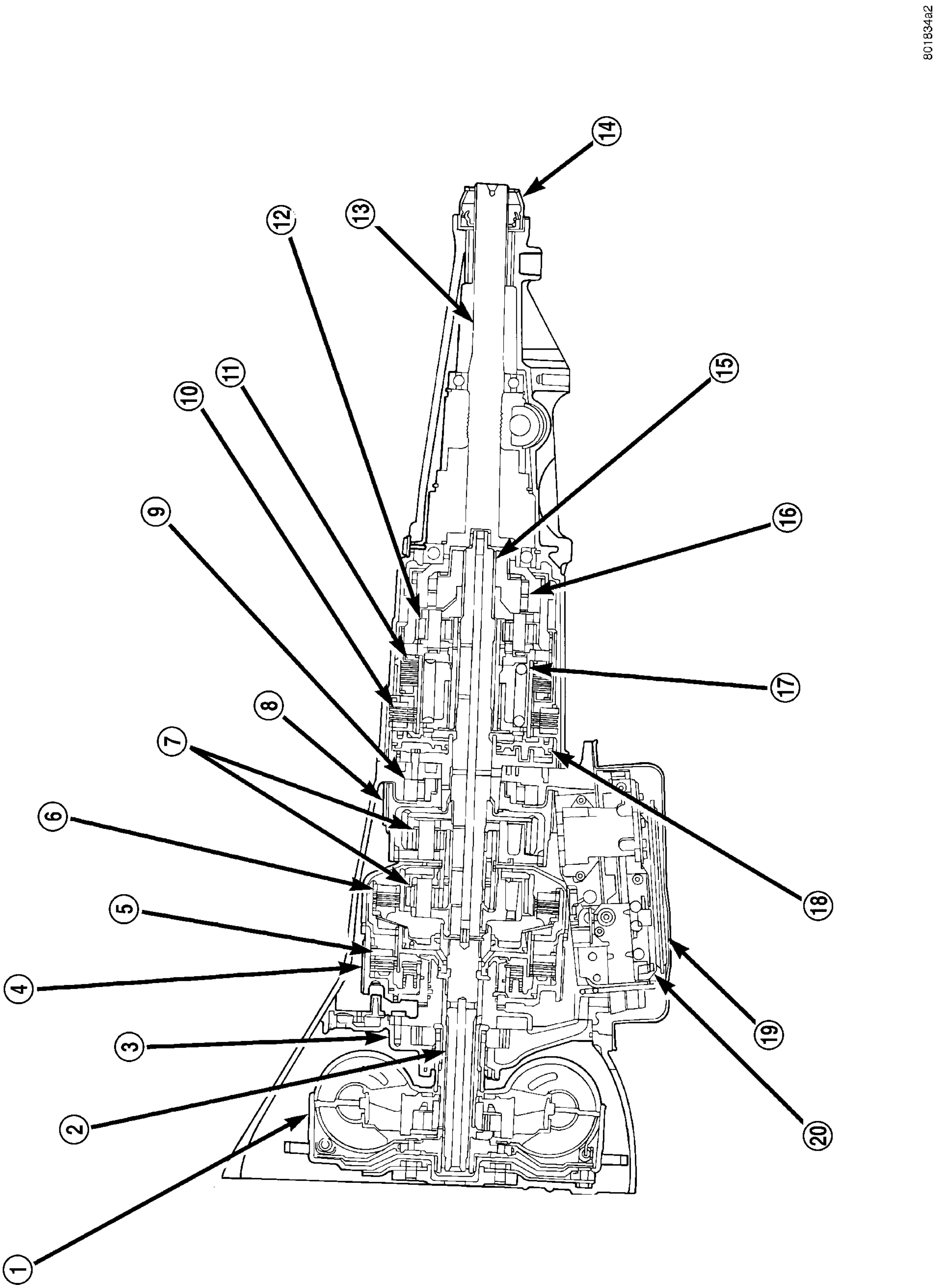


Fig. 1 46RE Transmission

AUTOMATIC TRANSMISSION - 46RE (Continued)

1 - TORQUE CONVERTER
2 - INPUT SHAFT
3 - OIL PUMP
4 - FRONT BAND
5 - FRONT CLUTCH
6 - REAR CLUTCH
7 - PLANETARIES
8 - REAR BAND
9 - OVERRUNNING CLUTCH
10 - OVERDRIVE CLUTCH
11 - DIRECT CLUTCH
12 - PLANETARY GEAR
13 - OUTPUT SHAFT
14 - SEAL
15 - INTERMEDIATE SHAFT
16 - OVERDRIVE OVERRUNNING CLUTCH
17 - DIRECT CLUTCH SPRING
18 - OVERDRIVE PISTON RETAINER
19 - FILTER
20 - VALVE BODY

IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

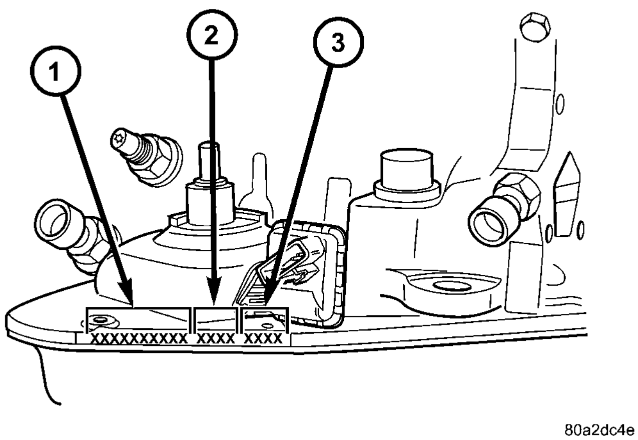


Fig. 2 Transmission Part And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

GEAR RATIOS

The 46RE gear ratios are:

1st	2.45:1
2nd	1.45:1
3rd	1.00:1
4th	0.69:1
Rev.	2.21

OPERATION

The application of each driving or holding component is controlled by the valve body based upon the manual lever position, throttle pressure, and governor pressure. The governor pressure is a variable pressure input to the valve body and is one of the signals that a shift is necessary. First through fourth gear are obtained by selectively applying and releasing the different clutches and bands. Engine power is thereby routed to the various planetary gear assemblies which combine with the overrunning clutch assemblies to generate the different gear ratios. The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch engages in fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface after the vehicle has warmed up. The torque converter clutch can also be engaged in the manual second gear position if high transmission temperatures are sensed by the PCM. The torque converter clutch will disengage momentarily when an increase in engine load is sensed by the PCM, such as when the vehicle begins to go uphill or the throttle pressure is increased. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature.

Since the overdrive clutch is applied in fourth gear only and the direct clutch is applied in all ranges except fourth gear, the transmission operation for park, neutral, and first through third gear will be described first. Once these powerflows are described, the third to fourth shift sequence will be described.

AUTOMATIC TRANSMISSION - 46RE (Continued)

PARK POWERFLOW

As the engine is running and the crankshaft is rotating, the flexplate and torque converter, which are also bolted to it, are all rotating in a clockwise direction as viewed from the front of the engine. The notched hub of the torque converter is connected to the oil pump's internal gear, supplying the transmission with oil pressure. As the converter turns, it turns the input shaft in a clockwise direction. As the input shaft is rotating, the front clutch hub-rear clutch retainer and all their associated parts are also rotating, all being directly connected to the input shaft. The power flow from the engine through the front clutch hub and rear clutch retainer stops at the rear clutch retainer. Therefore, no power flow to the output shaft occurs because no clutches are applied. The only mechanism in use at this time is the parking sprag (Fig. 3), which locks the parking gear on the output shaft to the transmission case.

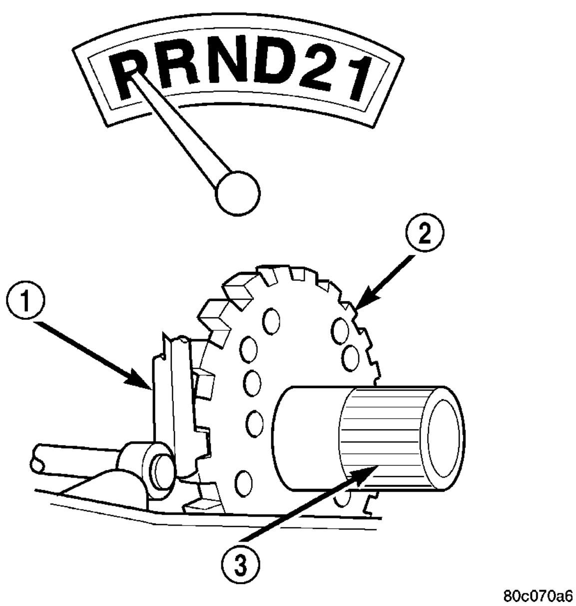


Fig. 3 Park Powerflow

1 - PAWL ENGAGED FOR PARK
2 - PARK SPRAG
3 - OUTPUT SHAFT

NEUTRAL POWERFLOW

With the gear selector in the NEUTRAL position (Fig. 4), the power flow of the transmission is essentially the same as in the park position. The only operational difference is that the parking sprag has been disengaged, unlocking the output shaft from the transmission case and allowing it to move freely.

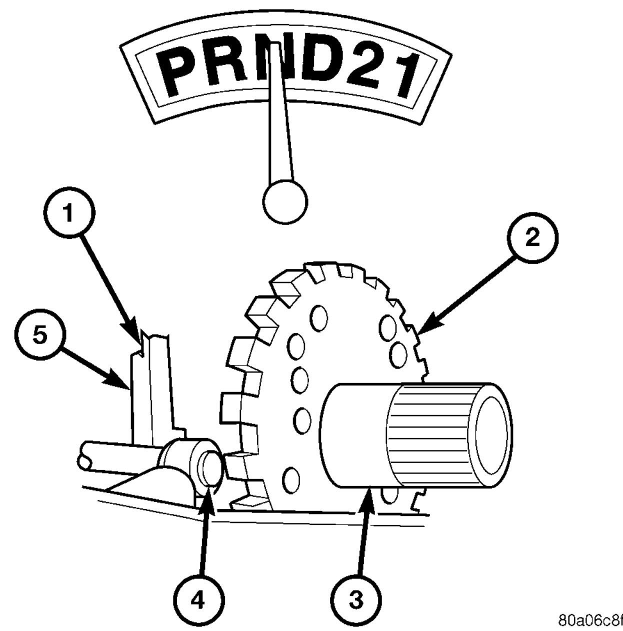


Fig. 4 Neutral Powerflow

1 - PAWL DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - PAWL

REVERSE POWERFLOW

When the gear selector is moved into the REVERSE position (Fig. 5), the front clutch and the rear band are applied. With the application of the front clutch, engine torque is applied to the sun gear, turning it in a clockwise direction. The clockwise rotation of the sun gear causes the rear planet pinions to rotate against engine rotation in a counterclockwise direction. The rear band is holding the low reverse drum, which is splined to the rear carrier. Since the rear carrier is being held, the torque from the planet pinions is transferred to the rear annulus gear, which is splined to the output shaft. The output shaft in turn rotates with the annulus gear in a counterclockwise direction giving a reverse gear output. The entire transmission of torque is applied to the rear planetary gearset only. Although there is torque input to the front gearset through the sun gear, no other member of the gearset is being held. During the entire reverse stage of operation, the front planetary gears are in an idling condition.

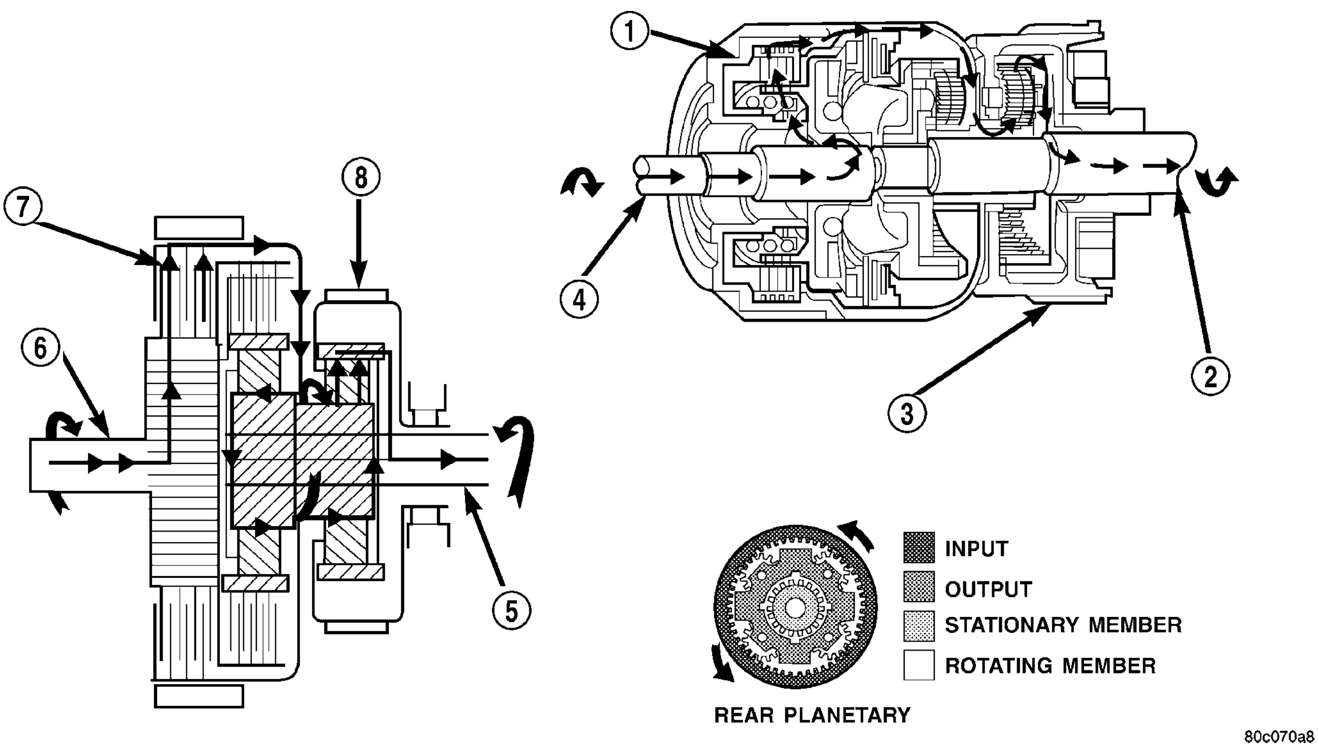


Fig. 5 Reverse Powerflow

1 - FRONT CLUTCH ENGAGED
2 - OUTPUT SHAFT
3 - LOW/REVERSE BAND APPLIED
4 - INPUT SHAFT
5 - OUTPUT SHAFT
6 - INPUT SHAFT
7 - FRONT CLUTCH ENGAGED
8 - LOW/REVERSE BAND APPLIED

AUTOMATIC TRANSMISSION - 46RE (Continued)

FIRST GEAR POWERFLOW

When the gearshift lever is moved into the DRIVE position the transmission goes into first gear (Fig. 6). As soon as the transmission is shifted from PARK or NEUTRAL to DRIVE, the rear clutch applies, applying the rear clutch pack to the front annulus gear. Engine torque is now applied to the front annulus gear turning it in a clockwise direction. With the front annulus gear turning in a clockwise direction, it causes the front planets to turn in a clockwise direction. The rotation of the front planets cause the sun to revolve in a counterclockwise direction. The sun gear now transfers its counterclockwise rotation to the rear planets which rotate back in a clockwise direction. With the rear annulus gear stationary, the rear planet rotation on the annulus gear causes the rear planet carrier to revolve in a counterclockwise direction. The rear planet carrier is splined into the low-reverse drum, and the low reverse drum is splined to the inner race of the over-running clutch. With the over-running clutch locked, the planet carrier is held, and the resulting torque provided by the planet pinions is transferred to the rear annulus gear. The rear annulus gear is splined to the output shaft and rotated along with it (clockwise) in an underdrive gear reduction mode.

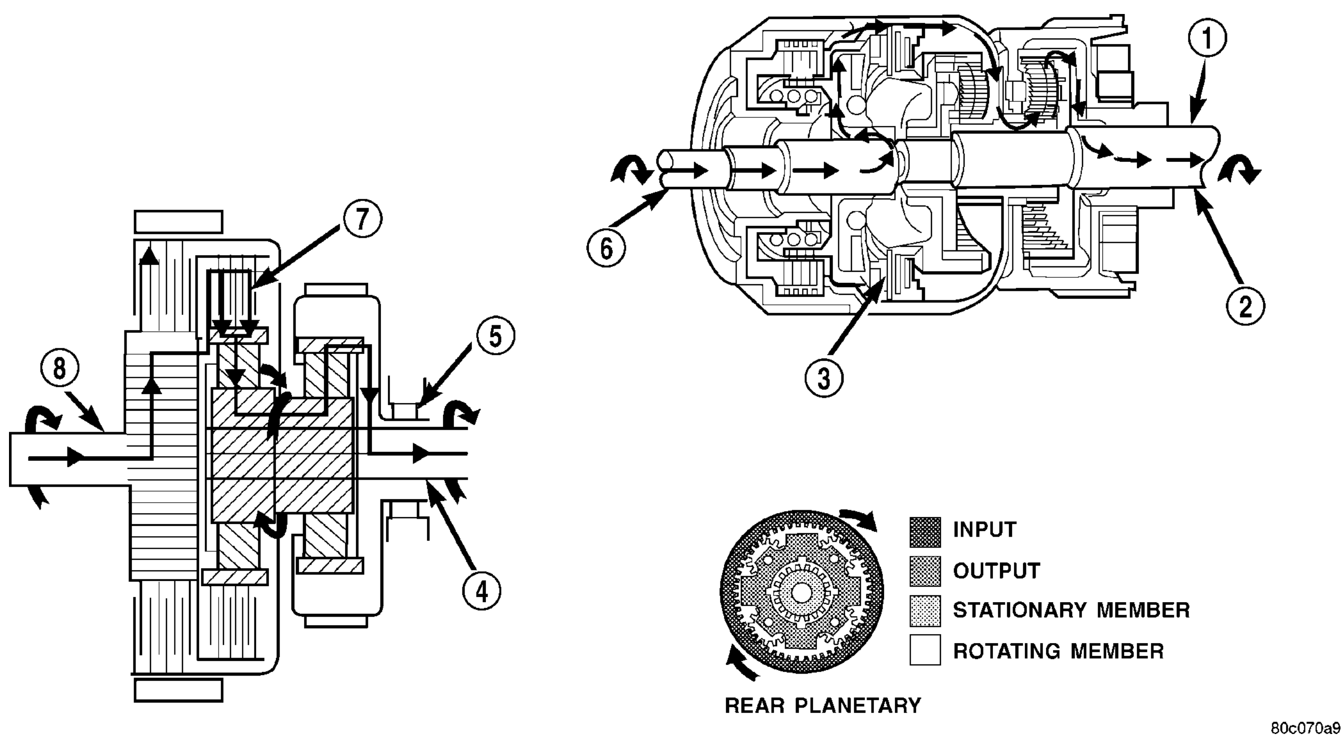


Fig. 6 First Gear Powerflow

1 - OUTPUT SHAFT
2 - OVER-RUNNING CLUTCH HOLDING
3 - REAR CLUTCH APPLIED
4 - OUTPUT SHAFT
5 - OVER-RUNNING CLUTCH HOLDING
6 - INPUT SHAFT
7 - REAR CLUTCH APPLIED
8 - INPUT SHAFT

AUTOMATIC TRANSMISSION - 46RE (Continued)

SECOND GEAR POWERFLOW

In DRIVE-SECOND (Fig. 7), the same elements are applied as in MANUAL-SECOND. Therefore, the power flow will be the same, and both gears will be discussed as one in the same. In DRIVE-SECOND, the transmission has proceeded from first gear to its shift point, and is shifting from first gear to second. The second gear shift is obtained by keeping the rear clutch applied and applying the front (kickdown) band. The front band holds the front clutch retainer that is locked to the sun gear driving shell. With the rear clutch still applied, the input is still on the front annulus gear turning it clockwise at engine speed. Now that the front band is holding the sun gear stationary, the annulus rotation causes the front planets to rotate in a clockwise direction. The front carrier is then also made to rotate in a clockwise direction but at a reduced speed. This will transmit the torque to the output shaft, which is directly connected to the front planet carrier. The rear planetary annulus gear will also be turning because it is directly splined to the output shaft. All power flow has occurred in the front planetary gear set during the drive-second stage of operation, and now the over-running clutch, in the rear of the transmission, is disengaged and freewheeling on its hub.

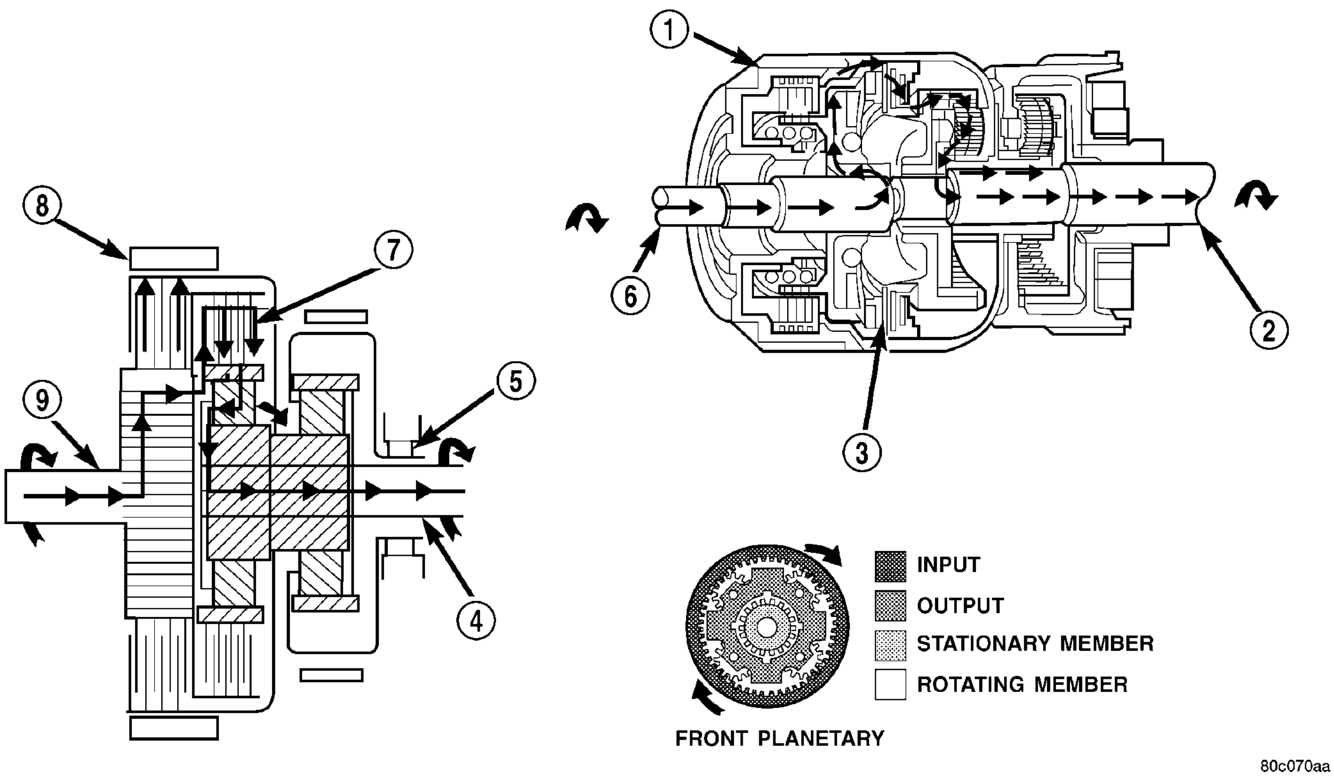


Fig. 7 Second Gear Powerflow

1 - KICKDOWN BAND APPLIED
2 - OUTPUT SHAFT
3 - REAR CLUTCH ENGAGED
4 - OUTPUT SHAFT
5 - OVER-RUNNING CLUTCH FREE-WHEELING
6 - INPUT SHAFT
7 - REAR CLUTCH APPLIED
8 - KICKDOWN BAND APPLIED
9 - INPUT SHAFT

DIRECT DRIVE POWERFLOW

The vehicle has accelerated and reached the shift point for the 2-3 upshift into direct drive (Fig. 8). When the shift takes place, the front band is released, and the front clutch is applied. The rear clutch stays applied as it has been in all the forward gears. With the front clutch now applied, engine torque is now on the front clutch retainer, which is locked to the sun gear driving shell. This means that the sun gear is now turning in engine rotation (clockwise) and at engine speed. The rear clutch is still applied so engine torque is also still on the front annulus gear. If two members of the same planetary set are driven, direct drive results. Therefore, when two members are rotating at the same speed and in the same direction, it is the same as being locked up. The rear planetary set is also locked up, given the sun gear is still the input, and the rear annulus gear must turn with the output shaft. Both gears are turning in the same direction and at the same speed. The front and rear planet pinions do not turn at all in direct drive. The only rotation is the input from the engine to the connected parts, which are acting as one common unit, to the output shaft.

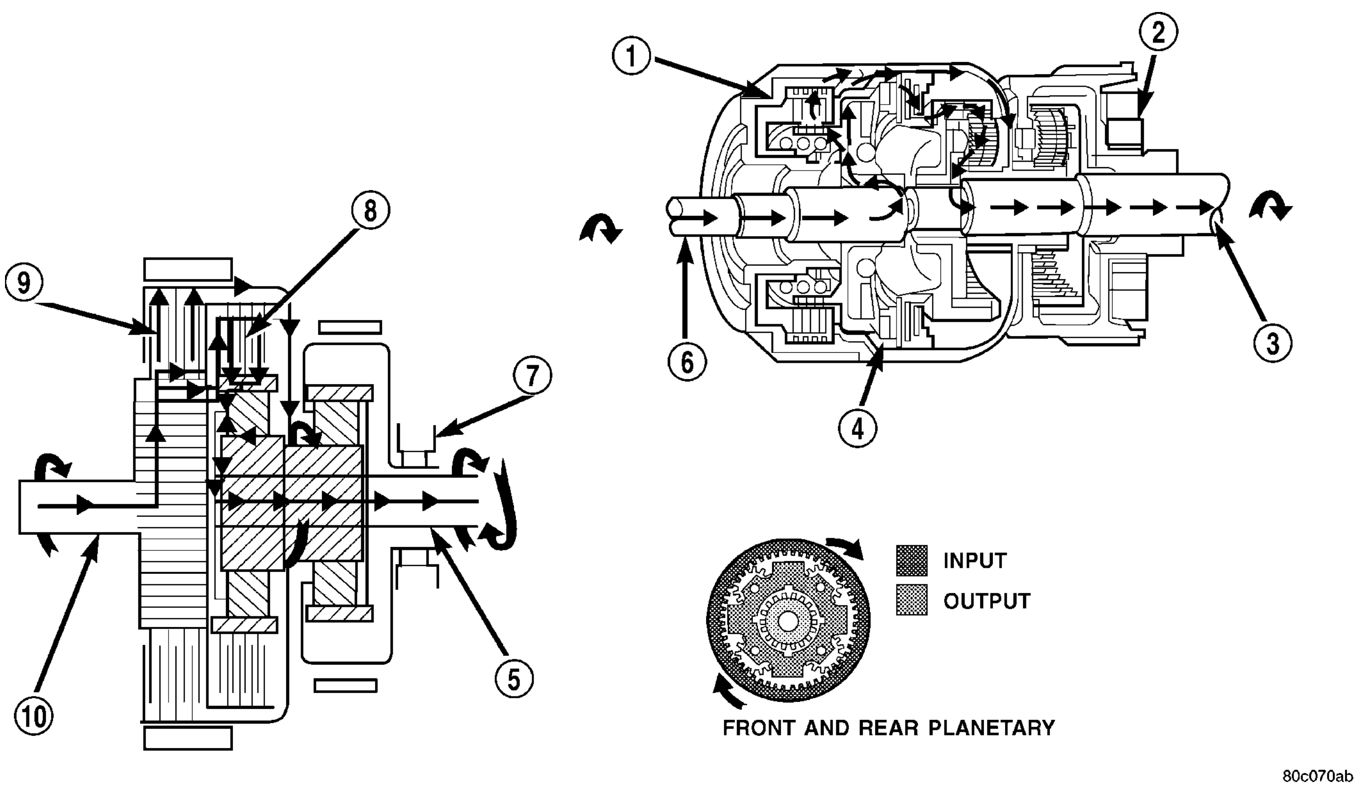


Fig. 8 Direct Drive Powerflow

1 - FRONT CLUTCH APPLIED
2 - OVER-RUNNING CLUTCH FREE-WHEELING
3 - OUTPUT SHAFT
4 - REAR CLUTCH APPLIED
5 - OUTPUT SHAFT
6 - INPUT SHAFT
7 - OVER-RUNNING CLUTCH FREE-WHEELING
8 - REAR CLUTCH APPLIED
9 - FRONT CLUTCH APPLIED
10 - INPUT SHAFT

FOURTH GEAR POWERFLOW

Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage or cable adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or electrical/mechanical component malfunctions. Begin diagnosis by checking the easily accessible items such as: fluid level and condition, linkage adjustments and electrical connections. A road test will determine if further diagnosis is necessary.

DIAGNOSIS AND TESTING - PRELIMINARY

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB® scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform hydraulic pressure test if shift problems were noted during road test.

(6) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

- (a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.
- (b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.
- (c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING - ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CLUTCH AND BAND APPLICATION CHART

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVER-RUNNING CLUTCH	OVER-DRIVE CLUTCH	DIRECT CLUTCH	OVER-RUNNING CLUTCH
Reverse	X			X			X	
Drive - First			X		X		X	X
Drive - Second		X	X				X	X
Drive - Third	X		X				X	X
Drive - Fourth	X		X			X		
Manual Second		X	X				X	X
Manual First			X	X	X		X	X

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help determine the probable cause.

DIAGNOSIS AND TESTING - HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse.

An accurate tachometer and pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 9).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

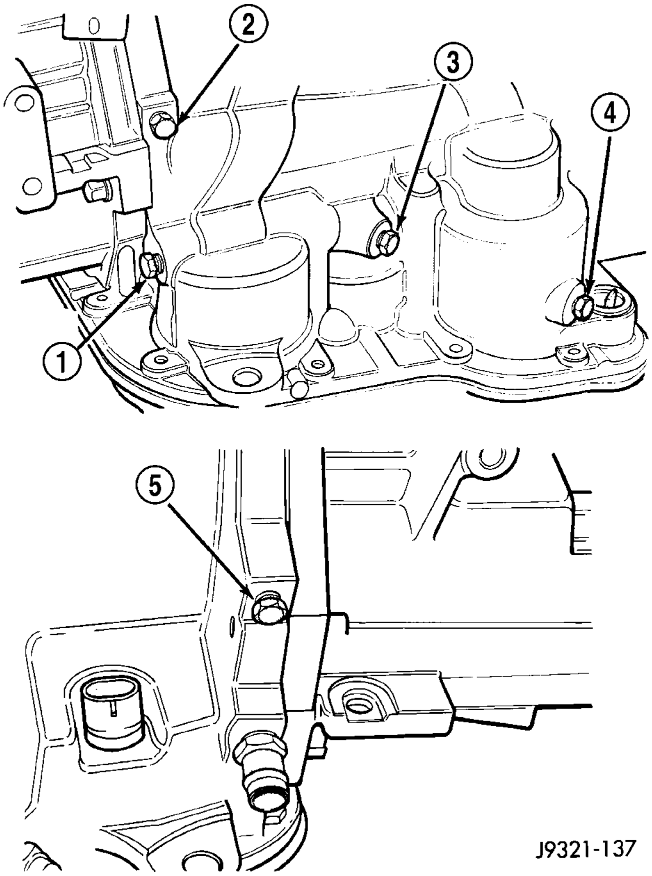


Fig. 9 Pressure Test Port Locations

1 - REAR SERVO TEST PORT
2 - GOVERNOR TEST PORT
3 - ACCUMULATOR TEST PORT
4 - FRONT SERVO TEST PORT
5 - OVERDRIVE CLUTCH TEST PORT

Test One - Transmission In Manual Low

This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

- Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as throttle lever is moved rearward.
- Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two - Transmission In 2 Range

This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.

(2) Have helper start and run engine at 1000 rpm.

(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.

(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

Test Three - Transmission In D Range Third Gear

This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.

(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.

(3) Move Gauge C-3293-SP over to front servo port for this test.

(4) Have helper start and run engine at 1600 rpm for this test.

(5) Move transmission shift lever two detents rearward from full forward position. This is D range.

(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

- Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.
- Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

AUTOMATIC TRANSMISSION - 46RE (Continued)

Test Four - Transmission In Reverse

This test checks pump output, pressure regulation and the front clutch and rear servo circuits. Use 300 psi Test Gauge C-3293-SP for this test.

(1) Leave vehicle on hoist and leave gauge C-3292 in place at accumulator port.

(2) Move 300 psi Gauge C-3293-SP back to rear servo port.

(3) Have helper start and run engine at 1600 rpm for test.

(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.

(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.

(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

Test Five - Governor Pressure

This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.

(2) Move transmission shift lever two detents rearward from full forward position. This is D range.

(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.

(4) Note governor pressure:

- Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.
- If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.

(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.

(7) Compare results of pressure test with analysis chart.

Test Six - Transmission In Overdrive Fourth Gear

This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3293-SP for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.

(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.

(3) Lower vehicle.

(4) Turn OD switch on.

(5) Secure test gauge so it can be viewed from drivers seat.

(6) Start engine and shift into D range.

(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.

(8) Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-827 kPa (90-120 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 896 kPa (130 psi) at full throttle.

(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

AUTOMATIC TRANSMISSION - 46RE (Continued)

DIAGNOSIS AND TESTING - AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 10).

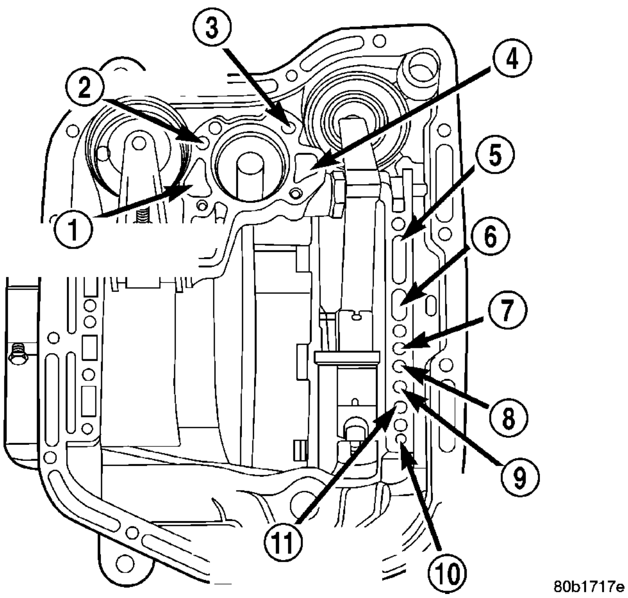


Fig. 10 Air Pressure Test Passages

1 - LINE PRESSURE TO ACCUMULATOR
2 - REAR SERVO APPLY
3 - FRONT SERVO APPLY
4 - FRONT SERVO RELEASE
5 - PUMP SUCTION
6 - PUMP PRESSURE
7 - FRONT CLUTCH APPLY
8 - REAR CLUTCH APPLY
9 - TO TORQUE CONVERTOR
10 - TO COOLER
11 - FROM TORQUE CONVERTER

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

DIAGNOSIS AND TESTING - CONVERTER HOUSING FLUID LEAK

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump body leaks follow the same path as a seal leak (Fig. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 11). Pump o-ring or gasket leaks usually travel down the inside of the converter housing. Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

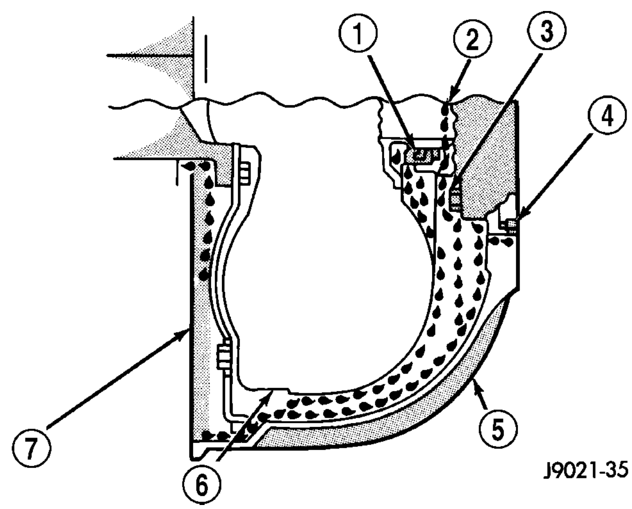


Fig. 11 Converter Housing Leak Paths

1 - PUMP SEAL
2 - PUMP VENT
3 - PUMP BOLT
4 - PUMP GASKET
5 - CONVERTER HOUSING
6 - CONVERTER
7 - REAR MAIN SEAL LEAK

AUTOMATIC TRANSMISSION - 46RE (Continued)

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

- Leaks at the weld joint around the outside diameter weld.
- Leaks at the converter hub weld.

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite™ 592, or Permatex® No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND TESTING - DIAGNOSIS CHARTS

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and converter clutch fault conditions.

The hydraulic flow charts in the Schematics and Diagrams section of this group, outline fluid flow and hydraulic circuitry. Circuit operation is provided for PARK, NEUTRAL, FIRST, SECOND, THIRD, FOURTH, MANUAL FIRST, MANUAL SECOND, and REVERSE gear ranges. Normal working pressures are also supplied for each of the gear ranges.

AUTOMATIC TRANSMISSION - 46RE (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Add Fluid
	2. Throttle Linkage Mis-adjusted.	2. Adjust linkage - setting may be too long.
	3. Mount and Driveline Bolts Loose.	3. Check engine mount, transmission mount, propeller shaft, rear spring to body bolts, rear control arms, crossmember and axle bolt torque. Tighten loose bolts and replace missing bolts.
	4. U-Joint Worn/Broken.	4. Remove propeller shaft and replace U-Joint.
	5. Axle Backlash Incorrect.	5. Check per Service Manual. Correct as needed.
	6. Hydraulic Pressure Incorrect.	6. Check pressure. Remove, overhaul or adjust valve body as needed.
	7. Band Mis-adjusted.	7. Adjust rear band.
	8. Valve Body Check Balls Missing.	8. Inspect valve body for proper check ball installation.
	9. Axle Pinion Flange Loose.	9. Replace nut and check pinion threads before installing new nut. Replace pinion gear if threads are damaged.
	10. Clutch, band or planetary component damaged.	10. Remove, disassemble and repair transmission as necessary.
	11. Converter Clutch Faulty.	11. Replace converter.
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Mis-adjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump).	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Mis-adjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB® scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Replace cooler.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check and inspect valve body. Replace valve body (as assembly) if any valve or bore is damaged. Clean and reassemble correctly if all parts are in good condition.
	7. Transmission Internal Component Damaged.	7. Remove and disassemble transmission. Repair or replace failed components as needed.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Mis-adjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB® scan tool and repair as required.
	8. Front Band Mis-adjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. Check for excessive foam on dipstick after normal driving. Check for loose pump bolts, defective gasket. Replace pump assembly if needed.
NO REVERSE (D RANGES OK)	1. Gearshift Linkage/Cable Mis-adjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Mis-adjusted/Worn.	3. Adjust band; replace.
	4. Valve Body Malfunction.	4. Remove and service valve body. Replace valve body if any valves or valve bores are worn or damaged.
	5. Rear Servo Malfunction.	5. Remove and disassemble transmission. Replace worn/damaged servo parts as necessary.
	6. Direct Clutch in Overdrive Worn.	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair stuck 1-2 shift valve or governor plug.
	3. Front Servo/Kickdown Band Damaged/Burned.	3. Repair/replace.
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Valve Body Malfunction.	1. Remove, clean and inspect. Look for stuck 1-2 valve or governor plug.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Circuit Electrical Fault.	1. Test with DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Remove, clean and inspect. Look for sticking 1-2 shift valve, 2-3 shift valve, governor plug or broken springs.
	3. Front Servo Piston Cocked in Bore.	3. Inspect servo and repair as required.
	4. Front Band Linkage Malfunction	4. Inspect linkage and look for bind in linkage.
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Throttle Linkage Mis-adjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to Valve Body Malfunction or Incorrect Hydraulic Control Pressure Adjustments.	3. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	4. Governor Circuit Electrical Fault.	4. Test with DRB® scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB® scan tool.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Mis-adjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB® scan tool, repair faulty component.
	4. Front Band Out of Adjustment.	4. Adjust Band.
	5. Clutch or Servo Malfunction.	5. Air pressure check operation of clutches and bands. Repair faulty component.
CREEPS IN NEUTRAL	1. Gearshift Linkage Mis-adjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Mis-assembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Mis-assembled.	3. Remove, disassemble, inspect valve body. Reassemble correctly if necessary. Replace assembly if valves or springs are damaged. Check for loose bolts or screws.
	4. Pump Passages Leaking.	4. Check pump for porous casting, scores on mating surfaces and excess rotor clearance. Repair as required. Loose pump bolts.
	5. Cooling System Cooler Plugged.	5. Replace cooler.
	6. Overrunning Clutch Damaged.	6. Replace clutch.
SLIPS IN REVERSE ONLY	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage.
	3. Rear Band Mis-adjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. Inspect and repair as required.
SLIPS IN FORWARD DRIVE RANGES	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Fluid Foaming.	2. Check for high oil level, bad pump gasket or seals, dirt between pump halves and loose pump bolts. Replace pump if necessary.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage.
	4. Gearshift Linkage Mis-adjusted.	4. Adjust linkage.
	5. Rear Clutch Worn.	5. Inspect and replace as needed.
	6. Low Hydraulic Pressure Due to Worn Pump, Incorrect Control Pressure Adjustments, Valve Body Warpage or Malfunction, Sticking, Leaking Seal Rings, Clutch Seals Leaking, Servo Leaks, Clogged Filter or Cooler Lines.	6. Perform hydraulic and air pressure tests to determine cause.
	7. Rear Clutch Malfunction, Leaking Seals or Worn Plates.	7. Air pressure check clutch-servo operation and repair as required.
	8. Overrunning Clutch Worn, Not Holding (Slips in 1 Only).	8. Replace Clutch.
SLIPS IN LOW GEAR ″D″ ONLY, BUT NOT IN MANUAL 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/ Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Mis-adjusted.	8. Adjust bands.
DRAGS OR LOCKS UP	1. Fluid Level Low.	1. Check and adjust level.
	2. Clutch Dragging/Failed	2. Air pressure check clutch operation and repair as required.
	3. Front or Rear Band Mis-adjusted.	3. Adjust bands.
	4. Case Leaks Internally.	4. Check for leakage between passages in case.
	5. Servo Band or Linkage Malfunction.	5. Air pressure check servo operation and repair as required.
	6. Overrunning Clutch Worn.	6. Remove and inspect clutch. Repair as required.
	7. Planetary Gears Broken.	7. Remove, inspect and repair as required (look for debris in oil pan).
	8. Converter Clutch Dragging.	8. Check for plugged cooler. Inspect pump for excessive side clearance. Replace pump as required.
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB® scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB® scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB® scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Mis-adjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB® scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB® scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.
WHINE/NOISE RELATED TO ENGINE SPEED	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Shift Cable Incorrect Routing.	2. Check shift cable for correct routing. Should not touch engine or bell housing.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 3-4 UPSHIFT	1. O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB® scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB® scan tool and replace if necessary.
	6. Neutral Sense to PCM Wire Shorted/Cut.	6. Test switch/sensor as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB® scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Mis-adjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB® scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/ grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance.	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.
HARSH 1-2, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Mis-adjusted.	1. Adjust linkage/cable.
	2. Neutral Sense Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Park/Neutral Switch, or Transmission Range Sensor Faulty.	3. Refer to service section for test and replacement procedure.
	4. Park/Neutral Switch, or Transmission Range Sensor Connection Faulty.	4. Connectors spread open. Repair.
	5. Valve Body Manual Lever Assembly Bent/Worn/Broken.	5. Inspect lever assembly and replace if damaged.
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct Clutch Pack (front clutch) Worn.	1. Disassemble unit and rebuild clutch pack.
	2. Rear Band Mis-adjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

AUTOMATIC TRANSMISSION - 46RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/ Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Park/Neutral Switch, or Transmission Range Sensor Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. Check for leaks at seal caused by worn seal or burr on converter hub (cutting seal), worn bushing, missing oil return, oil in front pump housing or hole plugged. Check for leaks past O-ring seal on pump or past pump-to-case bolts; pump housing porous, oil coming out vent due to overfill or leak past front band shaft access plug.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

STANDARD PROCEDURE - ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils™, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil™ tap, or equivalent, and installing a Heli-Coil™ insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil™, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL

NOTE: The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

(1) Disconnect battery negative cable.

(2) Raise vehicle.

(3) Remove the transfer case skid plate (Fig. 12), if equipped.

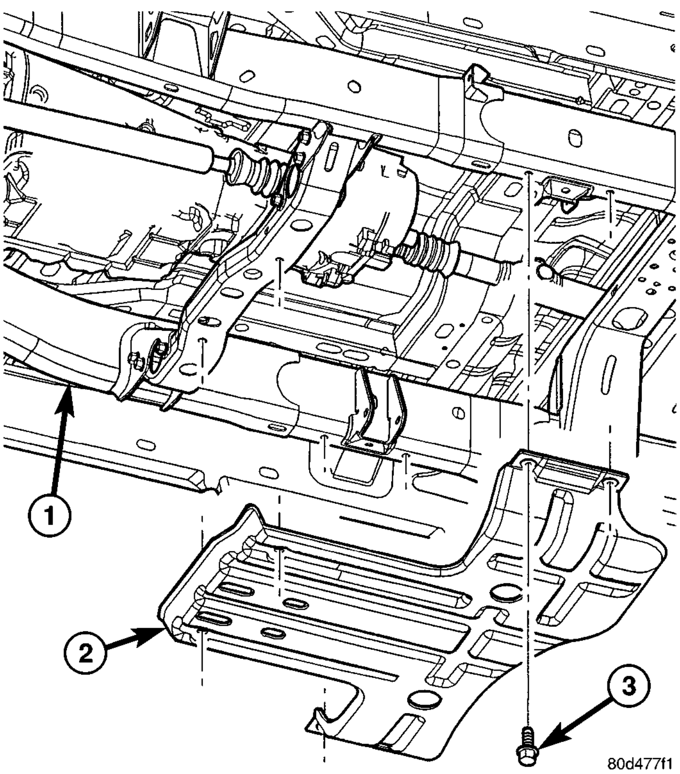


Fig. 12 Transfer Case Skid Plate

1 - FRAME RAIL
2 - SKID PLATE
3 - BOLTS (6)

(4) Disconnect and lower or remove necessary exhaust components.

(5) Remove engine-to-transmission struts (Fig. 13) and (Fig. 14).

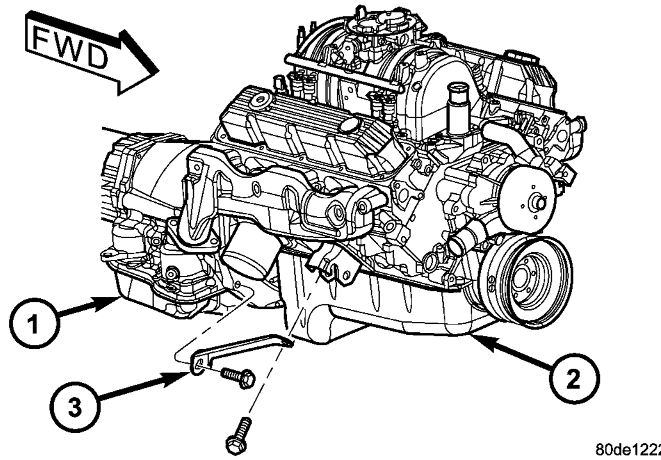


Fig. 13 Right Side Engine-to-Transmission Strut

1 - TRANSMISSION
2 - ENGINE
3 - STRUT

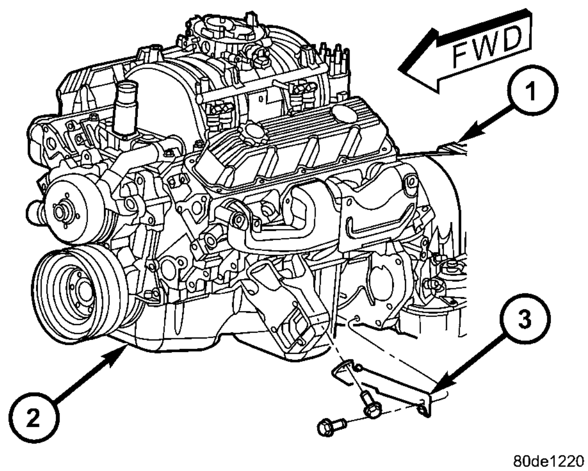


Fig. 14 Left Side Engine-to-Transmission Strut

1 - TRANSMISSION
2 - ENGINE
3 - STRUT

(6) Remove starter motor. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)

(7) Disconnect and remove the crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - REMOVAL) Retain the sensor attaching bolts.

(8) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(9) Remove torque converter access cover.

AUTOMATIC TRANSMISSION - 46RE (Continued)

(10) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(11) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove propeller shaft. On 4 x 4 models, remove both propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(12) Disconnect wires from the transmission range sensor and transmission solenoid connector.

(13) Disconnect gearshift cable (Fig. 15) from the transmission.

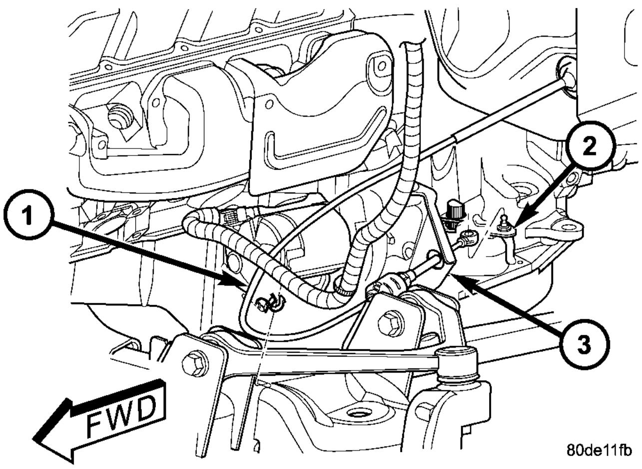


Fig. 15 Gearshift Cable At Transmission

1 - GEARSHIFT CABLE
2 - TRANSMISSION MANUAL LEVER
3 - CABLE SUPPORT BRACKET

(14) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(15) On 4X4 models, disconnect shift rod from transfer case shift lever.

(16) Support rear of engine with safety stand or jack.

(17) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(18) Remove bolts securing rear support and cushion (Fig. 16) and (Fig. 17) to transmission and crossmember and remove rear support.

(19) Remove bolts attaching crossmember to frame and remove crossmember.

(20) On 4X4 models, remove transfer case with transmission jack or aid of helper.

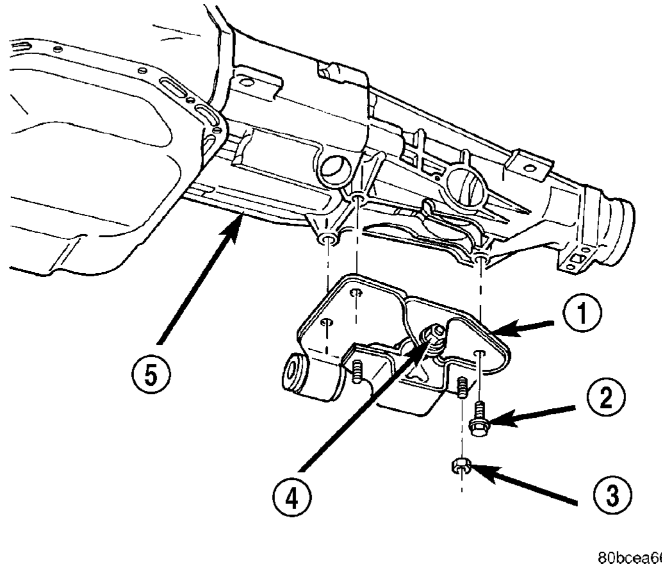


Fig. 16 Engine Rear Mount - 4X2 Automatic Transmission

1 - ENGINE REAR MOUNT
2 - BOLT
3 - NUT
4 - THROUGH BOLT NUT
5 - TRANSMISSION

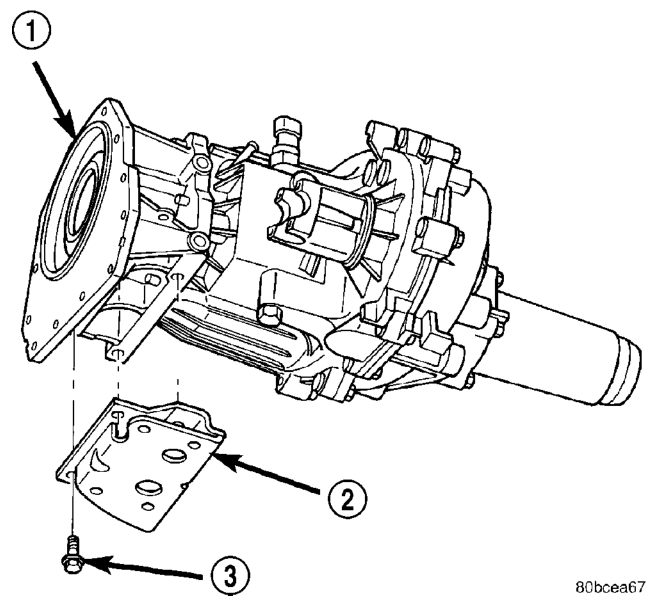


Fig. 17 Engine Rear Mount - 4X4 Automatic Transmission

1 - TRANSMISSION
2 - ENGINE REAR MOUNT
3 - BOLT

AUTOMATIC TRANSMISSION - 46RE (Continued)

(21) Disconnect fluid cooler lines at transmission (Fig. 18).

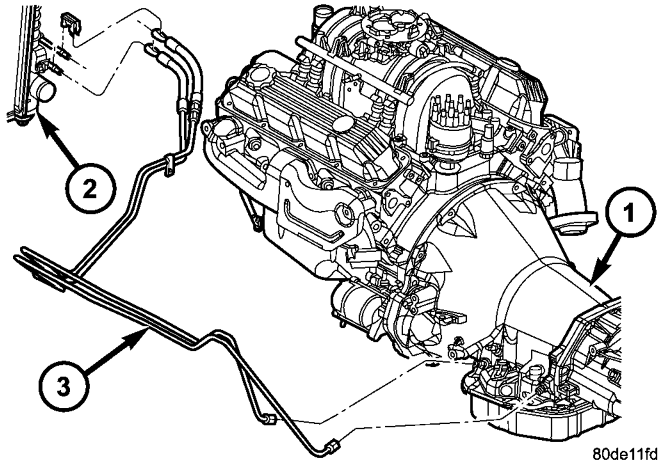


Fig. 18 Transmission Cooler Lines

1 - TRANSMISSION
2 - RADIATOR
3 - COOLER LINES

(22) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. On 4X4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 19).

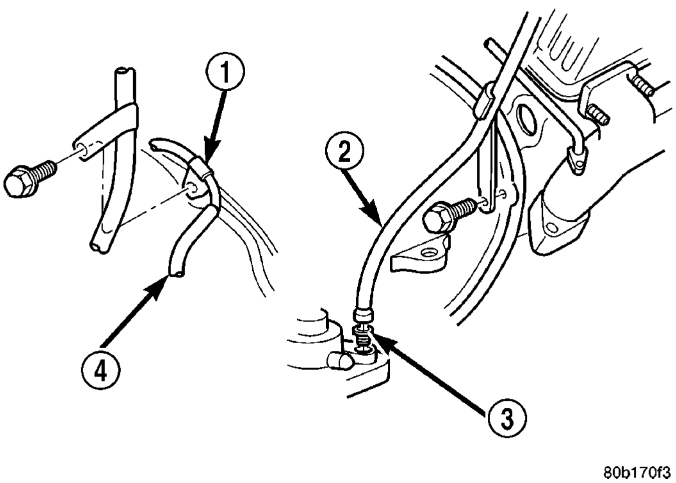


Fig. 19 Fill Tube Attachment

1 - TRANSFER CASE VENT TUBE
2 - FILL TUBE (V8)
3 - TUBE SEAL
4 - FILL TUBE (V6)

(23) Remove all converter housing bolts.
(24) Carefully work transmission and torque converter assembly rearward off engine block dowels.
(25) Lower transmission and remove assembly from under the vehicle.
(26) To remove torque converter, remove C-clamp from edge of bell housing and carefully slide torque converter out of the transmission.

DISASSEMBLY

(1) Clean exterior of transmission with suitable solvent or pressure washer.
(2) Place transmission in vertical position.
(3) Measure the input shaft end play as follows (Fig. 20).
(a) Attach Adapter 8266-5 to Handle 8266-8.
(b) Attach dial indicator C-3339 to Handle 8266-8.
(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-5 to secure it to the input shaft.
(d) Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.
(e) Move input shaft in and out and record reading. Record the maximum travel for assembly reference

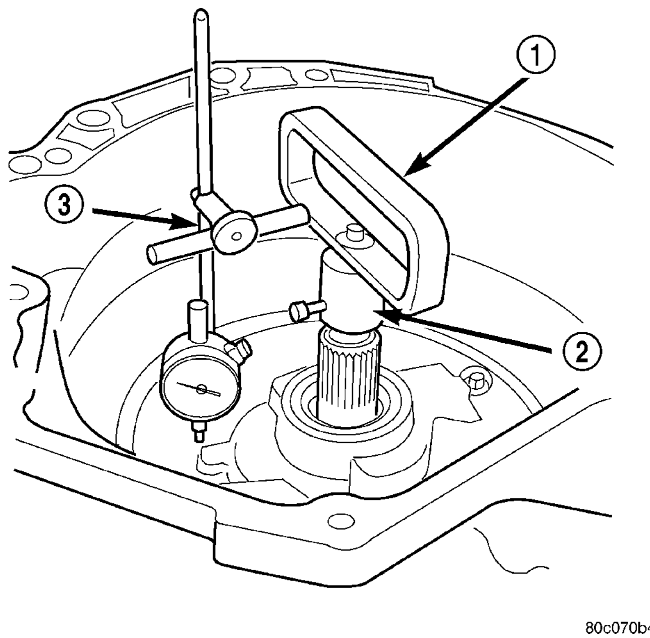


Fig. 20 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

(4) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.
(5) Remove transmission oil pan and gasket.

AUTOMATIC TRANSMISSION - 46RE (Continued)

(6) Remove filter from valve body (Fig. 21). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

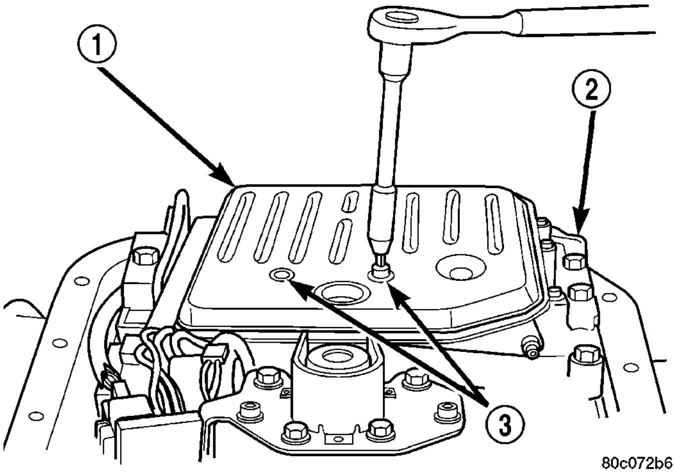


Fig. 21 Oil Filter Removal

1 - OIL FILTER
2 - VALVE BODY
3 - FILTER SCREWS (2)

(7) Remove the transmission range sensor.

(8) Remove hex head bolts attaching valve body to transmission case (Fig. 22). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

(9) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 23).

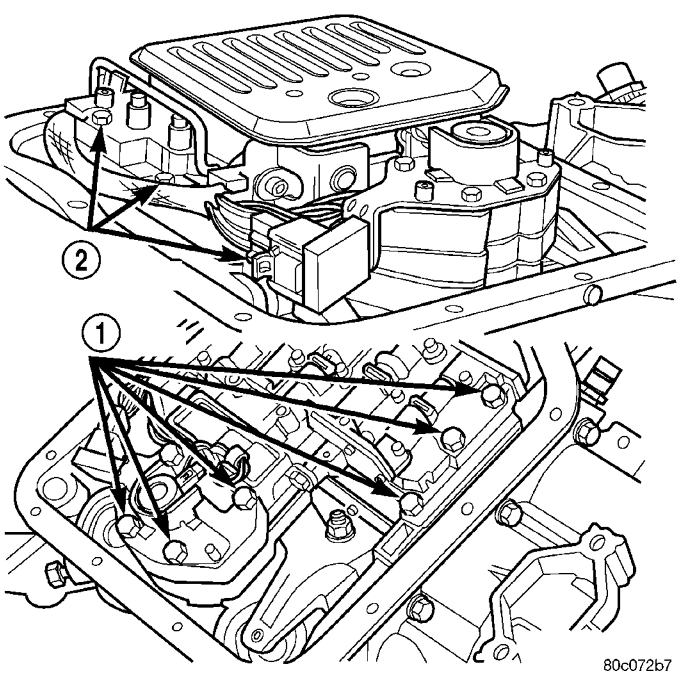


Fig. 22 Valve Body Bolt Locations

1 - VALVE BODY BOLTS
2 - VALVE BODY BOLTS

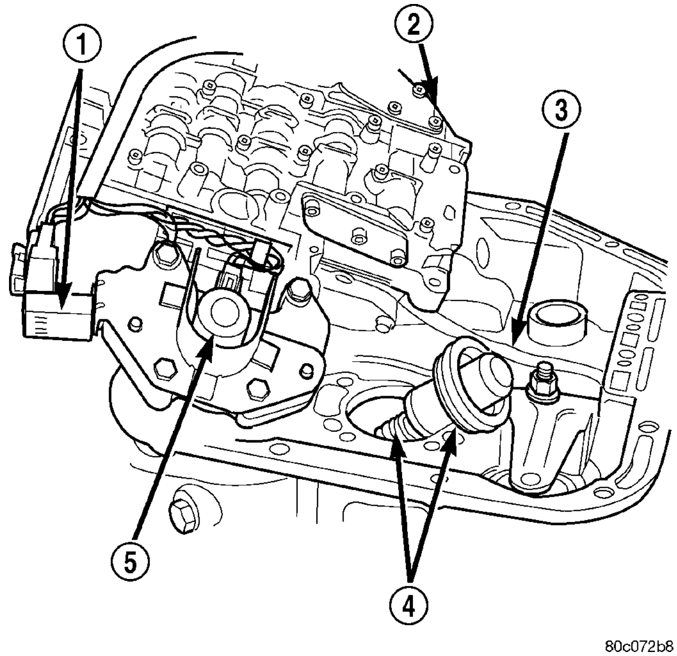


Fig. 23 Valve Body Removal

1 - GOVERNOR PRESSURE SENSOR
2 - VALVE BODY
3 - PARK ROD
4 - ACCUMULATOR PISTON
5 - GOVERNOR PRESSURE SOLENOID

(10) Remove accumulator outer spring, piston and inner spring (Fig. 24). Note position of piston and springs for assembly reference. Remove and discard piston seals if worn or cut.

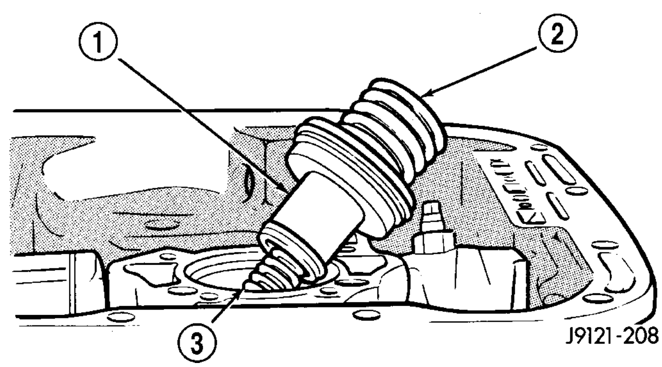


Fig. 24 Accumulator Component Removal

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

AUTOMATIC TRANSMISSION - 46RE (Continued)

(11) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

(12) Remove front band lever pin access plug (Fig. 25). Use square end of 1/4 in. drive extension to remove plug as shown.

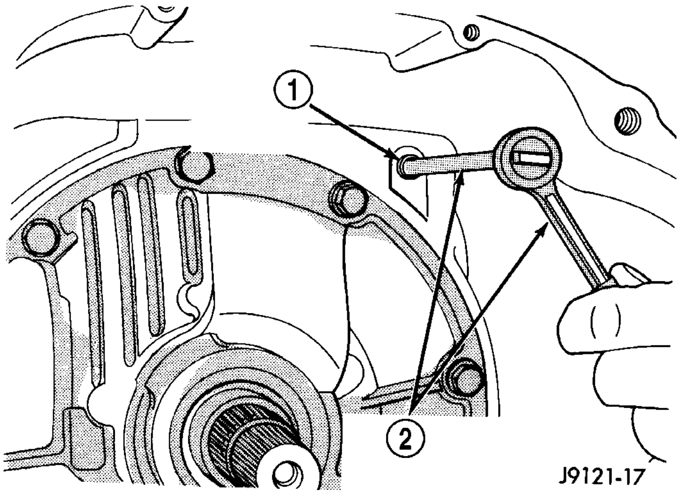


Fig. 25 Front Band Lever Pin Access Plug

1 - FRONT BAND REACTION PIN ACCESS PLUG
2 - 1/4 DRIVE EXTENSION AND RATCHET

(13) Remove oil pump and reaction shaft support assembly as follows:

(a) Tighten front band adjusting screw until band is tight around front clutch retainer (Fig. 26). This will prevent retainer from coming out with pump and possibly damaging clutch or pump components.

(b) Remove oil pump bolts.

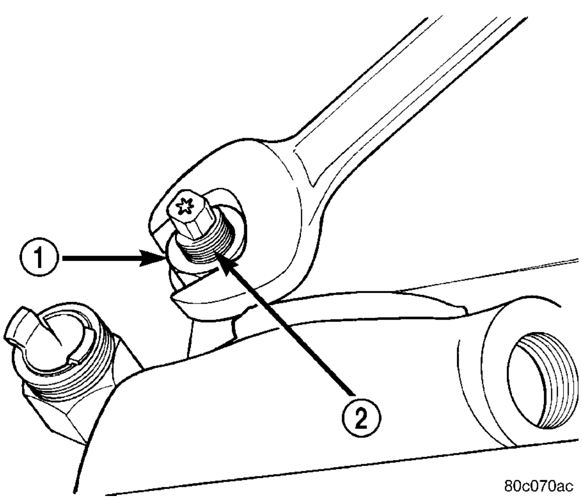


Fig. 26 Tightening Front Band To Hold Front Clutch In Place

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

(c) Thread Slide Hammer Tools C-3752 into threaded holes in flange of oil pump housing (Fig. 27).

(d) Remove oil pump and reaction shaft support by bumping slide hammers outward alternately to pull pump from case (Fig. 28).

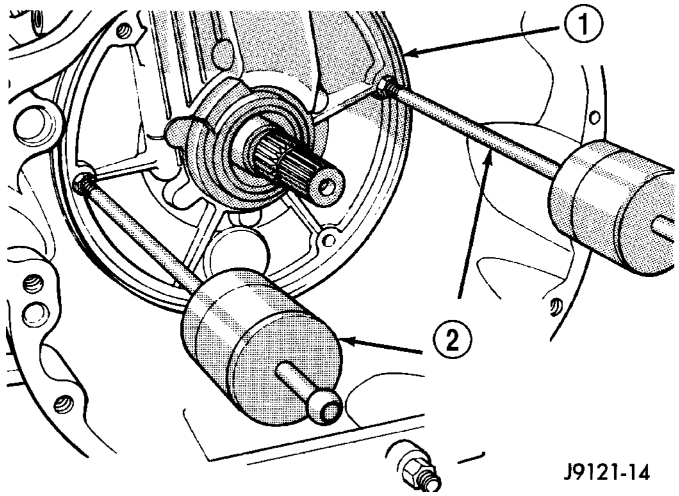


Fig. 27 Oil Pump Removal Tools

1 - PUMP HOUSING
2 - SLIDE HAMMER TOOLS (THREAD INTO PUMP HOUSING)

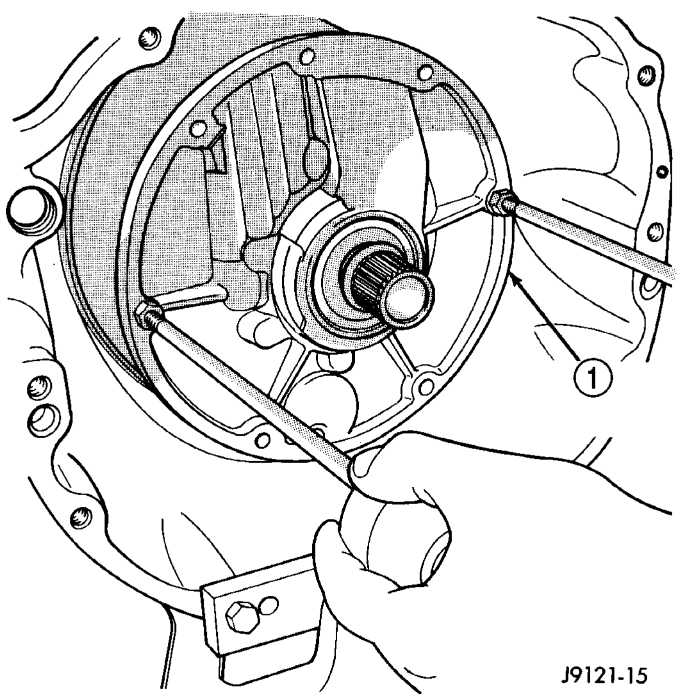


Fig. 28 Oil Pump Removal

1 - OIL PUMP AND REACTION SHAFT SUPPORT

AUTOMATIC TRANSMISSION - 46RE (Continued)

(14) Remove oil pump gasket (Fig. 29). Note gasket position in case for assembly reference.

(15) Loosen front band adjusting screw until band is completely loose.

(16) Remove front band strut and anchor (Fig. 30).

(17) Squeeze front band together slightly and slide band over front clutch retainer and out of case (Fig. 31).

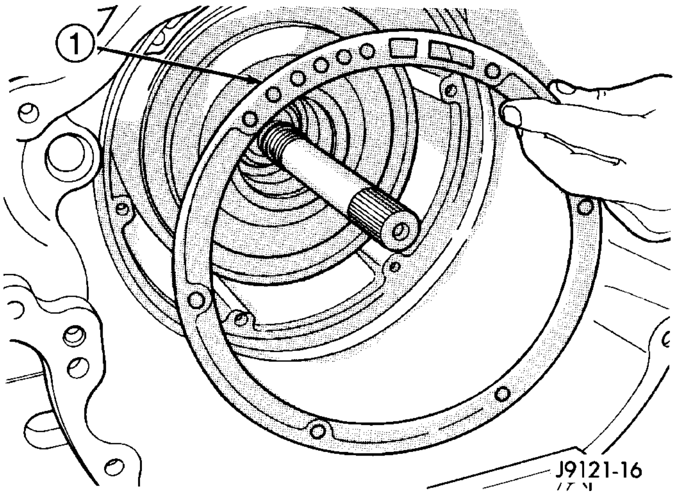


Fig. 29 Oil Pump Gasket

1 - OIL PUMP GASKET

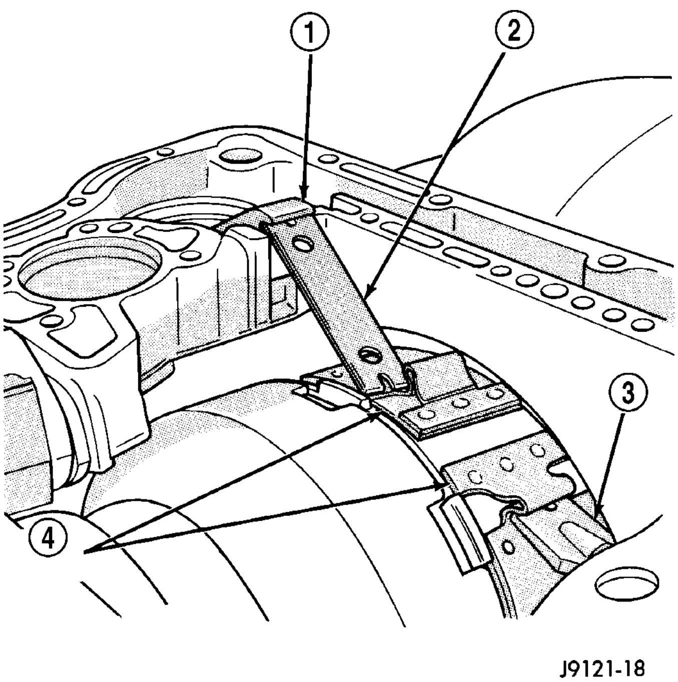


Fig. 30 Front Band Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

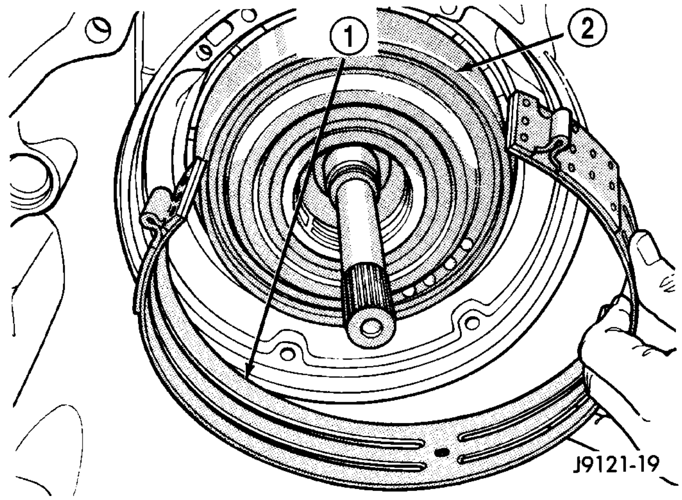


Fig. 31 Front Band Removal

1 - FRONT BAND
2 - FRONT CLUTCH RETAINER

(18) Remove front and rear clutch assemblies as a unit (Fig. 32).

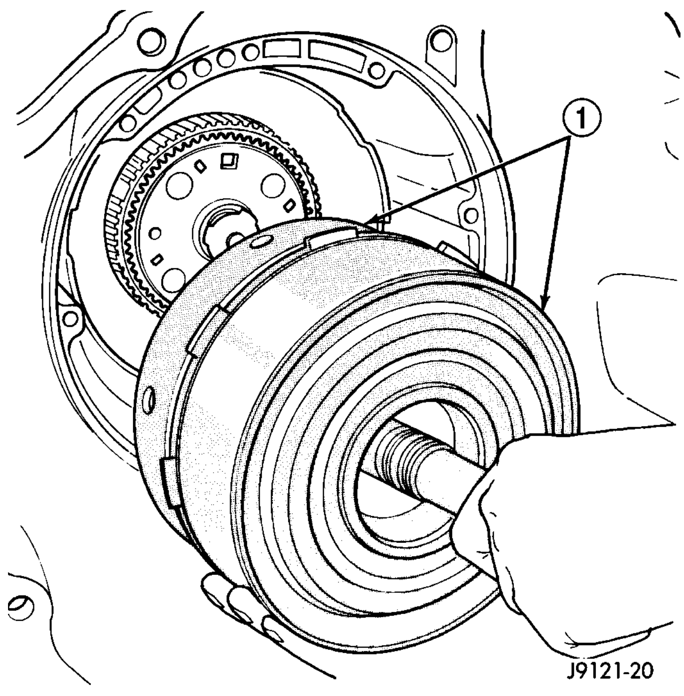


Fig. 32 Removing Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

AUTOMATIC TRANSMISSION - 46RE (Continued)

(19) Remove front band reaction pin and lever. Start pin through lever and out of case bore with drift or punch. Then use pencil magnet to withdraw pin completely (Fig. 33).

(20) Remove intermediate shaft thrust washer. Triangular shaped washer will either be on shaft pilot hub or in rear clutch retainer (Fig. 34).

(21) Remove thrust plate from intermediate shaft hub (Fig. 35).

(22) Remove intermediate shaft-planetary geartrain assembly (Fig. 36).

(23) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

(24) Loosen rear band locknut and loosen adjusting screw 3-4 turns.

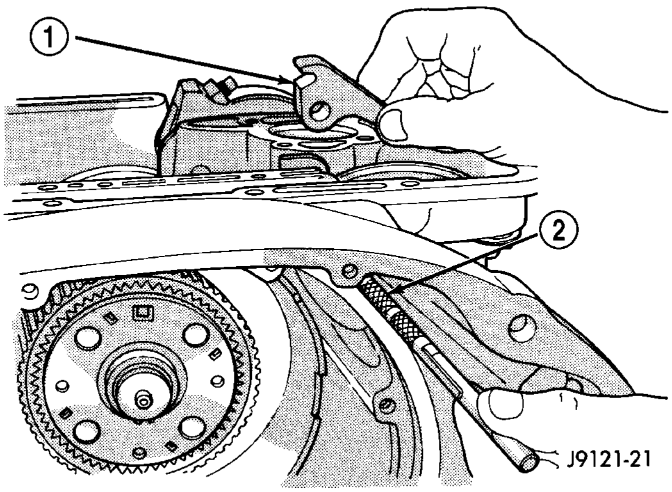


Fig. 33 Front Band Lever And Pin

1 - BAND LEVER
2 - USE PENCIL MAGNET TO REMOVE REACTION PIN

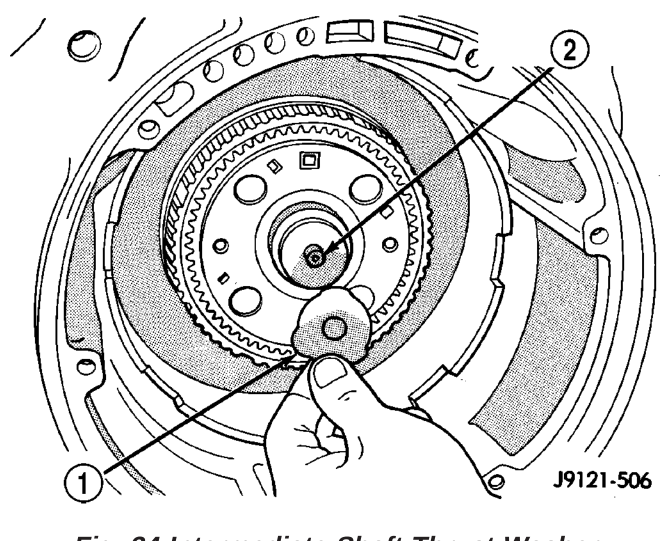


Fig. 34 Intermediate Shaft Thrust Washer

1 - THRUST WASHER
2 - INTERMEDIATE SHAFT PILOT HUB

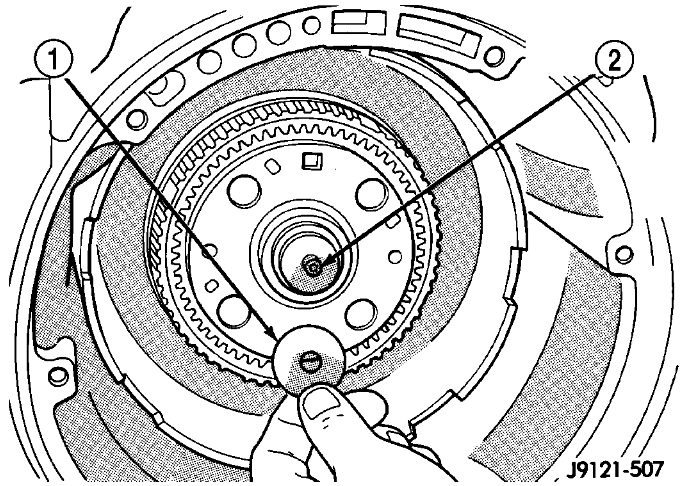


Fig. 35 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

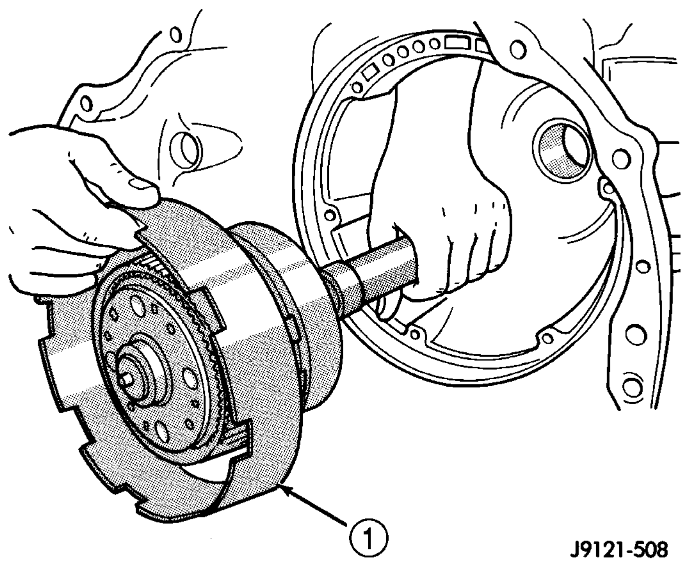


Fig. 36 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEARTRAIN ASSEMBLY

AUTOMATIC TRANSMISSION - 46RE (Continued)

(25) Remove snap-ring that retains low-reverse drum on overdrive piston retainer hub (Fig. 37).

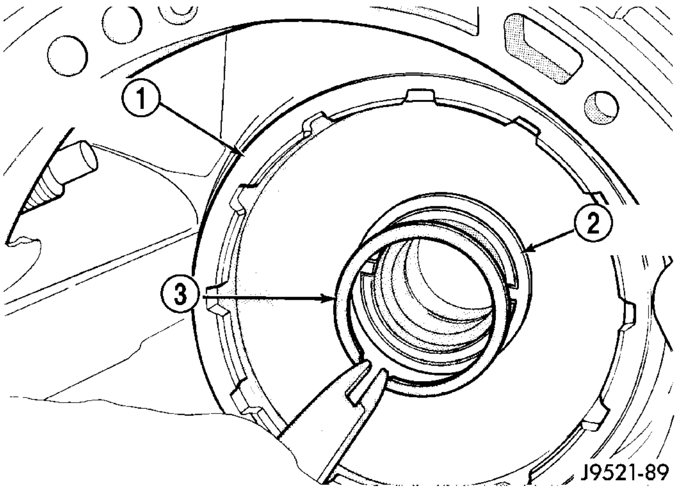


Fig. 37 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

(26) Slide low-reverse drum and thrust washer off piston retainer hub and out of rear band (Fig. 38).

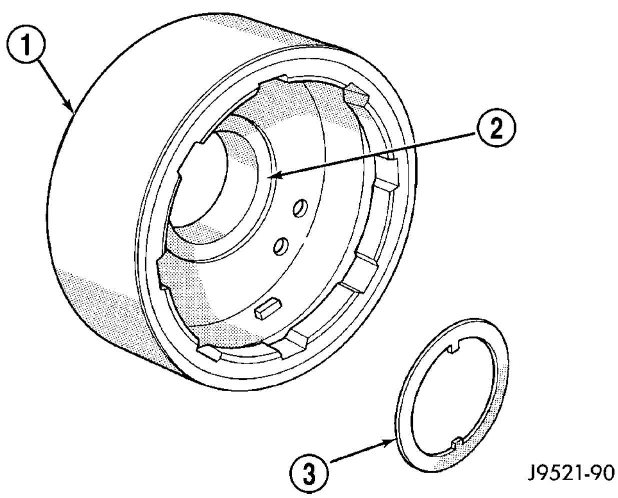


Fig. 38 Low-Reverse Drum And Thrust Washer

1 - LOW-REVERSE DRUM
2 - SPOTFACE FOR WASHER
3 - THRUST WASHER

(27) Note that overrunning clutch race will remain on splines of low-reverse drum after removal (Fig. 39). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

(28) Remove overrunning clutch assembly (Fig. 40). Assembly can be removed without displacing rollers and springs if care is exercised. Note position of rollers and springs for assembly reference.

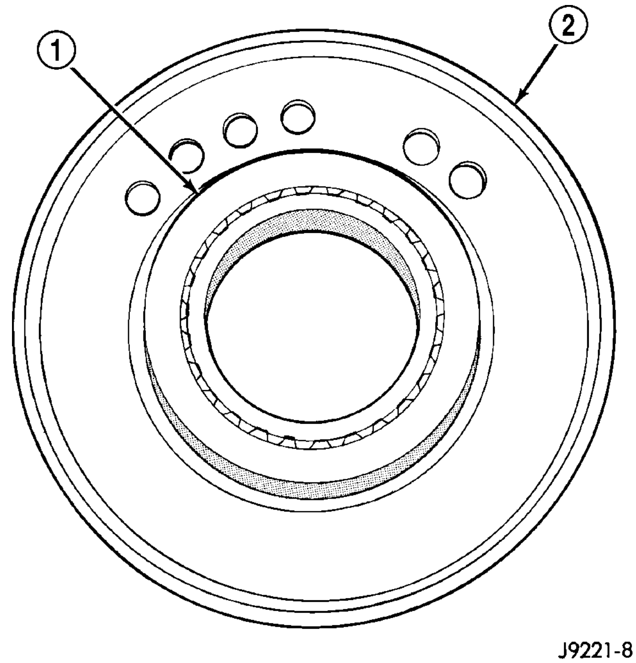


Fig. 39 Overrunning Clutch Race Position On Low-Reverse Drum

1 - OVERRUNNING CLUTCH RACE
2 - LOW-REVERSE DRUM

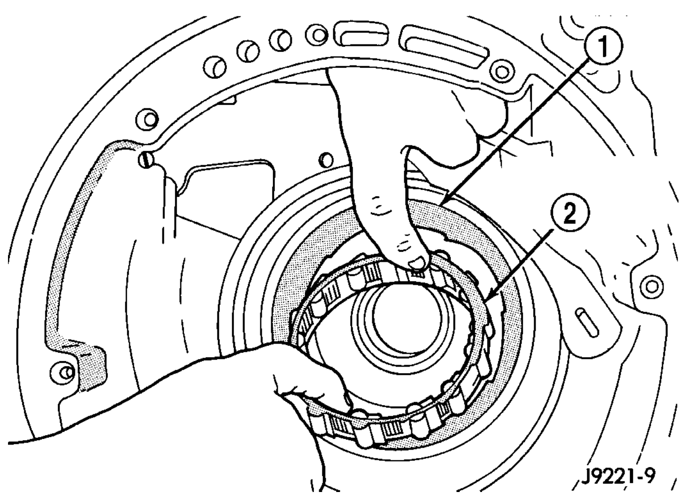


Fig. 40 Overrunning Clutch Removal

1 - CLUTCH CAM
2 - OVERRUNNING CLUTCH ASSEMBLY

AUTOMATIC TRANSMISSION - 46RE (Continued)

(29) Remove rear band adjusting lever, reaction lever and pin (Fig. 41).

(30) Remove strut from rear band. Keep strut with levers and pin for cleaning, inspection and assembly reference.

(31) Remove rear band and link (Fig. 42).

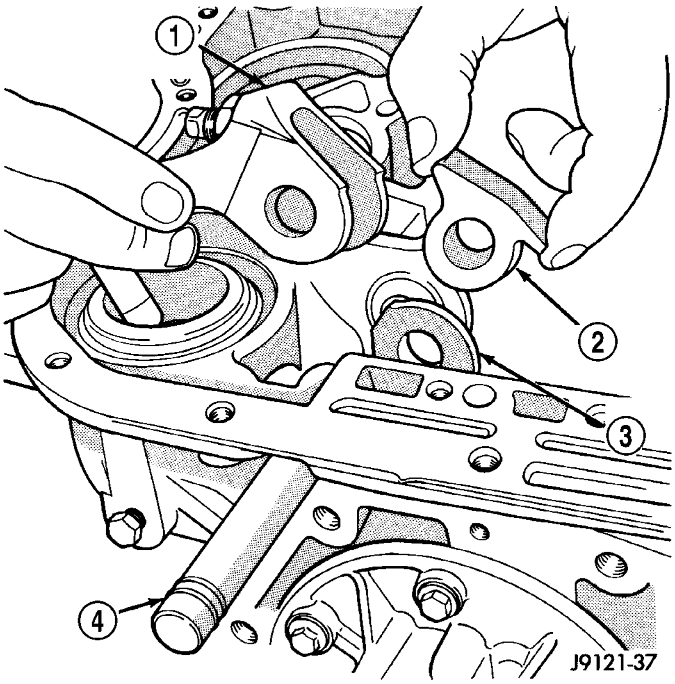


Fig. 41 Rear Band Levers And Pins

1 - REAR BAND ADJUSTING LEVER
2 - REACTION LEVER
3 - BAND LINK
4 - REAR BAND REACTION PIN

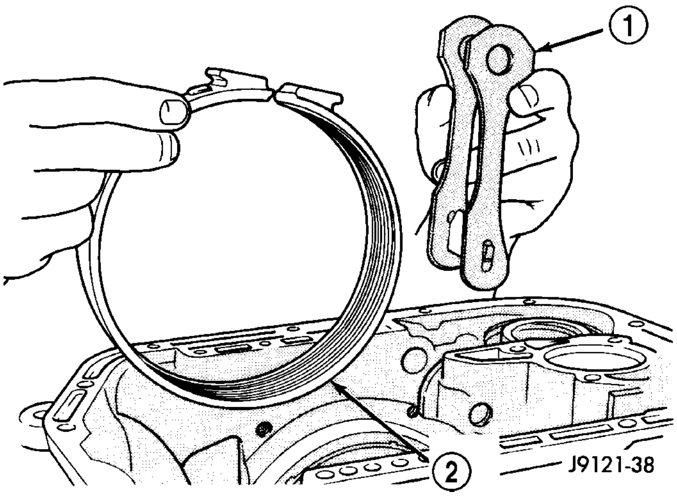


Fig. 42 Rear Band And Link

1 - BAND LINK
2 - REAR BAND

(32) Compress front servo rod guide with large C-clamp and Tool C-4470, or Compressor Tool C-3422-B (Fig. 43). Compress guide only enough to permit snap-ring removal (about 1/8 in.).

(33) Remove servo piston snap-ring (Fig. 43). Unseat one end of ring. Then carefully work removal tool around back of ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(34) Remove tools and remove servo piston and spring.

(35) Compress rear servo piston with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B (Fig. 44). Compress servo spring retainer only enough to permit snap-ring removal.

(36) Remove servo piston snap-ring (Fig. 44). Start one end of ring out of bore. Then carefully work removal tool around back of snap-ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(37) Remove tools and remove rear servo retainer, spring and piston assembly.

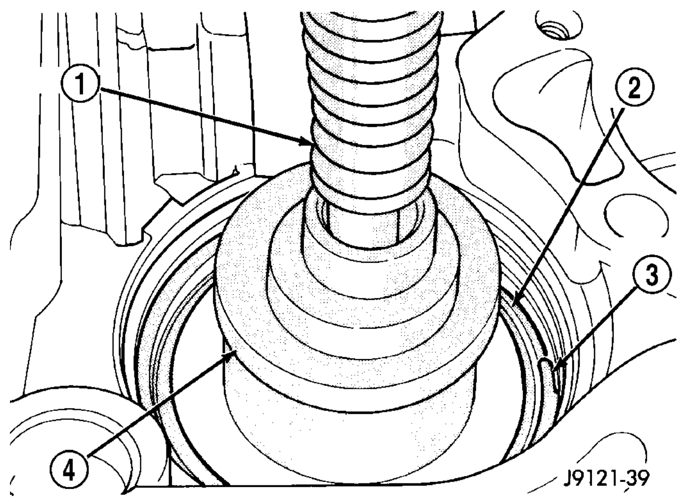


Fig. 43 Front Servo Retaining Snap-Ring

1 - C-CLAMP
2 - FRONT SERVO ROD GUIDE
3 - SNAP-RING
4 - TOOL C-4470

CLEANING

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

AUTOMATIC TRANSMISSION - 46RE (Continued)

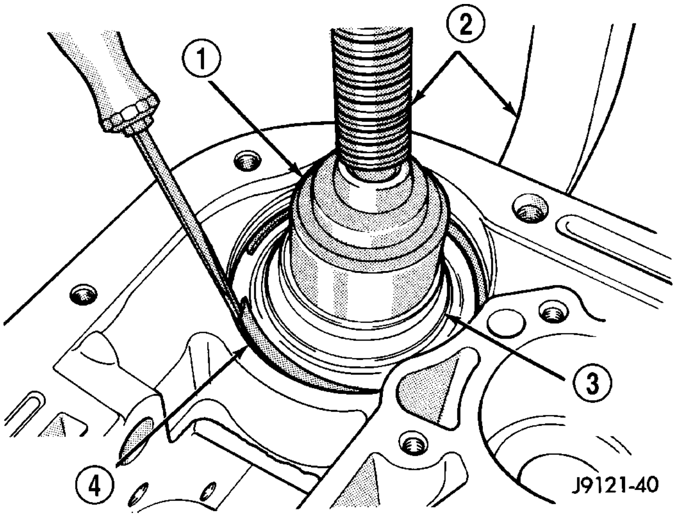


Fig. 44 Rear Servo Retaining Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

Lubricate transmission parts with Mopar® ATF +4, Automatic Transmission fluid during overhaul and assembly. Use petroleum jelly to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

ASSEMBLY

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for reassembly operations are equally clean.

Shop towels used for wiping off tools and your hands must be made from **lint free** materials. Lint will stick to transmission parts and could interfere with valve operation or even restrict fluid passages.

Lubricate transmission clutch and gear components with Mopar® ATF +4, Automatic Transmission fluid, during reassembly. Soak clutch discs in transmission fluid before installation.

Use Mopar® Door Ease, or Ru-Glyde™ on piston seals and O-rings to ease installation. Petroleum jelly can also be used to lubricate and hold thrust washers and plates in position during assembly.

Do not use chassis grease, bearing grease, white grease, or similar lubricants on any part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies are easily installed by hand when properly aligned. If a part seems difficult to install, it is either misaligned or incorrectly assembled. Verify that thrust washers, thrust plates and seal rings are correctly positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the intermediate shaft and rear support. Then lower the shaft and support into the hole and support the rear of the case directly on the bench.

AUTOMATIC TRANSMISSION - 46RE (Continued)

FRONT/REAR SERVO

(1) Lubricate rear servo piston seal with Mopar® Door Ease or ATF +4. Lubricate servo bore in case with ATF +4.

(2) Install rear servo piston in case. Position piston at slight angle to bore and insert piston with twisting motion (Fig. 45).

(3) Install rear servo spring and retainer in case bore (Fig. 46). Be sure spring is seated on piston.

(4) Compress rear servo piston with C-clamp or Valve Spring Compressor C-3422-B and install servo piston snap-ring (Fig. 47).

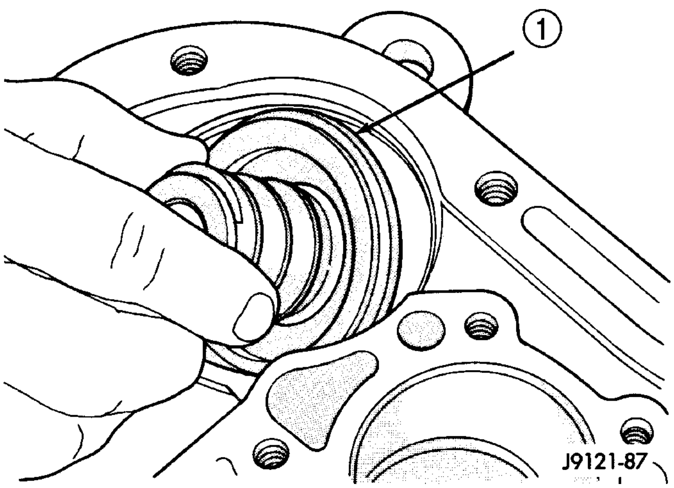


Fig. 45 Rear Servo Piston

1 - REAR SERVO PISTON

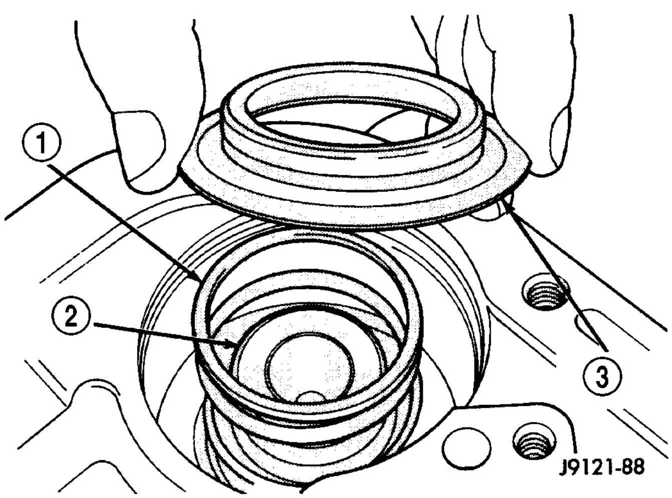


Fig. 46 Rear Servo Piston Spring And Retainer

1 - PISTON SPRING
2 - REAR SERVO PISTON
3 - SPRING RETAINER

(5) Lubricate front servo piston components and servo bore in case with transmission fluid.

(6) Install front servo piston in bore. Carefully "run" small, suitable tool around piston ring to press it back into groove and ease installation (Fig. 48). Rotate piston into bore at same time. Rock piston slightly to ease piston ring past snap-ring groove and into bore.

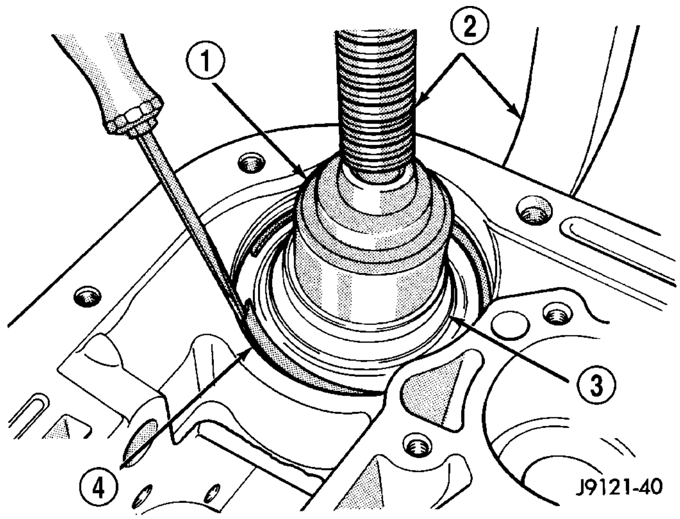


Fig. 47 Rear Servo Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

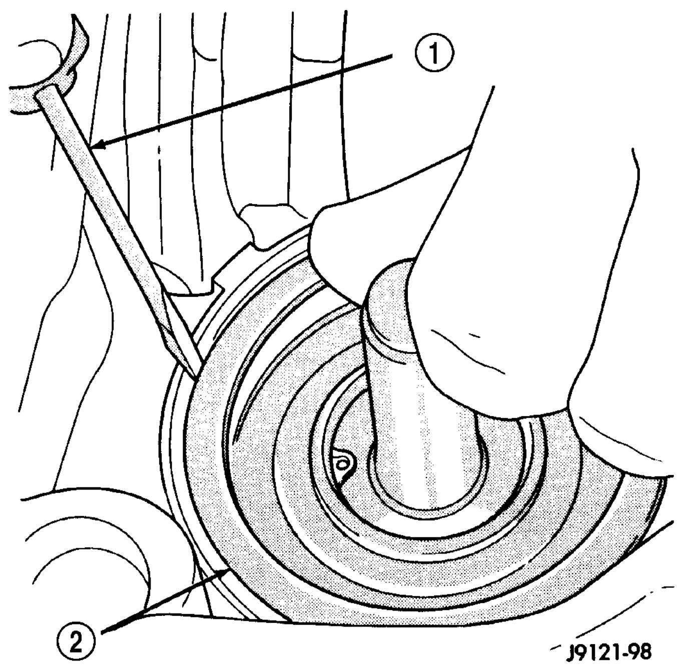


Fig. 48 Front Servo Piston

1 - USE SUITABLE TOOL TO HELP SEAT PISTON RING
2 - FRONT SERVO PISTON

(7) Bottom front servo piston in bore and install servo spring.

(8) Install front servo piston rod guide as follows:

(a) Place Tool SP-5560 (or similar size tool) on guide and position C-clamp on tool and case (Fig. 49).

(b) Slowly compress rod guide while simultaneously easing seal ring into bore with suitable tool.

(9) Install rod guide snap-ring (Fig. 49).

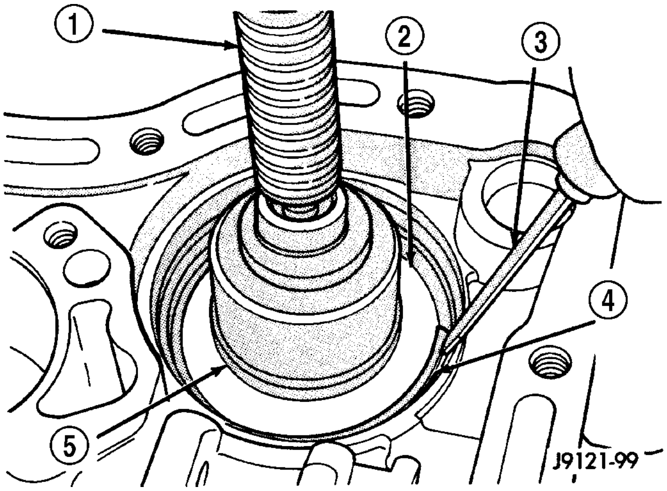


Fig. 49 Front Servo Rod Guide And Snap-Ring

1 - C-CLAMP
2 - ROD GUIDE
3 - SMALL SCREWDRIVER
4 - ROD GUIDE SNAP-RING
5 - TOOL SP-5560

OVERRUNNING CLUTCH, REAR BAND, AND LOW-REVERSE DRUM

(1) Install overrunning clutch components.

(2) Position rear band and link in case (Fig. 50).

(3) Install low-reverse drum (Fig. 51). Slide drum through rear band, onto piston retainer hub and into engagement with overrunning clutch and race.

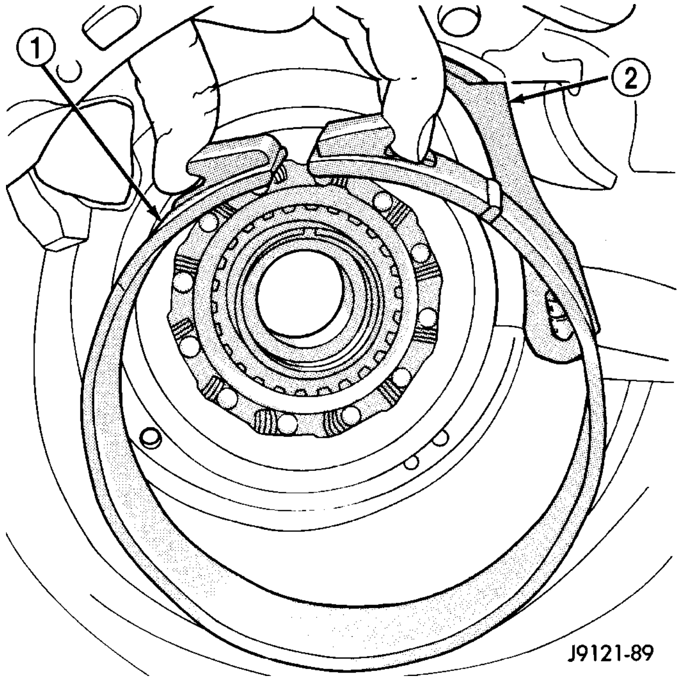


Fig. 50 Rear Band And Link

1 - REAR BAND
2 - BAND LINK

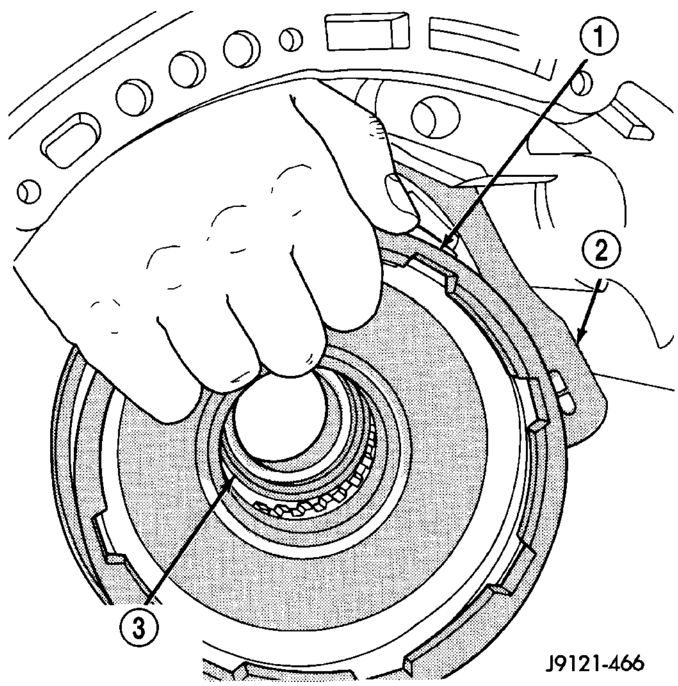


Fig. 51 Low-Reverse Drum

1 - LOW-REVERSE DRUM
2 - REAR BAND LINK
3 - HUB OF OVERDRIVE PISTON RETAINER

AUTOMATIC TRANSMISSION - 46RE (Continued)

(4) Install thrust washer in low-reverse drum spot-face (Fig. 52). Use petroleum jelly to hold washer in place.

(5) Install snap-ring that secures low-reverse drum to piston retainer hub (Fig. 52).

(6) Insert band reaction pin part way into case and band link (Fig. 53).

(7) Install rear band adjusting lever, reaction lever, and strut (Fig. 54). Be sure levers and strut are aligned and engaged before seating band reaction pin in case.

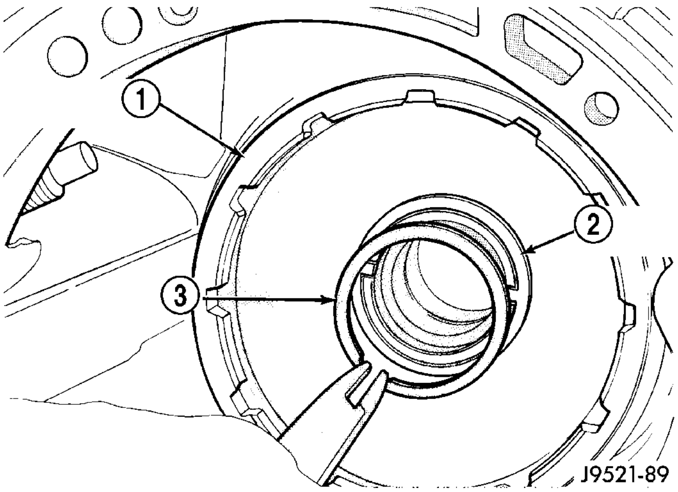


Fig. 52 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

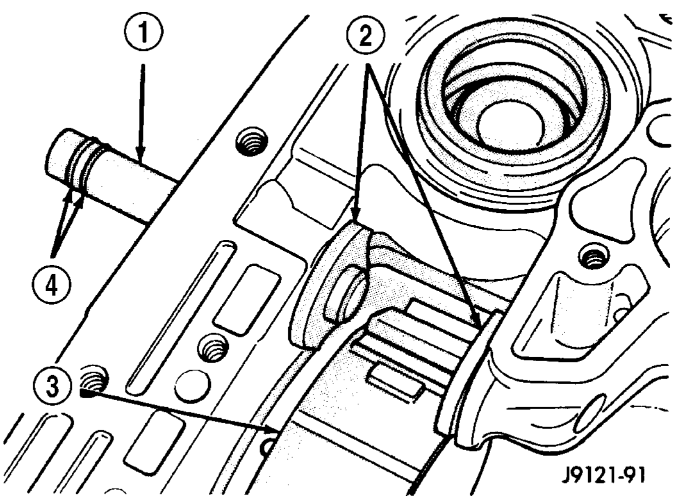


Fig. 53 Rear Band Reaction Pin

1 - REACTION PIN
2 - BAND LINK
3 - REAR BAND
4 - O-RINGS

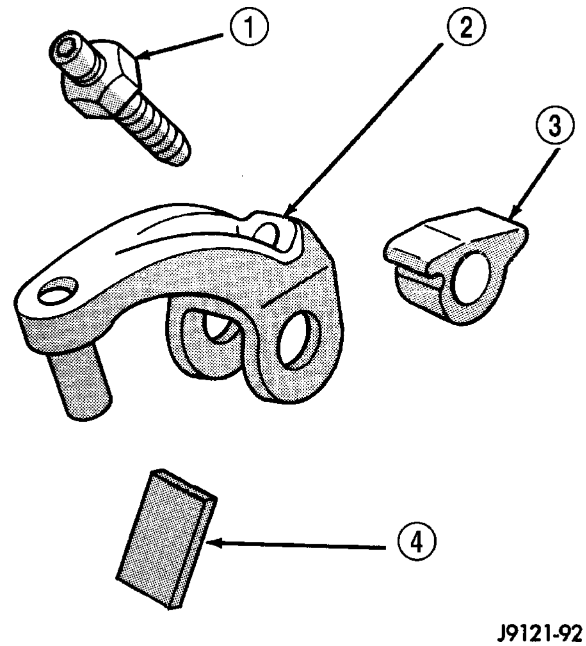


Fig. 54 Rear Band Levers And Strut

1 - ADJUSTING SCREW AND NUT
2 - ADJUSTING LEVER
3 - REACTION LEVER
4 - STRUT

PLANETARY GEARTRAIN, FRONT/REAR CLUTCH, AND FRONT BAND

(1) Remove Alignment Shaft 6227-2, if installed previously.

(2) Install assembled intermediate shaft and planetary geartrain (Fig. 55). Support shaft carefully during installation. Do not allow shaft bearing/bushing surfaces to become nicked or scratched.

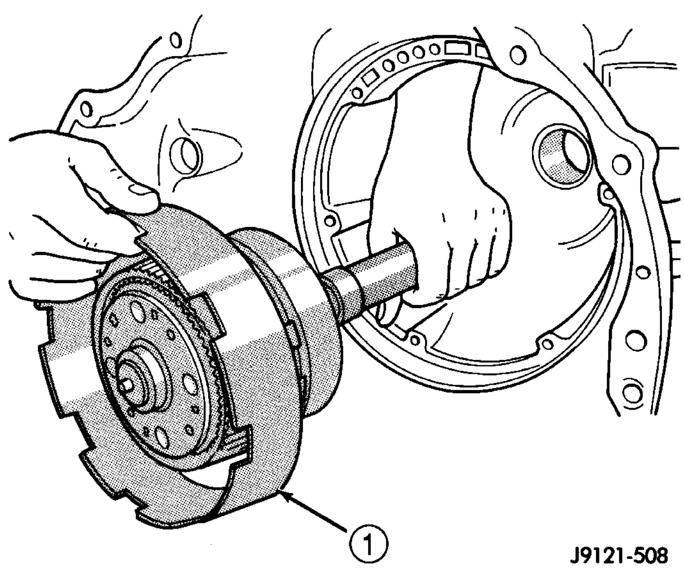


Fig. 55 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEARTRAIN ASSEMBLY

AUTOMATIC TRANSMISSION - 46RE (Continued)

(3) Lubricate intermediate shaft thrust plate with petroleum jelly and install plate on shaft pilot hub (Fig. 56).

(4) Check input shaft front seal rings, fiber thrust washer and rear seal ring (Fig. 57). Be ends of rear seal ring are hooked together and the square cut ends of front seal rings are firmly seated against each other. Lubricate seal rings with petroleum jelly after checking them.

(5) Assemble front and rear clutches (Fig. 58). Align lugs on front clutch discs. Mount front clutch on rear clutch. Turn front clutch retainer back and forth until front clutch discs are fully seated on rear clutch splined hub.

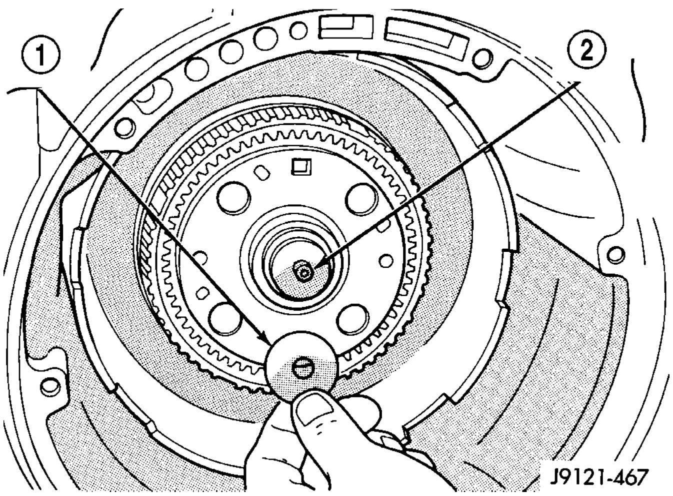


Fig. 56 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

(6) Install intermediate shaft thrust washer in hub of rear clutch retainer (Fig. 59). Use petroleum jelly to hold washer in place. Position washer so grooves are facing outward. Washer only fits one way in clutch retainer hub.

(7) Place transmission case in upright position, or place blocks under front end of transmission repair stand to tilt case rearward. This makes it easier to install front/rear clutch assembly.

(8) Align discs in rear clutch. Then install and engage assembly in front planetary and driving shell (Fig. 60). Turn clutch retainers back and forth until both clutches are seated.

(9) Position front band lever in case and over servo rod guide. Then install front band lever pin in case and slide it through lever.

(10) Coat threads of front band pin access plug with sealer and install it in case. Tighten plug to 17 N·m (13 ft. lbs.) torque.

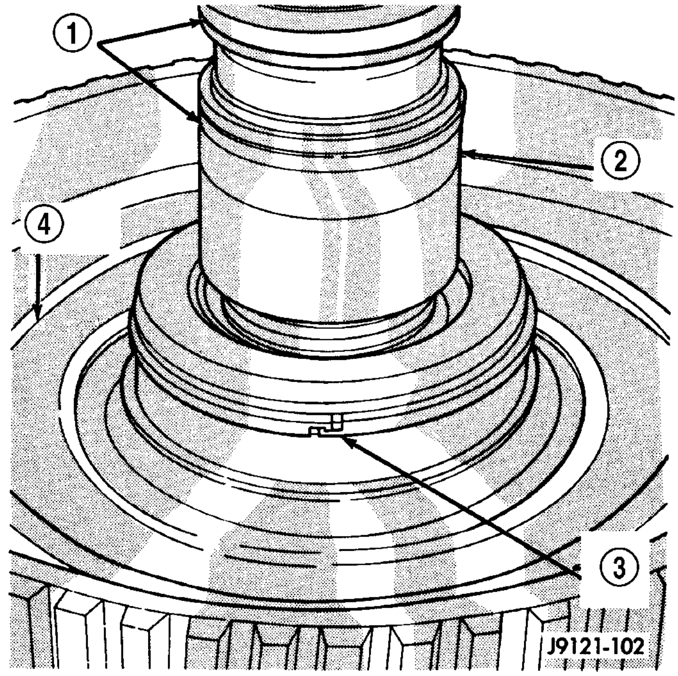


Fig. 57 Input Shaft Seal Rings And Thrust Washer

1 - TORLON® FRONT SEAL RINGS
2 - INPUT SHAFT
3 - REAR SEAL RING
4 - THRUST WASHER

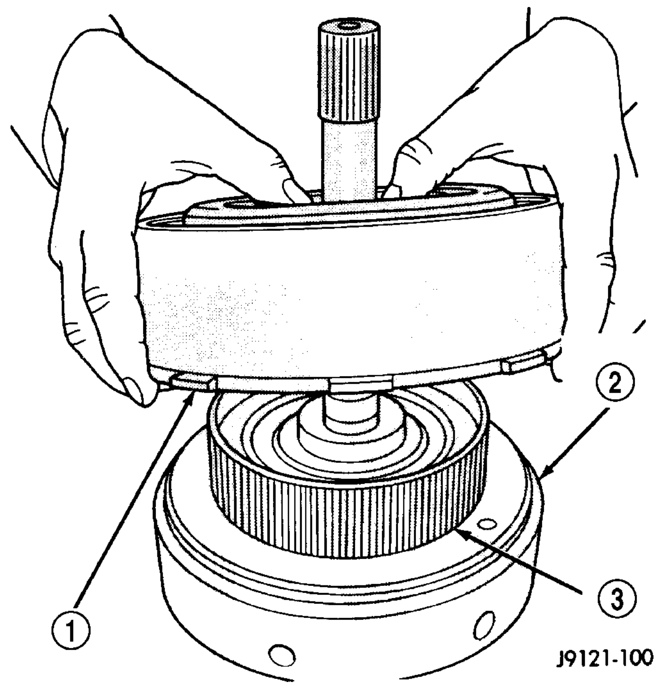


Fig. 58 Assembling Front And Rear Clutches

1 - FRONT CLUTCH ASSEMBLY
2 - REAR CLUTCH ASSEMBLY
3 - REAR CLUTCH SPLINED HUB

AUTOMATIC TRANSMISSION - 46RE (Continued)

(11) Slide front band over front clutch retainer and install front band strut and anchor (Fig. 61).

(12) Tighten front band adjusting screw until band is tight on clutch retainer. This will hold clutches in place while oil pump is being installed. Verify that front/rear clutch assembly is still properly seated before tightening band.

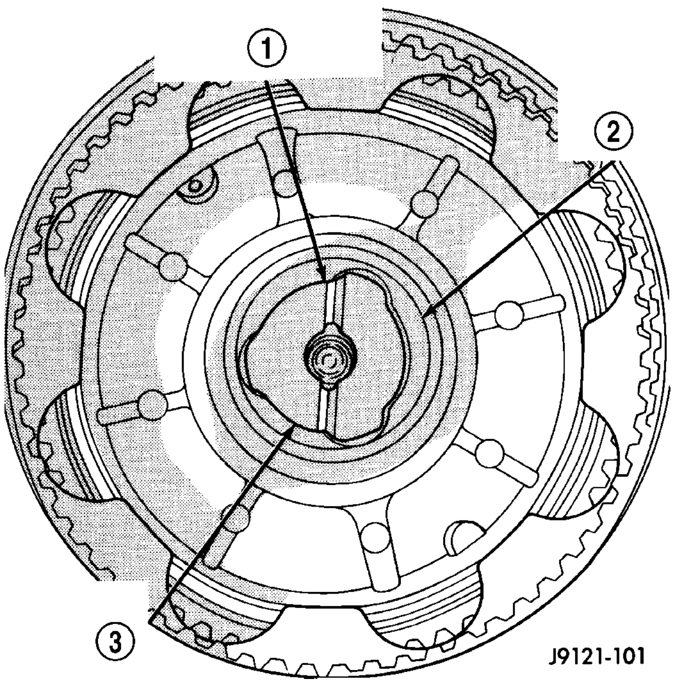


Fig. 59 Intermediate Shaft Thrust Washer

1 - BE SURE WASHER GROOVES FACE OUT AS SHOWN
2 - REAR CLUTCH RETAINER HUB
3 - THRUST WASHER

OIL PUMP

(1) Install oil pump Pilot Studs C-3288-B in case (Fig. 62).

(2) Install new oil pump gasket on pilot studs and seat it in case. Be sure gasket is properly aligned with fluid passages in case (Fig. 62).

(3) Coat the reaction shaft thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 63).

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

(4) Check seal rings on reaction shaft support. Be sure rings are hooked together correctly. Also be sure fiber thrust washer is in position (Fig. 64). Use extra petroleum jelly to hold washer in place if necessary.

(5) Lubricate oil pump seals with petroleum Mopar® ATF +4.

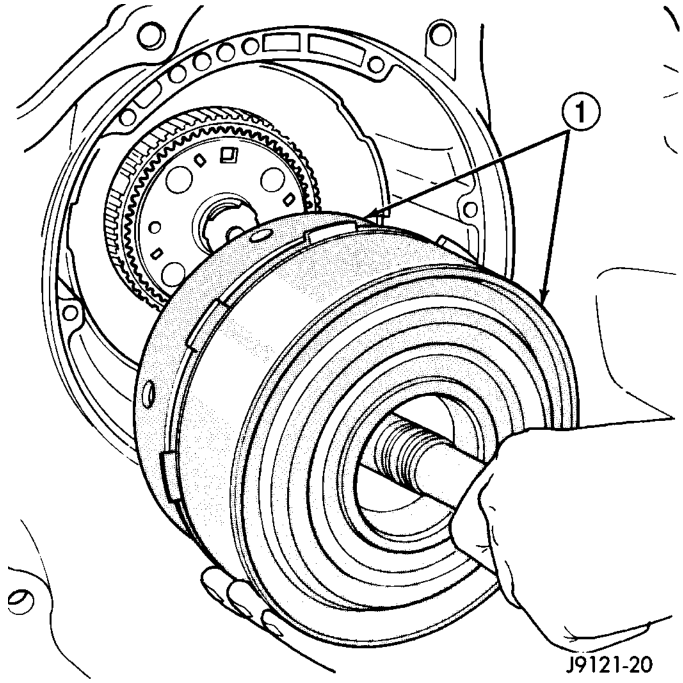


Fig. 60 Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

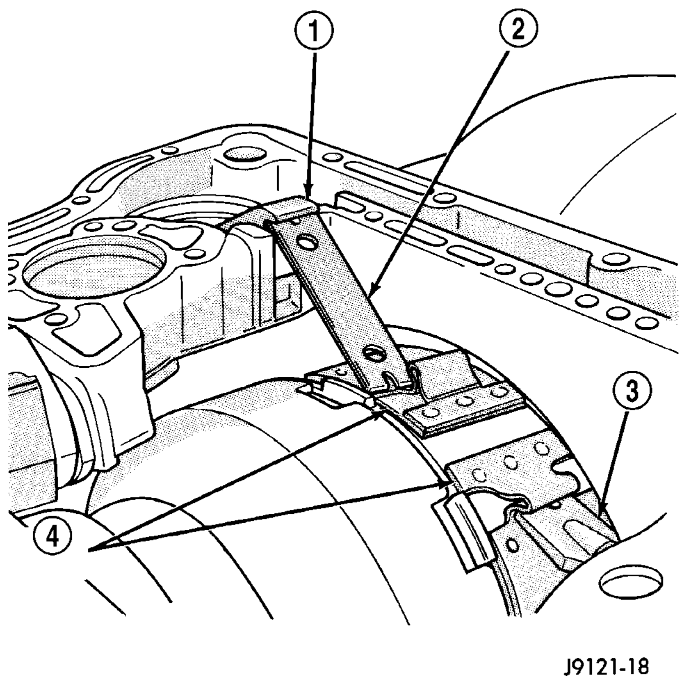


Fig. 61 Front Band And Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

AUTOMATIC TRANSMISSION - 46RE (Continued)

(6) Mount oil pump on pilot studs and slide pump into case opening (Fig. 65). Work pump into case by hand. Do not use a mallet or similar tools to seat pump.

(7) Remove pilot studs and install oil pump bolts. Tighten pump bolts alternately and evenly to fully seat pump in case. Then final-tighten pump bolts to 20 N·m (15 ft. lbs.) torque.

(8) Verify correct installation. Rotate input and intermediate shafts and check for bind. If bind exists, components are either mis-assembled, or not seated. Disassemble and correct as necessary before proceeding.

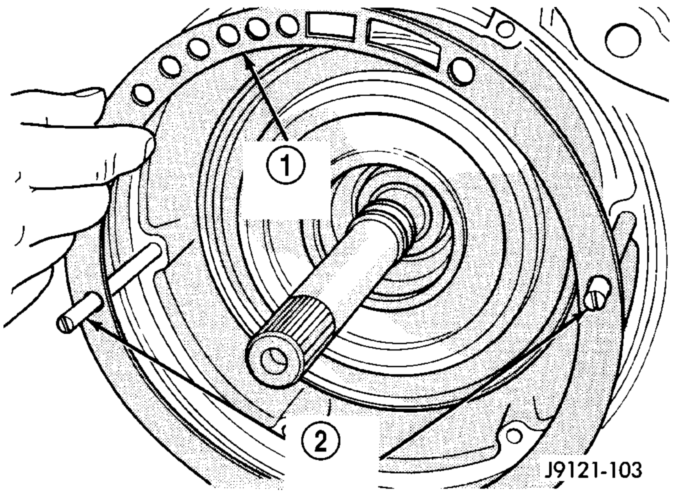


Fig. 62 Oil Pump Gasket And Pilot Studs

1 - OIL PUMP GASKET
2 - PILOT STUDS C-3288-B

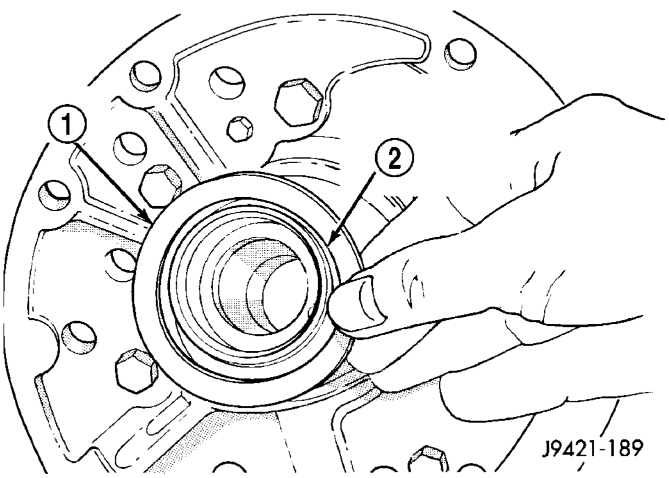


Fig. 63 Reaction Shaft Thrust Washer

1 - THRUST WASHER
2 - CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

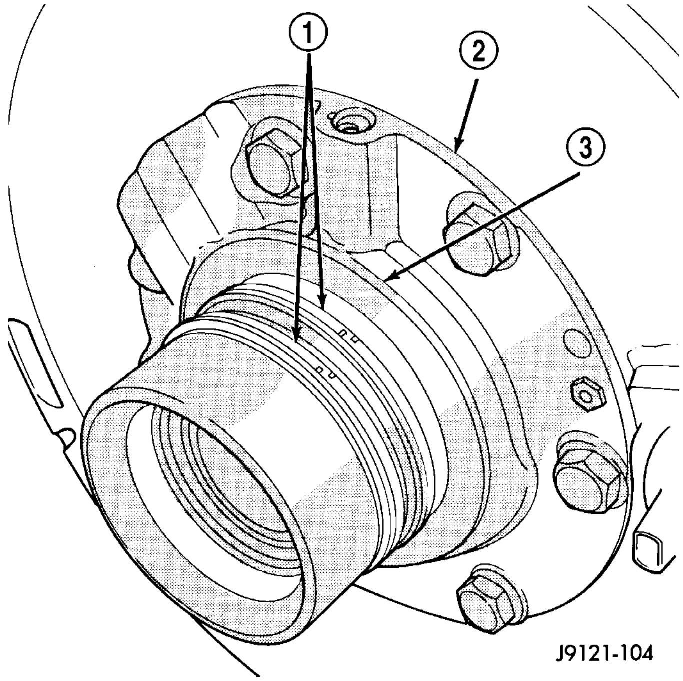


Fig. 64 Reaction Shaft Seal Ring And Thrust Washer

1 - SEAL RINGS
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER (FIBER)

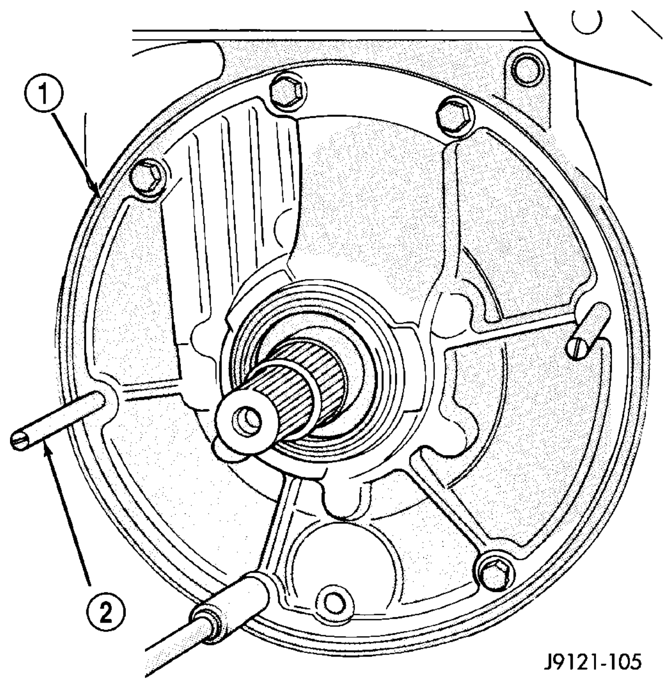


Fig. 65 Oil Pump

1 - SEAT OIL PUMP IN CASE BY HAND
2 - REMOVE PILOT STUDS WHEN PUMP IS SEATED

INPUT SHAFT END PLAY CHECK

NOTE: Overdrive unit must be installed in order to correctly measure the input shaft end-play.

(1) Measure input shaft end play (Fig. 66).

NOTE: If end play is incorrect, transmission is incorrectly assembled, or reaction shaft thrust washer is incorrect. The reaction shaft thrust washer is selective.

(a) Attach Adapter 8266-5 to Handle 8266-8.
(b) Attach dial indicator C-3339 to Handle 8266-8.
(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-5 to secure it to the input shaft.
(d) Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.
(e) Move input shaft in and out and record reading. End play should be 0.86 - 2.13 mm (0.034 - 0.084 in.). Adjust as necessary.

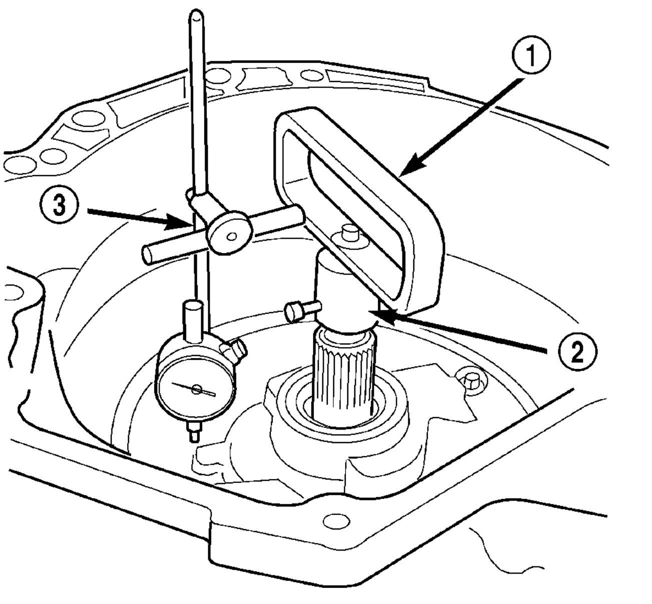


Fig. 66 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

ACCUMULATOR, VALVE BODY, OIL PAN, AND TORQUE CONVERTER

(1) Install accumulator inner spring, piston and outer spring (Fig. 67).
(2) Install new valve body manual shaft seal in case (Fig. 68). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.
(3) Install valve body as follows:

(a) Start park rod into park pawl. If rod will not slide past park pawl, pawl is engaged in park gear. Rotate overdrive output shaft with suitable size 12 point socket; this will free pawl and allow rod to engage.
(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case.
(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(4) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).
(5) Install the transmission range sensor.

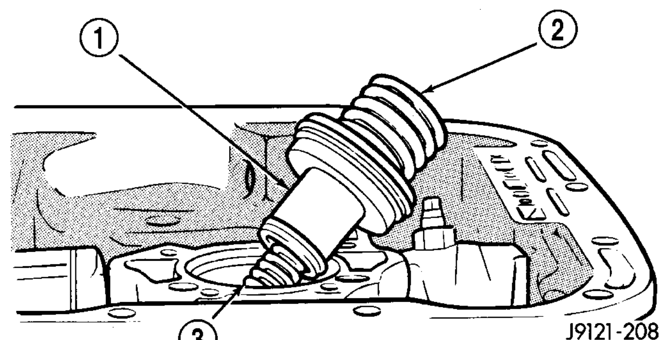


Fig. 67 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

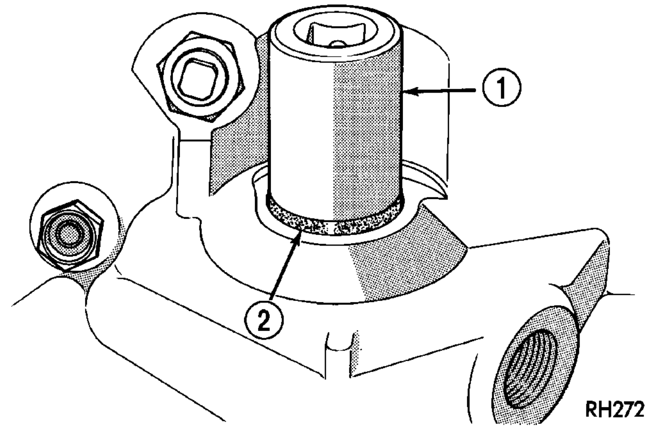


Fig. 68 Manual Lever Shaft Seal

1 - 15/16'' SOCKET
2 - SEAL

AUTOMATIC TRANSMISSION - 46RE (Continued)

CAUTION: If the condition of the transmission before the overhaul procedure caused excessive metallic or fiber contamination in the fluid, replace the torque converter. Fluid contamination and transmission failure can result if not done.

(6) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

BAND ADJUSTMENT AND FINAL

(1) Adjust front and rear bands as follows:

(a) Loosen locknut on each band adjusting screw 4-5 turns.

(b) Tighten both adjusting screws to 8 N·m (72 in. lbs.).

(c) Back off front band adjusting screw 2-7/8 turns.

(d) Back off rear band adjusting screw 2 turns.

(e) Hold each adjusting screw in position and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(2) Install magnet in oil pan. Magnet seats on small protrusion at corner of pan.

(3) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 17 N·m (13 ft. lbs.).

(4) Install throttle valve and shift selector levers on valve body manual lever shaft.

(5) Apply small quantity of dielectric grease to terminal pins of solenoid case connector and transmission range sensor.

(6) Fill transmission with recommended fluid. Refer to Service Procedures section of this group.

INSTALLATION

(1) Check torque converter hub and hub drive notches for sharp edges burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.

(2) Lubricate pocket in the rear oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub of the crankshaft with a light coating of Mopar® High Temp Grease.

(4) Align and install converter in oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 69). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

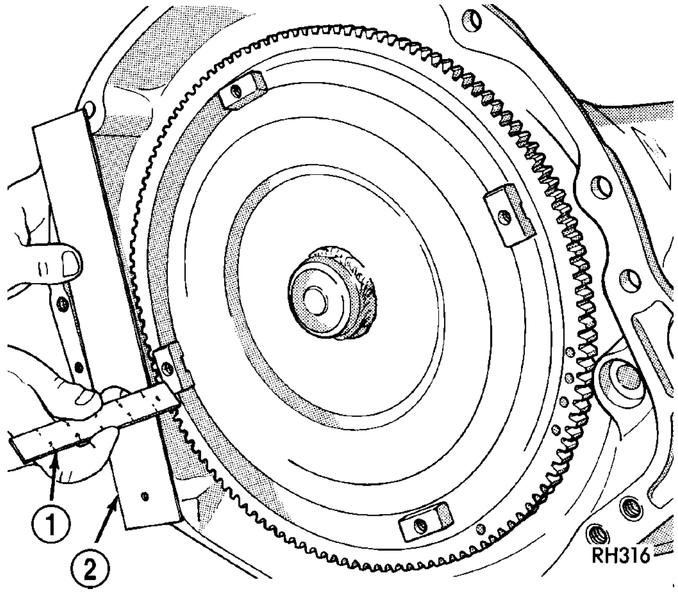


Fig. 69 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(8) Position transmission on jack and secure it with chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

(12) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(13) Install bolts attaching converter housing to engine.

(14) Install rear support.

(15) Install the rear transmission crossmember.

(16) Lower transmission onto crossmember and install bolts attaching transmission mount to crossmember.

(17) Remove engine support fixture.

(18) Install the transfer case, if equipped.

(19) Install crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - INSTALLATION)

AUTOMATIC TRANSMISSION - 46RE (Continued)

(20) Connect gearshift cable (Fig. 70) and throttle cable to transmission.

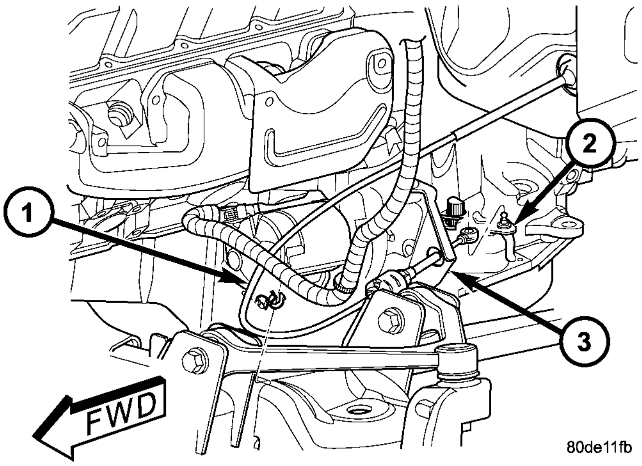


Fig. 70 Gearshift Cable At Transmission

1 - GEARSHIFT CABLE
2 - TRANSMISSION MANUAL LEVER
3 - CABLE SUPPORT BRACKET

(21) Connect wires to the transmission range sensor and transmission solenoid connector. Be sure the transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(22) Install torque converter-to-driveplate bolts.

(23) Install converter housing access cover.

(24) Install starter motor and cooler line bracket. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION)

(25) Connect cooler lines (Fig. 71) to transmission.

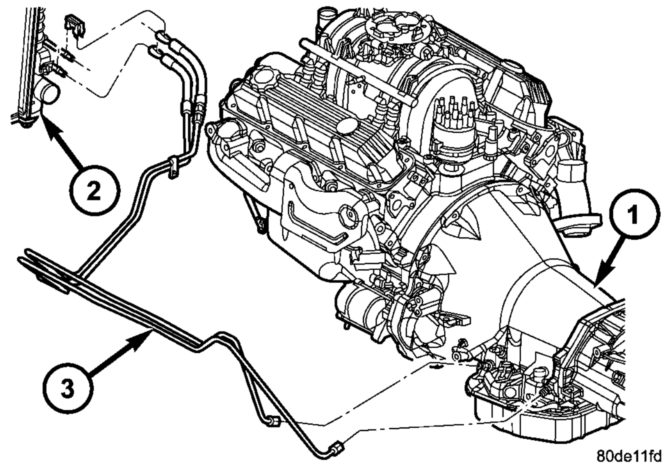


Fig. 71 Transmission Cooler Lines

1 - TRANSMISSION
2 - RADIATOR
3 - COOLER LINES

(26) Install transmission fill tube. Install new seal on tube before installation.

(27) Install any exhaust components previously removed.

(28) Align and connect propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(29) Adjust gearshift cable and throttle valve cable, if necessary.

(30) Install the transfer case skid plate, if equipped.

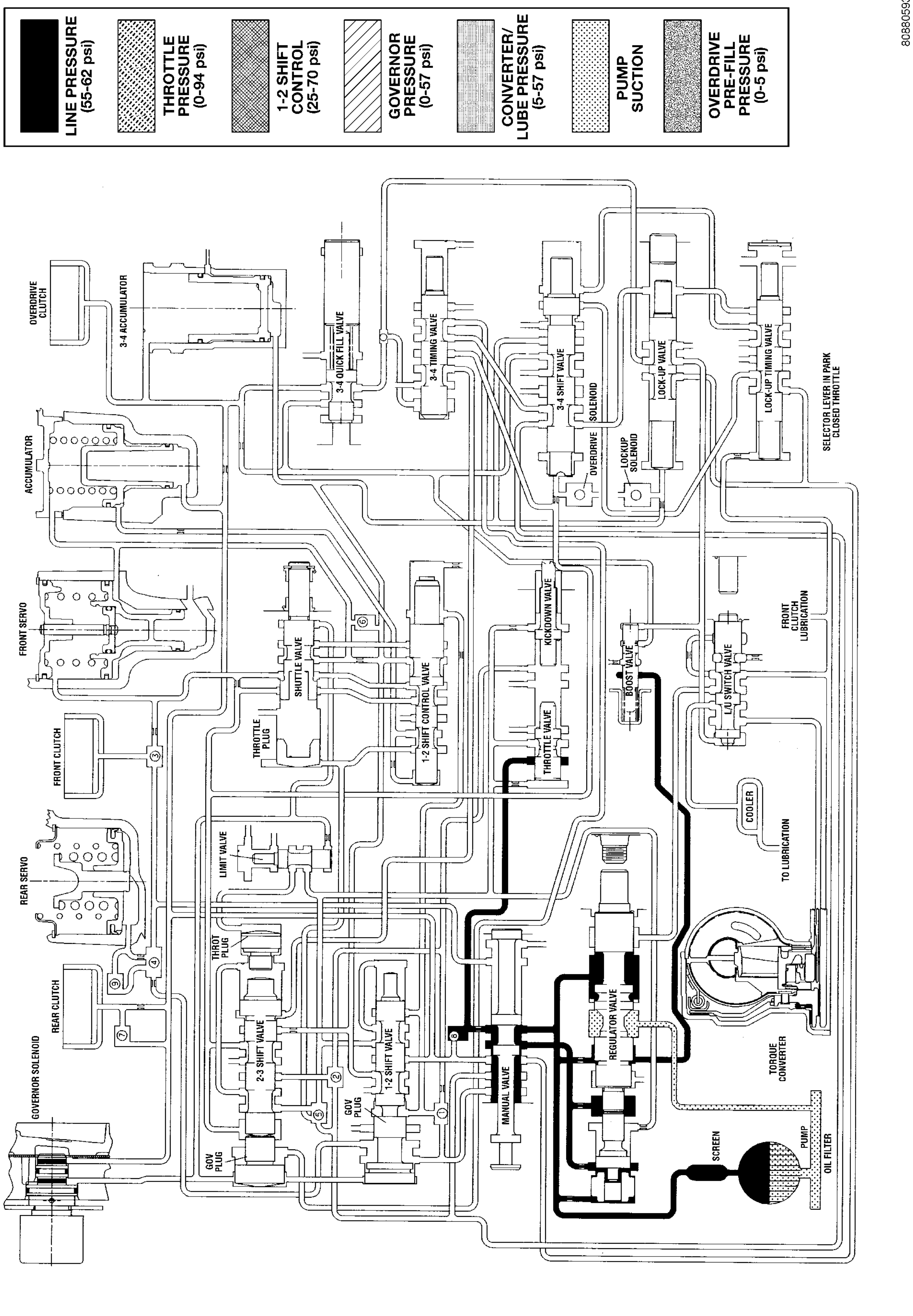
(31) Lower vehicle.

(32) Fill transmission with Mopar® ATF +4, Automatic Transmission fluid.

AUTOMATIC TRANSMISSION - 46RE (Continued)

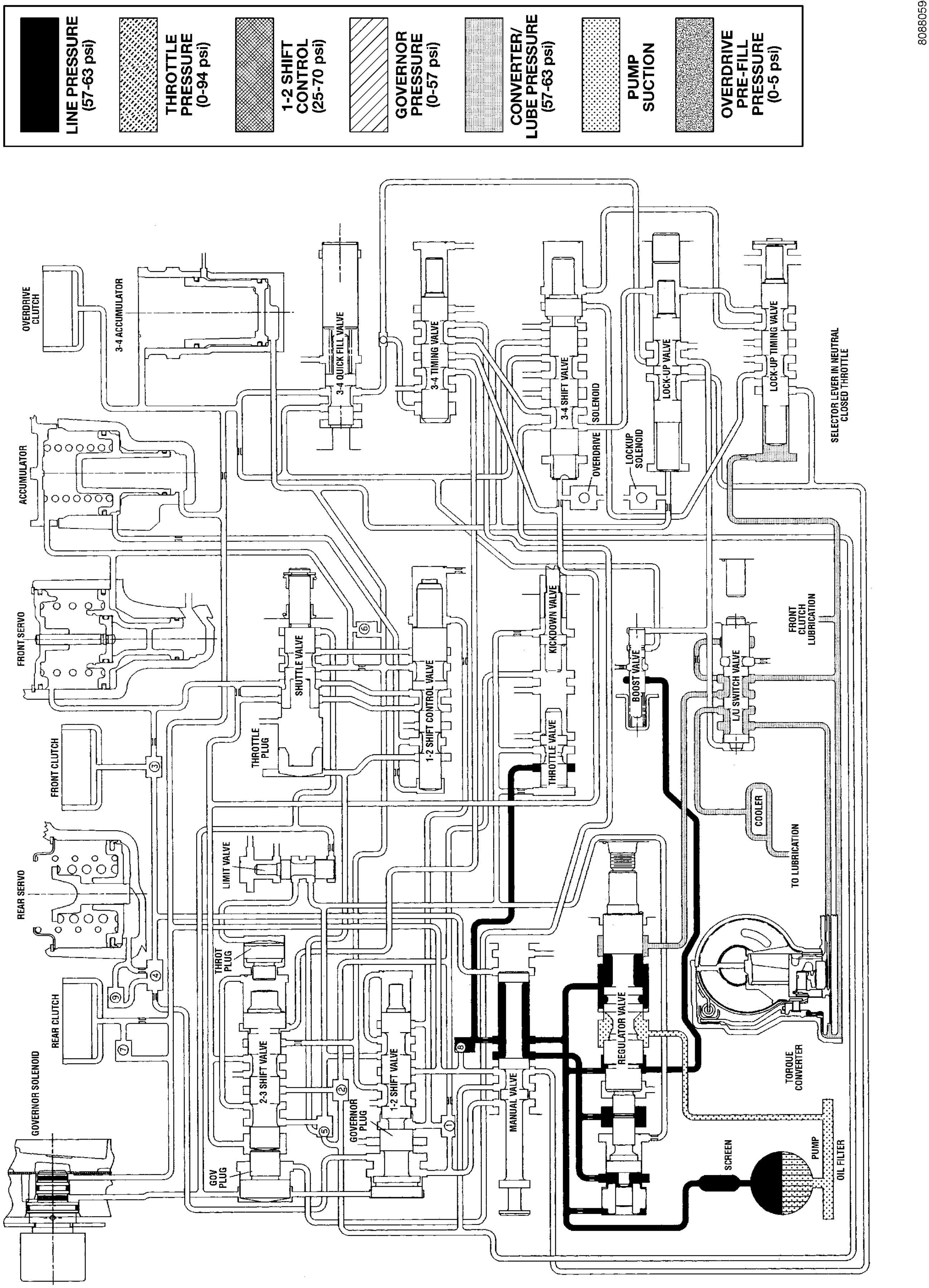
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



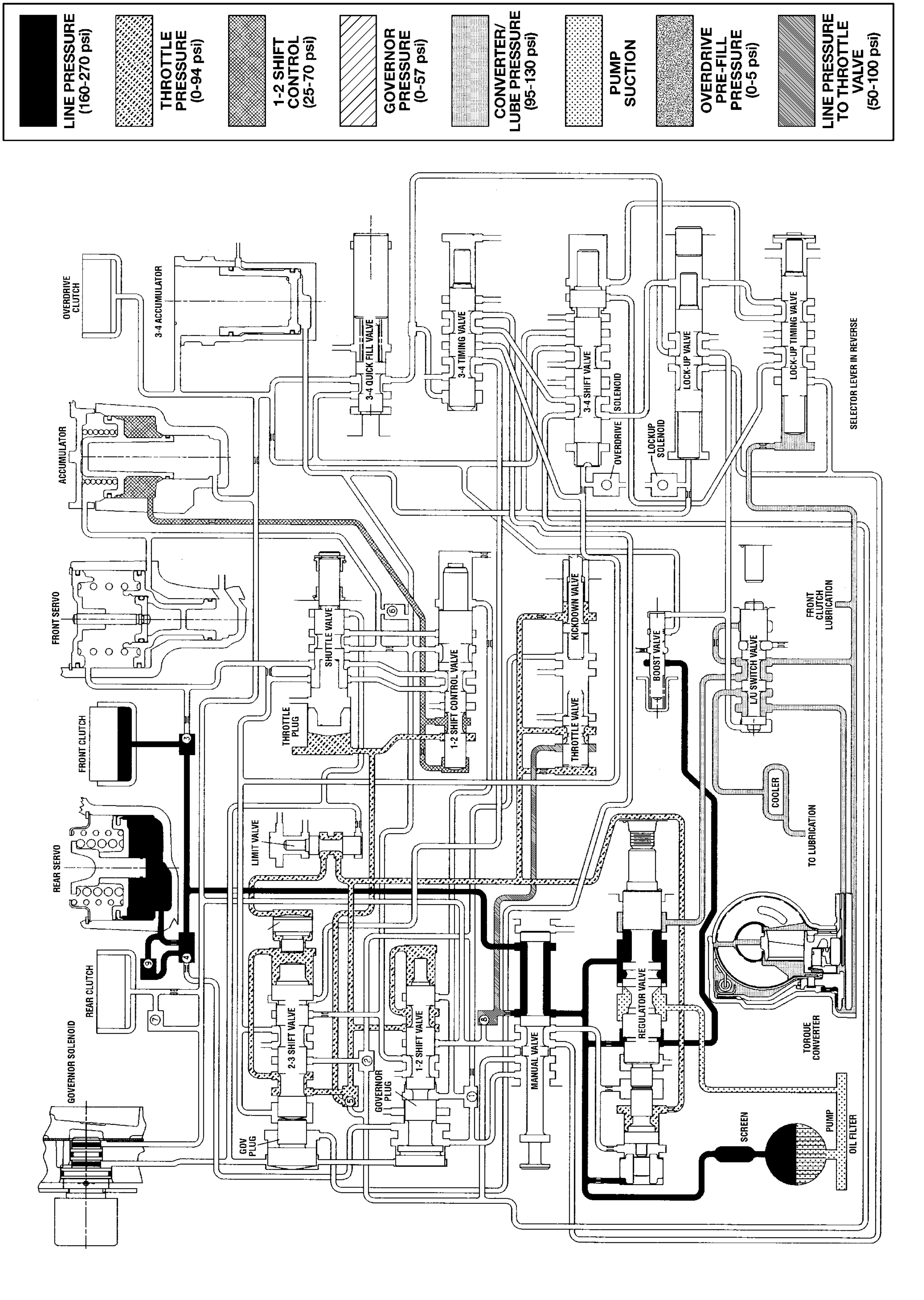
HYDRAULIC FLOW IN PARK

AUTOMATIC TRANSMISSION - 46RE (Continued)



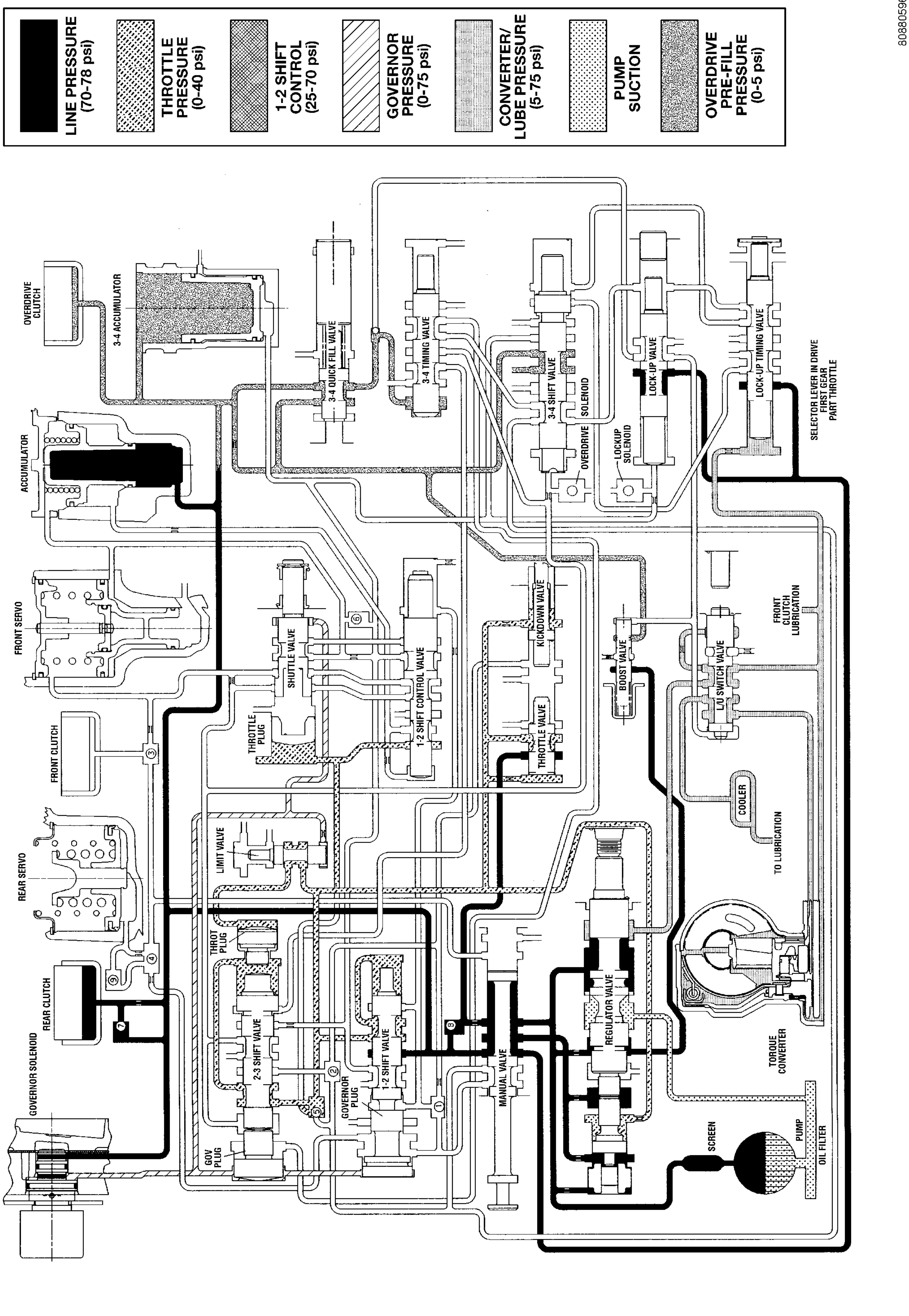
HYDRAULIC FLOW IN NEUTRAL

AUTOMATIC TRANSMISSION - 46RE (Continued)



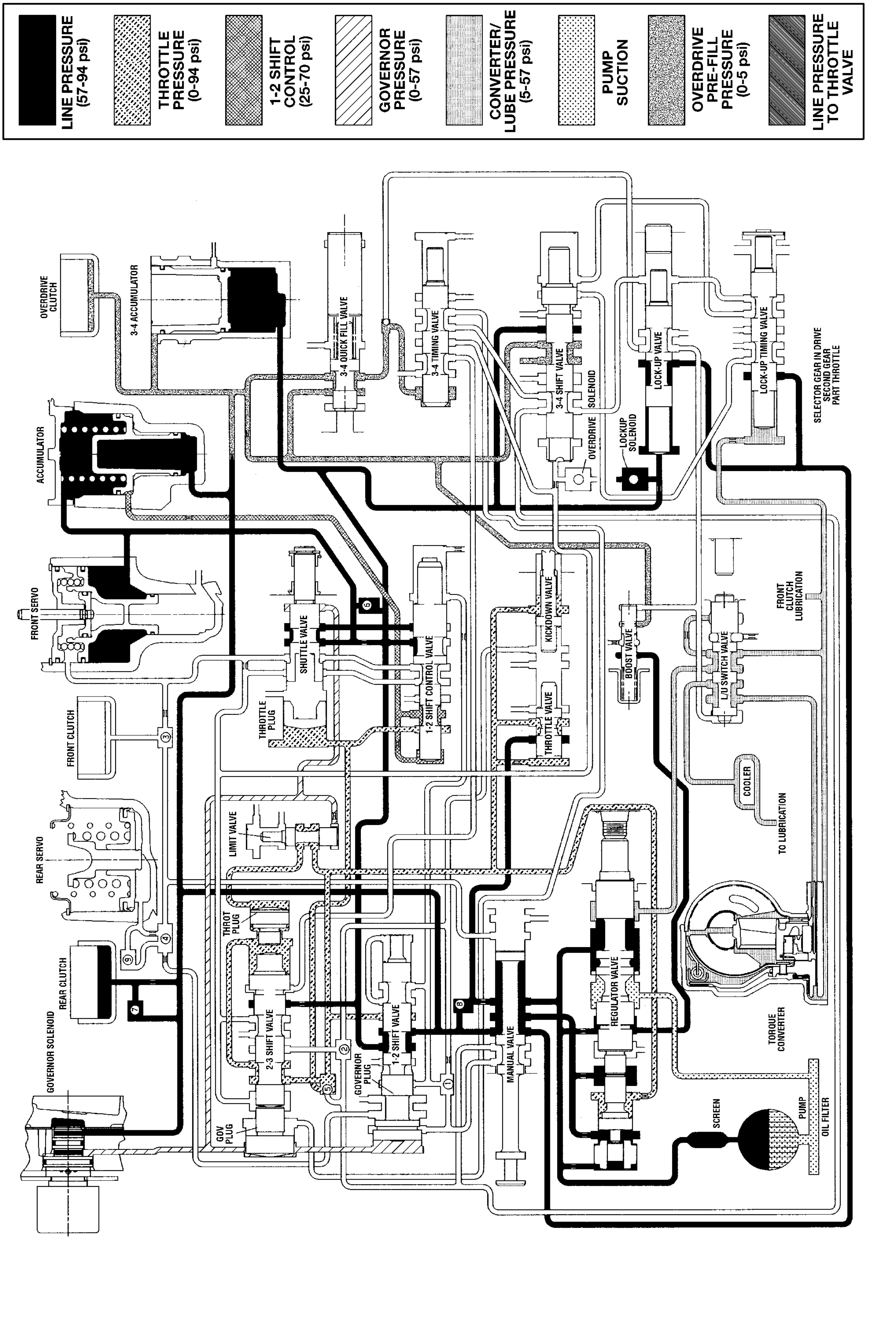
HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 46RE (Continued)



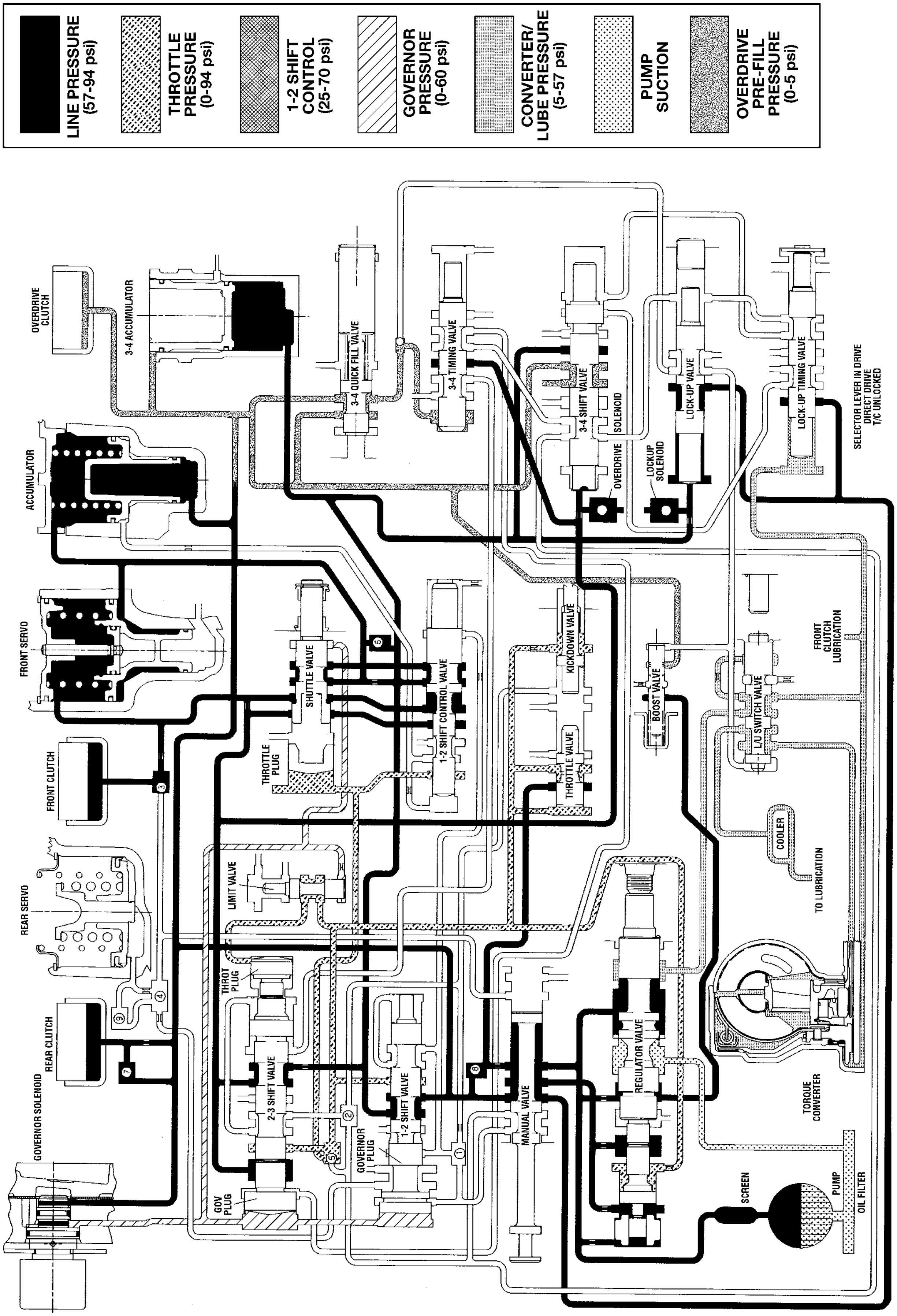
HYDRAULIC FLOW IN DRIVE FIRST GEAR

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW IN DRIVE SECOND GEAR

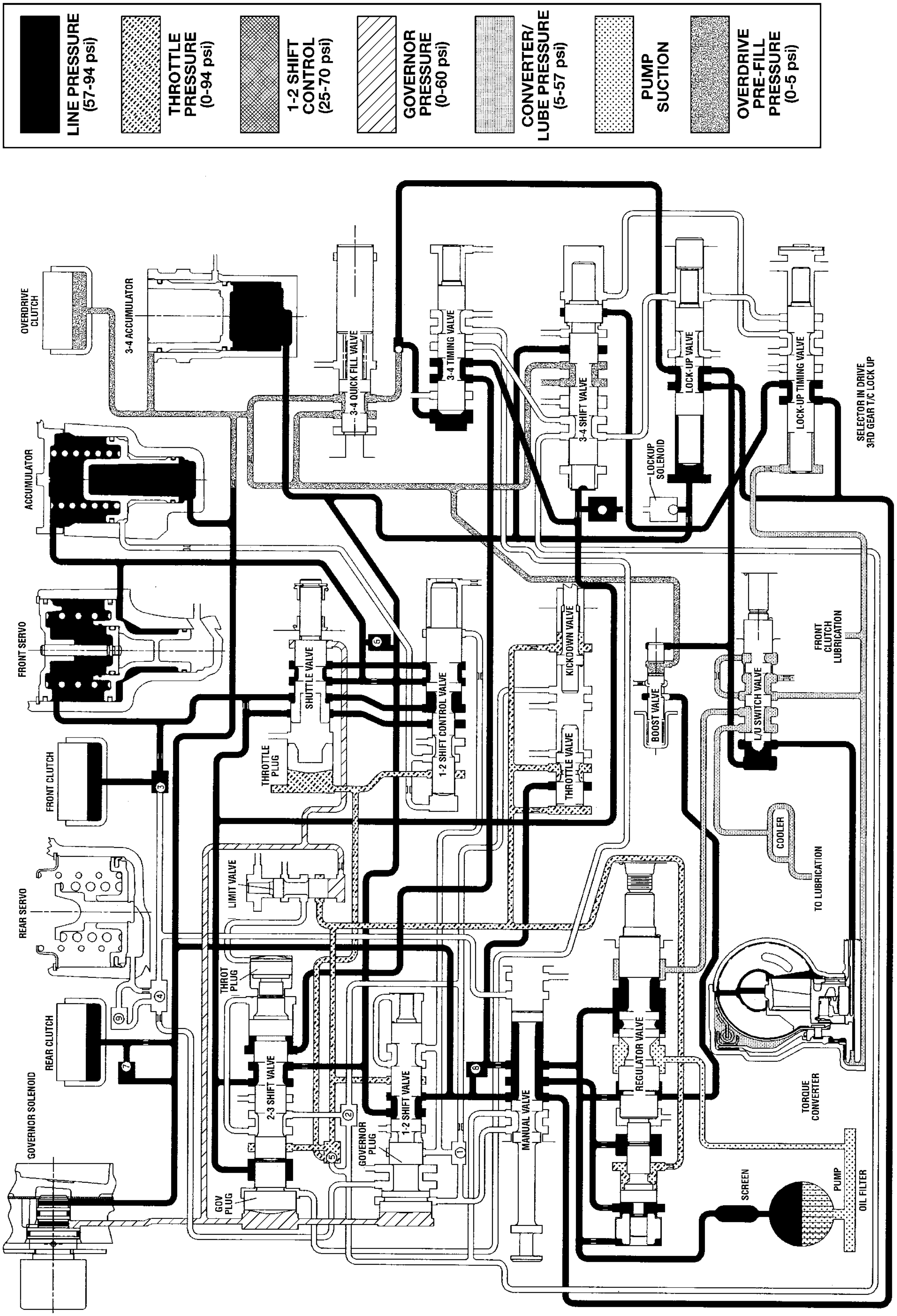
AUTOMATIC TRANSMISSION - 46RE (Continued)



80880598

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

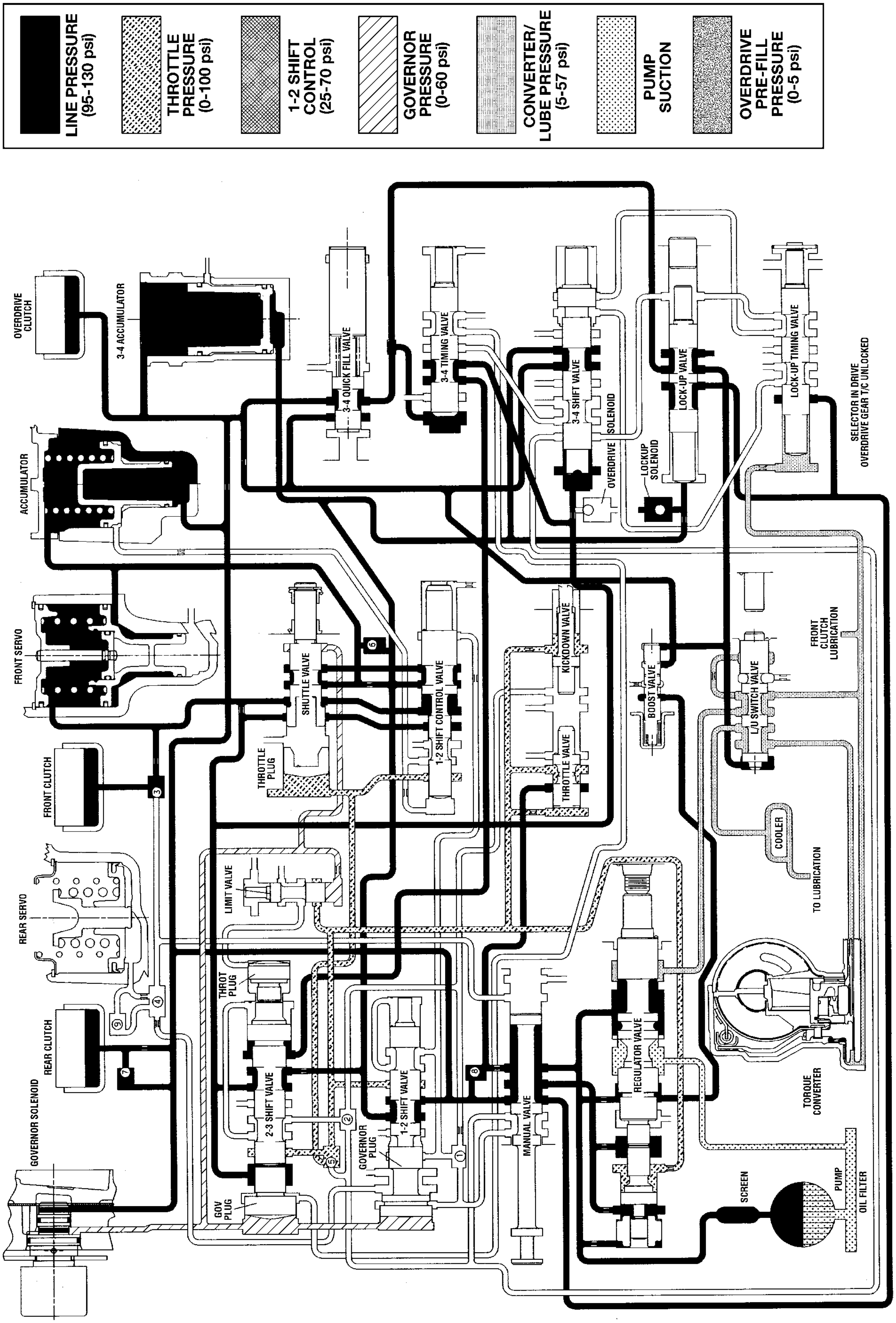
AUTOMATIC TRANSMISSION - 46RE (Continued)



80880599

HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

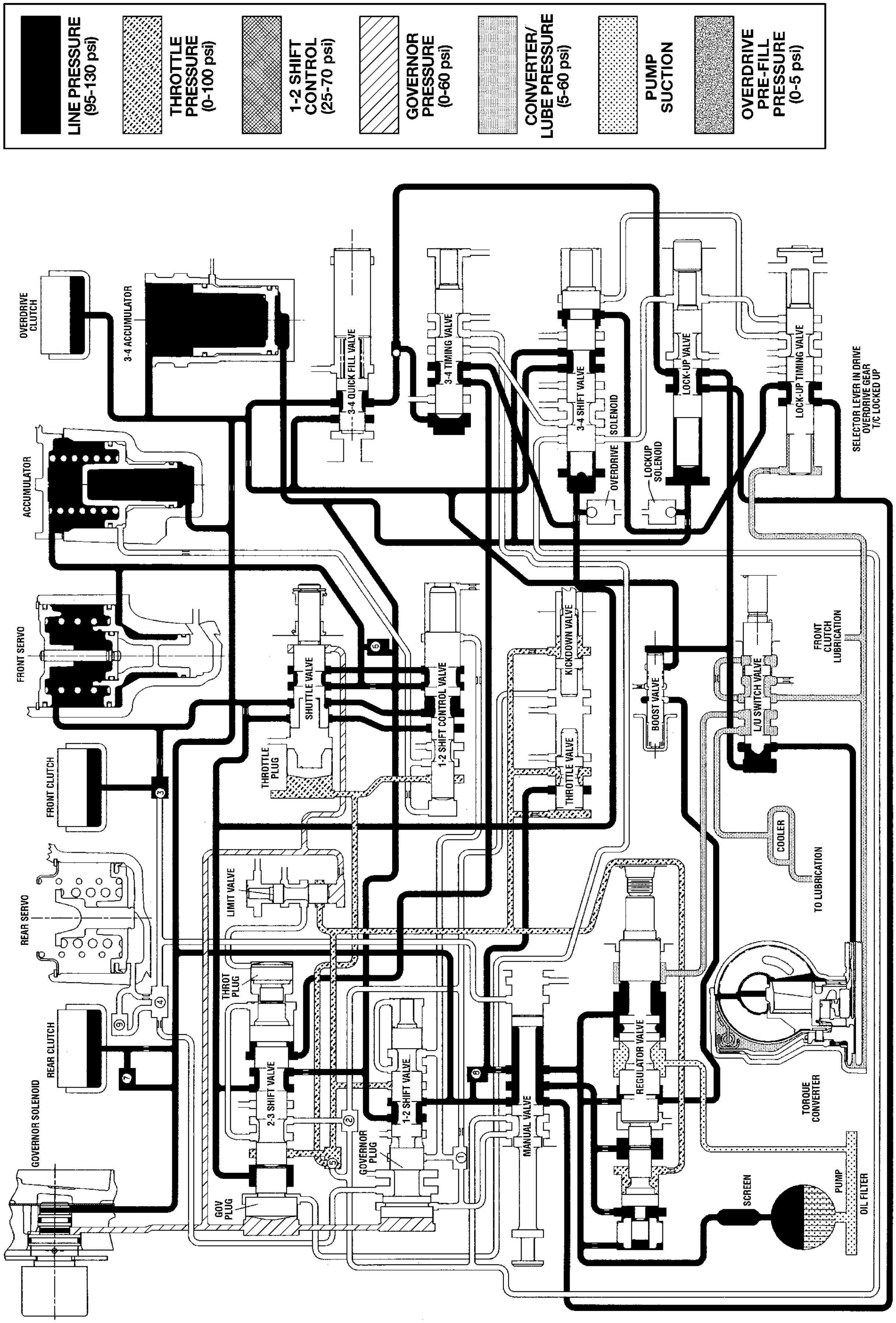
AUTOMATIC TRANSMISSION - 46RE (Continued)



80880559b

HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



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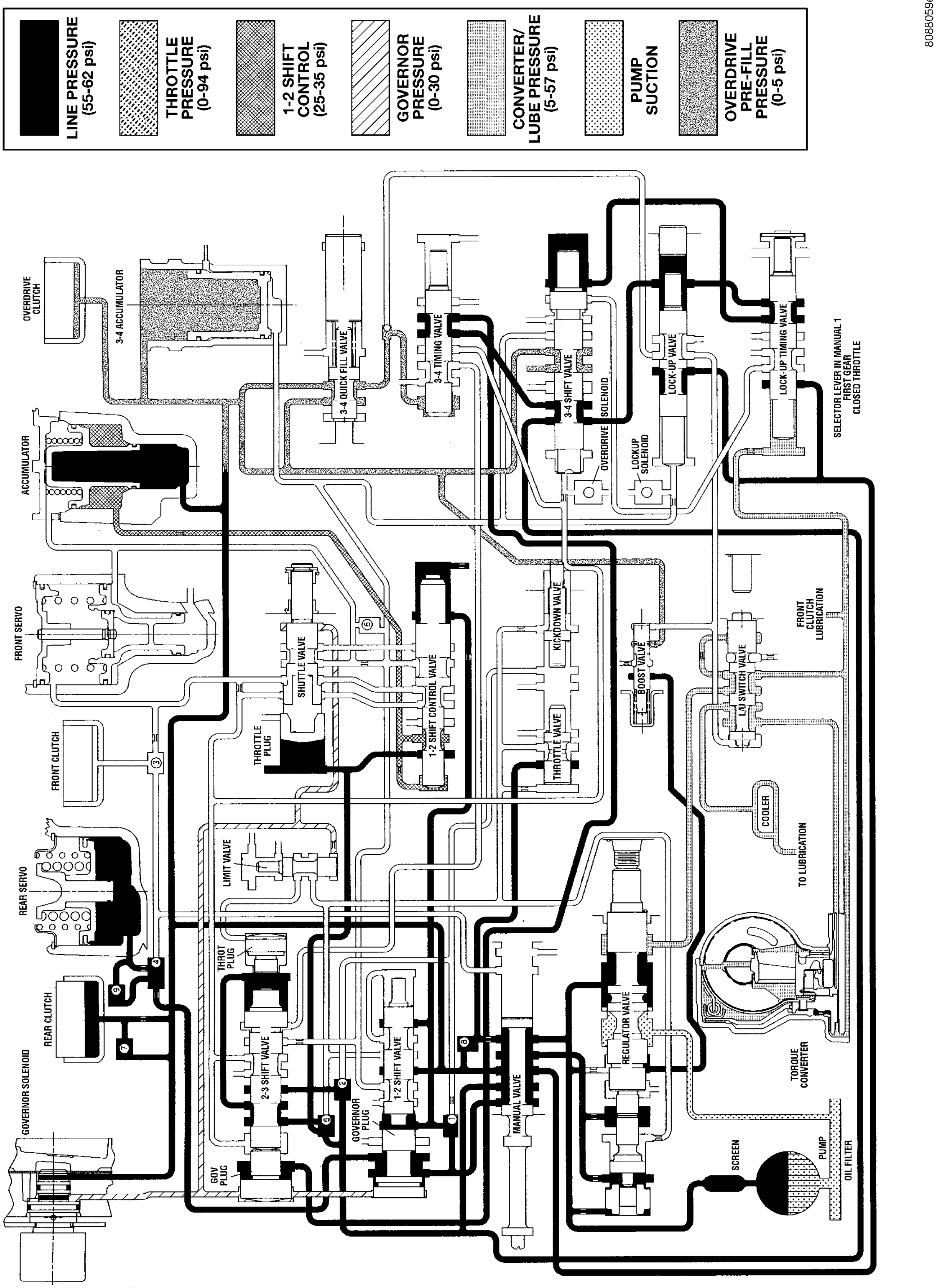
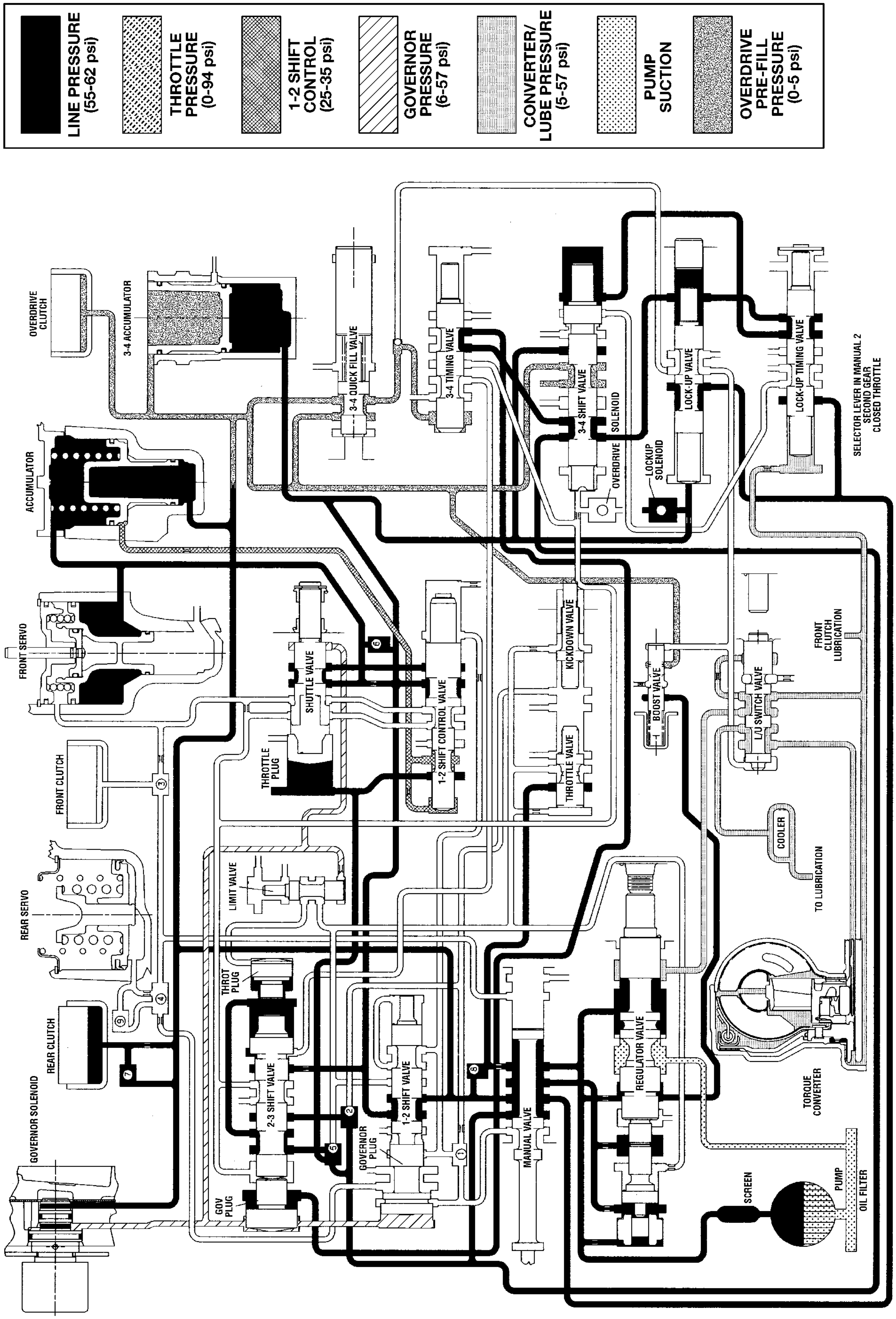
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW IN MANUAL LOW (1)

AUTOMATIC TRANSMISSION - 46RE (Continued)



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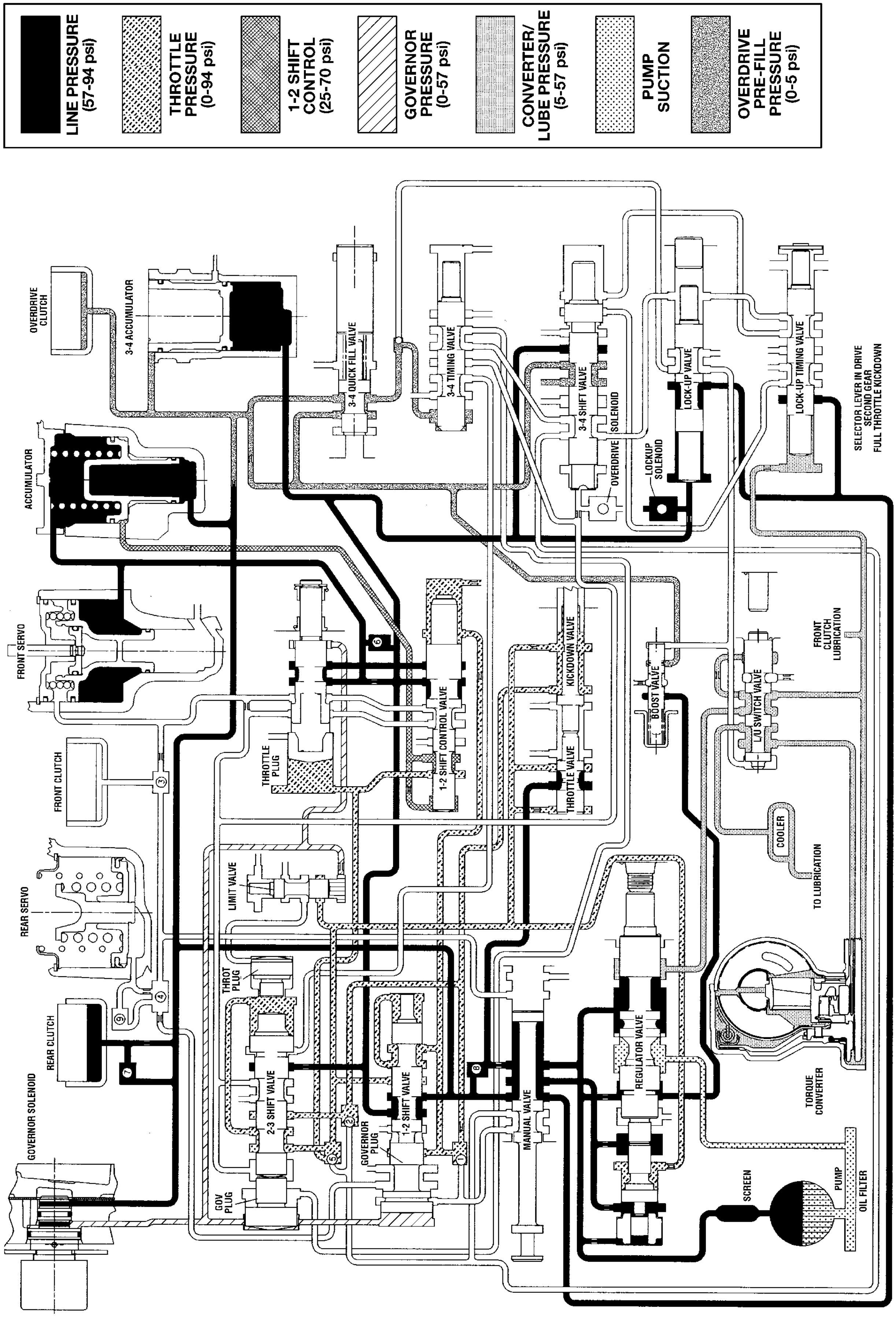
HYDRAULIC FLOW IN MANUAL SECOND (2)

AUTOMATIC TRANSMISSION - 46RE (Continued)



HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT (PASSING)

AUTOMATIC TRANSMISSION - 46RE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Planetary end play	0.150-1.22 mm	0.006-0.048 in.
Input shaft end play	0.86-2.13 mm	0.034-0.084 in.
Clutch pack clearance/ Front.	1.78-3.28 mm	0.070-0.129 in.
Clutch pack clearance/ Rear.	0.635-0.914 mm	0.025-0.036 in.
Front clutch	3 discs	
Rear clutch	4 discs	
Overdrive clutch	4 discs	
Direct clutch	8 discs	
Band adjustment from 72 in. lbs.		
Front band	Back off 2 7/8 turns	
Rear band	Back off 2 turns	
Recommended fluid	Mopar® ATF +4, Automatic Transmission Fluid	

GEAR RATIOS

1ST GEAR	2.45:1
2ND GEAR	1.45:1
3RD GEAR	1.0:1
4TH GEAR	0.69:1
REVERSE	2.21:1

THRUST WASHER/SPACER/SNAP-RING DIMENSIONS

Component	Metric	Inch
Front clutch thrust washer (reaction shaft support hub)	1.55 mm 2.15 mm 2.59 mm	0.061 in. 0.084 in. 0.102 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Intermediate shaft thrust plate (shaft hub pilot)	1.5-1.6 mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm 1.75-1.8 mm 2.1-2.2 mm	0.052-0.054 in. 0.068-0.070 in. 0.083-0.085 in.
Rear clutch pack snap-ring	1.5-1.6 mm 1.9-1.95 mm	0.060-0.062 in. 0.074-0.076 in.
Planetary geartrain snap-ring (at front of output shaft)	1.4-1.5 mm 1.6-1.7 mm	0.055-0.059 in. 0.062-0.066 in.
Overdrive piston thrust plate	Thrust plate and spacer are select fit. Refer to size charts and selection procedures in Overdrive Unit D&A procedures	
Intermediate shaft spacer		

AUTOMATIC TRANSMISSION - 46RE (Continued)

PRESSURE TEST

Overdrive clutch	Fourth gear only	Pressure should be 469-496 kPa (68-72 psi) with closed throttle and increase to 620-896 kPa (90-130 psi) at 1/2 to 3/4 throttle.
Line pressure (at accumulator)	Closed throttle	372-414 kPa (54-60 psi).
Front servo	Third or Fourth gear only	No more than 21 kPa (3 psi) lower than line pressure.
Rear servo	1 range R range	No more than 21 kPa (3 psi) lower than line pressure. 1103 kPa (160 psi) at idle, builds to 1862 kPa (270 psi) at 1600 rpm.
Governor	D range closed throttle	Pressure should respond smoothly to changes in mph and return to 0-7 kPa (0-1.5 psi) when stopped with transmission in D, 1, 2. Pressure above 7 kPa (1.5 psi) at stand still will prevent transmission from downshifting.

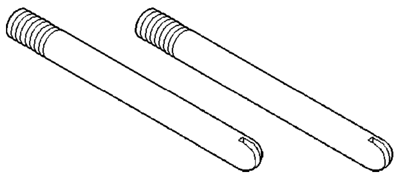
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	18	13	-
Bolt, torque convertor	31	-	270
Bolt, clevis bracket to crossmember	47	35	-
Bolt, clevis bracket to rear support	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Plug, front band reaction	17	13	-
Locknut, front band adj.	34	25	-
Bolt, fluid pan	17	13	-
Screws, fluid filter	4	-	35
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Bolt, O/D to trans.	34	25	-
Bolt, O/D piston retainer	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt, valve body to case	12	-	100
Sensor, trans speed	27	20	-
Screw, solenoid wiring connector	4	-	35
Screw, solenoid to transfer plate	4	-	35
Bracket, transmission range sensor mounting	34	-	300
Screw, transmission range sensor to mounting bracket	3.4	-	30

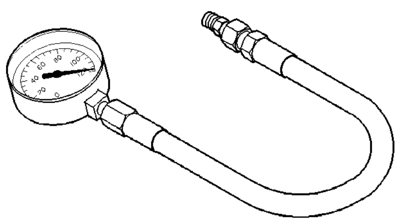
AUTOMATIC TRANSMISSION - 46RE (Continued)

SPECIAL TOOLS

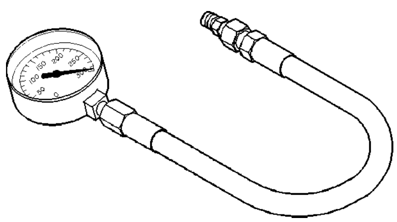
RE TRANSMISSION



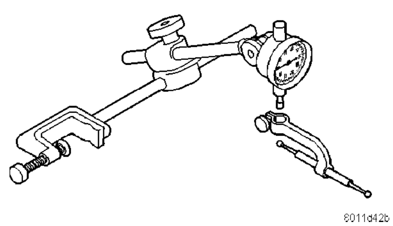
Studs, Oil Pump Pilot - C-3288-B



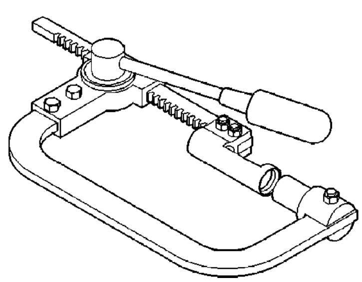
Gauge, Pressure - C-3292



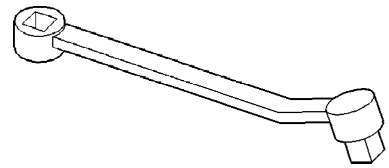
Gauge, Pressure - C-3293SP



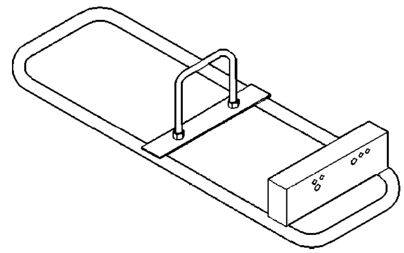
Set, Dial Indicator - C-3339



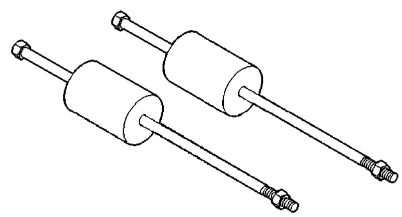
Compressor, Spring - C-3422-B



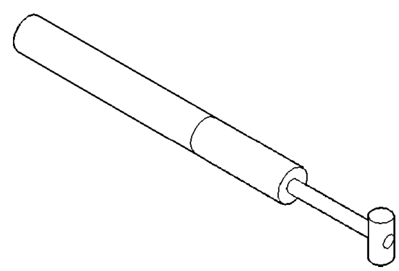
Adapter, Band Adjuster - C-3705



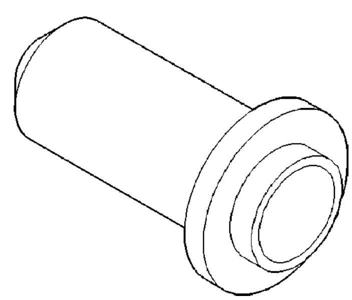
Stand, Transmission Repair - C-3750-B



Puller, Slide Hammer - C-3752

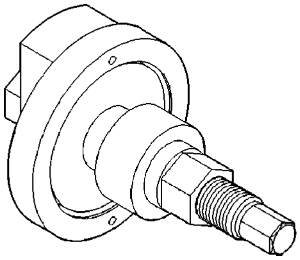


Gauge, Throttle Setting - C-3763

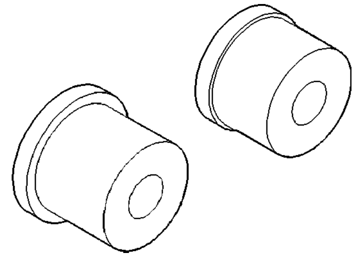


Installer, Seal - C-3860-A

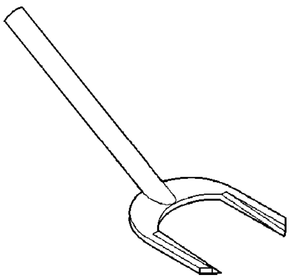
AUTOMATIC TRANSMISSION - 46RE (Continued)



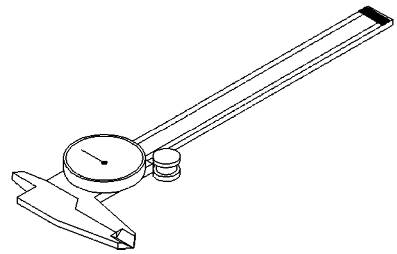
Compressor, Spring - C-3863-A



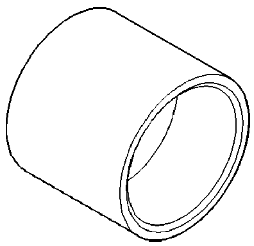
Remover/Installer, Bushing - C-4470



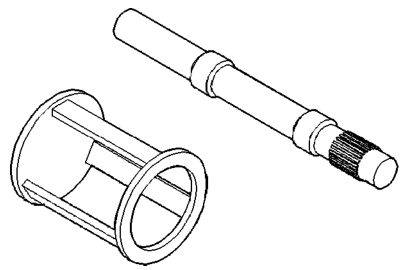
Remover, Seal - C-3985-B



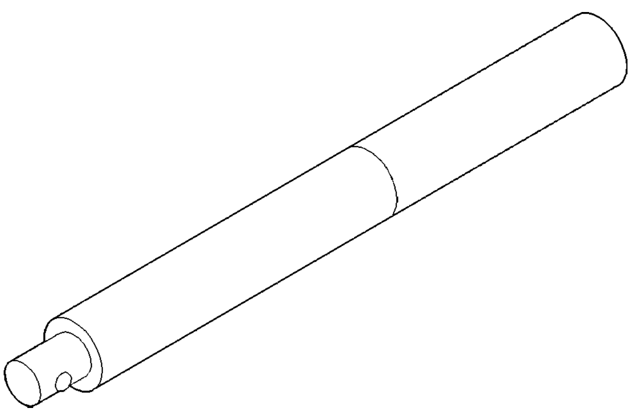
Dial Caliper - C-4962



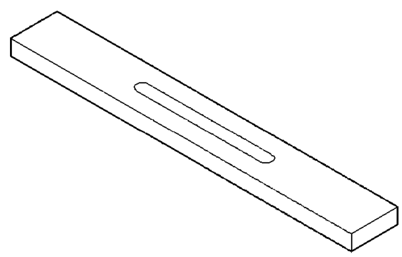
Installer, Seal - C-3995-A



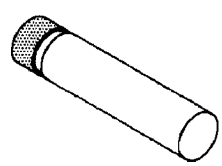
Spring Compressor and Alignment Shaft - 6227



Handle, Universal - C-4171

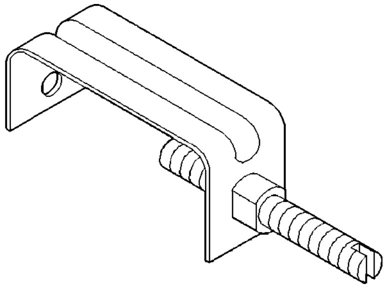


Bar, Gauge - 6311

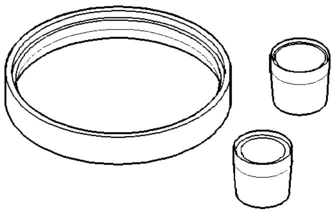


Gauge, Block - 6312

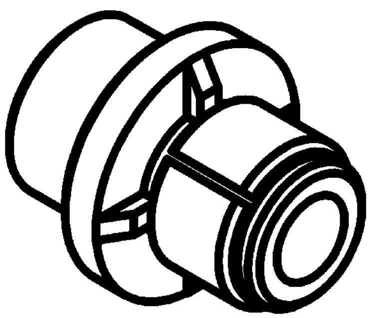
AUTOMATIC TRANSMISSION - 46RE (Continued)



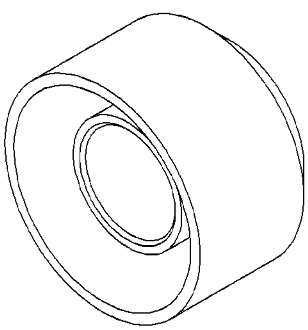
Retainer, Detent Ball and Spring - 6583



Installer, Overdrive Piston Seal - 8114



Socket, TRS Mounting Bracket - 8581



Installer, Seal - 9037

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 72) is a hydraulic device that has the sole purpose of cushioning the application of a band or clutch. The accumulator consists of a dual-land piston and a spring located in a bore in the transmission case. The 3-4 accumulator is located in a housing attached to the side of the valve body (Fig. 73).

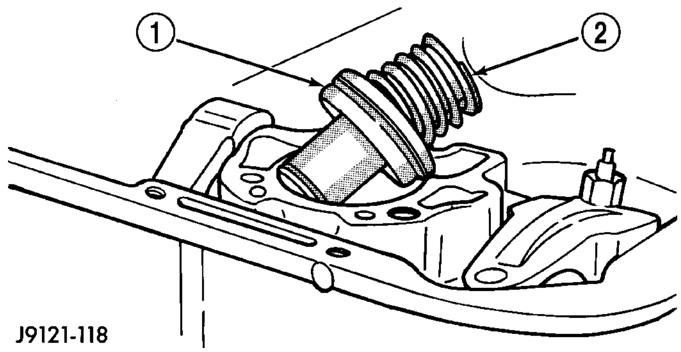


Fig. 72 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

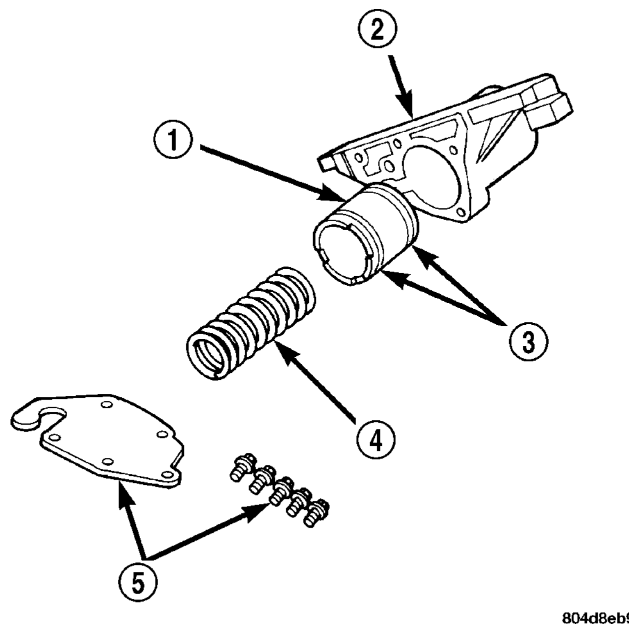


Fig. 73 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

ACCUMULATOR (Continued)

OPERATION

Both the accumulator and the 3-4 accumulator function the same. Line pressure is directed to the small end of the piston when the transmission is placed into a DRIVE position (Fig. 74), bottoming it against the accumulator plate. When the 1-2 upshift occurs (Fig. 75), line pressure is directed to the large end of the piston and then to the kickdown servo. As the line pressure reaches the accumulator, the combination of spring pressure and line pressure forces the piston away from the accumulator plate. This causes a balanced pressure situation, which results in a cushioned band application. After the kickdown servo has become immovable, line pressure will finish pushing the accumulator up into its bore. When the large end of the accumulator piston is seated in its bore, the band or clutch is fully applied.

NOTE: The accumulator is shown in the inverted position for illustrative purposes.

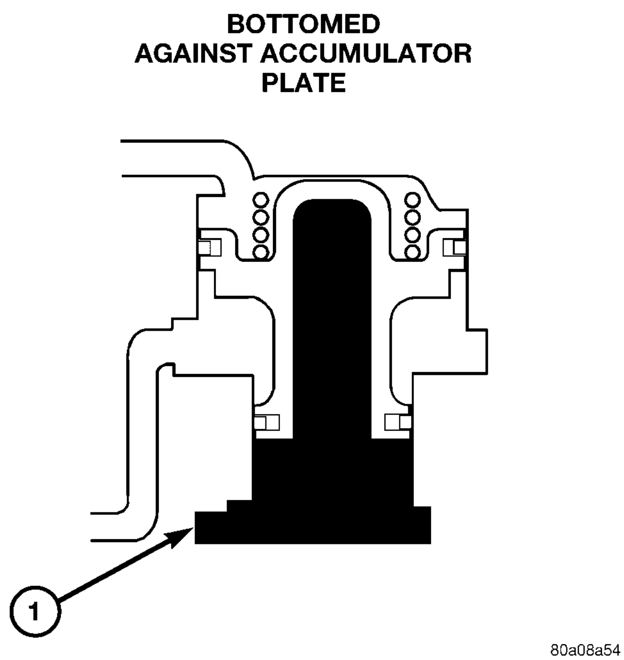


Fig. 74 Accumulator in DRIVE - FIRST Gear Position

1 - LINE PRESSURE

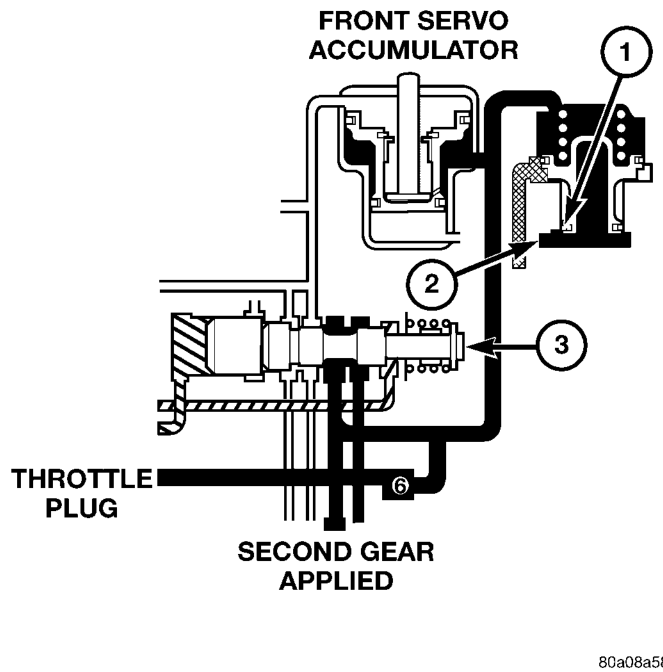


Fig. 75 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

INSPECTION

Inspect the accumulator piston and seal rings. Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator spring. Replace the spring if the coils are cracked, distorted or collapsed.

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

The kickdown, or "front", band (Fig. 76) holds the common sun gear of the planetary gear sets. The front (kickdown) band is made of steel, and faced on its inner circumference with a friction-type lining. One end of the band is anchored to the transmission case, and the other is acted on with a pushing force by a servo piston. The front band is a single-wrap design (the band does not completely encompass/ wrap the drum that it holds).

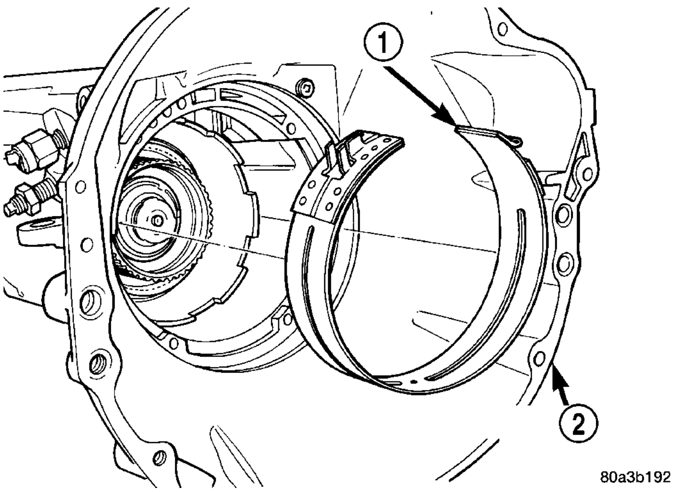


Fig. 76 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

LOW/REVERSE (REAR) BAND

The low/reverse band, or "rear", band (Fig. 77) is similar in appearance and operation to the front band. The rear band is also a single-wrap design (the band does not completely encompass/wrap the drum that it holds).

OPERATION

KICKDOWN (FRONT) BAND

The kickdown band holds the common sun gear of the planetary gear sets by applying and holding the front clutch retainer, which is splined to the sun gear driving shell, and in turn splined directly to the sun gear. The application of the band by the servo is typically done by an apply lever and link bar.

LOW/REVERSE (REAR) BAND

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

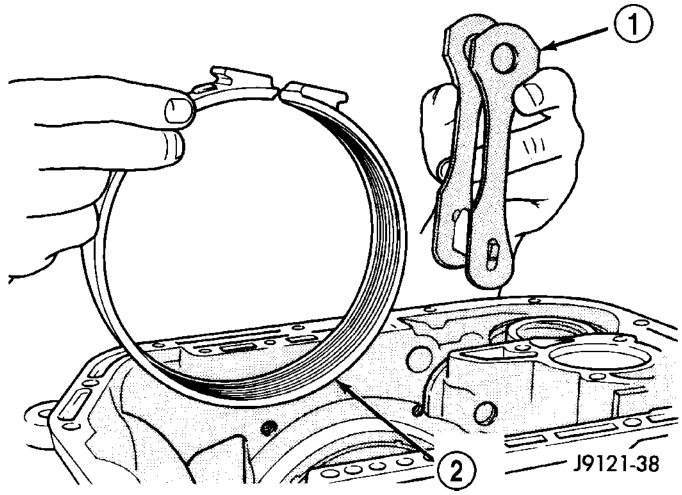


Fig. 77 Rear Band And Link

1 - BAND LINK
2 - REAR BAND

ADJUSTMENTS

ADJUSTMENT - BANDS

FRONT BAND

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut (Fig. 78). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and an appropriate Torx™ socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw, tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 2-7/8 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

REAR BAND

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

BANDS (Continued)

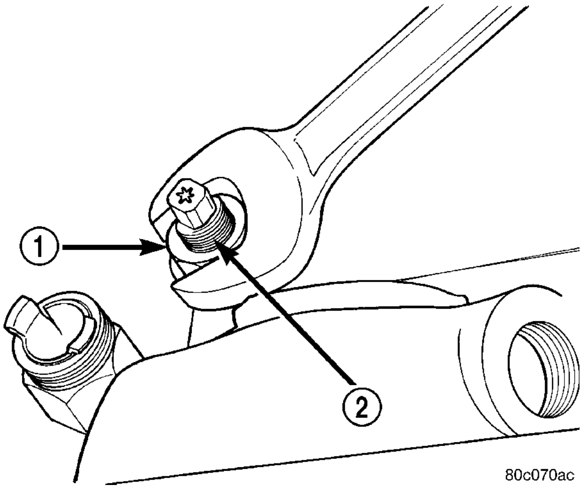


Fig. 78 Front Band Adjustment Screw Location

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

(4) Tighten adjusting screw to 8 N·m (72 in. lbs.) torque (Fig. 79).

(5) Back off adjusting screw 2 turns.

(6) Hold adjusting screw in place and tighten lock-nut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 13.6 N·m (125 in. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF +4, Automatic Transmission fluid.

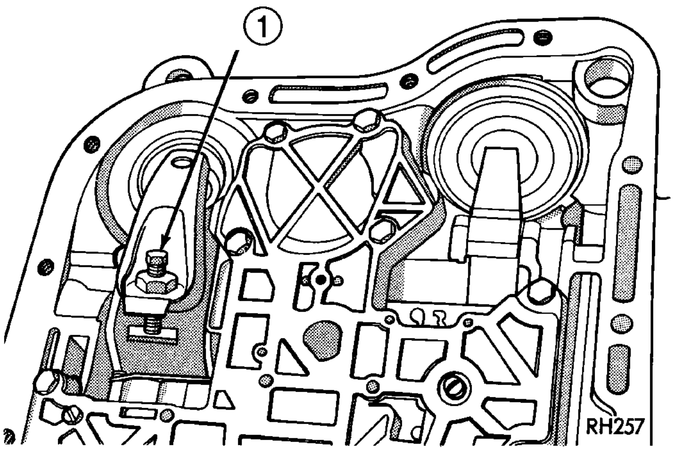


Fig. 79 Rear Band Adjustment Screw Location

1 - LOW-REVERSE BAND ADJUSTMENT

BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM

DESCRIPTION

The Brake Transmission Shifter Interlock (BTSI) (Fig. 80), is a solenoid operated system. It consists of a solenoid permanently mounted on the gearshift cable.

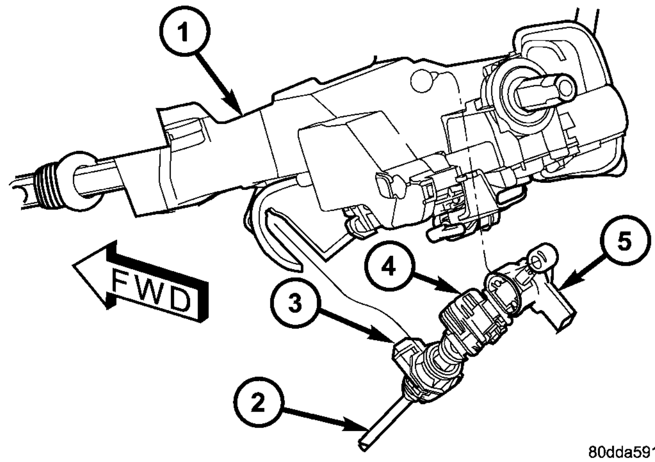


Fig. 80 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

OPERATION

The system locks the shifter into the PARK position. The interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed approximately one-half an inch. A magnetic holding device in line with the park lock cable is energized when the ignition is in the RUN position. When the key is in the RUN position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position, unless the shifter is fully locked into the PARK position.

BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM (Continued)

DIAGNOSIS AND TESTING - BRAKE TRANSMISSION SHIFT INTERLOCK

(1) Verify that the key can only be removed in the PARK position

(2) When the shift lever is in PARK And the shift handle pushbutton is in the "OUT" position, the ignition key cylinder should rotate freely from OFF to LOCK. When the shifter is in any other gear or neutral position, the ignition key cylinder should not rotate to the LOCK position.

(3) Shifting out of PARK should not be possible when the ignition key cylinder is in the OFF position.

(4) Shifting out of PARK should not be possible while applying normal pushbutton force and ignition key cylinder is in the RUN or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the ACCESSORY or LOCK positions.

(6) Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in RUN or START positions.

ADJUSTMENTS - BRAKE TRANSMISSION SHIFT INTERLOCK

Correct cable adjustment is important to proper interlock operation. The gearshift cable must be correctly adjusted in order to shift out of PARK.

ADJUSTMENT PROCEDURE

(1) Remove the steering column trim as necessary for access to the brake transmission shift interlock.

(2) Shift the transmission into the PARK position.

(3) Pull upward on both the BTSI lock tab and the gearshift cable lock tab (Fig. 81).

(4) Verify that the shift lever is in the PARK position.

(5) Verify positive engagement of the transmission park lock by attempting to rotate the propeller shaft. The shaft will not rotate when the park lock is engaged.

(6) Turn ignition switch to LOCK position. **Be sure ignition key cylinder is in the LOCK position. Cable will not adjust correctly in any other position.**

(7) Ensure that the cable is free to self-adjust by pushing cable rearward and releasing.

(8) Push the gearshift cable lock tab down until it snaps in place.

(9) Locate the BTSI alignment hole in the bottom of the BTSI mechanism between the BTSI lock tab and the BTSI connector.

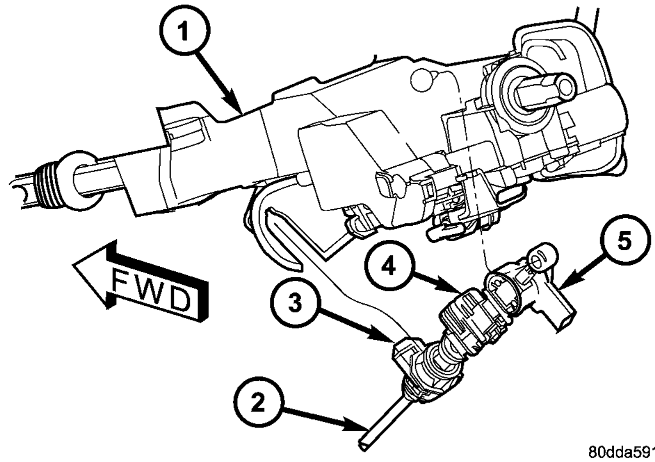


Fig. 81 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

(10) Move the BTSI assembly up or down on the gearshift cable until an appropriate size drill bit can be inserted into the alignment hole and through the assembly.

(11) Push the BTSI lock tab down until it snaps into place and remove the drill bit.

(12) Install any steering column trim previously removed.

BTSI FUNCTION CHECK

(1) Verify removal of ignition key allowed in PARK position only.

(2) When the shift lever is in PARK, the ignition key cylinder should rotate freely from off to lock. When the shifter is in any other position, the ignition key should not rotate from off to lock.

(3) Shifting out of PARK should be possible when the ignition key cylinder is in the off position.

(4) Shifting out of PARK should not be possible while applying normal force, and ignition key cylinder is in the run or start positions, unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the accessory or lock position.

(6) Shifting between any gear and NEUTRAL, or PARK, may be done without depressing foot brake with ignition switch in run or start positions.

(7) Engine starts must be possible with shifter lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any position other than PARK or NEUTRAL.

(8) With shifter lever in the:

- PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.
- PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.
- NEUTRAL position - Normal position. Engine starts must be possible.
- NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

ELECTRONIC GOVERNOR

DESCRIPTION

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 82).

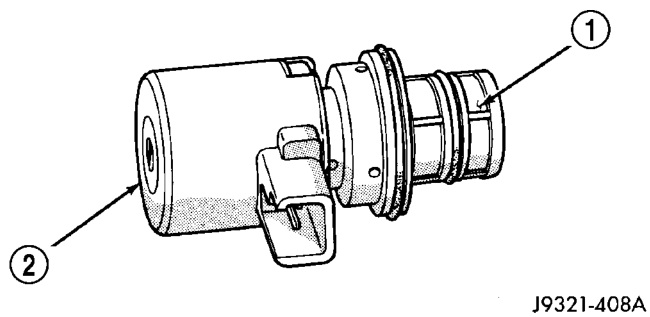


Fig. 82 Governor Pressure Solenoid Valve

1 - SOLENOID FILTER
2 - GOVERNOR PRESSURE SOLENOID

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 83).

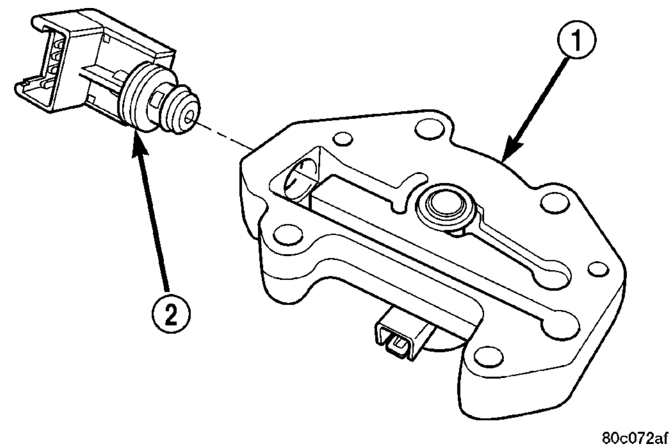


Fig. 83 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 83).

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, –1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

OPERATION

Compensation is required for performance variations of two of the input devices. Though the slope of the transfer functions is tightly controlled, offset may vary due to various environmental factors or manufacturing tolerances.

The pressure transducer is affected by barometric pressure as well as temperature. Calibration of the zero pressure offset is required to compensate for shifting output due to these factors.

ELECTRONIC GOVERNOR (Continued)

Normal calibration will be performed when sump temperature is above 50 degrees F, or in the absence of sump temperature data, after the first 10 minutes of vehicle operation. Calibration of the pressure transducer offset occurs each time the output shaft speed falls below 200 RPM. Calibration shall be repeated each 3 seconds the output shaft speed is below 200 RPM. A 0.5 second pulse of 95% duty cycle is applied to the governor pressure solenoid valve and the transducer output is read during this pulse. Averaging of the transducer signal is necessary to reject electrical noise.

Under cold conditions (below 50 degrees F sump), the governor pressure solenoid valve response may be too slow to guarantee 0 psi during the 0.5 second calibration pulse. Calibration pulses are continued during this period, however the transducer output valves are discarded. Transducer offset must be read at key-on, under conditions which promote a stable reading. This value is retained and becomes the offset during the ″cold″ period of operation.

GOVERNOR PRESSURE SOLENOID VALVE

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

GOVERNOR PRESSURE SENSOR

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

GOVERNOR PRESSURE CURVES

LOW TRANSMISSION FLUID TEMPERATURE

When the transmission fluid is cold the conventional governor can delay shifts, resulting in higher than normal shift speeds and harsh shifts. The electronically controlled low temperature governor pressure curve is higher than normal to make the transmission shift at normal speeds and sooner. The PCM uses a temperature sensor in the transmission oil sump to determine when low temperature governor pressure is needed.

NORMAL OPERATION

Normal operation is refined through the increased computing power of the PCM and through access to data on engine operating conditions provided by the PCM that were not available with the previous stand-alone electronic module. This facilitated the development of a load adaptive shift strategy - the ability to alter the shift schedule in response to vehicle load condition. One manifestation of this capability is grade ″hunting″ prevention - the ability of the transmission logic to delay an upshift on a grade if the engine does not have sufficient power to maintain speed in the higher gear. The 3-2 downshift and the potential for hunting between gears occurs with a heavily loaded vehicle or on steep grades. When hunting occurs, it is very objectionable because shifts are frequent and accompanied by large changes in noise and acceleration.

WIDE OPEN THROTTLE OPERATION

In wide-open throttle (WOT) mode, adaptive memory in the PCM assures that up-shifts occur at the preprogrammed optimum speed. WOT operation is determined from the throttle position sensor, which is also a part of the emission control system. The initial setting for the WOT upshift is below the optimum engine speed. As WOT shifts are repeated, the PCM learns the time required to complete the shifts by comparing the engine speed when the shifts occur to the optimum speed. After each shift, the PCM adjusts the shift point until the optimum speed is reached. The PCM also considers vehicle loading, grade and engine performance changes due to high altitude in determining when to make WOT shifts. It does this by measuring vehicle and engine acceleration and then factoring in the shift time.

TRANSFER CASE LOW RANGE OPERATION

On four-wheel drive vehicles operating in low range, the engine can accelerate to its peak more rapidly than in Normal range, resulting in delayed shifts and undesirable engine ″flare.″ The low range governor pressure curve is also higher than normal to initiate upshifts sooner. The PCM compares electronic vehicle speed signal used by the speedometer to the transmission output shaft speed signal to determine when the transfer case is in low range.

ELECTRONIC GOVERNOR (Continued)

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove transmission fluid pan and filter.

(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 84).

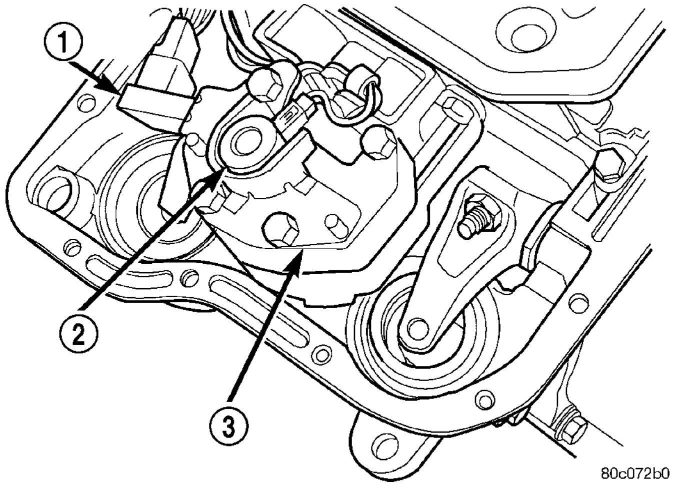


Fig. 84 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

(4) Remove screws holding pressure solenoid retainer to governor body.

(5) Separate solenoid retainer from governor (Fig. 85).

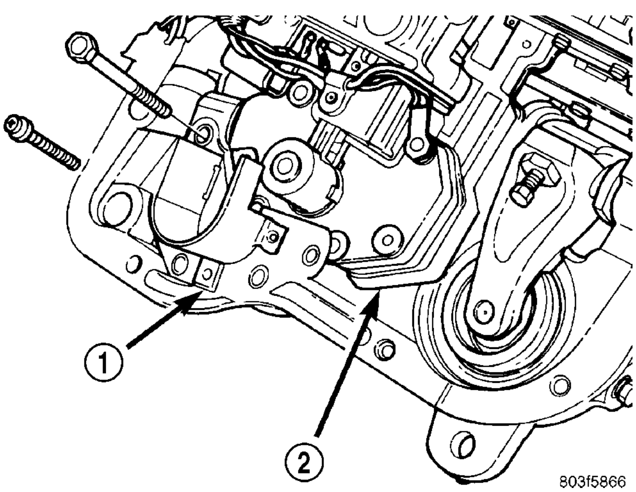


Fig. 85 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(6) Pull solenoid from governor body (Fig. 86).

(7) Pull pressure sensor from governor body.

(8) Remove bolts holding governor body to valve body.

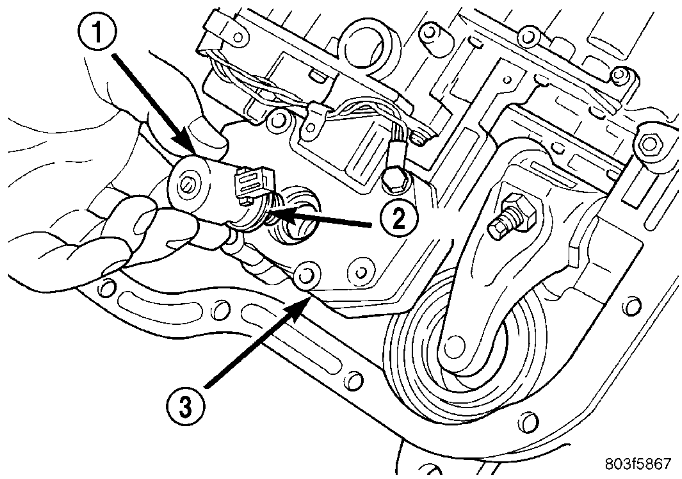


Fig. 86 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(9) Separate governor body from valve body (Fig. 87).

(10) Remove governor body gasket.

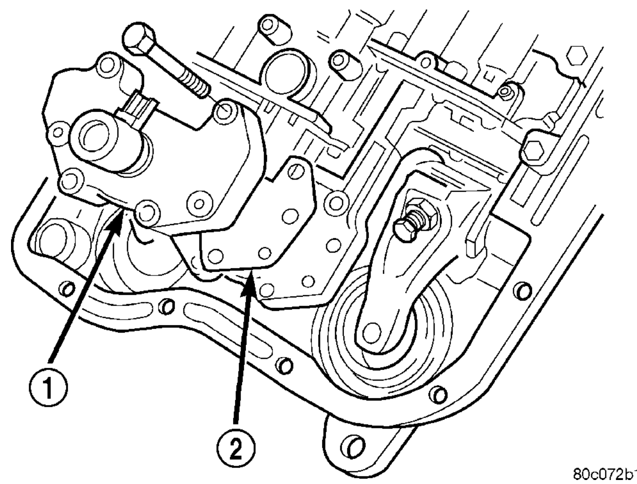


Fig. 87 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

ELECTRONIC GOVERNOR (Continued)

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace o-ring seals, clean the gasket surfaces and replace gasket.

(1) Place gasket in position on back of governor body (Fig. 88).

(2) Place governor body in position on valve body.

(3) Install bolts to hold governor body to valve body.

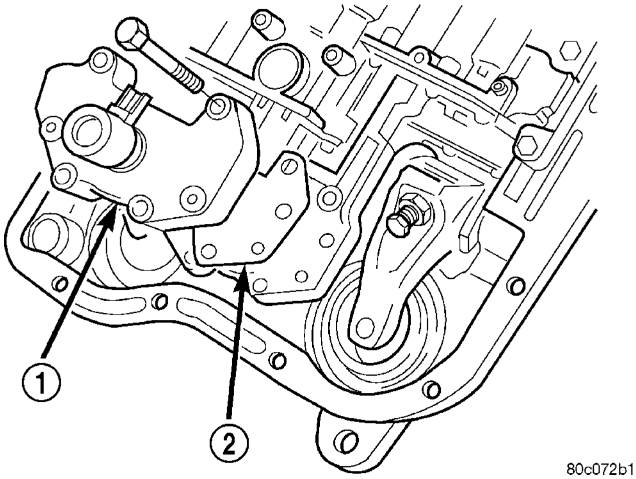


Fig. 88 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

(4) Lubricate o-ring on pressure sensor with transmission fluid.

(5) Align pressure sensor to bore in governor body.

(6) Push pressure sensor into governor body.

(7) Lubricate o-ring, on pressure solenoid, with transmission fluid.

(8) Align pressure solenoid to bore in governor body (Fig. 89).

(9) Push solenoid into governor body.

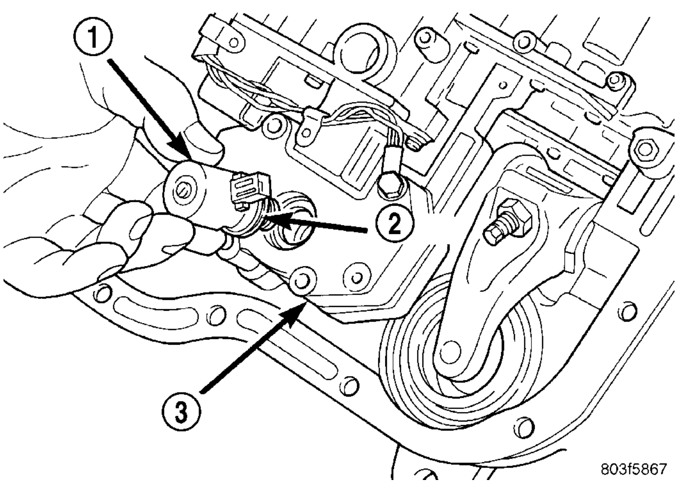


Fig. 89 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(10) Place solenoid retainer in position on governor (Fig. 90).

(11) Install screws to hold pressure solenoid retainer to governor body.

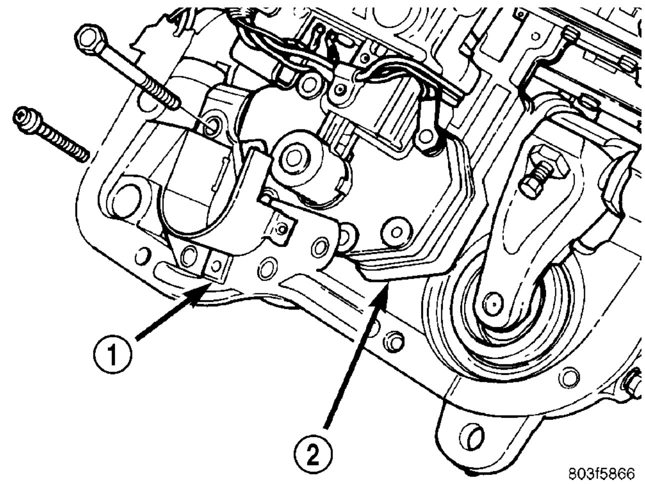


Fig. 90 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(12) Engage wire connectors into pressure sensor and solenoid (Fig. 91).

(13) Install transmission fluid pan and (new) filter.

(14) Lower vehicle and road test to verify repair.

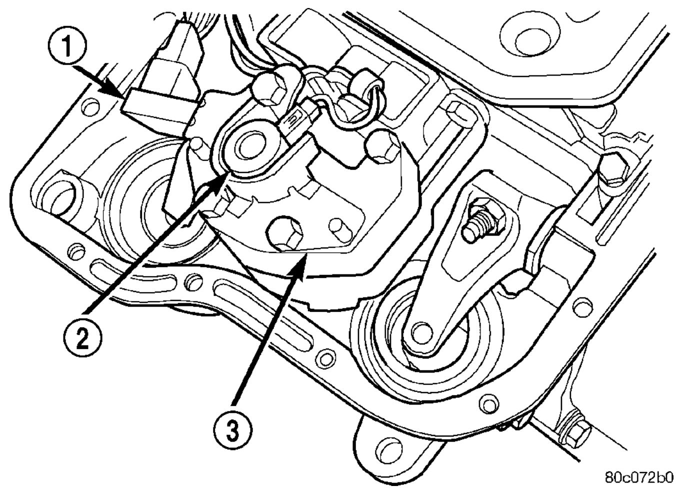


Fig. 91 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

EXTENSION HOUSING BUSHING

REMOVAL

(1) Remove extension housing yoke seal.

(2) Insert Remover 6957 into the extension housing. Tighten tool to bushing and remove bushing (Fig. 92).

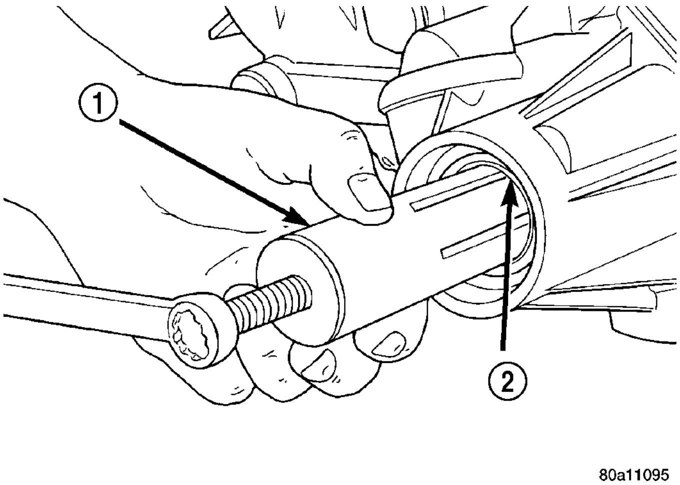


Fig. 92 Bushing Removal - Typical

1 - REMOVER
2 - EXTENSION HOUSING BUSHING

INSTALLATION

(1) Align bushing oil hole with oil slot in extension housing.

(2) Tap bushing into place with Installer 6951 and Handle C-4171.

(3) Install new oil seal in housing using Seal Installer C-3995-A (Fig. 93).

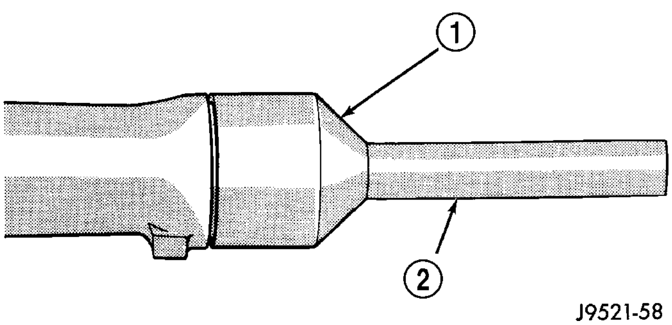


Fig. 93 Transmission Extension Housing Seal Installation

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with Seal Remover C-3985-B (Fig. 94) from overdrive housing.

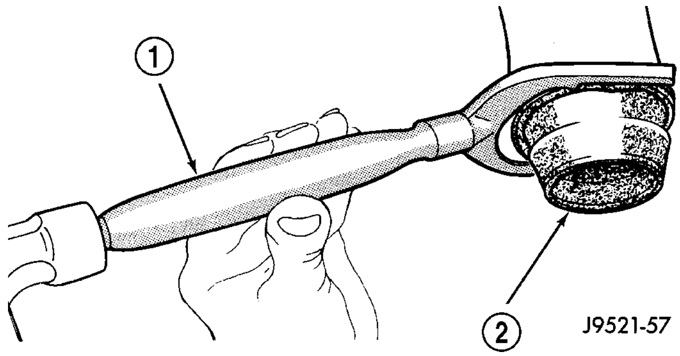


Fig. 94 Removing Transmission Housing Yoke Seal

1 - SPECIAL TOOL C-3985-B
2 - SEAL

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer C-3995-A (Fig. 95).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

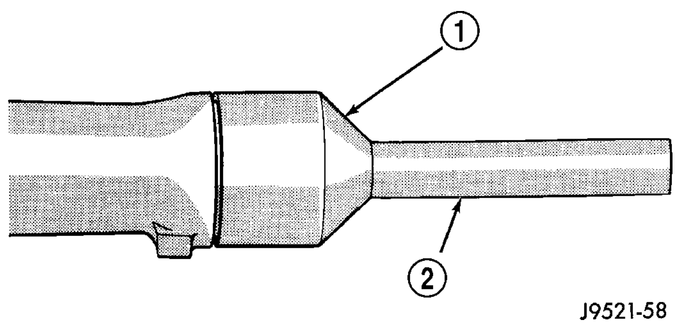


Fig. 95 Installing Transmission Housing Seal

1 - SPECIAL TOOL C-3995-A OR C-3972-A
2 - SPECIAL TOOL C-4471

FLUID AND FILTER

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve and clutch operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

DIAGNOSIS AND TESTING - CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has two primary causes.

(1) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(2) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

DIAGNOSIS AND TESTING - FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to replace contaminated converter after repair

The use of non-recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission, an overhaul is necessary.

The torque converter should be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

STANDARD PROCEDURE

STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmssion has too much fluid, the geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.**

The transmission fluid level can be checked two ways.

PROCEDURE ONE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive

FLUID AND FILTER (Continued)

vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to NEUTRAL.

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick (Fig. 96) and check fluid level as follows:

(a) Correct acceptable level is in crosshatch area.

(b) Correct maximum level is to MAX arrow mark.

(c) Incorrect level is at or below MIN line.

(d) If fluid is low, add only enough Mopar® ATF +4, Automatic Transmission fluid, to restore correct level. Do not overfill.

PROCEDURE TWO

(1) Start engine and apply parking brake.

(2) Shift the transmission into DRIVE for approximately 2 seconds.

(3) Shift the transmission into REVERSE for approximately 2 seconds.

(4) Shift the transmission into PARK.

(5) Hook up DRB® scan tool and select engine.

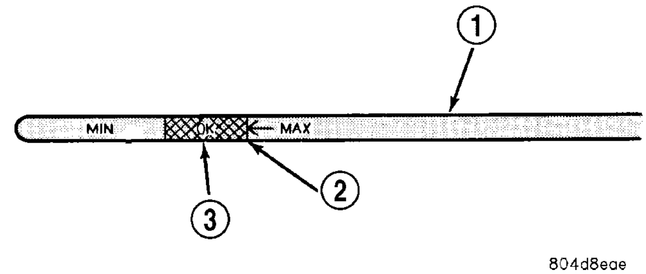


Fig. 96 Dipstick Fluid Level Marks - Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

(6) Select sensors.

(7) Read the transmission temperature value.

(8) Compare the fluid temperature value with the figure. (Fig. 97)

(9) Adjust transmission fluid level shown on the dipstick according to the figure.

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

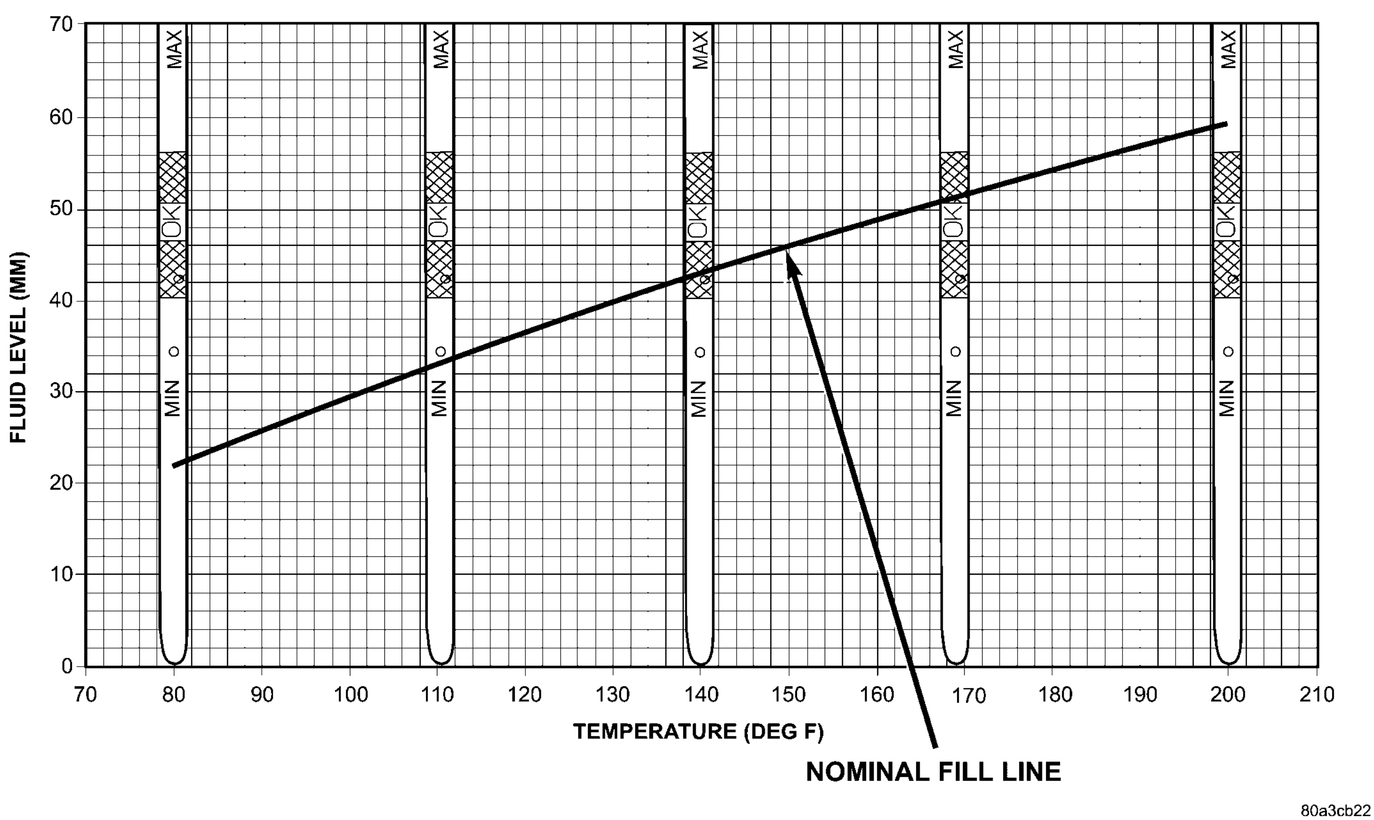


Fig. 97 46RE Fluid Fill Graph

FLUID AND FILTER (Continued)

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION). The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 98).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan and gasket away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan and gasket away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 99).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

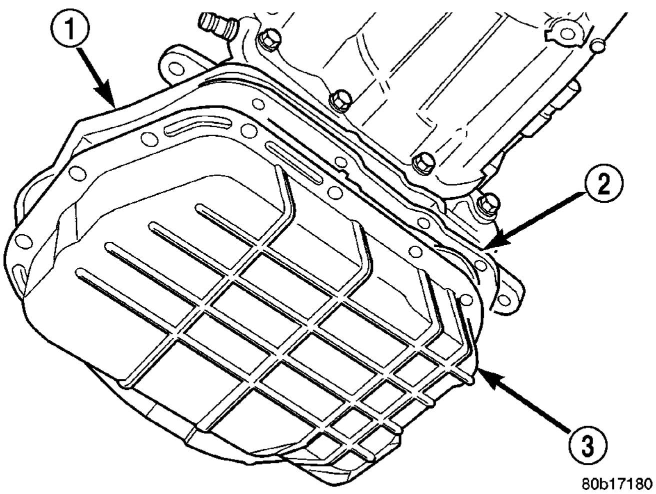


Fig. 98 Transmission Pan

1 - TRANSMISSION
2 - GASKET
3 - PAN

INSTALLATION

(1) Position a new transmission oil filter onto the valve body.

(2) Install the screws to hold the filter to the valve body. Tighten the screws to 4 N·m (35 in.lbs.).

(3) Clean the gasket surfaces of the transmission oil pan and transmission pan rail.

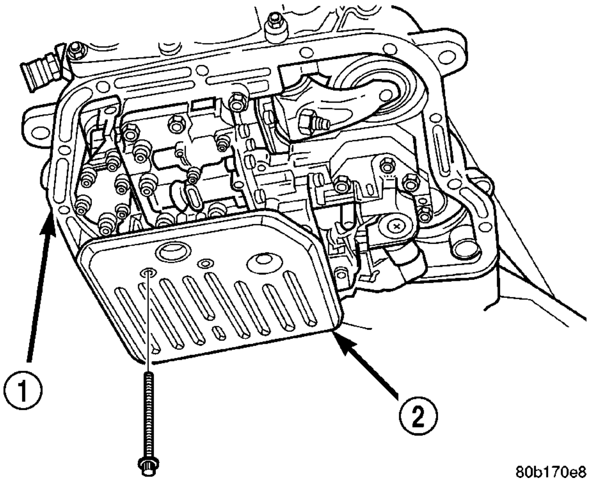


Fig. 99 Transmission Filter

1 - TRANSMISSION
2 - FILTER

NOTE: The transmission pan oil gasket is reusable. Inspect the sealing surfaces of the gasket. If the sealing ribs on both surfaces appear to be in good condition, clean the gasket of any foreign material and reinstall.

(4) Position the oil pan gasket onto the oil pan.

(5) Position the oil pan and gasket onto the transmission and install several bolts to hold the pan and gasket to the transmission.

(6) Install the remainder of the oil pan bolts. Tighten the bolts to 13.6 N·m (125 in.lbs.).

(7) Lower vehicle and fill transmission. (Refer to 21 - TRANSMISSION/AUTOMATIC/FLUID - STANDARD PROCEDURE)

STANDARD PROCEDURE - TRANSMISSION FILL

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF +4, Automatic Transmission Fluid, to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled, or torque converter was replaced or drained, add **12 pints (6 quarts)** of ATF +4 to transmission.

(3) Apply parking brakes.

(4) Start and run engine at normal curb idle speed.

(5) Apply service brakes, shift transmission through all gear ranges then back to NEUTRAL, set parking brake, and leave engine running at curb idle speed.

FLUID AND FILTER (Continued)

(6) Remove funnel, insert dipstick and check fluid level. If level is low, **add fluid to bring level to MIN mark on dipstick.** Check to see if the oil level is equal on both sides of the dipstick. If one side is noticably higher than the other, the dipstick has picked up some oil from the dipstick tube. Allow the oil to drain down the dipstick tube and re-check.

(7) Drive vehicle until transmission fluid is at normal operating temperature.

(8) With the engine running at curb idle speed, the gear selector in NEUTRAL, and the parking brake applied, check the transmission fluid level.

CAUTION: Do not overfill transmission, fluid foaming and shifting problems can result.

(9) Add fluid to bring level up to MAX arrow mark.

When fluid level is correct, shut engine off, release park brake, remove funnel, and install dipstick in fill tube.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 100) is composed of the front clutch retainer, pressure plate, clutch plates, driving discs, piston, piston return spring, return spring retainer, and snap-rings. The front clutch is the forward-most component in the transmission geartrain and is directly behind the oil pump and is considered a driving component.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved snap-ring is used to cushion the application of the clutch pack.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being released by the release spring, fluid flows through a

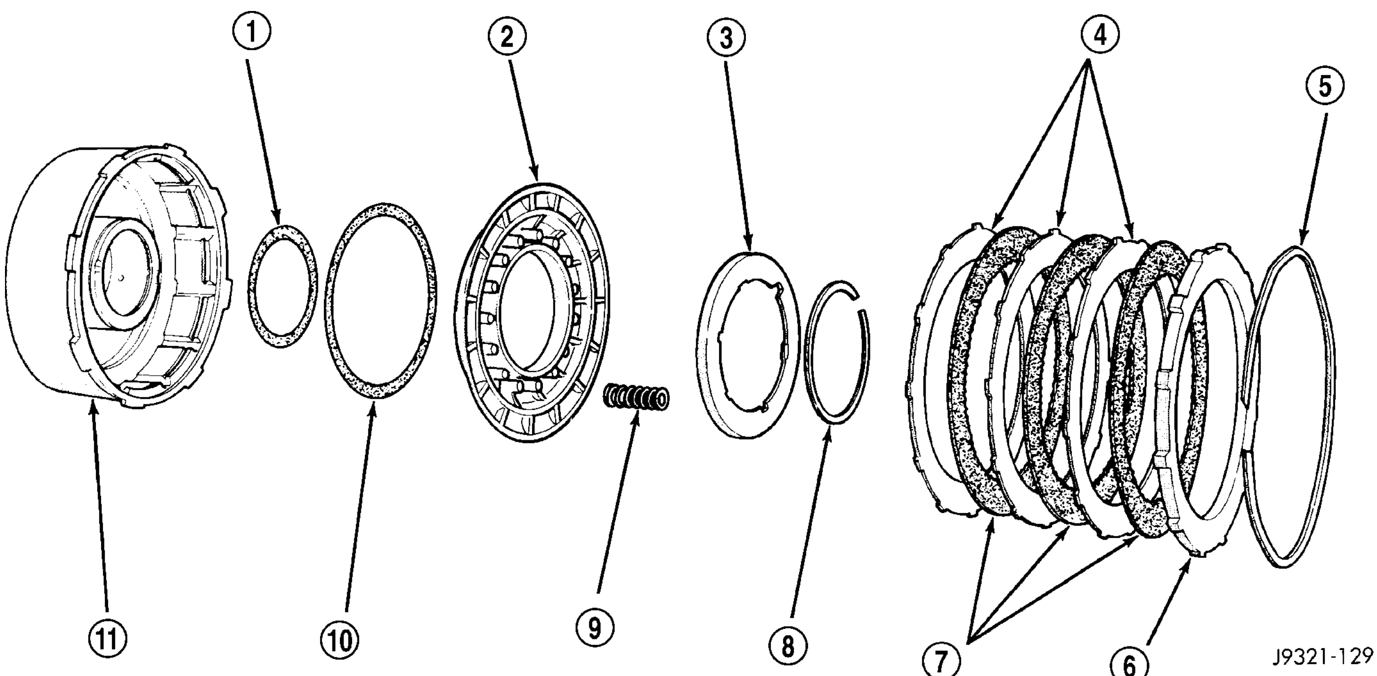


Fig. 100 Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS (9)
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

FRONT CLUTCH (Continued)

vent and one-way ball-check-valve located in the clutch retainer. The check-valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

DISASSEMBLY

(1) Remove the waved snap-ring, reaction plate, clutch plates, and clutch discs.

(2) Compress clutch piston retainer and piston springs with Compressor Tool C-3863-A (Fig. 101).

(3) Remove retainer snap-ring and remove compressor tool.

(4) Remove clutch piston springs (Fig. 102). Note position of piston springs for assembly reference.

(5) Remove clutch piston from retainer with a twisting motion.

(6) Remove and discard clutch piston inner and outer seals.

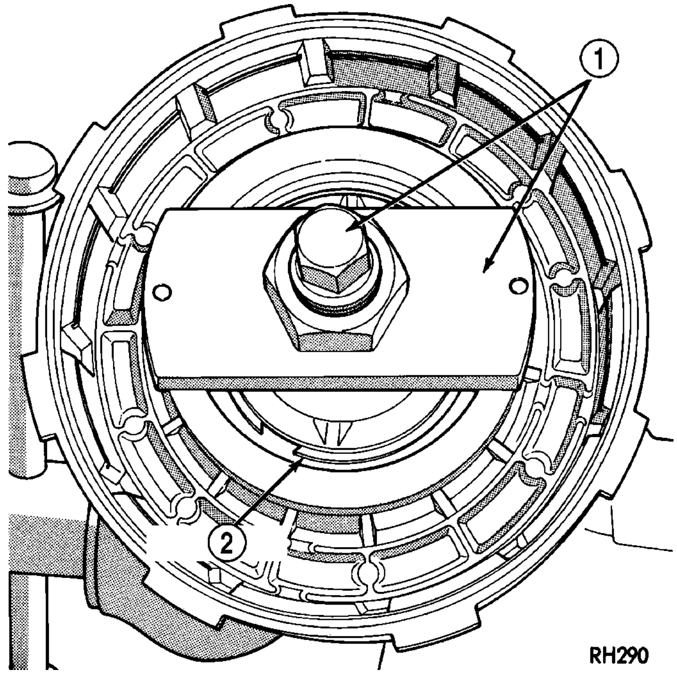


Fig. 101 Removing Front Clutch Spring Retainer Snap-Ring

1 - SPECIAL TOOL C-3863-A
2 - SNAP-RING

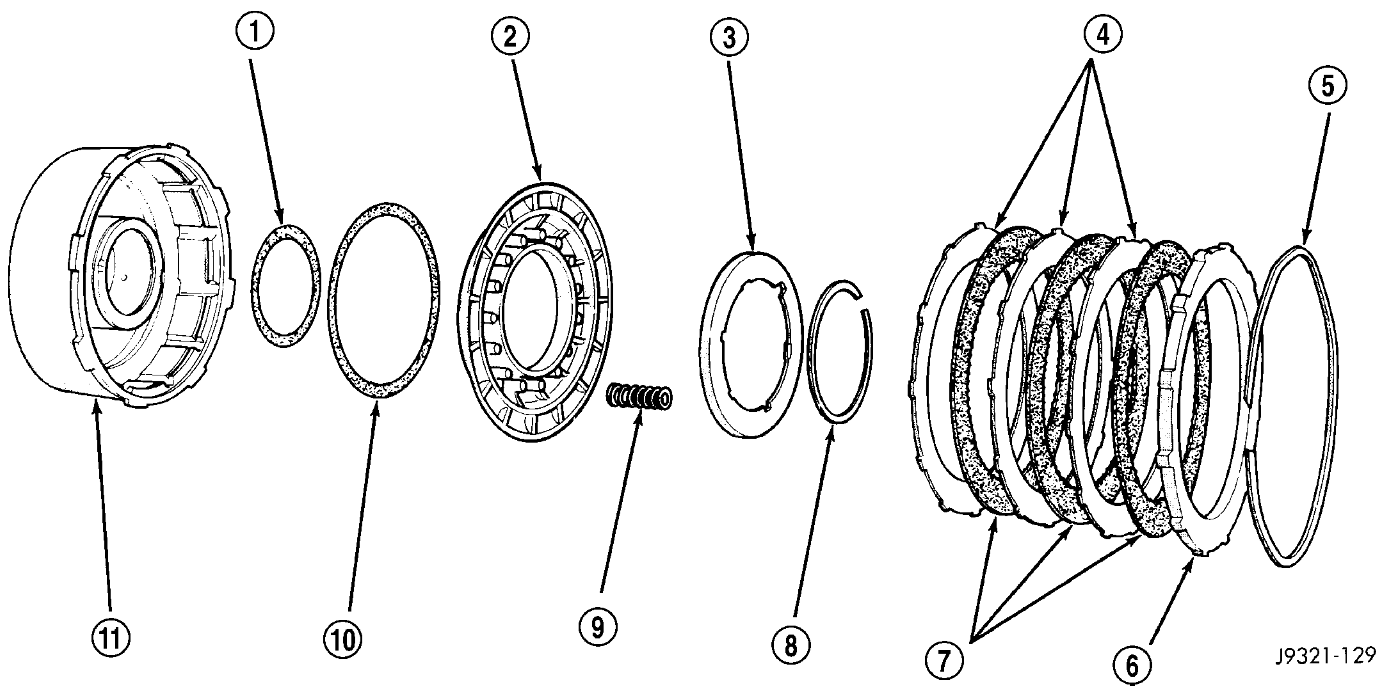


Fig. 102 Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS (9)
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

FRONT CLUTCH (Continued)

(7) Assemble Tool Handle C-4171 and Bushing Remover SP-3629 (Fig. 103).

(8) Insert remover tool in bushing and drive bushing straight out of clutch retainer.

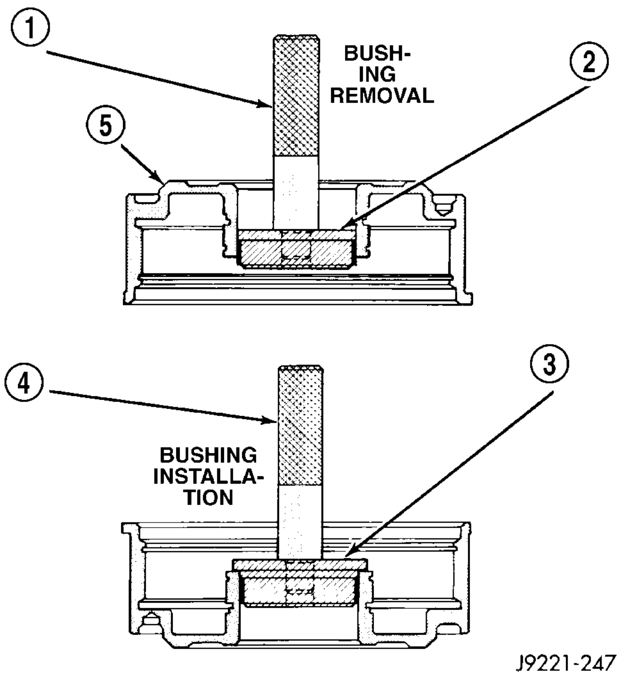


Fig. 103 Front Clutch Retainer Bushing Replacement Tools

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3629
3 - SPECIAL TOOL SP-5511
4 - SPECIAL TOOL C-4171
5 - FRONT CLUTCH RETAINER

INSPECTION

Inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and reaction plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plate are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston springs and spring retainer if either are distorted, warped or broken.

Check the lug grooves in the clutch piston retainer. The steel plates should slide freely in the slots. Replace the piston retainer if the grooves are worn or damaged. Also check action of the check ball in the piston retainer. The ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or there is any doubt about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check the clutch piston check ball. The ball should be securely in place. Replace the piston if the ball is missing, or seized in place.

ASSEMBLY

NOTE: The 46RE transmission uses three plates and discs for the front clutch.

(1) Mount Bushing Installer SP-5511 on tool handle (Fig. 104).

(2) Slide new bushing onto installer tool and start bushing into retainer.

(3) Tap new bushing into place until installer tool bottoms against clutch retainer.

(4) Remove installer tools and clean retainer thoroughly.

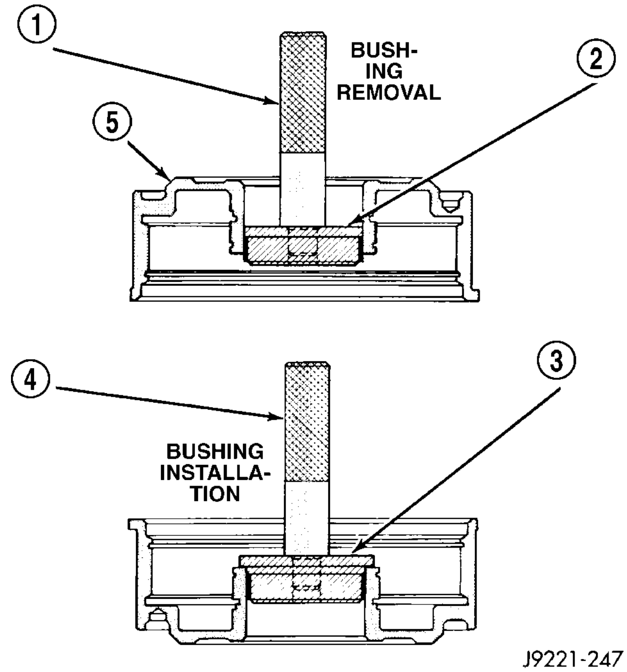


Fig. 104 Front Clutch Retainer Bushing Replacement Tools

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3629
3 - SPECIAL TOOL SP-5511
4 - SPECIAL TOOL C-4171
5 - FRONT CLUTCH RETAINER

(5) Soak clutch discs in transmission fluid.

(6) Install new inner piston seal onto the outer diameter of the clutch retainer inner hub.

(7) Install new outer seal onto the clutch piston. Be sure seal lips of both seals face the interior of the retainer.

(8) Lubricate new inner and outer piston seals with Ru-Glyde™, or Mopar® Door Ease.

(9) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.015 - 0.020 in. thick), can be used to guide seals into place if necessary.

FRONT CLUTCH (Continued)

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(10) Install and position nine clutch piston springs (Fig. 105).

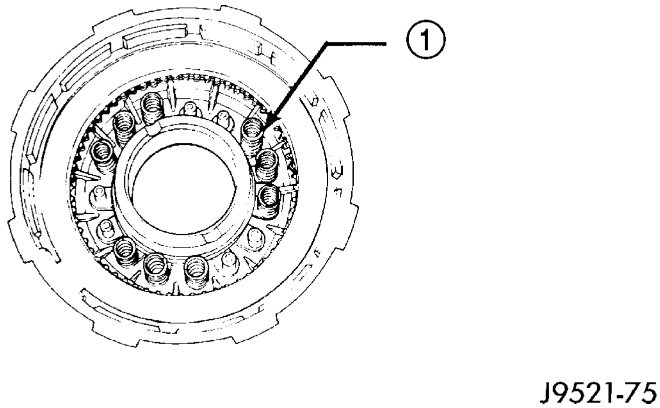


Fig. 105 Front Clutch Spring Position

1 - 9 SPRING CLUTCH

(11) Install spring retainer on top of piston springs.

(12) Compress spring retainer and piston springs with Tool C-3863-A.

(13) Install spring retainer snap-ring and remove compressor tool.

(14) Install clutch plates and discs (Fig. 102). Three clutch discs, three steel plates and one reaction plate are required.

(15) Install reaction plate followed by waved snap-ring.

(16) Check clutch pack clearance with feeler gauge (Fig. 106). Clearance between waved spring and pressure plate should 1.78 - 3.28 mm (0.070 - 0.129 in.). If clearance is incorrect, clutch plates, clutch discs, snap-ring, or pressure plate may have to be changed.

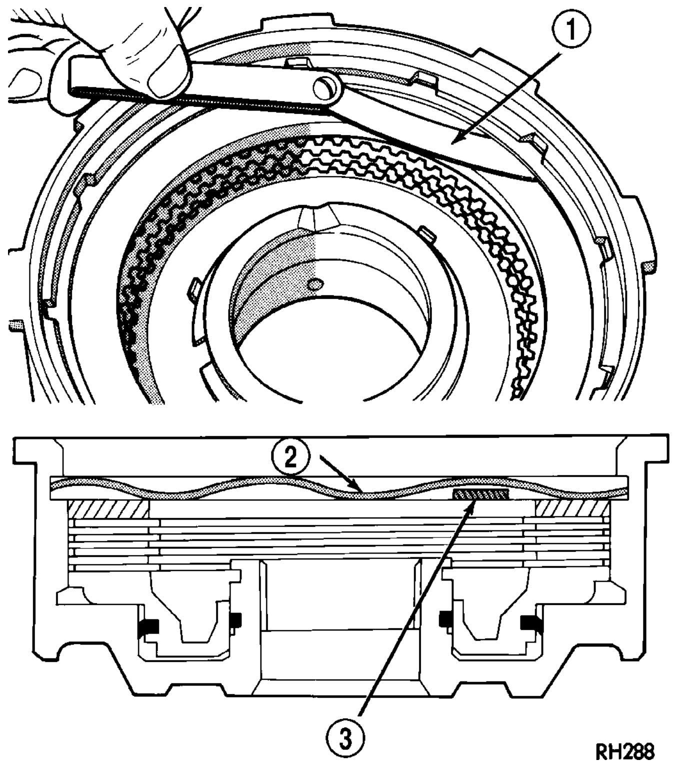


Fig. 106 Typical Method Of Measuring Front Clutch Pack Clearance

1 - FEELER GAUGE
2 - WAVED SNAP-RING
3 - FEELER GAUGE

FRONT SERVO

DESCRIPTION

The kickdown servo (Fig. 107) consists of a two-land piston with an inner piston, a piston rod and guide, and a return spring. The dual-land piston uses seal rings on its outer diameters and an O-ring for the inner piston.

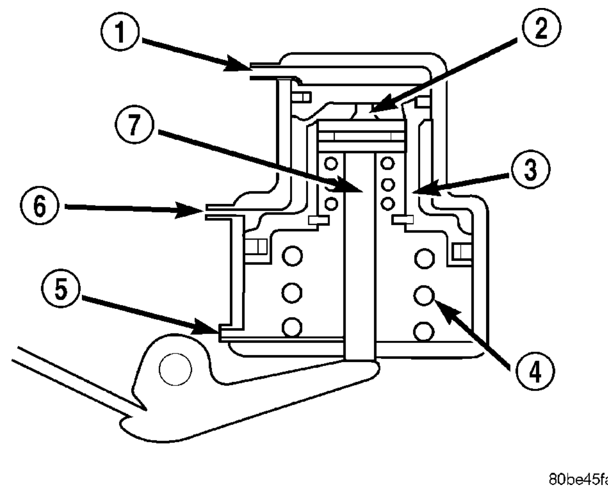


Fig. 107 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

FRONT SERVO (Continued)

OPERATION

The application of the piston is accomplished by applying pressure between the two lands of the piston. The pressure acts against the larger lower land to push the piston downward, allowing the piston rod to extend though its guide against the apply lever. Release of the servo at the 2-3 upshift is accomplished by a combination of spring and line pressure, acting on the bottom of the larger land of the piston. The small piston is used to cushion the application of the band by bleeding oil through a small orifice in the larger piston. The release timing of the kickdown servo is very important to obtain a smooth but firm shift. The release has to be very quick, just as the front clutch application is taking place. Otherwise, engine runaway or a shift hesitation will occur. To accomplish this, the band retains its holding capacity until the front clutch is applied, giving a small amount of overlap between them.

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 108).

(2) Remove small snap-ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

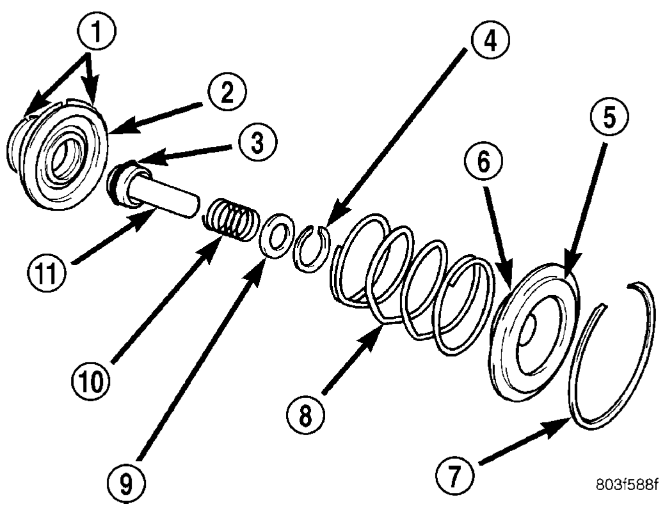


Fig. 108 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

CLEANING

Clean the servo piston components (Fig. 109) with solvent and dry them with compressed air.

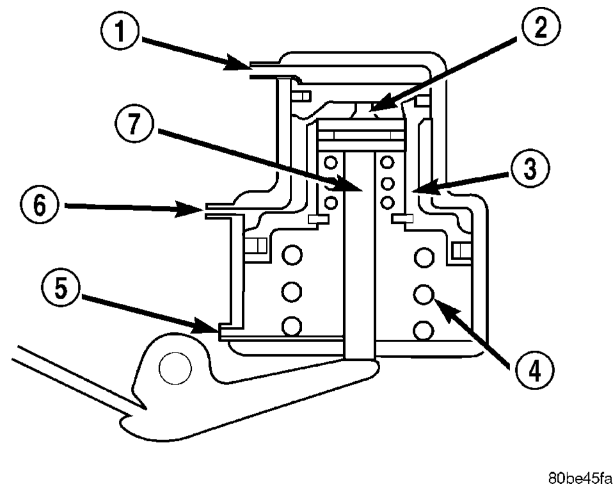


Fig. 109 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

INSPECTION

Inspect the servo components (Fig. 110). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap-ring if distorted or warped.

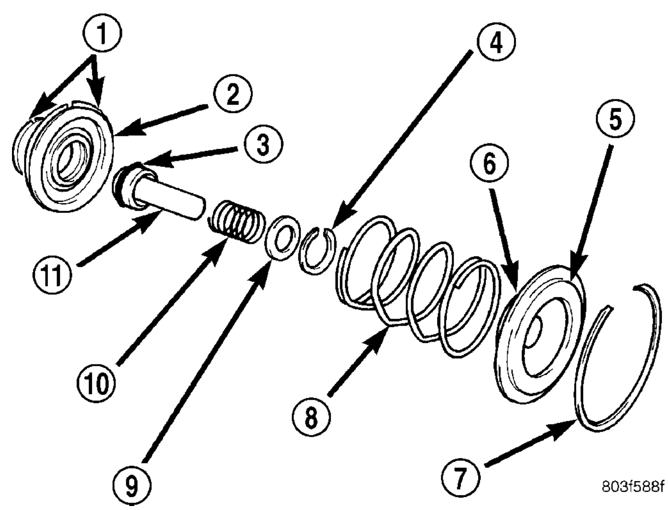


Fig. 110 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

FRONT SERVO (Continued)

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

ASSEMBLY

Clean and inspect front servo components.

(1) Lubricate new o-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap-ring (Fig. 111).

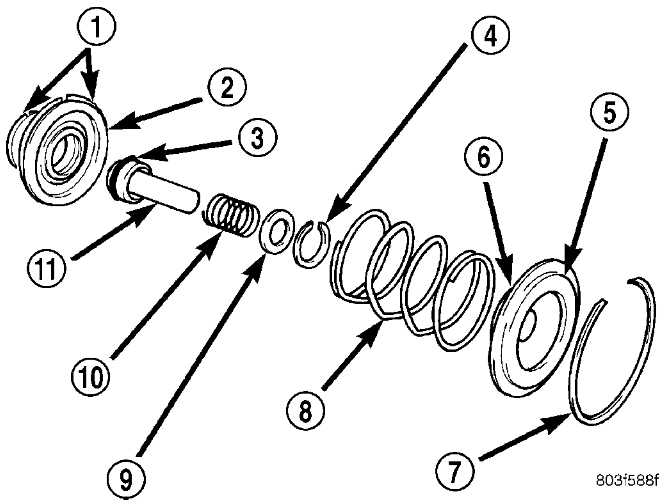


Fig. 111 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) Engine starts must be possible with shift lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any other gear position.

(2) With the shift lever in the:

(a) PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.

(b) PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.

(c) NEUTRAL position - Normal position. Engine starts must be possible.

(d) NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 112) or (Fig. 113).

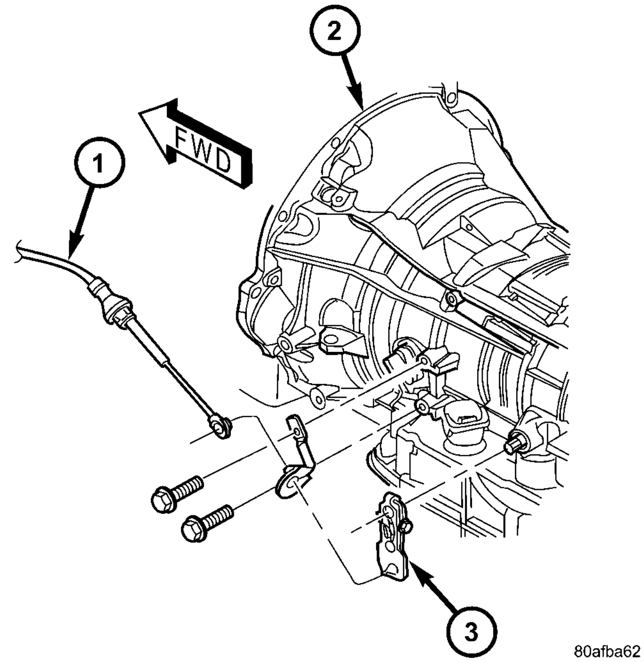


Fig. 112 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

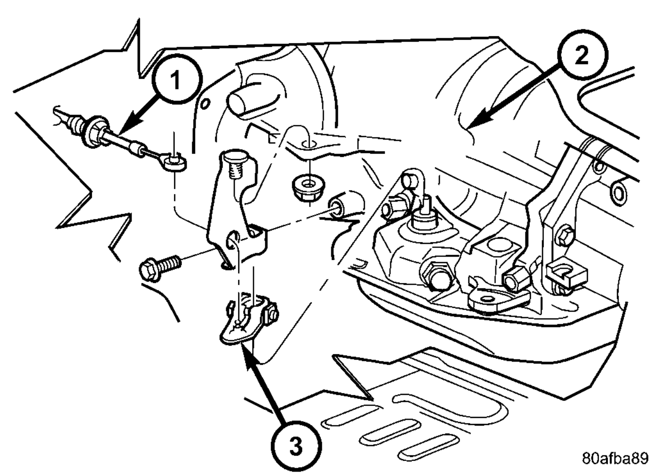


Fig. 113 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

GEARSHIFT CABLE (Continued)

(4) Lower the vehicle.

(5) Remove the dash panel insulation pad as necessary to access the gearshift cable grommet (Fig. 114).

(6) Remove grommet from the dash panel.

(7) Remove any steering column trim necessary to access the gearshift cable and BTSI mechanism.

(8) Disconnect the BTSI wiring connector.

(9) Disconnect cable at lower column bracket and shift lever pin and pull the cable through the dash panel opening into the vehicle (Fig. 115).

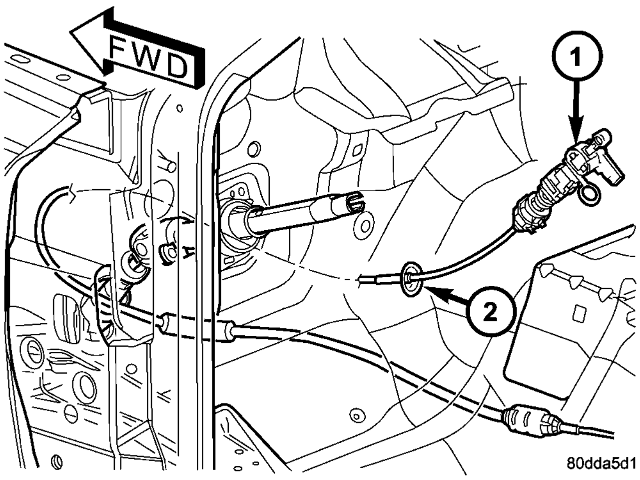


Fig. 114 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

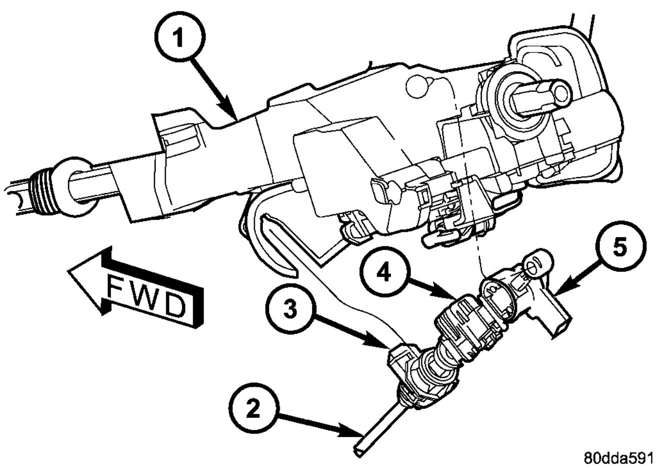


Fig. 115 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

(10) Remove gearshift cable from vehicle.

INSTALLATION

(1) Route the transmission end of the gearshift cable through the opening in the dash panel (Fig. 116).

(2) Seat the cable grommet into the dash panel opening.

(3) Snap the cable into the steering column bracket so the retaining ears (Fig. 117) are engaged and snap the cable eyelet onto the shift lever ball stud.

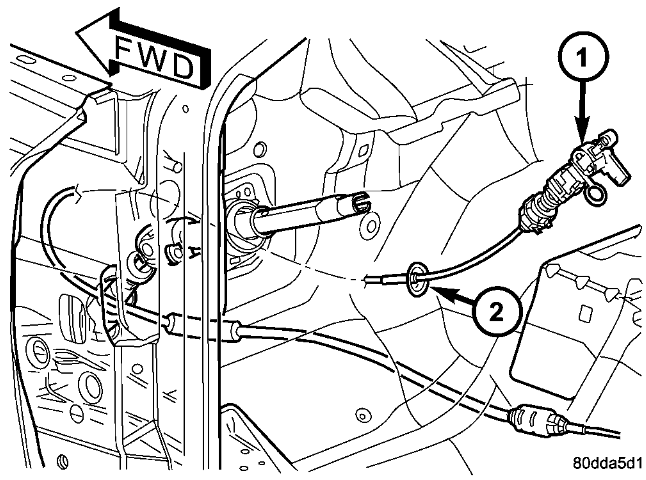


Fig. 116 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

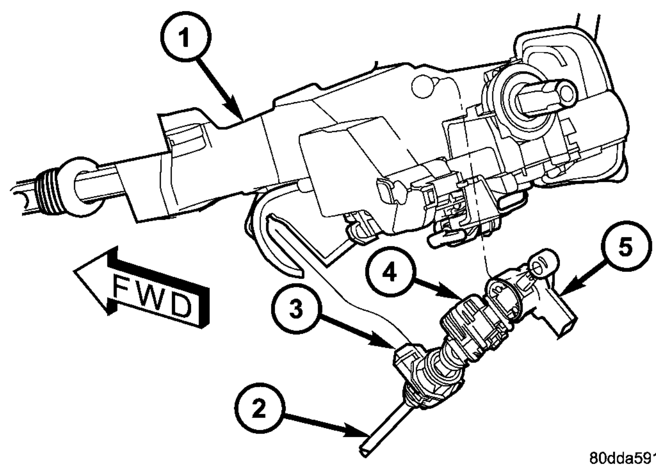


Fig. 117 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

GEARSHIFT CABLE (Continued)

(4) Raise the vehicle.

(5) Place the transmission manual shift lever in the “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(6) Route the gearshift cable through the transmission mounting bracket and secure the cable by snapping the cable retaining ears into the transmission bracket and snapping the cable eyelet on the manual shift lever ball stud.

(7) Lower vehicle.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock tab downward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable and BTSI mechanism as necessary.

ADJUSTMENTS

GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT if the engine starts only in these positions. Adjustment is INCORRECT if the engine starts in one but not both positions. If the engine starts in any position other than PARK or NEUTRAL, or if the engine will not start at all, the transmission range sensor may be faulty.

Gearshift Adjustment Procedure

(1) Shift transmission into PARK.

(2) Release cable adjuster lock tab (underneath the steering column) (Fig. 118) to unlock cable.

(3) Raise vehicle.

(4) Disengage the cable eyelet from the transmission manual shift lever.

(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.

(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap the cable eyelet onto the transmission manual shift lever.

(8) Lower vehicle.

(9) Lock shift cable by pressing cable adjuster lock tab downward until it snaps into place.

(10) Check engine starting. Engine should start only in PARK and NEUTRAL

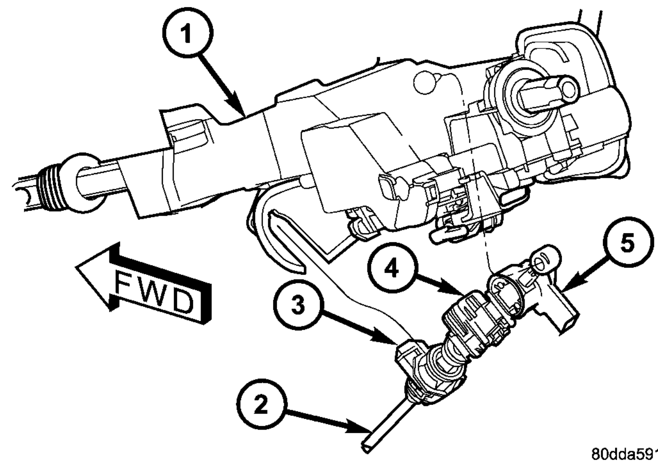


Fig. 118 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

OIL PUMP

DESCRIPTION

The oil pump (Fig. 119) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear, a housing, and a reaction shaft support.

OPERATION

As the torque converter rotates, the converter hub rotates the inner and outer gears. As the gears rotate, the clearance between the gear teeth increases in the crescent area, and creates a suction at the inlet side of the pump. This suction draws fluid through the pump inlet from the oil pan. As the clearance between the gear teeth in the crescent area decreases, it forces pressurized fluid into the pump outlet and to the valve body.

DISASSEMBLY

(1) Mark position of support in oil pump body for assembly alignment reference. Use scriber or paint to make alignment marks.

(2) Place pump body on two wood blocks.

(3) Remove reaction shaft support bolts and separate support from pump body (Fig. 120).

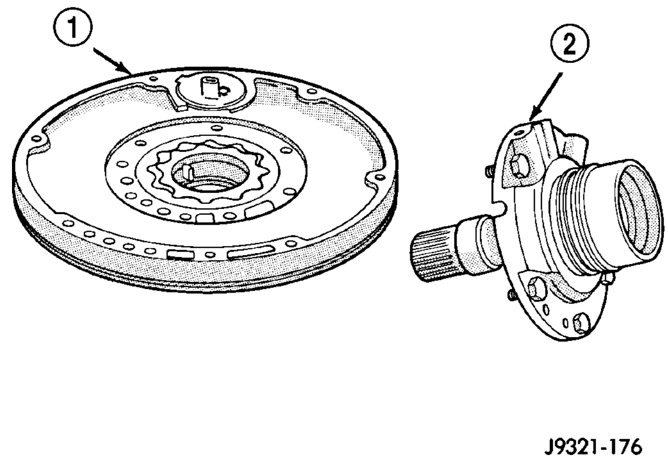


Fig. 120 Reaction Shaft Support

1 - OIL PUMP
2 - REACTION SHAFT SUPPORT

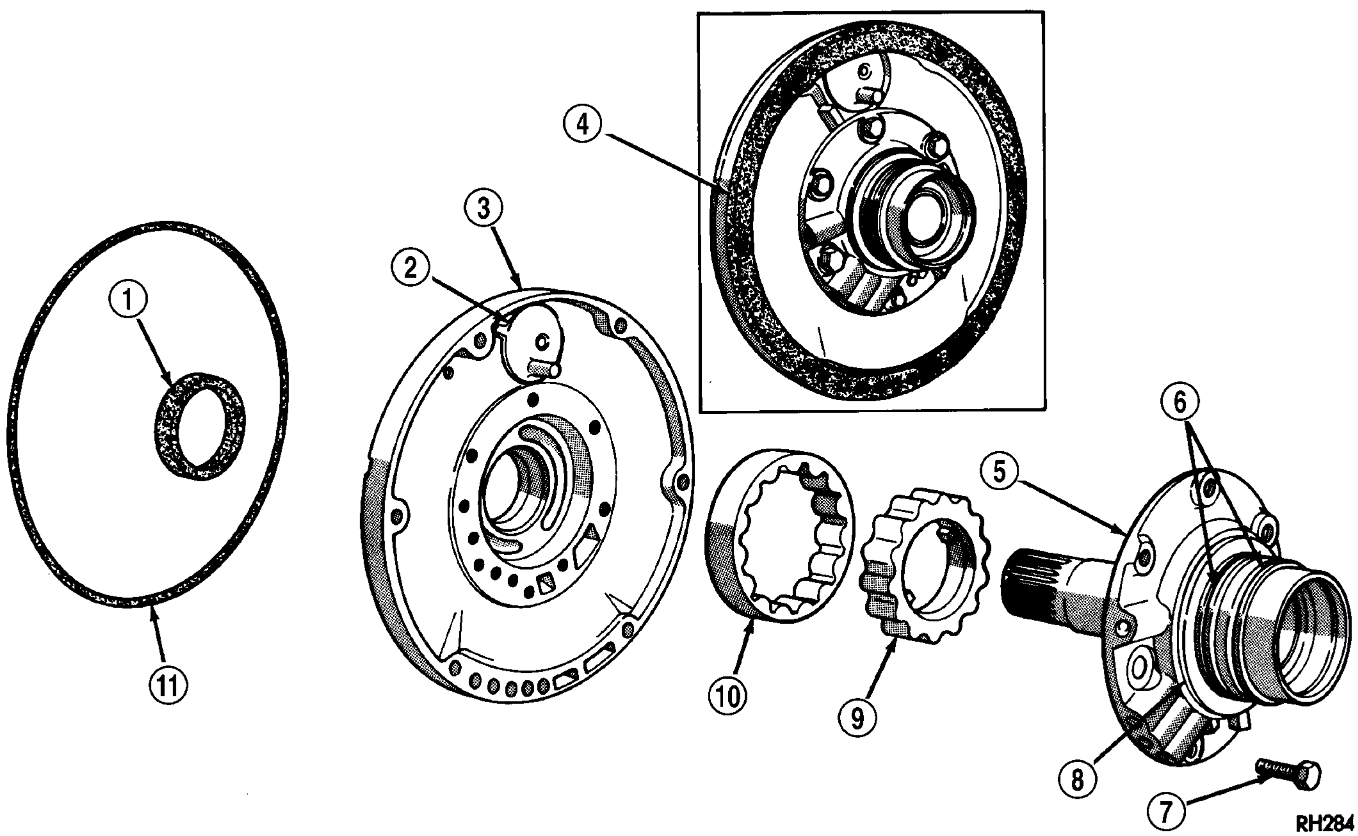


Fig. 119 Oil Pump Assembly

1 - OIL SEAL
2 - VENT BAFFLE
3 - OIL PUMP BODY
4 - GASKET
5 - REACTION SHAFT SUPPORT
6 - SEAL RINGS
7 - BOLTS (6)
8 - #1 THRUST WASHER (SELECTIVE)
9 - INNER GEAR
10 - OUTER GEAR
11 - “O” RING

OIL PUMP (Continued)

(4) Remove pump inner and outer gears (Fig. 121).

(5) Remove o-ring seal from pump body (Fig. 122). Discard seal after removal.

(6) Remove oil pump seal with Remover Tool C-3981. Discard seal after removal.

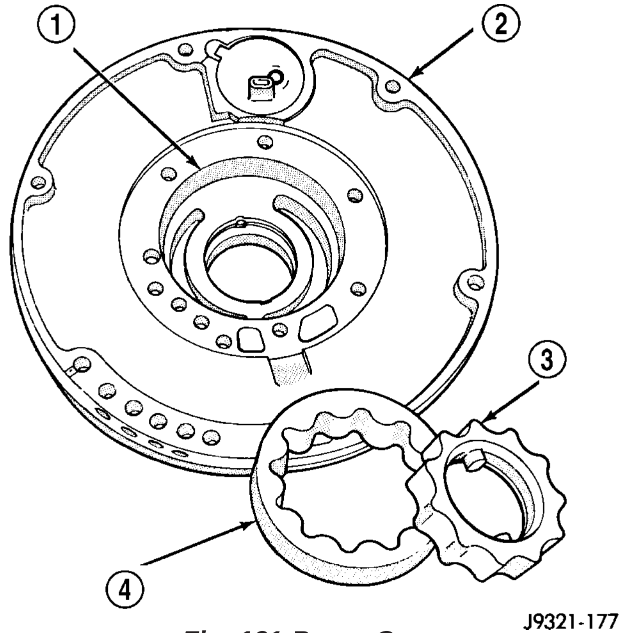


Fig. 121 Pump Gears

1 - GEAR BORE
2 - PUMP BODY
3 - INNER GEAR
4 - OUTER GEAR

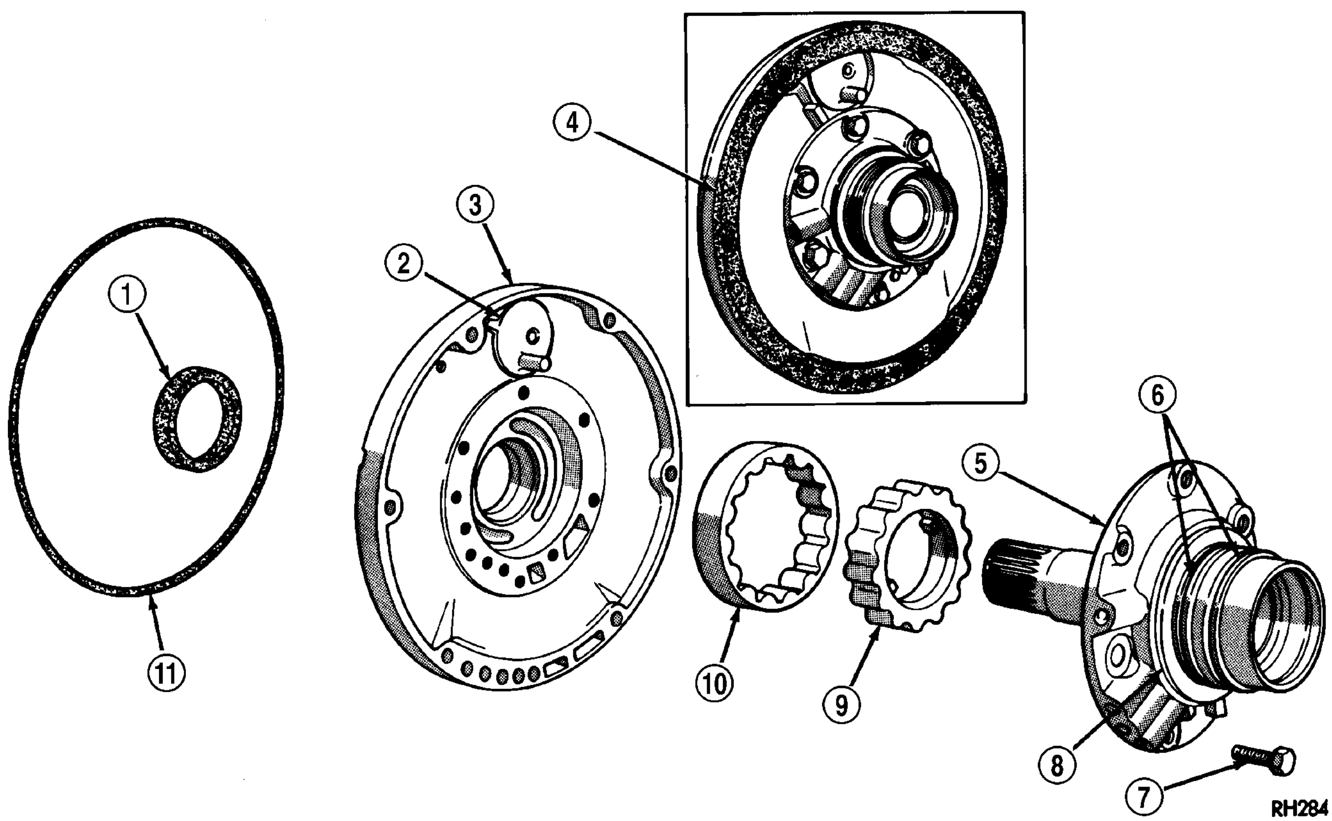


Fig. 122 Oil Pump Assembly

1 - OIL SEAL
2 - VENT BAFFLE
3 - OIL PUMP BODY
4 - GASKET
5 - REACTION SHAFT SUPPORT
6 - SEAL RINGS
7 - BOLTS (6)
8 - #1 THRUST WASHER (SELECTIVE)
9 - INNER GEAR
10 - OUTER GEAR
11 - “O” RING

OIL PUMP (Continued)

OIL PUMP BUSHING REMOVAL

(1) Position pump housing on clean, smooth surface with gear cavity facing down.

(2) Remove bushing with Tool Handle C-4171 and Bushing Remover SP-3550 (Fig. 123).

REACTION SHAFT SUPPORT BUSHING REMOVAL

(1) Assemble Cup Tool SP-3633, Nut SP-1191 and Bushing Remover SP-5301 (Fig. 124).

(2) Hold cup tool firmly against reaction shaft. Thread remover tool into bushing as far as possible by hand.

(3) Using wrench, thread remover tool an additional 3-4 turns into bushing to firmly engage tool.

(4) Tighten tool hex nut against cup tool to pull bushing from shaft. Clean all chips from shaft and support after bushing removal.

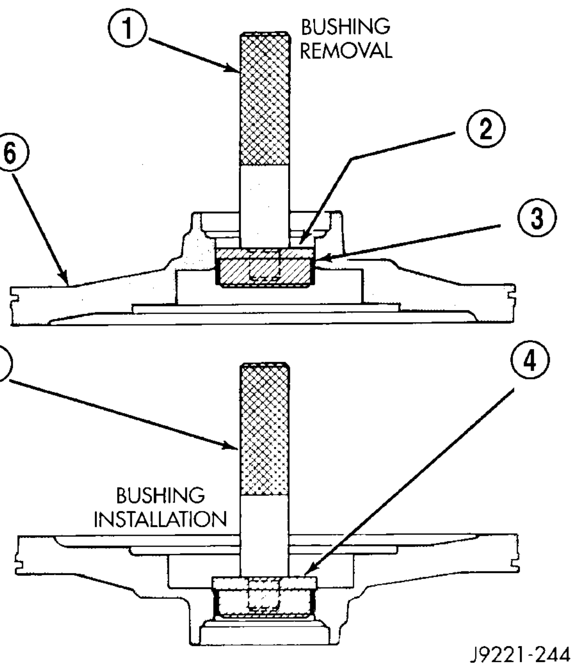


Fig. 123 Oil Pump Bushing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3550
3 - BUSHING
4 - SPECIAL TOOL SP-5118
5 - SPECIAL TOOL C-4171
6 - PUMP HOUSING

CLEANING

Clean pump and support components with solvent and dry them with compressed air.

INSPECTION

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

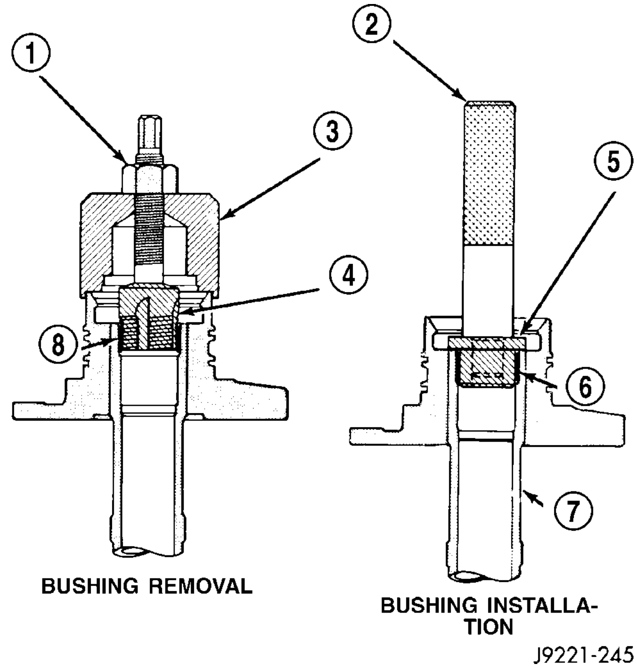


Fig. 124 Reaction Shaft Bushing

1 - SPECIAL TOOL SP-1191
2 - SPECIAL TOOL C-4171
3 - SPECIAL TOOL SP-3633
4 - SPECIAL TOOL SP-5301
5 - SPECIAL TOOL SP-5302
6 - BUSHING
7 - REACTION SHAFT
8 - BUSHING

Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Inspect the pump bushing. Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

Clearance between outer gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Clearance between inner gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Both clearances can be measured at the same time by installing the gears in the pump body and measure pump component clearances as follows:

(1) Position an appropriate piece of Plastigage™ across both gears.

(2) Align the plastigage to a flat area on the reaction shaft housing.

(3) Install the reaction shaft to the pump housing.

(4) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

OIL PUMP (Continued)

Clearance between inner gear tooth and outer gear should be 0.08 to 0.19 mm (0.0035 to 0.0075 in.). Measure clearance with an appropriate feeler gauge (Fig. 125).

Clearance between outer gear and pump housing should be 0.10 to 0.19 mm (0.004 to 0.0075 in.). Measure clearance with an appropriate feeler gauge.

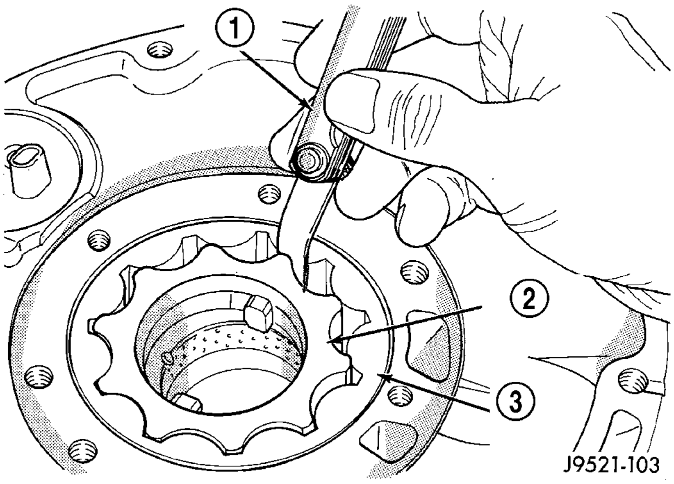


Fig. 125 Checking Pump Gear Tip Clearance

1 - FEELER GAUGE
2 - INNER GEAR
3 - OUTER GEAR

ASSEMBLY

OIL PUMP BUSHING

(1) Assemble Tool Handle C-4171 and Bushing Installer SP-5118 (Fig. 126).

(2) Place bushing on installer tool and start bushing into shaft.

(3) Tap bushing into place until Installer Tool SP-5118 bottoms in pump cavity. Keep tool and bushing square with bore. Do not allow bushing to become cocked during installation.

(4) Stake pump bushing in two places with blunt punch. Remove burrs from stake points with knife blade (Fig. 127).

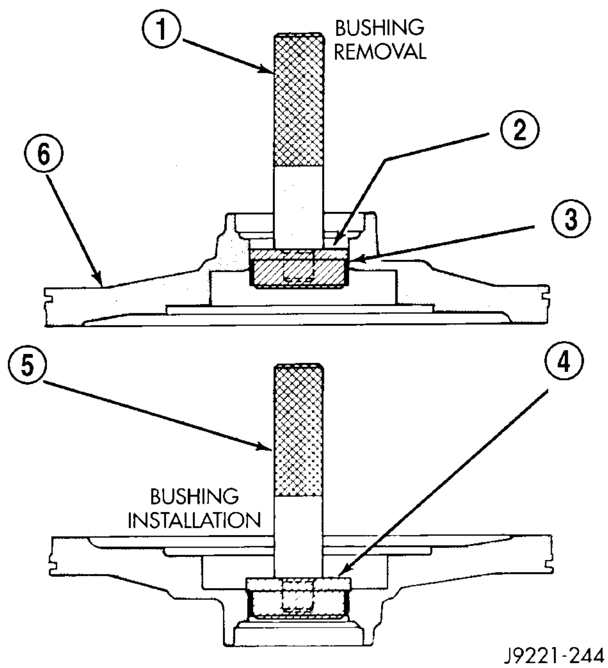


Fig. 126 Oil Pump Bushing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL SP-3550
3 - BUSHING
4 - SPECIAL TOOL SP-5118
5 - SPECIAL TOOL C-4171
6 - PUMP HOUSING

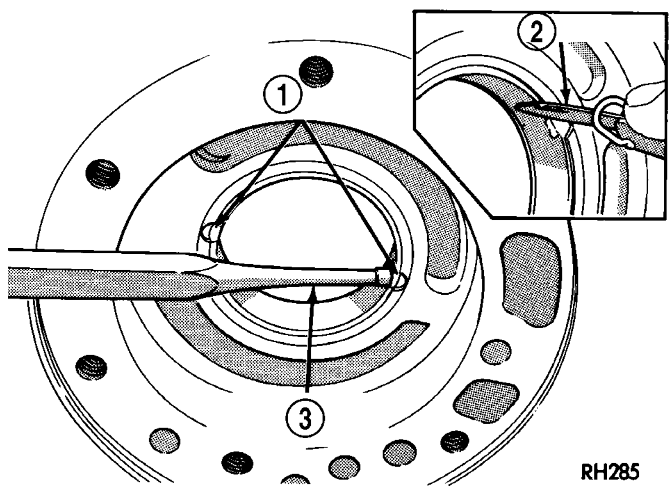


Fig. 127 Staking-Deburring Oil Pump Bushing

1 - TWO STAKES
2 - NARROW BLADE
3 - BLUNT PUNCH

OIL PUMP (Continued)

REACTION SHAFT SUPPORT BUSHING

(1) Place reaction shaft support upright on a clean, smooth surface.

(2) Assemble Bushing Installer Tools C-4171 and SP-5302. Then slide new bushing onto installer tool (Fig. 128).

(3) Start bushing in shaft. Tap bushing into shaft until installer tool bottoms against support flange.

(4) Clean reaction shaft support thoroughly after bushing replacement (to remove any chips).

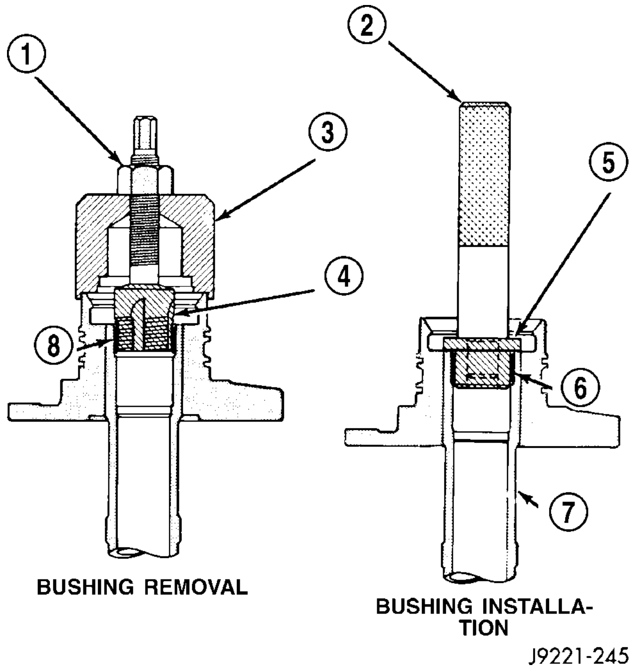


Fig. 128 Reaction Shaft Bushing

1 - SPECIAL TOOL SP-1191
2 - SPECIAL TOOL C-4171
3 - SPECIAL TOOL SP-3633
4 - SPECIAL TOOL SP-5301
5 - SPECIAL TOOL SP-5302
6 - BUSHING
7 - REACTION SHAFT
8 - BUSHING

OIL PUMP BODY

(1) Lubricate pump gears with transmission fluid and install them in pump body.

(2) Install thrust washer on reaction shaft support hub. Lubricate washer with petroleum jelly or transmission fluid before installation.

(3) If reaction shaft seal rings are being replaced, install new seal rings on support hub. Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(4) Align and install reaction shaft support on pump body.

(5) Install bolts attaching reaction shaft support to pump. Tighten bolts to 20 N·m (175 in. lbs.) torque.

(6) Install new pump seal with Installer Tool C-3860-A (Fig. 129). Use hammer or mallet to tap seal into place.

(7) Install new o-ring on pump body. Lubricate oil seal and o-ring with petroleum jelly.

(8) Cover pump assembly to prevent dust entry and set aside for assembly installation.

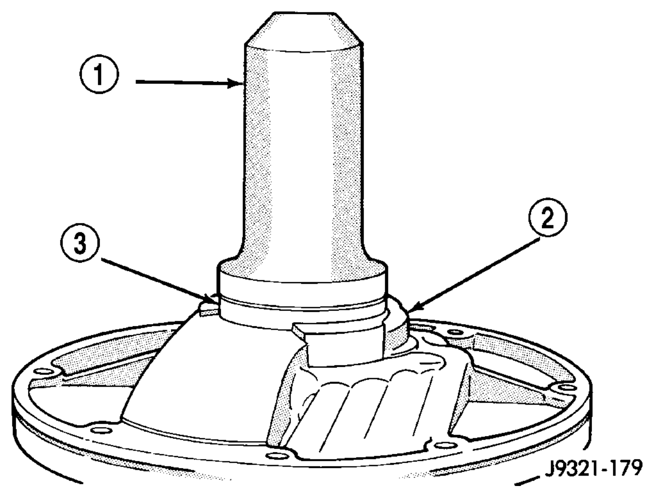


Fig. 129 Oil Pump Seal

1 - SPECIAL TOOL C-3860-A
2 - PUMP BODY
3 - PUMP SEAL

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft front bearing to overdrive geartrain. (Fig. 130).

(4) Pull bearing from output shaft.

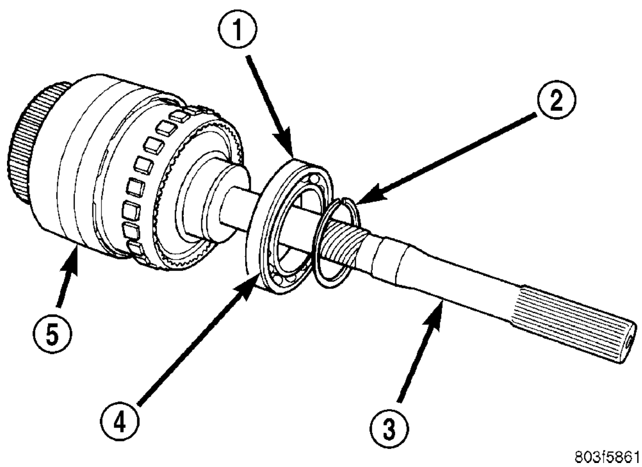


Fig. 130 Output Shaft Front Bearing

1 - OUTPUT SHAFT FRONT BEARING
2 - SNAP-RING
3 - OUTPUT SHAFT
4 - GROOVE TO REAR
5 - OVERDRIVE GEARTRAIN

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.

(2) Push bearing onto shaft until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing onto output shaft.

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle. (Refer to 21 - TRANSMISSION/AUTOMATIC/OVERDRIVE - REMOVAL)

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft rear bearing into overdrive housing (Fig. 131).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

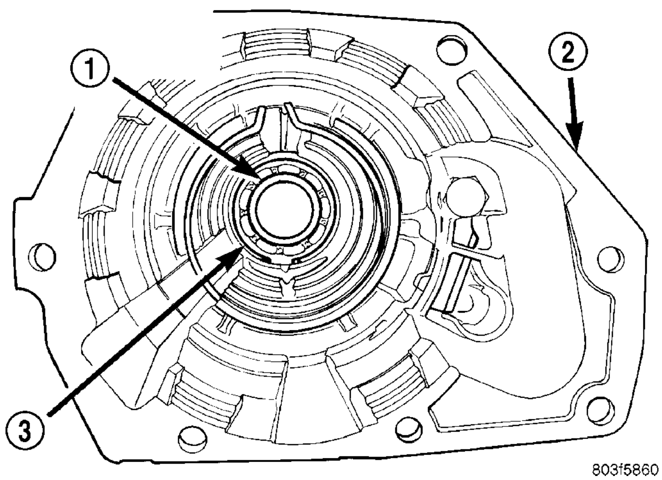


Fig. 131 Output Shaft Rear Bearing

1 - OUTPUT SHAFT REAR BEARING
2 - OVERDRIVE HOUSING
3 - SNAP-RING

INSTALLATION

(1) Place replacement bearing in position in housing.

(2) Using a suitable driver, drive bearing into housing until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing into housing (Fig. 131).

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OVERDRIVE CLUTCH

DESCRIPTION

The overdrive clutch (Fig. 132) is composed of the pressure plate, clutch plates, holding discs, overdrive piston retainer, piston, piston spacer, and snap-rings. The overdrive clutch is the forwardmost component in the transmission overdrive unit and is considered a holding component. The overdrive piston retainer, piston, and piston spacer are located on the rear of the main transmission case.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

OPERATION

To apply the clutch, pressure is applied between the piston retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through passages at the lower rear portion of the valve body area. With pressure applied between the piston retainer and piston, the piston moves away from the piston retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the intermediate shaft into the overdrive planetary gear set. The overdrive clutch discs are attached to the overdrive clutch hub while the overdrive clutch plates, reaction plate, and pressure plate are lugged to the overdrive housing. This allows the intermediate shaft to transfer the engine torque to the planetary gear and overrunning clutch. This drives the planetary gear inside the annulus, which is attached to the overdrive clutch drum and output shaft, creating the desired gear ratio. The waved snap-ring is used to cushion the application of the clutch pack.

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 133). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

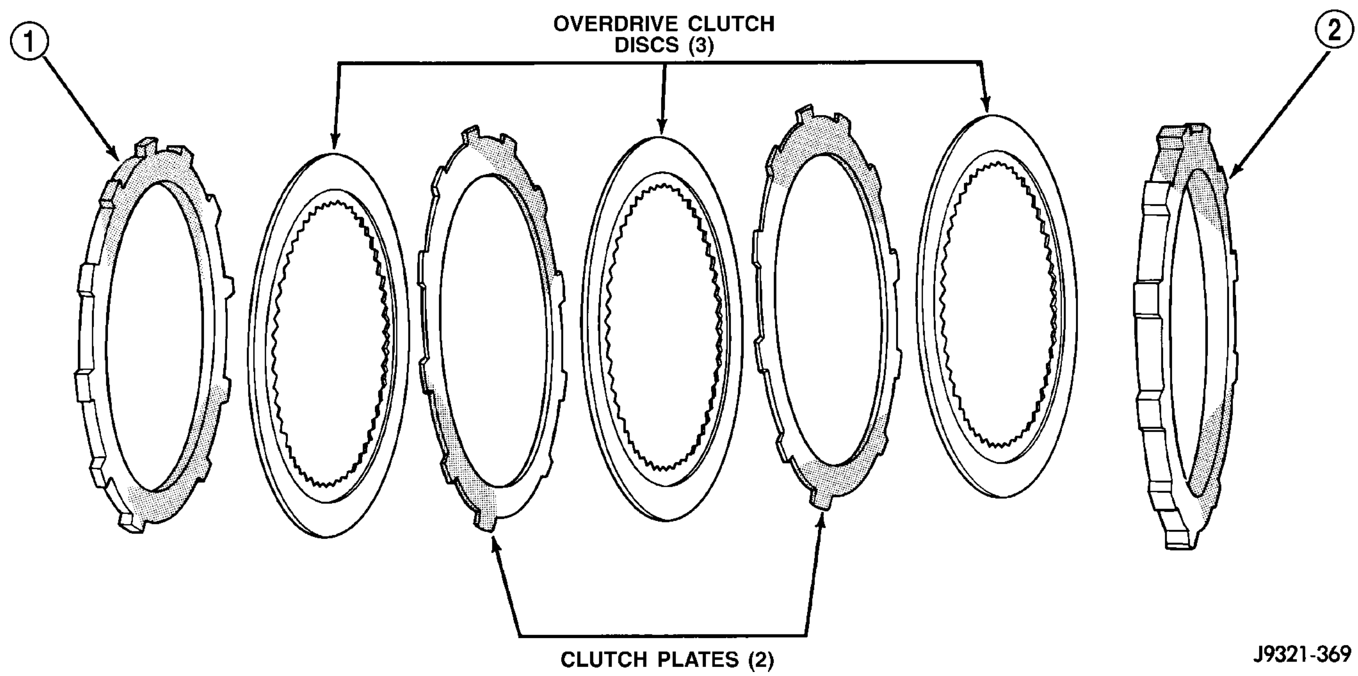


Fig. 132 Overdrive Clutch

1 - REACTION PLATE
2 - PRESSURE PLATE

OVERDRIVE SWITCH (Continued)

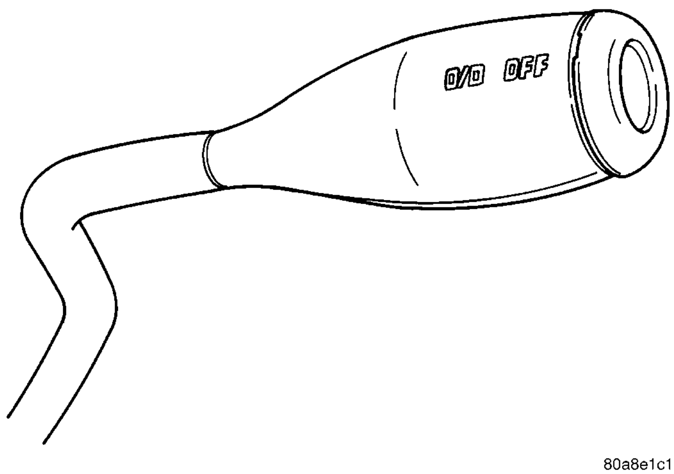


Fig. 133 Overdrive Off Switch

DIAGNOSIS AND TESTING - OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 134).

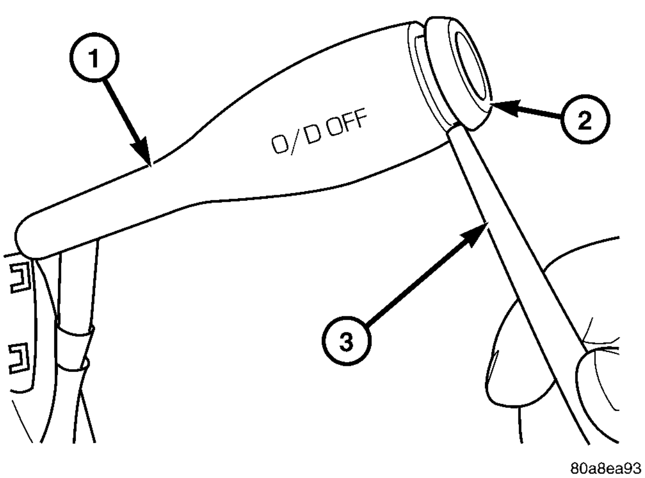


Fig. 134 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 135)

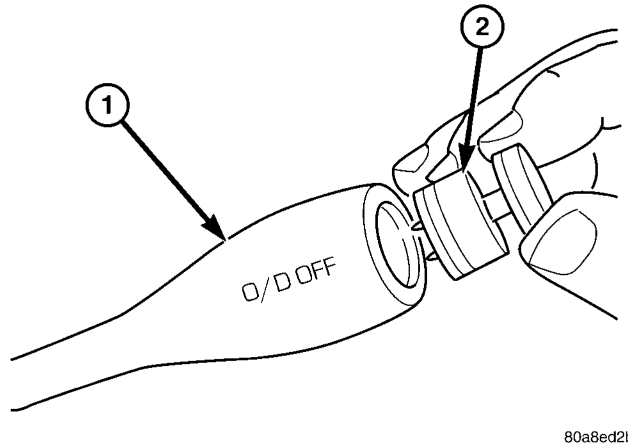


Fig. 135 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

(2) Install the overdrive off switch into the connector (Fig. 136)

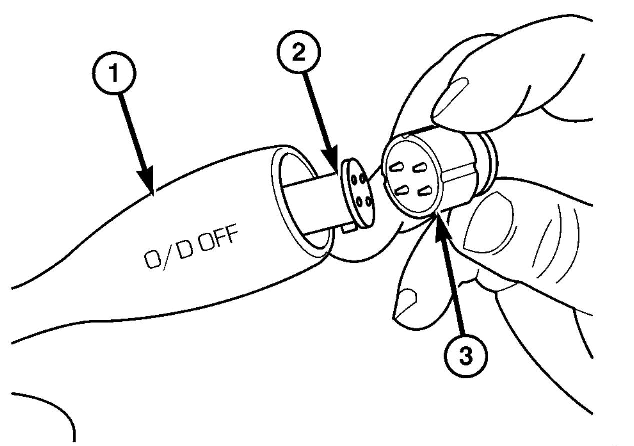


Fig. 136 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.

(4) Install the overdrive off switch retainer onto the shift lever.

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into PARK.
(2) Raise vehicle.
(3) Remove transfer case, if equipped.
(4) Mark propeller shaft universal joint(s) and axle pinion yoke, or the companion flange and flange yoke, for alignment reference at installation, if necessary.
(5) Disconnect and remove the rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)
(6) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.
(7) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.
(8) Support transmission with transmission jack.
(9) Remove bolts attaching overdrive unit to transmission (Fig. 137).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

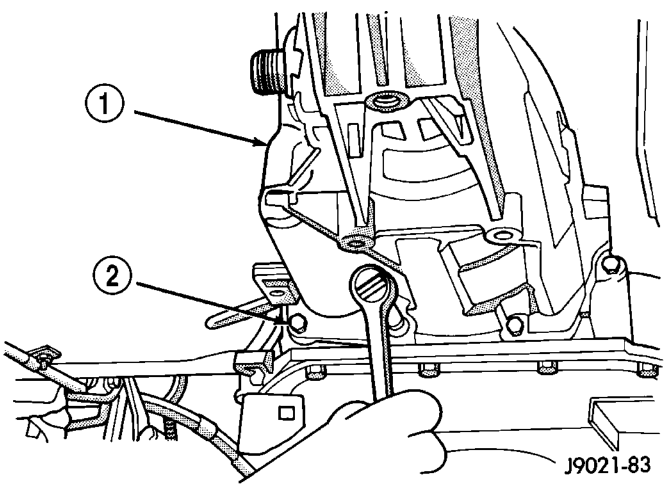


Fig. 137 Overdrive Unit Bolts

1 - OVERDRIVE UNIT
2 - ATTACHING BOLTS (7)

(10) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.
(11) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.
(12) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.
(13) Position drain pan on workbench.
(14) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.
(15) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.
(16) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

DISASSEMBLY

(1) Remove transmission speed sensor and o-ring seal from overdrive case (Fig. 138).
(2) Remove overdrive piston thrust bearing (Fig. 139).

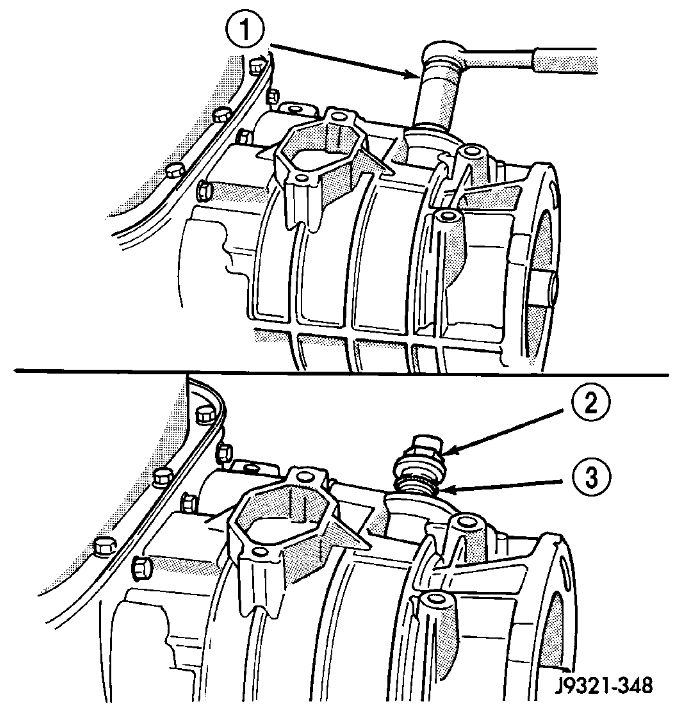


Fig. 138 Transmission Speed Sensor

1 - SOCKET AND WRENCH
2 - SPEED SENSOR
3 - O-RING

OVERDRIVE UNIT (Continued)

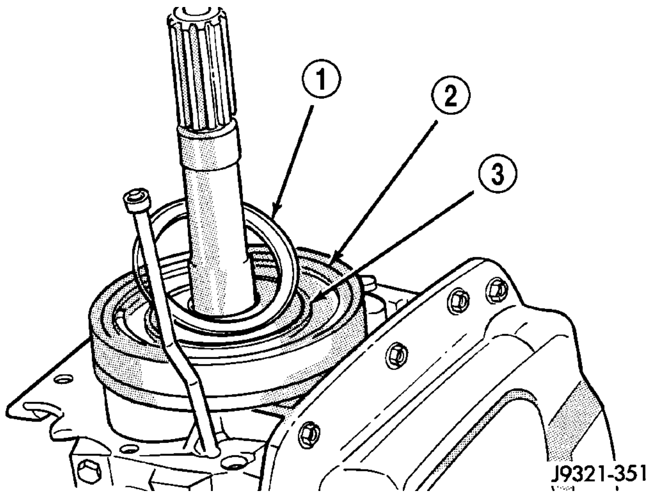


Fig. 139 Overdrive Piston Thrust Bearing Removal/ Installation

1 - THRUST BEARING
2 - OVERDRIVE PISTON
3 - THRUST PLATE

OVERDRIVE PISTON

(1) Remove overdrive piston thrust plate (Fig. 140). Retain thrust plate. It is a select fit part and may possibly be reused.

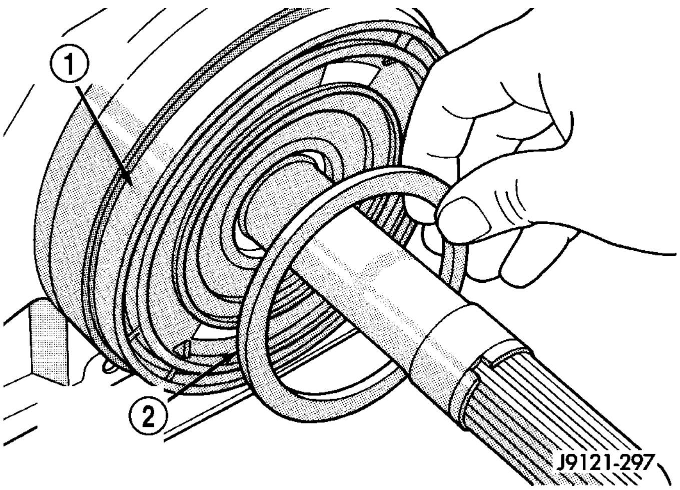


Fig. 140 Overdrive Piston Thrust Plate Removal/ Installation

1 - OVERDRIVE PISTON
2 - OVERDRIVE PISTON SPACER (SELECT FIT)

(2) Remove intermediate shaft spacer (Fig. 141). Retain spacer. It is a select fit part and may possibly be reused.

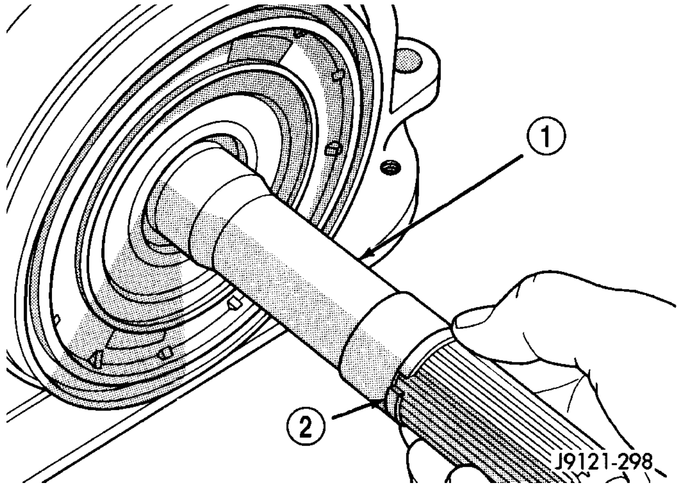


Fig. 141 Intermediate Shaft Spacer Location

1 - INTERMEDIATE SHAFT
2 - INTERMEDIATE SHAFT SPACER (SELECT FIT)

(3) Remove overdrive piston from retainer (Fig. 142).

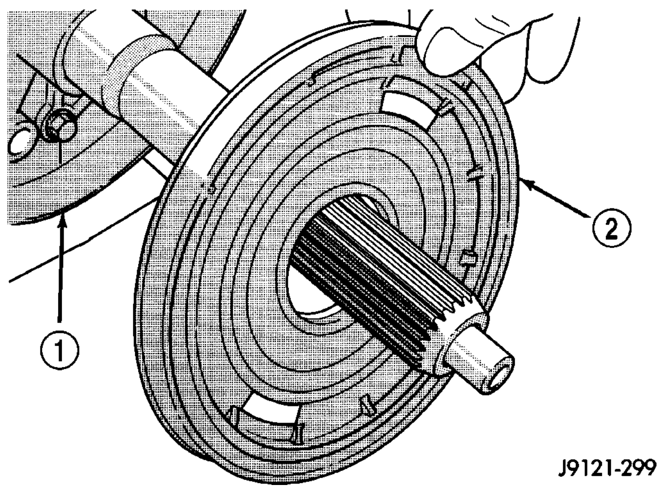


Fig. 142 Overdrive Piston Removal

1 - PISTON RETAINER
2 - OVERDRIVE PISTON

OVERDRIVE UNIT (Continued)

OVERDRIVE CLUTCH PACK

(1) Remove overdrive clutch pack wire retaining ring (Fig. 143).

(2) Remove overdrive clutch pack (Fig. 144).

(3) Note position of clutch pack components for assembly reference (Fig. 145).

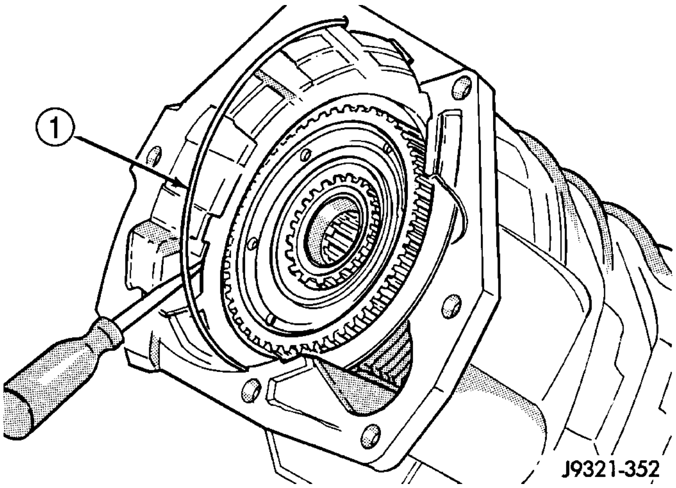


Fig. 143 Removing Overdrive Clutch Pack Retaining Ring

1 - OVERDRIVE CLUTCH PACK RETAINING RING

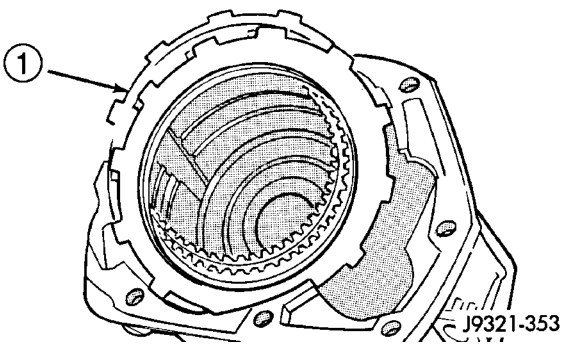


Fig. 144 Overdrive Clutch Pack Removal

1 - OVERDRIVE CLUTCH PACK

OVERDRIVE GEARTRAIN

(1) Remove overdrive clutch wave spring (Fig. 146).

(2) Remove overdrive clutch reaction snap-ring (Fig. 147). Note that snap-ring is located in same groove as wave spring.

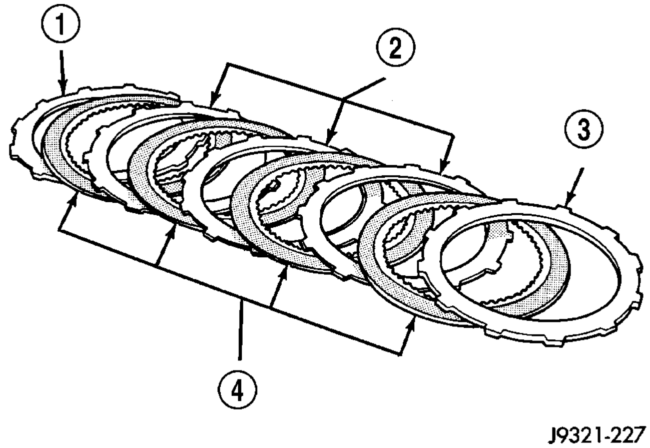


Fig. 145 Overdrive Clutch Component Position - Typical

1 - REACTION PLATE
2 - CLUTCH PLATES (3)
3 - PRESSURE PLATE
4 - CLUTCH DISCS (4)

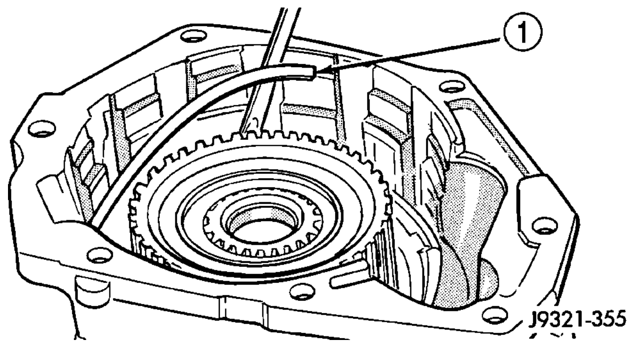


Fig. 146 Overdrive Clutch Wave Spring Removal

1 - WAVE SPRING

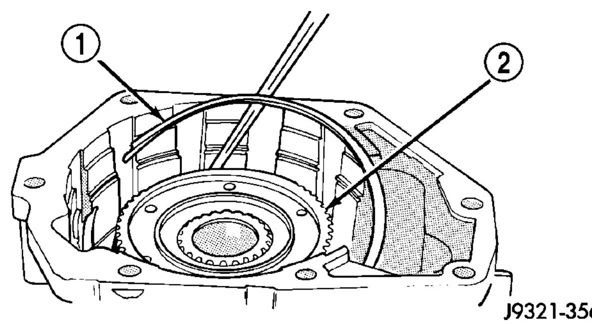


Fig. 147 Overdrive Clutch Reaction Snap-Ring Removal

1 - REACTION RING
2 - CLUTCH HUB

OVERDRIVE UNIT (Continued)

(3) Remove Torx™ head screws that attach access cover and gasket to overdrive case (Fig. 148).

(4) Remove access cover and gasket (Fig. 149).

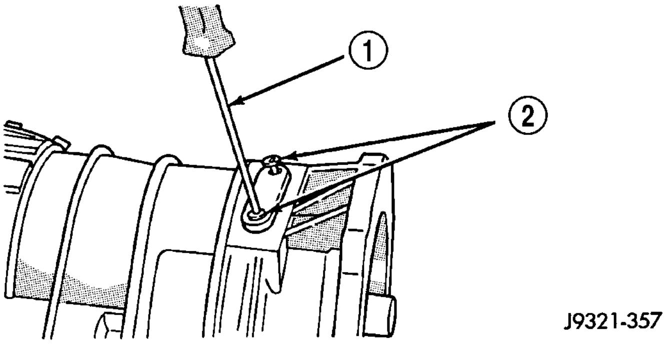


Fig. 148 Access Cover Screw Removal

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

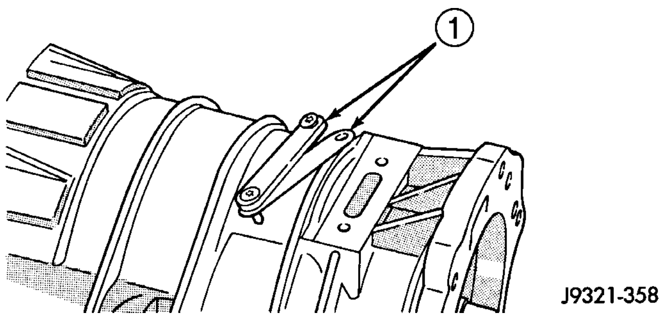


Fig. 149 Access Cover And Gasket Removal

1 - ACCESS COVER AND GASKET

(5) Expand output shaft bearing snap-ring with expanding-type snap-ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 150).

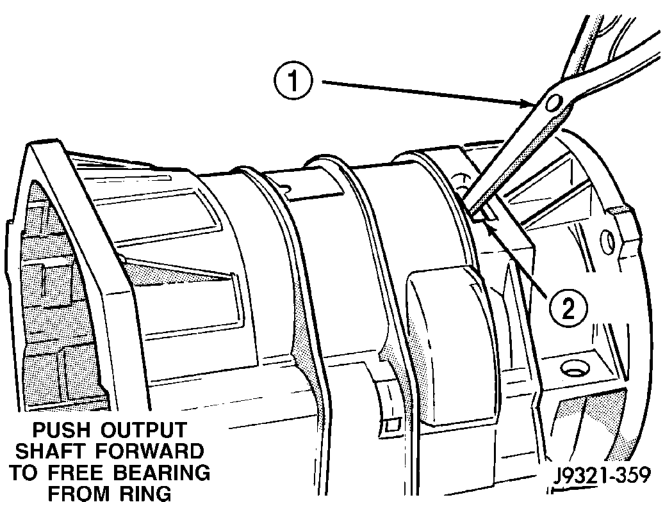


Fig. 150 Releasing Bearing From Locating Ring

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

(6) Lift gear case up and off geartrain assembly (Fig. 151).

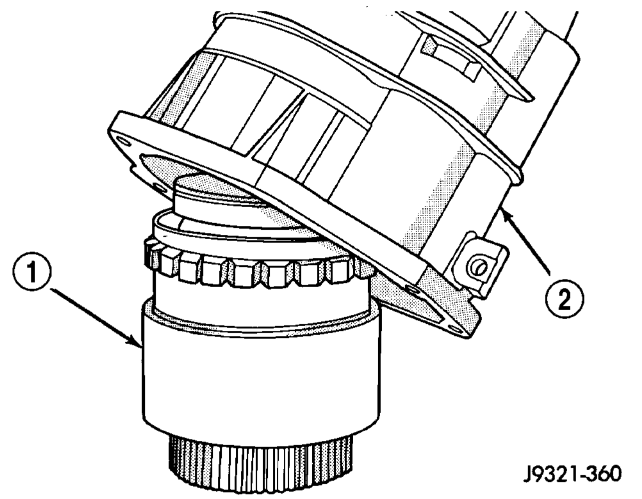


Fig. 151 Removing Geartrain

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

(7) Remove snap-ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 152).

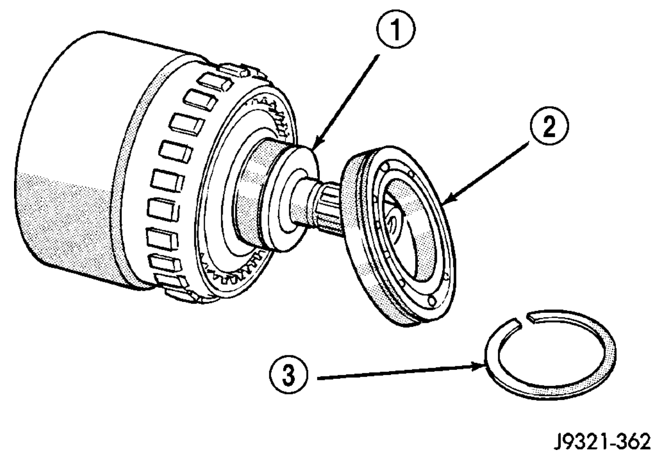


Fig. 152 Rear Bearing Removal

1 - OUTPUT SHAFT
2 - REAR BEARING
3 - SNAP-RING

OVERDRIVE UNIT (Continued)

DIRECT CLUTCH, HUB AND SPRING

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 153).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 153). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap-ring (Fig. 153).

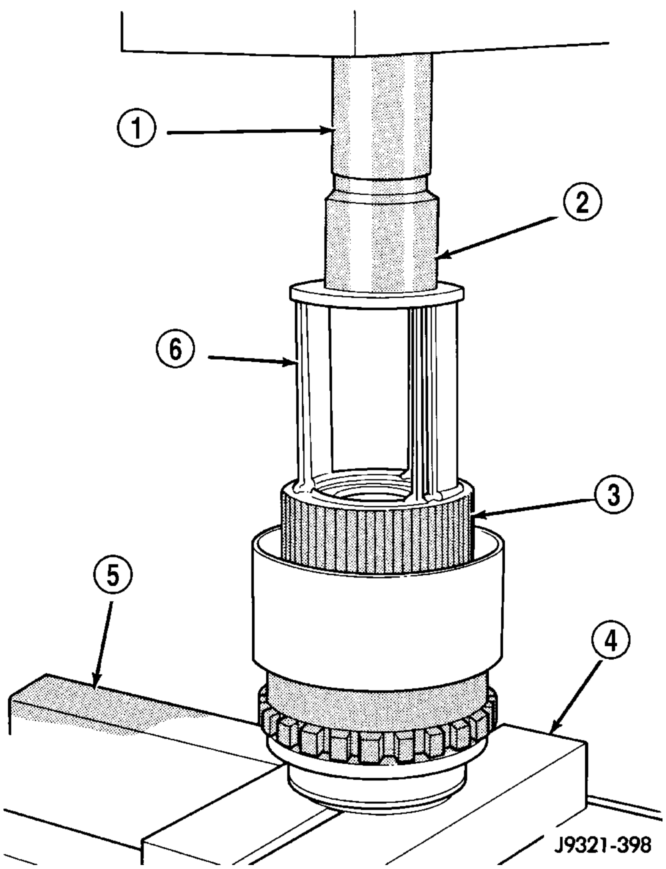


Fig. 153 Geartrain Mounted In Shop Press

1 - PRESS RAM
2 - SPECIAL TOOL C-3995-A (OR SIMILAR TOOL)
3 - CLUTCH HUB
4 - PLATES
5 - PRESS BED
6 - SPECIAL TOOL 6227-1

(4) Remove direct clutch pack snap-ring (Fig. 154).

(5) Remove direct clutch hub retaining ring (Fig. 155).

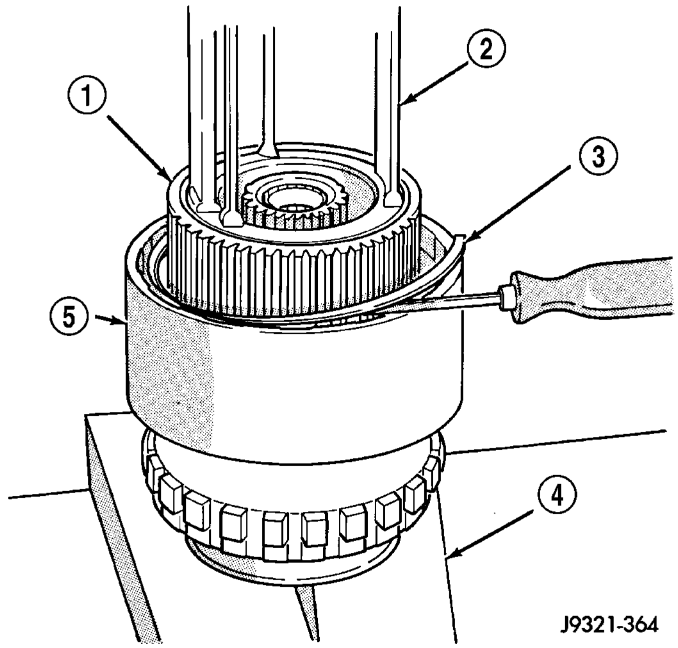


Fig. 154 Direct Clutch Pack Snap-Ring Removal

1 - CLUTCH HUB
2 - SPECIAL TOOL 6227-1
3 - DIRECT CLUTCH PACK SNAP-RING
4 - PRESS PLATES
5 - CLUTCH DRUM

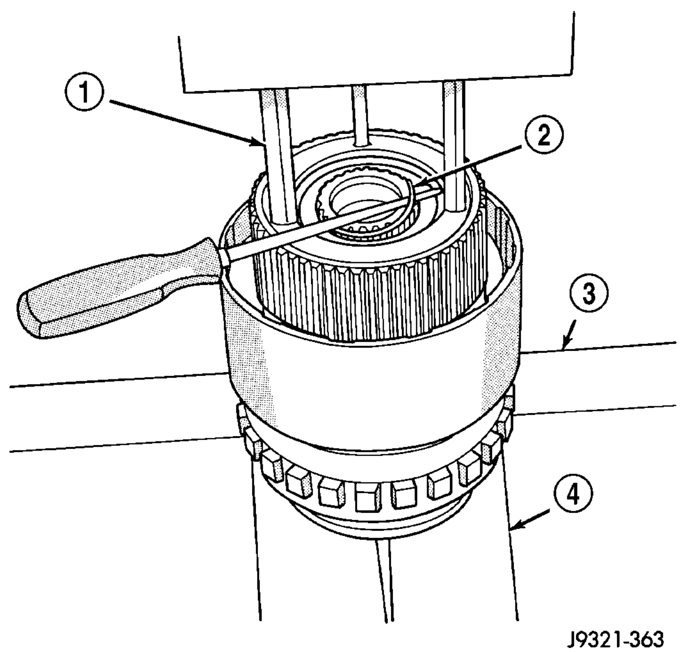


Fig. 155 Direct Clutch Hub Retaining Ring Removal

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING
3 - PRESS BED
4 - PRESS PLATES

OVERDRIVE UNIT (Continued)

(6) Release press load slowly and completely (Fig. 156).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 156).

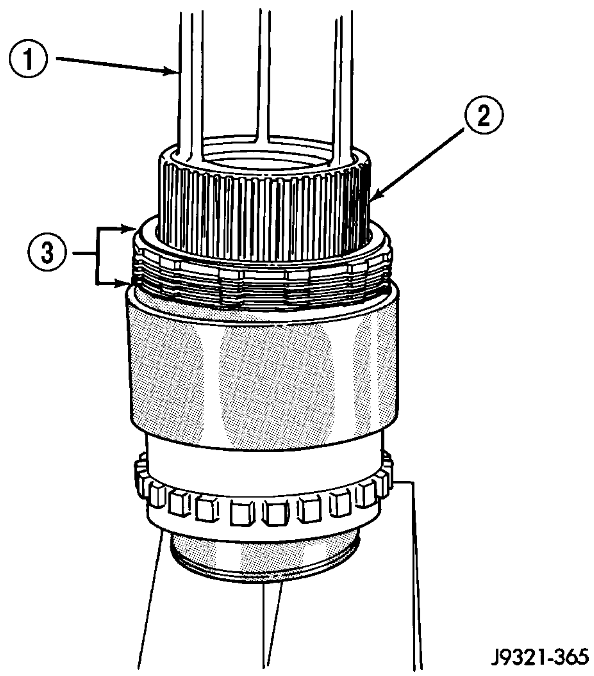


Fig. 156 Direct Clutch Pack Removal

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH HUB
3 - DIRECT CLUTCH PACK

GEARTRAIN

(1) Remove direct clutch hub and spring (Fig. 157).

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 158).

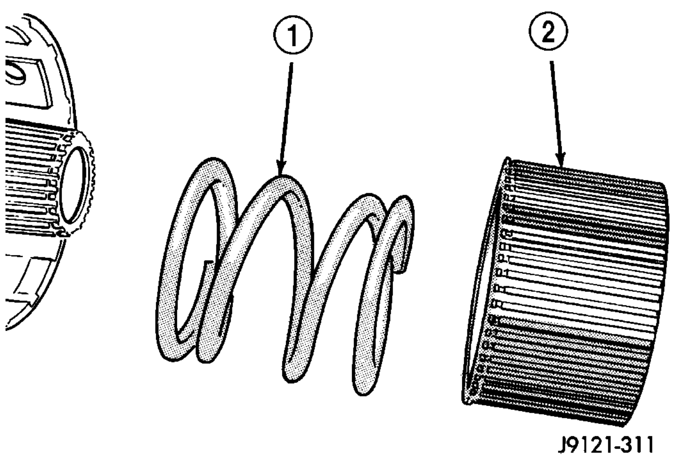


Fig. 157 Direct Clutch Hub And Spring Removal

1 - DIRECT CLUTCH SPRING
2 - DIRECT CLUTCH HUB

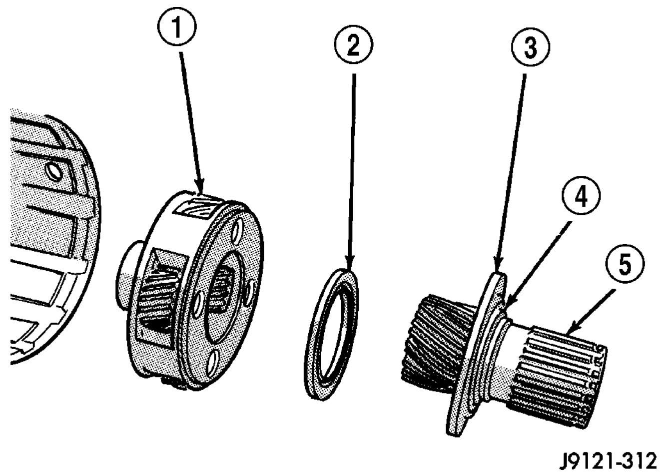


Fig. 158 Removing Sun Gear, Thrust Bearing And Planetary Gear

1 - PLANETARY GEAR
2 - PLANETARY THRUST BEARING
3 - CLUTCH SPRING PLATE
4 - SPRING PLATE SNAP-RING
5 - SUN GEAR

(3) Remove overrunning clutch assembly with expanding type snap-ring pliers (Fig. 159). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

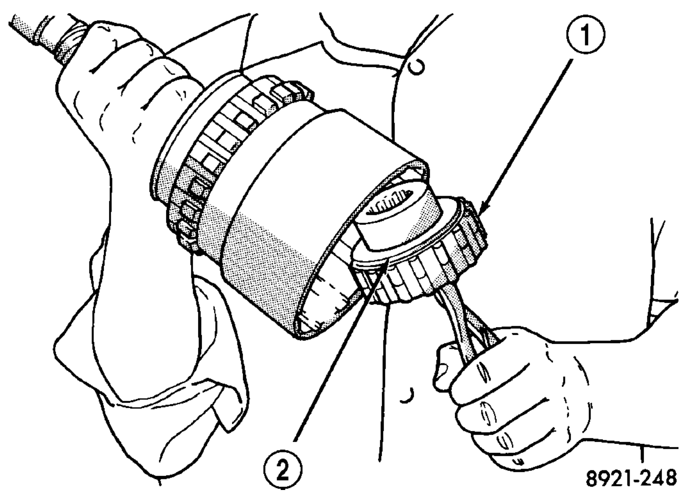


Fig. 159 Overrunning Clutch Assembly Removal/ Installation

1 - OVERRUNNING CLUTCH
2 - NEEDLE BEARING

OVERDRIVE UNIT (Continued)

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 160). Use small center punch or scriber to make alignment marks.

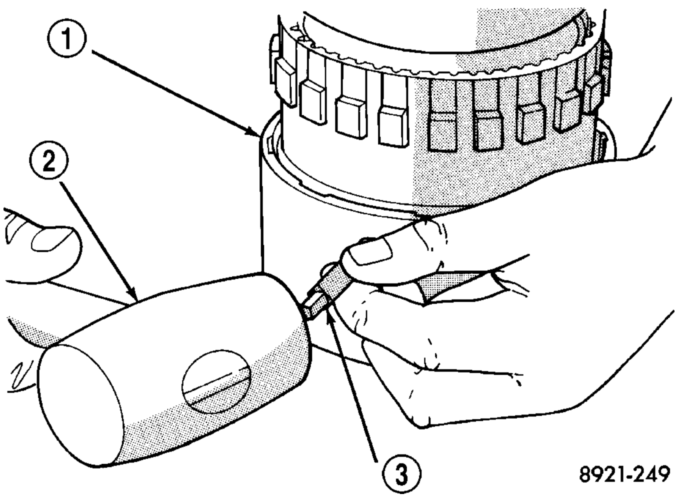


Fig. 160 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

1 - DIRECT CLUTCH DRUM
2 - HAMMER
3 - PUNCH

(7) Remove direct clutch drum rear retaining ring (Fig. 161).

(8) Remove direct clutch drum outer retaining ring (Fig. 162).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 163). Use punch or scriber to mark gear and shaft.

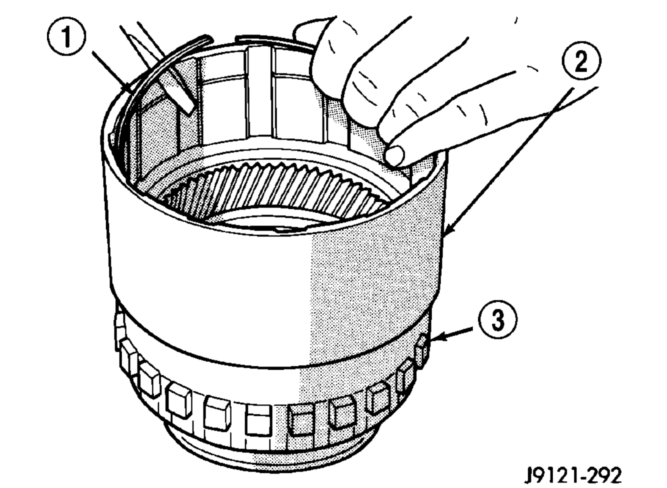


Fig. 161 Clutch Drum Inner Retaining Ring Removal

1 - INNER RETAINING RING
2 - DIRECT CLUTCH DRUM
3 - ANNULUS GEAR

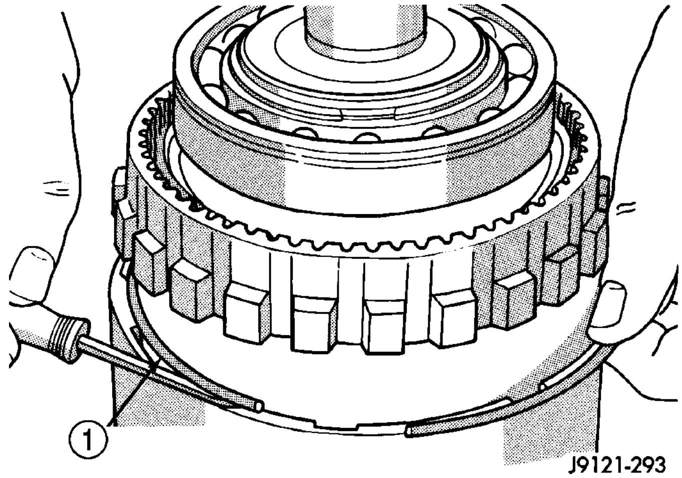


Fig. 162 Clutch Drum Outer Retaining Ring Removal

1 - OUTER RETAINING RING

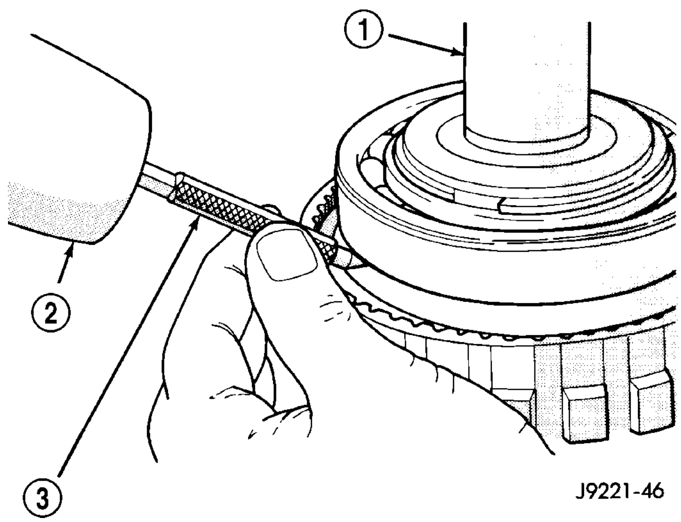


Fig. 163 Marking Annulus Gear And Output Shaft For Assembly Alignment

1 - OUTPUT SHAFT
2 - HAMMER
3 - PUNCH

(10) Remove snap-ring that secures annulus gear on output shaft (Fig. 164). Use two screwdrivers to unseat and work snap-ring out of groove as shown.

(11) Remove annulus gear from output shaft (Fig. 165). Use rawhide or plastic mallet to tap gear off shaft.

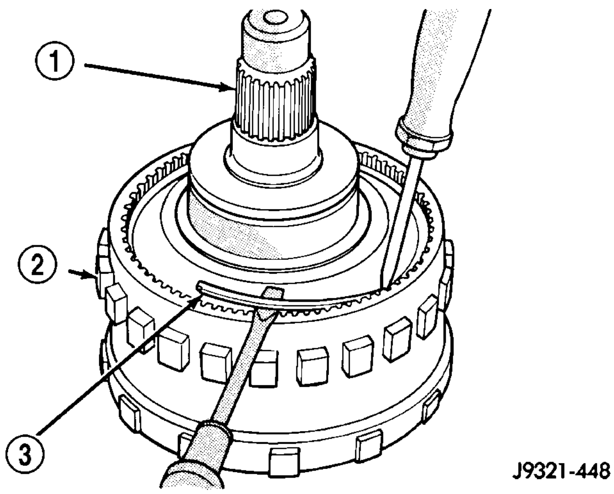


Fig. 164 Annulus Gear Snap-Ring Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR
3 - SNAP-RING

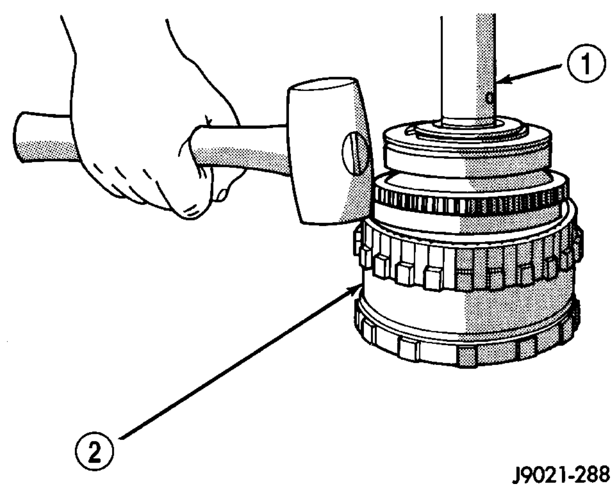


Fig. 165 Annulus Gear Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR

GEAR CASE AND PARK LOCK

(1) Remove locating ring from gear case.

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

(3) Remove reaction plug snap-ring and remove reaction plug.

(4) Remove output shaft seal.

CLEANING

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap-rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

INSPECTION

Check condition of the park lock components and the overdrive case.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

OVERDRIVE UNIT (Continued)

Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap-rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF +4, Automatic Transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install new pilot bushing and clutch hub bushing in output shaft if necessary (Fig. 166). Lubricate bushings with petroleum jelly, or transmission fluid.

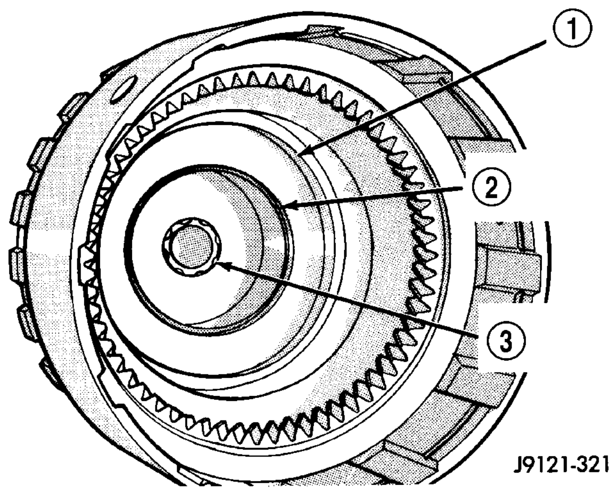


Fig. 166 Output Shaft Pilot Bushing

1 - OUTPUT SHAFT HUB
2 - OVERRUNNING CLUTCH HUB BUSHING
3 - INTERMEDIATE SHAFT PILOT BUSHING

(3) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap-ring (Fig. 167).

(4) Align and install clutch drum on annulus gear (Fig. 168). Be sure drum is engaged in annulus gear lugs.

(5) Install clutch drum outer retaining ring (Fig. 168).

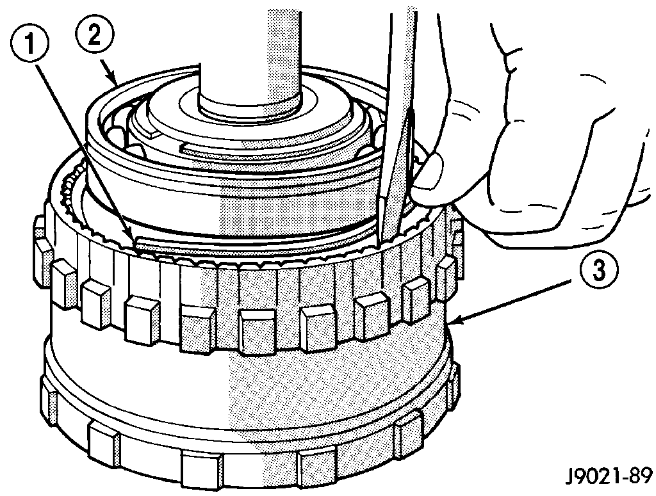


Fig. 167 Annulus Gear Installation

1 - SNAP-RING
2 - OUTPUT SHAFT FRONT BEARING
3 - ANNULUS GEAR

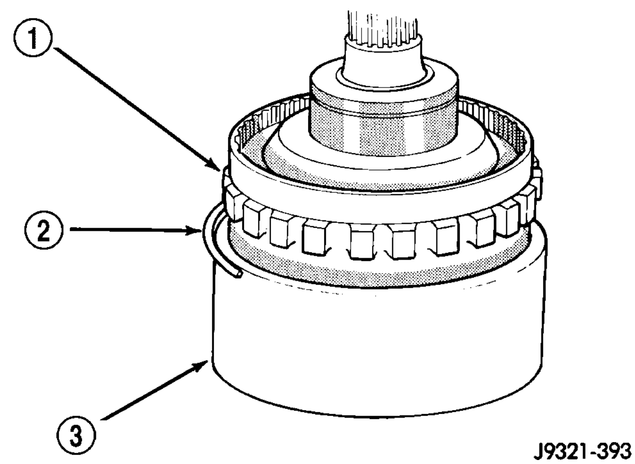


Fig. 168 Clutch Drum And Outer Retaining Ring Installation

1 - ANNULUS GEAR
2 - OUTER SNAP-RING
3 - CLUTCH DRUM

OVERDRIVE UNIT (Continued)

(6) Slide clutch drum forward and install inner retaining ring (Fig. 169).

(7) Install rear bearing and snap ring on output shaft (Fig. 170). Be sure locating ring groove in bearing is toward rear.

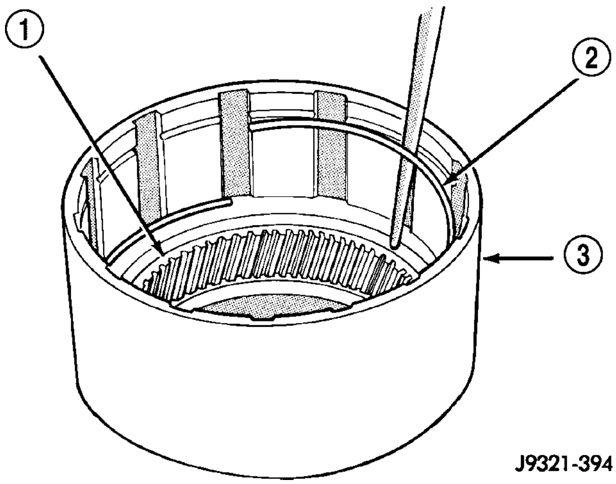


Fig. 169 Clutch Drum Inner Retaining Ring Installation

1 - ANNULUS GEAR
2 - INNER SNAP-RING
3 - CLUTCH DRUM

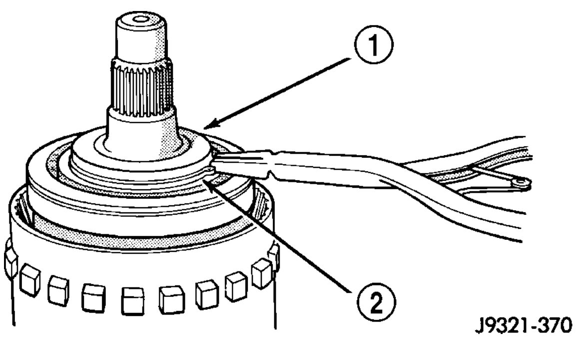


Fig. 170 Rear Bearing And Snap-Ring Installation

1 - REAR BEARING
2 - SNAP-RING

(8) Install overrunning clutch on hub (Fig. 171). Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.

(9) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.

(10) Install overrunning clutch in output shaft (Fig. 172). Insert snap ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

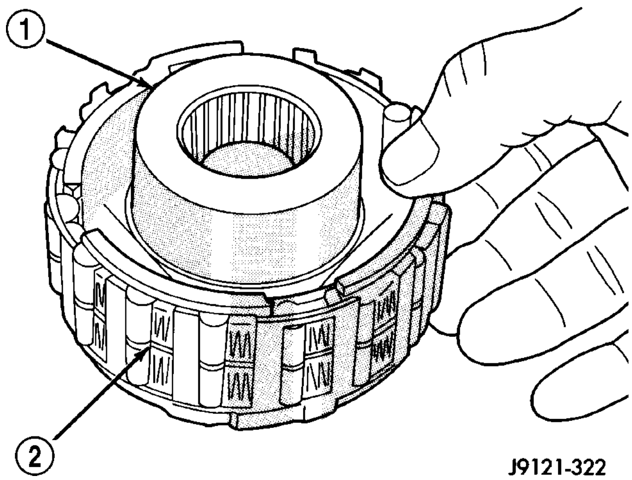


Fig. 171 Assembling Overrunning Clutch And Hub

1 - CLUTCH HUB
2 - OVERRUNNING CLUTCH

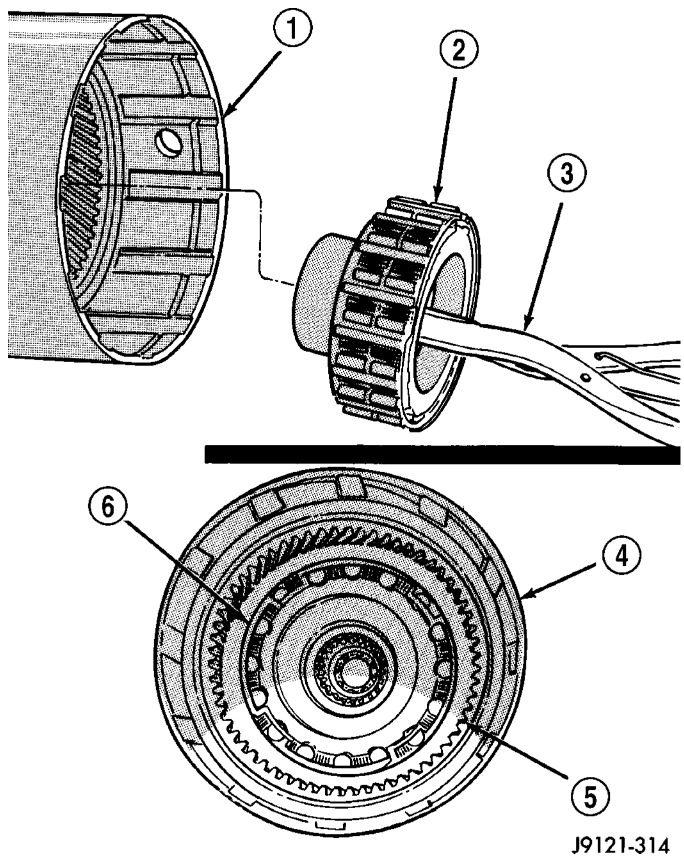


Fig. 172 Overrunning Clutch Installation

1 - CLUTCH DRUM
2 - OVERRUNNING CLUTCH ASSEMBLY
3 - EXPANDING-TYPE SNAP-RING PLIERS
4 - CLUTCH DRUM
5 - ANNULUS GEAR
6 - OVERRUNNING CLUTCH ASSEMBLY SEATED IN OUTPUT SHAFT

OVERDRIVE UNIT (Continued)

(11) Install planetary gear in annulus gear (Fig. 173). Be sure planetary pinions are fully seated in annulus gear before proceeding.

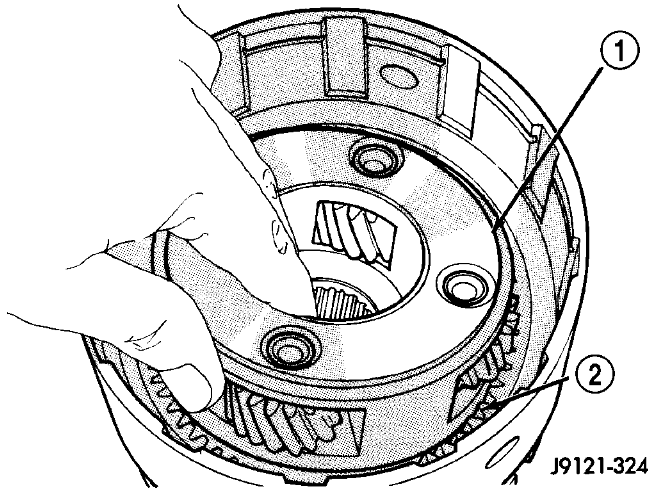


Fig. 173 Planetary Gear Installation

1 - PLANETARY GEAR
2 - ANNULUS GEAR

(12) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

(13) Install planetary thrust bearing on sun gear (Fig. 174). Slide bearing onto gear and seat it against spring plate as shown. Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.

(14) Install assembled sun gear, spring plate and thrust bearing (Fig. 175). Be sure sun gear and thrust bearing are fully seated before proceeding.

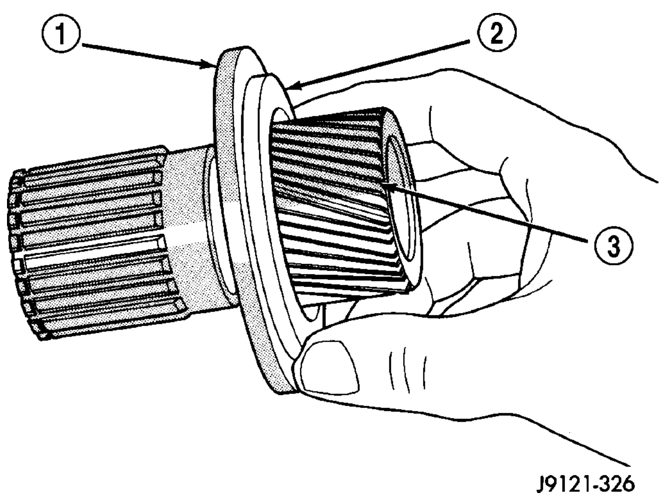


Fig. 174 Planetary Thrust Bearing Installation

1 - SPRING PLATE
2 - PLANETARY THRUST BEARING
3 - SUN GEAR

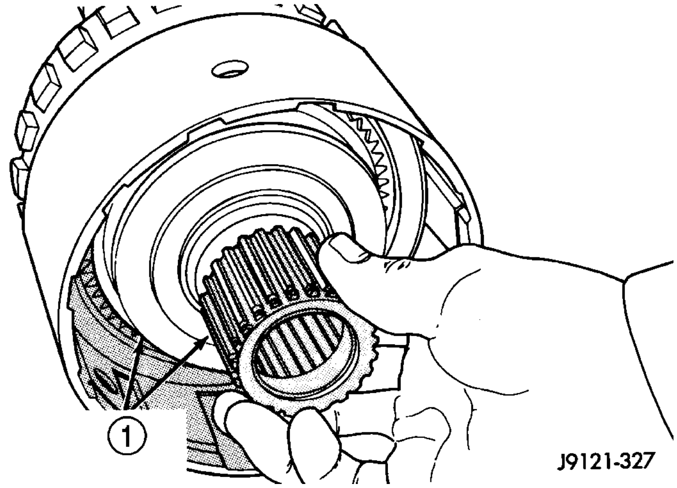


Fig. 175 Sun Gear Installation

1 - SUN GEAR AND SPRING PLATE ASSEMBLY

(15) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

(16) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 176). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

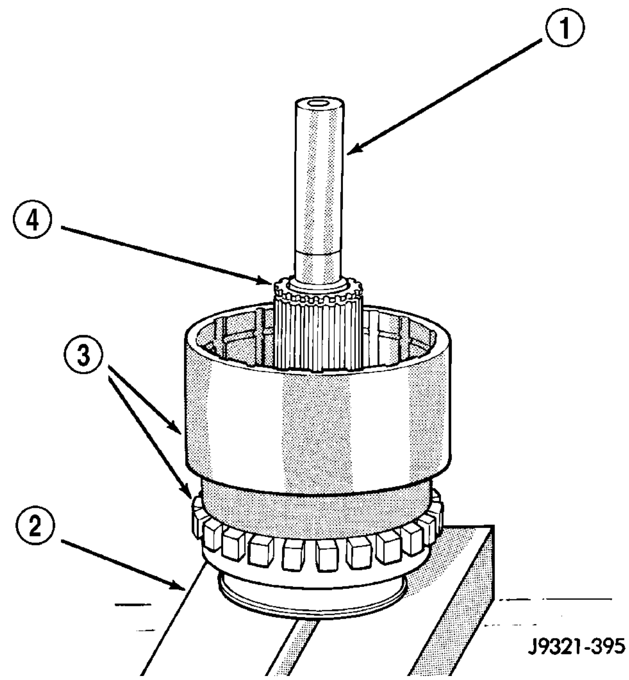


Fig. 176 Alignment Tool Installation

1 - SPECIAL TOOL 6227-2
2 - PRESS PLATES
3 - ASSEMBLED DRUM AND ANNULUS GEAR
4 - SUN GEAR

OVERDRIVE UNIT (Continued)

(17) Install direct clutch spring (Fig. 177). Be sure spring is properly seated on spring plate.

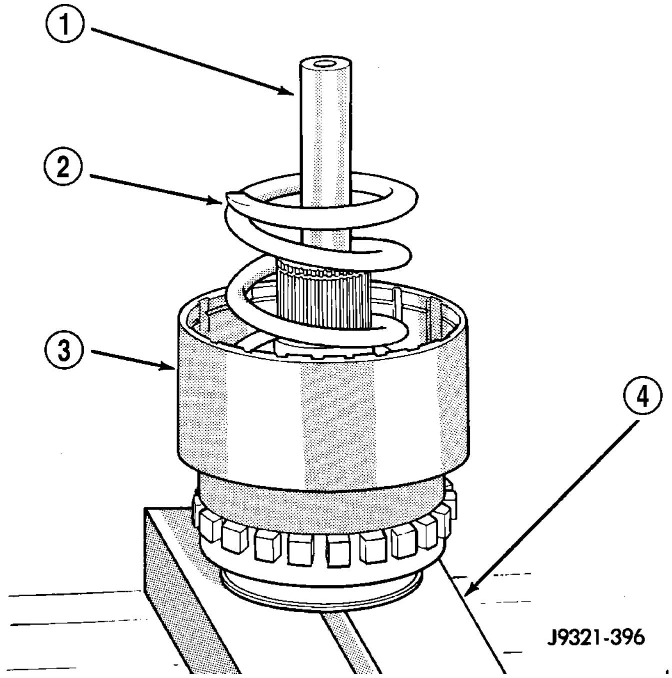


Fig. 177 Direct Clutch Spring Installation

1 - SPECIAL TOOL 6227-2
2 - DIRECT CLUTCH SPRING
3 - CLUTCH HUB
4 - PRESS PLATES

NOTE: The direct clutch in a 46RE transmission uses 8 clutch discs.

(18) Assemble and install direct clutch pack on hub as follows:

(a) Assemble clutch pack components (Fig. 178).

(b) Install direct clutch reaction plate on clutch hub first. Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counter-bore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 179).

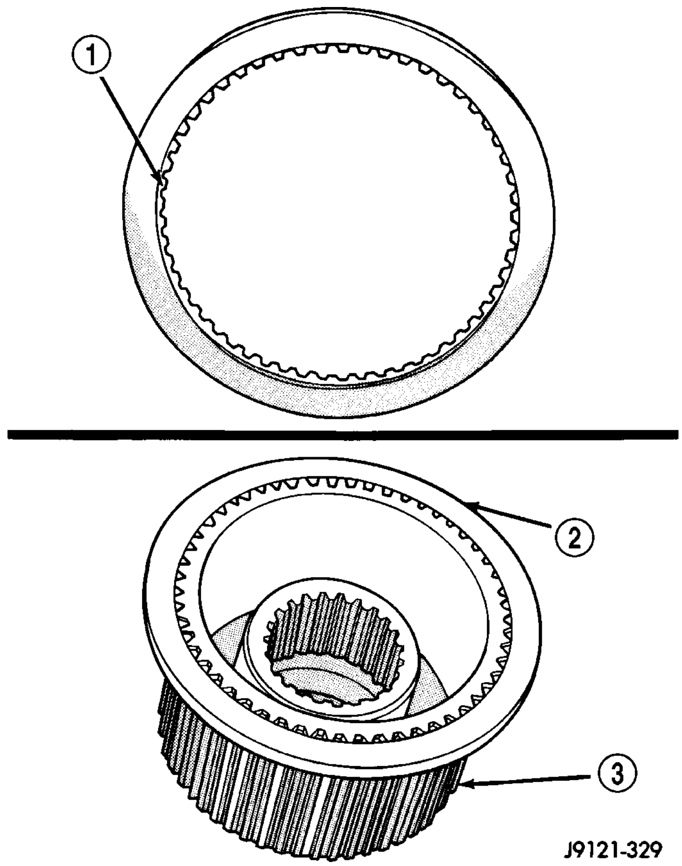


Fig. 179 Correct Position Of Direct Clutch Reaction Plate

1 - REACTION PLATE COUNTERBORE
2 - DIRECT CLUTCH REACTION PLATE (FLUSH WITH END OF HUB)
3 - CLUTCH HUB

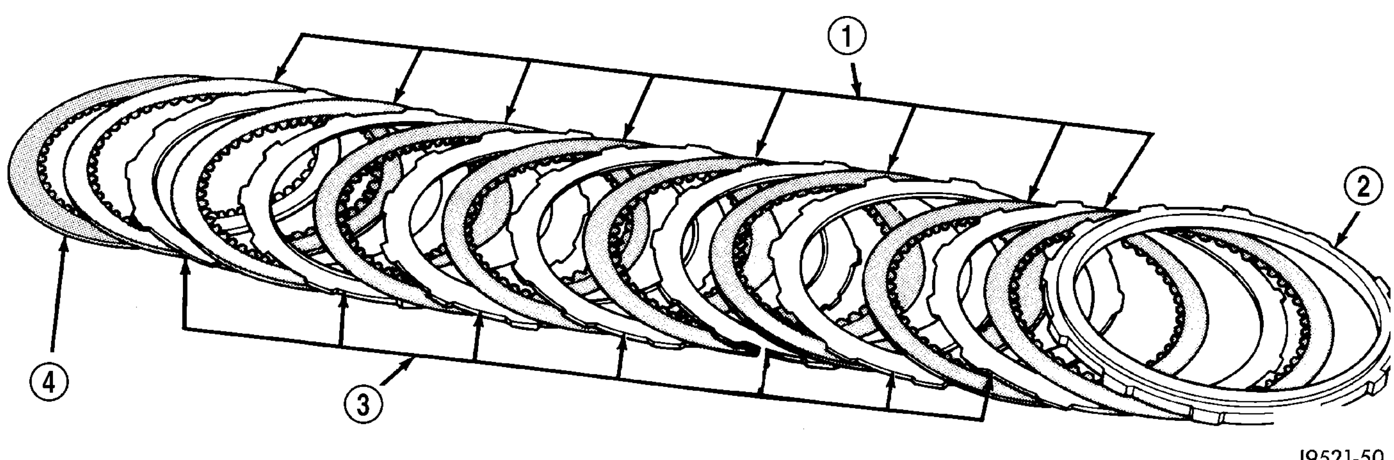


Fig. 178 46RE Direct Clutch Pack Components

1 - CLUTCH DISCS (8)
2 - PRESSURE PLATE
3 - CLUTCH PLATES (7)
4 - REACTION PLATE

OVERDRIVE UNIT (Continued)

(c) Install first clutch disc followed by a steel plate until all discs and plates have been installed.

(d) Install pressure plate. This is last clutch pack item to be installed. Be sure plate is installed with shoulder side facing upward (Fig. 180).

(19) Install clutch hub and clutch pack on direct clutch spring (Fig. 181). Be sure hub is started on sun gear splines before proceeding.

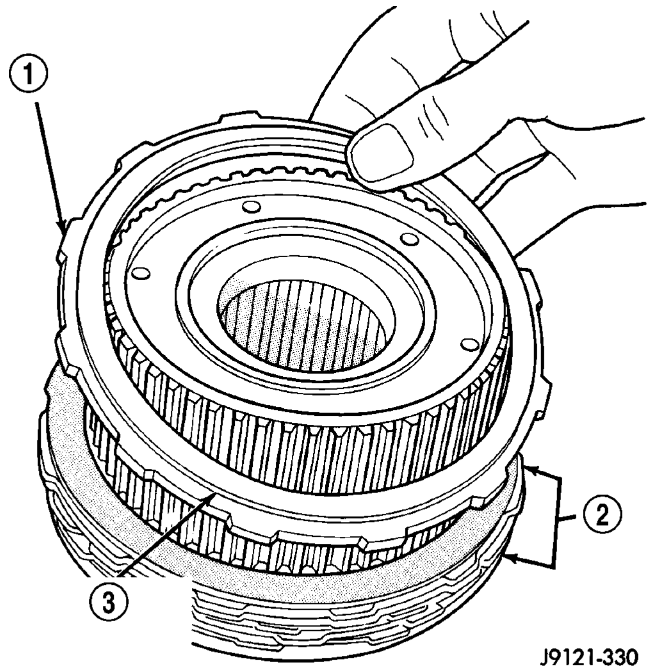


Fig. 180 Correct Position Of Direct Clutch

1 - DIRECT CLUTCH PRESSURE PLATE
2 - CLUTCH PACK
3 - BE SURE SHOULDER SIDE OF PLATE FACES UPWARD

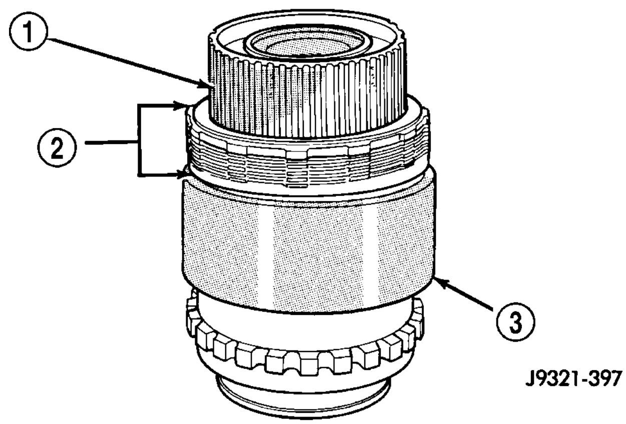


Fig. 181 Direct Clutch Pack And Clutch Hub Installation

1 - CLUTCH HUB
2 - DIRECT CLUTCH PACK
3 - CLUTCH DRUM

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(20) Position Compressor Tool 6227-1 on clutch hub.

(21) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(22) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring grooves for clutch pack snap ring and clutch hub retaining ring.

(23) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(24) Install direct clutch pack snap ring (Fig. 182). Be very sure snap ring is fully seated in clutch drum ring groove.

(25) Install clutch hub retaining ring (Fig. 183). Be very sure retaining ring is fully seated in sun gear ring groove.

(26) Slowly release press ram, remove compressor tools and remove geartrain assembly.

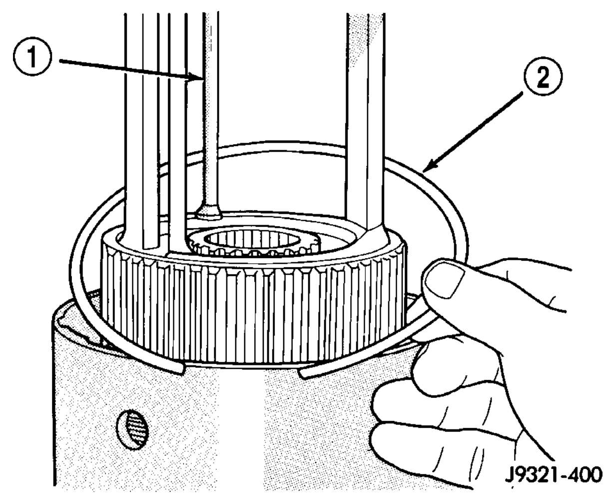


Fig. 182 Direct Clutch Pack Snap-Ring Installation

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH PACK SNAP-RING

GEAR CASE

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

OVERDRIVE UNIT (Continued)

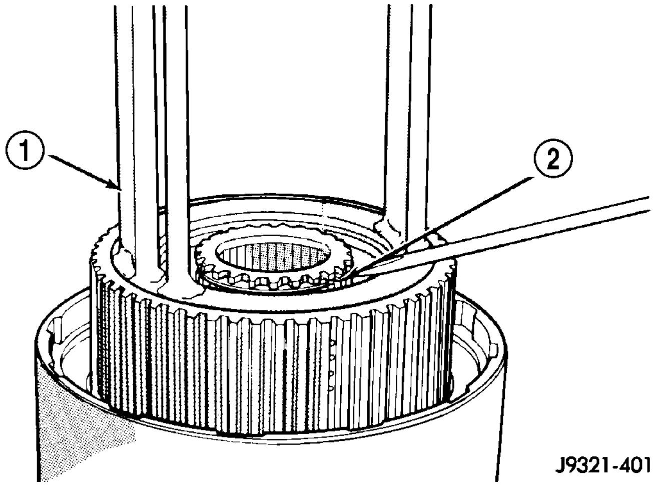


Fig. 183 Clutch Hub Retaining Ring Installation

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. Note that plug has locating pin at rear (Fig. 184). Be sure pin is seated in hole in case before installing snap ring.

(4) Install reaction plug snap-ring (Fig. 185). Compress snap ring only enough for installation; do not distort it.

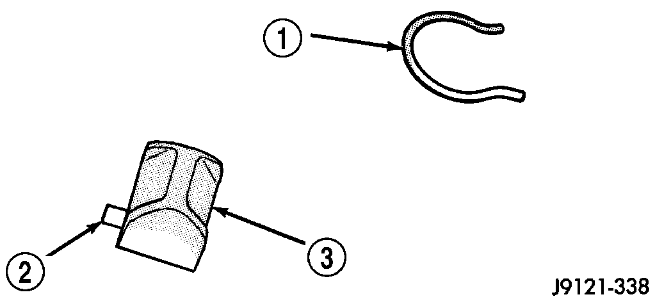


Fig. 184 Reaction Plug Locating Pin And Snap-Ring

1 - REACTION PLUG SNAP-RING (DO NOT OVERCOMPRESS TO INSTALL)
2 - LOCATING PIN
3 - PARK LOCK REACTION PLUG

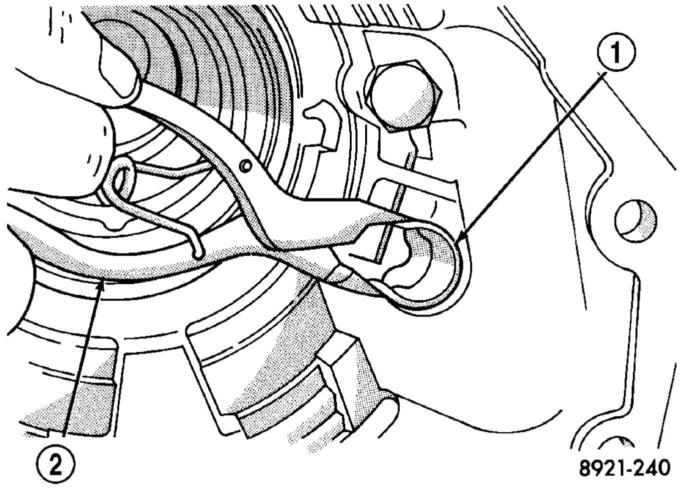


Fig. 185 Reaction Plug And Snap-Ring Installation

1 - REACTION PLUG SNAP-RING
2 - SNAP-RING PLIERS

(5) Install new seal in gear case. Use Handle C-4171 and Installer C-3995-A to seat seal in case.

(6) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 186).

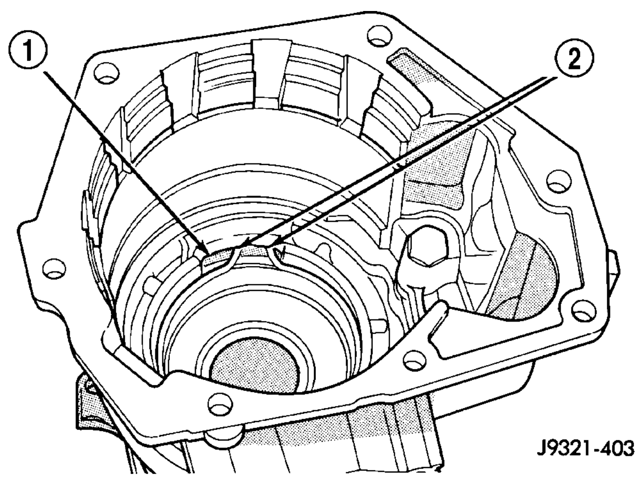


Fig. 186 Correct Rear Bearing Locating Ring Position

1 - CASE ACCESS HOLE
2 - TAB ENDS OF LOCATING RING

OVERDRIVE UNIT (Continued)

(7) Support geartrain on Tool 6227-1 (Fig. 187). Be sure tool is securely seated in clutch hub.

(8) Install overdrive gear case on geartrain (Fig. 187).

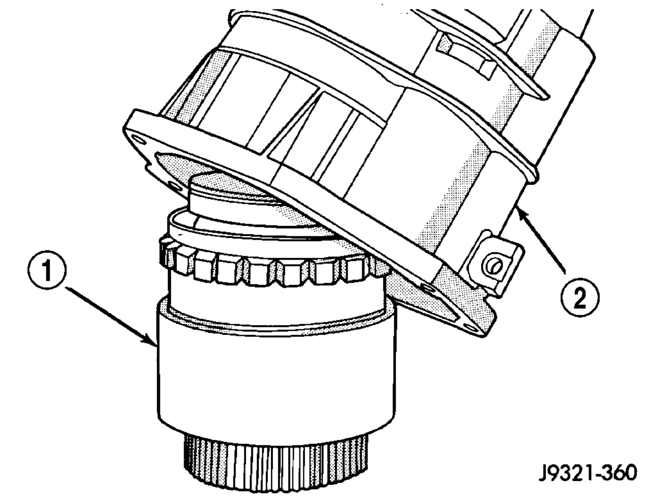


Fig. 187 Overdrive Gear Case Installation

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

(9) Expand front bearing locating ring with snap ring pliers (Fig. 188). Then slide case downward until locating ring locks in bearing groove and release snap ring.

(10) Install locating ring access cover and gasket in overdrive unit case (Fig. 189).

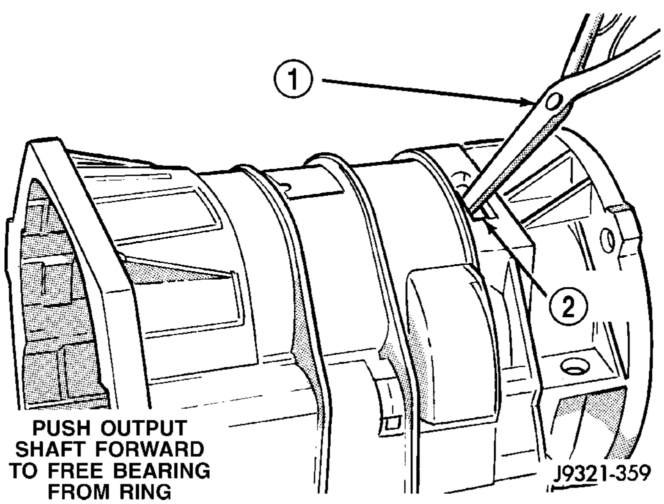


Fig. 188 Seating Locating Ring In Rear Bearing

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

OVERDRIVE CLUTCH

NOTE: The overdrive clutch in a 46RE transmission uses 4 clutch discs.

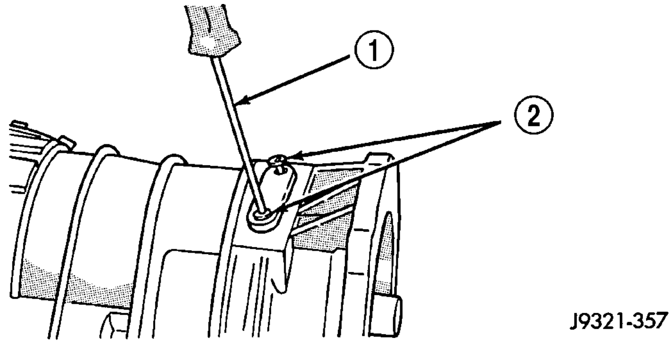


Fig. 189 Locating Ring Access Cover And Gasket Installation

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 190).

(2) Install wave spring on top of reaction ring (Fig. 191). Reaction ring and wave ring both fit in same ring groove. Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

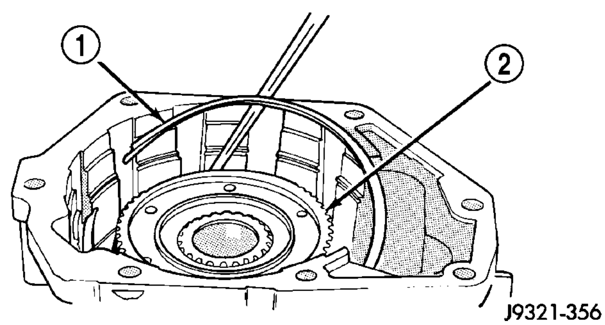


Fig. 190 Overdrive Clutch Reaction Ring Installation

1 - REACTION RING
2 - CLUTCH HUB

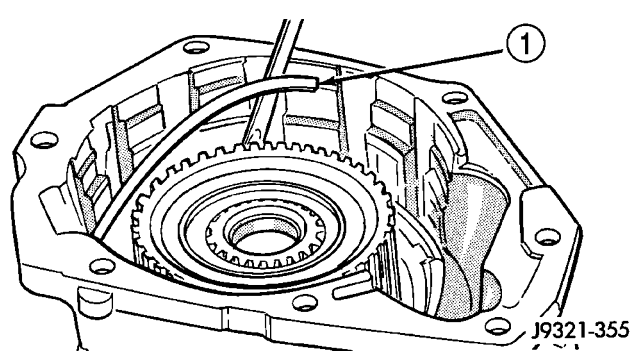


Fig. 191 Overdrive Clutch Wave Spring Installation

1 - WAVE SPRING

OVERDRIVE UNIT (Continued)

(3) Assemble overdrive clutch pack (Fig. 192).

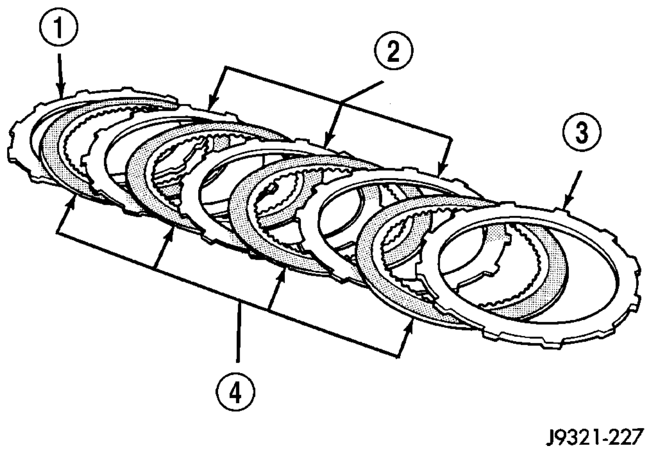


Fig. 192 46RE Overdrive Clutch Components

1 - REACTION PLATE
2 - CLUTCH PLATES (3)
3 - PRESSURE PLATE
4 - CLUTCH DISCS (4)

(4) Install overdrive clutch reaction plate first.

NOTE: The reaction plate is the same thickness as the pressure plate in a 46RE transmission.

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 193).

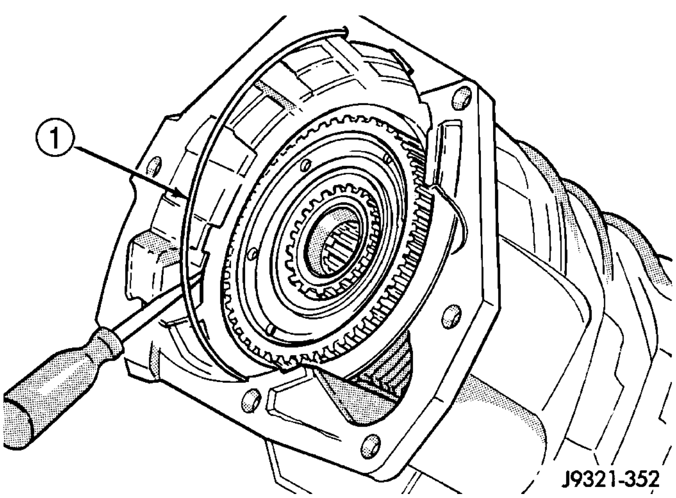


Fig. 193 Overdrive Clutch Pack Retaining Ring Installation

1 - OVERDRIVE CLUTCH PACK RETAINING RING

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 194). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 194).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 195).

(e) Remove Gauge Alignment Tool 6312.

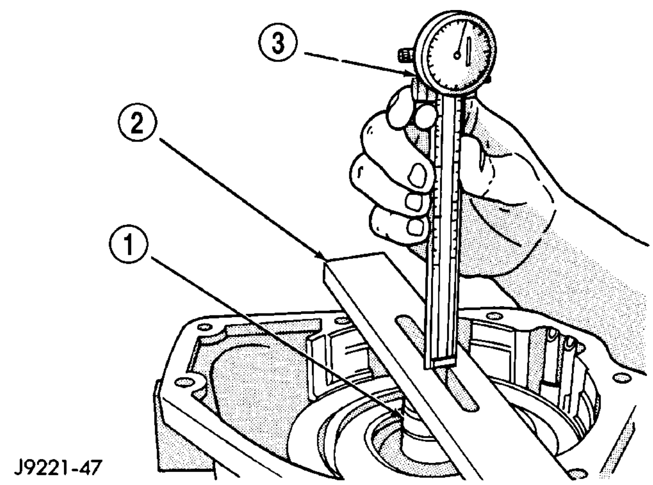


Fig. 194 Shaft End Play Measurement

1 - SPECIAL TOOL 6312
2 - SPECIAL TOOL 6311
3 - SPECIAL TOOL C-4962

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

J9121-341

Fig. 195 Intermediate Shaft End Play Spacer Selection

OVERDRIVE UNIT (Continued)

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 196).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 197).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

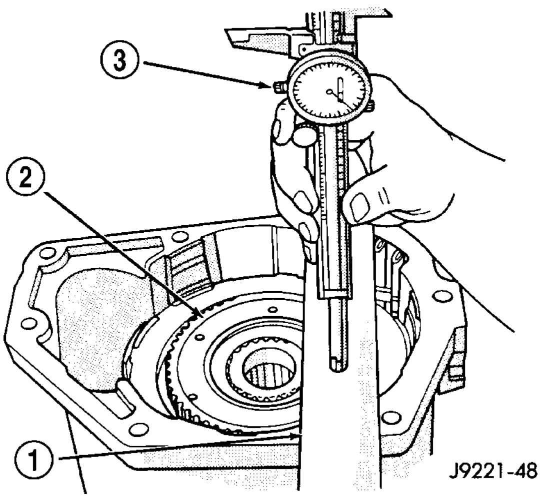


Fig. 196 Overdrive Piston Thrust Plate Measurement

1 - SPECIAL TOOL 6311
2 - DIRECT CLUTCH HUB THRUST BEARING SEAT
3 - SPECIAL TOOL C-4962

OVERDRIVE PISTON

(1) Install new seals on overdrive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

(5) Install overdrive piston in overdrive piston retainer by:

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 197 Overdrive Piston Thrust Plate Selection

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114–3 and inside Guide Ring 8114–1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and O-ring seal in overdrive case.

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 198).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 199).

OVERDRIVE UNIT (Continued)

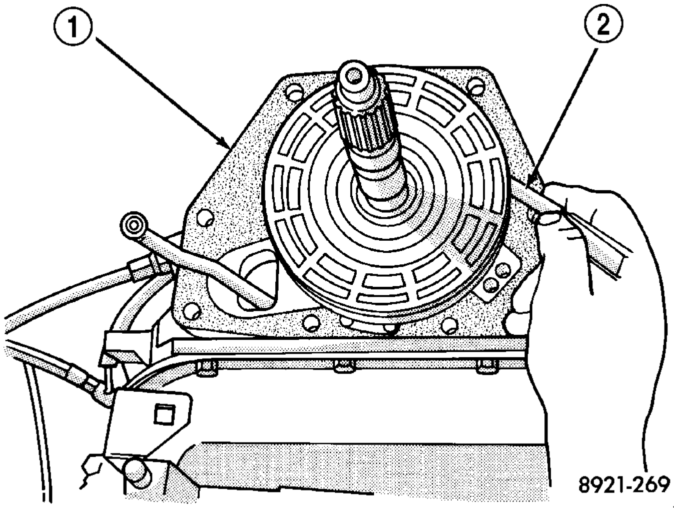


Fig. 198 Trimming Overdrive Case Gasket

1 - GASKET
2 - SHARP KNIFE

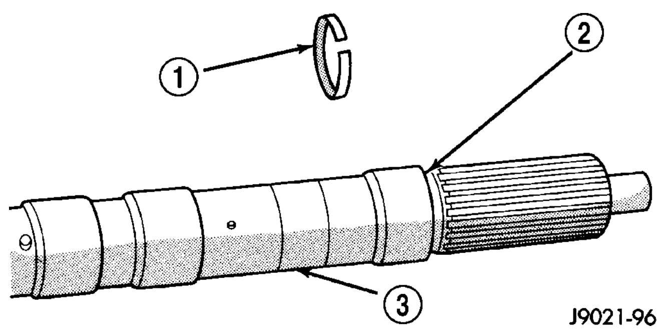


Fig. 199 Intermediate Shaft Selective Spacer Location

1 - SELECTIVE SPACER
2 - SPACER GROOVE
3 - INTERMEDIATE SHAFT

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Alignment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Connect the transmission speed sensor and overdrive wiring connectors.

(14) Install the transfer case, if equipped.

(15) Align and install rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

DESCRIPTION

The overrunning clutch (Fig. 200) consists of an inner race, an outer race (or cam), rollers and springs, and the spring retainer. The number of rollers and springs depends on what transmission and which overrunning clutch is being dealt with.

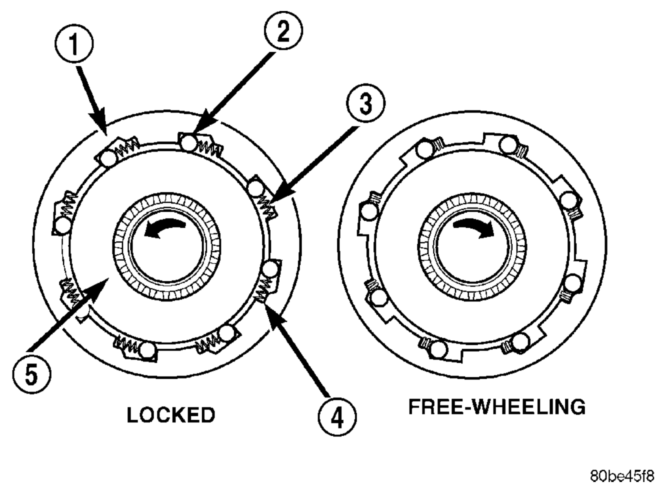


Fig. 200 Overrunning Clutch

1 - OUTER RACE (CAM)
2 - ROLLER
3 - SPRING
4 - SPRING RETAINER
5 - INNER RACE (HUB)

OPERATION

As the inner race is rotated in a clockwise direction (as viewed from the front of the transmission), the race causes the rollers to roll toward the springs, causing them to compress against their retainer. The compression of the springs increases the clearance between the rollers and cam. This increased clearance between the rollers and cam results in a freewheeling condition. When the inner race attempts to rotate counterclockwise, the action causes the rollers to roll in the same direction as the race, aided by the pushing of the springs. As the rollers try to move in the same direction as the inner race, they are wedged between the inner and outer races due to the design of the cam. In this condition, the clutch is locked and acts as one unit.

DISASSEMBLY

(1) Remove the overdrive piston (Fig. 201).
(2) Remove the overdrive piston retainer bolts.
(3) Remove overdrive piston retainer.
(4) Remove case gasket.
(5) Tap old cam out of case with pin punch. Insert punch through bolt holes at rear of case (Fig. 202). Alternate position of punch to avoid cocking cam during removal.
(6) Clean clutch cam bore and case. Be sure to remove all chips/shavings generated during cam removal.

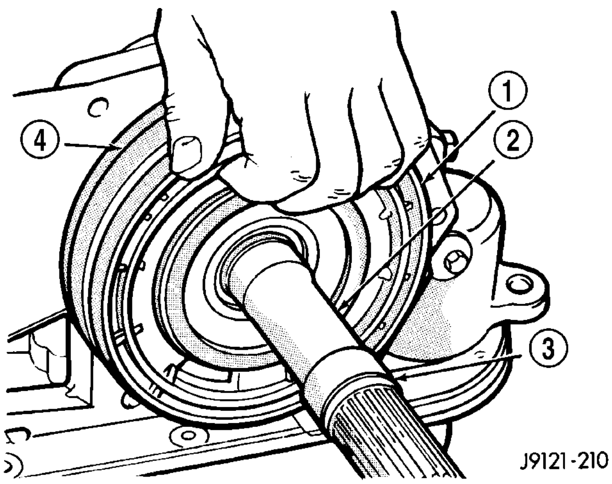


Fig. 201 Overdrive Piston Removal

1 - OVERDRIVE CLUTCH PISTON
2 - INTERMEDIATE SHAFT
3 - SELECTIVE SPACER
4 - PISTON RETAINER

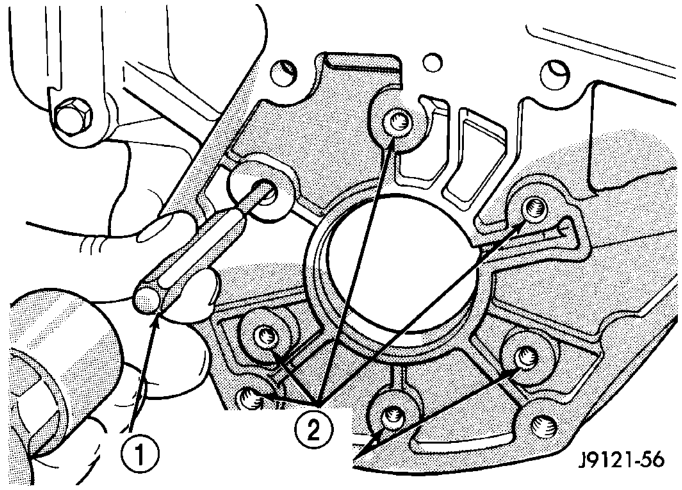


Fig. 202 Overrunning Clutch Cam

1 - PIN PUNCH
2 - REAR SUPPORT BOLT HOLES

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

INSPECTION

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

ASSEMBLY

(1) Temporarily install overdrive piston retainer in case. Use 3-4 bolts to secure retainer.

(2) Align and start new clutch cam in the transmission case. Be sure serrations on cam and in case are aligned (Fig. 203). Then tap cam into case just enough to hold it in place.

(3) Verify that cam is correctly positioned before proceeding any further. Narrow ends of cam ramps should be to left when cam is viewed from front end of case (Fig. 203).

(4) Insert Adapter Tool SP-5124 into piston retainer (Fig. 204).

(5) Assemble Puller Bolt SP-3701 and Press Plate SP-3583-A (Fig. 205).

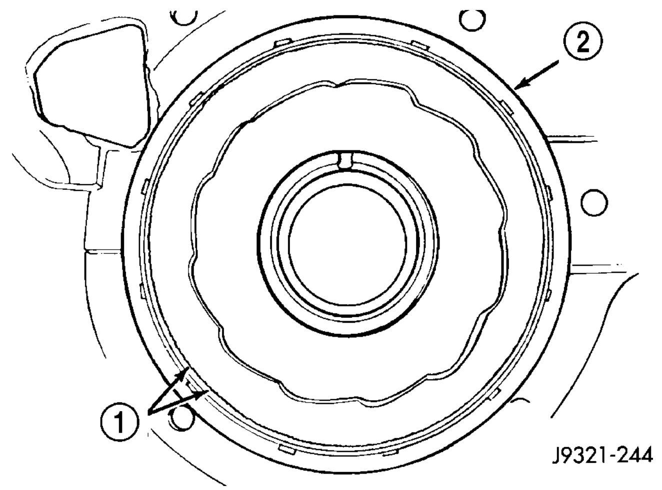


Fig. 203 Positioning Replacement Clutch Cam In Case

1 - ALIGN SERRATIONS ON CAM AND IN CASE
2 - CLUTCH CAM

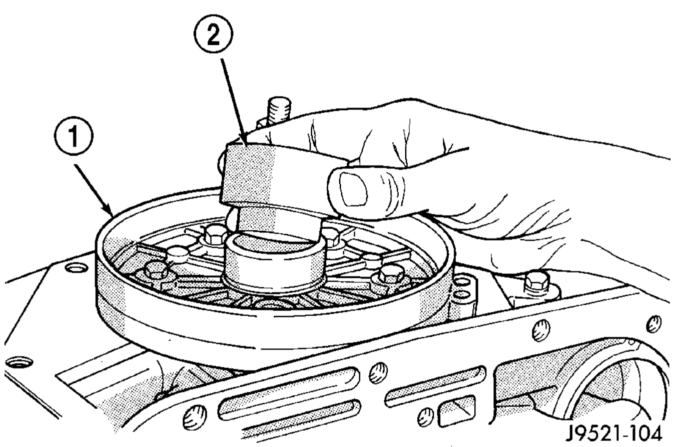


Fig. 204 Positioning Adapter Tool In Overdrive Piston Retainer

1 - PISTON RETAINER
2 - SPECIAL TOOL SP-5124

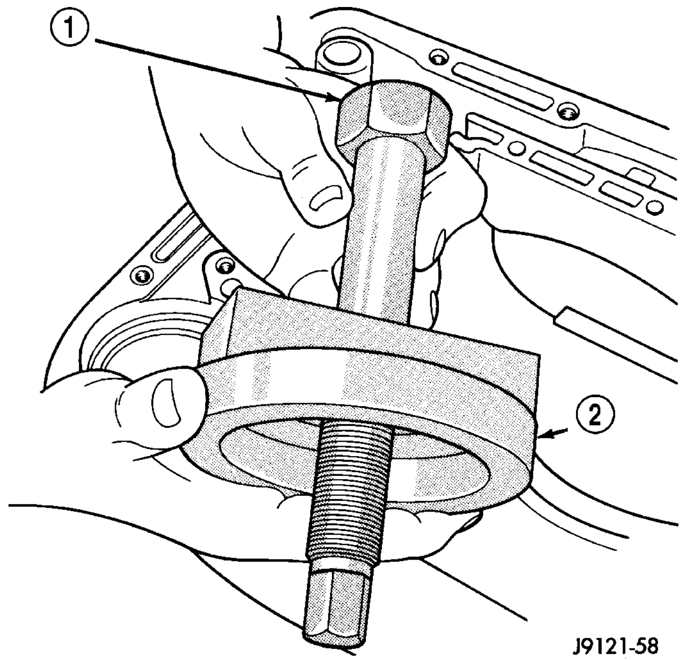


Fig. 205 Assembling Clutch Cam Puller Bolt And Press Plate

1 - PULLER BOLT SP-3701
2 - PRESS PLATE SP-3583-A

(6) Install assembled puller plate and bolt (Fig. 206). Insert bolt through cam, case and adapter tool. Be sure plate is seated squarely on cam.

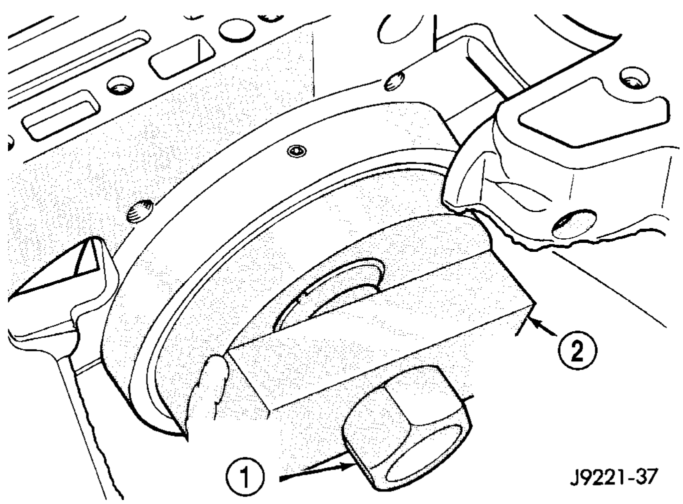


Fig. 206 Positioning Puller Plate On Clutch Cam

1 - SPECIAL TOOL SP-3701
2 - BE SURE PLATE SP-3583-A IS SEATED SQUARELY ON CAM

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(7) Hold puller plate and bolt in place and install puller nut SP-3701 on puller bolt (Fig. 207).

(8) Tighten puller nut to press clutch cam into case (Fig. 207). Be sure cam is pressed into case evenly and does not become cocked.

(9) Remove clutch cam installer tools.

(10) Stake case in 14 places around clutch cam to help secure cam in case. Use blunt punch or chisel to stake case.

(11) Remove piston retainer from case. Cover retainer with plastic sheeting, or paper to keep it dust free.

(12) Clean case and cam thoroughly. Be sure any chips/shavings generated during cam installation are removed from case.

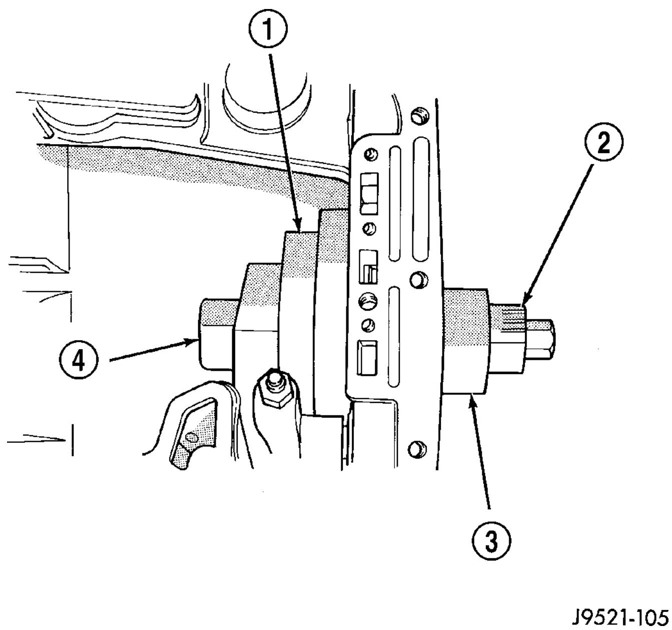


Fig. 207 Pressing Overrunning Clutch Cam Into Case

1 - SPECIAL TOOL SP-3583-A
2 - TIGHTEN NUT TO DRAW CAM INTO CASE (NUT IS PART OF BOLT SP-3701)
3 - SPECIAL TOOL SP-5124
4 - SPECIAL TOOL SP-3701

(13) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 208). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

(14) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 209). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

(15) Install new seals on overdrive piston.

(16) Stand transmission case upright on bellhousing.

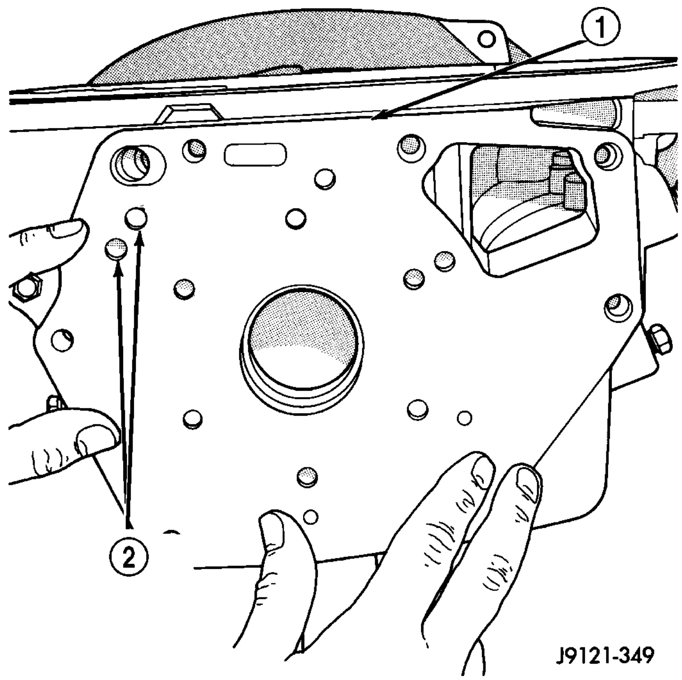


Fig. 208 Installing/Aligning Case Gasket

1 - CASE GASKET
2 - BE SURE GOVERNOR TUBE FEED HOLES IN CASE AND GASKET ARE ALIGNED

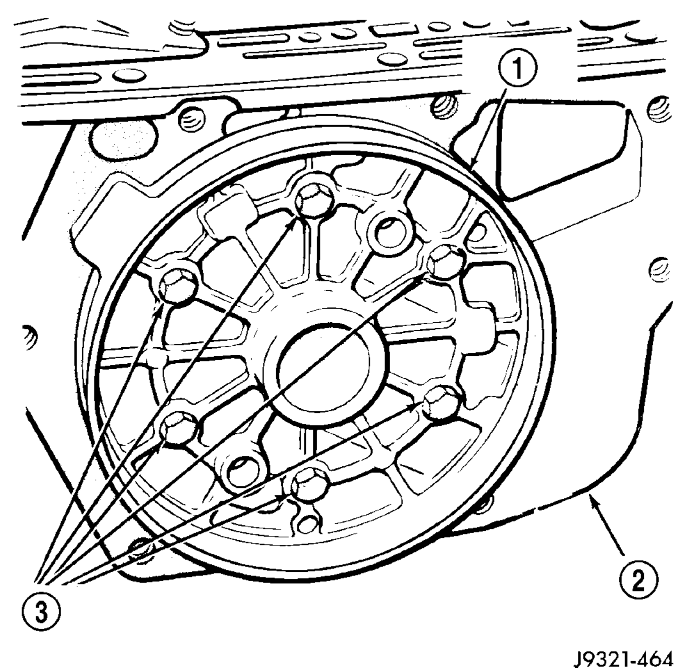


Fig. 209 Aligning Overdrive Piston Retainer

1 - PISTON RETAINER
2 - GASKET
3 - RETAINER BOLTS

(17) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(18) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(19) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114-3 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

PISTONS

DESCRIPTION

There are several sizes and types of pistons used in an automatic transmission. Some pistons are used to apply clutches, while others are used to apply bands. They all have in common the fact that they are round or circular in shape, located within a smooth walled cylinder, which is closed at one end and converts fluid pressure into mechanical movement. The fluid pressure exerted on the piston is contained within the system through the use of piston rings or seals.

OPERATION

The principal which makes this operation possible is known as Pascal's Law. Pascal's Law can be stated as: "Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas."

PRESSURE

Pressure (Fig. 210) is nothing more than force (lbs.) divided by area (in or ft.), or force per unit area. Given a 100 lb. block and an area of 100 sq. in. on the floor, the pressure exerted by the block is: 100 lbs. 100 in or 1 pound per square inch, or PSI as it is commonly referred to.

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 211) by applying a force to some given area in contact with the fluid. A good example of this is a cylinder filled with fluid and equipped with a piston that is closely fitted to the cylinder wall. If a force is applied to the piston, pressure will be developed in the fluid. Of course, no pressure will be created if the fluid is not confined. It will simply "leak" past the piston. There must be a resistance to flow in order to create pressure. Piston sealing is extremely important in hydraulic operation. Several kinds of seals are used to accomplish this within a transmission. These include but are not limited to O-rings, D-rings, lip seals, sealing rings, or extremely close tolerances between the piston and the cylinder wall. The force exerted is downward (gravity), however, the principle remains the same no matter which direction is taken. The pressure created in the fluid is equal to the force applied, divided by the piston area. If the force is 100 lbs., and the piston area is 10 sq. in., then the pressure created equals 10 PSI. Another interpretation of Pascal's Law is that regardless of container shape or size, the pressure will be maintained throughout, as long as the fluid is confined. In other words, the pressure in the fluid is the same everywhere within the container.

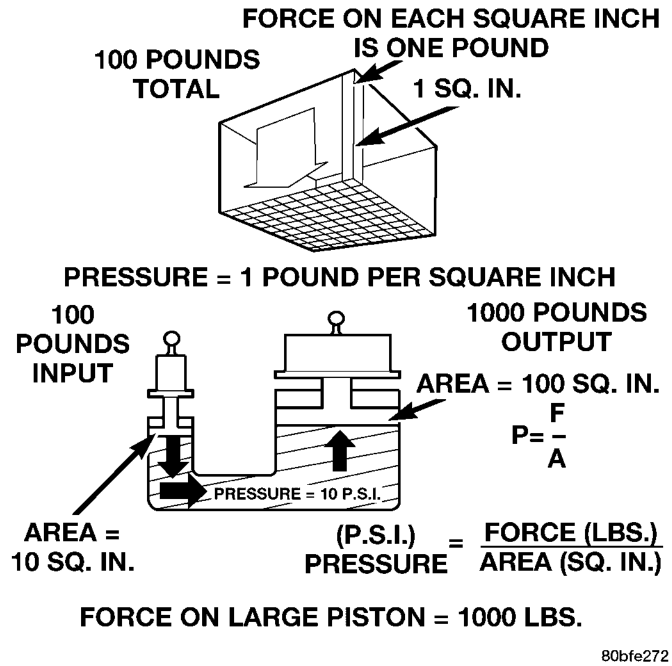


Fig. 210 Force and Pressure Relationship

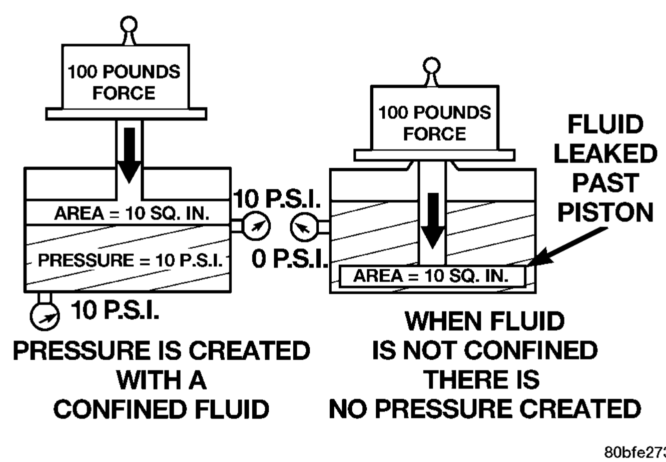


Fig. 211 Pressure on a Confined Fluid

PISTONS (Continued)

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 212), a force of 1000 lbs. can be moved with a force of only 100 lbs. The secret of force multiplication in hydraulic systems is the total fluid contact area employed. The illustration, (Fig. 212), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

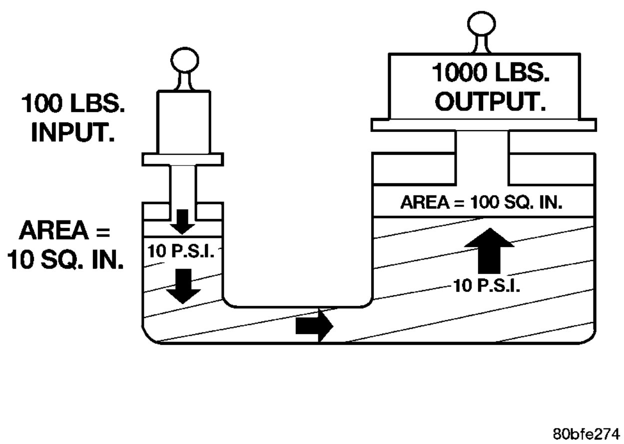


Fig. 212 Force Multiplication

PISTON TRAVEL

The relationship between hydraulic lever and a mechanical lever is the same. With a mechanical lever it's a weight-to-distance output rather than a pressure-to-area output. Using the same forces and areas as in the previous example, the smaller piston (Fig. 213) has to move ten times the distance required to move the larger piston one inch. Therefore, for every inch the larger piston moves, the smaller piston moves ten inches. This principle is true in other instances also. A common garage floor jack is a good example. To raise a car weighing 2000 lbs., an effort of only 100 lbs. may be required. For every inch the car moves upward, the input piston at the jack handle must move 20 inches downward.

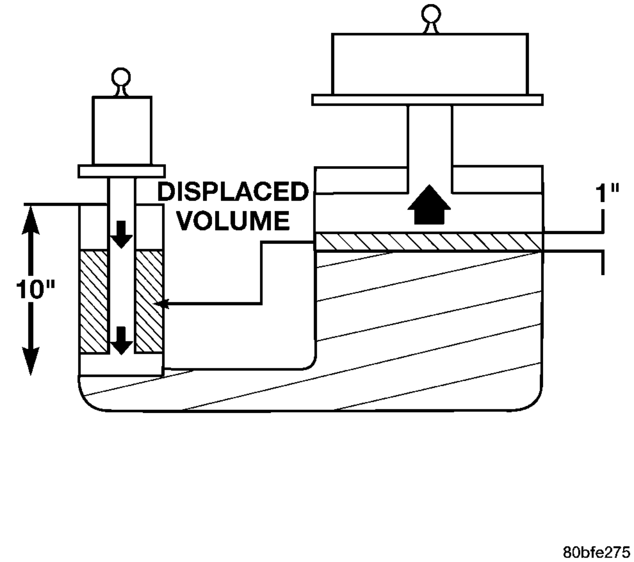


Fig. 213 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 214) are designated as the front, rear, and overdrive planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

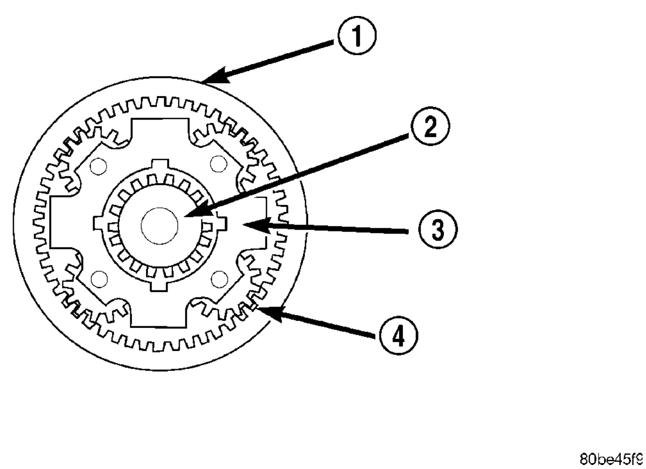


Fig. 214 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

• The sun gear which is at the center of the system.
• The planet carrier with planet pinion gears which are free to rotate on their own shafts and are in mesh with the sun gear.
• The annulus gear, which rotates around and is in mesh with the planet pinion gears.

NOTE: The number of pinion gears does not affect the gear ratio, only the duty rating.

OPERATION

With any given planetary gearset, several conditions must be met for power to be able to flow:
• One member must be held.
• Another member must be driven or used as an input.
• The third member may be used as an output for power flow.
• For direct drive to occur, two gear members in the front planetary gearset must be driven.

NOTE: Gear ratios are dependent on the number of teeth on the annulus and sun gears.

DISASSEMBLY

(1) Remove planetary snap-ring from intermediate shaft (Fig. 215). Discard snap-ring as it is not reusable.
(2) Remove front planetary gear and front annulus gear as assembly (Fig. 216).
(3) Remove front planetary gear and thrust washer from front annulus gear (Fig. 217). Note thrust washer position for assembly reference.

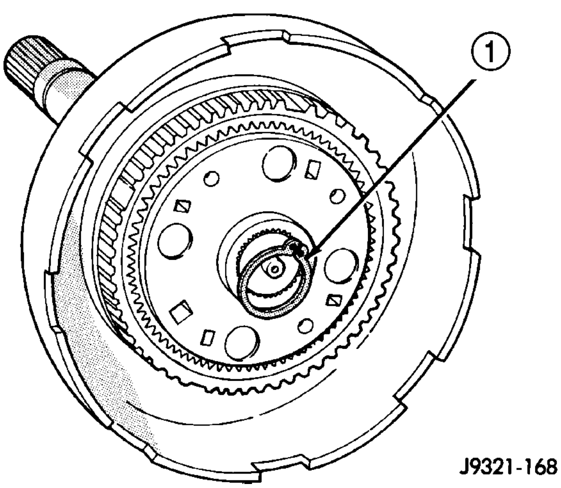


Fig. 215 Removing Planetary Snap-Ring

1 - PLANETARY SNAP-RING

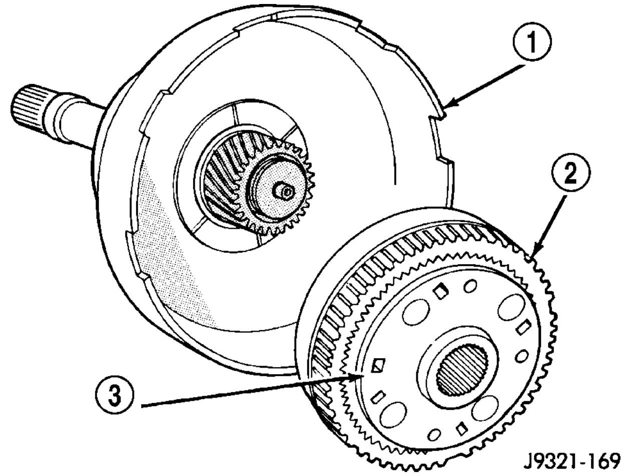


Fig. 216 Removing Front Planetary And Annulus Gears

1 - DRIVING SHELL
2 - FRONT ANNULUS GEAR
3 - FRONT PLANETARY GEAR

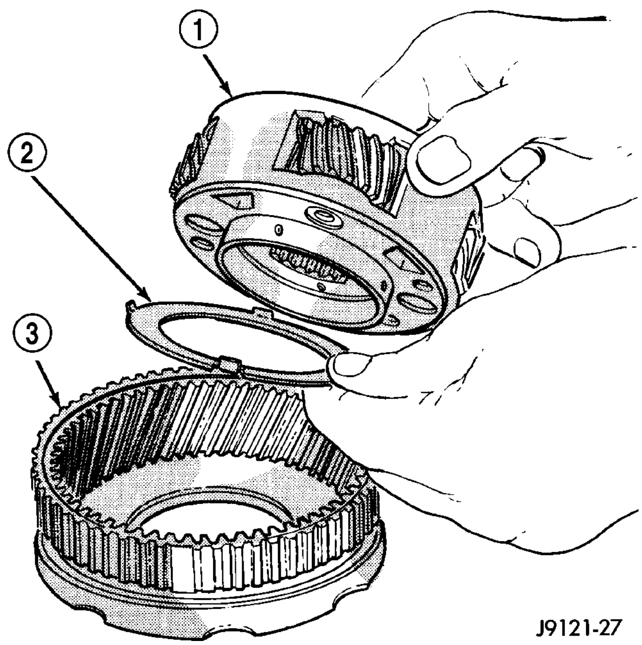


Fig. 217 Disassembling Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - TABBED THRUST WASHER
3 - FRONT ANNULUS GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(4) Remove tabbed thrust washer from driving shell (Fig. 218). Note washer position for assembly reference.

(5) Remove sun gear and driving shell as assembly (Fig. 219).

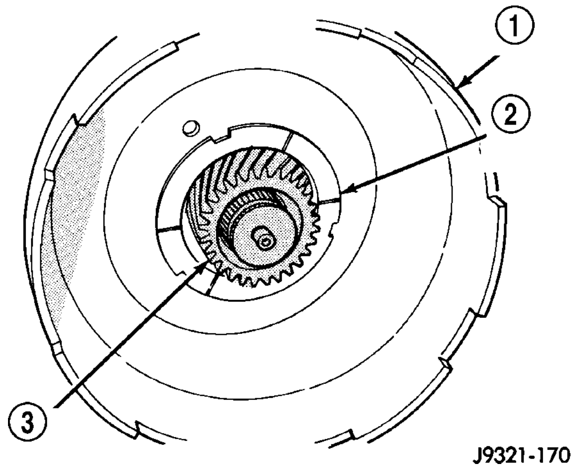


Fig. 218 Driving Shell Thrust Washer Removal

1 - DRIVING SHELL
2 - TABBED THRUST WASHER
3 - SUN GEAR

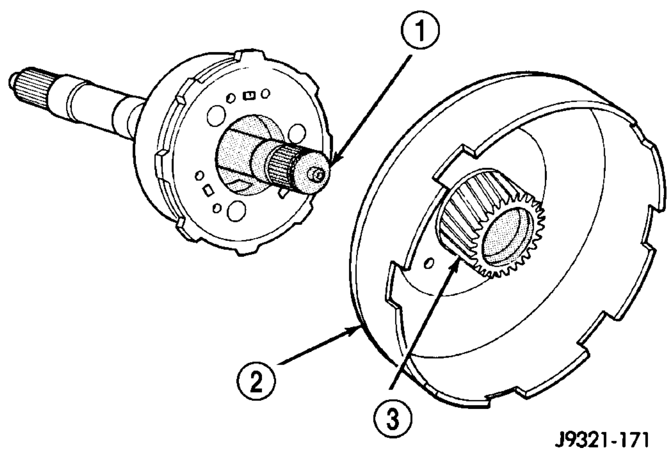


Fig. 219 Sun Gear And Driving Shell Removal

1 - INTERMEDIATE SHAFT
2 - DRIVING SHELL
3 - SUN GEAR

(6) Remove tabbed thrust washer from rear planetary gear (Fig. 220). Note washer position on gear for assembly reference.

(7) Remove rear planetary gear and rear annulus gear from intermediate shaft (Fig. 221).

(8) Remove thrust plate from rear annulus gear (Fig. 222).

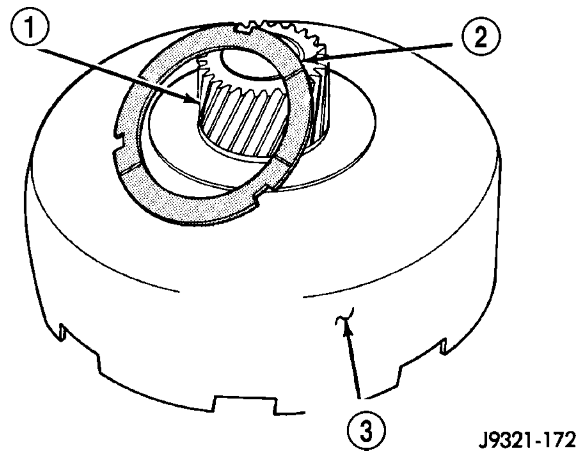


Fig. 220 Rear Planetary Thrust Washer Removal

1 - SUN GEAR
2 - REAR PLANETARY THRUST WASHER
3 - DRIVING SHELL

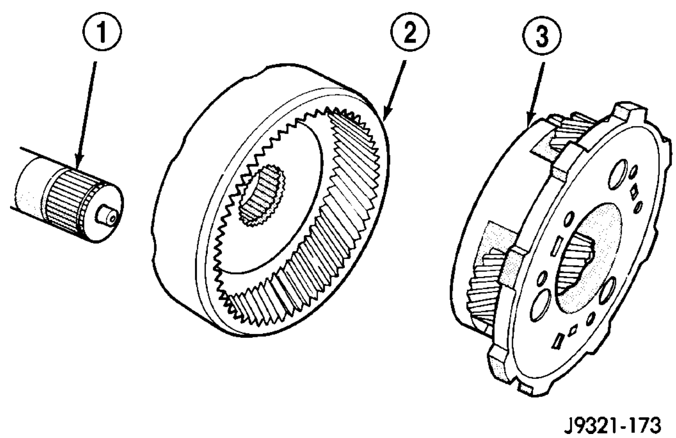


Fig. 221 Rear Planetary And Annulus Gear Removal

1 - INTERMEDIATE SHAFT
2 - REAR ANNULUS GEAR
3 - REAR PLANETARY GEAR

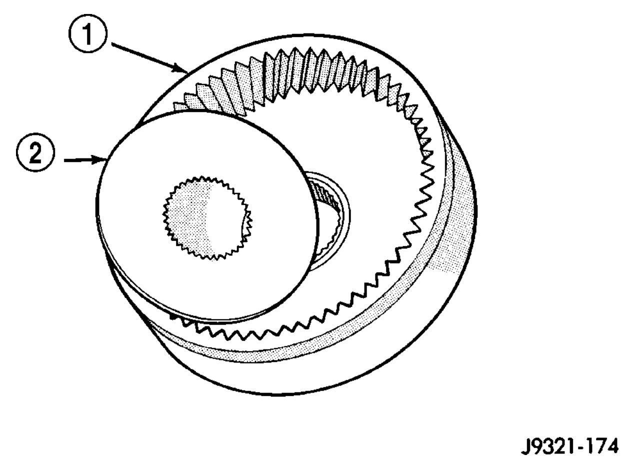


Fig. 222 Rear Annulus Thrust Plate Removal

1 - REAR ANNULUS GEAR
2 - THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

INSPECTION

Inspect the planetary gear sets and annulus gears. The planetary pinions, shafts, washers, and retaining pins are serviceable. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

Inspect the machined surfaces of the intermediate shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap-rings during geartrain assembly. Reusing snap-rings is not recommended.

ASSEMBLY

(1) Lubricate sun gear and planetary gears with transmission fluid during assembly. Use petroleum jelly to lubricate intermediate shaft bushing surfaces, thrust washers and thrust plates and to hold these parts in place during assembly.

(2) Install front snap-ring on sun gear and install gear in driving shell. Then install thrust plate over sun gear and against rear side of driving shell (Fig. 223). Install rear snap-ring to secure sun gear and thrust plate in driving shell.

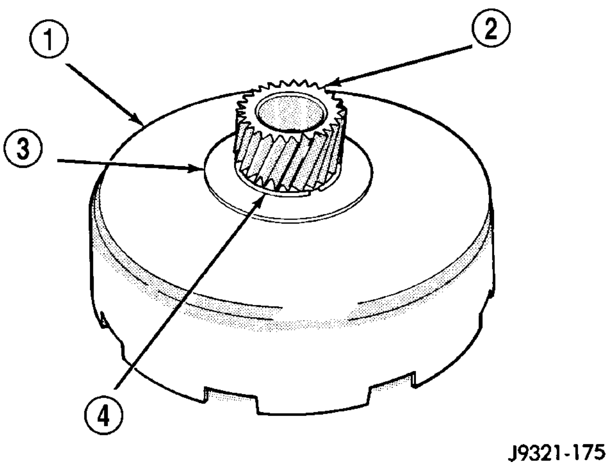


Fig. 223 Sun Gear Installation

1 - DRIVING SHELL
2 - SUN GEAR
3 - THRUST PLATE
4 - SUN GEAR REAR RETAINING RING

(3) Install rear annulus gear on intermediate shaft (Fig. 224).

(4) Install thrust plate in annulus gear (Fig. 225). Be sure plate is seated on shaft splines and against gear.

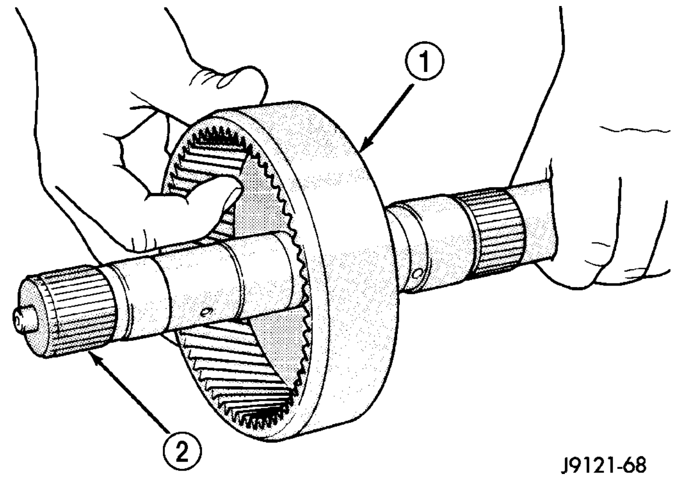


Fig. 224 Installing Rear Annulus Gear On Intermediate Shaft

1 - REAR ANNULUS GEAR
2 - OUTPUT SHAFT

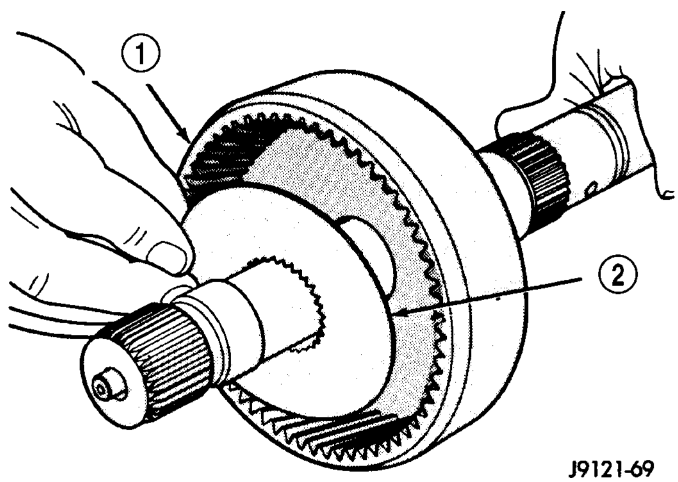


Fig. 225 Installing Rear Annulus Thrust Plate

1 - REAR ANNULUS GEAR
2 - THRUST PLATE

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(5) Install rear planetary gear in rear annulus gear (Fig. 226). Be sure planetary carrier is seated against annulus gear.

(6) Install tabbed thrust washer on front face of rear planetary gear (Fig. 227). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(7) Lubricate sun gear bushings with petroleum jelly or transmission fluid.

(8) Install sun gear and driving shell on intermediate shaft (Fig. 228). Seat shell against rear planetary gear. Verify that thrust washer on planetary gear was not displaced during installation.

(9) Install tabbed thrust washer in driving shell (Fig. 229), be sure washer tabs are seated in tab slots of driving shell. Use extra petroleum jelly to hold washer in place if desired.

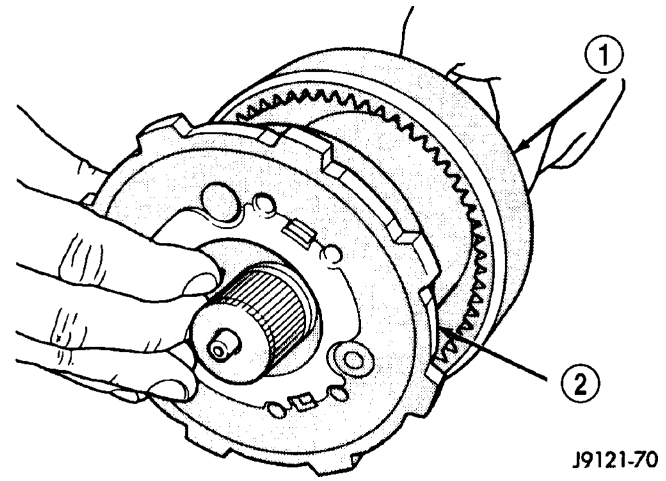


Fig. 226 Installing Rear Planetary Gear

1 - REAR ANNULUS GEAR
2 - REAR PLANETARY GEAR

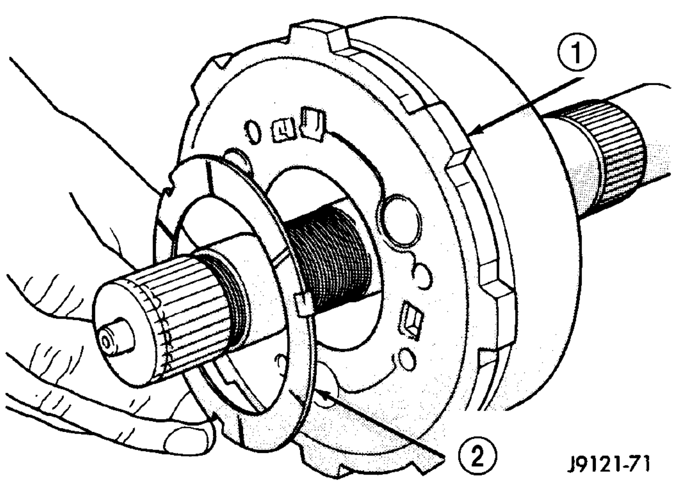


Fig. 227 Installing Rear Planetary Thrust Washer

1 - REAR PLANETARY GEAR
2 - TABBED THRUST WASHER

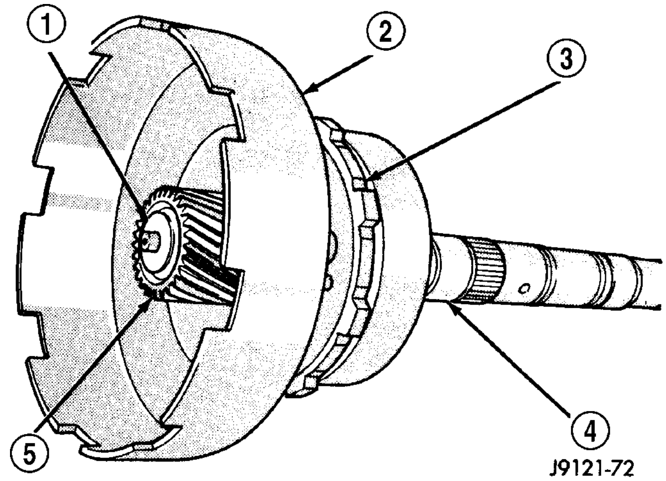


Fig. 228 Installing Sun Gear And Driving Shell

1 - OUTPUT SHAFT
2 - DRIVING SHELL
3 - REAR PLANETARY GEAR
4 - OUTPUT SHAFT
5 - SUN GEAR

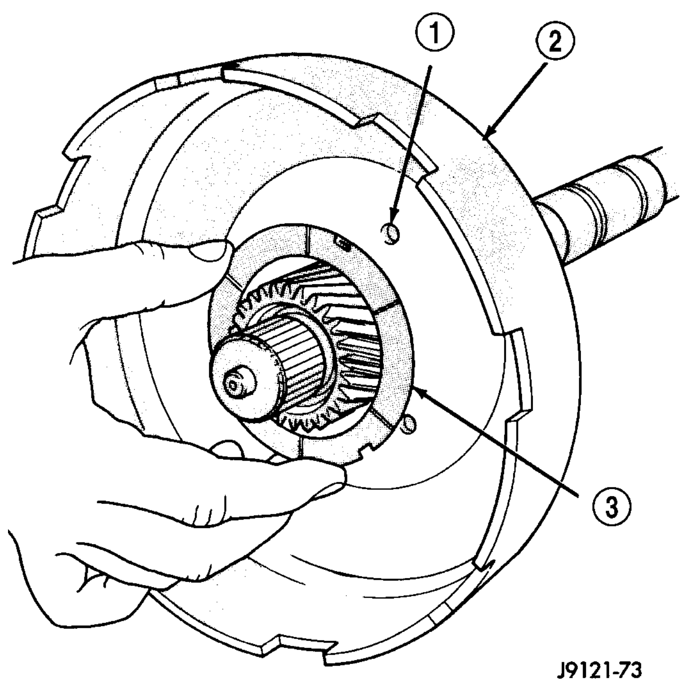


Fig. 229 Installing Driving Shell Thrust Washer

1 - TAB SLOTS (3)
2 - DRIVING SHELL
3 - TABBED THRUST WASHER

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(10) Install tabbed thrust washer on front planetary gear (Fig. 230). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

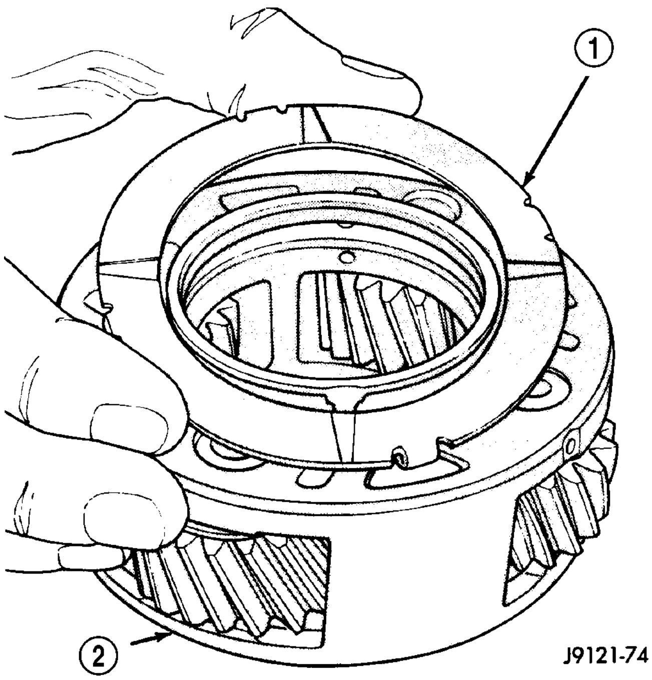


Fig. 230 Installing Thrust Washer On Front Planetary Gear

1 - TABBED THRUST WASHER
2 - FRONT PLANETARY GEAR

(11) Install front annulus gear over and onto front planetary gear (Fig. 231). Be sure gears are fully meshed and seated.

(12) Install front planetary and annulus gear assembly (Fig. 232). Hold gears together and slide them onto shaft. Be sure planetary pinions are seated on sun gear and that planetary carrier is seated on intermediate shaft.

(13) Place geartrain in upright position. Rotate gears to be sure all components are seated and properly assembled. Snap-ring groove at forward end of intermediate shaft will be completely exposed when components are assembled correctly.

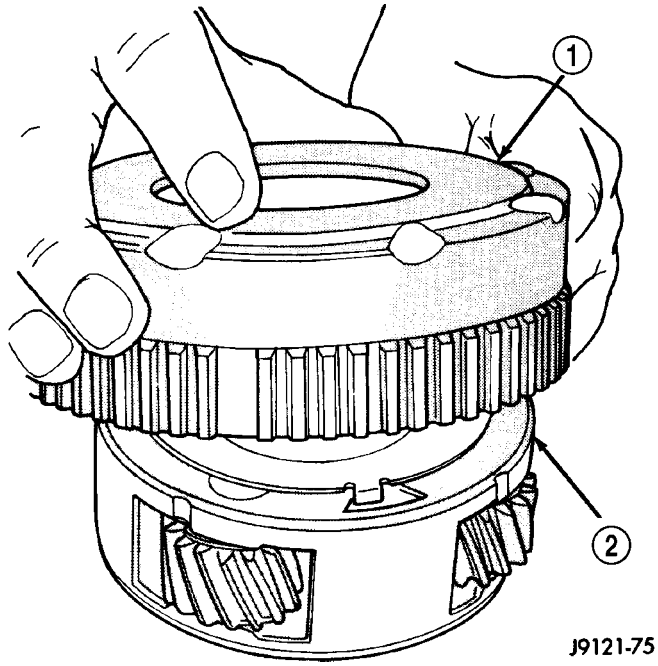


Fig. 231 Assembling Front Planetary And Annulus Gears

1 - FRONT ANNULUS GEAR
2 - FRONT PLANETARY GEAR

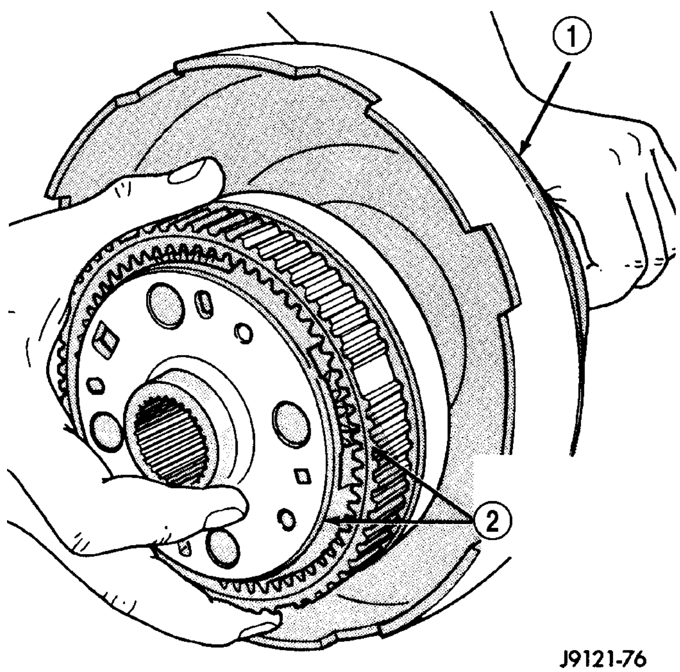


Fig. 232 Installing Front Planetary And Annulus Gear Assembly

1 - DRIVING SHELL
2 - ASSEMBLED FRONT PLANETARY AND ANNULUS GEARS

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(14) Install new planetary snap-ring in groove at end of intermediate shaft (Fig. 233).

(15) Turn planetary geartrain over. Position wood block under front end of intermediate shaft and support geartrain on shaft. Be sure all geartrain parts have moved forward against planetary snap-ring. This is important for accurate end play check.

(16) Check planetary geartrain end play with feeler gauge (Fig. 234). Insert gauge between rear annulus gear and shoulder on intermediate shaft as shown. End play should be 0.15 to 1.22 mm (0.006 to 0.048 in.).

(17) If end play is incorrect, install thinner/thicker planetary snap-ring as needed.

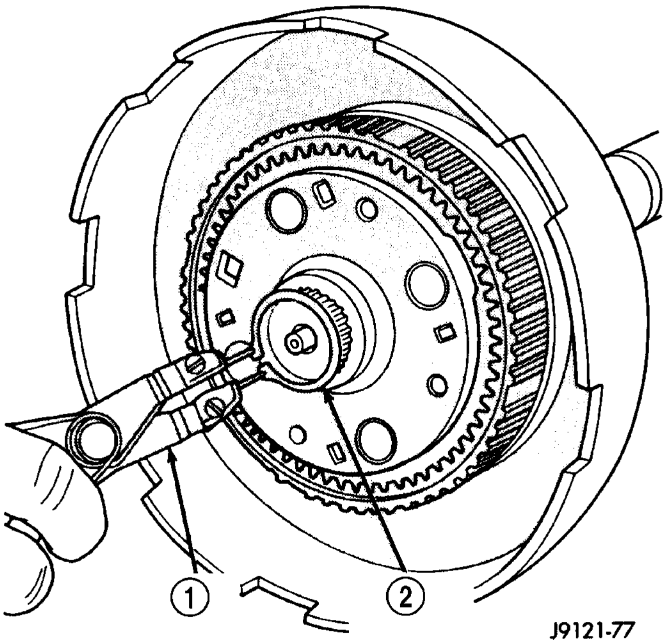


Fig. 233 Installing Planetary Snap-Ring

1 - SNAP-RING PLIERS
2 - PLANETARY SNAP-RING

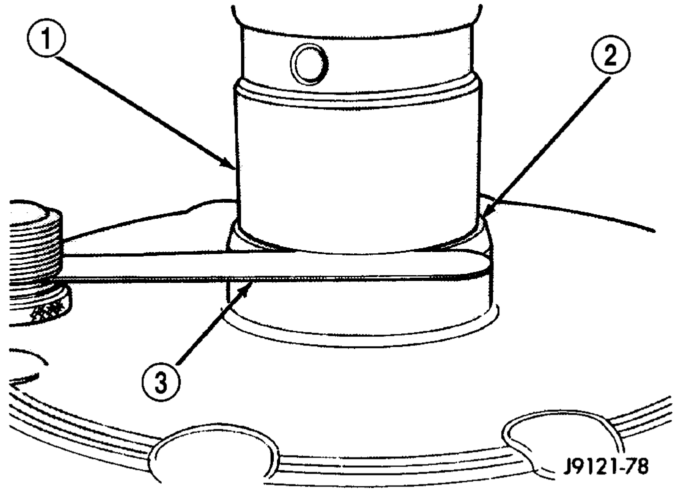


Fig. 234 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 235) is composed of the rear clutch retainer, pressure plate, clutch plates, driving discs, piston, Belleville spring, and snap-rings. The Belleville spring acts as a lever to multiply the force applied on to it by the apply piston. The increased apply force on the rear clutch pack, in comparison to the front clutch pack, is needed to hold against the greater torque load imposed onto the rear pack. The rear clutch is directly behind the front clutch and is considered a driving component.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

REAR CLUTCH (Continued)

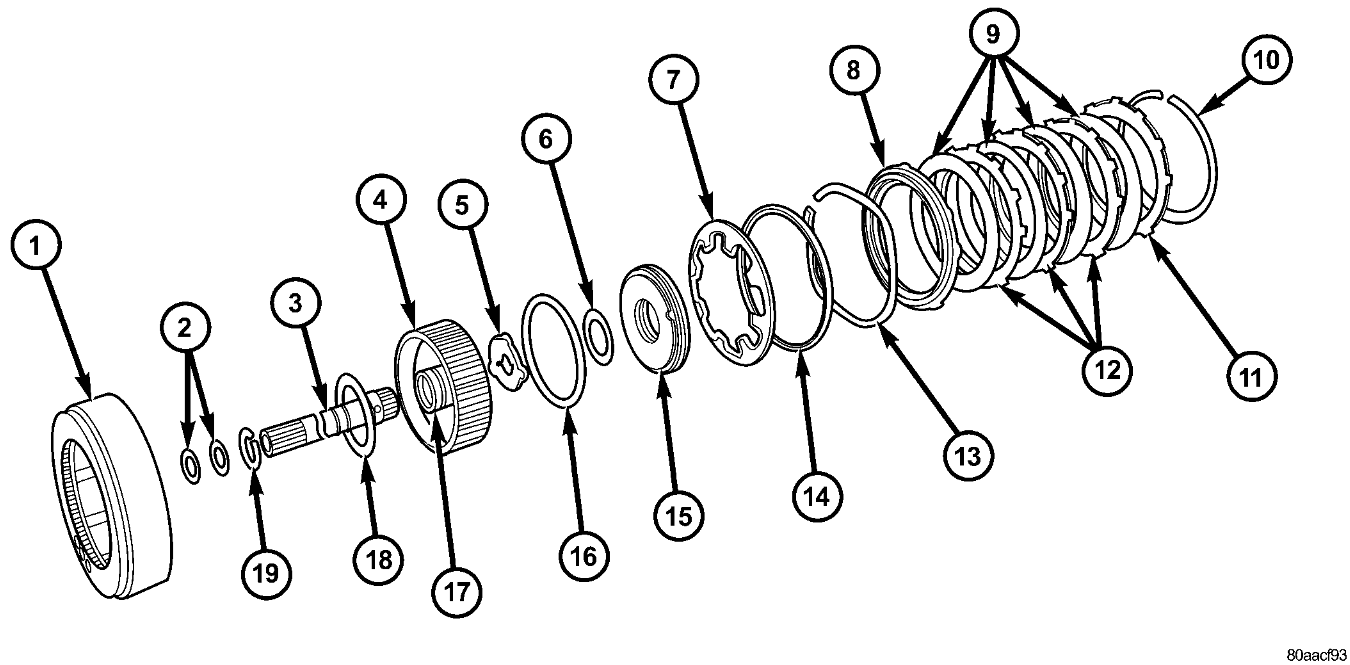


Fig. 235 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved spring is used to cushion the application of the clutch pack. The snap-ring is selective and used to adjust clutch pack clearance.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being released by the release spring, fluid flows through a vent and one-way ball-check-valve located in the piston. The check-valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

DISASSEMBLY

(1) Remove fiber thrust washer from forward side of clutch retainer.

(2) Remove input shaft front and rear seal rings.

(3) Remove selective clutch pack snap-ring (Fig. 236).

(4) Remove the reaction plate, clutch discs, steel plates, pressure plate, wave spring, spacer ring, and piston spring (Fig. 236).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft retaining ring. It may be necessary to press the input shaft in slightly to relieve tension on the retaining ring

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

REAR CLUTCH (Continued)

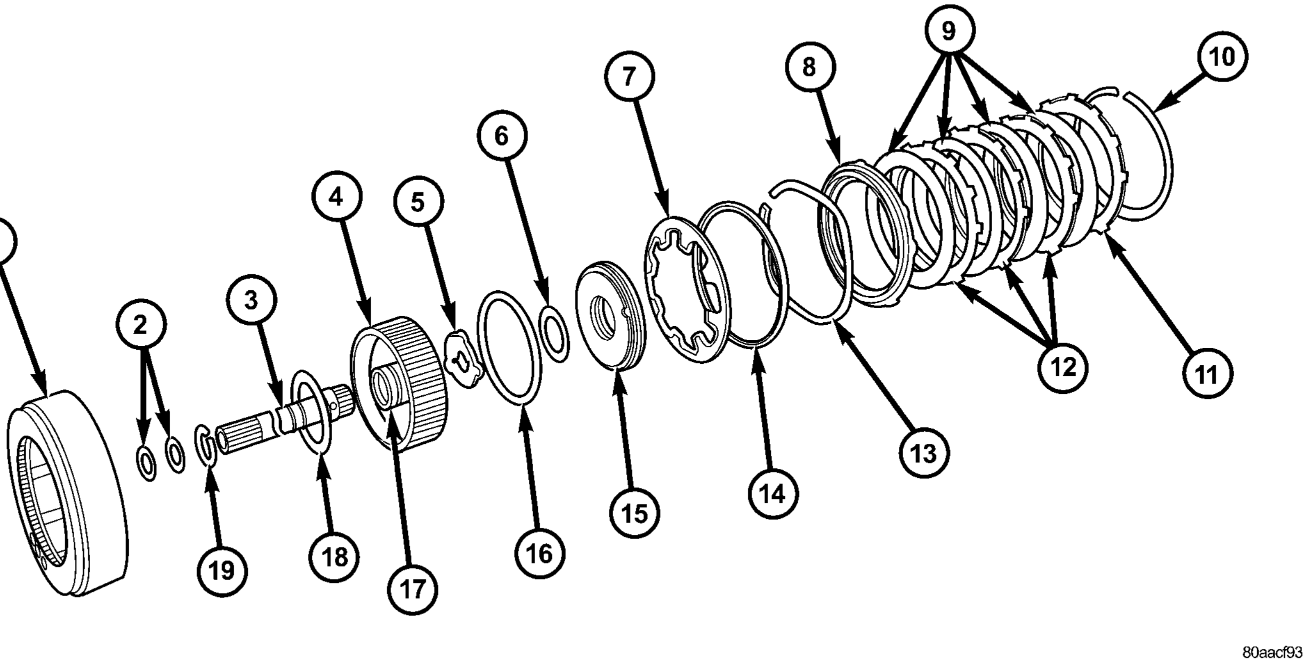


Fig. 236 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

CLEANING

Clean the clutch components with solvent and dry them with compressed air. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

INSPECTION

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary.

(a) Be sure clutch hub seal ring is fully seated in groove and is not twisted.

REAR CLUTCH (Continued)

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then partially press input shaft into retainer (Fig. 237). Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft retaining ring.

(5) Press the input shaft the remainder of the way into the clutch retainer.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(9) Install piston spring in retainer and on top of piston. Concave side of spring faces downward (toward piston).

(10) Install the spacer ring and wave spring into the retainer. Be sure spring is completely seated in retainer groove.

(11) Install pressure plate (Fig. 236). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

(12) Install first clutch disc in retainer on top of pressure plate. Then install a clutch plate followed by a clutch disc until entire clutch pack is installed (4 discs and 3 plates are required) (Fig. 236).

(13) Install the reaction plate.

(14) Install selective snap-ring. Be sure snap-ring is fully seated in retainer groove.

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 238).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 238).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.635 - 0.914 mm (0.025 - 0.036 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

The selective snap ring thicknesses are:

- 0.107 - 0.109 in.
- 0.098 - 0.100 in.
- 0.095 - 0.097 in.
- 0.083 - 0.085 in.
- 0.076 - 0.078 in.
- 0.071 - 0.073 in.
- 0.060 - 0.062 in.

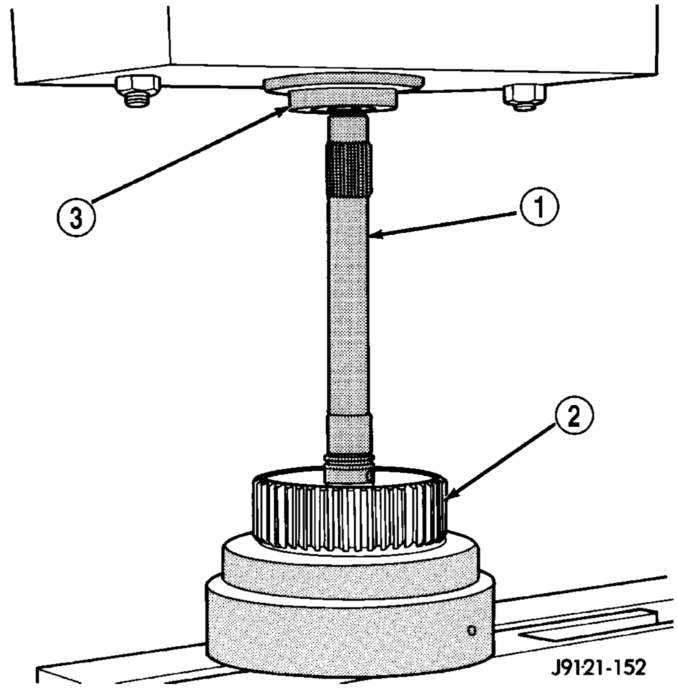


Fig. 237 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

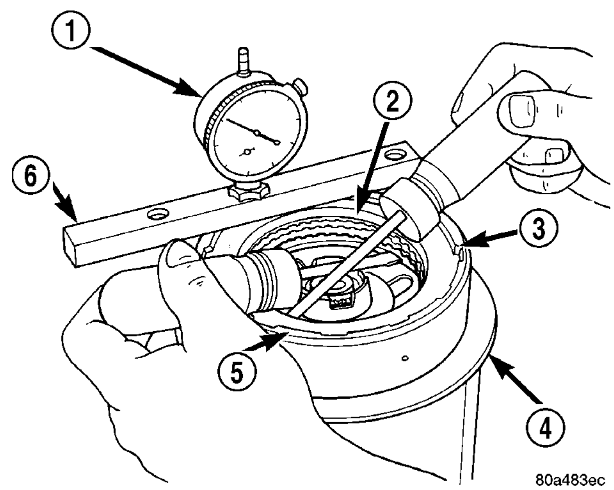


Fig. 238 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

REAR CLUTCH (Continued)

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 239). Use enough petroleum jelly to hold washer in place.

(17) Set rear clutch aside for installation during final assembly.

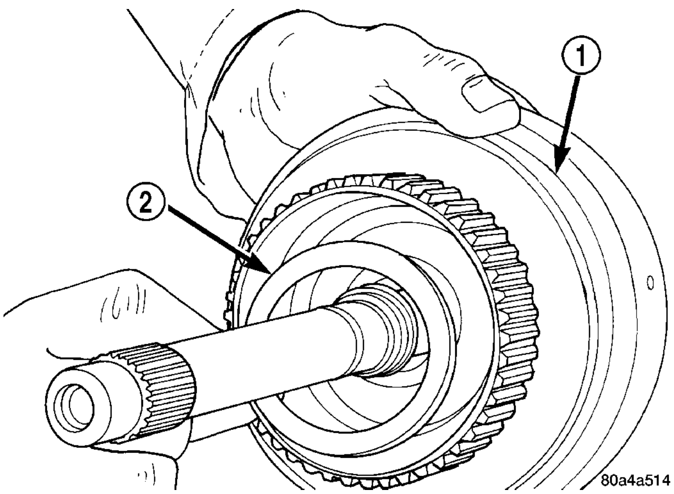


Fig. 239 Installing Rear Clutch Thrust Washer

1 - REAR CLUTCH RETAINER
2 - REAR CLUTCH THRUST WASHER

REAR SERVO

DESCRIPTION

The rear (low/reverse) servo consists of a single stage or diameter piston and a spring loaded plug. The spring is used to cushion the application of the rear (low/reverse) band.

OPERATION

While in the de-energized state (no pressure applied), the piston is held up in its bore by the piston spring. The plug is held down in its bore, in the piston, by the plug spring. When pressure is applied to the top of the piston, the plug is forced down in its bore, taking up any clearance. As the piston moves, it causes the plug spring to compress, and the piston moves down over the plug. The piston continues to move down until it hits the shoulder of the plug and fully applies the band. The period of time from the initial application, until the piston is against the shoulder of the plug, represents a reduced shocking of the band that cushions the shift.

DISASSEMBLY

(1) Remove small snap-ring and remove plug and spring from servo piston (Fig. 240).

(2) Remove and discard servo piston seal ring.

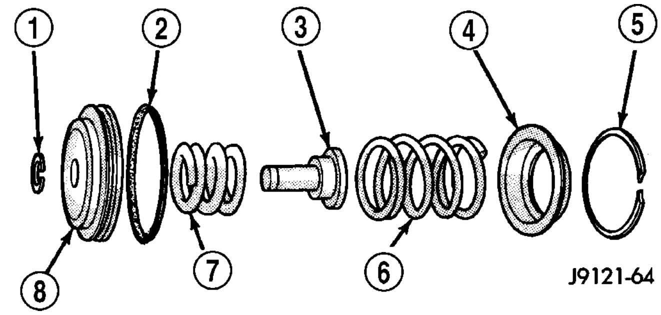


Fig. 240 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

CLEANING

Remove and discard the servo piston seal ring (Fig. 241). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap-rings and use new ones at assembly.

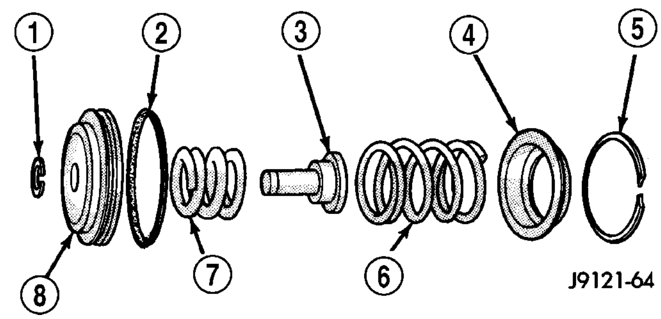


Fig. 241 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

REAR SERVO (Continued)

ASSEMBLY

(1) Lubricate piston and guide seals (Fig. 242) with petroleum jelly. Lubricate other servo parts with Mopar® ATF +4, Automatic Transmission fluid.

(2) Install new seal ring on servo piston.

(3) Assemble piston, plug, spring and new snap-ring.

(4) Lubricate piston seal lip with petroleum jelly.

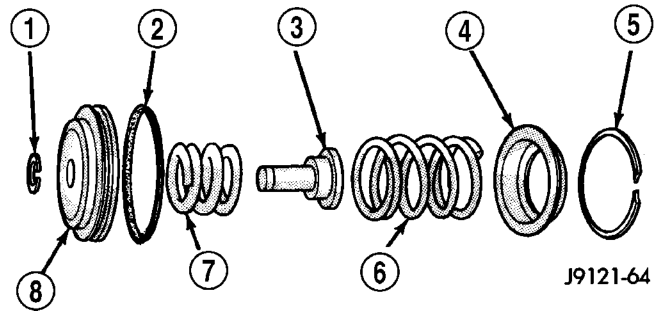


Fig. 242 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

SHIFT MECHANISM

DESCRIPTION

The gear shift mechanism provides six shift positions which are:

- PARK (P)
- REVERSE (R)
- NEUTRAL (N)
- DRIVE (D)
- Manual SECOND (2)
- Manual LOW (1)

OPERATION

Manual LOW (1) range provides first gear only. Overrun braking is also provided in this range. Manual SECOND (2) range provides first and second gear only.

DRIVE range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position. No upshift to fourth gear will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to third is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.
- Battery temperature is below -5° C (23° F).

SOLENOID

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, con-

SOLENOID (Continued)

stant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

SPEED SENSOR

DESCRIPTION

The speed sensor (Fig. 243) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed.

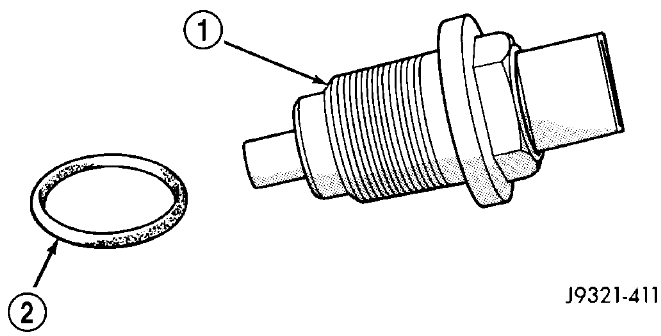


Fig. 243 Transmission Output Speed Sensor

1 - TRANSMISSION OUTPUT SHAFT SPEED SENSOR
2 - SEAL

OPERATION

Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. Signals from this sensor are shared with the powertrain control module.

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 244) adjustment is extremely important to proper operation. This adjustment positions the throttle valve, which controls shift speed, quality, and part-throttle downshift sensitivity.

If cable setting is too loose, early shifts and slippage between shifts may occur. If the setting is too tight, shifts may be delayed and part throttle downshifts may be very sensitive.

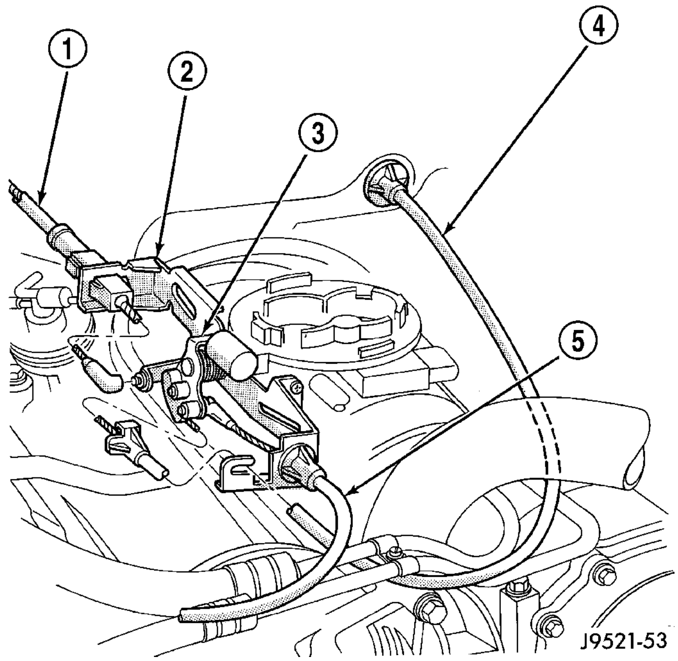


Fig. 244 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 245). The cable is attached to an arm mounted on the throttle lever shaft. A retaining clip at the engine-end of the cable is removed to provide for cable adjustment. The retaining clip is then installed back onto the throttle valve cable to lock in the adjustment.

THROTTLE VALVE CABLE (Continued)

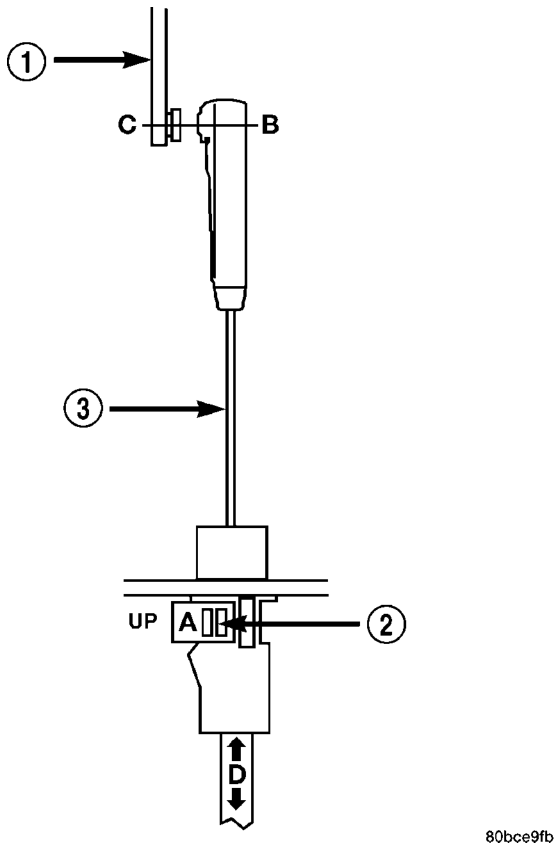


Fig. 245 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

ADJUSTMENTS - THROTTLE VALVE CABLE

A correctly adjusted throttle valve cable will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment will allow simultaneous movement without causing the transmission throttle lever to either move ahead of, or lag behind the lever on the throttle body.

ADJUSTMENT VERIFICATION

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position (Fig. 246). Then verify that the transmission throttle lever (Fig. 247) is also at idle (fully forward) position.

(4) Slide cable off attachment stud on throttle body lever.

(5) Compare position of cable end to attachment stud on throttle body lever:

- Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction (Fig. 248).

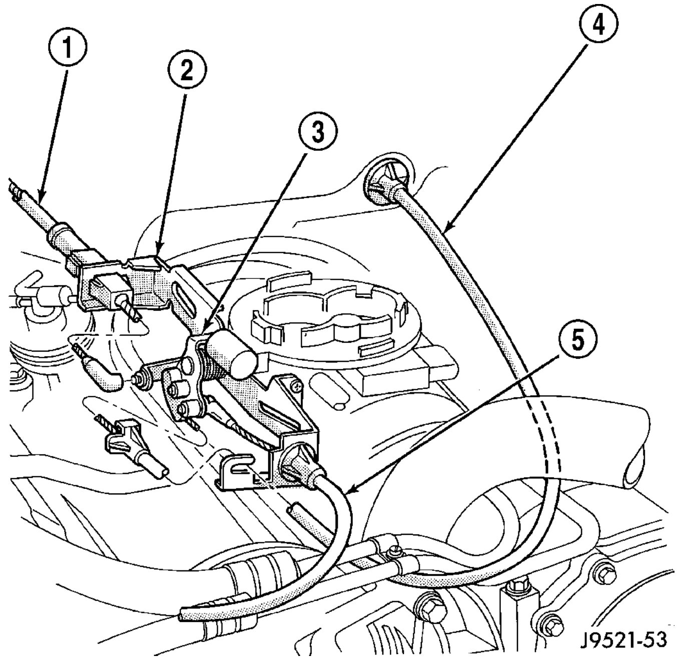


Fig. 246 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

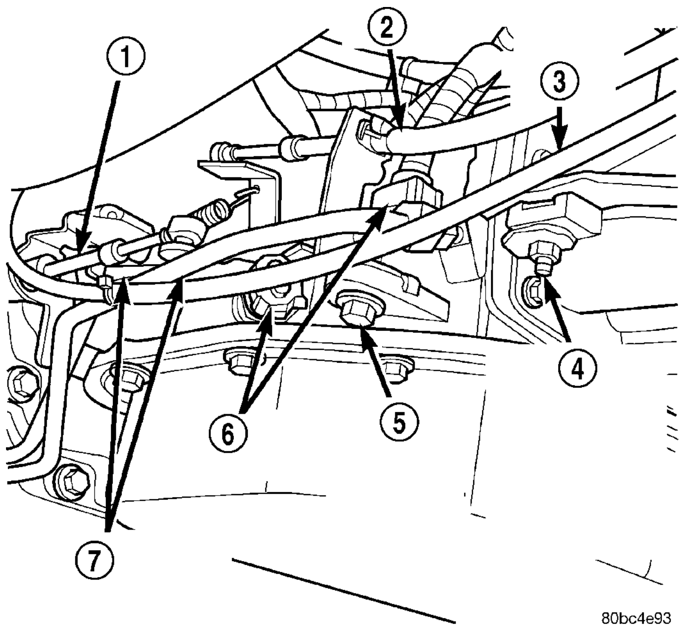


Fig. 247 Throttle Valve Cable at Transmission

1 - TRANSMISSION SHIFTER CABLE
2 - THROTTLE VALVE CABLE
3 - TRANSFER CASE SHIFTER CABLE
4 - TRANSFER CASE SHIFTER CABLE BRACKET RETAINING BOLT (1 OR 2)
5 - THROTTLE VALVE CABLE BRACKET RETAINING BOLT
6 - ELECTRICAL CONNECTORS
7 - TRANSMISSION FLUID LINES

THROTTLE VALVE CABLE (Continued)

• If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in Throttle Valve Cable Adjustment procedure.

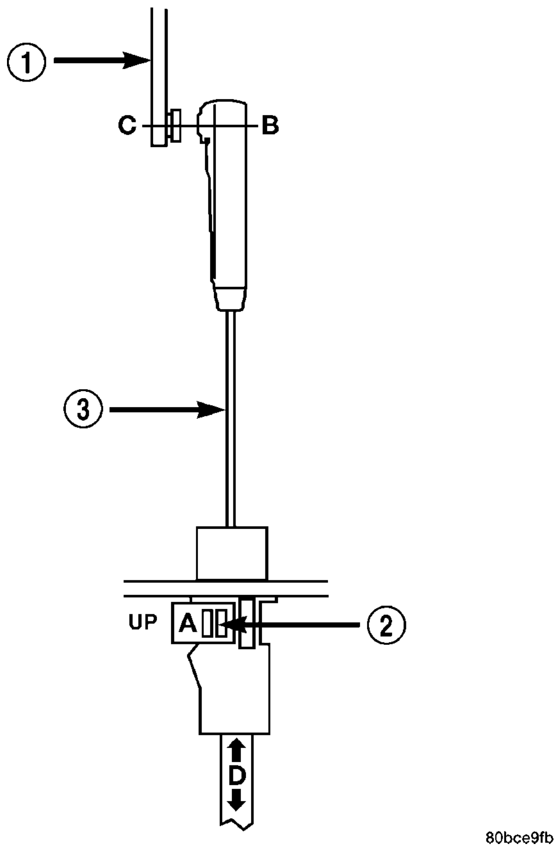


Fig. 248 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

(6) Reconnect cable end to attachment stud. Then with aid of a helper, observe movement of transmission throttle lever and lever on throttle body.

• If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.

• If transmission throttle lever moves ahead of, or lags behind throttle body lever, cable adjustment will be necessary. Or, if throttle body lever prevents transmission lever from returning to closed position, cable adjustment will be necessary.

ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position.

(2) Remove air cleaner if necessary.

(3) Disconnect cable end from attachment stud. **Carefully slide cable off stud. Do not pry or pull cable off.**

(4) Verify that transmission throttle lever is in fully closed position. Then be sure lever on throttle body is at curb idle position.

(5) Pry the T.V. cable lock (A) into the UP position (Fig. 248). This will unlock the cable and allow for readjustment.

(6) Apply just enough tension on the T.V. cable (B) to remove any slack in the cable.**Pulling too tight will cause the T.V. lever on the transmission to move out of its idle position, which will result in an incorrect T.V. cable adjustment.** Slide the sheath of the T.V. cable (D) back and forth until the centerlines of the T.V. cable end (B) and the throttle bell crank lever (C) are aligned within one millimeter (1mm) (Fig. 248).

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position (Fig. 248). This will lock the present T.V. cable adjustment.

NOTE: Be sure that as the cable is pulled forward and centered on the throttle lever stud, the cable housing moves smoothly with the cable. Due to the angle at which the cable housing enters the spring housing, the cable housing may bind slightly and create an incorrect adjustment.

(8) Reconnect the T.V. cable (B) to the throttle bellcrank lever (C).

(9) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 249) is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller and an electronically applied converter clutch. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The torque converter hub drives the transmission oil (fluid) pump.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure resulted in large amounts of metal or fiber contamination in the fluid.

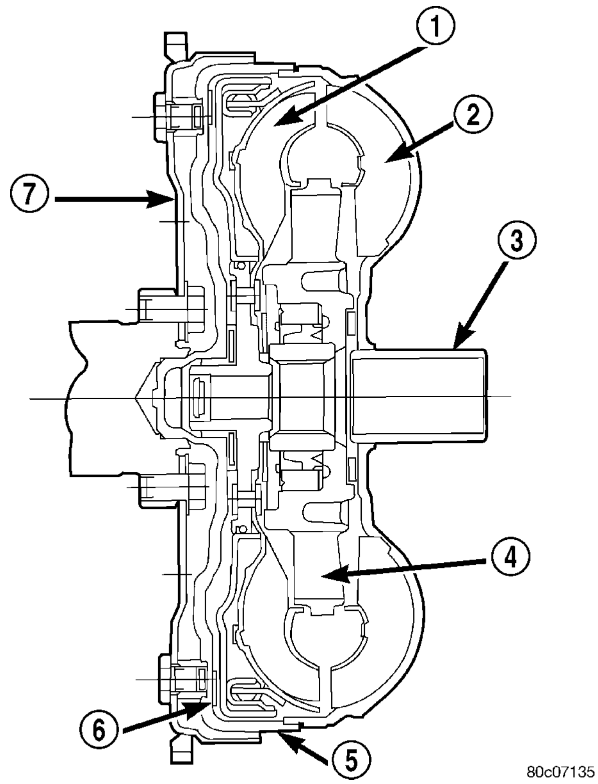


Fig. 249 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - FRONT COVER
6 - CONVERTER CLUTCH DISC
7 - DRIVE PLATE

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 250) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving members of the system.

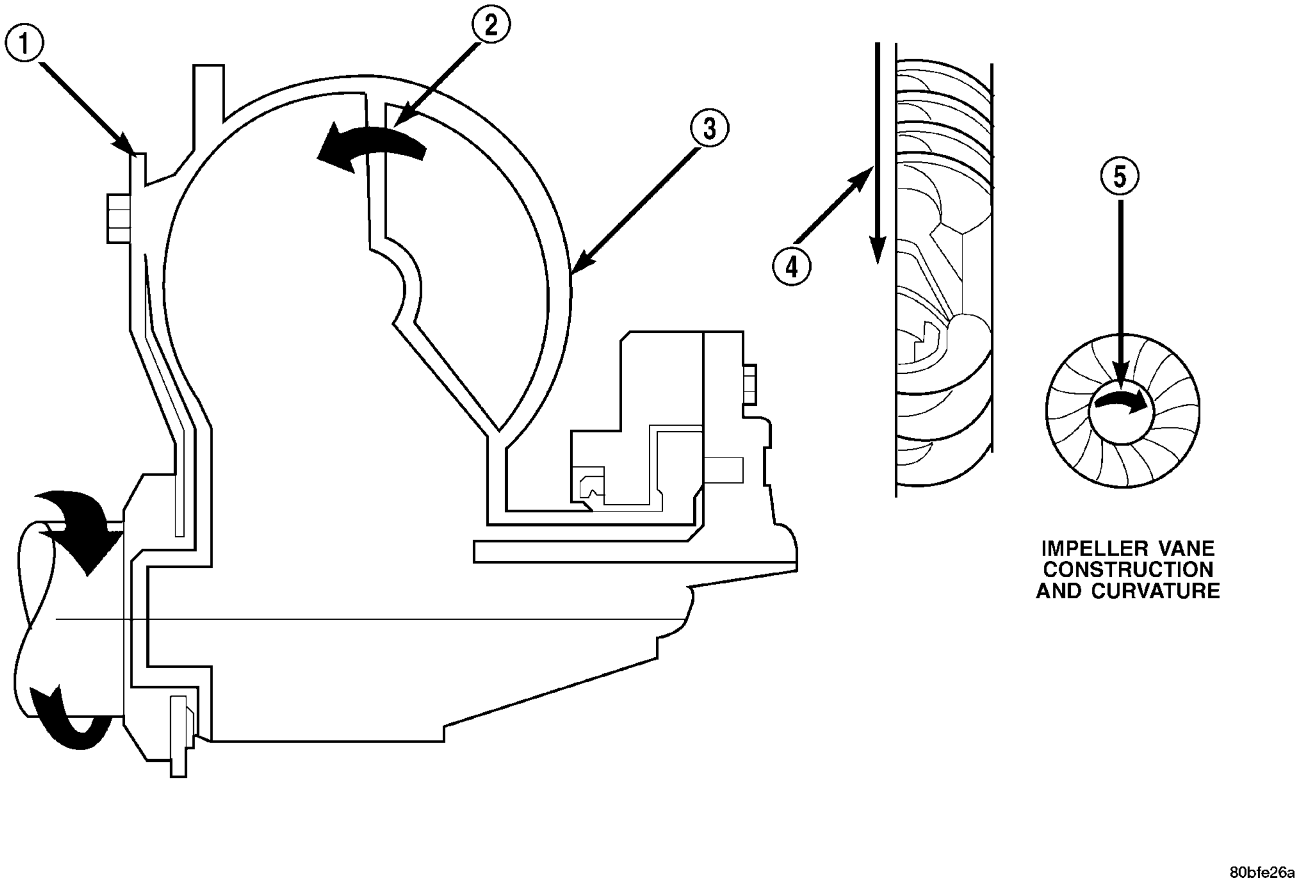


Fig. 250 Impeller

1 - ENGINE FLEXPLATE
2 - OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION
3 - IMPELLER VANES AND COVER ARE INTEGRAL
4 - ENGINE ROTATION
5 - ENGINE ROTATION

TORQUE CONVERTER (Continued)

TURBINE

The turbine (Fig. 251) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.

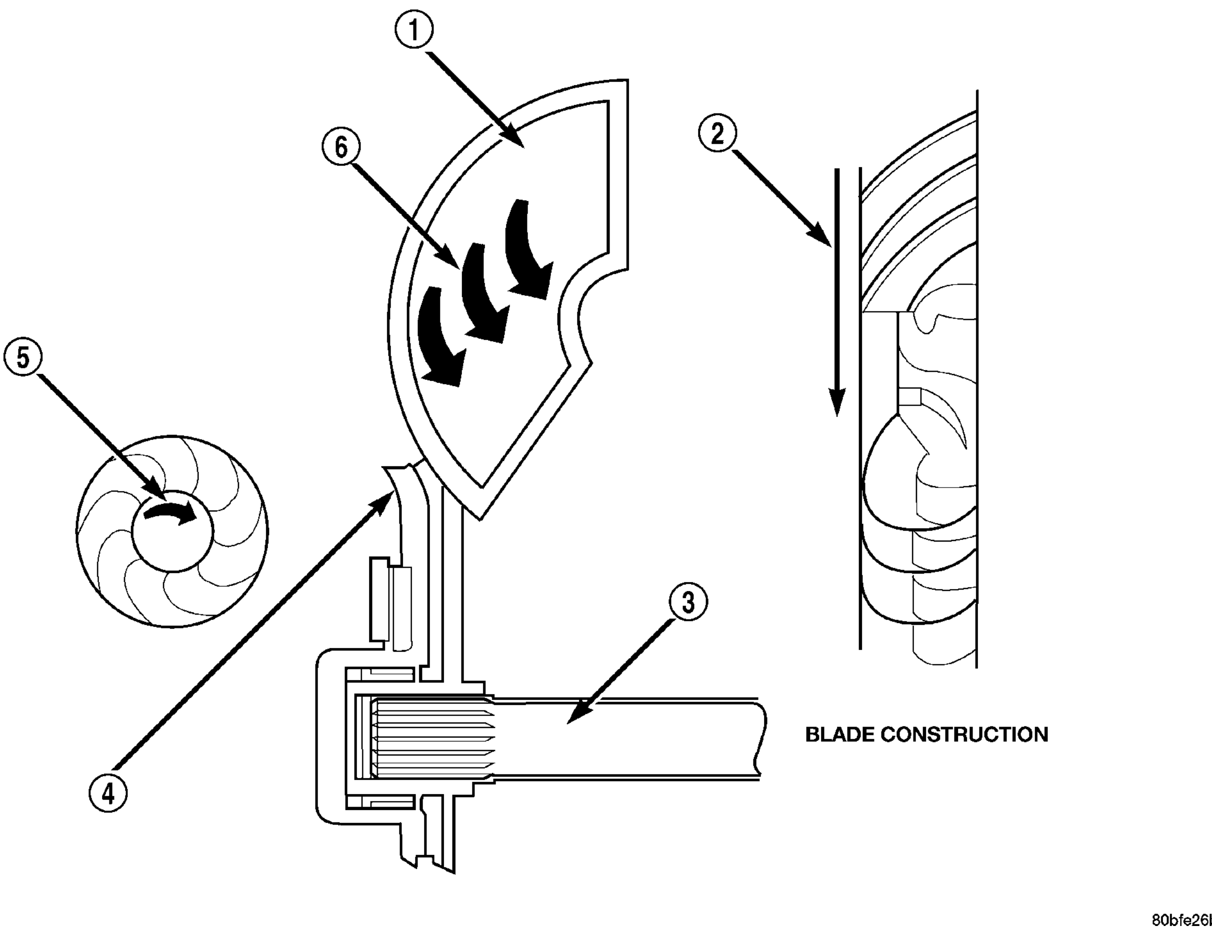


Fig. 251 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 252) is mounted on a stationary shaft which is an integral part of the oil pump. The stator is located between the impeller and turbine within the torque converter case (Fig. 253). The stator contains an over-running clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the over-running clutch, the torque multiplication feature of the torque converter is operational.

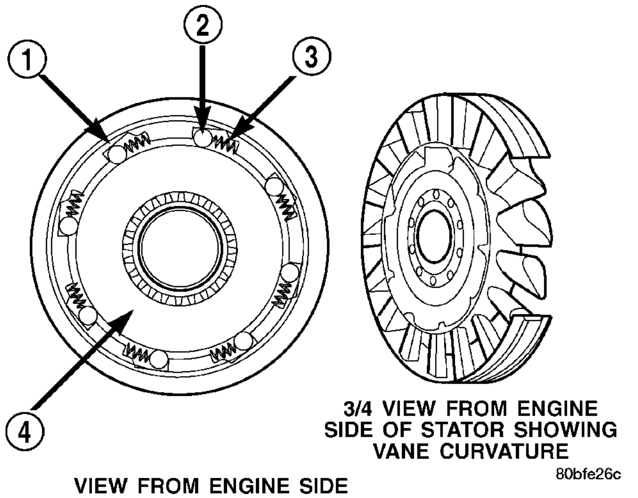


Fig. 252 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

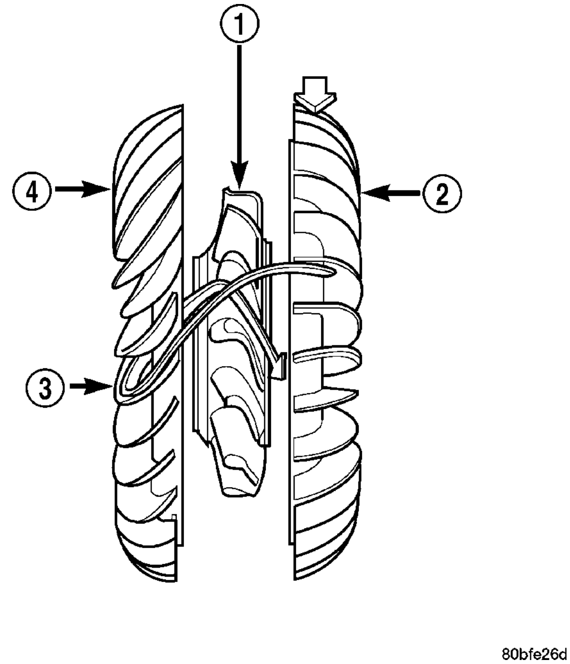


Fig. 253 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 254) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston was added to the turbine, and a friction material was added to the inside of the front cover to provide this mechanical lock-up.

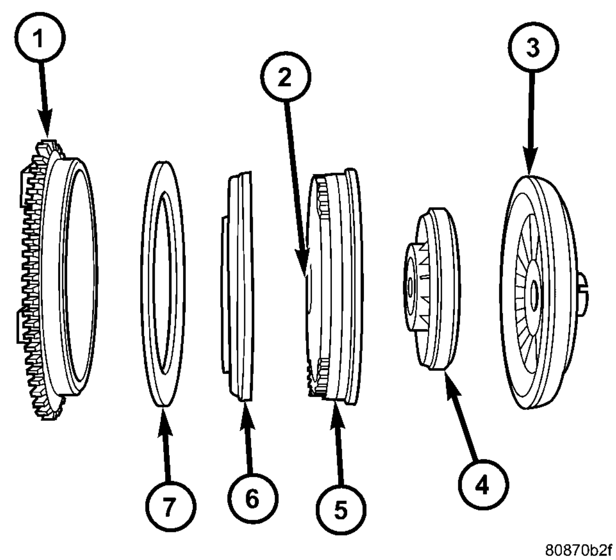


Fig. 254 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

TORQUE CONVERTER (Continued)

OPERATION

The converter impeller (Fig. 255) (driving member), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft.

TURBINE

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a “hindering” direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in such a direction that it would tend to slow it down.

STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 256). Under stall conditions (the turbine is stationary), the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counterclockwise direction. When this happens the overrunning clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a “helping” direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 2.4:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such as way as to cause it to lock-up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.

TORQUE CONVERTER CLUTCH (TCC)

The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch engages in fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface after the vehicle has warmed up. The torque converter clutch will disengage momentarily when an increase in engine load is sensed by the PCM, such as when the vehicle begins to go uphill or the throttle pressure is increased.

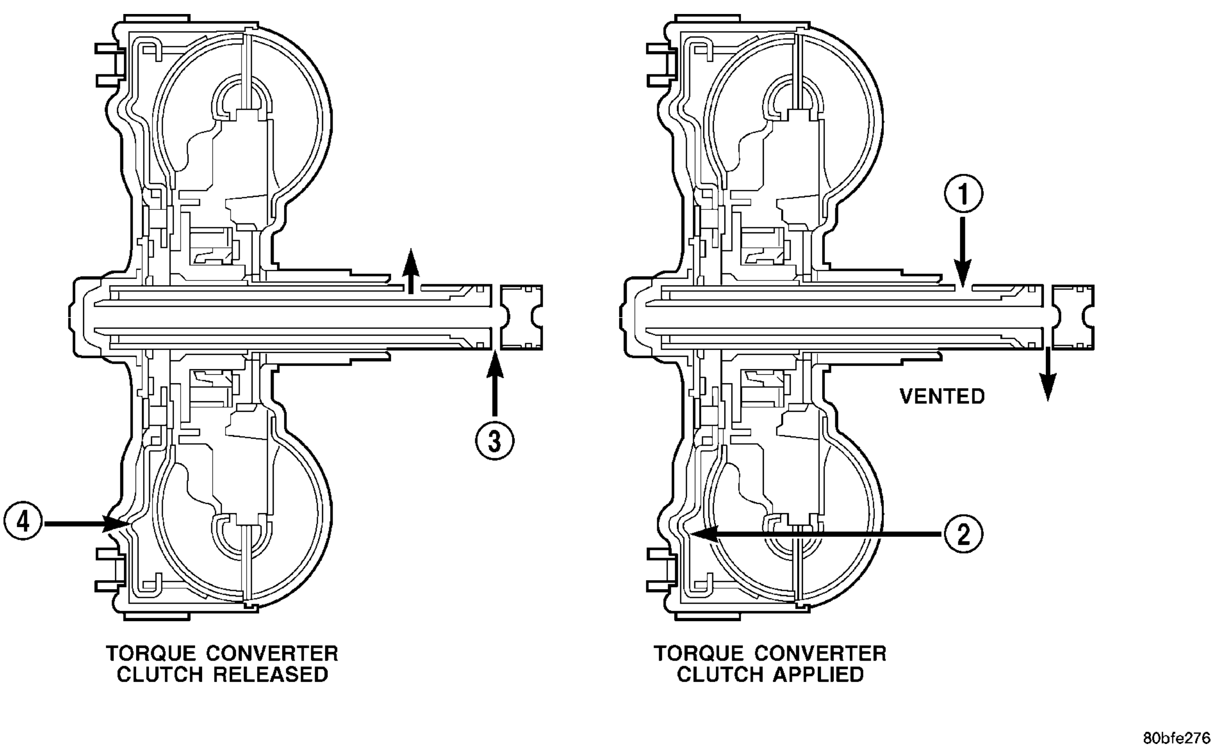


Fig. 255 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

TORQUE CONVERTER (Continued)

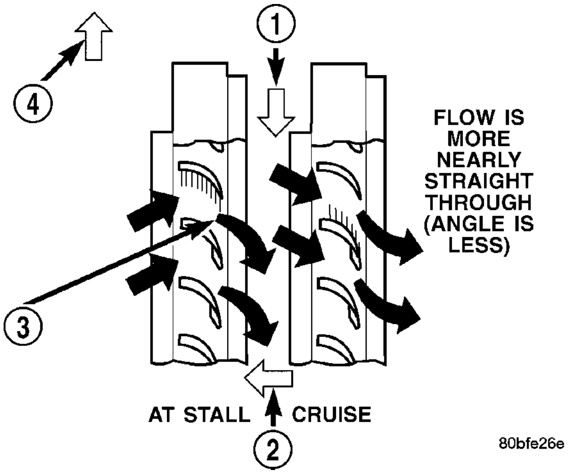


Fig. 256 Stator Operation

1 - DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
2 - FRONT OF ENGINE
3 - INCREASED ANGLE AS OIL STRIKES VANES
4 - DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition. The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or bushing while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 257). Surface of converter lugs should be 1/2 in. to rear of straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

(9) Fill the transmission with the recommended fluid.

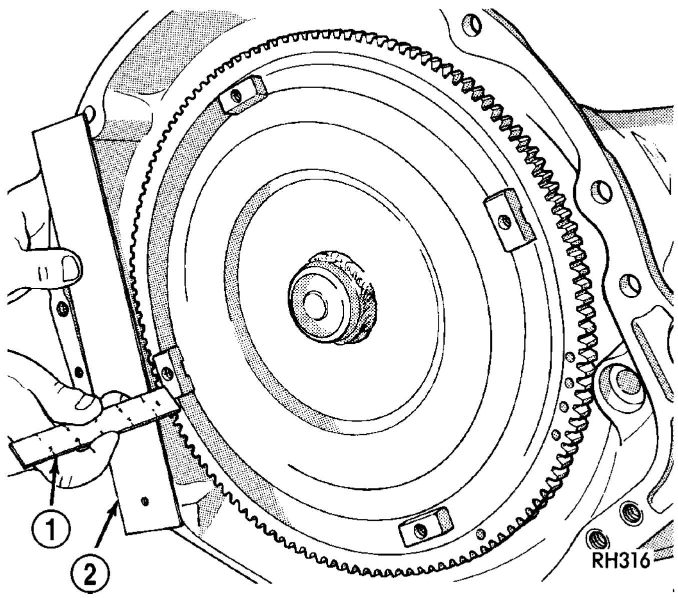


Fig. 257 Checking Torque Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

TORQUE CONVERTER DRAINBACK VALVE

DESCRIPTION

The drainback valve is located in the transmission cooler outlet (pressure) line.

OPERATION

The valve prevents fluid from draining from the converter into the cooler and lines when the vehicle is shut down for lengthy periods. Production valves have a hose nipple at one end, while the opposite end is threaded for a flare fitting. All valves have an arrow (or similar mark) to indicate direction of flow through the valve.

STANDARD PROCEDURE - TORQUE CONVERTER DRAINBACK VALVE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator

TORQUE CONVERTER DRAINBACK VALVE (Continued)

tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates significant amounts of sludge and/or clutch particles and metal shavings, the valve must be replaced.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) (Fig. 258) has 3 primary functions:

- Provide a PARK/NEUTRAL start signal to the engine controller and the starter relay.
- Turn the Back-up lamps on when the transmission is in REVERSE and the engine (ignition) is on.
- Provide a transmission range signal to the instrument cluster.

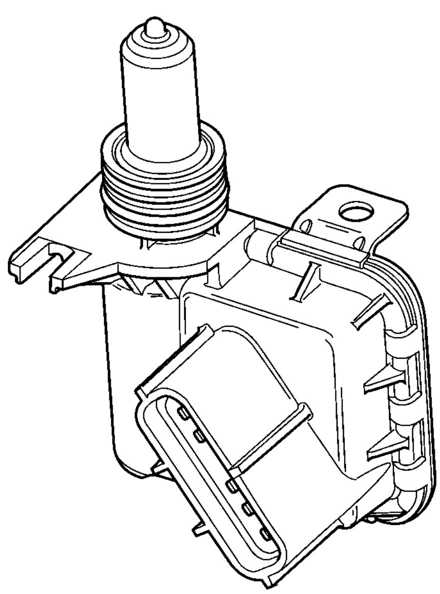

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Fig. 258 Transmission Range Sensor

The sensor is mounted in the transmission housing near the valve body, just above the pan rail. It's in the same position as the Park/Neutral switch on other transmissions. The TRS contacts a cammed surface on the manual valve lever. The cammed surface translates the rotational motion of the manual lever into the linear motion of the sensor. The cammed surface on the manual lever is comprised of two parts controlling the TRS signal: The insulator portion contacts the switch poppet when the manual lever is not in PARK or NEUTRAL. The manual lever itself contacts the poppet when the lever is in PARK or NEUTRAL; providing a ground for the signal from the starter relay and the JTEC engine controller.

OPERATION

As the switch moves through its linear motion (Fig. 259) contacts slide across a circuit board which changes the resistance between the range sensing pins of the switch. A power supply on the instrument cluster provides a regulated voltage signal to the switch. The return signal is decoded by the cluster, which then controls the PRNDL display to correspond with the correct transmission range. A bus message of transmission range is also sent by the cluster. In REVERSE range a second contact set closes the circuit providing power to the reverse lamps.

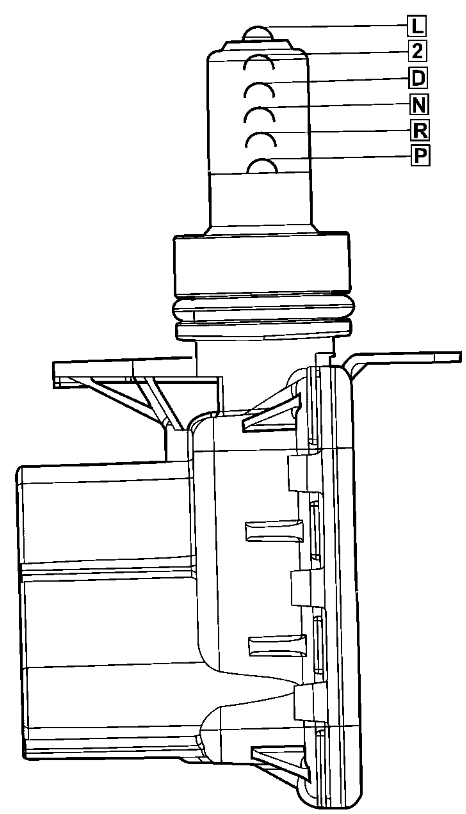

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Fig. 259 Transmission Range Sensor Linear Movement

TRANSMISSION RANGE SENSOR (Continued)

Mechanical State	Electronic Display (Ignition Unlocked)	Electronic Display (Ignition On)		
Indicated Gear Position			Transmission Status	Column Shifter Position
P	P	P	Vehicle is in PARK with the pawl engaged.	In the PARK gate.
	R		The PARK pawl is disengaged and the vehicle is free to roll, but REVERSE is not engaged.	Between the PARK and REVERSE gates.
R	R	R	The transmission is hydraulically in REVERSE.	In the REVERSE gate.
	N		The transmission is transitioning between REVERSE and NEUTRAL.	Between the REVERSE and NEUTRAL gates.
N	N	N	The vehicle is in NEUTRAL.	In the NEUTRAL gate.
	N		The transmission is transitioning between NEUTRAL and DRIVE, but is not in DRIVE.	Between the NEUTRAL and DRIVE gates.
D	D	D	The transmission is hydraulically in DRIVE.	In the DRIVE gate,
2	2	2	The transmission is hydraulically in Manual SECOND.	In the SECOND gate.
1	1	1	The transmission is hydraulically in Manual FIRST.	In the FIRST gate.

DIAGNOSIS AND TESTING - TRANSMISSION RANGE SENSOR (TRS)

NOTE: For all circuit identification in the following steps, Refer to the appropriate Wiring Information.

(1) Raise vehicle on suitable hoist.

(2) Disconnect the vehicle's shift cable from the manual lever.

(3) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(4) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(5) If the resistance is greater than 5 ohms in either of the previous steps, check for a dirty contact between the tip of the TRS rod and the valve body manual lever. If the contact is OK, replace the TRS.

(6) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be less than 5

TRANSMISSION RANGE SENSOR (Continued)

ohms. If the resistance is greater than 5 ohms, replace the TRS.

(7) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 522.2 ohms. If the resistance is not correct, replace the TRS.

(8) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 206.2 ohms. If the resistance is not correct, replace the TRS.

(9) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 108.6 ohms. If the resistance is not correct, replace the TRS.

(10) With the manual lever in the DRIVE position (the DRIVE position is with the manual lever moved three detents forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 59.9 ohms. If the resistance is not correct, replace the TRS.

(11) With the manual lever in the SECOND position (the SECOND position is with the manual lever moved one detent rearward of the full forward position), measure the resistance between the Transmission Range Sensor MUX and the Back-up Lamp feed pins of the TRS. The resistance should be 31.9 ohms. If the resistance is not correct, replace the TRS.

(12) With the manual lever in the LOW position (the LOW position is with the manual lever moved to the full forward position), measure the resistance between the Transmission Range Sensor MUX and the Back-up Lamp feed pins of the TRS. The resistance should be 13.7 ohms. If the resistance is not correct, replace the TRS.

REMOVAL

(1) Raise vehicle and position drain pan under the transmission range sensor (TRS).

(2) Move the transmission manual lever to the manual LOW position. The manual LOW position is with the manual lever in the forward-most detent.

(3) Disengage the wiring connector from the TRS.

(4) Remove the two screws holding the TRS to the TRS mounting bracket.

(5) Remove the TRS (Fig. 260) from the TRS mounting bracket by pulling it straight out of the bracket.

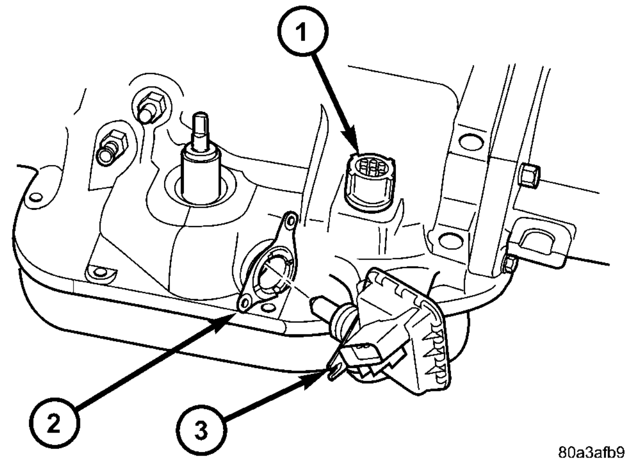


Fig. 260 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(6) Loosen the TRS mounting bracket in the transmission case using Adapter 8581 (Fig. 261).

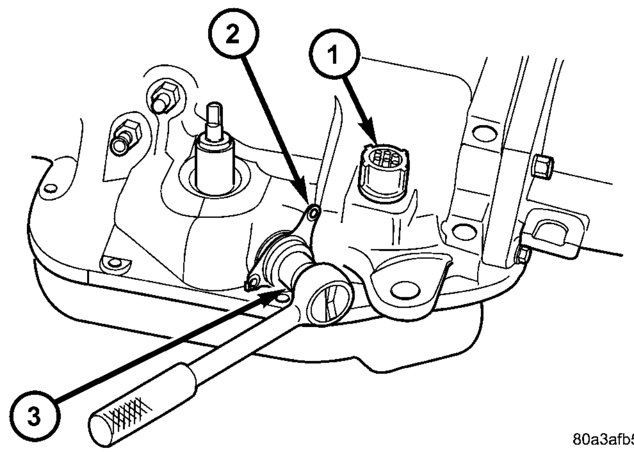


Fig. 261 Loosen the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

TRANSMISSION RANGE SENSOR (Continued)

(7) Remove the TRS mounting bracket (Fig. 262) from the transmission case.

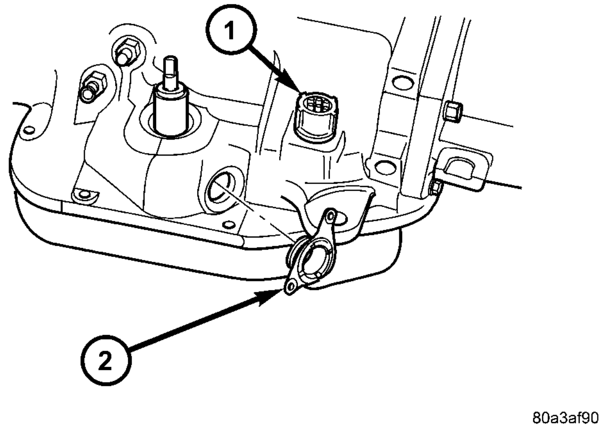


Fig. 262 Remove TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET

INSTALLATION

(1) Move the transmission manual shaft lever to the manual LOW position.

(2) Install the TRS mounting bracket into the transmission case. Using Adapter 8581 (Fig. 263), tighten the mounting bracket to 34 N·m (300 in.lbs.).

(3) Install the TRS (Fig. 264) into the mounting bracket with the wiring connector facing the front of the transmission.

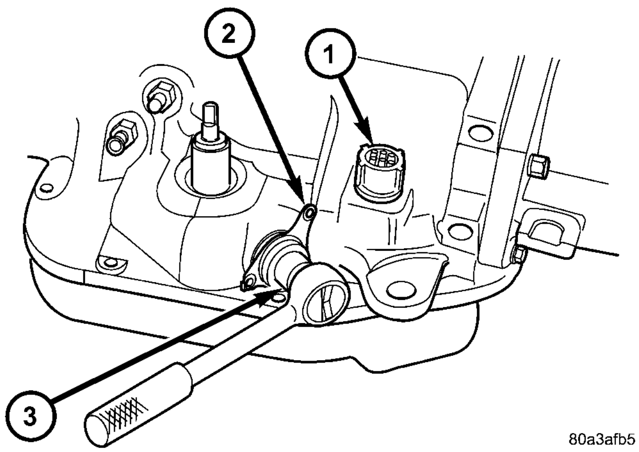


Fig. 263 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(4) Install the two screws to hold the TRS to the mounting bracket. Tighten the screws to 3.4 N·m (30 in.lbs.).

(5) Verify proper sensor operation (Fig. 265).

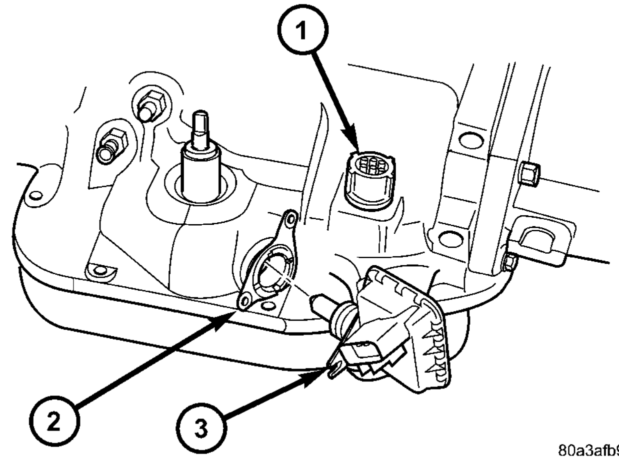


Fig. 264 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

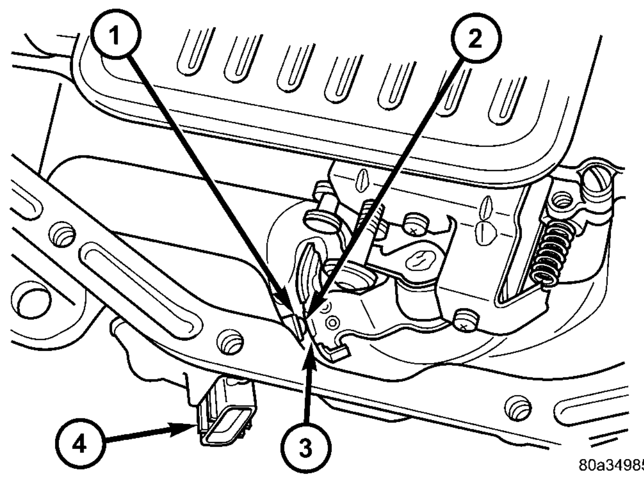


Fig. 265 Transmission Range Sensor Operation

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SENSOR PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - TRANSMISSION RANGE SENSOR

(6) Move the transmission manual shaft lever to the PARK position.

(7) Connect TRS wiring connector to the TRS and lower vehicle.

(8) Refill the transmission fluid to the correct level.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor (Fig. 266). The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 2000 ohms.

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

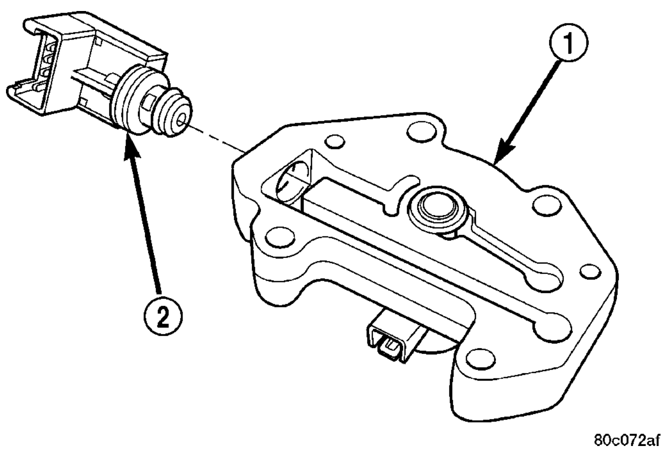


Fig. 266 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

OPERATION

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

VALVE BODY

DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and transfer plate. The valve body contains valves and check balls that control fluid delivery to the torque converter clutch, bands, and frictional clutches. The valve body contains the following components (Fig. 267), (Fig. 268), (Fig. 269), and (Fig. 270):

- Regulator valve
- Regulator valve throttle pressure plug
- Line pressure plug and sleeve
- Kickdown valve
- Kickdown limit valve
- 1-2 shift valve
- 1-2 control valve
- 2-3 shift valve
- 2-3 governor plug
- 3-4 shift valve
- 3-4 timing valve
- 3-4 quick fill valve
- 3-4 accumulator
- Throttle valve
- Throttle pressure plug
- Switch valve
- Manual valve
- Converter clutch lock-up valve
- Converter clutch lock-up timing Valve
- Shuttle valve
- Shuttle valve throttle plug
- Boost Valve
- 10 check balls

By adjusting the spring pressure acting on the regulator valve, transmission line pressure can be adjusted.

VALVE BODY (Continued)

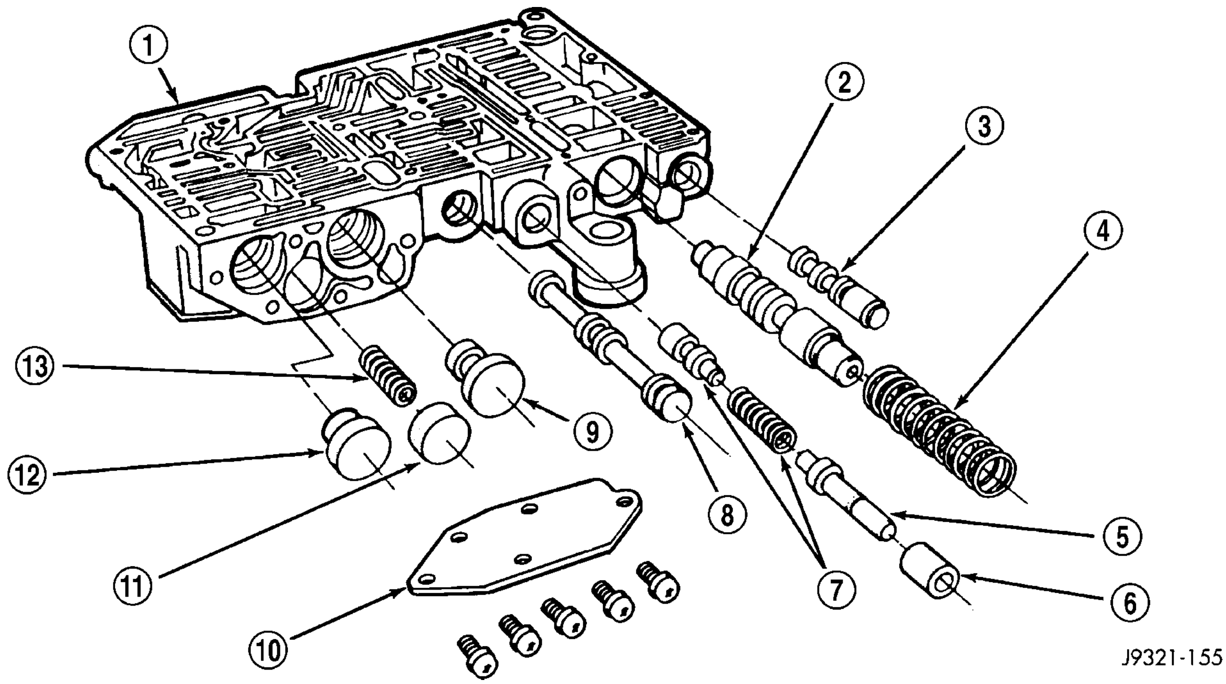


Fig. 267 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

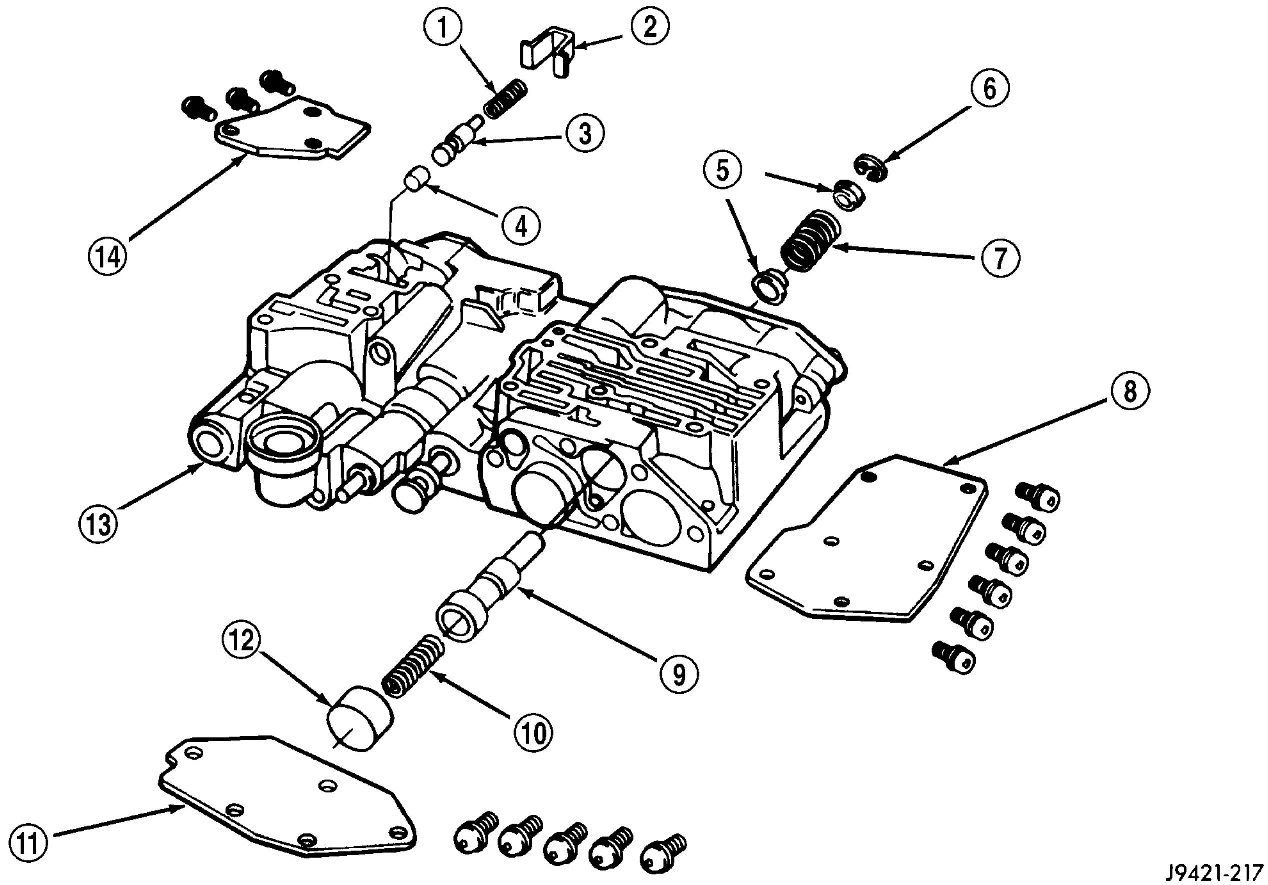


Fig. 268 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

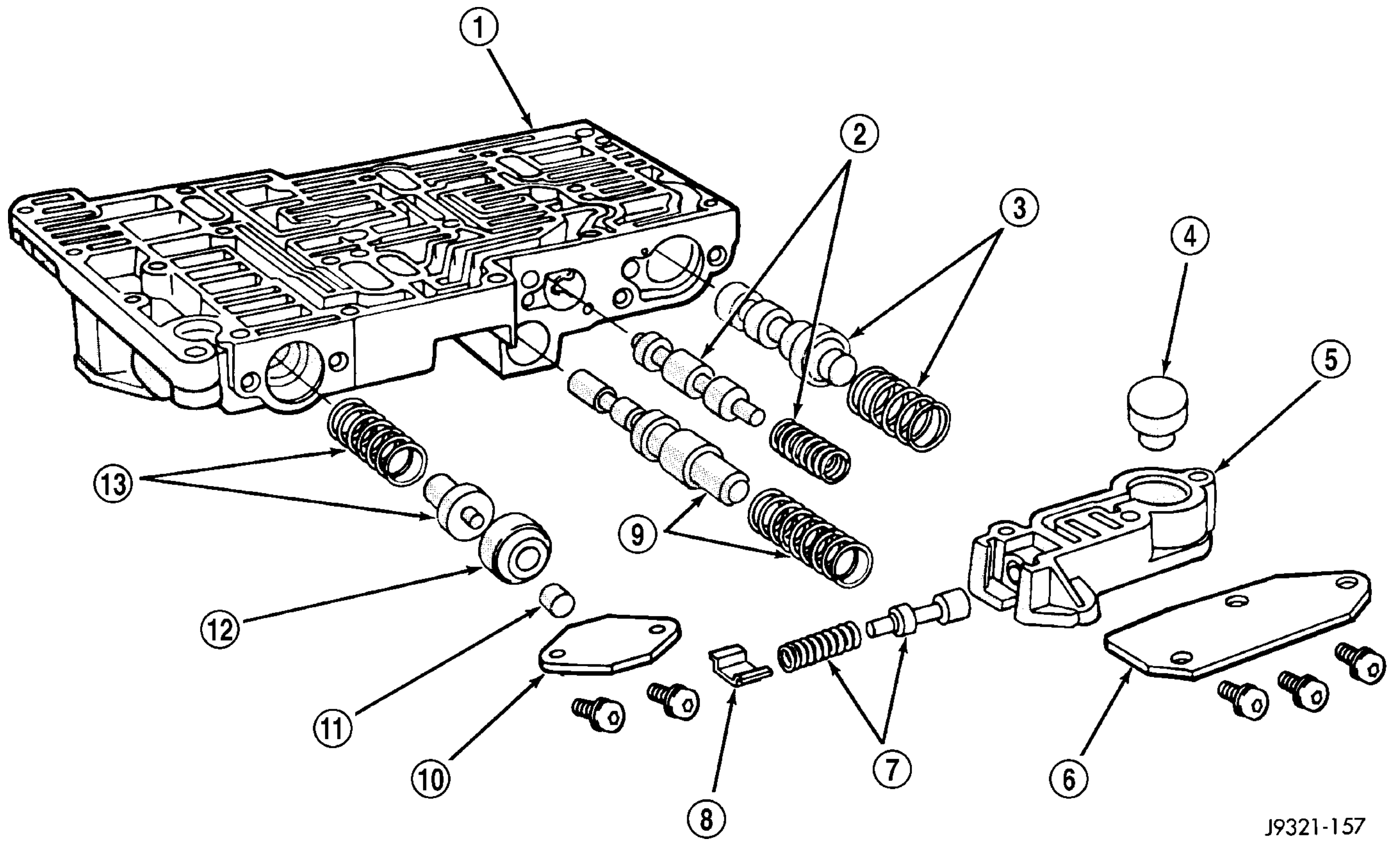


Fig. 269 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

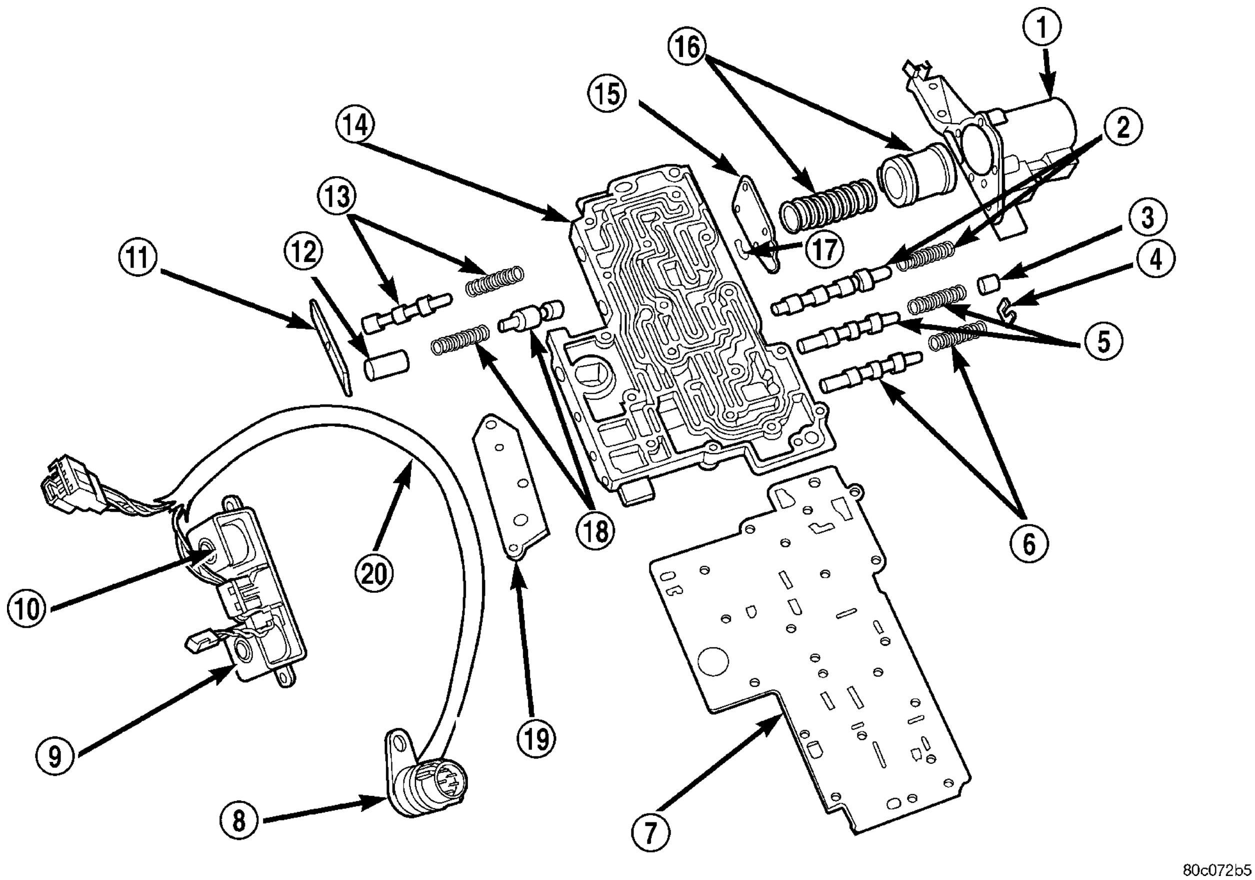


Fig. 270 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

CHECK BALLS

CHECK BALL NUMBER	DESCRIPTION
1	Allows either the manual valve to put line pressure on the 1-2 governor plug or the KD Valve to put WOT line pressure on the 1-2 governor plug.
2	Allows either the manual valve to put line pressure on the 2-3 governor plug or the KD Valve to put WOT line pressure on the 2-3 governor plug.
3	Allows either the Reverse circuit or the 3rd gear circuit to pressurize the front clutch.
4	Allows either the Manual Low circuit from the Manual Valve or the Reverse from the Manual Valve circuit to pressurize the rear servo.
5	Directs line pressure to the spring end of the 2-3 shift valve in either Manual Low or Manual 2nd, forcing the downshift to 2nd gear regardless of governor pressure.
6	Provides a by-pass around the front servo orifice so that the servo can release quickly.
7	Provides a by-pass around the rear clutch orifice so that the clutch can release quickly.
8	Directs reverse line pressure through an orifice to the throttle valve eliminating the extra leakage and insuring that Reverse line pressure pressure will be sufficient.
9	Provides a by-pass around the rear servo orifice so that the servo can release quickly.
10	Allows the lockup clutch to used at WOT in 3rd gear by putting line pressure from the 3-4 Timing Valve on the interlock area of the 2-3 shift valve, thereby preventing a 3rd gear Lock-up to 2nd gear kickdown.

REGULATOR VALVE

The pressure regulator valve is needed to control the hydraulic pressure within the system and reduce the amount of heat produced in the fluid. The pressure regulator valve is located in the valve body near the manual valve. The pressure regulator valve train controls the maximum pressure in the lines by metering the dumping of fluid back into the sump. Regulated pressure is referred to as “line pressure.”

The regulator valve (Fig. 271) has a spring on one end that pushes the valve to the left. This closes a dump (vent) that is used to lower pressure. The closing of the dump will cause the oil pressure to increase. Oil pressure on the opposite end of the valve pushes the valve to the right, opening the dump and lowering oil pressure. The result is spring pressure working against oil pressure to maintain the oil at specific pressures. With the engine running, fluid flows from the pump to the pressure regulator valve, manual valve, and the interconnected circuits. As fluid is sent through passages to the regulator valve, the pressure pushes the valve to the right against the large spring. It is also sent to the reaction areas on the left side of the throttle pressure plug and the line pressure plug. With the gear selector in the PARK position, fluid recirculates through the regulator and manual valves back to the sump.

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 272), fluid flows between two right side lands to the switch valve and torque converter. At low pump speeds, the flow is controlled by the pressure valve groove to reduce pressure to the torque converter. After the torque converter and switch valve fill with fluid, the switch valve becomes the controlling metering device for torque converter pressure. The regulator valve then begins to control the line pressure for the other transmission circuits. The balance of the fluid pressure pushing the valve to the right and the spring pressure pushing to the left determines the size of the metering passage at land #2 (land #1 being at the far right of the valve in the diagram). As fluid leaks past the land, it moves into a groove connected to the filter or sump. As the land meters the fluid to the sump, it causes the pressure to reduce and the spring decreases the size of the metering passage. When the size of the metering passage is reduced, the pressure rises again and the size of the land is increased again. Pressure is regulated by this constant balance of hydraulic and spring pressure.

VALVE BODY (Continued)

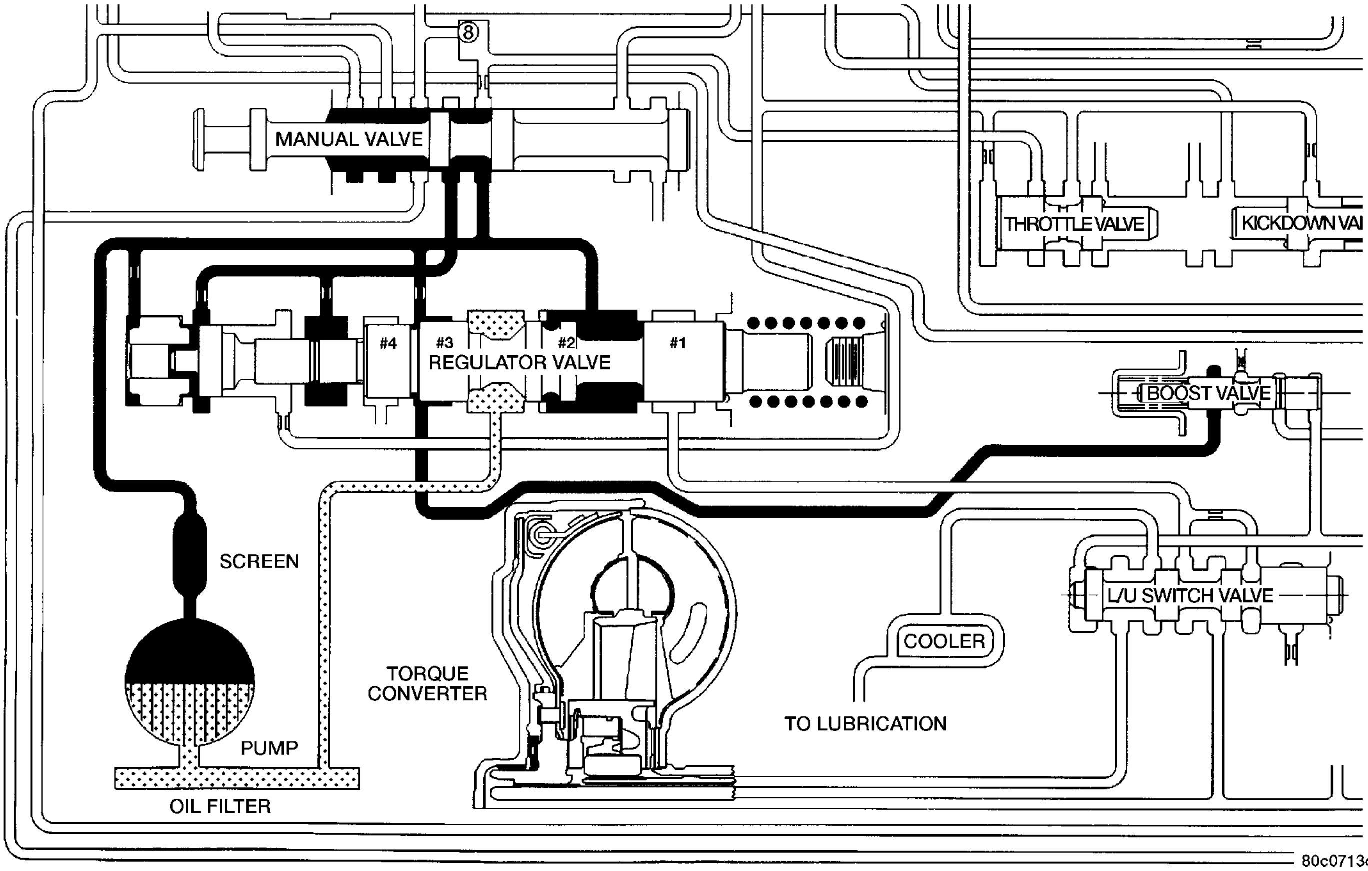


Fig. 271 Regulator Valve in PARK Position

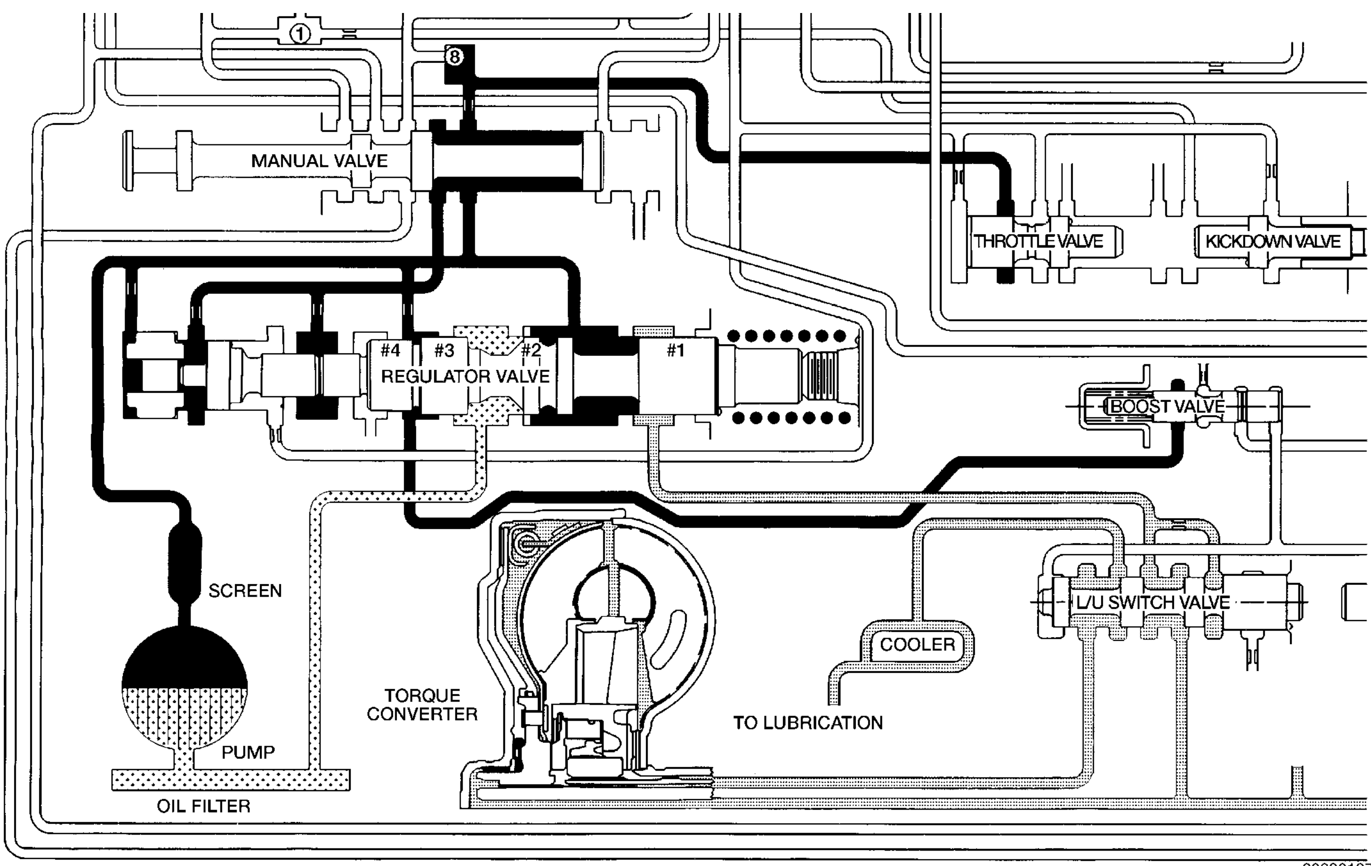


Fig. 272 Regulator Valve in NEUTRAL Position

VALVE BODY (Continued)

The metering at land #2 establishes the line pressure throughout the transmission. It is varied according to changes in throttle position and the transmission's internal condition within a range of 57-94 psi (except in REVERSE) (Fig. 273). The regulated line pressure in REVERSE (Fig. 274) is held at much higher pressures than in the other gear positions: 145-280 psi. The higher pressure for REVERSE is achieved by the manual valve blocking the supply of line pressure to the reaction area left of land #4. With this pressure blocked, there is less area for pressure to act on to balance the force of the spring on the right. This allows line pressure to push the valve train to the right, reducing the amount of fluid returned to the pump's inlet, increasing line pressure.

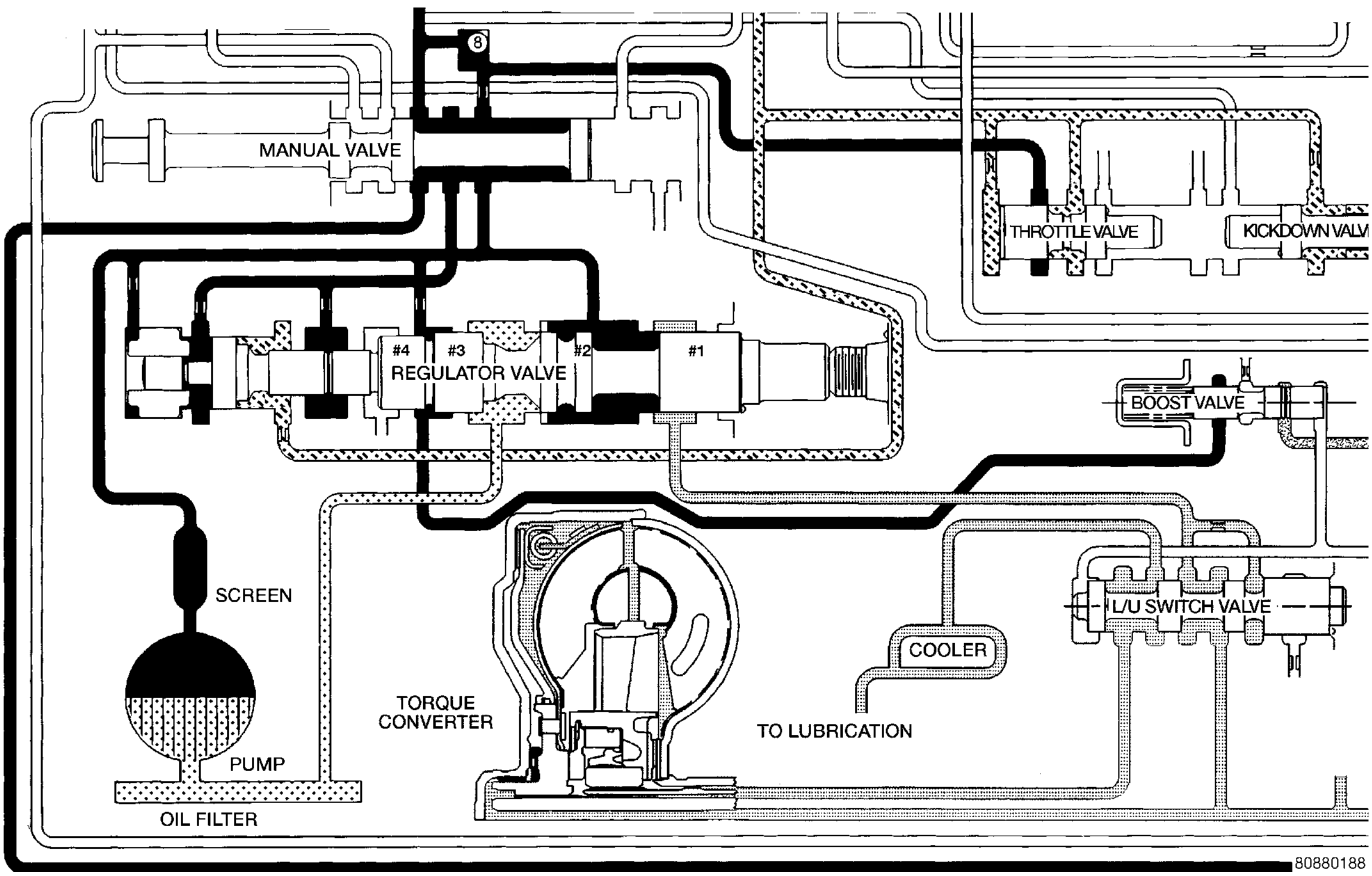


Fig. 273 Regulator Valve in DRIVE Position

VALVE BODY (Continued)

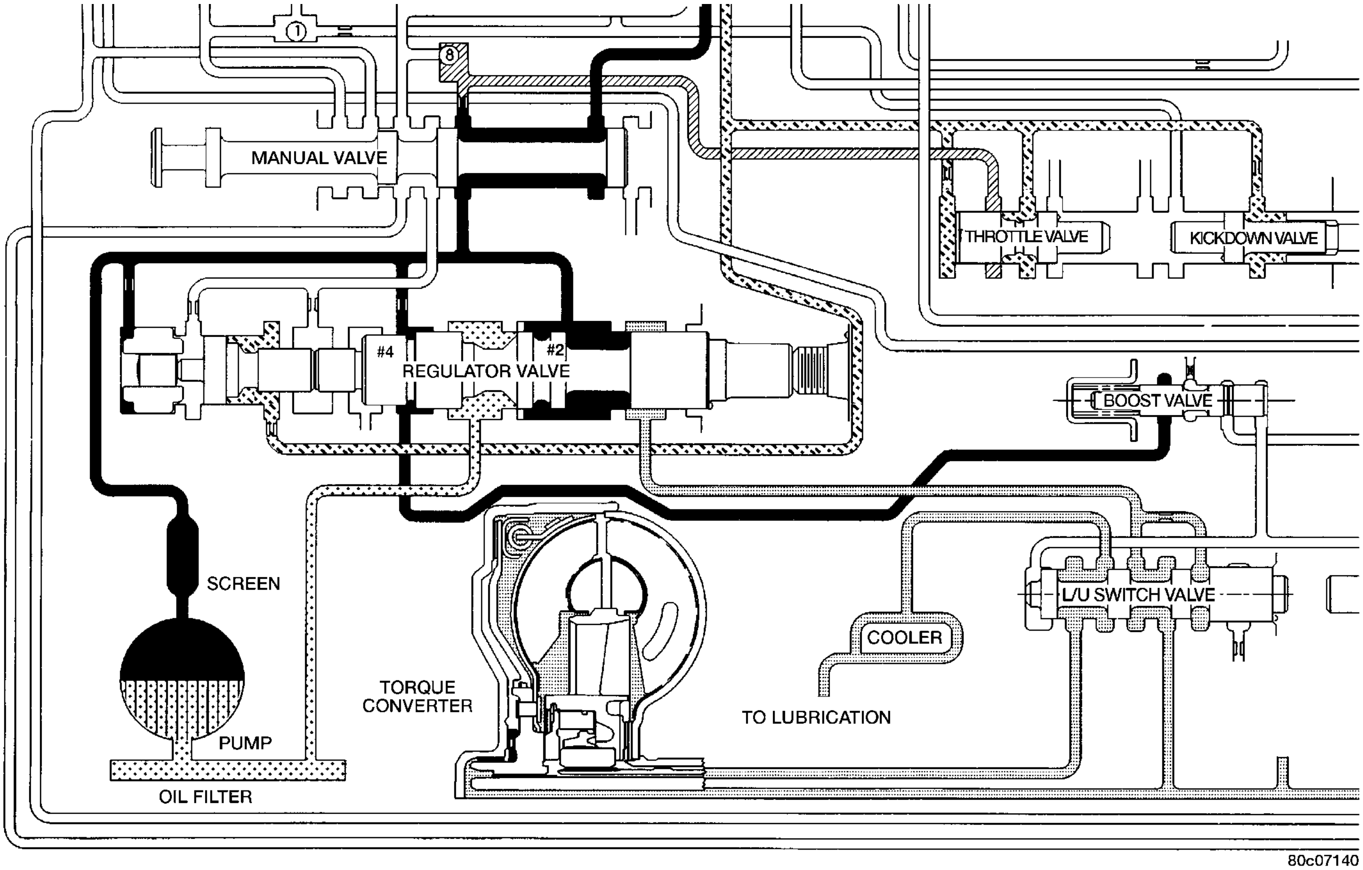


Fig. 274 Regulator Valve in REVERSE Position

VALVE BODY (Continued)

KICKDOWN VALVE

When the throttle valve is as far over to the left as it can go, the maximum line pressure possible will enter the throttle pressure circuit. In this case, throttle pressure will equal line pressure. With the kickdown valve (Fig. 275) pushed into the bore as far as it will go, fluid initially flows through the annular groove of the 2-3 shift valve (which will be in the direct drive position to the right).

After passing the annular groove, the fluid is routed to the spring end of the 2-3 shift valve. Fluid pressure reacting on the area of land #1 overcomes governor pressure, downshifting the 2-3 shift valve into the kickdown, or second gear stage of operation. The valve is held in the kickdown position by throttle pressure routed from a seated check ball (#2). Again, if vehicle speed is low enough, throttle pressure will also push the 1-2 shift valve left to seat its governor plug, and downshift to drive breakaway.

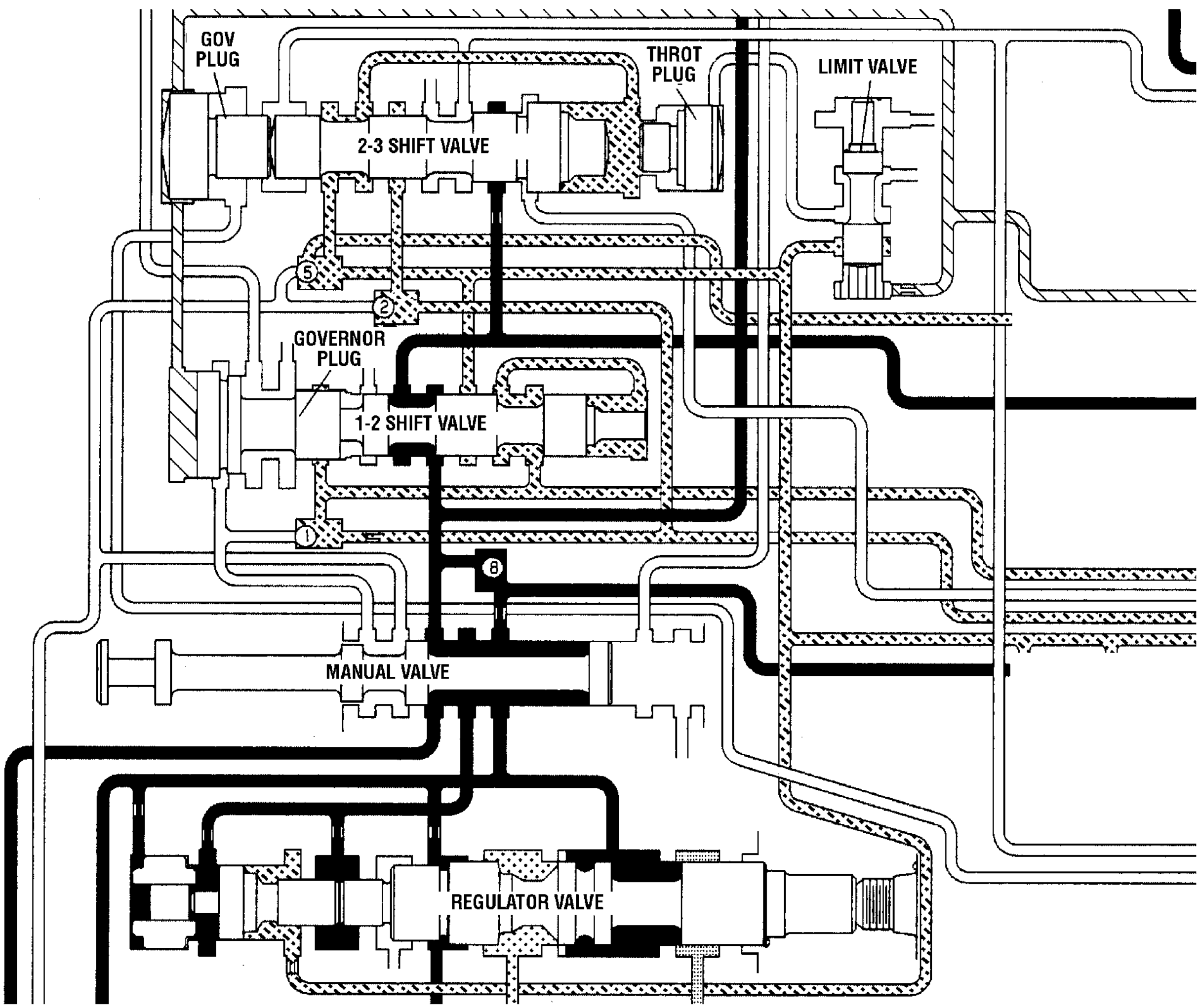


Fig. 275 Kickdown Valve-Wide Open Throttle

VALVE BODY (Continued)

KICKDOWN LIMIT VALVE

The purpose of the limit valve is to prevent a 3-2 downshift at higher speeds when a part-throttle downshift is not desirable. At these higher speeds only a full throttle 3-2 downshift will occur. At low road speeds (Fig. 276) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 277), the governor pressure also increases. The increased governor pressure acts on the reaction area of the bottom land of the limit valve overcoming the spring force trying to push the valve toward the bottom of its bore. This pushes the valve upward against the spring and bottoms the valve against the top of the housing. With the valve bottomed against the housing, the throttle pressure supplied to the valve will be closed off by the bottom land of the limit valve. When the supply of throttle pressure has been shut off, the 3-2 part throttle downshift plug becomes inoperative, because no pressure is acting on its reaction area.

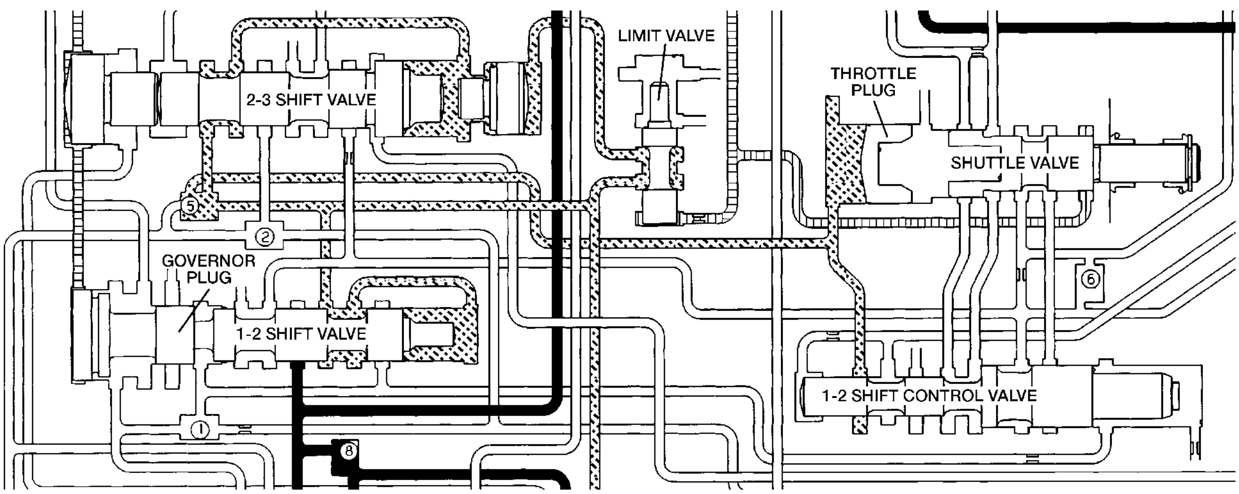


Fig. 276 Kickdown Limit Valve-Low Speeds

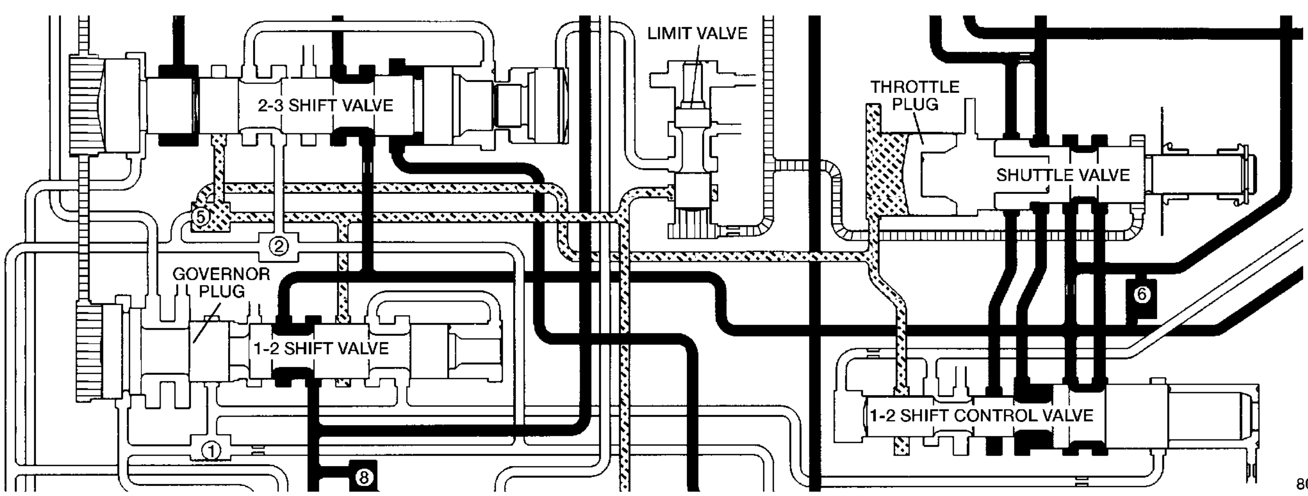


Fig. 277 Kickdown Limit Valve-High Speeds

VALVE BODY (Continued)

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 278), or mechanism, consists of: the 1-2 shift valve, governor plug, and a spring on the end of the valve. After the manual valve has been placed into a forward gear range, line pressure is directed to the 1-2 shift valve. As the throttle is depressed, throttle pressure is applied to the right side of the 1-2 shift valve assembly. With throttle pressure applied to the right side of the valve, there is now both spring pressure and throttle pressure acting on the valve, holding it against the governor plug. As the vehicle begins to move and build speed, governor pressure is created and is applied to the left of the valve at the governor plug.

When governor pressure builds to a point where it can overcome the combined force of the spring and throttle pressure on the other side of the valve, the valve will begin to move over to the right. As the valve moves to the right, the middle land of the valve will close off the circuit supplying the throttle pressure to the right side of the valve. When the throttle pressure is closed off, the valve will move even farther to the right, allowing line pressure to enter another circuit and energize the front servo, applying the front band (Fig. 279).

The governor plug serves a dual purpose:

- It allows the shift valves to move either left or right, allowing both upshifts and downshifts.
- When in a manual selection position, it will be hydraulically "blocked" into position so no upshift can occur.

The physical blocking of the upshift while in the manual "1" position is accomplished by the directing of line pressure between both lands of the governor plug. The line pressure reacts against the larger land of the plug, pushing the plug back against the end plate overcoming governor pressure. With the combination of the line pressure and spring pressure, the valve cannot move, preventing any upshift.

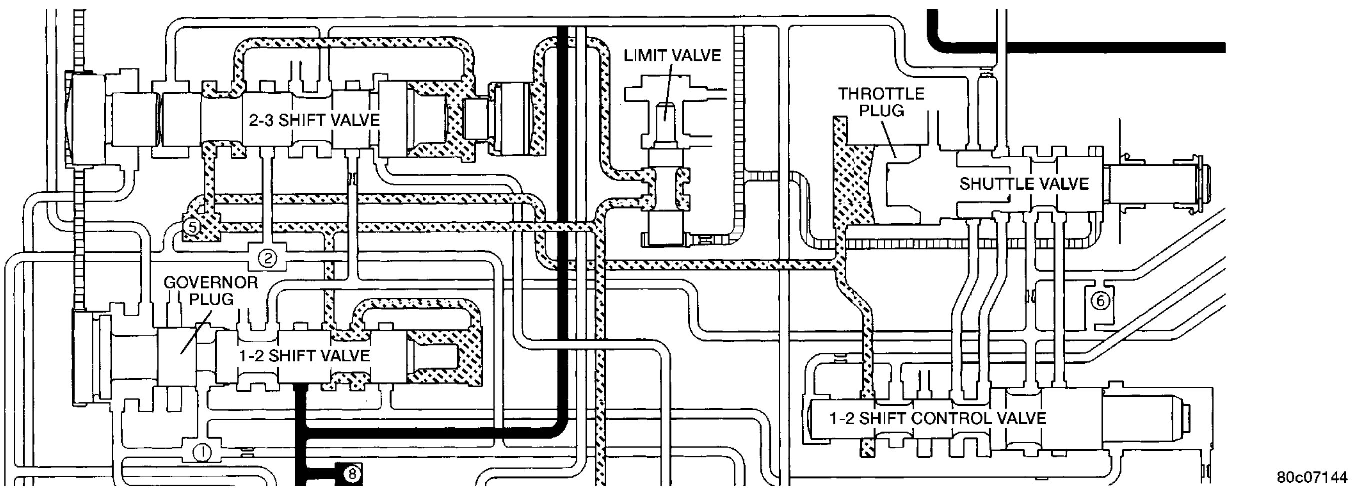


Fig. 278 1-2 Shift Valve-Before Shift

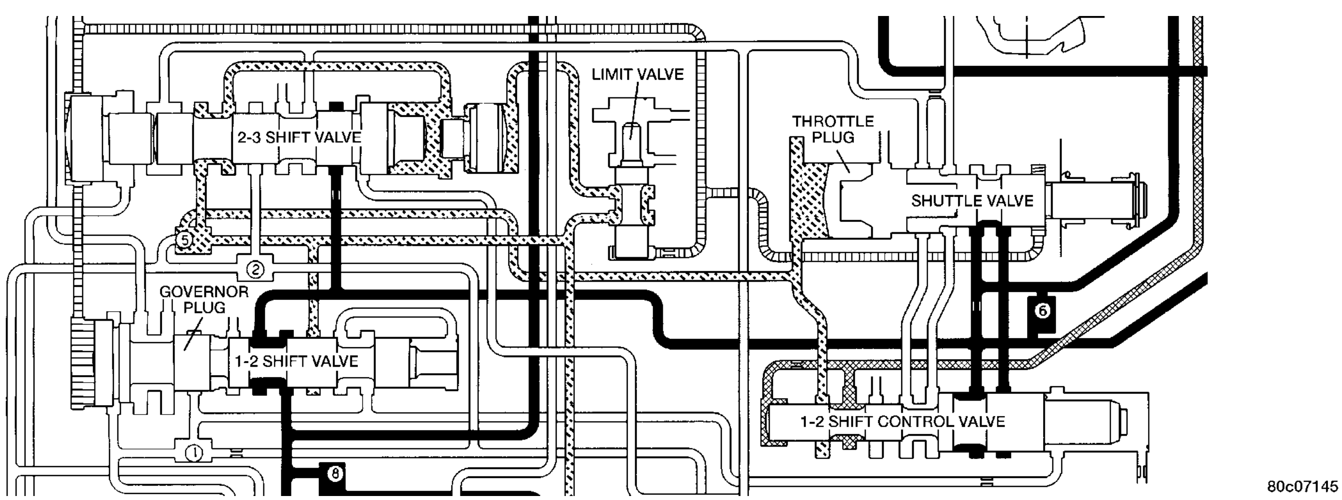


Fig. 279 1-2 Shift Valve-After Shift

VALVE BODY (Continued)

1-2 SHIFT CONTROL VALVE

It contains a valve with four lands and a spring. It is used as both a "relay" and "balanced" valve.

The valve has two specific operations (Fig. 280):

- Aid in quality of the 1-2 upshift.
- Aid in the quality and timing of the 3-2 kickdown ranges.

When the manual valve is set to the DRIVE position and the transmission is in the first or second gear range, 1-2 shift control or "modulated throttle pressure" is supplied to the middle of the accumulator piston by the 1-2 shift control valve. During the 1-2 upshift, this pressure is used to control the kickdown servo apply pressure that is needed to apply the kickdown and accumulator pistons. Thus, the 1-2 shift point is "cushioned" and the quality is improved. During a WOT kickdown, kickdown pressure is applied between the kickdown valve and the 1-2 shift control valve. This additional pressure is directed to the 1-2 shift control's spring cavity, adding to the spring load on the valve. The result of this increased "modulated" throttle pressure is a firmer WOT upshift.

2-3 SHIFT VALVE

The 2-3 shift valve mechanism (Fig. 281) consists of the 2-3 shift valve, governor plug and spring, and a throttle plug. After the 1-2 shift valve has completed its operation and applied the front band, line pressure is directed to the 2-3 shift valve through the connecting passages from the 1-2 shift valve. The line pressure will then dead–end at land #2 until the 2-3 valve is ready to make its shift. Now that the vehicle is in motion and under acceleration, there is throttle pressure being applied to the spring side of the valve and between lands #3 and #4.

As vehicle speed increases, governor pressure increases proportionately, until it becomes great enough to overcome the combined throttle and spring pressure on the right side of the valve. Since the throttle pressure end of the 2-3 shift valve is larger in diameter than the 1-2 shift valve, the 2-3 shift will always happen at a greater speed than the 1-2 shift. When this happens, the governor plug is forced against the shift valve moving it to the right. The shift valve causes land #4 to close the passage supplying throttle pressure to the 2-3 shift valve. Without throttle pressure present in the circuit now, the governor plug will push the valve over far enough to bottom the valve in its bore. This allows land #2 to direct line pressure to the front clutch.

After the shift (Fig. 282), line pressure is directed to the land between the shift valve and the governor plug, and to the release side of the kickdown servo. This releases the front band and applies the front clutch, shifting into third gear or direct drive. The rear clutch remains applied, as it has been in the other gears. During a manual "1" or manual "2" gear selection, line pressure is sent between the two lands of the 2-3 governor plug. This line pressure at the governor plug locks the shift valve into the second gear position, preventing an upshift into direct drive. The theory for the blocking of the valve is the same as that of the 1-2 shift valve.

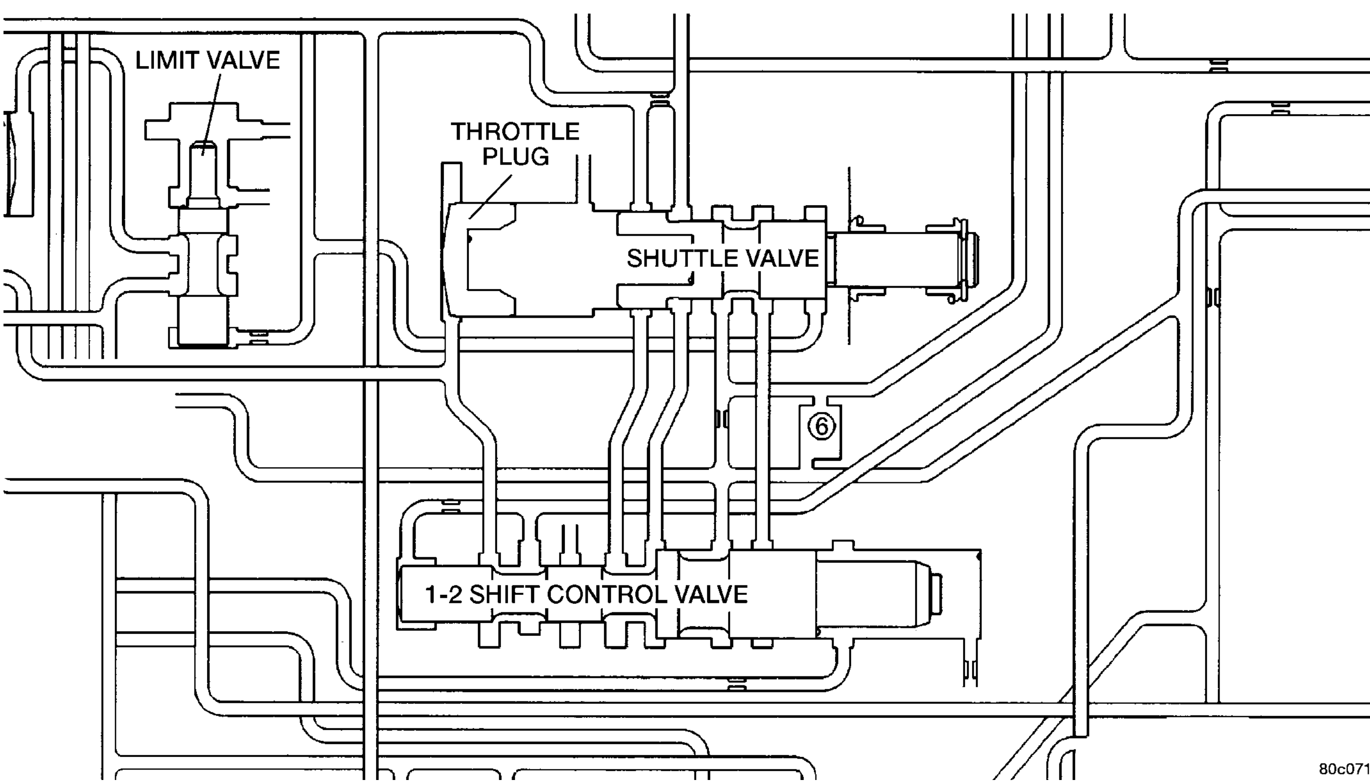


Fig. 280 1-2 Shift Control Valve

VALVE BODY (Continued)

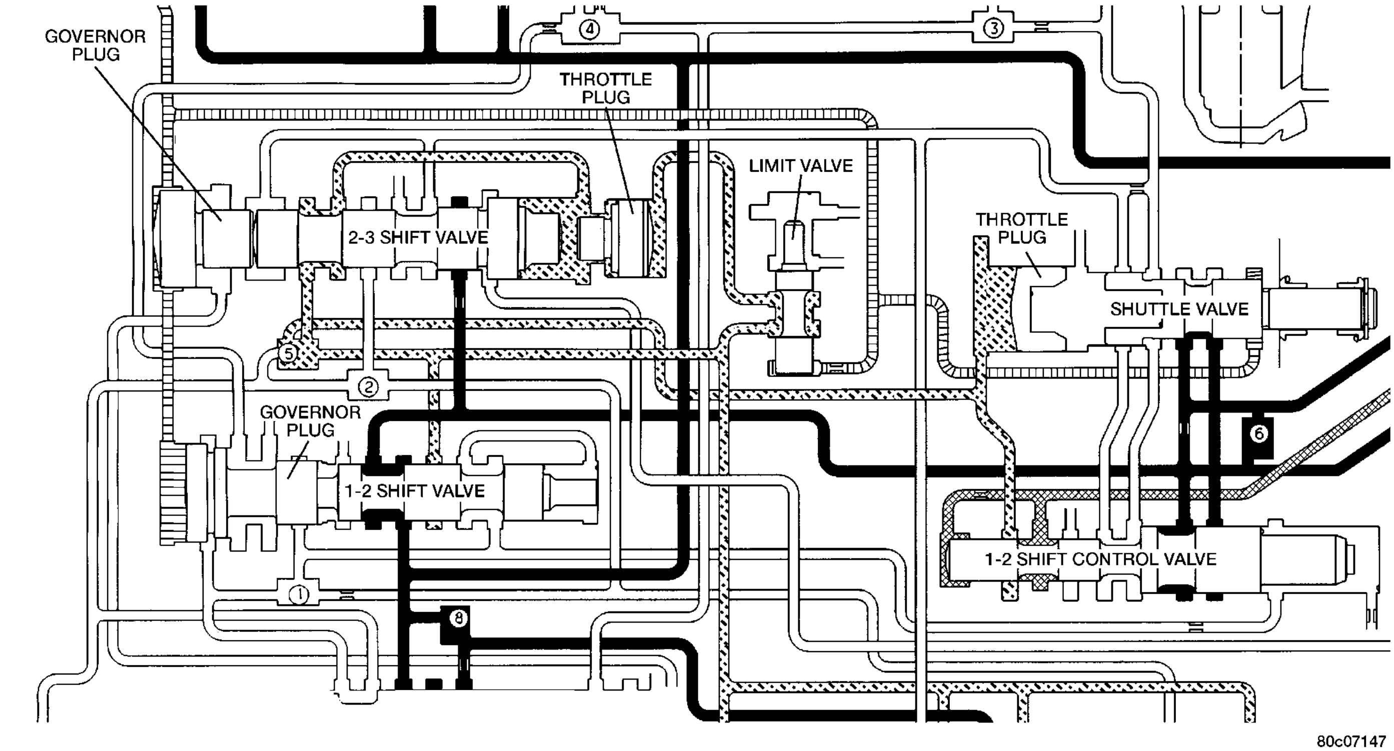


Fig. 281 2-3 Shift Valve-Before Shift

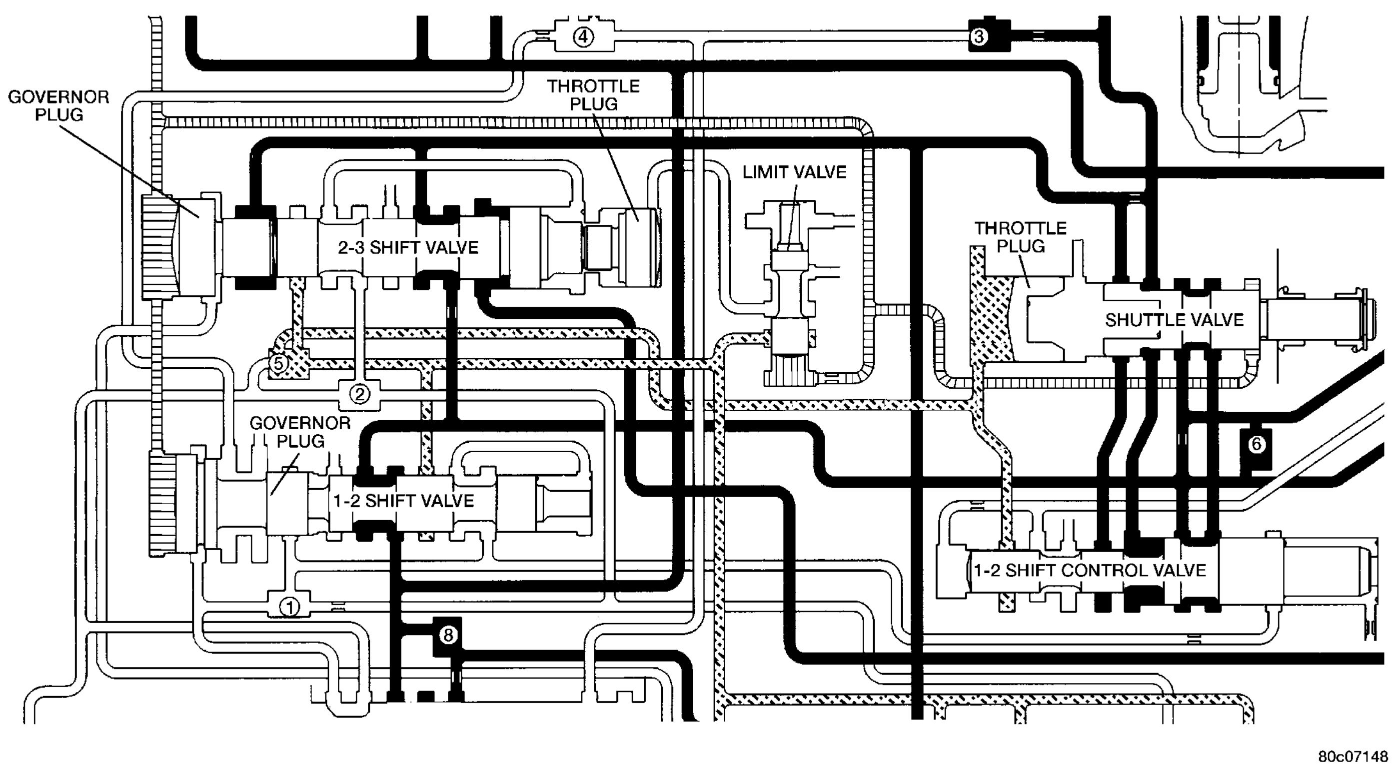


Fig. 282 2-3 Shift Valve-After Shift

VALVE BODY (Continued)

3-4 SHIFT VALVE

The PCM energizes the overdrive solenoid during the 3-4 upshift (Fig. 283). This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position (Fig. 284). This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston.

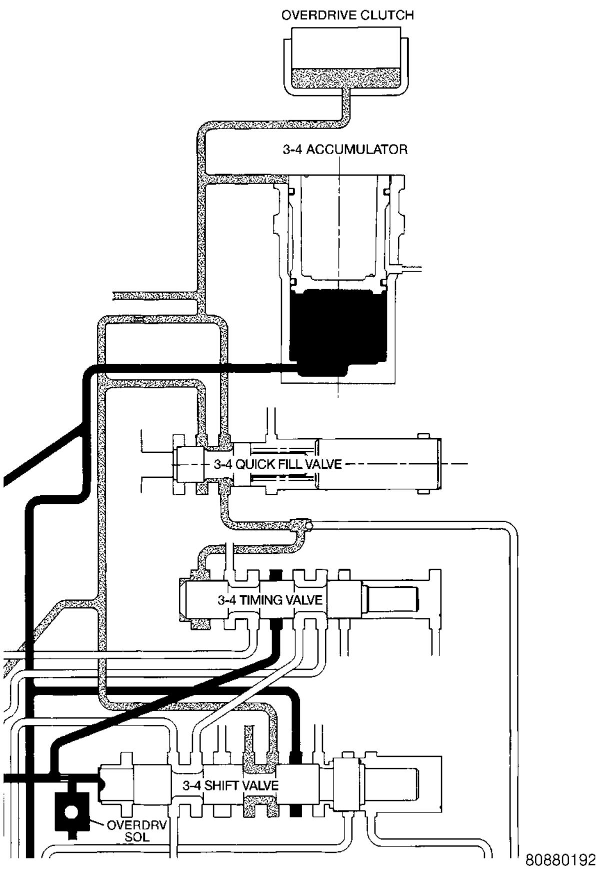


Fig. 283 3-4 Shift Valve Before Shift

3-4 TIMING VALVE

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve (Fig. 284). After the shift, the timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from downshifting before the 3-4 valve (Fig. 283).

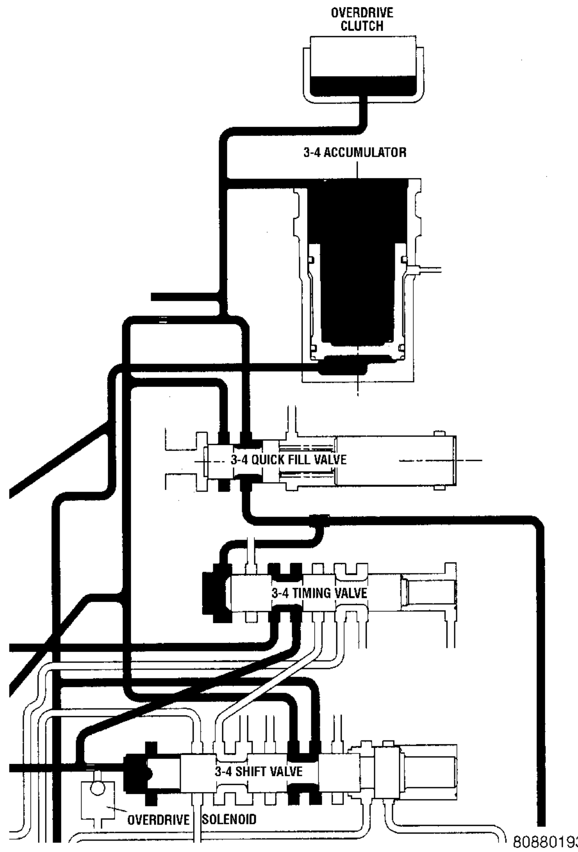


Fig. 284 3-4 Shift Valve After Shift

3-4 QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift (Fig. 283). This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass (Fig. 284). Clutch fill is then completed through the regular feed orifice.

VALVE BODY (Continued)

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 285) is being supplied with line pressure. The throttle valve meters and reduces the line pressure that now becomes throttle pressure. The throttle valve is moved by a spring and the kickdown valve, which is mechanically connected to the throttle. The larger the throttle opening, the higher the throttle pressure (to a maximum of line pressure). The smaller the throttle opening, the lower the throttle pressure (to a minimum of zero at idle). As engine speed increases, the increase in pump speed increases pump output. The increase in pressure and volume must be regulated to maintain the balance within the transmission. To do this, throttle pressure is routed to the reaction area on the right side of the throttle pressure plug (in the regulator valve).

The higher engine speed and line pressure would open the vent too far and reduce line pressure too much. Throttle pressure, which increases with engine speed (throttle opening), is used to oppose the movement of the pressure valve to help control the metering passage at the vent. The throttle pressure is combined with spring pressure to reduce the force of the throttle pressure plug on the pressure valve. The larger spring at the right closes the regulator valve passage and maintains or increases line pressure. The increased line pressure works against the reaction area of the line pressure plug and the reaction area left of land #3 simultaneously moves the regulator valve train to the right and controls the metering passage.

The kickdown valve, along with the throttle valve, serve to delay upshifts until the correct vehicle speed has been reached. It also controls downshifts upon driver demand, or increased engine load. If these valves were not in place, the shift points would be at the same speed for all throttle positions. The kickdown valve is actuated by a cam connected to the throttle. This is accomplished through either a linkage or a cable. The cam forces the kickdown valve toward the throttle valve compressing the spring between them and moving the throttle valve. As the throttle valve land starts to uncover its port, line pressure is “metered” out into the circuits and viewed as throttle pressure. This increased throttle pressure is metered out into the circuits it is applied to: the 1-2 and 2-3 shift valves. When the throttle pressure is high enough, a 3-2 downshift will occur. If the vehicle speed is low enough, a 2-1 downshift will occur.

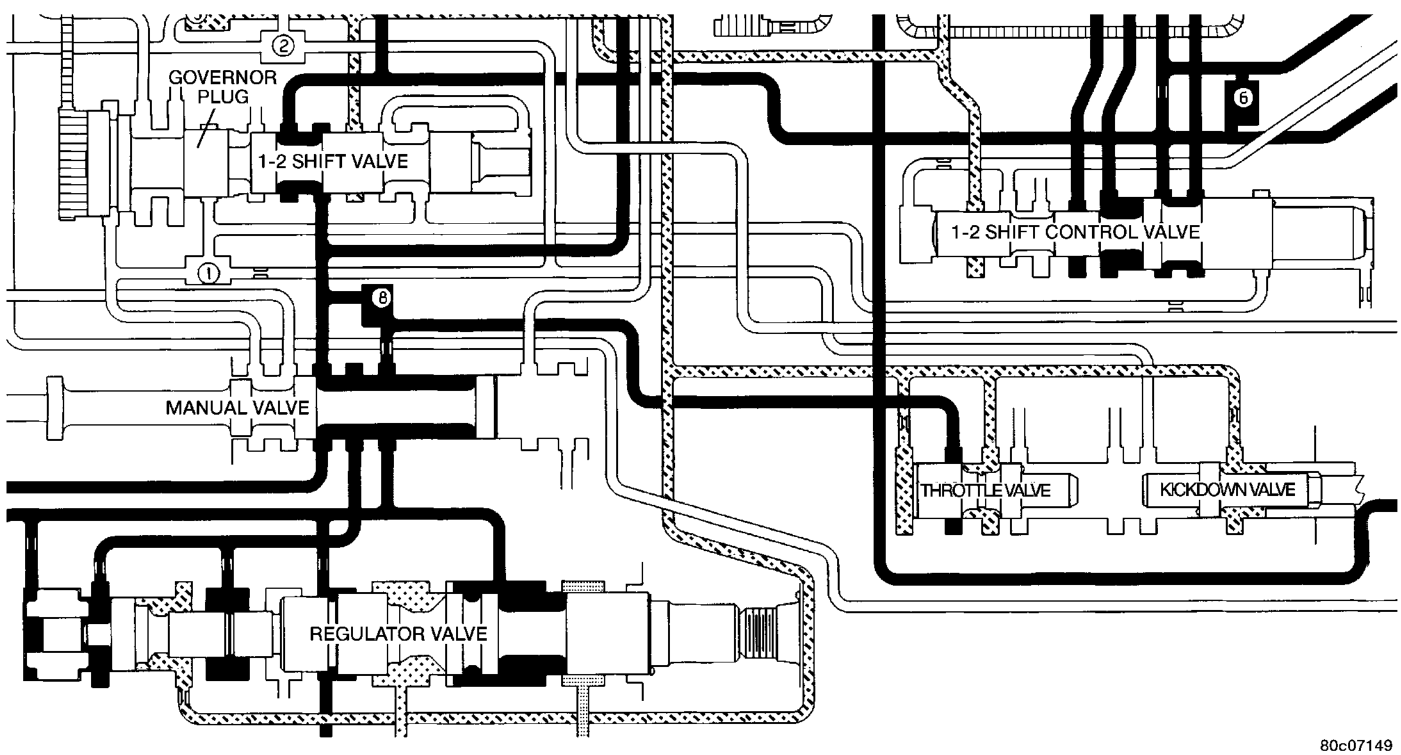


Fig. 285 Throttle Valve

VALVE BODY (Continued)

SWITCH VALVE

When the transmission is in Drive Second before the TCC application occurs (Fig. 286), the pressure regulator valve is supplying torque converter pressure to the switch valve. The switch valve directs this pressure through the transmission input shaft, into the converter, through the converter, back out between the input shaft and the reaction shaft, and back up to the switch valve. From the switch valve, the fluid pressure is directed to the transmission cooler, and lubrication pressure returns from the cooler to lubricate different portions of the transmission.

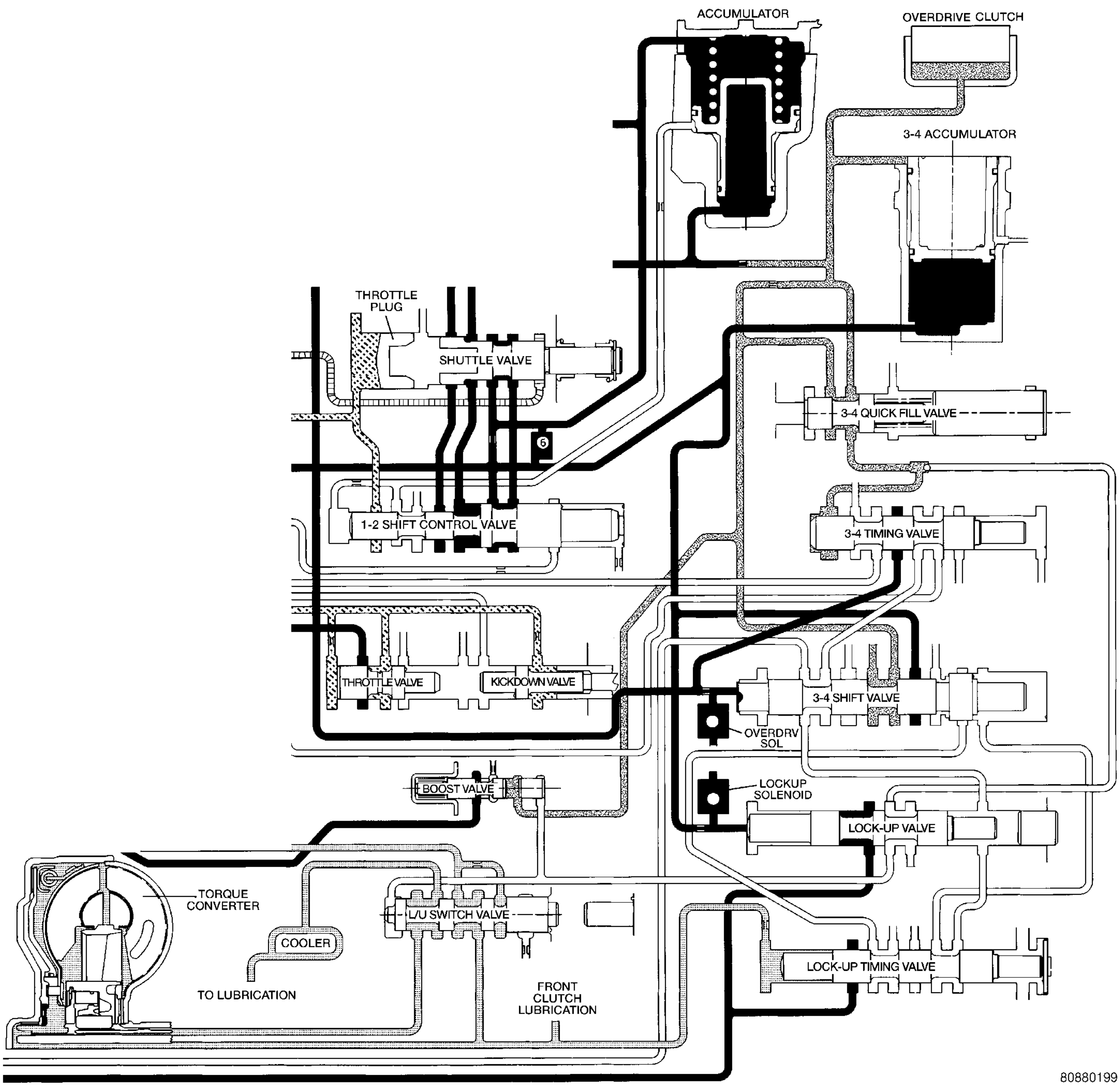


Fig. 286 Switch Valve-Torque Converter Unlocked

VALVE BODY (Continued)

Once the TCC control valve has moved to the right (Fig. 287), line pressure is directed to the tip of the switch valve, forcing the valve to the right. The switch valve now vents oil from the front of the piston in the torque converter, and supplies line pressure to the (rear) apply side of the torque converter piston. This pressure differential causes the piston to apply against the friction material, cutting off any further flow of line pressure oil. After the switch valve is shuttled right allowing line pressure to engage the TCC, torque converter pressure is directed past the switch valve into the transmission cooler and lubrication circuits.

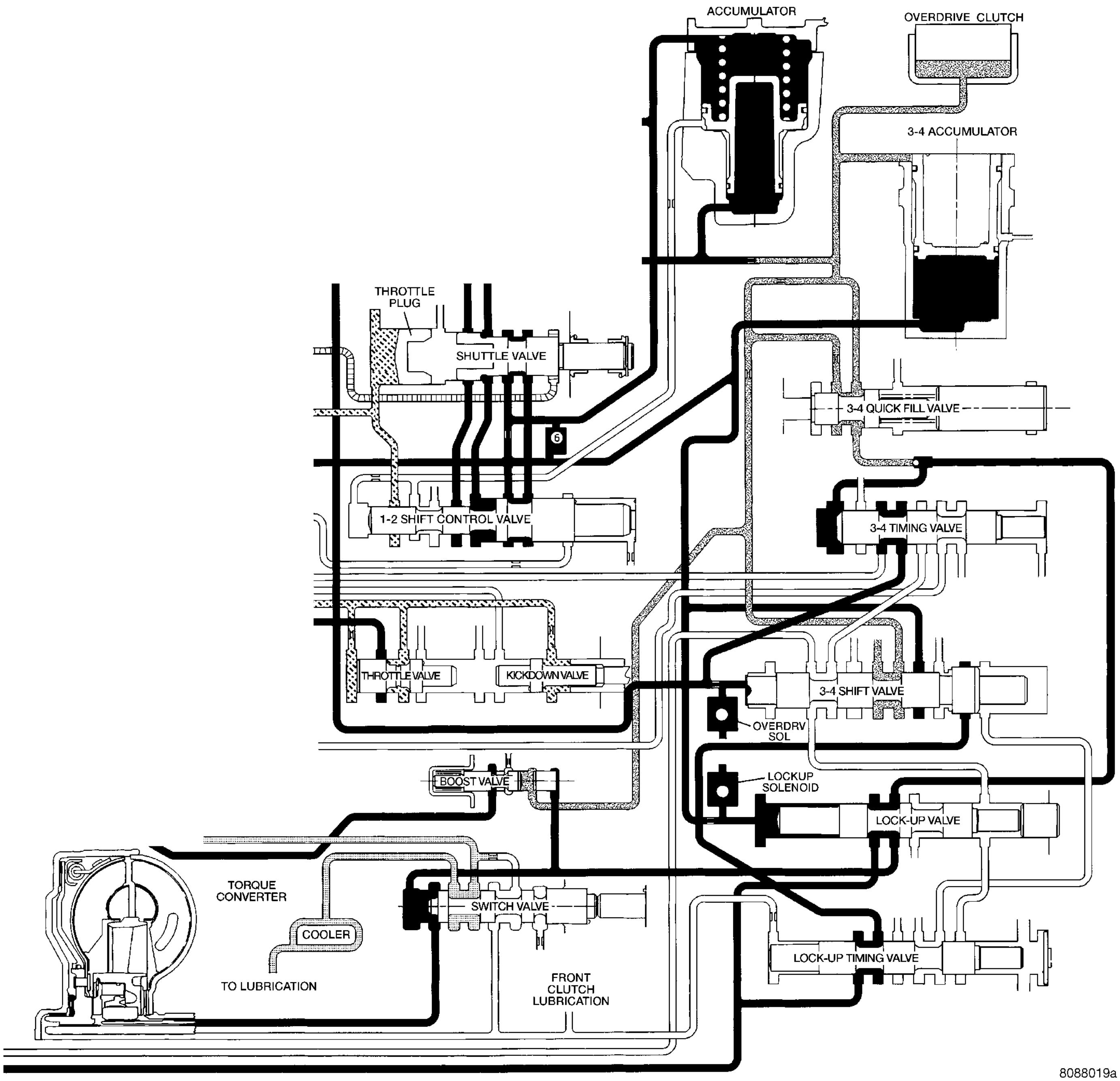


Fig. 287 Switch Valve-Torque Converter Locked

VALVE BODY (Continued)

MANUAL VALVE

The manual valve (Fig. 288) is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the side of the valve body. The valve is connected mechanically by either a cable or linkage to the gear-shift mechanism. The valve is held in each of its positions by a spring-loaded roller or ball that engages the "roostercomb" of the manual valve lever.

CONVERTER CLUTCH LOCK-UP VALVE

The torque converter clutch (TCC) lock-up valve controls the back (ON) side of the torque converter clutch. When the PCM energizes the TCC solenoid to engage the converter clutch piston, pressure is applied to the TCC lock-up valve which moves to the right and applies pressure to the torque converter clutch.

CONVERTER CLUTCH LOCK-UP TIMING VALVE

The torque converter clutch (TCC) lock-up timing valve is there to block any 4-3 downshift until the TCC is completely unlocked and the clutch is disengaged.

SHUTTLE VALVE

The assembly is contained in a bore in the valve body above the shift valves. When the manual valve is positioned in the Drive range, throttle pressure acts on the throttle plug of the shuttle valve (Fig. 280) to move it against a spring, increasing the spring force on the shuttle valve. During a part or full throttle 1-2 upshift, the throttle plug is bottomed by throttle pressure, holding the shuttle valve to the right against governor pressure, and opening a by–pass circuit. The shuttle valve controls the quality of the kickdown shift by restricting the rate of fluid discharge from the front clutch and servo release circuits. During a 3-2 kickdown, fluid discharges through the shuttle by-pass circuit. When the shuttle valve closes the by-pass circuit, fluid discharge is restricted and controlled for the application of the front band. During a 2-3 "lift foot" upshift, the shuttle valve by-passes the restriction to allow full fluid flow through the by-pass groove for a faster release of the band.

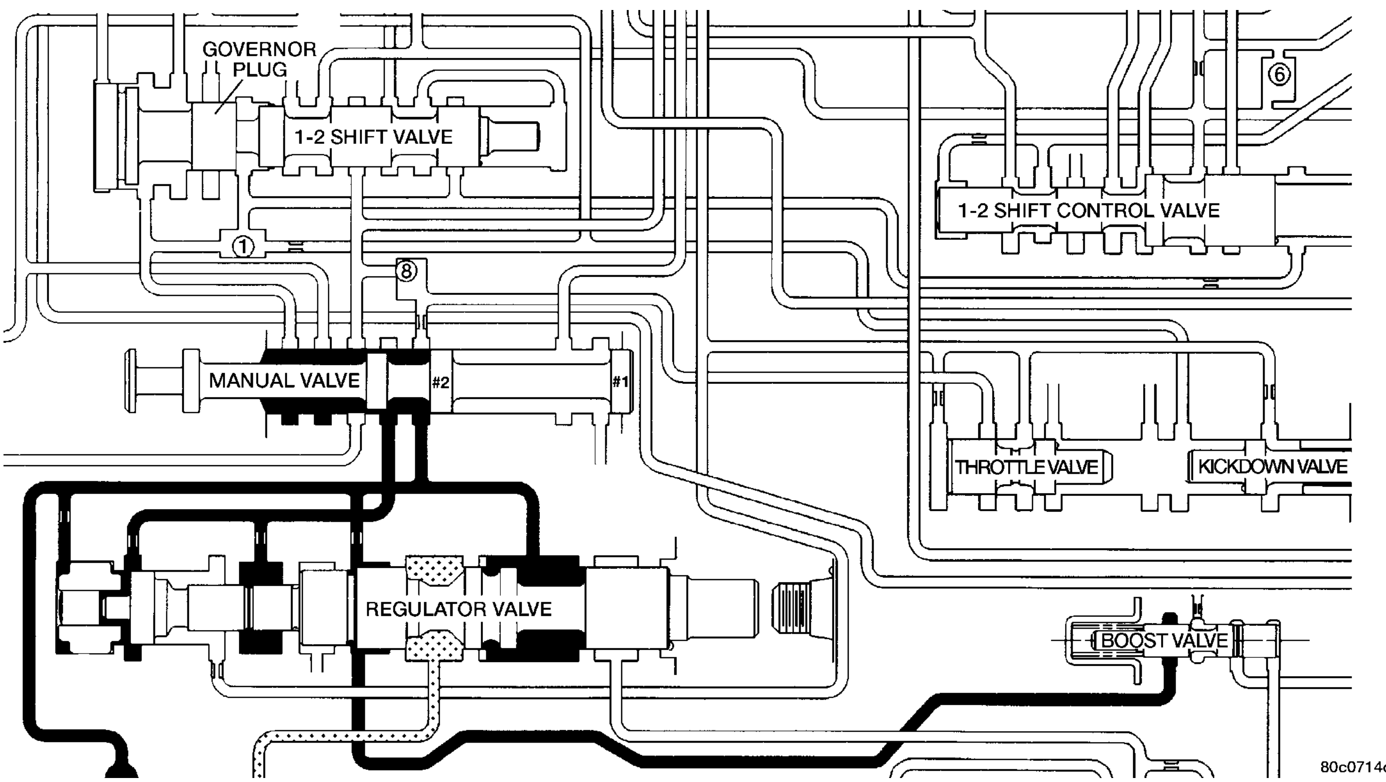


Fig. 288 Manual Valve

VALVE BODY (Continued)

BOOST VALVE

The boost valve (Fig. 289) provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts (Fig. 290), and when accelerating in fourth gear. The boost valve also serves to increase line pressure during torque converter lock-up.

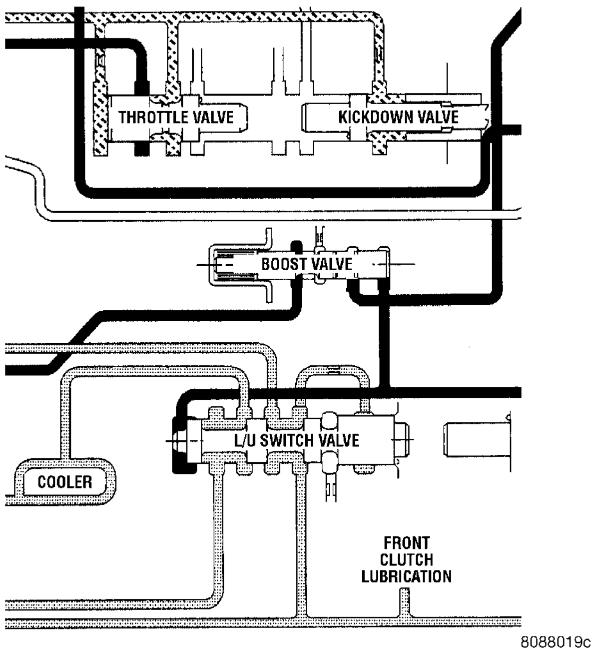


Fig. 289 Boost Valve Before Lock-up

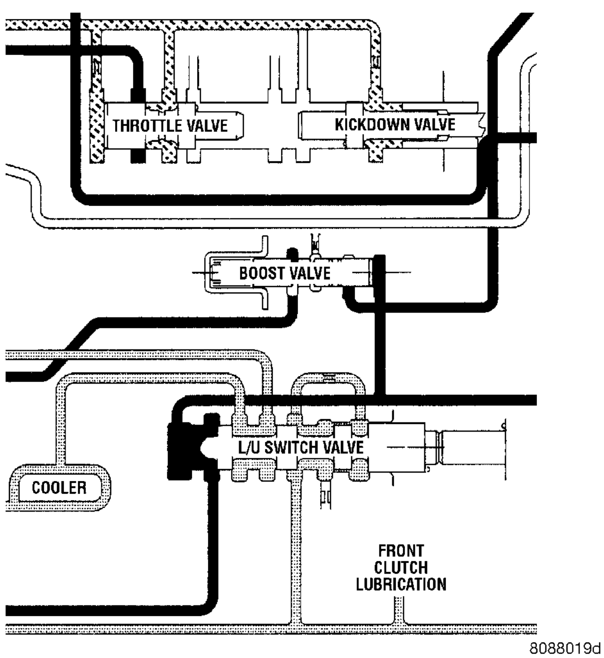


Fig. 290 Boost Valve After Lock-up

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor (includes transmission temperature thermistor).
- Converter clutch/overdrive solenoid assembly and harness.
- Governor housing gasket.
- Solenoid case connector O-rings.

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 291).

(5) Remove the transmission range sensor.

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Remove bolts attaching valve body to transmission case.

(10) Lower valve body enough to remove accumulator piston and springs.

(11) Work manual lever shaft and electrical connector out of transmission case.

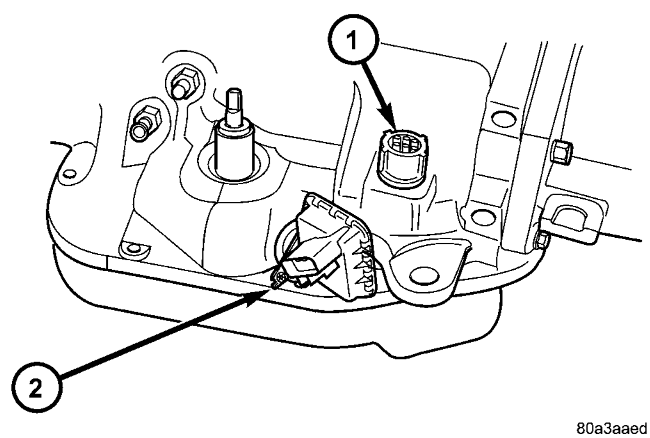


Fig. 291 Transmission Case Connector

1 - SOLENOID CASE CONNECTOR
2 - TRANSMISSION RANGE SENSOR

VALVE BODY (Continued)

(12) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 292).

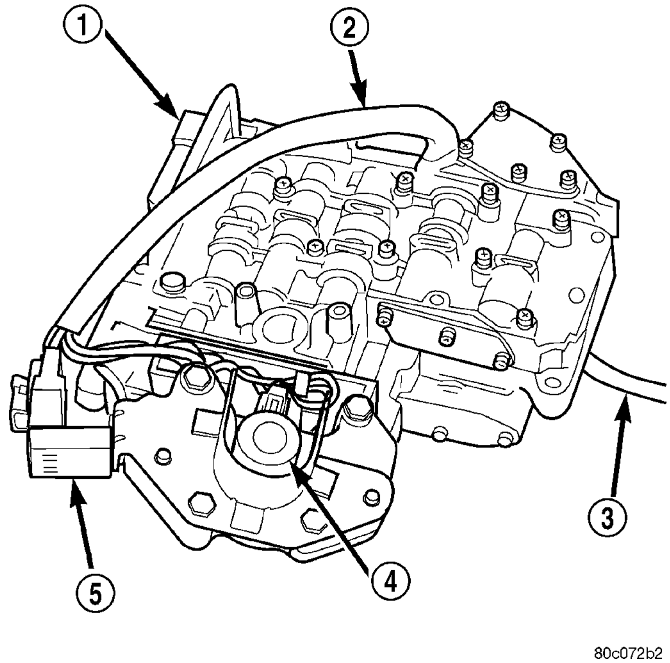


Fig. 292 Valve Body

1 - VALVE BODY
2 - WIRE HARNESS
3 - PARK ROD
4 - GOVERNOR PRESSURE SOLENOID
5 - GOVERNOR PRESSURE SENSOR

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Disconnect wires from governor pressure sensor and solenoid.

(2) Remove screws attaching governor body and retainer plate to transfer plate.

(3) Remove retainer plate, governor body and gasket from transfer plate.

(4) Remove governor pressure sensor from governor body.

(5) Remove governor pressure solenoid by pulling it straight out of bore in governor body. Remove and discard solenoid O-rings if worn, cut, or torn.

(6) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 293). Retain shoulder bolt. Either tape it to harness or thread it back into accumulator housing after connector removal.

(7) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 294).

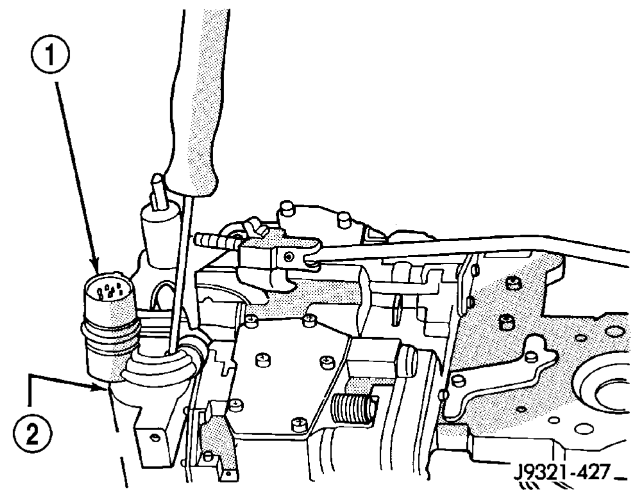


Fig. 293 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

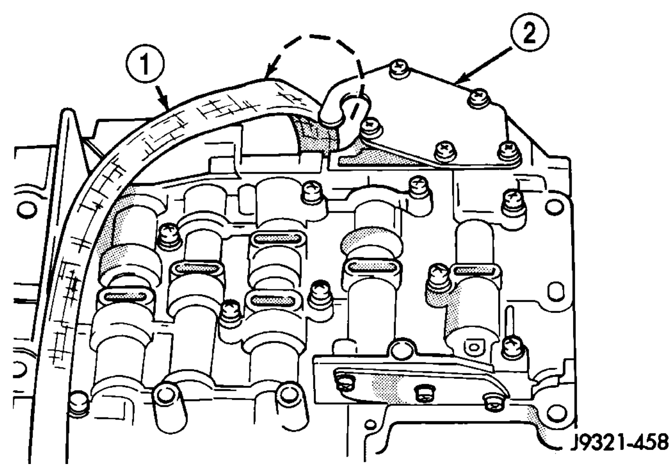


Fig. 294 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

VALVE BODY (Continued)

(8) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 295).

(9) Remove solenoid and harness assembly from valve body (Fig. 296).

(10) Remove boost valve cover (Fig. 297).

(11) Remove boost valve retainer, valve spring and boost valve (Fig. 298).

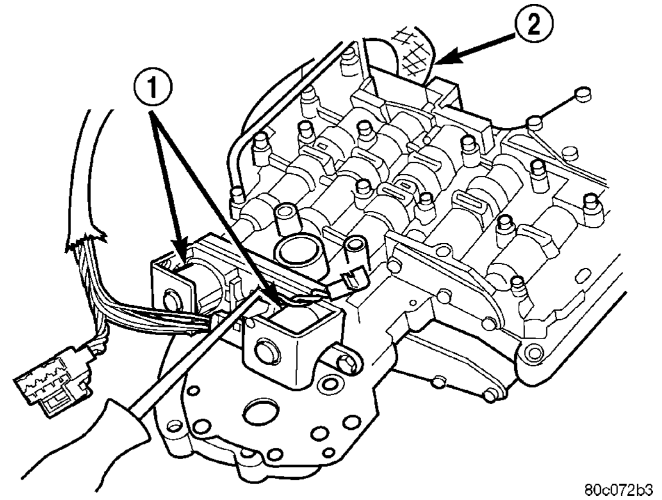


Fig. 295 Solenoid Assembly Screws

1 - OVERDRIVE/CONVERTER CLUTCH SOLENOID ASSEMBLY
2 - HARNESS

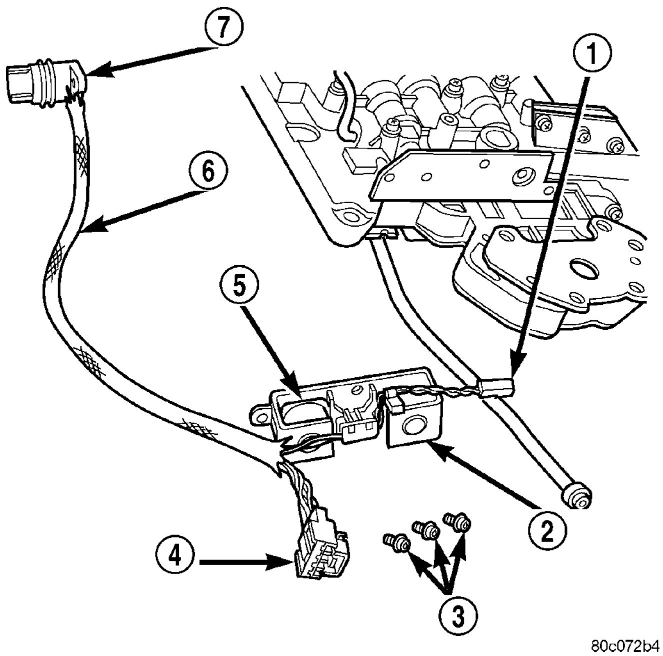


Fig. 296 Solenoid Assembly

1 - GOVERNOR SOLENOID WIRES
2 - CONVERTER CLUTCH SOLENOID
3 - SOLENOID SCREWS
4 - GOVERNOR SENSOR WIRES
5 - OVERDRIVE SOLENOID
6 - HARNESS
7 - CASE CONNECTOR

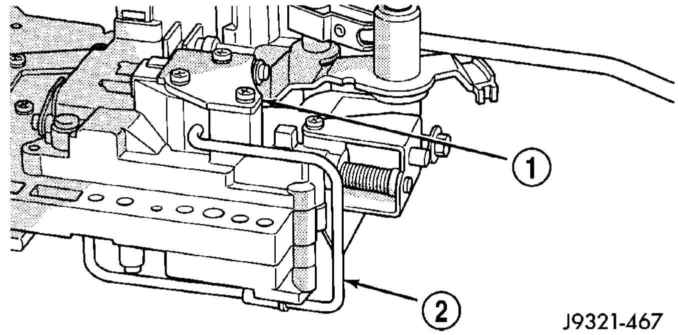


Fig. 297 Boost Valve Cover Location

1 - BOOST VALVE HOUSING AND COVER
2 - BOOST VALVE TUBE

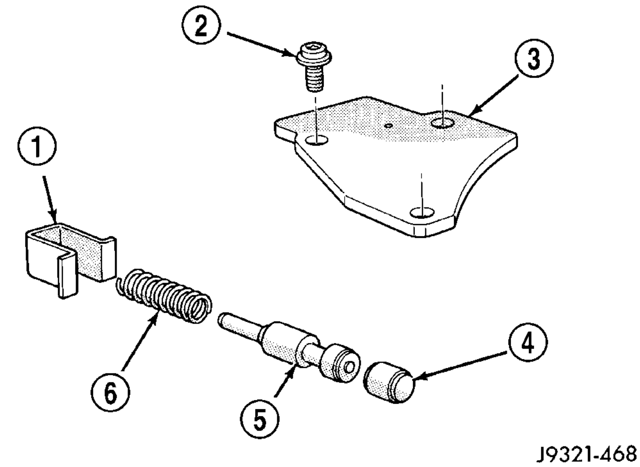


Fig. 298 Boost Valve Components

1 - SPRING AND VALVE RETAINER
2 - COVER SCREWS
3 - BOOST VALVE COVER
4 - BOOST VALVE PLUG
5 - BOOST VALVE
6 - BOOST VALVE SPRING

(12) Secure detent ball and spring with Retainer Tool 6583 (Fig. 299).

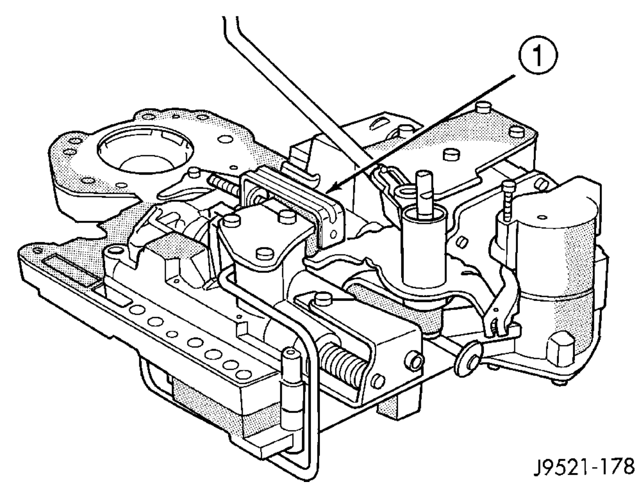


Fig. 299 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

VALVE BODY (Continued)

(13) Remove park rod E-clip and separate rod from manual lever (Fig. 300).

(14) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 301).

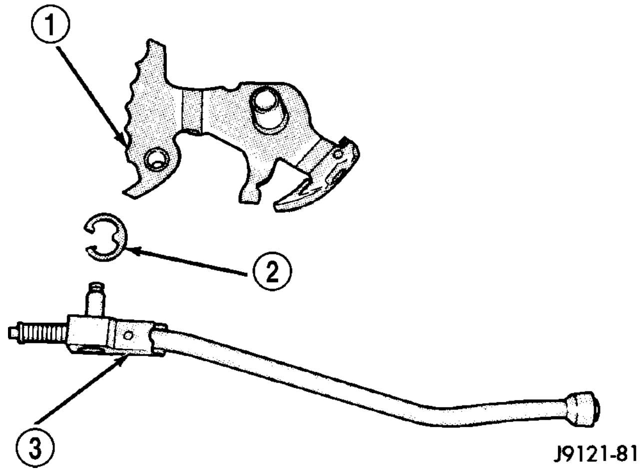


Fig. 300 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

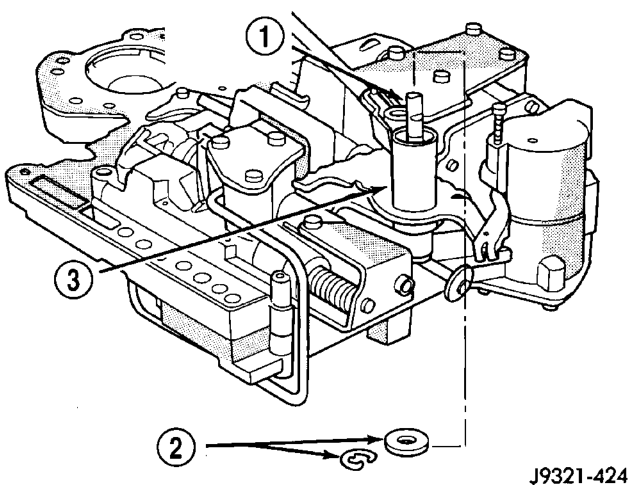


Fig. 301 Throttle Lever E-Clip And Washer

1 - THROTTLE LEVER SHAFT
2 - E-CLIP AND WASHER
3 - MANUAL SHAFT

(15) Remove manual lever and throttle lever (Fig. 302). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

(16) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 303).

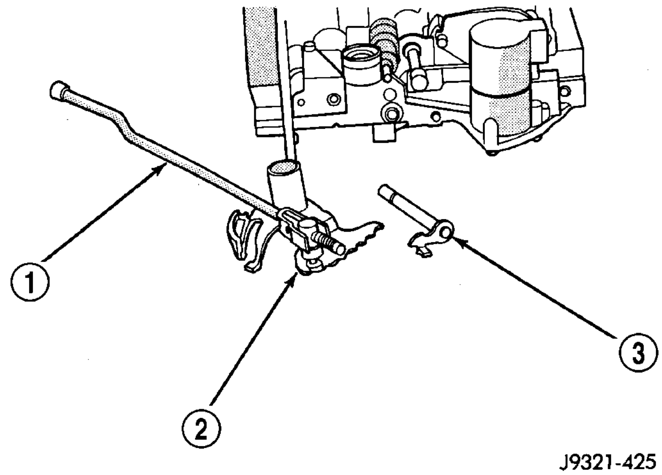


Fig. 302 Manual And Throttle Lever

1 - PARK ROD
2 - MANUAL LEVER ASSEMBLY
3 - THROTTLE LEVER

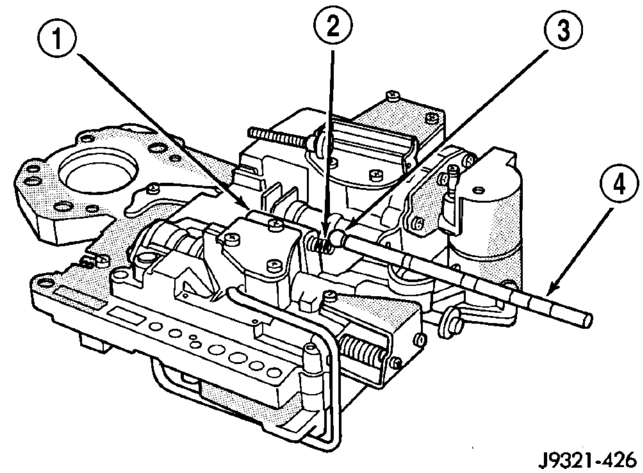


Fig. 303 Detent Ball And Spring

1 - DETENT HOUSING
2 - DETENT SPRING
3 - DETENT BALL
4 - PENCIL MAGNET

VALVE BODY (Continued)

(17) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 304). Hold bracket firmly against spring tension while removing last screw.

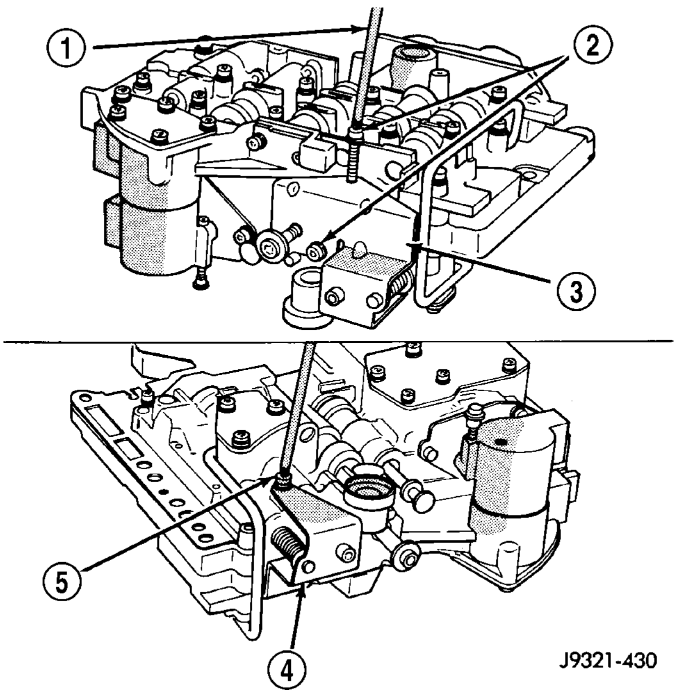


Fig. 304 Adjusting Screw Bracket Fastener

1 - T25 TORX™ BIT
2 - REMOVE THESE SCREWS FIRST
3 - BRACKET
4 - BRACKET
5 - REMOVE THIS SCREW LAST

(18) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 305). Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.

(19) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 306).

(20) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 306).

(21) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 307).

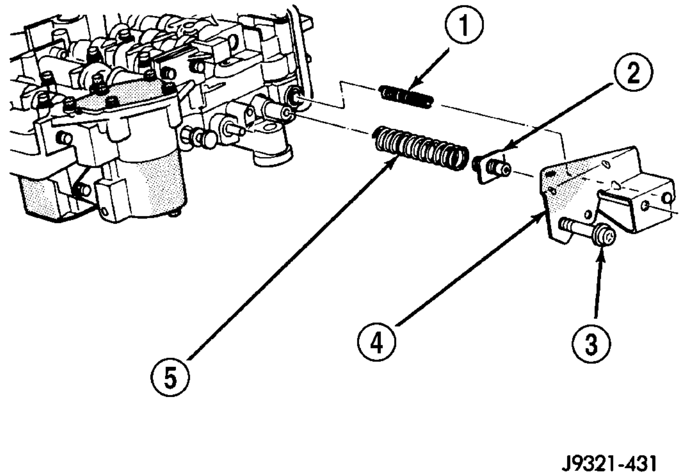


Fig. 305 Adjusting Screw Bracket

1 - SWITCH VALVE SPRING
2 - LINE PRESSURE SCREW
3 - THROTTLE PRESSURE ADJUSTING SCREW
4 - ADJUSTING SCREW BRACKET
5 - PRESSURE REGULATOR VALVE SPRING

VALVE BODY (Continued)

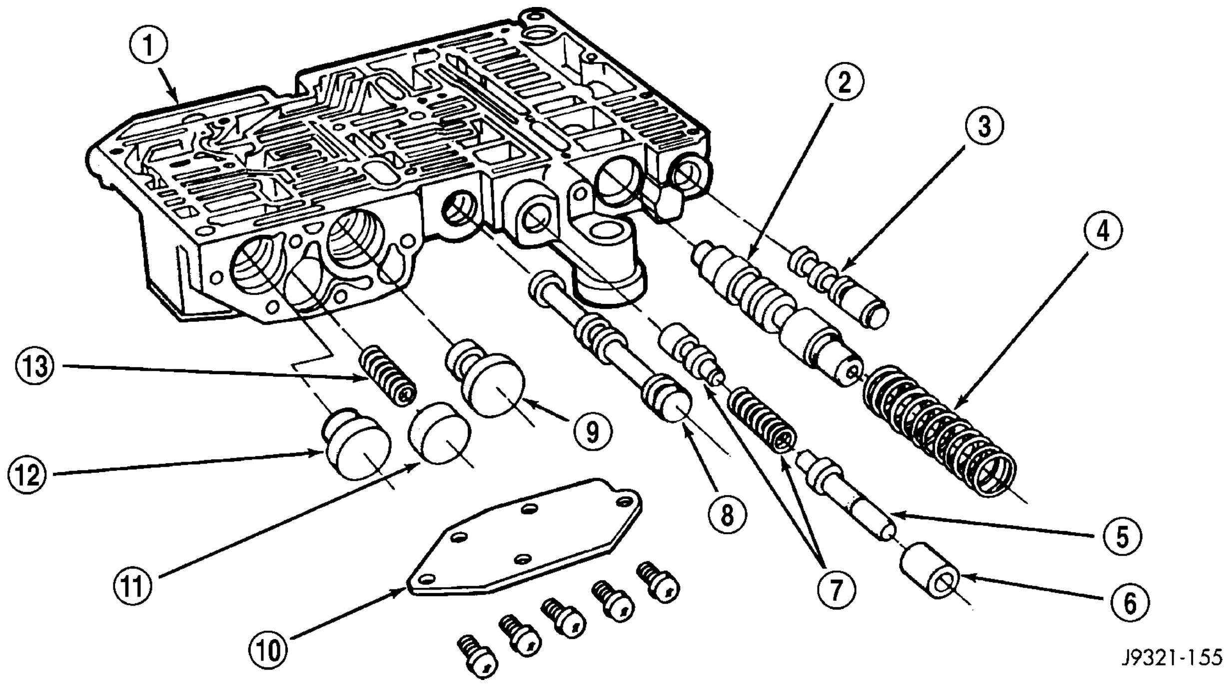


Fig. 306 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

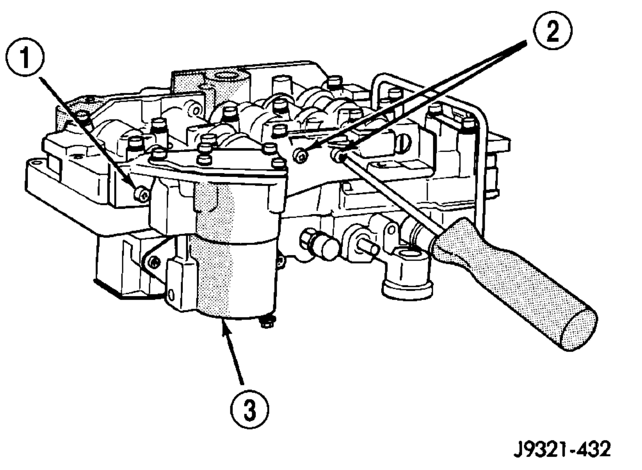


Fig. 307 Accumulator Housing Screw Locations

1 - LOOSEN THIS SCREW
2 - REMOVE THESE SCREWS
3 - 3-4 ACCUMULATOR HOUSING

(22) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 308).

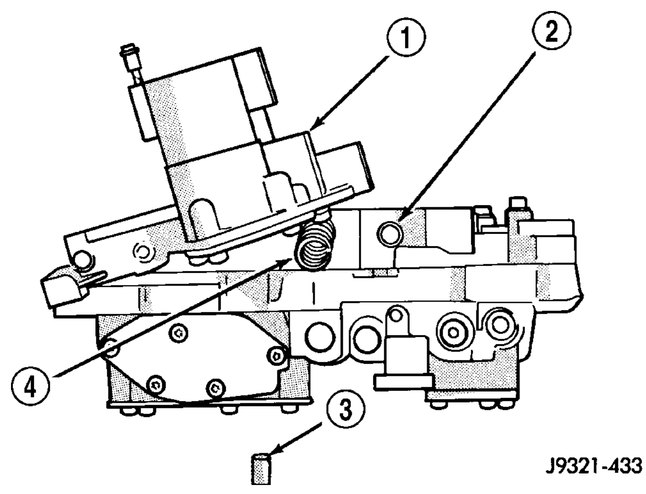


Fig. 308 3-4 Shift And Converter Clutch Valve Springs and Plug

1 - ACCUMULATOR HOUSING
2 - CONVERTER CLUTCH VALVE SPRING
3 - CLUTCH VALVE PLUG
4 - 3-4 SHIFT VALVE SPRING

VALVE BODY (Continued)

(23) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 309).

(24) Bend back tabs on boost valve tube brace (Fig. 310).

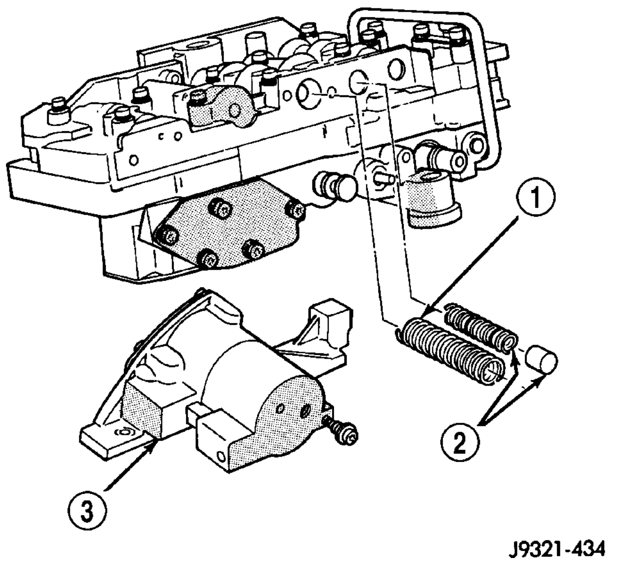


Fig. 309 Accumulator Housing, Valve Springs, and Plug

1 - 3-4 SHIFT VALVE SPRING
2 - CONVERTER CLUTCH VALVE SPRING AND PLUG
3 - 3-4 ACCUMULATOR HOUSING

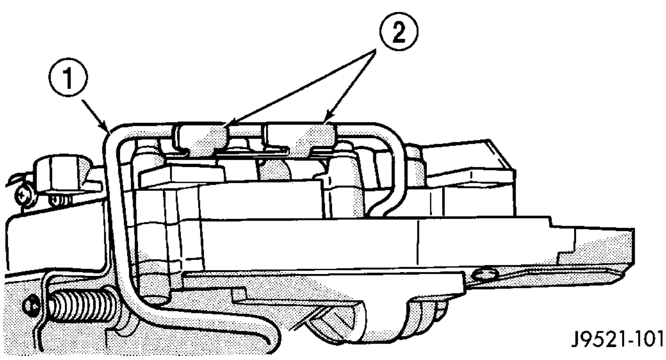


Fig. 310 Boost Valve Tube Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE (DOUBLE TAB)

(25) Remove boost valve connecting tube (Fig. 311). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

(26) Turn valve body over so lower housing is facing upward (Fig. 312). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(27) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 312). Note position of boost valve tube brace for assembly reference.

(28) Remove lower housing and overdrive separator plate from transfer plate (Fig. 312).

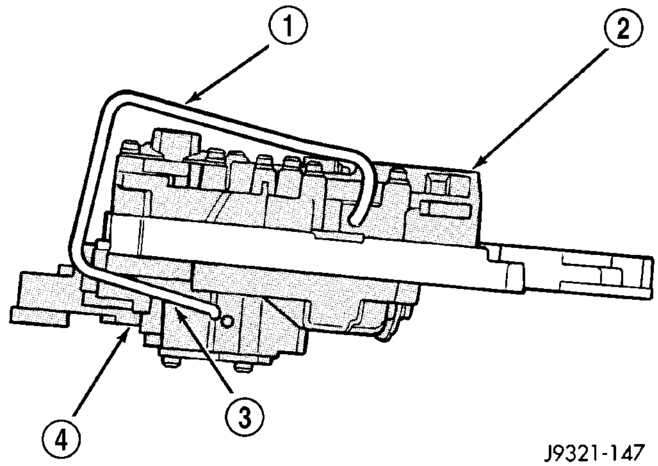


Fig. 311 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

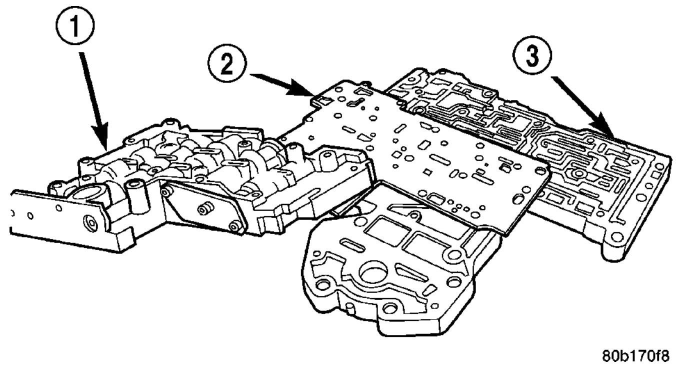


Fig. 312 Lower Housing

1 - LOWER HOUSING
2 - OVERDRIVE SEPARATOR PLATE
3 - TRANSFER PLATE AND UPPER HOUSING

VALVE BODY (Continued)

(29) Remove the Number 10 check ball from the transfer plate (Fig. 313). The check ball is approximately 4.8 mm (3/16 in.) in diameter.

(30) Remove transfer plate from upper housing (Fig. 314).

(31) Turn transfer plate over so upper housing separator plate is facing upward.

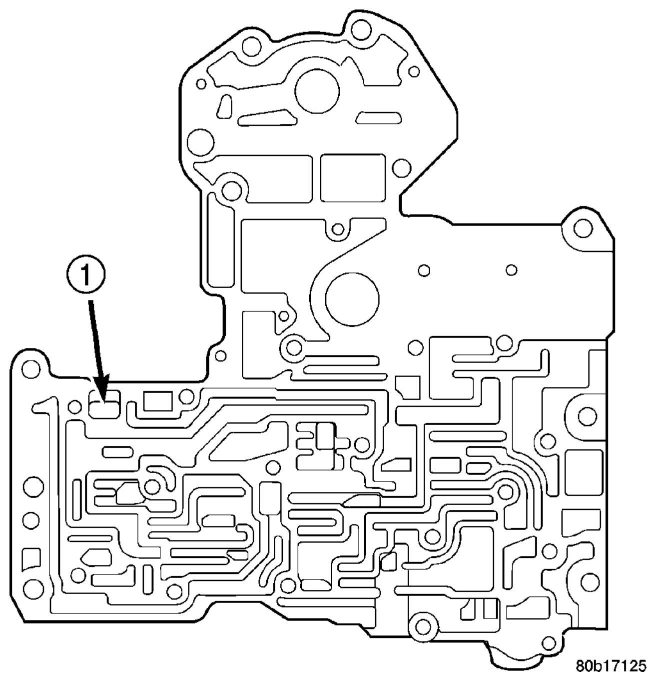


Fig. 313 Number 10 Check Ball

1 - NUMBER 10 CHECK BALL (3/16")

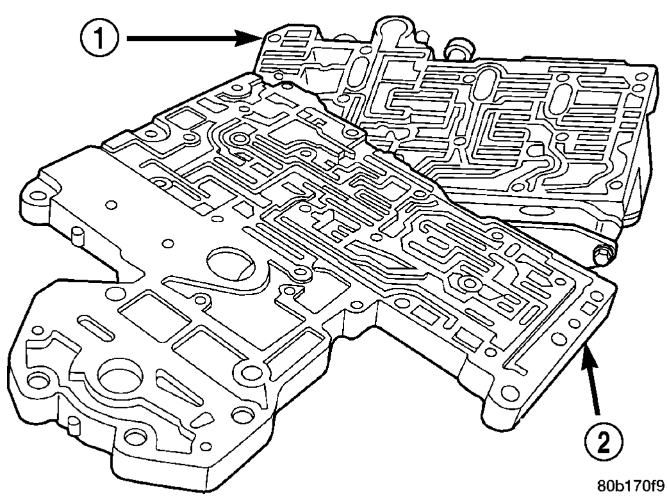


Fig. 314 Transfer Plate

1 - UPPER HOUSING
2 - TRANSFER PLATE

(32) Remove upper housing separator plate from transfer plate (Fig. 315). Note position of filter in separator plate for assembly reference.

(33) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 316).

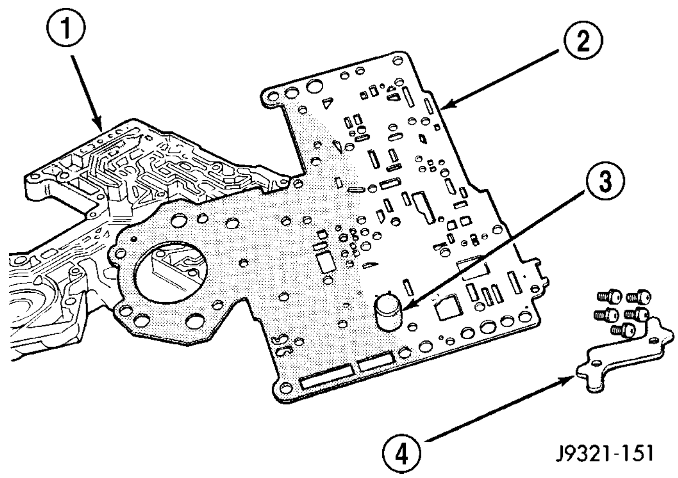


Fig. 315 Upper Housing Separator Plate

1 - TRANSFER PLATE
2 - UPPER HOUSING SEPARATOR PLATE
3 - FILTER SCREEN
4 - BRACE

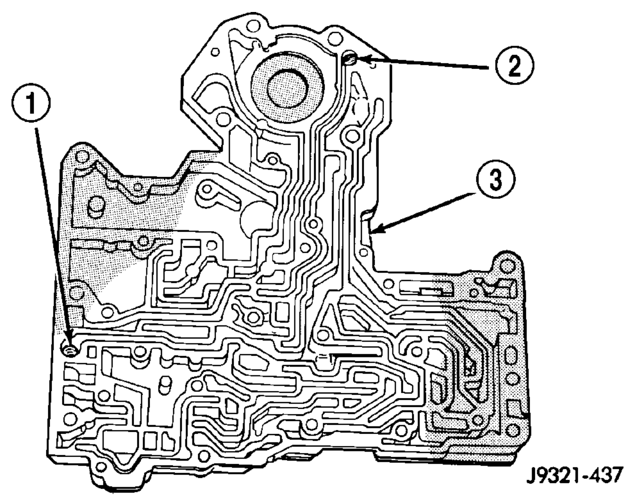


Fig. 316 Rear Clutch and Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY (Continued)

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 317). Then remove the one large diameter and the six smaller diameter check balls.

(2) Remove governor plug and shuttle valve covers (Fig. 319).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 318).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 319).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 306).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 320).

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 320).

(9) Remove 1-2 shift control valve and spring (Fig. 320).

(10) Remove 1-2 shift valve and spring (Fig. 320).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 320).

(12) Remove pressure plug cover (Fig. 320).

(13) Remove line pressure plug, sleeve, throttle pressure plug and spring (Fig. 320).

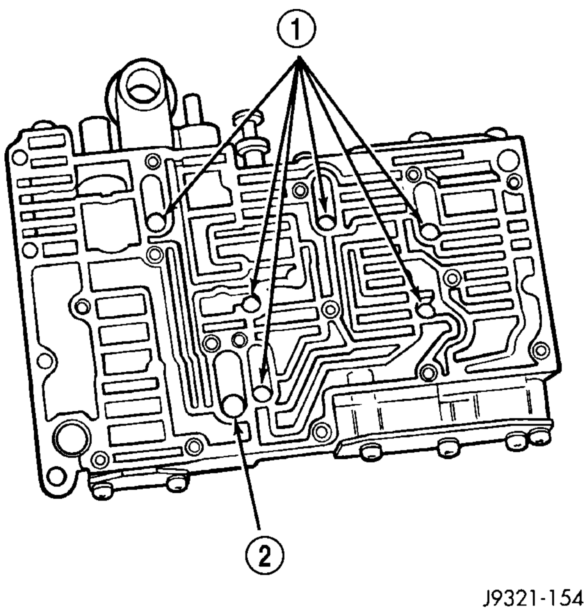


Fig. 317 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

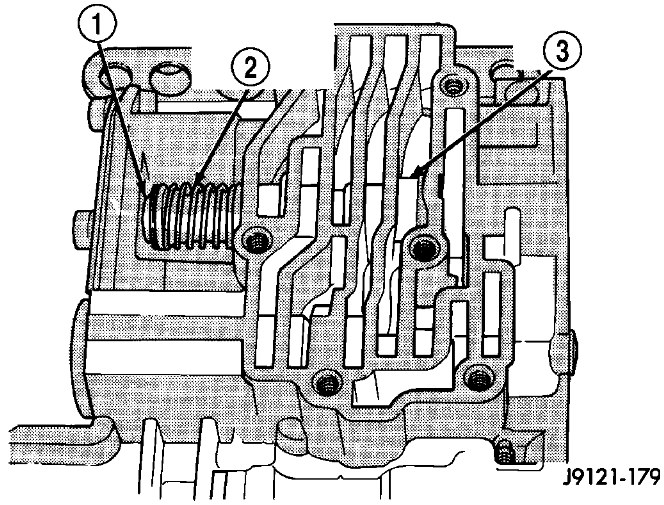


Fig. 318 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.

(2) Remove 3-4 timing valve and spring.

(3) Remove 3-4 quick fill valve, spring and plug.

(4) Remove 3-4 shift valve and spring.

(5) Remove converter clutch valve, spring and plug (Fig. 321).

(6) Remove converter clutch timing valve, retainer and valve spring.

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals (Fig. 322).

VALVE BODY (Continued)

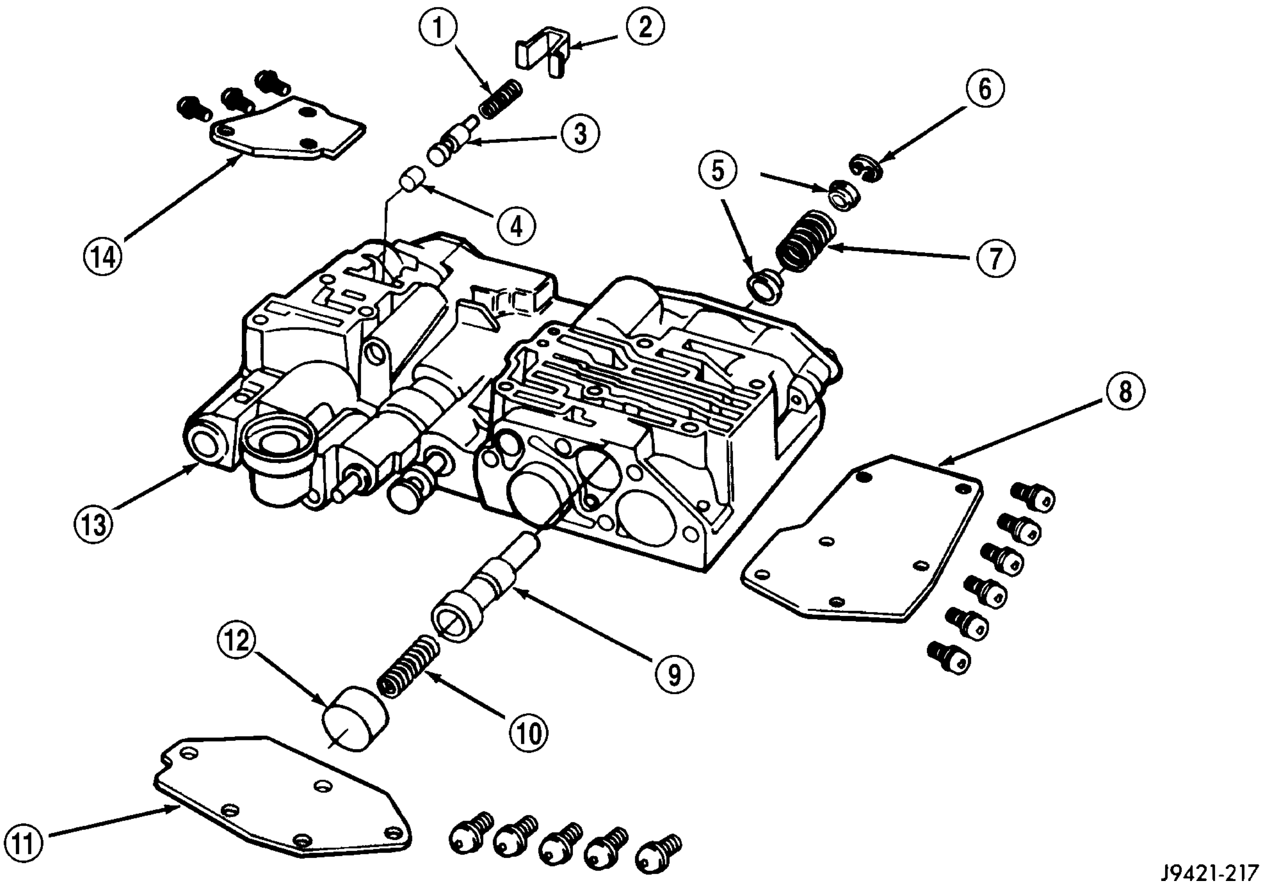


Fig. 319 Shuttle and Boost Valve Location

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

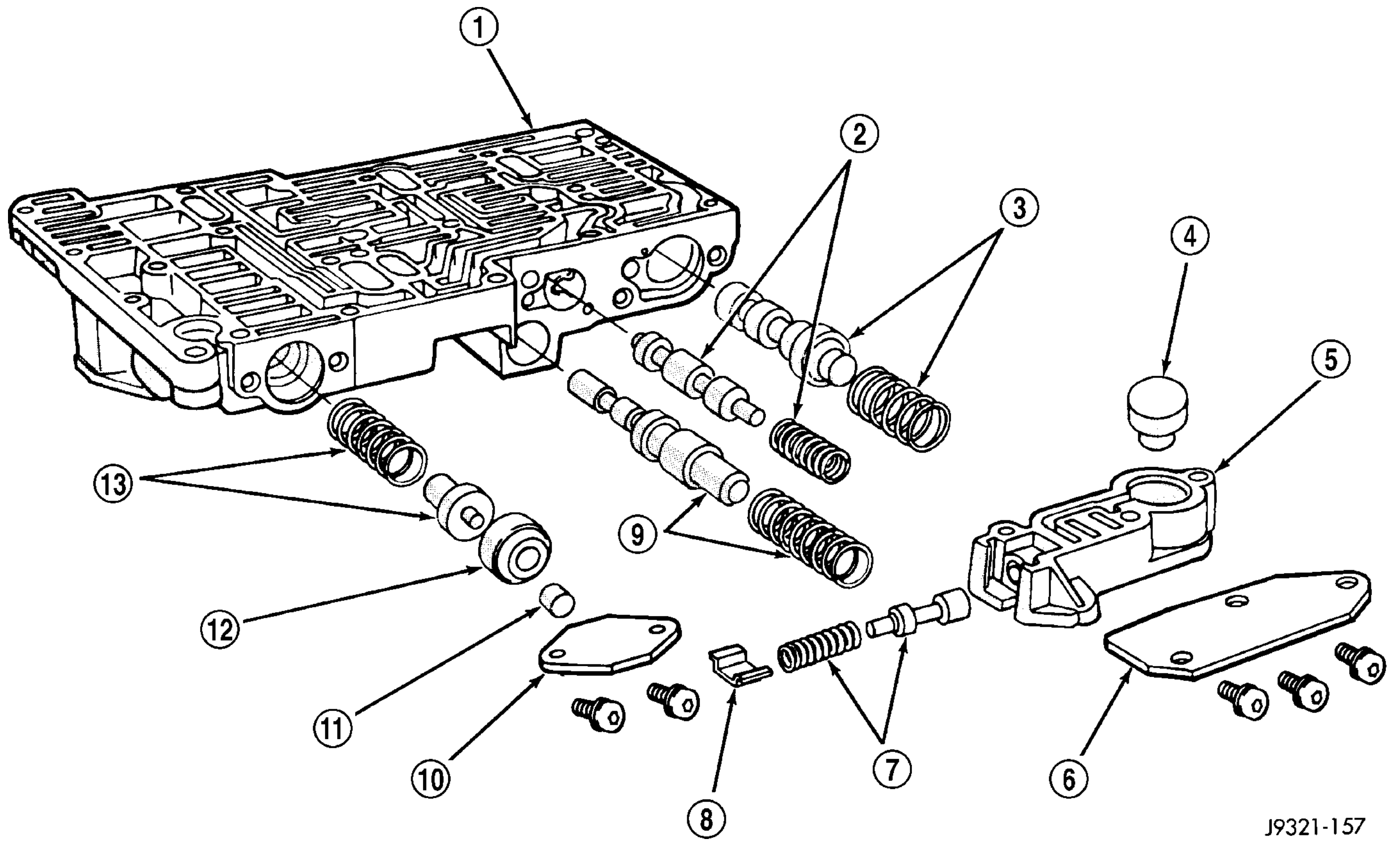


Fig. 320 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

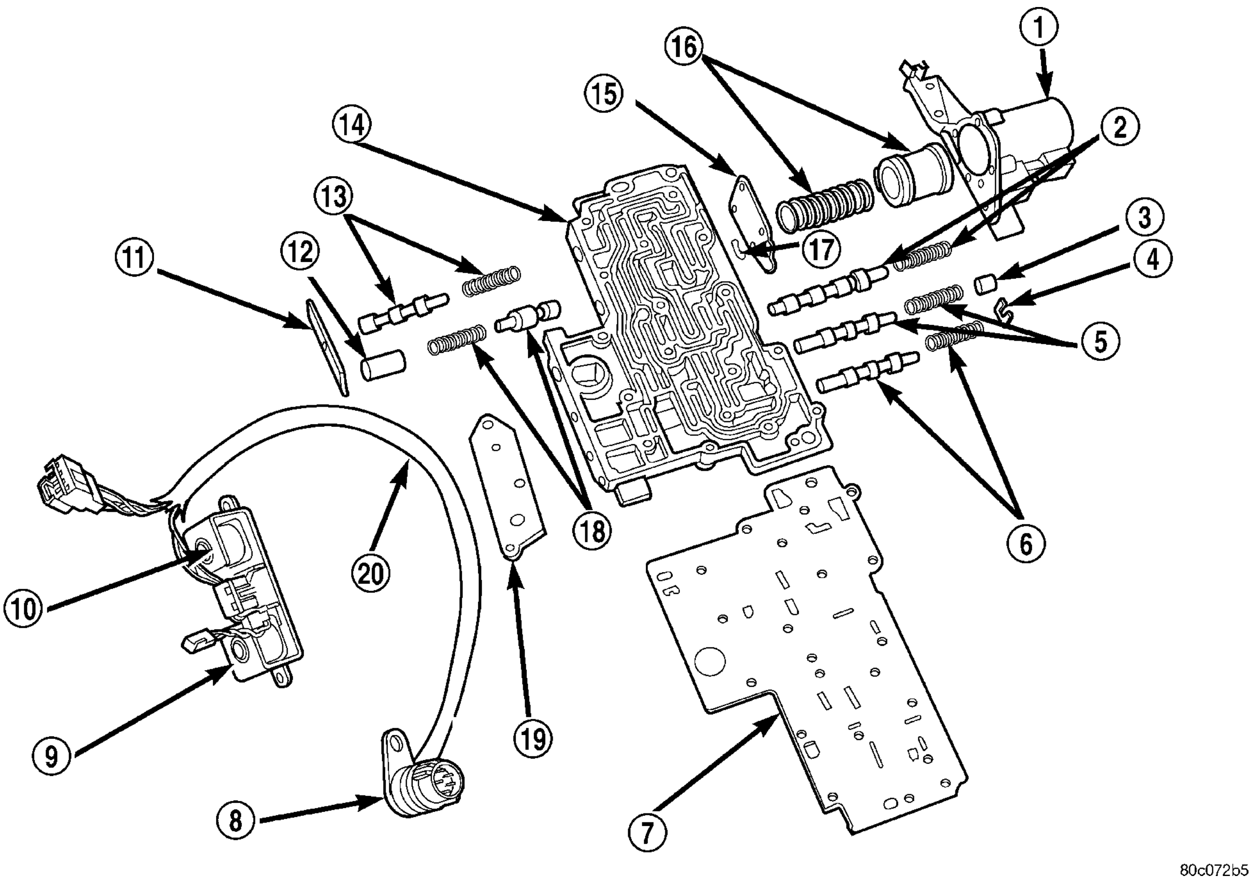


Fig. 321 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

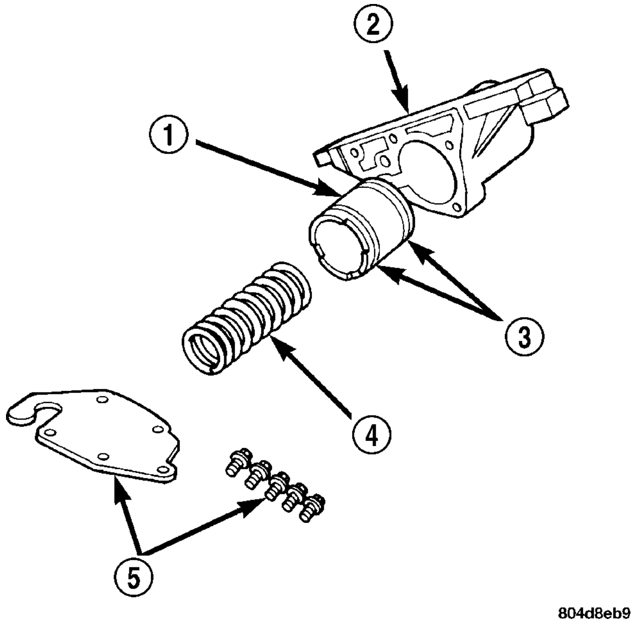


Fig. 322 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

INSPECTION

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.**Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

VALVE BODY (Continued)

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 321).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 322).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 323).

(2) Install filter screen in upper housing separator plate (Fig. 324).

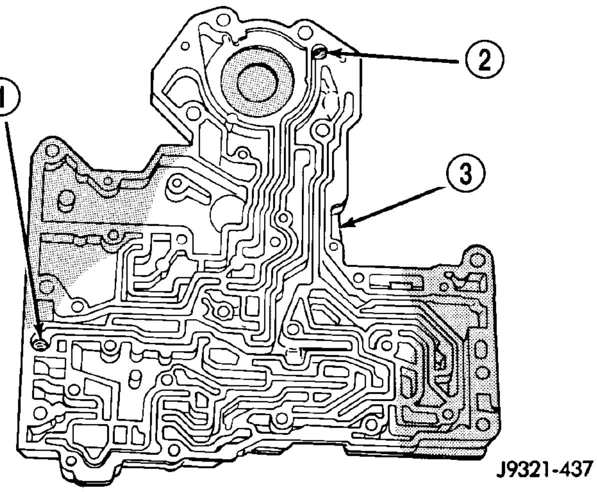


Fig. 323 Rear Clutch And Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

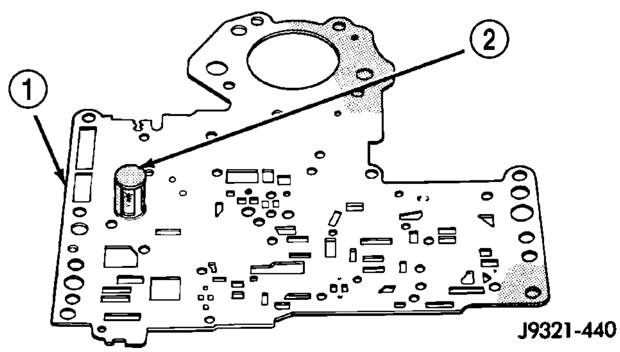


Fig. 324 Separator Plate Filter Screen Installation

1 - UPPER HOUSING SEPARATOR PLATE
2 - FILTER SCREEN

VALVE BODY (Continued)

(3) Align and position upper housing separator plate on transfer plate (Fig. 325).

(4) Install brace plate (Fig. 325). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

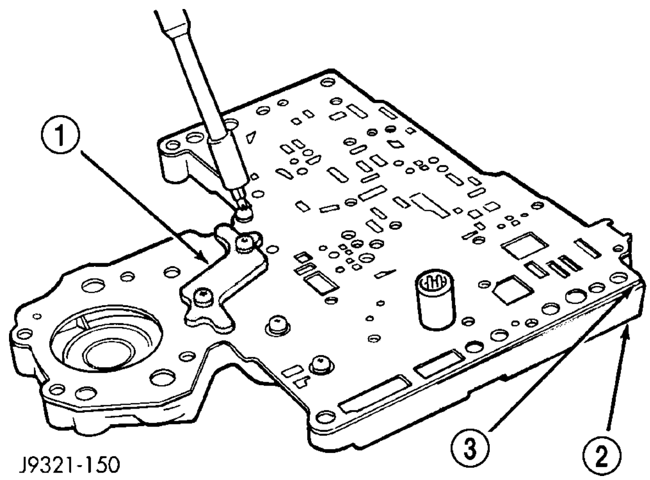


Fig. 325 Brace Plate

1 - BRACE
2 - TRANSFER PLATE
3 - SEPARATOR PLATE

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 326). Eight check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 6 check balls are approximately 6.3 mm (1/4 in.) in diameter.

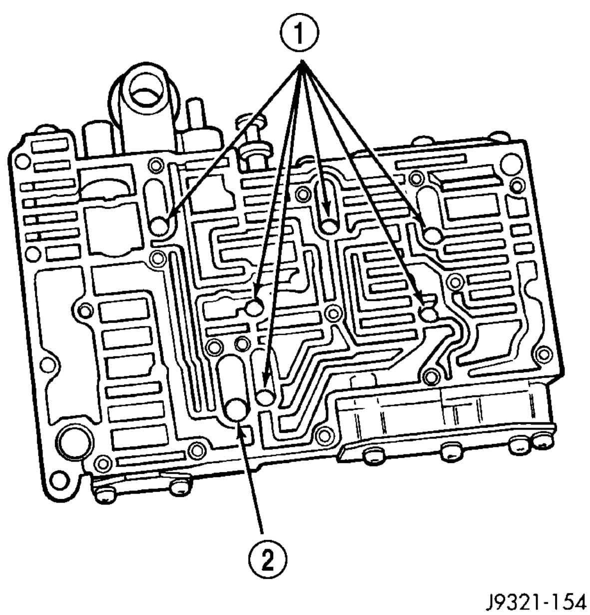


Fig. 326 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (6)
2 - LARGE DIAMETER CHECK BALL (1)

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 327). Be sure filter screen is seated in proper housing recess.

(3) Install the Number 10 check ball into the transfer plate (Fig. 328). The check ball is approximately 4.8 mm (3/16 in.) in diameter.

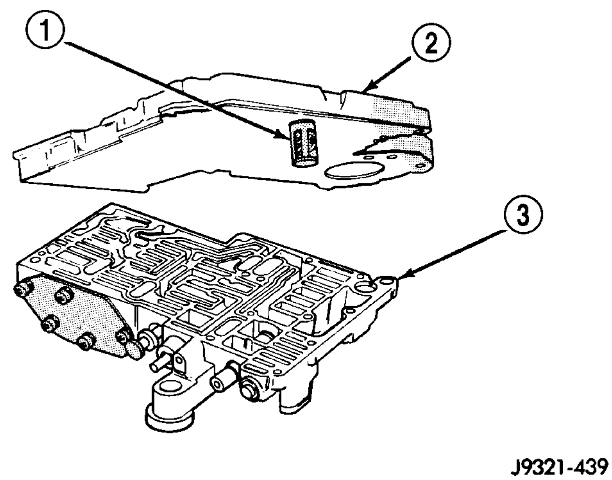


Fig. 327 Installing Transfer Plate On Upper Housing

1 - FILTER SCREEN
2 - TRANSFER PLATE/SEPARATOR PLATE ASSEMBLY
3 - UPPER HOUSING

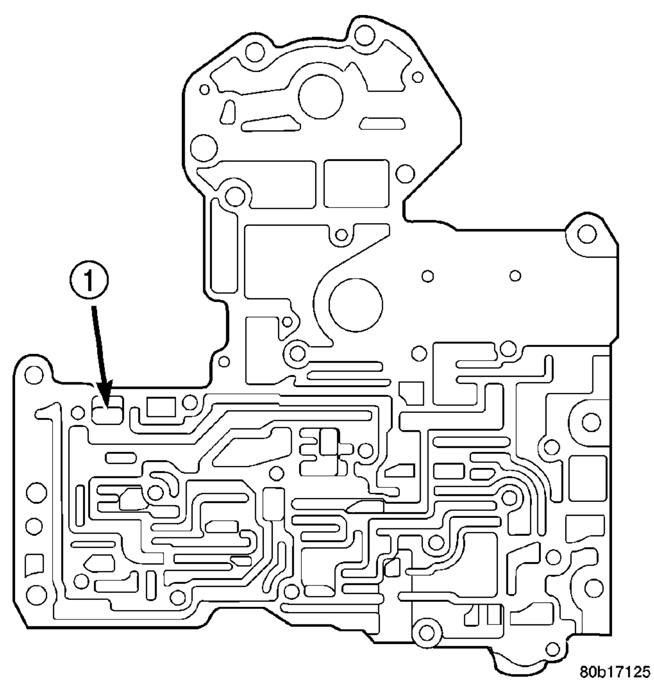


Fig. 328 Number 10 Check Ball

1 - NUMBER 10 CHECK BALL (3/16″)

VALVE BODY (Continued)

(4) Position lower housing separator plate on transfer plate (Fig. 329).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 330).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 330).

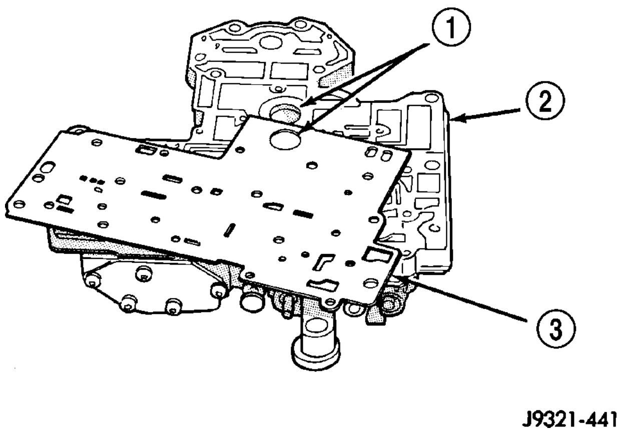


Fig. 329 Lower Housing Separator Plate

1 - BE SURE TO ALIGN BORES
2 - TRANSFER PLATE
3 - LOWER HOUSING (OVERDRIVE) SEPARATOR PLATE

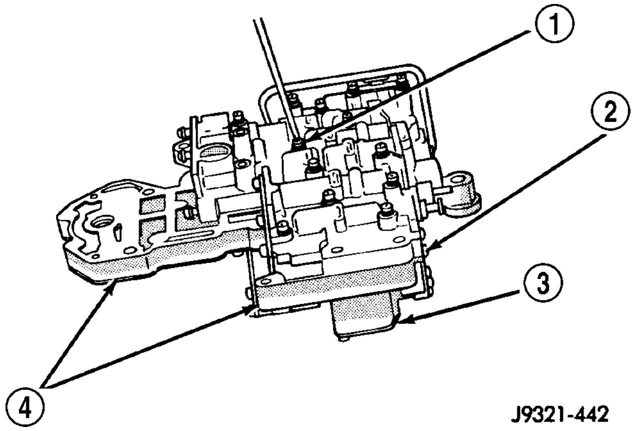


Fig. 330 Installing Lower Housing On Transfer Plate And Upper Housing

1 - VALVE BODY SCREWS (13)
2 - LOWER HOUSING
3 - UPPER HOUSING
4 - TRANSFER PLATE

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 331), (Fig. 332) and (Fig. 333) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure plug, sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

VALVE BODY (Continued)

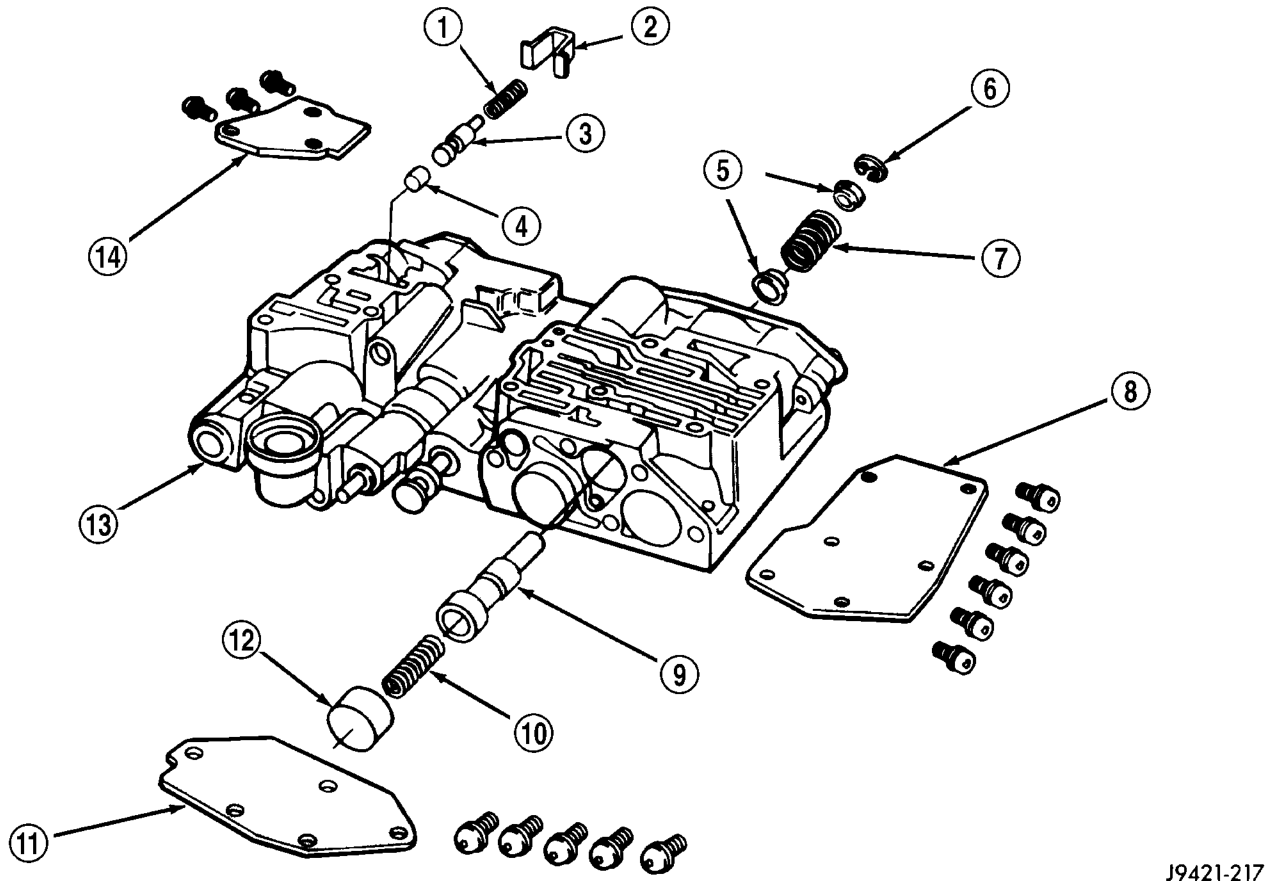


Fig. 331 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

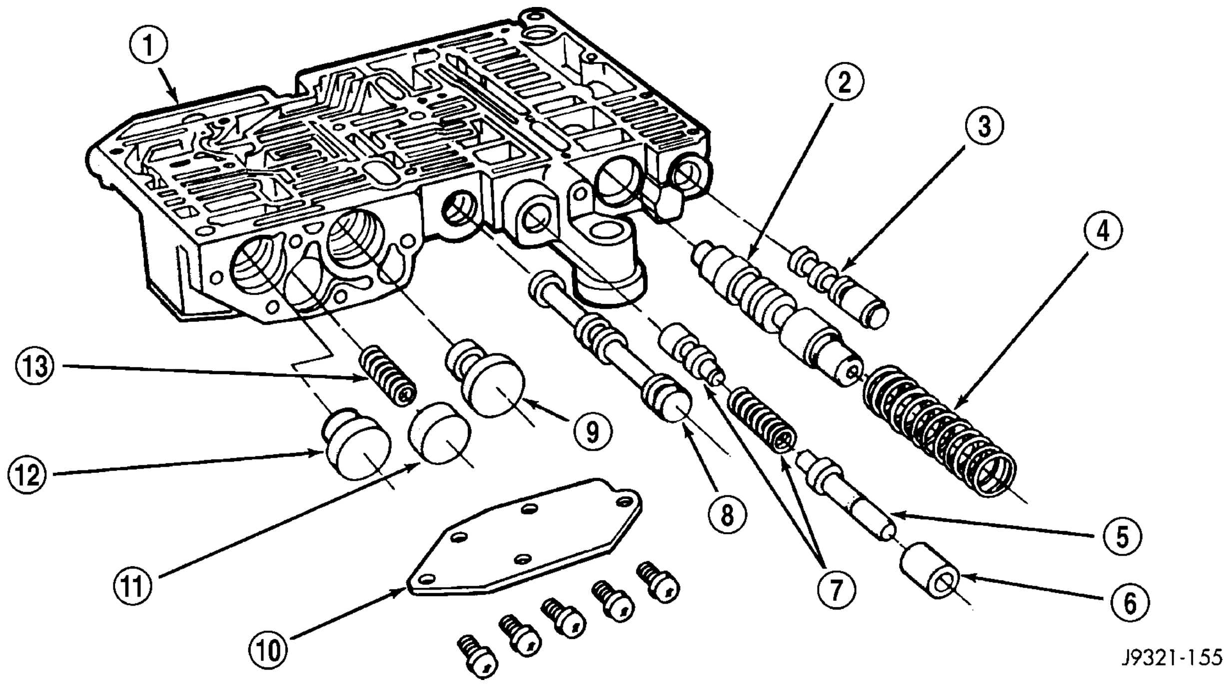


Fig. 332 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

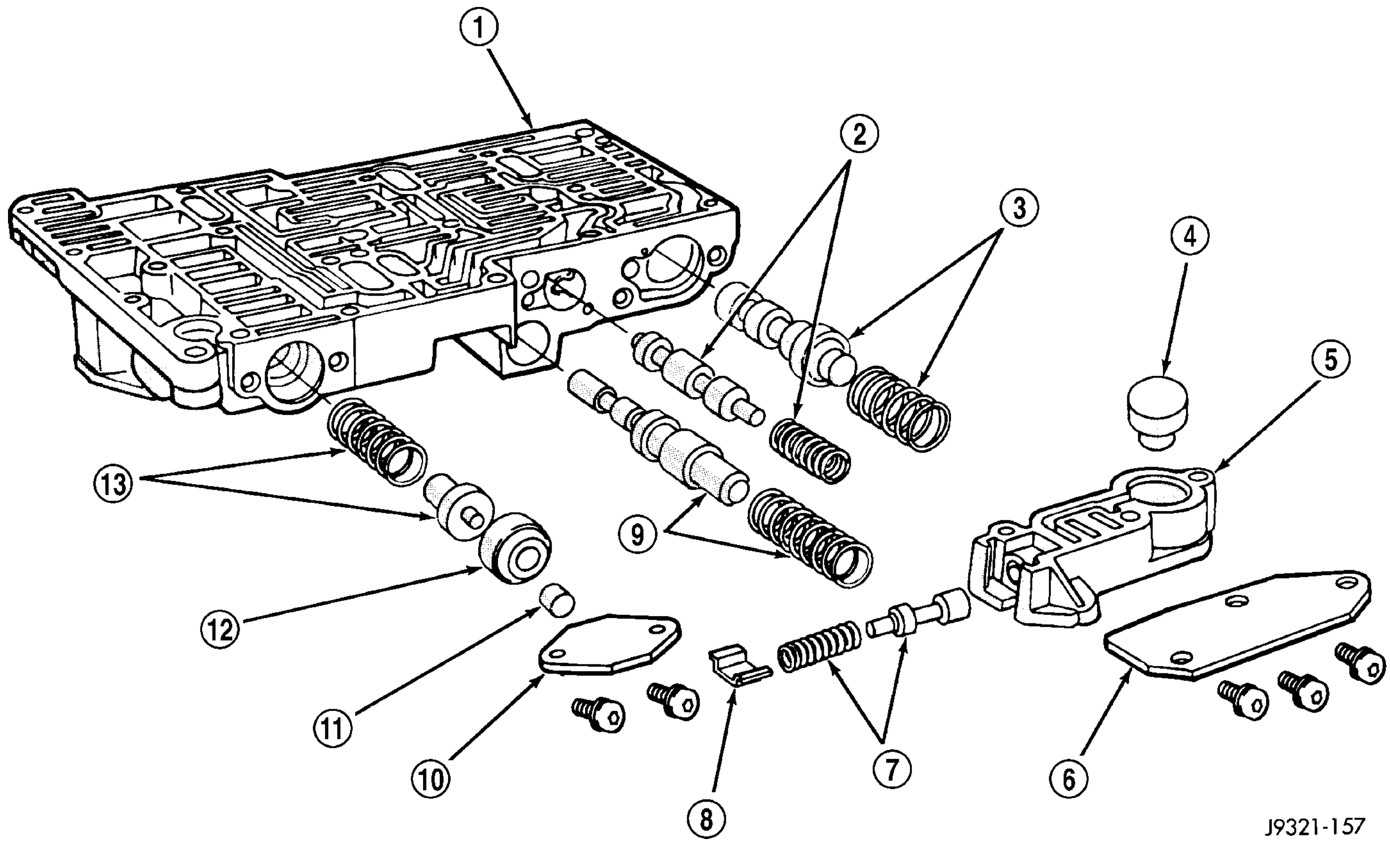


Fig. 333 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - LINE PRESSURE PLUG
12 - PLUG SLEEVE
13 - THROTTLE PRESSURE SPRING AND PLUG

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 334).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 334).

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 335).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 335).

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 336).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

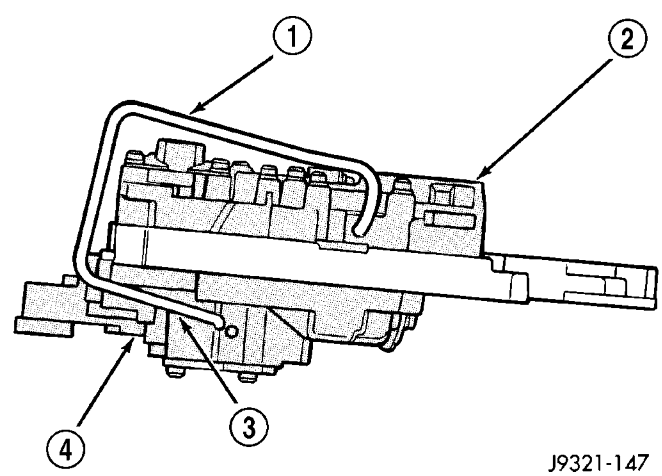


Fig. 334 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

VALVE BODY (Continued)

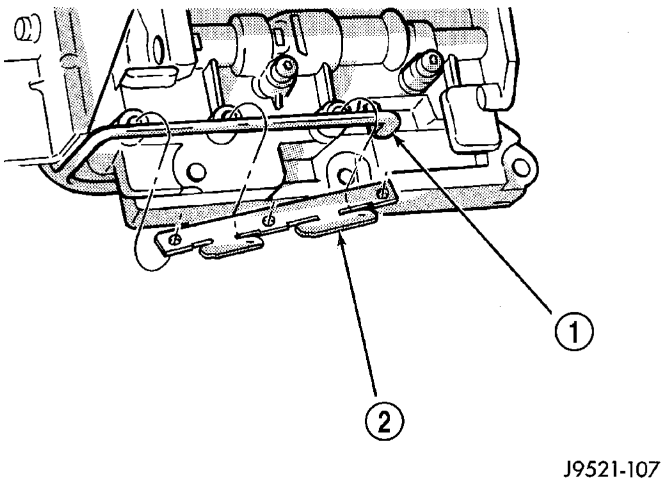


Fig. 335 Boost Valve Tube And Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE

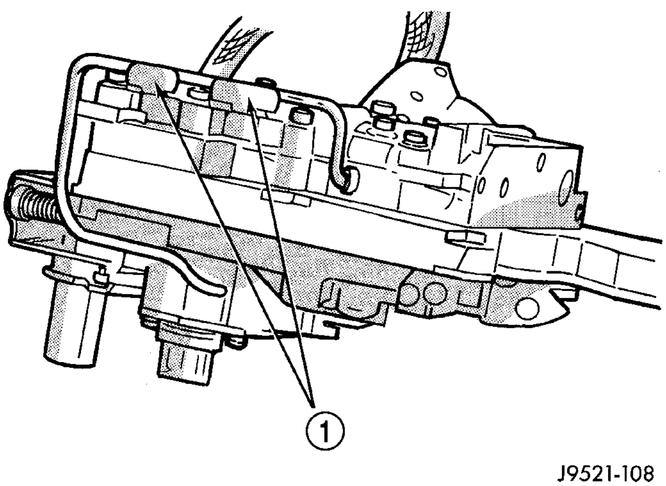


Fig. 336 Securing Boost Valve Tube With Brace Tabs

1 - BEND TABS UP AGAINST TUBE AS SHOWN

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 337).

(2) Loosely attach accumulator housing with right-side screw (Fig. 337). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 338). Tighten screws to 4 N·m (35 in. lbs.).

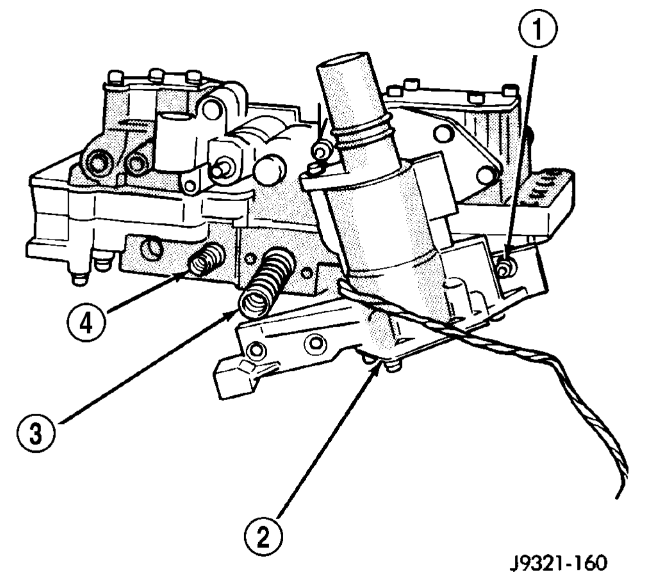


Fig. 337 Converter Clutch And 3-4 Shift Valve Springs

1 - RIGHT-SIDE SCREW
2 - 3-4 ACCUMULATOR
3 - 3-4 SHIFT VALVE SPRING
4 - CONVERTER CLUTCH VALVE SPRING

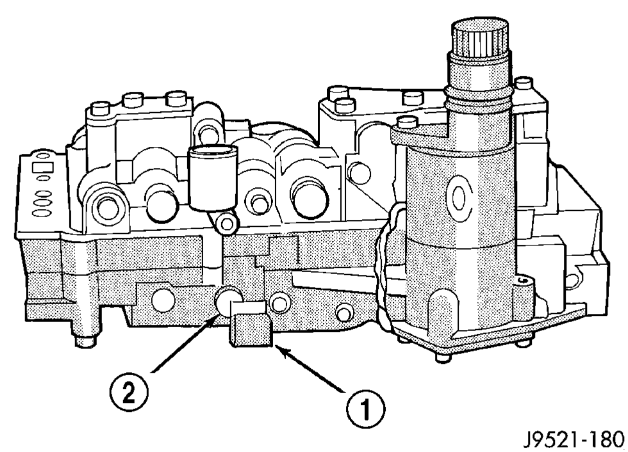


Fig. 338 Seating 3-4 Accumulator On Lower Housing

1 - ACCUMULATOR BOX
2 - CONVERTER CLUTCH VALVE PLUG

VALVE BODY (Continued)

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 339).

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 340).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

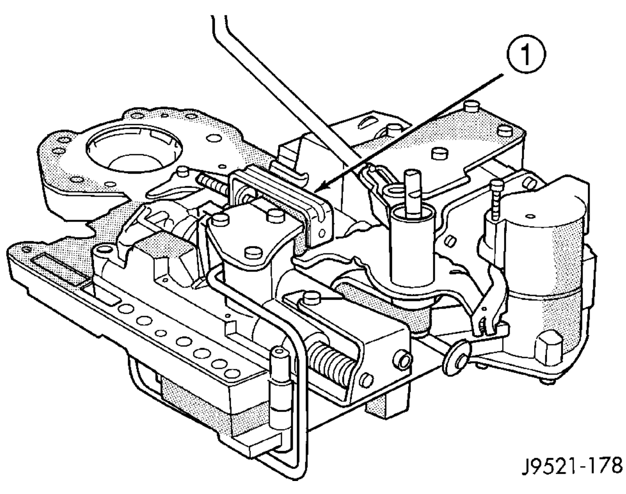


Fig. 339 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

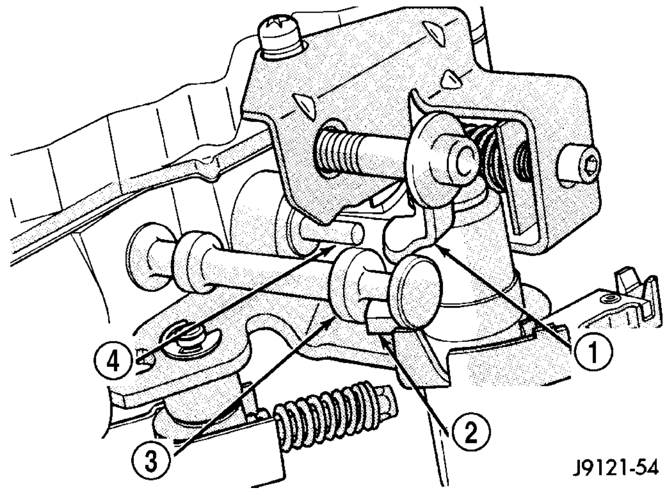


Fig. 340 Manual And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

(17) Perform Line Pressure and Throttle Pressure adjustments. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/VALVE BODY - ADJUSTMENTS)

(18) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(19) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 341). Seat tang in dimple before tightening connector screw.

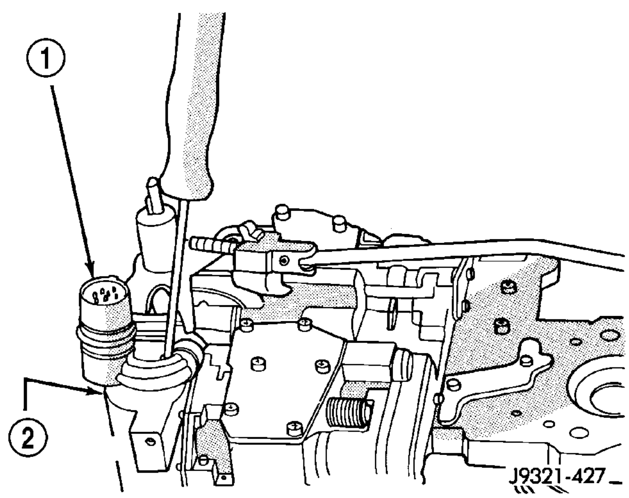


Fig. 341 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

VALVE BODY (Continued)

(20) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(21) Verify that solenoid wire harness is properly routed (Fig. 342). Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.

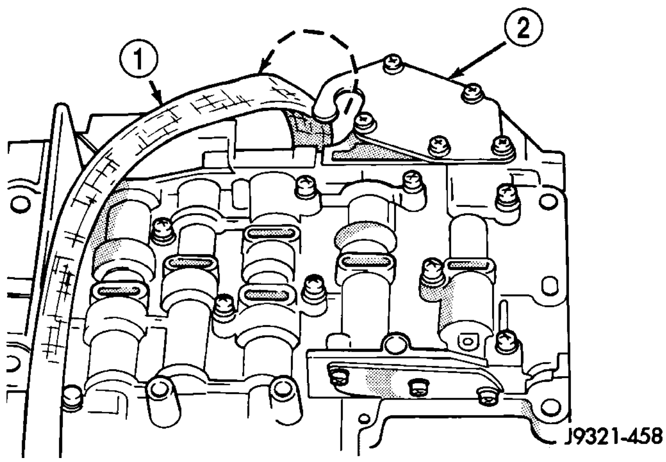


Fig. 342 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor.

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body.

(5) Install governor pressure solenoid in governor body. Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate.

(7) Install retainer plate on governor body and around solenoid. Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor.

(10) Install fluid filter and pan.

(11) Lower vehicle.

(12) Fill transmission with recommended fluid and road test vehicle to verify repair.

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 343). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 344).

(3) Check condition of seals on accumulator piston. Install new piston seals, if necessary.

(4) Verify that transmission range sensor is **NOT** installed. Valve body cannot be installed with sensor in place.

(5) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(6) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(7) Lubricate seal rings on valve body harness connector with petroleum jelly.

(8) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(9) Install accumulator spring and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(10) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(11) Then seat valve body in case and install one or two bolts to hold valve body in place.

(12) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(13) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(14) Install throttle and gearshift levers on valve body manual lever shaft.

VALVE BODY (Continued)

(15) Check and adjust front and rear bands if necessary.

(16) Connect solenoid case connector wires.

(17) Install the transmission range sensor.

(18) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(19) Lower vehicle and fill transmission with Mopar® ATF +4, Automatic Transmission fluid.

(20) Check and adjust gearshift and throttle valve cables, if necessary.

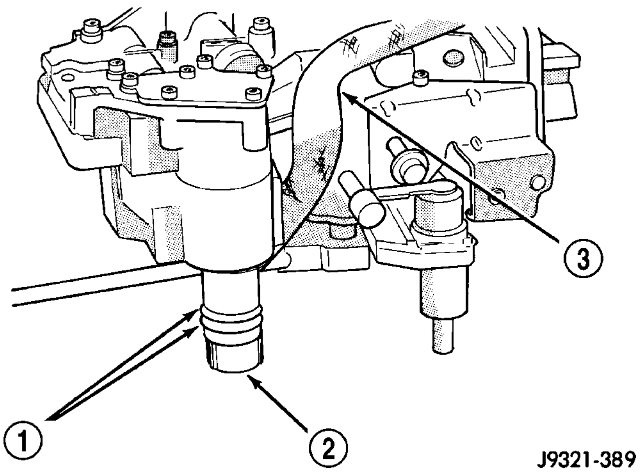


Fig. 343 Valve Body Harness Connector O-Ring Seal

1 - CONNECTOR O-RINGS
2 - VALVE BODY HARNESS CONNECTOR
3 - HARNESS

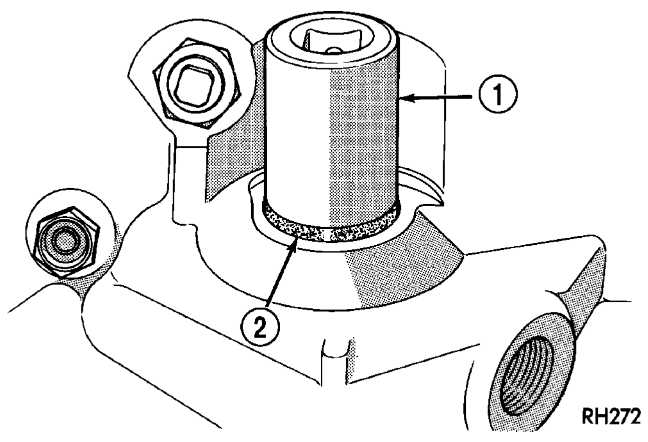


Fig. 344 Manual Lever Shaft Seal

1 - 15/16'' SOCKET
2 - SEAL

ADJUSTMENTS - VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 345).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

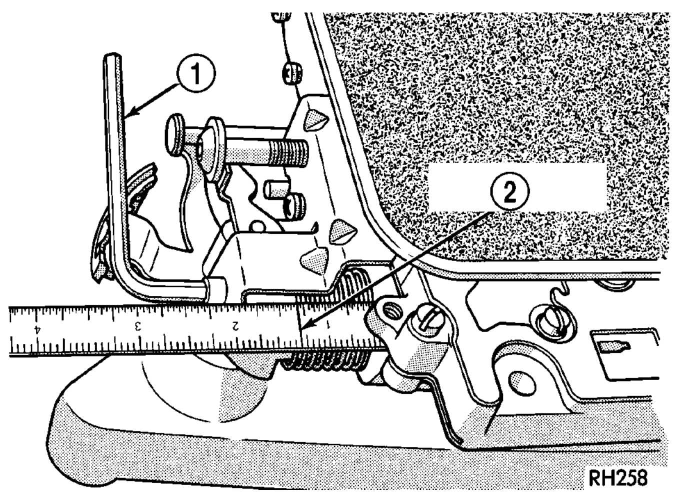


Fig. 345 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

VALVE BODY (Continued)

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 346).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

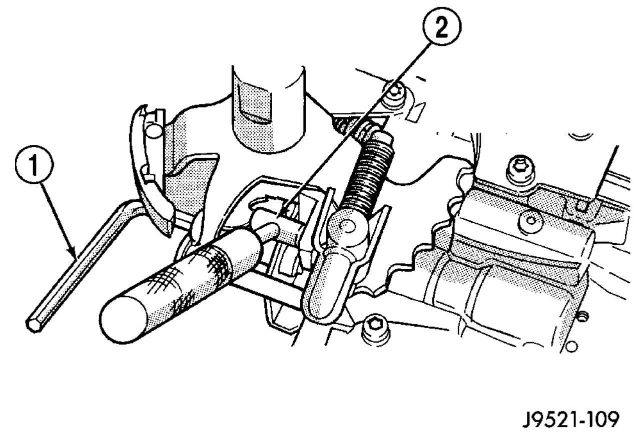


Fig. 346 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

AUTOMATIC TRANSMISSION - 48RE

TABLE OF CONTENTS

AUTOMATIC TRANSMISSION - 48RE

DESCRIPTION

The 48RE (Fig. 1) is a four speed fully automatic transmission with an electronic governor. The 48RE is equipped with a lock-up clutch in the torque converter. First through third gear ranges are provided by the clutches, bands, overrunning clutch, and planetary gear sets in the transmission. Fourth gear range is provided by the overdrive unit that contains an overdrive clutch, direct clutch, planetary gear set, and overrunning clutch.

The transmission contains a front, rear, and direct clutch which function as the input driving components. It also contains the kickdown (front) and the low/reverse (rear) bands which, along with the overrunning clutch and overdrive clutch, serve as the holding components. The driving and holding components combine to select the necessary planetary gear components, in the front, rear, or overdrive planetary gear set, transfer the engine power from the input shaft through to the output shaft.

The valve body is mounted to the lower side of the transmission and contains the valves to control pressure regulation, fluid flow control, and clutch/band application. The oil pump is mounted at the front of the transmission and is driven by the torque converter hub. The pump supplies the oil pressure necessary for clutch/band actuation and transmission lubrication.

AUTOMATIC TRANSMISSION - 48RE (Continued)

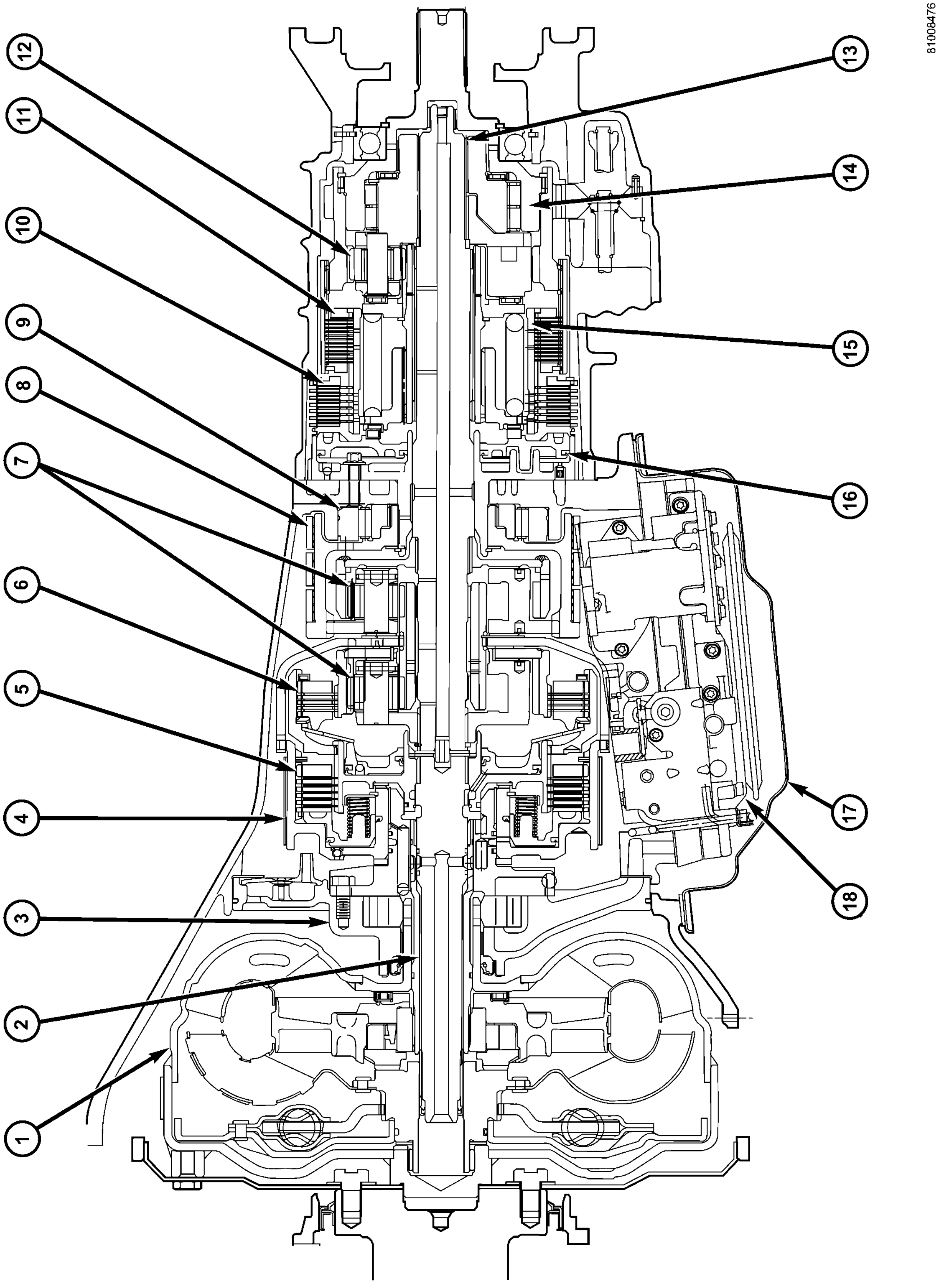


Fig. 1 48RE Transmission

AUTOMATIC TRANSMISSION - 48RE (Continued)

1 - TORQUE CONVERTER
2 - INPUT SHAFT
3 - OIL PUMP
4 - FRONT BAND
5 - FRONT CLUTCH
6 - REAR CLUTCH
7 - PLANETARIES
8 - REAR BAND
9 - OVERRUNNING CLUTCH
10 - OVERDRIVE CLUTCH
11 - DIRECT CLUTCH
12 - PLANETARY GEAR
13 - INTERMEDIATE SHAFT
14 - OVERDRIVE OVERRUNNING CLUTCH
15 - DIRECT CLUTCH SPRING
16 - OVERDRIVE PISTON RETAINER
17 - OIL PAN
18 - VALVE BODY

IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan gasket surface (Fig. 2). Refer to this information when ordering replacement parts.

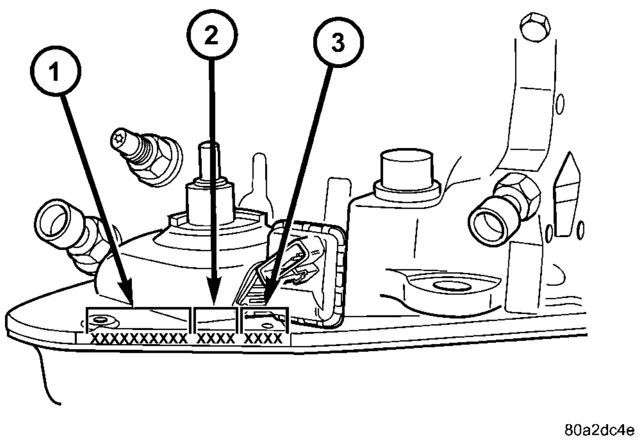


Fig. 2 Transmission Part And Serial Number Location

1 - PART NUMBER
2 - BUILD DATE
3 - SERIAL NUMBER

GEAR RATIOS

The 48RE gear ratios are:

1st	2.45:1
2nd	1.45:1
3rd	1.00:1
4th	0.69:1
Rev.	2.20:1

OPERATION

The application of each driving or holding component is controlled by the valve body based upon the manual lever position, throttle pressure, and governor pressure. The governor pressure is a variable pressure input to the valve body and is one of the signals that a shift is necessary. First through fourth gear are obtained by selectively applying and releasing the different clutches and bands. Engine power is thereby routed to the various planetary gear assemblies which combine with the overrunning clutch assemblies to generate the different gear ratios. The torque converter clutch is hydraulically applied and is released when fluid is vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch engages in fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, when the vehicle is cruising on a level surface after the vehicle has warmed up. The torque converter clutch can also be engaged in the manual second gear position if high transmission temperatures are sensed by the PCM. The torque converter clutch will disengage momentarily when an increase in engine load is sensed by the PCM, such as when the vehicle begins to go uphill or the throttle pressure is increased. The torque converter clutch feature increases fuel economy and reduces the transmission fluid temperature.

Since the overdrive clutch is applied in fourth gear only and the direct clutch is applied in all ranges except fourth gear, the transmission operation for park, neutral, and first through third gear will be described first. Once these powerflows are described, the third to fourth shift sequence will be described.

AUTOMATIC TRANSMISSION - 48RE (Continued)

PARK POWERFLOW

As the engine is running and the crankshaft is rotating, the flexplate and torque converter, which are also bolted to it, are all rotating in a clockwise direction as viewed from the front of the engine. The notched hub of the torque converter is connected to the oil pump's internal gear, supplying the transmission with oil pressure. As the converter turns, it turns the input shaft in a clockwise direction. As the input shaft is rotating, the front clutch hub-rear clutch retainer and all their associated parts are also rotating, all being directly connected to the input shaft. The power flow from the engine through the front clutch hub and rear clutch retainer stops at the rear clutch retainer. Therefore, no power flow to the output shaft occurs because no clutches are applied. The only mechanism in use at this time is the parking sprag (Fig. 3), which locks the parking gear on the output shaft to the transmission case.

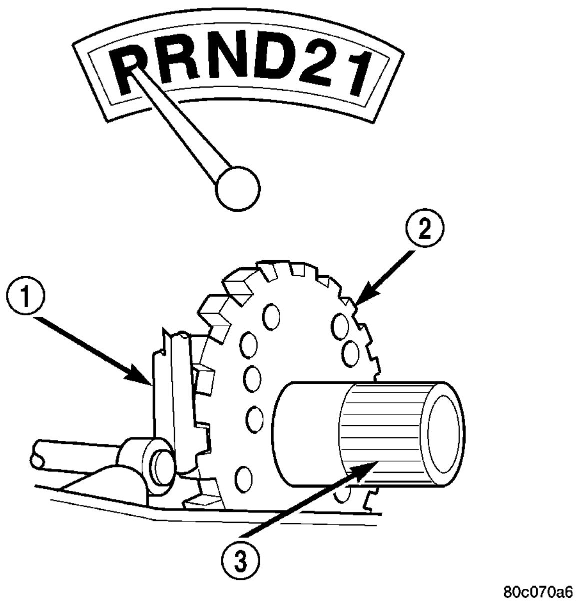


Fig. 3 Park Powerflow

1 - PAWL ENGAGED FOR PARK
2 - PARK SPRAG
3 - OUTPUT SHAFT

NEUTRAL POWERFLOW

With the gear selector in the NEUTRAL position (Fig. 4), the power flow of the transmission is essentially the same as in the park position. The only operational difference is that the parking sprag has been disengaged, unlocking the output shaft from the transmission case and allowing it to move freely.

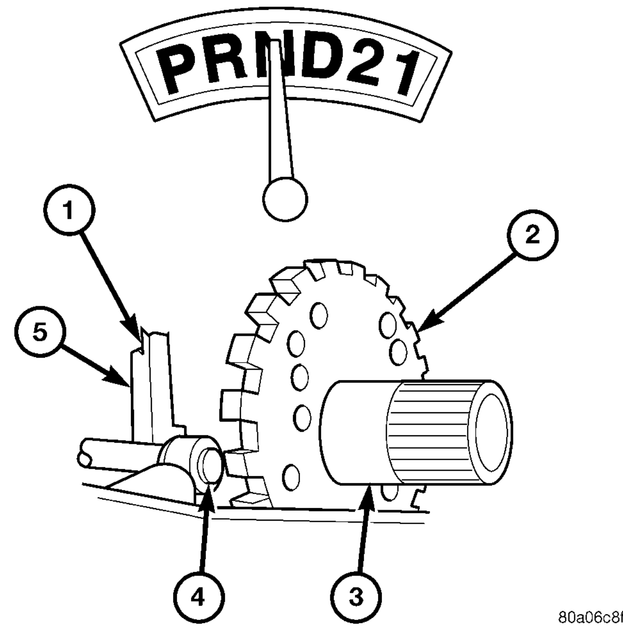


Fig. 4 Neutral Powerflow

1 - PAWL DISENGAGED FOR NEUTRAL
2 - PARK SPRAG
3 - OUTPUT SHAFT
4 - CAM
5 - PAWL

REVERSE POWERFLOW

When the gear selector is moved into the REVERSE position (Fig. 5), the front clutch and the rear band are applied. With the application of the front clutch, engine torque is applied to the sun gear, turning it in a clockwise direction. The clockwise rotation of the sun gear causes the rear planet pinions to rotate against engine rotation in a counterclockwise direction. The rear band is holding the low reverse drum, which is splined to the rear carrier. Since the rear carrier is being held, the torque from the planet pinions is transferred to the rear annulus gear, which is splined to the output shaft. The output shaft in turn rotates with the annulus gear in a counterclockwise direction giving a reverse gear output. The entire transmission of torque is applied to the rear planetary gearset only. Although there is torque input to the front gearset through the sun gear, no other member of the gearset is being held. During the entire reverse stage of operation, the front planetary gears are in an idling condition.

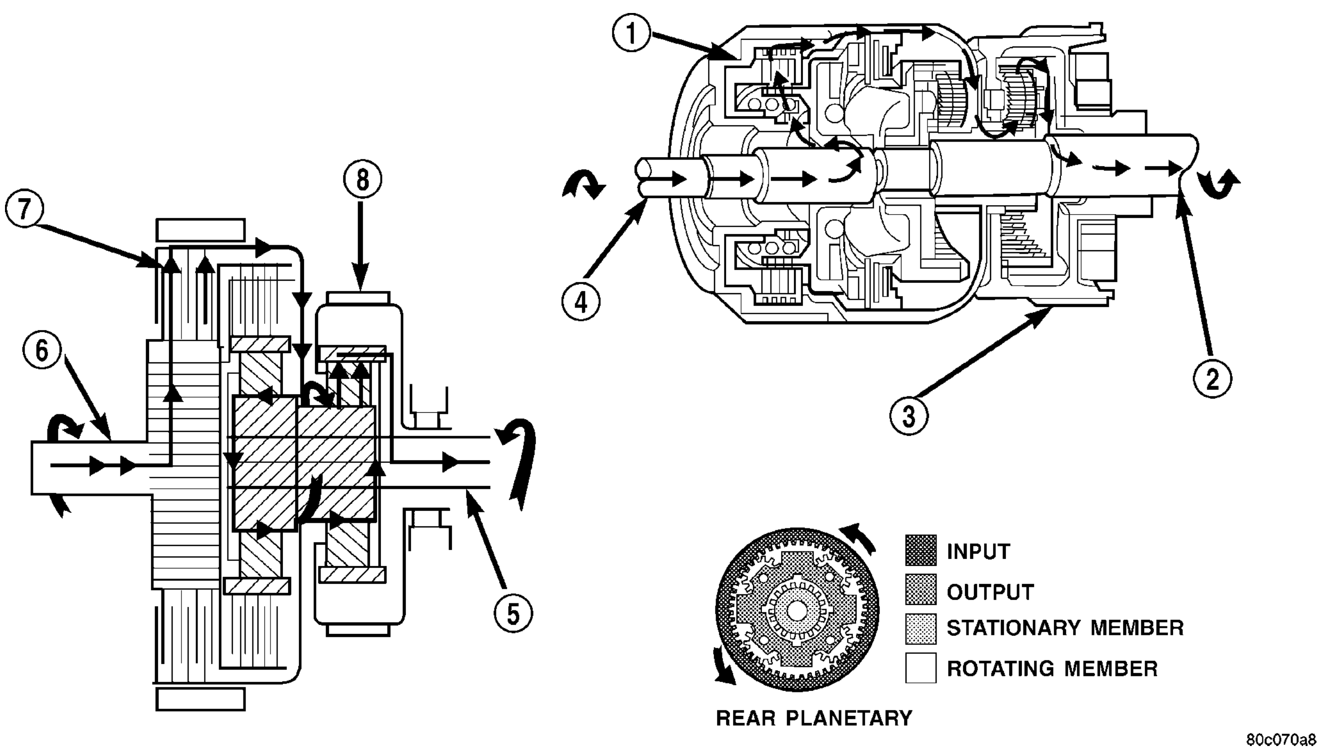


Fig. 5 Reverse Powerflow

1 - FRONT CLUTCH ENGAGED
2 - OUTPUT SHAFT
3 - LOW/REVERSE BAND APPLIED
4 - INPUT SHAFT
5 - OUTPUT SHAFT
6 - INPUT SHAFT
7 - FRONT CLUTCH ENGAGED
8 - LOW/REVERSE BAND APPLIED

AUTOMATIC TRANSMISSION - 48RE (Continued)

FIRST GEAR POWERFLOW

When the gearshift lever is moved into the DRIVE position the transmission goes into first gear (Fig. 6). As soon as the transmission is shifted from PARK or NEUTRAL to DRIVE, the rear clutch applies, applying the rear clutch pack to the front annulus gear. Engine torque is now applied to the front annulus gear turning it in a clockwise direction. With the front annulus gear turning in a clockwise direction, it causes the front planets to turn in a clockwise direction. The rotation of the front planets cause the sun to revolve in a counterclockwise direction. The sun gear now transfers its counterclockwise rotation to the rear planets which rotate back in a clockwise direction. With the rear annulus gear stationary, the rear planet rotation on the annulus gear causes the rear planet carrier to revolve in a counterclockwise direction. The rear planet carrier is splined into the low-reverse drum, and the low reverse drum is splined to the inner race of the over-running clutch. With the over-running clutch locked, the planet carrier is held, and the resulting torque provided by the planet pinions is transferred to the rear annulus gear. The rear annulus gear is splined to the output shaft and rotated along with it (clockwise) in an underdrive gear reduction mode.

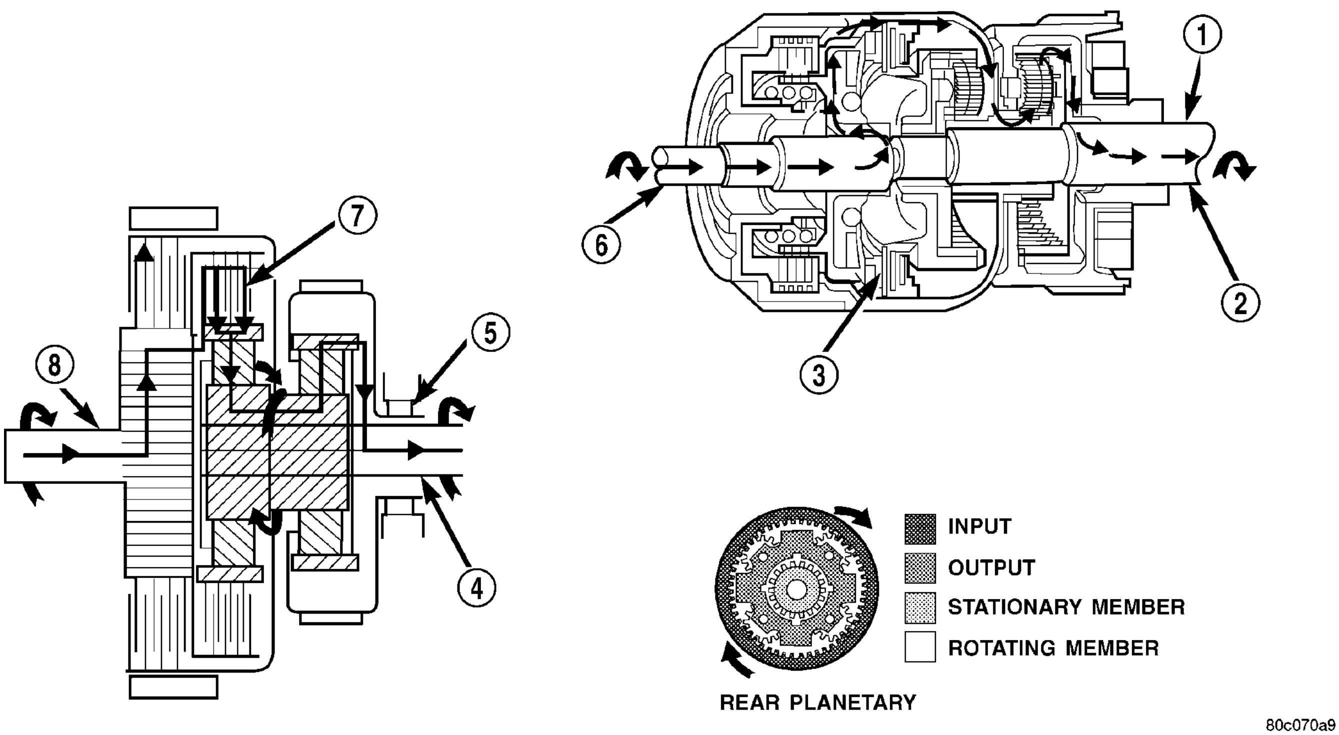


Fig. 6 First Gear Powerflow

1 - OUTPUT SHAFT
2 - OVER-RUNNING CLUTCH HOLDING
3 - REAR CLUTCH APPLIED
4 - OUTPUT SHAFT
5 - OVER-RUNNING CLUTCH HOLDING
6 - INPUT SHAFT
7 - REAR CLUTCH APPLIED
8 - INPUT SHAFT

SECOND GEAR POWERFLOW

In DRIVE-SECOND (Fig. 7), the same elements are applied as in MANUAL-SECOND. Therefore, the power flow will be the same, and both gears will be discussed as one in the same. In DRIVE-SECOND, the transmission has proceeded from first gear to its shift point, and is shifting from first gear to second. The second gear shift is obtained by keeping the rear clutch applied and applying the front (kickdown) band. The front band holds the front clutch retainer that is locked to the sun gear driving shell. With the rear clutch still applied, the input is still on the front annulus gear turning it clockwise at engine speed. Now that the front band is holding the sun gear stationary, the annulus rotation causes the front planets to rotate in a clockwise direction. The front carrier is then also made to rotate in a clockwise direction but at a reduced speed. This will transmit the torque to the output shaft, which is directly connected to the front planet carrier. The rear planetary annulus gear will also be turning because it is directly splined to the output shaft. All power flow has occurred in the front planetary gear set during the drive-second stage of operation, and now the over-running clutch, in the rear of the transmission, is disengaged and freewheeling on its hub.

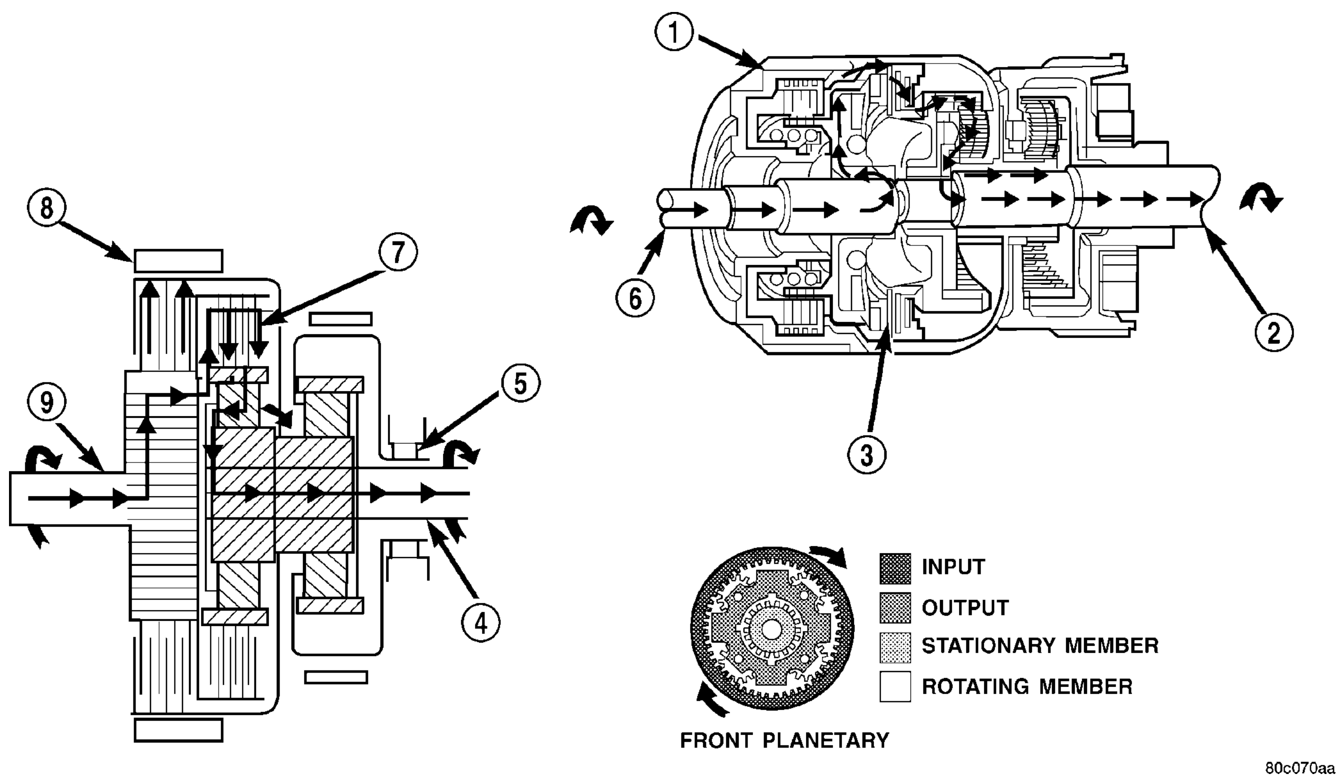


Fig. 7 Second Gear Powerflow

1 - KICKDOWN BAND APPLIED
2 - OUTPUT SHAFT
3 - REAR CLUTCH ENGAGED
4 - OUTPUT SHAFT
5 - OVER-RUNNING CLUTCH FREE-WHEELING
6 - INPUT SHAFT
7 - REAR CLUTCH APPLIED
8 - KICKDOWN BAND APPLIED
9 - INPUT SHAFT

AUTOMATIC TRANSMISSION - 48RE (Continued)

DIRECT DRIVE POWERFLOW

The vehicle has accelerated and reached the shift point for the 2-3 upshift into direct drive (Fig. 8). When the shift takes place, the front band is released, and the front clutch is applied. The rear clutch stays applied as it has been in all the forward gears. With the front clutch now applied, engine torque is now on the front clutch retainer, which is locked to the sun gear driving shell. This means that the sun gear is now turning in engine rotation (clockwise) and at engine speed. The rear clutch is still applied so engine torque is also still on the front annulus gear. If two members of the same planetary set are driven, direct drive results. Therefore, when two members are rotating at the same speed and in the same direction, it is the same as being locked up. The rear planetary set is also locked up, given the sun gear is still the input, and the rear annulus gear must turn with the output shaft. Both gears are turning in the same direction and at the same speed. The front and rear planet pinions do not turn at all in direct drive. The only rotation is the input from the engine to the connected parts, which are acting as one common unit, to the output shaft.

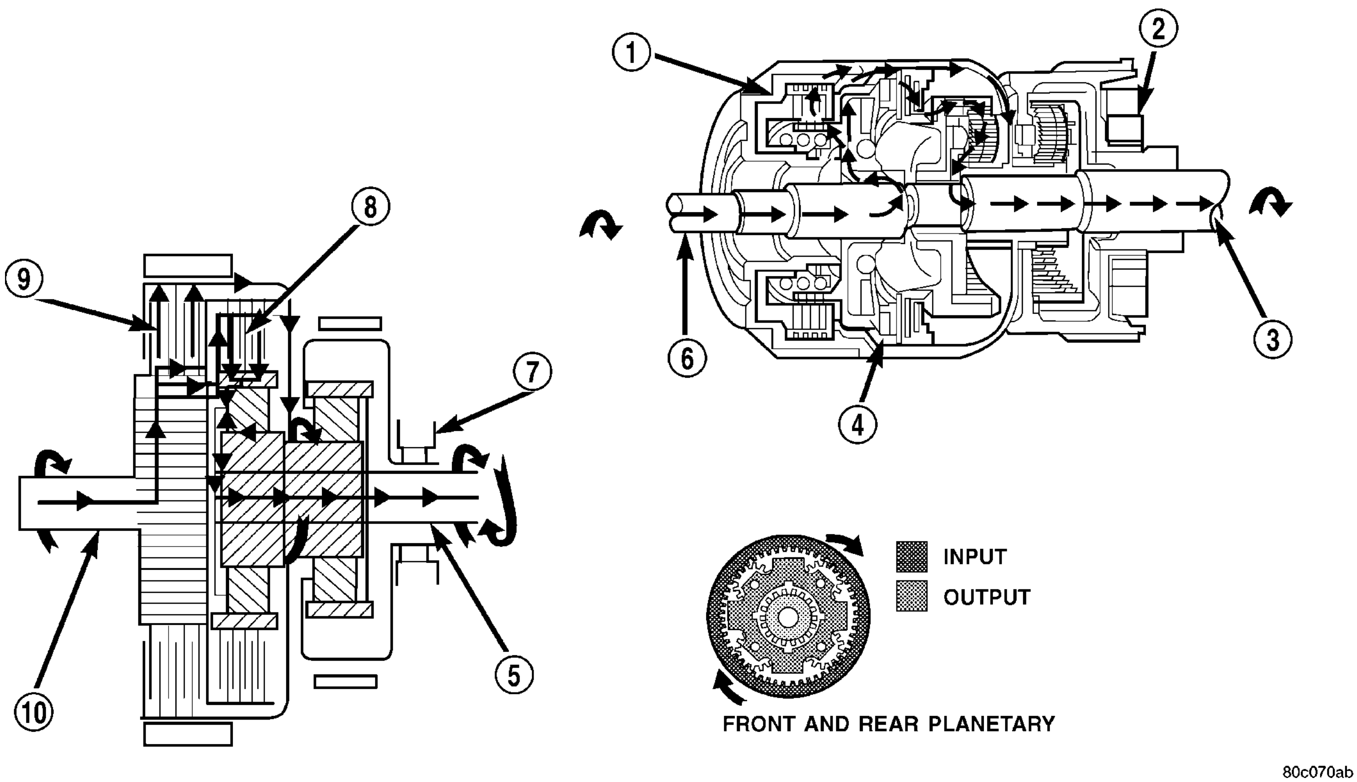


Fig. 8 Direct Drive Powerflow

1 - FRONT CLUTCH APPLIED
2 - OVER-RUNNING CLUTCH FREE-WHEELING
3 - OUTPUT SHAFT
4 - REAR CLUTCH APPLIED
5 - OUTPUT SHAFT
6 - INPUT SHAFT
7 - OVER-RUNNING CLUTCH FREE-WHEELING
8 - REAR CLUTCH APPLIED
9 - FRONT CLUTCH APPLIED
10 - INPUT SHAFT

FOURTH GEAR POWERFLOW

Fourth gear overdrive range is electronically controlled and hydraulically activated. Various sensor inputs are supplied to the powertrain control module to operate the overdrive solenoid on the valve body. The solenoid contains a check ball that opens and closes a vent port in the 3-4 shift valve feed passage. The overdrive solenoid (and check ball) are not energized in first, second, third, or reverse gear. The vent port remains open, diverting line pressure from the 2-3 shift valve away from the 3-4 shift valve. The overdrive control switch must be in the ON position to transmit overdrive status to the PCM. A 3-4 upshift occurs only when the overdrive solenoid is energized by the PCM. The PCM energizes the overdrive solenoid during the 3-4 upshift. This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position. This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston. Line pressure through the timing valve moves the overdrive piston into contact with the overdrive clutch. The direct clutch is disengaged before the overdrive clutch is engaged. The boost valve provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts, and when accelerating in fourth gear. The 3-4 accumulator cushions overdrive clutch engagement to smooth 3-4 upshifts. The accumulator is charged at the same time as apply pressure acts against the overdrive piston.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

Automatic transmission problems can be a result of poor engine performance, incorrect fluid level, incorrect linkage or cable adjustment, band or hydraulic control pressure adjustments, hydraulic system malfunctions or electrical/mechanical component malfunctions. Begin diagnosis by checking the easily accessible items such as: fluid level and condition, linkage adjustments and electrical connections. A road test will determine if further diagnosis is necessary.

DIAGNOSIS AND TESTING - PRELIMINARY

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVEABLE

(1) Check for transmission fault codes using DRB® scan tool.

(2) Check fluid level and condition.

(3) Adjust throttle and gearshift linkage if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform hydraulic pressure test if shift problems were noted during road test.

(6) Perform air-pressure test to check clutch-band operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift or throttle linkage.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

- (a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.
- (b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged drive plate, converter, oil pump, or input shaft.
- (c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING - ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul will be necessary to restore normal operation.

A slipping clutch or band can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch and Band Application chart provides a basis for analyzing road test results.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CLUTCH AND BAND APPLICATION CHART

SHIFT LEVER POSITION	TRANSMISSION CLUTCHES AND BANDS					OVERDRIVE CLUTCHES		
	FRONT CLUTCH	FRONT BAND	REAR CLUTCH	REAR BAND	OVER-RUNNING CLUTCH	OVER-DRIVE CLUTCH	DIRECT CLUTCH	OVER-RUNNING CLUTCH
Reverse	X			X			X	
Drive - First			X		X		X	X
Drive - Second		X	X				X	X
Drive - Third	X		X				X	X
Drive - Fourth	X		X			X		
Manual Second		X	X				X	X
Manual First			X	X	X		X	X

Note that the rear clutch is applied in all forward ranges (D, 2, 1). The transmission overrunning clutch is applied in first gear (D, 2 and 1 ranges) only. The rear band is applied in 1 and R range only.

Note that the overdrive clutch is applied only in fourth gear and the overdrive direct clutch and overrunning clutch are applied in all ranges except fourth gear.

For example: If slippage occurs in first gear in D and 2 range but not in 1 range, the transmission overrunning clutch is faulty. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that the front and rear clutches are applied simultaneously only in D range third and fourth gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping.

If the transmission slips in fourth gear but not in third gear, the overdrive clutch is slipping. By selecting another gear which does not use these clutches, the slipping unit can be determined. For example, if the transmission also slips in Reverse, the front clutch is slipping. If the transmission does not slip in Reverse, the rear clutch is slipping.

If slippage occurs during the 3-4 shift or only in fourth gear, the overdrive clutch is slipping. Similarly, if the direct clutch were to fail, the transmission would lose both reverse gear and overrun braking in 2 position (manual second gear).

If the transmission will not shift to fourth gear, the control switch, overdrive solenoid or related wiring may also be the problem cause.

This process of elimination can be used to identify a slipping unit and check operation. Proper use of the Clutch and Band Application Chart is the key.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be determined until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless a malfunction is obvious, such as no drive in D range first gear, do not disassemble the transmission. Perform the hydraulic and air pressure tests to help determine the probable cause.

DIAGNOSIS AND TESTING - HYDRAULIC PRESSURE TEST

Hydraulic test pressures range from a low of one psi (6.895 kPa) governor pressure, to 300 psi (2068 kPa) at the rear servo pressure port in reverse.

An accurate tachometer and pressure test gauges are required. Test Gauge C-3292 has a 100 psi range and is used at the accumulator, governor, and front servo ports. Test Gauge C-3293-SP has a 300 psi range and is used at the rear servo and overdrive ports where pressures exceed 100 psi.

Pressure Test Port Locations

Test ports are located at both sides of the transmission case (Fig. 9).

Line pressure is checked at the accumulator port on the right side of the case. The front servo pressure port is at the right side of the case just behind the filler tube opening.

AUTOMATIC TRANSMISSION - 48RE (Continued)

The rear servo and governor pressure ports are at the right rear of the transmission case. The overdrive clutch pressure port is at the left rear of the case.

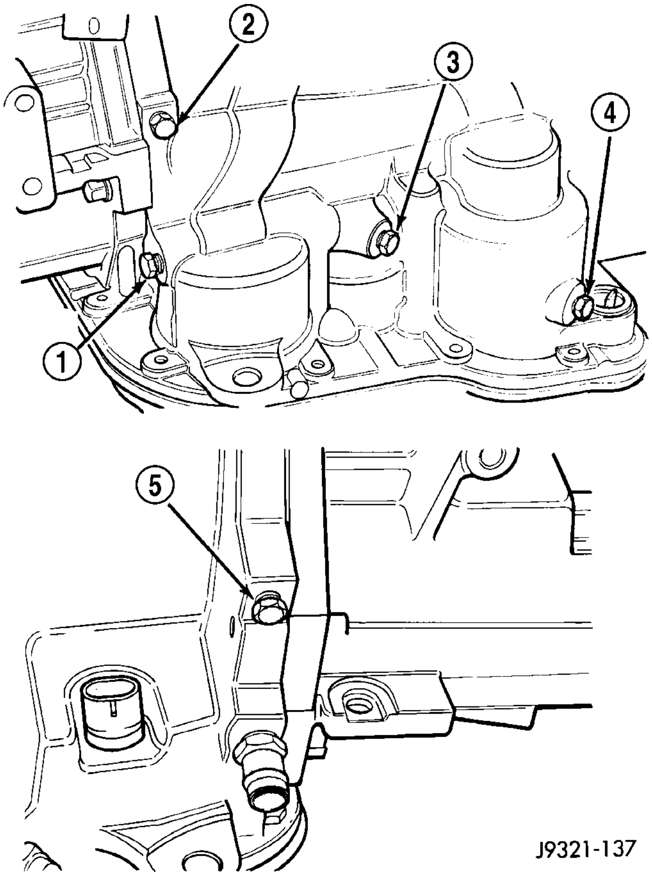


Fig. 9 Pressure Test Port Locations

1 - REAR SERVO TEST PORT
2 - GOVERNOR TEST PORT
3 - ACCUMULATOR TEST PORT
4 - FRONT SERVO TEST PORT
5 - OVERDRIVE CLUTCH TEST PORT

Test One - Transmission In Manual Low

This test checks pump output, pressure regulation, and condition of the rear clutch and servo circuit. Both test gauges are required for this test.

(1) Connect tachometer to engine. Position tachometer so it can be observed from driver seat if helper will be operating engine. Raise vehicle on hoist that will allow rear wheels to rotate freely.

(2) Connect 100 psi Gauge C-3292 to accumulator port. Then connect 300 psi Gauge C-3293-SP to rear servo port.

(3) Disconnect throttle and gearshift cables from levers on transmission valve body manual shaft.

(4) Have helper start and run engine at 1000 rpm.

(5) Move transmission shift lever fully forward into 1 range.

(6) Gradually move transmission throttle lever from full forward to full rearward position and note pressures on both gauges:

- Line pressure at accumulator port should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as throttle lever is moved rearward.
- Rear servo pressure should be same as line pressure within 3 psi (20.68 kPa).

Test Two - Transmission In 2 Range

This test checks pump output, line pressure and pressure regulation. Use 100 psi Test Gauge C-3292 for this test.

(1) Leave vehicle in place on hoist and leave Test Gauge C-3292 connected to accumulator port.

(2) Have helper start and run engine at 1000 rpm.

(3) Move transmission shift lever one detent rearward from full forward position. This is 2 range.

(4) Move transmission throttle lever from full forward to full rearward position and read pressure on gauge.

(5) Line pressure should be 54-60 psi (372-414 kPa) with throttle lever forward and gradually increase to 90-96 psi (621-662 kPa) as lever is moved rearward.

Test Three - Transmission In D Range Third Gear

This test checks pressure regulation and condition of the clutch circuits. Both test gauges are required for this test.

(1) Turn OD switch off.

(2) Leave vehicle on hoist and leave Gauge C-3292 in place at accumulator port.

(3) Move Gauge C-3293-SP over to front servo port for this test.

(4) Have helper start and run engine at 1600 rpm for this test.

(5) Move transmission shift lever two detents rearward from full forward position. This is D range.

(6) Read pressures on both gauges as transmission throttle lever is gradually moved from full forward to full rearward position:

- Line pressure at accumulator in D range third gear, should be 54-60 psi (372-414 kPa) with throttle lever forward and increase as lever is moved rearward.
- Front servo pressure in D range third gear, should be within 3 psi (21 kPa) of line pressure up to kickdown point.

Test Four - Transmission In Reverse

This test checks pump output, pressure regulation and the front clutch and rear servo circuits. Use 300 psi Test Gauge C-3293-SP for this test.

(1) Leave vehicle on hoist and leave gauge C-3292 in place at accumulator port.

(2) Move 300 psi Gauge C-3293-SP back to rear servo port.

AUTOMATIC TRANSMISSION - 48RE (Continued)

(3) Have helper start and run engine at 1600 rpm for test.

(4) Move transmission shift lever four detents rearward from full forward position. This is Reverse range.

(5) Move transmission throttle lever fully forward then fully rearward and note reading at Gauge C-3293-SP.

(6) Pressure should be 145 - 175 psi (1000-1207 kPa) with throttle lever forward and increase to 230 - 280 psi (1586-1931 kPa) as lever is gradually moved rearward.

Test Five - Governor Pressure

This test checks governor operation by measuring governor pressure response to changes in vehicle speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift. The test should be performed on the road or on a hoist that will allow the rear wheels to rotate freely.

(1) Move 100 psi Test Gauge C-3292 to governor pressure port.

(2) Move transmission shift lever two detents rearward from full forward position. This is D range.

(3) Have helper start and run engine at curb idle speed. Then firmly apply service brakes so wheels will not rotate.

(4) Note governor pressure:

- Governor pressure should be no more than 20.6 kPa (3 psi) at curb idle speed and wheels not rotating.
- If pressure exceeds 20.6 kPa (3 psi), a fault exists in governor pressure control system.

(5) Release brakes, slowly increase engine speed, and observe speedometer and pressure test gauge (do not exceed 30 mph on speedometer). Governor pressure should increase in proportion to vehicle speed. Or approximately 6.89 kPa (1 psi) for every 1 mph.

(6) Governor pressure rise should be smooth and drop back to no more than 20.6 kPa (3 psi), after engine returns to curb idle and brakes are applied to prevent wheels from rotating.

(7) Compare results of pressure test with analysis chart.

Test Six - Transmission In Overdrive Fourth Gear

This test checks line pressure at the overdrive clutch in fourth gear range. Use 300 psi Test Gauge C-3293-SP for this test. The test should be performed on the road or on a chassis dyno.

(1) Remove tachometer; it is not needed for this test.

(2) Move 300 psi Gauge to overdrive clutch pressure test port. Then remove other gauge and reinstall test port plug.

(3) Lower vehicle.

(4) Turn OD switch on.

(5) Secure test gauge so it can be viewed from drivers seat.

(6) Start engine and shift into D range.

(7) Increase vehicle speed gradually until 3-4 shift occurs and note gauge pressure.

(8) Pressure should be 524-565 kPa (76-82 psi) with closed throttle and increase to 690-896 kPa (100-130 psi) at 1/2 to 3/4 throttle. Note that pressure can increase to around 965 kPa (140 psi) at full throttle.

(9) Return to shop or move vehicle off chassis dyno.

PRESSURE TEST ANALYSIS CHART

TEST CONDITION	INDICATION
Line pressure OK during any one test	Pump and regulator valve OK
Line pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (seal rings, clutch seals)
Pressure low in D Fourth Gear Range	Overdrive clutch piston seal, or check ball problem
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck regulator valve, worn or faulty pump, low oil level
Governor pressure too high at idle speed	Governor pressure solenoid valve system fault. Refer to diagnostic book.
Governor pressure low at all mph figures	Faulty governor pressure solenoid, transmission control module, or governor pressure sensor
Lubrication pressure low at all throttle positions	Clogged fluid cooler or lines, seal rings leaking, worn pump bushings, pump, clutch retainer, or clogged filter.
Line pressure high	Output shaft plugged, sticky regulator valve
Line pressure low	Sticky regulator valve, clogged filter, worn pump

DIAGNOSIS AND TESTING - AIR TESTING TRANSMISSION CLUTCH AND BAND OPERATION

Air-pressure testing can be used to check transmission front/rear clutch and band operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check, after overhaul.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The servo and clutch apply passages are shown (Fig. 10).

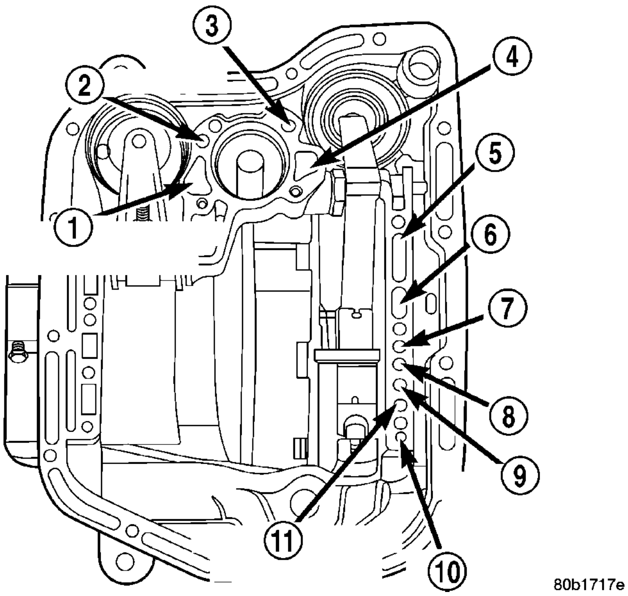


Fig. 10 Air Pressure Test Passages

1 - LINE PRESSURE TO ACCUMULATOR
2 - REAR SERVO APPLY
3 - FRONT SERVO APPLY
4 - FRONT SERVO RELEASE
5 - PUMP SUCTION
6 - PUMP PRESSURE
7 - FRONT CLUTCH APPLY
8 - REAR CLUTCH APPLY
9 - TO TORQUE CONVERTOR
10 - TO COOLER
11 - FROM TORQUE CONVERTER

Front Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through front clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Rear Clutch Air Test

Place one or two fingers on the clutch housing and apply air pressure through rear clutch apply passage. Piston movement can be felt and a soft thump heard as the clutch applies.

Front Servo Air Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

Rear Servo Air Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. Spring pressure should release the servo when air pressure is removed.

DIAGNOSIS AND TESTING - CONVERTER HOUSING FLUID LEAK

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Pump seal leaks tend to move along the drive hub and onto the rear of the converter. Pump body leaks follow the same path as a seal leak (Fig. 11). Pump vent or pump attaching bolt leaks are generally deposited on the inside of the converter housing and not on the converter itself (Fig. 11). Pump o-ring or gasket leaks usually travel down the inside of the converter housing. Front band lever pin plug leaks are generally deposited on the housing and not on the converter.

AUTOMATIC TRANSMISSION - 48RE (Continued)

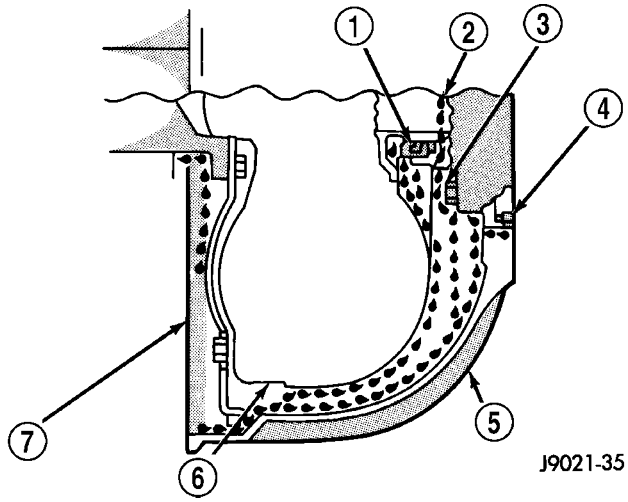


Fig. 11 Converter Housing Leak Paths

1 - PUMP SEAL
2 - PUMP VENT
3 - PUMP BOLT
4 - PUMP GASKET
5 - CONVERTER HOUSING
6 - CONVERTER
7 - REAR MAIN SEAL LEAK

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

- Leaks at the weld joint around the outside diameter weld.
- Leaks at the converter hub weld.

CONVERTER HOUSING AREA LEAK CORRECTION

(1) Remove converter.

(2) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front/rear clutches from coming out when oil pump is removed.

(3) Remove oil pump and remove pump seal. Inspect pump housing drainback and vent holes for obstructions. Clear holes with solvent and wire.

(4) Inspect pump bushing and converter hub. If bushing is scored, replace it. If converter hub is scored, either polish it with crocus cloth or replace converter.

(5) Install new pump seal, O-ring, and gasket. Replace oil pump if cracked, porous or damaged in any way. Be sure to loosen the front band before installing the oil pump, damage to the oil pump seal may occur if the band is still tightened to the front clutch retainer.

(6) Loosen kickdown lever pin access plug three turns. Apply Loctite™ 592, or Permatex® No. 2 to plug threads and tighten plug to 17 N·m (150 in. lbs.) torque.

(7) Adjust front band.

(8) Lubricate pump seal and converter hub with transmission fluid or petroleum jelly and install converter.

(9) Install transmission and converter housing dust shield.

(10) Lower vehicle.

DIAGNOSIS AND TESTING - DIAGNOSIS CHARTS

The diagnosis charts provide additional reference when diagnosing a transmission fault. The charts provide general information on a variety of transmission, overdrive unit and converter clutch fault conditions.

The hydraulic flow charts in the Schematics and Diagrams section of this group, outline fluid flow and hydraulic circuitry. Circuit operation is provided for PARK, NEUTRAL, FIRST, SECOND, THIRD, FOURTH, MANUAL FIRST, MANUAL SECOND, and REVERSE gear ranges. Normal working pressures are also supplied for each of the gear ranges.

AUTOMATIC TRANSMISSION - 48RE (Continued)

DIAGNOSIS CHARTS

CONDITION	POSSIBLE CAUSES	CORRECTION
HARSH ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Add Fluid
	2. Throttle Linkage Mis-adjusted.	2. Adjust linkage - setting may be too long.
	3. Mount and Driveline Bolts Loose.	3. Check engine mount, transmission mount, propeller shaft, rear spring to body bolts, rear control arms, crossmember and axle bolt torque. Tighten loose bolts and replace missing bolts.
	4. U-Joint Worn/Broken.	4. Remove propeller shaft and replace U-Joint.
	5. Axle Backlash Incorrect.	5. Check per Service Manual. Correct as needed.
	6. Hydraulic Pressure Incorrect.	6. Check pressure. Remove, overhaul or adjust valve body as needed.
	7. Band Mis-adjusted.	7. Adjust rear band.
	8. Valve Body Check Balls Missing.	8. Inspect valve body for proper check ball installation.
	9. Axle Pinion Flange Loose.	9. Replace nut and check pinion threads before installing new nut. Replace pinion gear if threads are damaged.
	10. Clutch, band or planetary component damaged.	10. Remove, disassemble and repair transmission as necessary.
	11. Converter Clutch Faulty.	11. Replace converter.
DELAYED ENGAGEMENT (FROM NEUTRAL TO DRIVE OR REVERSE)	1. Fluid Level Low.	1. Correct level and check for leaks.
	2. Filter Clogged.	2. Change filter.
	3. Gearshift Linkage Mis-adjusted.	3. Adjust linkage and repair linkage if worn or damaged.
	4. Torque Converter Drain Back (Oil drains from torque converter into transmission sump).	4. If vehicle moves normally after 5 seconds after shifting into gear, no repair is necessary. If longer, inspect pump bushing for wear. Replace pump house.
	5. Rear Band Mis-adjusted.	5. Adjust band.
	6. Valve Body Filter Plugged.	6. Replace fluid and filter. If oil pan and old fluid were full of clutch disc material and/or metal particles, overhaul will be necessary.
	7. Oil Pump Gears Worn/Damaged.	7. Remove transmission and replace oil pump.
	8. Governor Circuit and Solenoid Valve Electrical Fault.	8. Test with DRB® scan tool and repair as required.
	9. Hydraulic Pressure Incorrect.	9. Perform pressure test, remove transmission and repair as needed.
	10. Reaction Shaft Seal Rings Worn/Broken.	10. Remove transmission, remove oil pump and replace seal rings.
	11. Rear Clutch/Input Shaft, Rear Clutch Seal Rings Damaged.	11. Remove and disassemble transmission and repair as necessary.
	12. Regulator Valve Stuck.	12. Clean.
	13. Cooler Plugged.	13. Replace cooler.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO DRIVE RANGE (REVERSE OK)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Repair or replace linkage components.
	3. Rear Clutch Burnt.	3. Remove and disassemble transmission and rear clutch and seals. Repair/replace worn or damaged parts as needed.
	4. Valve Body Malfunction.	4. Remove and disassemble valve body. Replace assembly if any valves or bores are damaged.
	5. Transmission Overrunning Clutch Broken.	5. Remove and disassemble transmission. Replace overrunning clutch.
	6. Input Shaft Seal Rings Worn/ Damaged.	6. Remove and disassemble transmission. Replace seal rings and any other worn or damaged parts.
	7. Front Planetary Failed Broken.	7. Remove and repair.
NO DRIVE OR REVERSE (VEHICLE WILL NOT MOVE)	1. Fluid Level Low.	1. Add fluid and check for leaks if drive is restored.
	2. Gearshift Linkage/Cable Loose/Misadjusted.	2. Inspect, adjust and reassemble linkage as needed. Replace worn/damaged parts.
	3. U-Joint/Axle/Transfer Case Broken.	3. Perform preliminary inspection procedure for vehicle that will not move. Refer to procedure in diagnosis section.
	4. Filter Plugged.	4. Remove and disassemble transmission. Repair or replace failed components as needed. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary. Replace cooler as necessary.
	5. Oil Pump Damaged.	5. Perform pressure test to confirm low pressure. Replace pump body assembly if necessary.
	6. Valve Body Malfunctioned.	6. Check and inspect valve body. Replace valve body (as assembly) if any valve or bore is damaged. Clean and reassemble correctly if all parts are in good condition.
	7. Transmission Internal Component Damaged.	7. Remove and disassemble transmission. Repair or replace failed components as needed.
	8. Park Sprag not Releasing - Check Stall Speed, Worn/Damaged/Stuck.	8. Remove, disassemble, repair.
	9. Torque Converter Damage.	9. Inspect and replace as required.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SHIFTS DELAYED OR ERRATIC (SHIFTS ALSO HARSH AT TIMES)	1. Fluid Level Low/High.	1. Correct fluid level and check for leaks if low.
	2. Fluid Filter Clogged.	2. Replace filter. If filter and fluid contained clutch material or metal particles, an overhaul may be necessary.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage as described in service section.
	4. Throttle Linkage Binding.	4. Check cable for binding. Check for return to closed throttle at transmission.
	5. Gearshift Linkage/Cable Mis-adjusted.	5. Adjust linkage/cable as described in service section.
	6. Clutch or Servo Failure.	6. Remove valve body and air test clutch, and band servo operation. Disassemble and repair transmission as needed.
	7. Governor Circuit Electrical Fault.	7. Test using DRB® scan tool and repair as required.
	8. Front Band Mis-adjusted.	8. Adjust band.
	9. Pump Suction Passage Leak.	9. Check for excessive foam on dipstick after normal driving. Check for loose pump bolts, defective gasket. Replace pump assembly if needed.
NO REVERSE (D RANGES OK)	1. Gearshift Linkage/Cable Mis-adjusted/Damaged.	1. Repair or replace linkage parts as needed.
	2. Park Sprag Sticking.	2. Replace overdrive annulus gear.
	3. Rear Band Mis-adjusted/Worn.	3. Adjust band; replace.
	4. Valve Body Malfunction.	4. Remove and service valve body. Replace valve body if any valves or valve bores are worn or damaged.
	5. Rear Servo Malfunction.	5. Remove and disassemble transmission. Replace worn/damaged servo parts as necessary.
	6. Direct Clutch in Overdrive Worn.	6. Disassemble overdrive. Replace worn or damaged parts.
	7. Front Clutch Burnt.	7. Remove and disassemble transmission. Replace worn, damaged clutch parts as required.
HAS FIRST/REVERSE ONLY (NO 1-2 OR 2-3 UPSHIFT)	1. Governor Circuit Electrical Fault.	1. Test using DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Repair stuck 1-2 shift valve or governor plug.
	3. Front Servo/Kickdown Band Damaged/Burned.	3. Repair/replace.
MOVES IN 2ND OR 3RD GEAR, ABRUPTLY DOWNSHIFTS TO LOW	1. Valve Body Malfunction.	1. Remove, clean and inspect. Look for stuck 1-2 valve or governor plug.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO LOW GEAR (MOVES IN 2ND OR 3RD GEAR ONLY)	1. Governor Circuit Electrical Fault.	1. Test with DRB® scan tool and repair as required.
	2. Valve Body Malfunction.	2. Remove, clean and inspect. Look for sticking 1-2 shift valve, 2-3 shift valve, governor plug or broken springs.
	3. Front Servo Piston Cocked in Bore.	3. Inspect servo and repair as required.
	4. Front Band Linkage Malfunction	4. Inspect linkage and look for bind in linkage.
NO KICKDOWN OR NORMAL DOWNSHIFT	1. Throttle Linkage Mis-adjusted.	1. Adjust linkage.
	2. Accelerator Pedal Travel Restricted.	2. Verify floor mat is not under pedal, repair worn accelerator cable or bent brackets.
	3. Valve Body Hydraulic Pressures Too High or Too Low Due to Valve Body Malfunction or Incorrect Hydraulic Control Pressure Adjustments.	3. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	4. Governor Circuit Electrical Fault.	4. Test with DRB® scan tool and repair as required.
	5. Valve Body Malfunction.	5. Perform hydraulic pressure tests to determine cause and repair as required. Correct valve body pressure adjustments as required.
	6. TPS Malfunction.	6. Replace sensor, check with DRB® scan tool.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if required.
	8. Valve Body Malfunction.	8. Repair sticking 1-2, 2-3 shift valves, governor plugs, 3-4 solenoid, 3-4 shift valve, 3-4 timing valve.
STUCK IN LOW GEAR (WILL NOT UPSHIFT)	1. Throttle Linkage Mis-adjusted/ Stuck.	1. Adjust linkage and repair linkage if worn or damaged. Check for binding cable or missing return spring.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage and repair linkage if worn or damaged.
	3. Governor Component Electrical Fault.	3. Check operating pressures and test with DRB® scan tool, repair faulty component.
	4. Front Band Out of Adjustment.	4. Adjust Band.
	5. Clutch or Servo Malfunction.	5. Air pressure check operation of clutches and bands. Repair faulty component.
CREEPS IN NEUTRAL	1. Gearshift Linkage Mis-adjusted.	1. Adjust linkage.
	2. Rear Clutch Dragging/Warped.	2. Disassemble and repair.
	3. Valve Body Malfunction.	3. Perform hydraulic pressure test to determine cause and repair as required.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
BUZZING NOISE	1. Fluid Level Low	1. Add fluid and check for leaks.
	2. Shift Cable Mis-assembled.	2. Route cable away from engine and bell housing.
	3. Valve Body Mis-assembled.	3. Remove, disassemble, inspect valve body. Reassemble correctly if necessary. Replace assembly if valves or springs are damaged. Check for loose bolts or screws.
	4. Pump Passages Leaking.	4. Check pump for porous casting, scores on mating surfaces and excess rotor clearance. Repair as required. Loose pump bolts.
	5. Cooling System Cooler Plugged.	5. Replace cooler.
	6. Overrunning Clutch Damaged.	6. Replace clutch.
SLIPS IN REVERSE ONLY	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Gearshift Linkage Mis-adjusted.	2. Adjust linkage.
	3. Rear Band Mis-adjusted.	3. Adjust band.
	4. Rear Band Worn.	4. Replace as required.
	5. Overdrive Direct Clutch Worn.	5. Disassemble overdrive. Repair as needed.
	6. Hydraulic Pressure Too Low.	6. Perform hydraulic pressure tests to determine cause.
	7. Rear Servo Leaking.	7. Air pressure check clutch-servo operation and repair as required.
	8. Band Linkage Binding.	8. Inspect and repair as required.
SLIPS IN FORWARD DRIVE RANGES	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Fluid Foaming.	2. Check for high oil level, bad pump gasket or seals, dirt between pump halves and loose pump bolts. Replace pump if necessary.
	3. Throttle Linkage Mis-adjusted.	3. Adjust linkage.
	4. Gearshift Linkage Mis-adjusted.	4. Adjust linkage.
	5. Rear Clutch Worn.	5. Inspect and replace as needed.
	6. Low Hydraulic Pressure Due to Worn Pump, Incorrect Control Pressure Adjustments, Valve Body Warpage or Malfunction, Sticking, Leaking Seal Rings, Clutch Seals Leaking, Servo Leaks, Clogged Filter or Cooler Lines.	6. Perform hydraulic and air pressure tests to determine cause.
	7. Rear Clutch Malfunction, Leaking Seals or Worn Plates.	7. Air pressure check clutch-servo operation and repair as required.
	8. Overrunning Clutch Worn, Not Holding (Slips in 1 Only).	8. Replace Clutch.
SLIPS IN LOW GEAR "D" ONLY, BUT NOT IN MANUAL 1 POSITION	Overrunning Clutch Faulty.	Replace overrunning clutch.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
GROWLING, GRATING OR SCRAPING NOISES	1. Drive Plate Broken.	1. Replace.
	2. Torque Converter Bolts Hitting Dust Shield.	2. Dust shield bent. Replace or repair.
	3. Planetary Gear Set Broken/ Seized.	3. Check for debris in oil pan and repair as required.
	4. Overrunning Clutch Worn/Broken.	4. Inspect and check for debris in oil pan. Repair as required.
	5. Oil Pump Components Scored/ Binding.	5. Remove, inspect and repair as required.
	6. Output Shaft Bearing or Bushing Damaged.	6. Remove, inspect and repair as required.
	7. Clutch Operation Faulty.	7. Perform air pressure check and repair as required.
	8. Front and Rear Bands Mis-adjusted.	8. Adjust bands.
DRAGS OR LOCKS UP	1. Fluid Level Low.	1. Check and adjust level.
	2. Clutch Dragging/Failed	2. Air pressure check clutch operation and repair as required.
	3. Front or Rear Band Mis-adjusted.	3. Adjust bands.
	4. Case Leaks Internally.	4. Check for leakage between passages in case.
	5. Servo Band or Linkage Malfunction.	5. Air pressure check servo operation and repair as required.
	6. Overrunning Clutch Worn.	6. Remove and inspect clutch. Repair as required.
	7. Planetary Gears Broken.	7. Remove, inspect and repair as required (look for debris in oil pan).
	8. Converter Clutch Dragging.	8. Check for plugged cooler. Inspect pump for excessive side clearance. Replace pump as required.
NO 4-3 DOWNSHIFT	1. Circuit Wiring and/or Connectors Shorted.	1. Test wiring and connectors with test lamp and volt/ohmmeter. Repair wiring as necessary. Replace connectors and/or harnesses as required.
	2. PCM Malfunction.	2. Check PCM operation with DRB® scan tool. Replace PCM only if faulty.
	3. TPS Malfunction	3. Check TPS with DRB® scan tool at PCM.
	4. Lockup Solenoid Not Venting.	4. Remove valve body and replace solenoid assembly if plugged or shorted.
	5. Overdrive Solenoid Not Venting.	5. Remove valve body and replace solenoid if plugged or shorted.
	6. Valve Body Valve Sticking.	6. Repair stuck 3-4 shift valve or lockup timing valve.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 4-3 DOWNSHIFT WHEN CONTROL SWITCH IS TURNED OFF	1. Control Switch Open/Shorted.	1. Test and replace switch if faulty.
	2. Overdrive Solenoid Connector Shorted.	2. Test solenoids and replace if seized or shorted.
	3. PCM Malfunction.	3. Test with DRB® scan tool. Replace PCM if faulty.
	4. Valve Body Stuck Valves.	4. Repair stuck 3-4, lockup or lockup timing valve.
CLUNK NOISE FROM DRIVELINE ON CLOSED THROTTLE 4-3 DOWNSHIFT	1. Transmission Fluid Low.	1. Add Fluid.
	2. Throttle Cable Mis-adjusted.	2. Adjust cable.
	3. Overdrive Clutch Select Spacer Wrong Spacer.	3. Replace overdrive piston thrust plate spacer.
3-4 UPSHIFT OCCURS IMMEDIATELY AFTER 2-3 SHIFT	1. Overdrive Solenoid Connector or Wiring Shorted.	1. Test connector and wiring for loose connections, shorts or ground and repair as needed.
	2. TPS Malfunction.	2. Test TPS and replace as necessary. Check with DRB® scan tool.
	3. PCM Malfunction.	3. Test PCM with DRB® scan tool and replace controller if faulty.
	4. Overdrive Solenoid Malfunction.	4. Replace solenoid.
	5. Valve Body Malfunction.	5. Remove, disassemble, clean and inspect valve body components. Make sure all valves and plugs slide freely in bores. Polish valves with crocus cloth if needed.
WHINE/NOISE RELATED TO ENGINE SPEED	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Shift Cable Incorrect Routing.	2. Check shift cable for correct routing. Should not touch engine or bell housing.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO 3-4 UPSHIFT	1. O/D Switch In OFF Position.	1. Turn control switch to ON position.
	2. Overdrive Circuit Fuse Blown.	2. Replace fuse. Determine why fuse failed and repair as necessary (i.e., shorts or grounds in circuit).
	3. O/D Switch Wire Shorted/Open Cut.	3. Check wires/connections with 12V test lamp and voltmeter. Repair damaged or loose wire/connection as necessary.
	4. Distance or Coolant Sensor Malfunction.	4. Check with DRB® scan tool and repair or replace as necessary.
	5. TPS Malfunction.	5. Check with DRB® scan tool and replace if necessary.
	6. Neutral Sense to PCM Wire Shorted/Cut.	6. Test switch/sensor as described in service section and replace if necessary. Engine no start.
	7. PCM Malfunction.	7. Check with DRB® scan tool and replace if necessary.
	8. Overdrive Solenoid Shorted/Open.	8. Replace solenoid if shorted or open and repair loose or damaged wires (DRB® scan tool).
	9. Solenoid Feed Orifice in Valve Body Blocked.	9. Remove, disassemble, and clean valve body thoroughly. Check feed orifice.
	10. Overdrive Clutch Failed.	10. Disassemble overdrive and repair as needed.
	11. Hydraulic Pressure Low.	11. Pressure test transmission to determine cause.
	12. Valve Body Valve Stuck.	12. Repair stuck 3-4 shift valve, 3-4 timing valve.
	13. O/D Piston Incorrect Spacer.	13. Remove unit, check end play and install correct spacer.
	14. Overdrive Piston Seal Failure.	14. Replace both seals.
	15. O/D Check Valve/Orifice Failed.	15. Check for free movement and secure assembly (in piston retainer). Check ball bleed orifice.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
SLIPS IN OVERDRIVE FOURTH GEAR	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Overdrive Clutch Pack Worn.	2. Remove overdrive unit and rebuild clutch pack.
	3. Overdrive Piston Retainer Bleed Orifice Blown Out.	3. Disassemble transmission, remove retainer and replace orifice.
	4. Overdrive Piston or Seal Malfunction.	4. Remove overdrive unit. Replace seals if worn. Replace piston if damaged. If piston retainer is damaged, remove and disassemble the transmission.
	5. 3-4 Shift Valve, Timing Valve or Accumulator Malfunction.	5. Remove and overhaul valve body. Replace accumulator seals. Make sure all valves operate freely in bores and do not bind or stick. Make sure valve body screws are correctly tightened and separator plates are properly positioned.
	6. Overdrive Unit Thrust Bearing Failure.	6. Disassemble overdrive unit and replace thrust bearing (NO. 1 thrust bearing is between overdrive piston and clutch hub; NO. 2 thrust bearing is between the planetary gear and the direct clutch spring plate; NO. 3 thrust bearing is between overrunning clutch hub and output shaft).
	7. O/D Check Valve/Bleed Orifice Failure.	7. Check for function/secure orifice insert in O/D piston retainer.
DELAYED 3-4 UPSHIFT (SLOW TO ENGAGE)	1. Fluid Level Low.	1. Add fluid and check for leaks.
	2. Throttle Valve Cable Mis-adjusted.	2. Adjust throttle valve cable.
	3. Overdrive Clutch Pack Worn/ Burnt.	3. Remove unit and rebuild clutch pack.
	4. TPS Faulty.	4. Test with DRB® scan tool and replace as necessary
	5. Overdrive Clutch Bleed Orifice Plugged.	5. Disassemble transmission and replace orifice.
	6. Overdrive Solenoid or Wiring Shorted/Open.	6. Test solenoid and check wiring for loose/corroded connections or shorts/ grounds. Replace solenoid if faulty and repair wiring if necessary.
	7. Overdrive Excess Clearance.	7. Remove unit. Measure end play and select proper spacer.
	8. O/D Check Valve Missing or Stuck.	8. Check for presence of check valve. Repair or replace as required.
TORQUE CONVERTER LOCKS UP IN SECOND AND/OR THIRD GEAR	Lockup Solenoid, Relay or Wiring Shorted/Open.	Test solenoid, relay and wiring for continuity, shorts or grounds. Replace solenoid and relay if faulty. Repair wiring and connectors as necessary.
HARSH 1-2, 2-3, 3-4 OR 3-2 SHIFTS	Lockup Solenoid Malfunction.	Remove valve body and replace solenoid assembly.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
NO START IN PARK OR NEUTRAL	1. Gearshift Linkage/Cable Mis-adjusted.	1. Adjust linkage/cable.
	2. Neutral Sense Wire Open/Cut.	2. Check continuity with test lamp. Repair as required.
	3. Park/Neutral Switch, or Transmission Range Sensor Faulty.	3. Refer to service section for test and replacement procedure.
	4. Park/Neutral Switch, or Transmission Range Sensor Connection Faulty.	4. Connectors spread open. Repair.
	5. Valve Body Manual Lever Assembly Bent/Worn/Broken.	5. Inspect lever assembly and replace if damaged.
NO REVERSE (OR SLIPS IN REVERSE)	1. Direct Clutch Pack (front clutch) Worn.	1. Disassemble unit and rebuild clutch pack.
	2. Rear Band Mis-adjusted.	2. Adjust band.
	3. Front Clutch Malfunctioned/ Burned.	3. Air-pressure test clutch operation. Remove and rebuild if necessary.
	4. Overdrive Thrust Bearing Failure.	4. Disassemble geartrain and replace bearings.
	5. Direct Clutch Spring Collapsed/ Broken.	5. Remove and disassemble unit. Check clutch position and replace spring.

AUTOMATIC TRANSMISSION - 48RE (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS.	1. Fluid Lines and Fittings Loose/ Leaks/Damaged.	1. Tighten fittings. If leaks persist, replace fittings and lines if necessary.
	2. Fill Tube (where tube enters case) Leaks/Damaged.	2. Replace tube seal. Inspect tube for cracks in fill tube.
	3. Pressure Port Plug Loose Loose/Damaged.	3. Tighten to correct torque. Replace plug or reseal if leak persists.
	4. Pan Gasket Leaks.	4. Tighten pan screws (150 in. lbs.). If leaks persist, replace gasket.
	5. Valve Body Manual Lever Shaft Seal Leaks/Worn.	5. Replace shaft seal.
	6. Rear Bearing Access Plate Leaks.	6. Replace gasket. Tighten screws.
	7. Gasket Damaged or Bolts are Loose.	7. Replace bolts or gasket or tighten both.
	8. Adapter/Extension Gasket Damaged Leaks/Damaged.	8. Replace gasket.
	9. Park/Neutral Switch, or Transmission Range Sensor Leaks/Damaged.	9. Replace switch and gasket.
	10. Converter Housing Area Leaks.	10. Check for leaks at seal caused by worn seal or burr on converter hub (cutting seal), worn bushing, missing oil return, oil in front pump housing or hole plugged. Check for leaks past O-ring seal on pump or past pump-to-case bolts; pump housing porous, oil coming out vent due to overfill or leak past front band shaft access plug.
	11. Pump Seal Leaks/Worn/ Damaged.	11. Replace seal.
	12. Torque Converter Weld Leak/Cracked Hub.	12. Replace converter.
	13. Case Porosity Leaks.	13. Replace case.
NOISY OPERATION IN FOURTH GEAR ONLY	1. Overdrive Clutch Discs, Plates or Snap Rings Damaged.	1. Remove unit and rebuild clutch pack.
	2. Overdrive Piston or Planetary Thrust Bearing Damaged.	2. Remove and disassemble unit. Replace either thrust bearing if damaged.
	3. Output Shaft Bearings Scored/ Damaged.	3. Remove and disassemble unit. Replace either bearing if damaged.
	4. Planetary Gears Worn/Chipped.	4. Remove and overhaul overdrive unit.
	5. Overdrive Unit Overrunning Clutch Rollers Worn/Scored.	5. Remove and overhaul overdrive unit.

AUTOMATIC TRANSMISSION - 48RE (Continued)

STANDARD PROCEDURE - ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils™, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil™ tap, or equivalent, and installing a Heli-Coil™ insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil™, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL

NOTE: The overdrive unit can be removed and serviced separately. It is not necessary to remove the entire transmission assembly to perform overdrive unit repairs.

(1) Disconnect battery negative cable.

(2) Raise vehicle.

(3) Remove the transfer case skid plate (Fig. 12), if equipped.

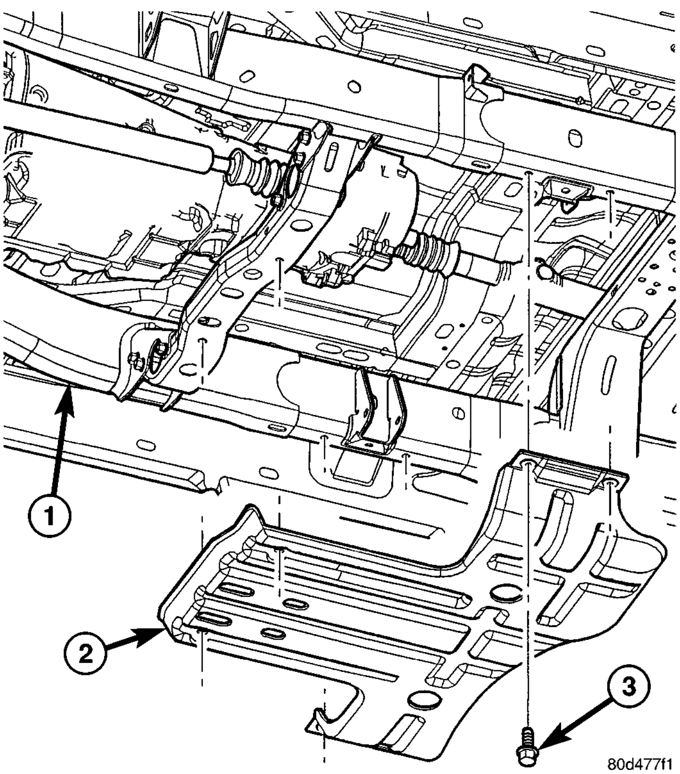


Fig. 12 Transfer Case Skid Plate

1 - FRAME RAIL
2 - SKID PLATE
3 - BOLTS (6)

(4) Disconnect and lower or remove necessary exhaust components.

(5) Remove engine-to-transmission struts (Fig. 13) and (Fig. 14).

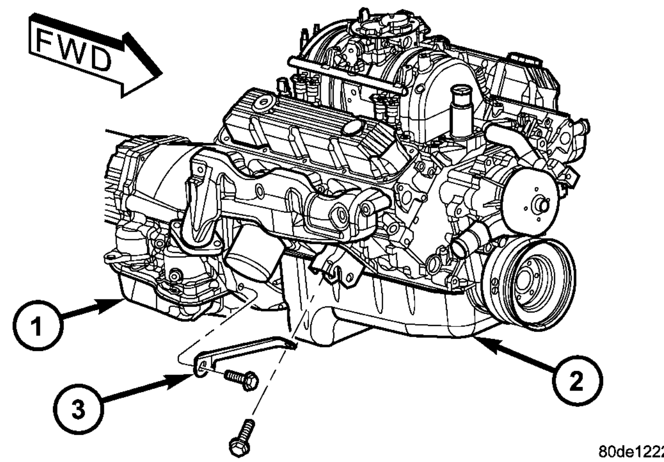


Fig. 13 Right Side Engine-to-Transmission Strut

1 - TRANSMISSION
2 - ENGINE
3 - STRUT

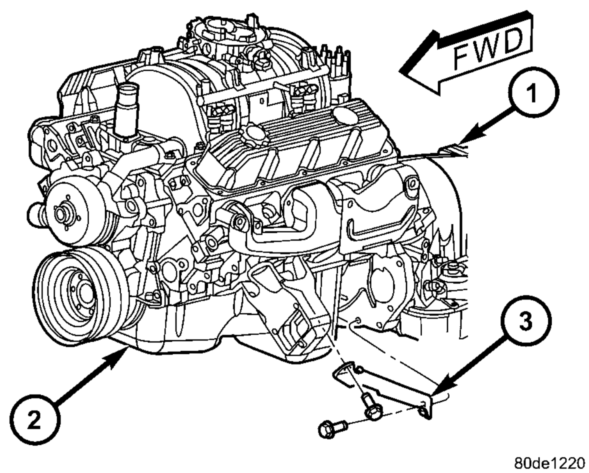


Fig. 14 Left Side Engine-to-Transmission Strut

1 - TRANSMISSION
2 - ENGINE
3 - STRUT

(6) Remove starter motor. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)

(7) Disconnect and remove the crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - REMOVAL) Retain the sensor attaching bolts.

(8) If transmission is being removed for overhaul, remove transmission oil pan, drain fluid and reinstall pan.

(9) Remove torque converter access cover.

AUTOMATIC TRANSMISSION - 48RE (Continued)

(10) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(11) Mark propeller shaft and axle yokes for assembly alignment. Then disconnect and remove propeller shaft. On 4 x 4 models, remove both propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(12) Disconnect wires from the transmission range sensor and transmission solenoid connector.

(13) Disconnect gearshift cable (Fig. 15) from the transmission.

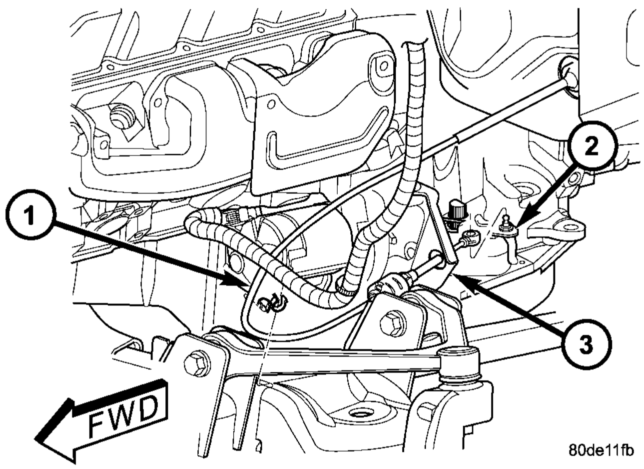


Fig. 15 Gearshift Cable At Transmission

1 - GEARSHIFT CABLE
2 - TRANSMISSION MANUAL LEVER
3 - CABLE SUPPORT BRACKET

(14) Disconnect throttle valve cable from transmission bracket and throttle valve lever.

(15) On 4X4 models, disconnect shift rod from transfer case shift lever.

(16) Support rear of engine with safety stand or jack.

(17) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(18) Remove bolts securing rear support and cushion (Fig. 16) and (Fig. 17) to transmission and crossmember and remove rear support.

(19) Remove bolts attaching crossmember to frame and remove crossmember.

(20) On 4X4 models, remove transfer case with transmission jack or aid of helper.

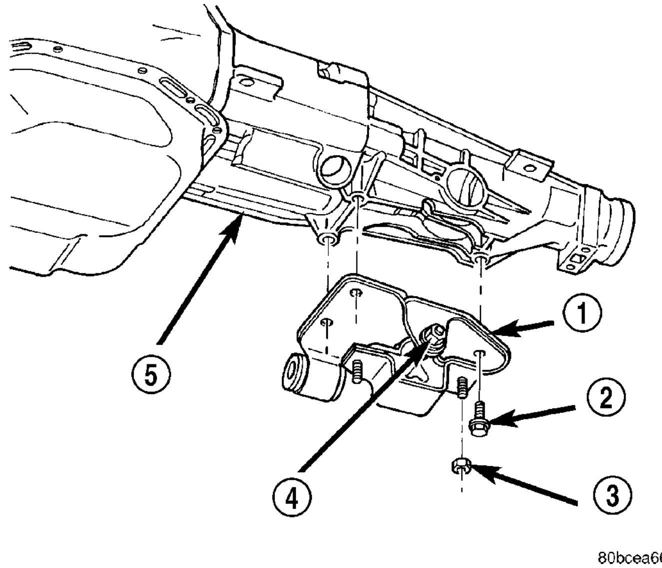


Fig. 16 Engine Rear Mount - 4X2 Automatic Transmission

1 - ENGINE REAR MOUNT
2 - BOLT
3 - NUT
4 - THROUGH BOLT NUT
5 - TRANSMISSION

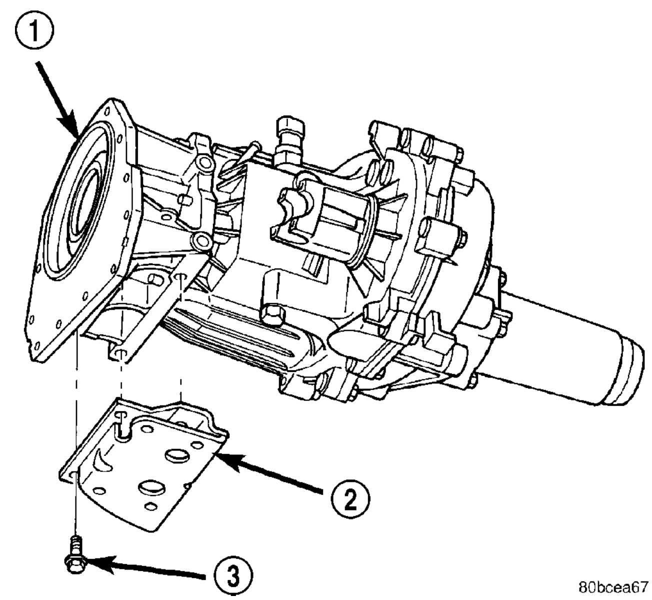


Fig. 17 Engine Rear Mount - 4X4 Automatic Transmission

1 - TRANSMISSION
2 - ENGINE REAR MOUNT
3 - BOLT

AUTOMATIC TRANSMISSION - 48RE (Continued)

(21) Disconnect fluid cooler lines at transmission (Fig. 18).

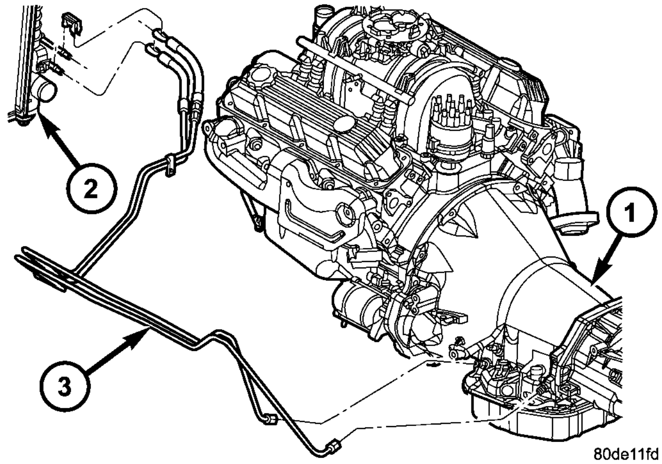


Fig. 18 Transmission Cooler Lines

1 - TRANSMISSION
2 - RADIATOR
3 - COOLER LINES

(22) Remove fill tube bracket bolts and pull tube out of transmission. Retain fill tube seal. On 4X4 models, it will also be necessary to remove bolt attaching transfer case vent tube to converter housing (Fig. 19).

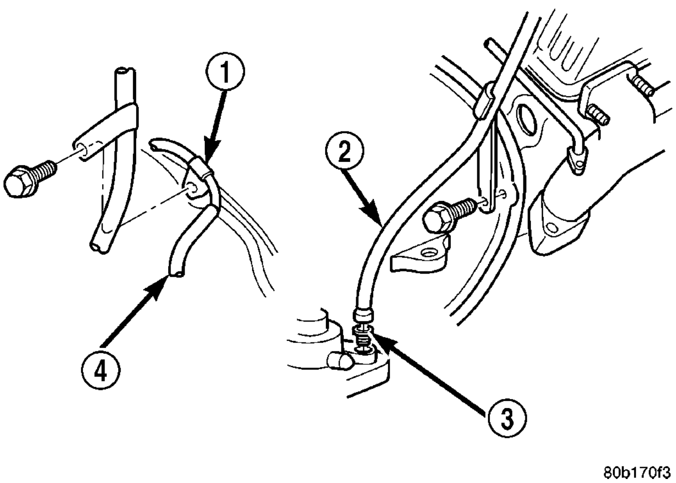


Fig. 19 Fill Tube Attachment

1 - TRANSFER CASE VENT TUBE
2 - FILL TUBE (V8)
3 - TUBE SEAL
4 - FILL TUBE (V6)

(23) Remove all converter housing bolts.

(24) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(25) Lower transmission and remove assembly from under the vehicle.

(26) To remove torque converter, remove C-clamp from edge of bell housing and carefully slide torque converter out of the transmission.

DISASSEMBLY

(1) Clean exterior of transmission with suitable solvent or pressure washer.

(2) Place transmission in vertical position.

(3) Measure the input shaft end play as follows (Fig. 20).

(a) Attach Adapter 8266-5 to Handle 8266-8.

(b) Attach dial indicator C-3339 to Handle 8266-8.

(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-5 to secure it to the input shaft.

(d) Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.

(e) Move input shaft in and out and record reading. Record the maximum travel for assembly reference

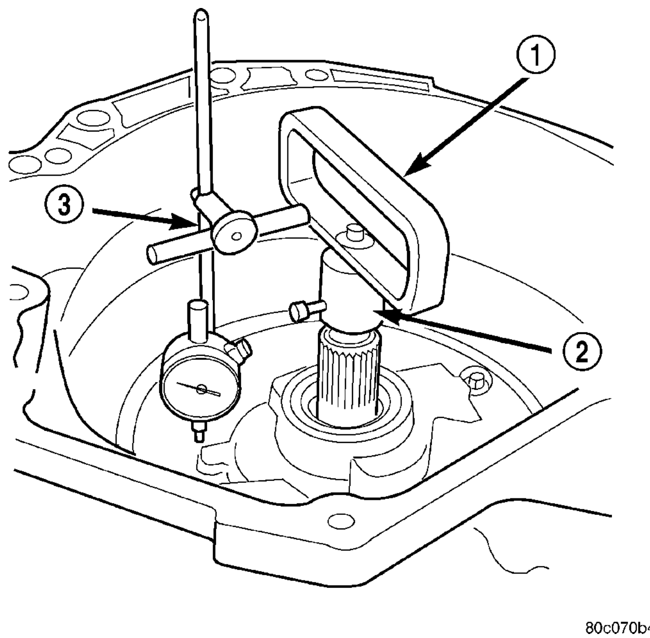


Fig. 20 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

(4) Remove throttle and shift levers from valve body manual shaft and throttle lever shaft.

(5) Remove transmission oil pan and gasket.

AUTOMATIC TRANSMISSION - 48RE (Continued)

(6) Remove filter from valve body (Fig. 21). Keep filter screws separate from other valve body screws. Filter screws are longer and should be kept with filter.

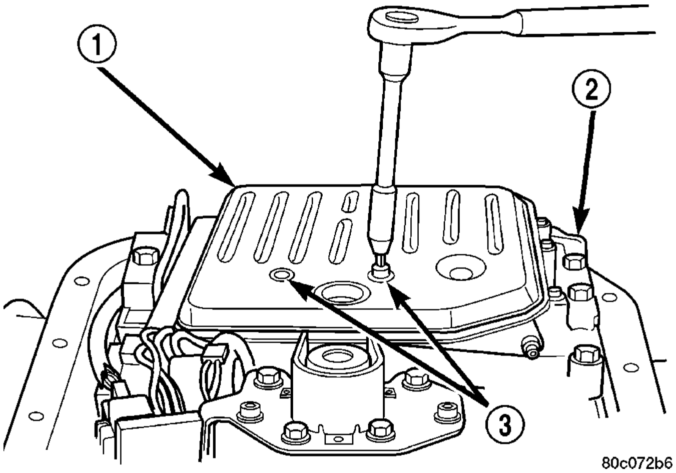


Fig. 21 Oil Filter Removal

1 - OIL FILTER
2 - VALVE BODY
3 - FILTER SCREWS (2)

(7) Remove the transmission range sensor..

(8) Remove hex head bolts attaching valve body to transmission case (Fig. 22). A total of 10 bolts are used. Note different bolt lengths for assembly reference.

(9) Remove valve body assembly. Push valve body harness connector out of case. Then work park rod and valve body out of case (Fig. 23).

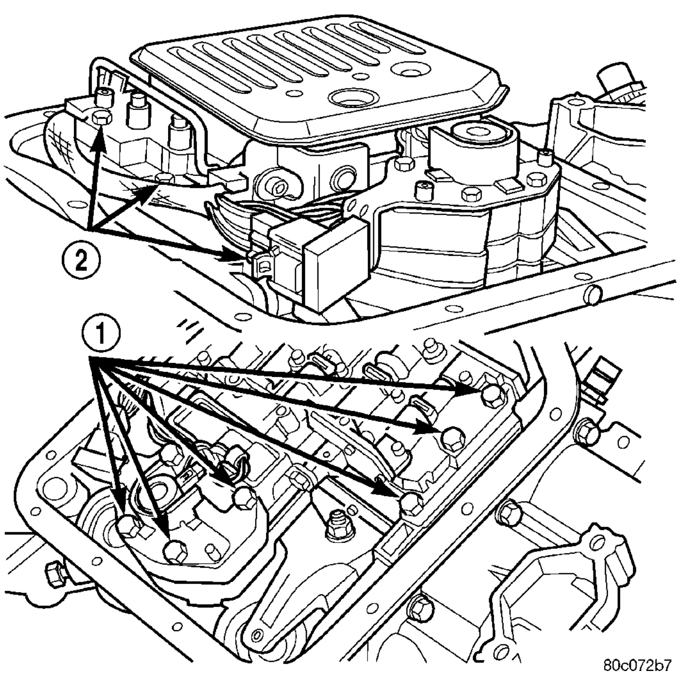


Fig. 22 Valve Body Bolt Locations

1 - VALVE BODY BOLTS
2 - VALVE BODY BOLTS

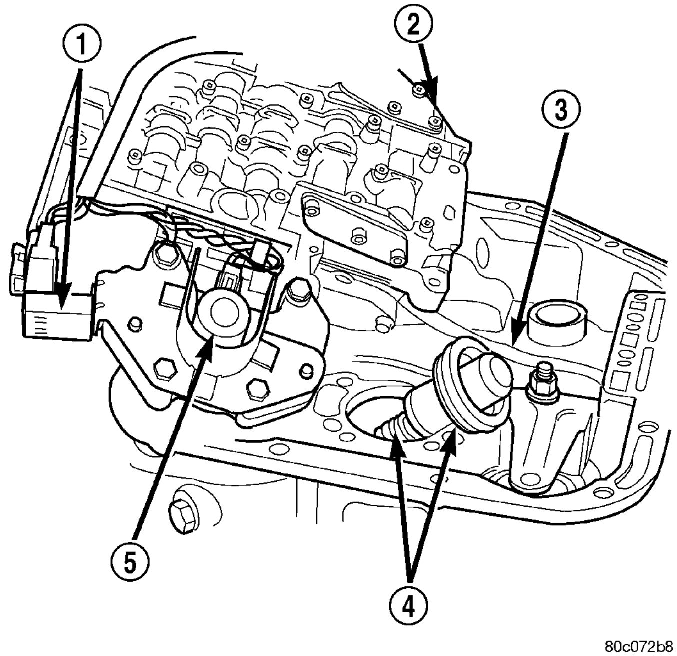


Fig. 23 Valve Body Removal

1 - GOVERNOR PRESSURE SENSOR
2 - VALVE BODY
3 - PARK ROD
4 - ACCUMULATOR PISTON
5 - GOVERNOR PRESSURE SOLENOID

(10) Remove accumulator outer spring, piston and inner spring (Fig. 24). Note position of piston and springs for assembly reference. Remove and discard piston seals if worn or cut.

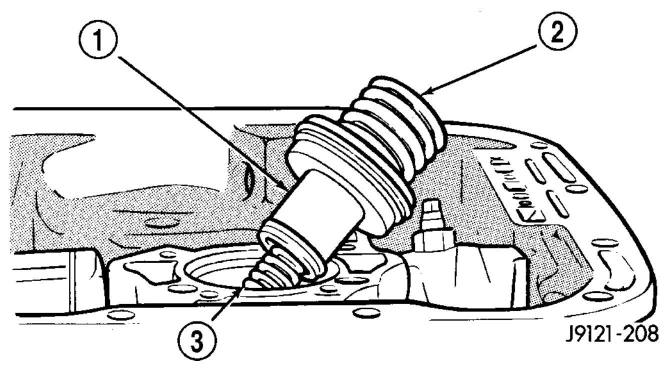


Fig. 24 Accumulator Component Removal

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

AUTOMATIC TRANSMISSION - 48RE (Continued)

(11) Remove pump oil seal with suitable pry tool or slide-hammer mounted screw.

(12) Remove front band lever pin access plug (Fig. 25). Use square end of 1/4 in. drive extension to remove plug as shown.

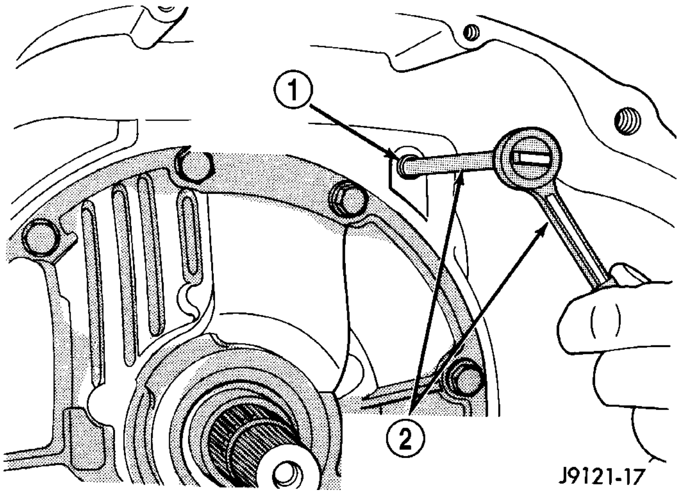


Fig. 25 Front Band Lever Pin Access Plug

1 - FRONT BAND REACTION PIN ACCESS PLUG
2 - 1/4 DRIVE EXTENSION AND RATCHET

(13) Remove oil pump and reaction shaft support assembly as follows:

(a) Tighten front band adjusting screw until band is tight around front clutch retainer (Fig. 26). This will prevent retainer from coming out with pump and possibly damaging clutch or pump components.

(b) Remove oil pump bolts.

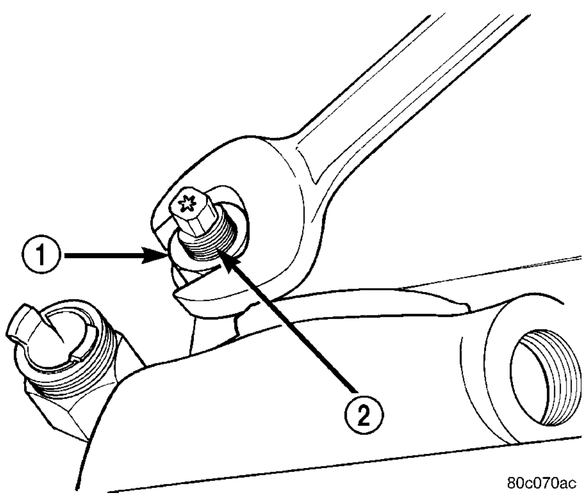


Fig. 26 Tightening Front Band To Hold Front Clutch In Place

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

(c) Thread Slide Hammer Tools C-3752 into threaded holes in flange of oil pump housing (Fig. 27).

(d) Remove oil pump and reaction shaft support by bumping slide hammers outward alternately to pull pump from case (Fig. 28).

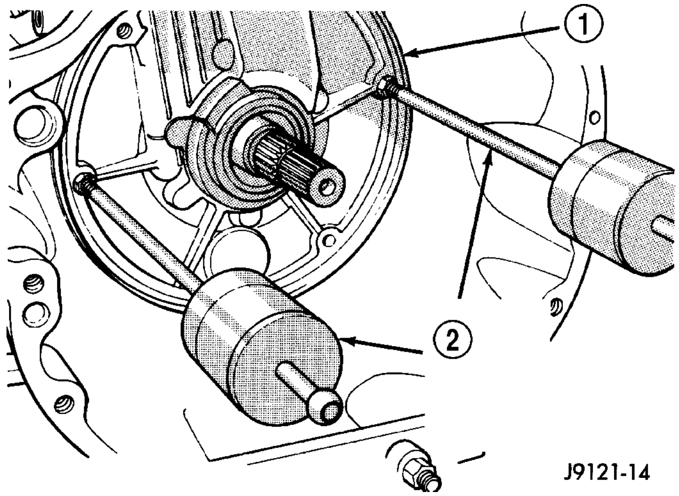


Fig. 27 Oil Pump Removal Tools

1 - PUMP HOUSING
2 - SLIDE HAMMER TOOLS (THREAD INTO PUMP HOUSING)

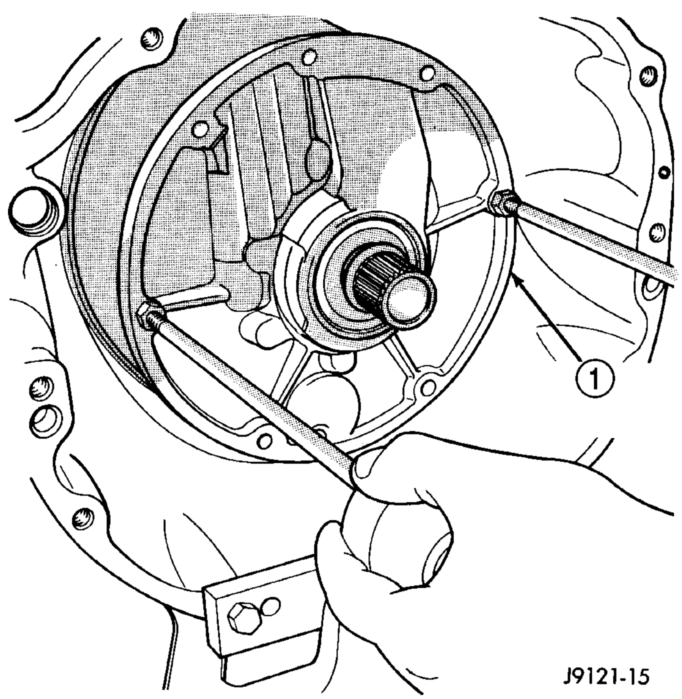


Fig. 28 Oil Pump Removal

1 - OIL PUMP AND REACTION SHAFT SUPPORT

AUTOMATIC TRANSMISSION - 48RE (Continued)

(14) Remove oil pump gasket (Fig. 29). Note gasket position in case for assembly reference.

(15) Loosen front band adjusting screw until band is completely loose.

(16) Remove front band strut and anchor (Fig. 30).

(17) Squeeze front band together slightly and slide band over front clutch retainer and out of case (Fig. 31).

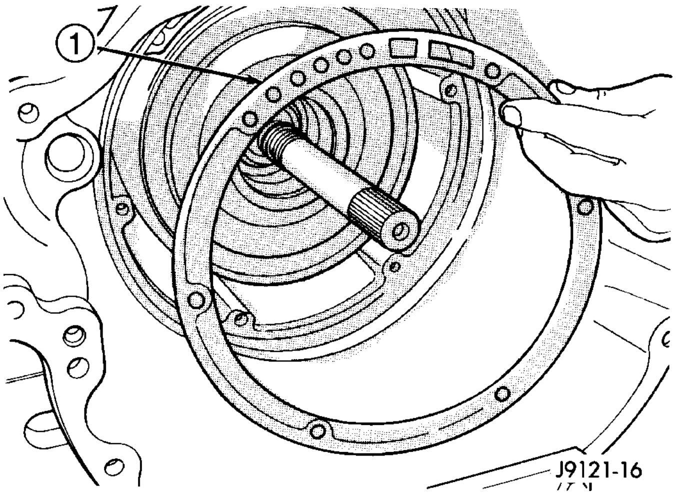


Fig. 29 Oil Pump Gasket

1 - OIL PUMP GASKET

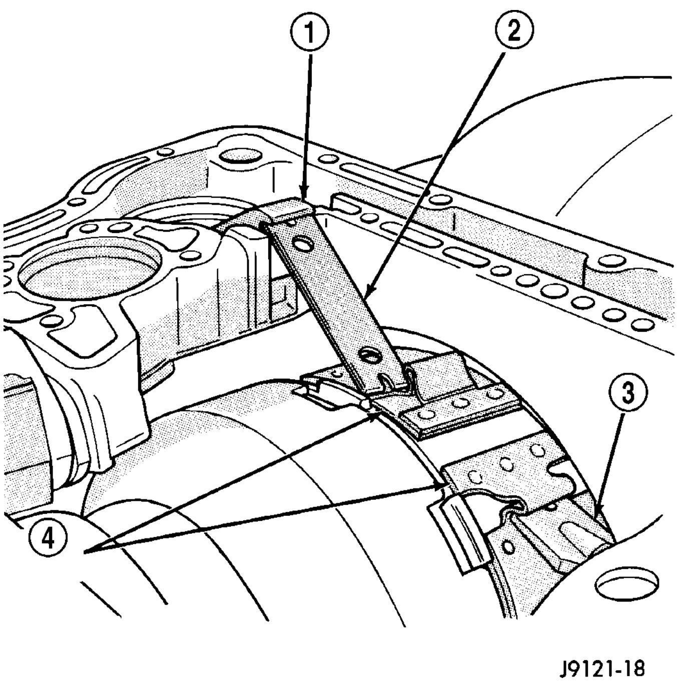


Fig. 30 Front Band Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

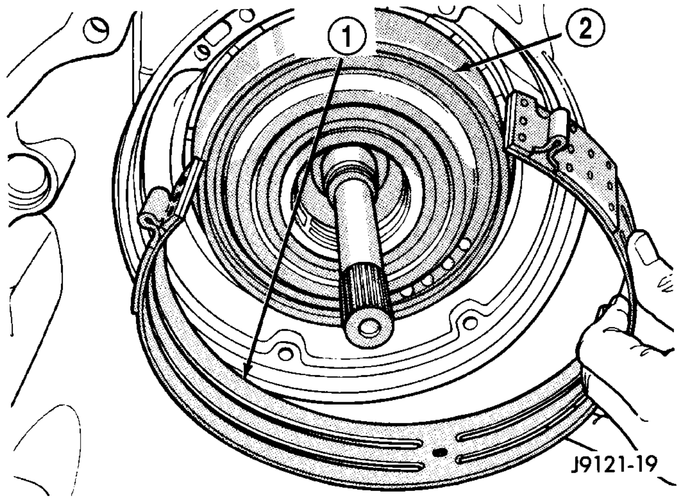


Fig. 31 Front Band Removal

1 - FRONT BAND
2 - FRONT CLUTCH RETAINER

(18) Remove front and rear clutch assemblies as a unit (Fig. 32).

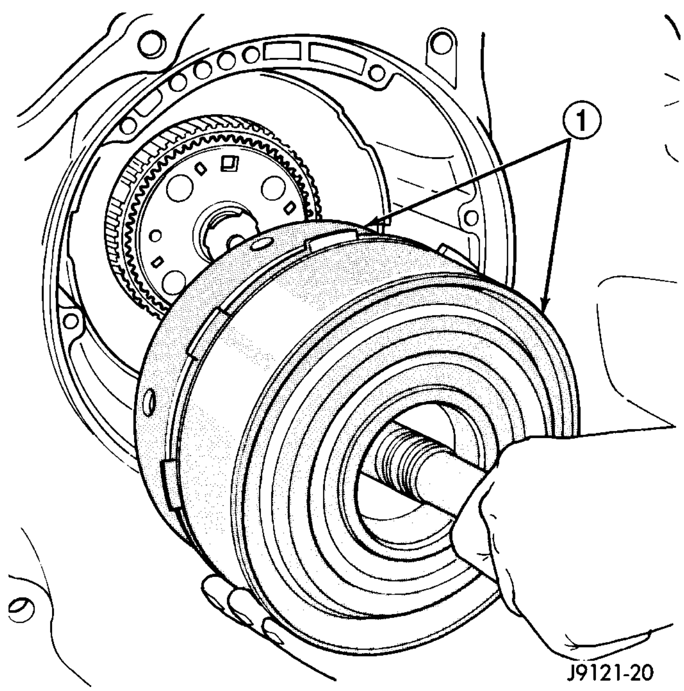


Fig. 32 Removing Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

AUTOMATIC TRANSMISSION - 48RE (Continued)

(19) Remove front band reaction pin and lever. Start pin through lever and out of case bore with drift or punch. Then use pencil magnet to withdraw pin completely (Fig. 33).

(20) Remove intermediate shaft thrust washer. Triangular shaped washer will either be on shaft pilot hub or in rear clutch retainer (Fig. 34).

(21) Remove thrust plate from intermediate shaft hub (Fig. 35).

(22) Remove intermediate shaft-planetary geartrain assembly (Fig. 36).

(23) If overdrive unit is not to be serviced, install Alignment Shaft 6227-2 into the overdrive unit to prevent misalignment of the overdrive clutches during service of main transmission components.

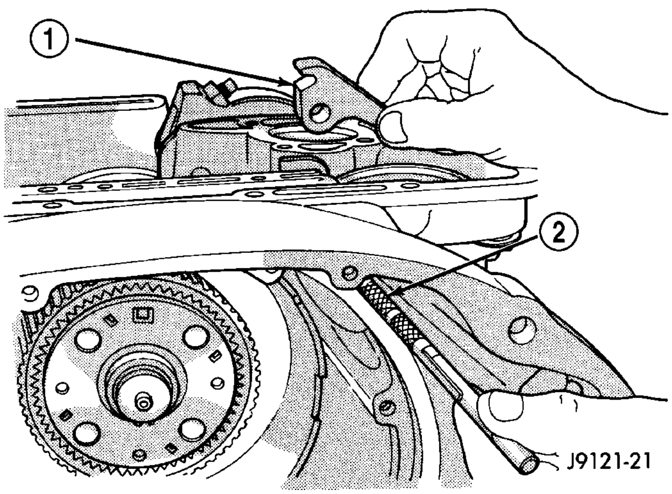


Fig. 33 Front Band Lever And Pin

1 - BAND LEVER
2 - USE PENCIL MAGNET TO REMOVE REACTION PIN

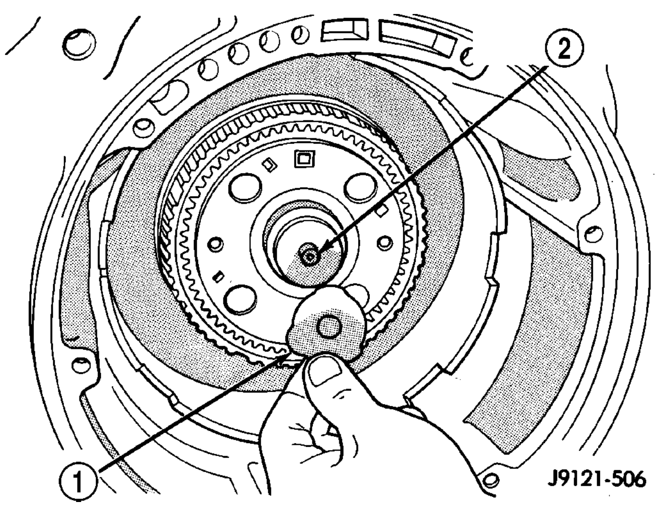


Fig. 34 Intermediate Shaft Thrust Washer

1 - THRUST WASHER
2 - INTERMEDIATE SHAFT PILOT HUB

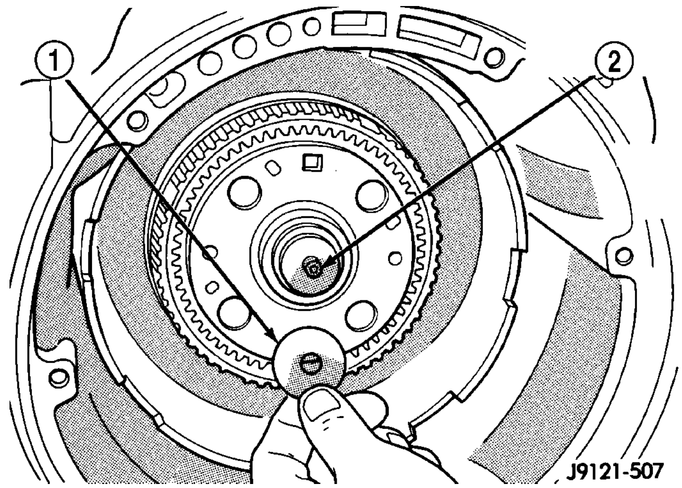


Fig. 35 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

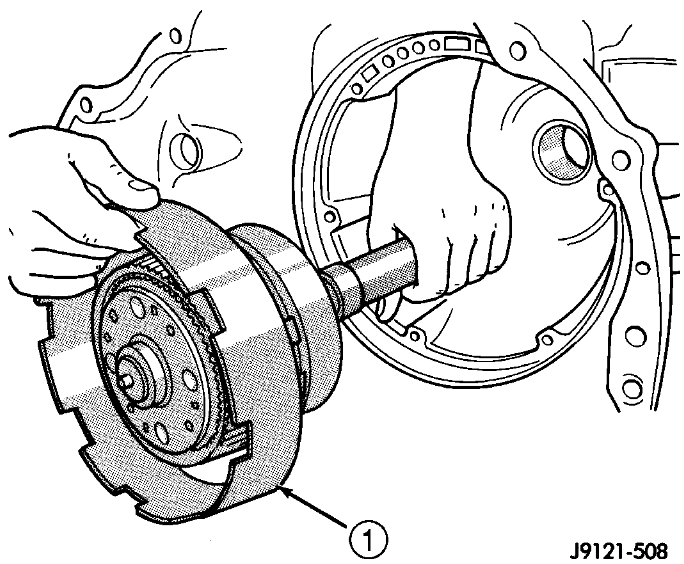


Fig. 36 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEAR TRAIN ASSEMBLY

AUTOMATIC TRANSMISSION - 48RE (Continued)

(24) Loosen rear band locknut and loosen adjusting screw 3-4 turns.

(25) Remove snap-ring that retains low-reverse drum on overdrive piston retainer hub (Fig. 37).

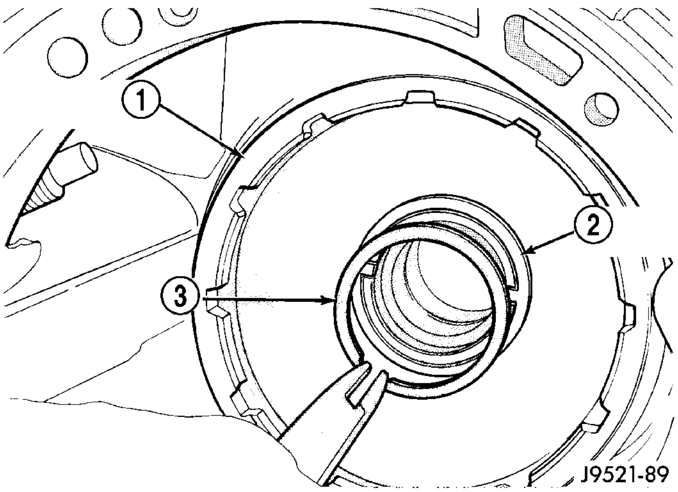


Fig. 37 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

(26) Slide low-reverse drum and thrust washer off piston retainer hub and out of rear band (Fig. 38).

(27) Note that overrunning clutch race will remain on splines of low-reverse drum after removal (Fig. 39). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

(28) Remove overrunning clutch assembly (Fig. 40). Assembly can be removed without displacing rollers and springs if care is exercised. Note position of rollers and springs for assembly reference.

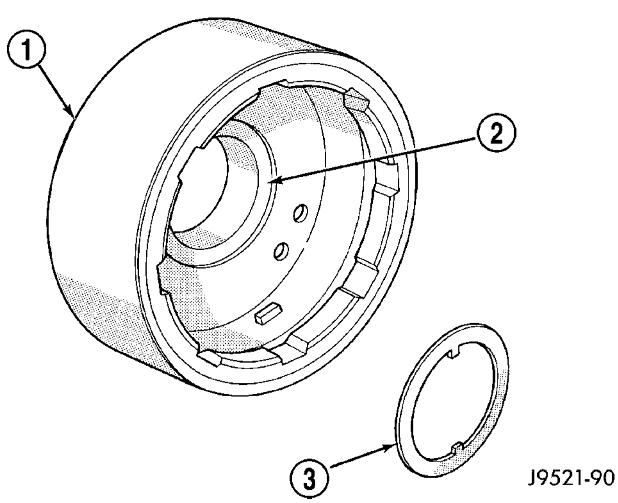


Fig. 38 Low-Reverse Drum And Thrust Washer

1 - LOW-REVERSE DRUM
2 - SPOTFACE FOR WASHER
3 - THRUST WASHER

(29) Remove rear band adjusting lever and reaction pin.

(30) Remove rear band.

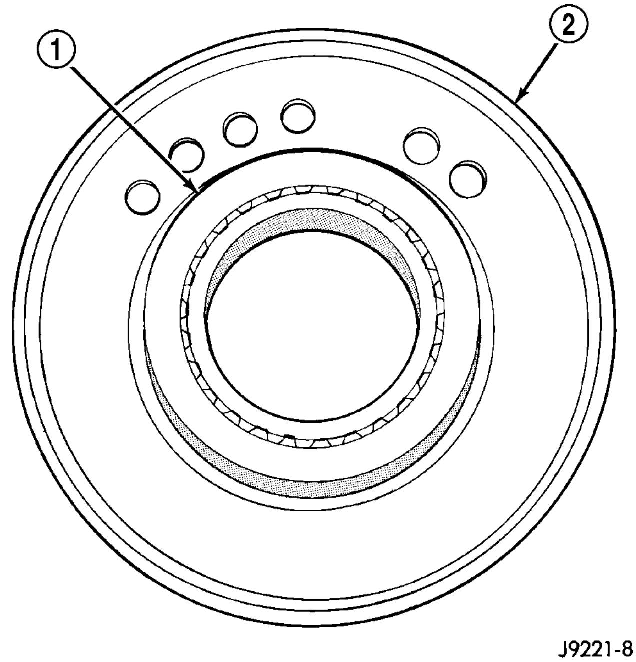


Fig. 39 Overrunning Clutch Race Position On Low-Reverse Drum

1 - OVERRUNNING CLUTCH RACE
2 - LOW-REVERSE DRUM

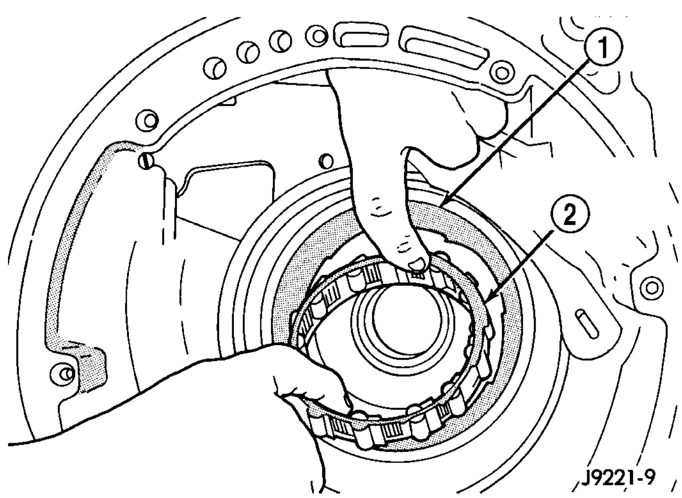


Fig. 40 Overrunning Clutch

1 - CLUTCH CAM
2 - OVERRUNNING CLUTCH ASSEMBLY

(31) Compress front servo rod guide with large C-clamp and Tool C-4470, or Compressor Tool C-3422-B (Fig. 41). Compress guide only enough to permit snap-ring removal (about 1/8 in.).

(32) Remove servo piston snap-ring (Fig. 41). Unseat one end of ring. Then carefully work removal tool around back of ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(33) Remove tools and remove servo piston and spring.

(34) Compress rear servo piston with C-clamp and Tool C-4470, or Valve Spring Compressor C-3422-B (Fig. 42). Compress servo spring retainer only enough to permit snap-ring removal.

(35) Remove servo piston snap-ring (Fig. 42). Start one end of ring out of bore. Then carefully work removal tool around back of snap-ring until free of ring groove. **Exercise caution when removing snap-ring. Servo bore can be scratched or nicked if care is not exercised.**

(36) Remove tools and remove rear servo retainer, spring and piston assembly.

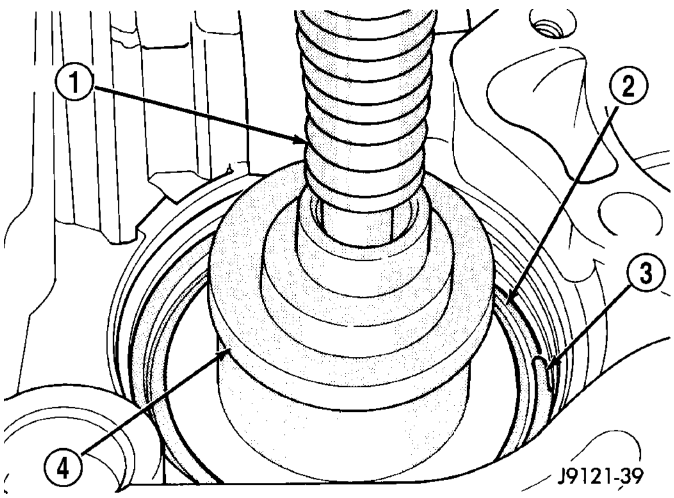


Fig. 41 Front Servo Retaining Snap-Ring

1 - C-CLAMP
2 - FRONT SERVO ROD GUIDE
3 - SNAP-RING
4 - TOOL C-4470

CLEANING

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

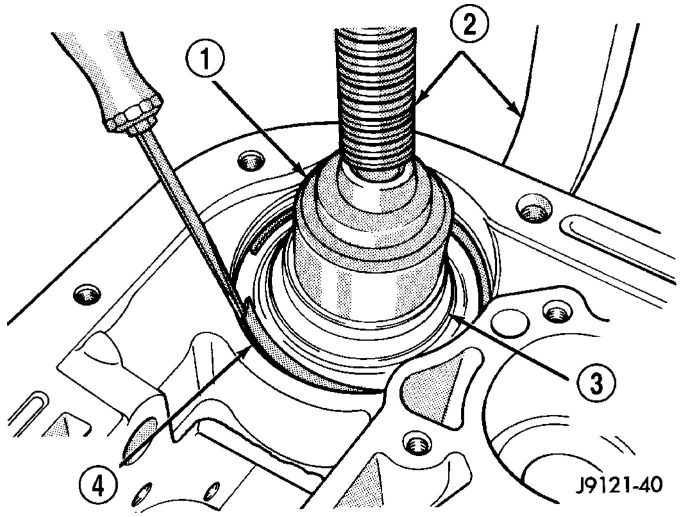


Fig. 42 Rear Servo Retaining Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

Lubricate transmission parts with Mopar® ATF +4, Automatic Transmission fluid during overhaul and assembly. Use petroleum jelly to prelubricate seals, O-rings, and thrust washers. Petroleum jelly can also be used to hold parts in place during reassembly.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

Lubricate the front band adjusting screw threads with petroleum jelly and thread the screw part-way into the case. Be sure the screw turns freely.

Inspect the transmission bushings during overhaul. Bushing condition is important as worn, scored bushings contribute to low pressures, clutch slip and accelerated wear of other components. However, do not replace bushings as a matter of course. Replace bushings only when they are actually worn, or scored.

Use recommended tools to replace bushings. The tools are sized and designed to remove, install, and seat bushings correctly. The bushing replacement tools are included in Bushing Tool Set C-3887-B.

Pre-sized service bushings are available for replacement purposes. Only the sun gear bushings are not serviced.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

ASSEMBLY

CAUTION: If the condition of the transmission before the overhaul procedure caused excessive metallic or fiber contamination in the fluid, replace the torque converter. Fluid contamination and transmission failure can result if not done.

Do not allow dirt, grease, or foreign material to enter the case or transmission components during assembly. Keep the transmission case and components clean. Also make sure the tools and workbench area used for reassembly operations are equally clean.

Shop towels used for wiping off tools and your hands must be made from **lint free** materials. Lint will stick to transmission parts and could interfere with valve operation or even restrict fluid passages.

Lubricate transmission clutch and gear components with Mopar® ATF +4 during reassembly. Soak clutch discs in transmission fluid before installation. Petroleum jelly can be used to lubricate and hold thrust washers and plates in position during assembly.

Do not use chassis grease, bearing grease, white grease, or similar lubricants on any part. These types of lubricants can eventually block or restrict fluid passages and valve operation. Use petroleum jelly only.

Do not force parts into place. The transmission components and sub-assemblies are easily installed by hand when properly aligned. If a part seems difficult to install, it is either misaligned or incorrectly assembled. Verify that thrust washers, thrust plates and seal rings are correctly positioned.

The planetary geartrain, front/rear clutch assemblies and oil pump are all much easier to install when the transmission case is upright. Either tilt the case upward with wood blocks, or cut a hole in the bench large enough for the intermediate shaft and rear support. Then lower the shaft and support into the hole and support the rear of the case directly on the bench.

FRONT/REAR SERVO

(1) Lubricate rear servo piston seal with ATF +4. Lubricate servo bore in case with ATF +4.

(2) Install rear servo piston in case. Position piston at slight angle to bore and insert piston with twisting motion (Fig. 43).

(3) Install rear servo spring and retainer in case bore (Fig. 44). Be sure spring is seated on piston.

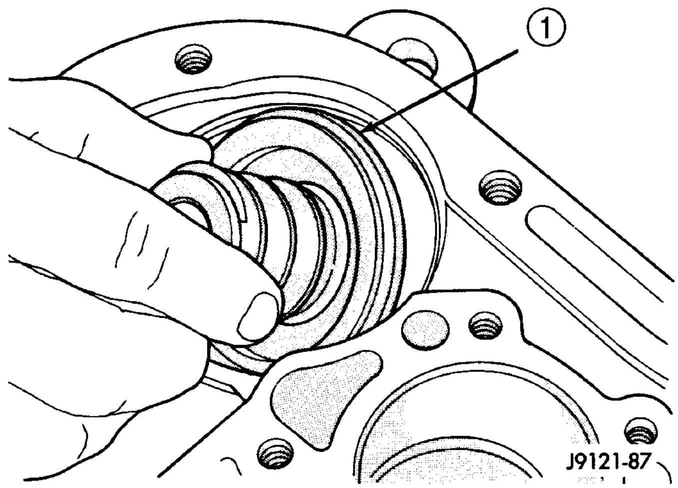


Fig. 43 Rear Servo Piston

1 - REAR SERVO PISTON

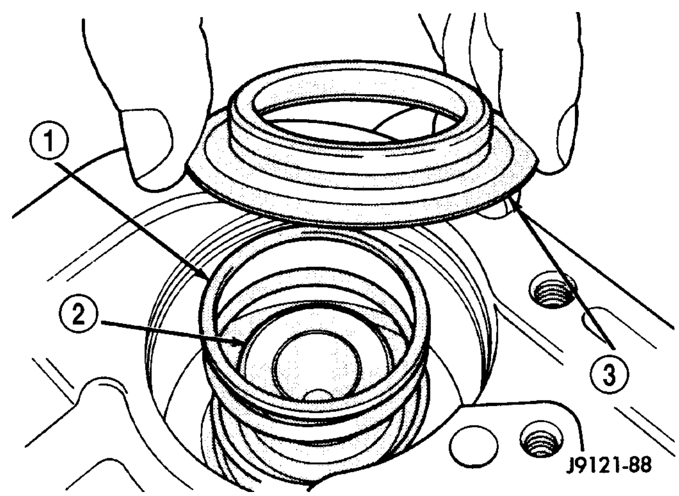


Fig. 44 Rear Servo Piston Spring And Retainer

1 - PISTON SPRING
2 - REAR SERVO PISTON
3 - SPRING RETAINER

AUTOMATIC TRANSMISSION - 48RE (Continued)

(4) Compress rear servo piston with C-clamp or Valve Spring Compressor C-3422-B and install servo piston snap-ring (Fig. 45).

(5) Lubricate front servo piston components and servo bore in case with transmission fluid.

(6) Install front servo piston in bore. Carefully “run” small, suitable tool around piston ring to press it back into groove and ease installation (Fig. 46). Rotate piston into bore at same time. Rock piston slightly to ease piston ring past snap-ring groove and into bore.

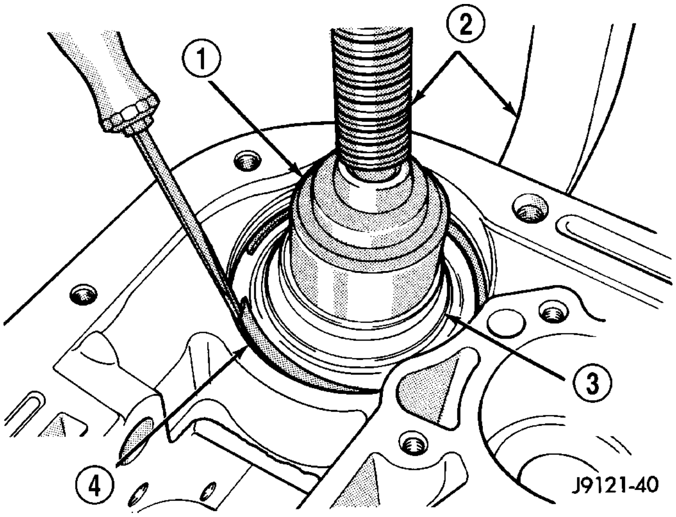


Fig. 45 Rear Servo Snap-Ring

1 - TOOL C-4470
2 - C-CLAMP
3 - REAR SERVO SPRING RETAINER
4 - RETAINER SNAP-RING

(7) Bottom front servo piston in bore and install servo spring.

(8) Install front servo piston rod guide as follows:

(a) Place Tool SP-5560 (or similar size tool) on guide and position C-clamp on tool and case (Fig. 47).

(b) Slowly compress rod guide while simultaneously easing seal ring into bore with suitable tool.

(9) Install rod guide snap-ring (Fig. 47).

OVERRUNNING CLUTCH, REAR BAND, AND LOW-REVERSE DRUM

(1) Install overrunning clutch components if not yet installed.

(2) Position rear band reaction pin and band in case. Be sure that the twin lugs on the band are seated against the reaction pin.

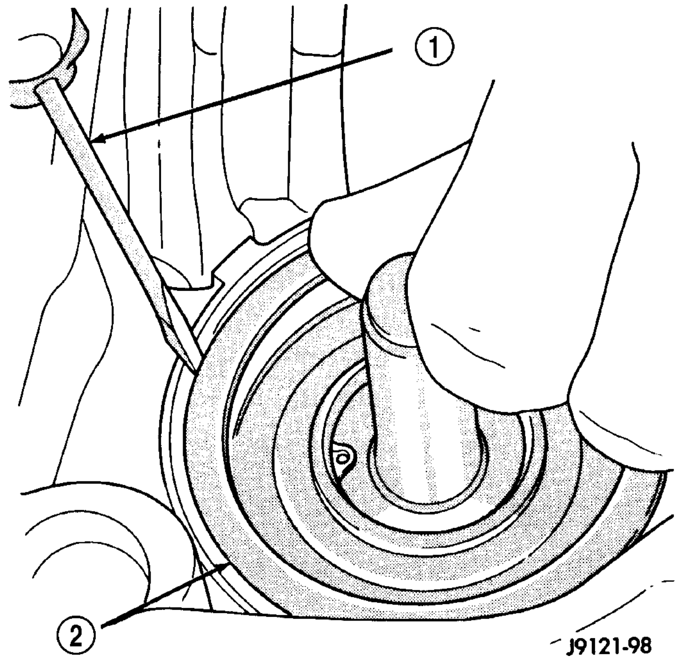


Fig. 46 Front Servo Piston

1 - USE SUITABLE TOOL TO HELP SEAT PISTON RING
2 - FRONT SERVO PISTON

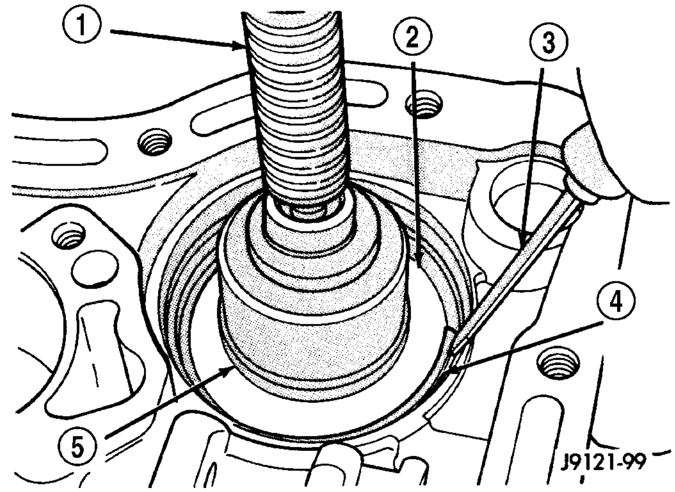


Fig. 47 Front Servo Rod Guide And Snap-Ring

1 - C-CLAMP
2 - ROD GUIDE
3 - SMALL SCREWDRIVER
4 - ROD GUIDE SNAP-RING
5 - TOOL SP-5560

(3) Install low-reverse drum. Slide drum through rear band, onto piston retainer hub and into engagement with overrunning clutch and race.

AUTOMATIC TRANSMISSION - 48RE (Continued)

(4) Install thrust washer in low-reverse drum spot-face (Fig. 48). Use petroleum jelly to hold washer in place.

(5) Install snap-ring that secures low-reverse drum to piston retainer hub (Fig. 48).

(6) Insert the rear band pivot pin part way into the case.

(7) Install rear band adjusting lever and pivot pin. Be sure lever and the single lug on the band are aligned and engaged before seating band pivot pin in case.

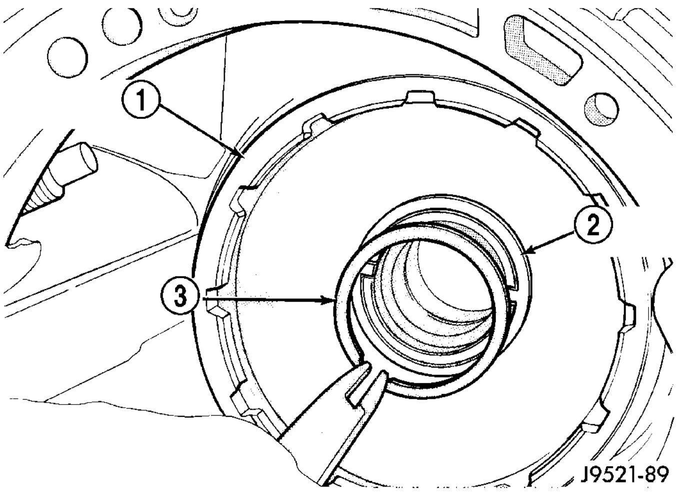


Fig. 48 Low-Reverse Drum Snap-Ring

1 - LOW-REVERSE DRUM
2 - TABBED WASHER
3 - SNAP-RING

PLANETARY GEARTRAIN, FRONT/REAR CLUTCH, AND FRONT BAND

(1) Remove Alignment Shaft 6227-2, if installed previously.

(2) Install assembled intermediate shaft and planetary geartrain (Fig. 49). **Support shaft carefully during installation. Do not allow shaft bearing/ bushing surfaces to become nicked or scratched.**

(3) Lubricate intermediate shaft thrust plate with petroleum jelly and install plate on shaft pilot hub (Fig. 50).

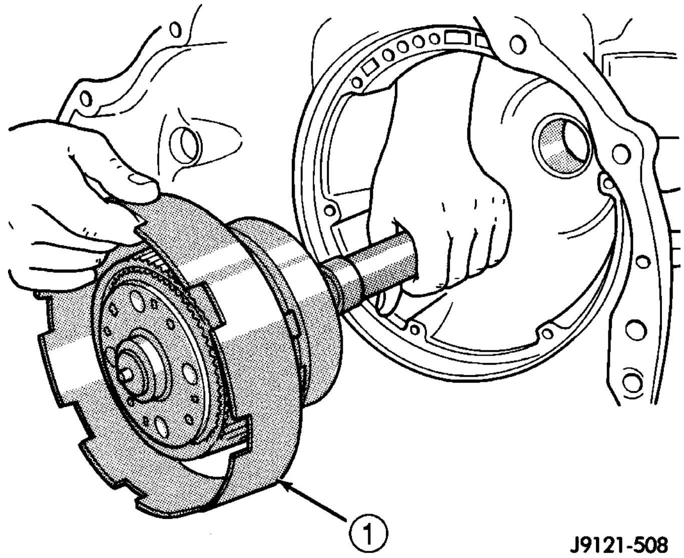


Fig. 49 Intermediate Shaft And Planetary Geartrain

1 - INTERMEDIATE SHAFT AND PLANETARY GEAR TRAIN ASSEMBLY

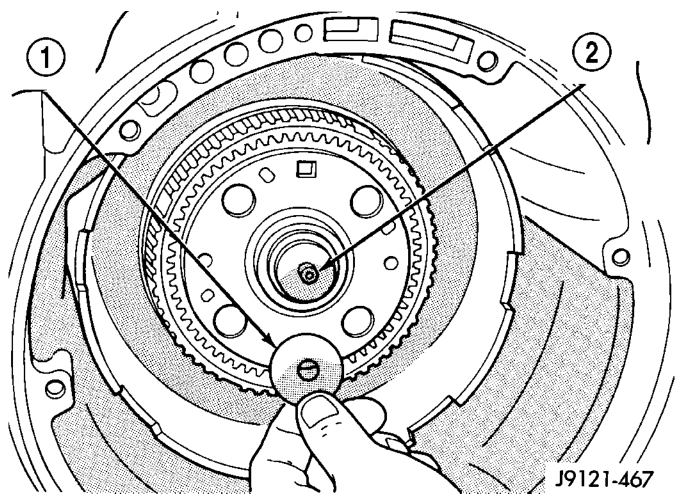


Fig. 50 Intermediate Shaft Thrust Plate

1 - SHAFT THRUST PLATE
2 - INTERMEDIATE SHAFT PILOT HUB

AUTOMATIC TRANSMISSION - 48RE (Continued)

(4) Check input shaft front seal rings, fiber thrust washer and rear seal ring (Fig. 51). Be sure the ends of the rear seal ring are hooked together and diagonal cut ends of front seal rings are firmly seated against each other as shown. Lubricate seal rings with petroleum jelly after checking them.

(5) Assemble front and rear clutches (Fig. 52). Align lugs on front clutch discs. Mount front clutch on rear clutch. Turn front clutch retainer back and forth until front clutch discs are fully seated on rear clutch splined hub.

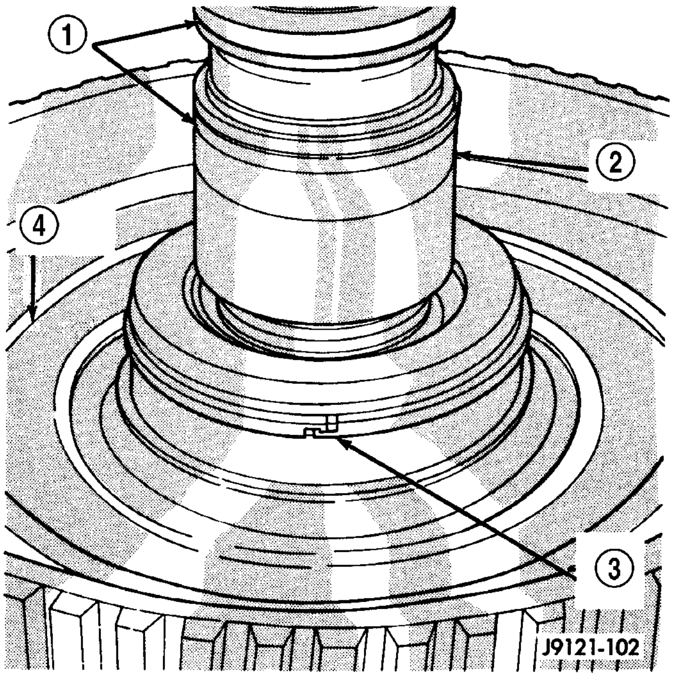


Fig. 51 Input Shaft Seal Rings And Thrust Washer

1 - TORLON® FRONT SEAL RINGS
2 - INPUT SHAFT
3 - REAR SEAL RING
4 - THRUST WASHER

(6) Install intermediate shaft thrust washer in hub of rear clutch retainer (Fig. 53). Use petroleum jelly to hold washer in place. Position washer so grooves are facing outward. **Washer only fits one way in clutch retainer hub.**

(7) Place transmission case in upright position, or place blocks under front end of transmission repair stand to tilt case rearward. This makes it easier to install front/rear clutch assembly.

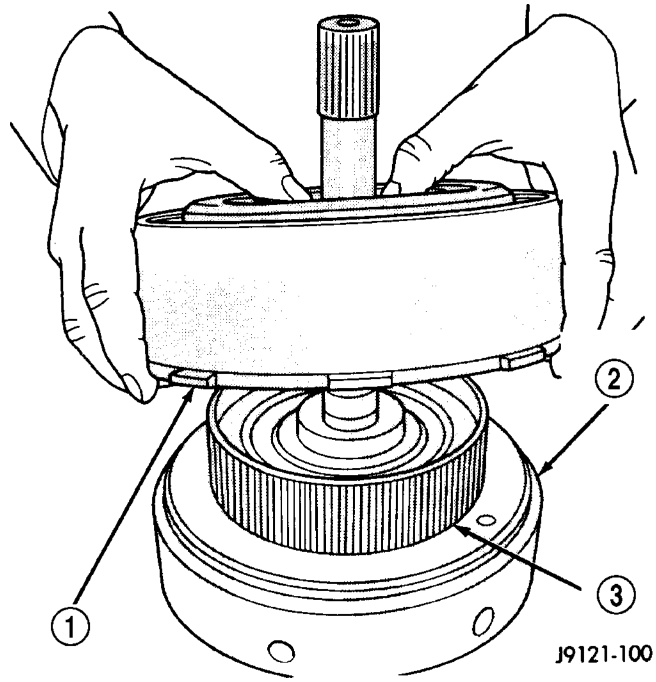


Fig. 52 Assembling Front And Rear Clutches

1 - FRONT CLUTCH ASSEMBLY
2 - REAR CLUTCH ASSEMBLY
3 - REAR CLUTCH SPLINED HUB

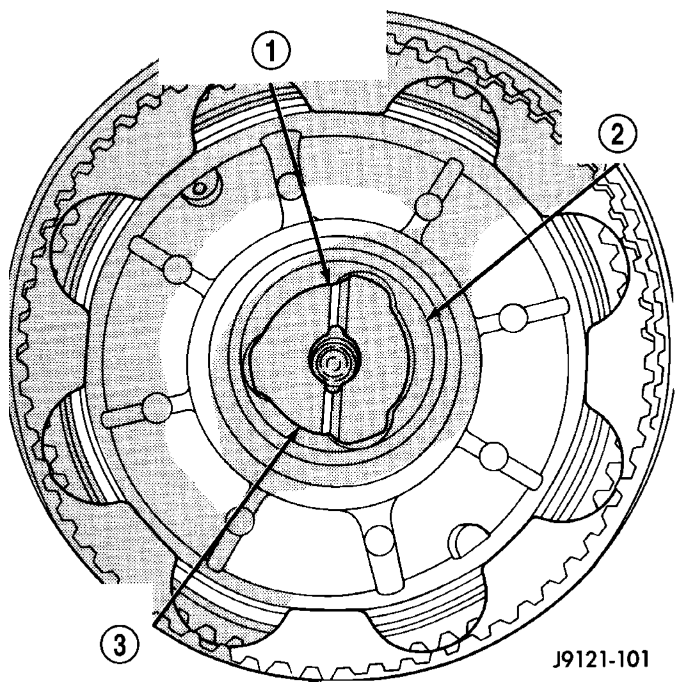


Fig. 53 Intermediate Shaft Thrust Washer

1 - BE SURE WASHER GROOVES FACE OUT AS SHOWN
2 - REAR CLUTCH RETAINER HUB
3 - SHAFT THRUST WASHER

AUTOMATIC TRANSMISSION - 48RE (Continued)

(8) Align discs in rear clutch. Then install and engage assembly in front planetary and driving shell (Fig. 54). Turn clutch retainers back and forth until both clutches are seated.

(9) Position front band lever in case and over servo rod guide. Then install front band lever pin in case and slide it through lever.

(10) Coat threads of front band pin access plug with sealer and install it in case. Tighten plug to 17 N·m (13 ft. lbs.) torque.

(11) Slide front band over front clutch retainer and install front band strut and anchor (Fig. 55).

(12) Tighten front band adjusting screw until band is tight on clutch retainer. This will hold clutches in place while oil pump is being installed. **Verify that front/rear clutch assembly is still properly seated before tightening band.**

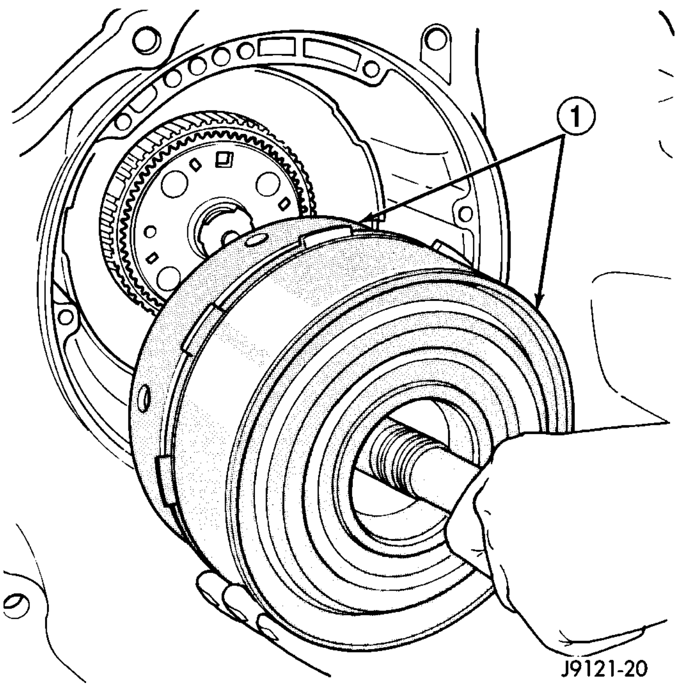


Fig. 54 Front/Rear Clutch Assemblies

1 - FRONT AND REAR CLUTCH ASSEMBLIES

OIL PUMP

(1) Install oil pump Pilot Studs C-3288-B in case (Fig. 56).

(2) Install new oil pump gasket on pilot studs and seat it in case. Be sure gasket is properly aligned with fluid passages in case (Fig. 56).

(3) Coat the reaction shaft thrust washer with petroleum jelly to hold it in place. Then install washer over reaction shaft hub and seat it on pump (Fig. 57).

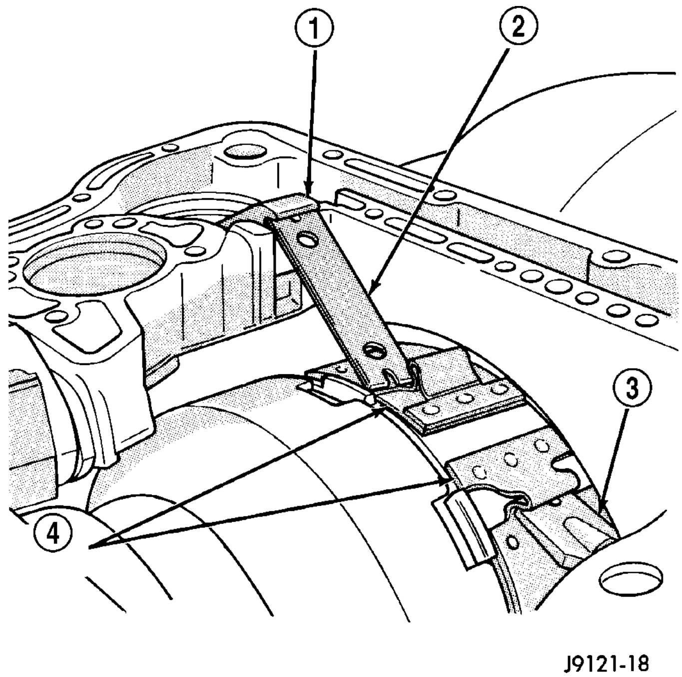


Fig. 55 Front Band And Linkage

1 - LEVER
2 - STRUT
3 - ANCHOR
4 - FRONT BAND

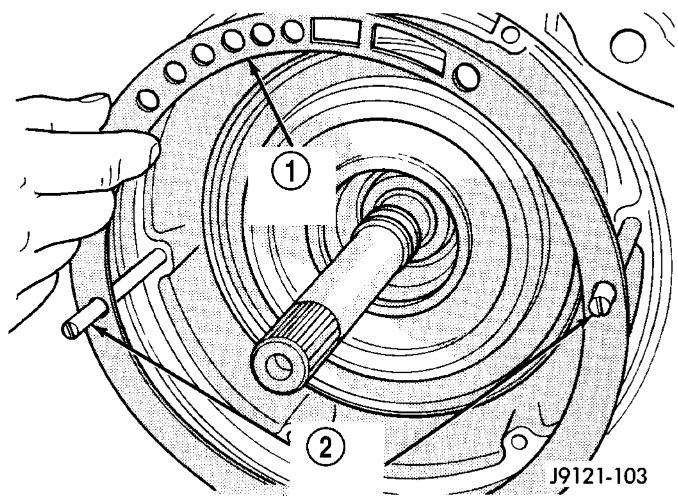


Fig. 56 Oil Pump Gasket And Pilot Studs

1 - OIL PUMP GASKET
2 - PILOT STUDS C-3288-B

CAUTION: The thrust washer bore (I.D.), is chamfered on one side. Make sure the chamfered side is installed so it faces the pump.

AUTOMATIC TRANSMISSION - 48RE (Continued)

(4) Check seal rings on reaction shaft support. Be sure rings are hooked together correctly. Also be sure fiber thrust washer is in position (Fig. 58). Use extra petroleum jelly to hold washer in place if necessary.

(5) Check the torque converter hub seal ring on the reaction shaft for damage. Also check that the seal ring rotates freely in the reaction shaft groove. Replace if necessary.

(6) Lubricate oil pump seals with petroleum Mopar® ATF +4.

(7) Mount oil pump on pilot studs and slide pump into case opening (Fig. 59). **Work pump into case by hand. Do not use a mallet or similar tools to seat pump.**

(8) Remove pilot studs and install oil pump bolts. Tighten pump bolts alternately and evenly to fully seat pump in case. Then final-tighten pump bolts to 20 N·m (15 ft. lbs.) torque.

(9) Verify correct installation. Rotate input and intermediate shafts and check for bind. If bind exists, components are either mis-assembled, or not seated. Disassemble and correct as necessary before proceeding.

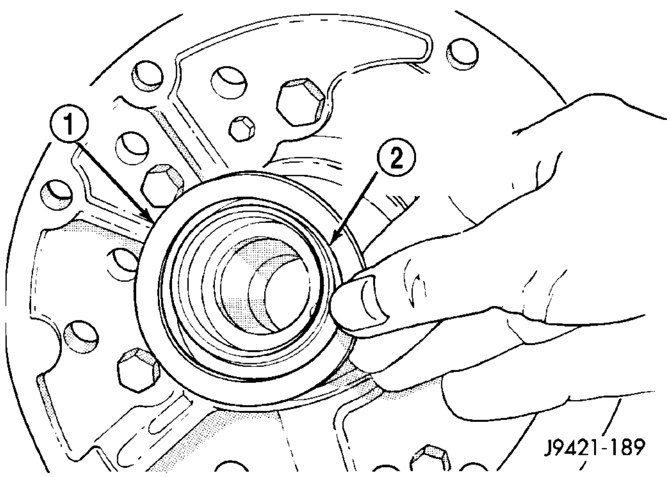


Fig. 57 Reaction Shaft Thrust Washer

1 - THRUST WASHER
2 - CHAMFERED SIDE OF WASHER BORE GOES TOWARD PUMP

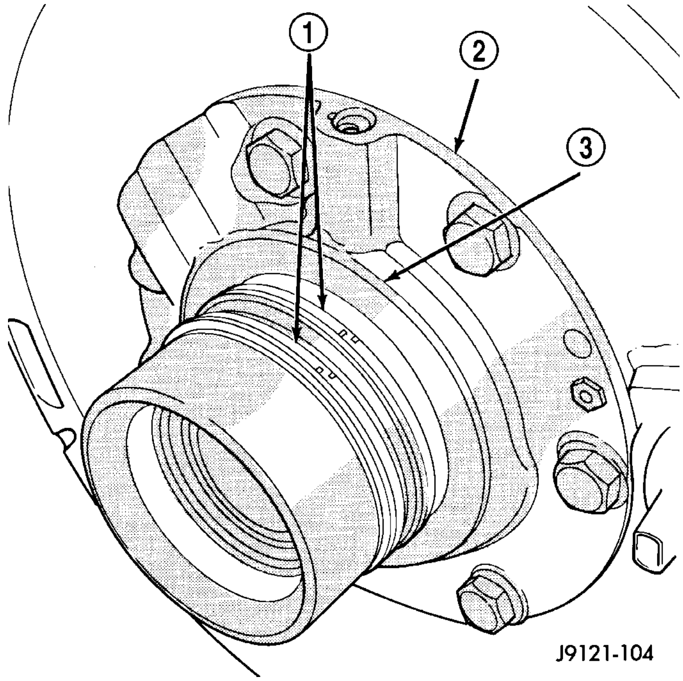


Fig. 58 Reaction Shaft Seal Ring And Thrust Washer

1 - SEAL RINGS
2 - REACTION SHAFT SUPPORT
3 - THRUST WASHER (FIBER)

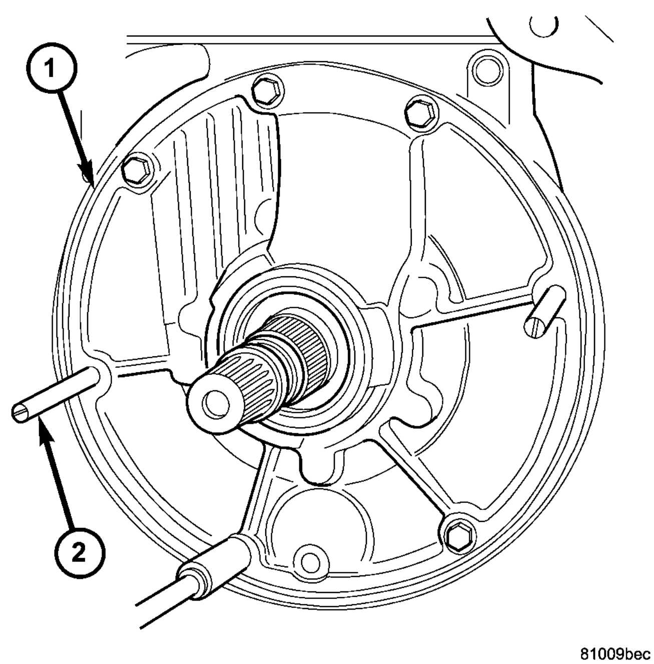


Fig. 59 Oil Pump

1 - SEAT OIL PUMP IN CASE BY HAND
2 - REMOVE PILOT STUDS WHEN PUMP IS SEATED

AUTOMATIC TRANSMISSION - 48RE (Continued)

INPUT SHAFT END PLAY CHECK

NOTE: Overdrive unit must be installed in order to correctly measure the input shaft end-play.

(1) Measure input shaft end play (Fig. 60).

NOTE: If end play is incorrect, transmission is incorrectly assembled, or reaction shaft thrust washer is incorrect. The reaction shaft thrust washer is selective.

(a) Attach Adapter 8266-5 to Handle 8266-8.

(b) Attach dial indicator C-3339 to Handle 8266-8.

(c) Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-5 to secure it to the input shaft.

(d) Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.

(e) Move input shaft in and out and record reading. End play should be 0.86 - 2.13 mm (0.034 - 0.084 in.). Adjust as necessary.

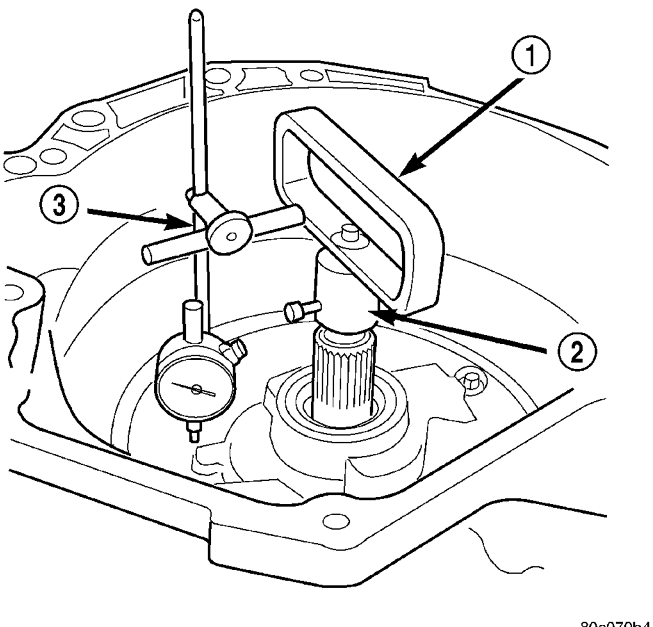


Fig. 60 Checking Input Shaft End Play

1 - TOOL 8266-8
2 - TOOL 8266-5
3 - TOOL C-3339

ACCUMULATOR, VALVE BODY, OIL PAN, AND TORQUE CONVERTER

(1) Install accumulator inner spring, piston and outer spring (Fig. 63).

(2) Verify that the transmission range sensor has **not** been installed in case. Valve body can not be installed if sensor is installed.

(3) Install new valve body manual shaft seal in case (Fig. 64). Lubricate seal lip and manual shaft with petroleum jelly. Start seal over shaft and into case. Seat seal with 15/16 inch, deep well socket.

(4) Install valve body as follows:

(a) Start park rod into park pawl. If rod will not slide past park pawl, pawl is engaged in park gear. Rotate overdrive output shaft with suitable size 12 point socket; this will free pawl and allow rod to engage.

(b) Align and seat valve body on case. Be sure manual lever shaft and overdrive connector are fully seated in case.

(c) Install and start all valve body attaching bolts by hand. Then tighten bolts evenly, in a diagonal pattern to 12 N·m (105 in. lbs.) torque. **Do not overtighten valve body bolts. This could result in distortion and cross leakage after installation.**.

(5) Install new filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.).

(6) Move the transmission manual shaft lever to the manual LOW position.

(7) Install the TRS mounting bracket into the transmission case. Using Adapter 8581 (Fig. 61), tighten the mounting bracket to 34 N·m (300 in.lbs.).

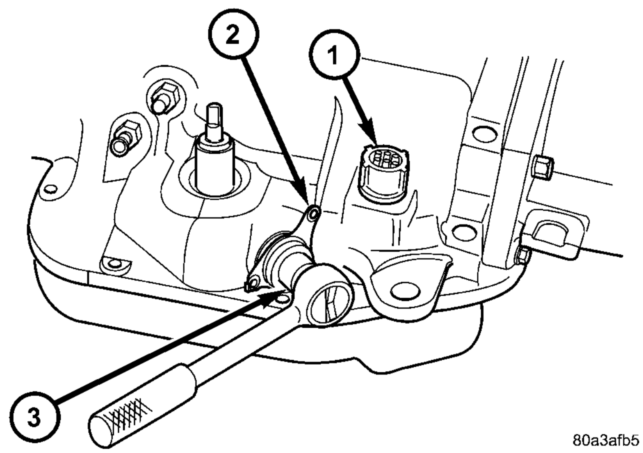


Fig. 61 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(8) Install the TRS (Fig. 62) into the mounting bracket with the wiring connector facing the front of the transmission.

(9) Install the two screws to hold the TRS to the mounting bracket. Tighten the screws to 3.4 N·m (30 in.lbs.).

CAUTION: If the condition of the transmission before the overhaul procedure caused excessive metallic or fiber contamination in the fluid, replace the torque converter. Fluid contamination and transmission failure can result if not done.

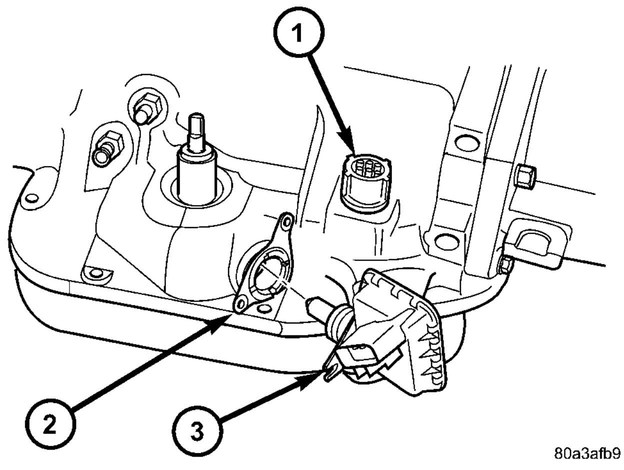


Fig. 62 Install the Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

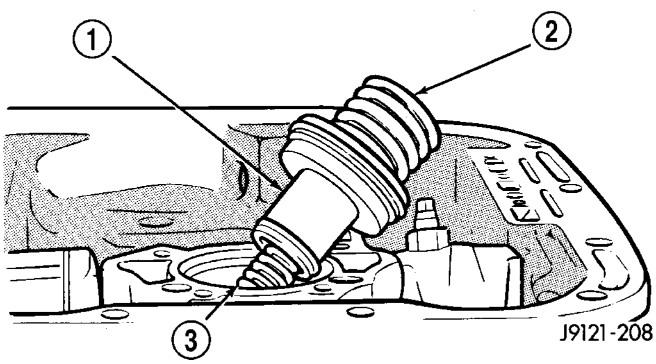


Fig. 63 Accumulator Piston And Springs

1 - ACCUMULATOR PISTON
2 - OUTER SPRING
3 - INNER SPRING

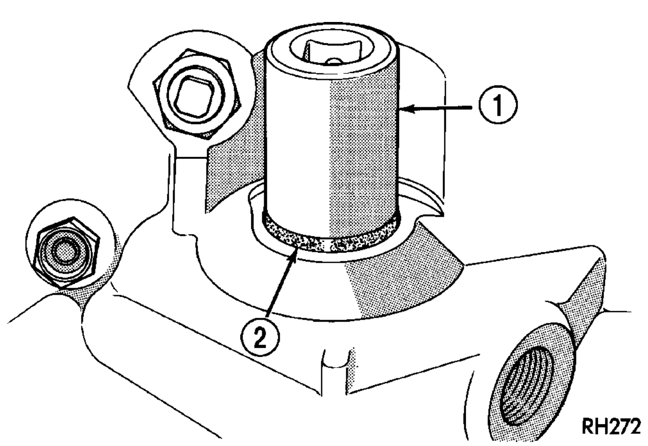


Fig. 64 Manual Lever Shaft Seal

1 - 15/16'' SOCKET
2 - SEAL

(10) Install torque converter. Use C-clamp or metal strap to hold converter in place for installation.

BAND ADJUSTMENT AND FINAL

(1) Adjust front and rear bands as follows:

(a) Loosen locknut on each band adjusting screw 4-5 turns.

(b) Tighten both adjusting screws to 8 N·m (72 in. lbs.).

(c) Back off front band adjusting screw 1-3/4 turns.

(d) Back off rear band adjusting screw 3 turns.

(e) Hold each adjusting screw in position and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(2) Install magnet in oil pan. Magnet seats on small protrusion at corner of pan.

(3) Position new oil pan gasket on case and install oil pan. Tighten pan bolts to 13.6 N·m (125 in. lbs.).

(4) Install throttle valve and shift selector levers on valve body manual lever shaft.

(5) Apply small quantity of dielectric grease to terminal pins of solenoid case connector and neutral switch.

(6) Fill transmission with recommended fluid.

INSTALLATION

(1) Check torque converter hub inner and outer diameters and hub drive notches for sharp edges burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.

(2) Lubricate pocket in the rear oil pump seal lip with transmission fluid.

(3) Lubricate converter pilot hub of the crankshaft with a light coating of Mopar® High Temp Grease.

(4) Align and install converter in oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 65). Surface of converter lugs should be 19mm (0.75 in.) to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

(8) Position transmission on jack and secure it with chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Raise transmission and align converter with drive plate and converter housing with engine block.

(11) Move transmission forward. Then raise, lower or tilt transmission to align converter housing with engine block dowels.

AUTOMATIC TRANSMISSION - 48RE (Continued)

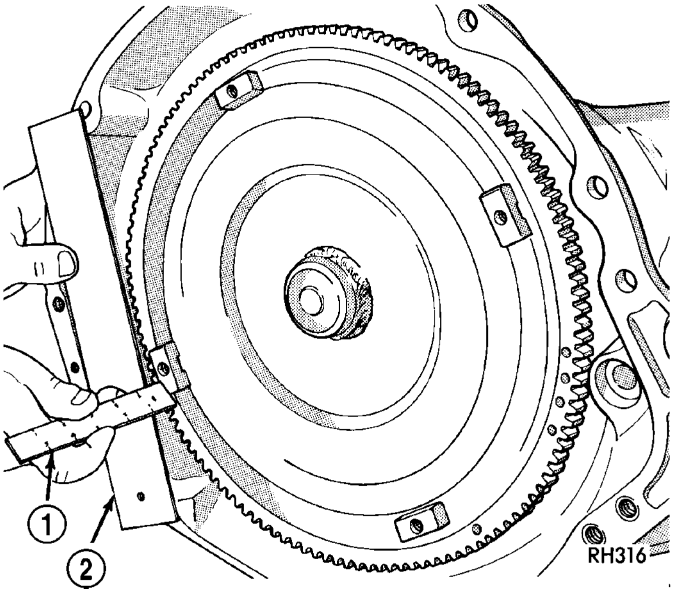


Fig. 65 Checking Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(12) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft.

(13) Install bolts attaching converter housing to engine.

(14) Install rear support.

(15) Install the rear transmission crossmember.

(16) Lower transmission onto crossmember and install bolts attaching transmission mount to cross-member.

(17) Remove engine support fixture.

(18) Install the transfer case, if equipped.

(19) Install crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - INSTALLATION)

(20) Connect gearshift cable (Fig. 66) and throttle cable to transmission.

(21) Connect wires to the transmission range sensor and transmission solenoid connector. Be sure the transmission harnesses are properly routed.

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

(22) Install torque converter-to-driveplate bolts.

(23) Install converter housing access cover.

(24) Install starter motor and cooler line bracket. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION)

(25) Connect cooler lines (Fig. 67) to transmission.

(26) Install transmission fill tube. Install new seal on tube before installation.

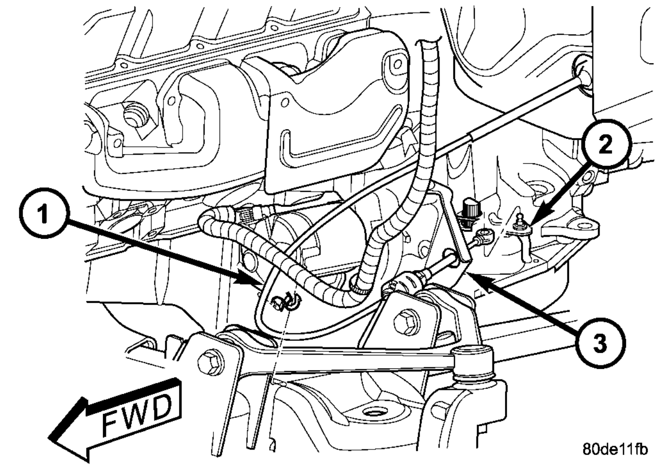


Fig. 66 Gearshift Cable At Transmission

1 - GEARSHIFT CABLE
2 - TRANSMISSION MANUAL LEVER
3 - CABLE SUPPORT BRACKET

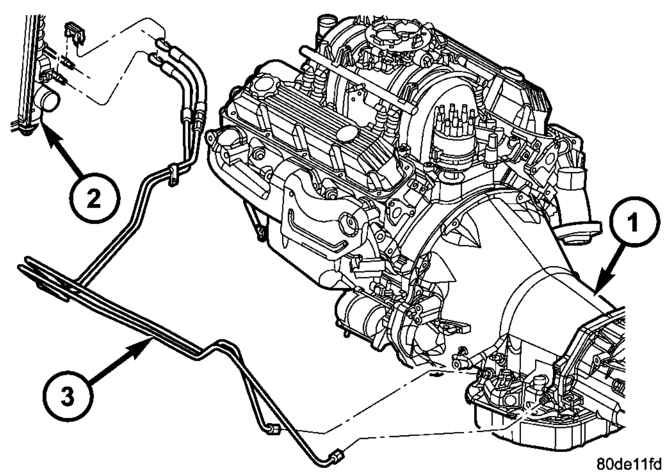


Fig. 67 Transmission Cooler Lines

1 - TRANSMISSION
2 - RADIATOR
3 - COOLER LINES

(27) Install any exhaust components previously removed.

(28) Align and connect propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(29) Adjust gearshift cable and throttle valve cable, if necessary.

(30) Install the transfer case skid plate, if equipped.

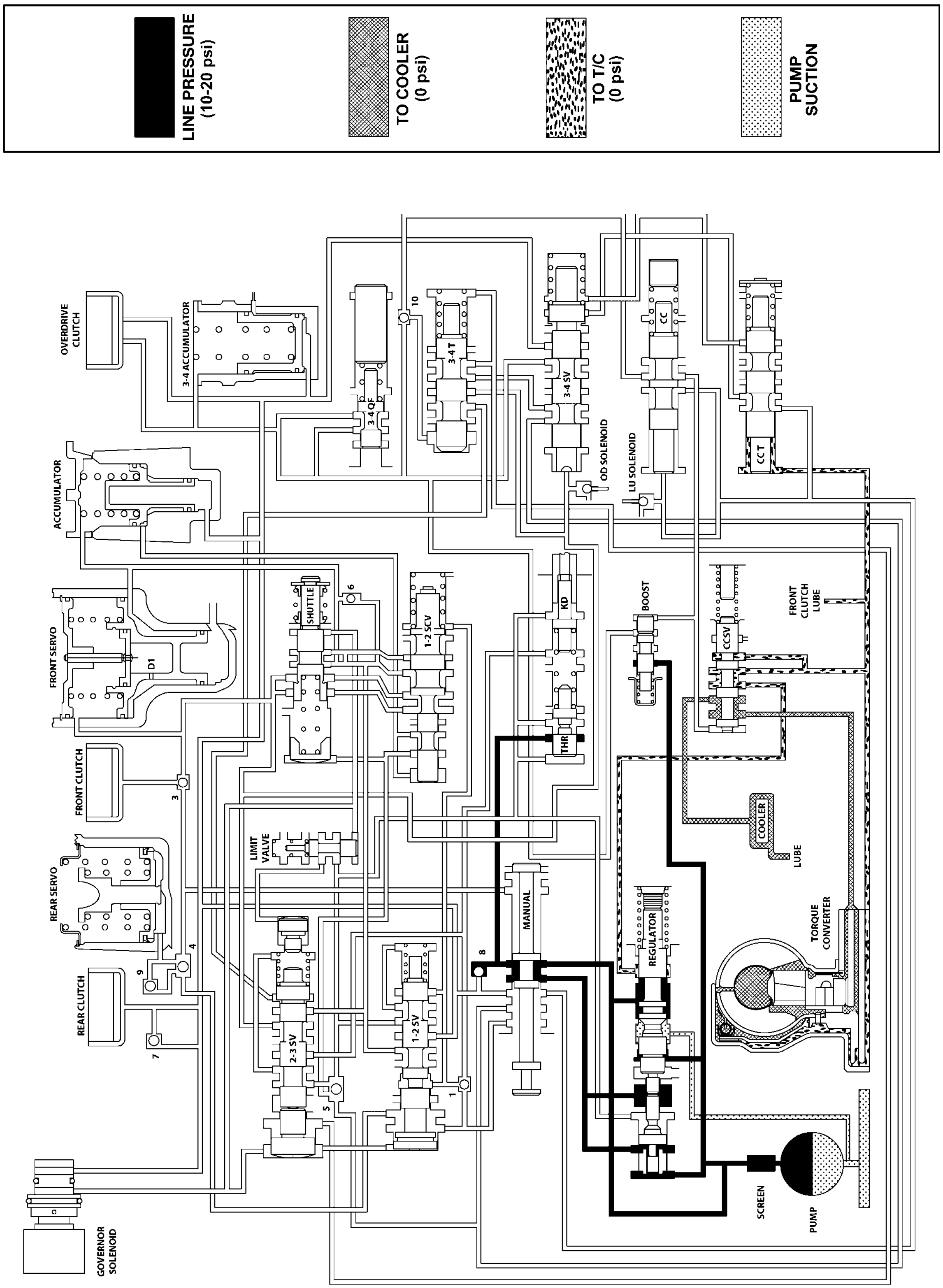
(31) Lower vehicle.

(32) Fill transmission with Mopar® ATF +4, Automatic Transmission fluid.

AUTOMATIC TRANSMISSION - 48RE (Continued)

SCHEMATICS AND DIAGRAMS

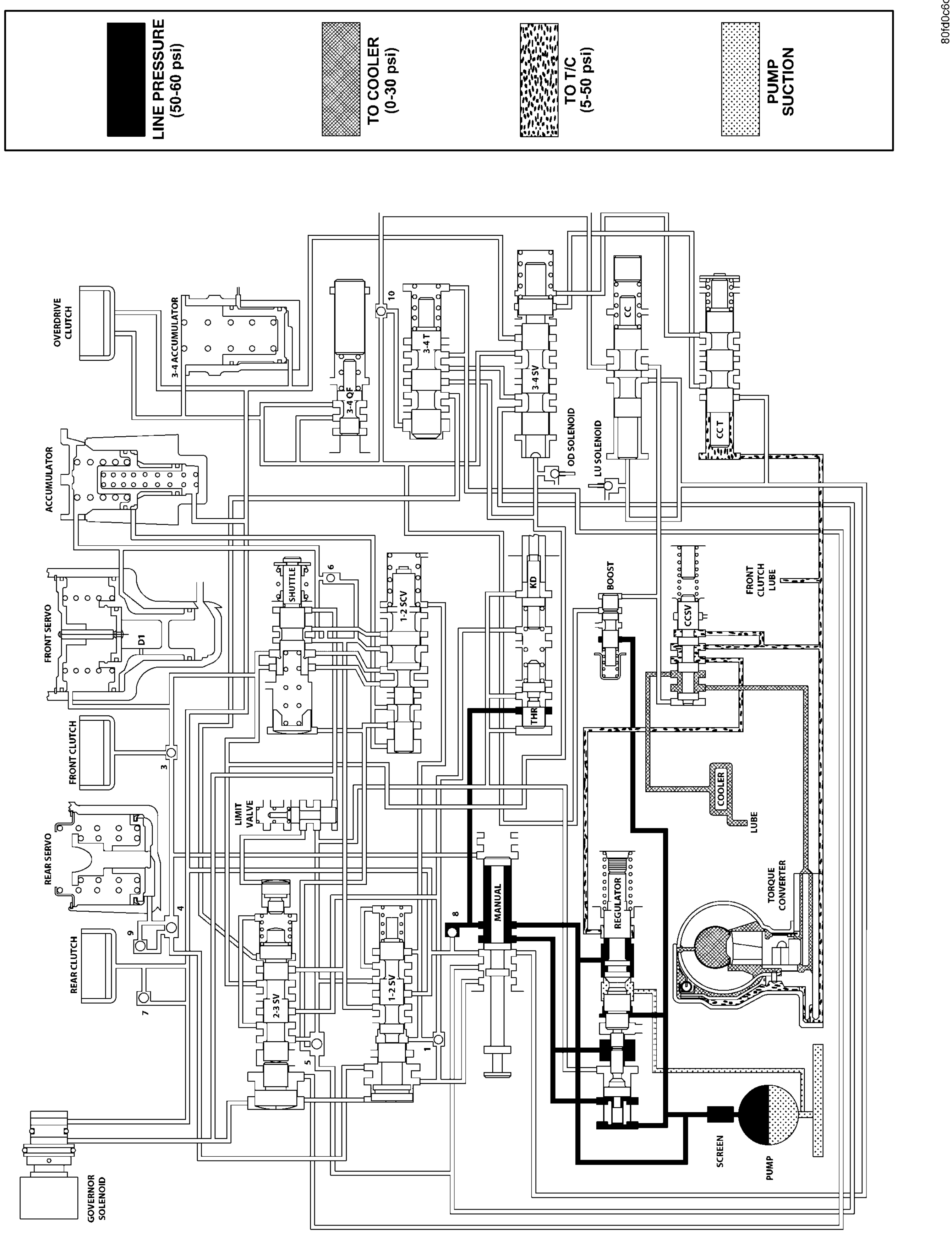
HYDRAULIC SCHEMATICS



80fd0c6b

HYDRAULIC FLOW IN PARK

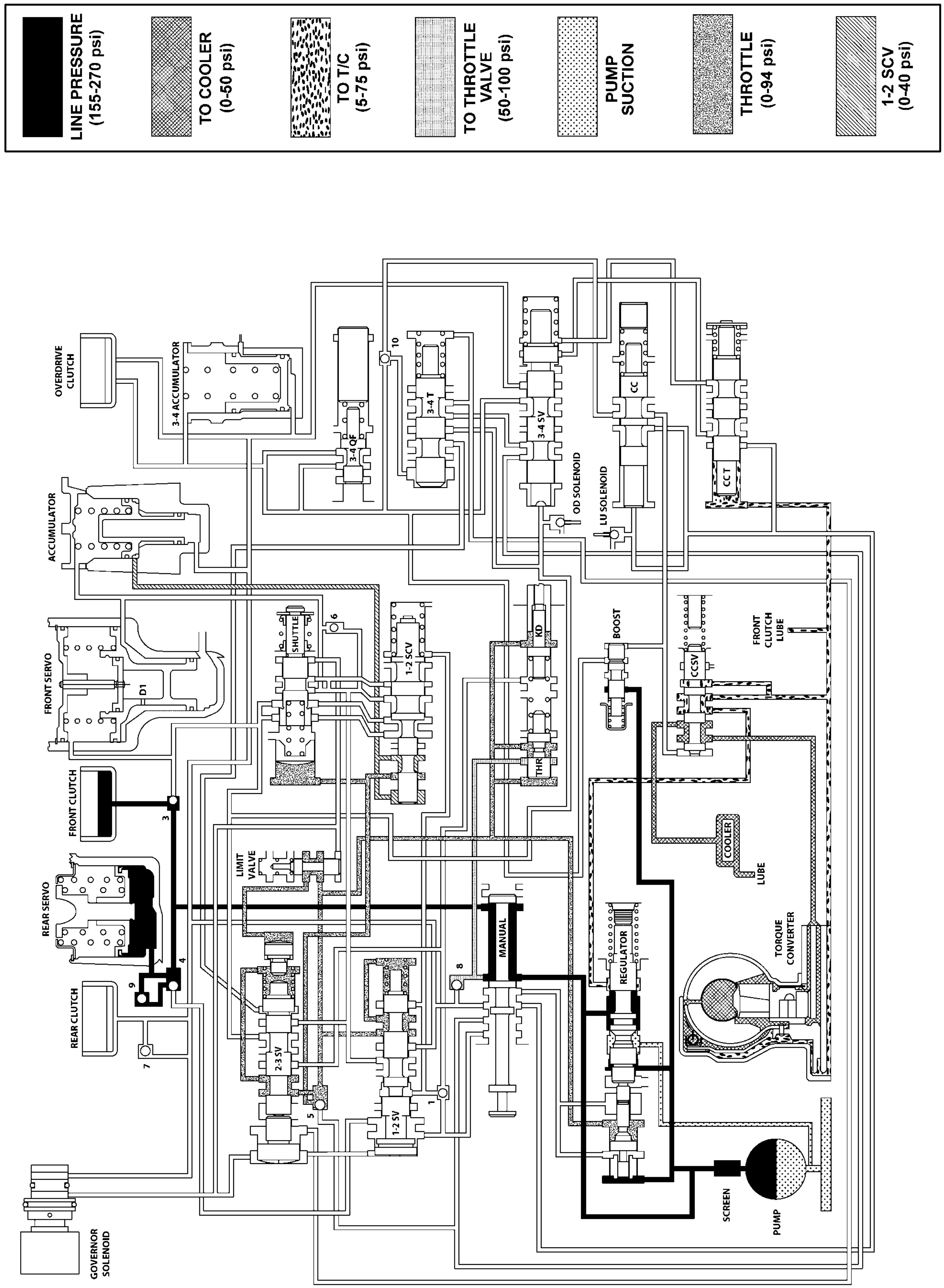
AUTOMATIC TRANSMISSION - 48RE (Continued)



HYDRAULIC FLOW IN NEUTRAL

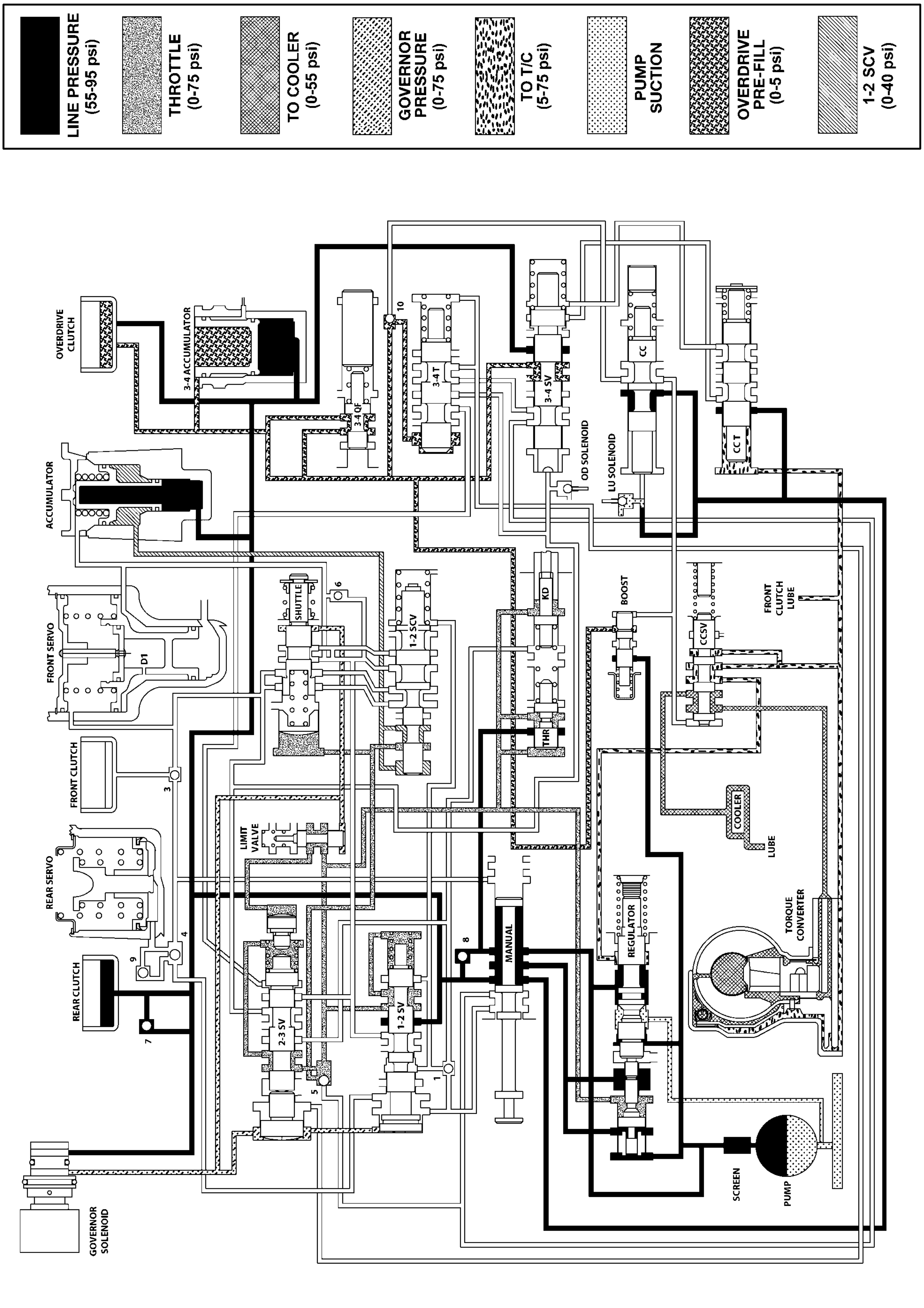
AUTOMATIC TRANSMISSION - 48RE (Continued)

80fd0c6d



HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 48RE (Continued)



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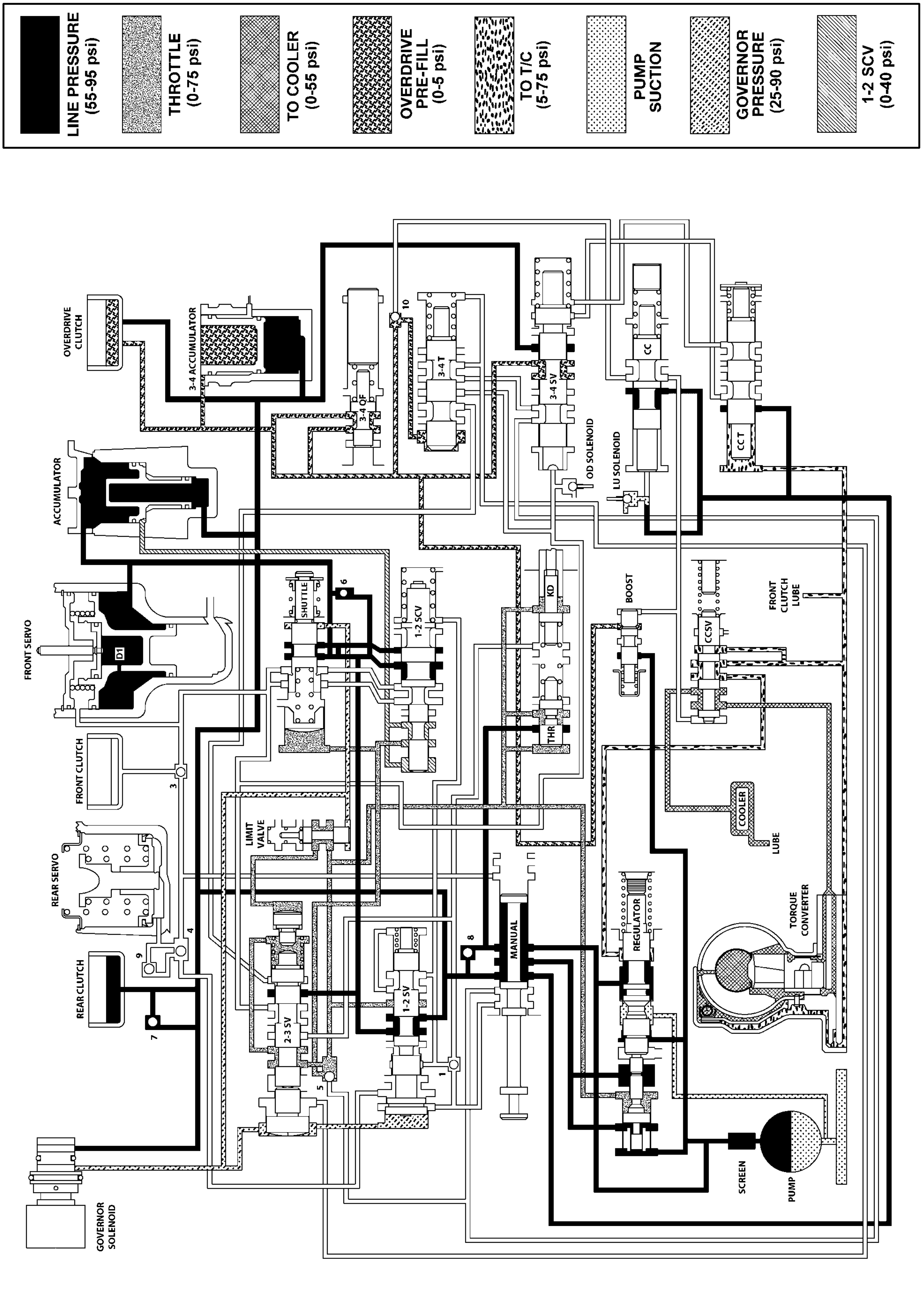
HYDRAULIC FLOW IN DRIVE FIRST GEAR

AUTOMATIC TRANSMISSION - 48RE (Continued)



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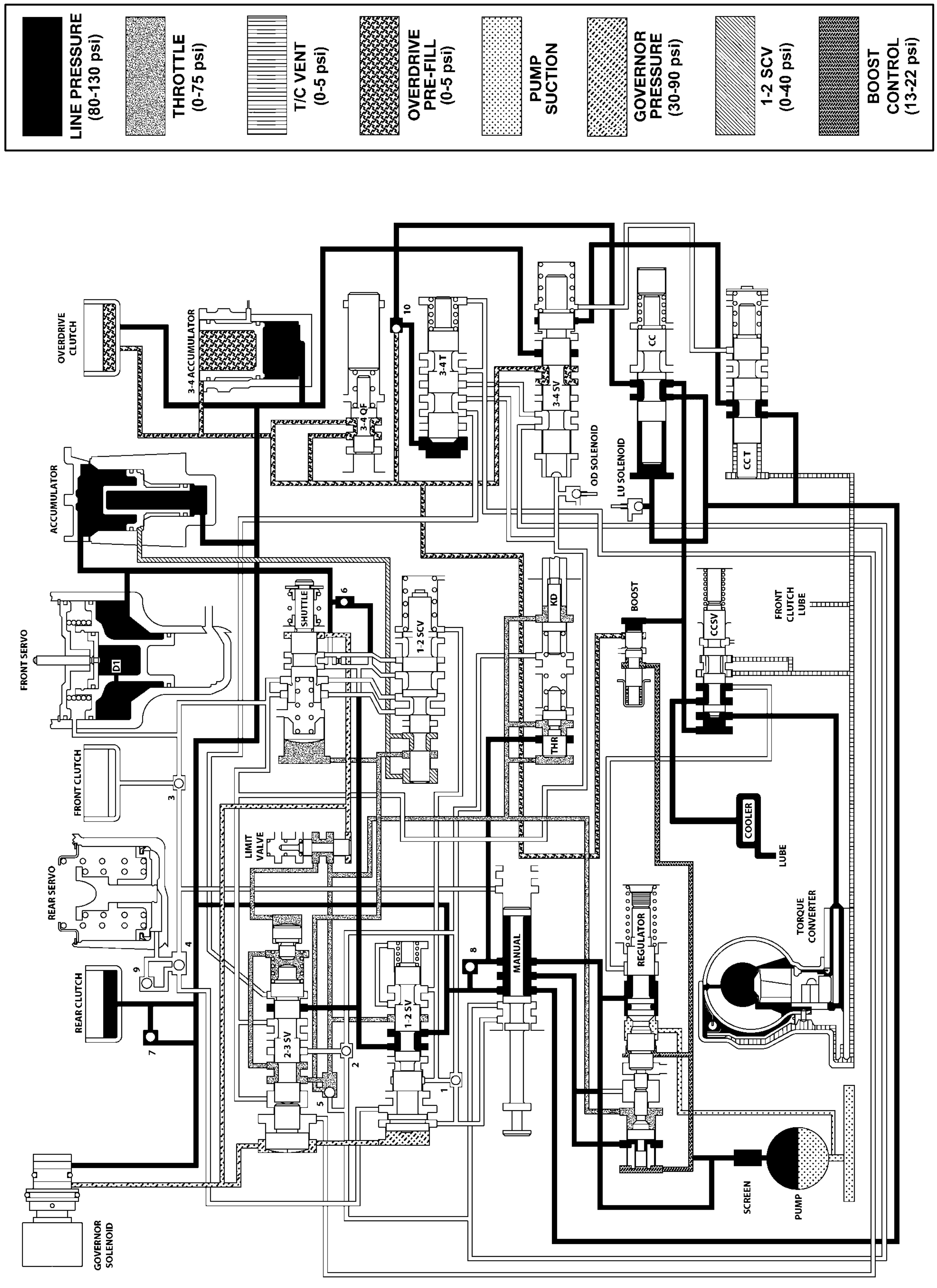
HYDRAULIC FLOW IN DRIVE SECOND GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 48RE (Continued)

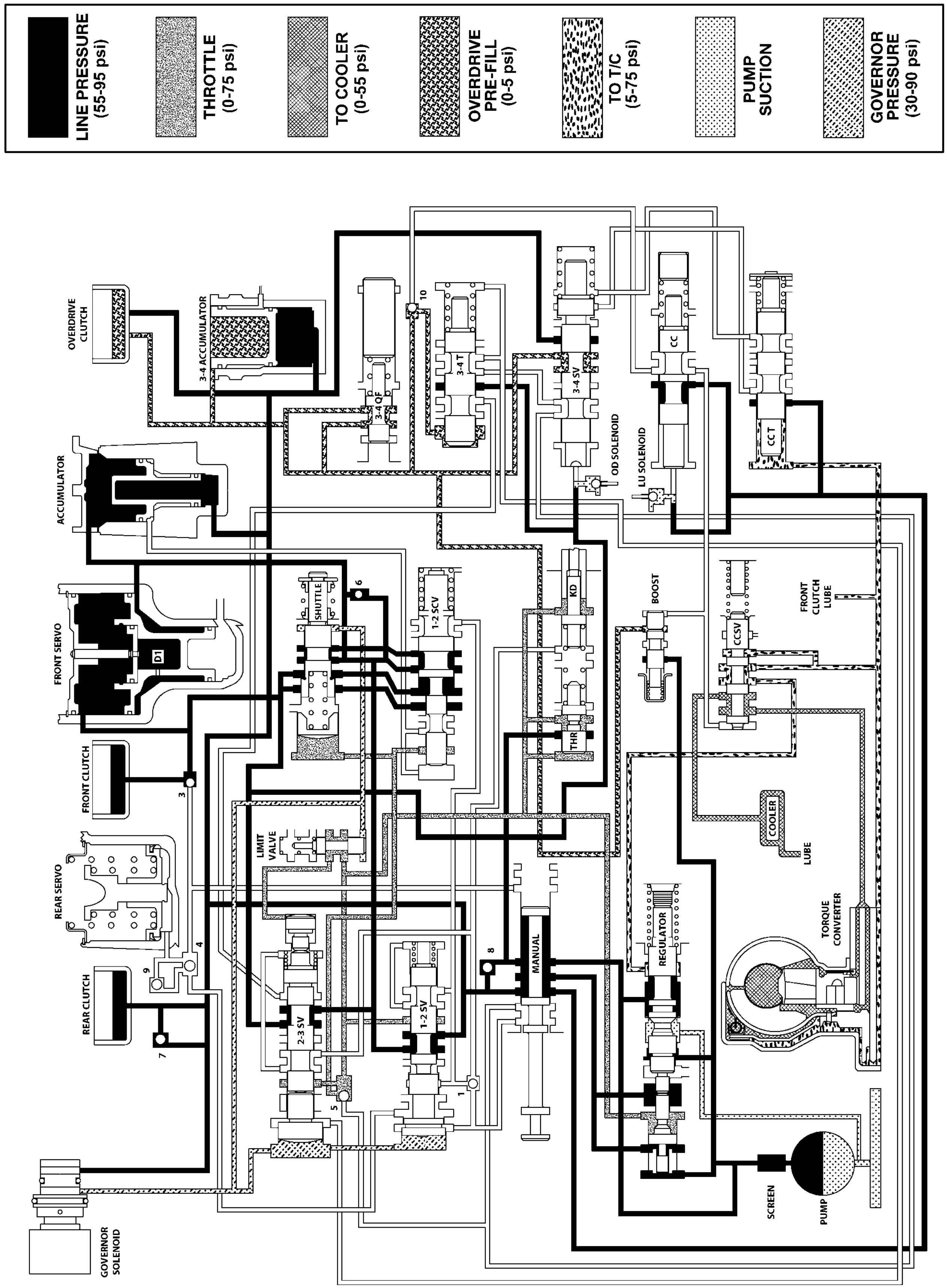


81004dd9

HYDRAULIC FLOW IN DRIVE SECOND GEAR (CONVERTER CLUTCH APPLIED)

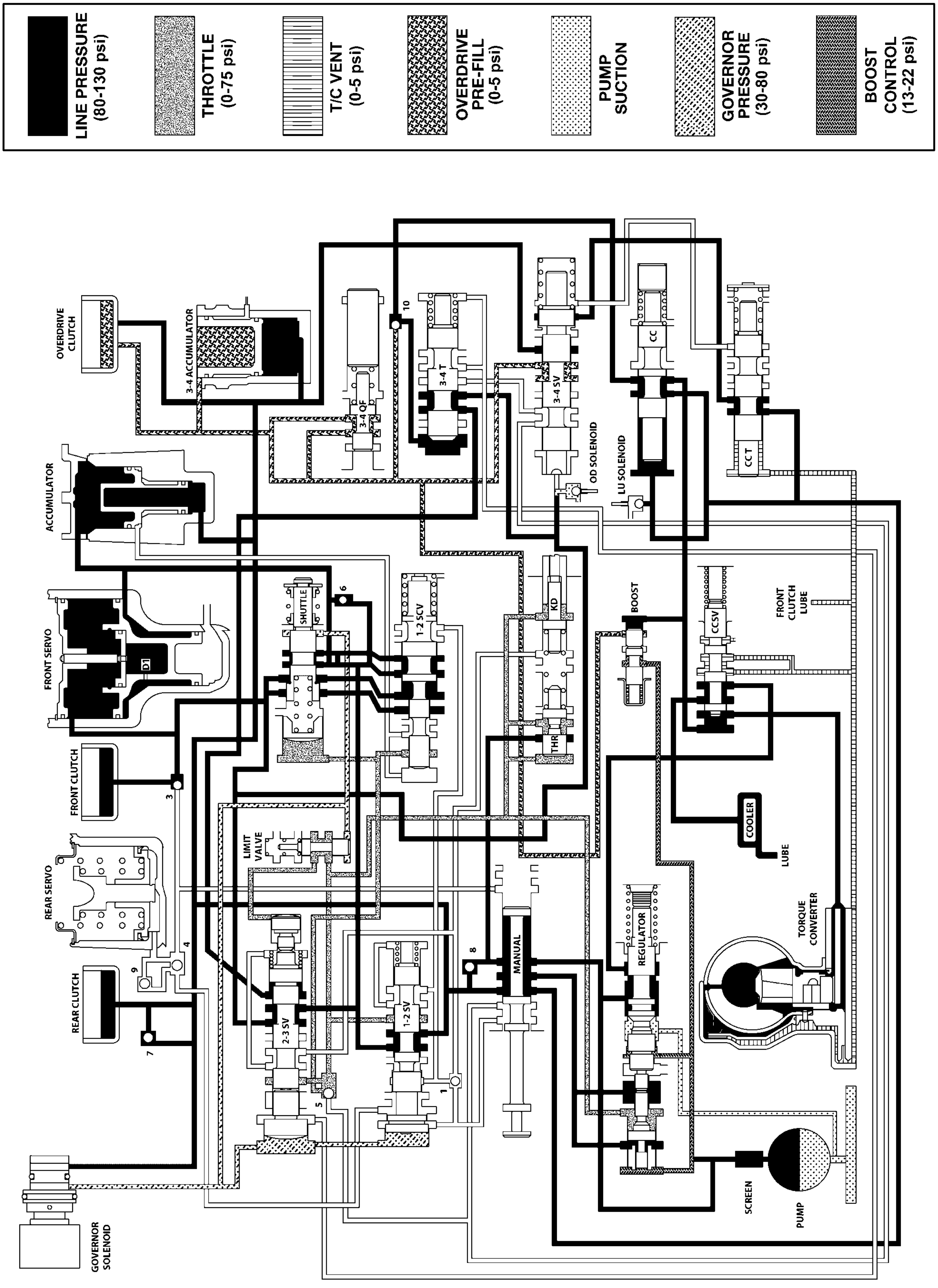
AUTOMATIC TRANSMISSION - 48RE (Continued)

80fd0c76



HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 48RE (Continued)



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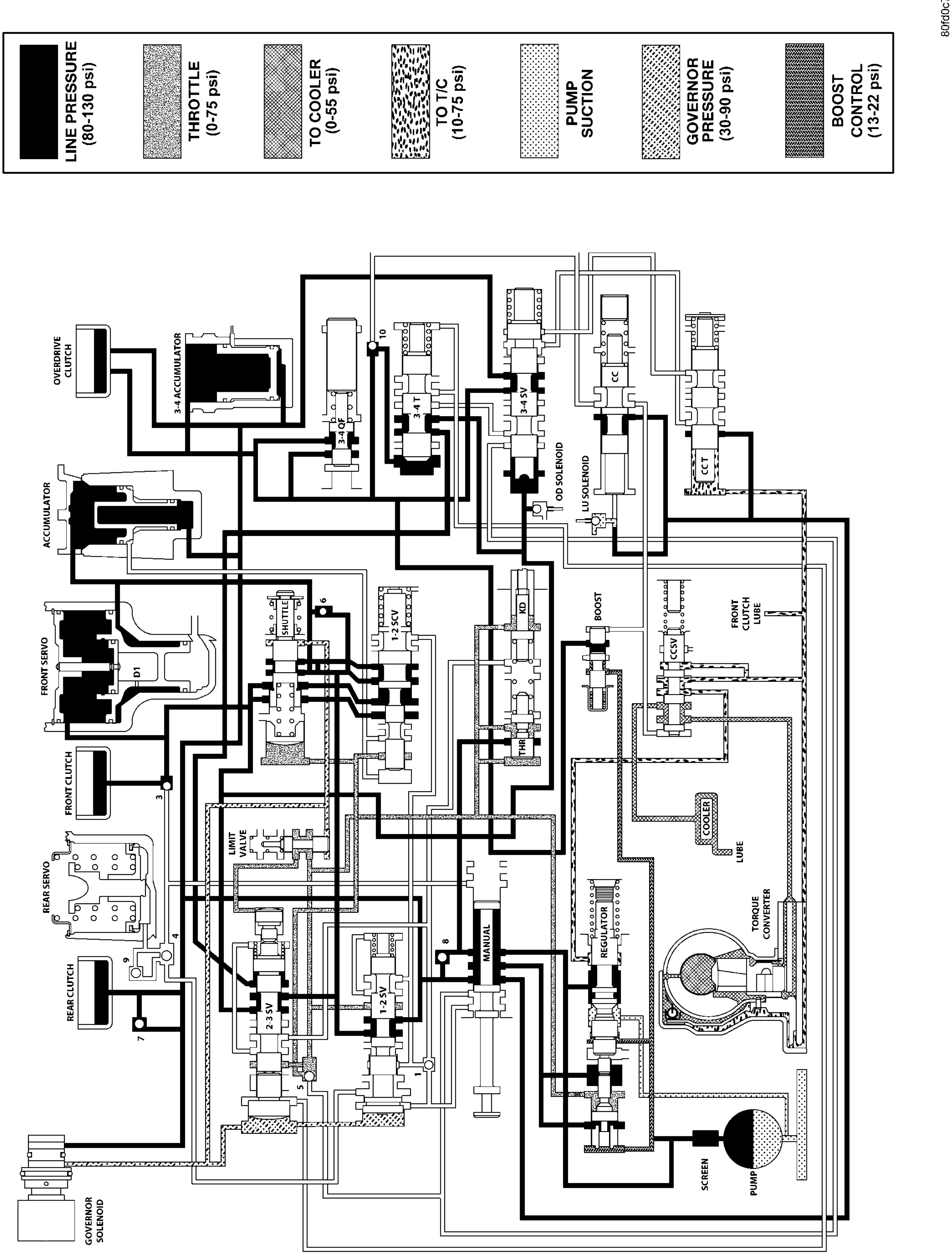
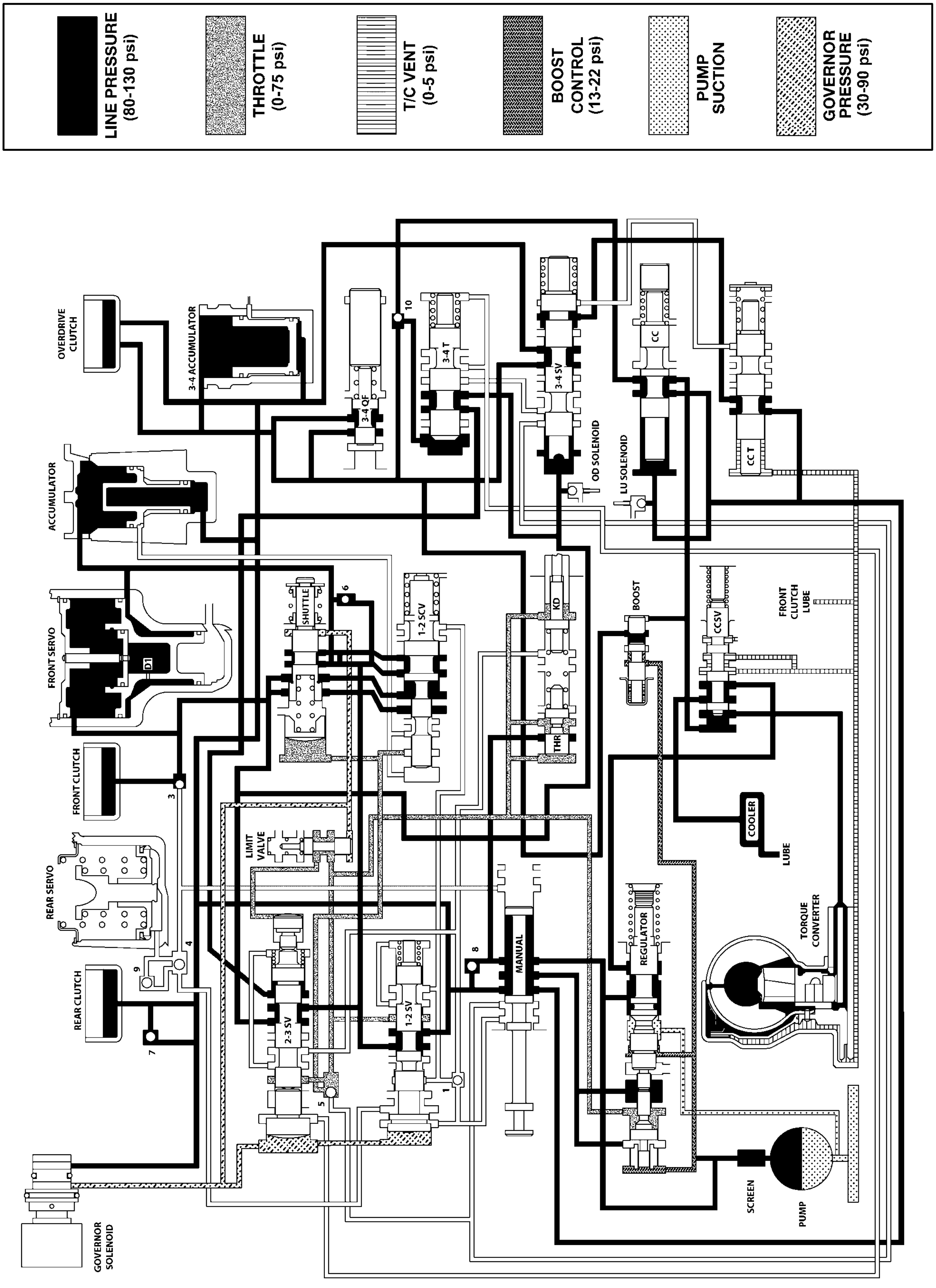
HYDRAULIC FLOW IN DRIVE THIRD GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 48RE (Continued)



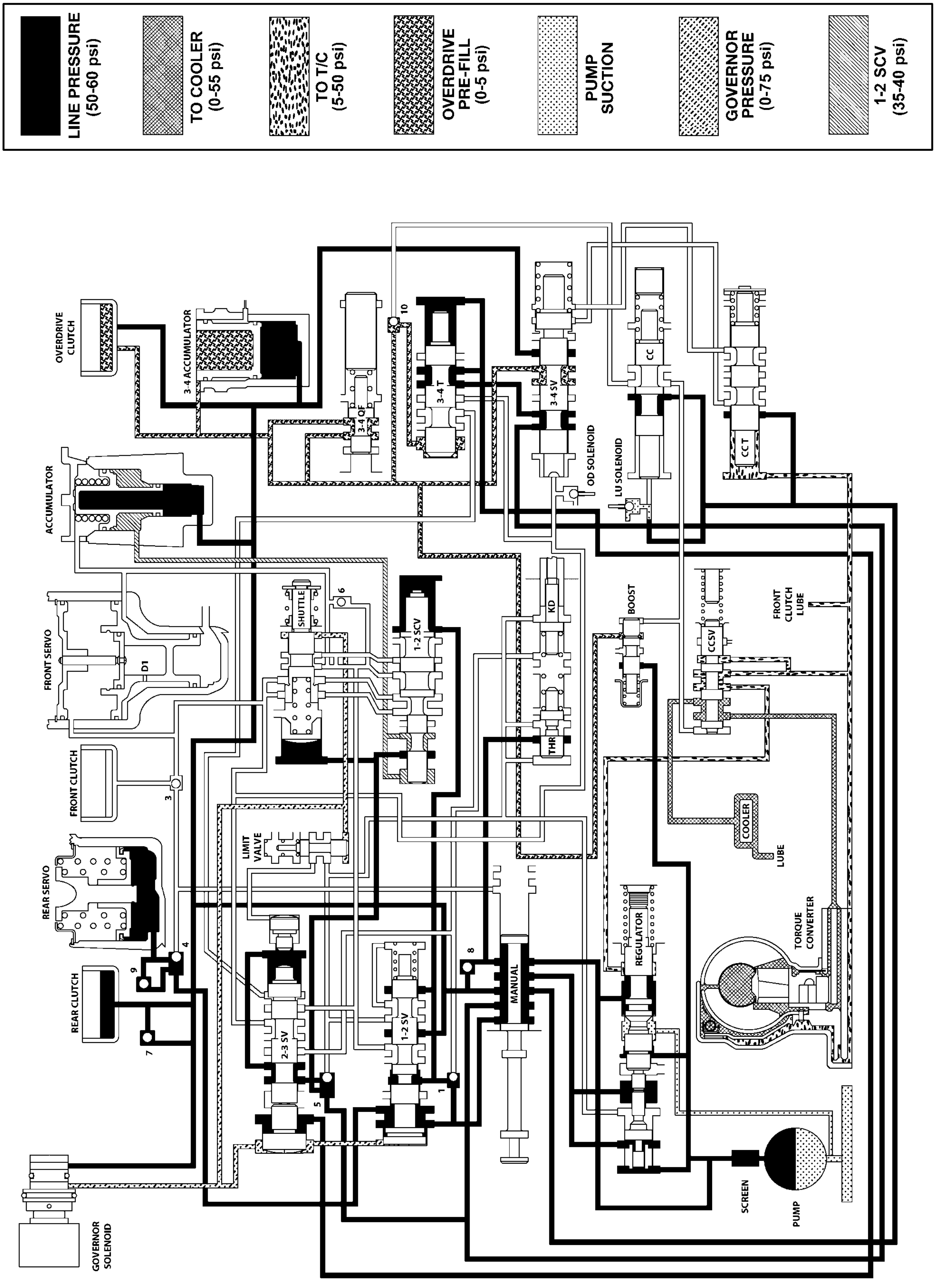
HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH NOT APPLIED)

AUTOMATIC TRANSMISSION - 48RE (Continued)



HYDRAULIC FLOW IN DRIVE FOURTH GEAR (CONVERTER CLUTCH APPLIED)

AUTOMATIC TRANSMISSION - 48RE (Continued)



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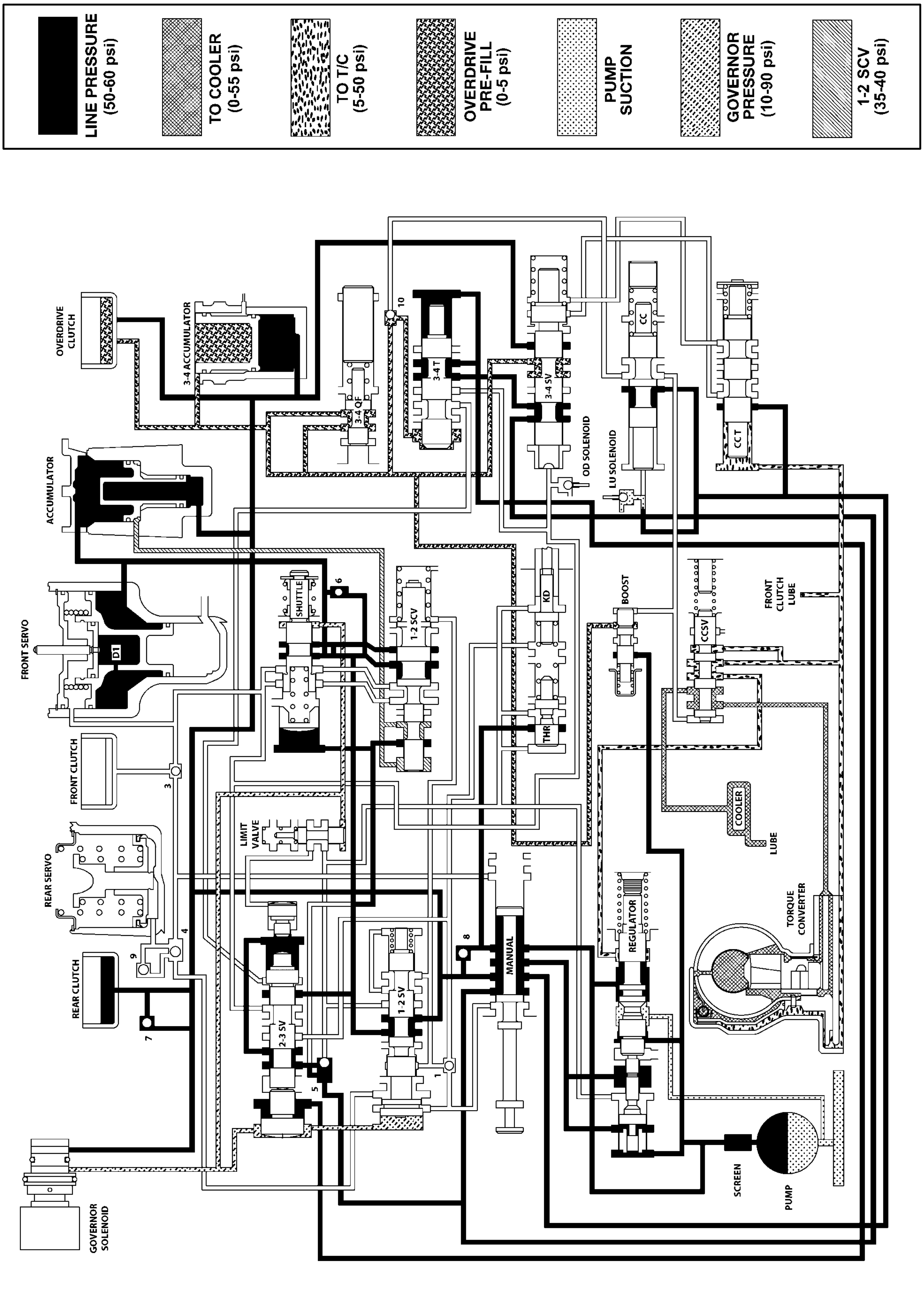
HYDRAULIC FLOW IN MANUAL LOW (1)

AUTOMATIC TRANSMISSION - 48RE (Continued)



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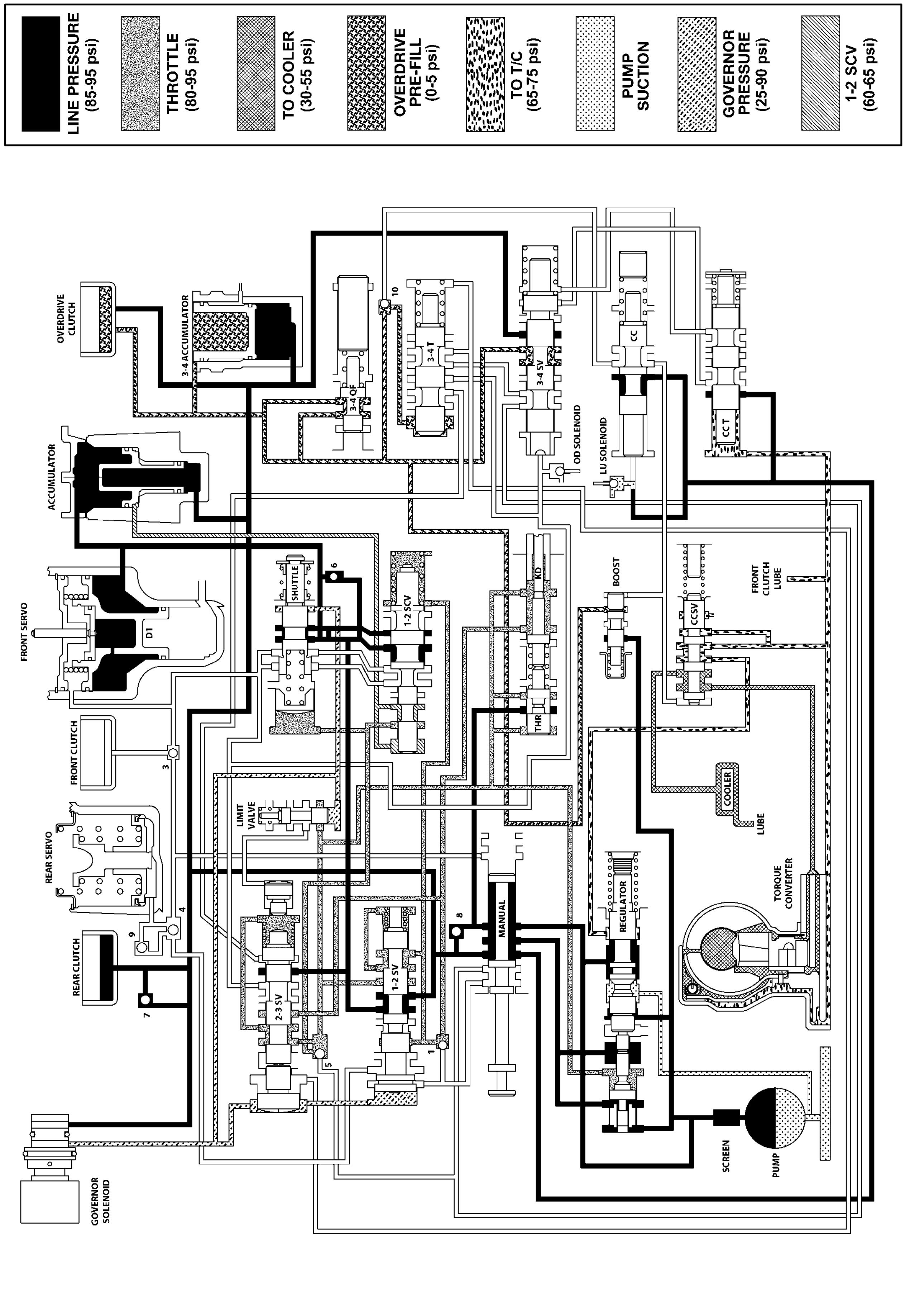
HYDRAULIC FLOW IN MANUAL SECOND (2)

AUTOMATIC TRANSMISSION - 48RE (Continued)



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HYDRAULIC FLOW DURING FULL THROTTLE 3-2 DOWNSHIFT (PASSING GEAR)

AUTOMATIC TRANSMISSION - 48RE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Planetary end play	0.150-1.22 mm	0.006-0.048 in.
Input shaft end play	0.86-2.13 mm	0.034-0.084 in.
Clutch pack clearance/ Front.	2.5-4.09 mm	0.098-0.161 in.
Clutch pack clearance/ Rear.	0.635-0.914 mm	0.025-0.036 in.
Front clutch	5 discs	
Rear clutch	4 discs	
Overdrive clutch	5(STD) or 6 (HO) discs	
Direct clutch	23 single sided discs	
Band adjustment from 72 in. lbs.		
Front band	Back off 1 3/4 turns	
Rear band	Back off 3 turns	
Recommended fluid	Mopar® ATF +4, Automatic Transmission Fluid	

GEAR RATIOS

1ST GEAR	2.45:1
2ND GEAR	1.45:1
3RD GEAR	1.00:1
4TH GEAR	0.69:1
REVERSE	2.21:1

THRUST WASHER/SPACER/SNAP-RING DIMENSIONS

Component	Metric	Inch
Front clutch thrust washer (reaction shaft support hub)	1.55 mm	0.061 in.
	2.15 mm	0.084 in.
	2.59 mm	0.102 in.
Rear clutch thrust washer (clutch retainer)	1.55 mm	0.061 in.
Intermediate shaft thrust plate (shaft hub pilot)	1.5-1.6 mm	0.060-0.063 in.
Output shaft thrust washer (rear clutch hub)	1.3-1.4 mm	0.052-0.054 in.
	1.75-1.8 mm	0.068-0.070 in.
	2.1-2.2 mm	0.083-0.085 in.
Rear clutch pack snap-ring	1.5-1.6 mm	0.060-0.062 in.
	1.9-1.95 mm	0.074-0.076 in.
Planetary geartrain snap-ring (at front of output shaft)	1.4-1.5 mm	0.055-0.059 in.
	1.6-1.7 mm	0.062-0.066 in.
Overdrive piston thrust plate	Thrust plate and spacer are select fit. Refer to size charts and selection procedures in Overdrive Unit D&A procedures	
Intermediate shaft spacer		

AUTOMATIC TRANSMISSION - 48RE (Continued)

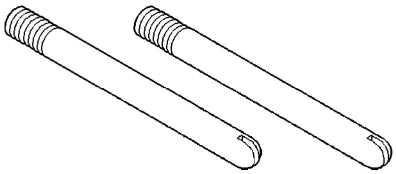
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	18	13	-
Bolt, torque convertor	31	-	270
Bolt, clevis bracket to crossmember	47	35	-
Bolt, clevis bracket to rear support	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Plug, front band reaction	17	13	-
Locknut, front band adj.	34	25	-
Bolt, fluid pan	17	13	-
Screws, fluid filter	4	-	35
Bolt, oil pump	20	15	-
Bolt, overrunning clutch cam	17	13	-
Bolt, O/D to trans.	34	25	-
Bolt, O/D piston retainer	17	13	-
Plug, pressure test port	14	10	-
Bolt, reaction shaft support	20	15	-
Locknut, rear band	41	30	-
Bolt, valve body to case	12	-	100
Sensor, trans speed	27	20	-
Screw, solenoid wiring connector	4	-	35
Screw, solenoid to transfer plate	4	-	35
Bracket, transmission range sensor mounting	34	-	300
Screw, transmission range sensor to mounting bracket	3.4	-	30

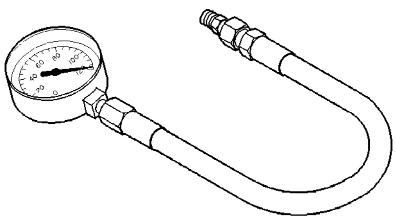
AUTOMATIC TRANSMISSION - 48RE (Continued)

SPECIAL TOOLS

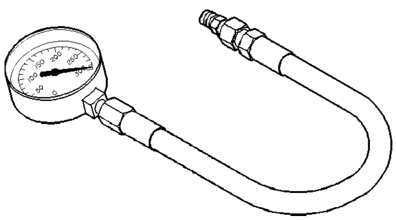
RE TRANSMISSION



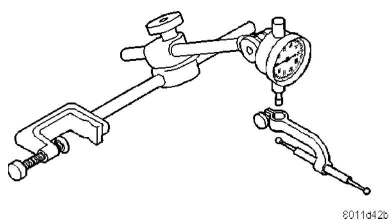
Studs, Oil Pump Pilot - C-3288-B



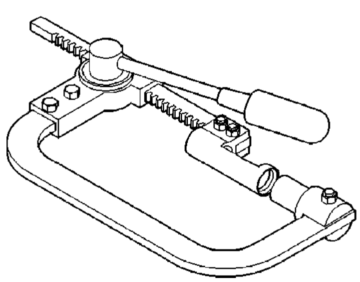
Gauge, Pressure - C-3292



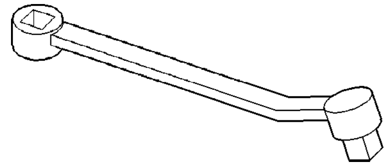
Gauge, Pressure - C-3293SP



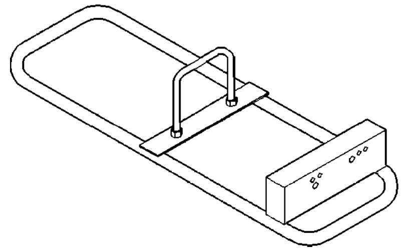
Set, Dial Indicator - C-3339



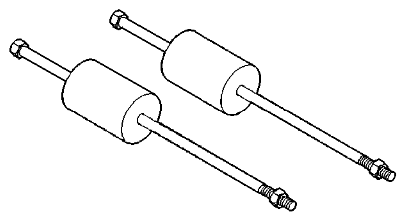
Compressor, Spring - C-3422-B



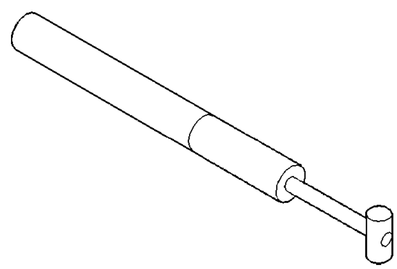
Adapter, Band Adjuster - C-3705



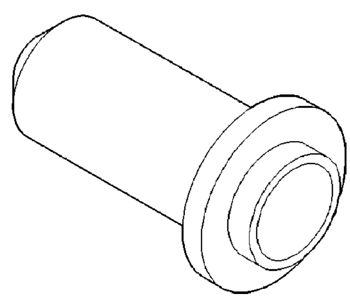
Stand, Transmission Repair - C-3750-B



Puller, Slide Hammer - C-3752

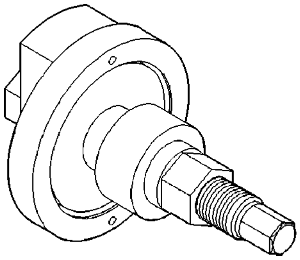


Gauge, Throttle Setting - C-3763

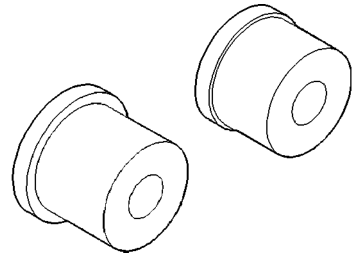


Installer, Seal - C-3860-A

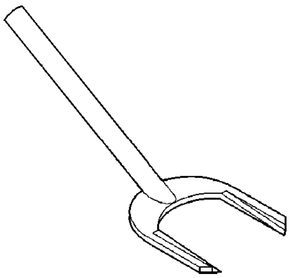
AUTOMATIC TRANSMISSION - 48RE (Continued)



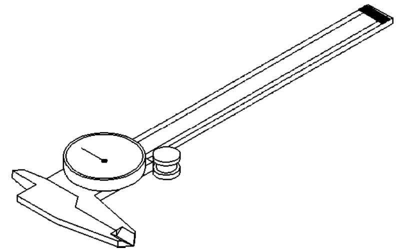
Compressor, Spring - C-3863-A



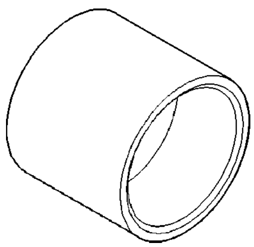
Remover/Installer, Bushing - C-4470



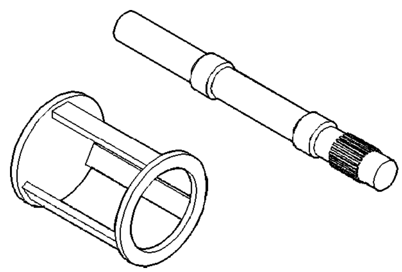
Remover, Seal - C-3985-B



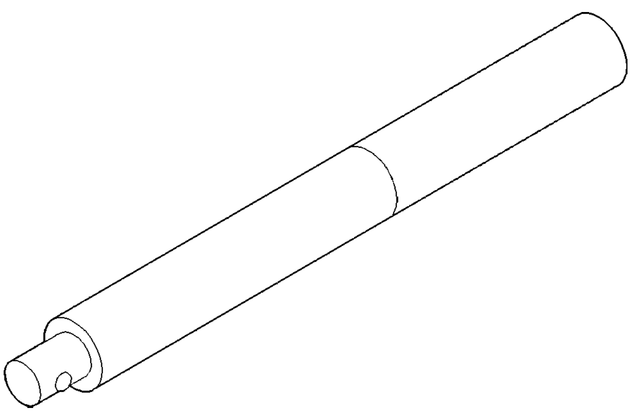
Dial Caliper - C-4962



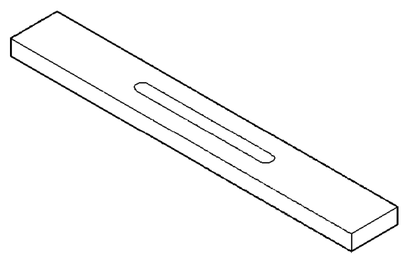
Installer, Seal - C-3995-A



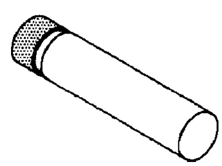
Spring Compressor and Alignment Shaft - 6227



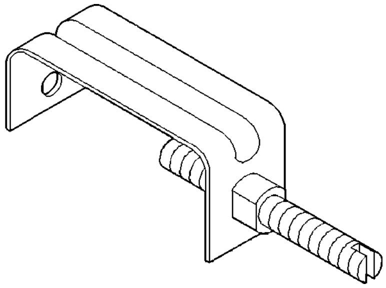
Handle, Universal - C-4171



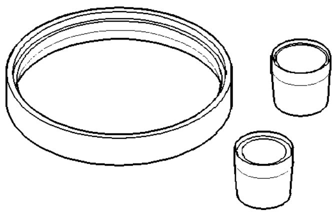
Bar, Gauge - 6311



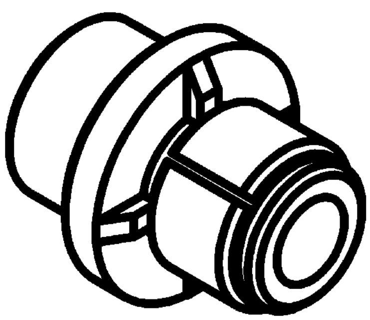
Gauge, Block - 6312



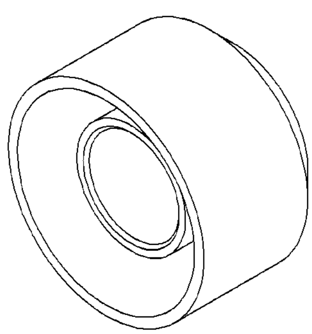
Retainer, Detent Ball and Spring - 6583



Installer, Overdrive Piston Seal - 8114



Socket, TRS Mounting Bracket - 8581



Installer, Seal - 9037

ACCUMULATOR

DESCRIPTION

The accumulator (Fig. 68) is a hydraulic device that has the sole purpose of cushioning the application of a band or clutch. The accumulator consists of a dual-land piston and a spring located in a bore in the transmission case. The 3-4 accumulator is located in a housing attached to the side of the valve body (Fig. 69).

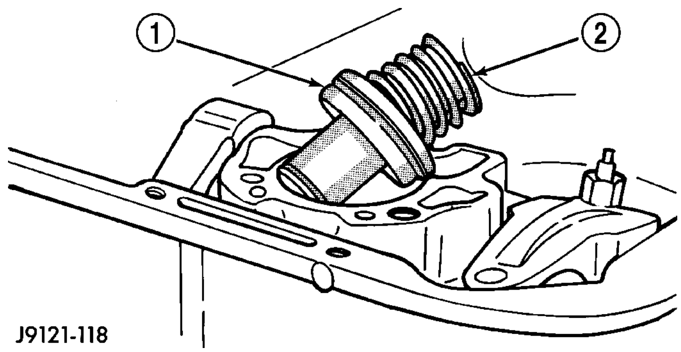


Fig. 68 Accumulator

1 - ACCUMULATOR PISTON
2 - PISTON SPRING

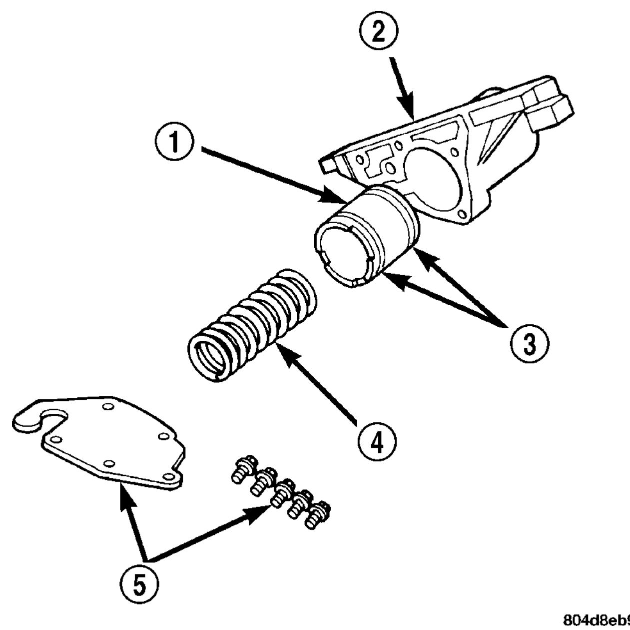


Fig. 69 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

ACCUMULATOR (Continued)

OPERATION

Both the accumulator and the 3-4 accumulator function the same. Line pressure is directed to the small end of the piston when the transmission is placed into a DRIVE position (Fig. 70), bottoming it against the accumulator plate. When the 1-2 upshift occurs (Fig. 71), line pressure is directed to the large end of the piston and then to the kickdown servo. As the line pressure reaches the accumulator, the combination of spring pressure and line pressure forces the piston away from the accumulator plate. This causes a balanced pressure situation, which results in a cushioned band application. After the kickdown servo has become immovable, line pressure will finish pushing the accumulator up into its bore. When the large end of the accumulator piston is seated in its bore, the band or clutch is fully applied.

NOTE: The accumulator is shown in the inverted position for illustrative purposes.

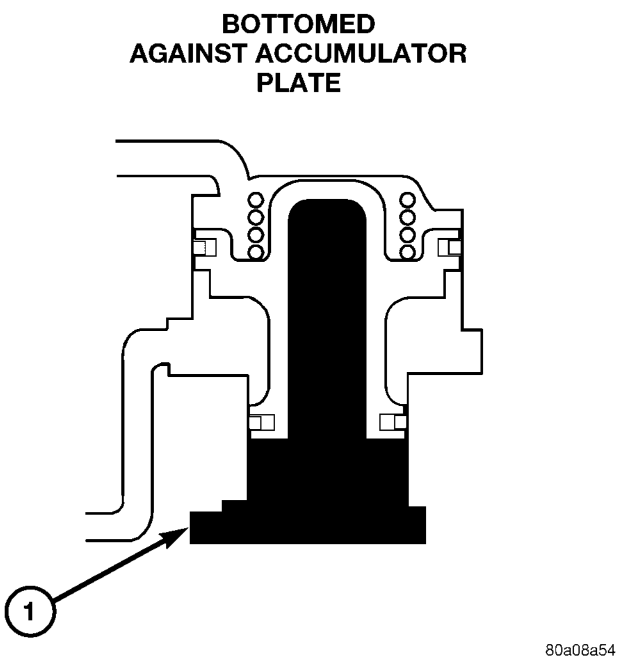


Fig. 70 Accumulator in DRIVE - FIRST Gear Position

1 - LINE PRESSURE

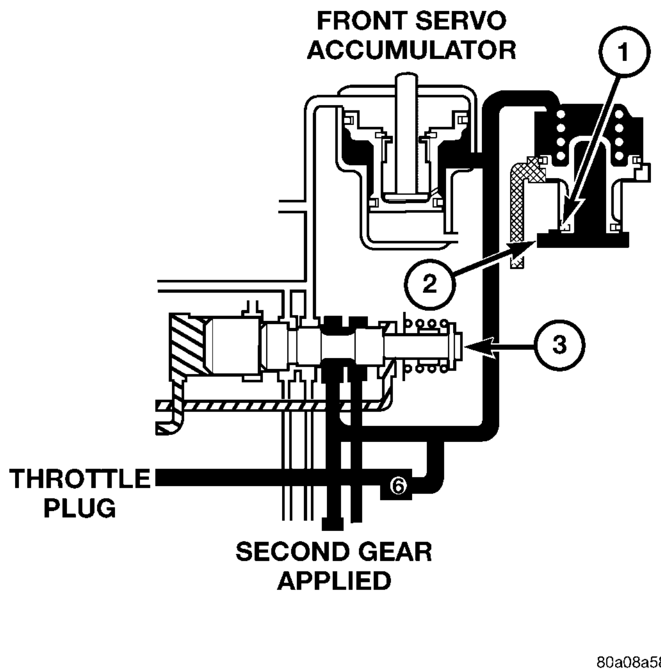


Fig. 71 Accumulator in SECOND Gear Position

1 - BOTTOM OF BORE
2 - LINE PRESSURE
3 - SHUTTLE VALVE

INSPECTION

Inspect the accumulator piston and seal rings. Replace the seal rings if worn or cut. Replace the piston if chipped or cracked.

Check condition of the accumulator spring. Replace the spring if the coils are cracked, distorted or collapsed.

BANDS

DESCRIPTION

KICKDOWN (FRONT) BAND

The kickdown, or “front”, band (Fig. 72) holds the common sun gear of the planetary gear sets. The front (kickdown) band is made of steel, and faced on its inner circumference with a friction-type lining. One end of the band is anchored to the transmission case, and the other is acted on with a pushing force by a servo piston. The front band is a single-wrap design (the band does not completely encompass/wrap the drum that it holds).

BANDS (Continued)

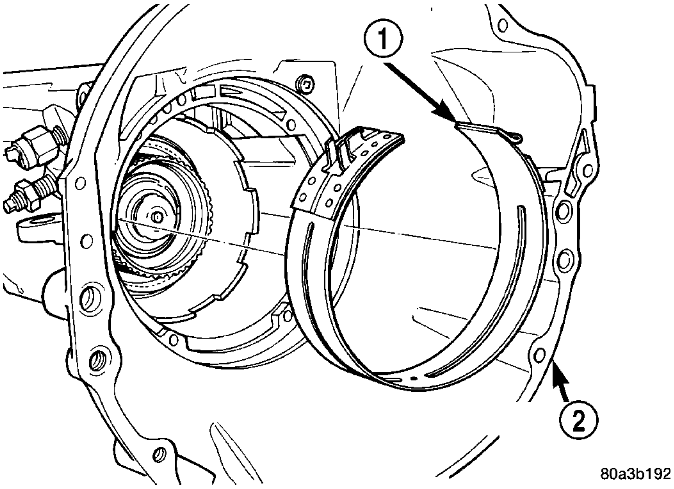


Fig. 72 Front Band

1 - FRONT BAND
2 - TRANSMISSION HOUSING

LOW/REVERSE (REAR) BAND

The low/reverse band, or "rear", band (Fig. 73) is similar in appearance and operation to the front band. The rear band is slightly different in that it does not use a link bar, but is acted directly on by the apply lever. This is referred to as a double-wrap band design (the drum is completely encompassed/wrapped by the band). The double-wrap band provides a greater holding power in comparison to the single-wrap design.

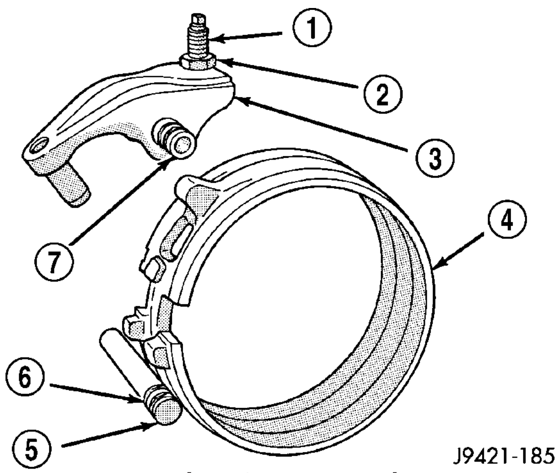


Fig. 73 Rear Band

1 - ADJUSTING SCREW
2 - LOCKNUT
3 - LEVER
4 - REAR BAND
5 - REACTION PIN
6 - O-RINGS
7 - PIVOT PIN

OPERATION

KICKDOWN (FRONT) BAND

The kickdown band holds the common sun gear of the planetary gear sets by applying and holding the front clutch retainer, which is splined to the sun gear driving shell, and in turn splined directly to the sun gear. The application of the band by the servo is typically done by an apply lever and link bar.

LOW/REVERSE (REAR) BAND

The rear band holds the rear planet carrier stationary by being mounted around and applied to the low/reverse drum.

ADJUSTMENTS

ADJUSTMENT - BANDS

FRONT BAND

The front (kickdown) band adjusting screw is located on the left side of the transmission case above the manual valve and throttle valve levers.

(1) Raise vehicle.

(2) Loosen band adjusting screw locknut (Fig. 74). Then back locknut off 3-5 turns. Be sure adjusting screw turns freely in case. Apply lubricant to screw threads if necessary.

(3) Tighten band adjusting screw to 8 N·m (72 in. lbs.) torque with Inch Pound Torque Wrench C-3380-A, a 3-in. extension and an appropriate Torx™ socket.

CAUTION: If Adapter C-3705 is needed to reach the adjusting screw, tighten the screw to only 5 N·m (47-50 in. lbs.) torque.

(4) Back off front band adjusting screw 1-3/4 turns.

(5) Hold adjuster screw in position and tighten locknut to 41 N·m (30 ft. lbs.) torque.

(6) Lower vehicle.

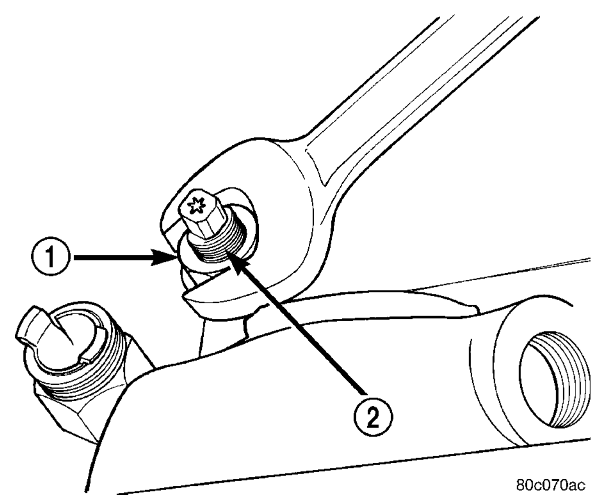


Fig. 74 Front Band Adjustment Screw Location

1 - LOCK-NUT
2 - FRONT BAND ADJUSTER

BANDS (Continued)

REAR BAND

The transmission oil pan must be removed for access to the rear band adjusting screw.

(1) Raise vehicle.

(2) Remove transmission oil pan and drain fluid.

(3) Loosen band adjusting screw locknut 5-6 turns. Be sure adjusting screw turns freely in lever.

(4) Tighten adjusting screw to 8 N·m (72 in. lbs.) torque (Fig. 75).

(5) Back off adjusting screw 3 turns.

(6) Hold adjusting screw in place and tighten locknut to 34 N·m (25 ft. lbs.) torque.

(7) Position new gasket on oil pan and install pan on transmission. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(8) Lower vehicle and refill transmission with Mopar® ATF +4, Automatic Transmission fluid.

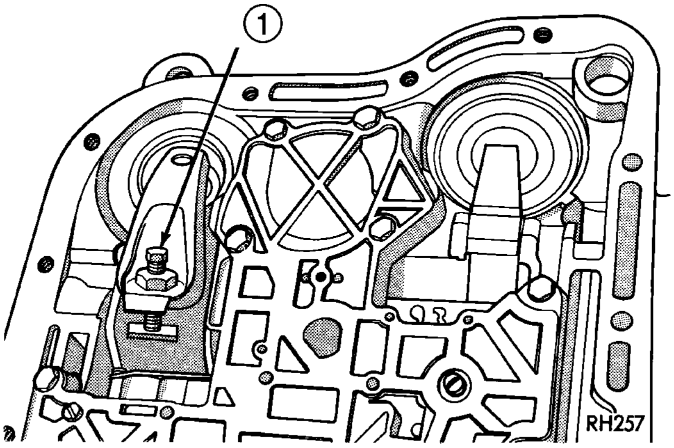


Fig. 75 Rear Band Adjustment Screw Location

1 - LOW-REVERSE BAND ADJUSTMENT

BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM

DESCRIPTION

The Brake Transmission Shifter Interlock (BTSI) (Fig. 76), is a solenoid operated system. It consists of a solenoid permanently mounted on the gearshift cable.

OPERATION

The system locks the shifter into the PARK position. The interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed approximately one-half an inch. A magnetic holding device in line with the park lock cable is energized when the ignition is in the RUN position. When the key is in the RUN position and the brake pedal is depressed, the shifter is

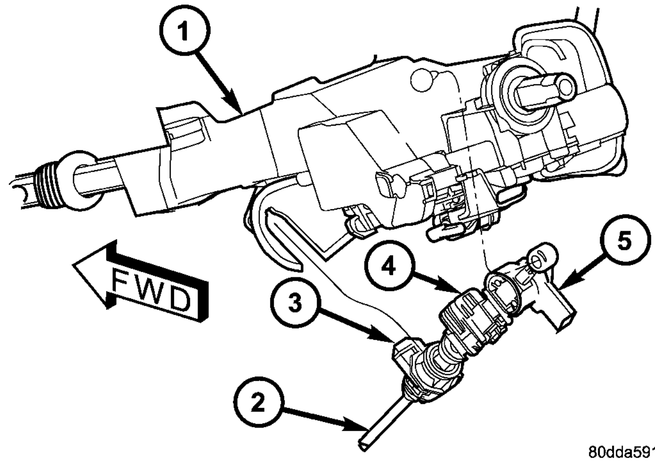


Fig. 76 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position, unless the shifter is fully locked into the PARK position.

DIAGNOSIS AND TESTING - BRAKE TRANSMISSION SHIFT INTERLOCK

(1) Verify that the key can only be removed in the PARK position

(2) When the shift lever is in PARK And the shift handle pushbutton is in the “OUT” position, the ignition key cylinder should rotate freely from OFF to LOCK. When the shifter is in any other gear or neutral position, the ignition key cylinder should not rotate to the LOCK position.

(3) Shifting out of PARK should not be possible when the ignition key cylinder is in the OFF position.

(4) Shifting out of PARK should not be possible while applying normal pushbutton force and ignition key cylinder is in the RUN or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the ACCESSORY or LOCK positions.

(6) Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in RUN or START positions.

ADJUSTMENTS - BRAKE TRANSMISSION SHIFT INTERLOCK

Correct cable adjustment is important to proper interlock operation. The gearshift cable must be correctly adjusted in order to shift out of PARK.

ADJUSTMENT PROCEDURE

(1) Remove the steering column trim as necessary for access to the brake transmission shift interlock.

(2) Shift the transmission into the PARK position.

(3) Pull upward on both the BTSI lock tab and the gearshift cable lock tab (Fig. 77).

(4) Verify that the shift lever is in the PARK position.

(5) Verify positive engagement of the transmission park lock by attempting to rotate the propeller shaft. The shaft will not rotate when the park lock is engaged.

(6) Turn ignition switch to LOCK position. **Be sure ignition key cylinder is in the LOCK position. Cable will not adjust correctly in any other position.**

(7) Ensure that the cable is free to self-adjust by pushing cable rearward and releasing.

(8) Push the gearshift cable lock tab down until it snaps in place.

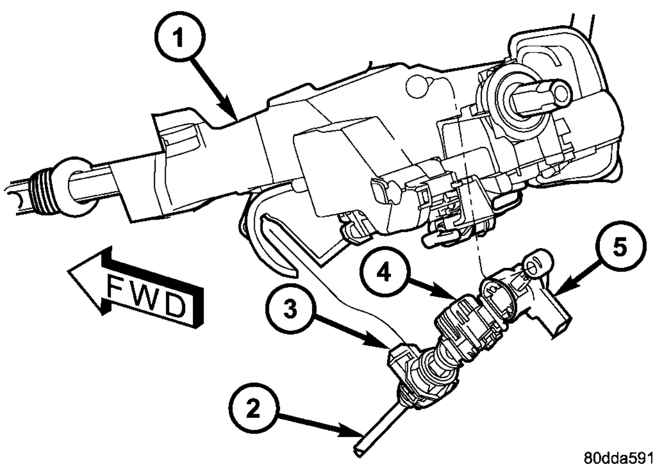


Fig. 77 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

(9) Locate the BTSI alignment hole in the bottom of the BTSI mechanism between the BTSI lock tab and the BTSI connector.

(10) Move the BTSI assembly up or down on the gearshift cable until an appropriate size drill bit can be inserted into the alignment hole and through the assembly.

(11) Push the BTSI lock tab down until it snaps into place and remove the drill bit.

(12) Install any steering column trim previously removed.

BTSI FUNCTION CHECK

(1) Verify removal of ignition key allowed in PARK position only.

(2) When the shift lever is in PARK, the ignition key cylinder should rotate freely from off to lock. When the shifter is in any other position, the ignition key should not rotate from off to lock.

(3) Shifting out of PARK should be possible when the ignition key cylinder is in the off position.

(4) Shifting out of PARK should not be possible while applying normal force, and ignition key cylinder is in the run or start positions, unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the accessory or lock position.

(6) Shifting between any gear and NEUTRAL, or PARK, may be done without depressing foot brake with ignition switch in run or start positions.

(7) Engine starts must be possible with shifter lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any position other than PARK or NEUTRAL.

(8) With shifter lever in the:

- PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.
- PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.
- NEUTRAL position - Normal position. Engine starts must be possible.
- NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

ELECTRONIC GOVERNOR

DESCRIPTION

Governor pressure is controlled electronically. Components used for governor pressure control include:

- Governor body
- Valve body transfer plate
- Governor pressure solenoid valve
- Governor pressure sensor
- Fluid temperature thermistor
- Throttle position sensor (TPS)
- Transmission speed sensor
- Powertrain control module (PCM)

ELECTRONIC GOVERNOR (Continued)

GOVERNOR PRESSURE SOLENOID VALVE

The solenoid valve is a duty-cycle solenoid which regulates the governor pressure needed for upshifts and downshifts. It is an electro-hydraulic device located in the governor body on the valve body transfer plate (Fig. 78).

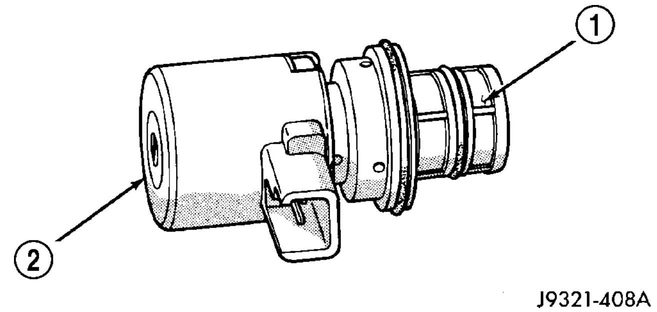


Fig. 78 Governor Pressure Solenoid Valve

1 - SOLENOID FILTER
2 - GOVERNOR PRESSURE SOLENOID

GOVERNOR PRESSURE SENSOR

The governor pressure sensor measures output pressure of the governor pressure solenoid valve (Fig. 79).

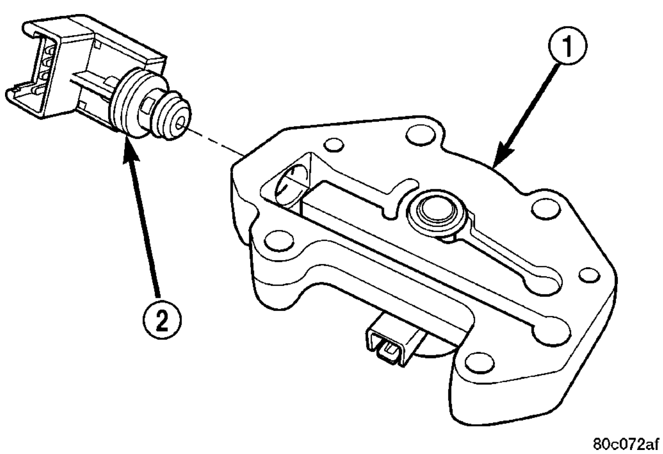


Fig. 79 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate is designed to supply transmission line pressure to the governor pressure solenoid valve and to return governor pressure.

The governor pressure solenoid valve is mounted in the governor body. The body is bolted to the lower side of the transfer plate (Fig. 79).

GOVERNOR PRESSURE CURVES

There are four governor pressure curves programmed into the transmission control module. The different curves allow the control module to adjust governor pressure for varying conditions. One curve is used for operation when fluid temperature is at, or below, –1°C (30°F). A second curve is used when fluid temperature is at, or above, 10°C (50°F) during normal city or highway driving. A third curve is used during wide-open throttle operation. The fourth curve is used when driving with the transfer case in low range.

OPERATION

Compensation is required for performance variations of two of the input devices. Though the slope of the transfer functions is tightly controlled, offset may vary due to various environmental factors or manufacturing tolerances.

The pressure transducer is affected by barometric pressure as well as temperature. Calibration of the zero pressure offset is required to compensate for shifting output due to these factors.

Normal calibration will be performed when sump temperature is above 50 degrees F, or in the absence of sump temperature data, after the first 10 minutes of vehicle operation. Calibration of the pressure transducer offset occurs each time the output shaft speed falls below 200 RPM. Calibration shall be repeated each 3 seconds the output shaft speed is below 200 RPM. A 0.5 second pulse of 95% duty cycle is applied to the governor pressure solenoid valve and the transducer output is read during this pulse. Averaging of the transducer signal is necessary to reject electrical noise.

Under cold conditions (below 50 degrees F sump), the governor pressure solenoid valve response may be too slow to guarantee 0 psi during the 0.5 second calibration pulse. Calibration pulses are continued during this period, however the transducer output valves are discarded. Transducer offset must be read at key-on, under conditions which promote a stable reading. This value is retained and becomes the offset during the ″cold″ period of operation.

GOVERNOR PRESSURE SOLENOID VALVE

The inlet side of the solenoid valve is exposed to normal transmission line pressure. The outlet side of the valve leads to the valve body governor circuit.

The solenoid valve regulates line pressure to produce governor pressure. The average current supplied to the solenoid controls governor pressure. One amp current produces zero kPa/psi governor pressure. Zero amps sets the maximum governor pressure.

The powertrain control module (PCM) turns on the trans control relay which supplies electrical power to the solenoid valve. Operating voltage is 12 volts (DC). The PCM controls the ground side of the solenoid using the governor pressure solenoid control circuit.

ELECTRONIC GOVERNOR (Continued)

GOVERNOR PRESSURE SENSOR

The sensor output signal provides the necessary feedback to the PCM. This feedback is needed to adequately control governor pressure.

GOVERNOR BODY AND TRANSFER PLATE

The transfer plate channels line pressure to the solenoid valve through the governor body. It also channels governor pressure from the solenoid valve to the governor circuit. It is the solenoid valve that develops the necessary governor pressure.

GOVERNOR PRESSURE CURVES

LOW TRANSMISSION FLUID TEMPERATURE

When the transmission fluid is cold the conventional governor can delay shifts, resulting in higher than normal shift speeds and harsh shifts. The electronically controlled low temperature governor pressure curve is higher than normal to make the transmission shift at normal speeds and sooner. The PCM uses a temperature sensor in the transmission oil sump to determine when low temperature governor pressure is needed.

NORMAL OPERATION

Normal operation is refined through the increased computing power of the PCM and through access to data on engine operating conditions provided by the PCM that were not available with the previous stand-alone electronic module. This facilitated the development of a load adaptive shift strategy - the ability to alter the shift schedule in response to vehicle load condition. One manifestation of this capability is grade ″hunting″ prevention - the ability of the transmission logic to delay an upshift on a grade if the engine does not have sufficient power to maintain speed in the higher gear. The 3-2 downshift and the potential for hunting between gears occurs with a heavily loaded vehicle or on steep grades. When hunting occurs, it is very objectionable because shifts are frequent and accompanied by large changes in noise and acceleration.

WIDE OPEN THROTTLE OPERATION

In wide-open throttle (WOT) mode, adaptive memory in the PCM assures that up-shifts occur at the preprogrammed optimum speed. WOT operation is determined from the throttle position sensor, which is also a part of the emission control system. The initial setting for the WOT upshift is below the optimum engine speed. As WOT shifts are repeated, the PCM learns the time required to complete the shifts by comparing the engine speed when the shifts occur to the optimum speed. After each shift, the PCM adjusts the shift point until the optimum speed is reached. The PCM also considers vehicle loading, grade and engine performance changes due to high altitude in determining when to make WOT shifts. It does this by measuring vehicle and engine acceleration and then factoring in the shift time.

TRANSFER CASE LOW RANGE OPERATION

On four-wheel drive vehicles operating in low range, the engine can accelerate to its peak more rapidly than in Normal range, resulting in delayed shifts and undesirable engine ″flare.″ The low range governor pressure curve is also higher than normal to initiate upshifts sooner. The PCM compares electronic vehicle speed signal used by the speedometer to the transmission output shaft speed signal to determine when the transfer case is in low range.

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Remove transmission fluid pan and filter.

(3) Disengage wire connectors from pressure sensor and solenoid (Fig. 80).

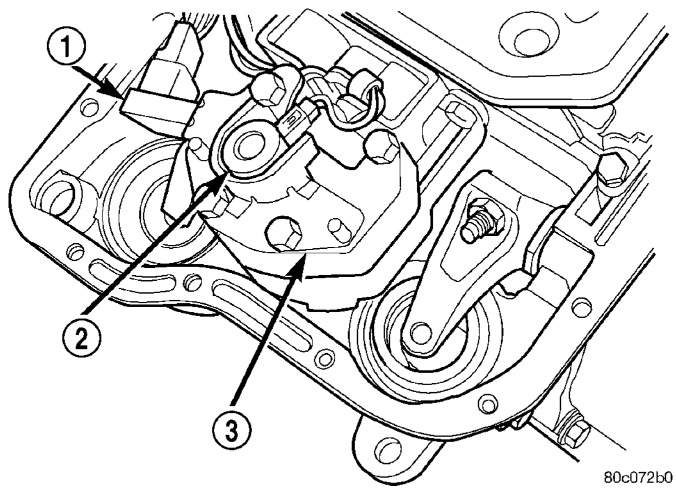


Fig. 80 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

ELECTRONIC GOVERNOR (Continued)

(4) Remove screws holding pressure solenoid retainer to governor body.

(5) Separate solenoid retainer from governor (Fig. 81).

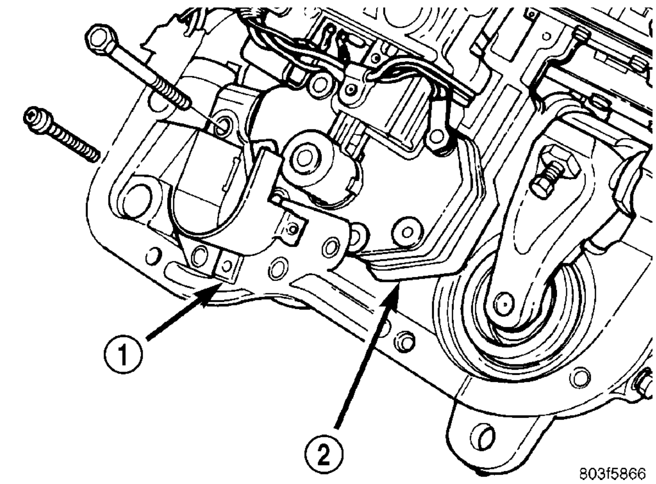


Fig. 81 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(6) Pull solenoid from governor body (Fig. 82).

(7) Pull pressure sensor from governor body.

(8) Remove bolts holding governor body to valve body.

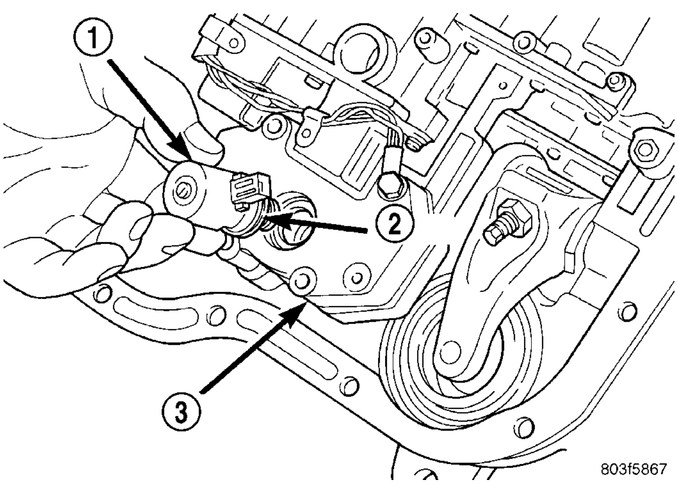


Fig. 82 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(9) Separate governor body from valve body (Fig. 83).

(10) Remove governor body gasket.

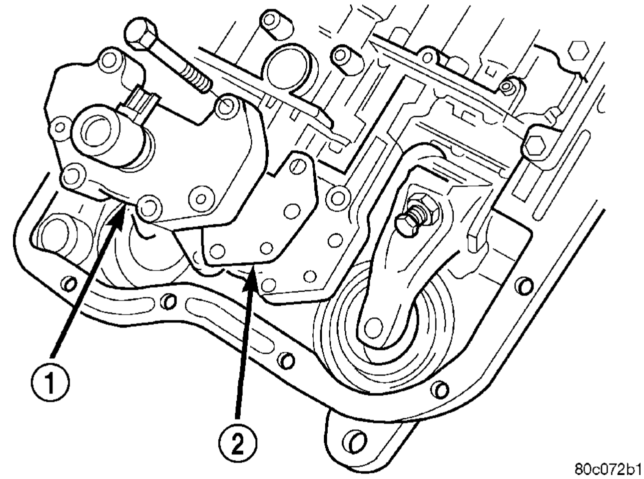


Fig. 83 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

INSTALLATION

Before installing the pressure sensor and solenoid in the governor body, replace o-ring seals, clean the gasket surfaces and replace gasket.

(1) Place gasket in position on back of governor body (Fig. 84).

(2) Place governor body in position on valve body.

(3) Install bolts to hold governor body to valve body.

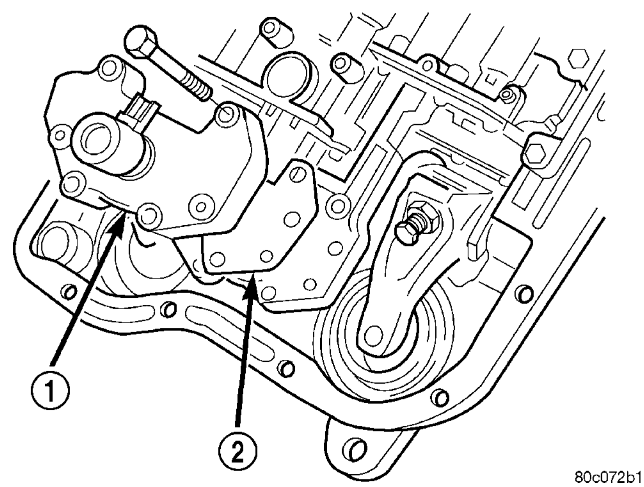


Fig. 84 Governor Body and Gasket

1 - GOVERNOR BODY
2 - GASKET

ELECTRONIC GOVERNOR (Continued)

(4) Lubricate o-ring on pressure sensor with transmission fluid.

(5) Align pressure sensor to bore in governor body.

(6) Push pressure sensor into governor body.

(7) Lubricate o-ring, on pressure solenoid, with transmission fluid.

(8) Align pressure solenoid to bore in governor body (Fig. 85).

(9) Push solenoid into governor body.

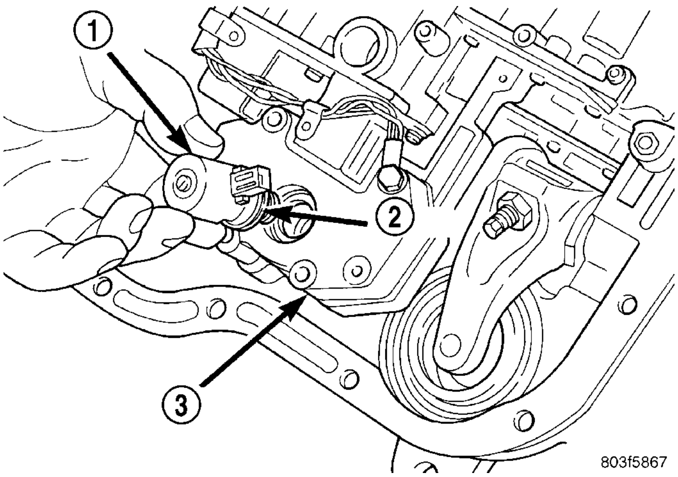


Fig. 85 Pressure Solenoid and O-ring

1 - PRESSURE SOLENOID
2 - O-RING
3 - GOVERNOR

(10) Place solenoid retainer in position on governor (Fig. 86).

(11) Install screws to hold pressure solenoid retainer to governor body.

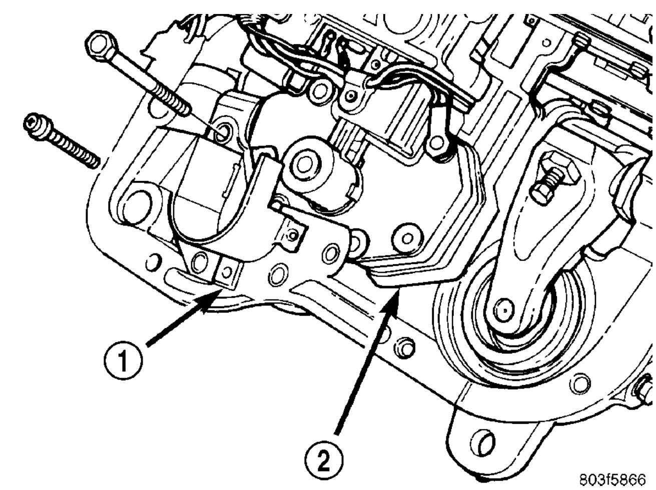


Fig. 86 Pressure Solenoid Retainer

1 - PRESSURE SOLENOID RETAINER
2 - GOVERNOR

(12) Engage wire connectors into pressure sensor and solenoid (Fig. 87).

(13) Install transmission fluid pan and (new) filter.

(14) Lower vehicle and road test to verify repair.

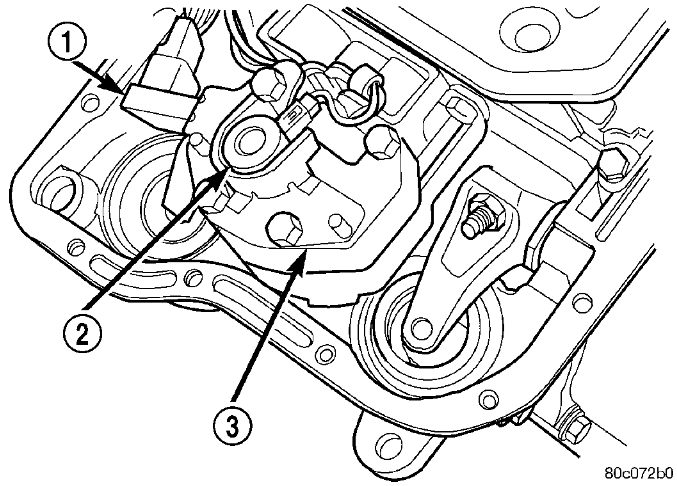


Fig. 87 Governor Solenoid And Pressure Sensor

1 - PRESSURE SENSOR
2 - PRESSURE SOLENOID
3 - GOVERNOR

EXTENSION HOUSING SEAL

REMOVAL

(1) Raise vehicle.

(2) Mark propeller shaft and axle yoke for alignment reference.

(3) Disconnect and remove propeller shaft.

(4) Remove old seal with a screw mounted in a slide hammer.

INSTALLATION

(1) Place seal in position on overdrive housing.

(2) Drive seal into overdrive housing with Seal Installer 9037 (Fig. 88).

(3) Carefully guide propeller shaft slip yoke into housing and onto output shaft splines. Align marks made at removal and connect propeller shaft to rear axle pinion yoke.

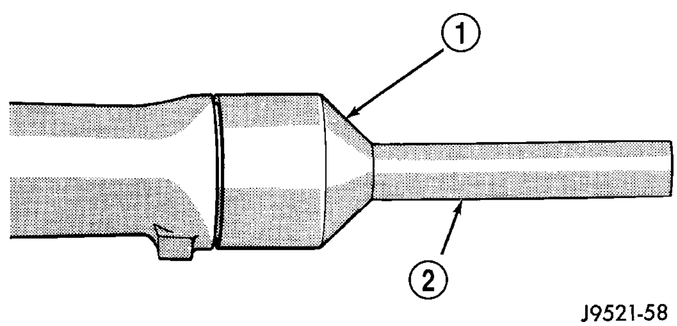


Fig. 88 Installing Overdrive Housing Yoke Seal

1 - SPECIAL TOOL 9037
2 - SPECIAL TOOL C-4171

FLUID AND FILTER

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve and clutch operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

DIAGNOSIS AND TESTING - CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has two primary causes.

(1) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(2) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

DIAGNOSIS AND TESTING - FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to replace contaminated converter after repair

The use of non-recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission, an overhaul is necessary.

The torque converter should be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

STANDARD PROCEDURE

STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmssion has too much fluid, the geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

Fluid level is checked with the engine running at curb idle speed, the transmission in NEUTRAL and the transmission fluid at normal operating temperature. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.**

The transmission fluid level can be checked two ways.

PROCEDURE ONE

(1) Transmission fluid must be at normal operating temperature for accurate fluid level check. Drive

FLUID AND FILTER (Continued)

vehicle if necessary to bring fluid temperature up to normal hot operating temperature of 82°C (180°F).

(2) Position vehicle on level surface.

(3) Start and run engine at curb idle speed.

(4) Apply parking brakes.

(5) Shift transmission momentarily into all gear ranges. Then shift transmission back to NEUTRAL.

(6) Clean top of filler tube and dipstick to keep dirt from entering tube.

(7) Remove dipstick (Fig. 89) and check fluid level as follows:

(a) Correct acceptable level is in crosshatch area.

(b) Correct maximum level is to MAX arrow mark.

(c) Incorrect level is at or below MIN line.

(d) If fluid is low, add only enough Mopar® ATF +4, type 9602, to restore correct level. Do not over-fill.

PROCEDURE TWO

(1) Start engine and apply parking brake.

(2) Shift the transmission into DRIVE for approximately 2 seconds.

(3) Shift the transmission into REVERSE for approximately 2 seconds.

(4) Shift the transmission into PARK.

(5) Hook up DRB® scan tool and select engine.

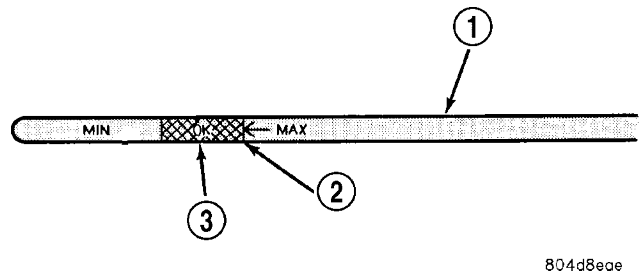


Fig. 89 Dipstick Fluid Level Marks—Typical

1 - DIPSTICK
2 - MAXIMUM CORRECT FLUID LEVEL
3 - ACCEPTABLE FLUID LEVEL

(6) Select sensors.

(7) Read the transmission temperature value.

(8) Compare the fluid temperature value with the chart.

(9) Adjust transmission fluid level shown on the dipstick according to the chart (Fig. 90).

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

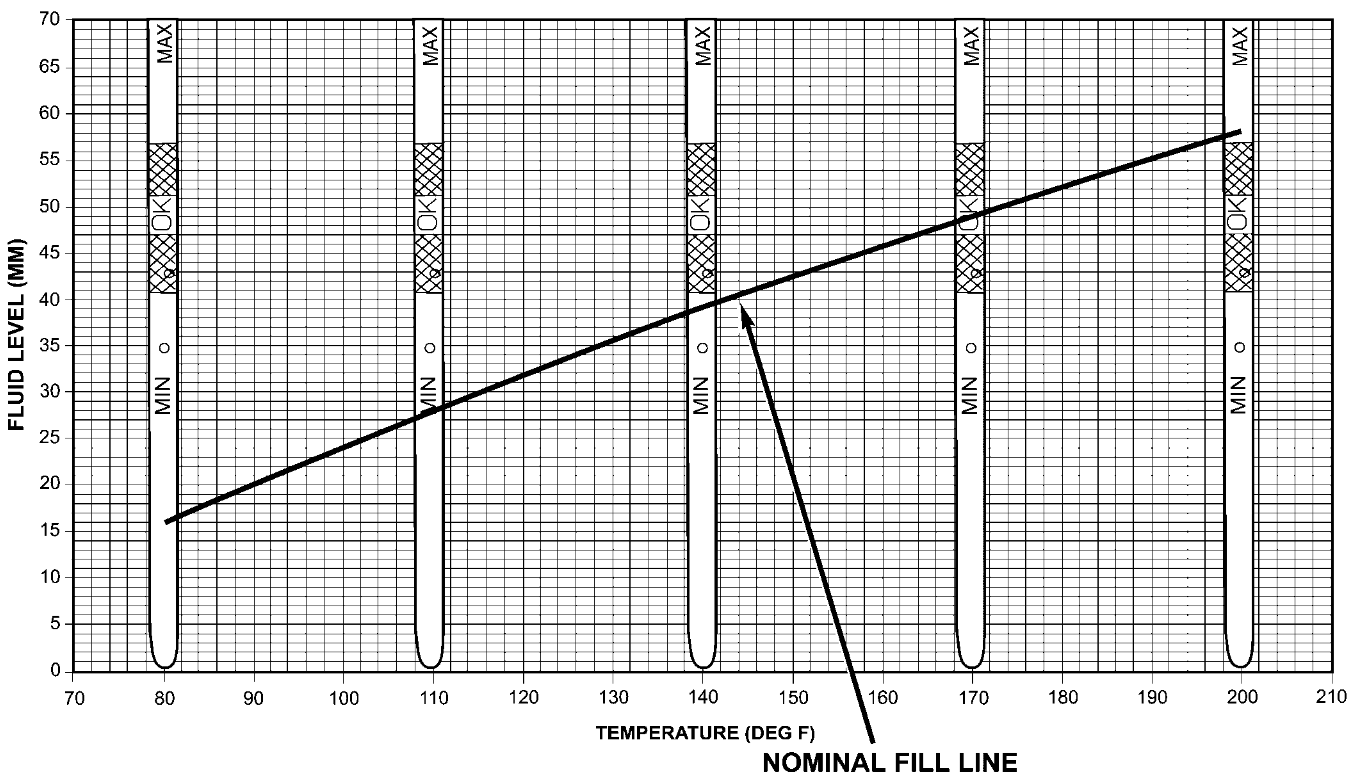


Fig. 90 48RE Fluid Fill Graph

FLUID AND FILTER (Continued)

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION). The service fluid fill after a filter change is approximately 3.8 liters (4.0 quarts).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission (Fig. 91).

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan and gasket away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolt holding pan to transmission.

(7) While holding pan level, lower pan and gasket away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screws holding filter to valve body (Fig. 92).

(10) Separate filter from valve body and pour fluid in filter into drain pan.

(11) Dispose of used trans fluid and filter properly.

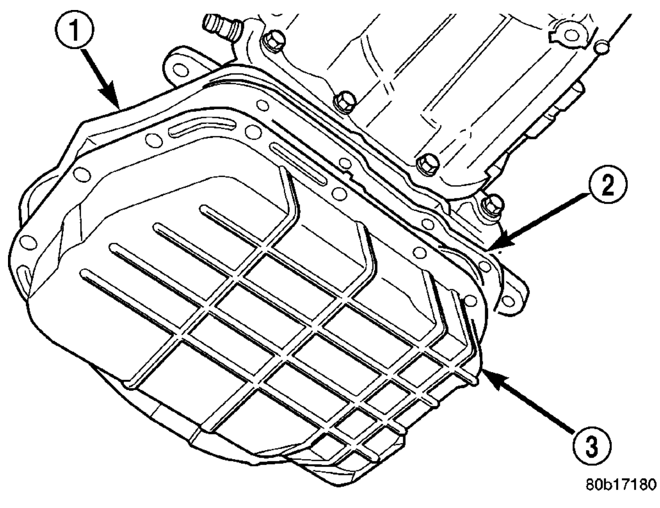


Fig. 91 Transmission Pan

1 - TRANSMISSION
2 - GASKET
3 - PAN

INSTALLATION

(1) Position a new transmission oil filter onto the valve body.

(2) Install the screws to hold the filter to the valve body. Tighten the screws to 4 N·m (35 in.lbs.).

(3) Clean the gasket surfaces of the transmission oil pan and transmission pan rail.

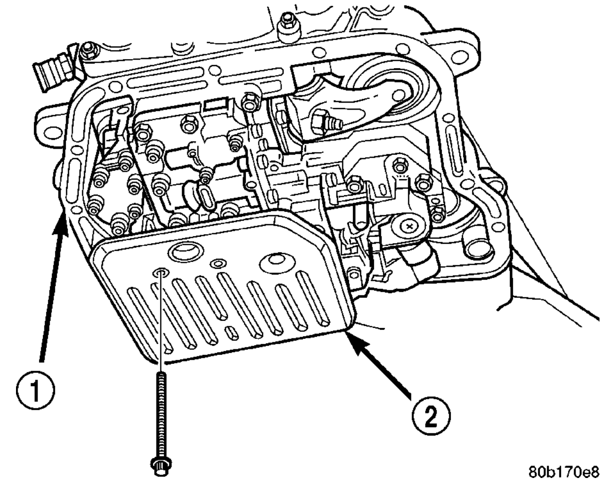


Fig. 92 Transmission Filter

1 - TRANSMISSION
2 - FILTER

NOTE: The transmission pan oil gasket is reusable. Inspect the sealing surfaces of the gasket. If the sealing ribs on both surfaces appear to be in good condition, clean the gasket of any foreign material and reinstall.

(4) Position the oil pan gasket onto the oil pan.

(5) Position the oil pan and gasket onto the transmission and install several bolts to hold the pan and gasket to the transmission.

(6) Install the remainder of the oil pan bolts. Tighten the bolts to 13.6 N·m (125 in.lbs.).

(7) Lower vehicle and fill transmission. (Refer to 21 - TRANSMISSION/AUTOMATIC/FLUID - STANDARD PROCEDURE)

STANDARD PROCEDURE - TRANSMISSION FILL

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF +4, Automatic Transmission Fluid, to transmission:

(a) If only fluid and filter were changed, add **3 pints (1-1/2 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled, or torque converter was replaced or drained, add **12 pints (6 quarts)** of ATF +4 to transmission.

(3) Apply parking brakes.

(4) Start and run engine at normal curb idle speed.

(5) Apply service brakes, shift transmission through all gear ranges then back to NEUTRAL, set parking brake, and leave engine running at curb idle speed.

(6) Remove funnel, insert dipstick and check fluid level. If level is low, **add fluid to bring level to MIN mark on dipstick.** Check to see if the oil level

FLUID AND FILTER (Continued)

is equal on both sides of the dipstick. If one side is noticably higher than the other, the dipstick has picked up some oil from the dipstick tube. Allow the oil to drain down the dipstick tube and re-check.

(7) Drive vehicle until transmission fluid is at normal operating temperature.

(8) With the engine running at curb idle speed, the gear selector in NEUTRAL, and the parking brake applied, check the transmission fluid level.

CAUTION: Do not overfill transmission, fluid foaming and shifting problems can result.

(9) Add fluid to bring level up to MAX arrow mark.

When fluid level is correct, shut engine off, release park brake, remove funnel, and install dipstick in fill tube.

FRONT CLUTCH

DESCRIPTION

The front clutch assembly (Fig. 93) is composed of the front clutch retainer, pressure plate, clutch plates, driving discs, piston, piston return spring, return spring retainer, and snap-rings. The front clutch is the forward-most component in the transmission geartrain and is directly behind the oil pump and is considered a driving component.

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved snap-ring is used to cushion the application of the clutch pack.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being released by the release spring, fluid flows through a vent and one-way ball-check-valve located in the clutch retainer. The check-valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

DISASSEMBLY

(1) Remove the waved snap-ring, reaction plate, clutch plates, and clutch discs.

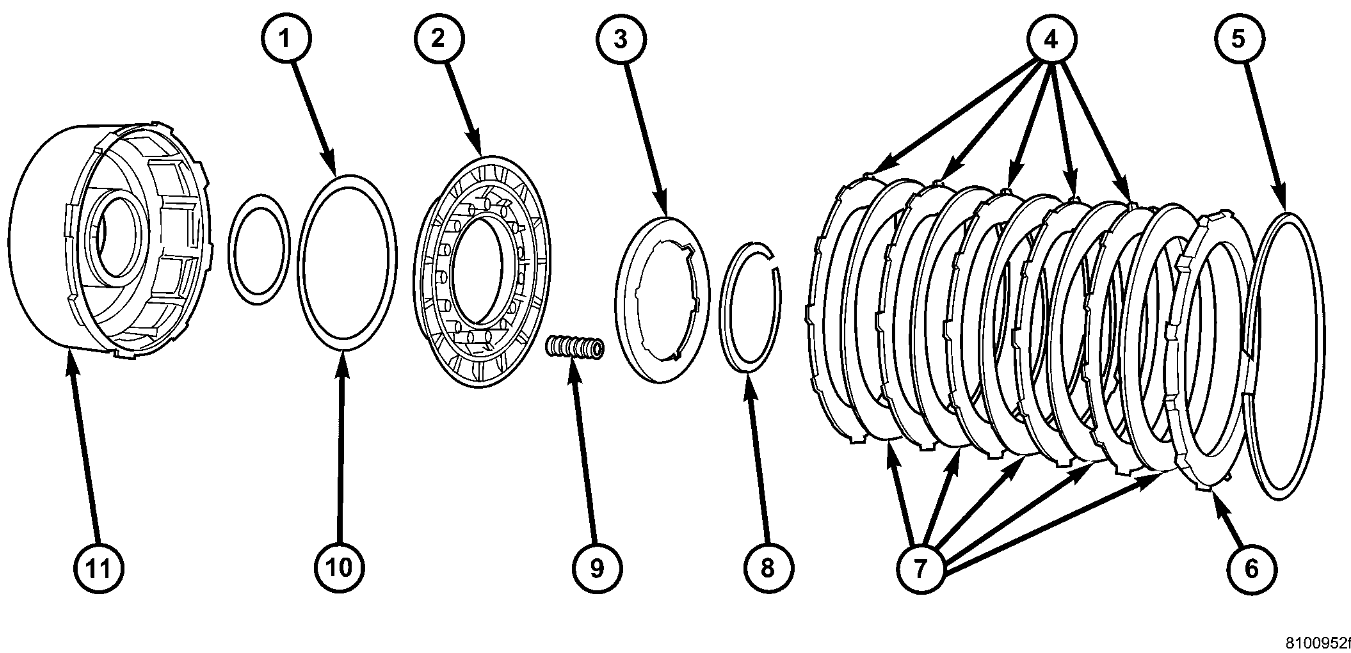


Fig. 93 48RE Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

FRONT CLUTCH (Continued)

(2) Compress clutch piston retainer and piston springs with Compressor Tool C-3863-A (Fig. 94).

(3) Remove retainer snap-ring and remove compressor tool.

(4) Remove clutch piston springs (Fig. 95). Note position and number of piston springs for assembly reference.

(5) Remove clutch piston from retainer with a twisting motion.

(6) Remove and discard clutch piston inner and outer seals.

INSPECTION

Inspect the front clutch components. Replace the clutch discs if warped, worn, scored, burned or charred, the lugs are damaged, or if the facing is flaking off. Replace the steel plates and reaction plate if heavily scored, warped, or broken. Be sure the driving lugs on the discs and plate are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston springs and spring retainer if either are distorted, warped or broken.

Check the lug grooves in the clutch piston retainer. The steel plates should slide freely in the slots. Replace the piston retainer if the grooves are worn or damaged. Also check action of the check ball in the piston retainer. The ball must move freely and not stick.

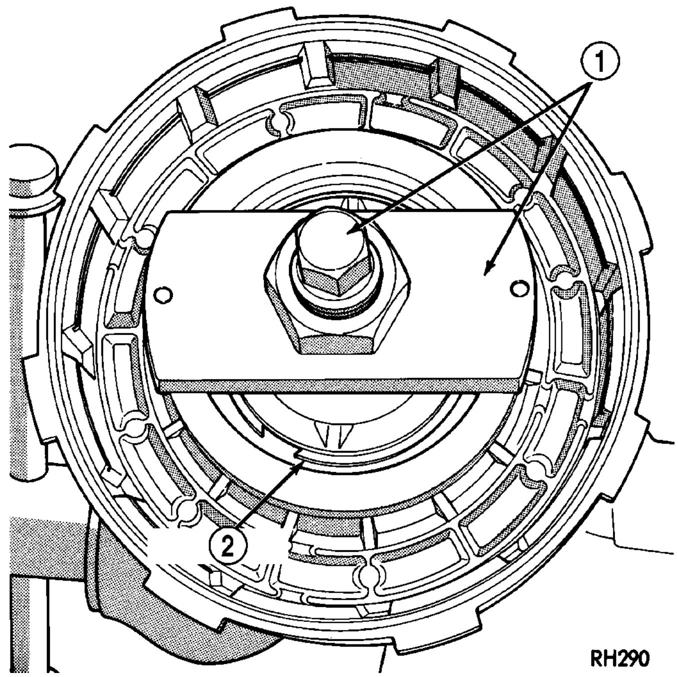


Fig. 94 Removing Front Clutch Spring Retainer Snap-Ring

1 - SPECIAL TOOL C-3863-A
2 - SNAP-RING

Replace the retainer bushing if worn, scored, or there is any doubt about bushing condition.

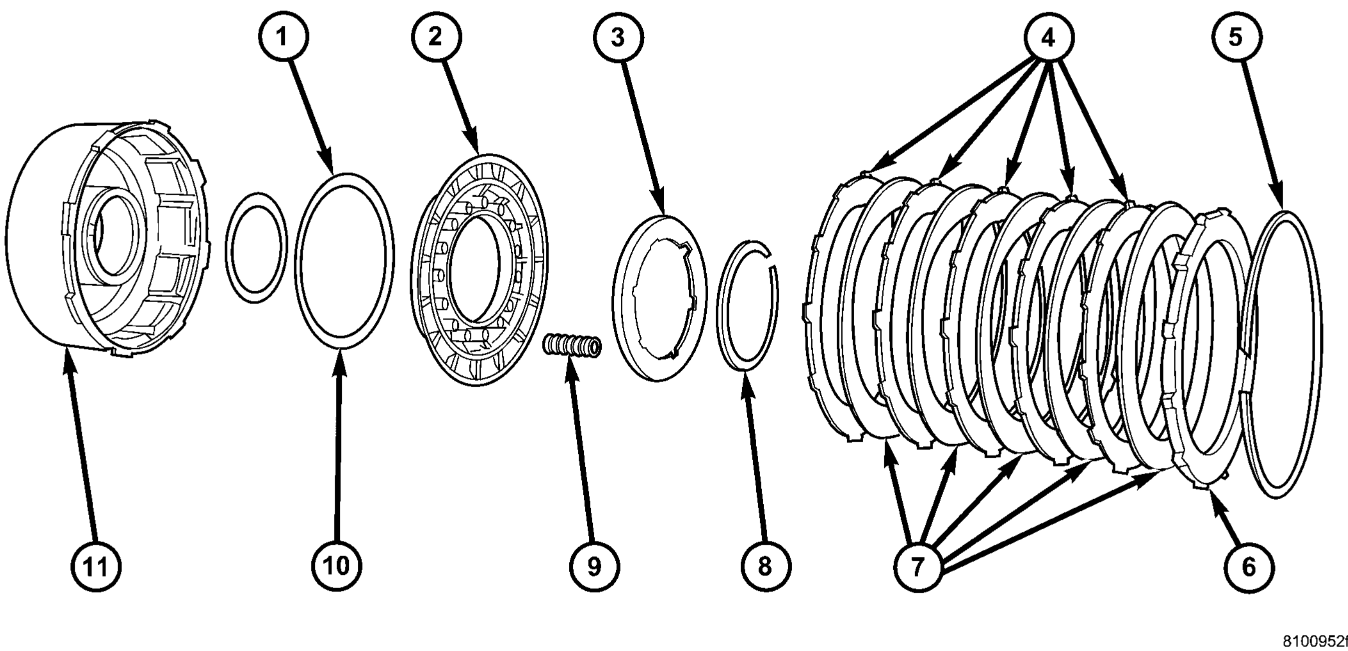


Fig. 95 48RE Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

FRONT CLUTCH (Continued)

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check the clutch piston check ball. The ball should be securely in place. Replace the piston if the ball is missing, or seized in place.

ASSEMBLY

NOTE: The 48RE transmission uses five plates and discs for the front clutch.

(1) Soak clutch discs in transmission fluid.

(2) Install new inner piston seal onto the outer diameter of the clutch retainer inner hub.

(3) Install new outer seal onto the clutch piston. Be sure seal lips of both seals face the interior of the retainer.

(4) Lubricate new inner and outer piston seals with petroleum jelly.

(5) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.015 - 0.020 in. thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

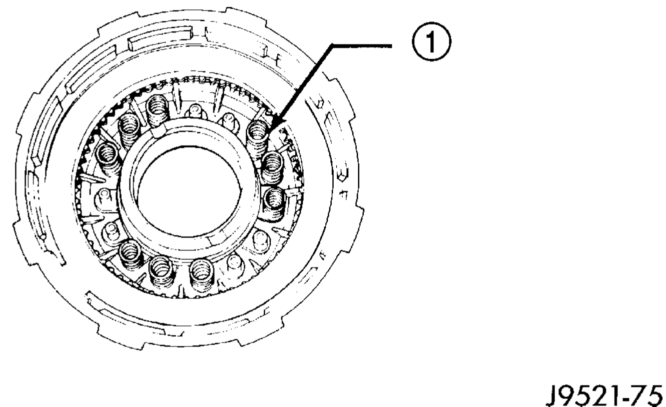


Fig. 96 Front Clutch Spring Position

1 - 9 SPRING CLUTCH

(6) Install and position nine clutch piston springs (Fig. 96).

(7) Install spring retainer on top of piston springs.

(8) Compress spring retainer and piston springs with Tool C-3863-A.

(9) Install spring retainer snap-ring and remove compressor tool.

(10) Install clutch plates and discs (Fig. 97). Five clutch discs, five steel plates and one reaction plate are required.

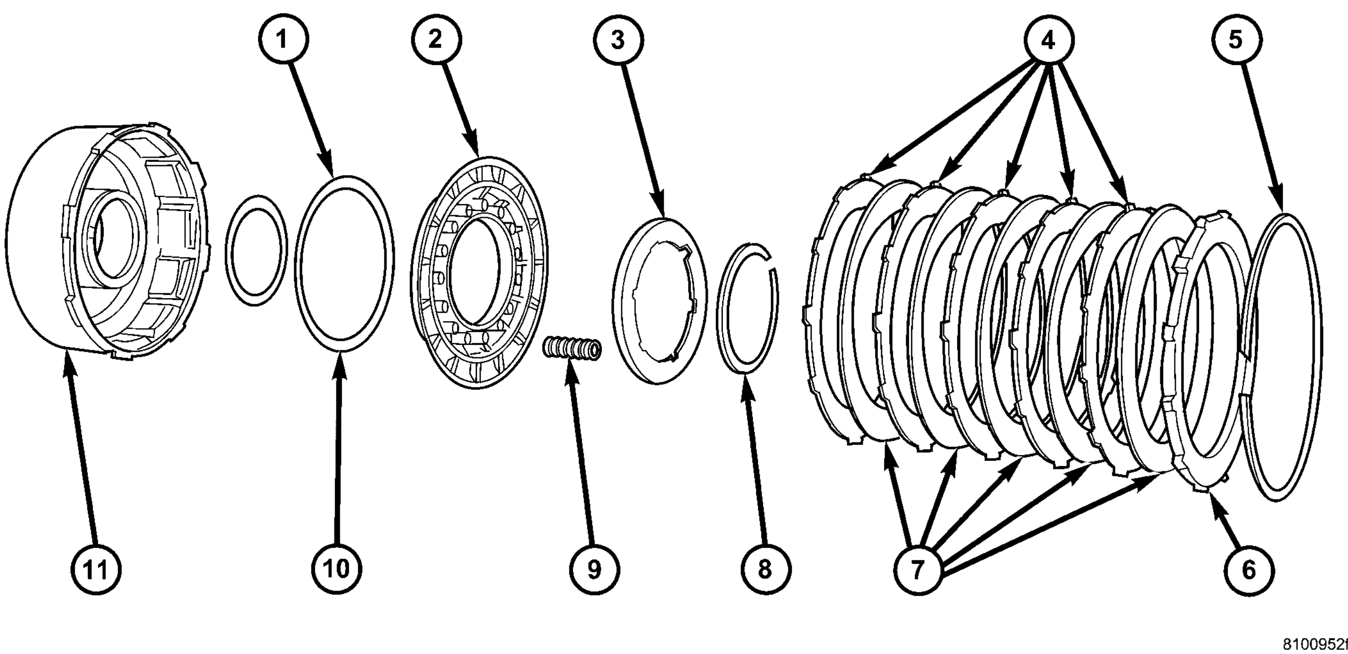


Fig. 97 48RE Front Clutch Components

1 - INNER PISTON SEAL
2 - CLUTCH PISTON
3 - CLUTCH PISTON SPRING RETAINER
4 - CLUTCH PLATES
5 - CLUTCH PACK SNAP-RING (WAVED)
6 - REACTION PLATE
7 - CLUTCH DISCS
8 - RETAINER SNAP-RING
9 - CLUTCH PISTON SPRINGS
10 - OUTER PISTON SEAL
11 - FRONT CLUTCH RETAINER

FRONT CLUTCH (Continued)

(11) Install reaction plate followed by waved snap-ring.

(12) Check clutch pack clearance with feeler gauge (Fig. 98). Clearance between waved spring and pressure plate should 2.5-4.09 mm (0.098-0.161 in.). If clearance is incorrect, clutch plates, clutch discs, snap-ring, or pressure plate may have to be changed.

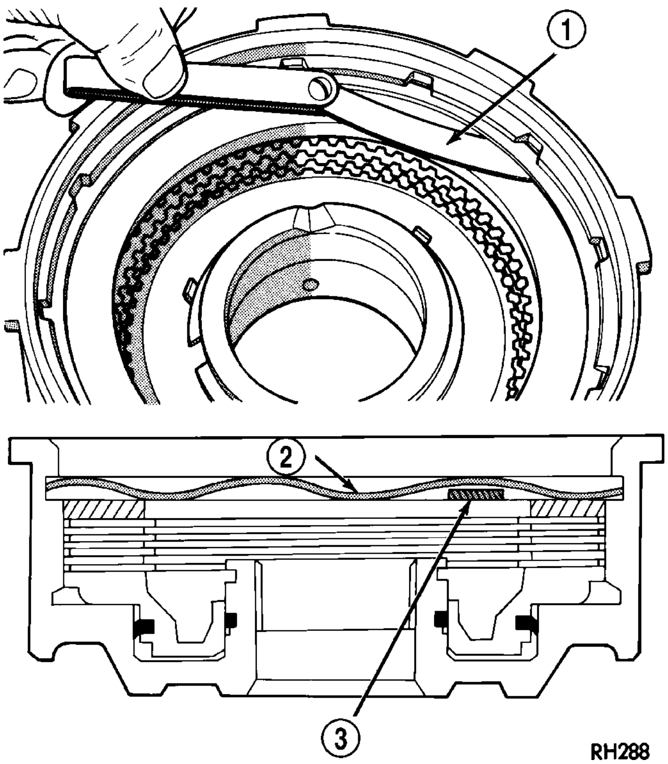


Fig. 98 Typical Method Of Measuring Front Clutch Pack Clearance

1 - FEELER GAUGE
2 - WAVED SNAP-RING
3 - FEELER GAUGE

FRONT SERVO

DESCRIPTION

The kickdown servo (Fig. 99) consists of a two-land piston with an inner piston, a piston rod and guide, and a return spring. The dual-land piston uses seal rings on its outer diameters and an O-ring for the inner piston.

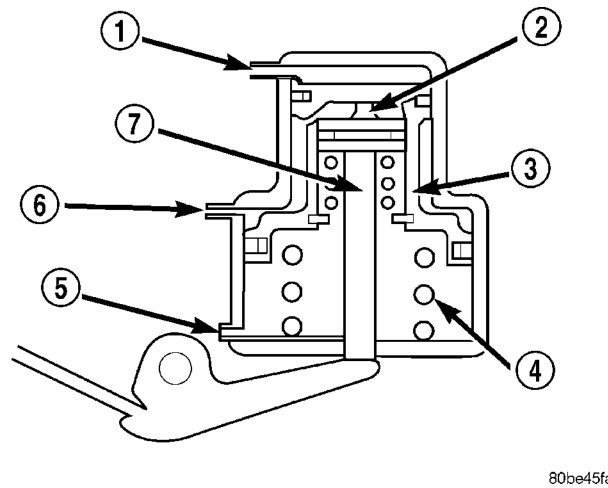


Fig. 99 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

OPERATION

The application of the piston is accomplished by applying pressure between the two lands of the piston. The pressure acts against the larger lower land to push the piston downward, allowing the piston rod to extend though its guide against the apply lever. Release of the servo at the 2-3 upshift is accomplished by a combination of spring and line pressure, acting on the bottom of the larger land of the piston. The small piston is used to cushion the application of the band by bleeding oil through a small orifice in the larger piston. The release timing of the kickdown servo is very important to obtain a smooth but firm shift. The release has to be very quick, just as the front clutch application is taking place. Otherwise, engine runaway or a shift hesitation will occur. To accomplish this, the band retains its holding capacity until the front clutch is applied, giving a small amount of overlap between them.

FRONT SERVO (Continued)

DISASSEMBLY

(1) Remove seal ring from rod guide (Fig. 100).

(2) Remove small snap-ring from servo piston rod. Then remove piston rod, spring and washer from piston.

(3) Remove and discard servo component O-ring and seal rings.

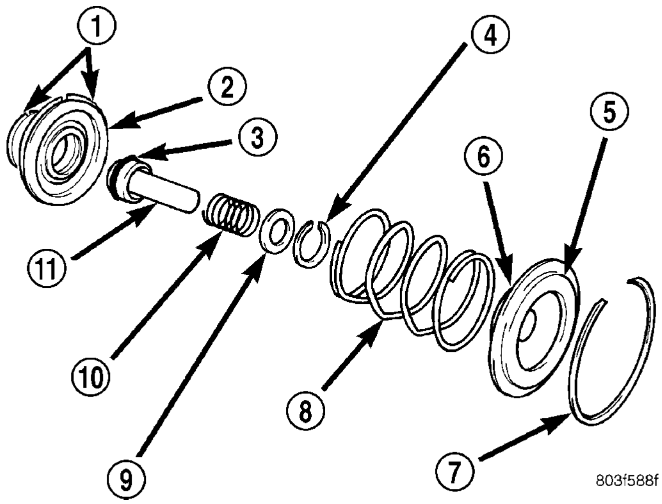


Fig. 100 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

CLEANING

Clean the servo piston components (Fig. 101) with solvent and dry them with compressed air.

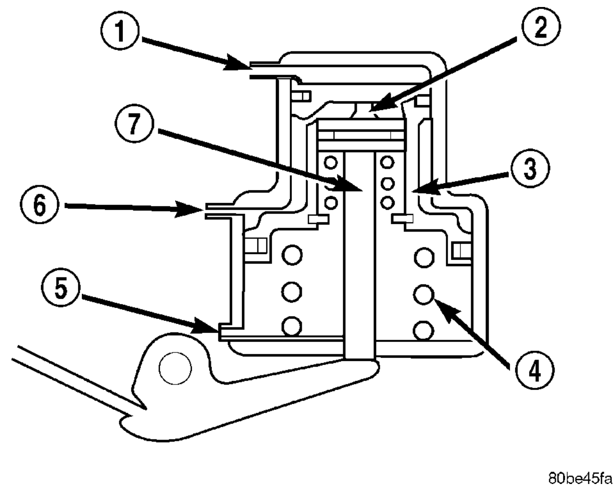


Fig. 101 Front Servo

1 - VENT
2 - INNER PISTON
3 - PISTON
4 - SPRING
5 - RELEASE PRESSURE
6 - APPLY PRESSURE
7 - PISTON ROD

INSPECTION

Inspect the servo components (Fig. 102). Replace the springs if collapsed, distorted or broken. Replace the guide, rod and piston if cracked, bent, or worn. Discard the servo snap-ring if distorted or warped.

Check the servo piston bore for wear. If the bore is severely scored, or damaged, it will be necessary to replace the case.

Replace any servo component if doubt exists about condition. Do not reuse suspect parts.

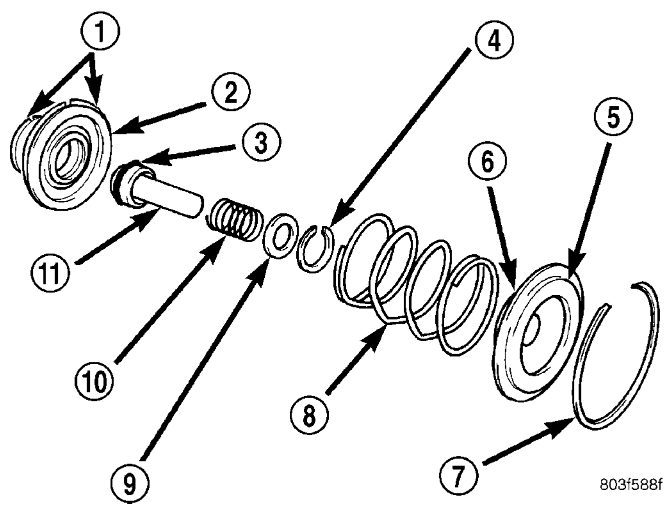


Fig. 102 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

ASSEMBLY

Clean and inspect front servo components.

(1) Lubricate new o-ring and seal rings with petroleum jelly and install them on piston, guide and rod.

FRONT SERVO (Continued)

(2) Install rod in piston. Install spring and washer on rod. Compress spring and install snap-ring (Fig. 103).

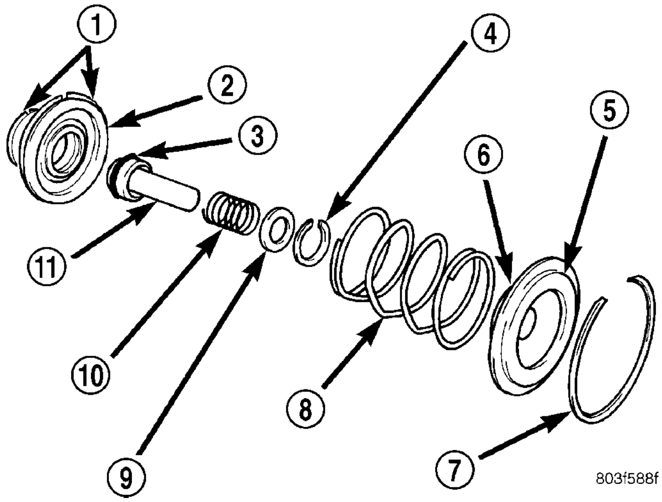


Fig. 103 Front Servo

1 - PISTON RINGS
2 - SERVO PISTON
3 - O-RING
4 - SNAP-RING
5 - PISTON ROD GUIDE
6 - SEAL RING
7 - SNAP-RING
8 - SERVO SPRING
9 - WASHER
10 - SPRING
11 - PISTON ROD

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) Engine starts must be possible with shift lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any other gear position.

(2) With the shift lever in the:

(a) PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.

(b) PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.

(c) NEUTRAL position - Normal position. Engine starts must be possible.

(d) NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 104) or (Fig. 105).

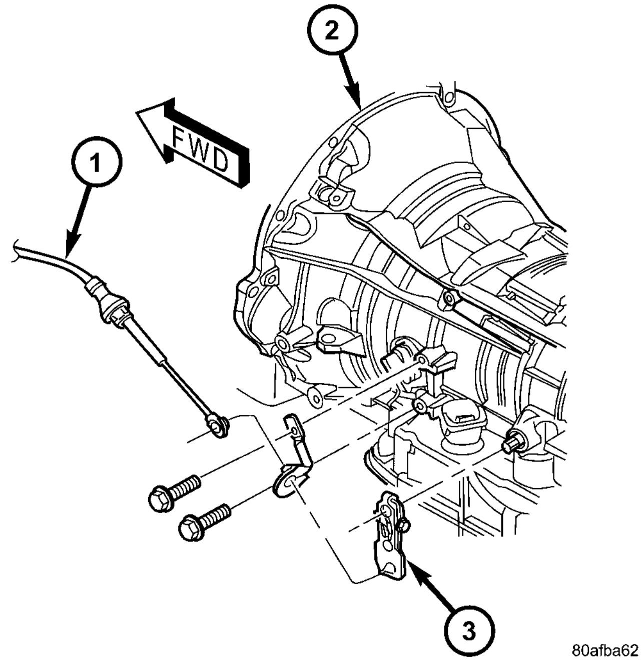


Fig. 104 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

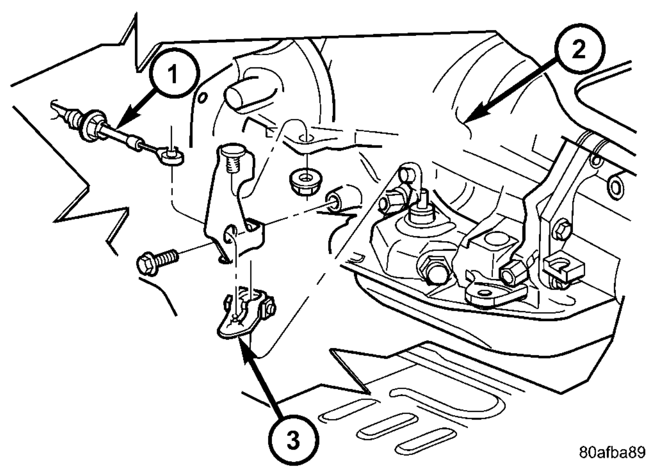


Fig. 105 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

GEARSHIFT CABLE (Continued)

(4) Lower the vehicle.

(5) Remove the dash panel insulation pad as necessary to access the gearshift cable grommet (Fig. 106).

(6) Remove grommet from the dash panel.

(7) Remove any steering column trim necessary to access the gearshift cable and BTSI mechanism.

(8) Disconnect the BTSI wiring connector.

(9) Disconnect cable at lower column bracket and shift lever pin and pull the cable through the dash panel opening into the vehicle (Fig. 107).

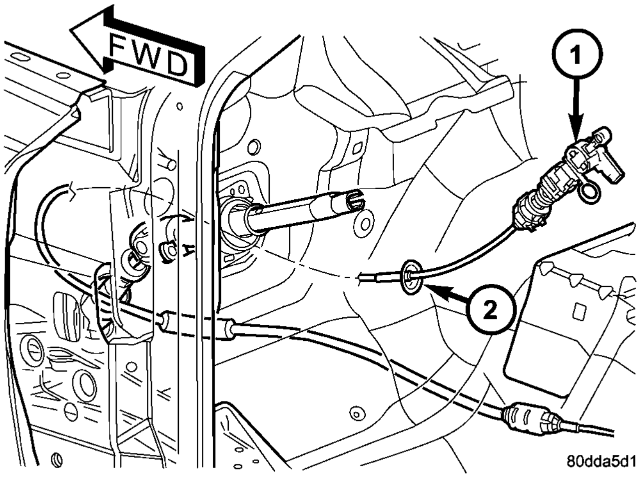


Fig. 106 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

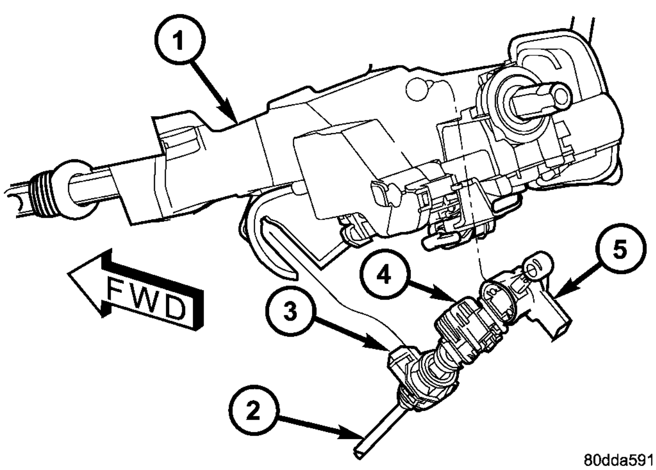


Fig. 107 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

(10) Remove gearshift cable from vehicle.

INSTALLATION

(1) Route the transmission end of the gearshift cable through the opening in the dash panel (Fig. 108).

(2) Seat the cable grommet into the dash panel opening.

(3) Snap the cable into the steering column bracket so the retaining ears (Fig. 109) are engaged and snap the cable eyelet onto the shift lever ball stud.

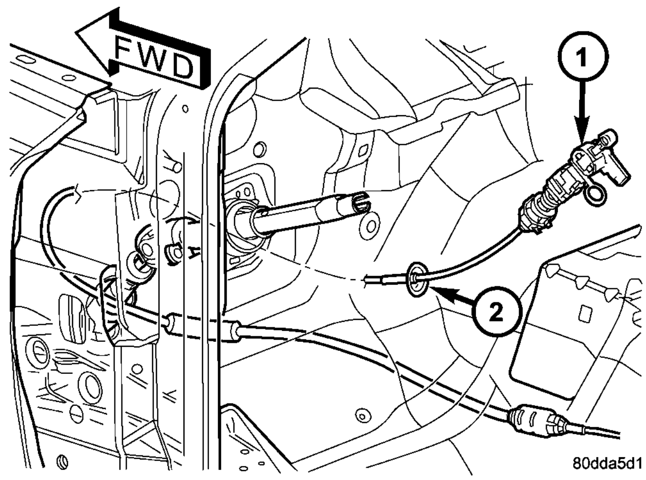


Fig. 108 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

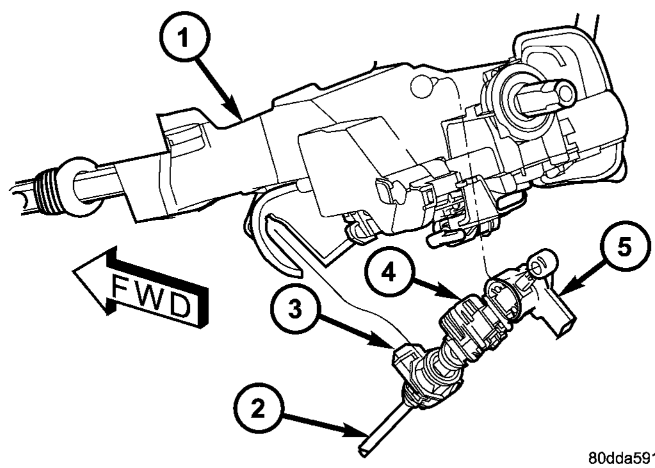


Fig. 109 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

GEARSHIFT CABLE (Continued)

(4) Raise the vehicle.

(5) Place the transmission manual shift lever in the "PARK" detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(6) Route the gearshift cable through the transmission mounting bracket and secure the cable by snapping the cable retaining ears into the transmission bracket and snapping the cable eyelet on the manual shift lever ball stud.

(7) Lower vehicle.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock tab downward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable and BTSI mechanism as necessary.

ADJUSTMENTS

GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT if the engine starts only in these positions. Adjustment is INCORRECT if the engine starts in one but not both positions. If the engine starts in any position other than PARK or NEUTRAL, or if the engine will not start at all, the transmission range sensor may be faulty.

Gearshift Adjustment Procedure

(1) Shift transmission into PARK.

(2) Release cable adjuster lock tab (underneath the steering column) (Fig. 110) to unlock cable.

(3) Raise vehicle.

(4) Disengage the cable eyelet from the transmission manual shift lever.

(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.

(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap the cable eyelet onto the transmission manual shift lever.

(8) Lower vehicle.

(9) Lock shift cable by pressing cable adjuster lock tab downward until it snaps into place.

(10) Check engine starting. Engine should start only in PARK and NEUTRAL

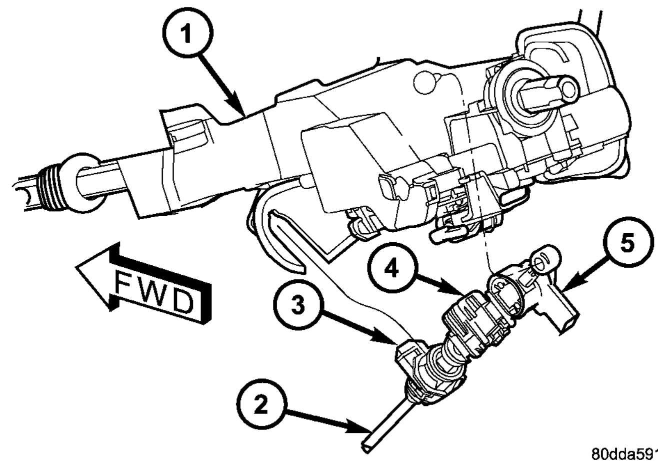


Fig. 110 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

OIL PUMP

DESCRIPTION

The oil pump (Fig. 111) is located in the pump housing inside the bell housing of the transmission case. The oil pump consists of an inner and outer gear, a housing, and a reaction shaft support.

OPERATION

As the torque converter rotates, the converter hub rotates the inner and outer gears. As the gears rotate, the clearance between the gear teeth increases in the crescent area, and creates a suction at the inlet side of the pump. This suction draws fluid through the pump inlet from the oil pan. As the clearance between the gear teeth in the crescent area decreases, it forces pressurized fluid into the pump outlet and to the valve body.

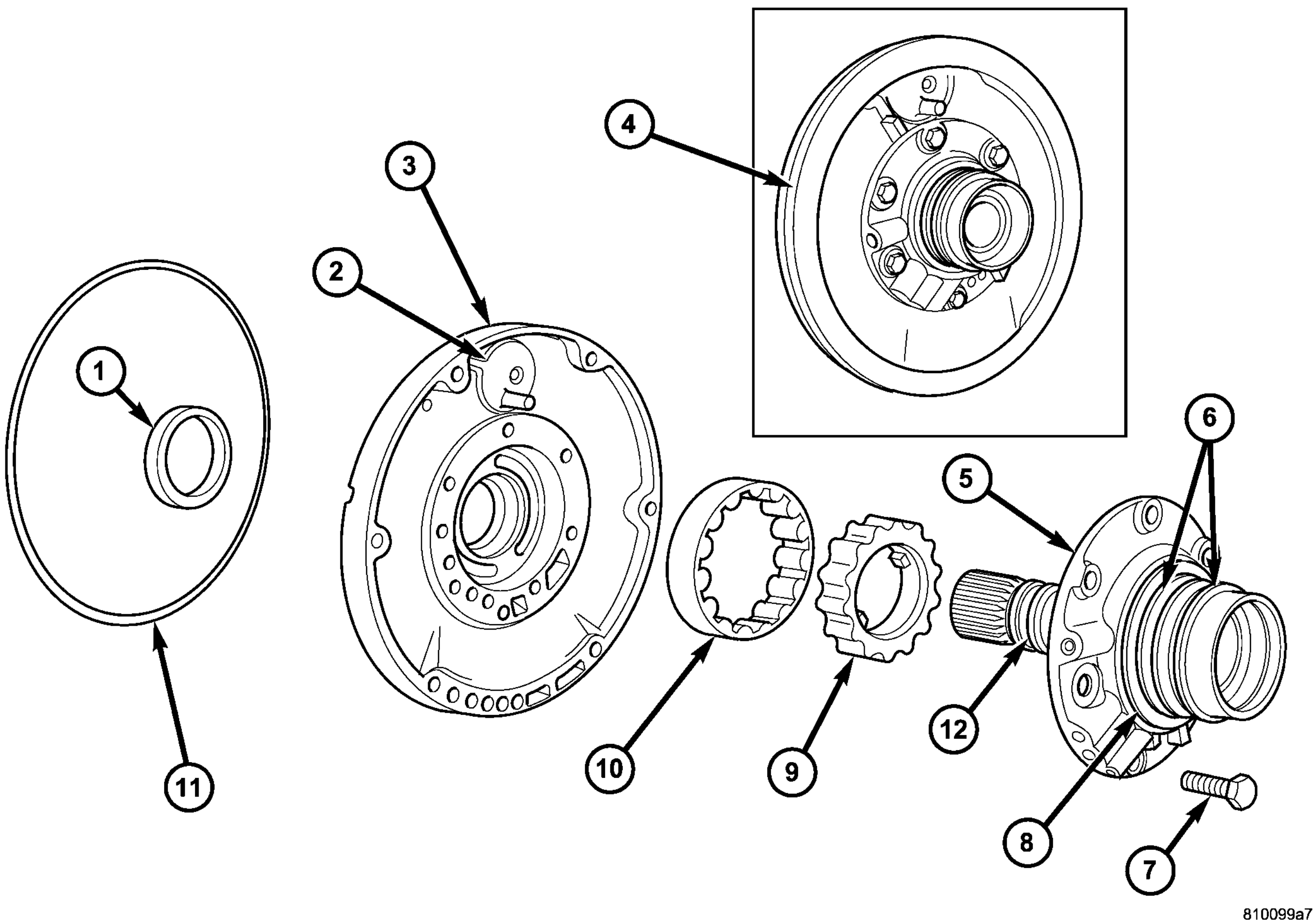


Fig. 111 Oil Pump Assembly

1 - OIL SEAL	7 - BOLTS (6)
2 - VENT BAFFLE	8 - #1 THRUST WASHER (SELECTIVE)
3 - OIL PUMP BODY	9 - INNER GEAR
4 - GASKET	10 - OUTER GEAR
5 - REACTION SHAFT SUPPORT	11 - “O” RING
6 - SEAL RINGS	12 - TORQUE CONVERTER SEAL RING

OIL PUMP (Continued)

DISASSEMBLY

(1) Mark position of support in oil pump body for assembly alignment reference. Use scriber or paint to make alignment marks.

(2) Place pump body on two wood blocks.

(3) Remove reaction shaft support bolts and separate support from pump body (Fig. 112).

(4) Remove pump inner and outer gears (Fig. 113).

(5) Remove o-ring seal from pump body (Fig. 114). Discard seal after removal.

(6) Remove oil pump seal with Remover Tool C-3981. Discard seal after removal.

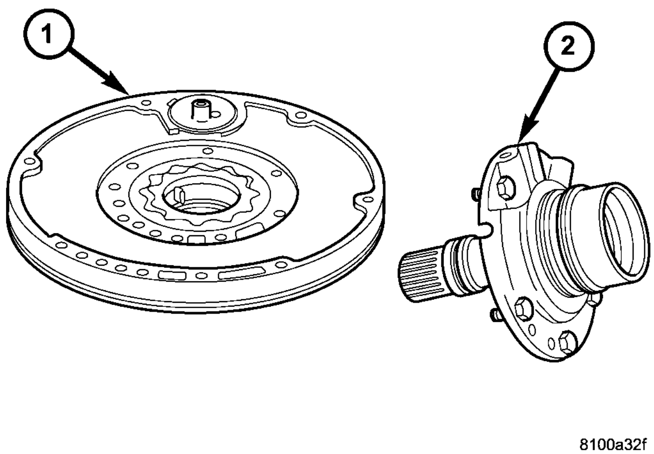


Fig. 112 Reaction Shaft Support

1 - OIL PUMP
2 - REACTION SHAFT SUPPORT

CLEANING

Clean pump and support components with solvent and dry them with compressed air.

INSPECTION

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Inspect the pump bushing. Then check the reaction shaft support bushing. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

Clearance between outer gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Clearance between inner gear and reaction shaft housing should be 0.010 to 0.063 mm (0.0004 to 0.0025 in.). Both clearances can be measured at the same time by installing the gears in the pump body and measure pump component clearances as follows:

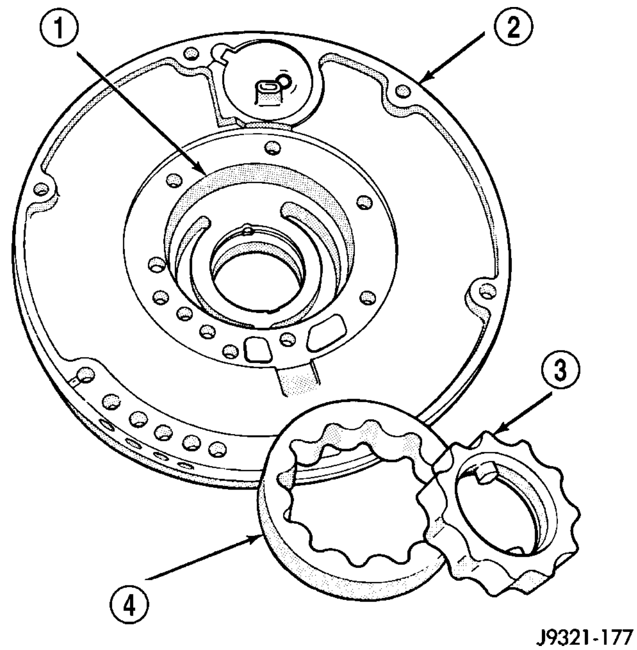


Fig. 113 Pump Gears

1 - GEAR BORE
2 - PUMP BODY
3 - INNER GEAR
4 - OUTER GEAR

(1) Position an appropriate piece of Plastigage™ across both gears.

(2) Align the plastigage to a flat area on the reaction shaft housing.

(3) Install the reaction shaft to the pump housing.

(4) Separate the reaction shaft housing from the pump housing and measure the Plastigage™ following the instructions supplied with it.

Clearance between inner gear tooth and outer gear should be 0.051 to 0.19 mm (0.002 to 0.0075 in.). Measure clearance with an appropriate feeler gauge (Fig. 115).

Clearance between outer gear and pump housing should be 0.10 to 0.229 mm (0.004 to 0.009 in.). Measure clearance with an appropriate feeler gauge.

ASSEMBLY

(1) Lubricate pump gears with transmission fluid and install them in pump body.

(2) Install thrust washer on reaction shaft support hub. Lubricate washer with petroleum jelly or transmission fluid before installation.

(3) If reaction shaft seal rings are being replaced, install new seal rings on support hub. Lubricate seal rings with transmission fluid or petroleum jelly after installation. Squeeze each ring until ring ends are securely hooked together.

OIL PUMP (Continued)

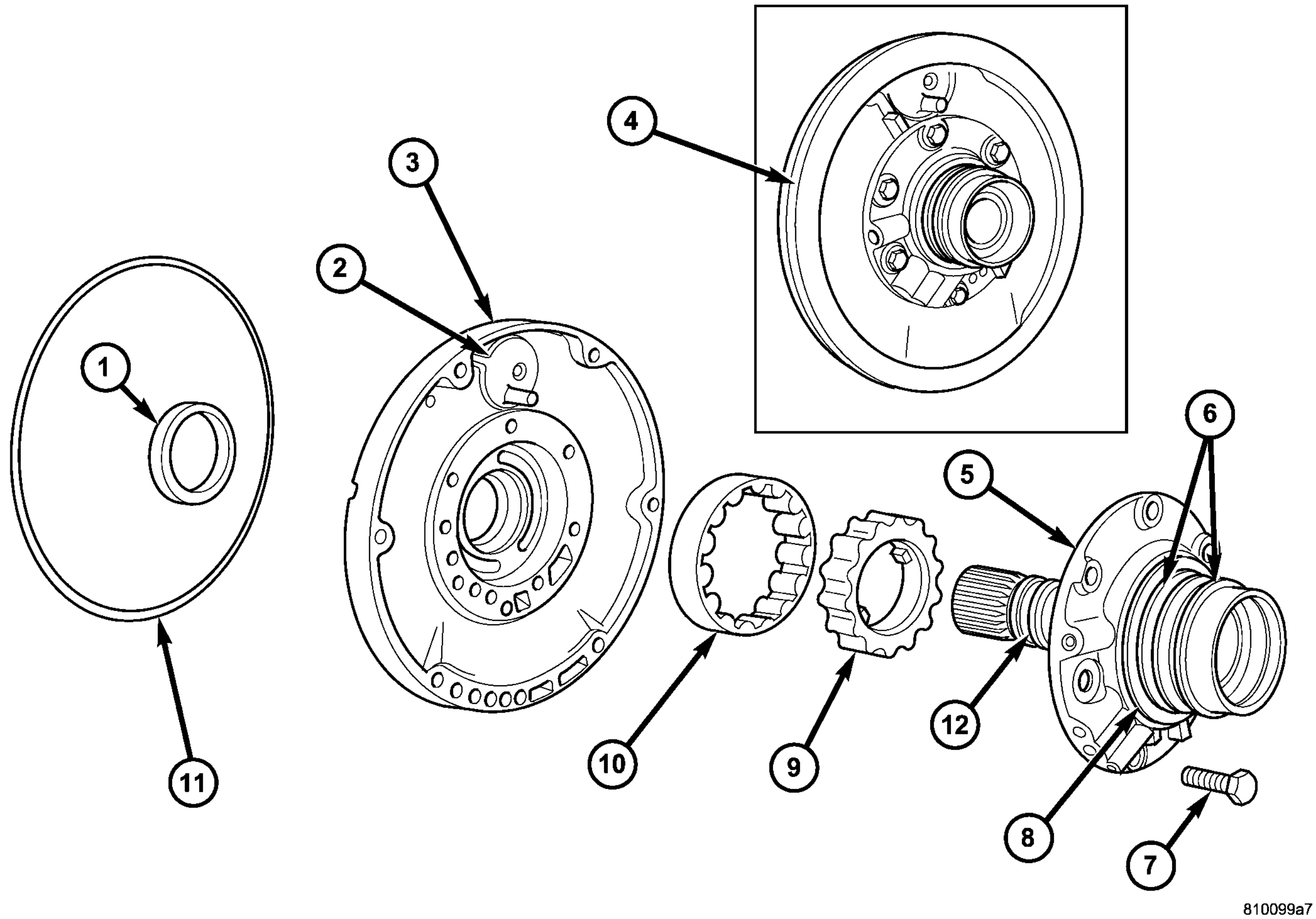


Fig. 114 Oil Pump Assembly

1 - OIL SEAL
2 - VENT BAFFLE
3 - OIL PUMP BODY
4 - GASKET
5 - REACTION SHAFT SUPPORT
6 - SEAL RINGS
7 - BOLTS (6)
8 - #1 THRUST WASHER (SELECTIVE)
9 - INNER GEAR
10 - OUTER GEAR
11 - “O” RING
12 - TORQUE CONVERTER SEAL RING

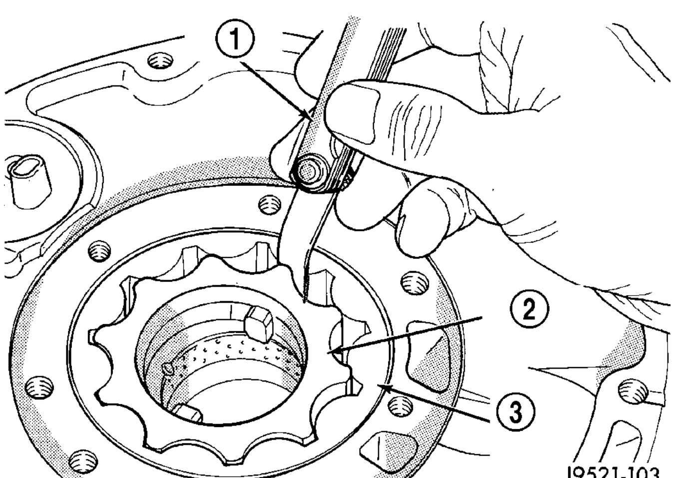


Fig. 115 Checking Pump Gear Tip Clearance

1 - FEELER GAUGE
2 - INNER GEAR
3 - OUTER GEAR

CAUTION: The reaction shaft support seal rings will break if overspread, or twisted. If new rings are being installed, spread them only enough for installation. Also be very sure the ring ends are securely hooked together after installation. Otherwise, the rings will either prevent pump installation, or break during installation.

(4) Align and install reaction shaft support on pump body.

(5) Install bolts attaching reaction shaft support to pump. Tighten bolts to 20 N·m (175 in. lbs.) torque.

OIL PUMP (Continued)

(6) Install new pump seal with Installer Tool C-3860-A (Fig. 116). Use hammer or mallet to tap seal into place.

(7) Install new o-ring on pump body. Lubricate oil seal and o-ring with petroleum jelly.

(8) Cover pump assembly to prevent dust entry and set aside for assembly installation.

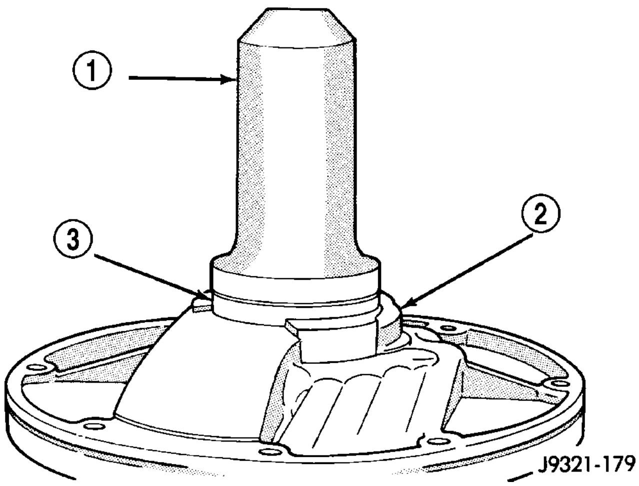


Fig. 116 Oil Pump Seal

1 - SPECIAL TOOL C-3860-A
2 - PUMP BODY
3 - PUMP SEAL

OUTPUT SHAFT FRONT BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle.

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft front bearing to overdrive geartrain. (Fig. 117).

(4) Pull bearing from output shaft.

INSTALLATION

(1) Place replacement bearing in position on geartrain with locating retainer groove toward the rear.

(2) Push bearing onto shaft until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing onto output shaft.

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

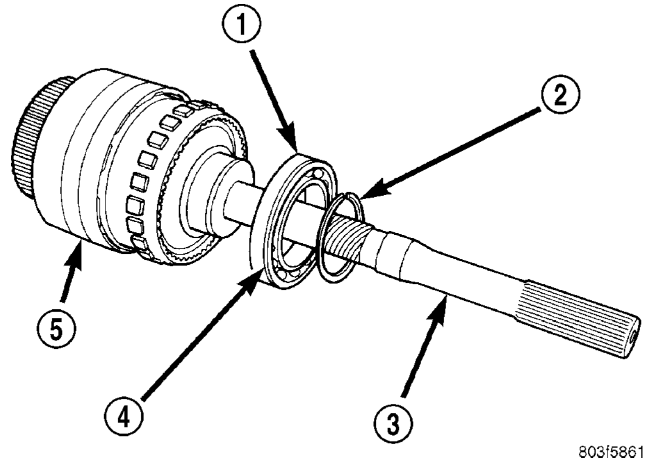


Fig. 117 Output Shaft Front Bearing

1 - OUTPUT SHAFT FRONT BEARING
2 - SNAP-RING
3 - OUTPUT SHAFT
4 - GROOVE TO REAR
5 - OVERDRIVE GEARTRAIN

OUTPUT SHAFT REAR BEARING

REMOVAL

(1) Remove overdrive unit from the vehicle. (Refer to 21 - TRANSMISSION/AUTOMATIC/OVERDRIVE - REMOVAL)

(2) Remove overdrive geartrain from housing.

(3) Remove snap-ring holding output shaft rear bearing into overdrive housing (Fig. 118).

(4) Using a suitable driver inserted through the rear end of housing, drive bearing from housing.

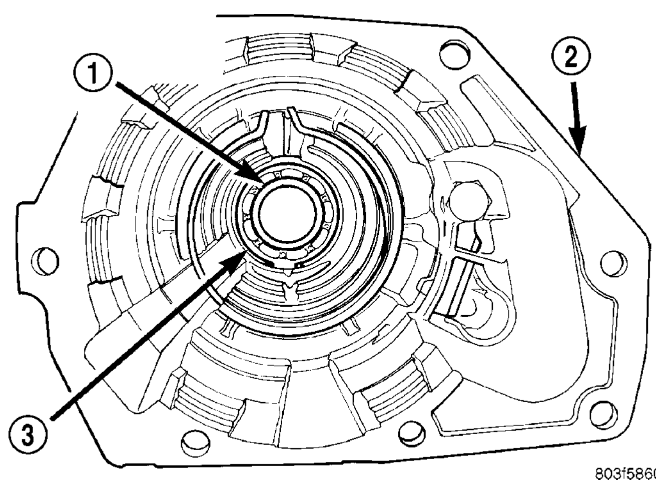


Fig. 118 Output Shaft Rear Bearing

1 - OUTPUT SHAFT REAR BEARING
2 - OVERDRIVE HOUSING
3 - SNAP-RING

INSTALLATION

(1) Place replacement bearing in position in housing.

(2) Using a suitable driver, drive bearing into housing until the snap-ring groove is visible.

(3) Install snap-ring to hold bearing into housing (Fig. 118).

(4) Install overdrive geartrain into housing.

(5) Install overdrive unit in vehicle.

OVERDRIVE CLUTCH

DESCRIPTION

The overdrive clutch (Fig. 119) is composed of the pressure plate, clutch plates, holding discs, overdrive piston retainer, piston, piston spacer, and snap-rings. The overdrive clutch is the forwardmost component in the transmission overdrive unit and is considered a holding component. The overdrive piston retainer, piston, and piston spacer are located on the rear of the main transmission case.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

OPERATION

To apply the clutch, pressure is applied between the piston retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through passages at the lower rear portion of the valve body area. With pressure applied between the piston retainer and piston, the piston moves away from the piston retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the intermediate shaft into the overdrive planetary gear set. The overdrive clutch discs are attached to the overdrive clutch hub while the overdrive clutch plates, reaction plate, and pressure plate are lugged to the overdrive housing. This allows the intermediate shaft to transfer the engine torque to the planetary gear and overrunning clutch. This drives the planetary gear inside the annulus, which is attached to the overdrive clutch drum and output shaft, creating the desired gear ratio. The waved snap-ring is used to cushion the application of the clutch pack for the 5 disc version of the overdrive clutch. The 6 disc overdrive clutch does not use a waved snap-ring.

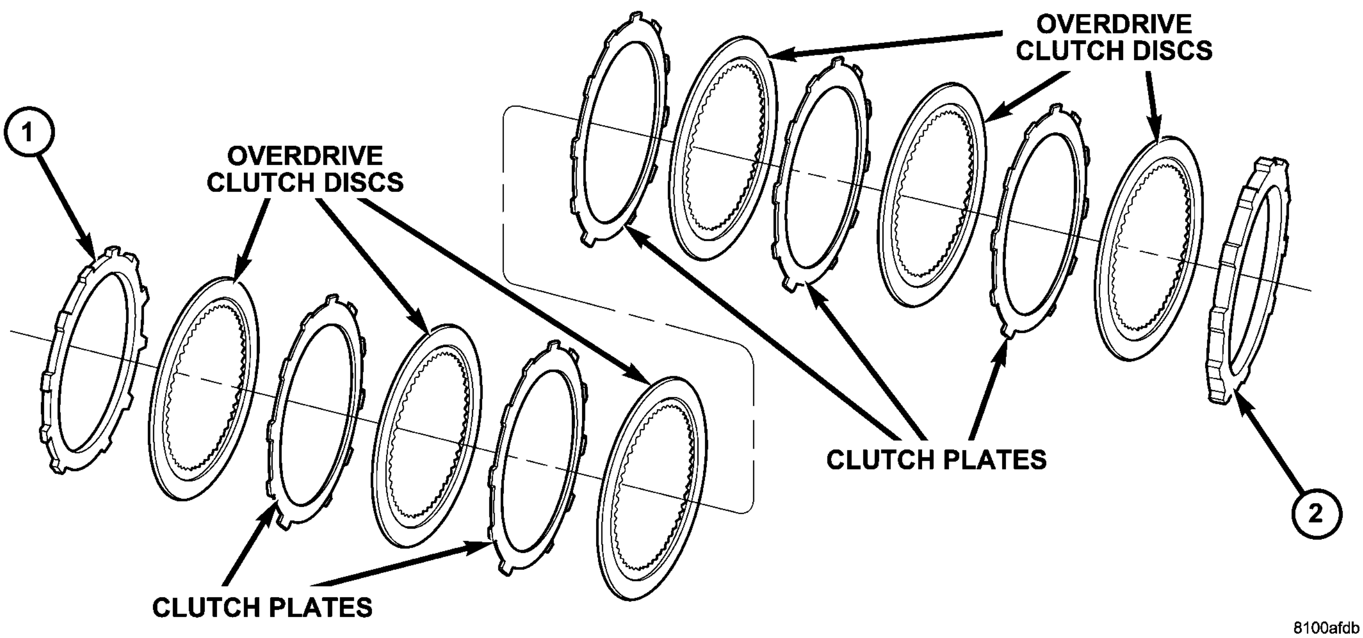


Fig. 119 Overdrive Clutch

1 - REACTION PLATE
2 - PRESSURE PLATE

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 120). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

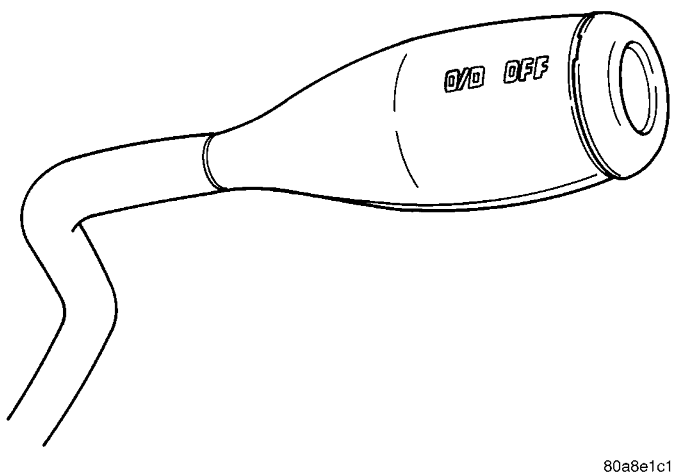


Fig. 120 Overdrive Off Switch

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

DIAGNOSIS AND TESTING - OVERDRIVE ELECTRICAL CONTROLS

The overdrive off switch, valve body solenoid, case connectors and related wiring can all be tested with a 12 volt test lamp or a volt/ohmmeter. Check continuity of each component when diagnosis indicates this is necessary.

Switch and solenoid continuity should be checked whenever the transmission fails to shift into fourth gear range.

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 121).

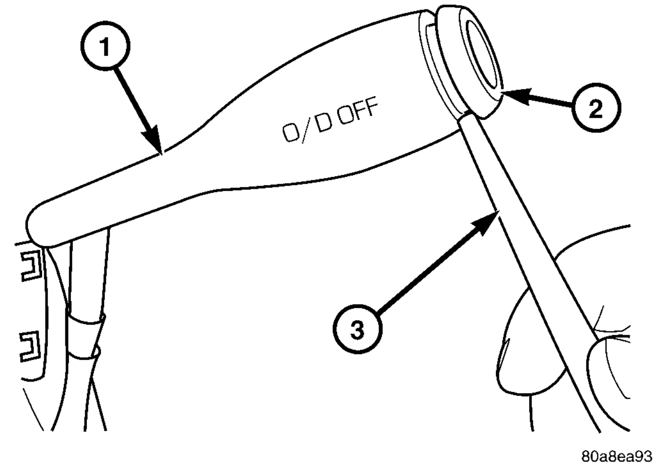


Fig. 121 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 122)

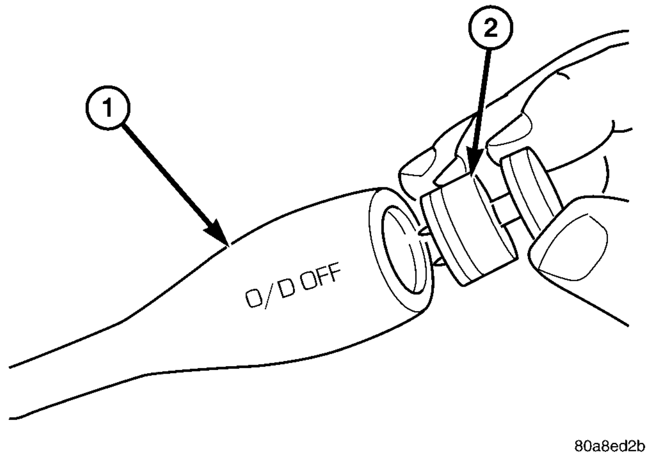


Fig. 122 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

OVERDRIVE SWITCH (Continued)

(2) Install the overdrive off switch into the connector (Fig. 123)

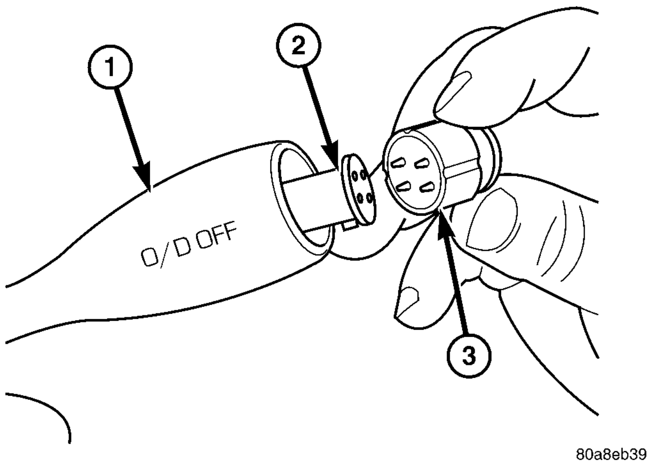


Fig. 123 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.

(4) Install the overdrive off switch retainer onto the shift lever.

OVERDRIVE UNIT

REMOVAL

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Remove transfer case, if equipped.

(4) Mark propeller shaft universal joint(s) and axle pinion yoke, or the companion flange and flange yoke, for alignment reference at installation, if necessary.

(5) Disconnect and remove the rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(6) Remove transmission oil pan, remove gasket, drain oil and reinstall pan.

(7) If overdrive unit had malfunctioned, or if fluid is contaminated, remove entire transmission. If diagnosis indicated overdrive problems only, remove just the overdrive unit.

(8) Support transmission with transmission jack.

(9) Remove bolts attaching overdrive unit to transmission (Fig. 124).

CAUTION: Support the overdrive unit with a jack before moving it rearward. This is necessary to prevent damaging the intermediate shaft. Do not allow the shaft to support the entire weight of the overdrive unit.

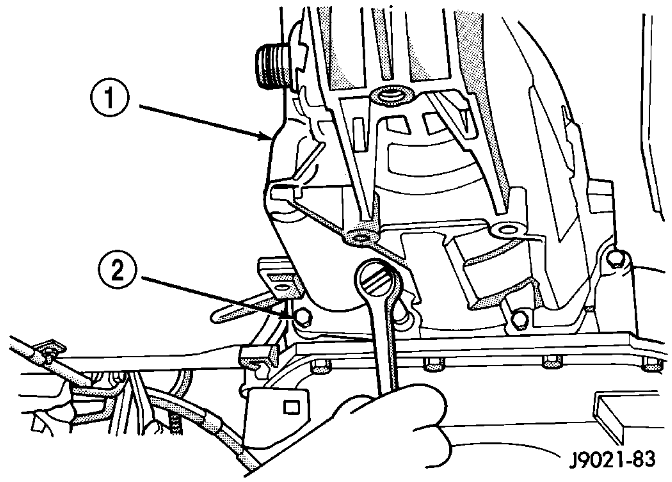


Fig. 124 Overdrive Unit Bolts

1 - OVERDRIVE UNIT
2 - ATTACHING BOLTS (7)

(10) Carefully work overdrive unit off intermediate shaft. Do not tilt unit during removal. Keep it as level as possible.

(11) If overdrive unit does not require service, immediately insert Alignment Tool 6227-2 in splines of planetary gear and overrunning clutch to prevent splines from rotating out of alignment. If misalignment occurs, overdrive unit will have to be disassembled in order to realign splines.

(12) Remove and retain overdrive piston thrust bearing. Bearing may remain on piston or in clutch hub during removal.

(13) Position drain pan on workbench.

(14) Place overdrive unit over drain pan. Tilt unit to drain residual fluid from case.

(15) Examine fluid for clutch material or metal fragments. If fluid contains these items, overhaul will be necessary.

(16) If overdrive unit does not require any service, leave alignment tool in position. Tool will prevent accidental misalignment of planetary gear and overrunning clutch splines.

OVERDRIVE UNIT (Continued)

DISASSEMBLY

(1) Remove transmission speed sensor and o-ring seal from overdrive case (Fig. 125).

(2) Remove overdrive piston thrust bearing (Fig. 126).

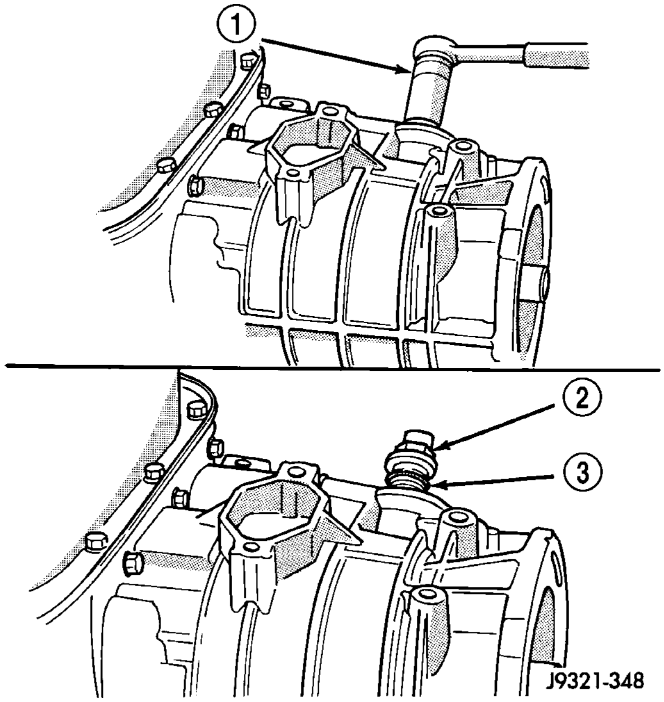


Fig. 125 Transmission Speed Sensor

1 - SOCKET AND WRENCH
2 - SPEED SENSOR
3 - O-RING

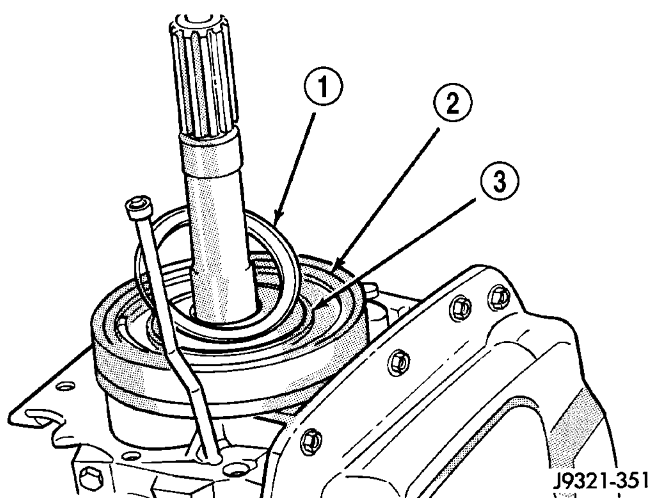


Fig. 126 Overdrive Piston Thrust Bearing Removal/ Installation

1 - THRUST BEARING
2 - OVERDRIVE PISTON
3 - THRUST PLATE

OVERDRIVE PISTON

(1) Remove overdrive piston thrust plate (Fig. 127). Retain thrust plate. It is a select fit part and may possibly be reused.

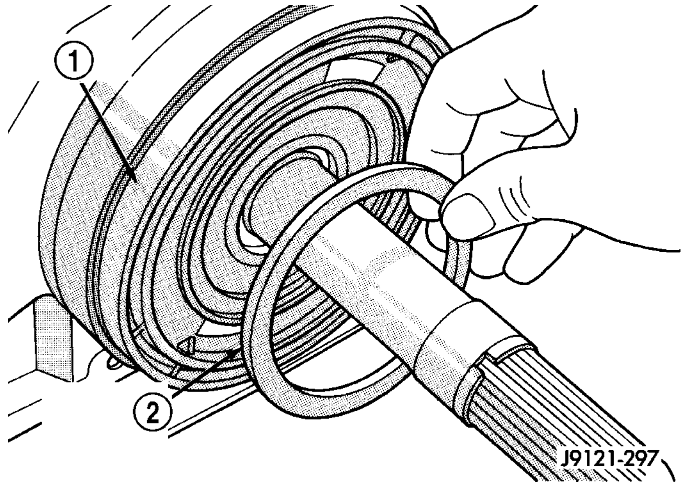


Fig. 127 Overdrive Piston Thrust Plate Removal/ Installation

1 - OVERDRIVE PISTON
2 - OVERDRIVE PISTON SPACER (SELECT FIT)

(2) Remove intermediate shaft spacer (Fig. 128). Retain spacer. It is a select fit part and may possibly be reused.

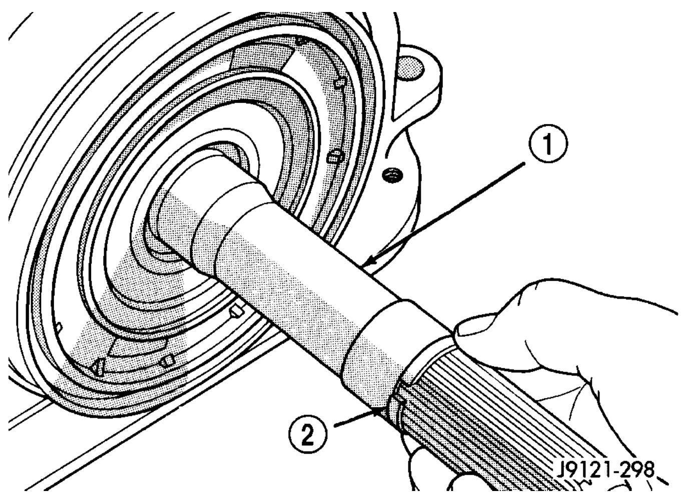


Fig. 128 Intermediate Shaft Spacer Location

1 - INTERMEDIATE SHAFT
2 - INTERMEDIATE SHAFT SPACER (SELECT FIT)

OVERDRIVE UNIT (Continued)

(3) Remove overdrive piston from retainer (Fig. 129).

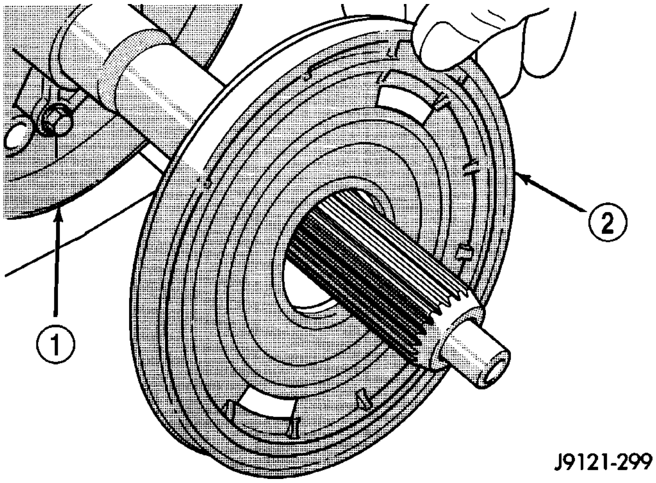


Fig. 129 Overdrive Piston Removal

1 - PISTON RETAINER
2 - OVERDRIVE PISTON

OVERDRIVE CLUTCH PACK

(1) Remove overdrive clutch pack wire retaining ring (Fig. 130).

(2) Remove overdrive clutch pack (Fig. 131).

(3) Note position of clutch pack components for assembly reference (Fig. 132).

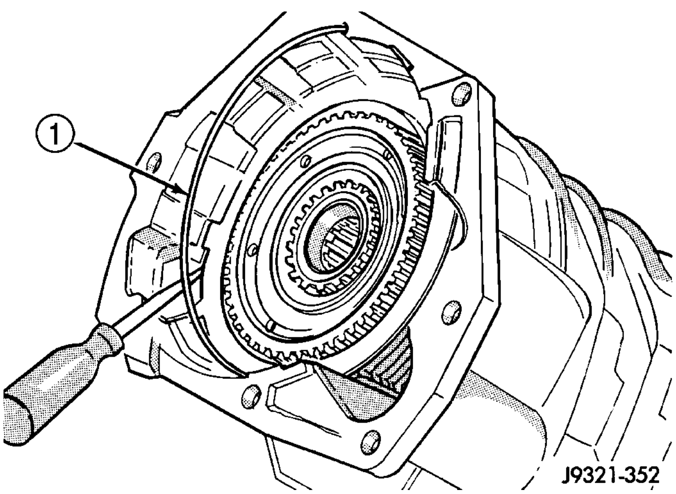


Fig. 130 Removing Overdrive Clutch Pack Retaining Ring

1 - OVERDRIVE CLUTCH PACK RETAINING RING

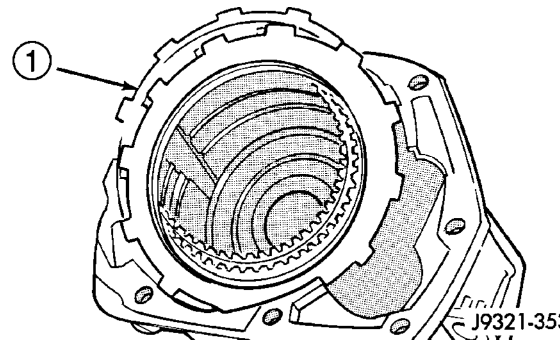


Fig. 131 Overdrive Clutch Pack Removal

1 - OVERDRIVE CLUTCH PACK

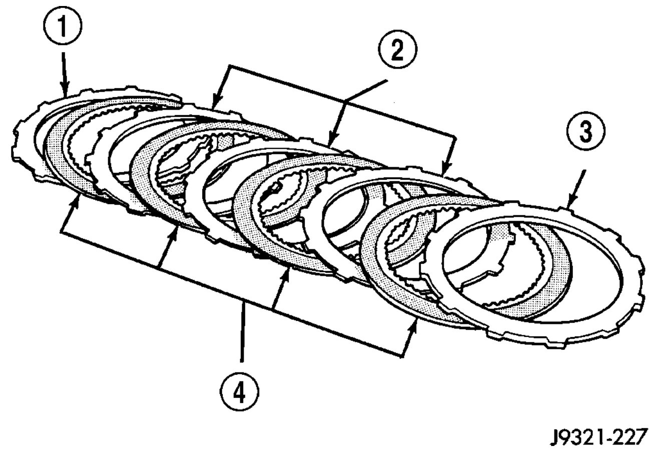


Fig. 132 Overdrive Clutch Component Position - Typical

1 - REACTION PLATE
2 - CLUTCH PLATES
3 - PRESSURE PLATE
4 - CLUTCH DISCS

OVERDRIVE GEARTRAIN

(1) Remove overdrive clutch wave spring (Fig. 133), 5 disc clutch only.

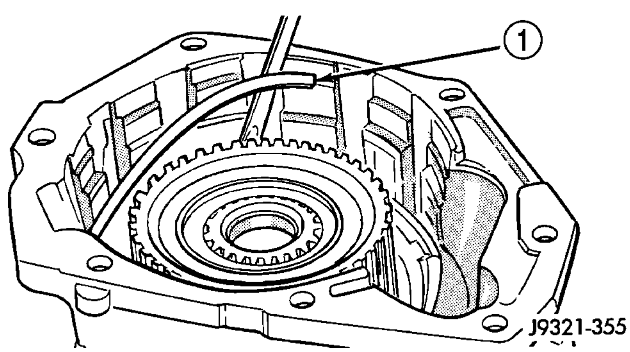


Fig. 133 Overdrive Clutch Wave Spring Removal - 5 Disc Clutch Only

1 - WAVE SPRING

OVERDRIVE UNIT (Continued)

(2) Remove overdrive clutch reaction snap-ring (Fig. 134). Note that snap-ring is located in same groove as wave spring.

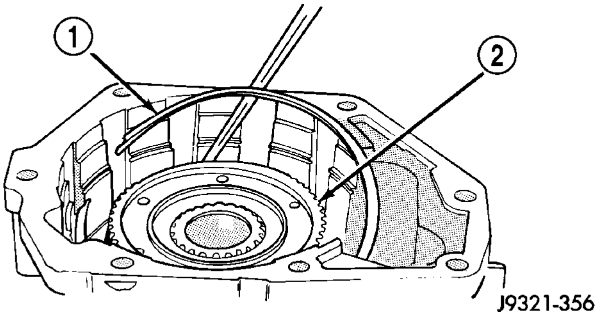


Fig. 134 Overdrive Clutch Reaction Snap-Ring Removal

1 - REACTION RING
2 - CLUTCH HUB

(3) Remove Torx™ head screws that attach access cover and gasket to overdrive case (Fig. 135).

(4) Remove access cover and gasket (Fig. 136).

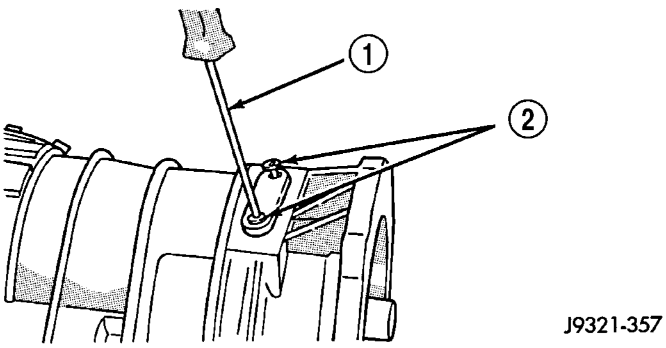


Fig. 135 Access Cover Screw Removal

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

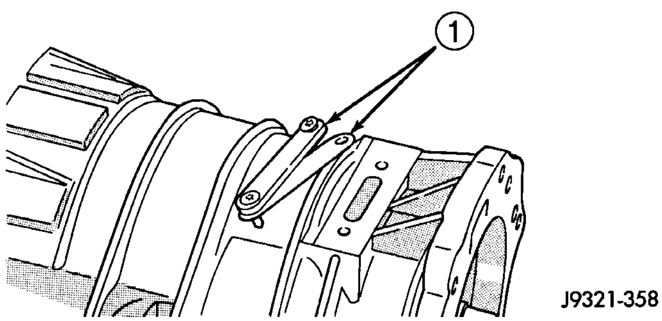


Fig. 136 Access Cover And Gasket Removal

1 - ACCESS COVER AND GASKET

(5) Expand output shaft bearing snap-ring with expanding-type snap-ring pliers. Then push output shaft forward to release shaft bearing from locating ring (Fig. 137).

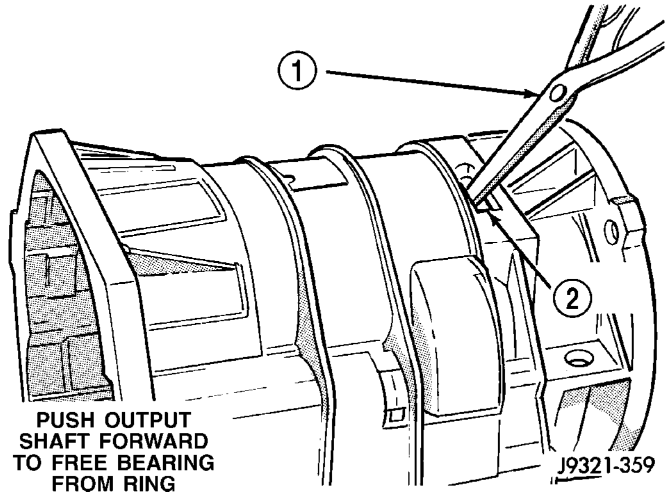


Fig. 137 Releasing Bearing From Locating Ring

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

(6) Lift gear case up and off geartrain assembly (Fig. 138).

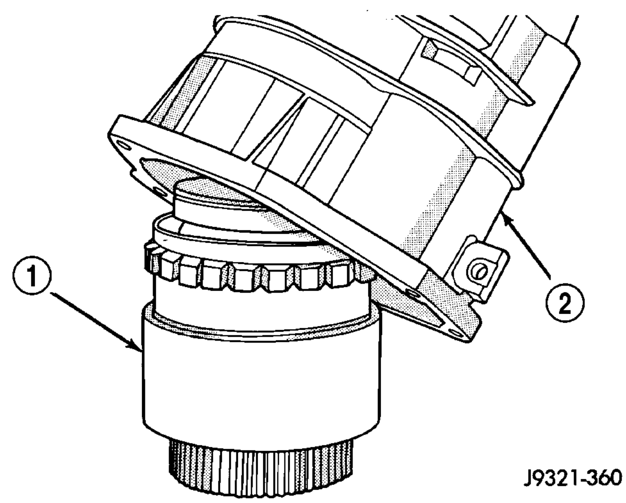


Fig. 138 Removing Geartrain

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

OVERDRIVE UNIT (Continued)

(7) Remove snap-ring that retains rear bearing on output shaft.

(8) Remove rear bearing from output shaft (Fig. 139).

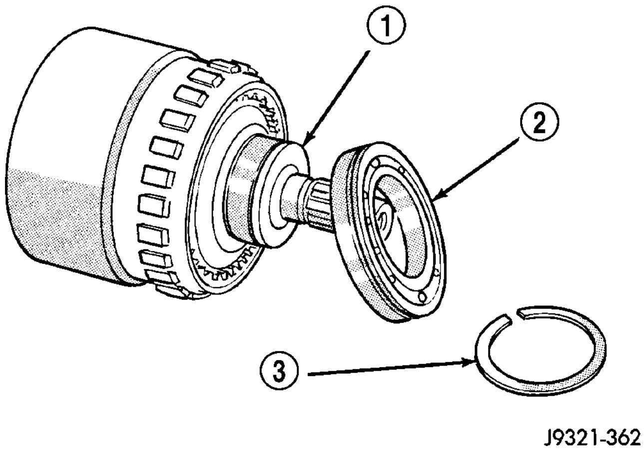


Fig. 139 Rear Bearing Removal

1 - OUTPUT SHAFT
2 - REAR BEARING
3 - SNAP-RING

DIRECT CLUTCH, HUB AND SPRING

WARNING: THE NEXT STEP IN DISASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE SPRING COMPRESSOR TOOL 6227-1 AND A HYDRAULIC SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 5-6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(1) Mount geartrain assembly in shop press (Fig. 140).

(2) Position Compressor Tool 6227-1 on clutch hub (Fig. 140). Support output shaft flange with steel press plates as shown and center assembly under press ram.

(3) Apply press pressure slowly. Compress hub and spring far enough to expose clutch hub retaining ring and relieve spring pressure on clutch pack snap-ring (Fig. 140).

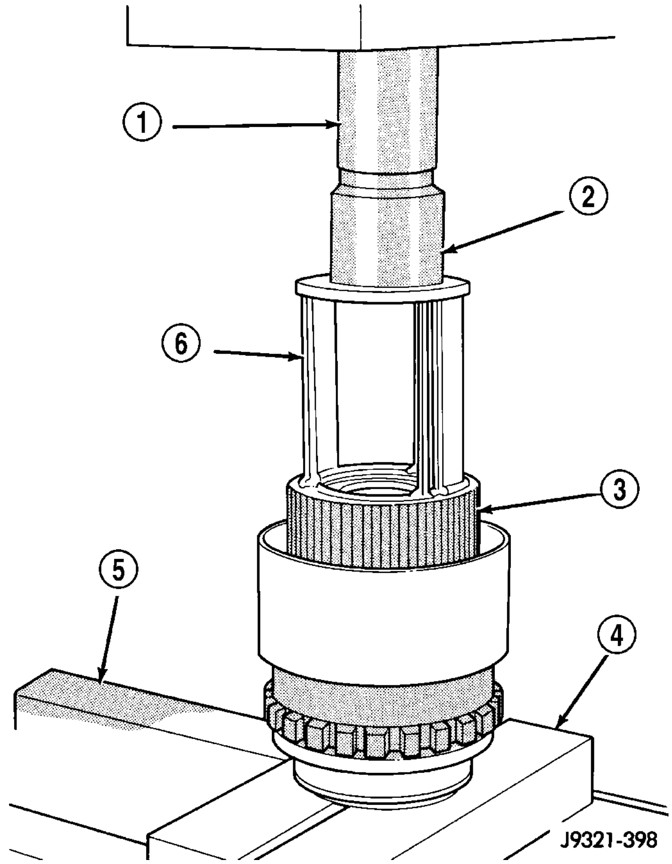


Fig. 140 Geartrain Mounted In Shop Press

1 - PRESS RAM
2 - SPECIAL TOOL C-3995-A (OR SIMILAR TOOL)
3 - CLUTCH HUB
4 - PLATES
5 - PRESS BED
6 - SPECIAL TOOL 6227-1

OVERDRIVE UNIT (Continued)

(4) Remove direct clutch pack snap-ring (Fig. 141).

(5) Remove direct clutch hub retaining ring (Fig. 142).

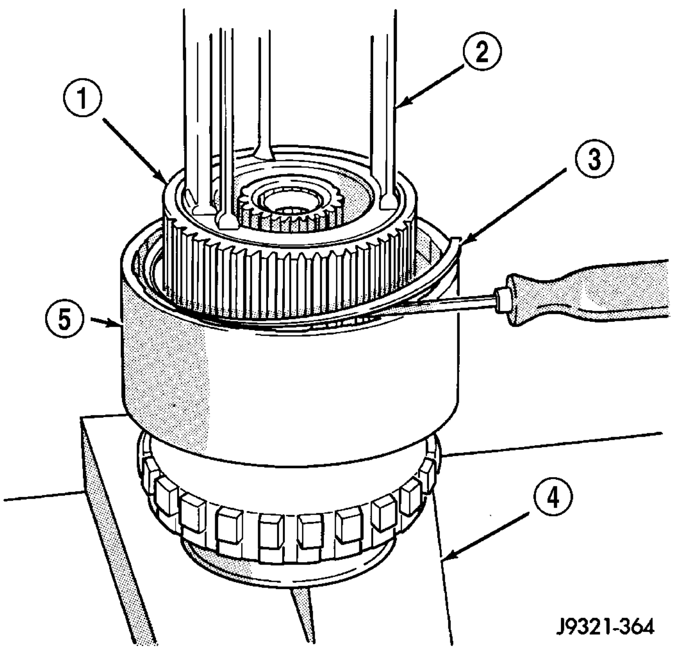


Fig. 141 Direct Clutch Pack Snap-Ring Removal

1 - CLUTCH HUB
2 - SPECIAL TOOL 6227-1
3 - DIRECT CLUTCH PACK SNAP-RING
4 - PRESS PLATES
5 - CLUTCH DRUM

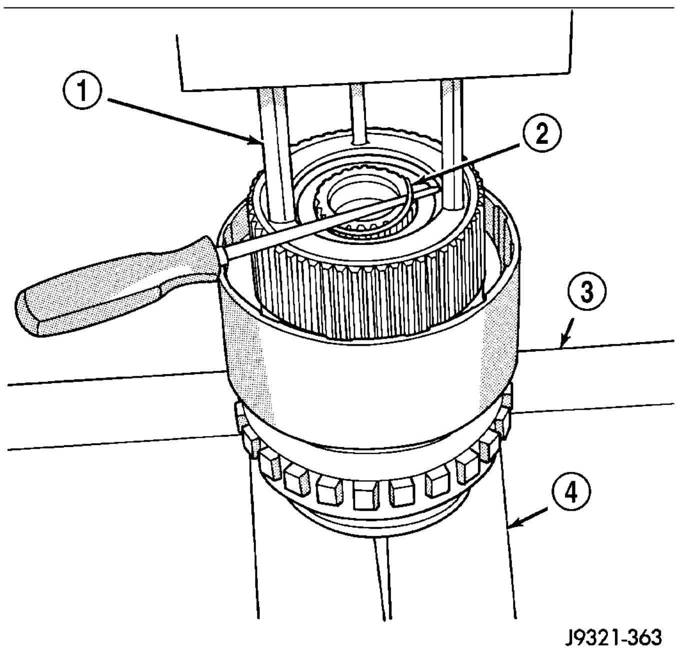


Fig. 142 Direct Clutch Hub Retaining Ring Removal

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING
3 - PRESS BED
4 - PRESS PLATES

(6) Release press load slowly and completely (Fig. 143).

(7) Remove Special Tool 6227-1. Then remove clutch pack from hub (Fig. 143). Note the orientation of the clutch discs. The clutch pack consists of 23 single-sided discs and they must be installed in the same orientation as they were removed.

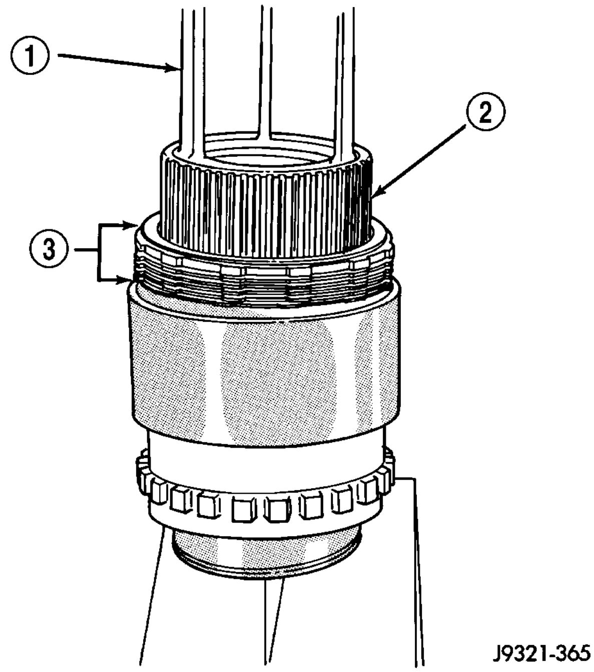


Fig. 143 Direct Clutch Pack Removal

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH HUB
3 - DIRECT CLUTCH PACK

GEARTRAIN

(1) Remove direct clutch hub and spring (Fig. 144).

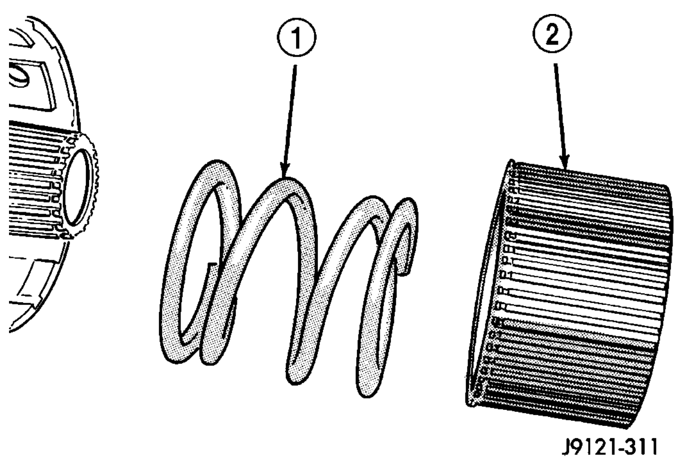


Fig. 144 Direct Clutch Hub And Spring Removal

1 - DIRECT CLUTCH SPRING
2 - DIRECT CLUTCH HUB

OVERDRIVE UNIT (Continued)

(2) Remove sun gear and spring plate. Then remove planetary thrust bearing and planetary gear (Fig. 145).

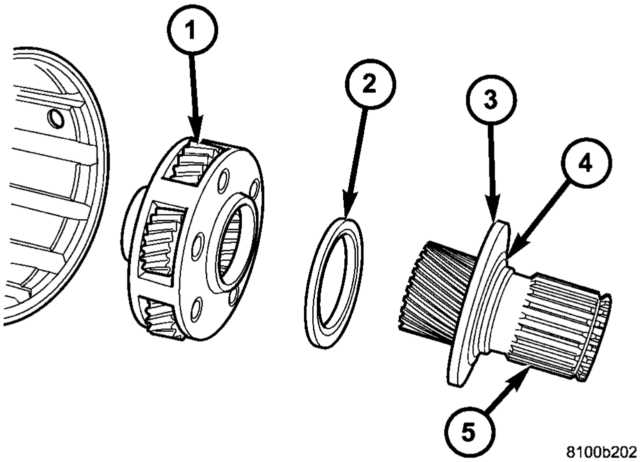


Fig. 145 Removing Sun Gear, Thrust Bearing And Planetary Gear

1 - PLANETARY GEAR
2 - PLANETARY THRUST BEARING
3 - CLUTCH SPRING PLATE
4 - SPRING PLATE SNAP-RING
5 - SUN GEAR

(3) Remove overrunning clutch assembly with expanding type snap-ring pliers (Fig. 146). Insert pliers into clutch hub. Expand pliers to grip hub splines and remove clutch with counterclockwise, twisting motion.

(4) Remove thrust bearing from overrunning clutch hub.

(5) Remove overrunning clutch from hub.

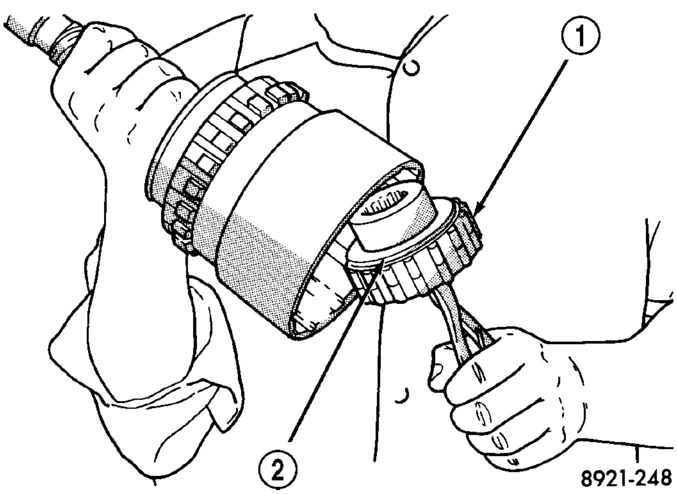


Fig. 146 Overrunning Clutch Assembly Removal/ Installation

1 - OVERRUNNING CLUTCH
2 - NEEDLE BEARING

(6) Mark position of annulus gear and direct clutch drum for assembly alignment reference (Fig. 147). Use small center punch or scriber to make alignment marks.

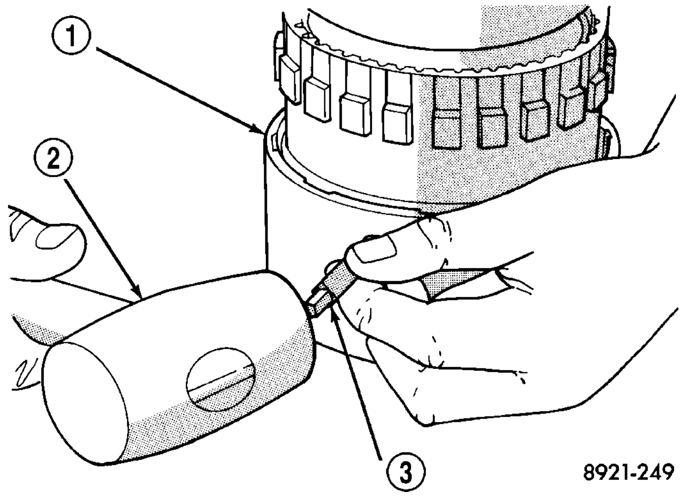


Fig. 147 Marking Direct Clutch Drum And Annulus Gear For Assembly Alignment

1 - DIRECT CLUTCH DRUM
2 - HAMMER
3 - PUNCH

(7) Remove direct clutch drum rear retaining ring (Fig. 148).

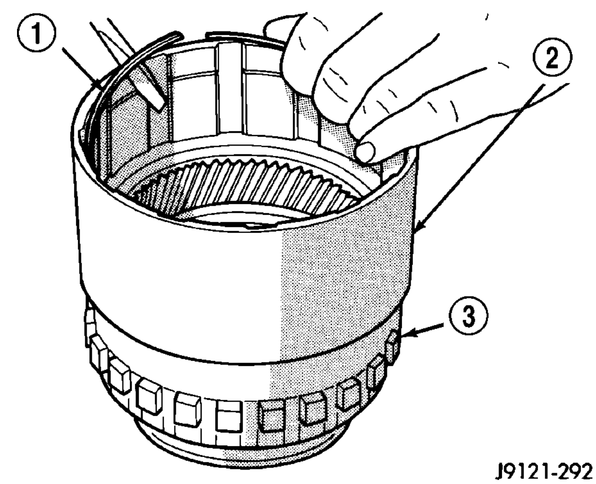


Fig. 148 Clutch Drum Inner Retaining Ring Removal

1 - INNER RETAINING RING
2 - DIRECT CLUTCH DRUM
3 - ANNULUS GEAR

OVERDRIVE UNIT (Continued)

(8) Remove direct clutch drum outer retaining ring (Fig. 149).

(9) Mark annulus gear and output shaft for assembly alignment reference (Fig. 150). Use punch or scriber to mark gear and shaft.

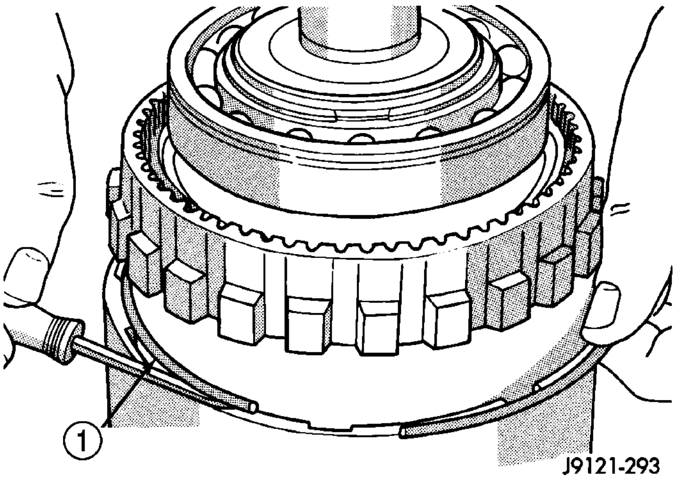


Fig. 149 Clutch Drum Outer Retaining Ring Removal

1 - OUTER RETAINING RING

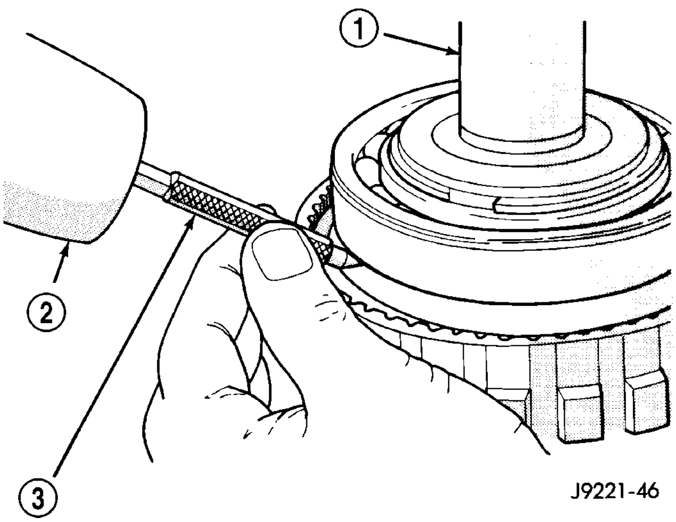


Fig. 150 Marking Annulus Gear And Output Shaft For Assembly Alignment

1 - OUTPUT SHAFT
2 - HAMMER
3 - PUNCH

(10) Remove snap-ring that secures annulus gear on output shaft (Fig. 151). Use two screwdrivers to unseat and work snap-ring out of groove as shown.

(11) Remove annulus gear from output shaft (Fig. 152). Use rawhide or plastic mallet to tap gear off shaft.

GEAR CASE AND PARK LOCK

(1) Remove locating ring from gear case.

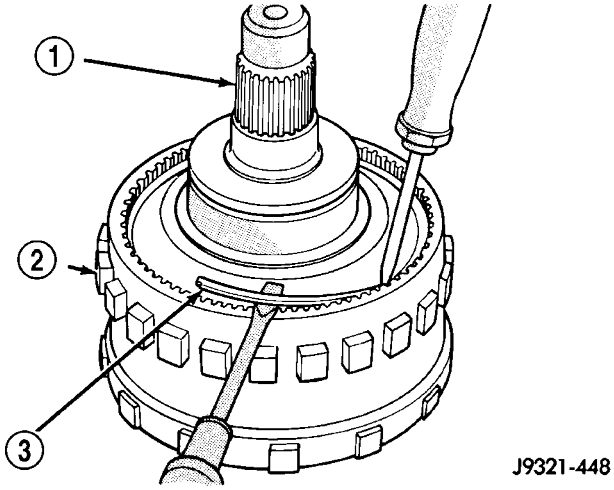


Fig. 151 Annulus Gear Snap-Ring Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR
3 - SNAP-RING

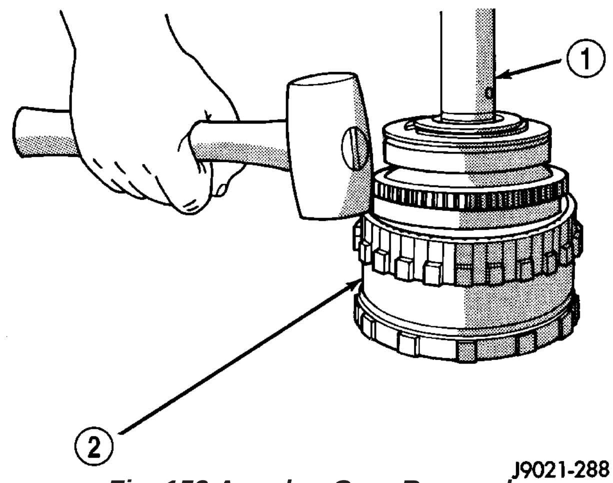


Fig. 152 Annulus Gear Removal

1 - OUTPUT SHAFT
2 - ANNULUS GEAR

(2) Remove park pawl shaft retaining bolt and remove shaft, pawl and spring.

(3) Remove reaction plug snap-ring and remove reaction plug.

(4) Remove output shaft seal.

CLEANING

Clean the geartrain and case components with solvent. Dry all parts except the bearings with compressed air. Allow bearings to air dry.

Do not use shop towels for wiping parts dry unless the towels are made from a lint-free material. A sufficient quantity of lint (from shop towels, cloths, rags, etc.) could plug the transmission filter and fluid passages.

Discard the old case gasket and seals. Do not attempt to salvage these parts. They are not reusable. Replace any of the overdrive unit snap-rings if distorted or damaged.

Minor nicks or scratches on components can be smoothed with crocus cloth. However, do not attempt to reduce severe scoring on any components with abrasive materials. Replace severely scored components; do not try to salvage them.

INSPECTION

Check condition of the park lock components and the overdrive case.

Check the bushings in the overdrive case. Replace the bushings if severely scored or worn. Also replace the case seal if loose, distorted, or damaged.

Examine the overdrive and direct clutch discs and plates. Replace the discs if the facing is worn, severely scored, or burned and flaking off. Replace the clutch plates if worn, heavily scored, or cracked. Check the lugs on the clutch plates for wear. The plates should slide freely in the drum. Replace the plates or drum if binding occurs.

Check condition of the annulus gear, direct clutch hub, clutch drum and clutch spring. Replace the gear, hub and drum if worn or damaged. Replace the spring if collapsed, distorted, or cracked.

Be sure the splines and lugs on the gear, drum and hub are in good condition. The clutch plates and discs should slide freely in these components.

Inspect the thrust bearings and spring plate. Replace the plate if worn or scored. Replace the bearings if rough, noisy, brinnelled, or worn.

Inspect the planetary gear assembly and the sun gear and bushings. If either the sun gear or the bushings are damaged, replace the gear and bushings as an assembly. The gear and bushings are not serviced separately.

The planetary carrier and pinions must be in good condition. Also be sure the pinion pins are secure and in good condition. Replace the carrier if worn or damaged.

Inspect the overrunning clutch and race. The race surface should be smooth and free of scores. Replace the overrunning clutch assembly or the race if either assembly is worn or damaged in any way.

Replace the shaft pilot bushing and inner bushing if damaged. Replace either shaft bearing if rough or noisy. Replace the bearing snap-rings if distorted or cracked.

Check the machined surfaces on the output shaft. These surfaces should clean and smooth. Very minor nicks or scratches can be smoothed with crocus cloth. Replace the shaft if worn, scored or damaged in any way.

Inspect the output shaft bushings. The small bushing is the intermediate shaft pilot bushing. The large bushing is the overrunning clutch hub bushing. Replace either bushing if scored, pitted, cracked, or worn.

ASSEMBLY

GEARTRAIN AND DIRECT CLUTCH

(1) Soak direct clutch and overdrive clutch discs in Mopar® ATF +4, Automatic Transmission fluid. Allow discs to soak for 10-20 minutes.

(2) Install annulus gear on output shaft, if removed. Then install annulus gear retaining snap-ring (Fig. 153).

(3) Align and install clutch drum on annulus gear (Fig. 154). Be sure drum is engaged in annulus gear lugs.

(4) Install clutch drum outer retaining ring (Fig. 154).

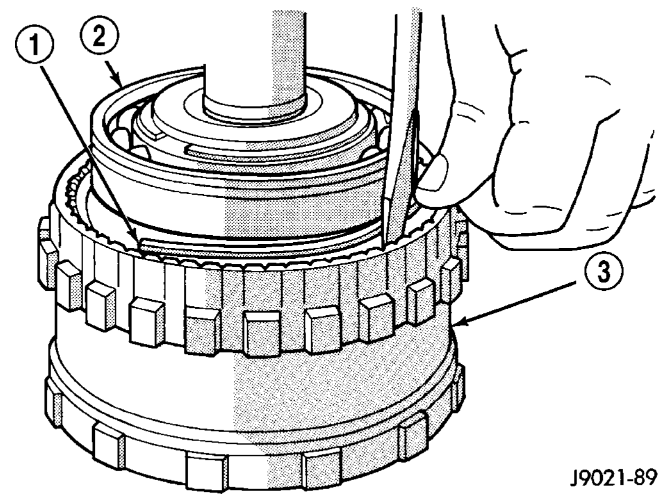


Fig. 153 Annulus Gear Installation

1 - SNAP-RING
2 - OUTPUT SHAFT FRONT BEARING
3 - ANNULUS GEAR

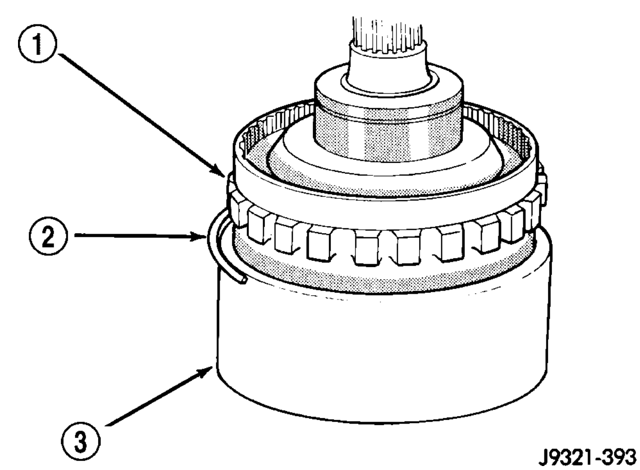


Fig. 154 Clutch Drum And Outer Retaining Ring Installation

1 - ANNULUS GEAR
2 - OUTER SNAP-RING
3 - CLUTCH DRUM

OVERDRIVE UNIT (Continued)

(5) Slide clutch drum forward and install inner retaining ring (Fig. 155).

(6) Install rear bearing and snap-ring on output shaft (Fig. 156). Be sure locating ring groove in bearing is toward rear.

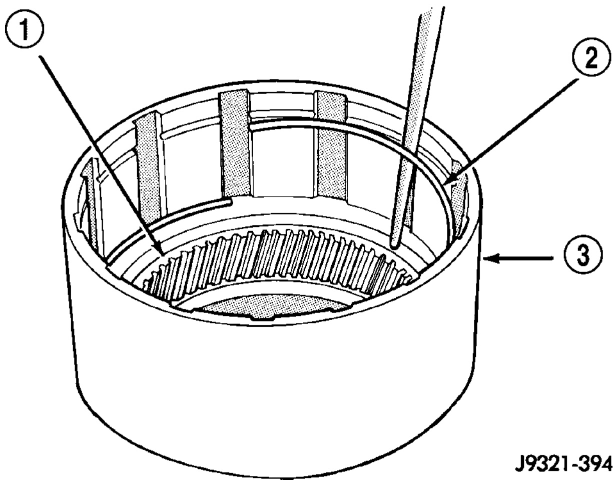


Fig. 155 Clutch Drum Inner Retaining Ring Installation

1 - ANNULUS GEAR
2 - INNER SNAP-RING
3 - CLUTCH DRUM

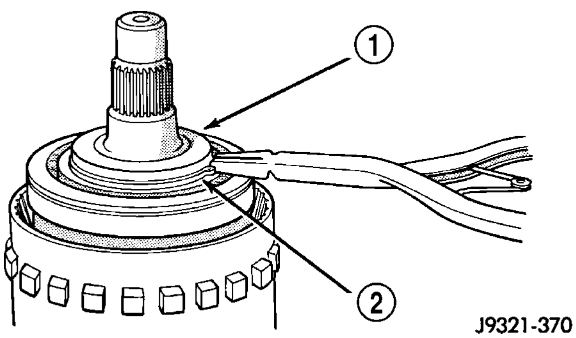


Fig. 156 Rear Bearing And Snap-Ring Installation

1 - REAR BEARING
2 - SNAP-RING

(7) Install overrunning clutch on hub (Fig. 157). Note that clutch only fits one way. Shoulder on clutch should seat in small recess at edge of hub.

(8) Install thrust bearing on overrunning clutch hub. Use generous amount of petroleum jelly to hold bearing in place for installation. Bearing fits one way only. Be sure bearing is seated squarely against hub. Reinstall bearing if it does not seat squarely.

(9) Install overrunning clutch in output shaft (Fig. 158). Insert snap-ring pliers in hub splines. Expand pliers to grip hub. Then install assembly with counterclockwise, twisting motion.

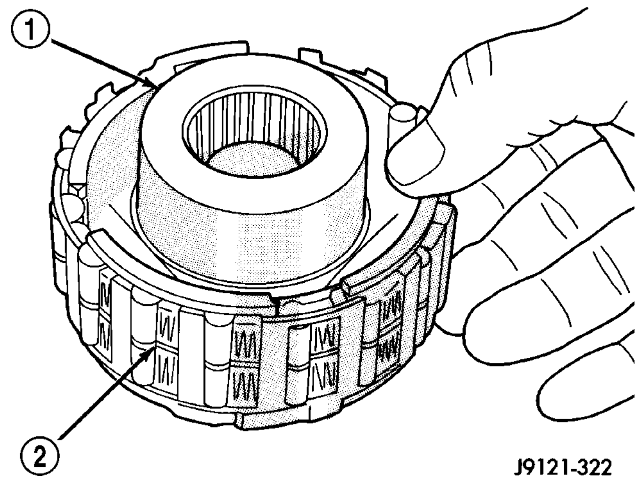


Fig. 157 Assembling Overrunning Clutch And Hub

1 - CLUTCH HUB
2 - OVERRUNNING CLUTCH

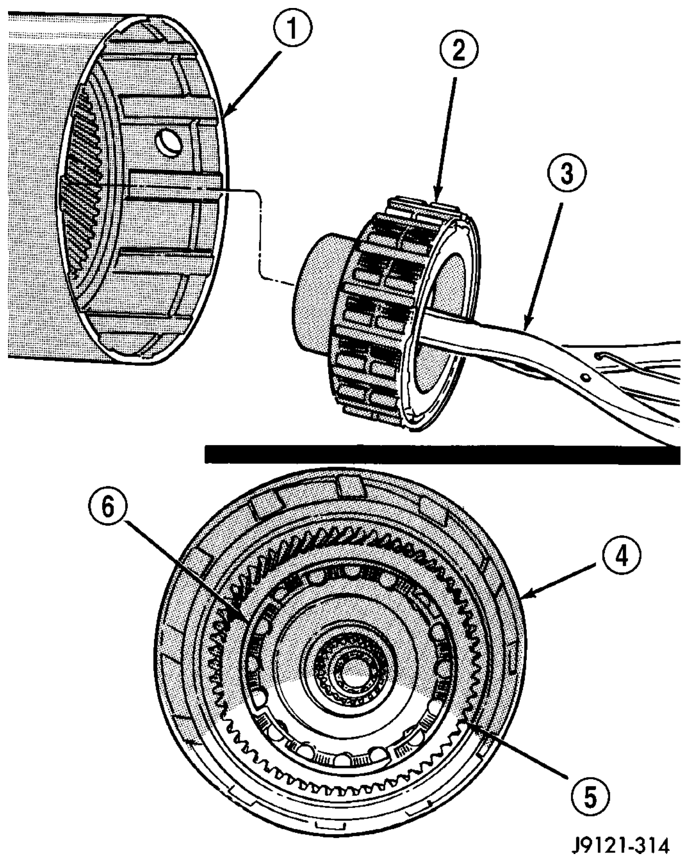


Fig. 158 Overrunning Clutch Installation

1 - CLUTCH DRUM
2 - OVERRUNNING CLUTCH ASSEMBLY
3 - EXPANDING-TYPE SNAP-RING PLIERS
4 - CLUTCH DRUM
5 - ANNULUS GEAR
6 - OVERRUNNING CLUTCH ASSEMBLY SEATED IN OUTPUT SHAFT

OVERDRIVE UNIT (Continued)

(10) Install planetary gear in annulus gear (Fig. 159). Be sure planetary pinions are fully seated in annulus gear before proceeding.

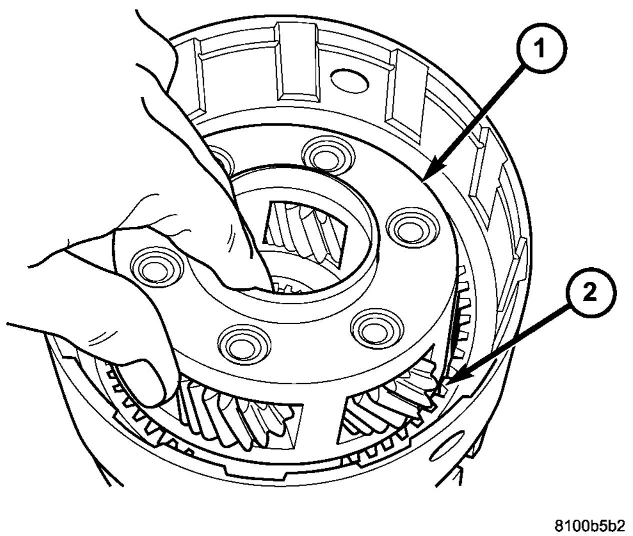


Fig. 159 Planetary Gear Installation

1 - PLANETARY GEAR
2 - ANNULUS GEAR

(11) Coat planetary thrust bearing and bearing contact surface of spring plate with generous amount of petroleum jelly. This will help hold bearing in place during installation.

(12) Install planetary thrust bearing on sun gear (Fig. 160). Slide bearing onto gear and seat it against spring plate as shown. Bearing fits one way only. If it does not seat squarely against spring plate, remove and reposition bearing.

(13) Install assembled sun gear, spring plate and thrust bearing (Fig. 161). Be sure sun gear and thrust bearing are fully seated before proceeding.

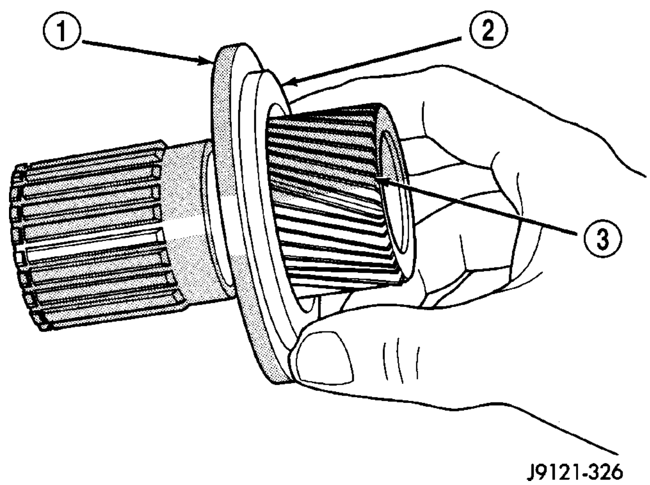


Fig. 160 Planetary Thrust Bearing Installation

1 - SPRING PLATE
2 - PLANETARY THRUST BEARING
3 - SUN GEAR

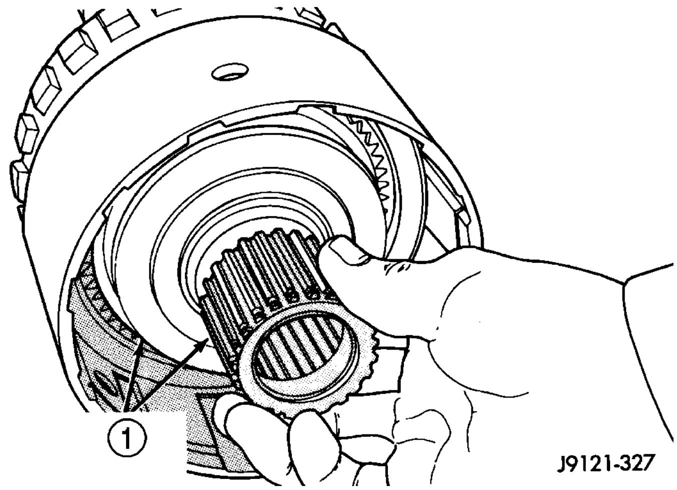


Fig. 161 Sun Gear Installation

1 - SUN GEAR AND SPRING PLATE ASSEMBLY

(14) Mount assembled output shaft, annulus gear, and clutch drum in shop press. Direct clutch spring, hub and clutch pack are easier to install with assembly mounted in press.

(15) Align splines in hubs of planetary gear and overrunning clutch with Alignment tool 6227-2 (Fig. 162). Insert tool through sun gear and into splines of both hubs. Be sure alignment tool is fully seated before proceeding.

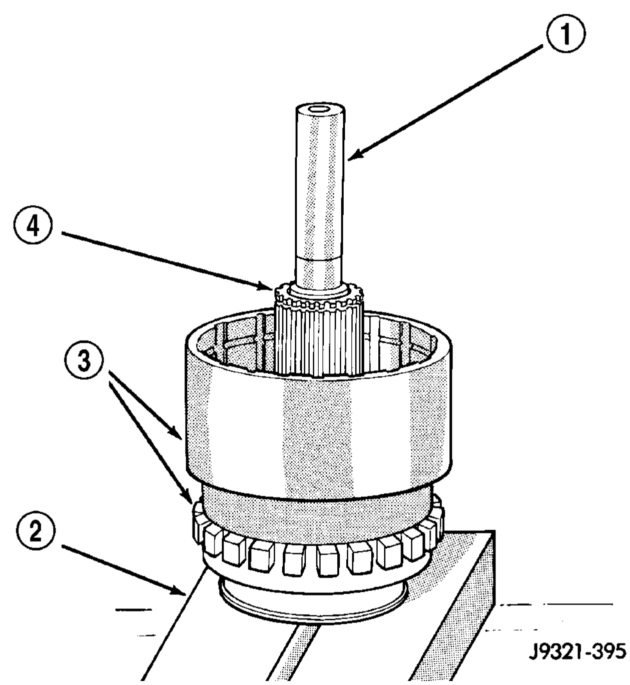


Fig. 162 Alignment Tool Installation

1 - SPECIAL TOOL 6227-2
2 - PRESS PLATES
3 - ASSEMBLED DRUM AND ANNULUS GEAR
4 - SUN GEAR

OVERDRIVE UNIT (Continued)

(16) Install direct clutch spring (Fig. 163). Be sure spring is properly seated on spring plate.

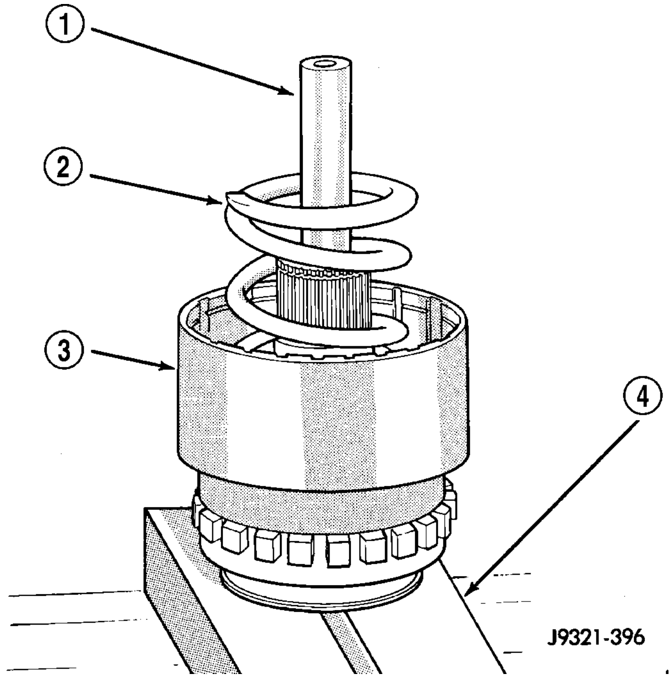


Fig. 163 Direct Clutch Spring Installation

1 - SPECIAL TOOL 6227-2
2 - DIRECT CLUTCH SPRING
3 - CLUTCH HUB
4 - PRESS PLATES

NOTE: The direct clutch in a 48RE transmission uses 23 single-sided clutch discs.

(17) Assemble and install direct clutch pack on hub as follows:

(a) Install direct clutch reaction plate on clutch hub first. Note that one side of reaction plate is counterbored. Be sure this side faces rearward. Splines at rear of hub are raised slightly. Counterbore in plate fits over raised splines. Plate should be flush with this end of hub (Fig. 164).

(b) Install first clutch disc with external lugs followed by a disc with internal spline teeth. Continue alternating internal and external discs until all discs have been installed.

(c) Install pressure plate. This is last clutch pack item to be installed. Be sure plate is installed with shoulder side facing upward (Fig. 165).

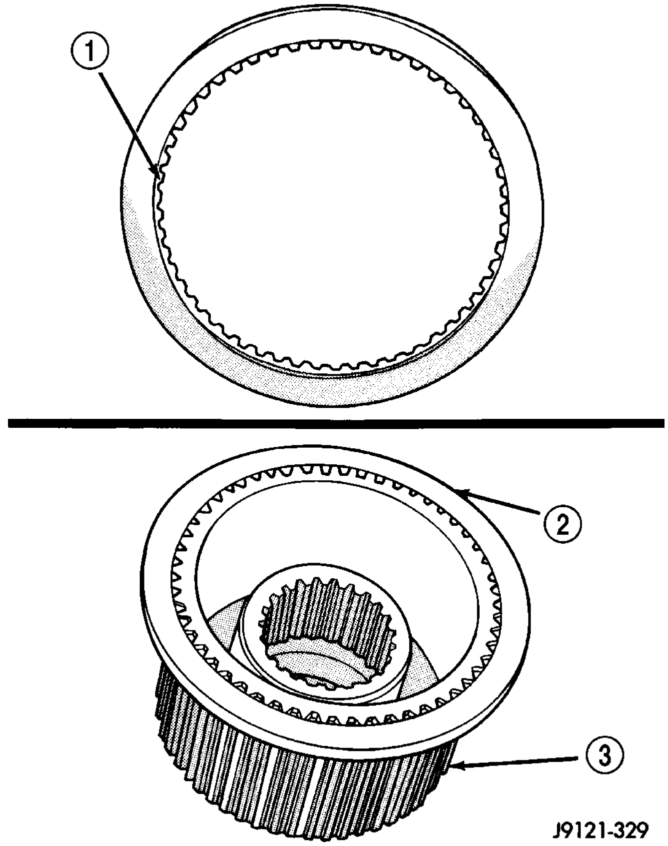


Fig. 164 Correct Position Of Direct Clutch Reaction Plate

1 - REACTION PLATE COUNTERBORE
2 - DIRECT CLUTCH REACTION PLATE (FLUSH WITH END OF HUB)
3 - CLUTCH HUB

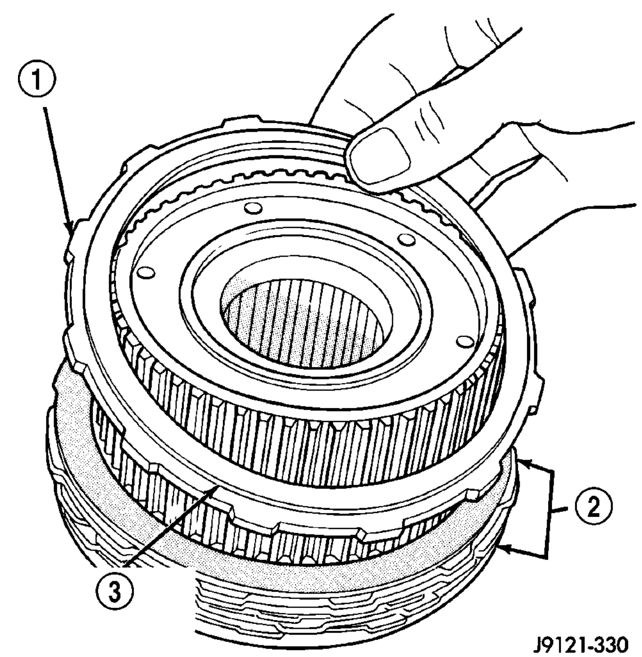


Fig. 165 Correct Position Of Direct Clutch

1 - DIRECT CLUTCH PRESSURE PLATE
2 - CLUTCH PACK
3 - BE SURE SHOULDER SIDE OF PLATE FACES UPWARD

OVERDRIVE UNIT (Continued)

(18) Install clutch hub and clutch pack on direct clutch spring (Fig. 166). Be sure hub is started on sun gear splines before proceeding.

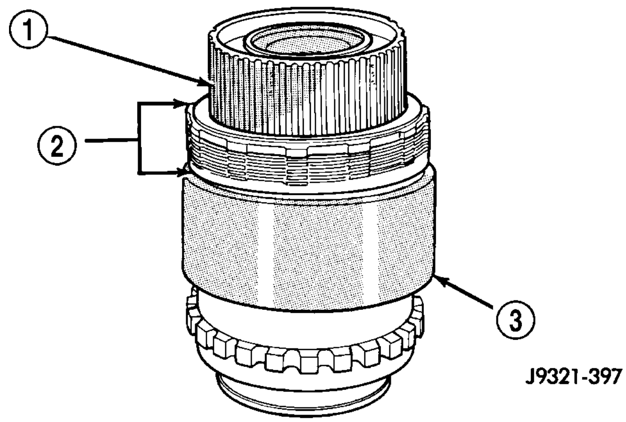


Fig. 166 Direct Clutch Pack And Clutch Hub Installation

1 - CLUTCH HUB
2 - DIRECT CLUTCH PACK
3 - CLUTCH DRUM

WARNING: THE NEXT STEP IN GEARTRAIN ASSEMBLY INVOLVES COMPRESSING THE DIRECT CLUTCH HUB AND SPRING. IT IS EXTREMELY IMPORTANT THAT PROPER EQUIPMENT BE USED TO COMPRESS THE SPRING AS SPRING FORCE IS APPROXIMATELY 830 POUNDS. USE COMPRESSOR TOOL C-6227-1 AND A HYDRAULIC-TYPE SHOP PRESS WITH A MINIMUM RAM TRAVEL OF 6 INCHES. THE PRESS MUST ALSO HAVE A BED THAT CAN BE ADJUSTED UP OR DOWN AS REQUIRED. RELEASE CLUTCH SPRING TENSION SLOWLY AND COMPLETELY TO AVOID PERSONAL INJURY.

(19) Position Compressor Tool 6227-1 on clutch hub.

(20) Compress clutch hub and spring just enough to place tension on hub and hold it in place.

(21) Slowly compress clutch hub and spring. Compress spring and hub only enough to expose ring grooves for clutch pack snap-ring and clutch hub retaining ring.

(22) Realign clutch pack on hub and seat clutch discs and plates in clutch drum.

(23) Install direct clutch pack snap-ring (Fig. 167). Be very sure snap-ring is fully seated in clutch drum ring groove.

(24) Install clutch hub retaining ring (Fig. 168). Be very sure retaining ring is fully seated in sun gear ring groove.

(25) Slowly release press ram, remove compressor tools and remove geartrain assembly.

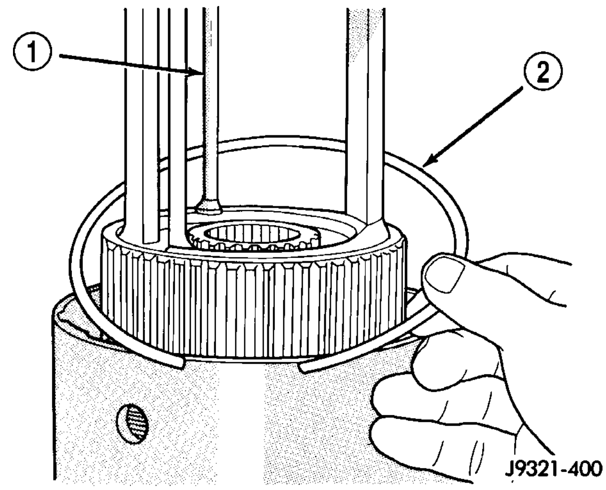


Fig. 167 Direct Clutch Pack Snap-Ring Installation

1 - SPECIAL TOOL 6227-1
2 - DIRECT CLUTCH PACK SNAP-RING

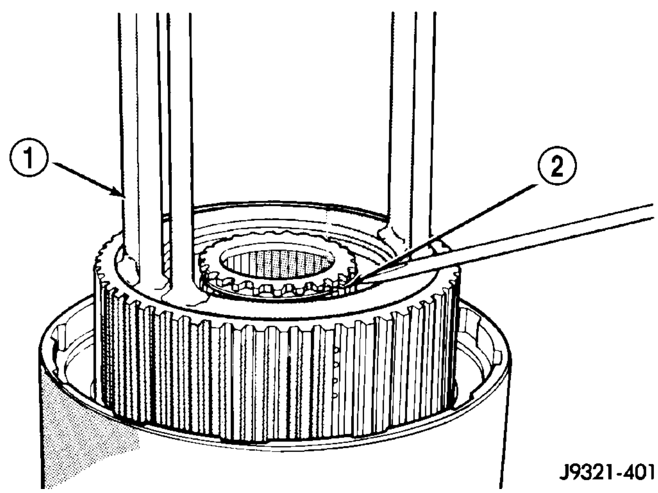


Fig. 168 Clutch Hub Retaining Ring Installation

1 - SPECIAL TOOL 6227-1
2 - CLUTCH HUB RETAINING RING

OVERDRIVE UNIT (Continued)

GEAR CASE

(1) Position park pawl and spring in case and install park pawl shaft. Verify that end of spring with 90° bend is hooked to pawl and straight end of spring is seated against case.

(2) Install pawl shaft retaining bolt. Tighten bolt to 27 N·m (20 ft. lbs.) torque.

(3) Install park lock reaction plug. Note that plug has locating pin at rear (Fig. 169). Be sure pin is seated in hole in case before installing snap-ring.

(4) Install reaction plug snap-ring (Fig. 170). Compress snap-ring only enough for installation; do not distort it.

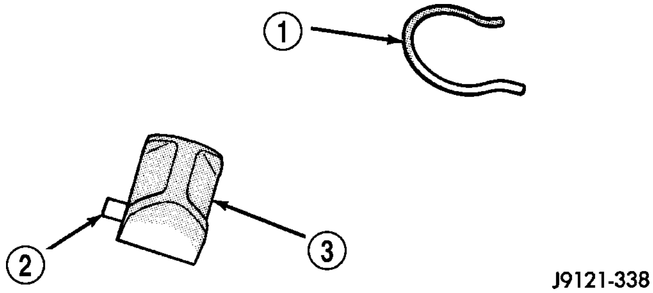


Fig. 169 Reaction Plug Locating Pin And Snap-Ring

1 - REACTION PLUG SNAP-RING (DO NOT OVERCOMPRESS TO INSTALL)
2 - LOCATING PIN
3 - PARK LOCK REACTION PLUG

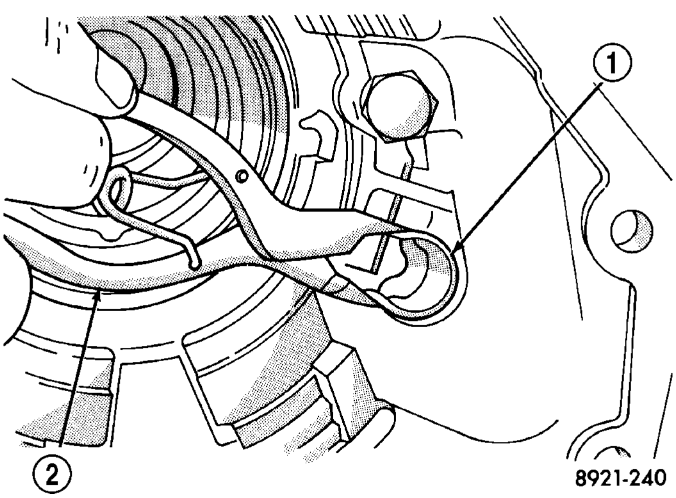


Fig. 170 Reaction Plug And Snap-Ring Installation

1 - REACTION PLUG SNAP-RING
2 - SNAP-RING PLIERS

(5) Verify that tab ends of rear bearing locating ring extend into access hole in gear case (Fig. 171).

(6) Support geartrain on Tool 6227-1 (Fig. 172). Be sure tool is securely seated in clutch hub.

(7) Install overdrive gear case on geartrain (Fig. 172).

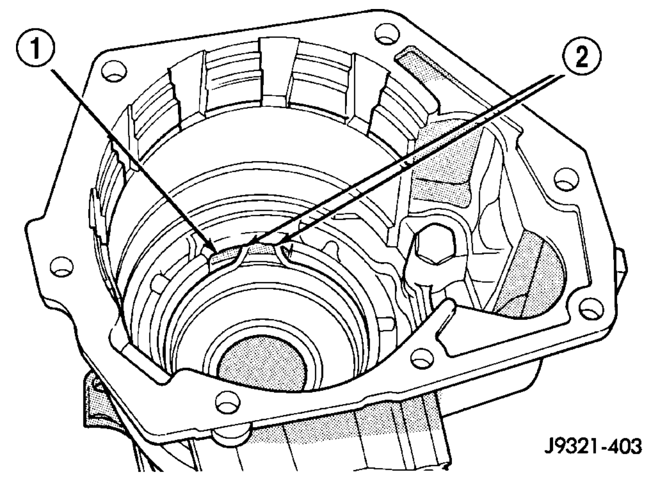


Fig. 171 Correct Rear Bearing Locating Ring Position

1 - CASE ACCESS HOLE
2 - TAB ENDS OF LOCATING RING

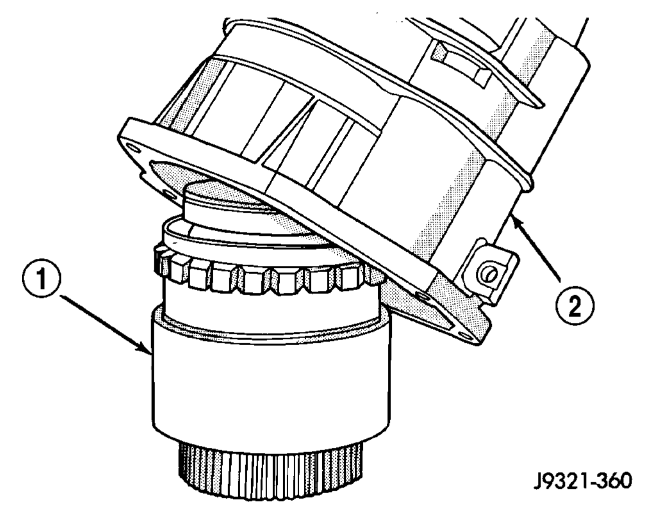


Fig. 172 Overdrive Gear Case Installation

1 - GEARTRAIN ASSEMBLY
2 - GEAR CASE

OVERDRIVE UNIT (Continued)

(8) Expand front bearing locating ring with snap-ring pliers (Fig. 173). Then slide case downward until locating ring locks in bearing groove and release snap-ring.

(9) Install locating ring access cover and gasket in overdrive unit case (Fig. 174).

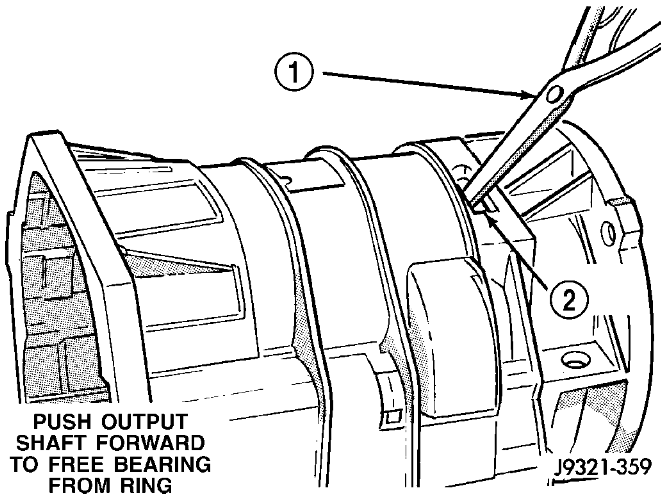


Fig. 173 Seating Locating Ring In Rear Bearing

1 - EXPAND BEARING LOCATING RING WITH SNAP-RING PLIERS
2 - ACCESS HOLE

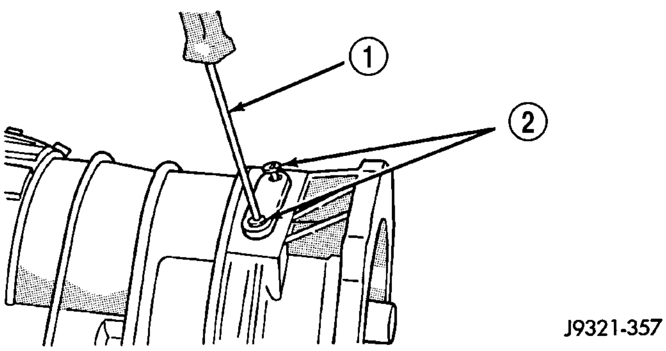


Fig. 174 Locating Ring Access Cover And Gasket Installation

1 - TORX SCREWDRIVER (T25)
2 - ACCESS COVER SCREWS

OVERDRIVE CLUTCH

NOTE: The overdrive clutch in a 48RE transmission uses 5 or 6 clutch discs depending on the application.

(1) Install overdrive clutch reaction ring first. Reaction ring is flat with notched ends (Fig. 175).

(2) For 5 disc overdrive clutch versions, install wave spring on top of reaction ring (Fig. 176). Reaction ring and wave ring both fit in same ring groove. Use screwdriver to seat each ring securely in groove. Also ensure that the ends of the two rings are offset from each other.

(3) Assemble overdrive clutch pack.

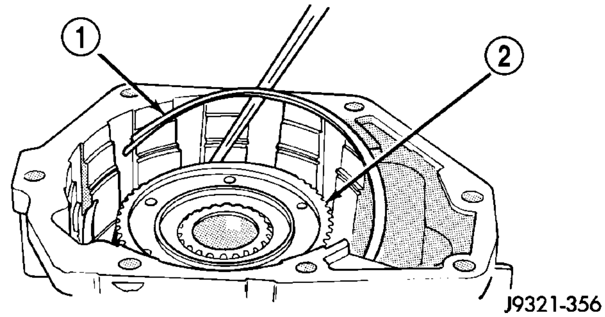


Fig. 175 Overdrive Clutch Reaction Ring Installation

1 - REACTION RING
2 - CLUTCH HUB

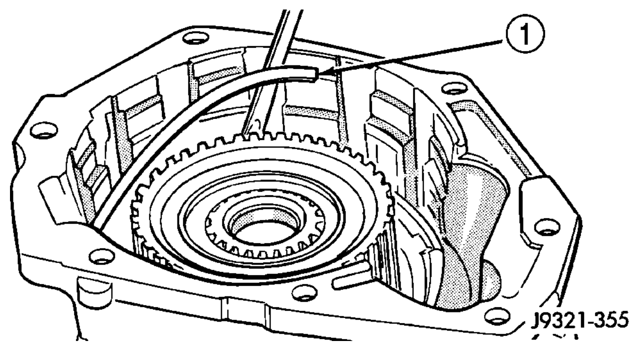


Fig. 176 Overdrive Clutch Wave Spring Installation - 5 Disc Clutch Only

1 - WAVE SPRING

(4) Install overdrive clutch reaction plate first.

(5) Install first clutch disc followed by first clutch plate. Then install remaining clutch discs and plates in same order.

(6) Install clutch pack pressure plate.

(7) Install clutch pack wire-type retaining ring (Fig. 177).

INTERMEDIATE SHAFT SPACER SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness intermediate shaft spacer as follows:

(a) Insert Special Tool 6312 through sun gear, planetary gear and into pilot bushing in output shaft. Be sure tool bottoms against planetary shoulder.

OVERDRIVE UNIT (Continued)

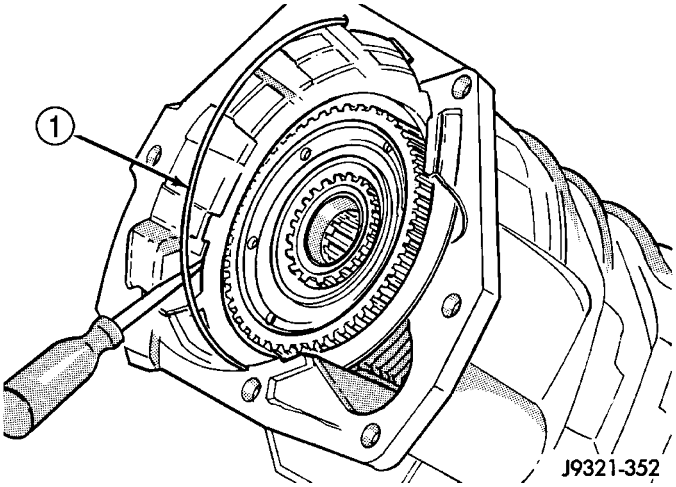


Fig. 177 Overdrive Clutch Pack Retaining Ring Installation

1 - OVERDRIVE CLUTCH PACK RETAINING RING

(b) Position Gauge Tool 6311 across face of overdrive case (Fig. 178). Then position Dial Caliper C-4962 over gauge tool.

(c) Extend sliding scale of dial caliper downward through gauge tool slot until scale contacts end of Gauge Alignment Tool 6312. Lock scale in place. Remove dial caliper tool and note distance measured (Fig. 178).

(d) Select proper thickness end play spacer from spacer chart based on distance measured (Fig. 179).

(e) Remove Gauge Alignment Tool 6312.

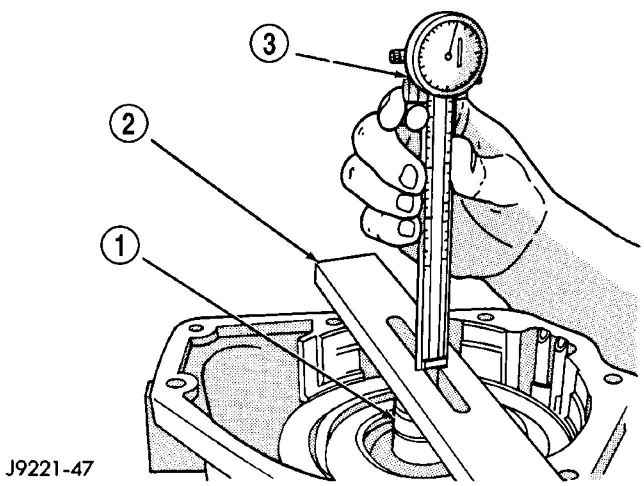


Fig. 178 Shaft End Play Measurement

1 - SPECIAL TOOL 6312
2 - SPECIAL TOOL 6311
3 - SPECIAL TOOL C-4962

OD THRUST PLATE SELECTION

(1) Place overdrive unit in vertical position. Mount it on blocks, or in workbench with appropriate size mounting hole cut into it. Be sure unit is facing upward for access to direct clutch hub. Also be sure output shaft is not loaded and internal components are moved rearward for accurate measurement.

(2) Determine correct thickness overdrive piston thrust plate as follows:

(a) Position Gauge Tool 6311 across face of overdrive case. Then position Dial Caliper C-4962 over gauge tool (Fig. 180).

(b) Measure distance to clutch hub thrust bearing seat at four points 90° apart. Then average measurements by adding them and dividing by 4.

(c) Select and install required thrust plate from information in thrust plate chart (Fig. 181).

(3) Leave Alignment Tool 6227-2 in place. Tool will keep planetary and clutch hub splines in alignment until overdrive unit is ready for installation on transmission.

(4) Transmission speed sensor can be installed at this time if desired. However, it is recommended that sensor not be installed until after overdrive unit is secured to transmission.

End Play Measurement (Inches)	Spacer Thickness (Inches)
.7336 - .7505	.158 - .159
.7506 - .7675	.175 - .176
.7676 - .7855	.193 - .194
.7856 - .8011	.211 - .212

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Fig. 179 Intermediate Shaft End Play Spacer Selection

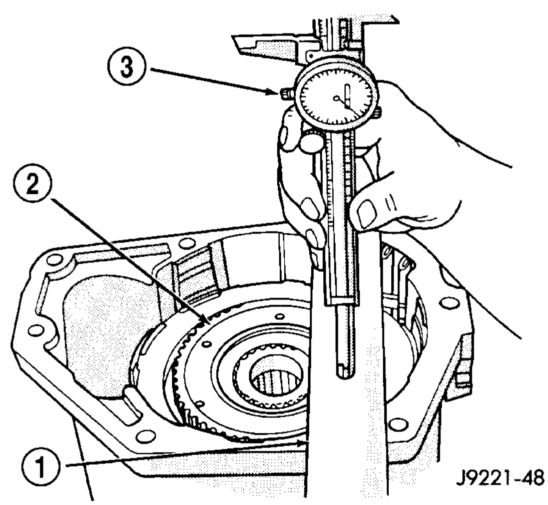

Fig. 180 Overdrive Piston Thrust Plate Measurement

1 - SPECIAL TOOL 6311
2 - DIRECT CLUTCH HUB THRUST BEARING SEAT
3 - SPECIAL TOOL C-4962

OVERDRIVE UNIT (Continued)

End Play Measurement (Inches)	Spacer Thickness (Inches)
1.7500 - 1.7649	.108 - .110
1.7650 - 1.7799	.123 - .125
1.7800 - 1.7949	.138 - .140
1.7950 - 1.8099	.153 - .155
1.8100 - 1.8249	.168 - .170
1.8250 - 1.8399	.183 - .185
1.8400 - 1.8549	.198 - .200
1.8550 - 1.8699	.213 - .215
1.8700 - 1.8849	.228 - .230
1.8850 - 1.8999	.243 - .245

J9121-342

Fig. 181 Overdrive Piston Thrust Plate Selection

OVERDRIVE PISTON

(1) Install new seals on overdrive piston.

(2) Stand transmission case upright on bellhousing.

(3) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(4) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

(5) Install overdrive piston in overdrive piston retainer by:

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® ATF+4.

(c) Install piston over Seal Guide 8114-3 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

(e) Verify that the locating lugs entered the lug bores in the retainer.

(6) Install intermediate shaft spacer on intermediate shaft.

(7) Install overdrive piston thrust plate on overdrive piston.

(8) Install overdrive piston thrust bearing on overdrive piston.

(9) Install transmission speed sensor and o-ring seal in overdrive case.

INSTALLATION

(1) Be sure overdrive unit Alignment Tool 6227-2 is fully seated before moving unit. If tool is not seated and gear splines rotate out of alignment, overdrive unit will have to be disassembled in order to realign splines.

(2) If overdrive piston retainer was not removed during service and original case gasket is no longer reusable, prepare new gasket by trimming it.

(3) Cut out old case gasket around piston retainer with razor knife (Fig. 182).

(4) Use old gasket as template and trim new gasket to fit.

(5) Position new gasket over piston retainer and on transmission case. Use petroleum jelly to hold gasket in place if necessary. Do not use any type of sealer to secure gasket. Use petroleum jelly only.

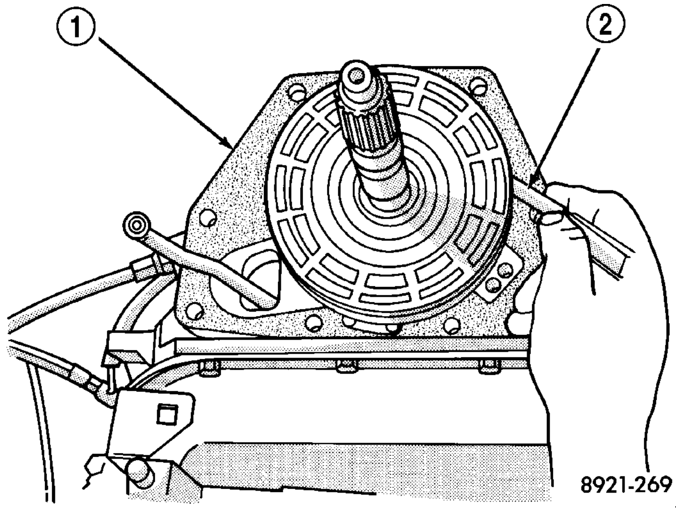

Fig. 182 Trimming Overdrive Case Gasket

1 - GASKET
2 - SHARP KNIFE

(6) Install selective spacer on intermediate shaft, if removed. Spacer goes in groove just rearward of shaft rear splines (Fig. 183).

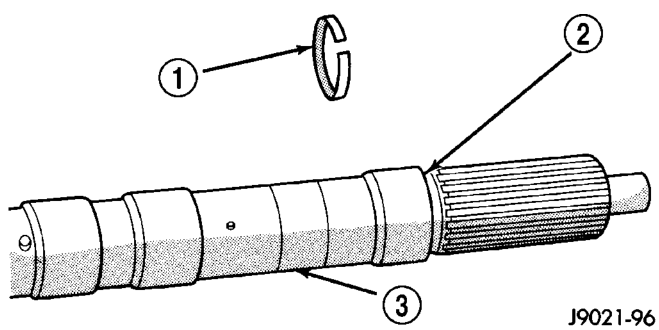

Fig. 183 Intermediate Shaft Selective Spacer Location

1 - SELECTIVE SPACER
2 - SPACER GROOVE
3 - INTERMEDIATE SHAFT

(7) Install thrust bearing in overdrive unit sliding hub. Use petroleum jelly to hold bearing in position.

CAUTION: Be sure the shoulder on the inside diameter of the bearing is facing forward.

(8) Verify that splines in overdrive planetary gear and overrunning clutch hub are aligned with Align-

OVERDRIVE UNIT (Continued)

ment Tool 6227-2. Overdrive unit cannot be installed if splines are not aligned. If splines have rotated out of alignment, unit will have to be disassembled to realign splines.

(9) Carefully slide Alignment Tool 6227-2 out of overdrive planetary gear and overrunning clutch splines.

(10) Raise overdrive unit and carefully slide it straight onto intermediate shaft. Insert park rod into park lock reaction plug at same time. Avoid tilting overdrive during installation as this could cause planetary gear and overrunning clutch splines to rotate out of alignment. If this occurs, it will be necessary to remove and disassemble overdrive unit to realign splines.

(11) Work overdrive unit forward on intermediate shaft until seated against transmission case.

(12) Install bolts attaching overdrive unit to transmission unit. Tighten bolts in diagonal pattern to 34 N·m (25 ft-lbs).

(13) Connect the transmission speed sensor and overdrive wiring connectors.

(14) Install the transfer case, if equipped.

(15) Align and install rear propeller shaft, if necessary. (Refer to 3 - DIFFERENTIAL & DRIVELINE/ PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER

DESCRIPTION

The overrunning clutch (Fig. 184) consists of an inner race, an outer race (or cam), rollers and springs, and the spring retainer. The number of rollers and springs depends on what transmission and which overrunning clutch is being dealt with.

OPERATION

As the inner race is rotated in a clockwise direction (as viewed from the front of the transmission), the race causes the rollers to roll toward the springs, causing them to compress against their retainer. The compression of the springs increases the clearance between the rollers and cam. This increased clearance between the rollers and cam results in a free-wheeling condition. When the inner race attempts to rotate counterclockwise, the action causes the rollers to roll in the same direction as the race, aided by the pushing of the springs. As the rollers try to move in the same direction as the inner race, they are wedged between the inner and outer races due to the design of the cam. In this condition, the clutch is locked and acts as one unit.

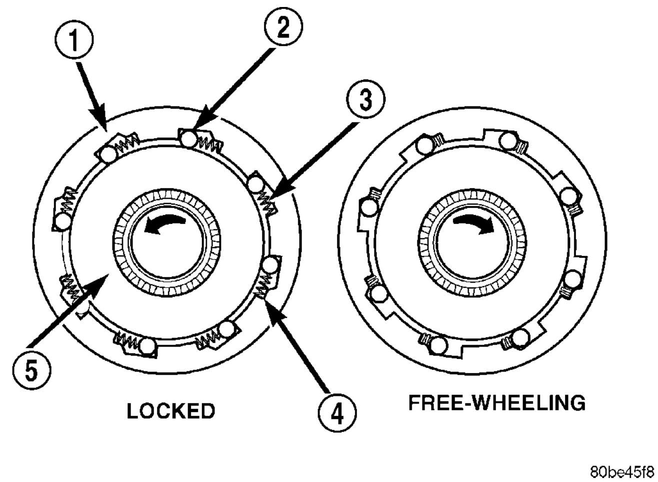

Fig. 184 Overrunning Clutch

1 - OUTER RACE (CAM)
2 - ROLLER
3 - SPRING
4 - SPRING RETAINER
5 - INNER RACE (HUB)

DISASSEMBLY

(1) Remove the overdrive piston (Fig. 185).
(2) Remove the overdrive piston retainer bolts.
(3) Remove overdrive piston retainer.
(4) Remove case gasket.

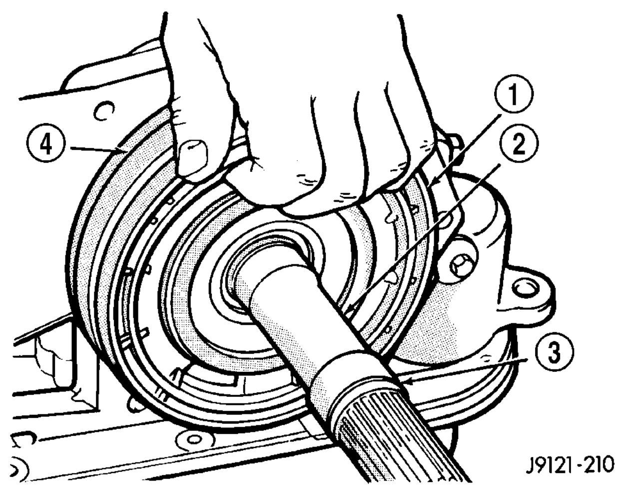

Fig. 185 Overdrive Piston Removal

1 - OVERDRIVE CLUTCH PISTON
2 - INTERMEDIATE SHAFT
3 - SELECTIVE SPACER
4 - PISTON RETAINER

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(5) Tap old cam out of case with pin punch. Insert punch through bolt holes at rear of case (Fig. 186). Alternate position of punch to avoid cocking cam during removal.

(6) Clean clutch cam bore and case. Be sure to remove all chips/shavings generated during cam removal.

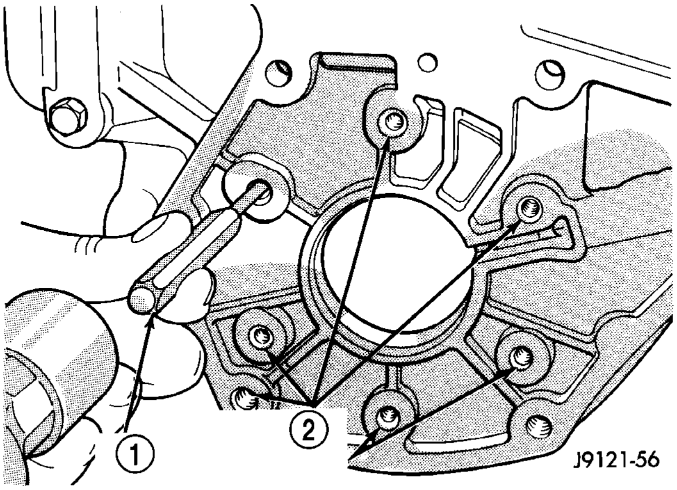

Fig. 186 Overrunning Clutch Cam

1 - PIN PUNCH
2 - REAR SUPPORT BOLT HOLES

CLEANING

Clean the overrunning clutch assembly, clutch cam, low-reverse drum, and overdrive piston retainer in solvent. Dry them with compressed air after cleaning.

INSPECTION

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse drum if the clutch race, roller surface or inside diameter is scored, worn or damaged. **Do not remove the clutch race from the low-reverse drum under any circumstances. Replace the drum and race as an assembly if either component is damaged.**

Examine the overdrive piston retainer carefully for wear, cracks, scoring or other damage. Be sure the retainer hub is a snug fit in the case and drum. Replace the retainer if worn or damaged.

ASSEMBLY

(1) Temporarily install overdrive piston retainer in case. Use 3-4 bolts to secure retainer.

(2) Align and start new clutch cam in the transmission case. Be sure serrations on cam and in case are aligned (Fig. 187). Then tap cam into case just enough to hold it in place.

(3) Verify that cam is correctly positioned before proceeding any further. Narrow ends of cam ramps should be to left when cam is viewed from front end of case (Fig. 187).

(4) Insert Adapter Tool SP-5124 into piston retainer (Fig. 188).

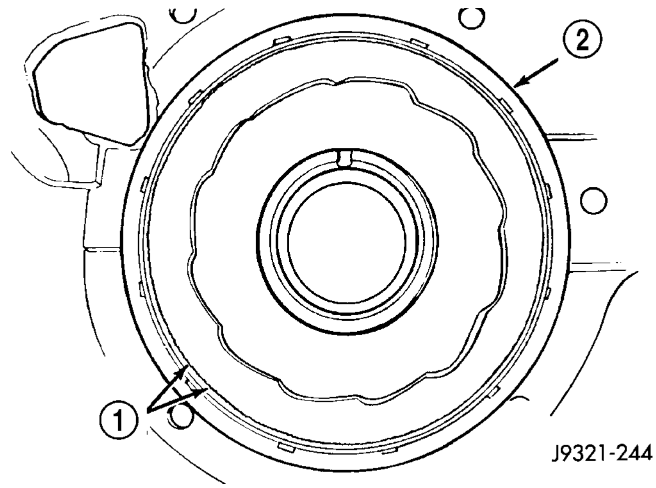

Fig. 187 Positioning Replacement Clutch Cam In Case

1 - ALIGN SERRATIONS ON CAM AND IN CASE
2 - CLUTCH CAM

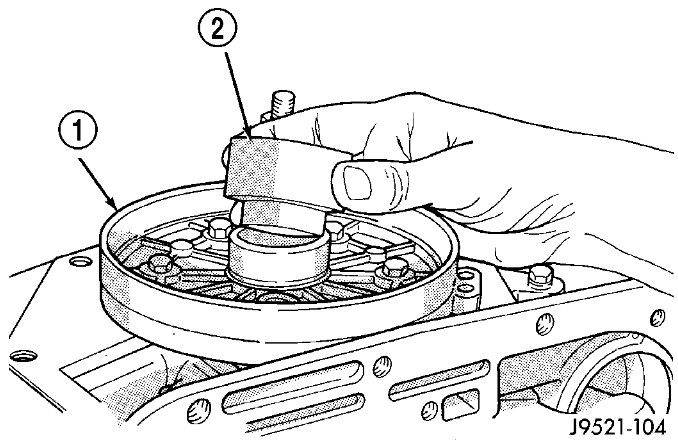

Fig. 188 Positioning Adapter Tool In Overdrive Piston Retainer

1 - PISTON RETAINER
2 - SPECIAL TOOL SP-5124

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(5) Assemble Puller Bolt SP-3701 and Press Plate SP-3583-A (Fig. 189).

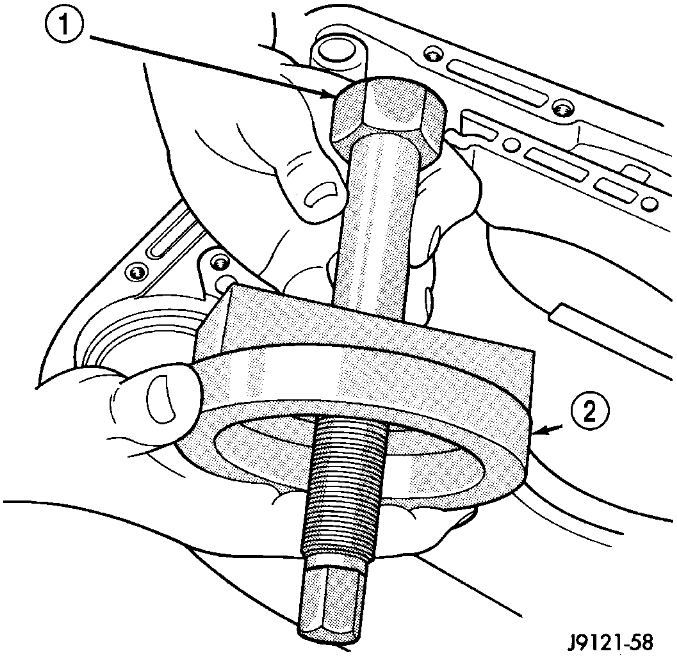

Fig. 189 Assembling Clutch Cam Puller Bolt And Press Plate

1 - PULLER BOLT SP-3701
2 - PRESS PLATE SP-3583-A

(6) Install assembled puller plate and bolt (Fig. 190). Insert bolt through cam, case and adapter tool. Be sure plate is seated squarely on cam.

(7) Hold puller plate and bolt in place and install puller nut SP-3701 on puller bolt (Fig. 191).

(8) Tighten puller nut to press clutch cam into case (Fig. 191). Be sure cam is pressed into case evenly and does not become cocked.

(9) Remove clutch cam installer tools.

(10) Stake case in 14 places around clutch cam to help secure cam in case. Use blunt punch or chisel to stake case.

(11) Remove piston retainer from case. Cover retainer with plastic sheeting, or paper to keep it dust free.

(12) Clean case and cam thoroughly. Be sure any chips/shavings generated during cam installation are removed from case.

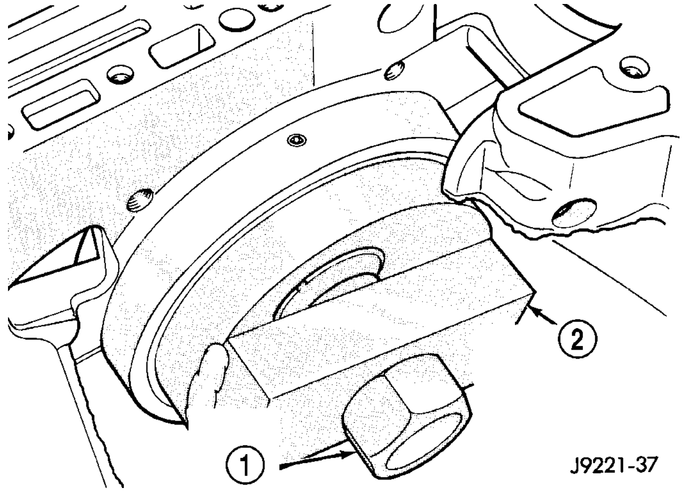

Fig. 190 Positioning Puller Plate On Clutch Cam

1 - SPECIAL TOOL SP-3701
2 - BE SURE PLATE SP-3583-A IS SEATED SQUARELY ON CAM

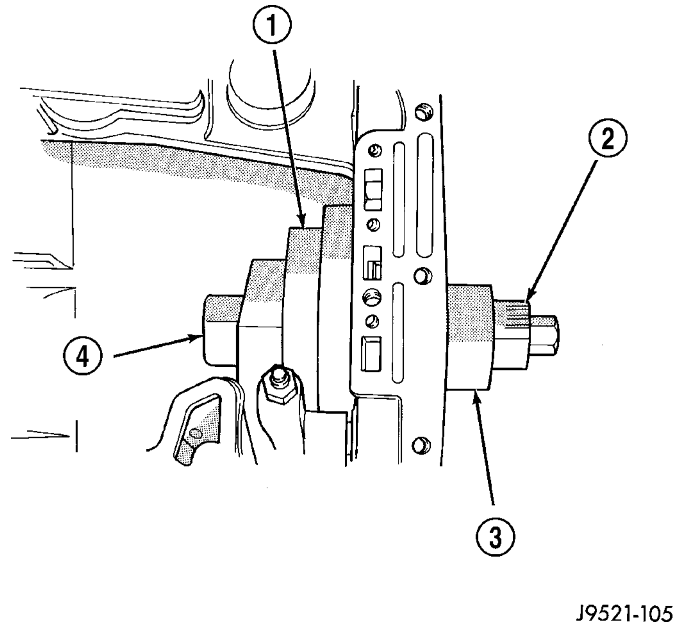

Fig. 191 Pressing Overrunning Clutch Cam Into Case

1 - SPECIAL TOOL SP-3583-A
2 - TIGHTEN NUT TO DRAW CAM INTO CASE (NUT IS PART OF BOLT SP-3701)
3 - SPECIAL TOOL SP-5124
4 - SPECIAL TOOL SP-3701

OVERRUNNING CLUTCH CAM/OVERDRIVE PISTON RETAINER (Continued)

(13) Install new gasket at rear of transmission case. Use petroleum jelly to hold gasket in place. Be sure to align governor feed holes in gasket with feed passages in case (Fig. 192). Also install gasket before overdrive piston retainer. Center hole in gasket is smaller than retainer and cannot be installed over retainer.

(14) Position overdrive piston retainer on transmission case and align bolt holes in retainer, gasket and case (Fig. 193). Then install and tighten retainer bolts to 17 N·m (13 ft. lbs.) torque.

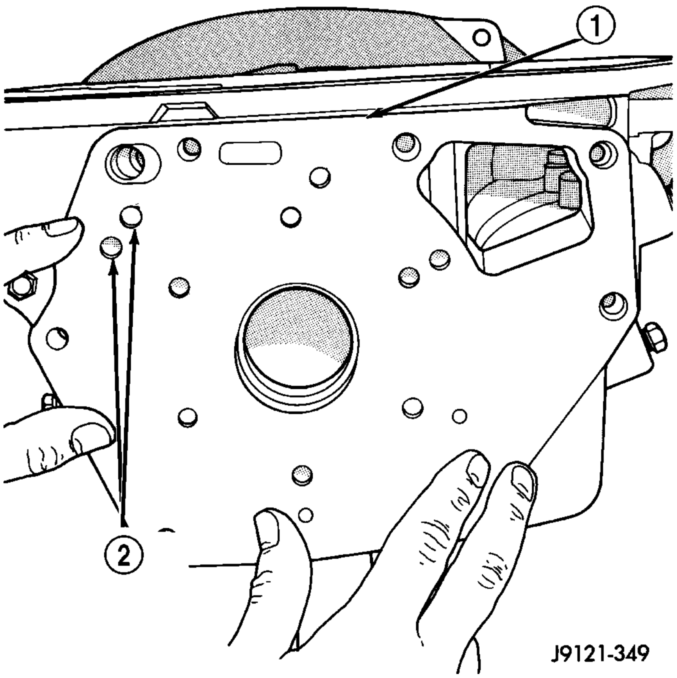

Fig. 192 Installing/Aligning Case Gasket

1 - CASE GASKET
2 - BE SURE GOVERNOR TUBE FEED HOLES IN CASE AND GASKET ARE ALIGNED

(15) Install new seals on overdrive piston.

(16) Stand transmission case upright on bellhousing.

(17) Position Guide Ring 8114-1 on outer edge of overdrive piston retainer.

(18) Position Seal Guide 8114-3 on inner edge of overdrive piston retainer.

(19) Install overdrive piston in overdrive piston retainer by: aligning locating lugs on overdrive piston to the two mating holes in retainer.

(a) Aligning locating lugs on overdrive piston to the two mating holes in retainer.

(b) Lubricate overdrive piston seals with Mopar® Door Ease, or equivalent.

(c) Install piston over Seal Guide 8114-3 and inside Guide Ring 8114-1.

(d) Push overdrive piston into position in retainer.

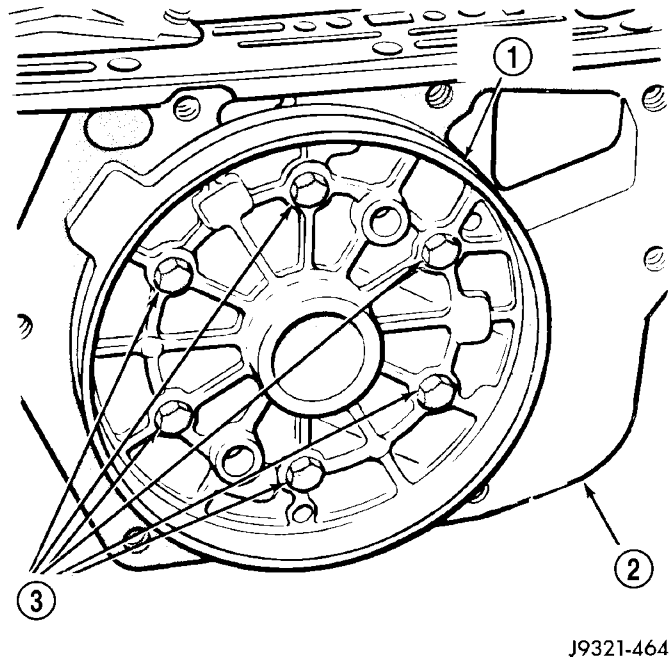

Fig. 193 Aligning Overdrive Piston Retainer

1 - PISTON RETAINER
2 - GASKET
3 - RETAINER BOLTS

(e) Verify that the locating lugs entered the lug bores in the retainer.

PISTONS

DESCRIPTION

There are several sizes and types of pistons used in an automatic transmission. Some pistons are used to apply clutches, while others are used to apply bands. They all have in common the fact that they are round or circular in shape, located within a smooth walled cylinder, which is closed at one end and converts fluid pressure into mechanical movement. The fluid pressure exerted on the piston is contained within the system through the use of piston rings or seals.

OPERATION

The principal which makes this operation possible is known as Pascal's Law. Pascal's Law can be stated as: "Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas."

PISTONS (Continued)

PRESSURE

Pressure (Fig. 194) is nothing more than force (lbs.) divided by area (in or ft.), or force per unit area. Given a 100 lb. block and an area of 100 sq. in. on the floor, the pressure exerted by the block is: 100 lbs. 100 in or 1 pound per square inch, or PSI as it is commonly referred to.

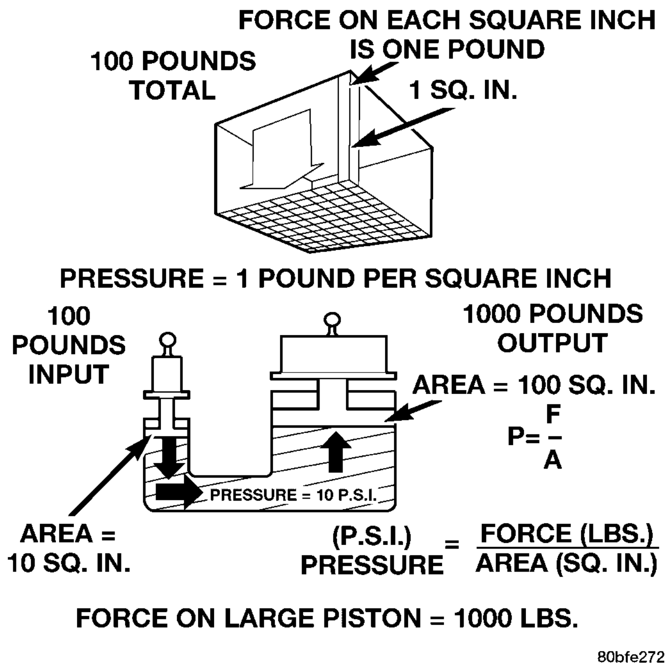

Fig. 194 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 195) by applying a force to some given area in contact with the fluid. A good example of this is a cylinder filled with fluid and equipped with a piston that is closely fitted to the cylinder wall. If a force is applied to the piston, pressure will be developed in the fluid. Of course, no pressure will be created if the fluid is not confined. It will simply "leak" past the piston. There must be a resistance to flow in order to create pressure. Piston sealing is extremely important in hydraulic operation. Several kinds of seals are used to accomplish this within a transmission. These include but are not limited to O-rings, D-rings, lip seals, sealing rings, or extremely close tolerances between the piston and the cylinder wall. The force exerted is downward (gravity), however, the principle remains the same no matter which direction is taken. The pressure created in the fluid is equal to the force applied, divided by the piston area. If the force is 100 lbs., and the piston area is 10 sq. in., then the pressure created equals 10 PSI. Another interpretation of Pascal's Law is that regardless of container shape or size, the pressure will be maintained throughout, as long as the fluid is confined. In other words, the pressure in the fluid is the same everywhere within the container.

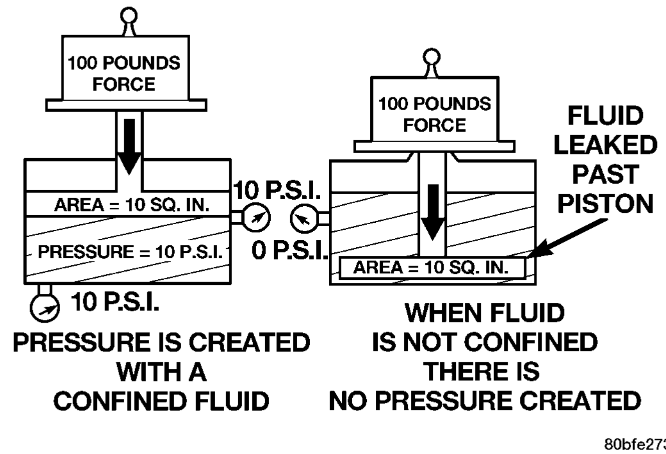

Fig. 195 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 196), a force of 1000 lbs. can be moved with a force of only 100 lbs. The secret of force multiplication in hydraulic systems is the total fluid contact area employed. The illustration, (Fig. 196), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

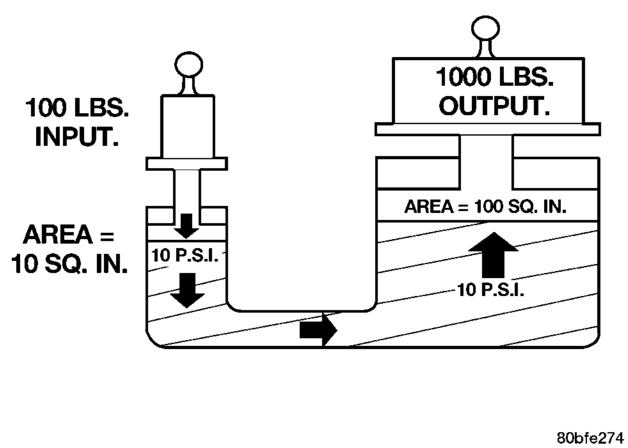

Fig. 196 Force Multiplication

PISTONS (Continued)

PISTON TRAVEL

The relationship between hydraulic lever and a mechanical lever is the same. With a mechanical lever it's a weight-to-distance output rather than a pressure-to-area output. Using the same forces and areas as in the previous example, the smaller piston (Fig. 197) has to move ten times the distance required to move the larger piston one inch. Therefore, for every inch the larger piston moves, the smaller piston moves ten inches. This principle is true in other instances also. A common garage floor jack is a good example. To raise a car weighing 2000 lbs., an effort of only 100 lbs. may be required. For every inch the car moves upward, the input piston at the jack handle must move 20 inches downward.

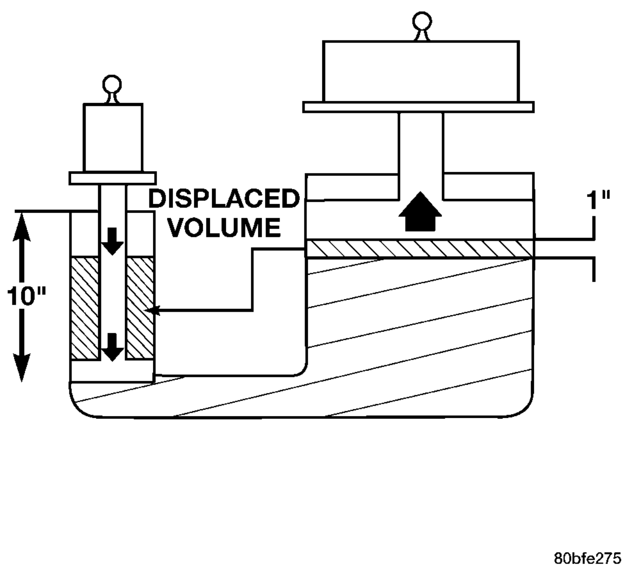

Fig. 197 Piston Travel

PLANETARY GEARTRAIN/ OUTPUT SHAFT

DESCRIPTION

The planetary gearsets (Fig. 198) are designated as the front, rear, and overdrive planetary gear assemblies and located in such order. A simple planetary gearset consists of three main members:

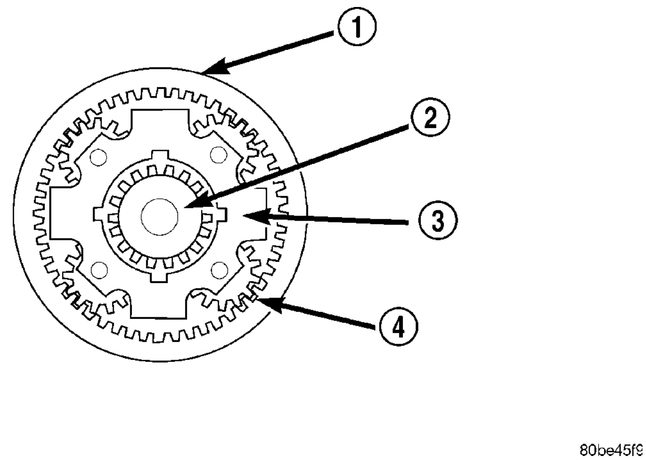

Fig. 198 Planetary Gearset

1 - ANNULUS GEAR
2 - SUN GEAR
3 - PLANET CARRIER
4 - PLANET PINIONS (4)

- The sun gear which is at the center of the system.
- The planet carrier with planet pinion gears which are free to rotate on their own shafts and are in mesh with the sun gear.
- The annulus gear, which rotates around and is in mesh with the planet pinion gears.

NOTE: The number of pinion gears does not affect the gear ratio, only the duty rating.

OPERATION

With any given planetary gearset, several conditions must be met for power to be able to flow:

- One member must be held.
- Another member must be driven or used as an input.
- The third member may be used as an output for power flow.
- For direct drive to occur, two gear members in the front planetary gearset must be driven.

NOTE: Gear ratios are dependent on the number of teeth on the annulus and sun gears.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

DISASSEMBLY

(1) Remove planetary snap-ring from intermediate shaft (Fig. 199). Discard snap-ring as it is not reusable.

(2) Remove front planetary gear and front annulus gear as assembly (Fig. 200).

(3) Remove front planetary gear and thrust washer from front annulus gear (Fig. 201). Note thrust washer position for assembly reference.

(4) Remove tabbed thrust washer from driving shell (Fig. 202). Note washer position for assembly reference.

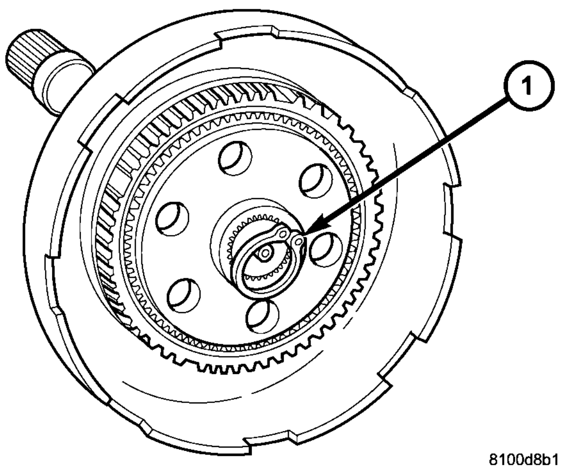

Fig. 199 Removing Planetary Snap-Ring

1 - PLANETARY SNAP-RING

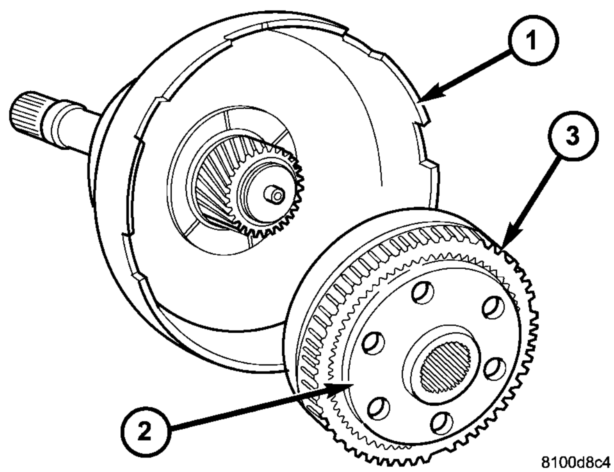

Fig. 200 Removing Front Planetary And Annulus Gears

1 - DRIVING SHELL
2 - FRONT ANNULUS GEAR
3 - FRONT PLANETARY GEAR

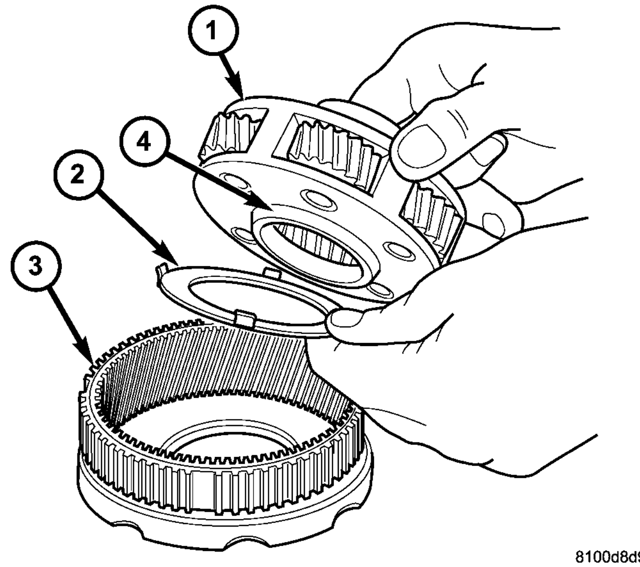

Fig. 201 Disassembling Front Planetary And Annulus Gears

1 - FRONT PLANETARY GEAR
2 - TABBED THRUST WASHER
3 - FRONT ANNULUS GEAR
4 - TORLON BUSHING

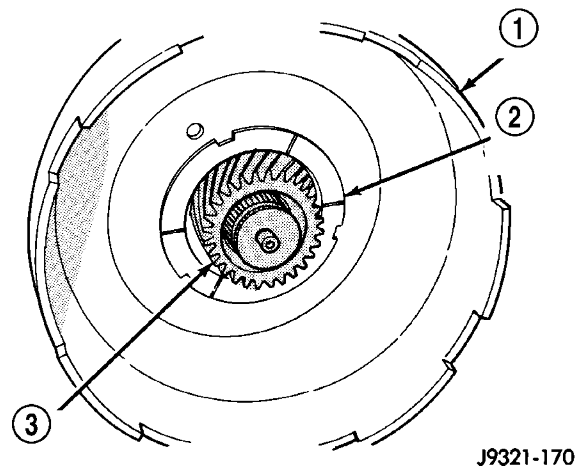

Fig. 202 Driving Shell Thrust Washer Removal

1 - DRIVING SHELL
2 - TABBED THRUST WASHER
3 - SUN GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(5) Remove sun gear and driving shell as assembly (Fig. 203).

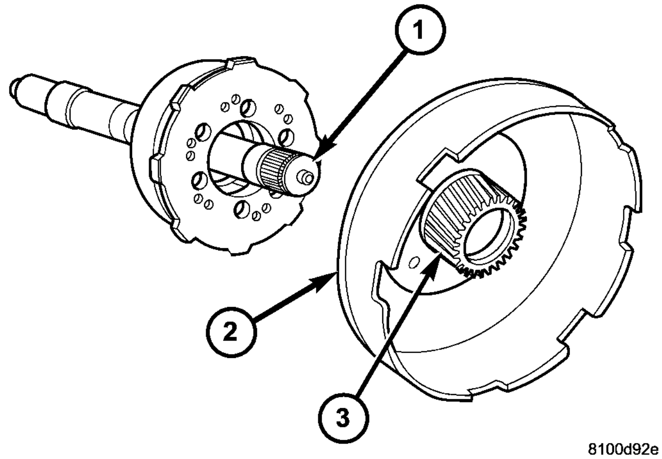

Fig. 203 Sun Gear And Driving Shell Removal

1 - INTERMEDIATE SHAFT
2 - DRIVING SHELL
3 - SUN GEAR

(6) Remove tabbed thrust washer from rear planetary gear (Fig. 204). Note washer position on gear for assembly reference.

(7) Remove rear planetary gear and rear annulus gear from intermediate shaft (Fig. 205).

(8) Remove thrust washer from rear planetary gear (Fig. 206).

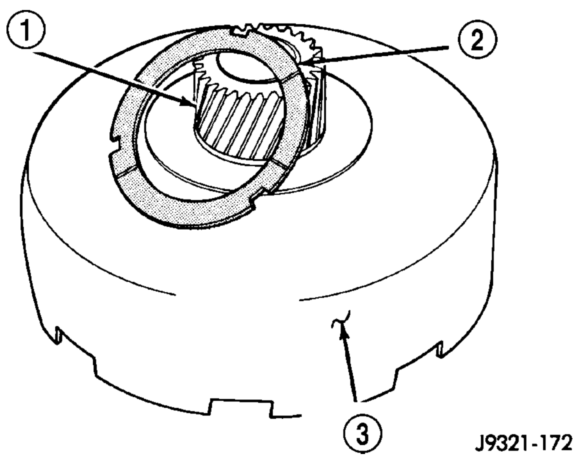

Fig. 204 Rear Planetary Thrust Washer Removal

1 - SUN GEAR
2 - REAR PLANETARY THRUST WASHER
3 - DRIVING SHELL

INSPECTION

Inspect the planetary gear sets and annulus gears. The planetary pinions, shafts, washers, and retaining pins are serviceable. However, if a pinion carrier is damaged, the entire planetary gear set must be replaced as an assembly.

Replace the annulus gears if the teeth are chipped, broken, or worn, or the gear is cracked. Replace the

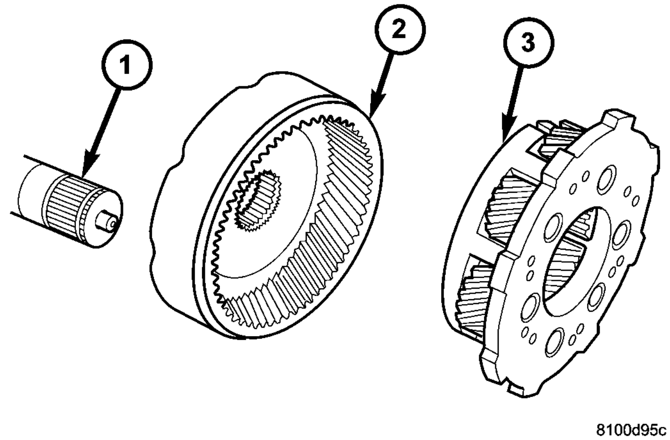

Fig. 205 Rear Planetary And Annulus Gear Removal

1 - INTERMEDIATE SHAFT
2 - REAR ANNULUS GEAR
3 - REAR PLANETARY GEAR

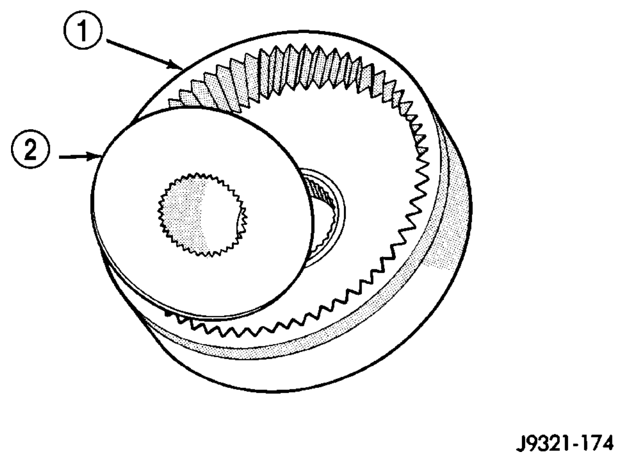

Fig. 206 Rear Annulus Thrust Washer Removal

1 - REAR ANNULUS GEAR
2 - THRUST WASHER

planetary thrust plates and the tabbed thrust washers if cracked, scored or worn.

Inspect the machined surfaces of the intermediate shaft. Be sure the oil passages are open and clear. Replace the shaft if scored, pitted, or damaged.

Inspect the sun gear and driving shell. If either component is worn or damaged, remove the sun gear rear retaining ring and separate the sun gear and thrust plate from the driving shell. Then replace the necessary component.

Replace the sun gear as an assembly if the gear teeth are chipped or worn. Also replace the gear as an assembly if the bushings are scored or worn. The sun gear bushings are not serviceable. Replace the thrust plate if worn, or severely scored. Replace the driving shell if distorted, cracked, or damaged in any way.

Replace all snap-rings during geartrain assembly. Reusing snap-rings is not recommended.

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

ASSEMBLY

(1) Lubricate sun gear and planetary gears with transmission fluid during assembly. Use petroleum jelly to lubricate intermediate shaft bushing surfaces, thrust washers and thrust plates and to hold these parts in place during assembly.

(2) Install front snap-ring on sun gear and install gear in driving shell. Then install thrust plate over sun gear and against rear side of driving shell (Fig. 207). Install rear snap-ring to secure sun gear and thrust plate in driving shell. Note that the large ID chamfer on the sun gear goes forward.

(3) Install rear annulus gear on intermediate shaft (Fig. 208).

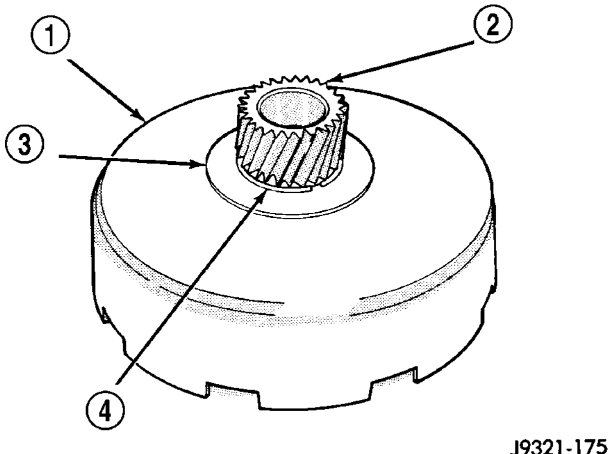

Fig. 207 Sun Gear Installation

1 - DRIVING SHELL
2 - SUN GEAR
3 - THRUST PLATE
4 - SUN GEAR REAR RETAINING RING

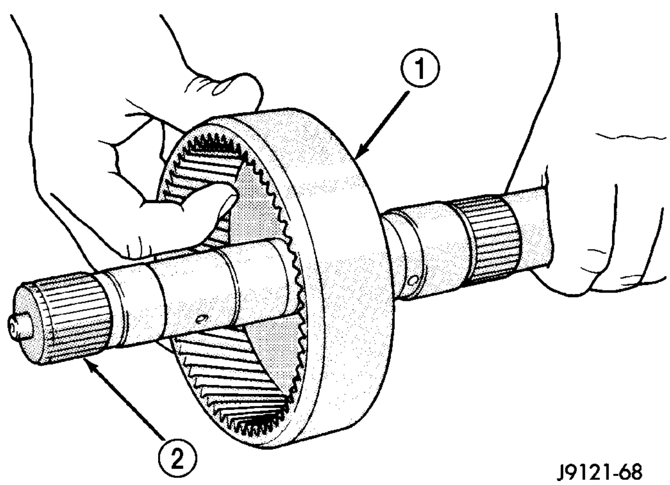

Fig. 208 Installing Rear Annulus Gear On Intermediate Shaft

1 - REAR ANNULUS GEAR
2 - OUTPUT SHAFT

(4) Install thrust washer to rear planetary gear (Fig. 209) using petroleum jelly. Be sure washer is seated against corner witht teh tabs completely in the locating holes.

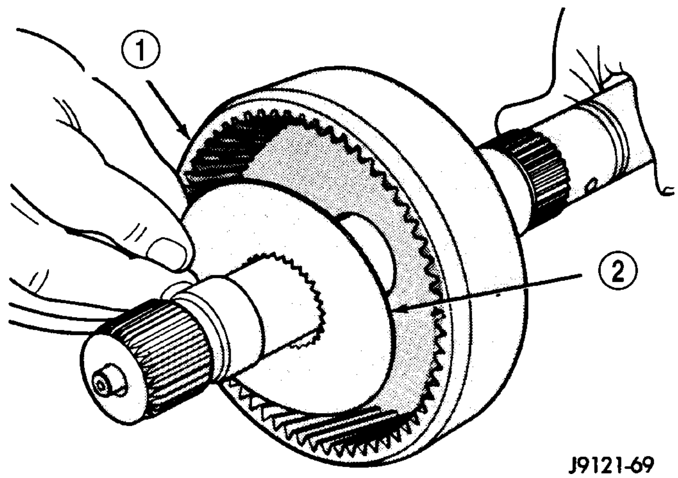

Fig. 209 Installing Rear Annulus Thrust Washer

1 - REAR ANNULUS GEAR
2 - THRUST WASHER

(5) Install rear planetary gear in rear annulus gear (Fig. 210). Be sure planetary carrier is seated against annulus gear.

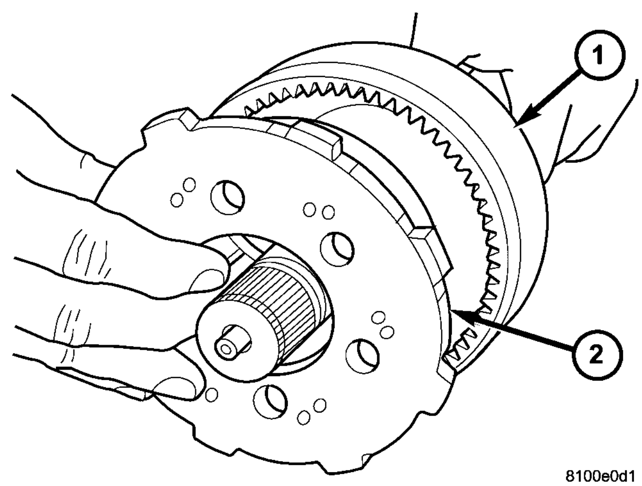

Fig. 210 Installing Rear Planetary Gear

1 - REAR ANNULUS GEAR
2 - REAR PLANETARY GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(6) Install tabbed thrust washer on front face of rear planetary gear (Fig. 211). Seat washer tabs in matching slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(7) Lubricate sun gear bushings with petroleum jelly or transmission fluid.

(8) Install sun gear and driving shell on intermediate shaft (Fig. 212). Seat shell against rear planetary gear. Verify that thrust washer on planetary gear was not displaced during installation.

(9) Install tabbed thrust washer in driving shell (Fig. 213), be sure washer tabs are seated in tab slots of driving shell. Use extra petroleum jelly to hold washer in place if desired.

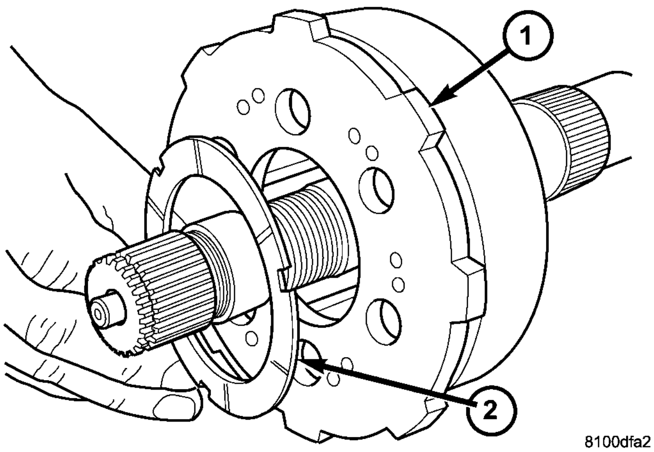

Fig. 211 Installing Rear Planetary Thrust Washer

1 - REAR PLANETARY GEAR
2 - TABBED THRUST WASHER

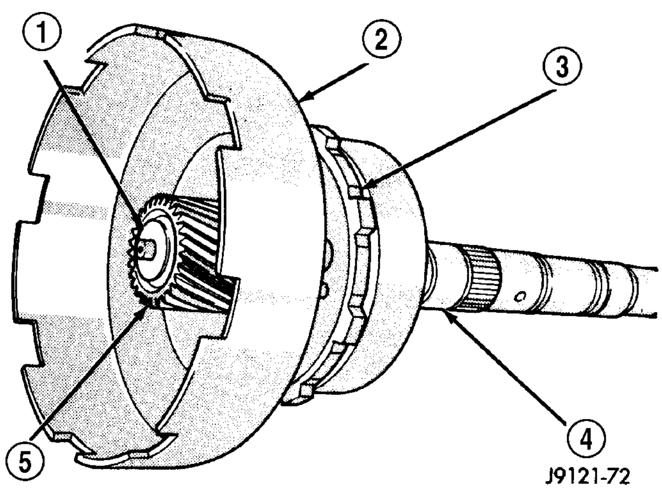

Fig. 212 Installing Sun Gear And Driving Shell

1 - OUTPUT SHAFT
2 - DRIVING SHELL
3 - REAR PLANETARY GEAR
4 - OUTPUT SHAFT
5 - SUN GEAR

(10) Install tabbed thrust washer on front planetary gear (Fig. 214). Seat washer tabs in matching

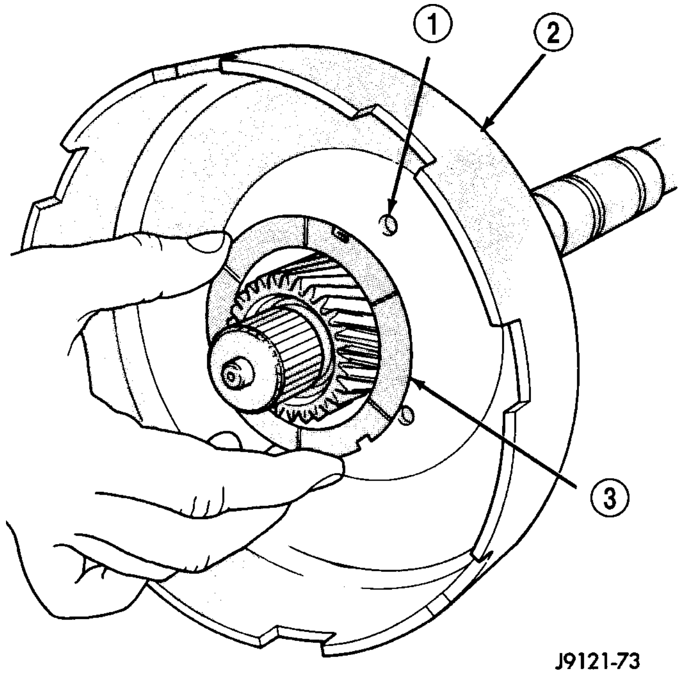

Fig. 213 Installing Driving Shell Thrust Washer

1 - TAB SLOTS (3)
2 - DRIVING SHELL
3 - TABBED THRUST WASHER

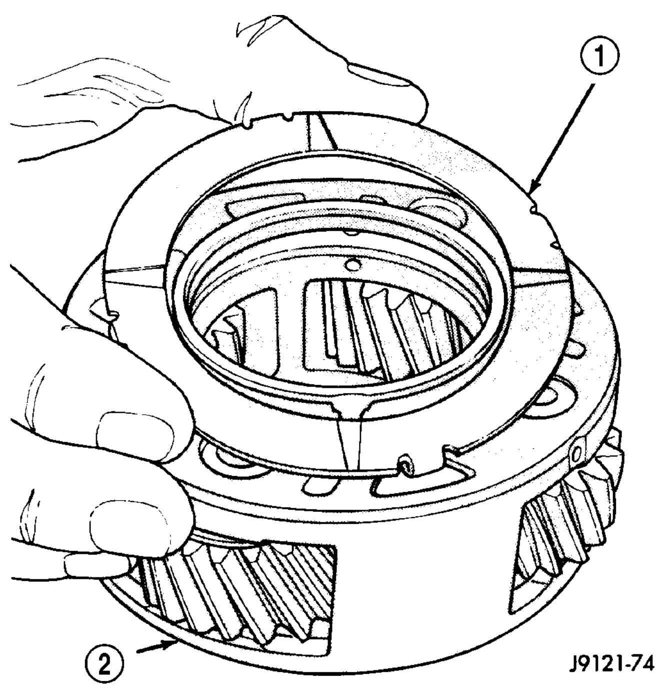

Fig. 214 Installing Thrust Washer On Front Planetary Gear

1 - TABBED THRUST WASHER
2 - FRONT PLANETARY GEAR

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

slots in face of gear carrier. Use extra petroleum jelly to hold washer in place if desired.

(11) Install the torlon bushing onto the front planetary carrier hub.

(12) Install front annulus gear over and onto front planetary gear (Fig. 215). Be sure gears are fully meshed and seated.

(13) Install front planetary and annulus gear assembly (Fig. 216). Hold gears together and slide them onto shaft. Be sure planetary pinions are seated on sun gear and that planetary carrier is seated on intermediate shaft.

(14) Place geartrain in upright position. Rotate gears to be sure all components are seated and properly assembled. Snap-ring groove at forward end of intermediate shaft will be completely exposed when components are assembled correctly.

(15) Install new planetary snap-ring in groove at end of intermediate shaft (Fig. 217).

(16) Turn planetary geartrain over. Position wood block under front end of intermediate shaft and support geartrain on shaft. Be sure all geartrain parts have moved forward against planetary snap-ring. This is important for accurate end play check.

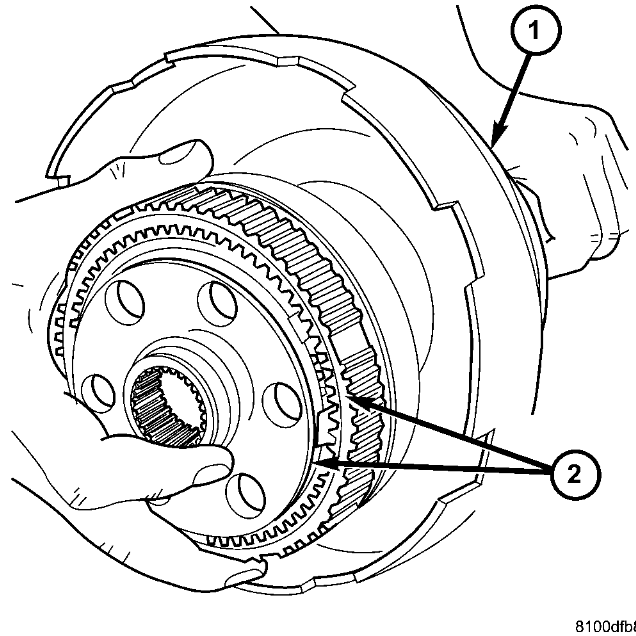

Fig. 216 Installing Front Planetary And Annulus Gear Assembly

1 - DRIVING SHELL
2 - ASSEMBLED FRONT PLANETARY AND ANNULUS GEARS

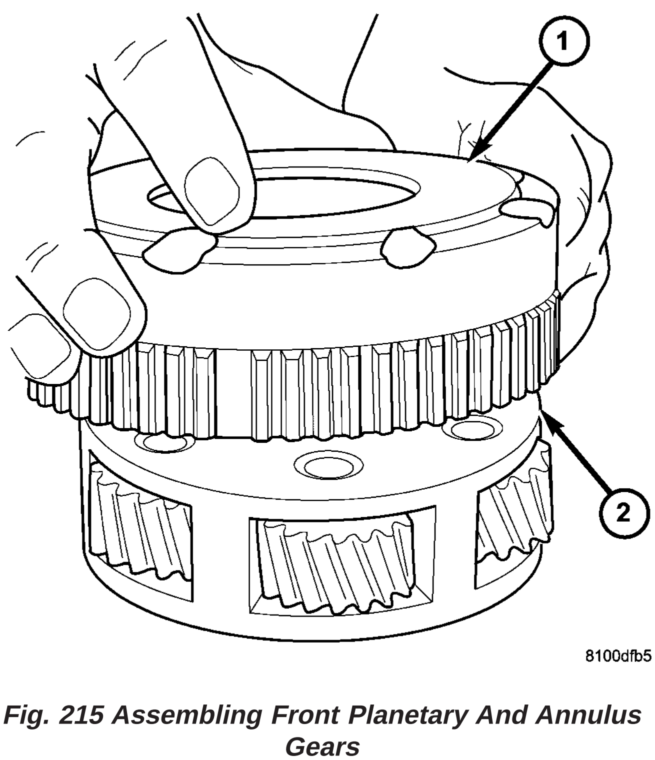

Fig. 215 Assembling Front Planetary And Annulus Gears

1 - FRONT ANNULUS GEAR
2 - FRONT PLANETARY GEAR

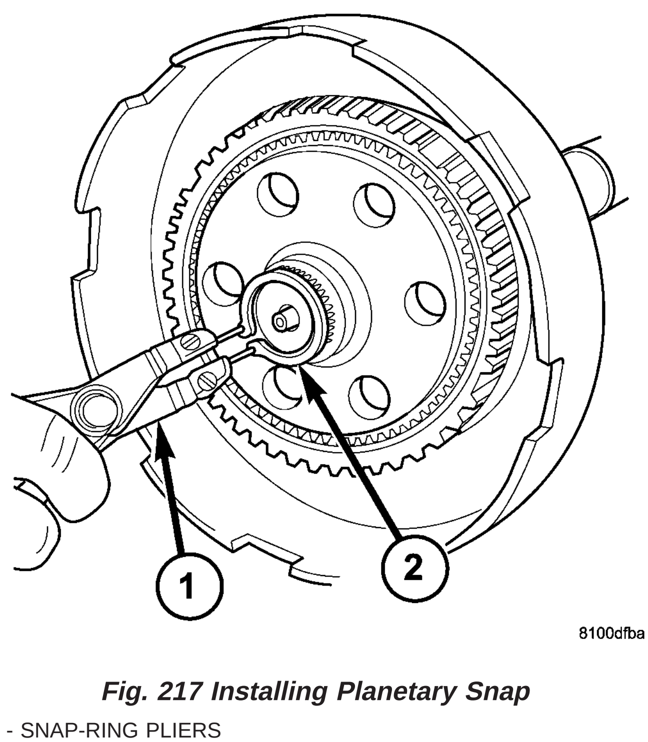

Fig. 217 Installing Planetary Snap

1 - SNAP-RING PLIERS
2 - PLANETARY SNAP-RING

PLANETARY GEARTRAIN/OUTPUT SHAFT (Continued)

(17) Check planetary geartrain end play with feeler gauge (Fig. 218). Insert gauge between rear annulus gear and shoulder on intermediate shaft as shown. End play should be 0.15 to 1.22 mm (0.006 to 0.048 in.).

(18) If end play is incorrect, install thinner/thicker planetary snap-ring as needed.

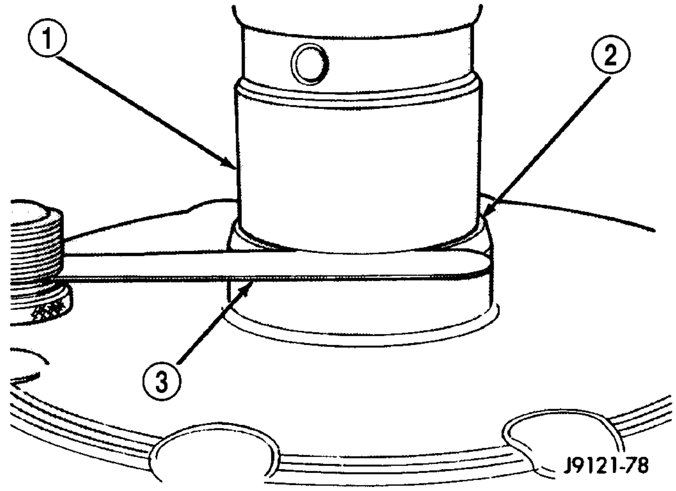

Fig. 218 Checking Planetary Geartrain End Play

1 - OUTPUT SHAFT
2 - REAR ANNULUS GEAR
3 - FEELER GAUGE

REAR CLUTCH

DESCRIPTION

The rear clutch assembly (Fig. 219) is composed of the rear clutch retainer, pressure plate, clutch plates, driving discs, piston, Belleville spring, and snap-rings. The Belleville spring acts as a lever to multiply the force applied on to it by the apply piston. The increased apply force on the rear clutch pack, in comparison to the front clutch pack, is needed to hold against the greater torque load imposed onto the rear pack. The rear clutch is directly behind the front clutch and is considered a driving component.

NOTE: The number of discs and plates may vary with each engine and vehicle combination.

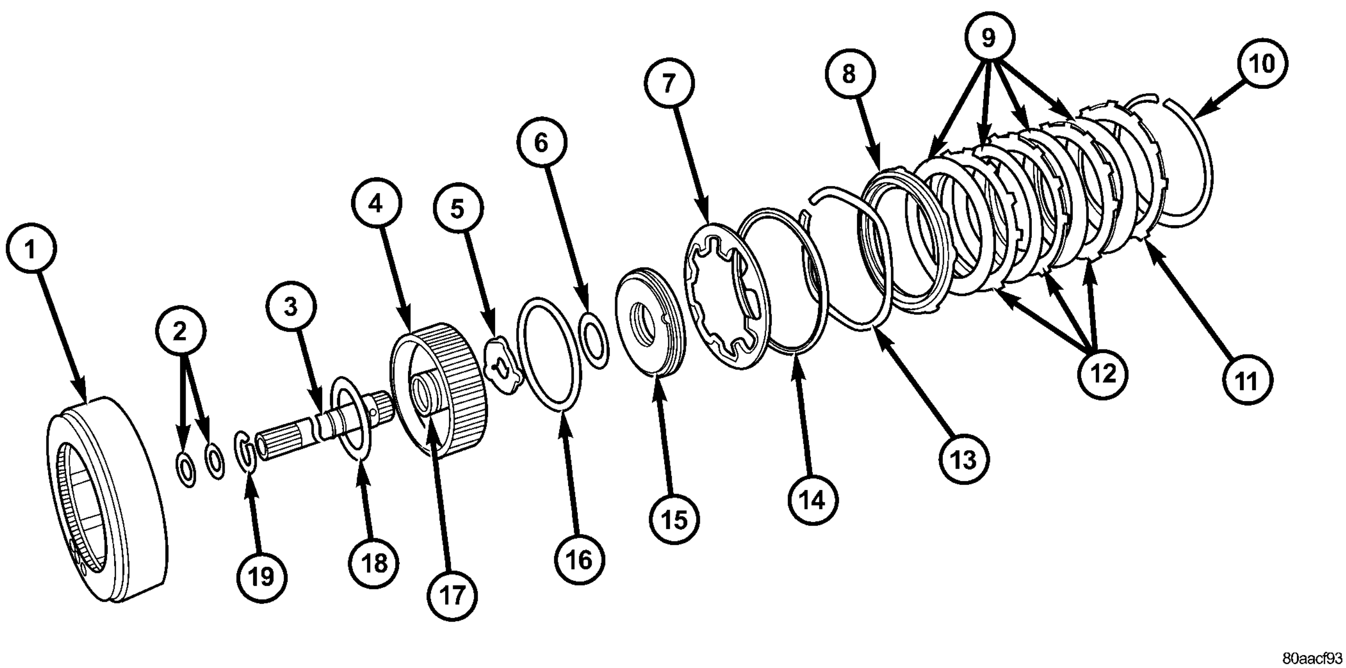

Fig. 219 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

REAR CLUTCH (Continued)

OPERATION

To apply the clutch, pressure is applied between the clutch retainer and piston. The fluid pressure is provided by the oil pump, transferred through the control valves and passageways, and enters the clutch through the hub of the reaction shaft support. With pressure applied between the clutch retainer and piston, the piston moves away from the clutch retainer and compresses the clutch pack. This action applies the clutch pack, allowing torque to flow through the input shaft into the driving discs, and into the clutch plates and pressure plate that are lugged to the clutch retainer. The waved spring is used to cushion the application of the clutch pack. The snap-ring is selective and used to adjust clutch pack clearance.

When pressure is released from the piston, the spring returns the piston to its fully released position and disengages the clutch. The release spring also helps to cushion the application of the clutch assembly. When the clutch is in the process of being released by the release spring, fluid flows through a vent and one-way ball-check-valve located in the piston. The check-valve is needed to eliminate the possibility of plate drag caused by centrifugal force acting on the residual fluid trapped in the clutch piston retainer.

DISASSEMBLY

(1) Remove fiber thrust washer from forward side of clutch retainer.

(2) Remove input shaft front and rear seal rings.

(3) Remove selective clutch pack snap-ring (Fig. 220).

(4) Remove the reaction plate, clutch discs, steel plates, pressure plate, wave spring, spacer ring, and piston spring (Fig. 220).

(5) Remove clutch piston with rotating motion.

(6) Remove and discard piston seals.

(7) Remove input shaft retaining ring. It may be necessary to press the input shaft in slightly to relieve tension on the retaining ring

(8) Press input shaft out of retainer with shop press and suitable size press tool. Use a suitably sized press tool to support the retainer as close to the input shaft as possible.

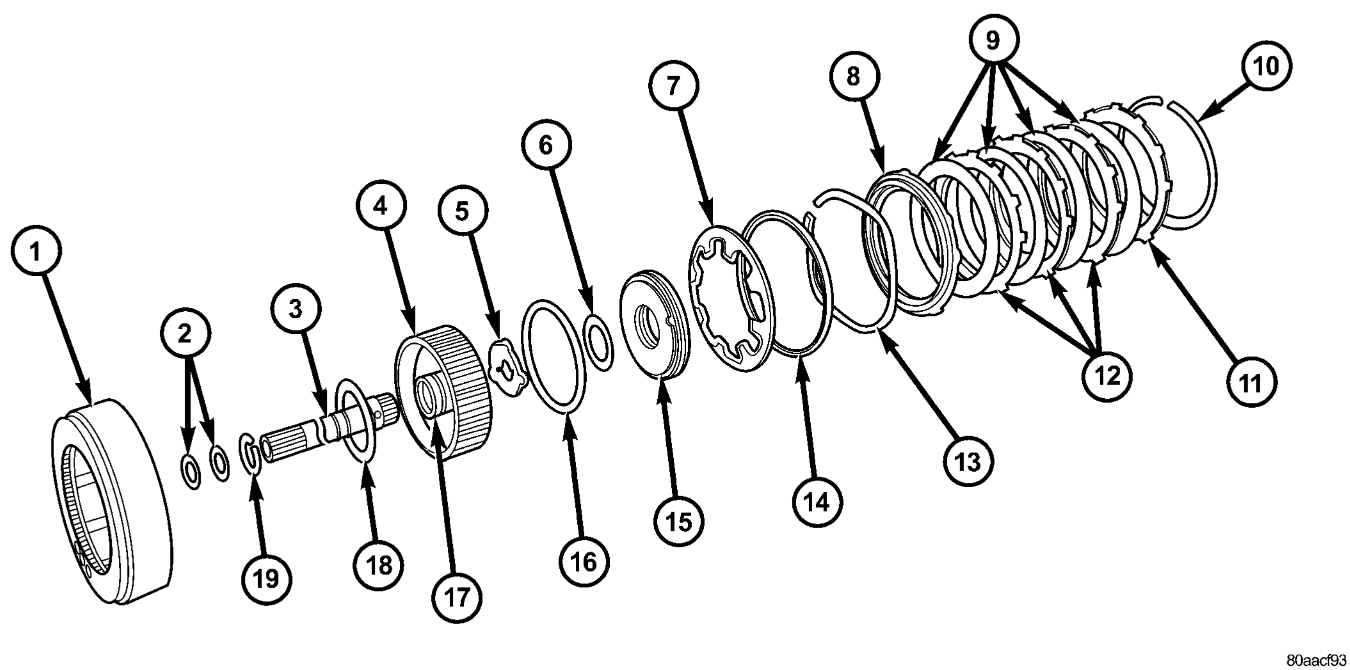

Fig. 220 Rear Clutch Components

1 - REAR CLUTCH RETAINER
2 - TORLON™ SEAL RINGS
3 - INPUT SHAFT
4 - PISTON RETAINER
5 - OUTPUT SHAFT THRUST WASHER
6 - INNER PISTON SEAL
7 - PISTON SPRING
8 - PRESSURE PLATE
9 - CLUTCH DISCS
10 - SNAP-RING (SELECTIVE)
11 - REACTION PLATE
12 - CLUTCH PLATES
13 - WAVE SPRING
14 - SPACER RING
15 - PISTON
16 - OUTER PISTON SEAL
17 - REAR SEAL RING
18 - FIBER THRUST WASHER
19 - RETAINING RING

REAR CLUTCH (Continued)

CLEANING

Clean the clutch components with solvent and dry them with compressed air. Do not use rags or shop towels to dry any of the clutch parts. Lint from such materials will adhere to component surfaces and could restrict or block fluid passages after assembly.

INSPECTION

Replace the clutch discs if warped, worn, scored, burned/charred, the lugs are damaged, or if the facing is flaking off. Replace the top and bottom pressure plates if scored, warped, or cracked. Be sure the driving lugs on the pressure and clutch plates are also in good condition. The lugs must not be bent, cracked or damaged in any way.

Replace the piston spring and wave spring if either part is distorted, warped or broken.

Check the lug grooves in the clutch retainer. The clutch and pressure plates should slide freely in the slots. Replace the retainer if the grooves are worn or damaged. Also check action of the check balls in the retainer and piston. Each check ball must move freely and not stick.

Replace the retainer bushing if worn, scored, or doubt exists about bushing condition.

Inspect the piston and retainer seal surfaces for nicks or scratches. Minor scratches can be removed with crocus cloth. However, replace the piston and/or retainer if the seal surfaces are seriously scored.

Check condition of the fiber thrust washer and metal output shaft thrust washer. Replace either washer if worn or damaged.

Check condition of the seal rings on the input shaft and clutch retainer hub. Replace the seal rings only if worn, distorted, or damaged. The input shaft front seal ring is teflon with chamfered ends. The rear ring is metal with interlocking ends.

Check the input shaft for wear, or damage. Replace the shaft if worn, scored or damaged in any way.

ASSEMBLY

(1) Soak clutch discs in transmission fluid while assembling other clutch parts.

(2) Install new seal rings on clutch retainer hub and input shaft if necessary.

(a) Be sure clutch hub seal ring is fully seated in groove and is not twisted.

(3) Lubricate splined end of input shaft and clutch retainer with transmission fluid. Then partially press input shaft into retainer (Fig. 221). Use a suitably sized press tool to support retainer as close to input shaft as possible.

(4) Install input shaft retaining ring.

(5) Press the input shaft the remainder of the way into the clutch retainer.

(6) Install new seals on clutch piston. Be sure lip of each seal faces interior of clutch retainer.

(7) Lubricate lip of piston seals with generous quantity of Mopar® Door Ease. Then lubricate retainer hub and bore with light coat of transmission fluid.

(8) Install clutch piston in retainer. Use twisting motion to seat piston in bottom of retainer. A thin strip of plastic (about 0.020″ thick), can be used to guide seals into place if necessary.

CAUTION: Never push the clutch piston straight in. This will fold the seals over causing leakage and clutch slip. In addition, never use any type of metal tool to help ease the piston seals into place. Metal tools will cut, shave, or score the seals.

(9) Install piston spring in retainer and on top of piston. Concave side of spring faces downward (toward piston).

(10) Install the spacer ring and wave spring into the retainer. Be sure spring is completely seated in retainer groove.

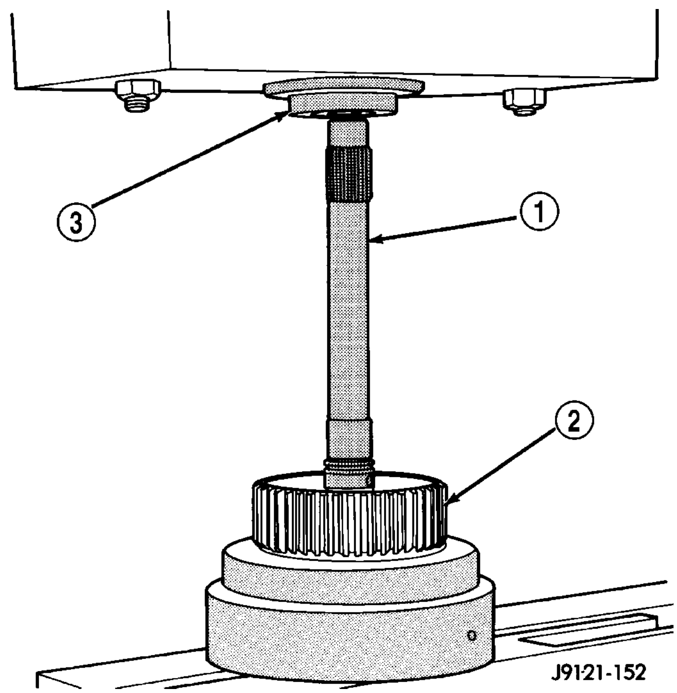

Fig. 221 Pressing Input Shaft Into Rear Clutch Retainer

1 - INPUT SHAFT
2 - REAR CLUTCH RETAINER
3 - PRESS RAM

(11) Install pressure plate (Fig. 220). Ridged side of plate faces downward (toward piston) and flat side toward clutch pack.

(12) Install first clutch disc in retainer on top of pressure plate. Then install a clutch plate followed

REAR CLUTCH (Continued)

by a clutch disc until entire clutch pack is installed (4 discs and 3 plates are required) (Fig. 220).

(13) Install the reaction plate.

(14) Install selective snap-ring. Be sure snap-ring is fully seated in retainer groove.

(15) Using a suitable gauge bar and dial indicator, measure clutch pack clearance (Fig. 222).

(a) Position gauge bar across the clutch drum with the dial indicator pointer on the pressure plate (Fig. 222).

(b) Using two small screw drivers, lift the pressure plate and release it.

(c) Zero the dial indicator.

(d) Lift the pressure plate until it contacts the snap-ring and record the dial indicator reading.

Clearance should be 0.635 - 0.914 mm (0.025 - 0.036 in.). If clearance is incorrect, steel plates, discs, selective snap ring and pressure plates may have to be changed.

The selective snap ring thicknesses are:

- 0.107 - 0.109 in.
- 0.098 - 0.100 in.
- 0.095 - 0.097 in.
- 0.083 - 0.085 in.
- 0.076 - 0.078 in.
- 0.071 - 0.073 in.
- 0.060 - 0.062 in.

(16) Coat rear clutch thrust washer with petroleum jelly and install washer over input shaft and into clutch retainer (Fig. 223). Use enough petroleum jelly to hold washer in place.

(17) Set rear clutch aside for installation during final assembly.

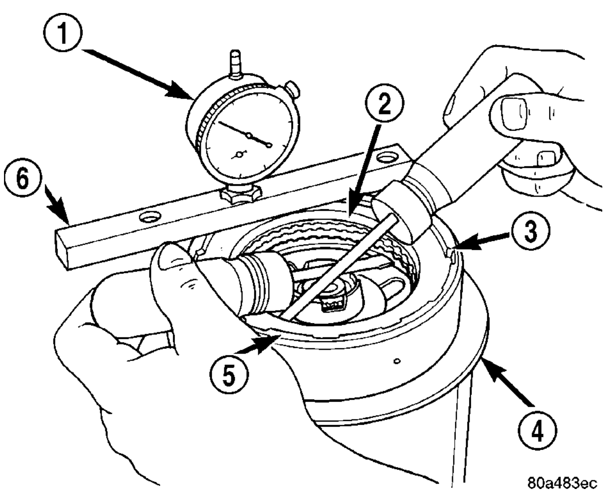

Fig. 222 Checking Rear Clutch Pack Clearance

1 - DIAL INDICATOR
2 - PRESSURE PLATE
3 - SNAP-RING
4 - STAND
5 - REAR CLUTCH
6 - GAUGE BAR

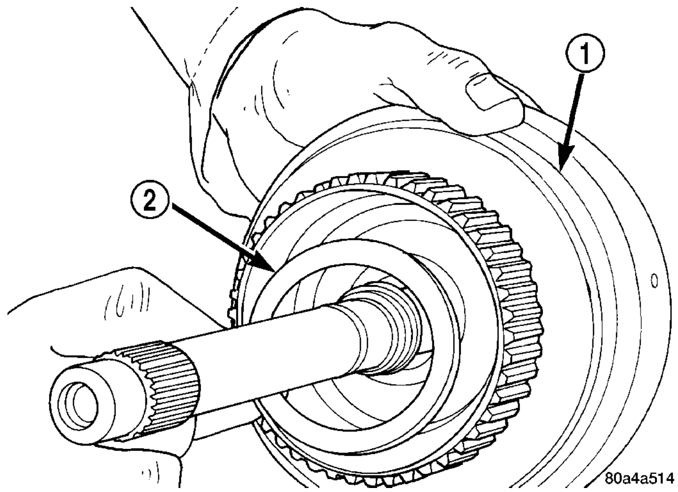

Fig. 223 Installing Rear Clutch Thrust Washer

1 - REAR CLUTCH RETAINER
2 - REAR CLUTCH THRUST WASHER

REAR SERVO

DESCRIPTION

The rear (low/reverse) servo consists of a single stage or diameter piston and a spring loaded plug. The spring is used to cushion the application of the rear (low/reverse) band.

OPERATION

While in the de-energized state (no pressure applied), the piston is held up in its bore by the piston spring. The plug is held down in its bore, in the piston, by the plug spring. When pressure is applied to the top of the piston, the plug is forced down in its bore, taking up any clearance. As the piston moves, it causes the plug spring to compress, and the piston moves down over the plug. The piston continues to move down until it hits the shoulder of the plug and fully applies the band. The period of time from the initial application, until the piston is against the shoulder of the plug, represents a reduced shocking of the band that cushions the shift.

REAR SERVO (Continued)

DISASSEMBLY

(1) Remove small snap-ring and remove plug and spring from servo piston (Fig. 224).

(2) Remove and discard servo piston seal ring.

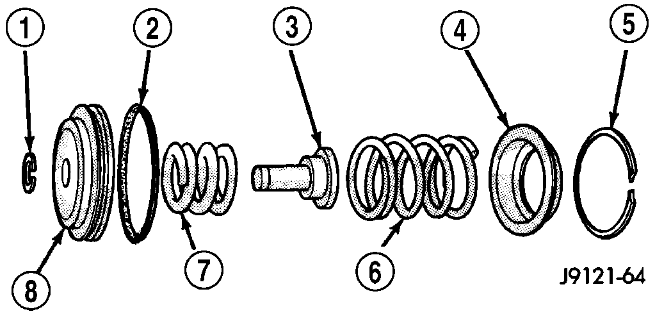

Fig. 224 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

CLEANING

Remove and discard the servo piston seal ring (Fig. 225). Then clean the servo components with solvent and dry with compressed air. Replace either spring if collapsed, distorted or broken. Replace the plug and piston if cracked, bent, or worn. Discard the servo snap-rings and use new ones at assembly.

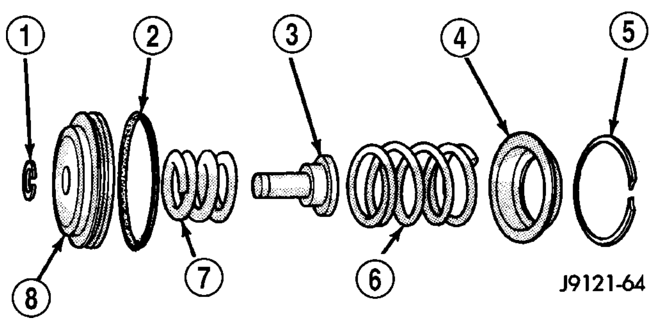

Fig. 225 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

ASSEMBLY

(1) Lubricate piston and guide seals (Fig. 226) with petroleum jelly. Lubricate other servo parts with Mopar® ATF +4, Automatic Transmission fluid.

(2) Install new seal ring on servo piston.

(3) Assemble piston, plug, spring and new snap-ring.

(4) Lubricate piston seal lip with petroleum jelly.

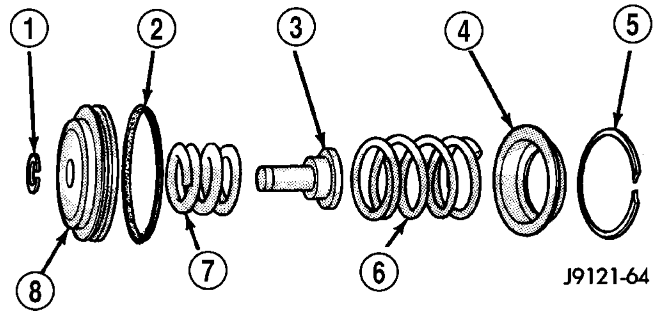

Fig. 226 Rear Servo Components

1 - SNAP-RING
2 - PISTON SEAL
3 - PISTON PLUG
4 - SPRING RETAINER
5 - SNAP-RING
6 - PISTON SPRING
7 - CUSHION SPRING
8 - PISTON

SHIFT MECHANISM

DESCRIPTION

The gear shift mechanism provides six shift positions which are:

- PARK (P)
- REVERSE (R)
- NEUTRAL (N)
- DRIVE (D)
- Manual SECOND (2)
- Manual LOW (1)

OPERATION

Manual LOW (1) range provides first gear only. Overrun braking is also provided in this range. Manual SECOND (2) range provides first and second gear only.

DRIVE range provides first, second third and overdrive fourth gear ranges. The shift into overdrive fourth gear range occurs only after the transmission has completed the shift into D third gear range. No further movement of the shift mechanism is required to complete the 3-4 shift.

The fourth gear upshift occurs automatically when the overdrive selector switch is in the ON position. No upshift to fourth gear will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to third is not yet complete.
- Vehicle speed is too low for the 3-4 shift to occur.
- Battery temperature is below -5° C (23° F).

SOLENOID

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

SPEED SENSOR

DESCRIPTION

The speed sensor (Fig. 227) is located in the overdrive gear case. The sensor is positioned over the park gear and monitors transmission output shaft rotating speed.

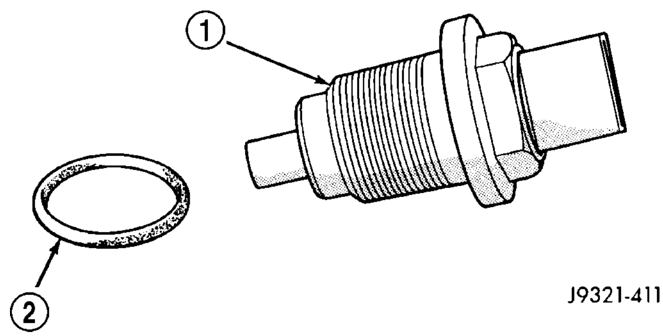

Fig. 227 Transmission Output Speed Sensor

1 - TRANSMISSION OUTPUT SHAFT SPEED SENSOR
2 - SEAL

OPERATION

Speed sensor signals are triggered by the park gear lugs as they rotate past the sensor pickup face. Input signals from the sensor are sent to the transmission control module for processing. Signals from this sensor are shared with the powertrain control module.

THROTTLE VALVE CABLE

DESCRIPTION

Transmission throttle valve cable (Fig. 228) adjustment is extremely important to proper operation. This adjustment positions the throttle valve, which controls shift speed, quality, and part-throttle downshift sensitivity.

If cable setting is too loose, early shifts and slippage between shifts may occur. If the setting is too tight, shifts may be delayed and part throttle downshifts may be very sensitive.

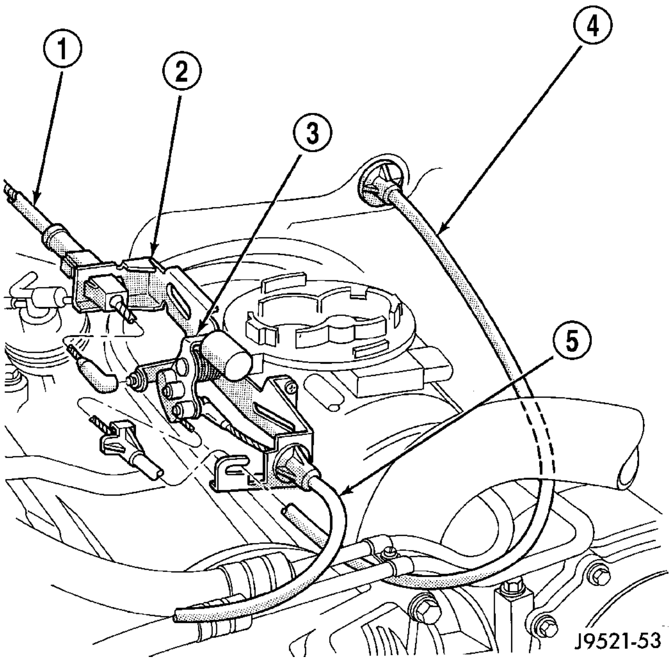

Fig. 228 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

The transmission throttle valve is operated by a cam on the throttle lever. The throttle lever is operated by an adjustable cable (Fig. 229). The cable is attached to an arm mounted on the throttle lever shaft. A retaining clip at the engine-end of the cable is removed to provide for cable adjustment. The retaining clip is then installed back onto the throttle valve cable to lock in the adjustment.

ADJUSTMENTS - THROTTLE VALVE CABLE

A correctly adjusted throttle valve cable will cause the throttle lever on the transmission to move simultaneously with the throttle body lever from the idle position. Proper adjustment will allow simultaneous movement without causing the transmission throttle

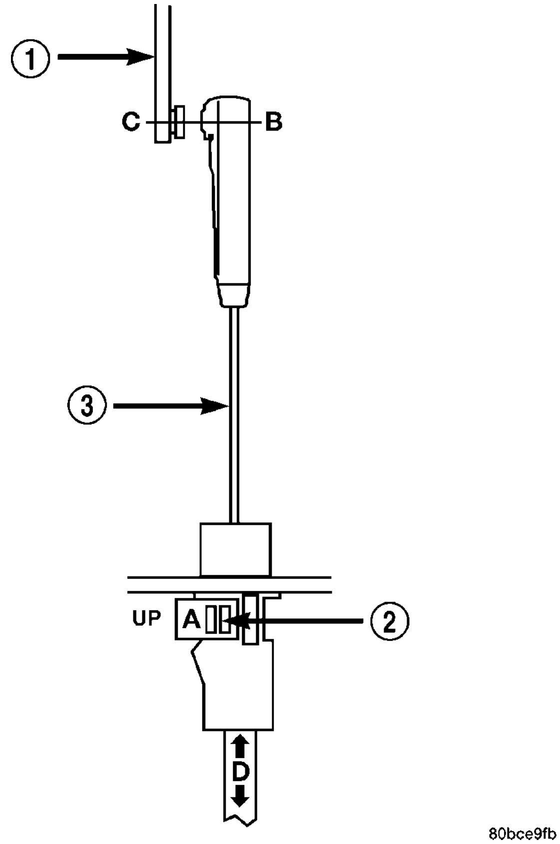

Fig. 229 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

lever to either move ahead of, or lag behind the lever on the throttle body.

ADJUSTMENT VERIFICATION

(1) Turn ignition key to OFF position.

(2) Remove air cleaner.

(3) Verify that lever on throttle body is at curb idle position (Fig. 230). Then verify that the transmission throttle lever (Fig. 231) is also at idle (fully forward) position.

(4) Slide cable off attachment stud on throttle body lever.

(5) Compare position of cable end to attachment stud on throttle body lever:

- Cable end and attachment stud should be aligned (or centered on one another) to within 1 mm (0.039 in.) in either direction (Fig. 232).
- If cable end and attachment stud are misaligned (off center), cable will have to be adjusted as described in Throttle Valve Cable Adjustment procedure.

(6) Reconnect cable end to attachment stud. Then with aid of a helper, observe movement of transmission throttle lever and lever on throttle body.

THROTTLE VALVE CABLE (Continued)

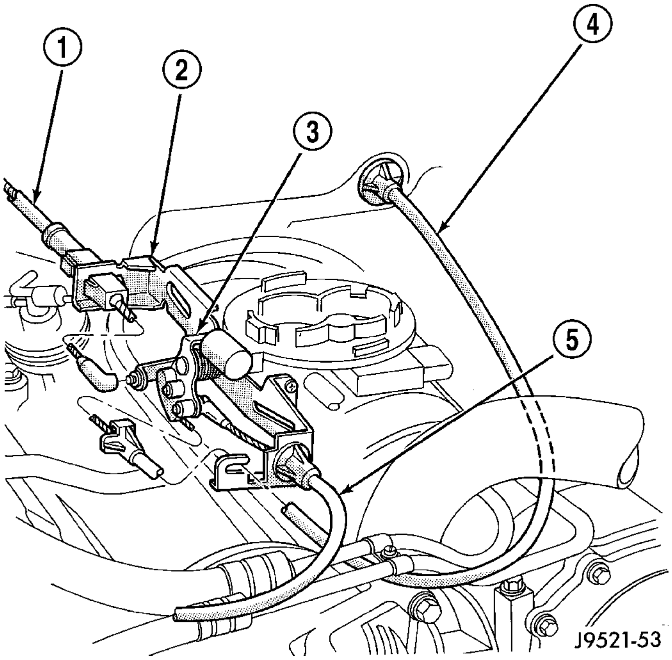

Fig. 230 Throttle Valve Cable Attachment - At Engine

1 - THROTTLE VALVE CABLE
2 - CABLE BRACKET
3 - THROTTLE BODY LEVER
4 - ACCELERATOR CABLE
5 - SPEED CONTROL CABLE

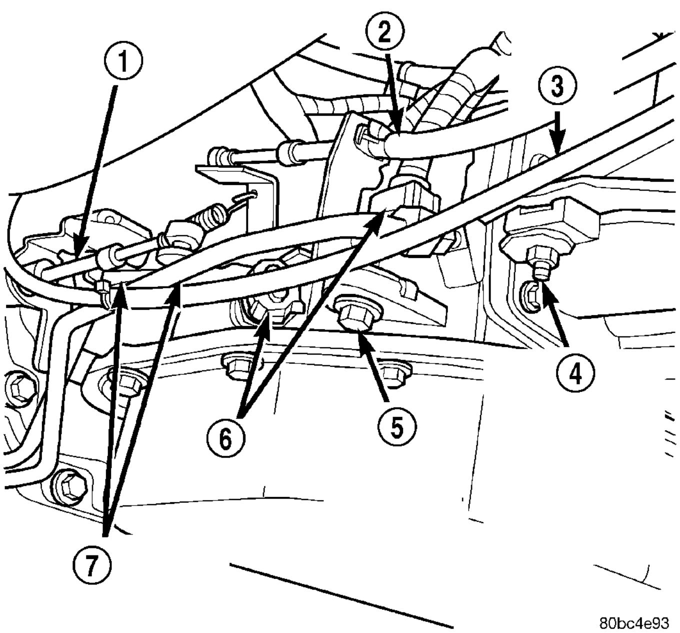

Fig. 231 Throttle Valve Cable at Transmission

1 - TRANSMISSION SHIFTER CABLE
2 - THROTTLE VALVE CABLE
3 - TRANSFER CASE SHIFTER CABLE
4 - TRANSFER CASE SHIFTER CABLE BRACKET RETAINING BOLT (1 OR 2)
5 - THROTTLE VALVE CABLE BRACKET RETAINING BOLT
6 - ELECTRICAL CONNECTORS
7 - TRANSMISSION FLUID LINES

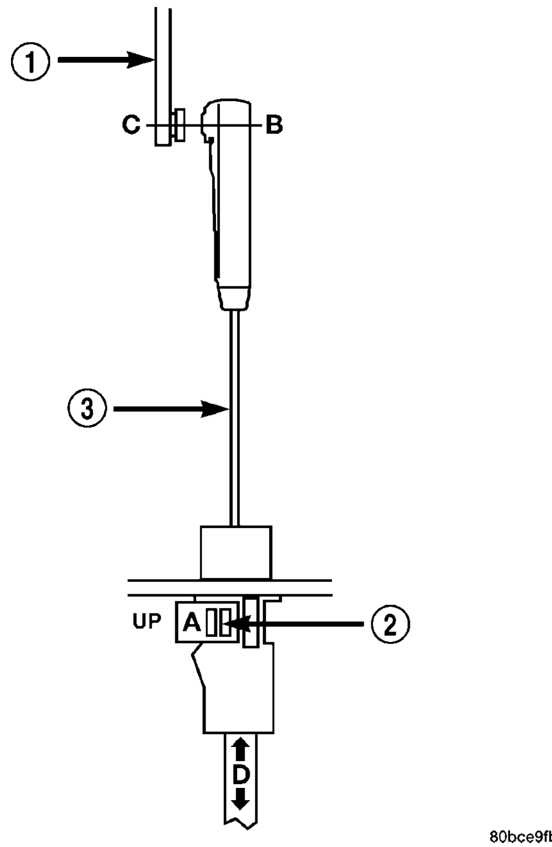

Fig. 232 Throttle Valve Cable at Throttle Linkage

1 - THROTTLE LINKAGE
2 - THROTTLE VALVE CABLE LOCKING CLIP
3 - THROTTLE VALVE CABLE

- If both levers move simultaneously from idle to half-throttle and back to idle position, adjustment is correct.
- If transmission throttle lever moves ahead of, or lags behind throttle body lever, cable adjustment will be necessary. Or, if throttle body lever prevents transmission lever from returning to closed position, cable adjustment will be necessary.

ADJUSTMENT PROCEDURE

(1) Turn ignition switch to OFF position.

(2) Remove air cleaner if necessary.

(3) Disconnect cable end from attachment stud. **Carefully slide cable off stud. Do not pry or pull cable off.**

(4) Verify that transmission throttle lever is in fully closed position. Then be sure lever on throttle body is at curb idle position.

(5) Pry the T.V. cable lock (A) into the UP position (Fig. 232). This will unlock the cable and allow for readjustment.

(6) Apply just enough tension on the T.V. cable (B) to remove any slack in the cable.**Pulling too tight will cause the T.V. lever on the transmission to move out of its idle position, which will result**

THROTTLE VALVE CABLE (Continued)

in an incorrect T.V. cable adjustment. Slide the sheath of the T.V. cable (D) back and forth until the centerlines of the T.V. cable end (B) and the throttle bell crank lever (C) are aligned within one millimeter (1mm) (Fig. 232).

(7) While holding the T.V. cable in the set position push the T.V. cable lock (A) into the down position (Fig. 232). This will lock the present T.V. cable adjustment.

NOTE: Be sure that as the cable is pulled forward and centered on the throttle lever stud, the cable housing moves smoothly with the cable. Due to the angle at which the cable housing enters the spring housing, the cable housing may bind slightly and create an incorrect adjustment.

(8) Reconnect the T.V. cable (B) to the throttle bellcrank lever (C).

(9) Check cable adjustment. Verify transmission throttle lever and lever on throttle body move simultaneously.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 233) is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller and an electronically applied converter clutch. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The torque converter hub drives the transmission oil (fluid) pump.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure resulted in large amounts of metal or fiber contamination in the fluid. If the fluid is contaminated, flush the all transmission fluid cooler(s) and lines.

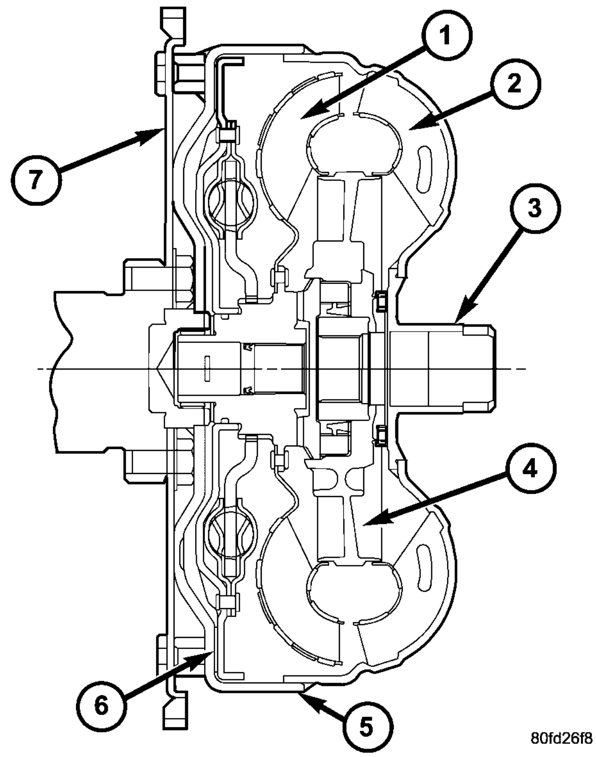

Fig. 233 Torque Converter Assembly

1 - TURBINE
2 - IMPELLER
3 - HUB
4 - STATOR
5 - FRONT COVER
6 - CONVERTER CLUTCH DISC
7 - DRIVE PLATE

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 234) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving members of the system.

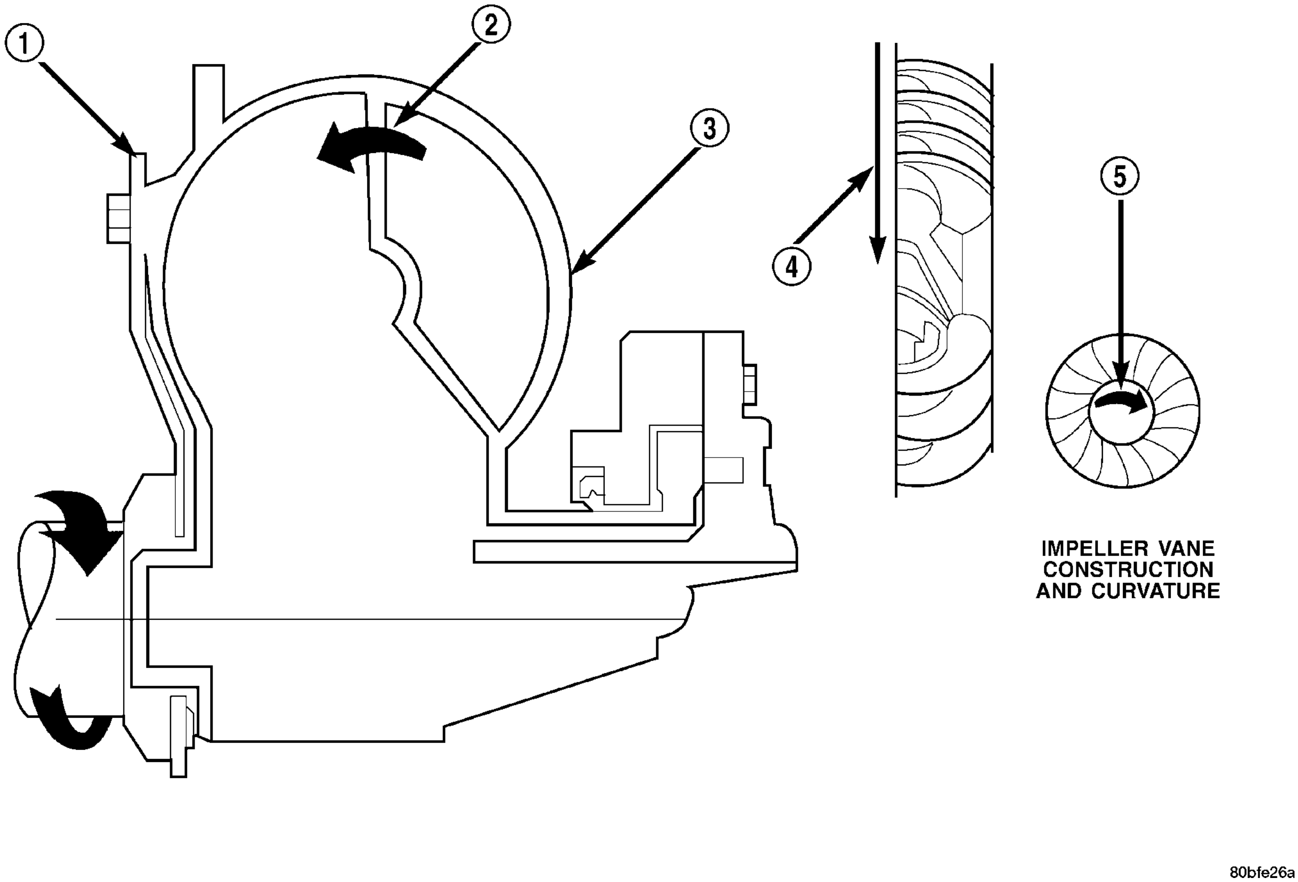

Fig. 234 Impeller

1 - ENGINE FLEXPLATE
2 - OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION
3 - IMPELLER VANES AND COVER ARE INTEGRAL
4 - ENGINE ROTATION
5 - ENGINE ROTATION

TORQUE CONVERTER (Continued)

TURBINE

The turbine (Fig. 235) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.

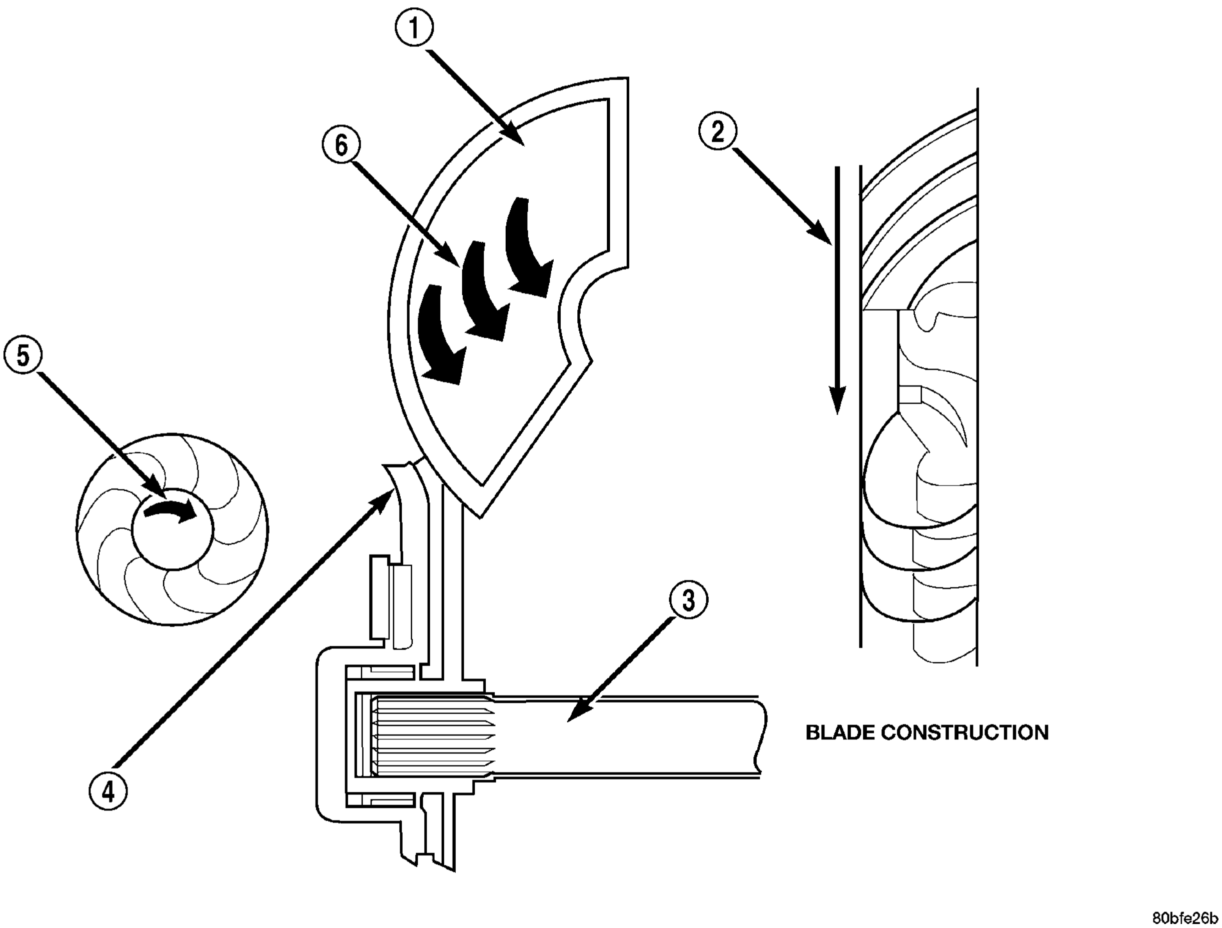

Fig. 235 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 236) is mounted on a stationary shaft which is an integral part of the oil pump. The stator is located between the impeller and turbine within the torque converter case (Fig. 237). The stator contains an over-running clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the over-running clutch, the torque multiplication feature of the torque converter is operational.

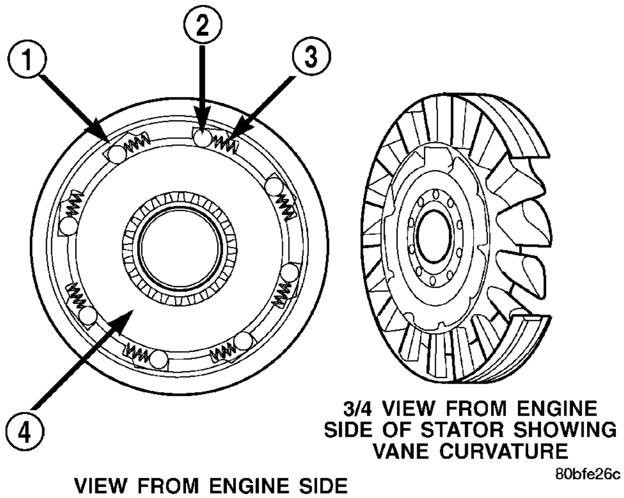

Fig. 236 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

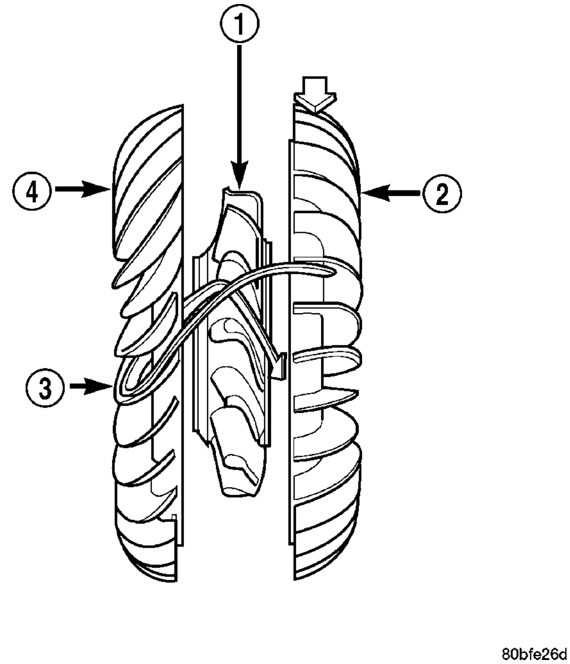

Fig. 237 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 238) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston was added to the turbine, and a friction material was added to the inside of the front cover to provide this mechanical lock-up.

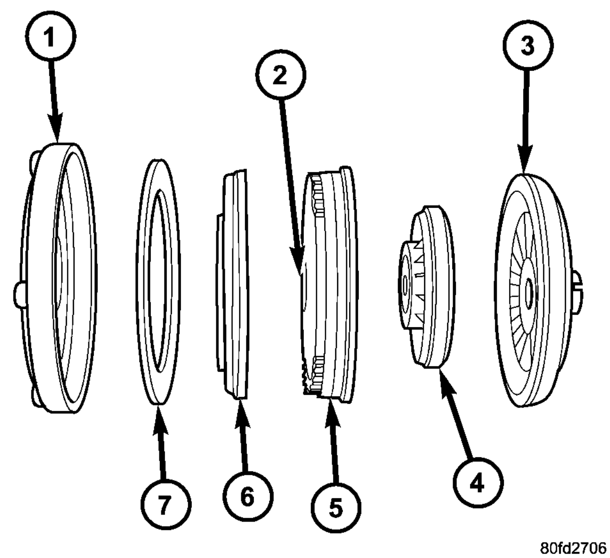

Fig. 238 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

OPERATION

The converter impeller (Fig. 239) (driving member), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft.

TURBINE

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a "hindering" direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in a direction that would tend to slow it down.

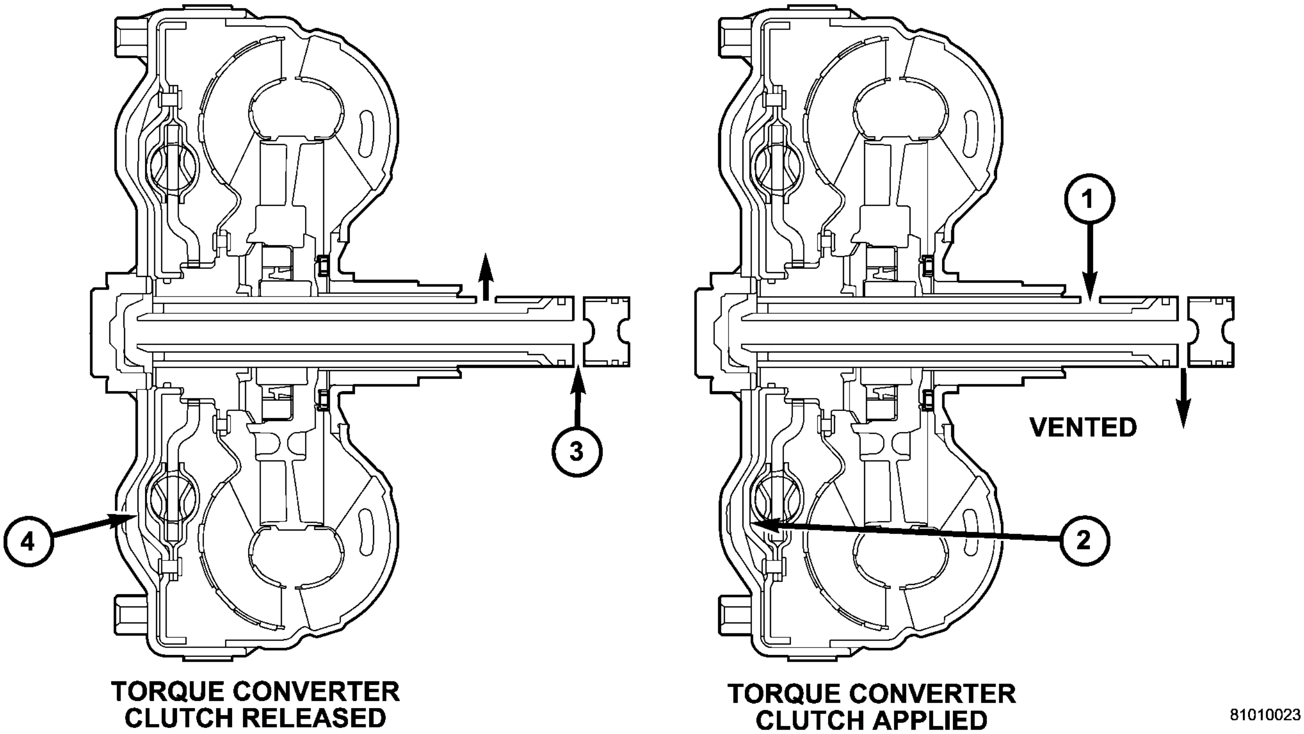

Fig. 239 Torque Converter Fluid Operation

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

TORQUE CONVERTER (Continued)

STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 240). Under stall conditions the turbine is stationary and the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counterclockwise direction. When this happens the over-running clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a "helping" direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 1.75:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such as way as to cause it to lock-up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.

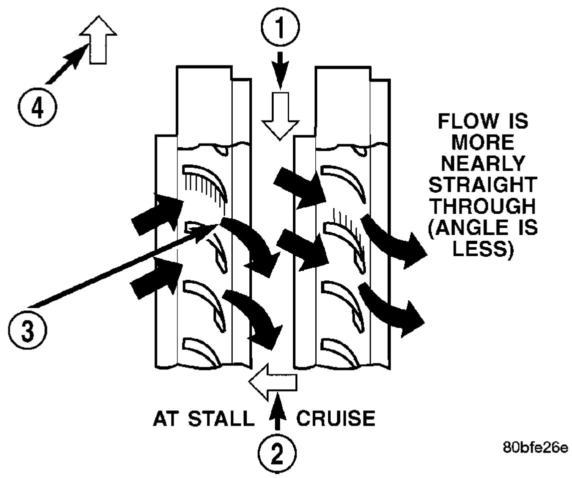

Fig. 240 Stator Operation

1 - DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
2 - FRONT OF ENGINE
3 - INCREASED ANGLE AS OIL STRIKES VANES
4 - DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

TORQUE CONVERTER CLUTCH (TCC)

The torque converter clutch is hydraulically applied or released when fluid is feed or vented from the hydraulic circuit by the torque converter control (TCC) solenoid on the valve body. The torque converter clutch is controlled by the Powertrain Control Module (PCM). The torque converter clutch engages in fourth gear, and in third gear under various conditions, such as when the O/D switch is OFF, or when the vehicle is cruising on a level surface after the vehicle has warmed up. The torque converter clutch may disengage momentarily when an increase in engine load is sensed by the PCM, such as when the vehicle begins to go uphill or the throttle pressure is increased.

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition. The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive notches for sharp edges, burrs, scratches, or nicks. Polish the hub and notches with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or bushing while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 241). Surface of converter lugs should be 19mm (0.75 in.) to the rear of the straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

(9) Fill the transmission with the recommended fluid.

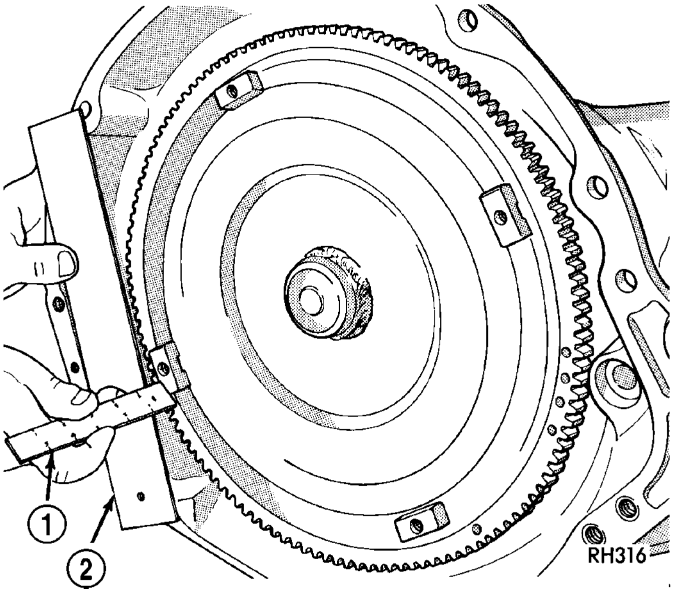

Fig. 241 Typical Method Of Checking Converter Seating

1 - SCALE
2 - STRAIGHTEDGE

TORQUE CONVERTER DRAINBACK VALVE

DESCRIPTION

The drainback valve is located in the transmission cooler outlet (pressure) line.

OPERATION

The valve prevents fluid from draining from the converter into the cooler and lines when the vehicle is shut down for lengthy periods. Production valves have a hose nipple at one end, while the opposite end is threaded for a flare fitting. All valves have an arrow (or similar mark) to indicate direction of flow through the valve.

STANDARD PROCEDURE - TORQUE CONVERTER DRAINBACK VALVE

The converter drainback check valve is located in the cooler outlet (pressure) line near the radiator tank. The valve prevents fluid drainback when the vehicle is parked for lengthy periods. The valve check ball is spring loaded and has an opening pressure of approximately 2 psi.

The valve is serviced as an assembly; it is not repairable. Do not clean the valve if restricted, or contaminated by sludge, or debris. If the valve fails, or if a transmission malfunction occurs that generates significant amounts of sludge and/or clutch particles and metal shavings, the valve must be replaced.

The valve must be removed whenever the cooler and lines are reverse flushed. The valve can be flow tested when necessary. The procedure is exactly the same as for flow testing a cooler.

If the valve is restricted, installed backwards, or in the wrong line, it will cause an overheating condition and possible transmission failure.

CAUTION: The drainback valve is a one-way flow device. It must be properly oriented in terms of flow direction for the cooler to function properly. The valve must be installed in the pressure line. Otherwise flow will be blocked and would cause an overheating condition and eventual transmission failure.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) (Fig. 242) has 3 primary functions:

- Provide a PARK/NEUTRAL start signal to the engine controller and the starter relay.
- Turn the Back-up lamps on when the transmission is in REVERSE and the engine (ignition) is on.
- Provide a transmission range signal to the instrument cluster.

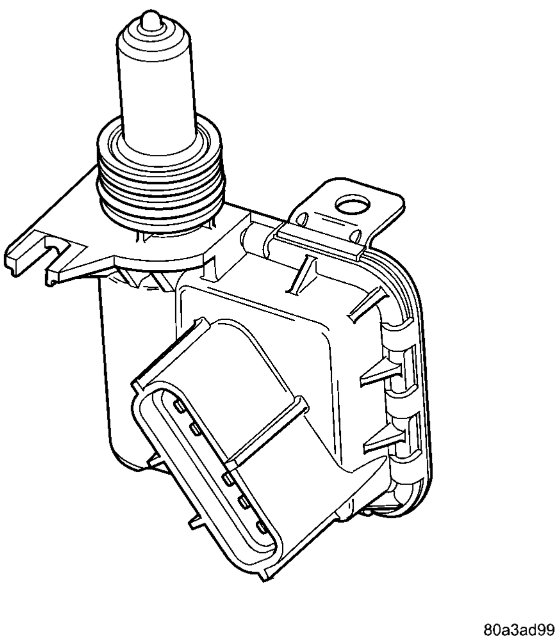

Fig. 242 Transmission Range Sensor

The sensor is mounted in the transmission housing near the valve body, just above the pan rail. It's in the same position as the Park/Neutral switch on other transmissions. The TRS contacts a cammed surface on the manual valve lever. The cammed surface translates the rotational motion of the manual lever into the linear motion of the sensor. The cammed surface on the manual lever is comprised of two parts controlling the TRS signal: The insulator portion contacts the switch poppet when the manual lever is not in PARK or NEUTRAL. The manual lever itself contacts the poppet when the lever is in PARK or NEUTRAL; providing a ground for the signal from the starter relay and the JTEC engine controller.

OPERATION

As the switch moves through its linear motion (Fig. 243) contacts slide across a circuit board which changes the resistance between the range sensing pins of the switch. A power supply on the instrument cluster provides a regulated voltage signal to the switch. The return signal is decoded by the cluster, which then controls the PRNDL display to correspond with the correct transmission range. A bus message of transmission range is also sent by the cluster. In REVERSE range a second contact set closes the circuit providing power to the reverse lamps.

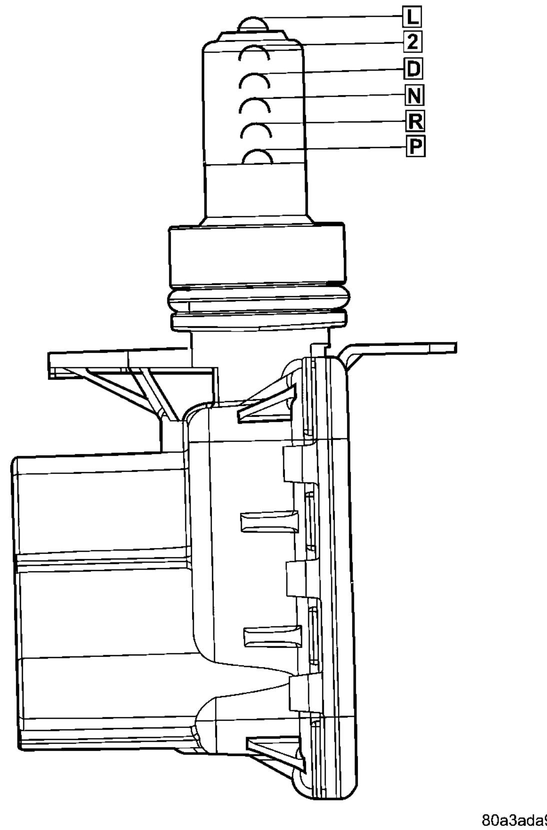

Fig. 243 Transmission Range Sensor Linear Movement

TRANSMISSION RANGE SENSOR (Continued)

Mechanical State	Electronic Display (Ignition Unlocked)	Electronic Display (Ignition On)		
Indicated Gear Position			Transmission Status	Column Shifter Position
P	P	P	Vehicle is in PARK with the pawl engaged.	In the PARK gate.
	R		The PARK pawl is disengaged and the vehicle is free to roll, but REVERSE is not engaged.	Between the PARK and REVERSE gates.
R	R	R	The transmission is hydraulically in REVERSE.	In the REVERSE gate.
	N		The transmission is transitioning between REVERSE and NEUTRAL.	Between the REVERSE and NEUTRAL gates.
N	N	N	The vehicle is in NEUTRAL.	In the NEUTRAL gate.
	N		The transmission is transitioning between NEUTRAL and DRIVE, but is not in DRIVE.	Between the NEUTRAL and DRIVE gates.
D	D	D	The transmission is hydraulically in DRIVE.	In the DRIVE gate,
2	2	2	The transmission is hydraulically in Manual SECOND.	In the SECOND gate.
1	1	1	The transmission is hydraulically in Manual FIRST.	In the FIRST gate.

DIAGNOSIS AND TESTING - TRANSMISSION RANGE SENSOR (TRS)

NOTE: For all circuit identification in the following steps, Refer to the appropriate Wiring Information.

(1) Raise vehicle on suitable hoist.

(2) Disconnect the vehicle's shift cable from the manual lever.

(3) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(4) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Park/Neutral Position Sense pin of the TRS and the transmission case. The resistance should be less than 5 ohms.

(5) If the resistance is greater than 5 ohms in either of the previous steps, check for a dirty contact between the tip of the TRS rod and the valve body manual lever. If the contact is OK, replace the TRS.

(6) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Fused Ignition Switch Output and the Back-up Lamp feed pins of the TRS. The resistance should be less than 5

TRANSMISSION RANGE SENSOR (Continued)

ohms. If the resistance is greater than 5 ohms, replace the TRS.

(7) With the manual lever in the PARK position (the PARK position is with the manual lever moved to the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 522.2 ohms. If the resistance is not correct, replace the TRS.

(8) With the manual lever in the REVERSE position (the REVERSE position is with the manual lever moved one detent forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 206.2 ohms. If the resistance is not correct, replace the TRS.

(9) With the manual lever in the NEUTRAL position (the NEUTRAL position is with the manual lever moved two detents forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 108.6 ohms. If the resistance is not correct, replace the TRS.

(10) With the manual lever in the DRIVE position (the DRIVE position is with the manual lever moved three detents forward of the full rearward position), measure the resistance between the Transmission Range Sensor MUX and the Transmission Range Sensor 5V Supply pins of the TRS. The resistance should be 59.9 ohms. If the resistance is not correct, replace the TRS.

(11) With the manual lever in the SECOND position (the SECOND position is with the manual lever moved one detent rearward of the full forward position), measure the resistance between the Transmission Range Sensor MUX and the Back-up Lamp feed pins of the TRS. The resistance should be 31.9 ohms. If the resistance is not correct, replace the TRS.

(12) With the manual lever in the LOW position (the LOW position is with the manual lever moved to the full forward position), measure the resistance between the Transmission Range Sensor MUX and the Back-up Lamp feed pins of the TRS. The resistance should be 13.7 ohms. If the resistance is not correct, replace the TRS.

REMOVAL

(1) Raise vehicle and position drain pan under the transmission range sensor (TRS).

(2) Move the transmission manual lever to the manual LOW position. The manual LOW position is with the manual lever in the forward-most detent.

(3) Disengage the wiring connector from the TRS.

(4) Remove the two screws holding the TRS to the TRS mounting bracket.

(5) Remove the TRS (Fig. 244) from the TRS mounting bracket by pulling it straight out of the bracket.

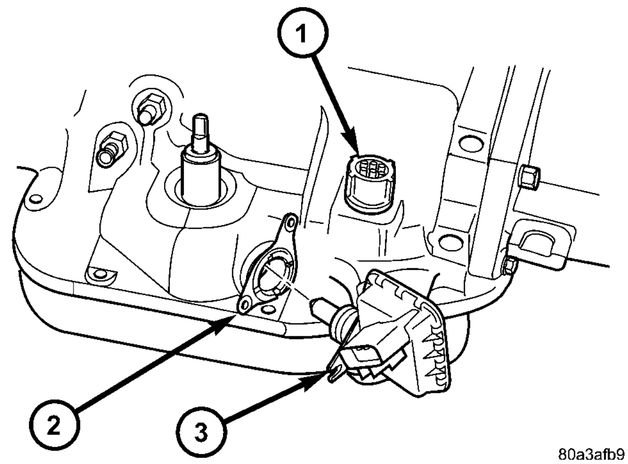

Fig. 244 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

(6) Loosen the TRS mounting bracket in the transmission case using Adapter 8581 (Fig. 245).

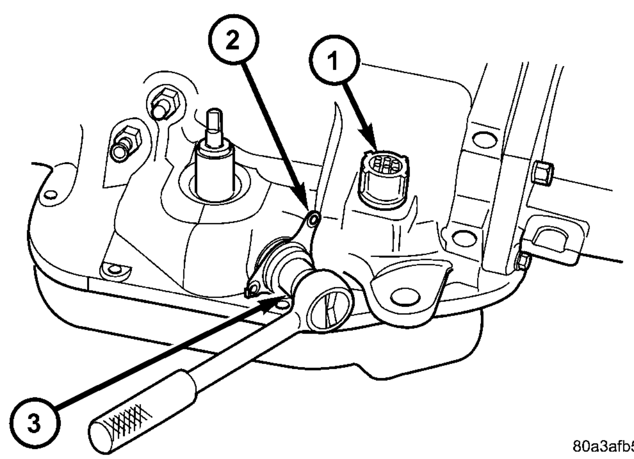

Fig. 245 Loosen the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

TRANSMISSION RANGE SENSOR (Continued)

(7) Remove the TRS mounting bracket (Fig. 246) from the transmission case.

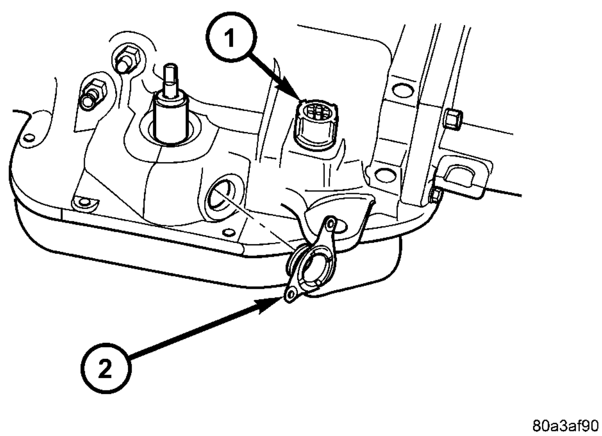

Fig. 246 Remove TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET

INSTALLATION

(1) Move the transmission manual shaft lever to the manual LOW position.

(2) Install the TRS mounting bracket into the transmission case. Using Adapter 8581 (Fig. 247), tighten the mounting bracket to 34 N·m (300 in.lbs.).

(3) Install the TRS (Fig. 248) into the mounting bracket with the wiring connector facing the front of the transmission.

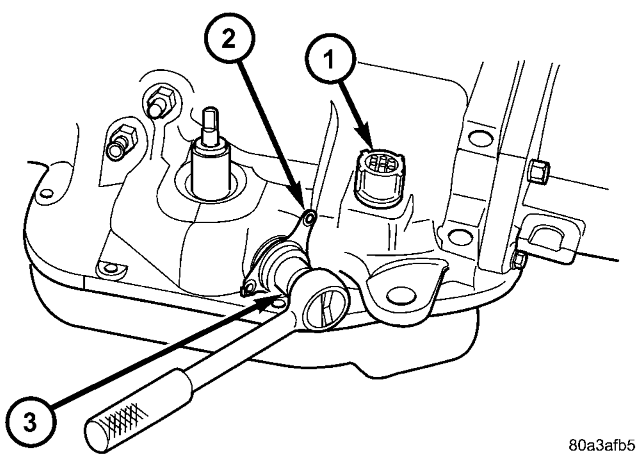

Fig. 247 Tighten the TRS Mounting Bracket

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - ADAPTER 8581

(4) Install the two screws to hold the TRS to the mounting bracket. Tighten the screws to 3.4 N·m (30 in.lbs.).

(5) Verify proper sensor operation (Fig. 249).

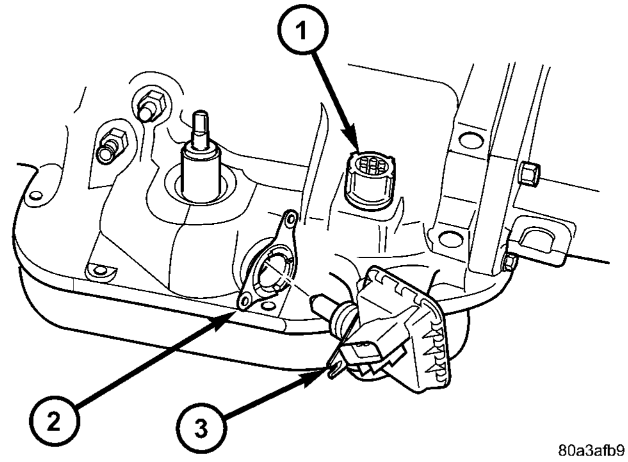

Fig. 248 Remove Transmission Range Sensor

1 - SOLENOID CASE CONNECTOR
2 - TRS MOUNTING BRACKET
3 - TRANSMISSION RANGE SENSOR

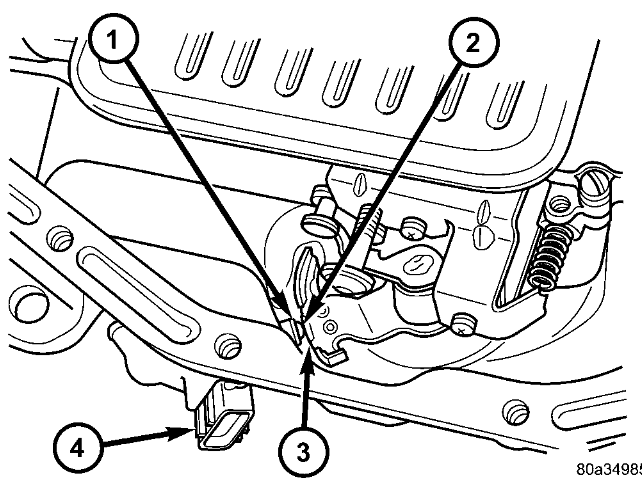

Fig. 249 Transmission Range Sensor Operation

1 - NEUTRAL CONTACT
2 - MANUAL LEVER AND SENSOR PLUNGER IN REVERSE POSITION
3 - PARK CONTACT
4 - TRANSMISSION RANGE SENSOR

(6) Move the transmission manual shaft lever to the PARK position.

(7) Connect TRS wiring connector to the TRS and lower vehicle.

(8) Refill the transmission fluid to the correct level.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

Transmission fluid temperature readings are supplied to the transmission control module by the thermistor (Fig. 250). The temperature readings are used to control engagement of the fourth gear overdrive clutch, the converter clutch, and governor pressure. Normal resistance value for the thermistor at room temperature is approximately 2000 ohms.

The thermistor is part of the governor pressure sensor assembly and is immersed in transmission fluid at all times.

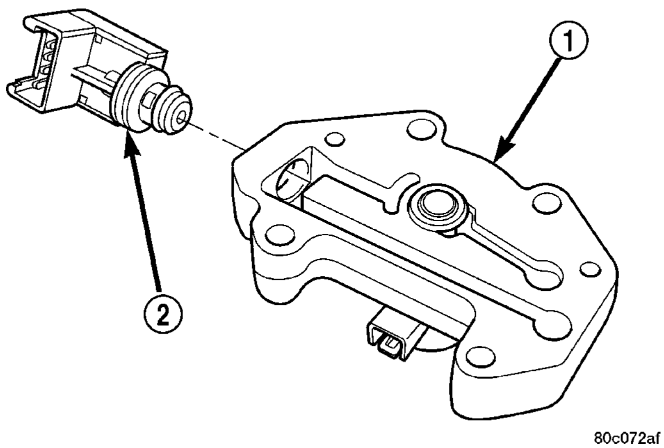

Fig. 250 Governor Pressure Sensor

1 - GOVERNOR BODY
2 - GOVERNOR PRESSURE SENSOR/TRANSMISSION FLUID TEMPERATURE THERMISTOR

OPERATION

The PCM prevents engagement of the converter clutch and overdrive clutch, when fluid temperature is below approximately 10°C (50°F).

If fluid temperature exceeds 126°C (260°F), the PCM causes a 4-3 downshift and engage the converter clutch. Engagement is according to the third gear converter clutch engagement schedule.

The overdrive OFF lamp in the instrument panel illuminates when the shift back to third occurs. The transmission will not allow fourth gear operation until fluid temperature decreases to approximately 110°C (230°F).

VALVE BODY

DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and transfer plate. The valve body contains valves and check balls that control fluid delivery to the torque converter clutch, bands, and frictional clutches. The valve body contains the following components (Fig. 251), (Fig. 252), (Fig. 253), and (Fig. 254):

- Regulator valve
- Regulator valve throttle pressure plug
- Line pressure sleeve
- Kickdown valve
- Kickdown limit valve
- 1-2 shift valve
- 1-2 control valve
- 2-3 shift valve
- 2-3 governor plug
- 3-4 shift valve
- 3-4 timing valve
- 3-4 quick fill valve
- 3-4 accumulator
- Throttle valve
- Throttle pressure plug
- Switch valve
- Manual valve
- Converter clutch lock-up valve
- Converter clutch lock-up timing Valve
- Shuttle valve
- Shuttle valve throttle plug
- Boost Valve
- 9 check balls

By adjusting the spring pressure acting on the regulator valve, transmission line pressure can be adjusted.

VALVE BODY (Continued)

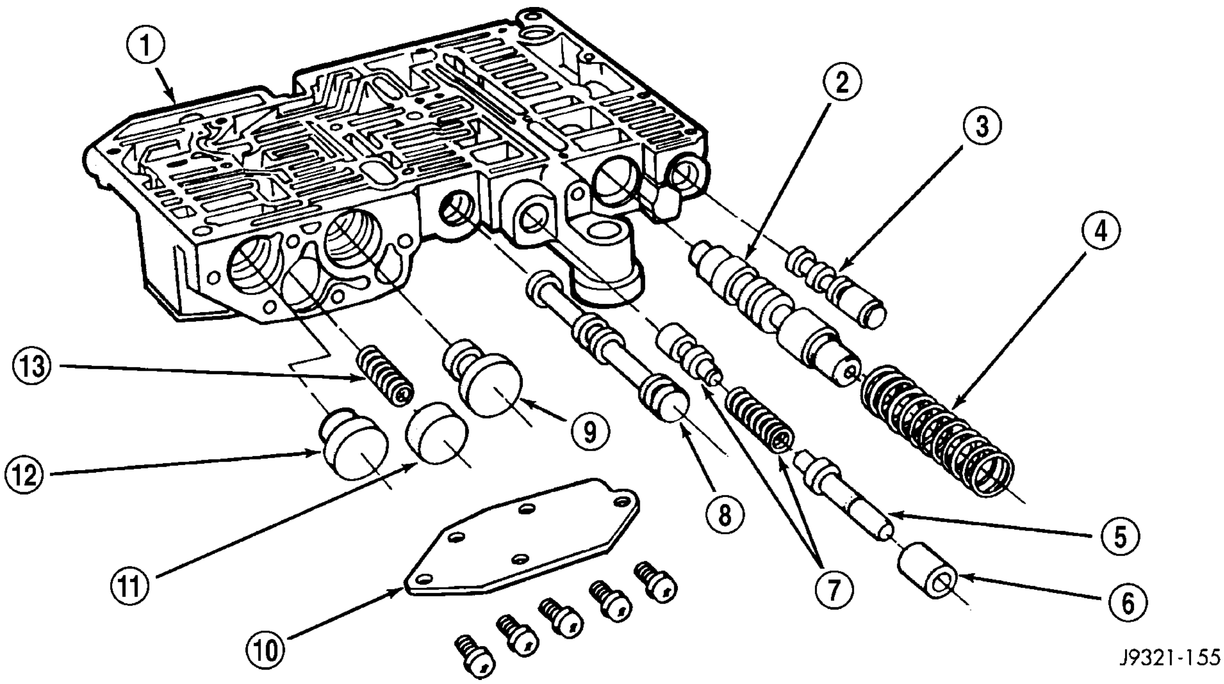

Fig. 251 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

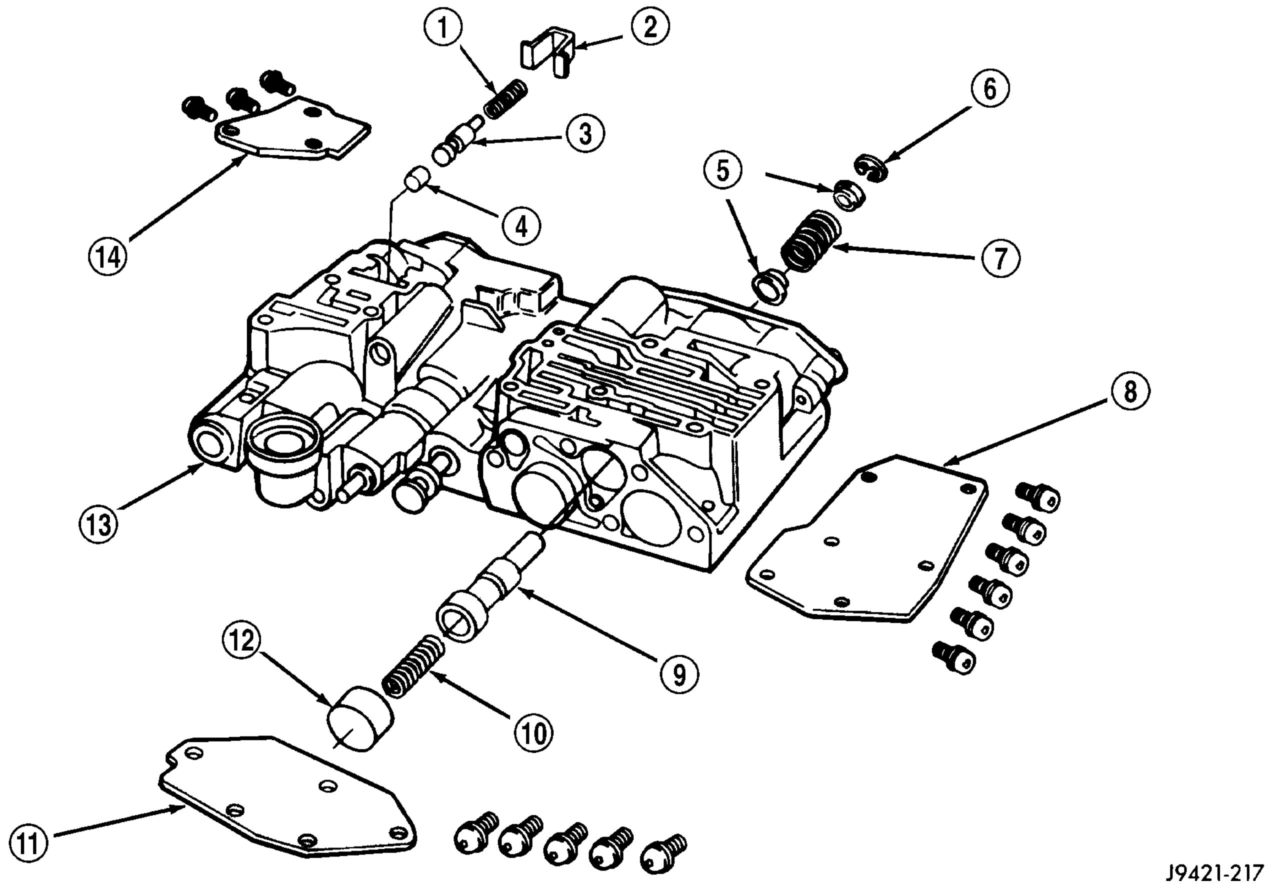

Fig. 252 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

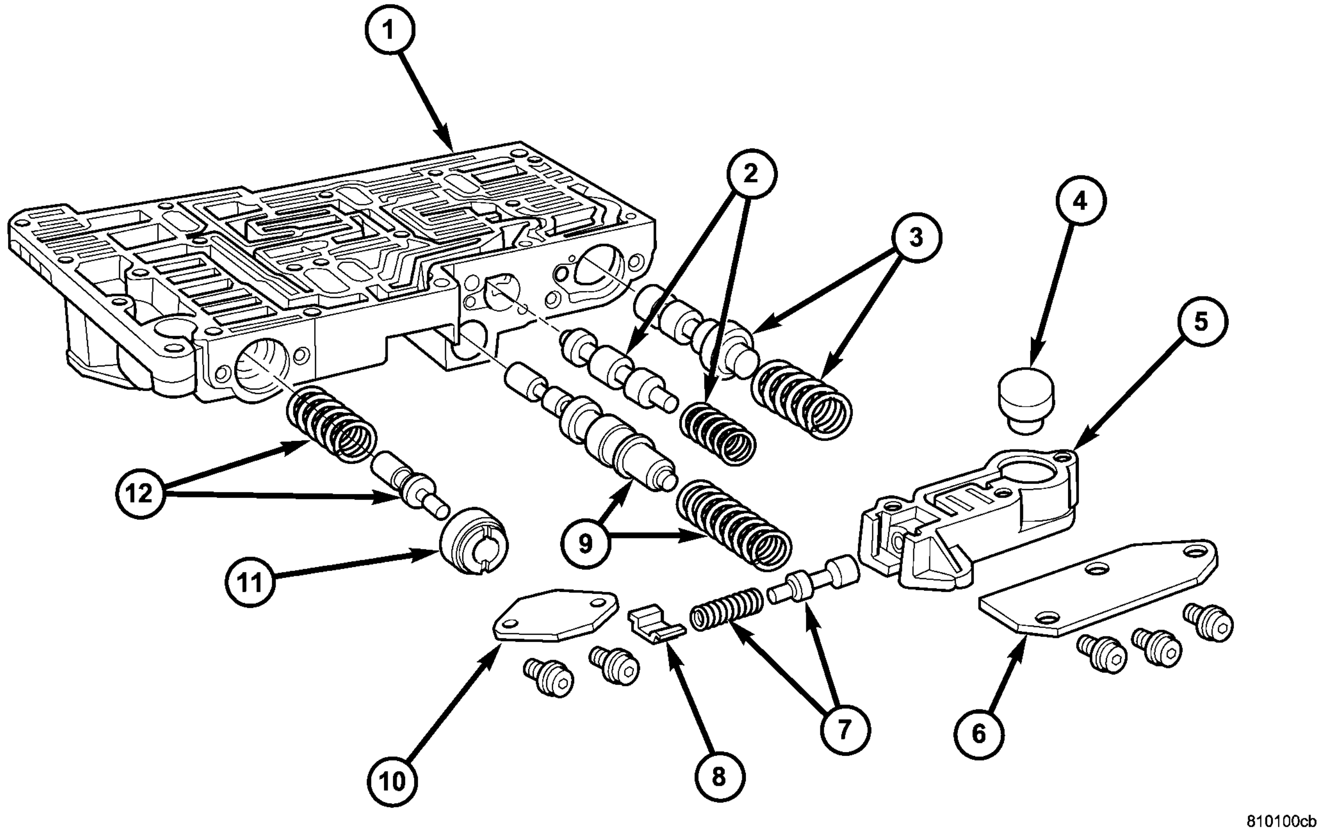

Fig. 253 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - PLUG SLEEVE
12 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

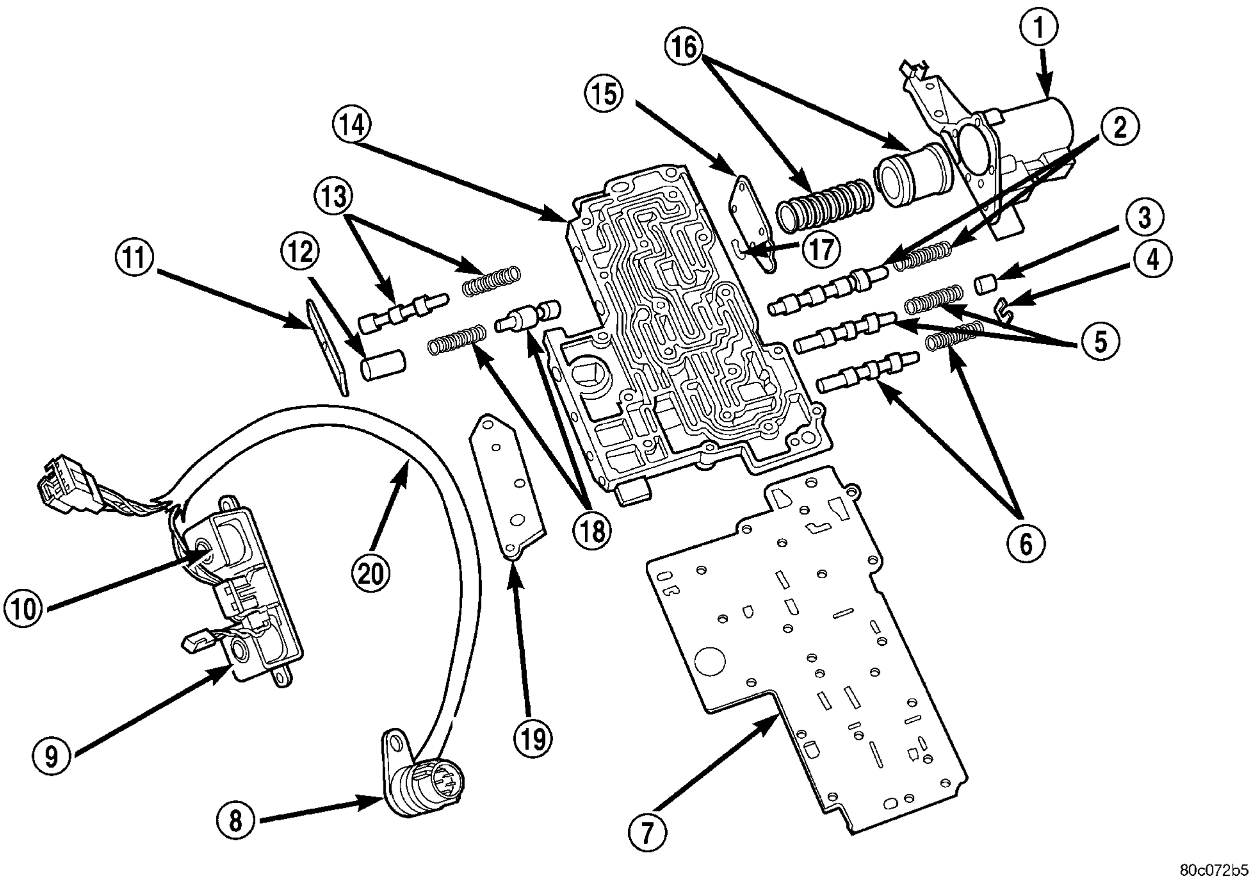

Fig. 254 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

CHECK BALLS

CHECK BALL NUMBER	DESCRIPTION
1	Allows either the manual valve to put line pressure on the 1-2 governor plug or the KD Valve to put WOT line pressure on the 1-2 governor plug.
3	Allows either the Reverse circuit or the 3rd gear circuit to pressurize the front clutch.
4	Allows either the Manual Low circuit from the Manual Valve or the Reverse from the Manual Valve circuit to pressurize the rear servo.
5	Directs line pressure to the spring end of the 2-3 shift valve in either Manual Low or Manual 2nd, forcing the downshift to 2nd gear regardless of governor pressure.
6	Provides a by-pass around the front servo orifice so that the servo can release quickly.
7	Provides a by-pass around the rear clutch orifice so that the clutch can release quickly.
8	Directs reverse line pressure through an orifice to the throttle valve eliminating the extra leakage and insuring that Reverse line pressure pressure will be sufficient.
9	Provides a by-pass around the rear servo orifice so that the servo can release quickly.
10	Allows the lockup clutch to used at WOT in 3rd gear by putting line pressure from the 3-4 Timing Valve on the interlock area of the 2-3 shift valve, thereby preventing a 3rd gear Lock-up to 2nd gear kickdown.

REGULATOR VALVE

The pressure regulator valve is needed to control the hydraulic pressure within the system and reduce the amount of heat produced in the fluid. The pressure regulator valve is located in the valve body near the manual valve. The pressure regulator valve train controls the maximum pressure in the lines by metering the dumping of fluid back into the sump. Regulated pressure is referred to as “line pressure.”

The regulator valve (Fig. 255) has a spring on one end that pushes the valve to the left. This closes a dump (vent) that is used to lower pressure. The closing of the dump will cause the oil pressure to increase. Oil pressure on the opposite end of the valve pushes the valve to the right, opening the dump and lowering oil pressure. The result is spring pressure working against oil pressure to maintain the oil at specific pressures. With the engine running, fluid flows from the pump to the pressure regulator valve, manual valve, and the interconnected circuits. As fluid is sent through passages to the regulator valve, the pressure pushes the valve to the right against the large spring. It is also sent to the reaction areas on the left side of the throttle pressure plug and the line pressure plug. With the gear selector in the PARK position, fluid recirculates through the regulator and manual valves back to the sump.

Meanwhile, the torque converter is filled slowly. In all other gear positions (Fig. 256), fluid flows between two right side lands to the switch valve and torque converter. At low pump speeds, the flow is controlled by the pressure valve groove to reduce pressure to the torque converter. After the torque converter and switch valve fill with fluid, the switch valve becomes the controlling metering device for torque converter pressure. The regulator valve then begins to control the line pressure for the other transmission circuits. The balance of the fluid pressure pushing the valve to the right and the spring pressure pushing to the left determines the size of the metering passage at land #2 (land #1 being at the far right of the valve in the diagram). As fluid leaks past the land, it moves into a groove connected to the filter or sump. As the land meters the fluid to the sump, it causes the pressure to reduce and the spring decreases the size of the metering passage. When the size of the metering passage is reduced, the pressure rises again and the size of the land is increased again. Pressure is regulated by this constant balance of hydraulic and spring pressure.

VALVE BODY (Continued)

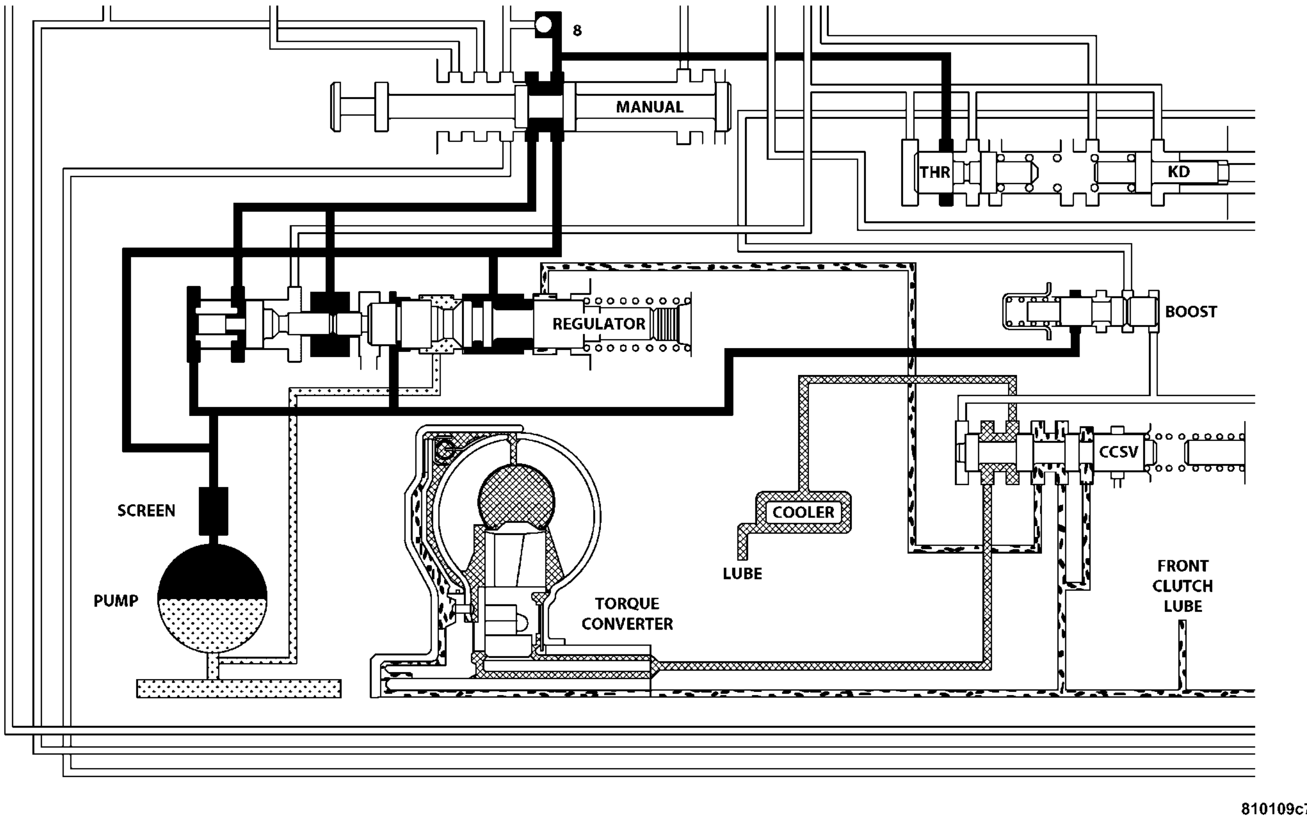

Fig. 255 Regulator Valve in Park Position

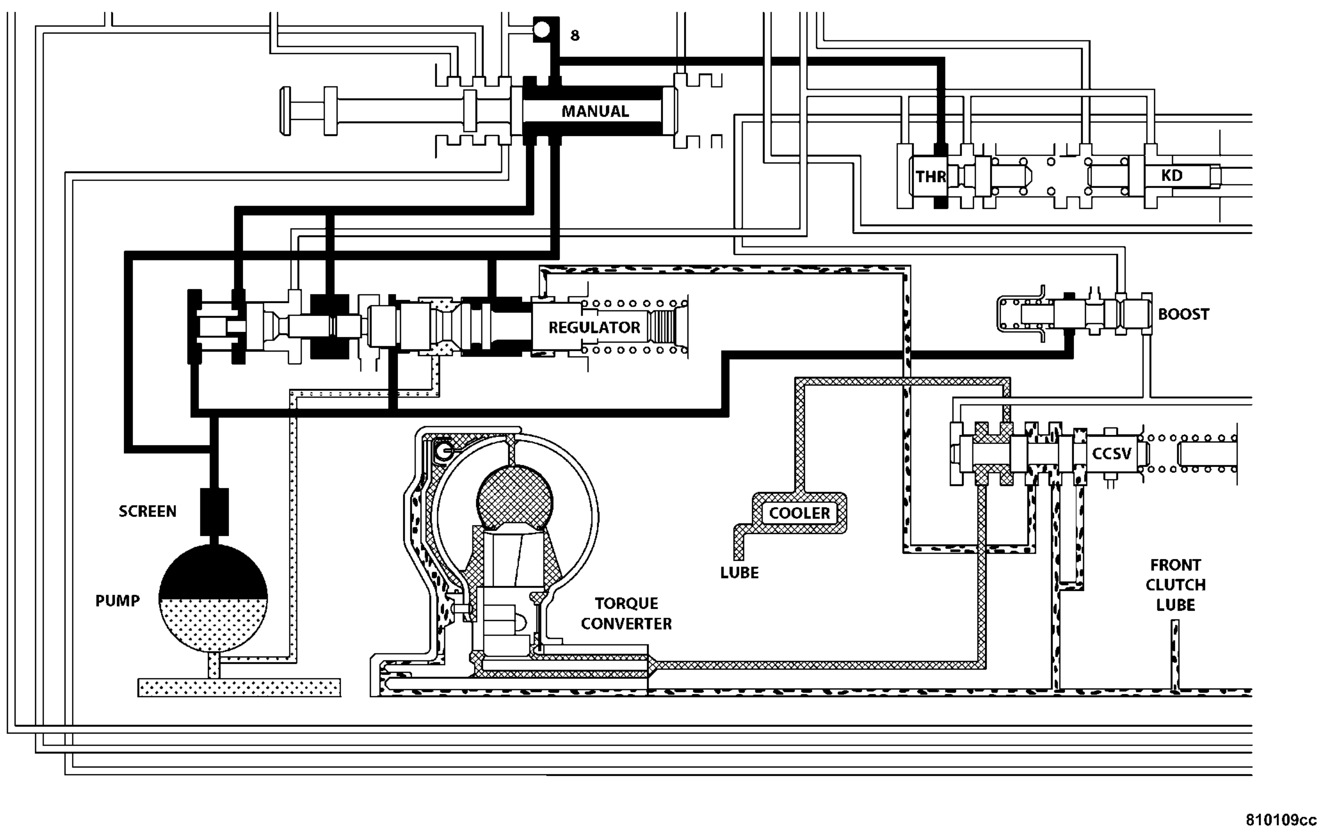

Fig. 256 Regulator Valve in Neutral Position

VALVE BODY (Continued)

The metering at land #2 establishes the line pressure throughout the transmission. It is varied according to changes in throttle position and the transmission's internal condition within a range of 57-94 psi (except in REVERSE) (Fig. 257). The regulated line pressure in REVERSE (Fig. 258) is held at much higher pressures than in the other gear positions: 145-280 psi. The higher pressure for REVERSE is achieved by the manual valve blocking the supply of line pressure to the reaction area left of land #4. With this pressure blocked, there is less area for pressure to act on to balance the force of the spring on the right. This allows line pressure to push the valve train to the right, reducing the amount of fluid returned to the pump's inlet, increasing line pressure.

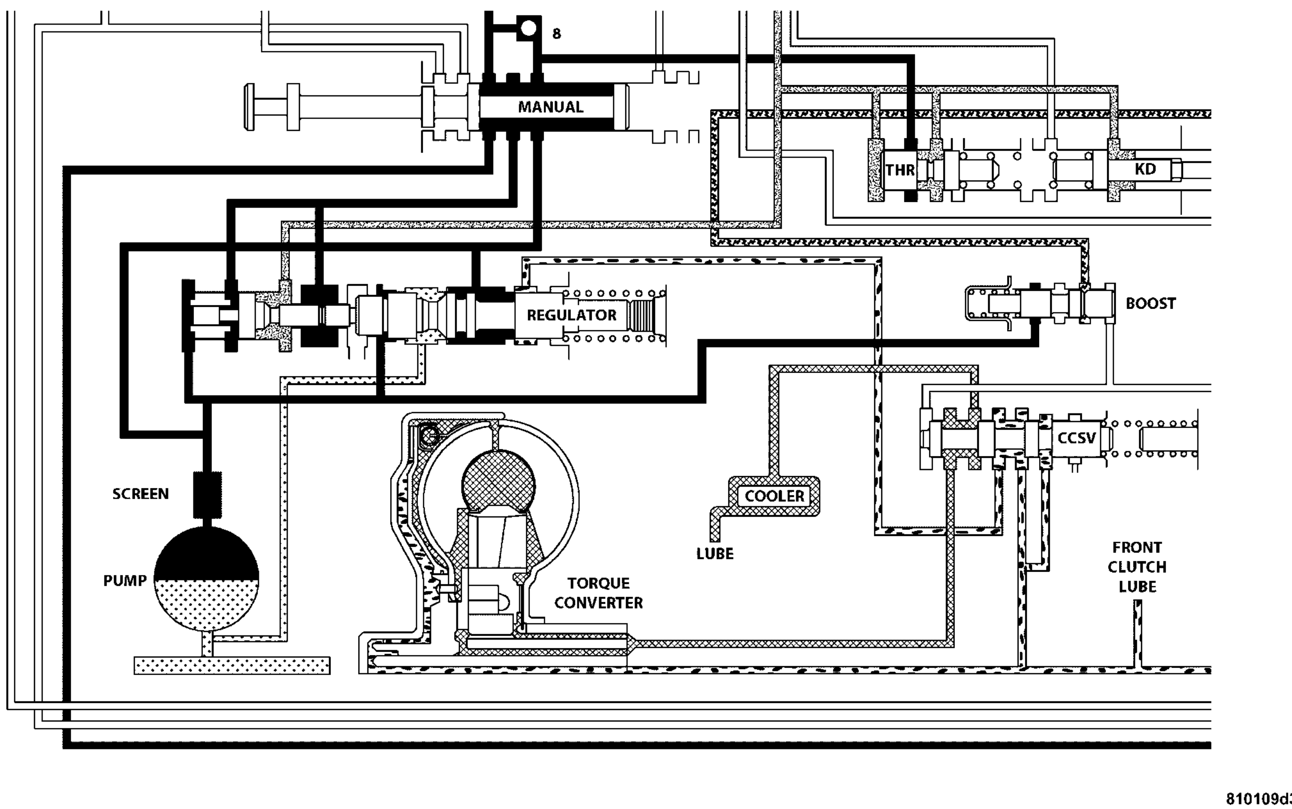

Fig. 257 Regulator Valve in Drive Position

VALVE BODY (Continued)

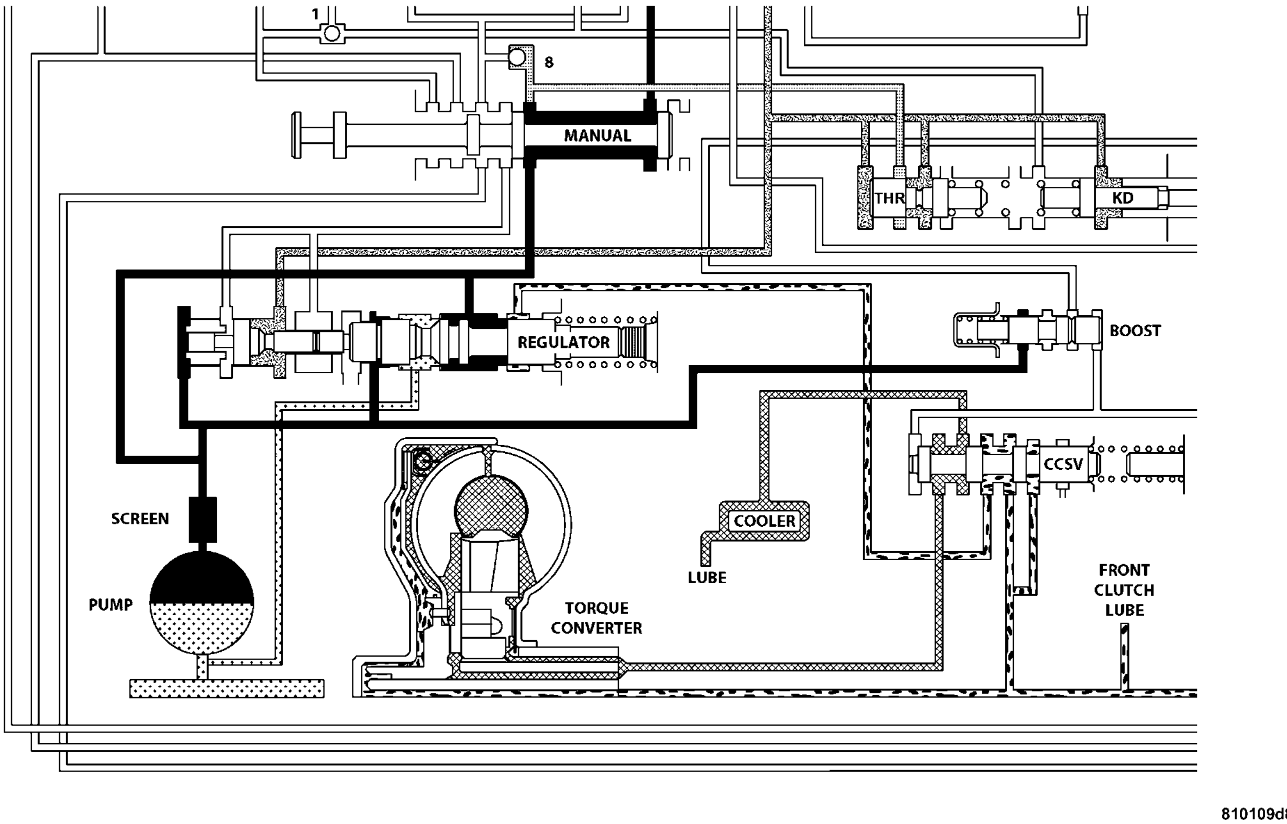

Fig. 258 Regulator Valve in Reverse Position

VALVE BODY (Continued)

KICKDOWN VALVE

When the throttle valve is as far over to the left as it can go, the maximum line pressure possible will enter the throttle pressure circuit. In this case, throttle pressure will equal line pressure. With the kickdown valve (Fig. 259) pushed into the bore as far as it will go, fluid initially flows through the annular groove of the 2-3 shift valve (which will be in the direct drive position to the right).

After passing the annular groove, the fluid is routed to the spring end of the 2-3 shift valve. Fluid pressure reacting on the area of land #1 overcomes governor pressure, downshifting the 2-3 shift valve into the kickdown, or second gear stage of operation. The valve is held in the kickdown position by throttle pressure routed from a seated check ball (#2). Again, if vehicle speed is low enough, throttle pressure will also push the 1-2 shift valve left to seat its governor plug, and downshift to drive breakaway.

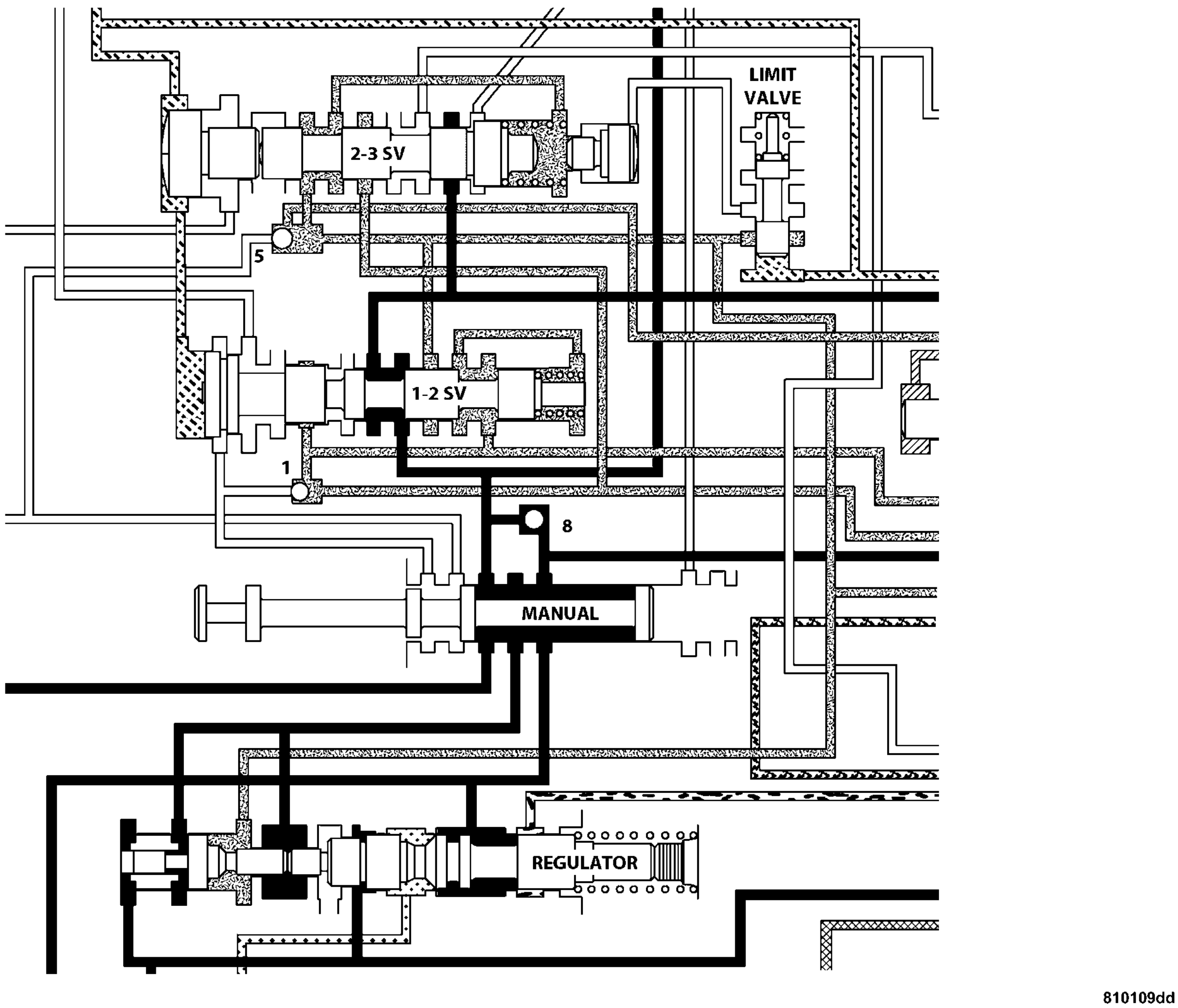

Fig. 259 Kickdown Valve - Wide Open Throttle

VALVE BODY (Continued)

KICKDOWN LIMIT VALVE

The purpose of the limit valve is to prevent a 3-2 downshift at higher speeds when a part-throttle downshift is not desirable. At these higher speeds only a full throttle 3-2 downshift will occur. At low road speeds (Fig. 260) the limit valve does not come into play and does not affect the downshifts. As the vehicle's speed increases (Fig. 261), the governor pressure also increases. The increased governor pressure acts on the reaction area of the bottom land of the limit valve overcoming the spring force trying to push the valve toward the bottom of its bore. This pushes the valve upward against the spring and bottoms the valve against the top of the housing. With the valve bottomed against the housing, the throttle pressure supplied to the valve will be closed off by the bottom land of the limit valve. When the supply of throttle pressure has been shut off, the 3-2 part throttle downshift plug becomes inoperative, because no pressure is acting on its reaction area.

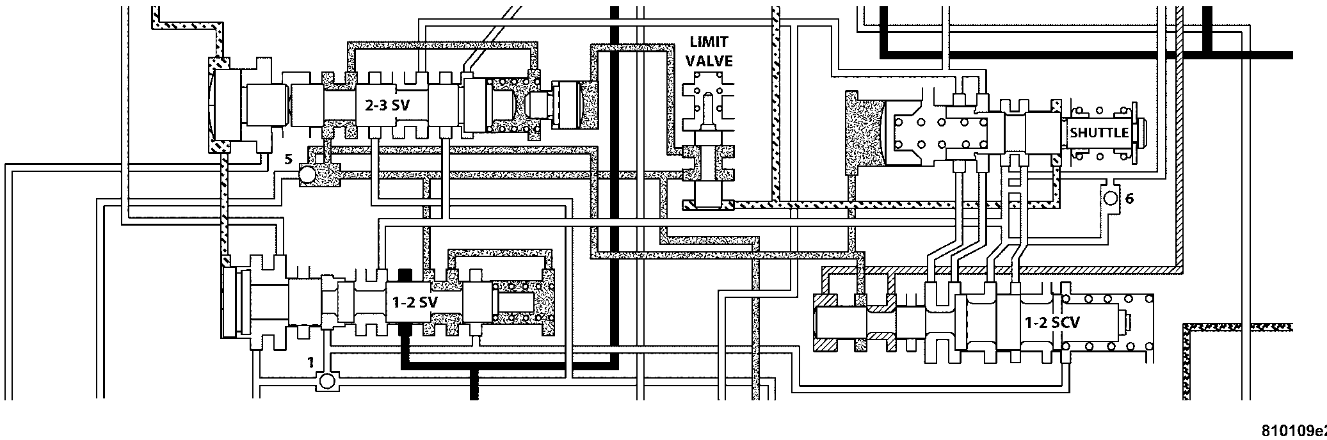

Fig. 260 Kickdown Limit Valve - Low Speeds

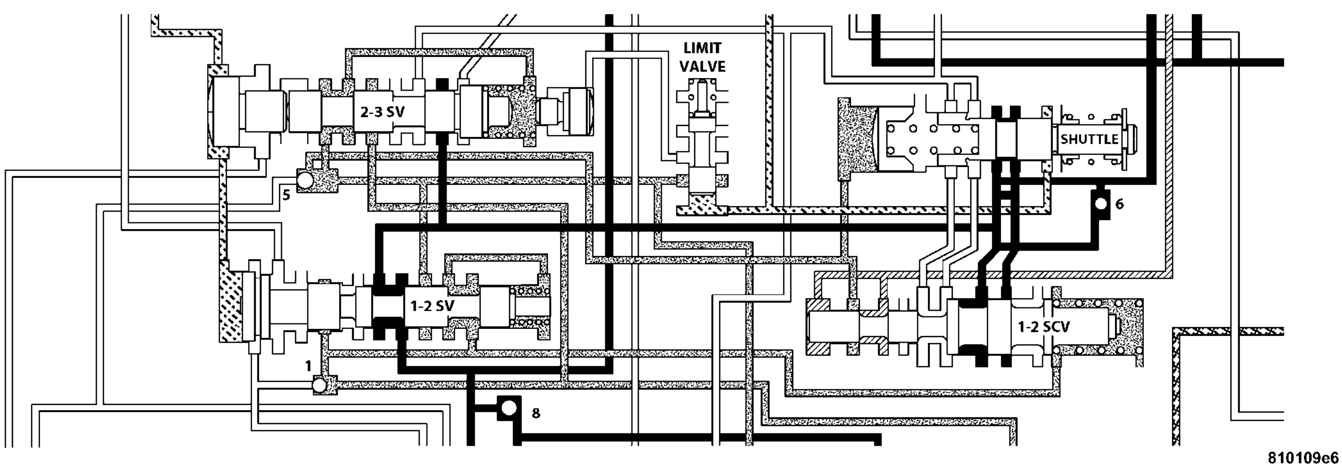

Fig. 261 Kickdown Limit Valve - High Speeds

VALVE BODY (Continued)

1-2 SHIFT VALVE

The 1-2 shift valve assembly (Fig. 262), or mechanism, consists of: the 1-2 shift valve, governor plug, and a spring on the end of the valve. After the manual valve has been placed into a forward gear range, line pressure is directed to the 1-2 shift valve. As the throttle is depressed, throttle pressure is applied to the right side of the 1-2 shift valve assembly. With throttle pressure applied to the right side of the valve, there is now both spring pressure and throttle pressure acting on the valve, holding it against the governor plug. As the vehicle begins to move and build speed, governor pressure is created and is applied to the left of the valve at the governor plug.

When governor pressure builds to a point where it can overcome the combined force of the spring and throttle pressure on the other side of the valve, the valve will begin to move over to the right. As the valve moves to the right, the middle land of the valve will close off the circuit supplying the throttle pressure to the right side of the valve. When the throttle pressure is closed off, the valve will move even farther to the right, allowing line pressure to enter another circuit and energize the front servo, applying the front band (Fig. 263).

The governor plug serves a dual purpose:

• It allows the shift valves to move either left or right, allowing both upshifts and downshifts.

• When in a manual selection position, it will be hydraulically "blocked" into position so no upshift can occur.

The physical blocking of the upshift while in the manual "1" position is accomplished by the directing of line pressure between both lands of the governor plug. The line pressure reacts against the larger land of the plug, pushing the plug back against the end plate overcoming governor pressure. With the combination of the line pressure and spring pressure, the valve cannot move, preventing any upshift.

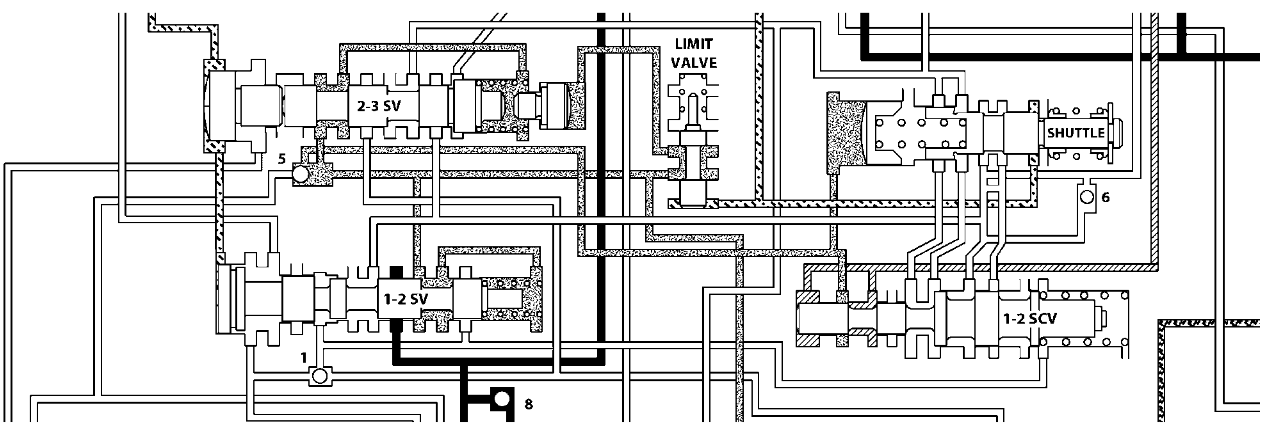

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Fig. 262 1-2 Shift Valve - Before Shift

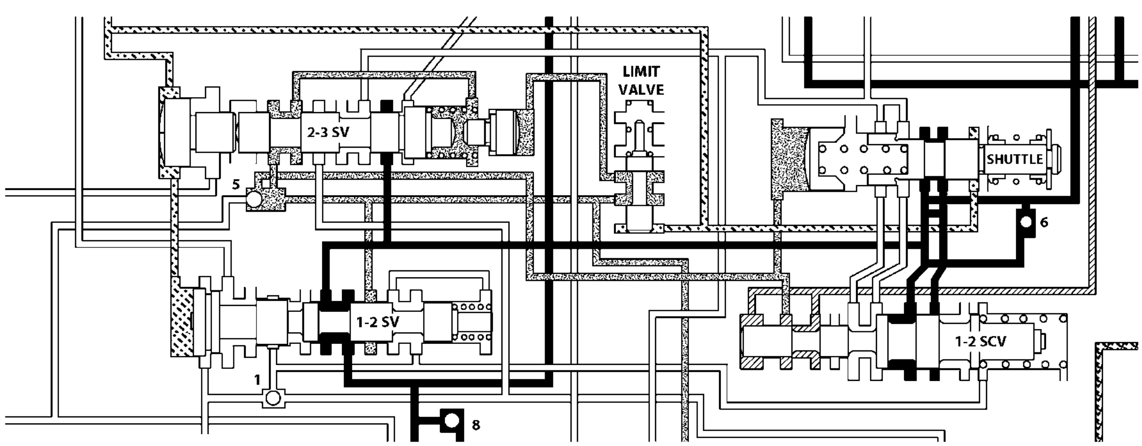

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Fig. 263 1-2 Shift Valve - After Shift

VALVE BODY (Continued)

1-2 SHIFT CONTROL VALVE

It contains a valve with four lands and a spring. It is used as both a "relay" and "balanced" valve.

The valve has two specific operations (Fig. 264):

- Aid in quality of the 1-2 upshift.
- Aid in the quality and timing of the 3-2 kickdown ranges.

When the manual valve is set to the DRIVE position and the transmission is in the first or second gear range, 1-2 shift control or "modulated throttle pressure" is supplied to the middle of the accumulator piston by the 1-2 shift control valve. During the 1-2 upshift, this pressure is used to control the kickdown servo apply pressure that is needed to apply the kickdown and accumulator pistons. Thus, the 1-2 shift point is "cushioned" and the quality is improved. During a WOT kickdown, kickdown pressure is applied between the kickdown valve and the 1-2 shift control valve. This additional pressure is directed to the 1-2 shift control's spring cavity, adding to the spring load on the valve. The result of this increased "modulated" throttle pressure is a firmer WOT upshift.

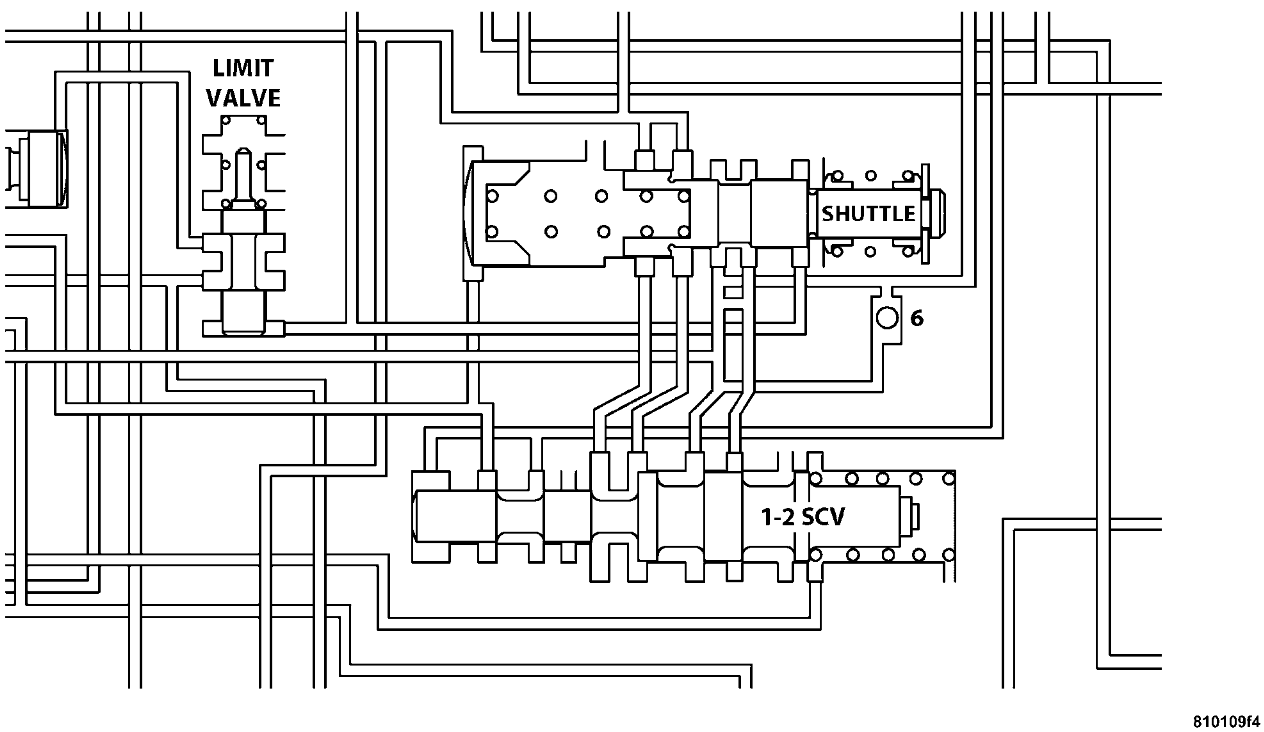

Fig. 264 1-2 Shift Control Valve

VALVE BODY (Continued)

2-3 SHIFT VALVE

The 2-3 shift valve mechanism (Fig. 265) consists of the 2-3 shift valve, governor plug and spring, and a throttle plug. After the 1-2 shift valve has completed its operation and applied the front band, line pressure is directed to the 2-3 shift valve through the connecting passages from the 1-2 shift valve. The line pressure will then dead–end at land #2 until the 2-3 valve is ready to make its shift. Now that the vehicle is in motion and under acceleration, there is throttle pressure being applied to the spring side of the valve and between lands #3 and #4.

As vehicle speed increases, governor pressure increases proportionately, until it becomes great enough to overcome the combined throttle and spring pressure on the right side of the valve. Since the throttle pressure end of the 2-3 shift valve is larger in diameter than the 1-2 shift valve, the 2-3 shift will always happen at a greater speed than the 1-2 shift. When this happens, the governor plug is forced against the shift valve moving it to the right. The shift valve causes land #4 to close the passage supplying throttle pressure to the 2-3 shift valve. Without throttle pressure present in the circuit now, the governor plug will push the valve over far enough to bottom the valve in its bore. This allows land #2 to direct line pressure to the front clutch.

After the shift (Fig. 266), line pressure is directed to the release side of the kickdown servo. This releases the front band and applies the front clutch, shifting into third gear or direct drive. The rear clutch remains applied, as it has been in the other gears. During a manual "1" or manual "2" gear selection, line pressure is sent between the two lands of the 2-3 governor plug. This line pressure at the governor plug locks the shift valve into the second gear position, preventing an upshift into direct drive. The theory for the blocking of the valve is the same as that of the 1-2 shift valve.

If the manual "2" or manual "1" gear position is selected from the drive position, the PCM will control the timing of the downshift by targeting for a high governor pressure. When a safe vehicle speed is reached, the PCM will switch to its normal control governor curve and the downshift will occur.

3-4 SHIFT VALVE

The PCM energizes the overdrive solenoid during the 3-4 upshift (Fig. 267). This causes the solenoid check ball to close the vent port allowing line pressure from the 2-3 shift valve to act directly on the 3-4 upshift valve. Line pressure on the 3-4 shift valve overcomes valve spring pressure moving the valve to the upshift position (Fig. 268). This action exposes the feed passages to the 3-4 timing valve, 3-4 quick fill valve, 3-4 accumulator, and ultimately to the overdrive piston.

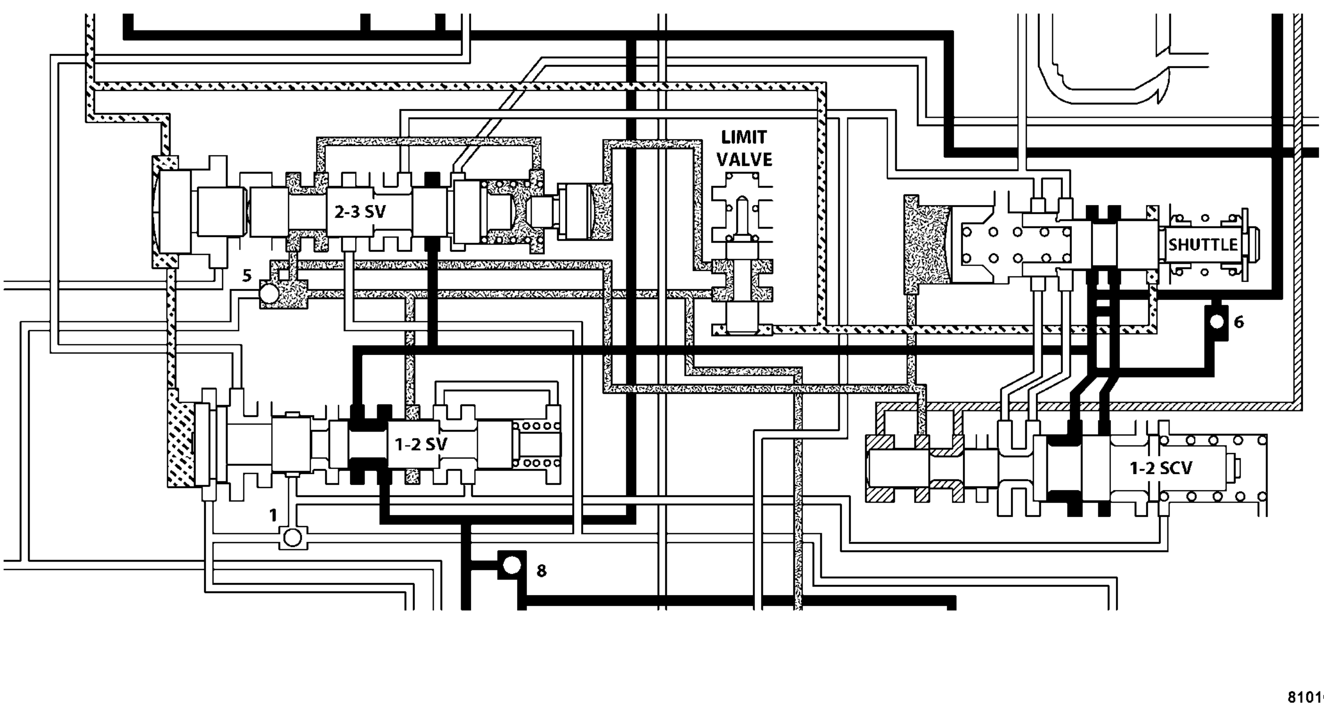

Fig. 265 2-3 Shift Valve - Before Shift

VALVE BODY (Continued)

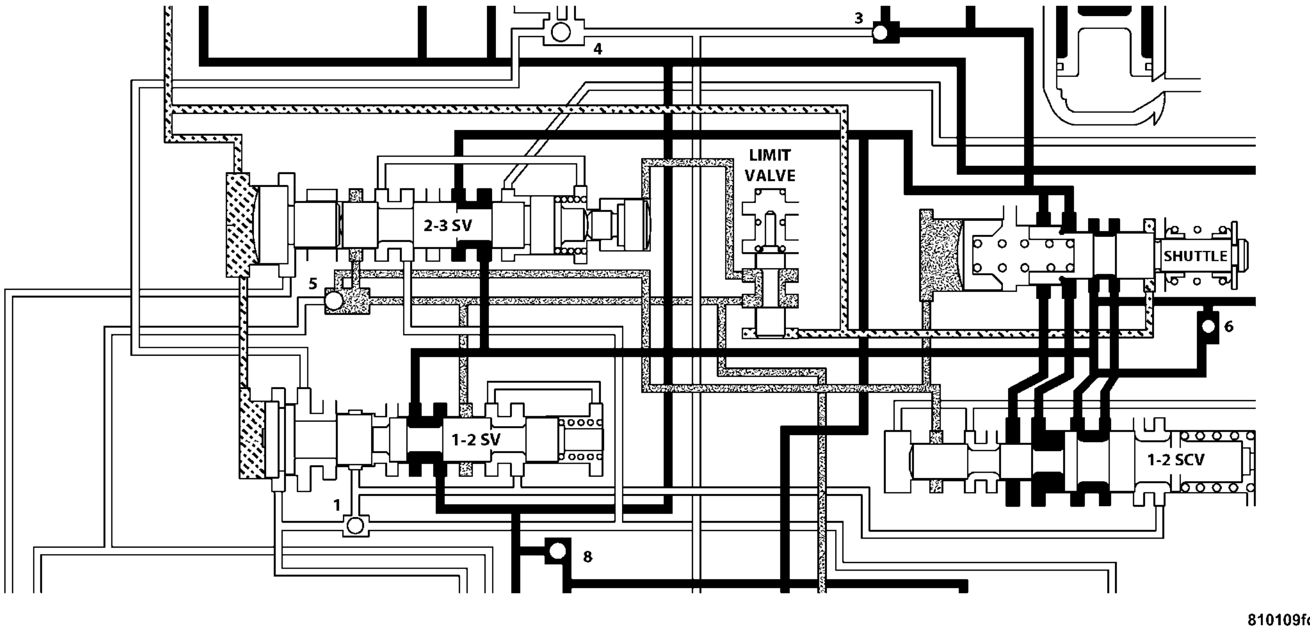

Fig. 266 2-3 Shift Valve - After Shift

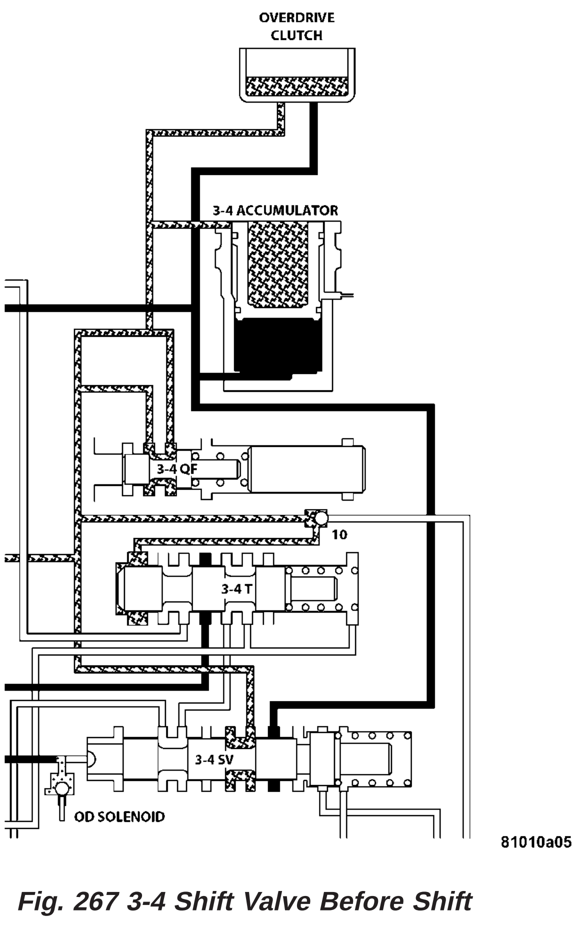

Fig. 267 3-4 Shift Valve Before Shift

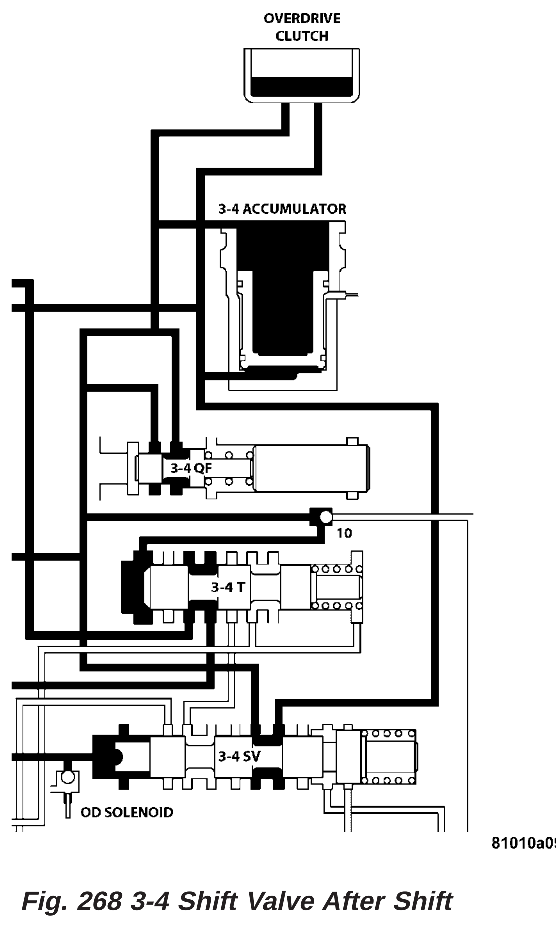

Fig. 268 3-4 Shift Valve After Shift

3-4 TIMING VALVE

The 3-4 timing valve is moved by line pressure coming through the 3-4 shift valve (Fig. 268) or the converter clutch valve. After the shift, the timing valve holds the 2-3 shift valve in an upshift position. The purpose is to prevent the 2-3 valve from downshifting while either the overdrive clutch or converter clutch is applied (Fig. 267).

VALVE BODY (Continued)

3-4 QUICK FILL VALVE

The 3-4 quick fill valve provides faster engagement of the overdrive clutch during 3-4 upshifts. The valve temporarily bypasses the clutch piston feed orifice at the start of a 3-4 upshift (Fig. 267). This exposes a larger passage into the piston retainer resulting in a much faster clutch fill and apply sequence. The quick fill valve does not bypass the regular clutch feed orifice throughout the 3-4 upshift. Instead, once a predetermined pressure develops within the clutch, the valve closes the bypass (Fig. 268). Clutch fill is then completed through the regular feed orifice.

THROTTLE VALVE

In all gear positions the throttle valve (Fig. 269) is being supplied with line pressure. The throttle valve meters and reduces the line pressure that now becomes throttle pressure. The throttle valve is moved by a spring and the kickdown valve, which is mechanically connected to the throttle. The larger the throttle opening, the higher the throttle pressure (to a maximum of line pressure). The smaller the throttle opening, the lower the throttle pressure (to a minimum of zero at idle). As engine speed increases, the increase in pump speed increases pump output. The increase in pressure and volume must be regulated to maintain the balance within the transmission. To do this, throttle pressure is routed to the reaction area on the right side of the throttle pressure plug (in the regulator valve).

The higher engine speed and line pressure would open the vent too far and reduce line pressure too much. Throttle pressure, which increases with engine speed (throttle opening), is used to oppose the movement of the pressure valve to help control the metering passage at the vent. The throttle pressure is combined with spring pressure to reduce the force of the throttle pressure plug on the pressure valve. The larger spring at the right closes the regulator valve passage and maintains or increases line pressure. The increased line pressure works against the reaction area of the line pressure plug and the reaction area left of land #3 simultaneously moves the regulator valve train to the right and controls the metering passage.

The kickdown valve, along with the throttle valve, serve to delay upshifts until the correct vehicle speed has been reached. It also controls downshifts upon driver demand, or increased engine load. If these valves were not in place, the shift points would be at the same speed for all throttle positions. The kickdown valve is actuated by a cam connected to the throttle. This is accomplished through either a linkage or a cable. The cam forces the kickdown valve toward the throttle valve compressing the spring between them and moving the throttle valve. As the throttle valve land starts to uncover its port, line pressure is “metered” out into the circuits and viewed as throttle pressure. This increased throttle pressure is metered out into the circuits it is applied to: the 1-2 and 2-3 shift valves. When the throttle pressure is high enough, a 3-2 downshift will occur. If the vehicle speed is low enough, a 2-1 downshift will occur.

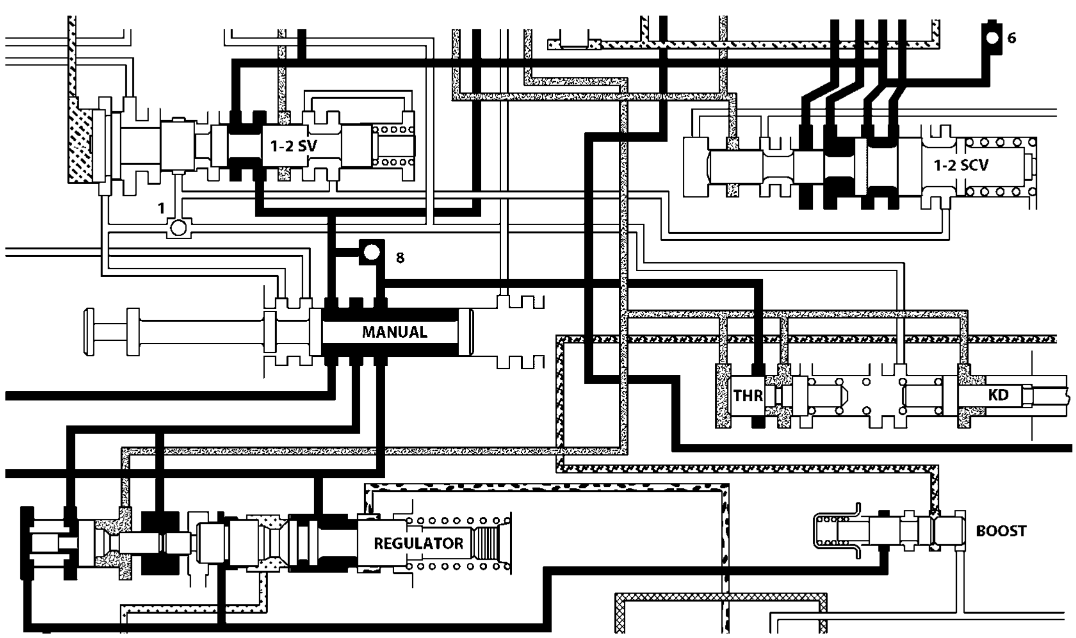

Fig. 269 Throttle Valve

VALVE BODY (Continued)

SWITCH VALVE

When the transmission is in Drive Second before the TCC application occurs (Fig. 270), the pressure regulator valve is supplying torque converter pressure to the switch valve. The switch valve directs this pressure through the transmission input shaft, into the converter, through the converter, back out between the input shaft and the reaction shaft, and back up to the switch valve. From the switch valve, the fluid pressure is directed to the transmission cooler, and lubrication pressure returns from the cooler to lubricate different portions of the transmission.

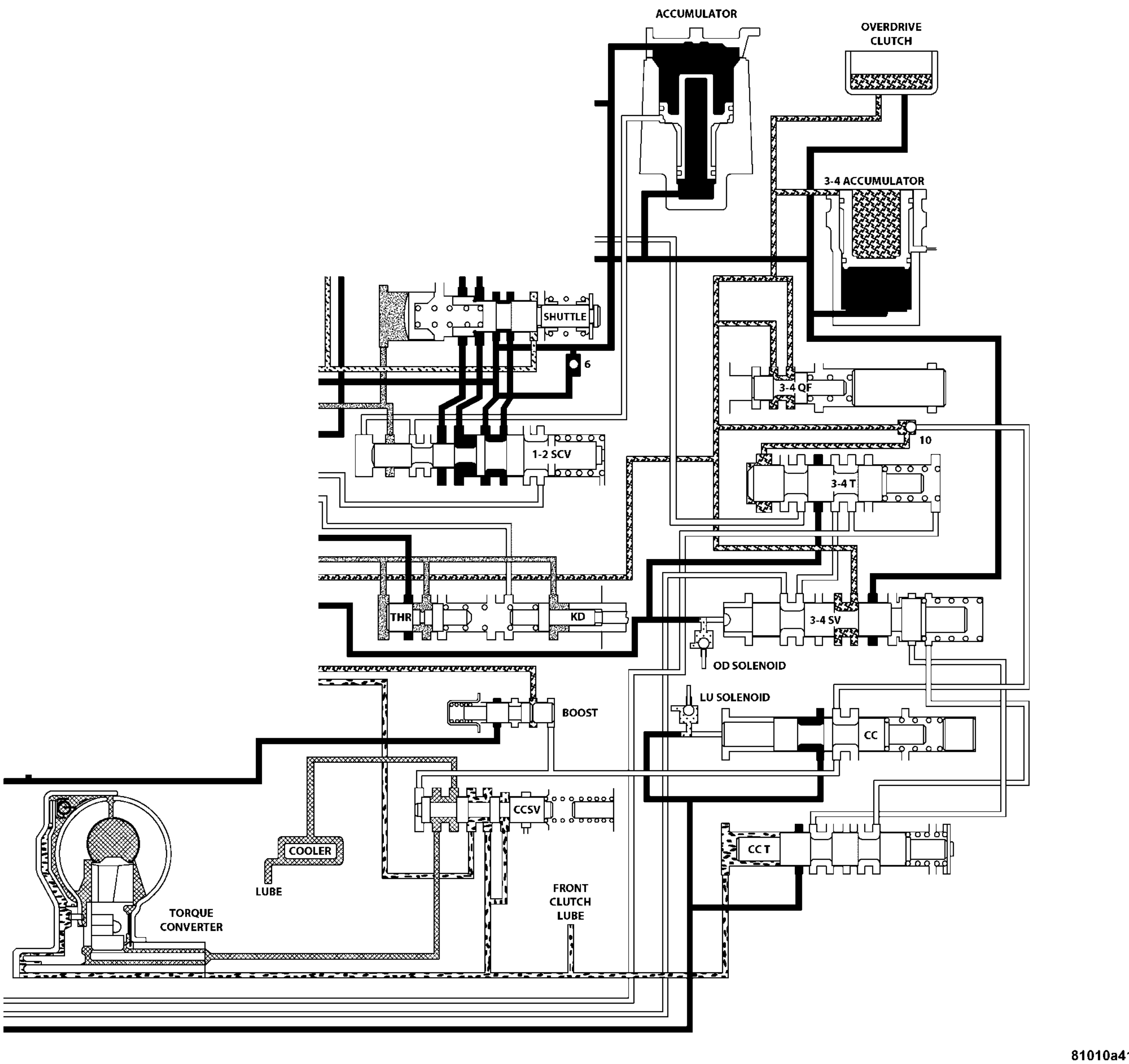

Fig. 270 Switch Valve - Torque Converter Unlocked

VALVE BODY (Continued)

Once the TCC control valve has moved to the right (Fig. 271), line pressure is directed to the tip of the switch valve, forcing the valve to the right. The switch valve now vents oil from the front of the piston in the torque converter, and supplies line pressure to the (rear) apply side of the torque converter piston. This pressure differential causes the piston to apply against the friction material, cutting off any further flow of line pressure oil. After the switch valve is shuttled right allowing line pressure to engage the TCC, torque converter pressure is directed past the switch valve into the transmission cooler and lubrication circuits.

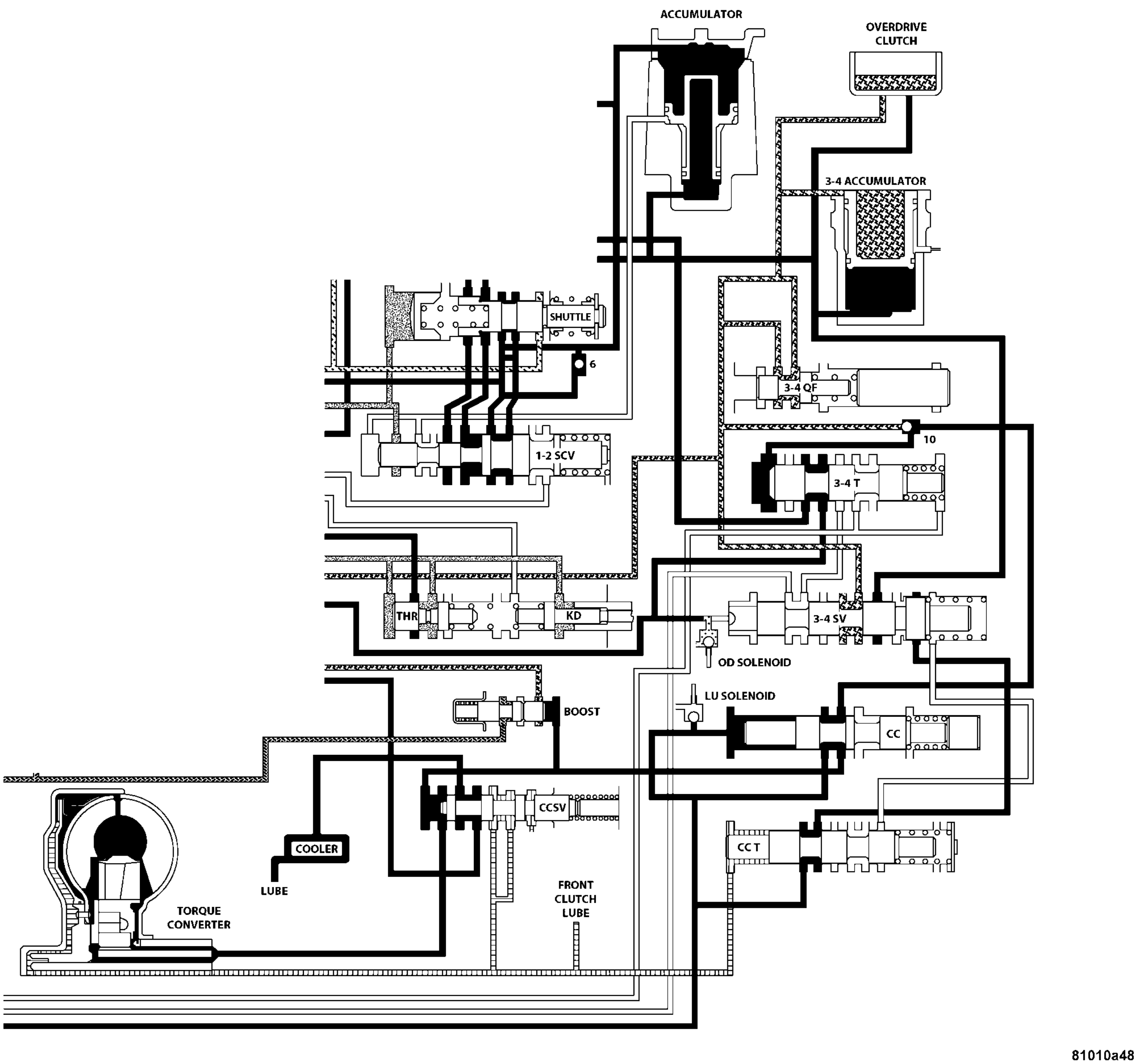

Fig. 271 Switch Valve - Torque Converter Locked

VALVE BODY (Continued)

MANUAL VALVE

The manual valve (Fig. 272) is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the side of the valve body. The valve is connected mechanically by either a cable or linkage to the gear-shift mechanism. The valve is held in each of its positions by a spring-loaded roller or ball that engages the “roostercomb” of the manual valve lever.

CONVERTER CLUTCH LOCK-UP VALVE

The torque converter clutch (TCC) lock-up valve controls the back (ON) side of the torque converter clutch. When the PCM energizes the TCC solenoid to engage the converter clutch piston, pressure is applied to the TCC lock-up valve which moves to the right and applies pressure to the torque converter clutch.

CONVERTER CLUTCH LOCK-UP TIMING VALVE

The torque converter clutch (TCC) lock-up timing valve is there to block any 4-3 downshift until the TCC is completely unlocked and the clutch is disengaged.

SHUTTLE VALVE

The assembly is contained in a bore in the valve body above the shift valves. When the manual valve is positioned in the Drive range, throttle pressure acts on the throttle plug of the shuttle valve (Fig. 264) to move it against a spring, increasing the spring force on the shuttle valve. During a part or full throttle 1-2 upshift, the throttle plug is bottomed by throttle pressure, holding the shuttle valve to the right against governor pressure, and opening a by–pass circuit. The shuttle valve controls the quality of the kickdown shift by restricting the rate of fluid discharge from the front clutch and servo release circuits. During a 3-2 kickdown, fluid discharges through the shuttle by-pass circuit. When the shuttle valve closes the by-pass circuit, fluid discharge is restricted and controlled for the application of the front band. During a 2-3 “lift foot” upshift, the shuttle valve by-passes the restriction to allow full fluid flow through the by-pass groove for a faster release of the band.

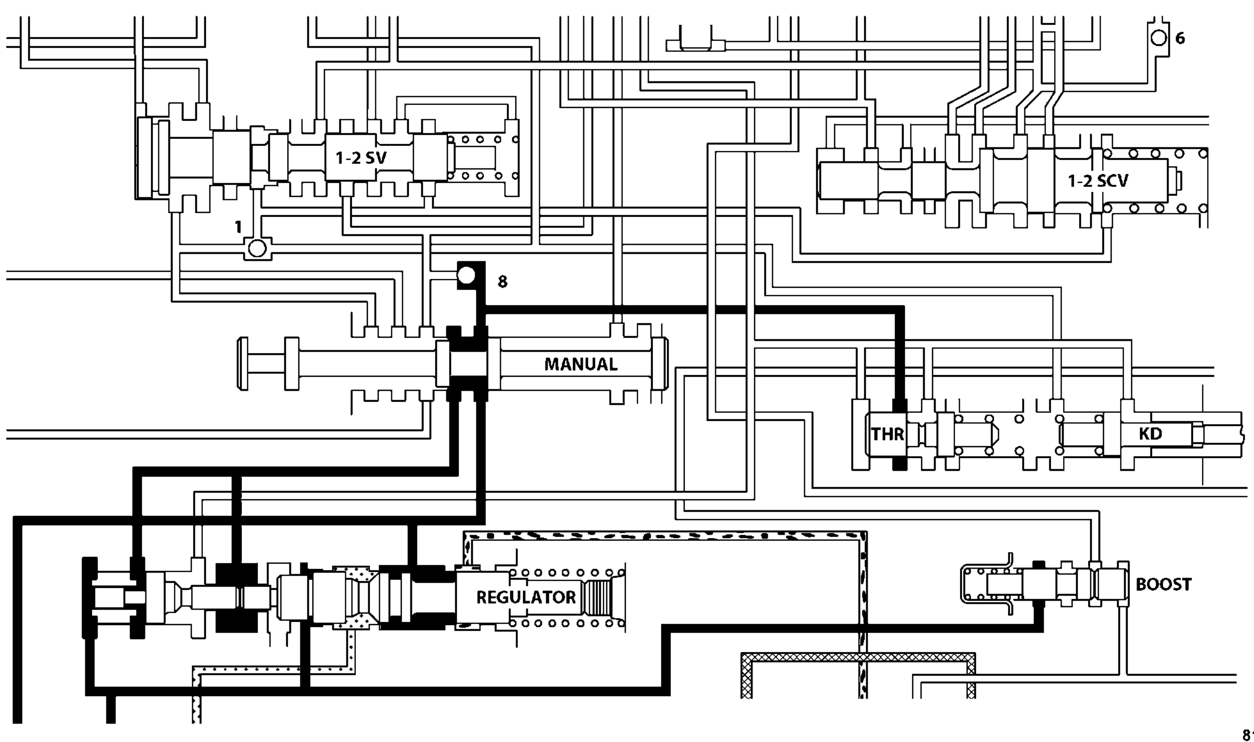

Fig. 272 Manual Valve

VALVE BODY (Continued)

BOOST VALVE

The boost valve (Fig. 273) provides increased fluid apply pressure to the overdrive clutch during 3-4 upshifts (Fig. 274), and when accelerating in fourth gear. The boost valve also serves to increase line pressure during torque converter lock-up.

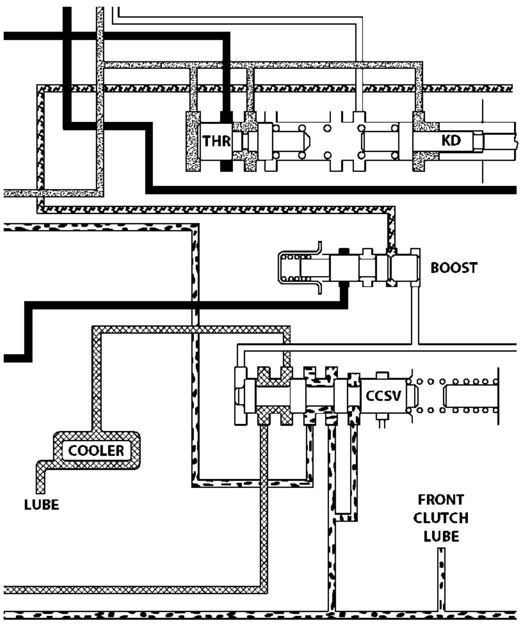

Fig. 273 Boost Valve Before Lock-up

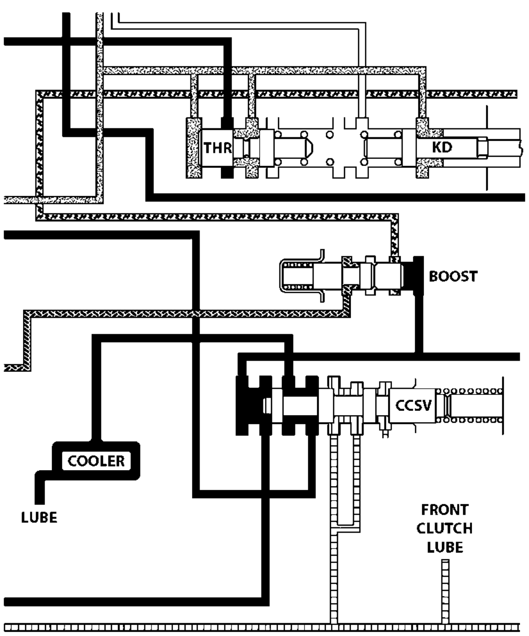

Fig. 274 Boost Valve After Lock-up

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components.

The only replaceable valve body components are:

- Manual lever.
- Manual lever washer, seal, E-clip, and shaft seal.
- Manual lever detent ball.
- Throttle lever.
- Fluid filter.
- Pressure adjusting screw bracket.
- Governor pressure solenoid.
- Governor pressure sensor (includes transmission temperature thermistor).
- Converter clutch/overdrive solenoid assembly and harness.
- Governor housing gasket.
- Solenoid case connector O-rings.

(1) Shift transmission into NEUTRAL.

(2) Raise vehicle.

(3) Remove gearshift and throttle levers from shaft of valve body manual lever.

(4) Disconnect wires at solenoid case connector (Fig. 275).

(5) Remove the transmission range sensor.

(6) Position drain pan under transmission oil pan.

(7) Remove transmission oil pan and gasket.

(8) Remove fluid filter from valve body.

(9) Remove bolts attaching valve body to transmission case.

(10) Lower valve body enough to remove accumulator piston and springs.

(11) Work manual lever shaft and electrical connector out of transmission case.

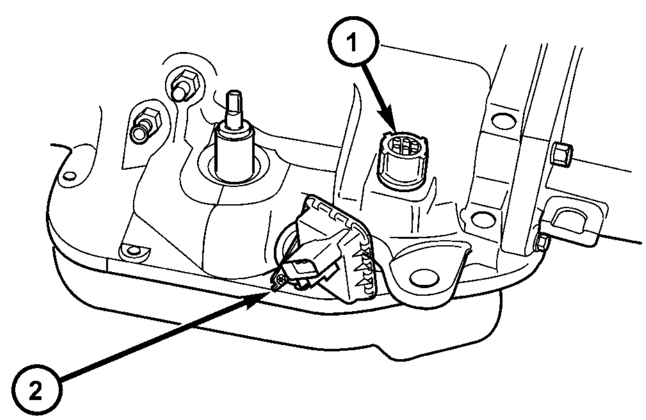

Fig. 275 Transmission Case Connector

1 - SOLENOID CASE CONNECTOR
2 - TRANSMISSION RANGE SENSOR

VALVE BODY (Continued)

(12) Lower valve body, rotate valve body away from case, pull park rod out of sprag, and remove valve body (Fig. 276).

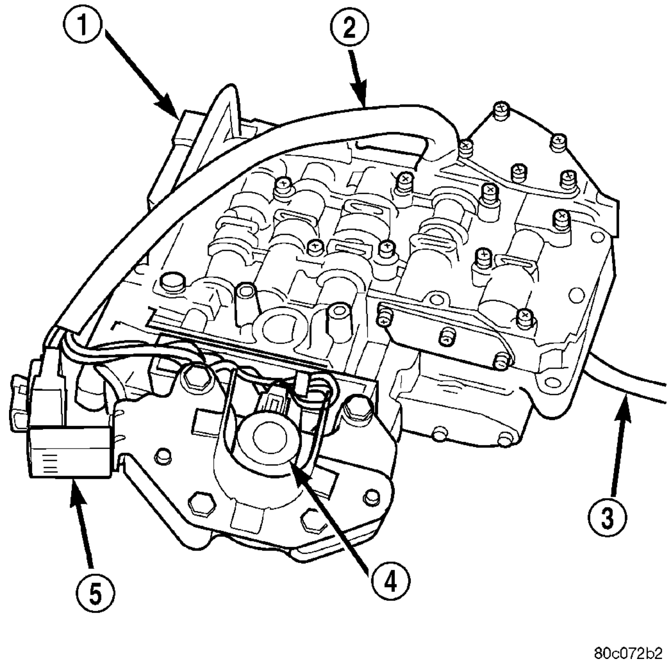

Fig. 276 Valve Body

1 - VALVE BODY
2 - WIRE HARNESS
3 - PARK ROD
4 - GOVERNOR PRESSURE SOLENOID
5 - GOVERNOR PRESSURE SENSOR

DISASSEMBLY

CAUTION: Do not clamp any valve body component in a vise. This practice can damage the component resulting in unsatisfactory operation after assembly and installation. Do not use pliers to remove any of the valves, plugs or springs and do not force any of the components out or into place. The valves and valve body housings will be damaged if force is used. Tag or mark the valve body springs for reference as they are removed. Do not allow them to become intermixed.

(1) Disconnect wires from governor pressure sensor and solenoid.

(2) Remove screws attaching governor body and retainer plate to transfer plate.

(3) Remove retainer plate, governor body and gasket from transfer plate.

(4) Remove governor pressure sensor from governor body.

(5) Remove governor pressure solenoid by pulling it straight out of bore in governor body. Remove and discard solenoid O-rings if worn, cut, or torn.

(6) Remove small shoulder bolt that secures solenoid harness case connector to 3-4 accumulator housing (Fig. 277). Retain shoulder bolt. Either tape it to harness or thread it back into accumulator housing after connector removal.

(7) Unhook overdrive/converter solenoid harness from 3-4 accumulator cover plate (Fig. 278).

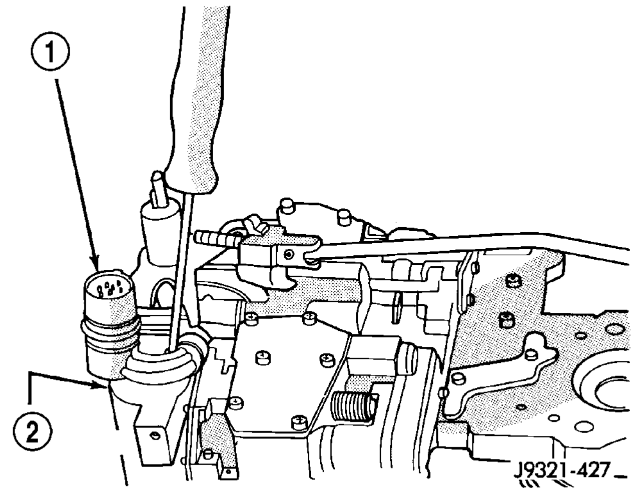

Fig. 277 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

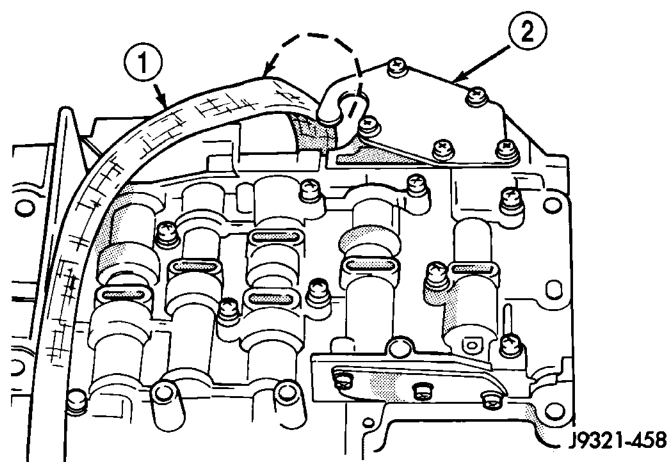

Fig. 278 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

VALVE BODY (Continued)

(8) Turn valve body over and remove screws that attach overdrive/converter solenoid assembly to valve body (Fig. 279).

(9) Remove solenoid and harness assembly from valve body (Fig. 280).

(10) Remove boost valve cover (Fig. 281).

(11) Remove boost valve retainer, valve spring and boost valve (Fig. 282).

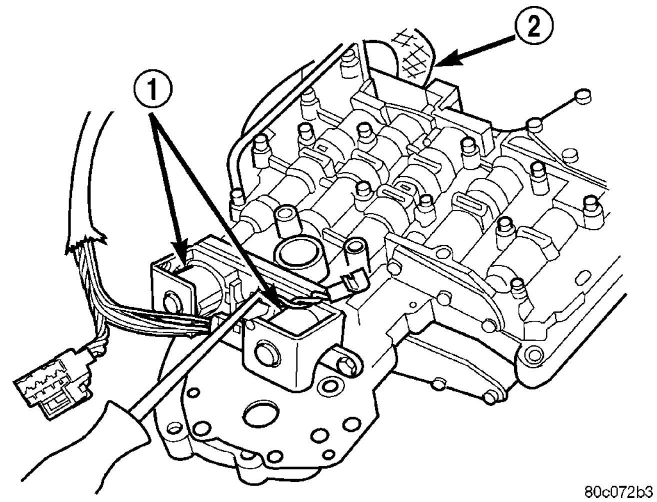

Fig. 279 Solenoid Assembly Screws

1 - OVERDRIVE/CONVERTER CLUTCH SOLENOID ASSEMBLY
2 - HARNESS

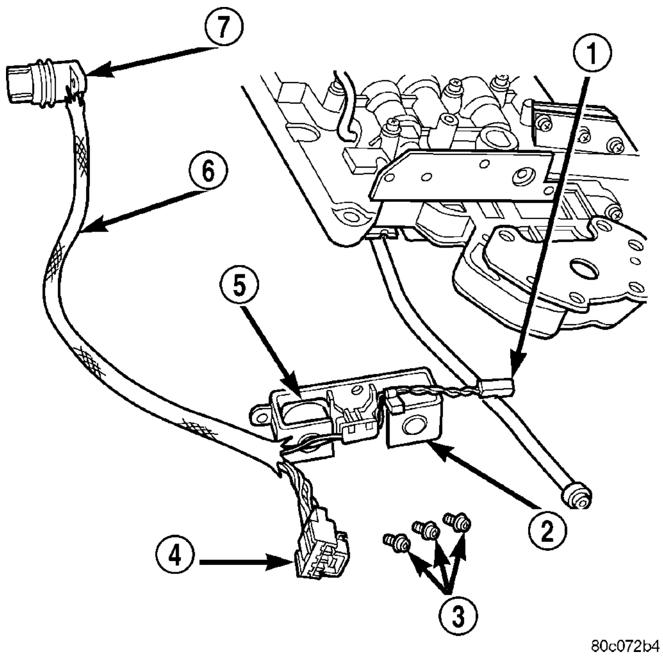

Fig. 280 Solenoid Assembly

1 - GOVERNOR SOLENOID WIRES
2 - CONVERTER CLUTCH SOLENOID
3 - SOLENOID SCREWS
4 - GOVERNOR SENSOR WIRES
5 - OVERDRIVE SOLENOID
6 - HARNESS
7 - CASE CONNECTOR

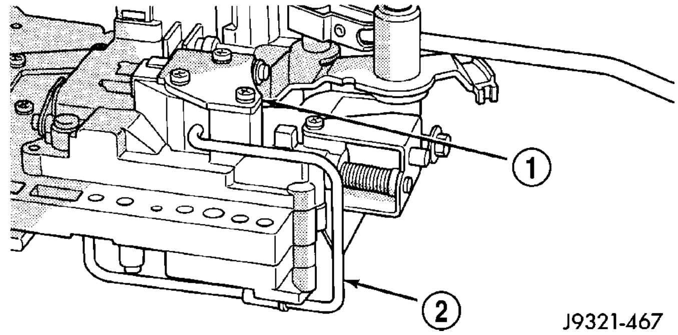

Fig. 281 Boost Valve Cover Location

1 - BOOST VALVE HOUSING AND COVER
2 - BOOST VALVE TUBE

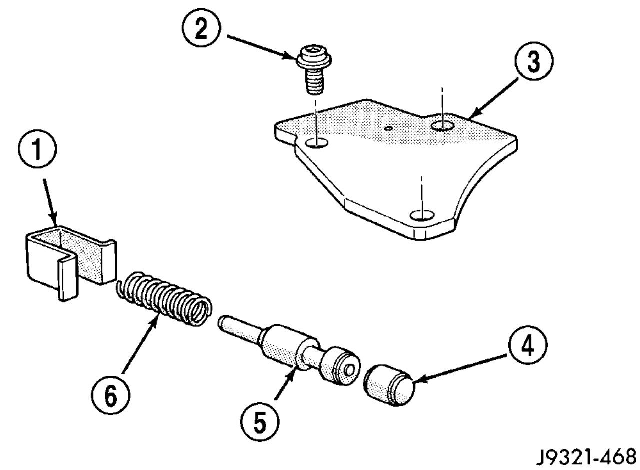

Fig. 282 Boost Valve Components

1 - SPRING AND VALVE RETAINER
2 - COVER SCREWS
3 - BOOST VALVE COVER
4 - BOOST VALVE PLUG
5 - BOOST VALVE
6 - BOOST VALVE SPRING

(12) Secure detent ball and spring with Retainer Tool 6583 (Fig. 283).

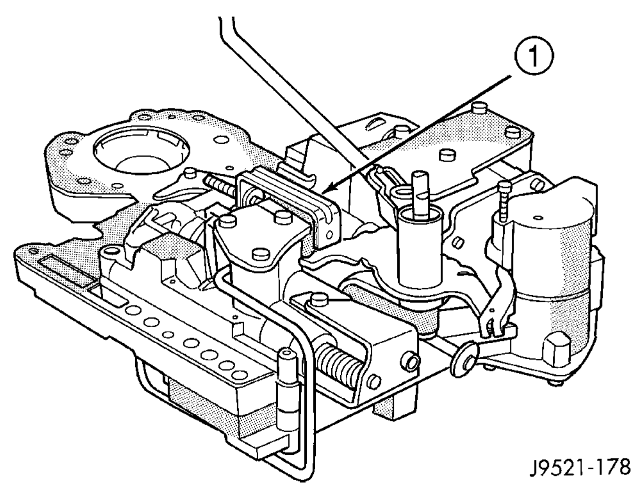

Fig. 283 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

VALVE BODY (Continued)

(13) Remove park rod E-clip and separate rod from manual lever (Fig. 284).

(14) Remove E-clip and washer that retains throttle lever shaft in manual lever (Fig. 285).

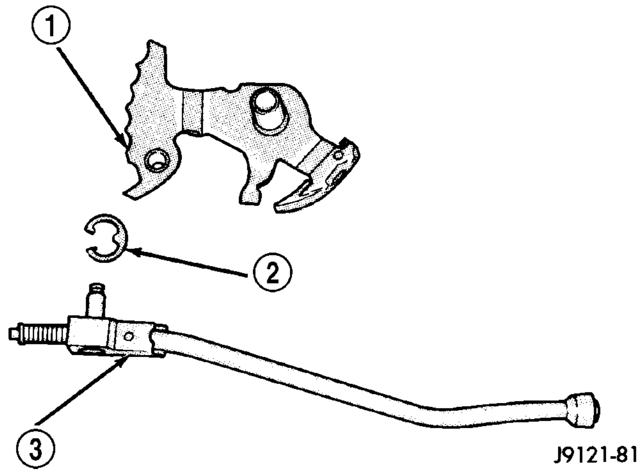

Fig. 284 Park Rod

1 - MANUAL LEVER
2 - E-CLIP
3 - PARK ROD

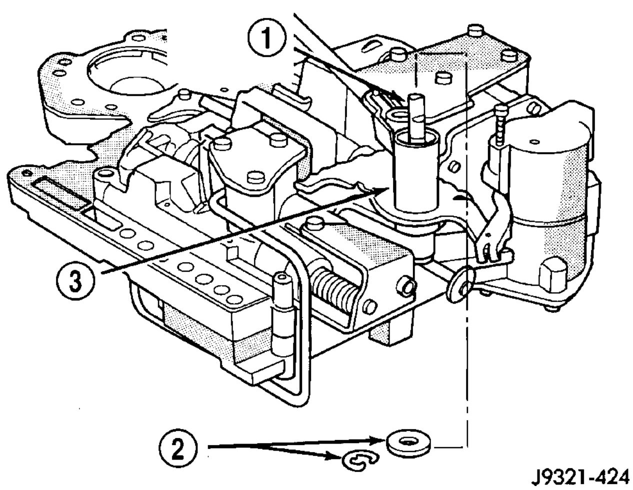

Fig. 285 Throttle Lever E-Clip And Washer

1 - THROTTLE LEVER SHAFT
2 - E-CLIP AND WASHER
3 - MANUAL SHAFT

(15) Remove manual lever and throttle lever (Fig. 286). Rotate and lift manual lever off valve body and throttle lever shaft. Then slide throttle lever out of valve body.

(16) Position pencil magnet next to detent housing to catch detent ball and spring. Then carefully remove Retainer Tool 6583 and remove detent ball and spring (Fig. 287).

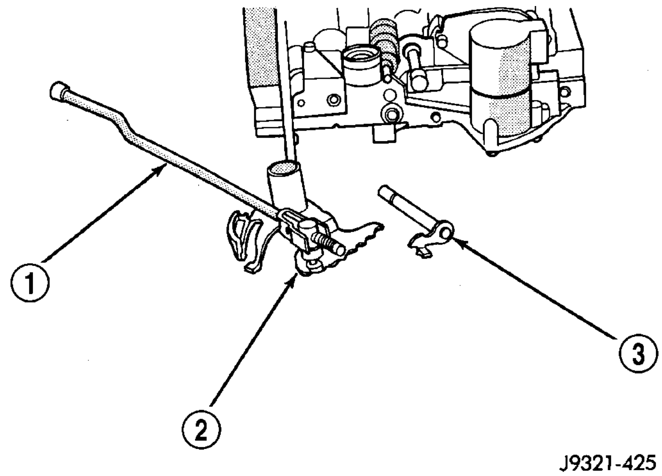

Fig. 286 Manual And Throttle Lever

1 - PARK ROD
2 - MANUAL LEVER ASSEMBLY
3 - THROTTLE LEVER

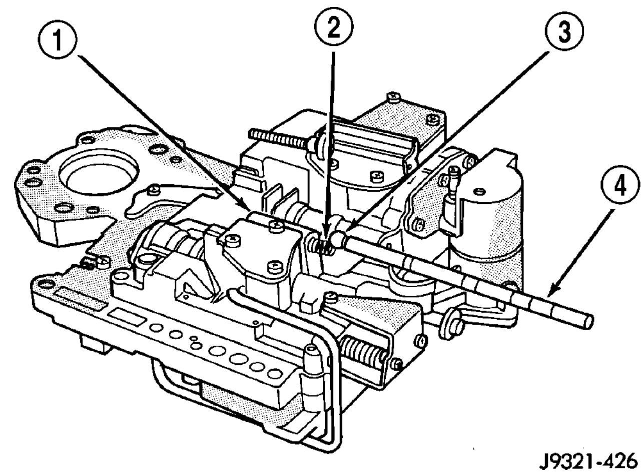

Fig. 287 Detent Ball And Spring

1 - DETENT HOUSING
2 - DETENT SPRING
3 - DETENT BALL
4 - PENCIL MAGNET

VALVE BODY (Continued)

(17) Remove screws attaching pressure adjusting screw bracket to valve body and transfer plate (Fig. 288). Hold bracket firmly against spring tension while removing last screw.

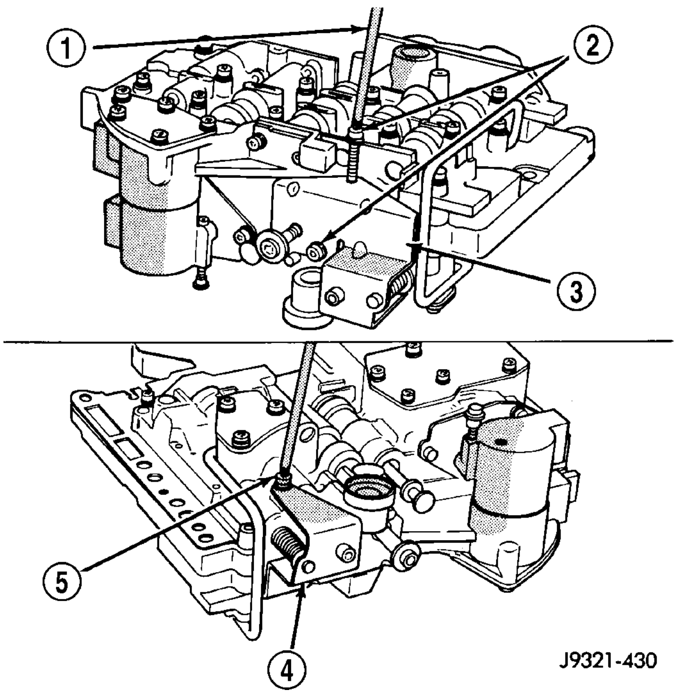

Fig. 288 Adjusting Screw Bracket Fastener

1 - T25 TORX™ BIT
2 - REMOVE THESE SCREWS FIRST
3 - BRACKET
4 - BRACKET
5 - REMOVE THIS SCREW LAST

(18) Remove adjusting screw bracket, line pressure adjusting screw, pressure regulator valve spring and switch valve spring (Fig. 289). Do not remove throttle pressure adjusting screw from bracket and do not disturb setting of either adjusting screw during removal.

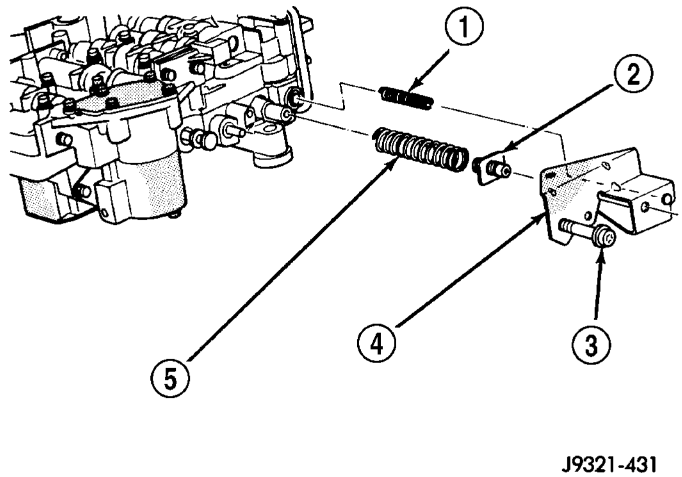

Fig. 289 Adjusting Screw Bracket

1 - SWITCH VALVE SPRING
2 - LINE PRESSURE SCREW
3 - THROTTLE PRESSURE ADJUSTING SCREW
4 - ADJUSTING SCREW BRACKET
5 - PRESSURE REGULATOR VALVE SPRING

(19) Turn upper housing over and remove switch valve, regulator valve and spring, and manual valve (Fig. 290).

(20) Remove kickdown detent, kickdown valve, and throttle valve and spring (Fig. 290).

(21) Loosen left-side 3-4 accumulator housing attaching screw about 2-3 threads. Then remove center and right-side housing attaching screws (Fig. 291).

(22) Carefully rotate 3-4 accumulator housing upward and remove 3-4 shift valve spring and converter clutch valve plug and spring (Fig. 292).

VALVE BODY (Continued)

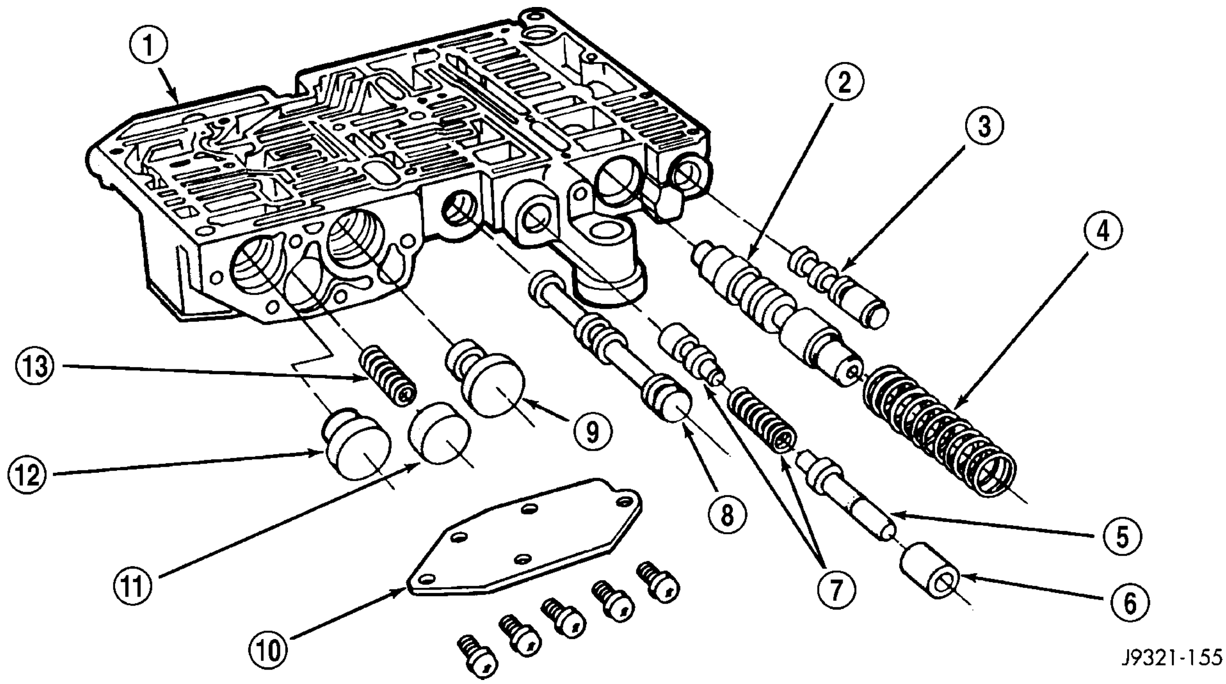

Fig. 290 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

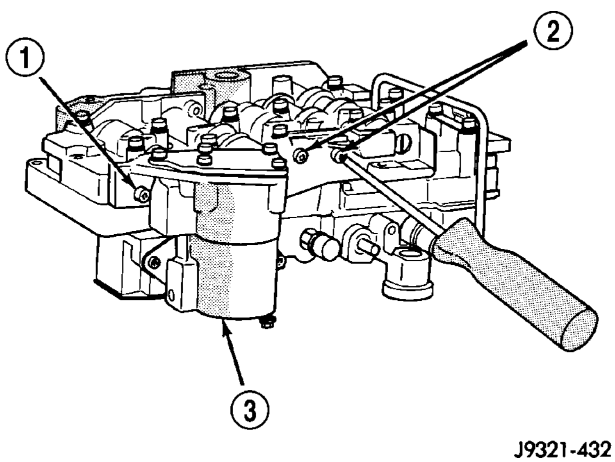

Fig. 291 Accumulator Housing Screw Locations

1 - LOOSEN THIS SCREW
2 - REMOVE THESE SCREWS
3 - 3-4 ACCUMULATOR HOUSING

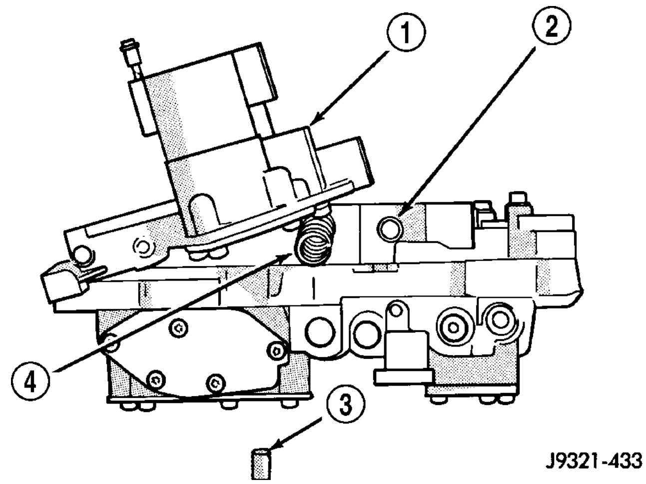

Fig. 292 3-4 Shift And Converter Clutch Valve Springs and Plug

1 - ACCUMULATOR HOUSING
2 - CONVERTER CLUTCH VALVE SPRING
3 - CLUTCH VALVE PLUG
4 - 3-4 SHIFT VALVE SPRING

VALVE BODY (Continued)

(23) Remove left-side screw and remove 3-4 accumulator housing from valve body (Fig. 293).

(24) Bend back tabs on boost valve tube brace (Fig. 294).

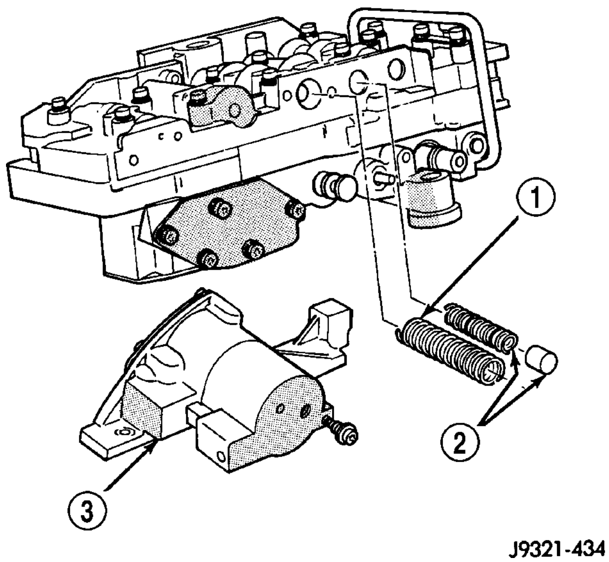

Fig. 293 Accumulator Housing, Valve Springs, and Plug

1 - 3-4 SHIFT VALVE SPRING
2 - CONVERTER CLUTCH VALVE SPRING AND PLUG
3 - 3-4 ACCUMULATOR HOUSING

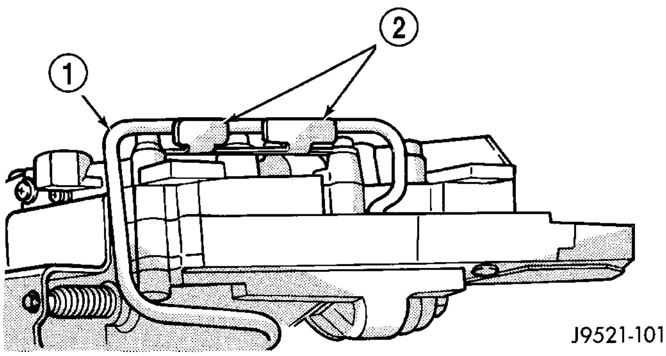

Fig. 294 Boost Valve Tube Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE (DOUBLE TAB)

(25) Remove boost valve connecting tube (Fig. 295). Disengage tube from upper housing port first. Then rock opposite end of tube back and forth to work it out of lower housing.

CAUTION: Do not use tools to loosen or pry the connecting tube out of the valve body housings. Loosen and remove the tube by hand only.

(26) Turn valve body over so lower housing is facing upward (Fig. 296). In this position, the two check balls in upper housing will remain in place and not fall out when lower housing and separator plate are removed.

(27) Remove screws attaching valve body lower housing to upper housing and transfer plate (Fig. 296). Note position of boost valve tube brace for assembly reference.

(28) Remove lower housing and overdrive separator plate from transfer plate (Fig. 296).

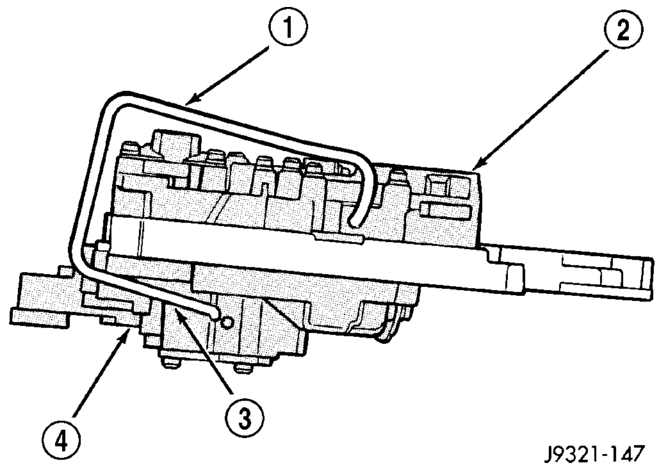

Fig. 295 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

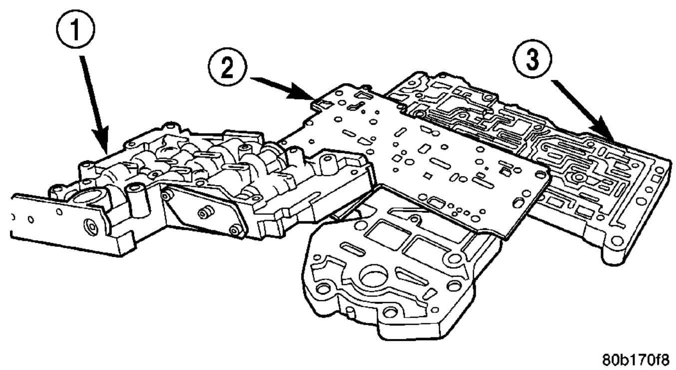

Fig. 296 Lower Housing

1 - LOWER HOUSING
2 - OVERDRIVE SEPARATOR PLATE
3 - TRANSFER PLATE AND UPPER HOUSING

VALVE BODY (Continued)

(29) Remove the Number 10 check ball from the transfer plate (Fig. 297). The check ball is approximately 4.8 mm (3/16 in.) in diameter.

(30) Remove transfer plate from upper housing (Fig. 298).

(31) Turn transfer plate over so upper housing separator plate is facing upward.

(32) Remove upper housing separator plate from transfer plate (Fig. 299). Note position of filter in separator plate for assembly reference.

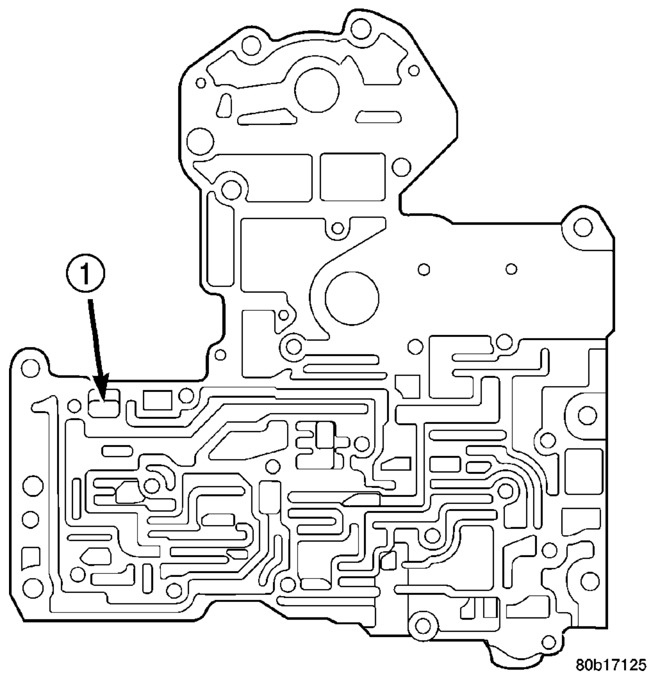

Fig. 297 Number 10 Check Ball

1 - NUMBER 10 CHECK BALL (3/16″)

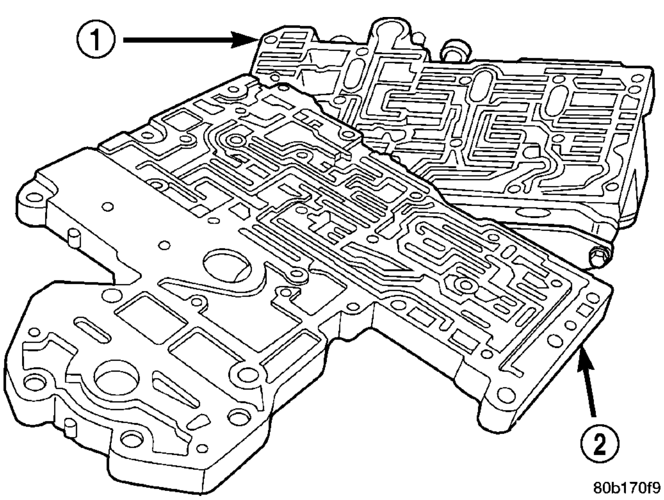

Fig. 298 Transfer Plate

1 - UPPER HOUSING
2 - TRANSFER PLATE

(33) Remove rear clutch and rear servo check balls from transfer plate. Note check ball location for assembly reference (Fig. 300).

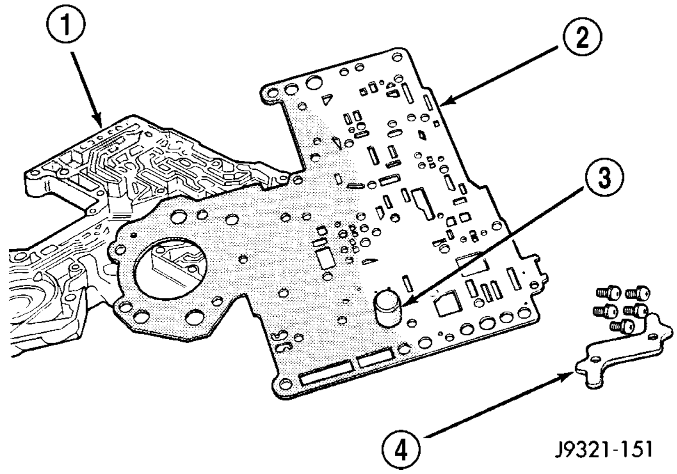

Fig. 299 Upper Housing Separator Plate

1 - TRANSFER PLATE
2 - UPPER HOUSING SEPARATOR PLATE
3 - FILTER SCREEN
4 - BRACE

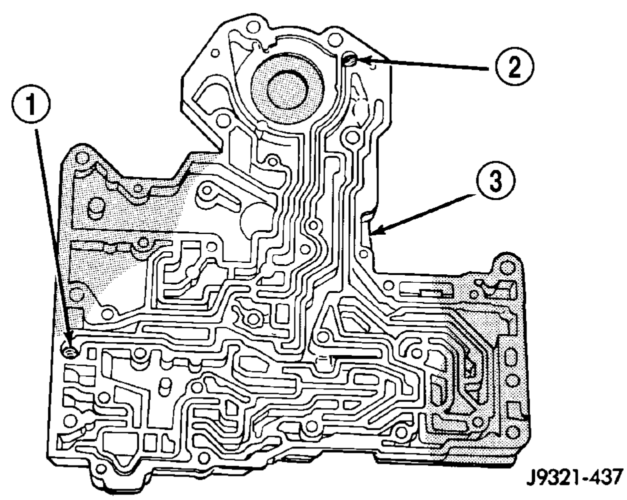

Fig. 300 Rear Clutch and Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

VALVE BODY (Continued)

VALVE BODY UPPER HOUSING

(1) Note location of check balls in valve body upper housing (Fig. 301). Then remove the one large diameter and the five smaller diameter check balls.

(2) Remove governor plug and shuttle valve covers (Fig. 303).

(3) Remove E-clip that secures shuttle valve secondary spring on valve stem (Fig. 302).

(4) Remove throttle plug, primary spring, shuttle valve, secondary spring, and spring guides (Fig. 303).

(5) Remove boost valve retainer, spring and valve if not previously removed.

(6) Remove throttle plug and 1-2 and 2-3 governor plugs (Fig. 290).

(7) Turn upper housing around and remove limit valve and shift valve covers (Fig. 304).

(8) Remove limit valve housing. Then remove retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing (Fig. 304).

(9) Remove 1-2 shift control valve and spring (Fig. 304).

(10) Remove 1-2 shift valve and spring (Fig. 304).

(11) Remove 2-3 shift valve and spring from valve body (Fig. 304).

(12) Remove pressure plug cover (Fig. 304).

(13) Remove line pressure sleeve, throttle pressure plug and spring (Fig. 304).

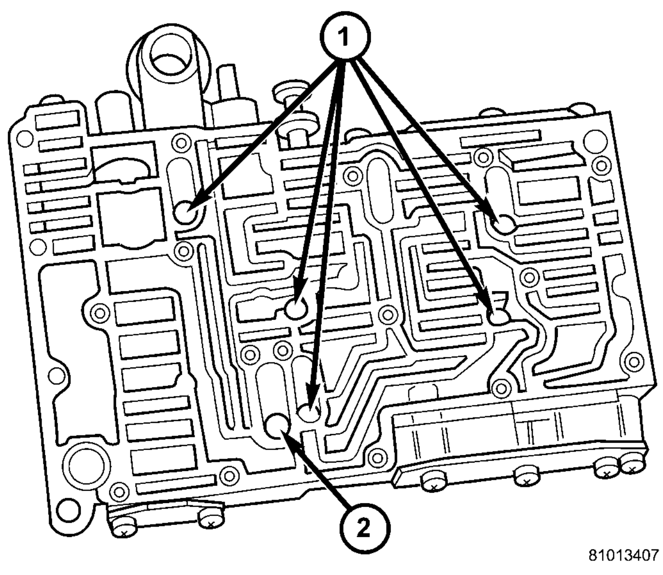

Fig. 301 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (5)
2 - LARGE DIAMETER CHECK BALL (1)

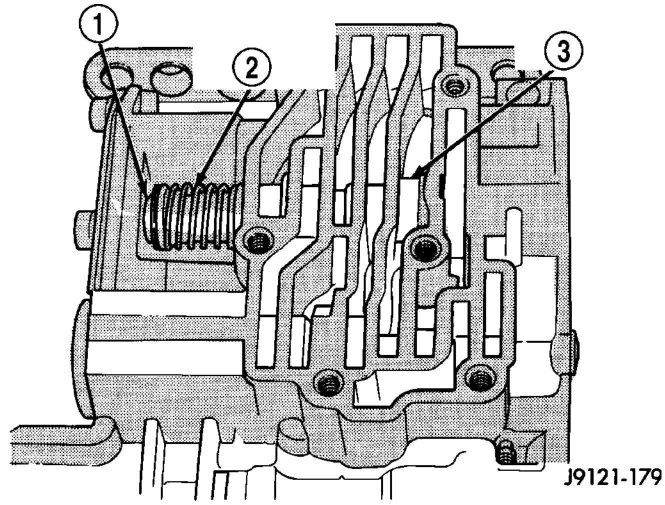

Fig. 302 Shuttle Valve E-Clip And Secondary Spring

1 - E-CLIP
2 - SECONDARY SPRING AND GUIDES
3 - SHUTTLE VALVE

VALVE BODY (Continued)

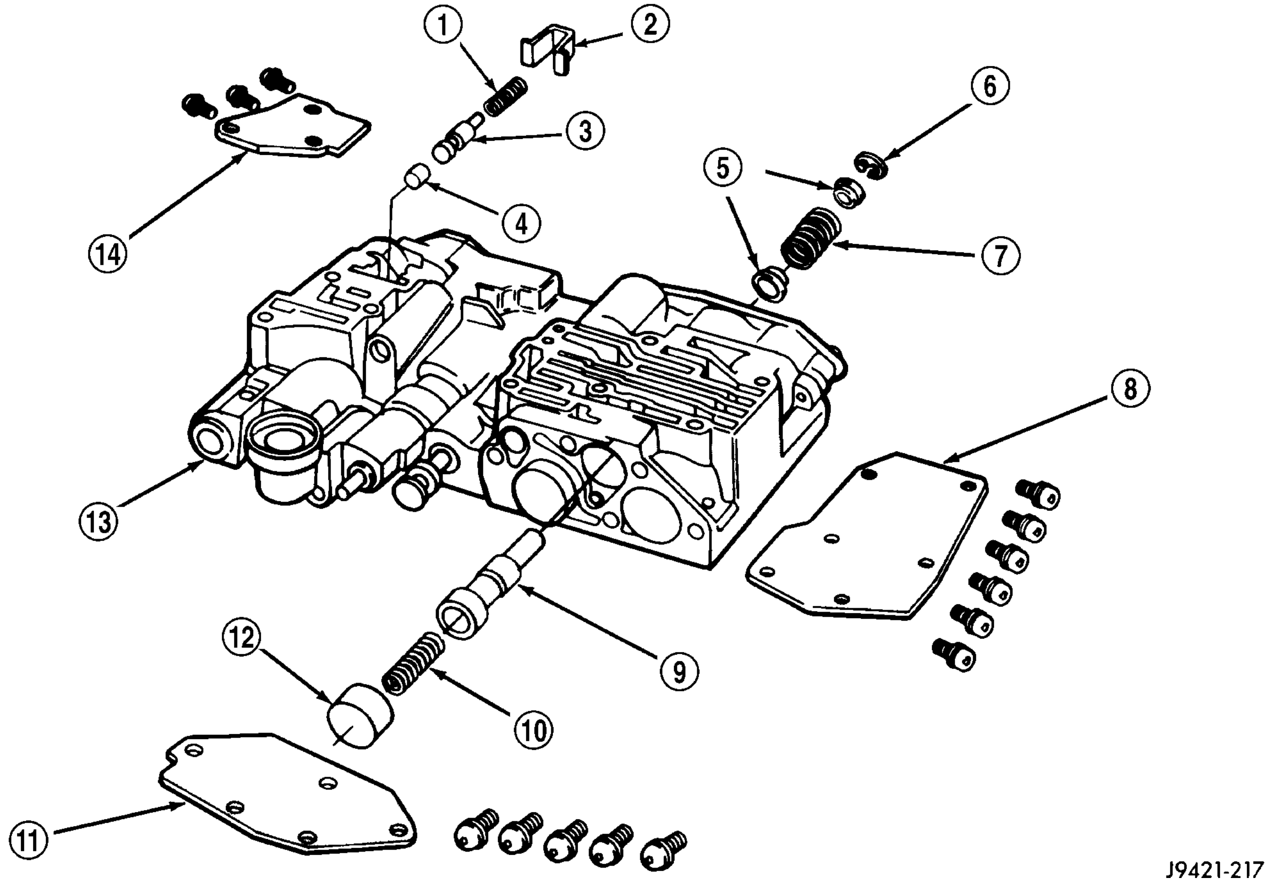

Fig. 303 Shuttle and Boost Valve Location

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

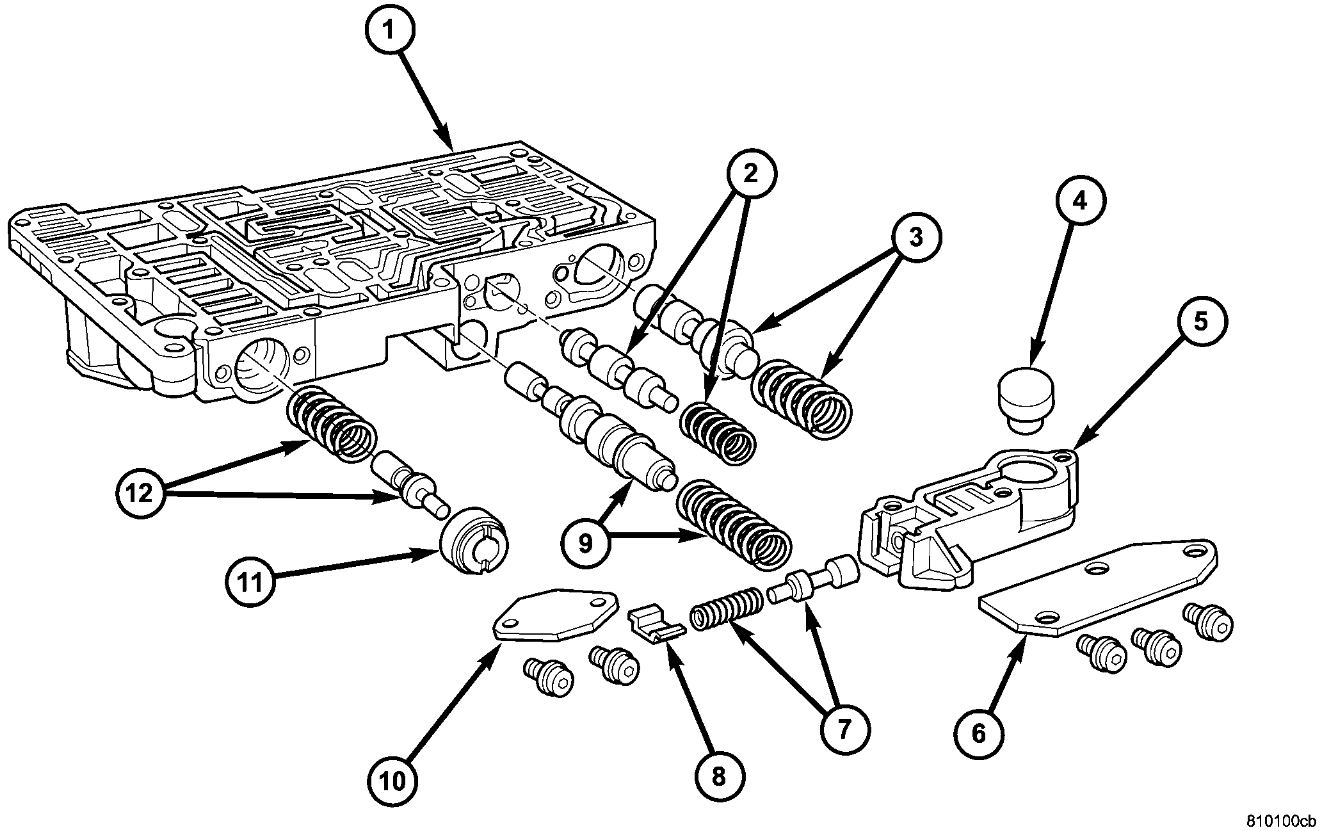

Fig. 304 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - PLUG SLEEVE
12 - THROTTLE PRESSURE SPRING AND PLUG

VALVE BODY (Continued)

VALVE BODY LOWER HOUSING

(1) Remove timing valve cover.
(2) Remove 3-4 timing valve and spring.
(3) Remove 3-4 quick fill valve, spring and plug.
(4) Remove 3-4 shift valve and spring.
(5) Remove converter clutch valve, spring and plug (Fig. 305).
(6) Remove converter clutch timing valve, retainer and valve spring.

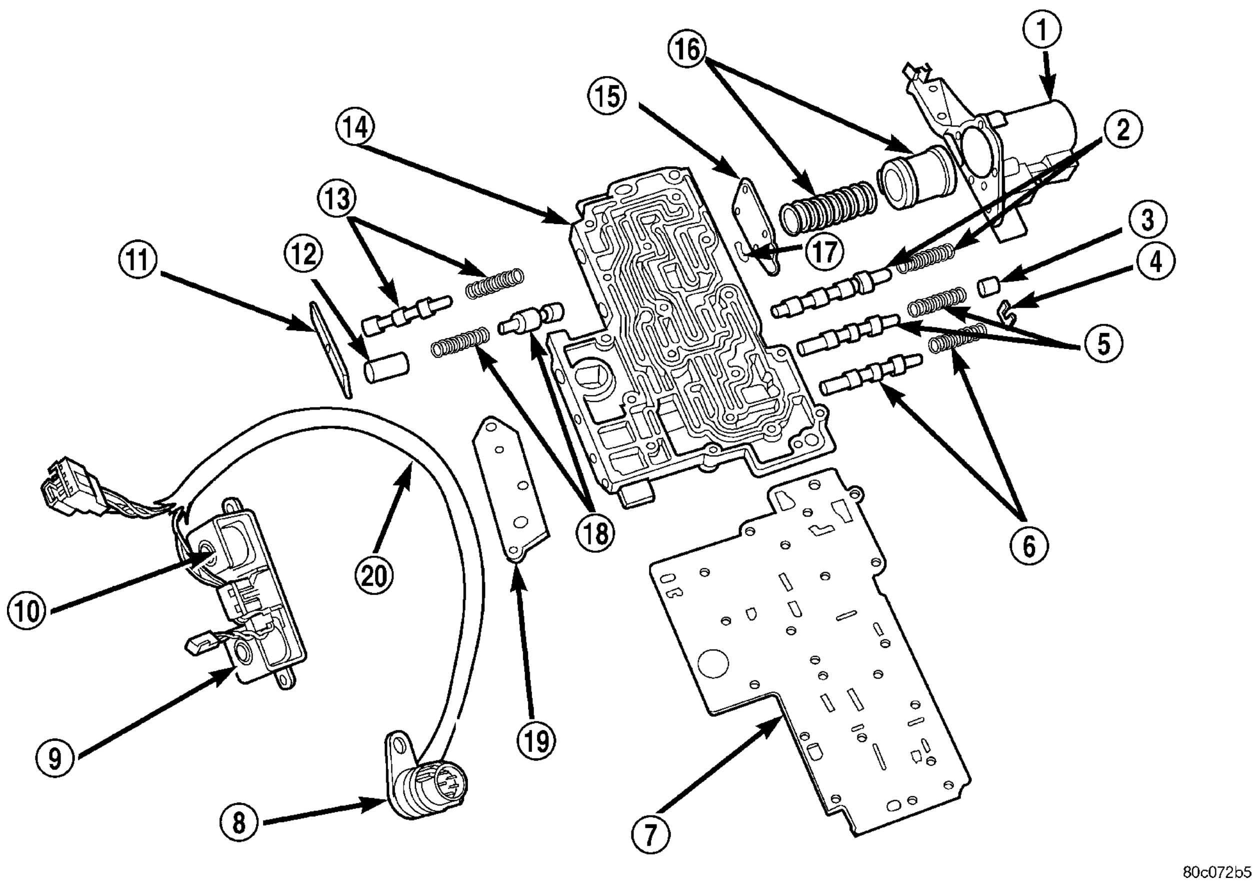

Fig. 305 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

3-4 ACCUMULATOR HOUSING

(1) Remove end plate from housing.

(2) Remove piston spring.

(3) Remove piston. Remove and discard piston seals (Fig. 306).

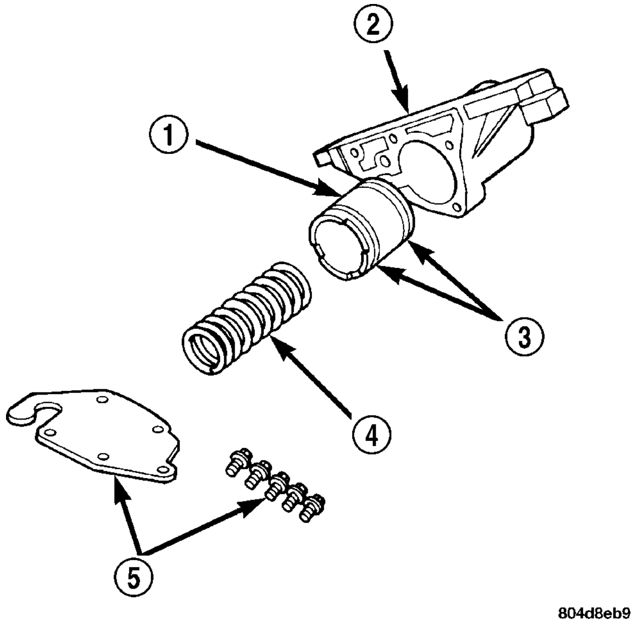

Fig. 306 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution.

Do not immerse any of the electrical components in cleaning solution. Clean the governor solenoid and sensor and the dual solenoid and harness assembly by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

Wipe the governor pressure sensor and solenoid valve with dry, lint free shop towels only. The O-rings on the sensor and solenoid valve are the only serviceable components. Be sure the vent ports in the solenoid valve are open and not blocked by dirt or debris. Replace the valve and/or sensor only when DRB scan tool diagnosis indicates this is necessary. Or, if either part has sustained physical damage (dented, deformed, broken, etc.).

CAUTION: Do not turn the small screw at the end of the solenoid valve for any reason. Turning the screw in either direction will ruin solenoid calibration and result in solenoid failure. In addition, the filter on the solenoid valve is NOT serviceable. Do not try to remove the filter as this will damage the valve housing.

INSPECTION

Inspect the throttle and manual valve levers and shafts. Do not attempt to straighten a bent shaft or correct a loose lever. Replace these components if worn, bent, loose or damaged in any way.

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straightedge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

CAUTION: Many of the valves and plugs, such as the throttle valve, shuttle valve plug, 1-2 shift valve and 1-2 governor plug, are made of coated aluminum. Aluminum components are identified by the dark color of the special coating applied to the surface (or by testing with a magnet). Do not sand aluminum valves or plugs under any circumstances. This practice could damage the special coating causing the valves/plugs to stick and bind.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.**Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

VALVE BODY (Continued)

Check the two separator plates for distortion or damage of any kind. Inspect the upper housing, lower housing, 3-4 accumulator housing, and transfer plate carefully. Be sure all fluid passages are clean and clear. Check condition of the upper housing and transfer plate check balls as well. The check balls and ball seats must not be worn or damaged.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

The only serviceable valve body components are listed below. The remaining valve body components are serviced only as part of a complete valve body assembly. Serviceable parts are:

- dual solenoid and harness assembly
- solenoid gasket
- solenoid case connector O-rings and shoulder bolt
- switch valve and spring
- pressure adjusting screw and bracket assembly
- throttle lever
- manual lever and shaft seal
- throttle lever shaft seal, washer, and E-clip
- fluid filter and screws
- detent ball and spring
- valve body screws
- governor pressure solenoid
- governor pressure sensor and retaining clip
- park lock rod and E-clip

ASSEMBLY

CAUTION: Do not force valves or plugs into place during reassembly. If the valve body bores, valves and plugs are free of distortion or burrs, the valve body components should all slide into place easily. In addition, do not overtighten the transfer plate and valve body screws during reassembly. Overtightening can distort the housings resulting in valve sticking, cross leakage and unsatisfactory operation. Tighten valve body screws to recommended torque only.

LOWER HOUSING

(1) Lubricate valves, springs, and the housing valve and plug bores with clean transmission fluid (Fig. 307).

(2) Install 3-4 timing valve spring and valve in lower housing.

(3) Install 3-4 quick fill valve in lower housing.

(4) Install 3-4 quick fill valve spring and plug in housing.

(5) Install timing valve end plate. Tighten end plate screws to 4 N·m (35 in. lbs.) torque.

VALVE BODY (Continued)

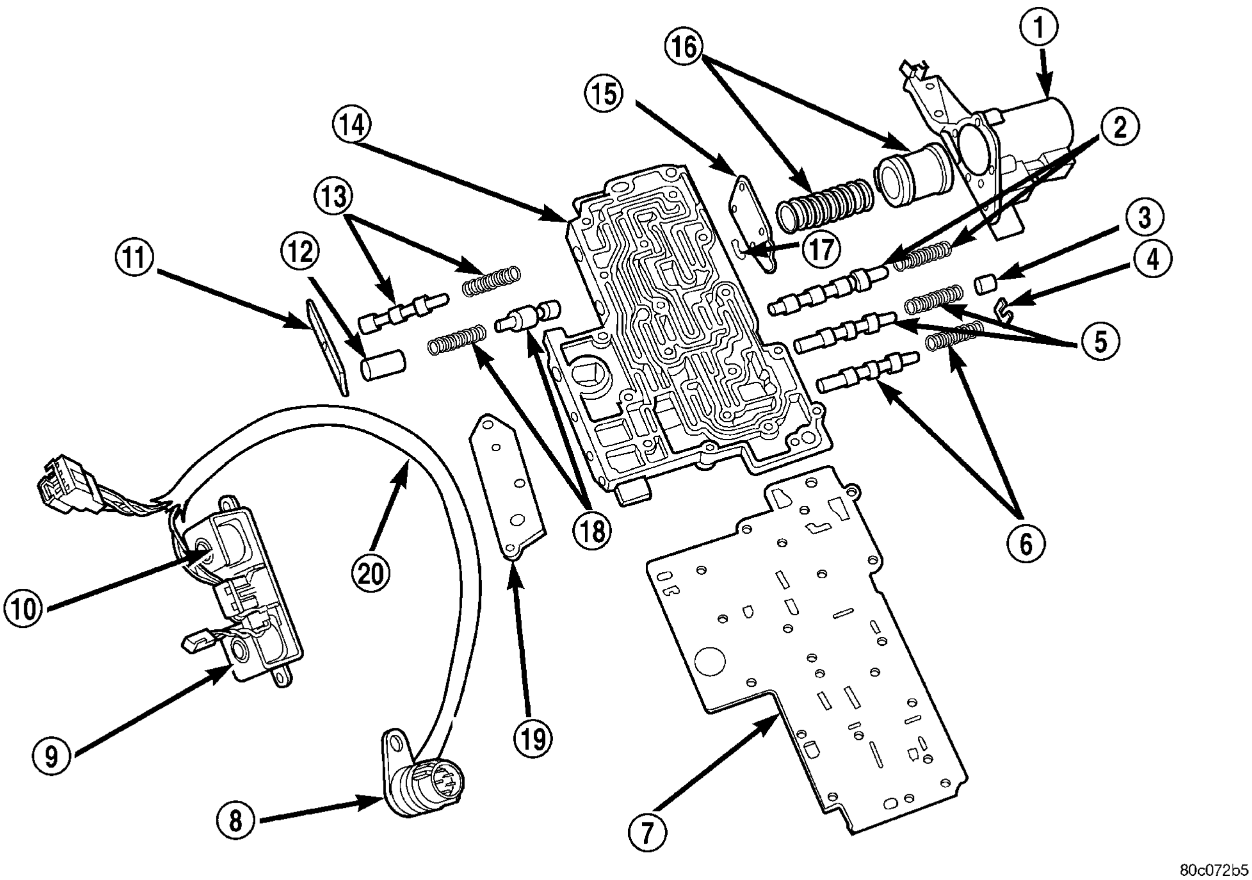

Fig. 307 Lower Housing Shift Valves and Springs

1 - 3-4 ACCUMULATOR HOUSING
2 - 3-4 SHIFT VALVE AND SPRING
3 - PLUG
4 - SPRING RETAINER
5 - CONVERTER CLUTCH VALVE AND SPRING
6 - CONVERTER CLUTCH TIMING VALVE AND SPRING
7 - OVERDRIVE SEPARATOR PLATE
8 - CASE CONNECTOR
9 - CONVERTER CLUTCH SOLENOID
10 - OVERDRIVE SOLENOID
11 - TIMING VALVE COVER
12 - PLUG
13 - 3-4 TIMING VALVE AND SPRING
14 - LOWER HOUSING
15 - ACCUMULATOR END PLATE
16 - 3-4 ACCUMULATOR PISTON AND SPRING
17 - E-CLIP
18 - 3-4 QUICK FILL SPRING AND VALVE
19 - SOLENOID GASKET
20 - HARNESS

VALVE BODY (Continued)

3-4 ACCUMULATOR

(1) Lubricate accumulator piston, seals and housing piston bore with clean transmission fluid (Fig. 308).

(2) Install new seal rings on accumulator piston.

(3) Install piston and spring in housing.

(4) Install end plate on housing.

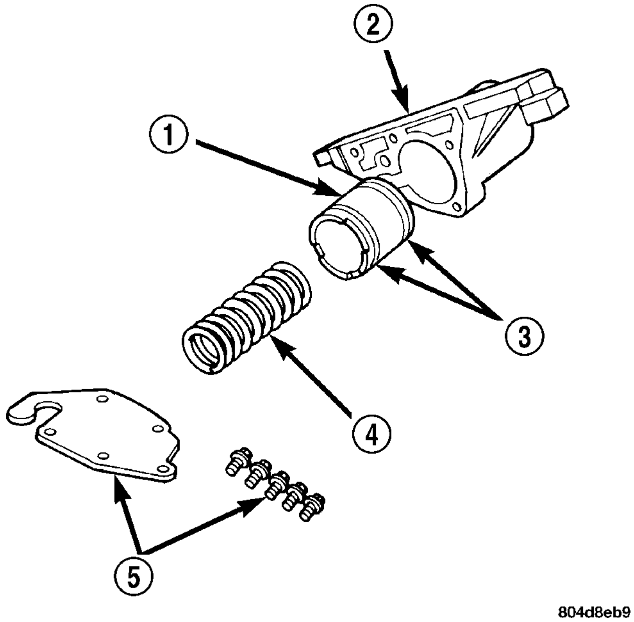

Fig. 308 3-4 Accumulator and Housing

1 - ACCUMULATOR PISTON
2 - 3-4 ACCUMULATOR HOUSING
3 - TEFLON SEALS
4 - PISTON SPRING
5 - COVER PLATE AND SCREWS

TRANSFER PLATE

(1) Install rear clutch and rear servo check balls in transfer plate (Fig. 309).

(2) Install filter screen in upper housing separator plate (Fig. 310).

(3) Align and position upper housing separator plate on transfer plate (Fig. 311).

(4) Install brace plate (Fig. 311). Tighten brace attaching screws to 4 N·m (35 in. lbs.) torque.

(5) Install remaining separator plate attaching screws. Tighten screws to 4 N·m (35 in. lbs.) torque.

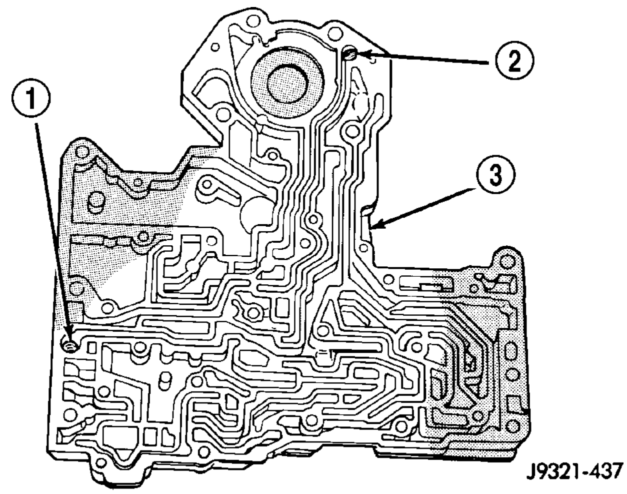

Fig. 309 Rear Clutch And Rear Servo Check Ball Locations

1 - REAR CLUTCH CHECK BALL
2 - REAR SERVO CHECK BALL
3 - TRANSFER PLATE

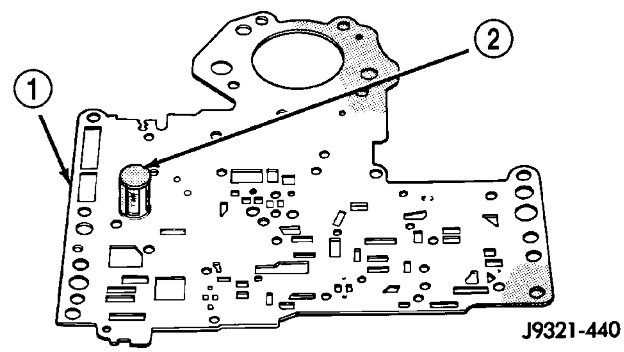

Fig. 310 Separator Plate Filter Screen Installation

1 - UPPER HOUSING SEPARATOR PLATE
2 - FILTER SCREEN

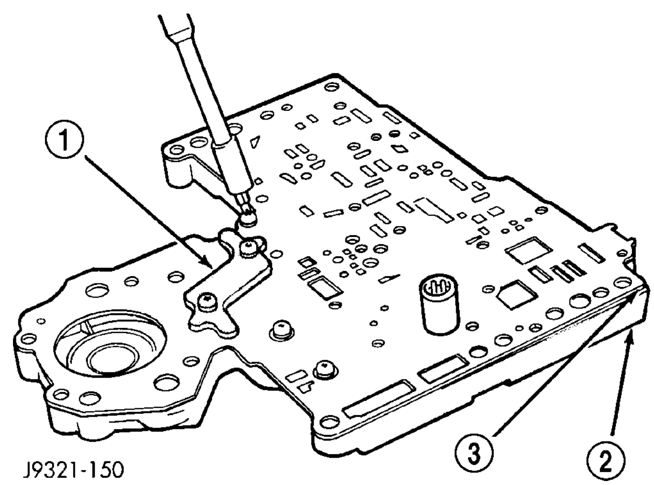

Fig. 311 Brace Plate

1 - BRACE
2 - TRANSFER PLATE
3 - SEPARATOR PLATE

VALVE BODY (Continued)

UPPER AND LOWER HOUSING

(1) Position upper housing so internal passages and check ball seats are facing upward. Then install check balls in housing (Fig. 312). Seven check balls are used. The single large check ball is approximately 8.7 mm (11/32 in.) diameter. The single small check ball is approximately 4.8 mm (3/16 in.) in diameter. The remaining 5 check balls are approximately 6.3 mm (1/4 in.) in diameter.

(2) Position assembled transfer plate and upper housing separator plate on upper housing (Fig. 313). Be sure filter screen is seated in proper housing recess.

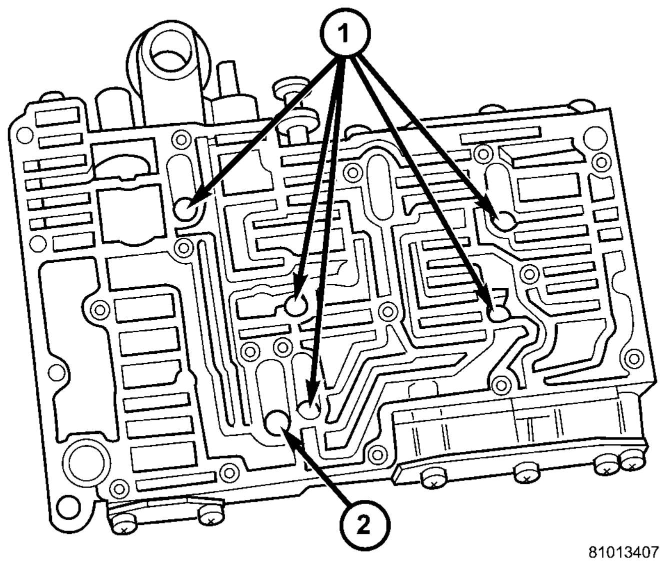

Fig. 312 Check Ball Locations In Upper Housing

1 - SMALL DIAMETER CHECK BALLS (5)
2 - LARGE DIAMETER CHECK BALL (1)

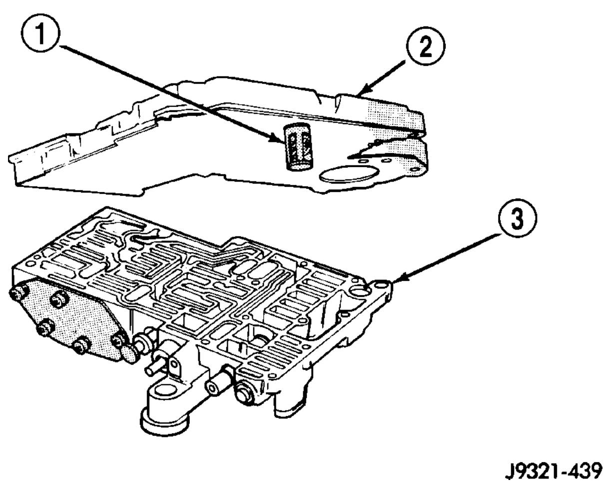

Fig. 313 Installing Transfer Plate On Upper Housing

1 - FILTER SCREEN
2 - TRANSFER PLATE/SEPARATOR PLATE ASSEMBLY
3 - UPPER HOUSING

(3) Install the Number 10 check ball into the transfer plate (Fig. 314). The check ball is approximately 4.8 mm (3/16 in.) in diameter.

(4) Position lower housing separator plate on transfer plate (Fig. 315).

(5) Install lower housing on assembled transfer plate and upper housing (Fig. 316).

(6) Install and start all valve body screws by hand except for the screws to hold the boost valve tube brace. Save those screws for later installation. Then tighten screws evenly to 4 N·m (35 in. lbs.) torque. Start at center and work out to sides when tightening screws (Fig. 316).

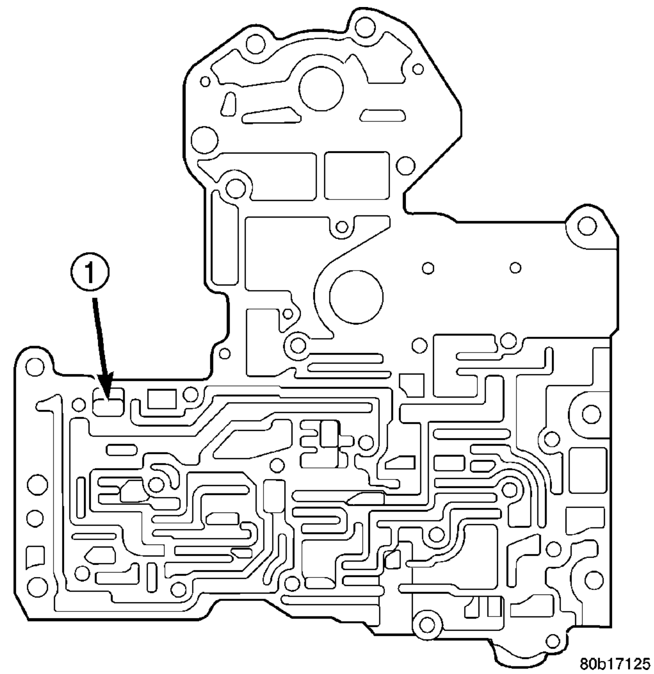

Fig. 314 Number 10 Check Ball

1 - NUMBER 10 CHECK BALL (3/16″)

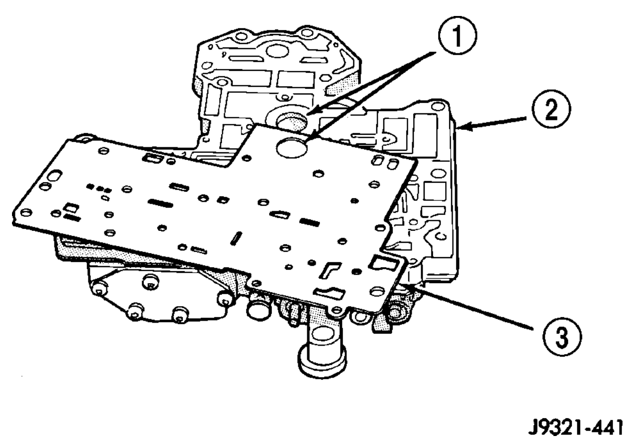

Fig. 315 Lower Housing Separator Plate

1 - BE SURE TO ALIGN BORES
2 - TRANSFER PLATE
3 - LOWER HOUSING (OVERDRIVE) SEPARATOR PLATE

VALVE BODY (Continued)

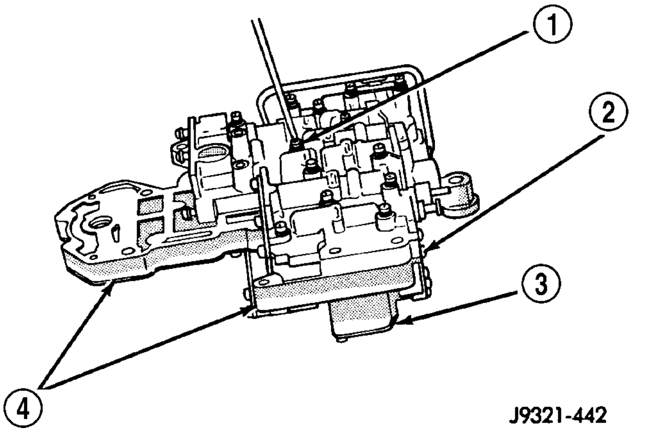

Fig. 316 Installing Lower Housing On Transfer Plate And Upper Housing

1 - VALVE BODY SCREWS (13)
2 - LOWER HOUSING
3 - UPPER HOUSING
4 - TRANSFER PLATE

UPPER HOUSING VALVE AND PLUG

Refer to (Fig. 317), (Fig. 318) and (Fig. 319) to perform the following steps.

(1) Lubricate valves, plugs, springs with clean transmission fluid.

(2) Assemble regulator valve line pressure sleeve, throttle plug and spring. Insert assembly in upper housing and install cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(3) Install 1-2 and 2-3 shift valves and springs.

(4) Install 1-2 shift control valve and spring.

(5) Install retainer, spring, limit valve, and 2-3 throttle plug from limit valve housing.

(6) Install limit valve housing and cover plate. Tighten screws to 4 N·m (35 in. lbs.).

(7) Install shuttle valve as follows:

(a) Insert plastic guides in shuttle valve secondary spring and install spring on end of valve.

(b) Install shuttle valve into housing.

(c) Hold shuttle valve in place.

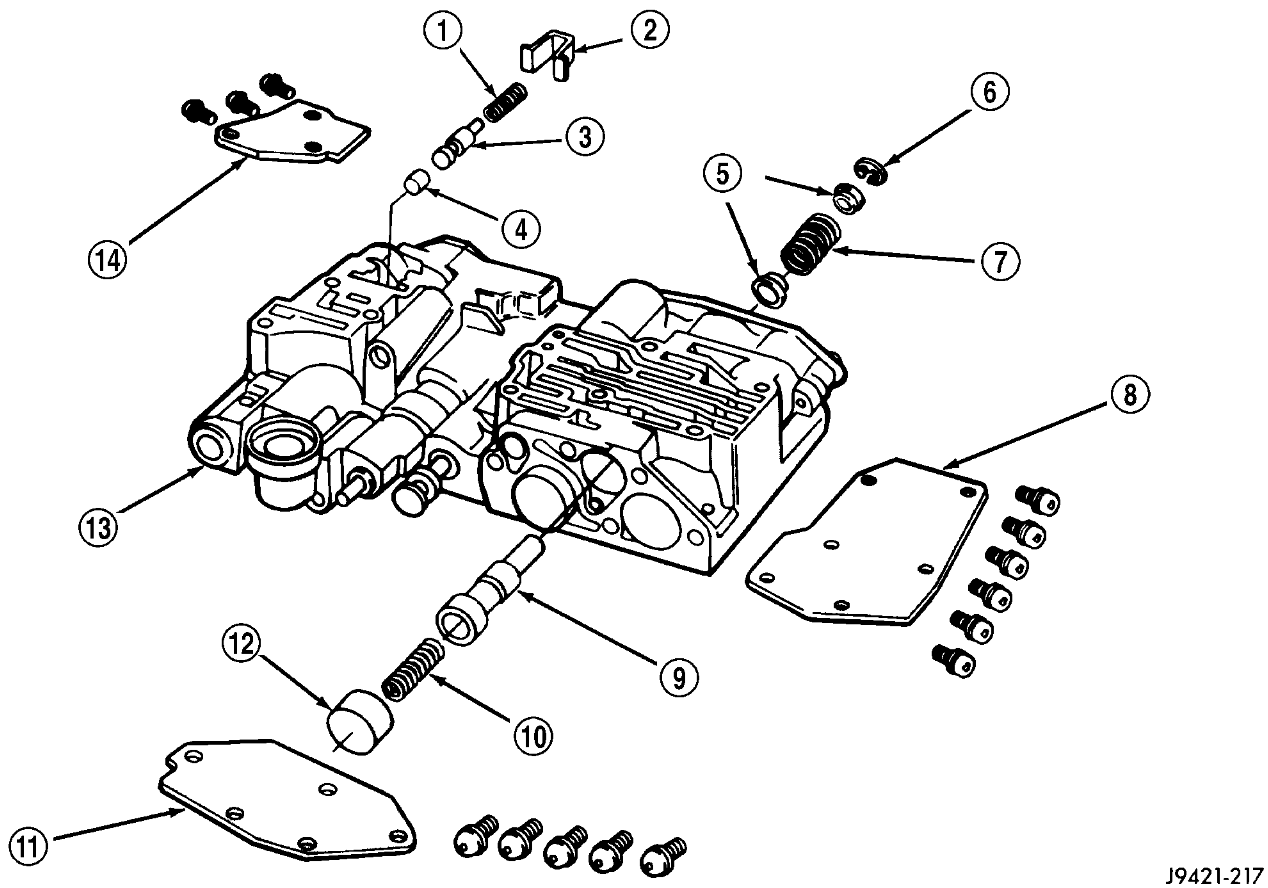

Fig. 317 Shuttle and Boost Valve Locations

1 - SPRING
2 - RETAINER
3 - BOOST VALVE
4 - BOOST VALVE PLUG
5 - SPRING GUIDES
6 - E-CLIP
7 - SHUTTLE VALVE SECONDARY SPRING
8 - SHUTTLE VALVE COVER
9 - SHUTTLE VALVE
10 - SHUTTLE VALVE PRIMARY SPRING
11 - GOVERNOR PLUG COVER
12 - THROTTLE PLUG
13 - UPPER HOUSING
14 - BOOST VALVE COVER

VALVE BODY (Continued)

(d) Compress secondary spring and install E-clip in groove at end of shuttle valve.

(e) Verify that spring and E-clip are properly seated before proceeding.

(8) Install shuttle valve cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(9) Install 1-2 and 2-3 valve governor plugs in valve body.

(10) Install shuttle valve primary spring and throttle plug.

(11) Align and install governor plug cover. Tighten cover screws to 4 N·m (35 in. lbs.) torque.

BOOST VALVE TUBE AND BRACE

(1) Position valve body assembly so lower housing is facing upward (Fig. 320).

(2) Lubricate tube ends and housing ports with transmission fluid or petroleum jelly.

(3) Start tube in lower housing port first. Then swing tube downward and work opposite end of tube into upper housing port (Fig. 320).

(4) Insert and seat each end of tube in housings.

(5) Slide tube brace under tube and into alignment with valve body screw holes (Fig. 321).

(6) Install and finger tighten three screws that secure tube brace to valve body housings (Fig. 321).

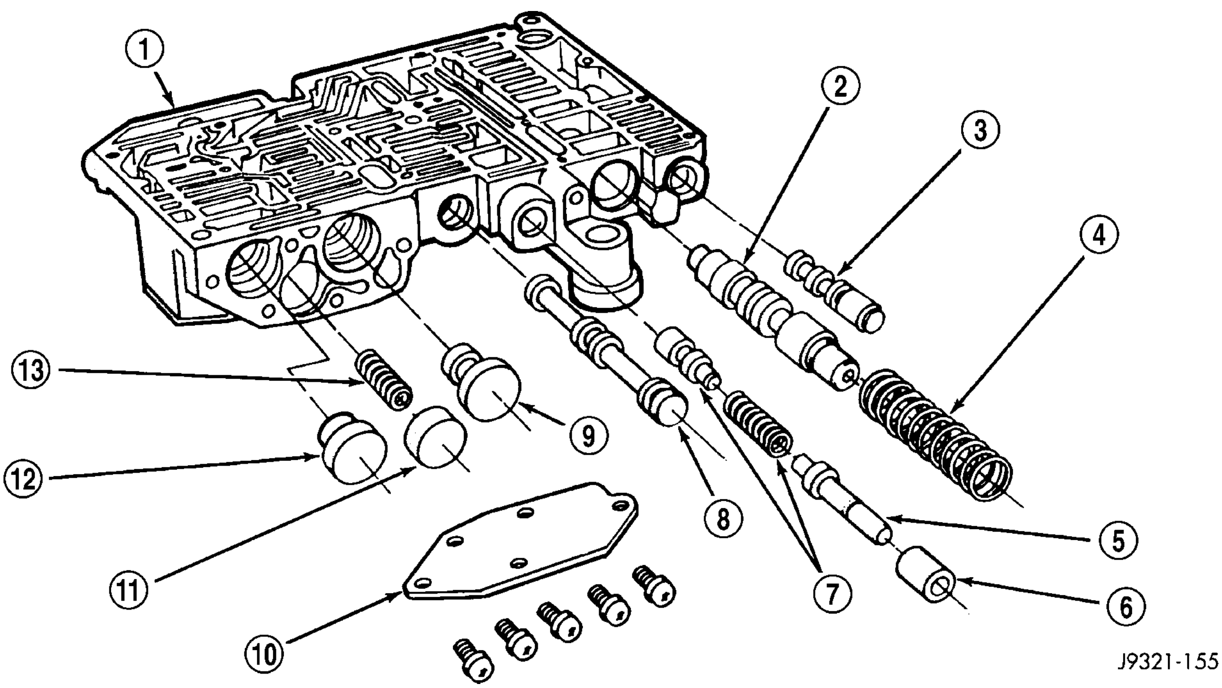

Fig. 318 Upper Housing Control Valve Locations

1 - UPPER HOUSING
2 - REGULATOR VALVE
3 - SWITCH VALVE
4 - REGULATOR VALVE SPRING
5 - KICKDOWN VALVE
6 - KICKDOWN DETENT
7 - THROTTLE VALVE AND SPRING
8 - MANUAL VALVE
9 - 1-2 GOVERNOR PLUG
10 - GOVERNOR PLUG COVER
11 - THROTTLE PLUG
12 - 2-3 GOVERNOR PLUG
13 - SHUTTLE VALVE PRIMARY SPRING

VALVE BODY (Continued)

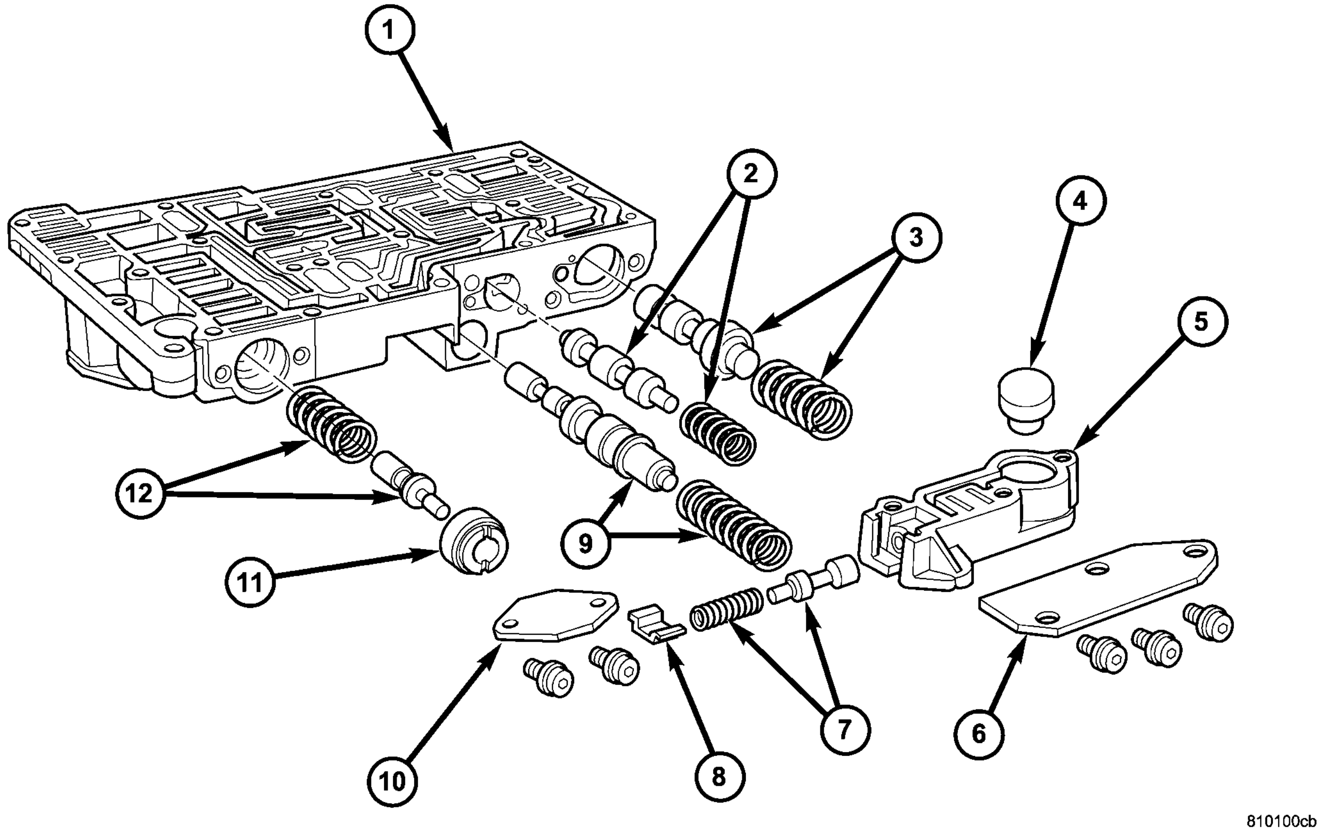

Fig. 319 Upper Housing Shift Valve and Pressure Plug Locations

1 - UPPER HOUSING
2 - 1-2 SHIFT VALVE AND SPRING
3 - 2-3 SHIFT VALVE AND SPRING
4 - 2-3 THROTTLE PLUG
5 - LIMIT VALVE HOUSING
6 - LIMIT VALVE COVER
7 - LIMIT VALVE AND SPRING
8 - RETAINER
9 - 1-2 SHIFT CONTROL VALVE AND SPRING
10 - PRESSURE PLUG COVER
11 - PLUG SLEEVE
12 - THROTTLE PRESSURE SPRING AND PLUG

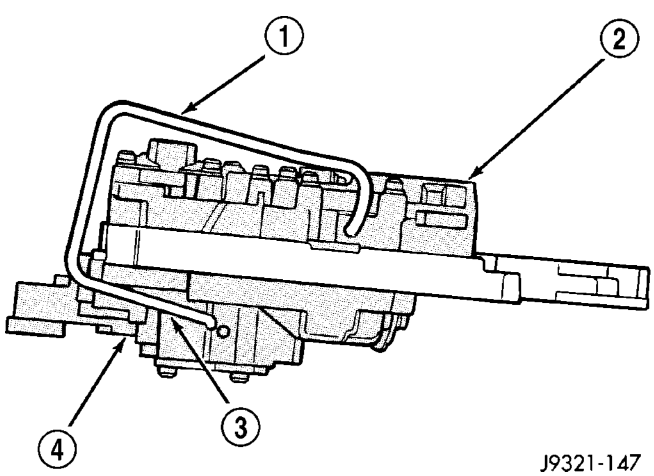

Fig. 320 Boost Valve Tube

1 - BOOST VALVE TUBE
2 - LOWER HOUSING
3 - DISENGAGE THIS END OF TUBE FIRST
4 - UPPER HOUSING

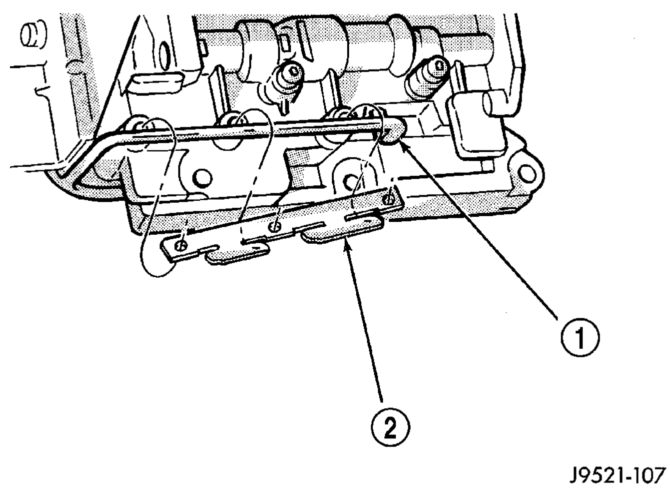

Fig. 321 Boost Valve Tube And Brace

1 - BOOST VALVE TUBE
2 - TUBE BRACE

VALVE BODY (Continued)

(7) Bend tube brace tabs up and against tube to hold it in position (Fig. 322).

(8) Tighten all valve body housing screws to 4 N·m (35 in. lbs.) torque after tube and brace are installed. Tighten screws in diagonal pattern starting at center and working outward.

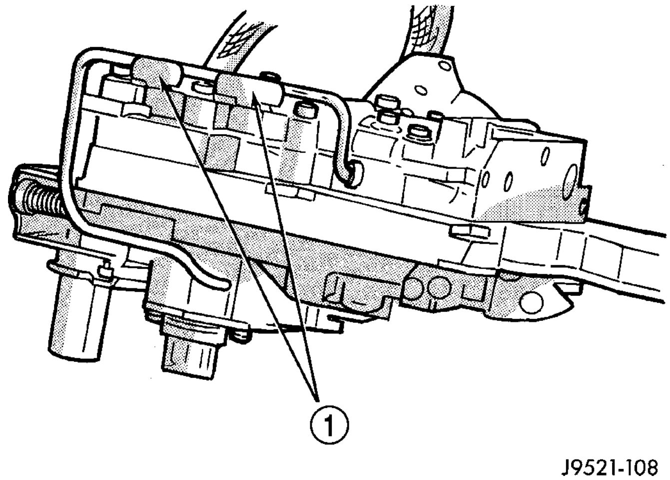

Fig. 322 Securing Boost Valve Tube With Brace Tabs

1 - BEND TABS UP AGAINST TUBE AS SHOWN

3-4 ACCUMULATOR

(1) Position converter clutch valve and 3-4 shift valve springs in housing (Fig. 323).

(2) Loosely attach accumulator housing with right-side screw (Fig. 323). Install only one screw at this time as accumulator must be free to pivot upward for ease of installation.

(3) Install 3-4 shift valve and spring.

(4) Install converter clutch timing valve and spring.

(5) Position plug on end of converter clutch valve spring. Then compress and hold springs and plug in place with fingers of one hand.

(6) Swing accumulator housing upward over valve springs and plug.

(7) Hold accumulator housing firmly in place and install remaining two attaching screws. Be sure springs and clutch valve plug are properly seated (Fig. 324). Tighten screws to 4 N·m (35 in. lbs.).

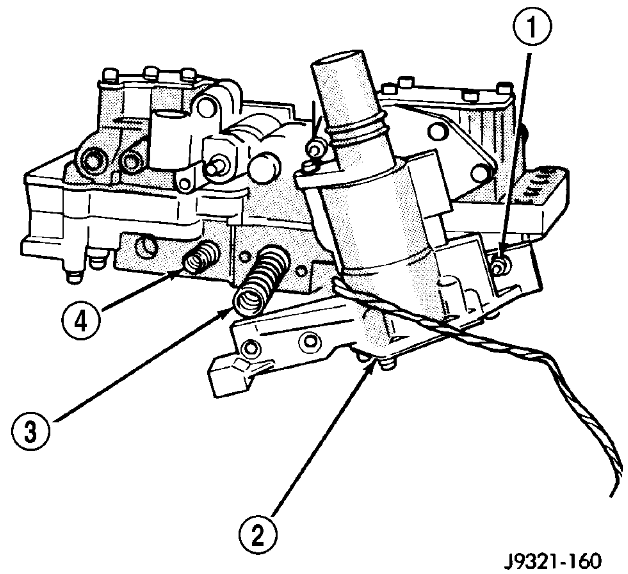

Fig. 323 Converter Clutch And 3-4 Shift Valve Springs

1 - RIGHT-SIDE SCREW
2 - 3-4 ACCUMULATOR
3 - 3-4 SHIFT VALVE SPRING
4 - CONVERTER CLUTCH VALVE SPRING

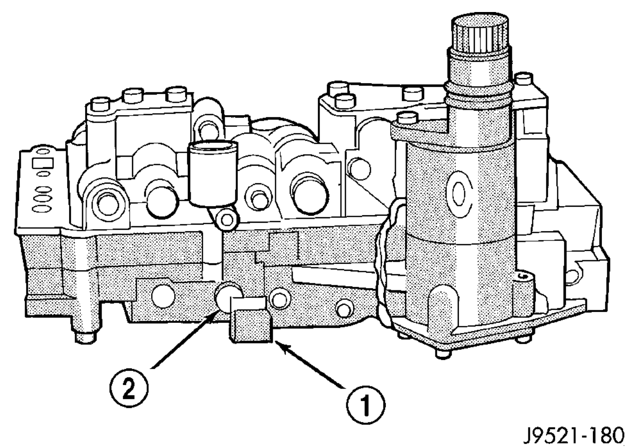

Fig. 324 Seating 3-4 Accumulator On Lower Housing

1 - ACCUMULATOR BOX
2 - CONVERTER CLUTCH VALVE PLUG

VALVE BODY (Continued)

VALVE BODY FINAL

(1) Install boost valve, valve spring, retainer and cover plate. Tighten cover plate screws to 4 N·m (35 in. lbs.) torque.

(2) Insert manual lever detent spring in upper housing.

(3) Position detent ball on end of spring. Then hold detent ball and spring in detent housing with Retainer Tool 6583 (Fig. 325).

(4) Install throttle lever in upper housing. Then install manual lever over throttle lever and start manual lever into housing.

(5) Align manual lever with detent ball and manual valve. Hold throttle lever upward. Then press down on manual lever until fully seated. Remove detent ball retainer tool after lever is seated.

(6) Then install manual lever seal, washer and E-clip.

(7) Verify that throttle lever is aligned with end of kickdown valve stem and that manual lever arm is engaged in manual valve (Fig. 326).

(8) Position line pressure adjusting screw in adjusting screw bracket.

(9) Install spring on end of line pressure regulator valve.

(10) Install switch valve spring on tang at end of adjusting screw bracket.

(11) Install manual valve.

(12) Install throttle valve and spring.

(13) Install kickdown valve and detent.

(14) Install pressure regulator valve.

(15) Install switch valve.

(16) Position adjusting screw bracket on valve body. Align valve springs and press bracket into place. Install short, upper bracket screws first and long bottom screw last. Verify that valve springs and bracket are properly aligned. Then tighten all three bracket screws to 4 N·m (35 in. lbs.) torque.

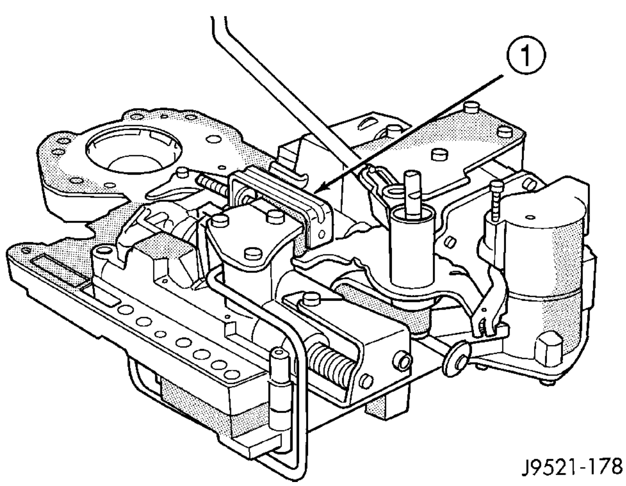

Fig. 325 Detent Ball Spring

1 - SPECIAL TOOL 6583 POSITIONED ON DETENT HOUSING

(17) Perform Line Pressure and Throttle Pressure adjustments. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC/VALVE BODY - ADJUSTMENTS)

(18) Lubricate solenoid case connector O-rings and shaft of manual lever with light coat of petroleum jelly.

(19) Attach solenoid case connector to 3-4 accumulator with shoulder-type screw. Connector has small locating tang that fits in dimple at top of accumulator housing (Fig. 327). Seat tang in dimple before tightening connector screw.

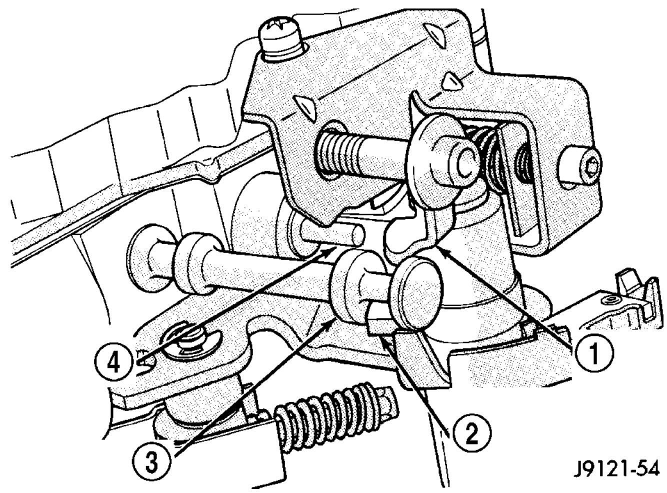

Fig. 326 Manual And Throttle Lever Alignment

1 - THROTTLE LEVER
2 - MANUAL LEVER VALVE ARM
3 - MANUAL VALVE
4 - KICKDOWN VALVE

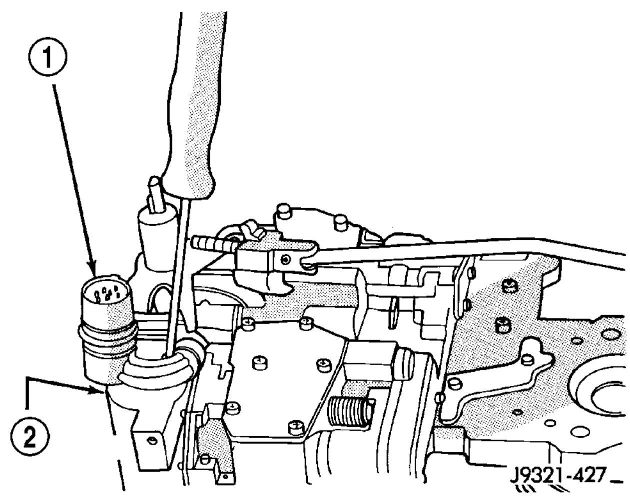

Fig. 327 Solenoid Harness Case Connector Shoulder Bolt

1 - SOLENOID HARNESS CASE CONNECTOR
2 - 3-4 ACCUMULATOR HOUSING

VALVE BODY (Continued)

(20) Install solenoid assembly and gasket. Tighten solenoid attaching screws to 8 N·m (72 in. lbs.) torque.

(21) Verify that solenoid wire harness is properly routed (Fig. 328). Solenoid harness must be clear of manual lever and park rod and not be pinched between accumulator housing and cover.

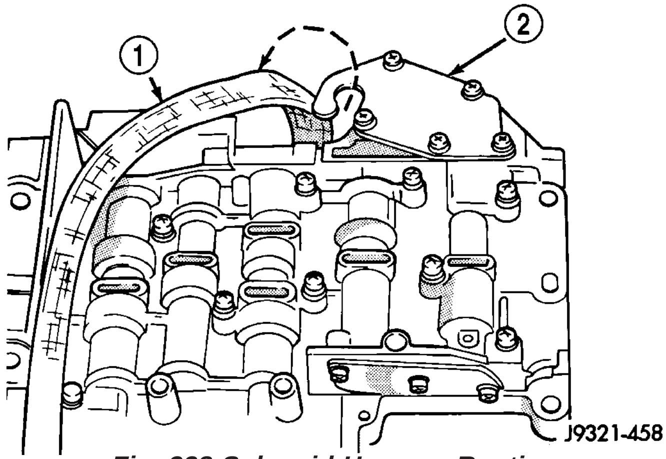

Fig. 328 Solenoid Harness Routing

1 - OVERDRIVE/CONVERTER SOLENOID WIRE HARNESS
2 - 3-4 ACCUMULATOR COVER PLATE

GOVERNOR BODY, SENSOR AND SOLENOID

(1) Turn valve body assembly over so accumulator side of transfer plate is facing down.

(2) Install new O-rings on governor pressure solenoid and sensor.

(3) Lubricate solenoid and sensor O-rings with clean transmission fluid.

(4) Install governor pressure sensor in governor body.

(5) Install governor pressure solenoid in governor body. Push solenoid in until it snaps into place in body.

(6) Position governor body gasket on transfer plate.

(7) Install retainer plate on governor body and around solenoid. Be sure solenoid connector is positioned in retainer cutout.

(8) Align screw holes in governor body and transfer plate. Then install and tighten governor body screws to 4 N·m (35 in. lbs.) torque.

(9) Connect harness wires to governor pressure solenoid and governor pressure sensor.

(10) Install fluid filter and pan.

(11) Lower vehicle.

(12) Fill transmission with recommended fluid and road test vehicle to verify repair.

INSTALLATION

(1) Check condition of O-ring seals on valve body harness connector (Fig. 329). Replace seals on connector body if cut or worn.

(2) Check condition of manual lever shaft seal in transmission case. Replace seal if lip is cut or worn. Install new seal with 15/16 deep well socket (Fig. 330).

(3) Check condition of seals on accumulator piston. Install new piston seals, if necessary.

(4) Verify that transmission range sensor is **NOT** installed. Valve body cannot be installed with sensor in place.

(5) Place valve body manual lever in low (1 position) so ball on park lock rod will be easier to install in sprag.

(6) Lubricate shaft of manual lever with petroleum jelly. This will ease inserting shaft through seal in case.

(7) Lubricate seal rings on valve body harness connector with petroleum jelly.

(8) Position valve body in case and work end of park lock rod into and through pawl sprag. Turn propeller shaft to align sprag and park lock teeth if necessary. The rod will click as it enters pawl. Move rod to check engagement.

CAUTION: It is possible for the park rod to displace into a cavity just above the pawl sprag during installation. Make sure the rod is actually engaged in the pawl and has not displaced into this cavity.

(9) Install accumulator spring and piston into case. Then swing valve body over piston and outer spring to hold it in place.

(10) Align accumulator piston and outer spring, manual lever shaft and electrical connector in case.

(11) Then seat valve body in case and install one or two bolts to hold valve body in place.

(12) Tighten valve body bolts alternately and evenly to 11 N·m (100 in. lbs.) torque.

(13) Install new fluid filter on valve body. Tighten filter screws to 4 N·m (35 in. lbs.) torque.

(14) Install throttle and gearshift levers on valve body manual lever shaft.

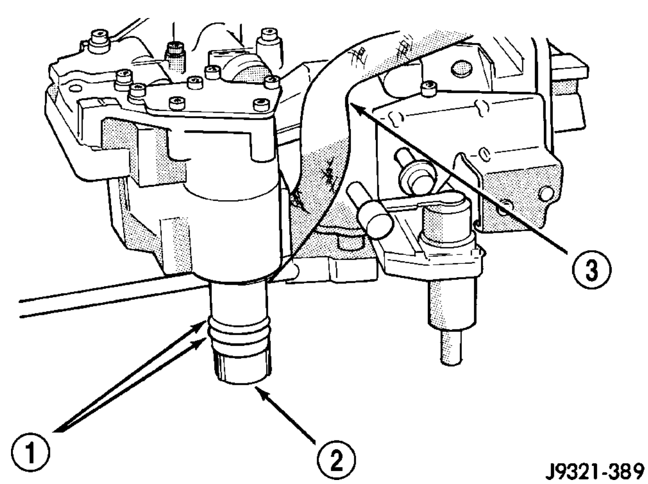

Fig. 329 Valve Body Harness Connector O-Ring Seal

1 - CONNECTOR O-RINGS
2 - VALVE BODY HARNESS CONNECTOR
3 - HARNESS

VALVE BODY (Continued)

(15) Check and adjust front and rear bands if necessary.

(16) Connect solenoid case connector wires.

(17) Install the transmission range sensor.

(18) Install oil pan and new gasket. Tighten pan bolts to 17 N·m (13 ft. lbs.) torque.

(19) Lower vehicle and fill transmission with Mopar® ATF +4, Automatic Transmission fluid.

(20) Check and adjust gearshift and throttle valve cables, if necessary.

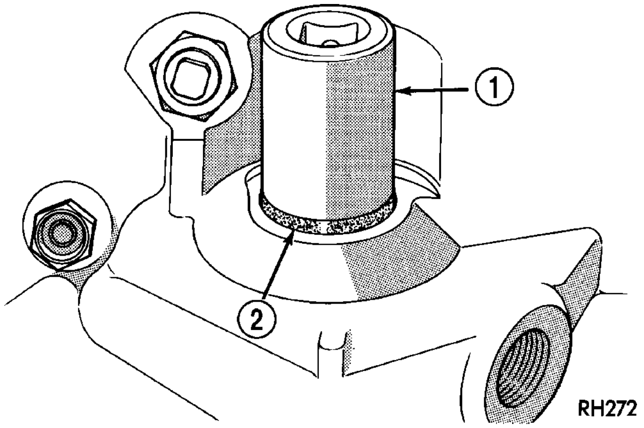

Fig. 330 Manual Lever Shaft Seal

1 - 15/16'' SOCKET
2 - SEAL

ADJUSTMENTS - VALVE BODY

CONTROL PRESSURE ADJUSTMENTS

There are two control pressure adjustments on the valve body;

- Line Pressure
- Throttle Pressure

Line and throttle pressures are interdependent because each affects shift quality and timing. As a result, both adjustments must be performed properly and in the correct sequence. Adjust line pressure first and throttle pressure last.

LINE PRESSURE ADJUSTMENT

Measure distance from the valve body to the inner edge of the adjusting screw with an accurate steel scale (Fig. 331).

Distance should be 33.4 mm (1-5/16 in.).

If adjustment is required, turn the adjusting screw in, or out, to obtain required distance setting.

NOTE: The 33.4 mm (1-5/16 in.) setting is an approximate setting. Manufacturing tolerances may make it necessary to vary from this dimension to obtain desired pressure.

One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa).

Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.

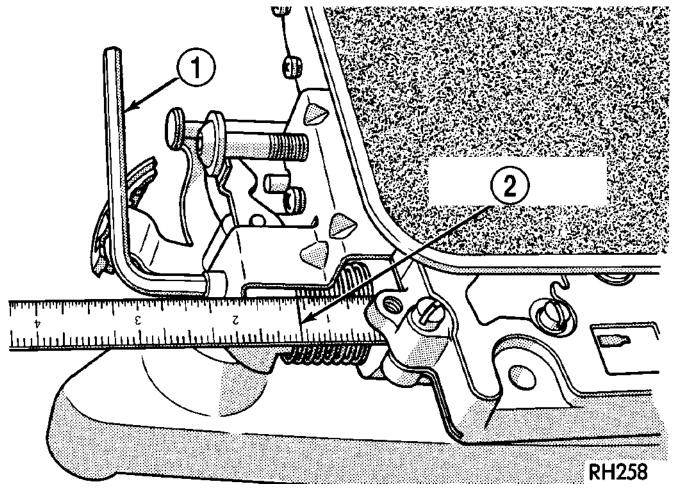

Fig. 331 Line Pressure Adjustment

1 - WRENCH
2 - 1–5/16 INCH

THROTTLE PRESSURE ADJUSTMENT

Insert Gauge Tool C-3763 between the throttle lever cam and the kickdown valve stem (Fig. 332).

Push the gauge tool inward to compress the kickdown valve against the spring and bottom the throttle valve.

Maintain pressure against kickdown valve spring. Turn throttle lever stop screw until the screw head touches throttle lever tang and the throttle lever cam touches gauge tool.

NOTE: The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed to obtain correct adjustment.

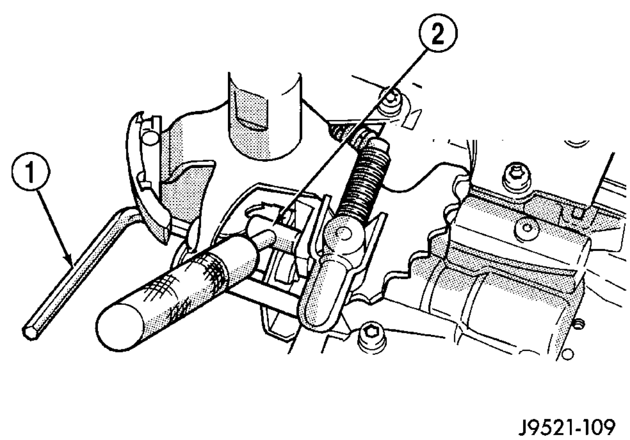

Fig. 332 Throttle Pressure Adjustment

1 - HEX WRENCH (IN THROTTLE LEVER ADJUSTING SCREW)
2 - SPECIAL TOOL C-3763 (POSITIONED BETWEEN THROTTLE LEVER AND KICKDOWN VALVE)

AUTOMATIC TRANSMISSION - 45RFE/545RFE

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AUTOMATIC TRANSMISSION - 45RFE/545RFE

DESCRIPTION

The 45RFE/545RFE automatic transmissions is a sophisticated, multi-range, electronically controlled transmission which combines optimized gear ratios for responsive performance, state of the art efficiency features and low NVH. Other features include driver adaptive shifting and three planetary gear sets to provide wide ratio capability with precise ratio steps for optimum driveability. The three planetary gear sets also make available a unique alternate second gear ratio. The primary 2nd gear ratio fits between 1st and 3rd gears for normal through-gear accelerations. The alternate second gear ratio (2prime) allows smoother 4-2 kickdowns at high speeds to provide 2nd gear passing performance over a wider highway cruising range.

The hydraulic portion of the transmission consists of the transmission fluid, fluid passages, hydraulic valves, and various line pressure control components.

The primary mechanical components of the transmission consist of the following:

- Three multiple disc input clutches
- Three multiple disc holding clutches
- Five hydraulic accumulators
- Three planetary gear sets
- Dual Stage Hydraulic oil pump
- Valve body
- Solenoid pack

The TCM is the “heart” or “brain” of the electronic control system and relies on information from various direct and indirect inputs (sensors, switches, etc.) to determine driver demand and vehicle operating conditions. With this information, the TCM can calculate and perform timely and quality shifts through various output or control devices (solenoid pack, transmission control relay, etc.).

TRANSMISSION IDENTIFICATION

Transmission identification numbers are stamped on the left side of the case just above the oil pan sealing surface (Fig. 1). Refer to this information when ordering replacement parts. A label is attached to the transmission case above the stamped numbers.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

The label gives additional information which may also be necessary for identification purposes.

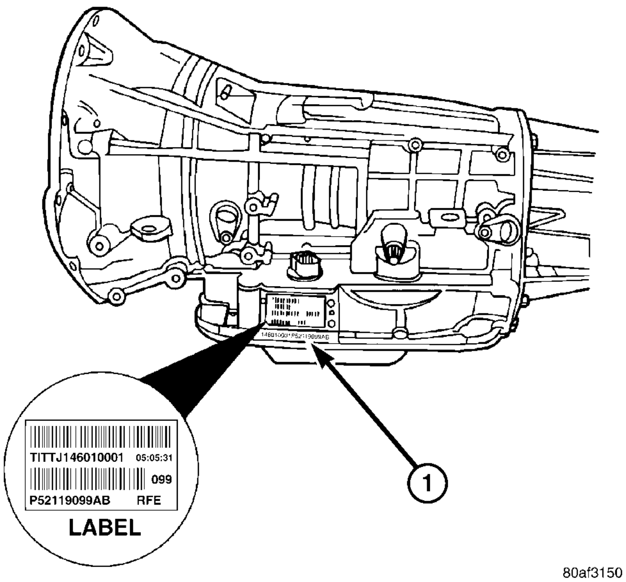


Fig. 1 Transmission Part And Serial Number Location

1 - IDENTIFICATION NUMBERS (STAMPED)

GEAR RATIOS

The 45RFE gear ratios are:

1st	3.00:1
2nd	1.67:1
2nd Prime	1.50:1
3rd	1.00:1
4th	0.75:1
Reverse	3.00:1

GEAR RATIOS

The 545RFE gear ratios are:

1st	3.00:1
2nd	1.67:1
2nd Prime	1.50:1
3rd	1.00:1
4th	0.75:1
5th	0.67:1
Reverse	3.00:1

OPERATION

The 45RFE/545RFE offers full electronic control of all automatic up and downshifts, and features real-time adaptive closed-loop shift and pressure control. Electronic shift and torque converter clutch controls help protect the transmission from damage due to high temperatures, which can occur under severe operating conditions. By altering shift schedules, line pressure, and converter clutch control, these controls reduce heat generation and increase transmission cooling.

To help reduce efficiency-robbing parasitic losses, the transmissions includes a dual-stage transmission fluid pump with electronic output pressure control. Under most driving conditions, pump output pressure greatly exceeds that which is needed to keep the clutches applied. The 45RFE/545RFE pump-pressure control system monitors input torque and adjusts the pump pressure accordingly. The primary stage of the pump works continuously; the second stage is bypassed when demand is low. The control system also monitors input and output speed and, if incipient clutch slip is observed, the pressure control solenoid duty cycle is varied, increasing pressure in proportion to demand.

A high-travel torque converter damper assembly allows earlier torque converter clutch engagement to reduce slippage. Needle-type thrust bearings reduce internal friction. The 45RFE/545RFE is packaged in a one-piece die-cast aluminum case. To reduce NVH, the case has high lateral, vertical and torsional stiffness. It is also designed to maximize the benefit of the structural dust cover that connects the bottom of the bell housing to the engine bedplate, enhancing overall power train stiffness. Dual filters protect the pump and other components. A pump return filter is added to the customary main sump filter. Independent lubrication and cooler circuits assure ample pressure for normal transmission operation even if the cooler is obstructed or the fluid cannot flow due to extremely low temperatures.

The hydraulic control system design (without electronic assist) provides the transmission with PARK, REVERSE, NEUTRAL, SECOND, and THIRD gears, based solely on driver shift lever selection. This design allows the vehicle to be driven (in “limp-in” mode) in the event of a electronic control system failure, or a situation that the Transmission Control Module (TCM) recognizes as potentially damaging to the transmission.

The TCM also performs certain self-diagnostic functions and provides comprehensive information (sensor data, DTC’s, etc.) which is helpful in proper diagnosis and repair. This information can be viewed with the DRB® scan tool.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - AUTOMATIC TRANSMISSION

CAUTION: Before attempting any repair on a RFE automatic transmission, check for Diagnostic Trouble Codes with the DRB® scan tool.

Transmission malfunctions may be caused by these general conditions:

- Poor engine performance
- Improper adjustments
- Hydraulic malfunctions
- Mechanical malfunctions
- Electronic malfunctions

Diagnosis of these problems should always begin by checking the easily accessible variables: fluid level and condition, gearshift cable adjustment. Then perform a road test to determine if the problem has been corrected or if more diagnosis is necessary. If the problem persists after the preliminary tests and corrections are completed, hydraulic pressure checks should be performed.

DIAGNOSIS AND TESTING - PRELIMINARY

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

VEHICLE IS DRIVABLE

(1) Check for transmission fault codes using DRB® scan tool.

(2) Check fluid level and condition.

(3) Adjust gearshift cable if complaint was based on delayed, erratic, or harsh shifts.

(4) Road test and note how transmission upshifts, downshifts, and engages.

(5) Perform hydraulic pressure test if shift problems were noted during road test.

(6) Perform air-pressure test to check clutch operation.

VEHICLE IS DISABLED

(1) Check fluid level and condition.

(2) Check for broken or disconnected gearshift cable.

(3) Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.

(4) Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:

(a) If propeller shaft turns but wheels do not, problem is with differential or axle shafts.

(b) If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged driveplate, converter, oil pump, or input shaft.

(c) If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

DIAGNOSIS AND TESTING - ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that all diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, overrunning clutch, or line pressure problems.

A slipping clutch can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch Application charts provide a basis for analyzing road test results.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

45RFE CLUTCH APPLICATION CHART

SLP	UD	OD	R	2C	4C	L/R	OVERRUNNING
P–PARK						ON	
R–REVERSE			ON			ON	
N-NEUTRAL						ON	
D–OVERDRIVE FIRST	ON					ON*	ON
SECOND	ON			ON			
SECOND PRIME	ON				ON		
THIRD	ON	ON					
FOURTH		ON			ON		
LIMP-IN	ON	ON					
2–FIRST	ON					ON*	ON
SECOND	ON			ON			
LIMP-IN	ON			ON			
1–LOW	ON					ON	ON

*L/R clutch is on only with the output shaft speed below 150 rpm.

545RFE CLUTCH APPLICATION CHART

SLP	UD	OD	R	2C	4C	L/R	OVERRUNNING
P–PARK						ON	
R–REVERSE			ON			ON	
N-NEUTRAL						ON	
D–OVERDRIVE FIRST	ON					ON*	ON
SECOND	ON			ON			
SECOND PRIME	ON				ON		
THIRD	ON	ON					
FOURTH		ON			ON		
FIFTH		ON		ON			
LIMP-IN	ON	ON					
2–FIRST	ON					ON*	ON
SECOND	ON			ON			
LIMP-IN	ON			ON			
1–LOW	ON					ON	ON

*L/R clutch is on only with the output shaft speed below 150 rpm.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

DIAGNOSIS AND TESTING - HYDRAULIC PRESSURE TEST

An accurate tachometer and pressure test gauges are required. Test Gauge C-3293-SP has a 300 psi range and is used at all locations where pressures exceed 100 psi.

Pressure Test Port Locations

Only two pressure ports are supplied on the transmission case. The torque converter clutch apply and release ports are located on the right side of the transmission case (Fig. 2).

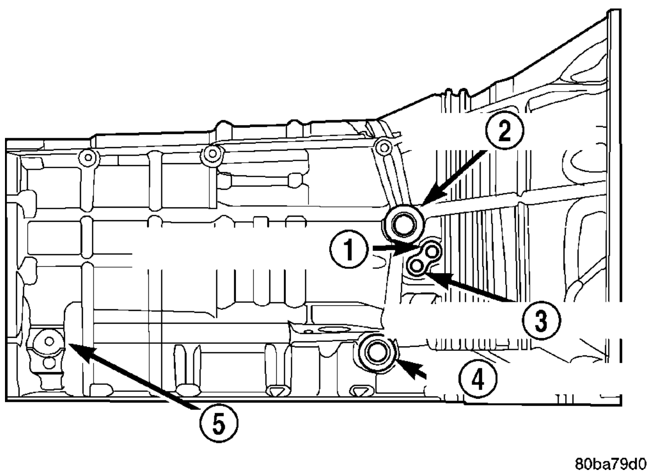


Fig. 2 Torque Converter Pressure Locations

1 - TCC RELEASE
2 - TO COOLER
3 - TCC APPLY
4 - FROM COOLER
5 - LINE PRESSURE SENSOR

To determine the line pressure, there are two available methods. The DRB® scan tool can be used to read line pressure from the line pressure sensor. The second method is to install Line Pressure Adapter 8259 (Fig. 4) into the transmission case and then install the pressure gauge and the original sensor into the adapter. This will allow a comparison of the DRB® readings and the gauge reading to determine the accuracy of the line pressure sensor. The DRB® line pressure reading should match the gauge reading within ±10 psi.

In order to access any other pressure tap locations, the transmission oil pan must be removed, the pressure port plugs removed and Valve Body Pressure Tap Adapter 8258-A (Fig. 5) installed. The extensions supplied with Adapter 8258-A will allow the installation of pressure gauges to the valve body. Refer to (Fig. 3) for correct pressure tap location identification.

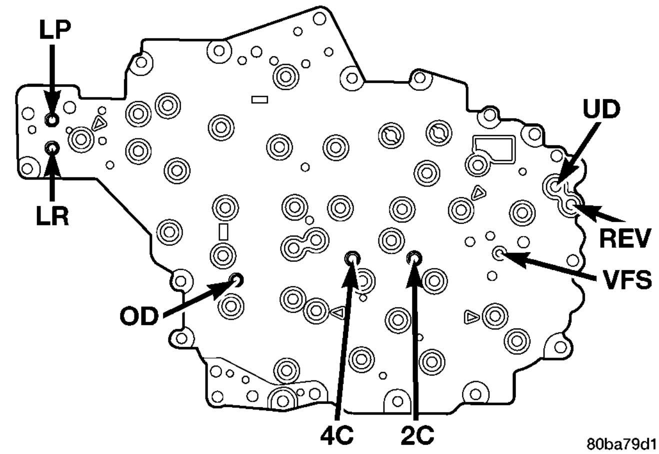


Fig. 3 Pressure Tap Locations

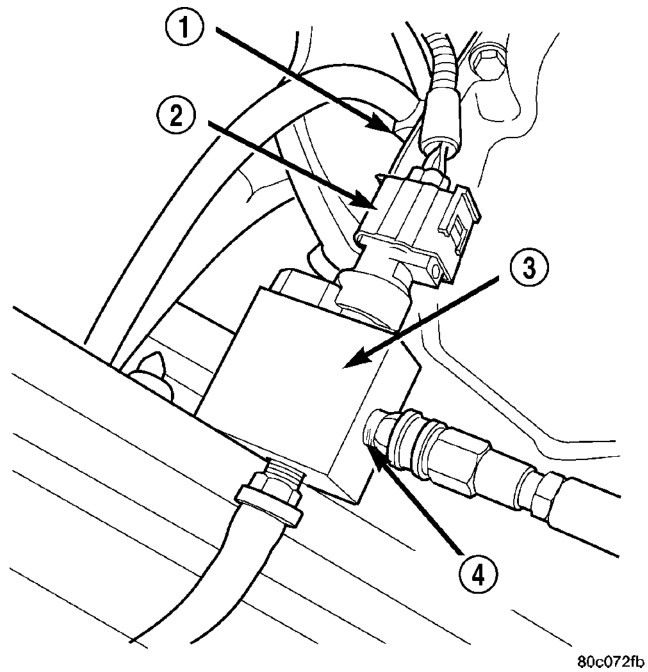


Fig. 4 Line Pressure Adapter 8259

1 - LINE PRESSURE SENSOR PORT
2 - LINE PRESSURE SENSOR
3 - TOOL 8259
4 - PRESSURE TAP

TEST PROCEDURE

All pressure readings should be taken with the transmission fluid level full, transmission oil at the normal operating temperature, and the engine at 1500 rpm. Check the transmission for proper operation in each gear position that is in question or if a specific element is in question, check the pressure readings in at least two gear positions that employ that element. Refer to the Hydraulic Schematics at the rear of this section to determine the correct pressures for each element in a given gear position.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

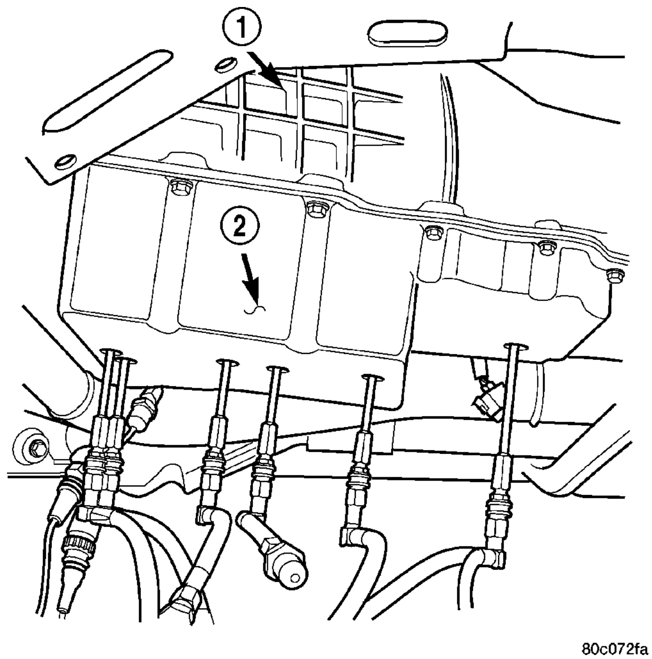


Fig. 5 Valve Body Pressure Tap Adapter 8258-A

1 - 45RFE TRANSMISSION
2 - TOOL 8258-A

NOTE: The 45RFE/545RFE utilizes closed loop control of pump line pressure. The pressure readings may therefore vary greatly but should always follow line pressure.

Some common pressures that can be measured to evaluate pump and clutch performance are the upshift/downshift pressures, garage shift pressures, and TCC pressure. The upshift/downshift pressure for all shifts are shown in UPSHIFT PRESSURES and DOWNSHIFT PRESSURES. In-gear maximum pressure for each gear position is shown in IN-GEAR PRESSURES. The garage shift pressure when performing a N-R shift is 220 psi for 3.7L/4.7L equipped vehicles and 250 psi for 5.7L equipped vehicles. The garage shift pressure for the R-N shift is 120 psi. The garage shift pressure for the N-1 shift is 135 psi for 3.7L/4.7L equipped vehicles and 165 psi for 5.7L equipped vehicles. Torque converter lock-up pressure is 120 psi for 3.7L/4.7L equipped vehicles and 125 psi for 5.7L equipped vehicles.

UPSHIFT PRESSURES

ENGINE	1-2	2-3	2prime-3	3-4	2prime-4	2-5	3-5	4-5
5.7L	150	125	125	135	135	135	135	135
3.7L/ 4.7L	120	120	120	120	120	120	120	130

DOWNSHIFT PRESSURES

ENG-INE	5-4	5-3	5-2	4-3	4-2 prime	3-2	3-2 prime	2 prime -1	2-1	3-1
5.7L	135	135	135	135	135	135	135	135	135	135
3.7L/ 4.7L	120	120	120	120	120	120	120	120	120	120

IN-GEAR PRESSURES

ENGINE	1	2	2 prime	3	4	5	NEUT-RAL	REV-ERSE
5.7L	160	135	135	135	135	135	120	250
3.7L/ 4.7L	135	120	120	120	120	120	120	220

DIAGNOSIS AND TESTING - AIR CHECKING TRANSMISSION CLUTCH OPERATION

Air-pressure testing can be used to check transmission clutch operation. The test can be conducted with the transmission either in the vehicle or on the work bench, as a final check.

Air-pressure testing requires that the oil pan and valve body be removed from the transmission. The clutch apply passages are shown (Fig. 6).

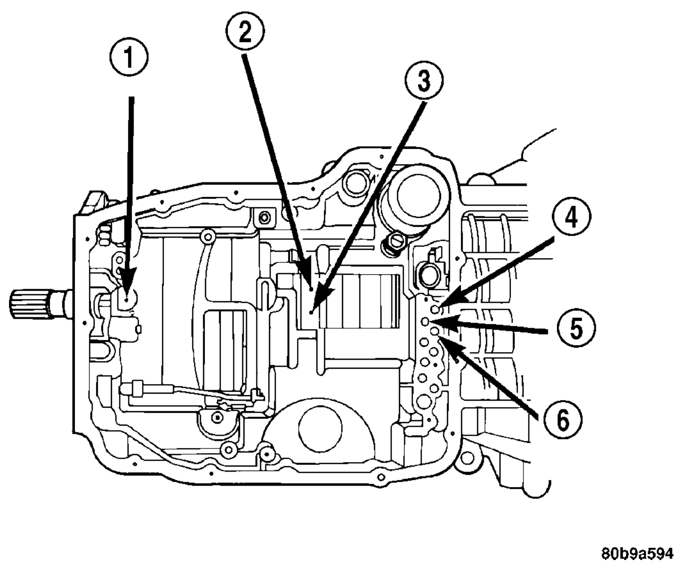


Fig. 6 Air Pressure Test Passages

1 - LOW REVERSE CLUTCH
2 - 4TH CLUTCH
3 - 2ND CLUTCH
4 - OVERDRIVE CLUTCH
5 - UNDERDRIVE CLUTCH
6 - REVERSE CLUTCH

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

NOTE: The air supply which is used must be free of moisture and dirt. Use a pressure of 30 psi to test clutch operation.

Apply air pressure at each port. If the clutch is functioning, a soft thump will be heard as the clutch is applied. The clutch application can also be felt by touching the appropriate element while applying air pressure. As the air pressure is released, the clutch should also release.

DIAGNOSIS AND TESTING - CONVERTER HOUSING FLUID LEAK

When diagnosing converter housing fluid leaks, two items must be established before repair.

(1) Verify that a leak condition actually exists.

(2) Determined the true source of the leak.

Some suspected converter housing fluid leaks may not be leaks at all. They may only be the result of residual fluid in the converter housing, or excess fluid spilled during factory fill or fill after repair. Converter housing leaks have several potential sources. Through careful observation, a leak source can be identified before removing the transmission for repair. Torque converter seal leaks tend to move along the drive hub and onto the rear of the converter. Pump cover seal tend to run down the cover and the inside surface of the bellhousing.

Some leaks, or suspected leaks, may be particularly difficult to locate. If necessary, a Mopar® approved dye may be used to locate a leak.

TORQUE CONVERTER LEAK POINTS

Possible sources of converter leaks are:

(1) Leaks at the weld joint around the outside diameter weld (Fig. 7).

(2) Leaks at the converter hub weld (Fig. 7).

STANDARD PROCEDURE - ALUMINUM THREAD REPAIR

Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils™, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil™ tap, or equivalent, and installing a Heli-Coil™ insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil™, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

REMOVAL

(1) Disconnect the negative battery cable.

(2) Raise and support the vehicle

(3) Remove any necessary skid plates. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)

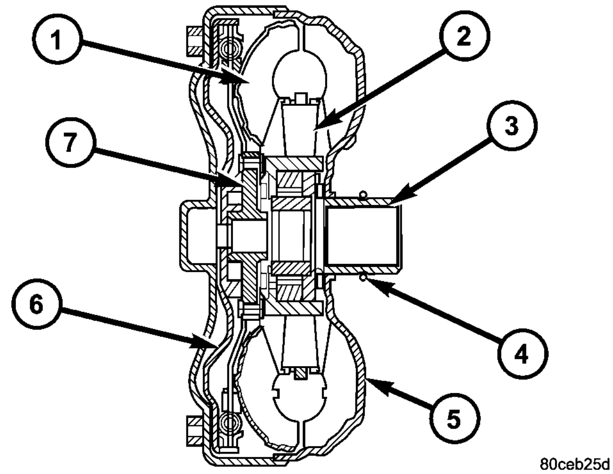


Fig. 7 Torque Converter Assembly

1 - TURBINE ASSEMBLY
2 - STATOR
3 - CONVERTER HUB
4 - O-RING
5 - IMPELLER ASSEMBLY
6 - CONVERTER CLUTCH PISTON
7 - TURBINE HUB

(4) Mark propeller shaft and axle companion flanges for assembly alignment.

(5) Remove the rear propeller shaft

(6) Remove the front propeller shaft, if necessary.

(7) Remove the engine to transmission collar (Fig. 8).

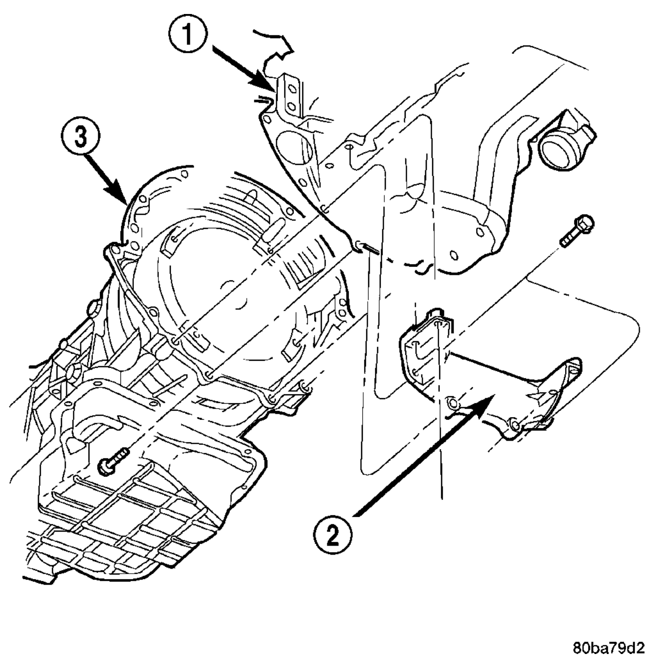


Fig. 8 Transmission Collar

1 - ENGINE
2 - ENGINE TO TRANSMISSION COLLAR
3 - TRANSMISSION

(8) Remove the exhaust support bracket from the rear of the transmission.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(9) Disconnect and lower or remove any necessary exhaust components.

(10) Remove the starter motor.

(11) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on dampener bolt.

(12) Disengage the output speed sensor connector from the output speed sensor (Fig. 9).

(13) Disengage the input speed sensor connector from the input speed sensor (Fig. 10).

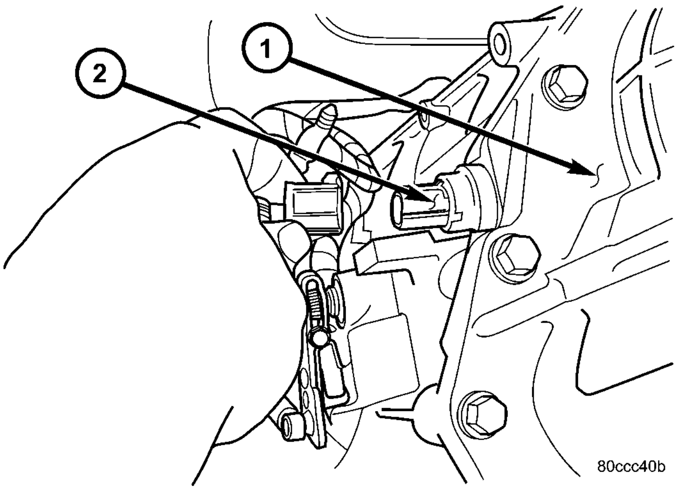


Fig. 9 Disconnect Output Speed Sensor

1 - TRANSMISSION
2 - OUTPUT SPEED SENSOR

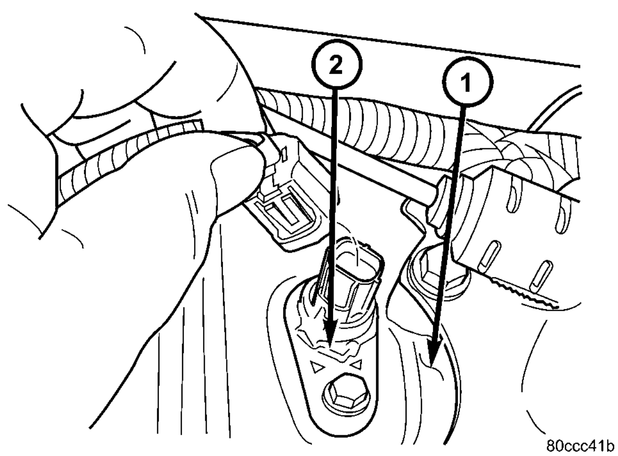


Fig. 10 Disconnect Input Speed Sensor

1 - TRANSMISSION
2 - INPUT SPEED SENSOR

(14) Disengage the transmission solenoid/TRS assembly connector from the transmission solenoid/ TRS assembly (Fig. 11).

(15) Disengage the line pressure sensor connector from the line pressure sensor (Fig. 12).

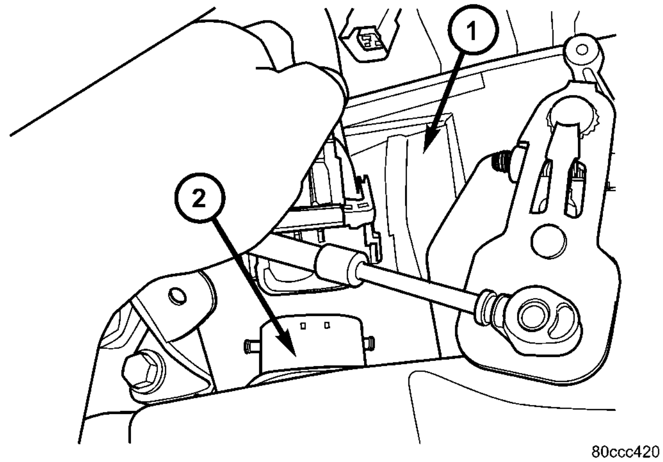


Fig. 11 Disconnect Transmission Solenoid/TRS Assembly

1 - TRANSMISSION
2 - TRANSMISSION SOLENOID/TRS ASSEMBLY

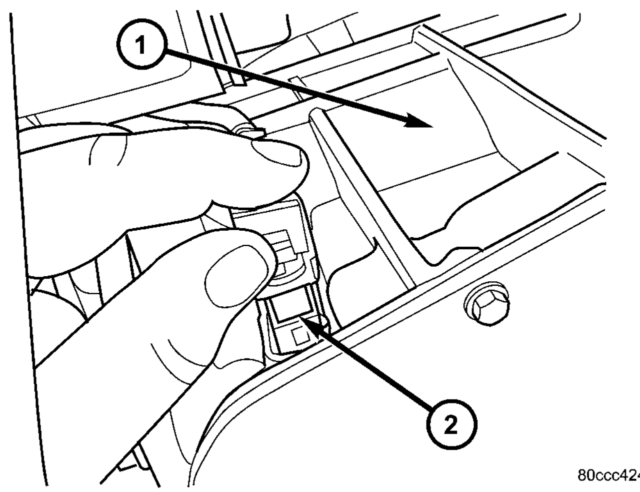


Fig. 12 Disconnect Line Pressure Sensor

1 - TRANSMISSION
2 - LINE PRESSURE SENSOR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(16) Disconnect gearshift cable from transmission manual valve lever (Fig. 13).

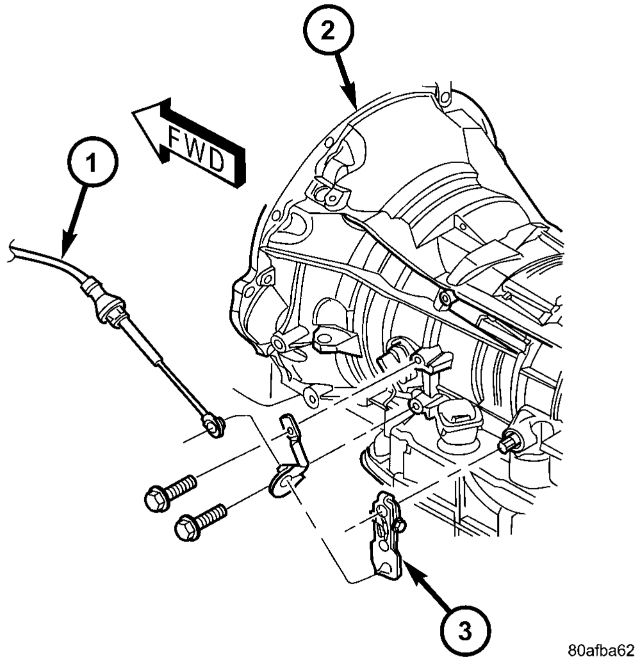


Fig. 13 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

(17) Disconnect the transmission vent hose from the transmission.

(18) Support rear of engine with safety stand or jack.

(19) Raise transmission slightly with service jack to relieve load on crossmember and supports.

(20) Remove bolts securing rear support and cushion to transmission and crossmember.

(21) Remove transfer case, if necessary.

(22) Disconnect transmission fluid cooler lines at transmission fittings and clips.

(23) Remove all remaining converter housing bolts.

(24) Carefully work transmission and torque converter assembly rearward off engine block dowels.

(25) Hold torque converter in place during transmission removal.

(26) Lower transmission and remove (Fig. 14) assembly from under the vehicle.

(27) To remove torque converter, carefully slide torque converter out of the transmission.

DISASSEMBLY

(1) Drain fluid from transmission.

(2) Clean exterior of transmission with suitable solvent or pressure washer.

(3) Remove the torque converter from the transmission.

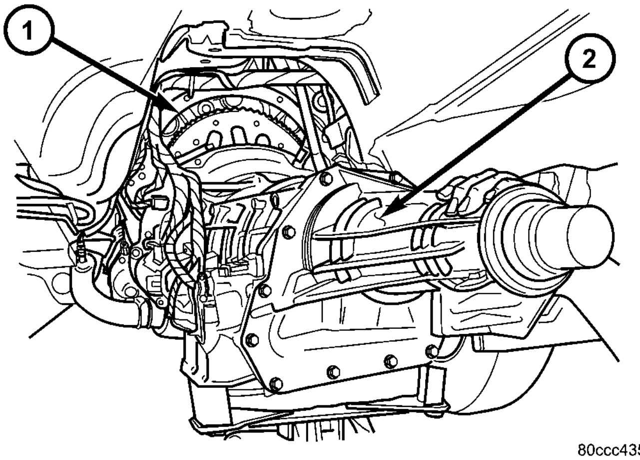


Fig. 14 Remove Transmission

1 - ENGINE
2 - TRANSMISSION

(4) Remove the manual shift lever from the transmission.

(5) Remove the input, output, and line pressure sensors from the transmission case (Fig. 15).

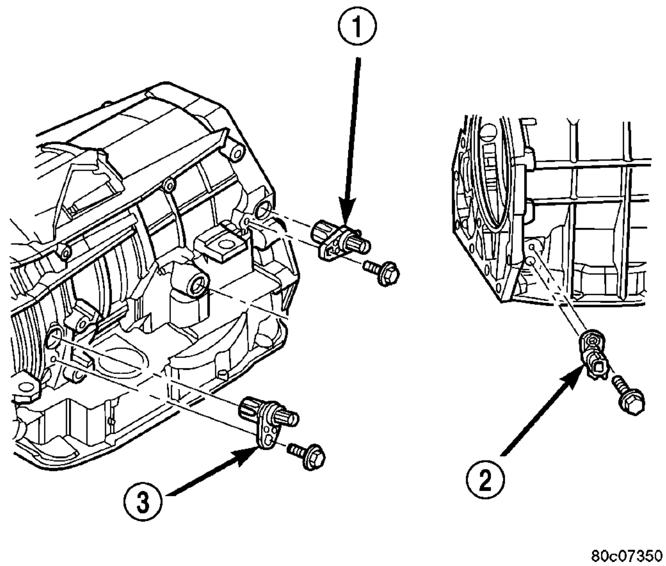


Fig. 15 Remove Input, Output, and Line Pressure Sensors

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(6) Inspect the ends of the sensors for debris, which may indicate the nature of the transmission failure.

(7) Install Support Stand 8257 onto the transmission case (Fig. 16).

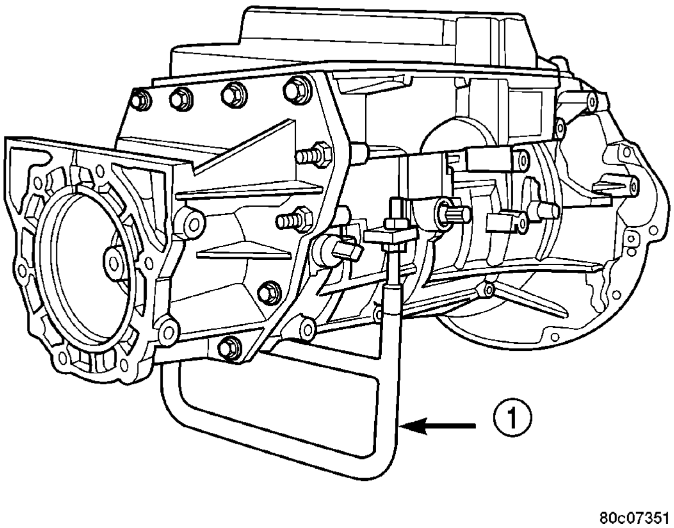


Fig. 16 Install Support Stand - Tool 8257

1 - TOOL 8257

(8) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 17).

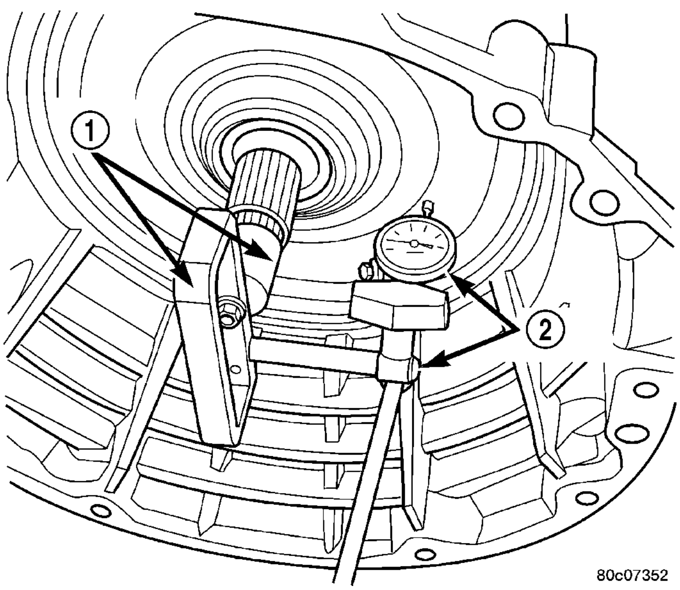


Fig. 17 Measure Input Shaft End Play

1 - TOOL 8266
2 - TOOL C-3339

NOTE: When measuring the input shaft end-play, two ″stops″ will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first ″stop″ felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

(9) Remove the bolts holding the transmission extension/adapter housing to the transmission case.

(10) Remove the extension/adapter housing from the transmission case.

(11) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 18).

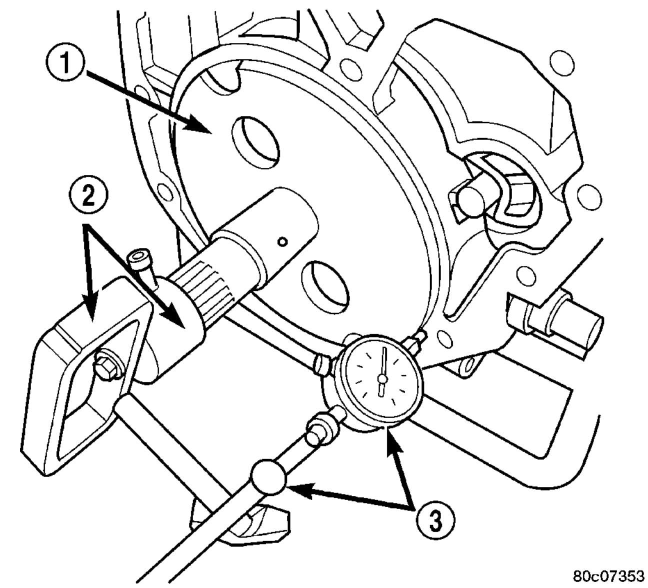


Fig. 18 Measure Output Shaft End Play

1 - TOOL 8261
2 - TOOL 8266
3 - TOOL C-3339

(12) Remove the bolts holding the transmission oil pan to the transmission case.

(13) Remove the transmission oil pan from the transmission case.

(14) Remove the primary oil filter and the oil cooler return filter (Fig. 19).

(15) Remove the cooler return filter bypass valve.

(16) Remove the bolts holding the valve body to the transmission case (Fig. 20).

(17) Remove the valve body from the transmission case.

(18) Remove the outer snap-ring securing the transmission front cover into the transmission case (Fig. 21).

(19) Remove the inner snap-ring securing the transmission front cover to the oil pump (Fig. 21).

(20) Reaching through a case opening in the valve body area with a long blunted tool, remove the transmission front cover from the transmission case.

(21) Remove the bolts holding the oil pump into the transmission case (Fig. 22).

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

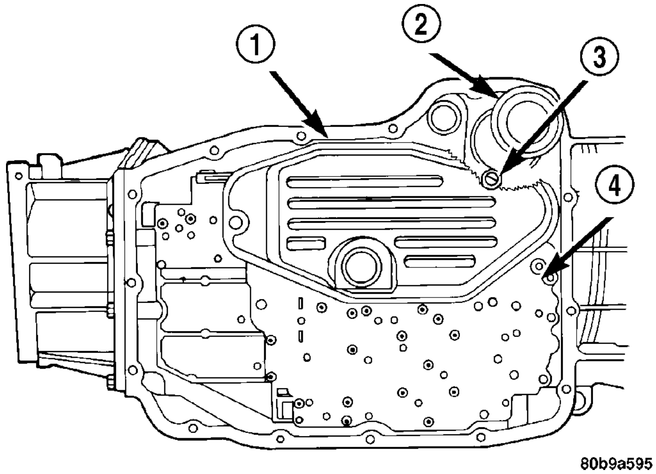


Fig. 19 Remove Primary Oil and Cooler Filters

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

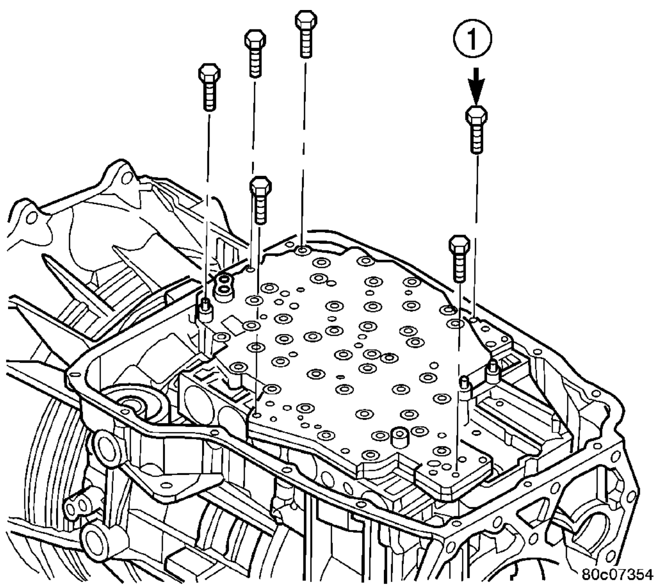


Fig. 20 Remove Valve Body Assembly

1 - VALVE BODY TO CASE BOLT (6)

(22) Remove the oil pump. Hold inward on the input shaft to prevent pulling the input clutch assembly with the oil pump (Fig. 22).

NOTE: If the input shaft is not held during oil pump removal, the input clutch assembly will attempt to move forward with the oil pump and the numbers 2, 3, or 4 bearings inside the input clutch assembly may become dislodged.

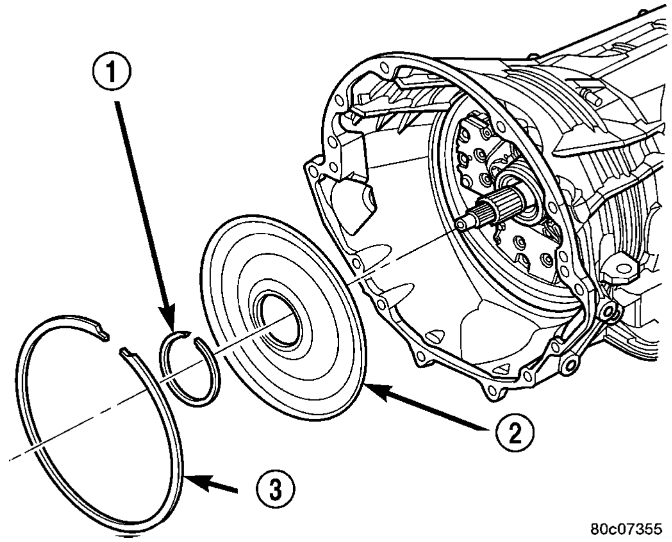


Fig. 21 Remove Transmission Front Cover

1 - INNER SNAP-RING
2 - TRANSMISSION COVER
3 - OUTER SNAP-RING

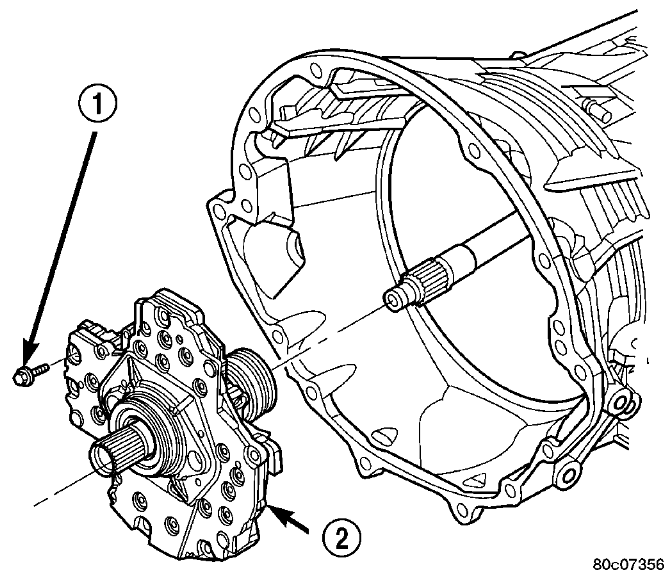


Fig. 22 Remove Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

(23) Remove the number 1 bearing from the input clutch assembly (Fig. 23).

(24) Remove the input clutch assembly from the transmission case (Fig. 23).

(25) Remove the number 5 bearing and selective thrust plate from the input clutch assembly (Fig. 23), or the 4C clutch retainer/bulkhead.

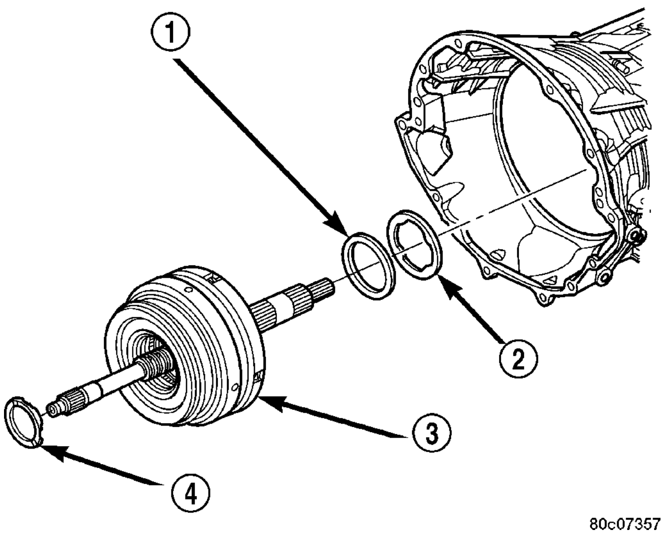


Fig. 23 Remove Input Clutch Assembly

1 - BEARING NUMBER 5
2 - THRUST PLATE (SELECT)
3 - INPUT CLUTCH ASSEMBLY
4 - BEARING NUMBER 1

(26) Remove the 4C clutch retainer/bulkhead tapered snap-ring from the transmission case (Fig. 24).

(27) Remove the 4C clutch retainer/bulkhead from the transmission case (Fig. 24).

(28) Remove the front 2C clutch pack snap-ring from the transmission case (Fig. 25).

(29) Remove the 2C clutch pack from the transmission case (Fig. 25).

(30) Remove the rear selective plate and number 6 bearing from the reaction annulus (Fig. 26).

(31) Remove the reaction annulus from the reaction planetary carrier (Fig. 26).

(32) Remove the number 7 bearing (Fig. 26).

(33) Remove the reaction sun gear (Fig. 26).

(34) Remove the number 8 bearing from the reaction planetary carrier (Fig. 26).

(35) Remove the reaction planetary carrier (Fig. 26). Note that this planetary gear set has three pinion gears.

(36) Remove the number 9 bearing from the reverse planetary gear set (Fig. 26).

(37) Remove the snap-ring holding the park sprag gear onto the output shaft (Fig. 27).

(38) Remove the park sprag gear from the output shaft (Fig. 28).

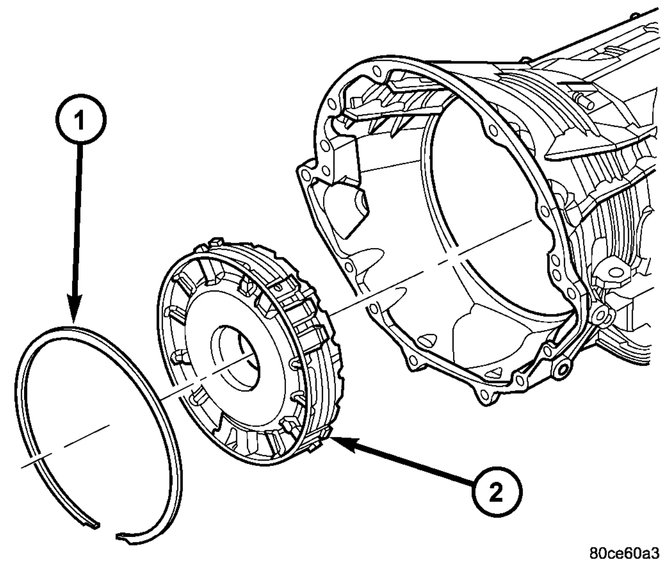


Fig. 24 Remove 4C Clutch Retainer/Bulkhead

1 - SNAP-RING
2 - 4C CLUTCH RETAINER/BULKHEAD

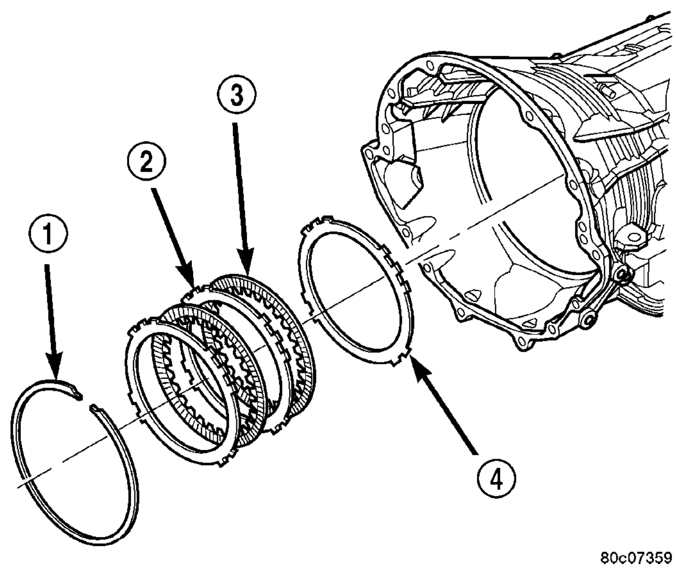


Fig. 25 Remove 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

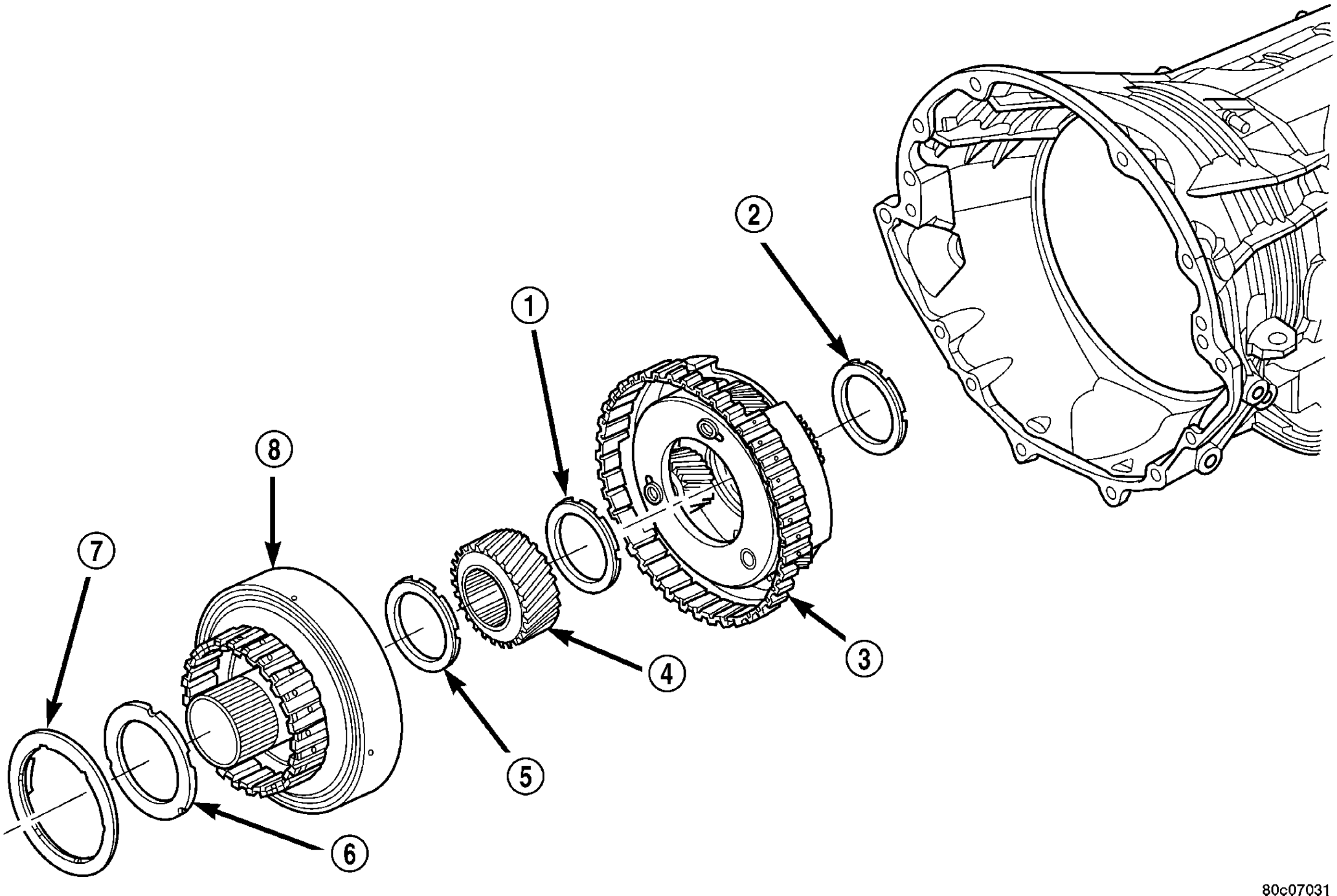


Fig. 26 Remove Reaction Annulus and Carrier

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

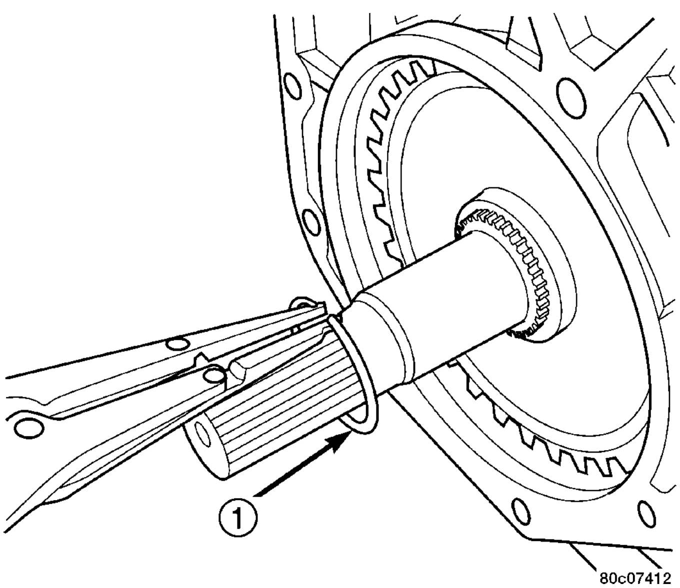


Fig. 27 Remove Park Sprag Snap-Ring

1 - SNAP-RING

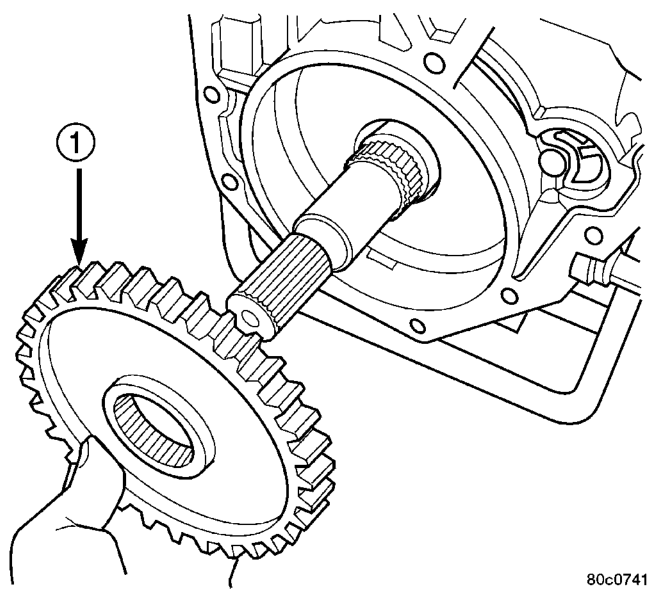


Fig. 28 Remove Park Sprag Gear

1 - PARK SPRAG GEAR

(39) Remove the input/reverse planetary assembly (Fig. 29).

(40) Remove the number 12 bearing from the input/reverse planetary assembly (Fig. 29).

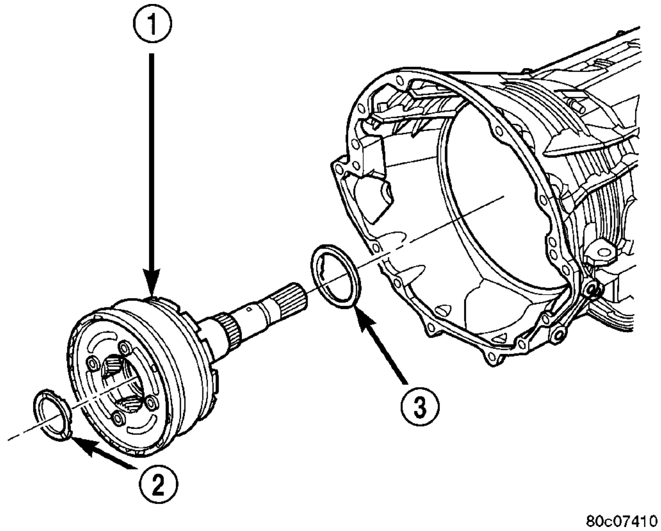


Fig. 29 Remove Input/Reverse Planetary Assembly

1 - INPUT/REVERSE PLANETARY ASSEMBLY
2 - BEARING NUMBER 9
3 - BEARING NUMBER 12

(41) Remove the snap-ring holding the low/reverse clutch retainer into the transmission case (Fig. 30).

(42) Remove the low/reverse clutch retainer from the transmission case (Fig. 30).

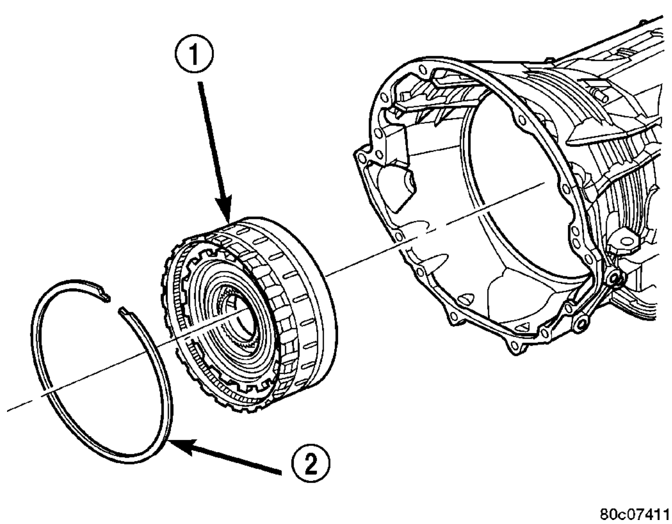


Fig. 30 Remove Low/Reverse Clutch Retainer

1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY
2 - SNAP-RING

(43) Remove the park pawl rod and e-clip (Fig. 31).

(44) Remove the park pawl rod guide snap-ring (Fig. 31).

(45) Remove the park pawl rod guide (Fig. 31).

(46) Remove the park pawl pivot shaft, park pawl, and spring (Fig. 31).

(47) Remove the manual selector shaft (Fig. 31).

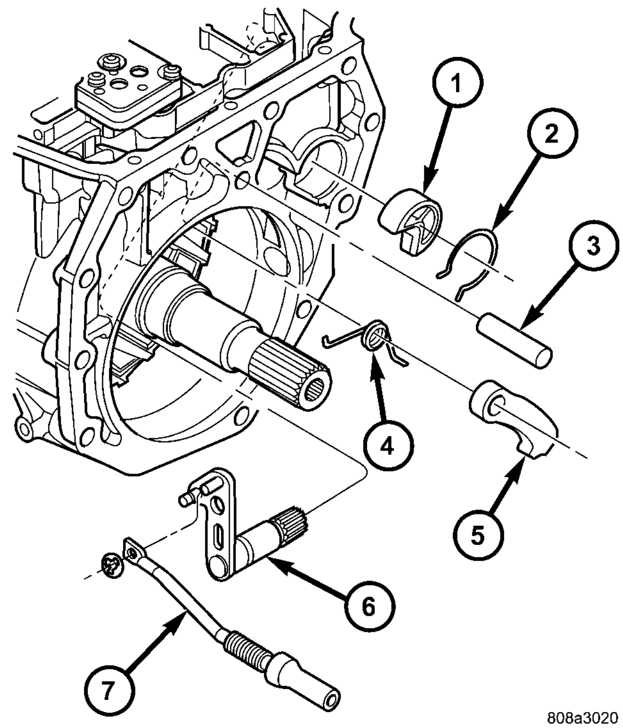


Fig. 31 Manual Shaft/Park Lock Components

1 - GUIDE
2 - SNAP-RING
3 - SHAFT
4 - SPRING
5 - PARK PAWL
6 - MANUAL SHAFT/LEVER
7 - PARK ROD

(48) Remove the manual selector shaft seal.

(49) Remove the dipstick tube seal.

CLEANING

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on shafts, or valves, use extreme care to avoid rounding off sharp edges. Sharp edges are vital as they prevent foreign matter from getting between the valve and valve bore.

Do not reuse oil seals, gaskets, seal rings, or O-rings during overhaul. Replace these parts as a matter of course. Also do not reuse snap rings or E-clips that are bent or distorted. Replace these parts as well.

Lubricate transmission parts with Mopar® ATF +4, Automatic Transmission Fluid, during overhaul and assembly. Use petroleum jelly, Mopar® Door Ease, or Ru-Glyde to prelubricate seals, O-rings, and thrust

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

washers. Petroleum jelly can also be used to hold parts in place during reassembly.

Clean the case in a solvent tank. Flush the case bores and fluid passages thoroughly with solvent. Dry the case and all fluid passages with compressed air. Be sure all solvent is removed from the case and that all fluid passages are clear.

NOTE: Do not use shop towels or rags to dry the case (or any other transmission component) unless they are made from lint-free materials. Lint will stick to case surfaces and transmission components and circulate throughout the transmission after assembly. A sufficient quantity of lint can block fluid passages and interfere with valve body operation.

INSPECTION

Inspect the case for cracks, porous spots, worn bores, or damaged threads. Damaged threads can be repaired with Helicoil thread inserts. However, the case will have to be replaced if it exhibits any type of damage or wear.

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the cooler filter bypass valve.

(3) Torque the bypass valve to specification. The valve uses a tapered pipe thread and excessive torque can damage the transmission case. Tighten the cooler filter bypass valve to 4.5 N·m (40 in.lbs.).

(4) Install a new selector shaft seal using Seal Installer 8253 (Fig. 32).

(5) Install the manual selector shaft and retaining screw. Tighten the manual selector shaft retaining screw to 28 N·m (250 in.lbs.).

(6) Install the park pawl, spring, and shaft (Fig. 33).

(7) Install the park rod and e-clip (Fig. 33).

(8) Install the park rod guide and snap-ring (Fig. 33).

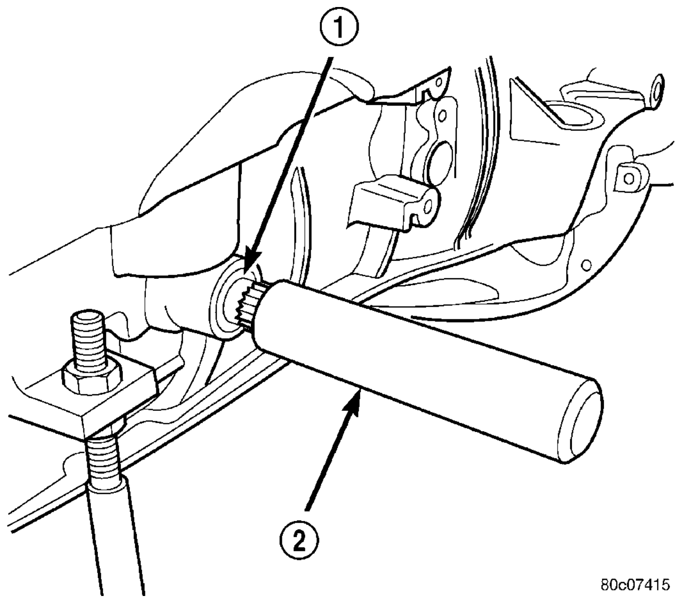


Fig. 32 Install Selector Shaft

1 - SEAL
2 - TOOL 8253

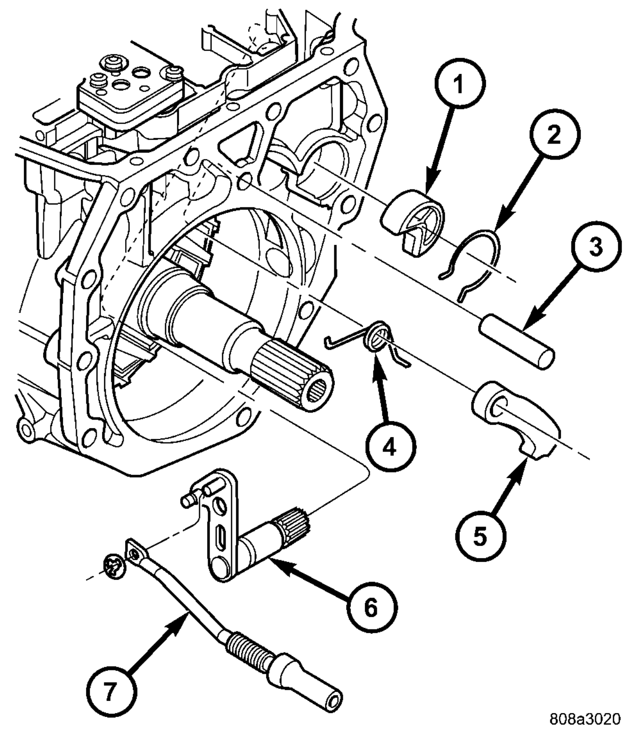


Fig. 33 Manual Shaft/Park Lock Components

1 - GUIDE
2 - SNAP-RING
3 - SHAFT
4 - SPRING
5 - PARK PAWL
6 - MANUAL SHAFT/LEVER
7 - PARK ROD

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(9) Install a new dipstick tube seal using Seal Installer 8254 (Fig. 34).

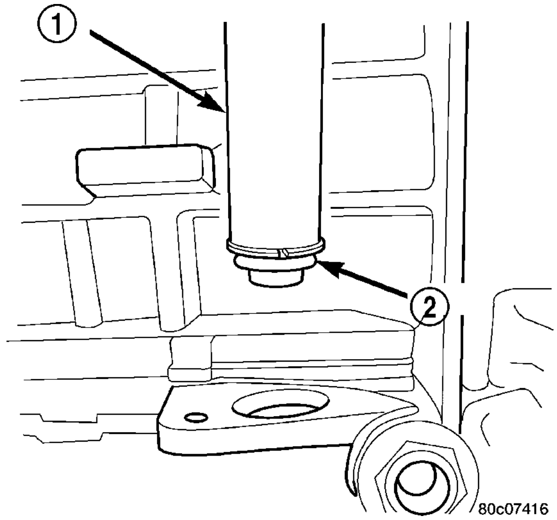


Fig. 34 Install Dipstick Tube Seal Using Tool 8254

1 - TOOL 8254
2 - SEAL

NOTE: Before final assembly of transmission centerline, the 2C/4C clutch components should be installed into position and measured as follows:

(10) Install the 2C reaction plate into the transmission case (Fig. 35). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

(11) Install the 2C clutch pack into the transmission case (Fig. 35).

(12) Install the flat 2C clutch snap-ring into the transmission case (Fig. 35).

(13) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area.

(14) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case. Make sure that the open ends of the snap-ring are located in the case opening toward the valve body area.

(15) Using a feeler gauge through the opening in the rear of the transmission case, measure the 2C clutch pack clearance between the 2C reaction plate and the transmission case at four different points. The average of these measurements is the 2C clutch pack clearance. The correct clutch clearance is 0.455-1.335 mm (0.018-0.053 in.). The reaction plate is not selective. If the clutch pack clearance is not within specification, the reaction plate, all the friction discs, and steels must be replaced.

(16) Remove the 4C retainer/bulkhead and all of the 2C clutch components from the transmission case.

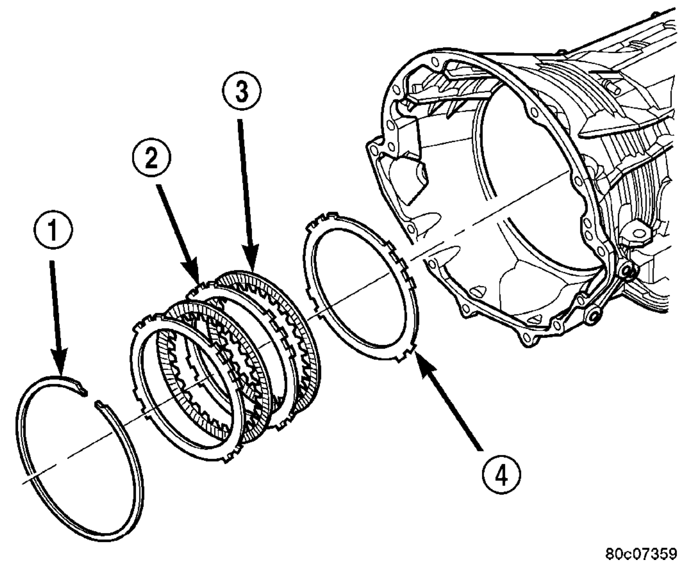


Fig. 35 Install 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

(17) Install the low/reverse clutch assembly (Fig. 36). Make sure that the oil feed hole points toward the valve body area and that the bleed orifice is aligned with the notch in the rear of the transmission case.

(18) Install the snap-ring to hold the low/reverse clutch retainer into the transmission case (Fig. 36). The snap-ring is tapered and must be installed with the tapered side forward. Once installed, verify that the snap-ring is fully seated in the snap-ring groove.

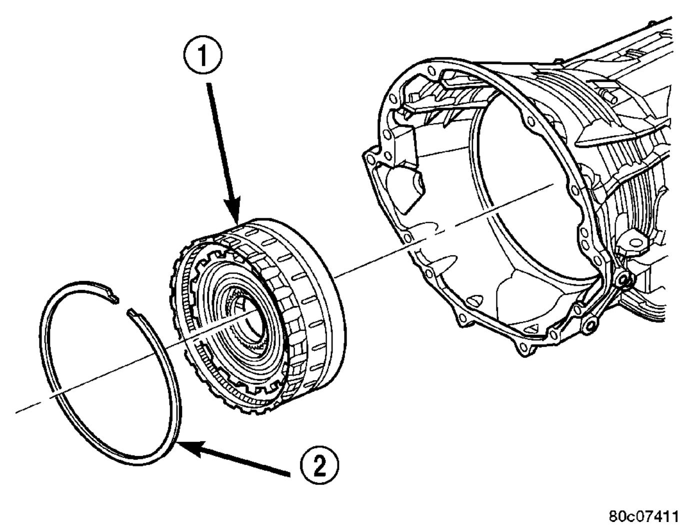


Fig. 36 Install Low/Reverse Clutch Retainer

1 - LOW/REVERSE OVERRUNNING CLUTCH ASSEMBLY
2 - SNAP-RING

(19) Air check the low/reverse clutch and verify correct overrunning clutch operation.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(20) Install the number 12 bearing over the output shaft and against the rear planetary gear set. The flat side of the bearing goes toward the planetary gearset and the raised tabs on the inner race should face the rear of the transmission.

(21) Install the reverse/input planetary assembly through the low/reverse clutch assembly (Fig. 37).

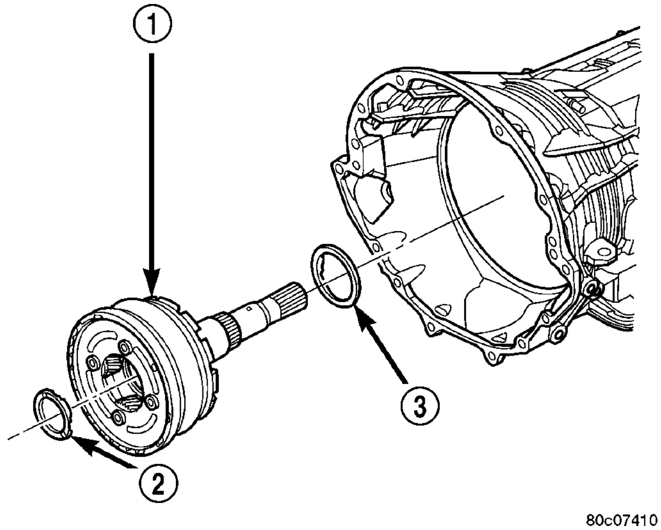


Fig. 37 Install Input/Reverse Planetary Assembly

1 - INPUT/REVERSE PLANETARY ASSEMBLY
2 - BEARING NUMBER 9
3 - BEARING NUMBER 12

(22) Install the park sprag onto the output shaft (Fig. 38).

(23) Install the snap-ring to hold the park sprag onto the output shaft (Fig. 39).

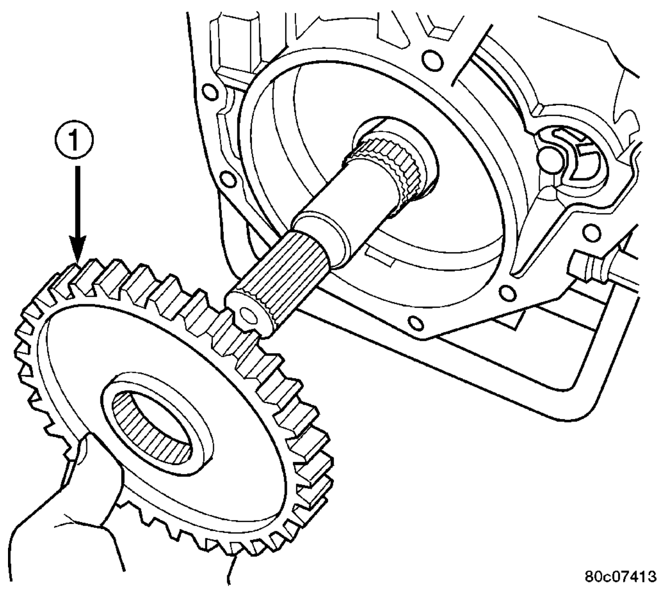


Fig. 38 Install Park Sprag Gear

1 - PARK SPRAG GEAR

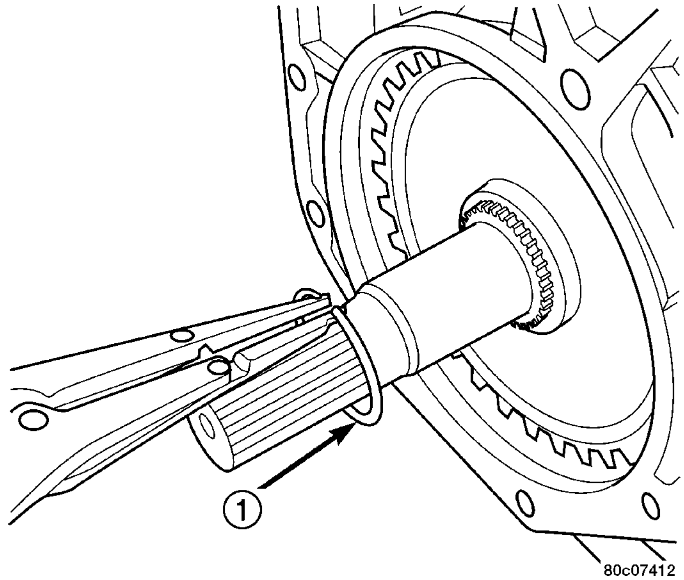


Fig. 39 Install Park Sprag Snap-Ring

1 - SNAP-RING

(24) Install the 2C reaction plate into the transmission case (Fig. 40). The reaction plate is directional. The plate must be installed with the flat side toward the front of the transmission.

(25) Install the 2C clutch pack into the transmission case (Fig. 40).

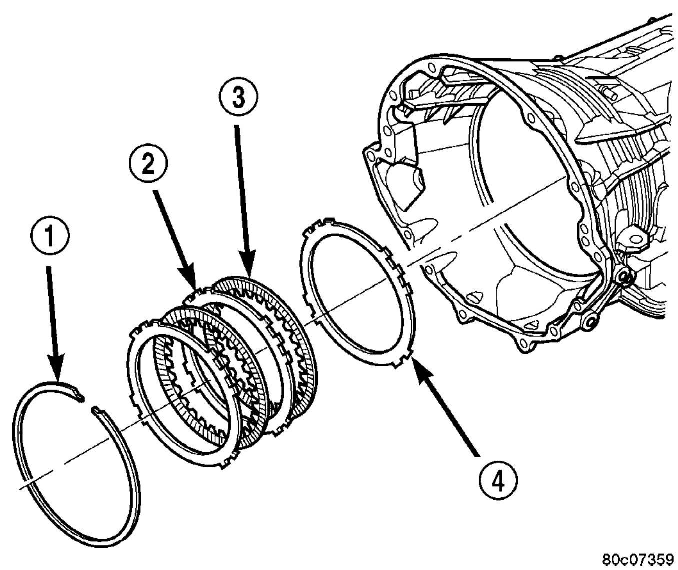


Fig. 40 Install 2C Clutch Pack

1 - SNAP-RING
2 - PLATE
3 - DISC
4 - REACTION PLATE

(26) Install the number 8 bearing inside the reaction carrier with the outer race against the reaction planetary carrier.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(27) Install the reaction planetary gear set and the number 9 bearing, with the inner race against the reaction planetary carrier, into the transmission case (Fig. 41).

(28) Install the flat 2C clutch snap-ring into the transmission case (Fig. 40).

(29) Install the reaction sun gear into the reaction planetary gear set. **Make sure** the small shoulder is facing the front of the transmission (Fig. 41).

(30) Install the number 7 bearing onto the reaction sun gear with the inner race against the sun gear (Fig. 41).

(31) Install the output shaft selective thrust plate onto the reaction annulus with the oil grooves facing the annulus gear and the tabs and notches aligned as shown in (Fig. 42).

(32) Install the number 6 bearing against the output shaft selective thrust plate with the flat side against the thrust plate (Fig. 41) and the raised tabs on the inner race facing the front of the transmission.

(33) Install the reaction annulus into the reaction planetary gear set (Fig. 41).

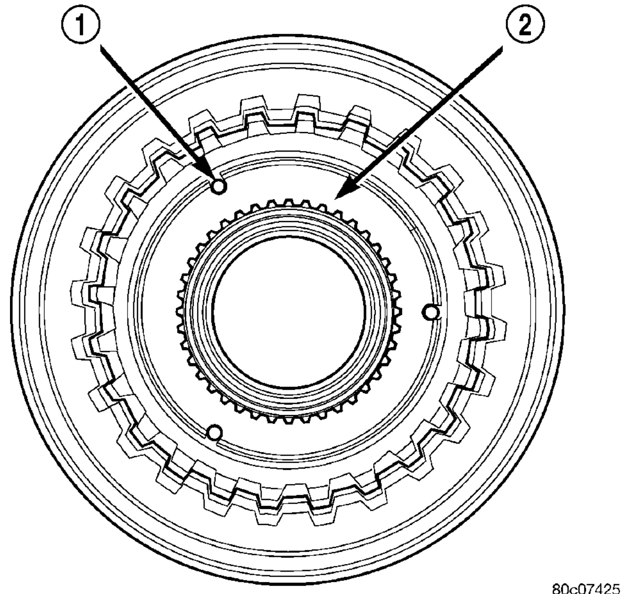


Fig. 42 Thrust Plate Alignment

1 - LOCATING LUG (3)
2 - THRUST PLATE

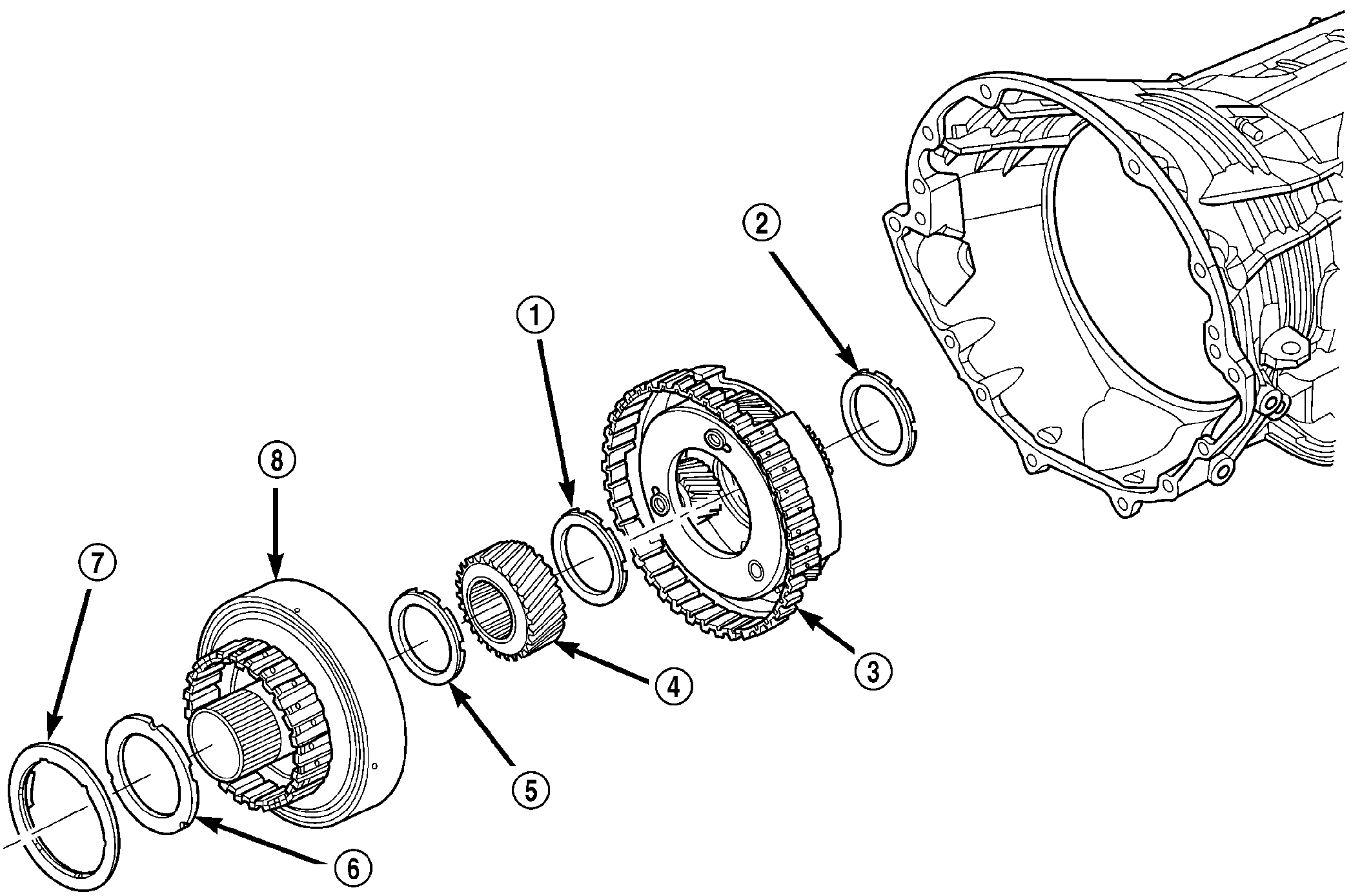


Fig. 41 Install Reaction Annulus and Carrier

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(34) Install the 4C retainer/bulkhead into the transmission case. Make sure that the oil feed holes are pointing toward the valve body area. Rotate the reaction annulus during the installation of the 4C retainer/bulkhead to ease installation.

(35) Install the 4C retainer/bulkhead tapered snap-ring into the transmission case (Fig. 43) with the taper toward the front of the case. Make sure that the open ends of the snap-ring are located in the case opening toward the valve body area.

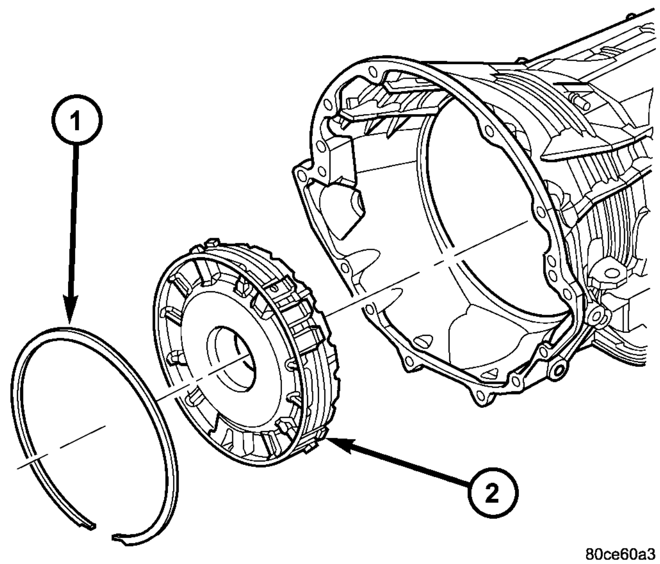


Fig. 43 Install 4C Clutch Retainer/Bulkhead

1 - SNAP-RING
2 - 4C CLUTCH RETAINER/BULKHEAD

(36) Air check the 2C and 4C clutch operation.

(37) Using Alignment Plate 8261, Adapter 8266-17 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the output shaft end-play (Fig. 44). The correct output shaft end-play is 0.22-0.55 mm (0.009-0.021 in.). Adjust as necessary. Install the chosen output shaft selective thrust plate and re-measure end-play to verify selection.

(38) Apply a bead of RTV silicone and install the extension/adapter housing onto the transmission case.

(39) Install and torque the bolts to hold the extension/adapter housing onto the transmission case. The correct torque is 54 N·m (40 ft.lbs.).

(40) Install the number 5 bearing and selective thrust plate onto the 4C retainer/bulkhead (Fig. 45). Be sure that the outer race of the bearing is against the thrust plate.

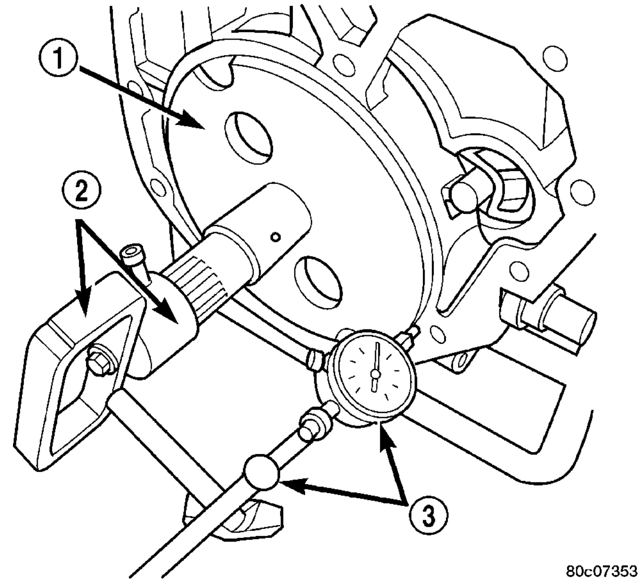


Fig. 44 Measure Output Shaft End Play

1 - TOOL 8261
2 - TOOL 8266
3 - TOOL C-3339

(41) Install the input clutch assembly into the transmission case (Fig. 45). Make sure that the input clutch assembly is fully installed by performing a visual inspection through the input speed sensor hole. If the tone wheel teeth on the input clutch assembly are centered in the hole, the assembly is fully installed.

(42) Install the number 1 bearing with the outer race up in the pocket of the input clutch assembly (Fig. 45).

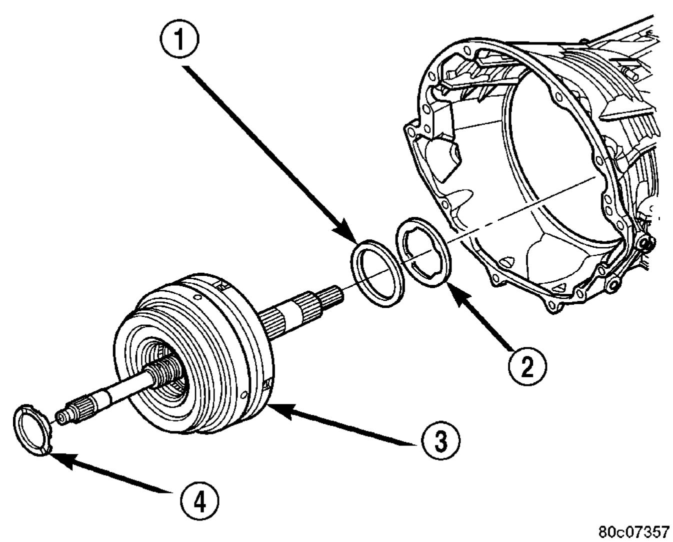


Fig. 45 Install Input Clutch Assembly

1 - BEARING NUMBER 5
2 - THRUST PLATE (SELECT)
3 - INPUT CLUTCH ASSEMBLY
4 - BEARING NUMBER 1

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(43) Install the oil pump into the transmission case (Fig. 46).

(44) Install the bolts to hold the oil pump into the transmission case. Tighten the oil pump bolts to 28 N·m (250 in.lbs.).

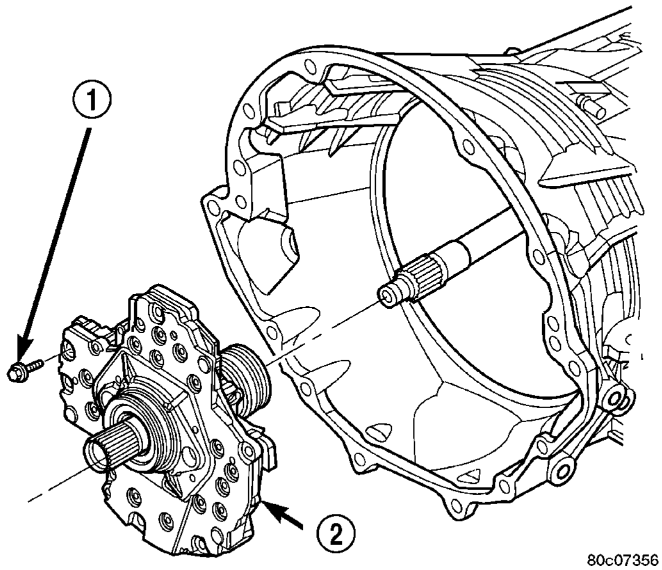


Fig. 46 Install Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

(45) Using Adapter 8266-1 from End-Play Tool Set 8266 and Dial Indicator C-3339, measure and record the input shaft end-play (Fig. 47). The correct end-play is 0.46-0.89 mm (0.018-0.035 in.). Adjust as necessary. Install the chosen thrust plate on the number 5 bearing and re-measure end-play to verify selection.

NOTE: When measuring the input shaft end-play, two ″stops″ will be felt. When the input shaft is pushed inward and the dial indicator zeroed, the first ″stop″ felt when the input shaft is pulled outward is the movement of the input shaft in the input clutch housing hub. This value should not be included in the end-play measured value and therefore must be recorded and subtracted from the dial indicator reading.

(46) Install the transmission front cover into the transmission case (Fig. 48).

(47) Install the outer snap-ring to hold the transmission front cover into the transmission case (Fig. 48).

(48) Partially install the inner transmission front cover snap-ring onto the oil pump (Fig. 48).

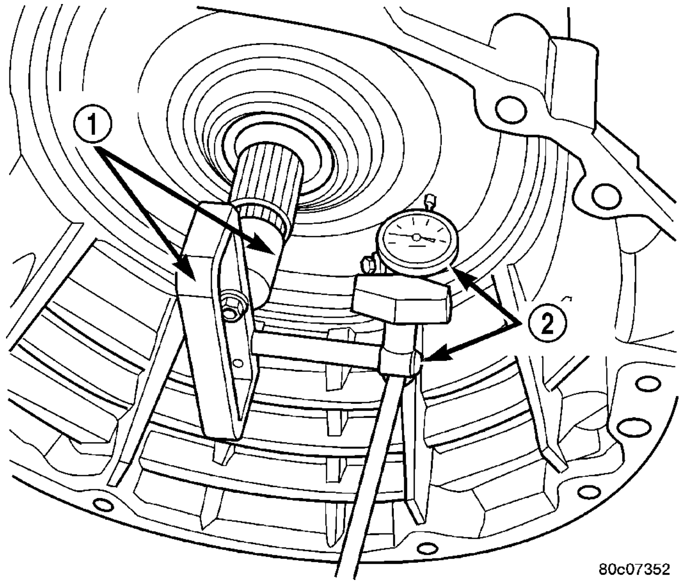


Fig. 47 Measure Input Shaft End Play

1 - TOOL 8266
2 - TOOL C-3339

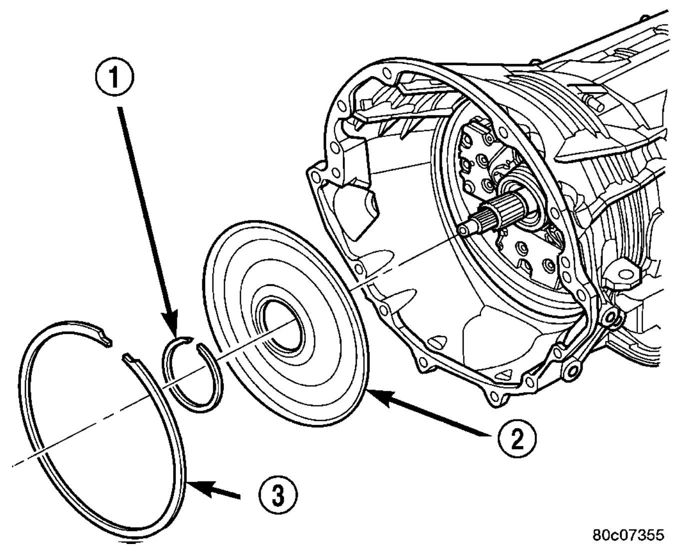


Fig. 48 Install the Transmission Front Cover

1 - INNER SNAP-RING
2 - TRANSMISSION COVER
3 - OUTER SNAP-RING

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(49) Using Installer 8255, install the inner transmission front cover snap-ring the remainder of the way onto the oil pump (Fig. 49).

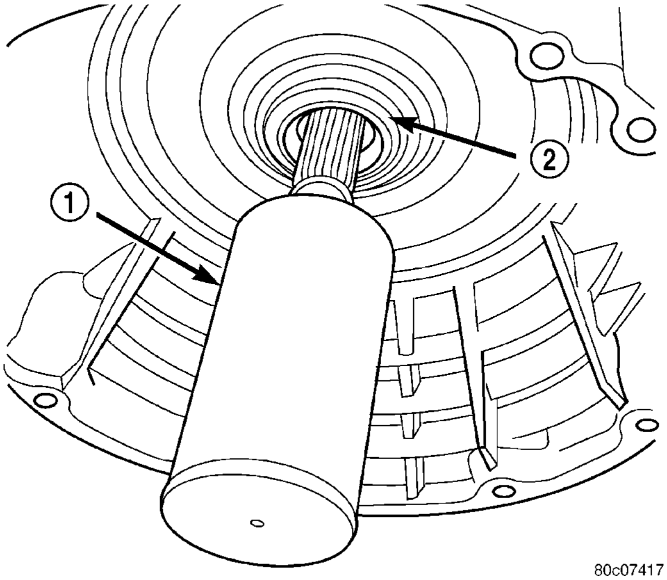


Fig. 49 Seat Snap-Ring Using Tool 8255

1 - TOOL 8255
2 - SNAP-RING

(50) Install the valve body (Fig. 50). Verify that the pin on the manual lever has properly engaged the TRS selector plate. Tighten the valve body to transmission case bolts to 12 N·m (105 in.lbs.).

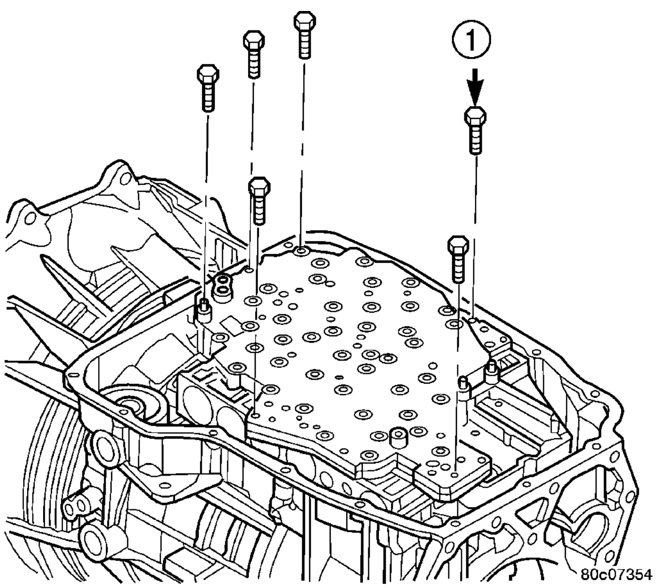


Fig. 50 Install Valve Body Assembly

1 - VALVE BODY TO CASE BOLT (6)

(51) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

CAUTION: The primary oil filter seal MUST be fully installed flush against the oil pump body. DO NOT install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.

(52) Install the primary oil filter and the oil cooler return filter (Fig. 51). Tighten the screw to hold the primary oil filter to the valve body to 4.5 N·m (40 in.lbs.). Using Oil Filter Wrench 8321, tighten the cooler return oil filter to the transmission case to 14 N·m (125 in.lbs.).

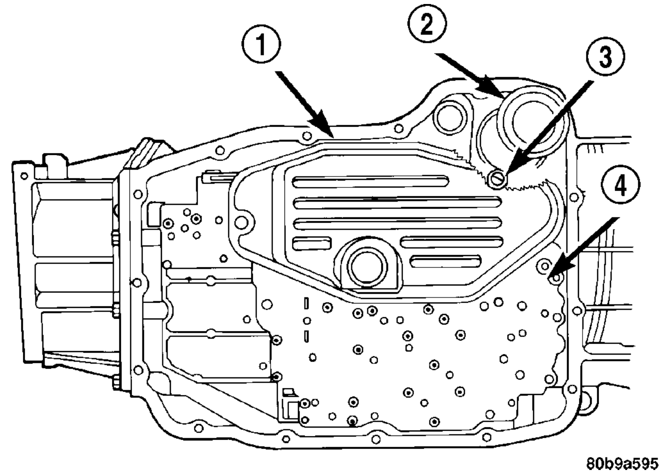


Fig. 51 Install Primary Oil and Cooler Filters

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

(53) Apply RTV silicone to the oil pan and install the transmission oil pan. Tighten the bolts to 12 N·m (105 in.lbs.).

(54) Install the input, output, and line pressure sensors (Fig. 52). Tighten the bolts to 12 N·m (105 in.lbs.).

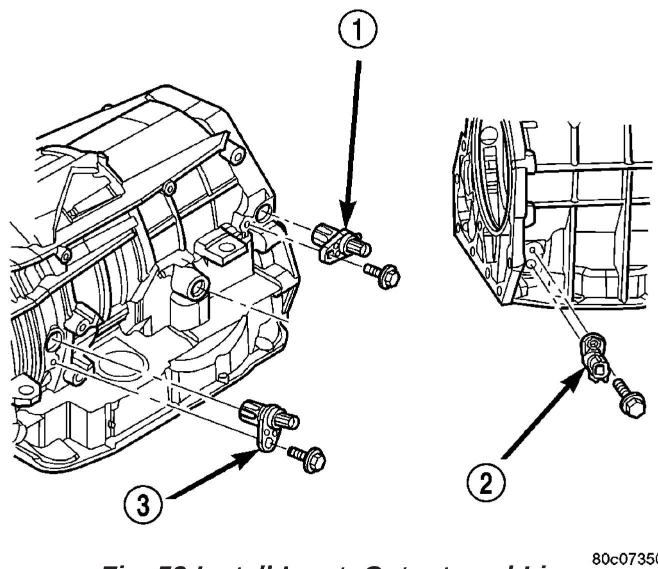


Fig. 52 Install Input, Output, and Line Pressure Sensors

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(55) Install the manual shift lever from the transmission. Torque the retaining cross-bolt to 16 N·m (140 in.lbs.).

INSTALLATION

(1) Check torque converter hub and hub drive flats for sharp edges burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper and crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free of any debris. The hub must be smooth to avoid damaging pump seal at installation.

(2) If a replacement transmission is being installed, transfer any components necessary, such as the manual shift lever and shift cable bracket, from the original transmission onto the replacement transmission.

(3) Lubricate oil pump seal lip with transmission fluid.

(4) Align converter and oil pump.

(5) Carefully insert converter in oil pump. Then rotate converter back and forth until fully seated in pump gears.

(6) Check converter seating with steel scale and straightedge (Fig. 53). Surface of converter lugs should be at least 13mm (1/2 in.) to rear of straightedge when converter is fully seated.

(7) Temporarily secure converter with C-clamp.

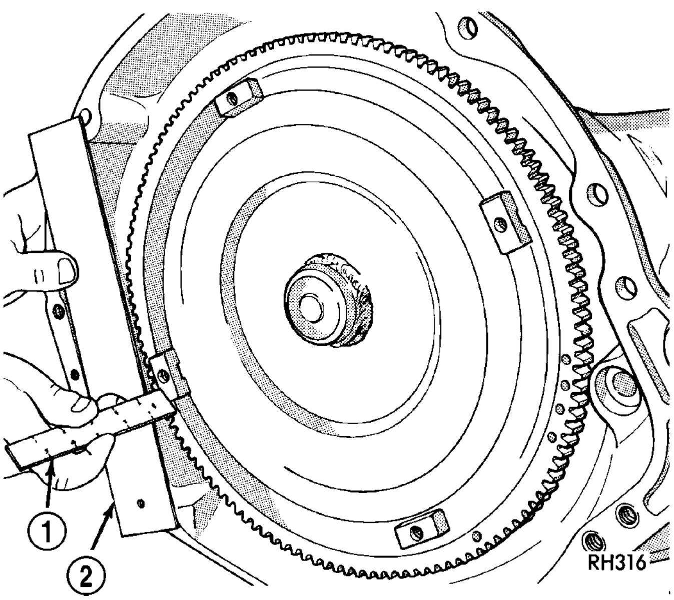


Fig. 53 Checking Torque Converter Seating - Typical

1 - SCALE
2 - STRAIGHTEDGE

(8) Position transmission on jack and secure it with chains.

(9) Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

(10) Apply a light coating of Mopar® High Temp Grease to the torque converter hub pocket in the rear pocket of the engine's crankshaft.

(11) Raise transmission (Fig. 54) and align the torque converter with the drive plate and transmission converter housing with the engine block.

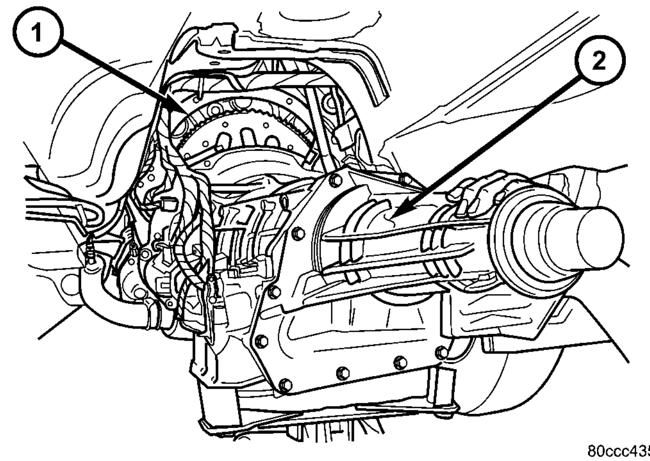


Fig. 54 Install Transmission

1 - ENGINE
2 - TRANSMISSION

(12) Move transmission forward. Then raise, lower or tilt transmission to align the converter housing with engine block dowels.

(13) Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft. Verify that no wires, or the transmission vent hose, have become trapped between the engine block and the transmission.

(14) Install two bolts to attach the transmission to the engine.

(15) Install remaining torque converter housing to engine bolts. Tighten to 68 N·m (50 ft.lbs.).

(16) Install transfer case, if equipped. Tighten transfer case nuts to 35 N·m (26 ft.lbs.).

(17) Install rear support to transmission. Tighten bolts to 47 N·m (35 ft.lbs.).

(18) Lower transmission onto crossmember and install bolts attaching transmission mount to crossmember. Tighten clevis bracket to crossmember bolts to 47 N·m (35 ft.lbs.). Tighten the clevis bracket to rear support bolt to 68 N·m (50 ft.lbs.).

(19) Remove engine support fixture.

(20) Connect gearshift cable to transmission.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(21) Connect wires to solenoid and pressure switch assembly (Fig. 55) connector, input (Fig. 56) and output (Fig. 57) speed sensors, and line pressure sensor (Fig. 58). Be sure transmission harnesses are properly routed.

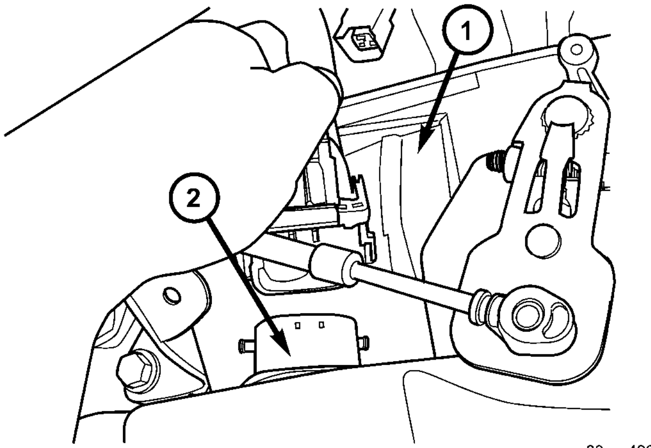


Fig. 55 Connect Transmission Solenoid

1 - TRANSMISSION
2 - TRANSMISSION SOLENOID/TRS ASSEMBLY

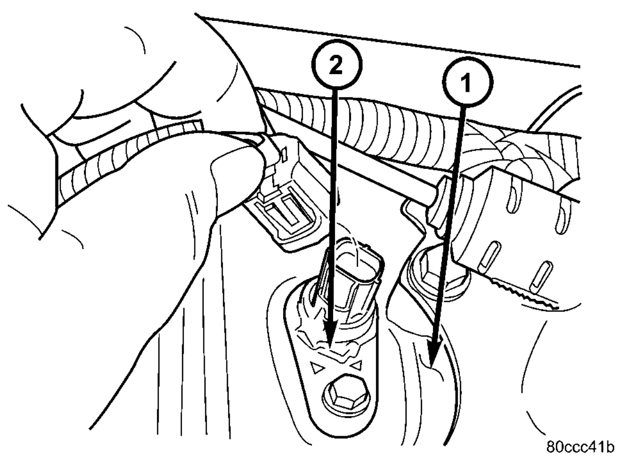


Fig. 56 Connect Input Speed Sensor

1 - TRANSMISSION
2 - INPUT SPEED SENSOR

CAUTION: It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

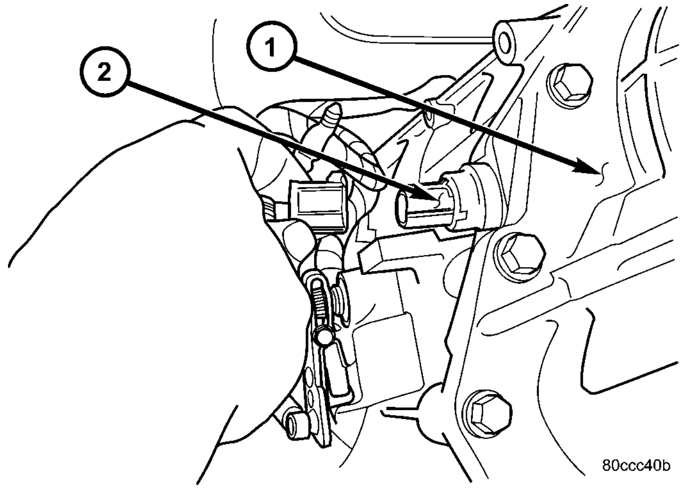


Fig. 57 Connect Output Speed Sensor

1 - TRANSMISSION
2 - OUTPUT SPEED SENSOR

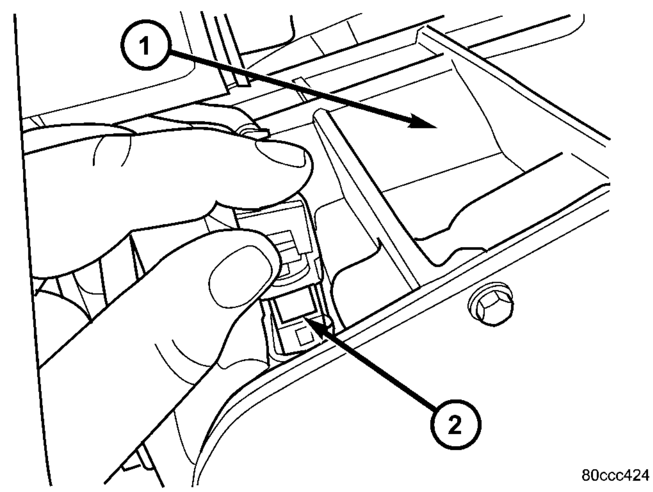


Fig. 58 Connect Line Pressure Sensor

1 - TRANSMISSION
2 - LINE PRESSURE SENSOR

(22) Install torque converter-to-driveplate bolts. Tighten bolts to 31 N·m (270 in. lbs.).

(23) Install starter motor and cooler line bracket.

(24) Connect cooler lines to transmission.

(25) Install transmission fill tube.

(26) Install exhaust components, if necessary.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

(27) Install the engine collar (Fig. 59) onto the transmission and the engine. Tighten the bolts to 54 N·m (40 ft.lbs.).

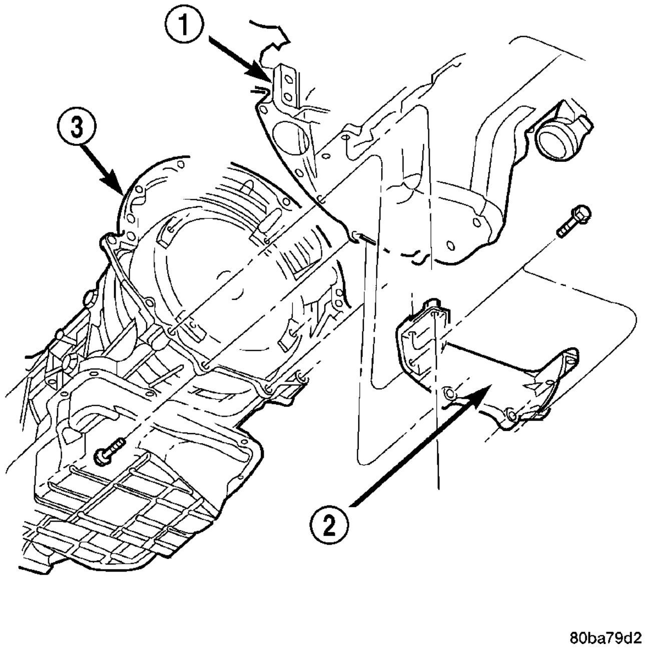


Fig. 59 Transmission Collar

1 - ENGINE
2 - ENGINE TO TRANSMISSION COLLAR
3 - TRANSMISSION

(28) Align and connect propeller shaft(s).

(29) Adjust gearshift cable if necessary.

(30) Install any skid plates removed previously. (Refer to 13 - FRAMES & BUMPERS/FRAME/ TRANSFER CASE SKID PLATE - INSTALLATION)

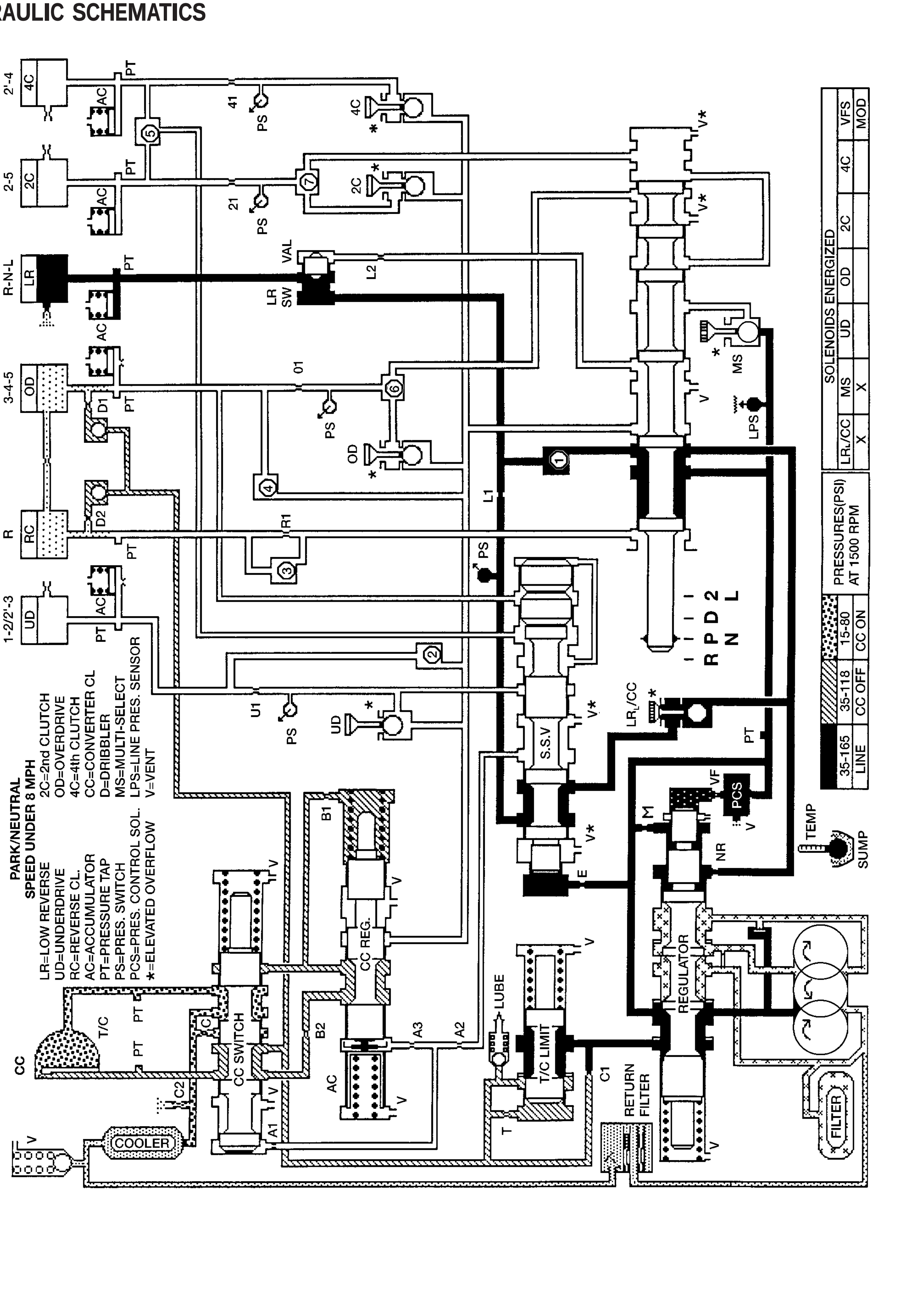
(31) Lower vehicle.

(32) Fill transmission with Mopar® ATF +4, Automatic Transmission Fluid.

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

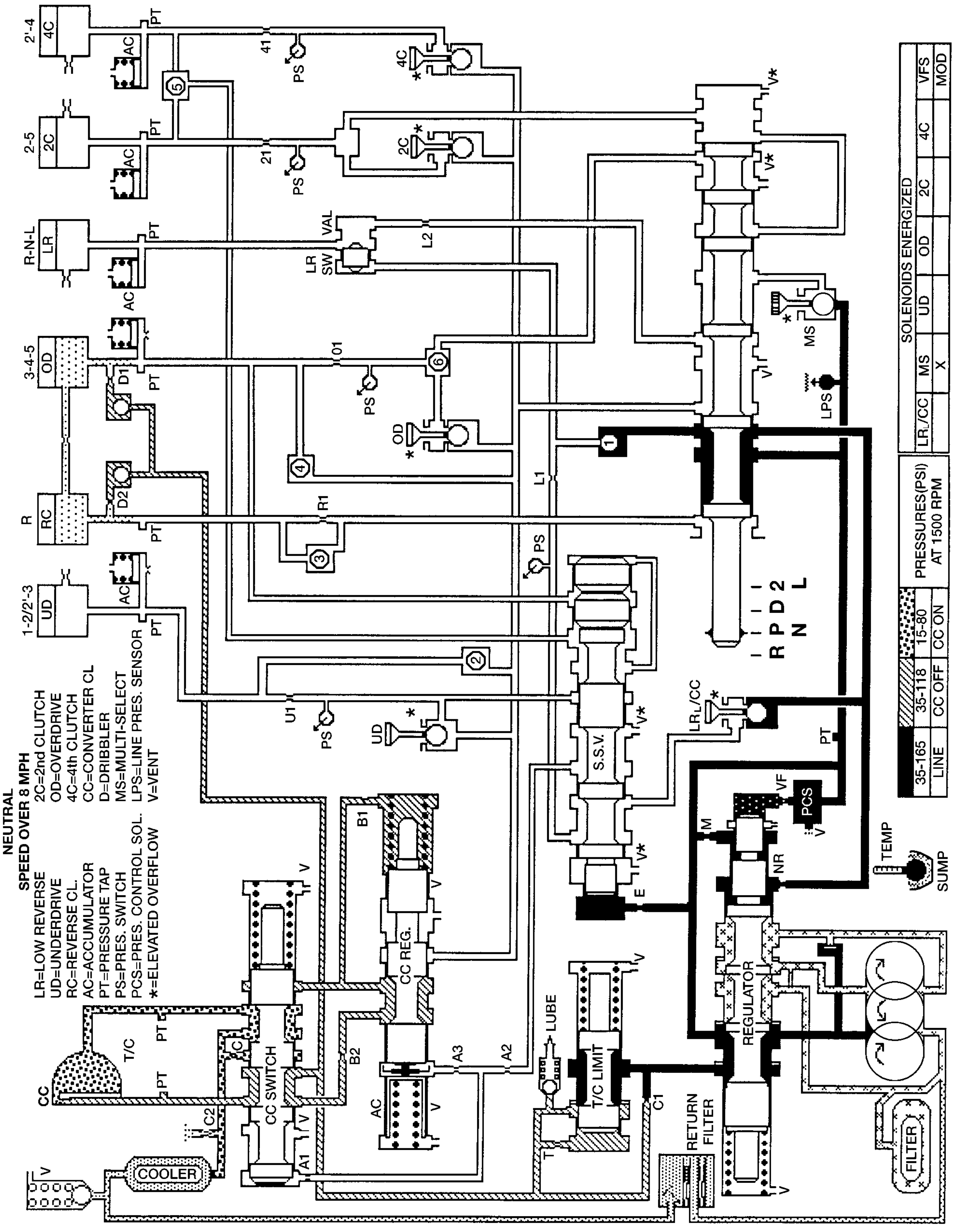
SCHEMATICS AND DIAGRAMS

HYDRAULIC SCHEMATICS



HYDRAULIC FLOW IN PARK/NEUTRAL

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



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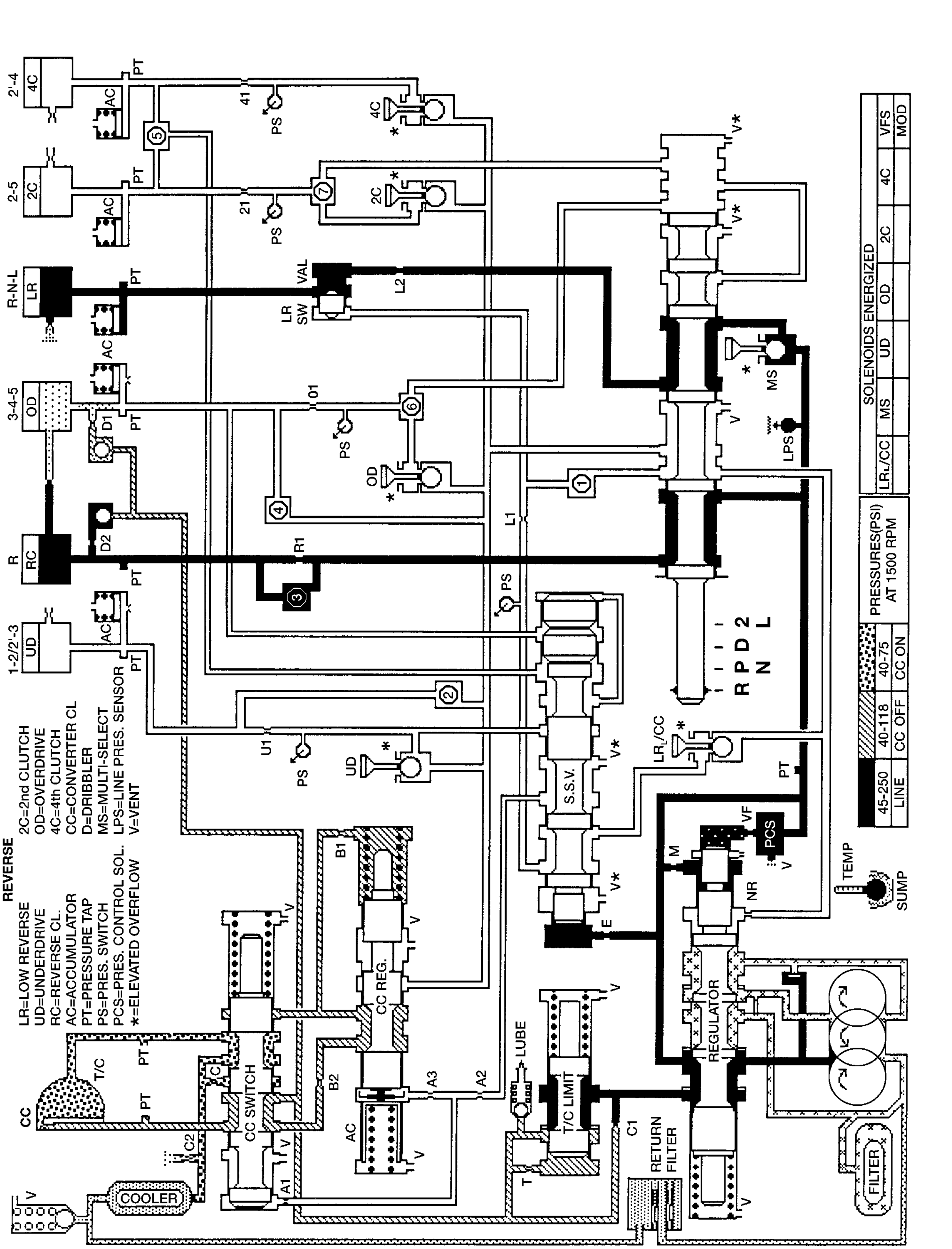
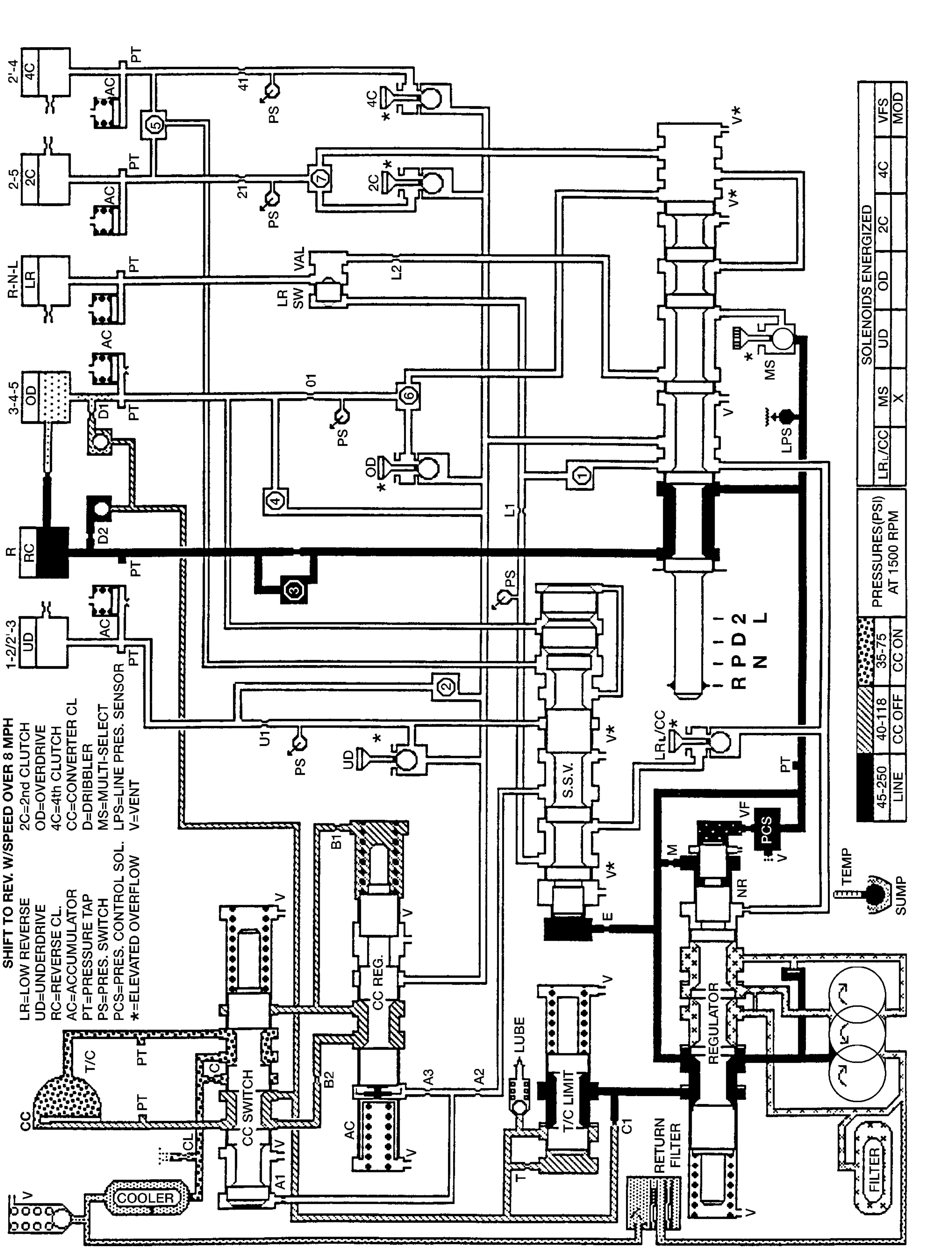
HYDRAULIC FLOW IN NEUTRAL OVER 8MPH

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



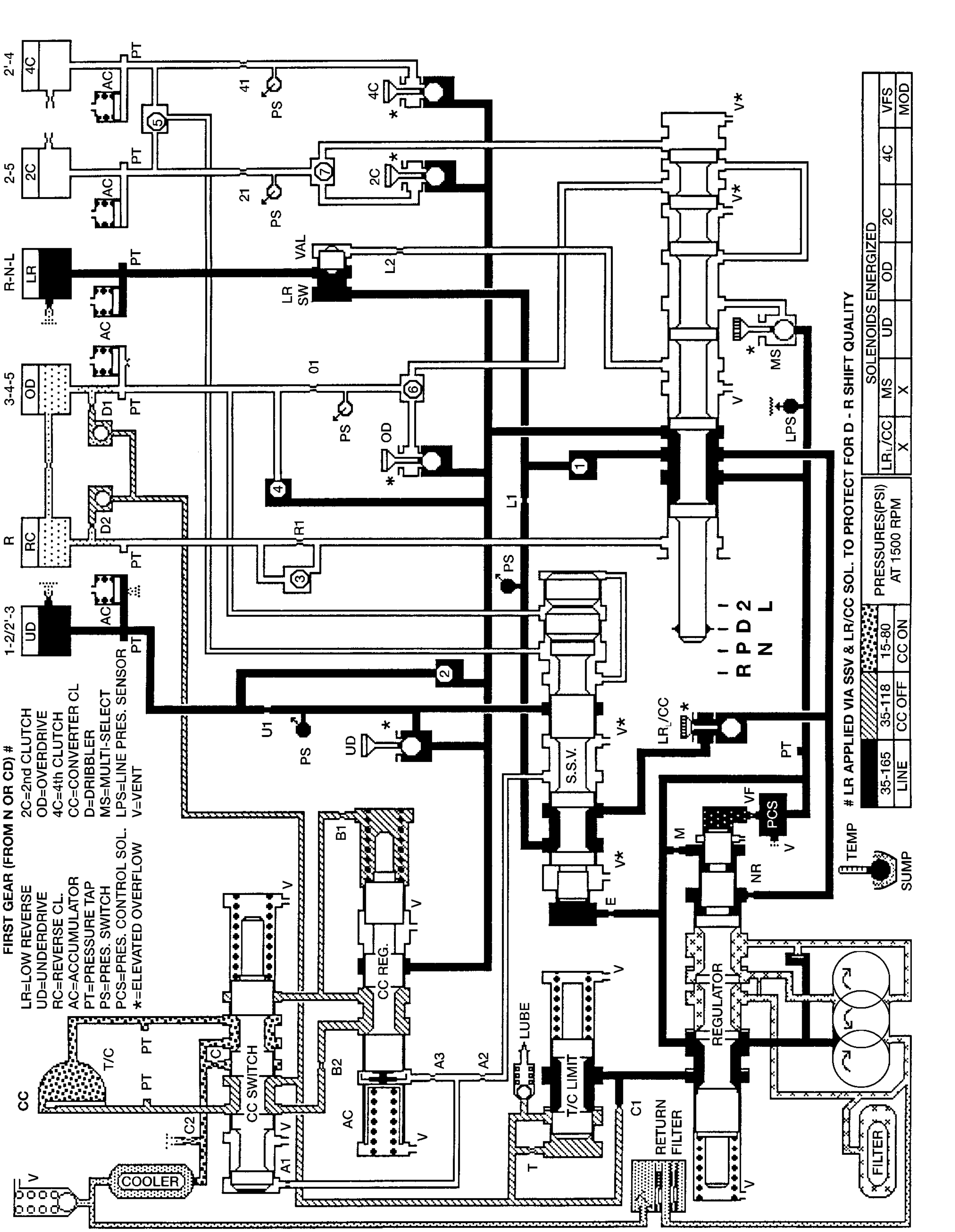
HYDRAULIC FLOW IN REVERSE

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



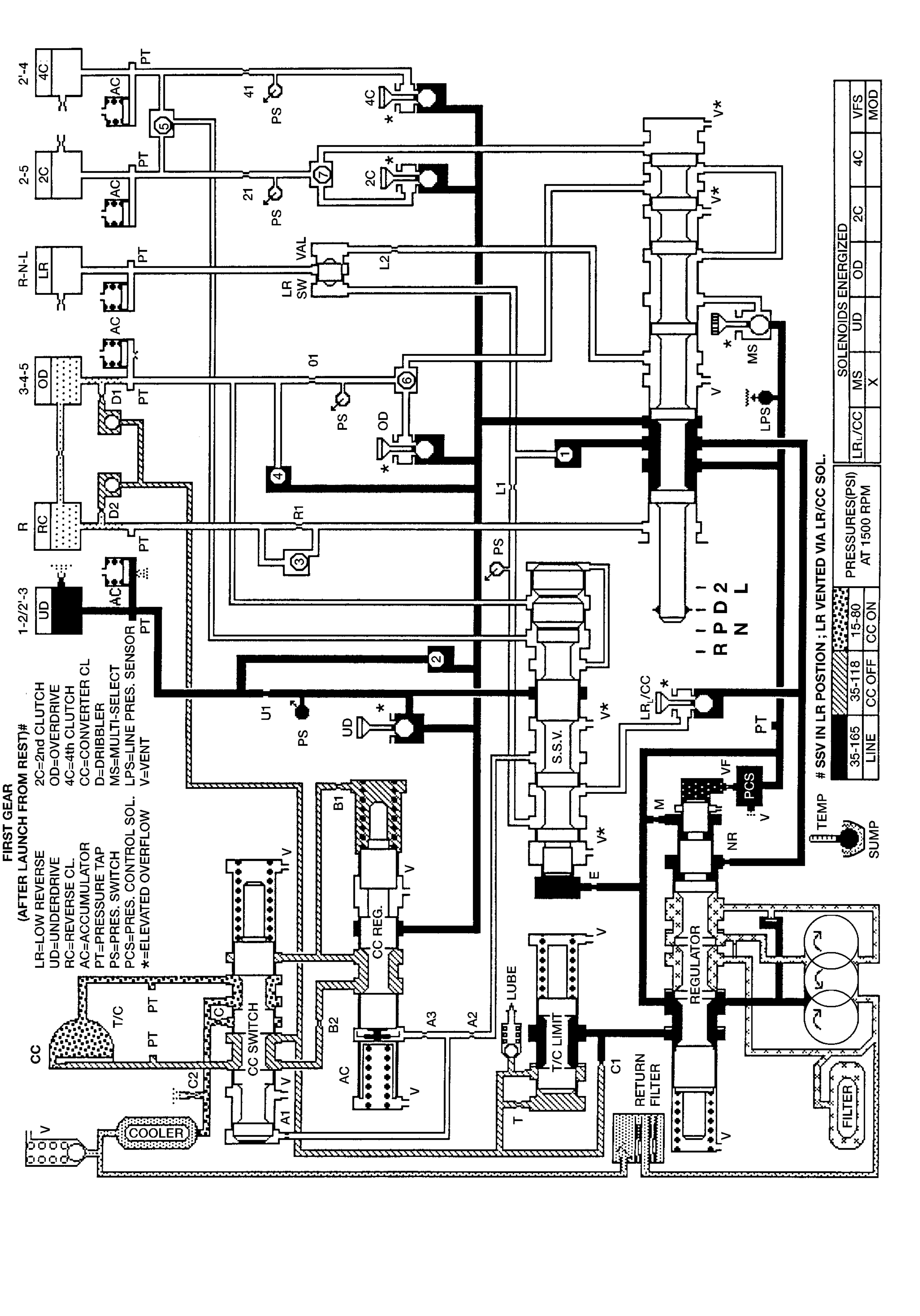
HYDRAULIC FLOW IN REVERSE BLOCK

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



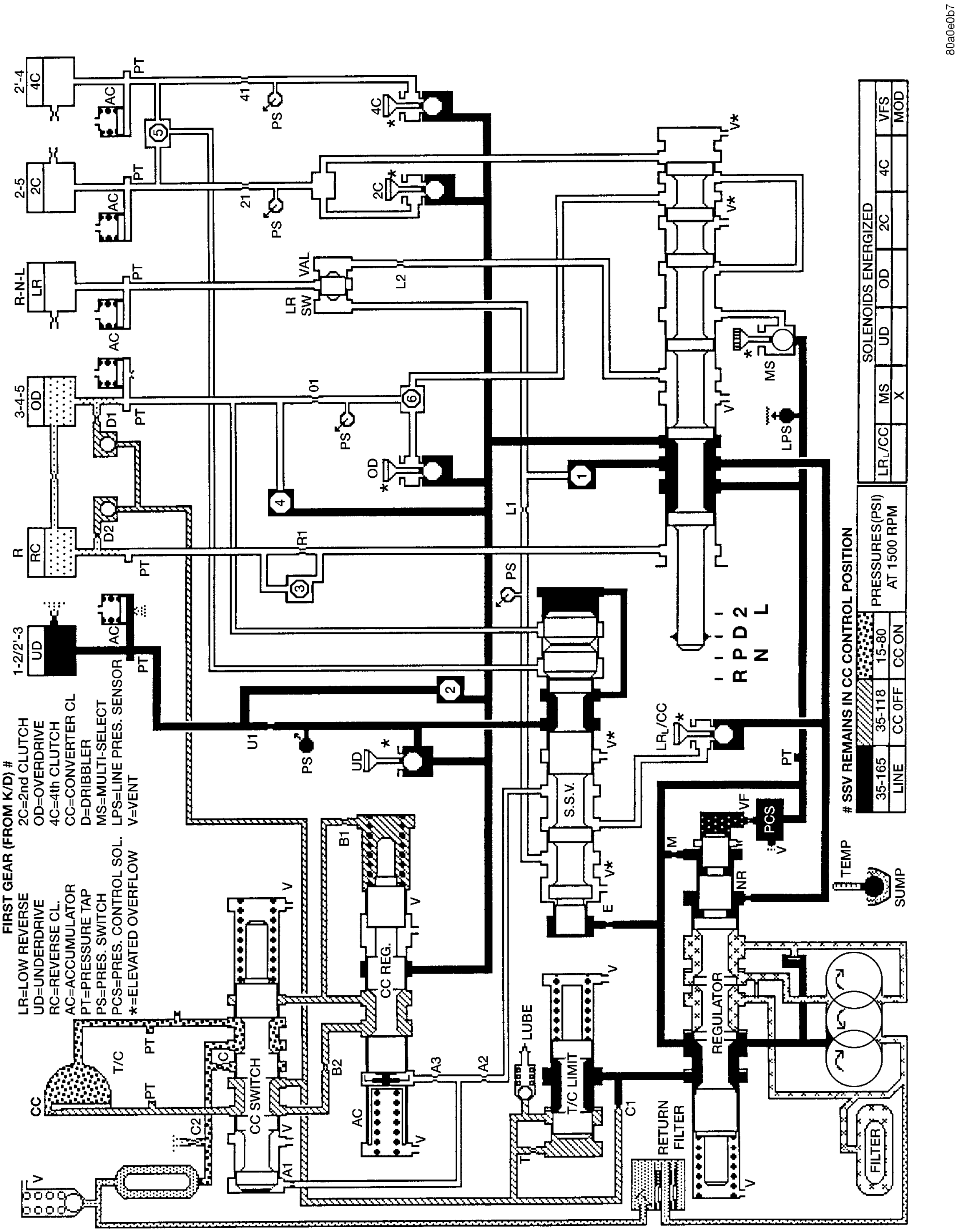
HYDRAULIC FLOW IN FIRST GEAR (FROM N OR OD)

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



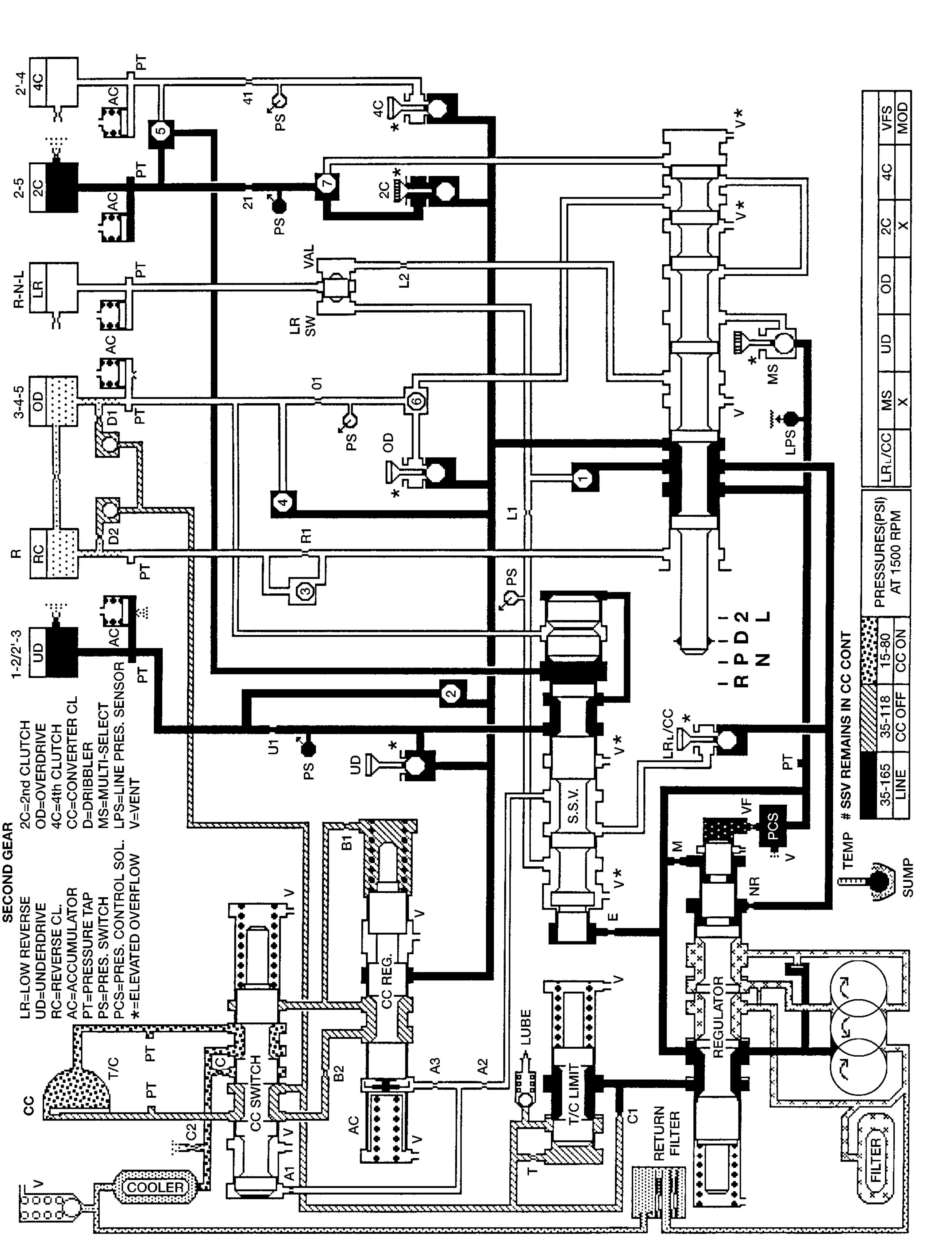
HYDRAULIC FLOW IN FIRST GEAR (AFTER LAUNCH FROM REST)

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



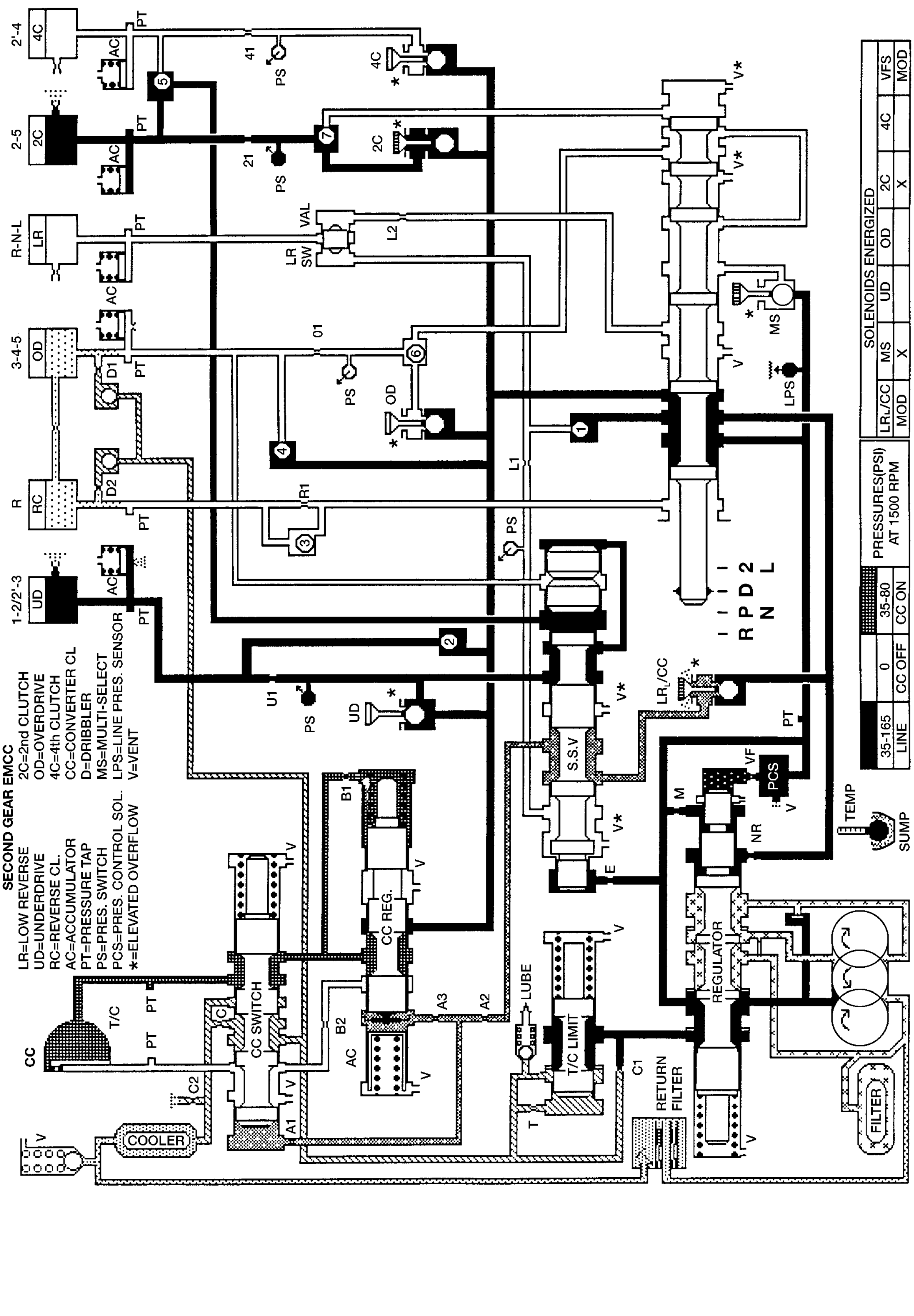
HYDRAULIC FLOW IN FIRST GEAR (FROM K/D)

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



HYDRAULIC FLOW IN SECOND GEAR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



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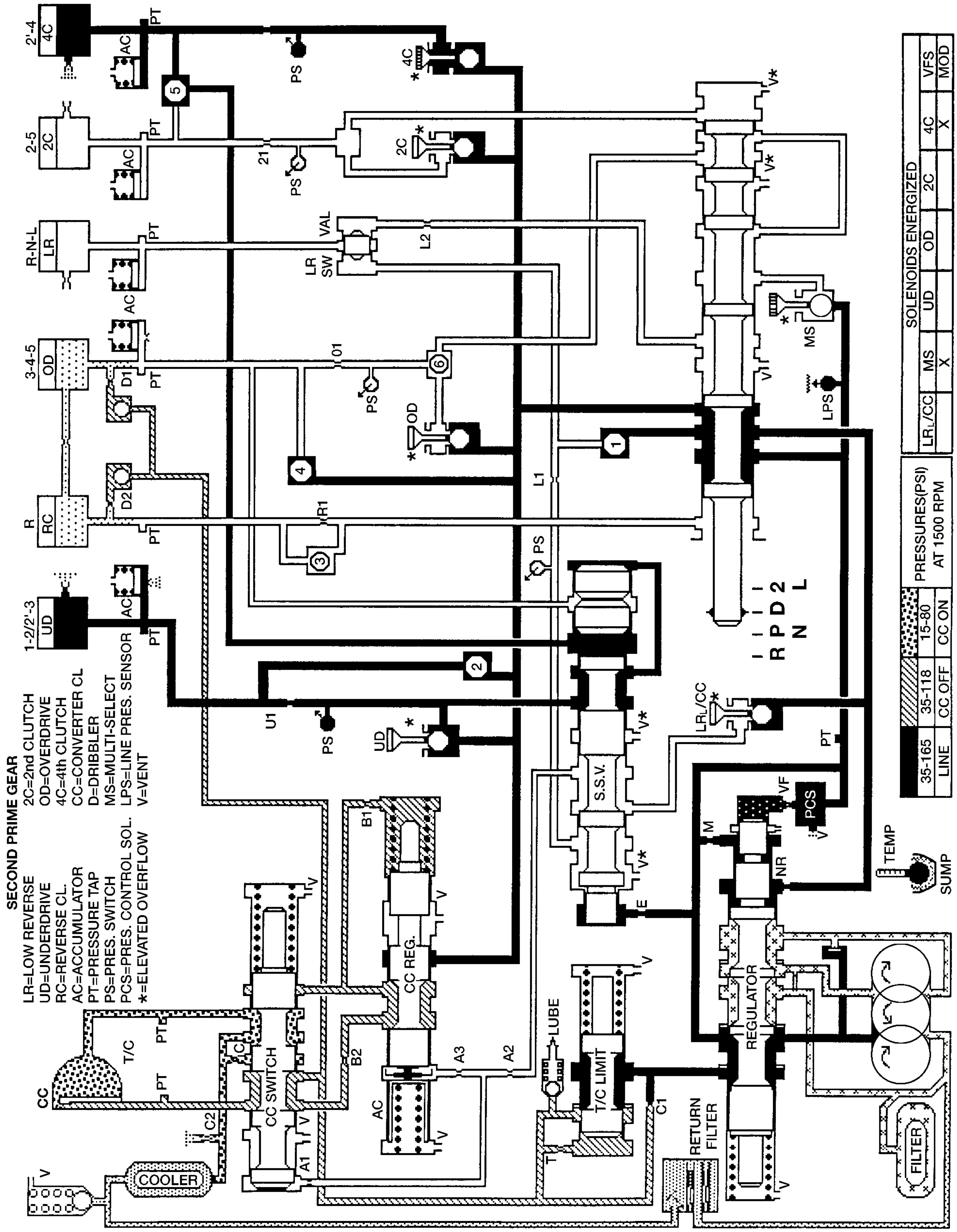
HYDRAULIC FLOW IN SECOND GEAR EMCC

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



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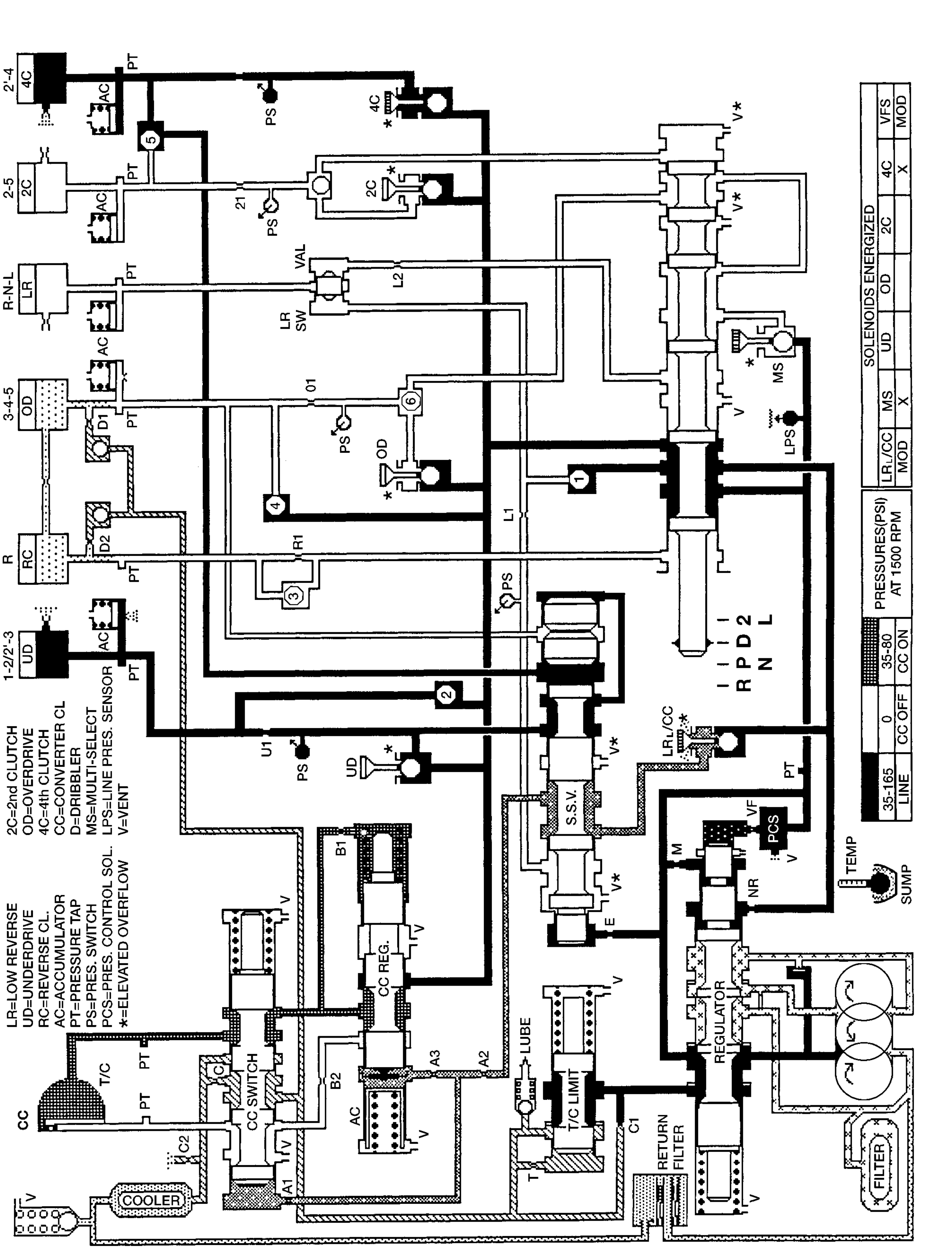
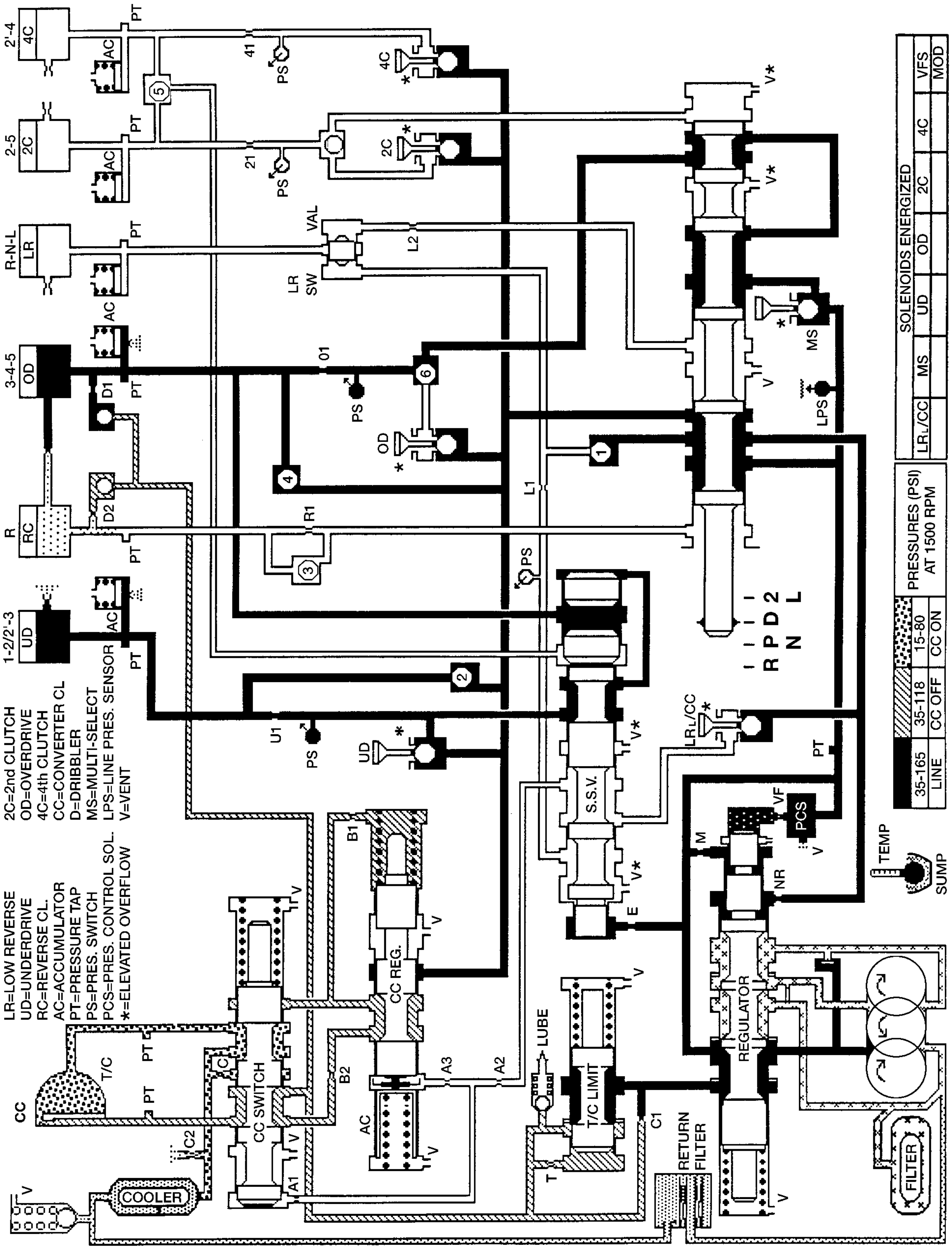
HYDRAULIC FLOW IN SECOND PRIME GEAR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



HYDRAULIC FLOW IN SECOND PRIME GEAR EMCC

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



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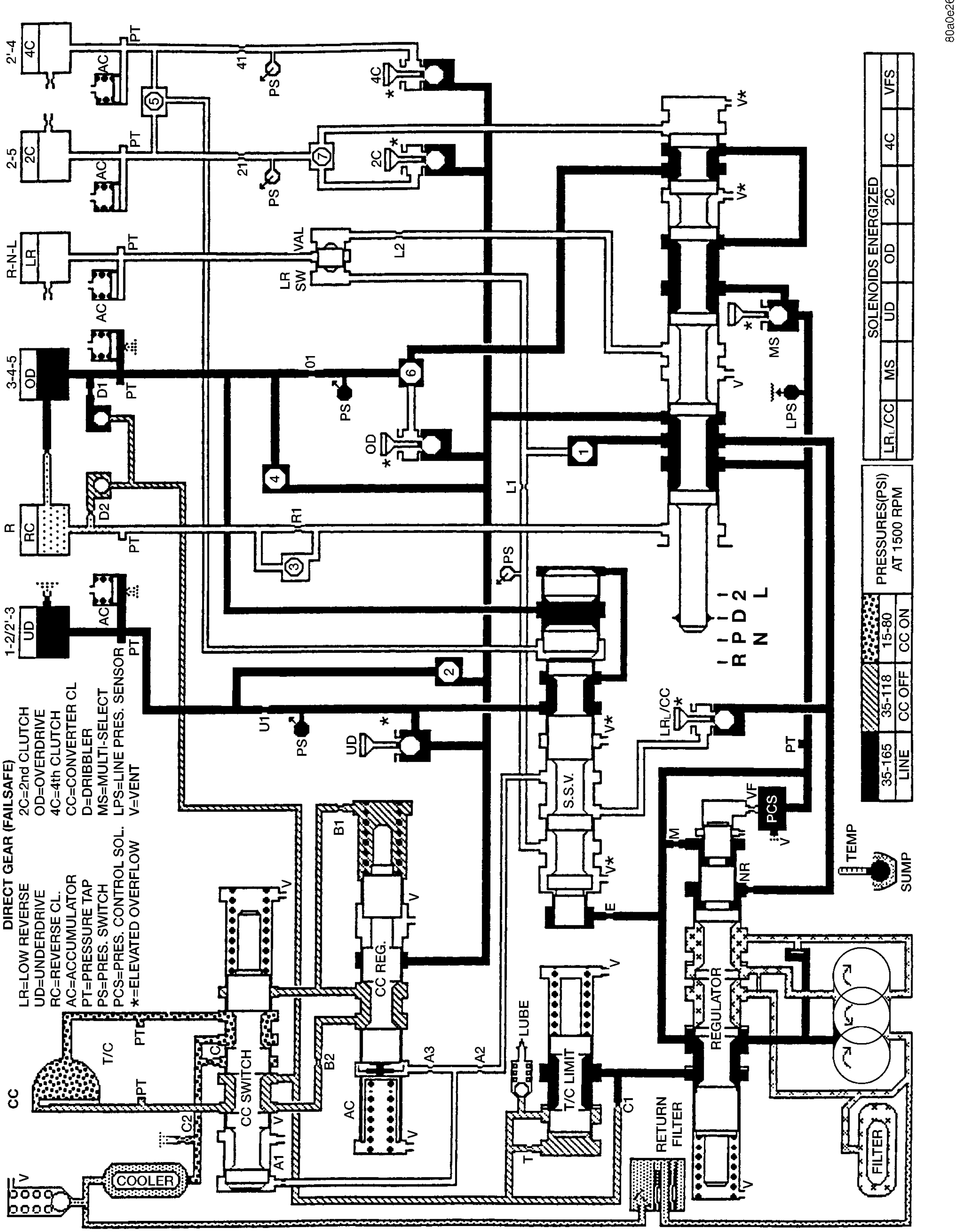
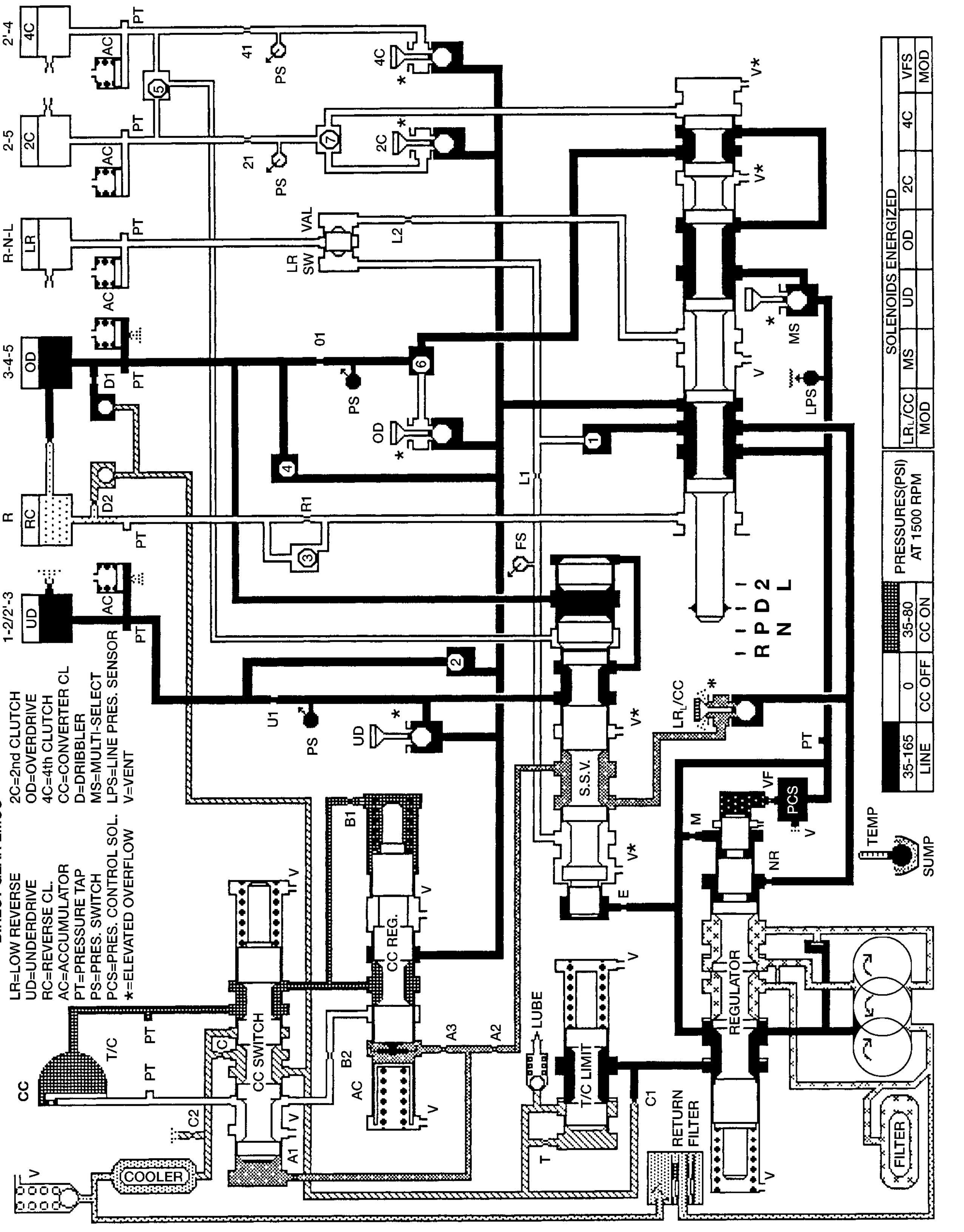
HYDRAULIC FLOW IN DIRECT GEAR

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



HYDRAULIC FLOW IN DIRECT GEAR (FAILSAFE)

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



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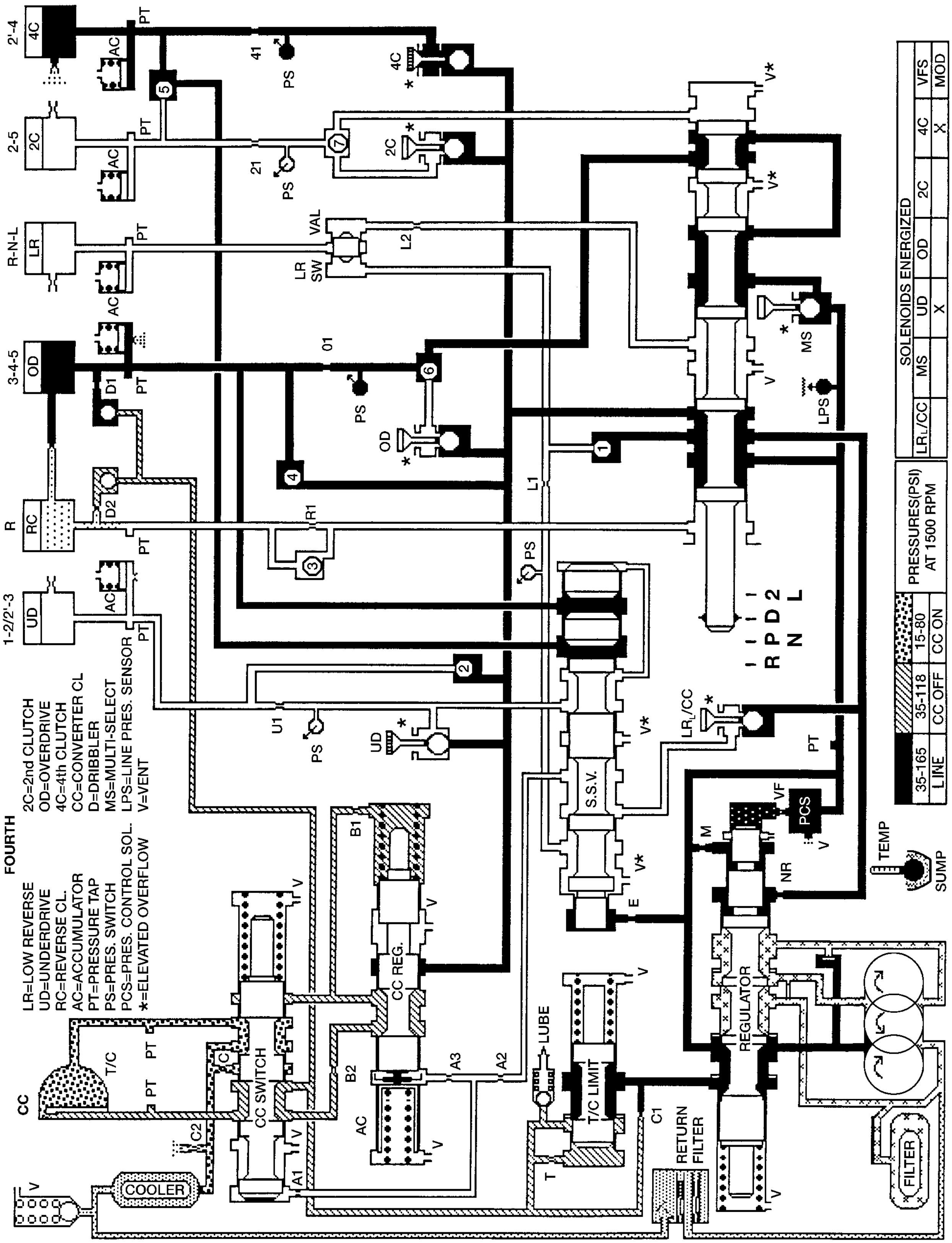
HYDRAULIC FLOW IN DIRECT GEAR EMCC

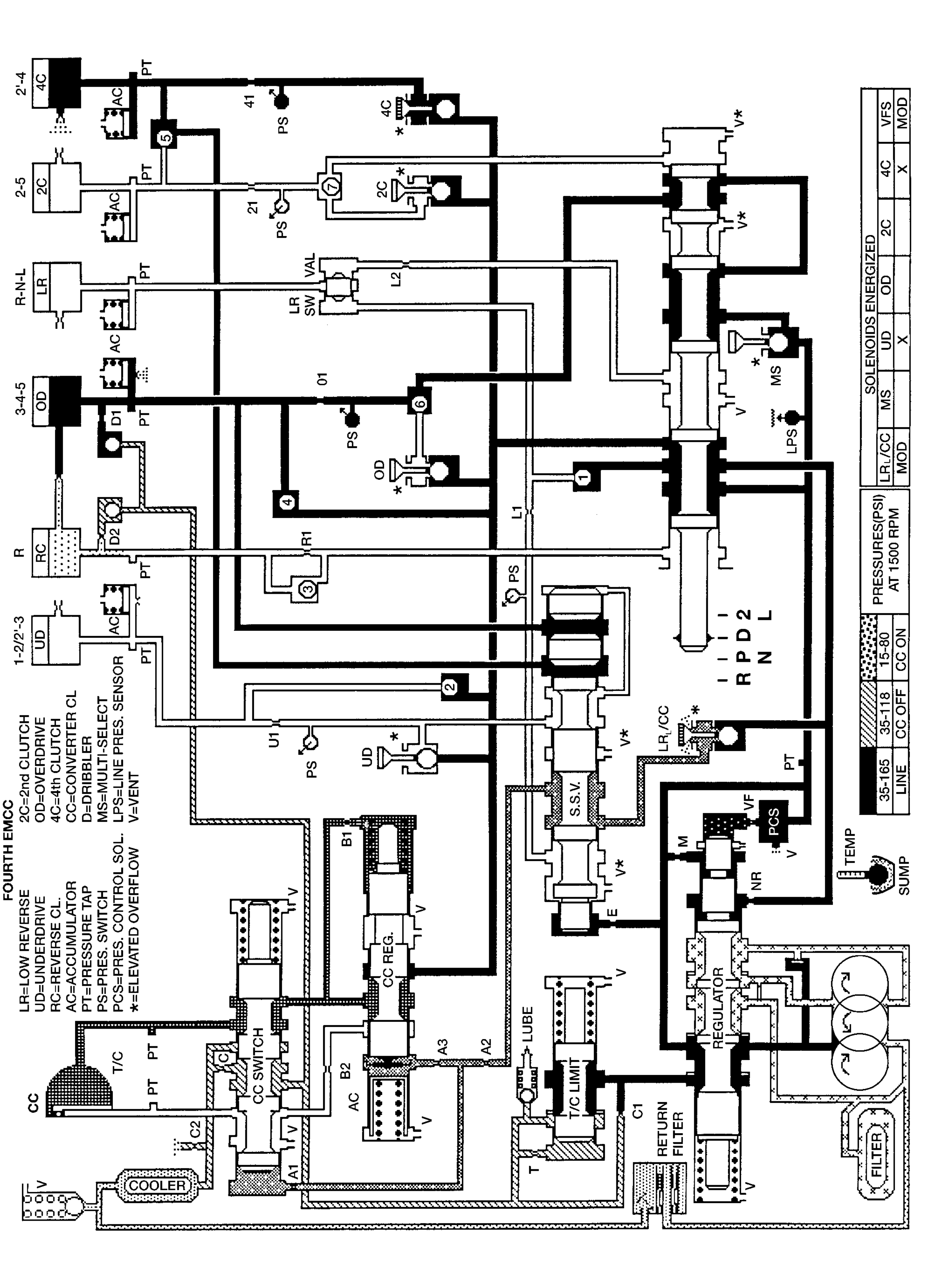
AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

80a0e373



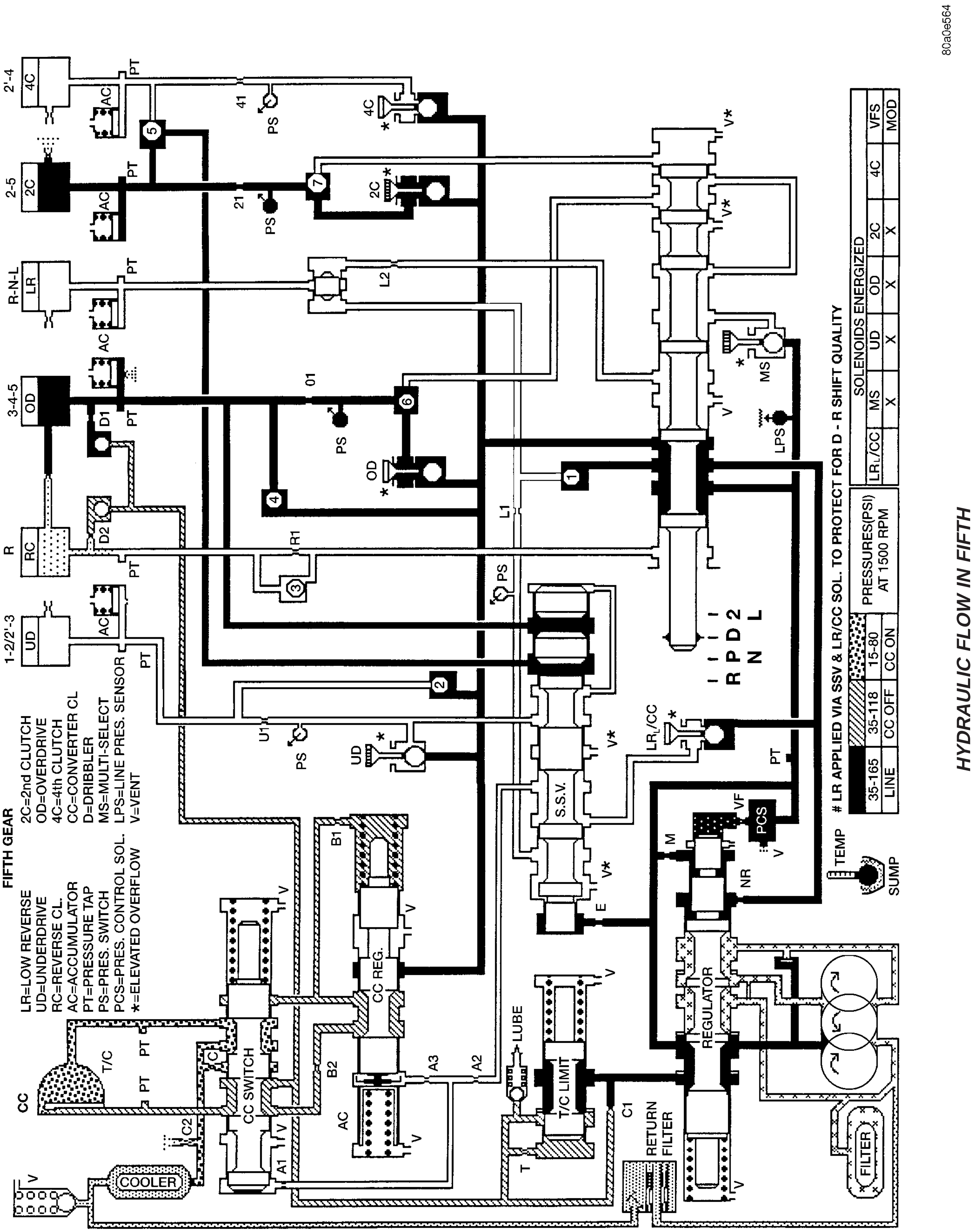
HYDRAULIC FLOW IN FOURTH

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



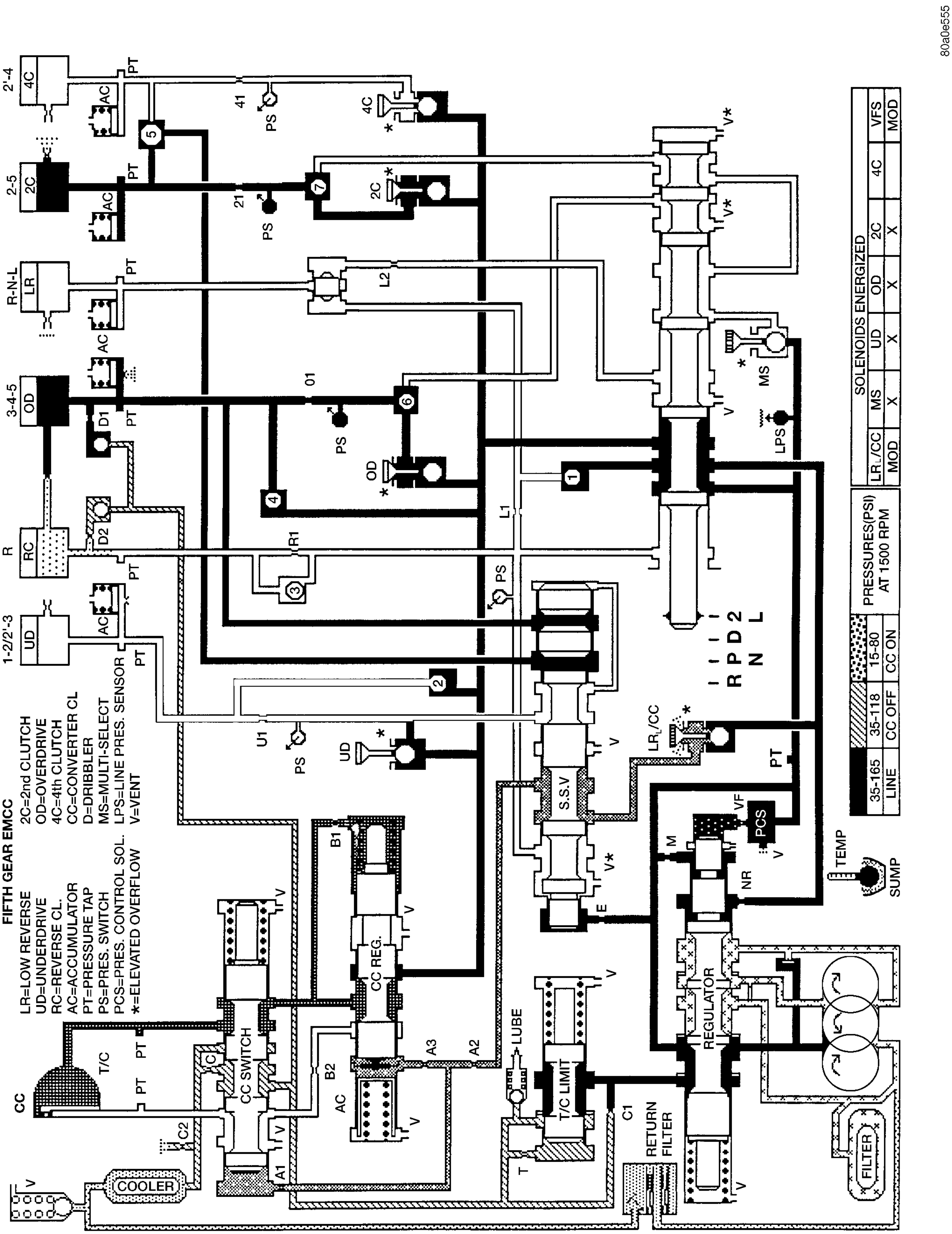
HYDRAULIC FLOW IN FOURTH EMCC

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



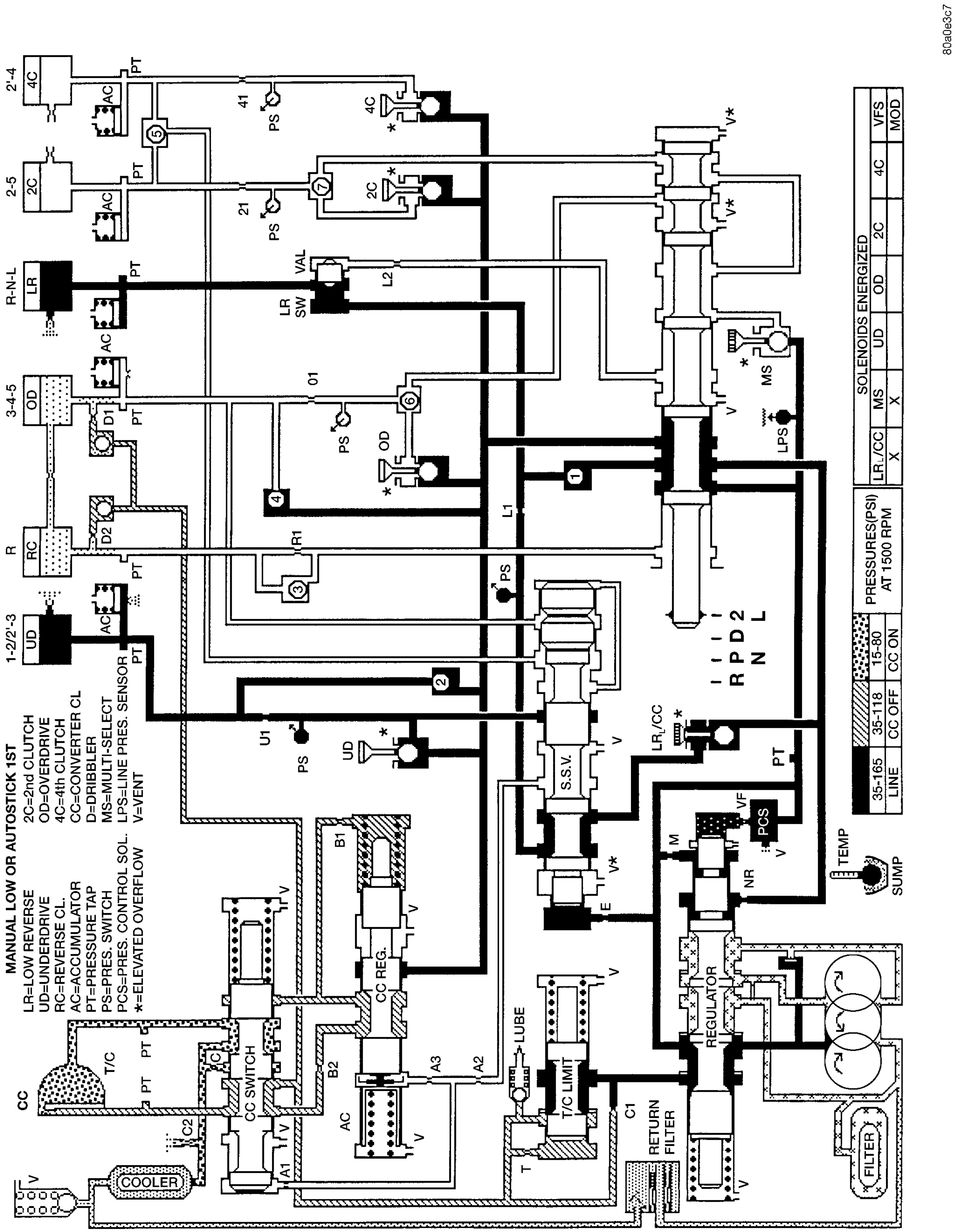
HYDRAULIC FLOW IN FIFTH

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



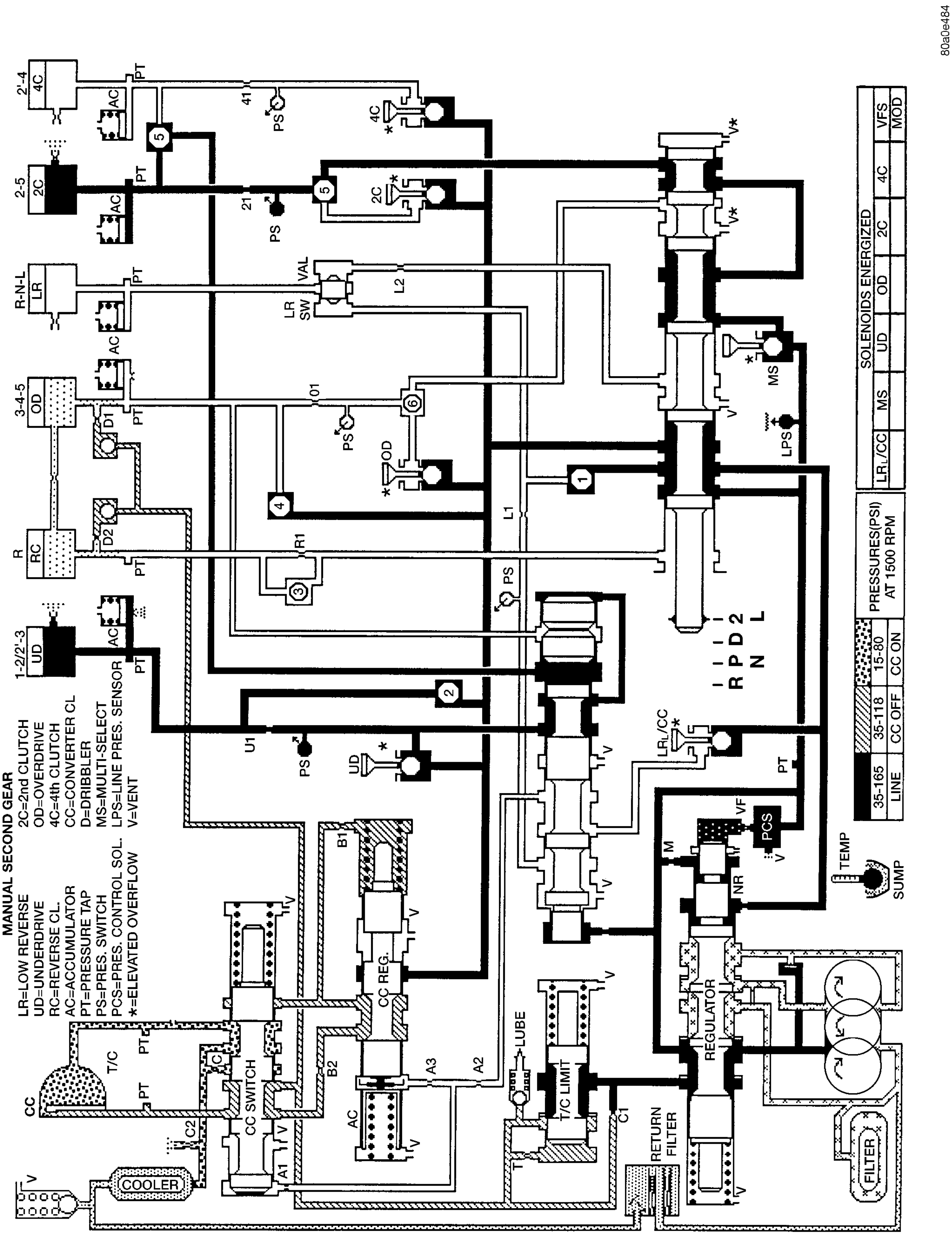
HYDRAULIC FLOW IN FIFTH EMCC

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



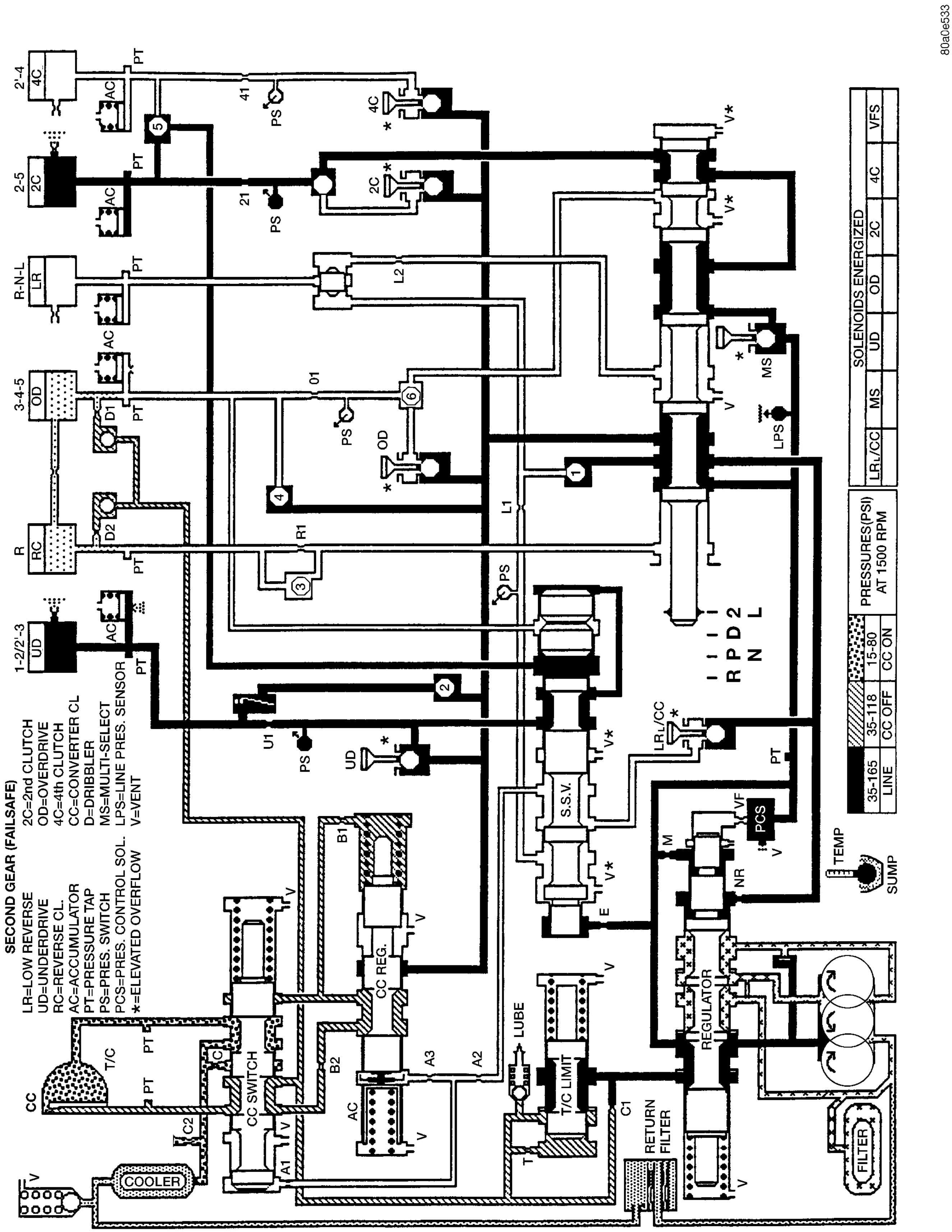
HYDRAULIC FLOW IN MANUAL LOW OR AUTOSTICK 1ST

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



HYDRAULIC FLOW IN MANUAL SECOND

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



HYDRAULIC FLOW IN MANUAL SECOND (FAILSAFE)

AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

SPECIFICATIONS

TRANSMISSION

GENERAL

Component	Metric	Inch
Output Shaft End Play	0.22-0.55 mm	0.009-0.021 in.
Input Shaft End Play	0.46-0.89 mm	0.018-0.035 in.
2C Clutch Pack Clearance	0.455-1.335 mm	0.018-0.053 in.
4C Clutch Pack Clearance	0.770-1.390 mm	0.030-0.055 in.
L/R Clutch Pack Clearance	1.00-1.74 mm	0.039-0.069 in.
OD Clutch Pack Clearance	1.103-1.856 mm	0.043-0.073 in.
UD Clutch Pack Clearance	0.84-1.54 mm	0.033-0.061 in.
Reverse Clutch Pack Clearance	0.81-1.24 mm	0.032-0.049 in.
Recommended fluid	Mopar® ATF +4	

GEAR RATIOS

1ST	3.00:1
2ND	1.67:1
2ND Prime	1.50:1
3RD	1.0:1
4TH	0.75:1
5TH	0.67:1
REVERSE	3.00:1

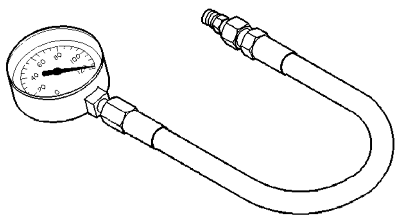
TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Fitting, cooler line at trans	17.5	-	155
Bolt, torque convertor	31	23	-
Bolt/nut, crossmember	68	50	-
Bolt, driveplate to crankshaft	75	55	-
Bolt, oil pan	11.8	-	105
Screw, primary fluid filter	4.5	-	40
Bolt, oil pump	28.2	-	250
Bolt, oil pump body to cover	4.5	-	40
Screw, plate to oil pump body	4.5	-	40
Bolt, valve body to case	11.8	-	105
Plug, pressure test port	5.1	-	45
Bolt, reaction shaft support	11.8	-	105
Screw, valve body to transfer plate	5.6	-	50
Screw, solenoid module to transfer plate	5.7	-	50
Screw, accumulator cover	4.5	-	40
Screw, detent spring	4.5	-	40
Bolt, input speed sensor	11.8	-	105
Bolt, output speed sensor	11.8	-	105
Bolt, line pressure sensor	11.8	-	105
Bolt, extension housing	54	40	-
Valve, cooler return filter bypass	4.5	-	40
Screw, manual valve cam retaining	4.5	-	40
Bolt, manual lever	28.2	-	250

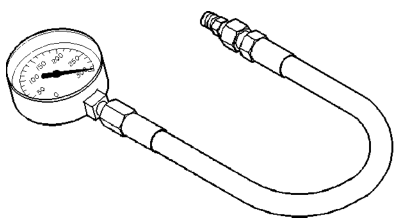
AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)

SPECIAL TOOLS

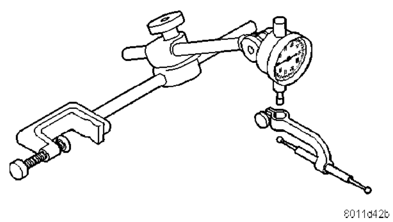
RFE TRANSMISSION



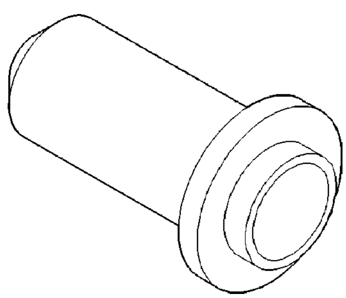
Gauge, Oil Pressure - C-3292



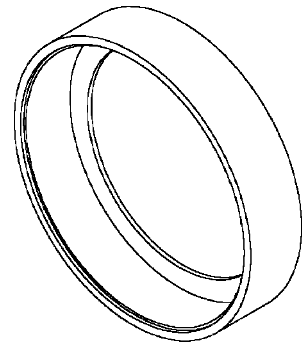
Gauge, Oil Pressure - C-3293SP



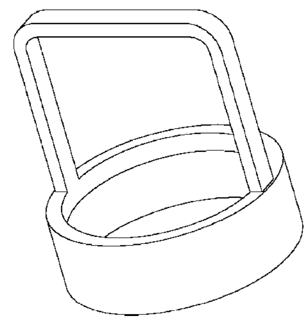
Dial Indicator - C-3339



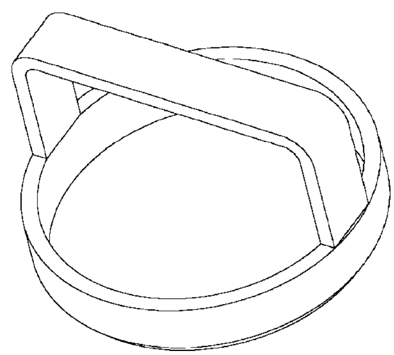
Installer, Seal - C-3860-A



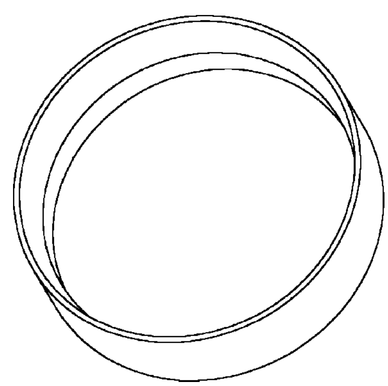
Compressor, Spring - 8249



Compressor, Spring - 8250

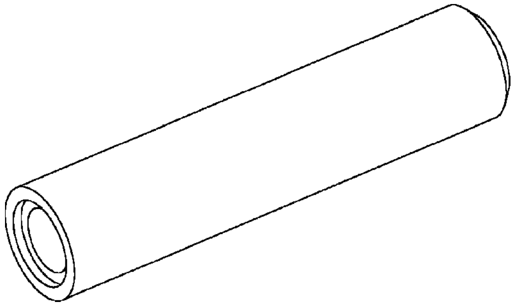


Compressor, Spring - 8251

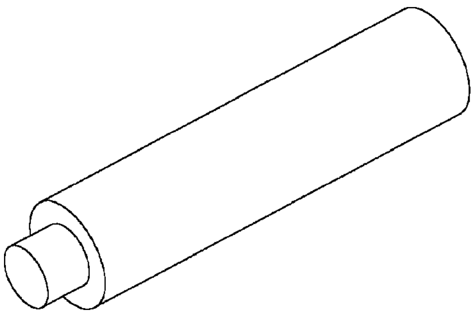


Installer, Piston - 8252

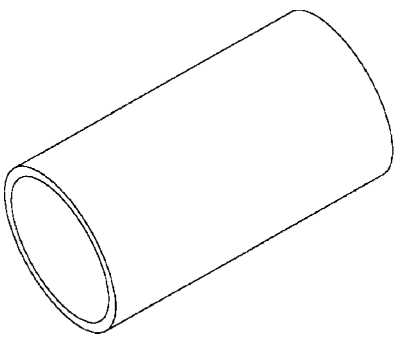
AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



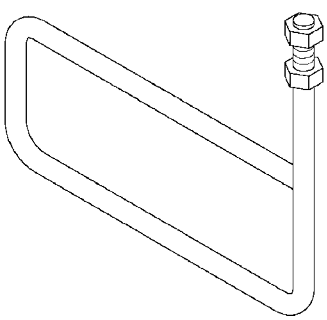
Installer, Seal - 8253



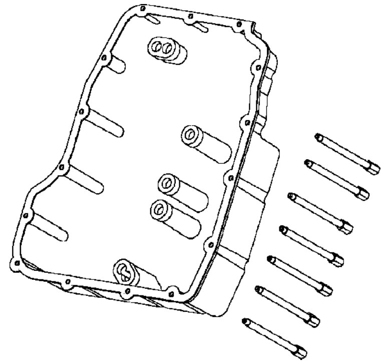
Installer, Seal - 8254



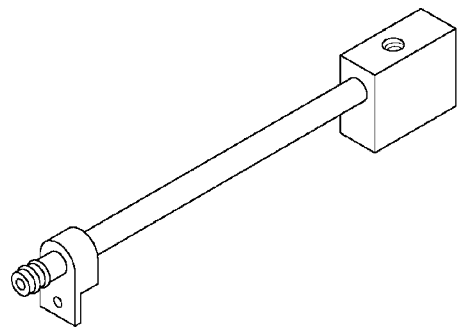
Installer, Snap-ring - 8255



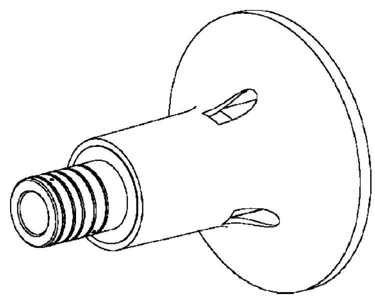
Stand, Support - 8257



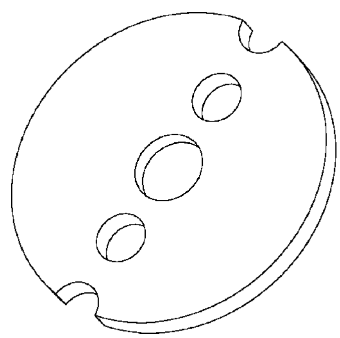
Adapter, Pressure Tap - 8258-A



Adapter, Line Pressure - 8259

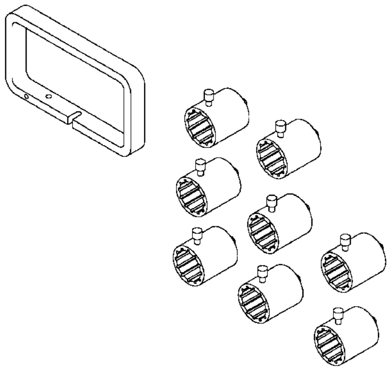


Fixture, Input Clutch Pressure - 8260

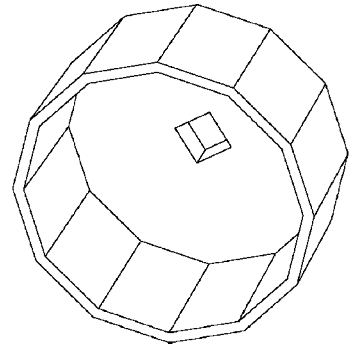


Plate, Alignment - 8261

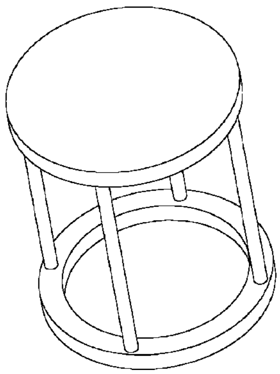
AUTOMATIC TRANSMISSION - 45RFE/545RFE (Continued)



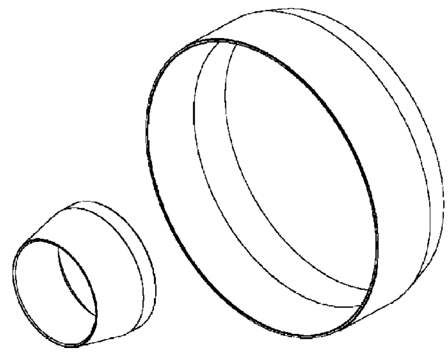
End Play Set - 8266



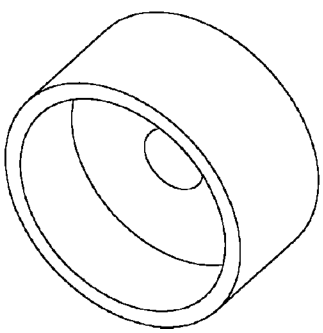
Wrench, Filter - 8321



Compressor, Spring - 8285



Installer, Piston - 8504



Installer, Bearing - 8320

4C RETAINER/BULKHEAD

DISASSEMBLY

(1) Remove the 2C piston belleville spring snap-ring from the 4C retainer /bulkhead (Fig. 60).

(2) Remove the 2C piston Belleville spring from the retainer/bulkhead (Fig. 60).

(3) Remove the 2C piston from the retainer/bulkhead. Use 20 psi of air pressure to remove the piston if necessary.

(4) Remove the 4C clutch snap-ring from the retainer/bulkhead (Fig. 60).

(5) Remove the 4C clutch pack from the retainer/bulkhead (Fig. 60).

(6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and remove the snap-ring (Fig. 60).

(7) Remove the 4C piston return spring and piston from the retainer/bulkhead (Fig. 60). Use 20 psi of air pressure to remove the piston if necessary.

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install new seals on the 2C and 4C pistons (Fig. 60).

(3) Lubricate all seals with Mopar® ATF +4 prior to installation.

(4) Install the 4C piston into the 4C retainer/bulkhead (Fig. 60).

(5) Position the 4C piston return spring onto the 4C piston.

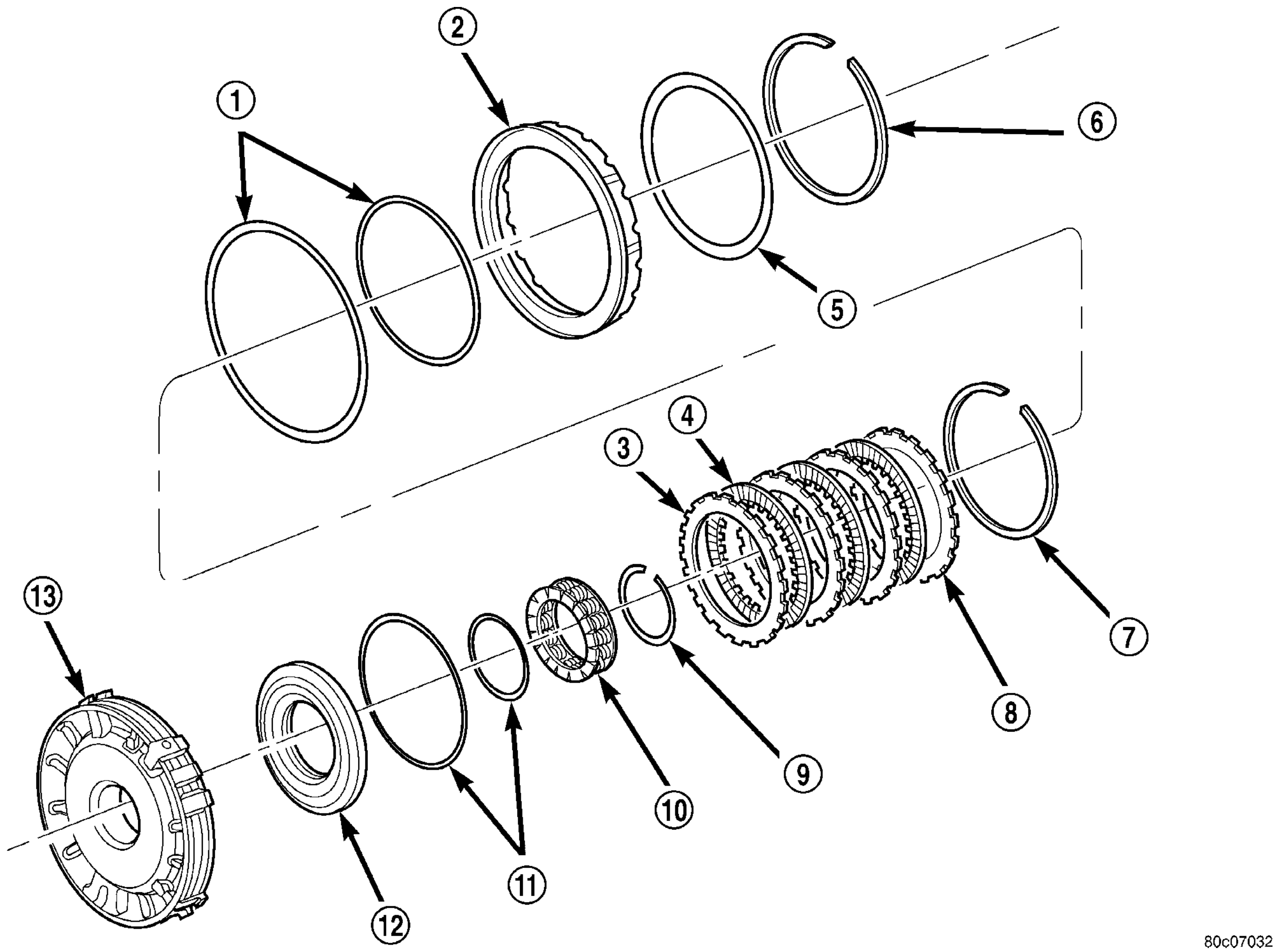


Fig. 60 4C Retainer/Bulkhead Components

1 - SEAL
2 - 2C PISTON
3 - PLATE
4 - DISC
5 - 2C BELLEVILLE SPRING
6 - SNAP-RING
7 - SNAP-RING (SELECT)
8 - REACTION PLATE
9 - SNAP-RING
10 - RETURN SPRING
11 - SEAL
12 - 4C PISTON
13 - 4C RETAINER/BULKHEAD

4C RETAINER/BULKHEAD (Continued)

(6) Using Spring Compressor 8250 and a suitable shop press, compress the 4C piston return spring and install the snap-ring (Fig. 61).

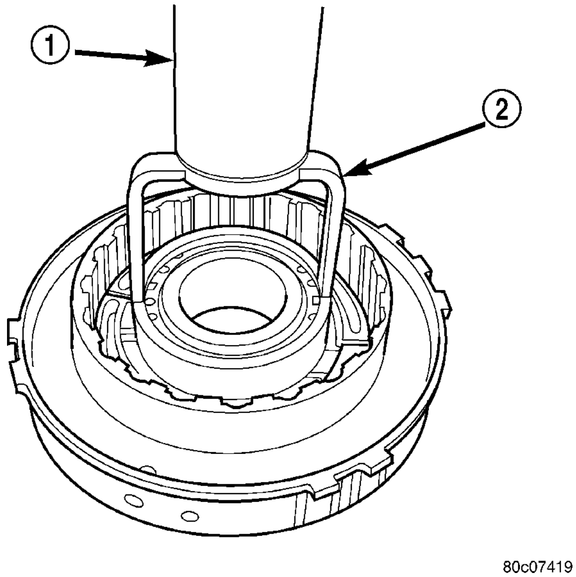


Fig. 61 Compress 4C Piston Return Spring Using Tool 8250

1 - PRESS
2 - TOOL 8250

(7) Assemble and install the 4C clutch pack into the retainer/bulkhead (Fig. 60) with the steel separator plate against the piston.

(8) Install the 4C reaction plate and snap-ring into the retainer/bulkhead (Fig. 60). The 4C reaction plate is non-directional.

(9) Measure the 4C clutch clearance. The correct clutch clearance is 0.77-1.39 mm (0.030-0.055 in.). The snap-ring is selectable. Install the chosen snap-ring and re-measure to verify the selection.

(10) Install the 2C piston into the retainer/bulkhead (Fig. 60).

(11) Position the 2C Belleville spring onto the 2C piston.

(12) Position the 2C Belleville spring snap-ring onto the 2C Belleville spring (Fig. 60).

(13) Using Spring Compressor 8249 and a suitable shop press (Fig. 62), compress the belleville spring until the snap-ring is engaged with the snap-ring groove in the retainer/bulkhead.

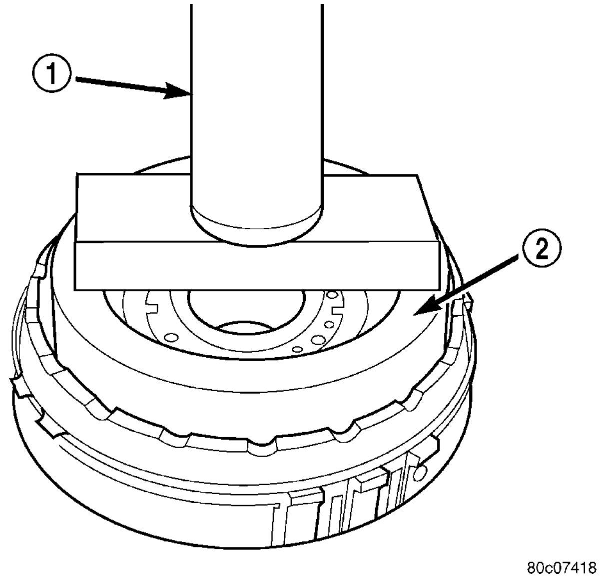


Fig. 62 Compress 2C Belleville Spring Using Tool 8249

1 - PRESS
2 - TOOL 8249

ADAPTER HOUSING SEAL

REMOVAL

(1) Remove the transfer case from the transmission.

(2) Using a screw mounted on a slide hammer, remove the adapter housing seal.

INSTALLATION

(1) Clean the adapter seal bore in the adapter housing of any residue or particles remaining from the original seal.

(2) Install new oil seal in the adapter housing using Seal Installer C-3860-A (Fig. 63). A properly installed seal is flush to the face of the seal bore.

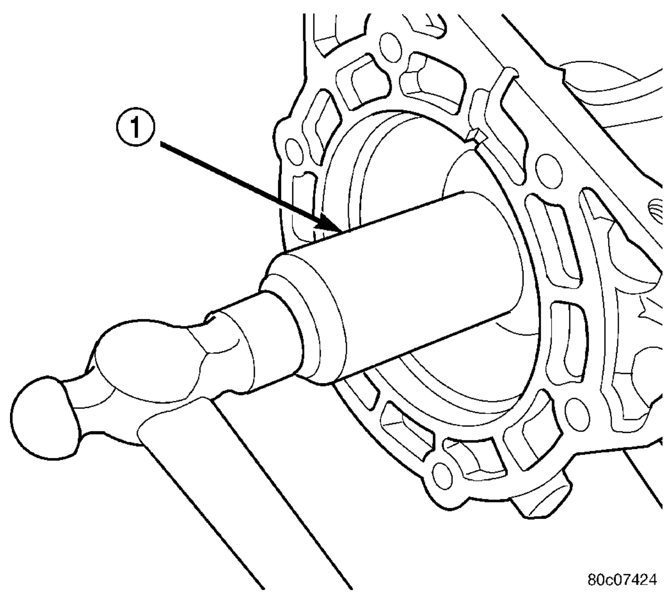


Fig. 63 Adapter Housing Seal Installation

1 - TOOL C-3860-A

(3) Install the transfer case onto the transmission.

BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM

DESCRIPTION

The Brake Transmission Shifter Interlock (BTSI) (Fig. 64), is a solenoid operated system. It consists of a solenoid permanently mounted on the gearshift cable.

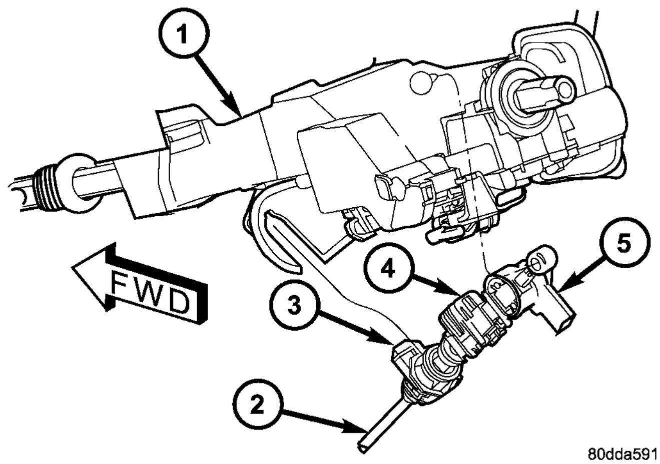


Fig. 64 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

OPERATION

The system locks the shifter into the PARK position. The interlock system is engaged whenever the ignition switch is in the LOCK or ACCESSORY position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed approximately one-half an inch. A magnetic holding device in line with the park lock cable is energized when the ignition is in the RUN position. When the key is in the RUN position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK or ACCESSORY position, unless the shifter is fully locked into the PARK position.

DIAGNOSIS AND TESTING - BRAKE TRANSMISSION SHIFT INTERLOCK

(1) Verify that the key can only be removed in the PARK position

(2) When the shift lever is in PARK And the shift handle pushbutton is in the “OUT” position, the ignition key cylinder should rotate freely from OFF to LOCK. When the shifter is in any other gear or neutral position, the ignition key cylinder should not rotate to the LOCK position.

(3) Shifting out of PARK should not be possible when the ignition key cylinder is in the OFF position.

(4) Shifting out of PARK should not be possible while applying normal pushbutton force and ignition key cylinder is in the RUN or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the ACCESSORY or LOCK positions.

(6) Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in RUN or START positions.

ADJUSTMENTS - BRAKE TRANSMISSION SHIFT INTERLOCK

Correct cable adjustment is important to proper interlock operation. The gearshift cable must be correctly adjusted in order to shift out of PARK.

ADJUSTMENT PROCEDURE

(1) Remove the steering column trim as necessary for access to the brake transmission shift interlock.

(2) Shift the transmission into the PARK position.

(3) Pull upward on both the BTSI lock tab and the gearshift cable lock tab (Fig. 65).

(4) Verify that the shift lever is in the PARK position.

(5) Verify positive engagement of the transmission park lock by attempting to rotate the propeller shaft. The shaft will not rotate when the park lock is engaged.

(6) Turn ignition switch to LOCK position. **Be sure ignition key cylinder is in the LOCK position. Cable will not adjust correctly in any other position.**

(7) Ensure that the cable is free to self-adjust by pushing cable rearward and releasing.

(8) Push the gearshift cable lock tab down until it snaps in place.

(9) Locate the BTSI alignment hole in the bottom of the BTSI mechanism between the BTSI lock tab and the BTSI connector.

(10) Move the BTSI assembly up or down on the gearshift cable until an appropriate size drill bit can be inserted into the alignment hole and through the assembly.

(11) Push the BTSI lock tab down until it snaps into place and remove the drill bit.

(12) Install any steering column trim previously removed.

BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM (Continued)

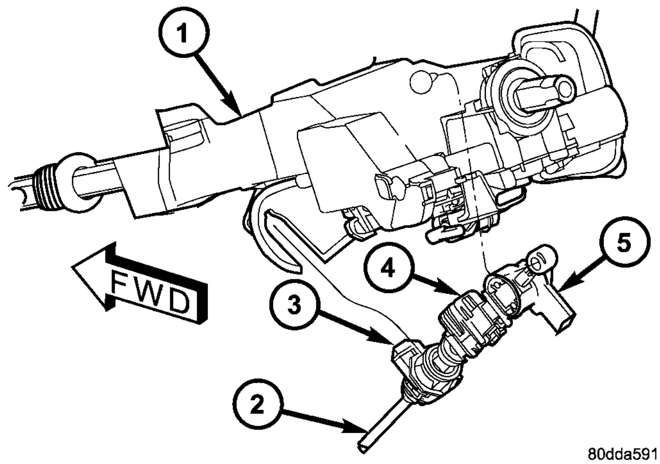


Fig. 65 Brake Transmission Interlock Mechanism

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

BTSI FUNCTION CHECK

(1) Verify removal of ignition key allowed in PARK position only.

(2) When the shift lever is in PARK, the ignition key cylinder should rotate freely from off to lock. When the shifter is in any other position, the ignition key should not rotate from off to lock.

(3) Shifting out of PARK should be possible when the ignition key cylinder is in the off position.

(4) Shifting out of PARK should not be possible while applying normal force, and ignition key cylinder is in the run or start positions, unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

(5) Shifting out of PARK should not be possible when the ignition key cylinder is in the accessory or lock position.

(6) Shifting between any gear and NEUTRAL, or PARK, may be done without depressing foot brake with ignition switch in run or start positions.

(7) Engine starts must be possible with shifter lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any position other than PARK or NEUTRAL.

(8) With shifter lever in the:

• PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.

• PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.

• NEUTRAL position - Normal position. Engine starts must be possible.

• NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

FLUID AND FILTER

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve and clutch operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

DIAGNOSIS AND TESTING - CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has three primary causes.

(1) Internal clutch slippage, usually caused by low line pressure, inadequate clutch apply pressure, or clutch seal failure.

(2) A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged main cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.

(3) Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

DIAGNOSIS AND TESTING - FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

• adding incorrect fluid

• failure to clean dipstick and fill tube when checking level

• engine coolant entering the fluid

FLUID AND FILTER (Continued)

- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to replace contaminated converter after repair

The use of non-recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission, an overhaul is necessary.

The torque converter should be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

STANDARD PROCEDURE

STANDARD PROCEDURE - FLUID LEVEL CHECK

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmssion has too much fluid, the geartrain churns up foam and cause the same conditions which occur with a low fluid level.

In either case, air bubbles can cause overheating and/or fluid oxidation, and varnishing. This can interfere with normal valve, clutch, and accumulator operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

The transmission has a dipstick to check oil level. It is located on the right side of the engine. Be sure to wipe all dirt from dipstick handle before removing.

The torque converter fills in both the P (PARK) and N (NEUTRAL) positions. Place the selector lever in P (PARK) to be sure that the fluid level check is accurate. **The engine should be running at idle speed for at least one minute, with the vehicle on level ground.** At normal operating temperature (approximately 82 C. or 180 F.), the fluid level is correct if it is in the HOT region (cross-hatched area) on the oil level indicator. The fluid level will be approximately at the upper COLD hole of the dipstick at 70° F fluid temperature.

NOTE: Engine and Transmission should be at normal operating temperature before performing this procedure.

(1) Start engine and apply parking brake.

(2) Shift the transmission into DRIVE for approximately 2 seconds.

(3) Shift the transmission into REVERSE for approximately 2 seconds.

(4) Shift the transmission into PARK.

(5) Hook up DRB® scan tool and select transmission.

(6) Select sensors.

(7) Read the transmission temperature value.

(8) Compare the fluid temperature value with the chart. (Fig. 66)

(9) Adjust transmission fluid level shown on the dipstick according to the chart.

NOTE: After adding any fluid to the transmission, wait a minimum of 2 minutes for the oil to fully drain from the fill tube into the transmission before rechecking the fluid level.

(10) Check transmission for leaks.

STANDARD PROCEDURE - FLUID AND FILTER REPLACEMENT

For proper service intervals (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION).

REMOVAL

(1) Hoist and support vehicle on safety stands.

(2) Place a large diameter shallow drain pan beneath the transmission pan.

(3) Remove bolts holding front and sides of pan to transmission.

(4) Loosen bolts holding rear of pan to transmission.

(5) Slowly separate front of pan away from transmission allowing the fluid to drain into drain pan.

(6) Hold up pan and remove remaining bolts holding pan to transmission.

(7) While holding pan level, lower pan away from transmission.

(8) Pour remaining fluid in pan into drain pan.

(9) Remove screw holding filter to valve body (Fig. 67).

FLUID AND FILTER (Continued)

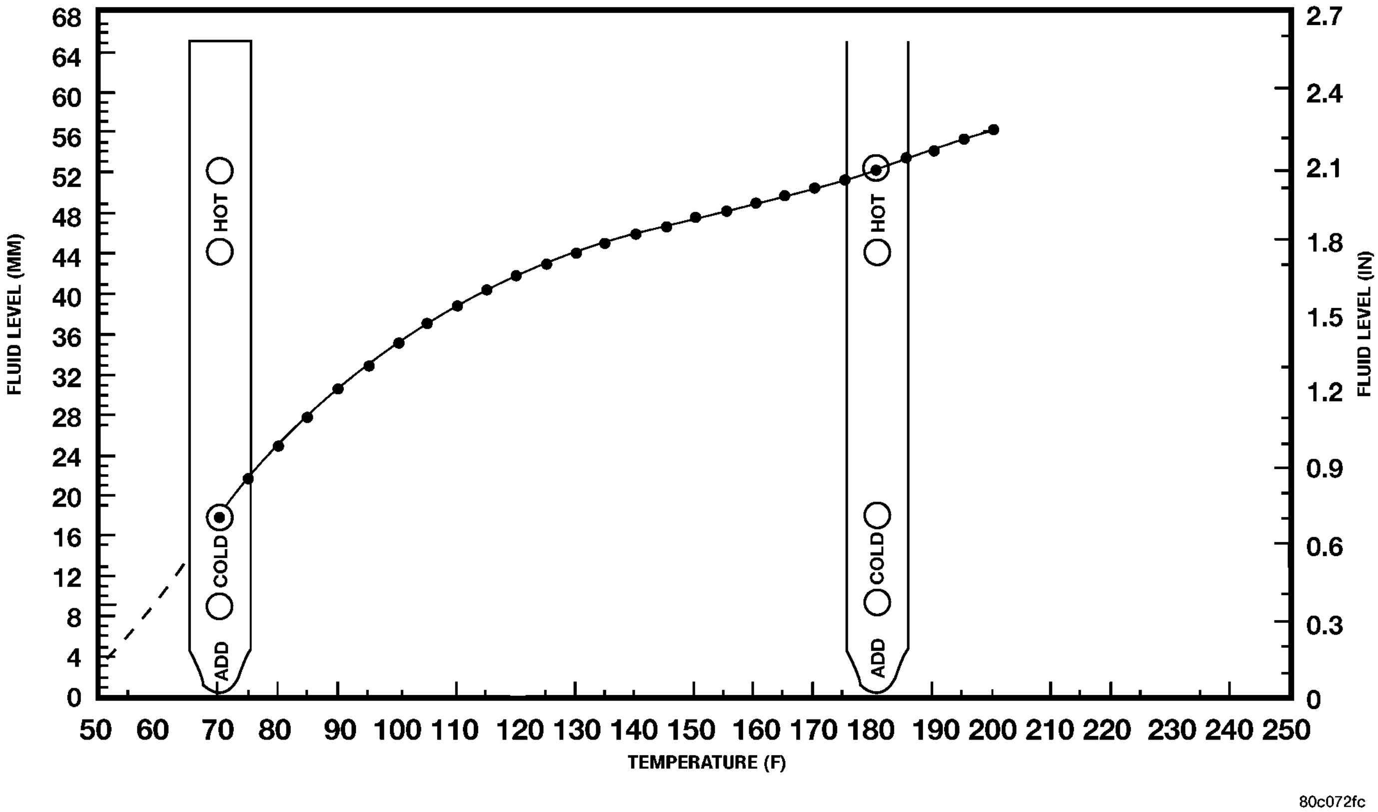


Fig. 66 Transmission Fluid Temperature Chart

(10) Separate filter from valve body and oil pump and pour fluid in filter into drain pan.

(11) Remove and discard the oil filter seal from the bottom of the oil pump.

(12) If replacing the cooler return filter, use Oil Filter Wrench 8321 to remove the filter from the transmission.

(13) Dispose of used trans fluid and filter(s) properly.

INSPECTION

Inspect bottom of pan and magnet for excessive amounts of metal. A light coating of clutch material on the bottom of the pan does not indicate a problem unless accompanied by a slipping condition or shift lag. If fluid and pan are contaminated with excessive amounts of debris, refer to the diagnosis section of this group.

CLEANING

(1) Using a suitable solvent, clean pan and magnet.

(2) Using a suitable gasket scraper, clean original sealing material from surface of transmission case and the transmission pan.

INSTALLATION

(1) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

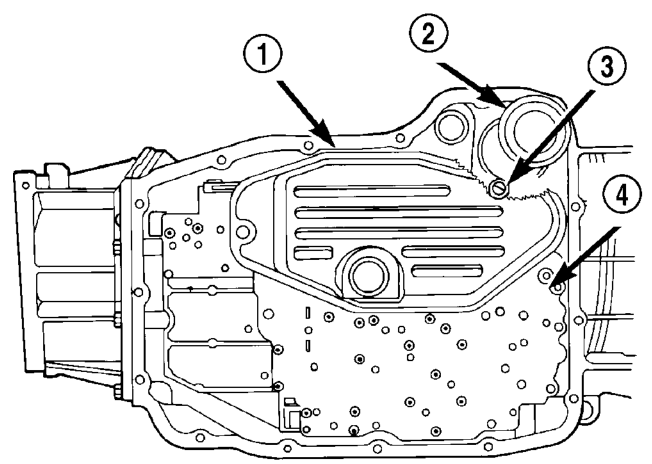


Fig. 67 Transmission Filters - 4X4 Shown

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

CAUTION: The primary oil filter seal MUST be fully installed flush against the oil pump body. DO NOT install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.

FLUID AND FILTER (Continued)

(2) Place replacement filter in position on valve body and into the oil pump.

(3) Install screw to hold filter to valve body (Fig. 67). Tighten screw to 4.5 N·m (40 in. lbs.) torque.

(4) Install new cooler return filter onto the transmission, if necessary. Torque the filter to 14.12 N·m (125 in.lbs.).

(5) Place bead of Mopar® RTV sealant onto the transmission case sealing surface.

(6) Place pan in position on transmission.

(7) Install bolts to hold pan to transmission. Tighten bolts to 11.8 N·m (105 in. lbs.) torque.

(8) Lower vehicle and fill transmission with Mopar® ATF +4.

STANDARD PROCEDURE - TRANSMISSION FILL

To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

(1) Remove dipstick and insert clean funnel in transmission fill tube.

(2) Add following initial quantity of Mopar® ATF +4 to transmission:

(a) If only fluid and filter were changed, add **10 pints (5 quarts)** of ATF +4 to transmission.

(b) If transmission was completely overhauled and the torque converter was replaced or drained, add **24 pints (12 quarts)** of ATF +4 to transmission.

(3) Check the transmission fluid (Refer to 21 - TRANSMISSION/AUTOMATIC - RFE/FLUID - STANDARD PROCEDURE) and adjust as required.

GEARSHIFT CABLE

DIAGNOSIS AND TESTING - GEARSHIFT CABLE

(1) Engine starts must be possible with shift lever in PARK or NEUTRAL positions only. Engine starts must not be possible in any other gear position.

(2) With the shift lever in the:

(a) PARK position - Apply upward force on the shift arm and remove pressure. Engine starts must be possible.

(b) PARK position - Apply downward force on the shift arm and remove pressure. Engine starts must be possible.

(c) NEUTRAL position - Normal position. Engine starts must be possible.

(d) NEUTRAL position - Engine running and brakes applied, apply upward force on the shift arm. Transmission shall not be able to shift from neutral to reverse.

REMOVAL

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Disengage cable eyelet at transmission shift lever and pull cable adjuster out of mounting bracket (Fig. 68) or (Fig. 69).

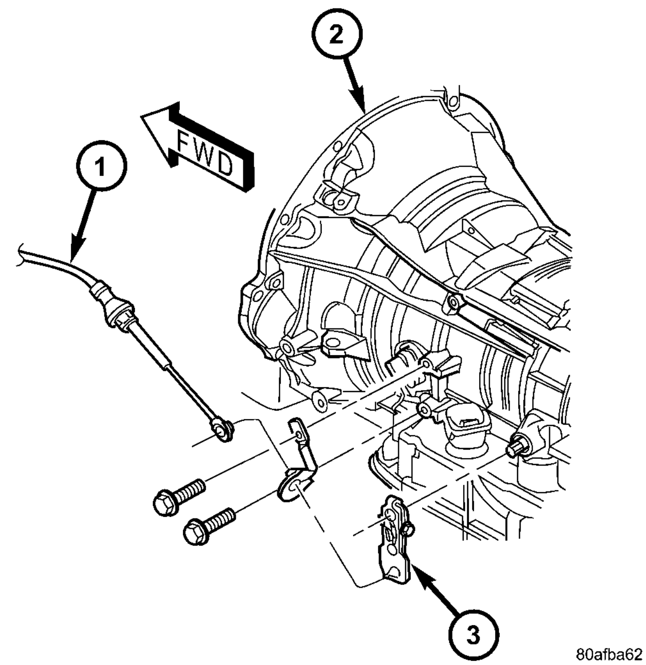


Fig. 68 Gearshift Cable at Transmission - RFE

1 - GEARSHIFT CABLE
2 - RFE TRANSMISSION
3 - MANUAL LEVER

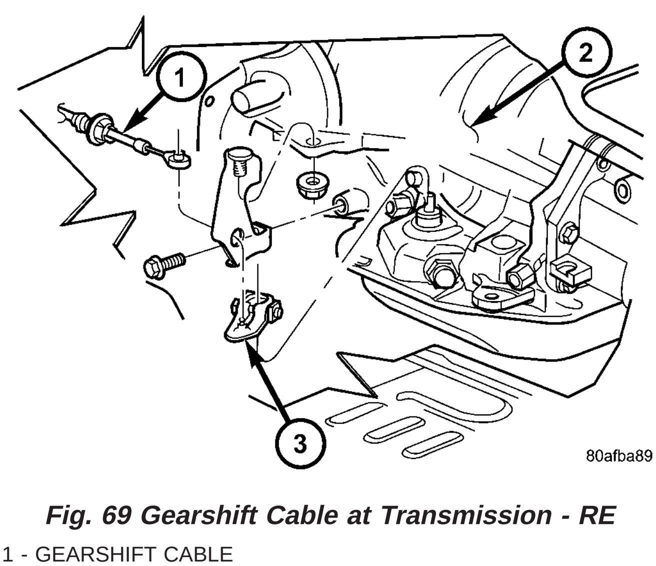


Fig. 69 Gearshift Cable at Transmission - RE

1 - GEARSHIFT CABLE
2 - RE TRANSMISSION
3 - MANUAL LEVER

GEARSHIFT CABLE (Continued)

(4) Lower the vehicle.

(5) Remove the dash panel insulation pad as necessary to access the gearshift cable grommet (Fig. 70).

(6) Remove grommet from the dash panel.

(7) Remove any steering column trim necessary to access the gearshift cable and BTSI mechanism.

(8) Disconnect the BTSI wiring connector.

(9) Disconnect cable at lower column bracket and shift lever pin and pull the cable through the dash panel opening into the vehicle (Fig. 71).

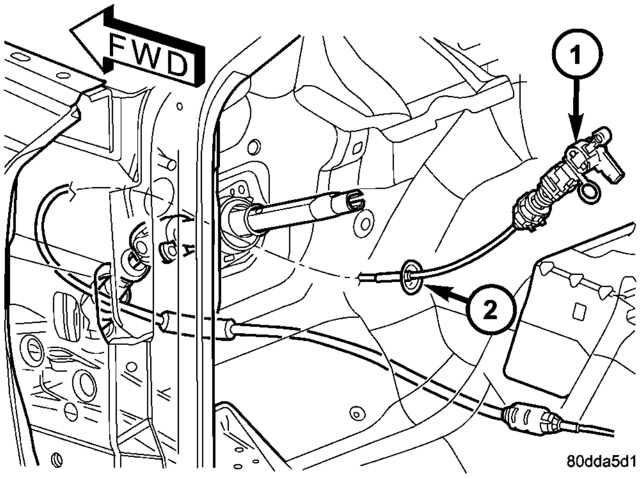


Fig. 70 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

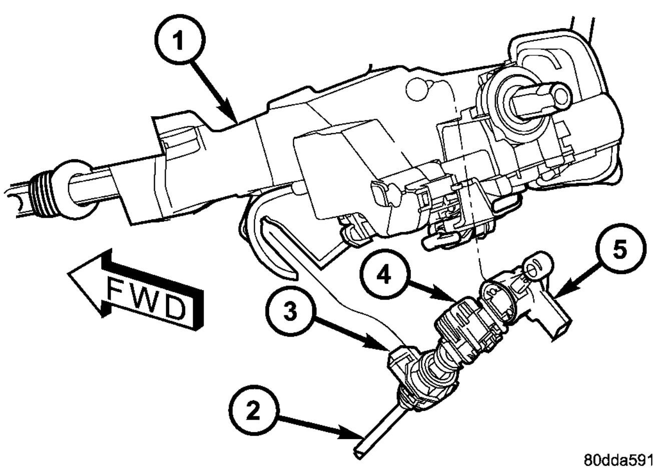


Fig. 71 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

(10) Remove gearshift cable from vehicle.

INSTALLATION

(1) Route the transmission end of the gearshift cable through the opening in the dash panel (Fig. 72).

(2) Seat the cable grommet into the dash panel opening.

(3) Snap the cable into the steering column bracket so the retaining ears (Fig. 73) are engaged and snap the cable eyelet onto the shift lever ball stud.

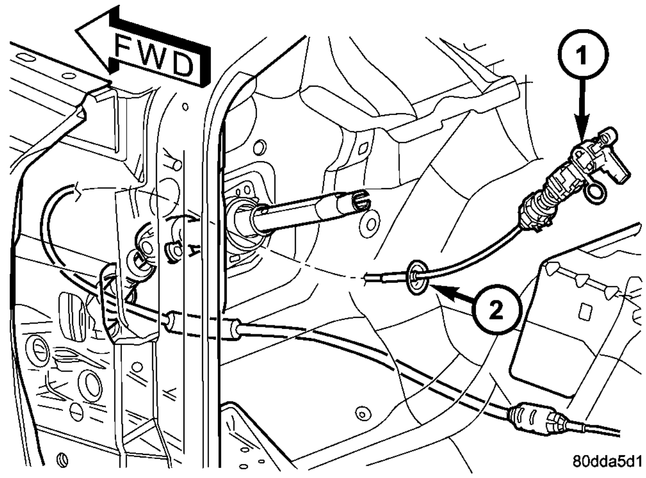


Fig. 72 Gearshift Cable at the Dash Panel

1 - GEARSHIFT CABLE
2 - GROMMET

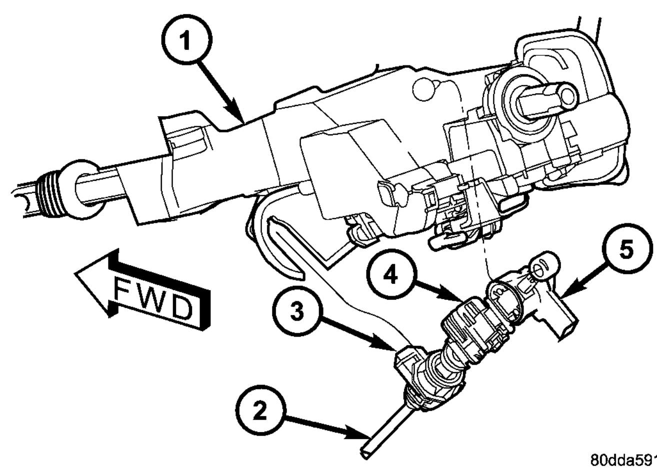


Fig. 73 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

GEARSHIFT CABLE (Continued)

(4) Raise the vehicle.

(5) Place the transmission manual shift lever in the “PARK” detent (rearmost) position and rotate prop shaft to ensure transmission is in PARK.

(6) Route the gearshift cable through the transmission mounting bracket and secure the cable by snapping the cable retaining ears into the transmission bracket and snapping the cable eyelet on the manual shift lever ball stud.

(7) Lower vehicle.

(8) Lock the shift cable adjustment by pressing the cable adjuster lock tab downward until it snaps into place.

(9) Check for proper operation of the transmission range sensor.

(10) Adjust the gearshift cable and BTSI mechanism as necessary.

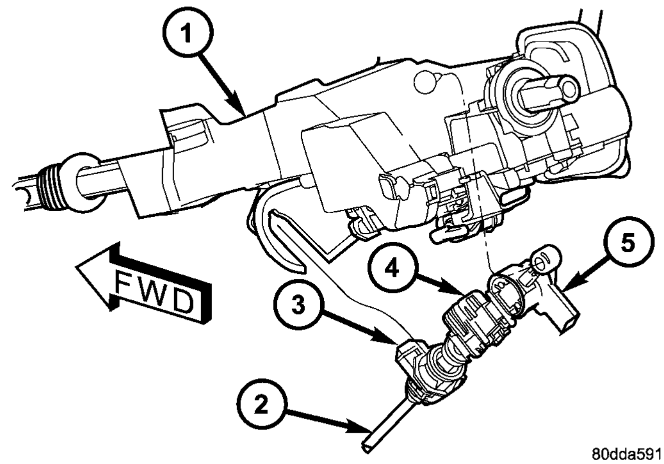


Fig. 74 Gearshift Cable at Steering Column

1 - STEERING COLUMN
2 - GEARSHIFT CABLE
3 - GEARSHIFT CABLE LOCK TAB
4 - BTSI SOLENOID LOCK TAB
5 - BTSI CONNECTOR

ADJUSTMENTS

GEARSHIFT CABLE

Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT if the engine starts only in these positions. Adjustment is INCORRECT if the engine starts in one but not both positions. If the engine starts in any position other than PARK or NEUTRAL, or if the engine will not start at all, the transmission range sensor may be faulty.

Gearshift Adjustment Procedure

(1) Shift transmission into PARK.

(2) Release cable adjuster lock tab (underneath the steering column) (Fig. 74) to unlock cable.

(3) Raise vehicle.

(4) Disengage the cable eyelet from the transmission manual shift lever.

(5) Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.

(6) Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.

(7) Snap the cable eyelet onto the transmission manual shift lever.

(8) Lower vehicle.

(9) Lock shift cable by pressing cable adjuster lock tab downward until it snaps into place.

(10) Check engine starting. Engine should start only in PARK and NEUTRAL

HOLDING CLUTCHES

DESCRIPTION

Three hydraulically applied multi-disc clutches are used to hold some planetary geartrain components stationary while the input clutches drive others. The 2C, 4C, and Low/Reverse clutches are considered holding clutches. The 2C and 4C clutches are located in the 4C retainer/bulkhead (Fig. 75), while the Low/Reverse clutch is located at the rear of the transmission case (Fig. 76).

OPERATION

2C CLUTCH

The 2C clutch is hydraulically applied in second and fifth gear by pressurized fluid against the 2C piston. When the 2C clutch is applied, the reverse sun gear assembly is held or grounded to the transmission case by holding the reaction planetary carrier.

HOLDING CLUTCHES (Continued)

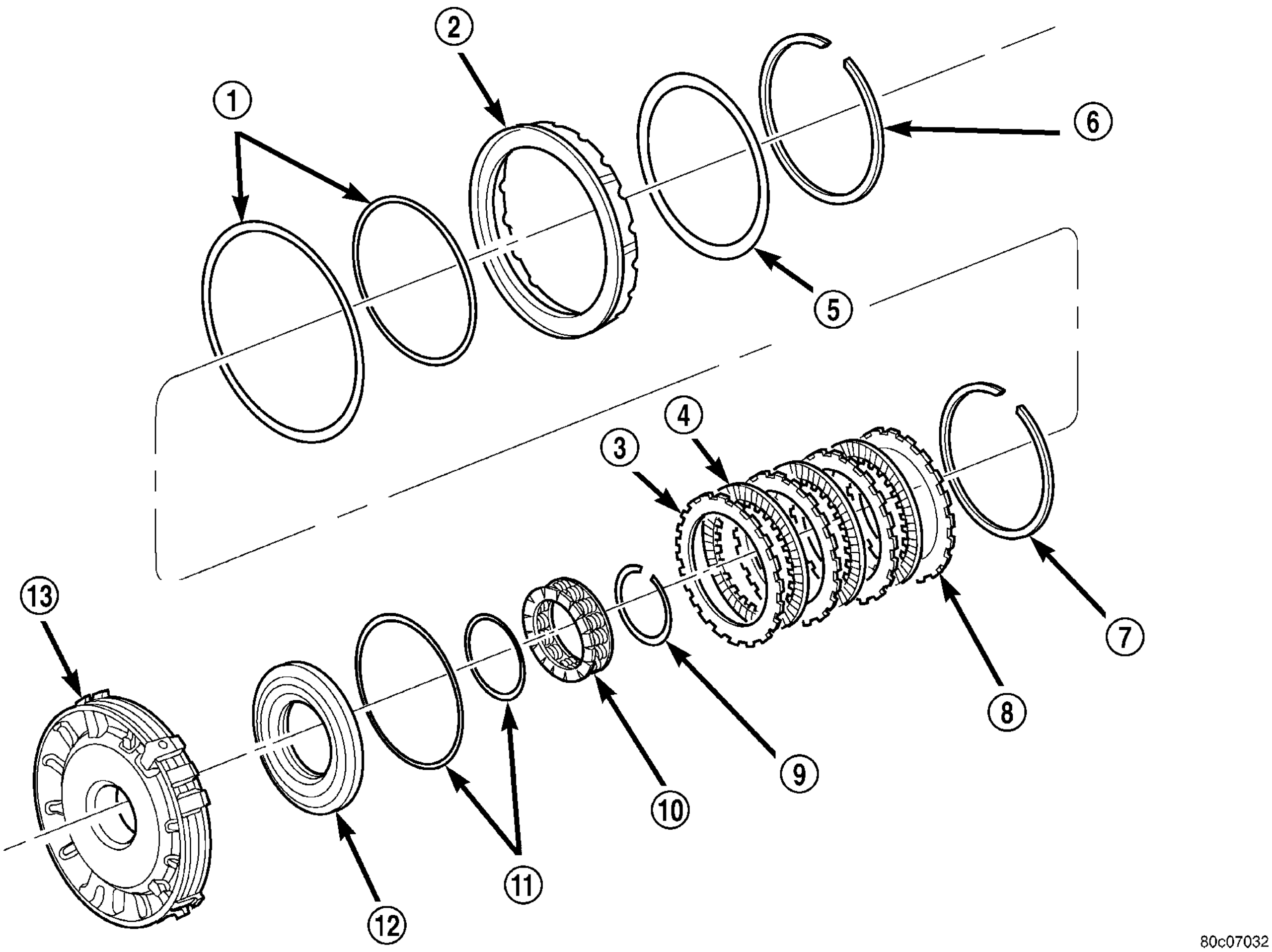


Fig. 75 2C and 4C Clutches

1 - SEAL
2 - 2C PISTON
3 - PLATE
4 - DISC
5 - 2C BELLEVILLE SPRING
6 - SNAP-RING
7 - SNAP-RING (SELECT)
8 - REACTION PLATE
9 - SNAP-RING
10 - RETURN SPRING
11 - SEAL
12 - 4C PISTON
13 - 4C RETAINER/BULKHEAD

4C CLUTCH

The 4C clutch is hydraulically applied in second prime and fourth gear by pressurized fluid against the 4C clutch piston. When the 4C clutch is applied, the reaction annulus gear is held or grounded to the transmission case.

LOW/REVERSE CLUTCH

The Low/Reverse clutch is hydraulically applied in park, reverse, neutral, and first gear, only at low speeds, by pressurized fluid against the Low/Reverse clutch piston. When the Low/Reverse clutch is applied, the input annulus assembly is held or grounded to the transmission case.

HOLDING CLUTCHES (Continued)

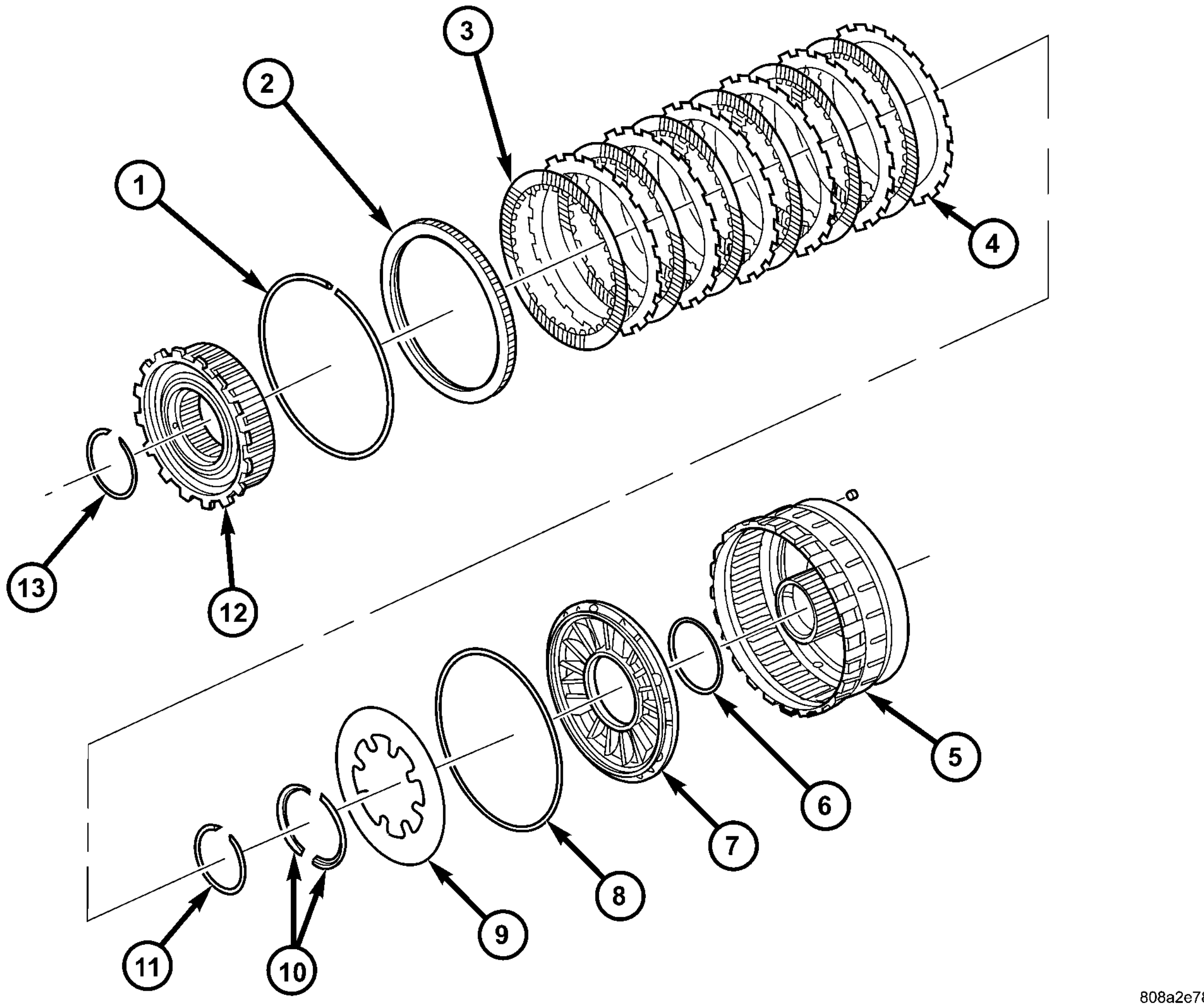


Fig. 76 Low/Reverse Clutch

1 - SNAP-RING (SELECT)
2 - REACTION PLATE
3 - DISC
4 - PLATE
5 - L/R CLUTCH RETAINER
6 - SEAL
7 - PISTON
8 - SEAL
9 - BELLEVILLE SPRING
10 - RETAINER
11 - SNAP-RING
12 - OVERRUNNING CLUTCH
13 - SNAP-RING

INPUT CLUTCH ASSEMBLY

DESCRIPTION

Three hydraulically applied input clutches are used to drive planetary components. The underdrive, overdrive, and reverse clutches are considered input clutches and are contained within the input clutch assembly (Fig. 77) and (Fig. 78). The input clutch assembly also contains:

- Input shaft
- Input hub
- Clutch retainer
- Underdrive piston
- Overdrive/reverse piston
- Overdrive hub
- Underdrive hub

OPERATION

The three input clutches are responsible for driving different components of the planetary geartrain.

UNDERDRIVE CLUTCH

The underdrive clutch is hydraulically applied in first, second, second prime, and third (direct) gears by pressurized fluid against the underdrive piston. When the underdrive clutch is applied, the underdrive hub drives the input sun gear.

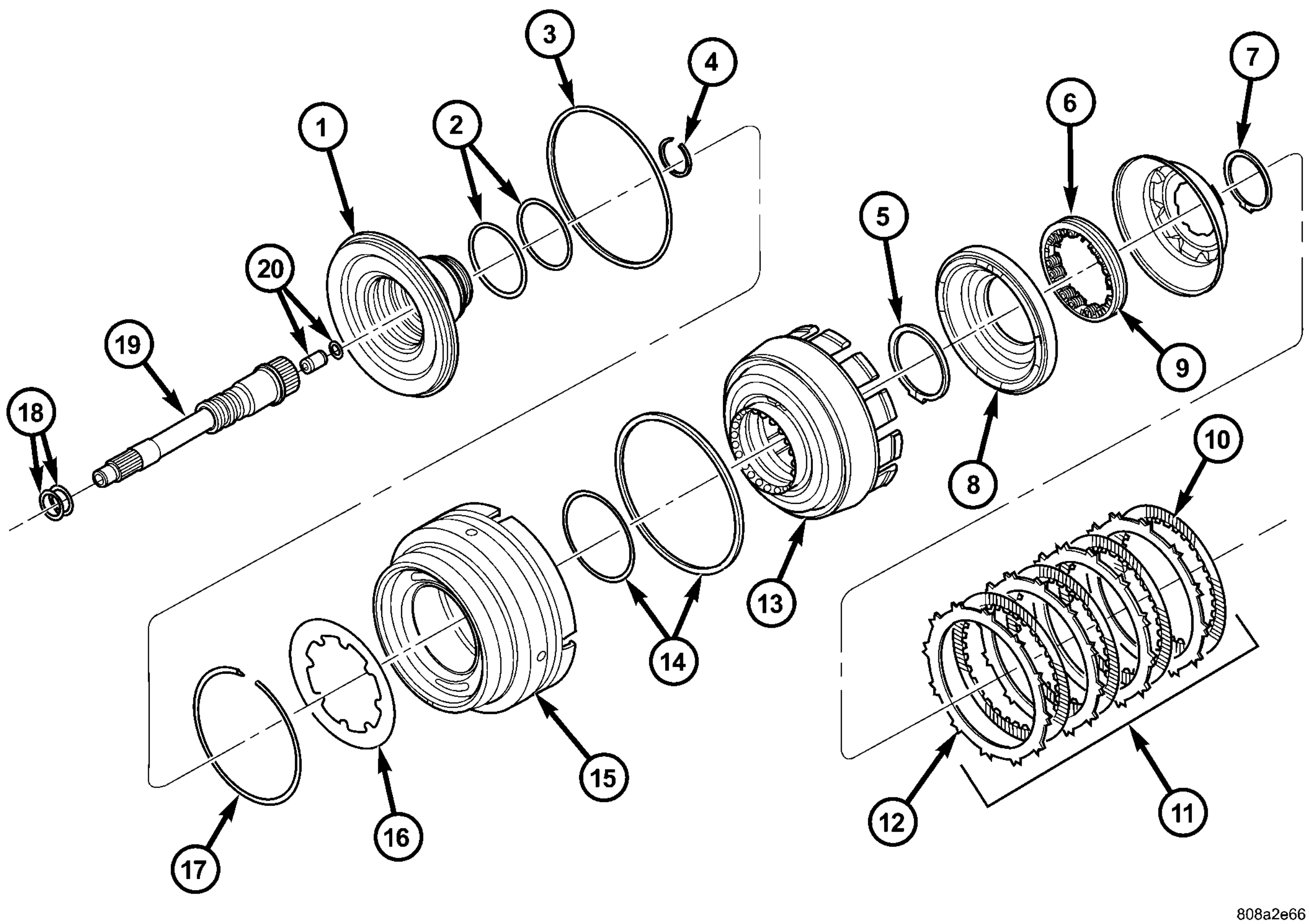


Fig. 77 Input Clutch Assembly - Part 1

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

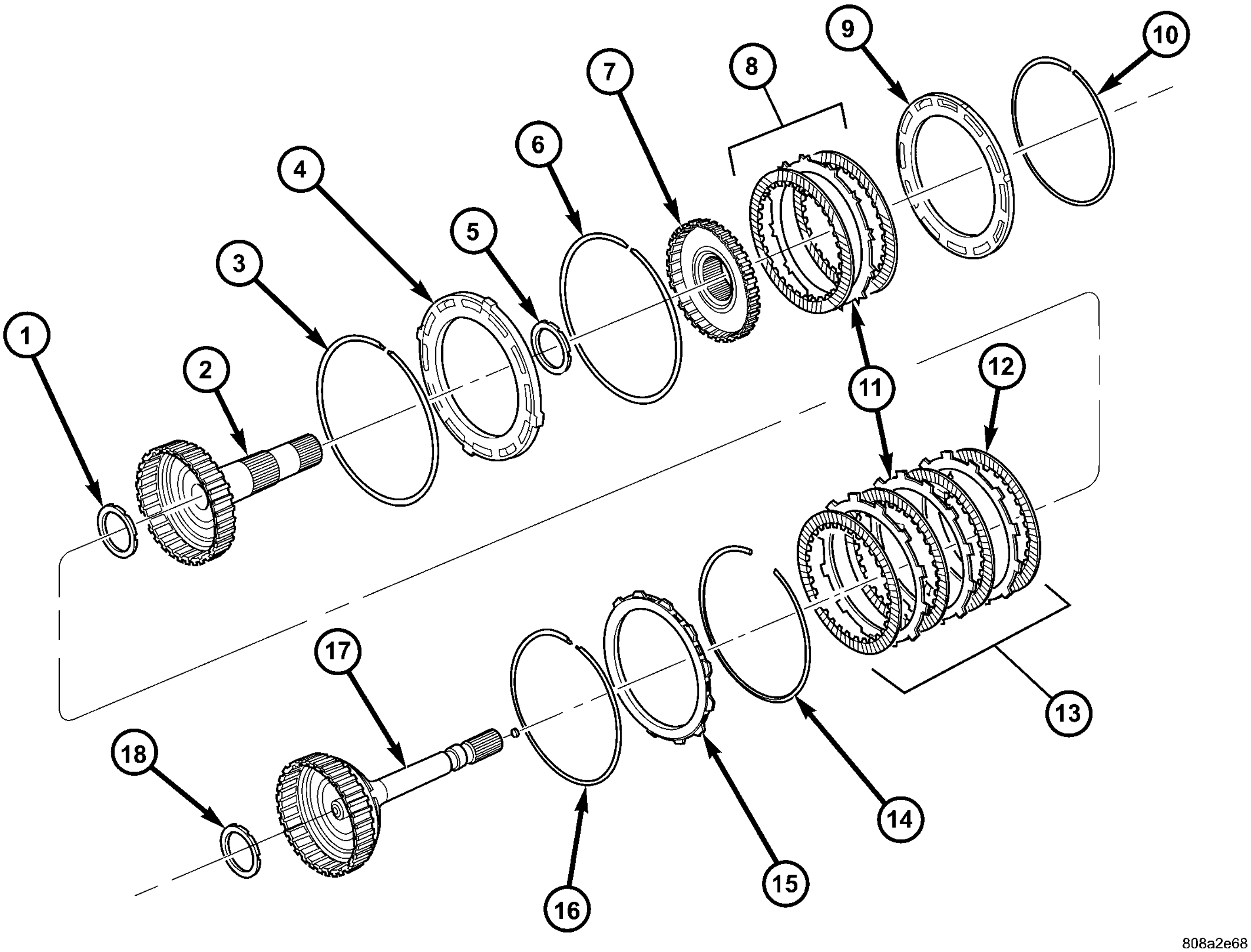


Fig. 78 Input Clutch Assembly - Part 2

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

OVERDRIVE CLUTCH

The overdrive clutch is hydraulically applied in third (direct), fourth, and fifth gears by pressurized fluid against the overdrive/reverse piston. When the overdrive clutch is applied, the overdrive hub drives the reverse carrier/input annulus assembly.

REVERSE CLUTCH

The reverse clutch is hydraulically applied in reverse gear by pressurized fluid against the overdrive/reverse piston. When the reverse clutch is applied, the reaction annulus gear is driven.

DISASSEMBLY

(1) Remove the reverse reaction plate selective snap-ring from the input clutch retainer (Fig. 79).

(2) Remove the reverse reaction plate from the input clutch retainer.

(3) Remove the reverse hub and reverse clutch pack from the input clutch retainer.

(4) Remove the number 4 bearing from the overdrive hub.

(5) Remove the overdrive hub from the input clutch retainer (Fig. 79).

INPUT CLUTCH ASSEMBLY (Continued)

(6) Remove the number 3 bearing from the underdrive hub.

(7) Remove the OD/reverse reaction plate snap-ring from the input clutch retainer.

(8) Remove the underdrive hub, overdrive clutch, and overdrive reaction plate from the input clutch retainer (Fig. 79).

NOTE: The overdrive friction discs and steel discs are thicker than the matching components in the underdrive and reverse clutches.

(9) Remove the number 2 bearing from the input clutch hub.

(10) Remove the overdrive clutch wave snap-ring from the input clutch retainer.

(11) Remove the UD/OD reaction plate tapered snap-ring from the input clutch retainer.

(12) Remove the UD/OD reaction plate from the input clutch retainer.

(13) Remove the UD/OD reaction plate flat snap-ring from the input clutch retainer (Fig. 79).

(14) Remove the underdrive clutch pack from the input clutch retainer (Fig. 81).

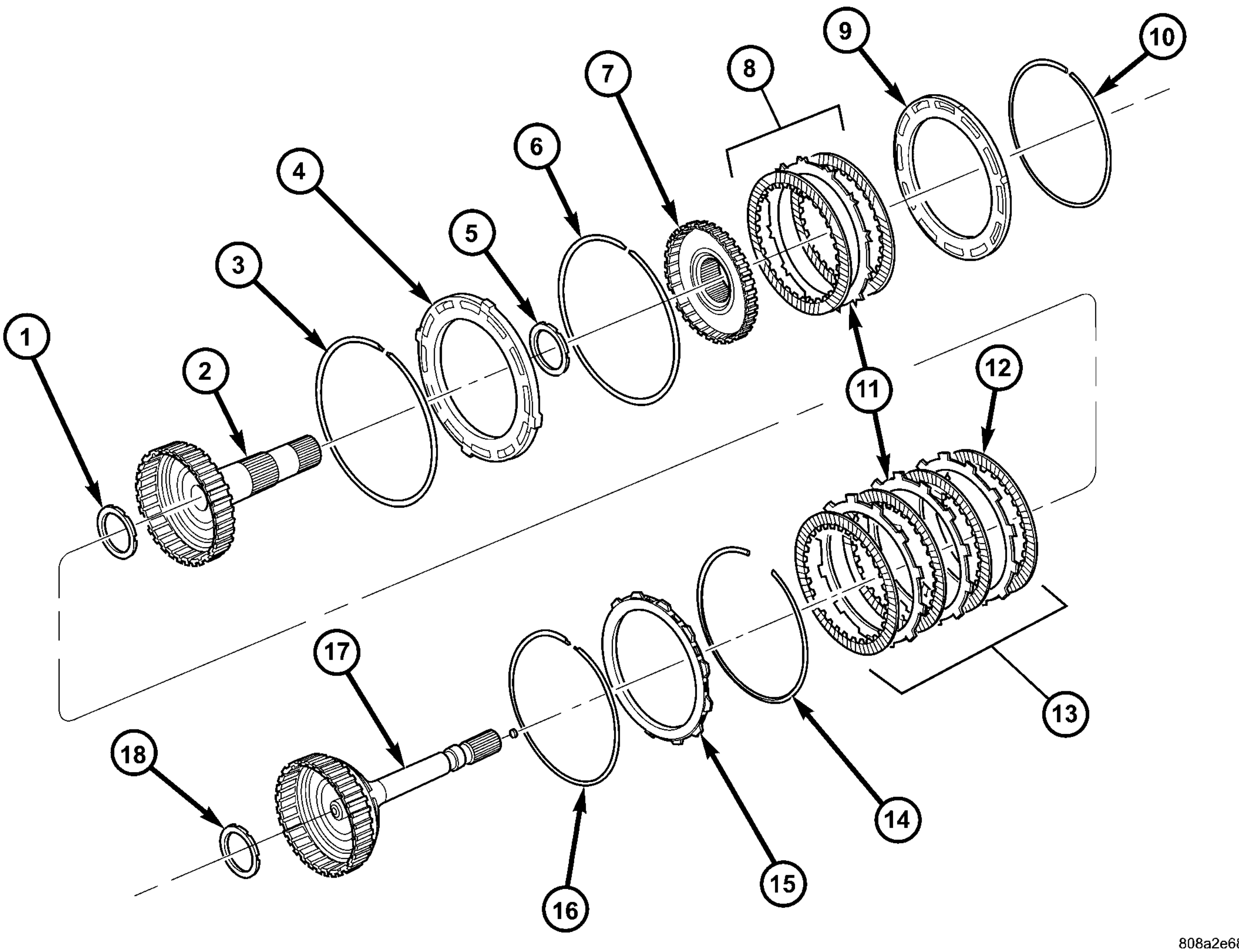


Fig. 79 Input Clutch Assembly - Part 2

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

INPUT CLUTCH ASSEMBLY (Continued)

(15) Using Spring Compressor 8251, compress the UD/OD balance piston and remove the snap-ring from the input clutch hub (Fig. 80).

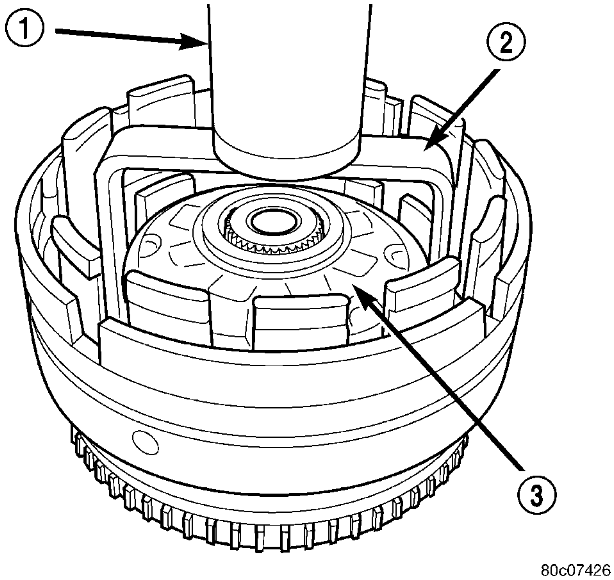


Fig. 80 Compressing UD/OD Balance Piston Using Tool 8251

1 - PRESS
2 - TOOL 8251
3 - BALANCE PISTON

(16) Remove the UD/OD balance piston and piston return spring from the input clutch retainer (Fig. 81).

(17) Remove the underdrive piston from the input clutch retainer (Fig. 81).

NOTE: Both the UD/OD balance piston and the underdrive piston have seals molded onto them. If the seal is damaged, do not attempt to install a new seal onto the piston. The piston/seal must be replaced as an assembly.

(18) Remove the input clutch retainer tapered snap-ring.

(19) Separate input clutch retainer from input clutch hub.

(20) Separate OD/reverse piston from input clutch hub retainer (Fig. 81).

(21) Remove all seals and o-rings from the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to make note of which o-ring belongs in which location.

ASSEMBLY

(1) Install all new seals and o-rings onto the input shaft and input hub. The o-rings on the input hub are color coded. Be sure to install the correct o-ring in the correct location.

(2) Check the transmission lubrication check valve located in the input shaft using shop air. The valve should only allow air flow in one direction. If the valve allows no air flow, or air flow in both directions, the valve will need to be replaced.

(3) Lubricate all seals with Mopar® ATF +4, Automatic Transmission Fluid, prior to installation.

(4) Assemble the OD/reverse piston onto the input clutch hub (Fig. 82).

(5) Assemble the input clutch retainer onto the input clutch hub.

INPUT CLUTCH ASSEMBLY (Continued)

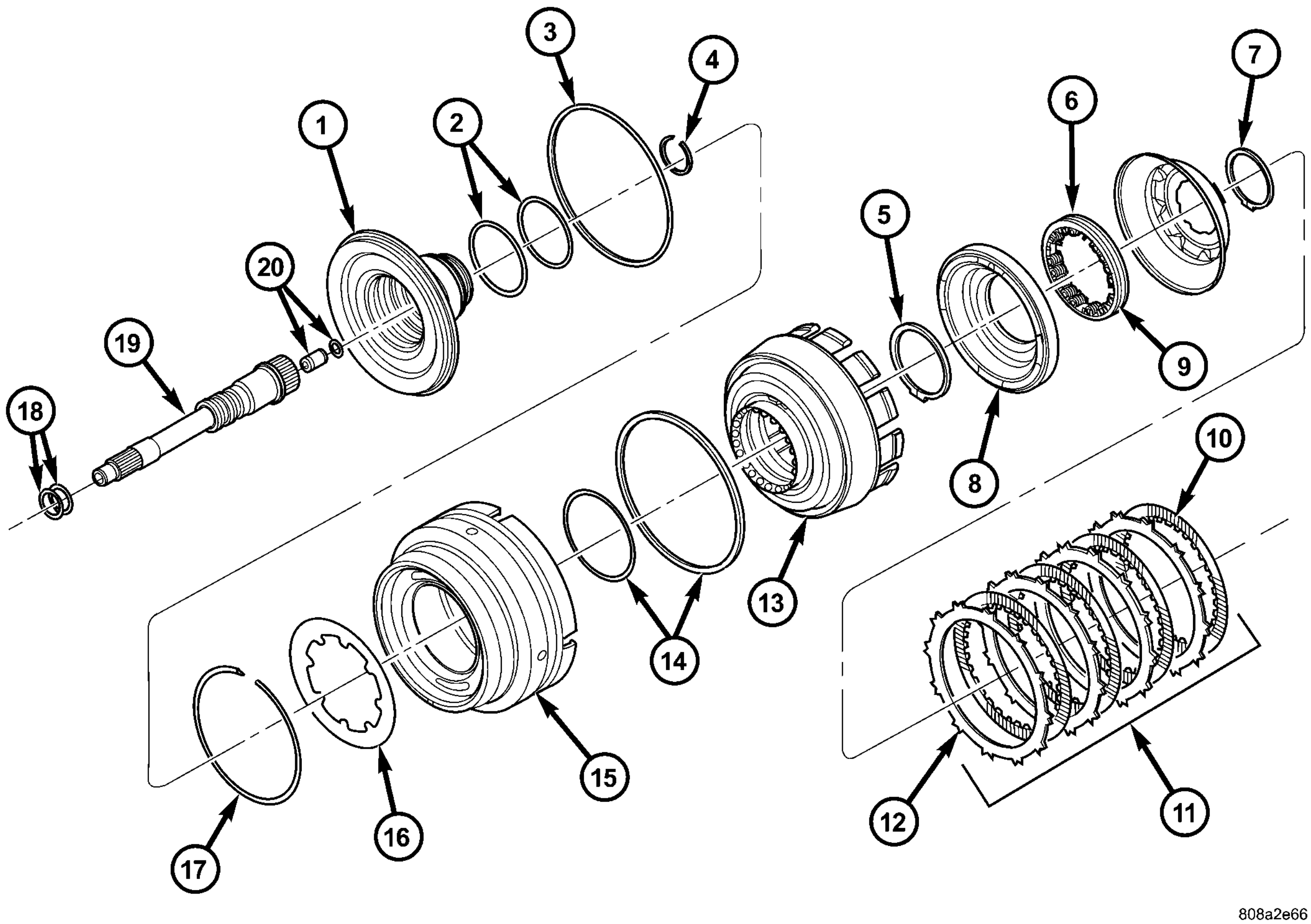


Fig. 81 Input Clutch Assembly - Part 1

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

INPUT CLUTCH ASSEMBLY (Continued)

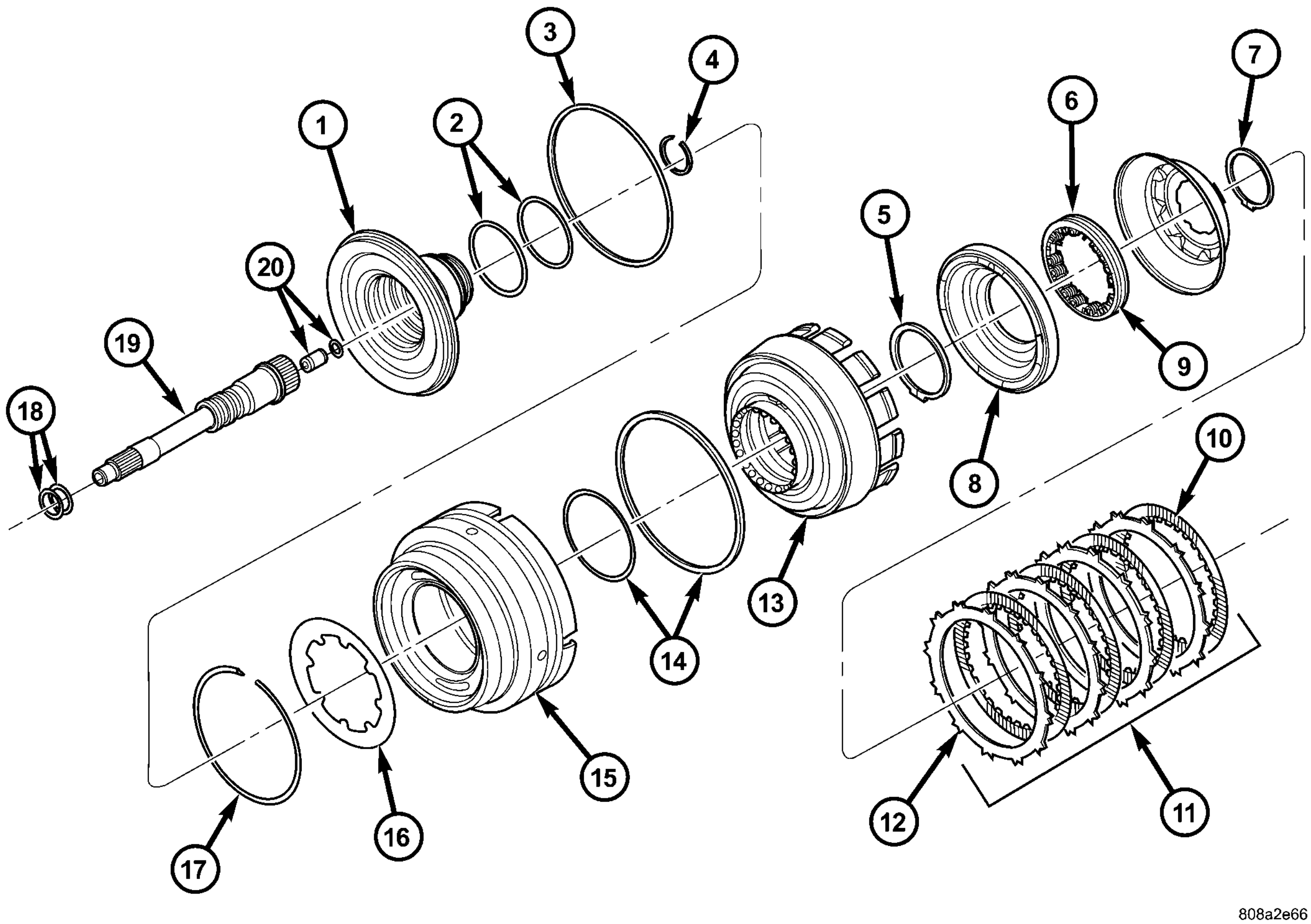


Fig. 82 Input Clutch Assembly - Part I

1 - INPUT CLUTCH HUB
2 - O-RING SEALS
3 - SEAL
4 - SNAP-RING
5 - SNAP-RING
6 - UD BALANCE PISTON
7 - SNAP-RING
8 - UD PISTON
9 - SPRING
10 - DISC
11 - UD CLUTCH
12 - PLATE
13 - CLUTCH RETAINER
14 - SEAL
15 - OD/REV PISTON
16 - BELLEVILLE SPRING
17 - SNAP-RING
18 - SEAL RINGS
19 - INPUT SHAFT
20 - LUBRICATION CHECK VALVE AND SNAP-RING

INPUT CLUTCH ASSEMBLY (Continued)

(6) Install the input clutch retainer tapered snap-ring with tapered side up onto the input clutch hub.

(7) Install Piston Guides 8504 into the input clutch retainer (Fig. 83) and onto the input clutch hub to guide the inner and outer underdrive piston seals into position.

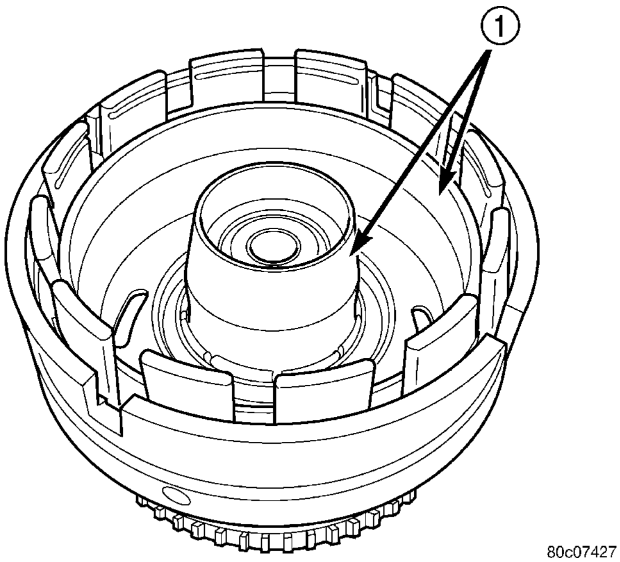


Fig. 83 Install Underdrive Piston Using Tool 8504

1 - TOOL 8504

(8) Install the underdrive piston into the input clutch retainer and over the input clutch hub (Fig. 82).

(9) Install the UD/OD balance piston return spring pack into the input clutch retainer.

(10) Install Piston Guide 8252 into the input clutch retainer (Fig. 84) to guide the UD/OD balance piston seal into position inside the underdrive piston.

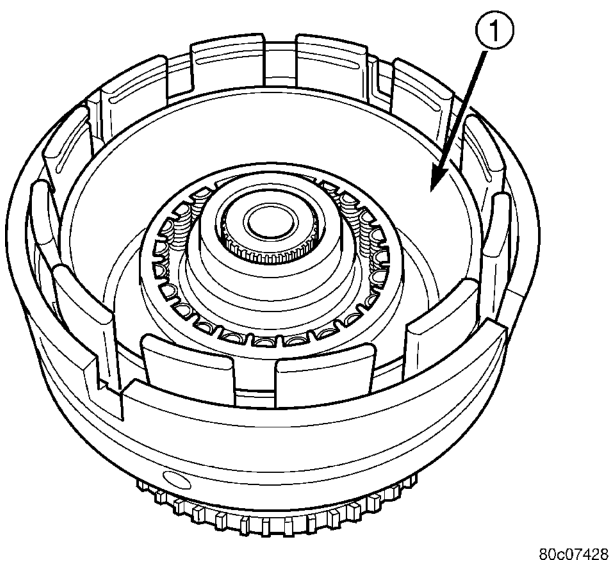


Fig. 84 Install Balance Piston Using Tool 8252

1 - TOOL 8252

(11) Install the UD/OD balance piston into the input clutch retainer and the underdrive piston.

(12) Using Spring Compressor 8251, compress the UD/OD return spring pack and secure the piston in place with the snap-ring (Fig. 85).

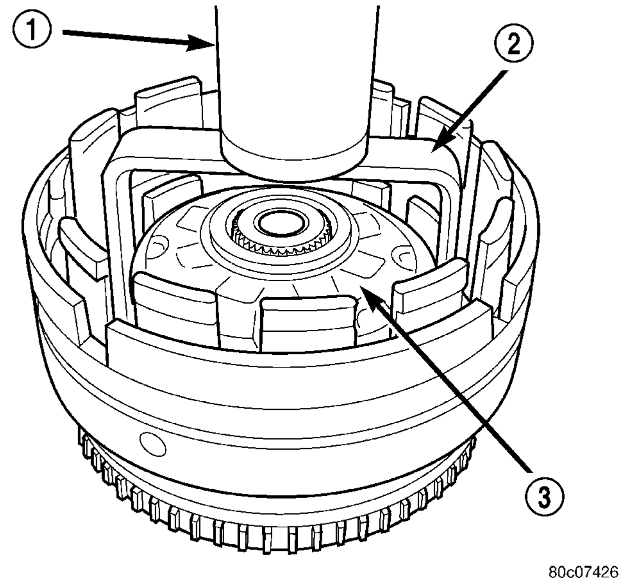


Fig. 85 Compressing UD/OD Balance Piston Using Tool 8251

1 - PRESS
2 - TOOL 8251
3 - BALANCE PISTON

INPUT CLUTCH ASSEMBLY (Continued)

(13) Install the underdrive clutch pack into the input clutch retainer (Fig. 82).

(14) Install the UD/OD reaction plate lower flat snap-ring (Fig. 86). The correct snap-ring can be identified by the two tabbed ears.

(15) Install the UD/OD reaction plate into the input clutch retainer. The reaction plate is to be installed with the big step down.

(16) Install the UD/OD reaction plate upper tapered snap-ring with tapered side up.

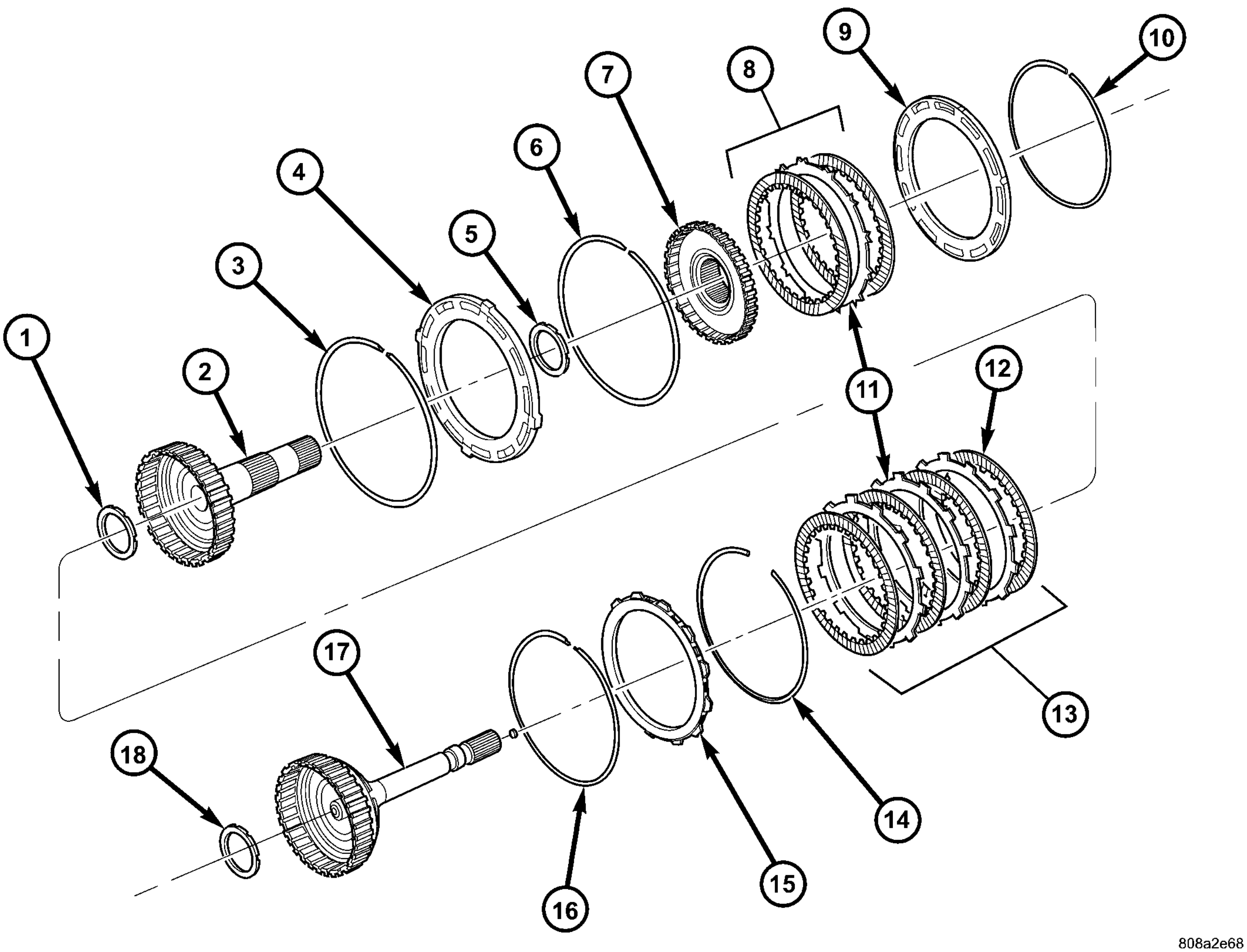


Fig. 86 Input Clutch Assembly - Part II

1 - BEARING NUMBER 3
2 - OD HUB/SHAFT
3 - SNAP-RING (WAVE)
4 - REV/OD REACTION PLATE
5 - BEARING NUMBER 4
6 - SNAP-RING (FLAT)
7 - REVERSE HUB/SHAFT
8 - REVERSE CLUTCH
9 - REVERSE REACTION PLATE
10 - SNAP-RING (SELECT)
11 - PLATE
12 - DISC
13 - OD CLUTCH
14 - SNAP-RING (TAPERED)
15 - UD/OD REACTION PLATE
16 - SNAP-RING (FLAT)
17 - UD HUB/SHAFT
18 - BEARING NUMBER 2

INPUT CLUTCH ASSEMBLY (Continued)

(17) Install the input clutch assembly into Input Clutch Pressure Fixture 8260 (Fig. 87). Mount a dial indicator to the assembly, push down on the clutch discs and zero the indicator against the underdrive clutch discs (Fig. 88). Apply 20 psi of air pressure to the underdrive clutch and record the dial indicator reading. Measure and record UD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with UD clutch pack clearance specification. The correct clutch clearance is 0.84-1.54 mm (0.033-0.061 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.

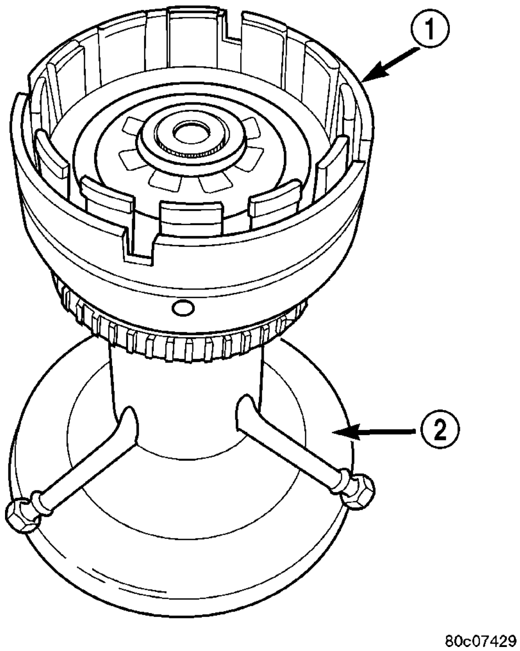


Fig. 87 Input Clutch Assembly Mounted on Tool 8260

1 - INPUT CLUTCH ASSEMBLY
2 - TOOL 8260

(18) Install the overdrive clutch pack into the input clutch retainer (Fig. 86). The overdrive steel separator plates can be identified by the lack of the half-moon cuts in the locating tabs.

(19) Install the overdrive clutch wavy snap-ring with the two tabbed ears into the input clutch retainer.

(20) Install the OD/reverse reaction plate into the input clutch retainer. The reaction plate is non-directional (Fig. 86).

(21) Install the OD/reverse reaction plate flat snap-ring into the input clutch retainer.

(22) Mount a dial indicator to the assembly and zero the indicator against the OD/reverse reaction plate (Fig. 89). Apply 20 psi of air pressure to the overdrive clutch and record the dial indicator reading. Measure and record OD clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with OD clutch pack clearance specification.Verify that the clutch clearance is 1.103-1.856 mm (0.043-0.073 in.). The reaction plate is not selective. If the clutch clearance is not within specification, replace the reaction plate along with all the friction and steel discs.

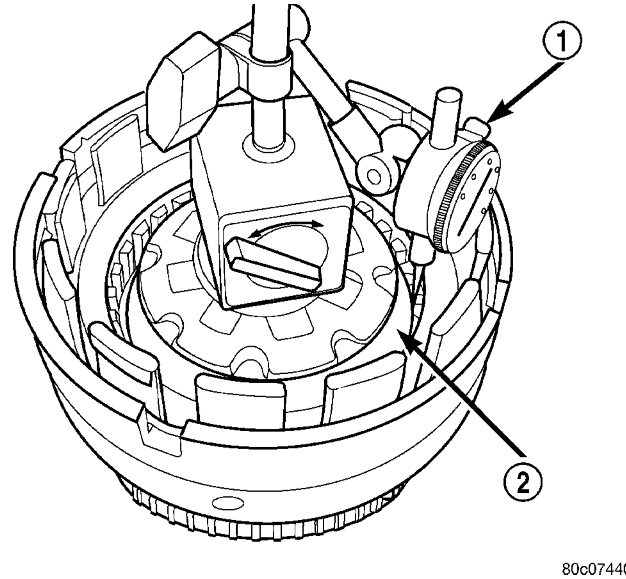


Fig. 88 Measuring UD Clutch Clearance

1 - TOOL C-3339
2 - UNDERDRIVE CLUTCH PACK

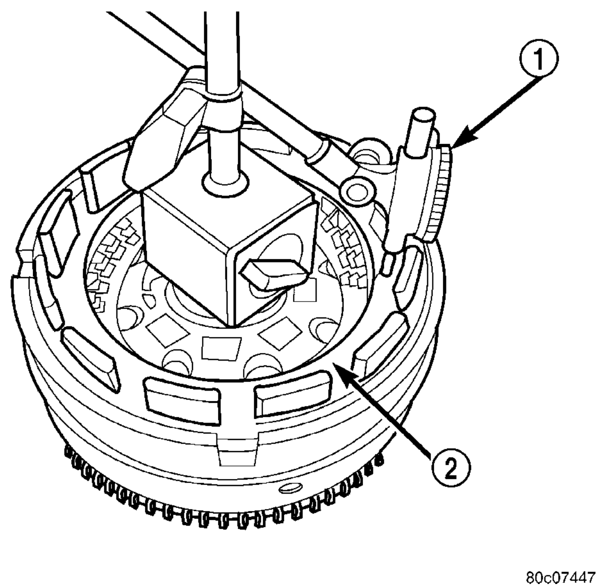


Fig. 89 Measuring OD Clutch Clearance

1 - TOOL C-3339
2 - OD/REV REACTION PLATE

(23) Install the reverse clutch pack into the input clutch retainer (Fig. 86).

(24) Install the reverse reaction plate into the input clutch retainer.

(25) Install the reverse reaction plate selective snap-ring into the input clutch retainer.

(26) Mount a dial indicator to the assembly, push down on the clutch discs, pull up on the reaction plate to ensure the plate is properly seated and zero the indicator against the reverse clutch discs (Fig. 90). Apply 20 psi of air pressure to the reverse clutch and record the dial indicator reading. Measure and record Reverse clutch pack measurement in four (4) places, 90° apart. Take average of four measurements and compare with Reverse clutch pack clearance specification. The correct clutch clearance is 0.58-1.47 mm (0.023-0.058 in.). Adjust as necessary. Install the chosen snap-ring and re-measure to verify selection.

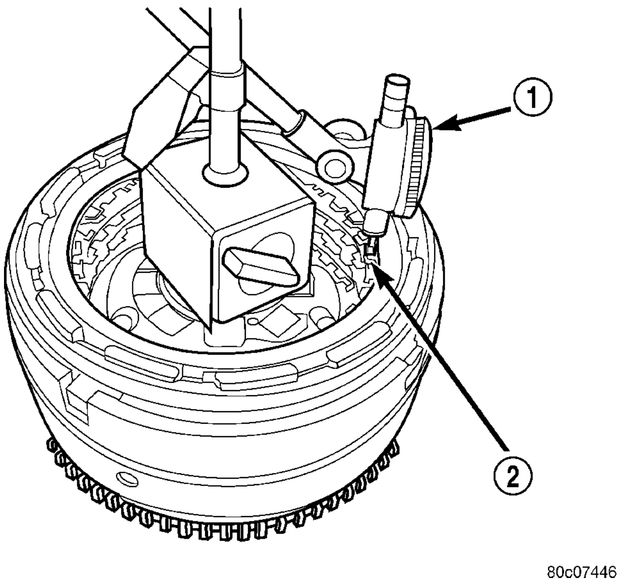


Fig. 90 Measuring Reverse Clutch Clearance

1 - TOOL C-3339
2 - REVERSE CLUTCH PACK

(27) Remove the reverse clutch pack from the input clutch retainer.

(28) Install the number 2 bearing onto the underdrive hub with outer race against the hub with petroleum jelly.

(29) Install the underdrive hub into the input clutch retainer.

(30) Install the number 3 bearing into the overdrive hub with the outer race against the hub with petroleum jelly.

(31) Install the overdrive hub into the input clutch retainer.

(32) Install the number 4 bearing into the reverse hub with outer race against the hub with petroleum jelly.

(33) Install the reverse hub into the input clutch retainer.

(34) Install the complete reverse clutch pack.

(35) Install the reverse reaction plate and snap-ring.

(36) Push up on reaction plate to allow reverse clutch to move freely.

INPUT SPEED SENSOR

DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

INPUT SPEED SENSOR (Continued)

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the input speed sensor (Fig. 91).

(4) Remove the bolt holding the input speed sensor to the transmission case.

(5) Remove the input speed sensor from the transmission case.

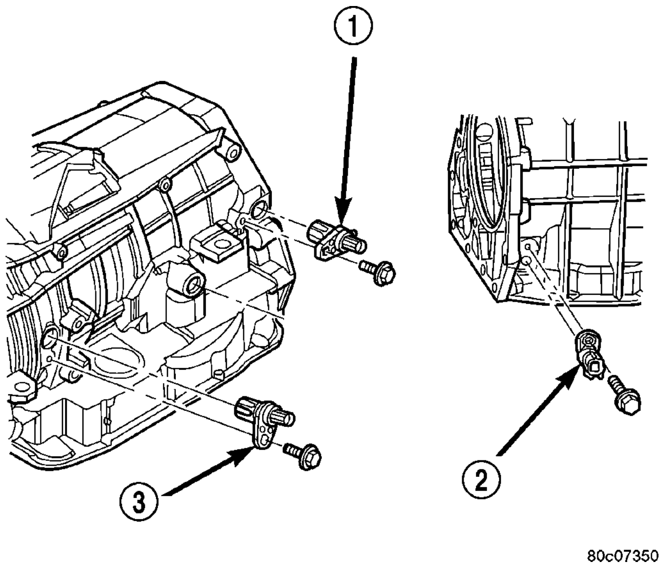


Fig. 91 Input Speed Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

INSTALLATION

(1) Install the input speed sensor into the transmission case.

(2) Install the bolt to hold the input speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the input speed sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

LINE PRESSURE (LP) SENSOR

DESCRIPTION

The TCM utilizes a closed-loop system to control transmission line pressure. The system contains a variable force style solenoid, the Pressure Control Solenoid, mounted on the side of the solenoid and pressure switch assembly. The solenoid is duty cycle controlled by the TCM to vent the unnecessary line pressure supplied by the oil pump back to the sump. The system also contains a variable pressure style sensor, the Line Pressure Sensor, which is a direct input to the TCM. The line pressure solenoid monitors the transmission line pressure and completes the feedback loop to the TCM. The TCM uses this information to adjust its control of the pressure control solenoid to achieve the desired line pressure.

OPERATION

The TCM calculates the desired line pressure based upon inputs from the transmission and engine. The TCM calculates the torque input to the transmission and uses that information as the primary input to the calculation. The line pressure is set to a predetermined value during shifts and when the transmission is in the PARK and NEUTRAL positions. This is done to ensure consistent shift quality. During all other operation, the actual line pressure is compared to the desired line pressure and adjustments are made to the pressure control solenoid duty cycle.

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the line pressure sensor (Fig. 92).

(4) Remove the bolt holding the line pressure sensor to the transmission case.

(5) Remove the line pressure sensor from the transmission case.

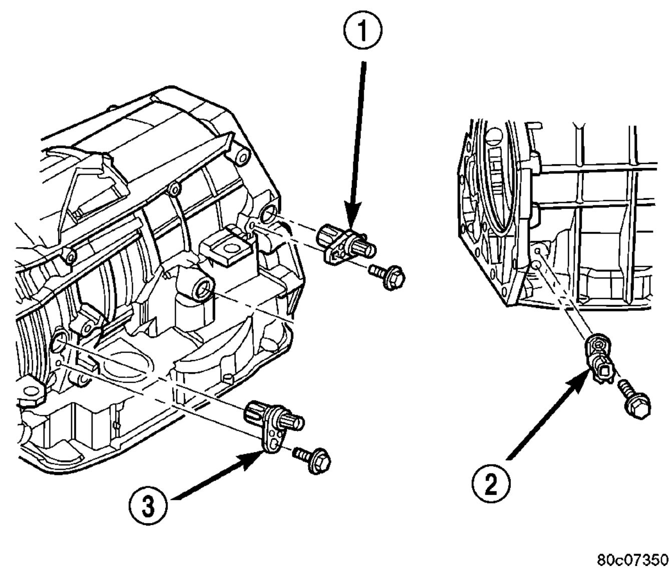


Fig. 92 Line Pressure Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

INSTALLATION

(1) Install the line pressure sensor into the transmission case.

(2) Install the bolt to hold the line pressure sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the line pressure sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

LOW/REVERSE CLUTCH

DISASSEMBLY

(1) Remove the inner overrunning clutch snap-ring from the low/reverse clutch retainer (Fig. 93).

(2) Remove the outer low/reverse reaction plate flat snap-ring (Fig. 93).

(3) Remove the low/reverse clutch and the overrunning clutch from the low/reverse clutch retainer as an assembly (Fig. 93).

(4) Separate the low/reverse clutch from the overrunning clutch.

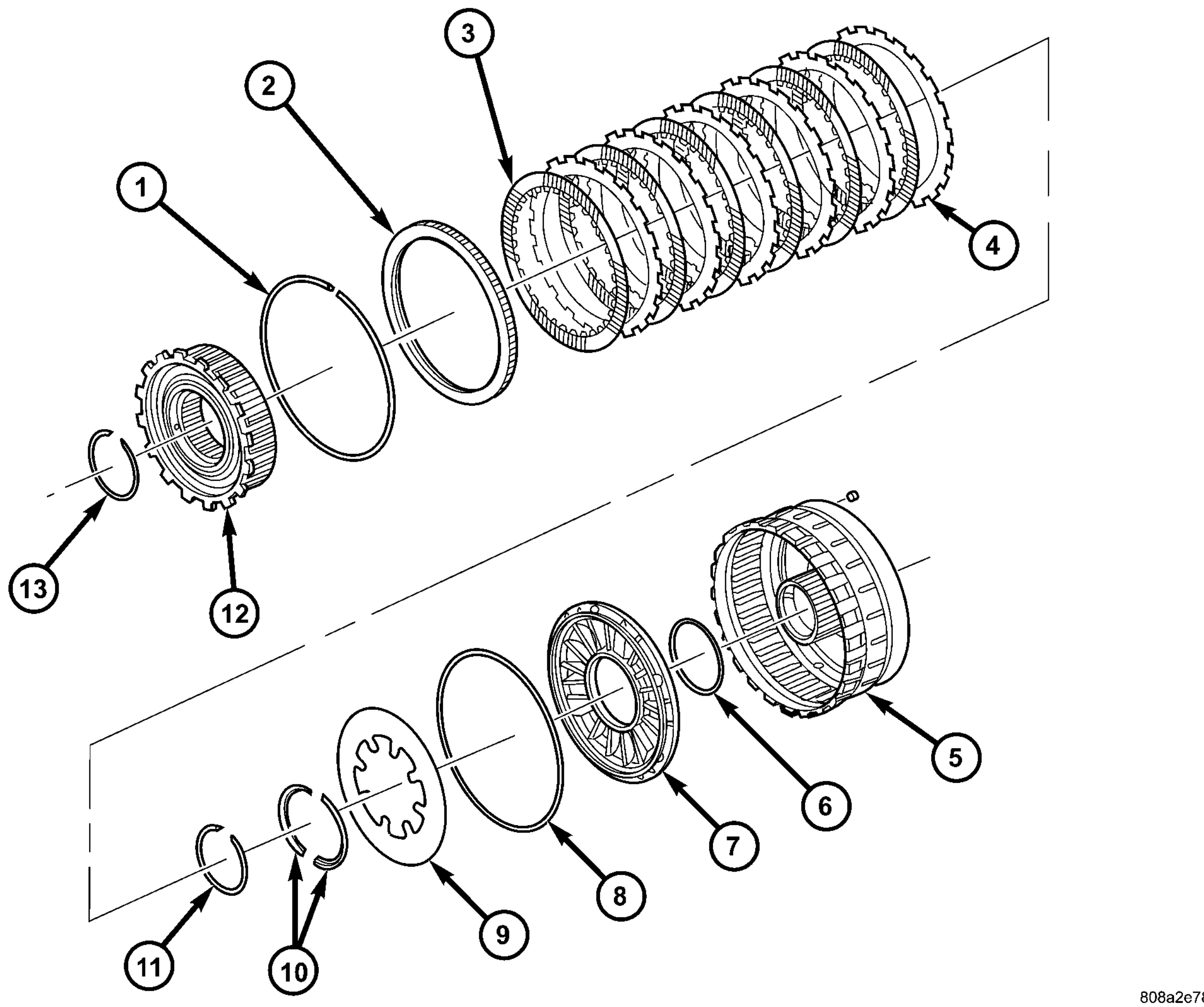


Fig. 93 Low/Reverse Clutch Assembly

1 - SNAP-RING (SELECT)
2 - REACTION PLATE
3 - DISC
4 - PLATE
5 - L/R CLUTCH RETAINER
6 - SEAL
7 - PISTON
8 - SEAL
9 - BELLEVILLE SPRING
10 - RETAINER
11 - SNAP-RING
12 - OVERRUNNING CLUTCH
13 - SNAP-RING

LOW/REVERSE CLUTCH (Continued)

(5) Remove the overrunning clutch snap-ring (Fig. 94).

(6) Remove the spacer from the overrunning clutch (Fig. 94).

(7) Separate the inner and outer races of the overrunning clutch (Fig. 94).

(8) Remove the overrunning clutch lower snap-ring (Fig. 94).

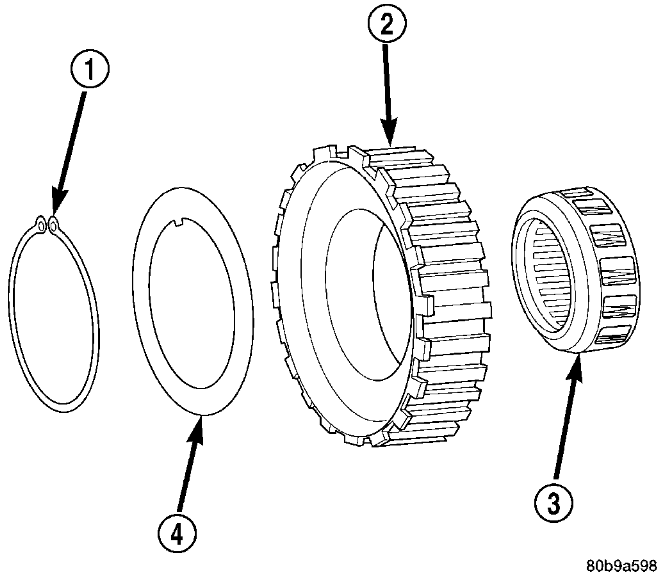


Fig. 94 Overrunning Clutch

1 - SNAP-RING
2 - OUTER RACE
3 - OVERRUNNING CLUTCH
4 - SPACER

(9) Using Spring Compressor 8285 and a suitable shop press (Fig. 95), compress the low/reverse piston Belleville spring and remove the split retaining ring holding the Belleville spring into the low/reverse clutch retainer.

(10) Remove the low/reverse clutch Belleville spring and piston from the low/reverse clutch retainer. Use 20 psi of air pressure to remove the piston if necessary.

CLEANING

Clean the overrunning clutch assembly, clutch cam, and low-reverse clutch retainer. Dry them with compressed air after cleaning.

INSPECTION

Inspect condition of each clutch part after cleaning. Replace the overrunning clutch roller and spring assembly if any rollers or springs are worn or damaged, or if the roller cage is distorted, or damaged. Replace the cam if worn, cracked or damaged.

Replace the low-reverse clutch retainer if the clutch race, roller surface or inside diameter is scored, worn or damaged.

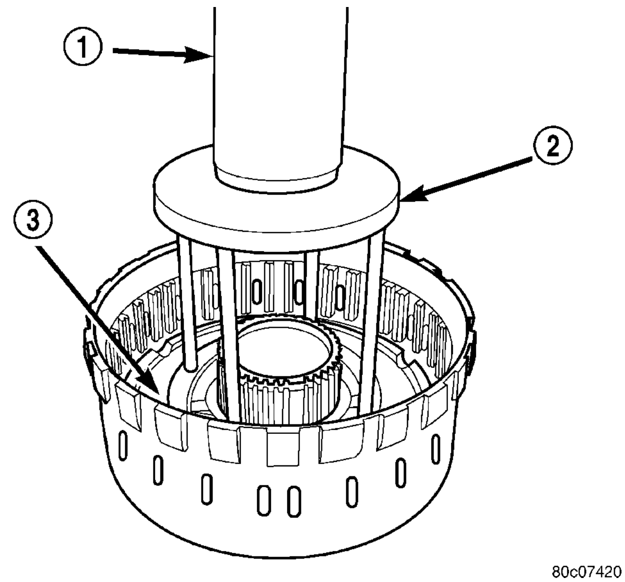


Fig. 95 Compress Low/Reverse Belleville Spring Using Tool 8285

1 - PRESS
2 - TOOL 8285
3 - BELLEVILLE SPRING

ASSEMBLY

(1) Check the bleed orifice to ensure that it is not plugged or restricted.

(2) Install a new seal on the low/reverse piston. Lubricate the seal with Mopar® ATF +4, Automatic Transmission Fluid, prior to installation.

(3) Install the low/reverse piston into the low/reverse clutch retainer.

(4) Position the low/reverse piston Belleville spring on the low/reverse piston.

(5) Using Spring Compressor 8285 and a suitable shop press (Fig. 95), compress the low/reverse piston Belleville spring and install the split retaining ring to hold the Belleville spring into the low/reverse clutch retainer.

(6) Install the lower overrunning clutch snap-ring (Fig. 94).

(7) Assemble the inner and outer races of the overrunning clutch (Fig. 94).

(8) Position the overrunning clutch spacer on the overrunning clutch.

(9) Install the upper overrunning clutch snap-ring (Fig. 94).

(10) Assemble and install the low/reverse clutch pack into the low/reverse clutch retainer (Fig. 93).

(11) Install the low/reverse reaction plate into the low/reverse clutch retainer (Fig. 93). The reaction plate is directional and must be installed with the flat side down.

(12) Install the low/reverse clutch pack snap-ring (Fig. 93). The snap-ring is selectable and should be chosen to give the correct clutch pack clearance.

LOW/REVERSE CLUTCH (Continued)

(13) Measure the low/reverse clutch pack clearance and adjust as necessary. The correct clutch clearance is 1.00-1.74 mm (0.039-0.075 in.).

(14) Install the overrunning clutch into the low/reverse clutch retainer making sure that the index splines are aligned with the retainer.

(15) Install the overrunning clutch inner snap-ring.

OIL PUMP

DESCRIPTION

The oil pump (Fig. 96) is located at the front of the transmission inside the bell housing and behind the transmission front cover. The oil pump consists of two independent pumps (Fig. 97), a number of valves (Fig. 98), a front seal (Fig. 99), and a bolt on reaction shaft. The converter clutch switch and regulator valves, pressure regulator valve, and converter pressure limit valve are all located in the oil pump valve body.

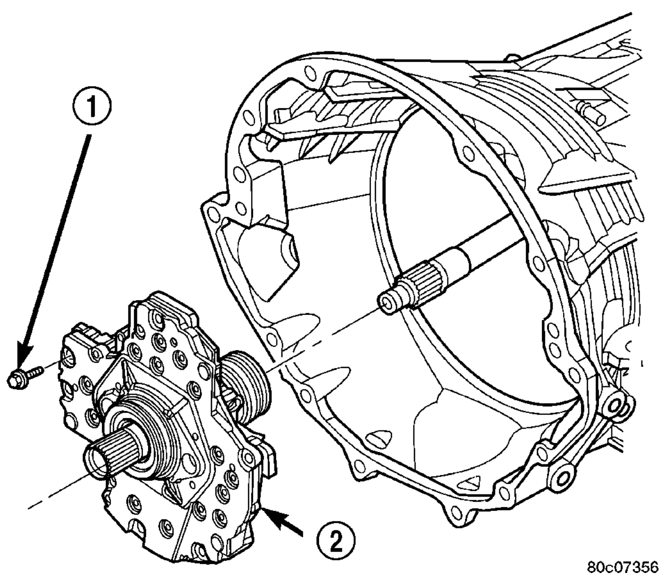


Fig. 96 Oil Pump

1 - OIL PUMP TO CASE BOLT (6)
2 - OIL PUMP

OPERATION

As the torque converter rotates, the converter hub rotates the oil pump drive gear. As the drive gear rotates both driven gears, a vacuum is created when the gear teeth come out of mesh. This suction draws fluid through the pump inlet from the oil pan. As the gear teeth come back into mesh, pressurized fluid is forced into the pump outlet and to the oil pump valves.

At low speeds, both sides of the pump supply fluid to the transmission. As the speed of the torque converter increases, the flow from both sides increases until the flow from the primary side alone is sufficient to meet system demands. At this point, the check valve located between the two pumps closes. The secondary side is shut down and the primary side supplies all the fluid to the transmission.

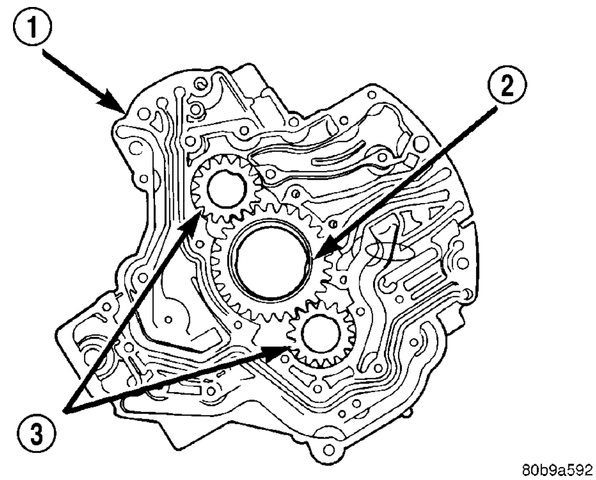


Fig. 97 Oil Pump Gears

1 - PUMP HOUSING
2 - DRIVE GEAR
3 - DRIVEN GEARS

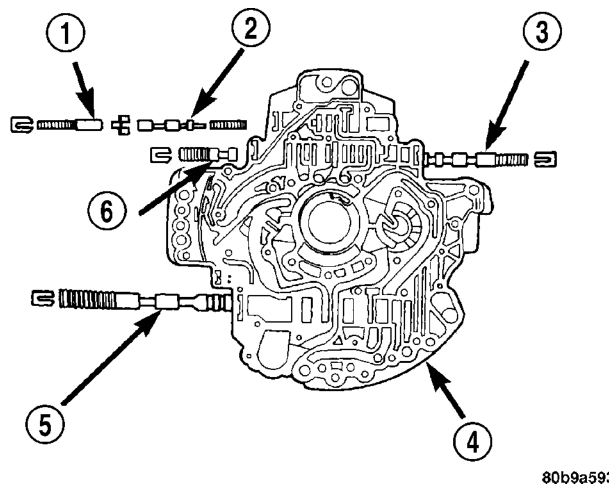


Fig. 98 Oil Pump Valves

1 - TORQUE CONVERTER CLUTCH ACCUMULATOR VALVE
2 - TORQUE CONVERTER CLUTCH CONTROL VALVE
3 - TORQUE CONVERTER CLUTCH SWITCH VALVE
4 - PUMP VALVE BODY
5 - PRESSURE REGULATOR VALVE
6 - TORQUE CONVERTER CLUTCH LIMIT VALVE

CONVERTER CLUTCH SWITCH VALVE

The converter clutch switch valve is used to control the hydraulic pressure supplied to the front (OFF) side of the torque converter clutch.

OIL PUMP (Continued)

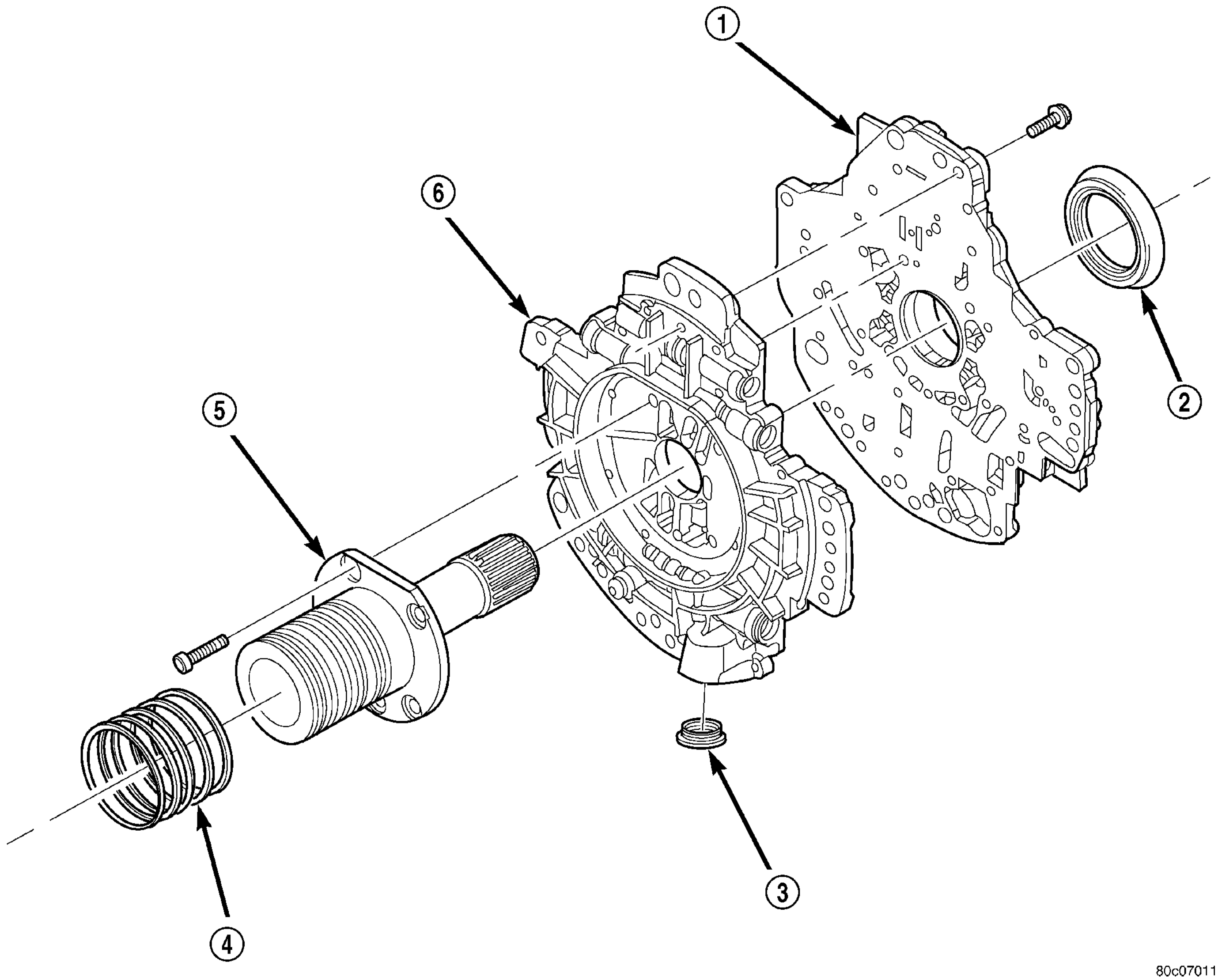


Fig. 99 Oil Pump Reaction Shaft

1 - PUMP HOUSING	4 - SEAL RING (5)
2 - SEAL	5 - REACTION SHAFT SUPPORT
3 - OIL FILTER SEAL	6 - PUMP VALVE BODY

CONVERTER CLUTCH REGULATOR VALVE

The converter clutch regulator valve is used to control the hydraulic pressure supplied to the back (ON) side of the torque converter clutch.

TORQUE CONVERTER LIMIT VALVE

The torque converter limit valve serves to limit the available line pressure to the torque converter clutch.

STANDARD PROCEDURE - OIL PUMP VOLUME CHECK

Measuring the oil pump output volume will determine if sufficient oil flow to the transmission oil cooler exists, and whether or not an internal transmission failure is present.

Verify that the transmission fluid is at the proper level. Refer to the Fluid Level Check procedure in this section. If necessary, fill the transmission to the proper level with Mopar® ATF +4, Automatic Transmission Fluid.

(1) Disconnect the **To cooler** line at the cooler inlet and place a collecting container under the disconnected line.

CAUTION: With the fluid set at the proper level, fluid collection should not exceed (1) quart or internal damage to the transmission may occur.

(2) Run the engine **at 1800 rpm**, with the shift selector in neutral. Verify that the transmission fluid temperature is below 104.5° C (220° F) for this test.

OIL PUMP (Continued)

(3) If one quart of transmission fluid is collected in the container in 30 seconds or less, oil pump flow volume is within acceptable limits. If fluid flow is intermittent, or it takes more than 30 seconds to collect one quart of fluid, refer to the Hydraulic Pressure tests in this section for further diagnosis.

(4) Re-connect the **To cooler** line to the transmission cooler inlet.

(5) Refill the transmission to proper level.

DISASSEMBLY

(1) Remove the bolts holding the reaction shaft support to the oil pump (Fig. 100).

(2) Remove the reaction shaft support from the oil pump (Fig. 100).

(3) Remove all bolts holding the oil pump halves together (Fig. 100).

(4) Using suitable prying tools, separate the oil pump sections by inserting the tools in the supplied areas and prying the halves apart.

NOTE: The oil pump halves are aligned to each other through the use of two dowels. Be sure to pry upward evenly to prevent damage to the oil pump components.

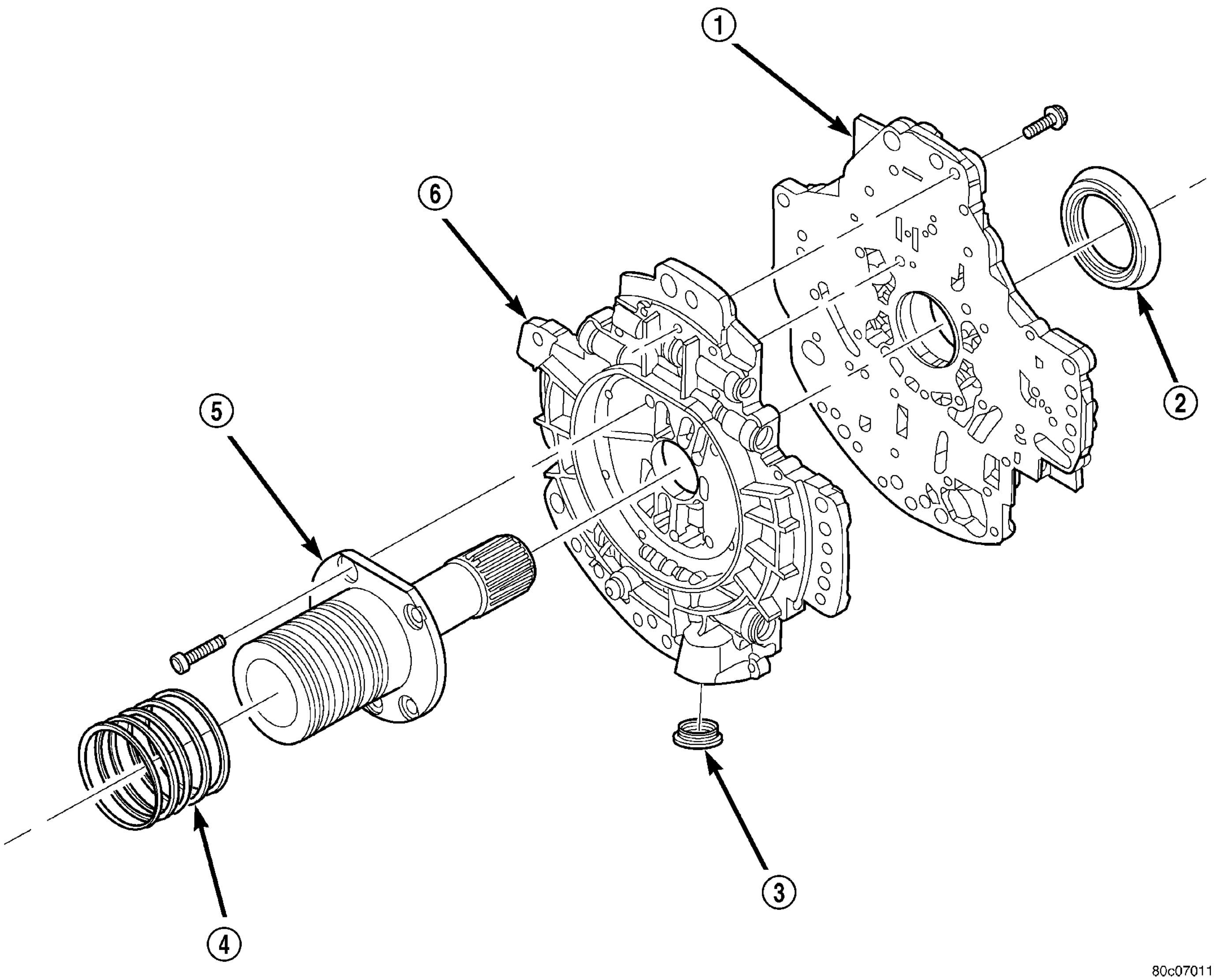


Fig. 100 Oil Pump Assembly

1 - PUMP HOUSING
2 - SEAL
3 - OIL FILTER SEAL
4 - SEAL RING (5)
5 - REACTION SHAFT SUPPORT
6 - PUMP VALVE BODY

OIL PUMP (Continued)

(5) Remove the screws holding the separator plate onto the oil pump body (Fig. 101).

(6) Remove the separator plate from the oil pump body (Fig. 101).

(7) Mark all gears for location. The gears are select fit and if the oil pump is to be reused, the gears must be returned to their original locations.

(8) Remove the oil pump gears from the oil pump case (Fig. 101).

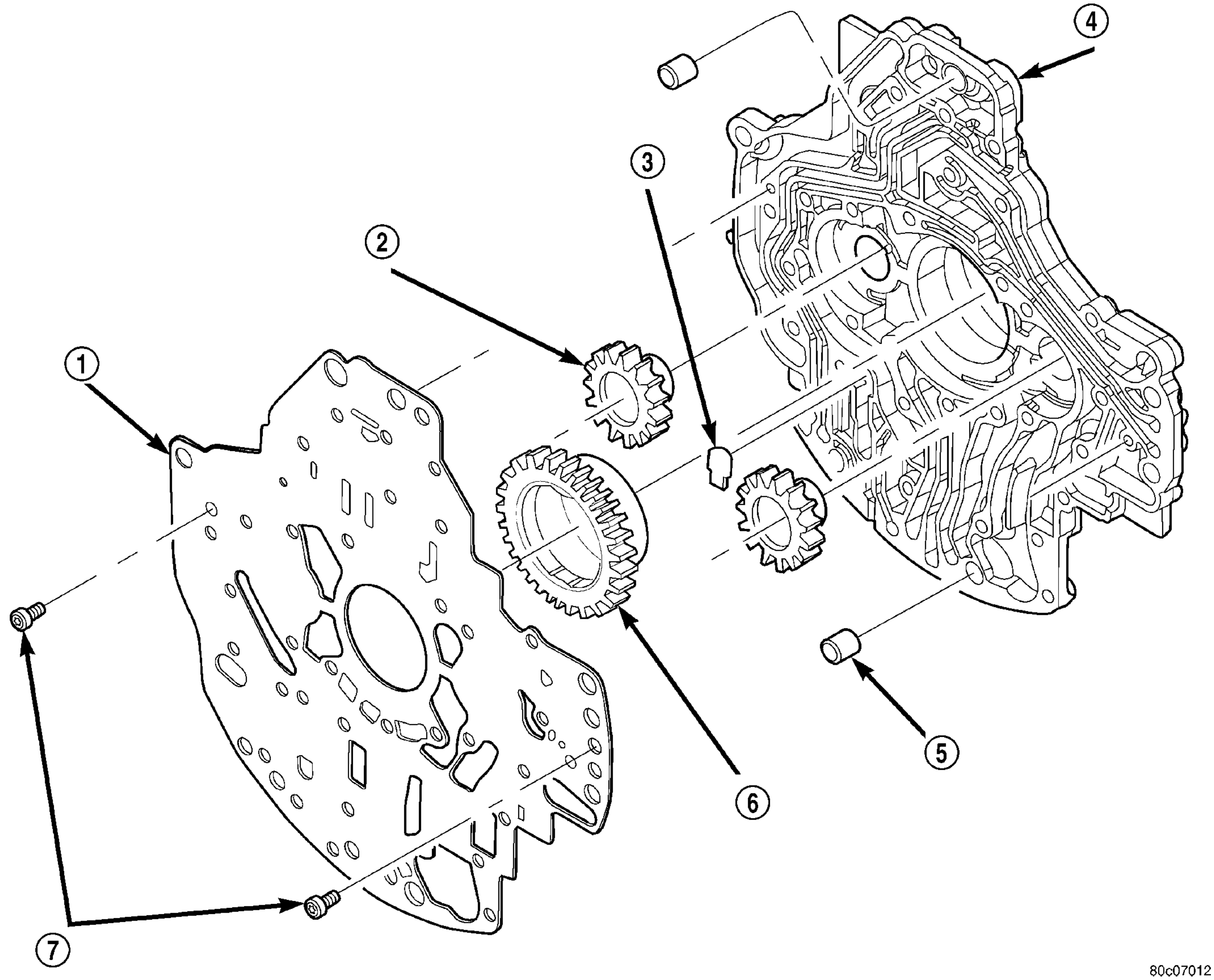


Fig. 101 Oil Pump Housing and Gears

1 - SEPARATOR PLATE
2 - DRIVEN GEAR (2)
3 - CHECK VALVE
4 - PUMP HOUSING
5 - DOWEL (2)
6 - DRIVE GEAR
7 - SCREW

OIL PUMP (Continued)

(9) Remove the oil pump valve retainers and associated valve and spring one at a time (Fig. 102) (Fig. 103). Mark the combination of components as a group and tag them as to the location from which they were removed.

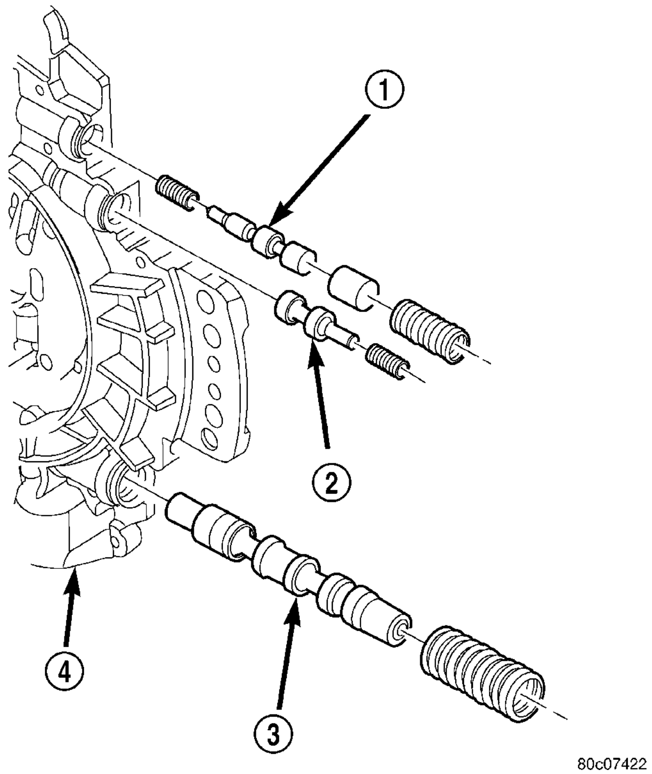


Fig. 102 Oil Pump Valve Body

1 - T/C REGULATOR VALVE
2 - T/C LIMIT VALVE
3 - REGULATOR VALVE
4 - OIL PUMP VALVE BODY

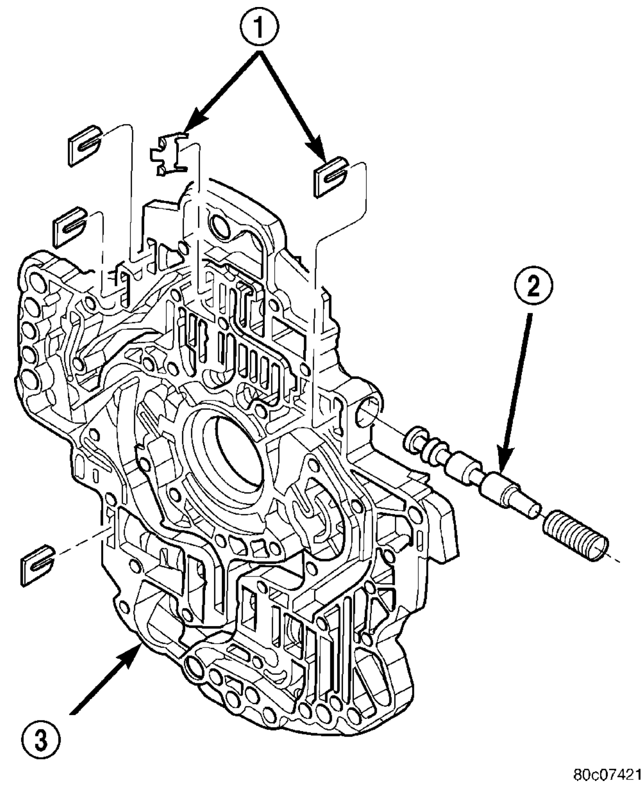


Fig. 103 T/C Switch Valve

1 - RETAINER
2 - T/C SWITCH VALVE
3 - OIL PUMP VALVE BODY

CLEANING

Clean pump and support components with solvent and dry them with compressed air.

INSPECTION

Check condition of the seal rings and thrust washer on the reaction shaft support. The seal rings do not need to be replaced unless cracked, broken, or severely worn.

Inspect the pump and support components. Replace the pump or support if the seal ring grooves or machined surfaces are worn, scored, pitted, or damaged. Replace the pump gears if pitted, worn chipped, or damaged.

Inspect the pump reaction shaft support bushings. Replace either bushing only if heavily worn, scored or damaged. It is not necessary to replace the bushings unless they are actually damaged.

Inspect the valves and plugs for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

Inspect all the valve and plug bores in the oil pump cover. Use a penlight to view the bore interiors. Replace the oil pump if any bores are distorted or scored. Inspect all of the valve springs. The springs must be free of distortion, warpage or broken coils.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

ASSEMBLY

(1) Clean and inspect all components. Make sure that all passages are thoroughly cleaned and are free from dirt or debris. Make sure that all valves move freely in their proper bore. Make sure that all gear pockets and bushings are free from excessive wear and scoring. Replace the oil pump if any excessive wear or scoring is found.

(2) Coat the gears with Mopar® ATF +4 and install into their original locations.

(3) Lubricate the oil pump valves with Mopar® ATF +4 and install the valve, spring and retainer

OIL PUMP (Continued)

into the appropriate oil pump valve body bore (Fig. 102) (Fig. 103).

(4) Place the separator plate onto the oil pump body (Fig. 101).

(5) Install the screws to hold the separator plate onto the oil pump body (Fig. 101). Tighten the screws to 4.5 N·m (40 in.lbs.).

(6) Position the oil pump cover onto the locating dowels (Fig. 100).

(7) Seat the two oil pump halves together and install all bolts finger tight.

(8) Torque all bolts down slowly starting in the center and working outward. The correct torque is 4.5 N·m (40 in.lbs.).

(9) Verify that the oil pump gears rotate freely and smoothly.

(10) Position the reaction shaft support into the oil pump (Fig. 100).

(11) Install and torque the bolts to hold the reaction shaft support to the oil pump (Fig. 100). The correct torque is 12 N·m (105 in.lbs.).

OIL PUMP FRONT SEAL

REMOVAL

(1) Remove transmission from the vehicle.

(2) Remove the torque converter from the transmission.

(3) Using a screw mounted in a slide hammer, remove the oil pump front seal.

INSTALLATION

(1) Clean seal bore of the oil pump of any residue or particles from the original seal.

(2) Install new oil seal in the oil pump housing using Seal Installer C-3860-A (Fig. 104).

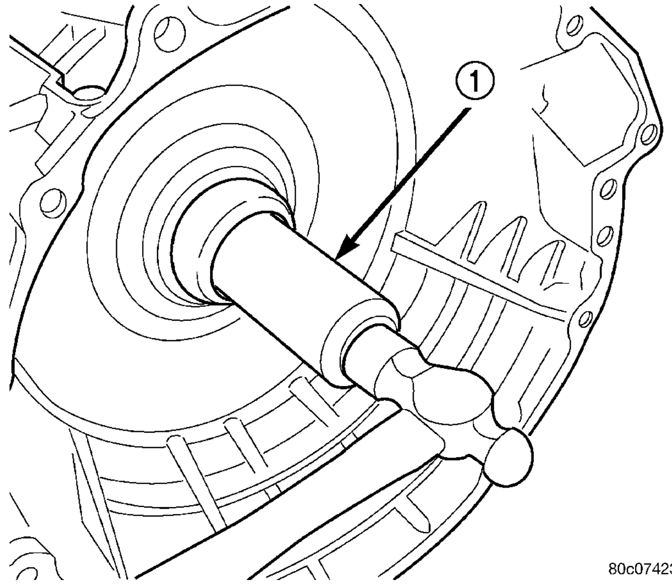


Fig. 104 Install Oil Pump Front Seal

1 - TOOL C-3860-A

OUTPUT SPEED SENSOR

DESCRIPTION

The Input and Output Speed Sensors are two-wire magnetic pickup devices that generate AC signals as rotation occurs. They are mounted in the left side of the transmission case and are considered primary inputs to the Transmission Control Module (TCM).

OPERATION

The Input Speed Sensor provides information on how fast the input shaft is rotating. As the teeth of the input clutch hub pass by the sensor coil, an AC voltage is generated and sent to the TCM. The TCM interprets this information as input shaft rpm.

The Output Speed Sensor generates an AC signal in a similar fashion, though its coil is excited by rotation of the rear planetary carrier lugs. The TCM interprets this information as output shaft rpm.

The TCM compares the input and output speed signals to determine the following:

- Transmission gear ratio
- Speed ratio error detection
- CVI calculation

The TCM also compares the input speed signal and the engine speed signal to determine the following:

- Torque converter clutch slippage
- Torque converter element speed ratio

REMOVAL

(1) Raise vehicle.

(2) Place a suitable fluid catch pan under the transmission.

(3) Remove the wiring connector from the output speed sensor (Fig. 105).

(4) Remove the bolt holding the output speed sensor to the transmission case.

(5) Remove the output speed sensor from the transmission case.

INSTALLATION

(1) Install the output speed sensor into the transmission case.

(2) Install the bolt to hold the output speed sensor into the transmission case. Tighten the bolt to 11.9 N·m (105 in.lbs.).

(3) Install the wiring connector onto the output speed sensor

(4) Verify the transmission fluid level. Add fluid as necessary.

(5) Lower vehicle.

OVERDRIVE SWITCH (Continued)

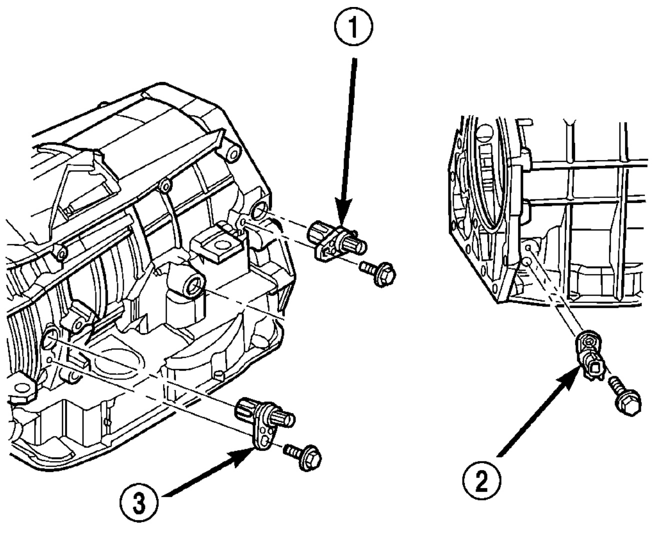


Fig. 105 Output Speed Sensor

1 - OUTPUT SPEED SENSOR
2 - LINE PRESSURE SENSOR
3 - INPUT SPEED SENSOR

OVERDRIVE SWITCH

DESCRIPTION

The overdrive OFF (control) switch is located in the shift lever arm (Fig. 106). The switch is a momentary contact device that signals the PCM to toggle current status of the overdrive function.

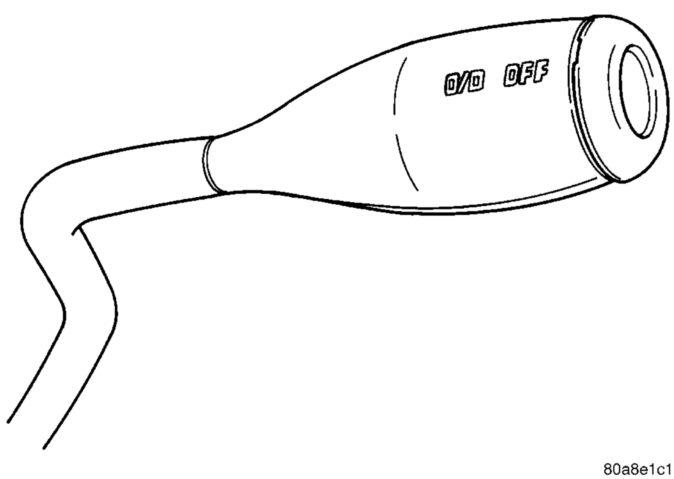


Fig. 106 Overdrive Off Switch

OPERATION

At key-on, overdrive operation is allowed. Pressing the switch once causes the overdrive OFF mode to be entered and the overdrive OFF switch lamp to be illuminated. Pressing the switch a second time causes normal overdrive operation to be restored and the overdrive lamp to be turned off. The overdrive OFF mode defaults to ON after the ignition switch is cycled OFF and ON. The normal position for the control switch is the ON position. The switch must be in this position to energize the solenoid and allow a 3-4 upshift. The control switch indicator light illuminates only when the overdrive switch is turned to the OFF position, or when illuminated by the transmission control module.

REMOVAL

(1) Using a plastic trim tool, remove the overdrive off switch retainer from the shift lever (Fig. 107).

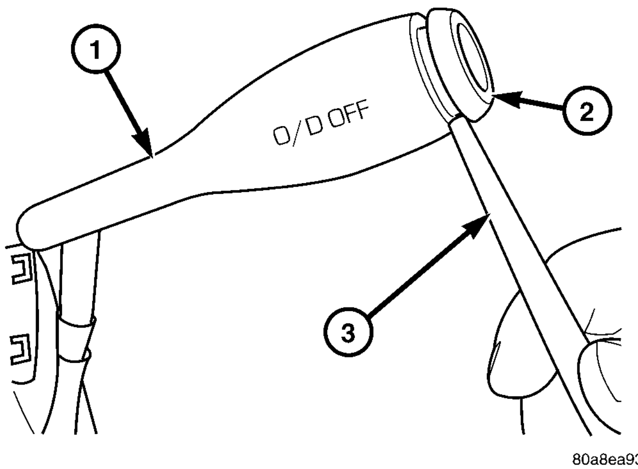


Fig. 107 Overdrive Off Switch Retainer

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH RETAINER
3 - PLASTIC TRIM TOOL

(2) Pull the switch outwards to release it from the connector in the lever (Fig. 108)

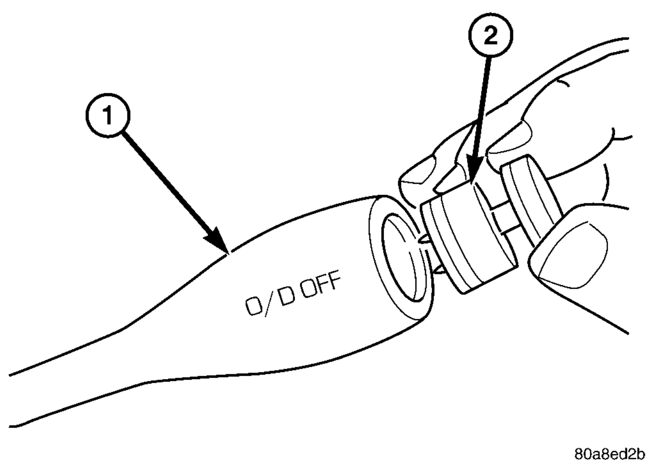


Fig. 108 Remove the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH

OVERDRIVE SWITCH (Continued)

INSTALLATION

NOTE: There is enough slack in the wire to pull out the connector from the lever.

(1) Pull the connector out of the lever just enough to grasp it.

CAUTION: Be careful not to bend the pins on the overdrive off switch. Use care when installing the switch, as it is not indexed, and can be accidentally installed incorrectly.

(2) Install the overdrive off switch into the connector (Fig. 109)

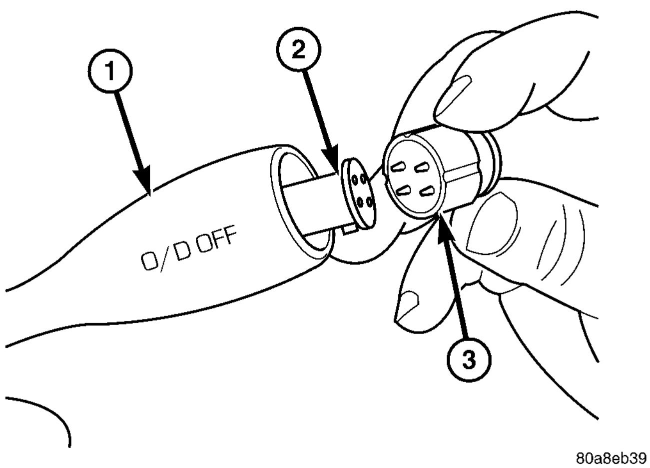


Fig. 109 Install the Overdrive Off Switch

1 - GEAR SHIFT LEVER
2 - OVERDRIVE OFF SWITCH WIRING CONNECTOR
3 - OVERDRIVE OFF SWITCH

(3) Push the overdrive off switch and wiring into the shift lever.

(4) Install the overdrive off switch retainer onto the shift lever.

PISTONS

DESCRIPTION

There are several sizes and types of pistons used in an automatic transmission. Some pistons are used to apply clutches, while others are used to apply bands. They all have in common the fact that they are round or circular in shape, located within a smooth walled cylinder, which is closed at one end and converts fluid pressure into mechanical movement. The fluid pressure exerted on the piston is contained within the system through the use of piston rings or seals.

OPERATION

The principal which makes this operation possible is known as Pascal's Law. Pascal's Law can be stated as: "Pressure on a confined fluid is transmitted equally in all directions and acts with equal force on equal areas."

PRESSURE

Pressure (Fig. 110) is nothing more than force (lbs.) divided by area (in or ft.), or force per unit area. Given a 100 lb. block and an area of 100 sq. in. on the floor, the pressure exerted by the block is: 100 lbs. 100 in or 1 pound per square inch, or PSI as it is commonly referred to.

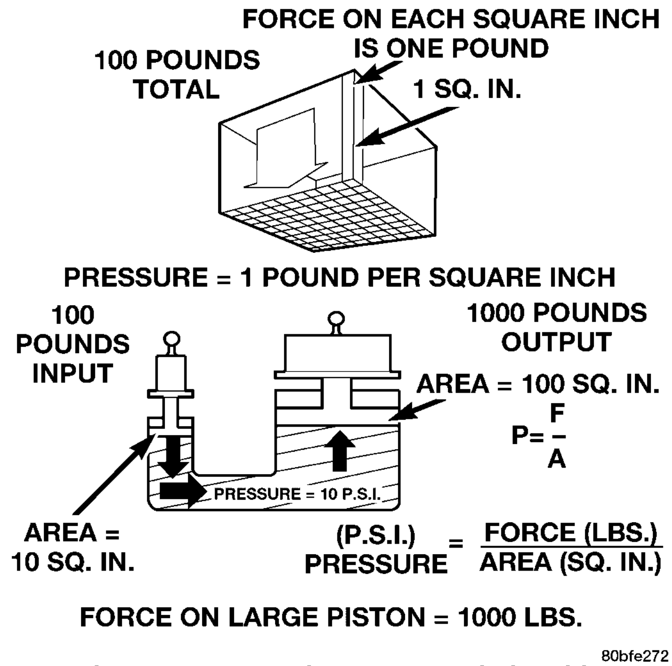


Fig. 110 Force and Pressure Relationship

PRESSURE ON A CONFINED FLUID

Pressure is exerted on a confined fluid (Fig. 111) by applying a force to some given area in contact with the fluid. A good example of this is a cylinder filled with fluid and equipped with a piston that is closely fitted to the cylinder wall. If a force is applied to the piston, pressure will be developed in the fluid. Of course, no pressure will be created if the fluid is not confined. It will simply "leak" past the piston. There must be a resistance to flow in order to create pressure. Piston sealing is extremely important in hydraulic operation. Several kinds of seals are used to accomplish this within a transmission. These include but are not limited to O-rings, D-rings, lip seals, sealing rings, or extremely close tolerances between the piston and the cylinder wall. The force exerted is downward (gravity), however, the principle remains the same no matter which direction is taken. The pressure created in the fluid is equal to the force applied, divided by the piston area. If the force is 100 lbs., and the piston area is 10 sq. in., then the pressure created equals 10 PSI. Another interpretation of

PISTONS (Continued)

Pascal's Law is that regardless of container shape or size, the pressure will be maintained throughout, as long as the fluid is confined. In other words, the pressure in the fluid is the same everywhere within the container.

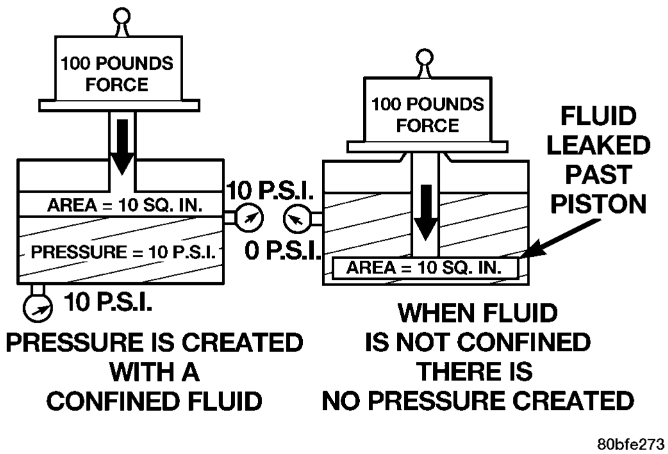


Fig. 111 Pressure on a Confined Fluid

FORCE MULTIPLICATION

Using the 10 PSI example used in the illustration (Fig. 112), a force of 1000 lbs. can be moved with a force of only 100 lbs. The secret of force multiplication in hydraulic systems is the total fluid contact area employed. The illustration, (Fig. 112), shows an area that is ten times larger than the original area. The pressure created with the smaller 100 lb. input is 10 PSI. The concept "pressure is the same everywhere" means that the pressure underneath the larger piston is also 10 PSI. Pressure is equal to the force applied divided by the contact area. Therefore, by means of simple algebra, the output force may be found. This concept is extremely important, as it is also used in the design and operation of all shift valves and limiting valves in the valve body, as well as the pistons, of the transmission, which activate the clutches and bands. It is nothing more than using a difference of area to create a difference in pressure to move an object.

PISTON TRAVEL

The relationship between hydraulic lever and a mechanical lever is the same. With a mechanical lever it's a weight-to-distance output rather than a pressure-to-area output. Using the same forces and areas as in the previous example, the smaller piston

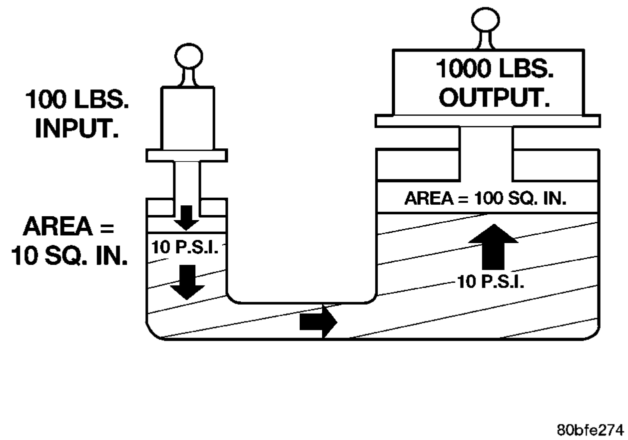


Fig. 112 Force Multiplication

(Fig. 113) has to move ten times the distance required to move the larger piston one inch. Therefore, for every inch the larger piston moves, the smaller piston moves ten inches. This principle is true in other instances also. A common garage floor jack is a good example. To raise a car weighing 2000 lbs., an effort of only 100 lbs. may be required. For every inch the car moves upward, the input piston at the jack handle must move 20 inches downward.

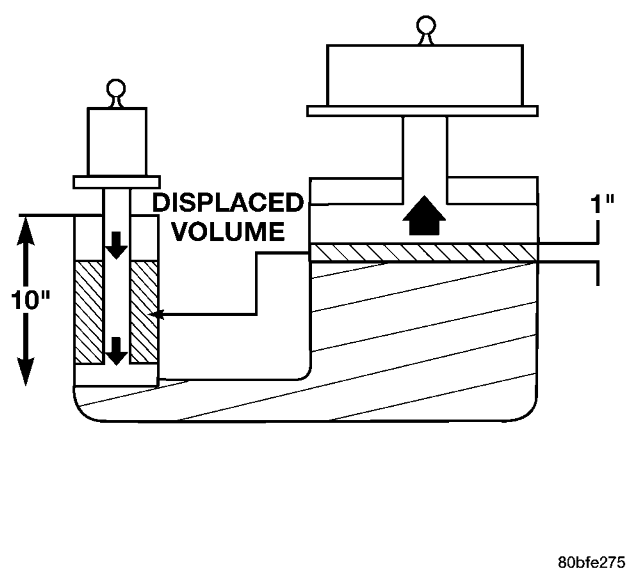


Fig. 113 Piston Travel

PLANETARY GEARTRAIN

DESCRIPTION

The planetary geartrain is located behind the 4C retainer/bulkhead, toward the rear of the transmission. The planetary geartrain consists of three primary assemblies:

- Reaction (Fig. 114).
- Reverse (Fig. 115).
- Input (Fig. 115).

OPERATION

REACTION PLANETARY GEARTRAIN

The reaction planetary carrier and reverse sun gear of the reaction planetary geartrain are a single component which is held by the 2C clutch when required. The reaction annulus gear is a stand alone component that can be driven by the reverse clutch or held by the 4C clutch. The reaction sun gear is driven by the overdrive clutch.

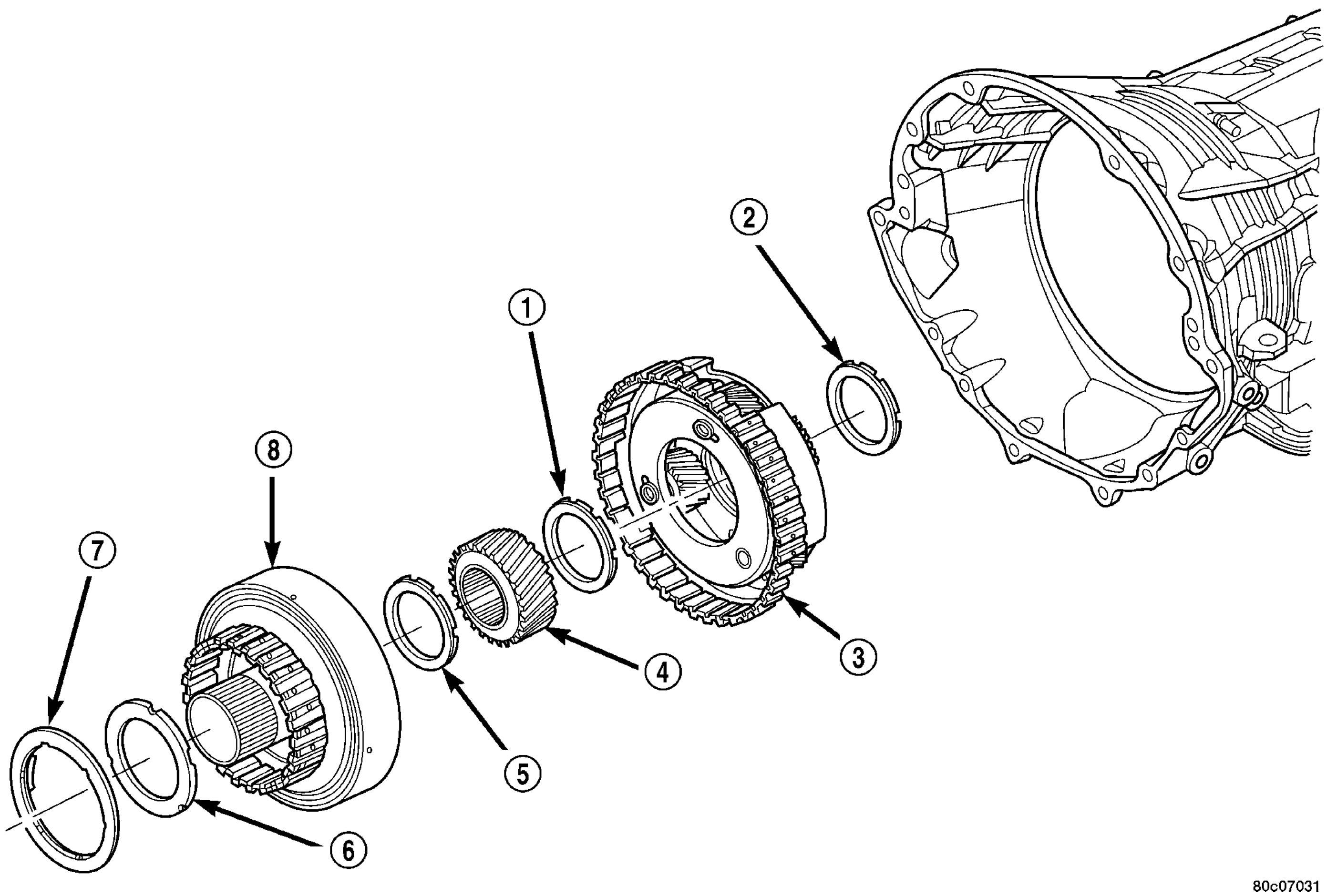


Fig. 114 Reaction Planetary Geartrain

1 - BEARING NUMBER 8
2 - BEARING NUMBER 9
3 - REACTION PLANETARY CARRIER
4 - REACTION SUN GEAR
5 - BEARING NUMBER 7
6 - THRUST PLATE (SELECT)
7 - BEARING NUMBER 6
8 - REACTION ANNULUS

PLANETARY GEARTRAIN (Continued)

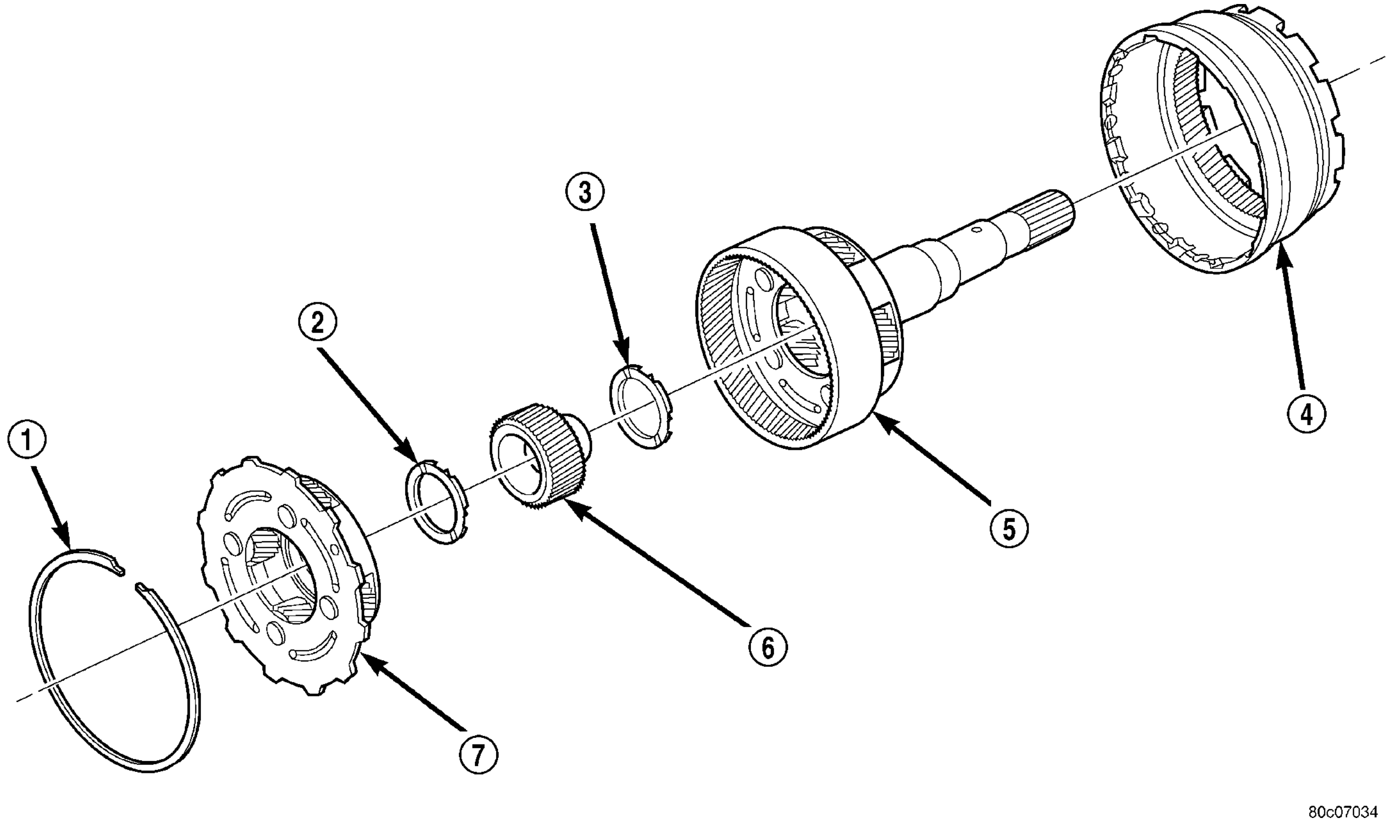


Fig. 115 Reverse/Input Planetary Geartrain

1 - SNAP-RING
2 - BEARING NUMBER 10
3 - BEARING NUMBER 11
4 - INPUT ANNULUS
5 - INPUT PLANETARY CARRIER
6 - INPUT SUN GEAR
7 - REVERSE PLANETARY CARRIER

REVERSE PLANETARY GEARTRAIN

The reverse planetary geartrain is the middle of the three planetary sets. The reverse planetary carrier can be driven by the overdrive clutch as required. The reverse planetary carrier is also splined to the input annulus gear, which can be held by the low/reverse clutch. The reverse planetary annulus, input planetary carrier, and output shaft are all one piece.

INPUT PLANETARY GEARTRAIN

The input sun gear of the input planetary geartrain is driven by the underdrive clutch.

PLANETARY GEARTRAIN (Continued)

DISASSEMBLY

(1) Remove the snap-ring holding the input annulus into the input carrier (Fig. 116).

(2) Remove the input annulus from the input carrier (Fig. 116).

(3) Remove the number 9 bearing from the reverse planetary carrier. Note that this planetary carrier has four pinion gears.

(4) Remove the reverse planetary gear carrier (Fig. 116).

(5) Remove the number 10 bearing from the input sun gear (Fig. 116).

(6) Remove the input sun gear from the input carrier (Fig. 116).

(7) Remove the number 11 bearing from the input carrier (Fig. 116).

CLEANING

Clean the planetary components in solvent and dry them with compressed air.

INSPECTION

Check sun gear and driving shell condition. Replace the gear if damaged or if the bushings are scored or worn. The bushings are not serviceable. Replace the driving shell if worn, cracked or damaged.

Replace planetary gear sets if gears, pinion pins, or carrier are damaged in any way. Replace the annulus gears and supports if either component is worn or damaged.

Replace the output shaft if the machined surfaces are scored, pitted, or damaged in any way. Also replace the shaft if the splines are damaged, or exhibits cracks at any location.

ASSEMBLY

(1) Clean and inspect all components. Replace any components which show evidence of excessive wear or scoring.

(2) Install the number 11 bearing into the input planetary carrier so that the inner race will be toward the front of the transmission (Fig. 116).

(3) Install the input sun gear into the input carrier (Fig. 116).

(4) Install the number 10 bearing onto the rear of the reverse planetary carrier with the inner race toward the carrier (Fig. 116).

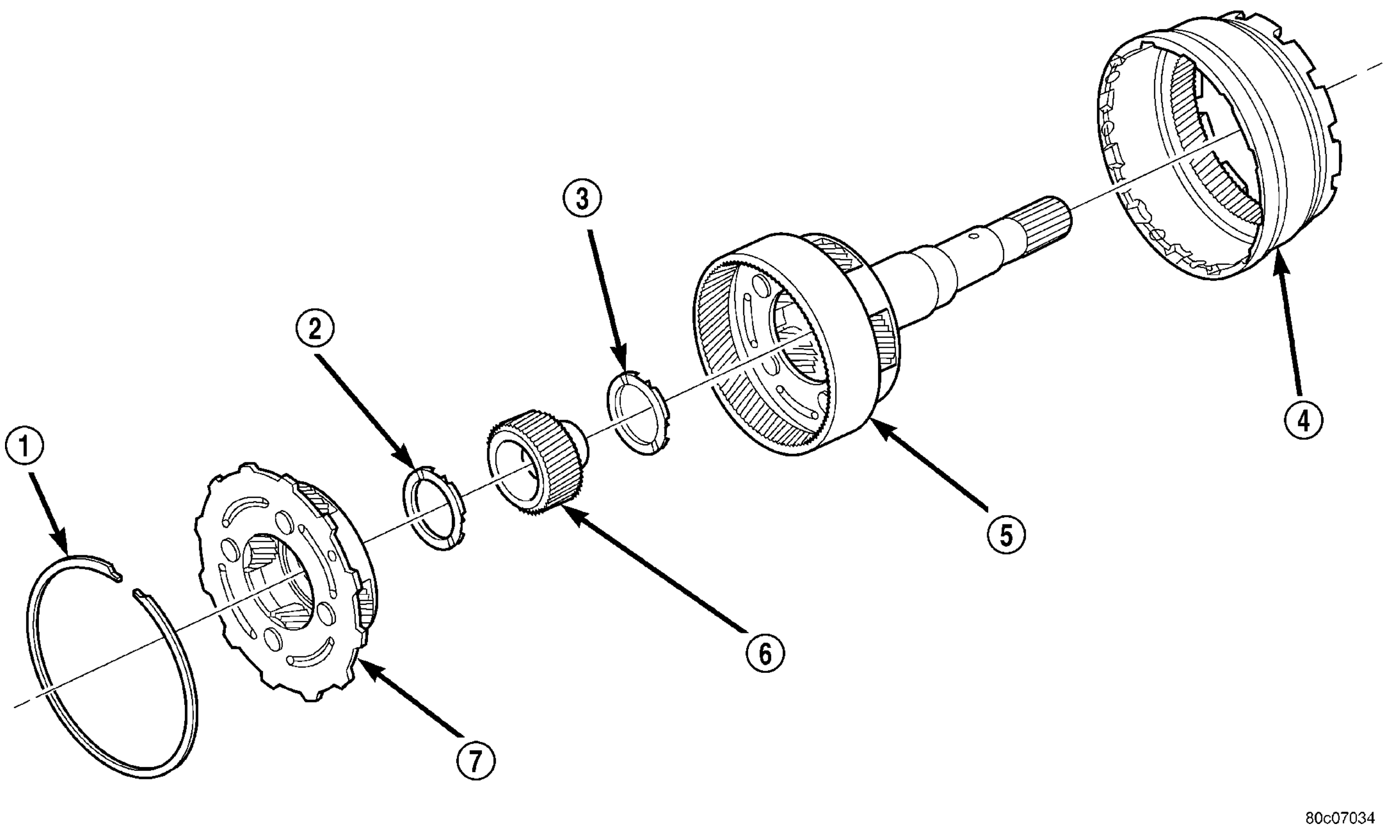


Fig. 116 Reverse/Input Planetary Carrier Assembly

1 - SNAP-RING
2 - BEARING NUMBER 10
3 - BEARING NUMBER 11
4 - INPUT ANNULUS
5 - INPUT PLANETARY CARRIER
6 - INPUT SUN GEAR
7 - REVERSE PLANETARY CARRIER

(5) Install the number 9 bearing onto the front of the reverse planetary carrier with the outer race toward the carrier and the inner race facing upward (Fig. 116).

(6) Install the reverse planetary gear carrier into the input carrier (Fig. 116).

(7) Install the input annulus gear into the input carrier (Fig. 116).

(8) Install the snap-ring to hold the input annulus gear into the input carrier (Fig. 116).

SHIFT MECHANISM

DESCRIPTION

The gear shift mechanism provides six shift positions which are:

- Park (P)
- Reverse (R)
- Neutral (N)
- Drive (D)
- Manual second (2)
- Manual low (1)

OPERATION

MANUAL LOW (1) range provides first gear only. Overrun braking is also provided in this range. MANUAL SECOND (2) range provides first and second gear only.

DRIVE range provides FIRST, SECOND, THIRD, OVERDRIVE FOURTH, and OVERDRIVE FIFTH (if applicable) gear ranges. The shift into OVERDRIVE FOURTH and FIFTH (if applicable) gear ranges occurs only after the transmission has completed the shift into D THIRD gear range. No further movement of the shift mechanism is required to complete the 3-4 or 4-5 (if applicable) shifts.

The FOURTH and FIFTH (if applicable) gear upshifts occur automatically when the overdrive selector switch is in the ON position. No upshift to FOURTH or FIFTH (if applicable) gears will occur if any of the following are true:

- The transmission fluid temperature is below 10° C (50° F) or above 121° C (250° F).
- The shift to THIRD is not yet complete.
- Vehicle speed is too low for the 3-4 or 4-5 (if applicable) shifts to occur.

Upshifts into FOURTH or FIFTH (if applicable) will be delayed when the transmission fluid temperature is below 4.5° C (40° F) or above 115.5° C (240° F).

SOLENOID SWITCH VALVE

DESCRIPTION

The Solenoid Switch Valve (SSV) is located in the valve body and controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.

OPERATION

The Solenoid Switch Valve controls line pressure from the LR-TCC solenoid. In 1st gear, the SSV will be in the downshifted position, thus directing fluid to the L/R clutch circuit. In 2nd, 3rd, 4th, and 5th (if applicable) gears, the solenoid switch valve will be in the upshifted position and directs the fluid into the torque converter clutch (TCC) circuit.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

SOLENOIDS

DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

SOLENOIDS (Continued)

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

TORQUE CONVERTER

DESCRIPTION

The torque converter (Fig. 117) is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine, a stator, an overrunning clutch, an impeller and an electronically applied converter clutch. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The torque converter hub drives the transmission oil (fluid) pump and contains an o-ring seal to better control oil flow.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.

CAUTION: The torque converter must be replaced if a transmission failure resulted in large amounts of metal or fiber contamination in the fluid.

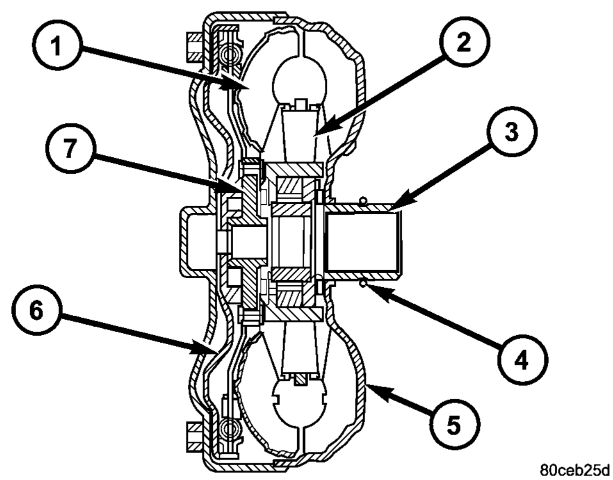


Fig. 117 Torque Converter Assembly

1 - TURBINE ASSEMBLY
2 - STATOR
3 - CONVERTER HUB
4 - O-RING
5 - IMPELLER ASSEMBLY
6 - CONVERTER CLUTCH PISTON
7 - TURBINE HUB

TORQUE CONVERTER (Continued)

IMPELLER

The impeller (Fig. 118) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving members of the system.

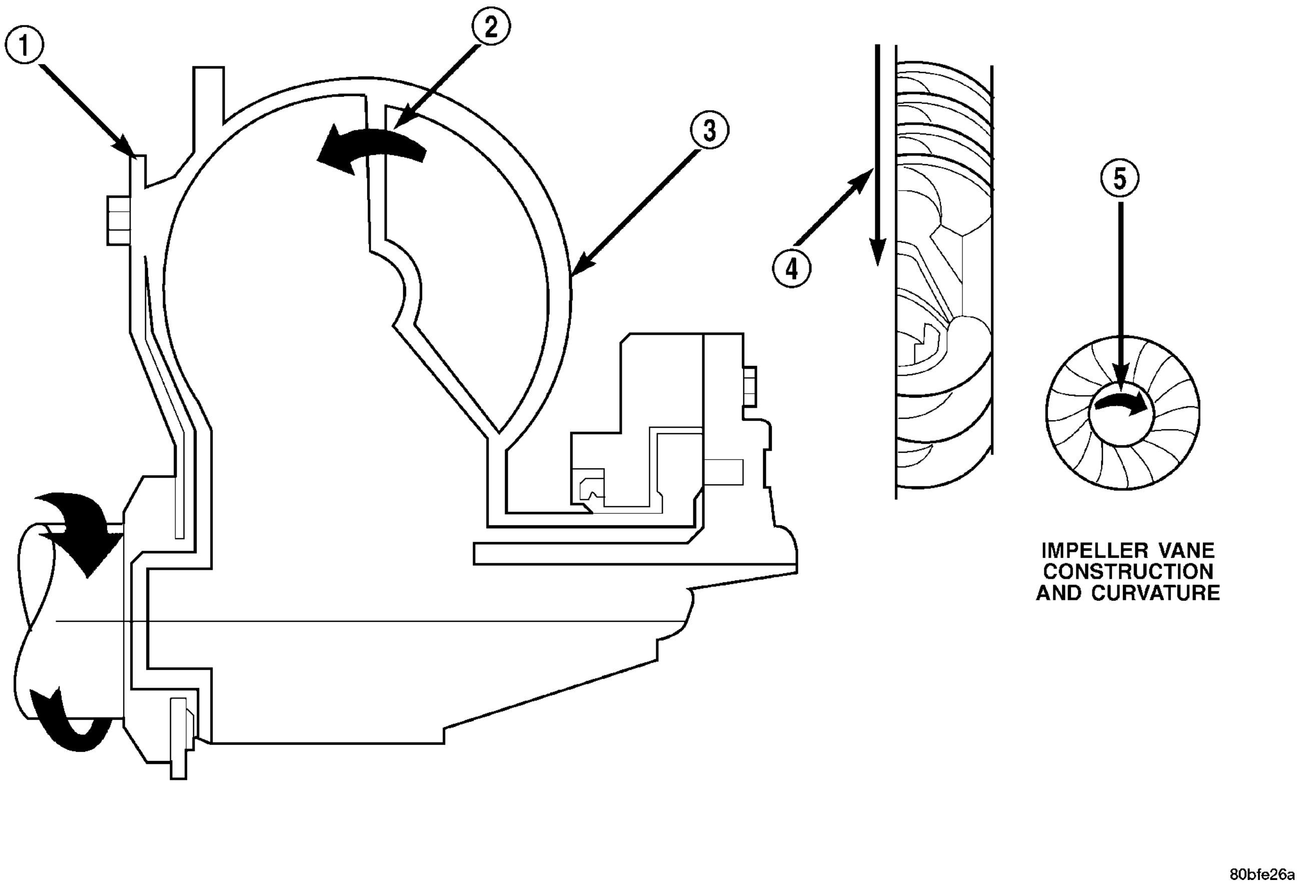


Fig. 118 Impeller

1 - ENGINE FLEXPLATE
2 - OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION
3 - IMPELLER VANES AND COVER ARE INTEGRAL
4 - ENGINE ROTATION
5 - ENGINE ROTATION

TORQUE CONVERTER (Continued)

TURBINE

The turbine (Fig. 119) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.

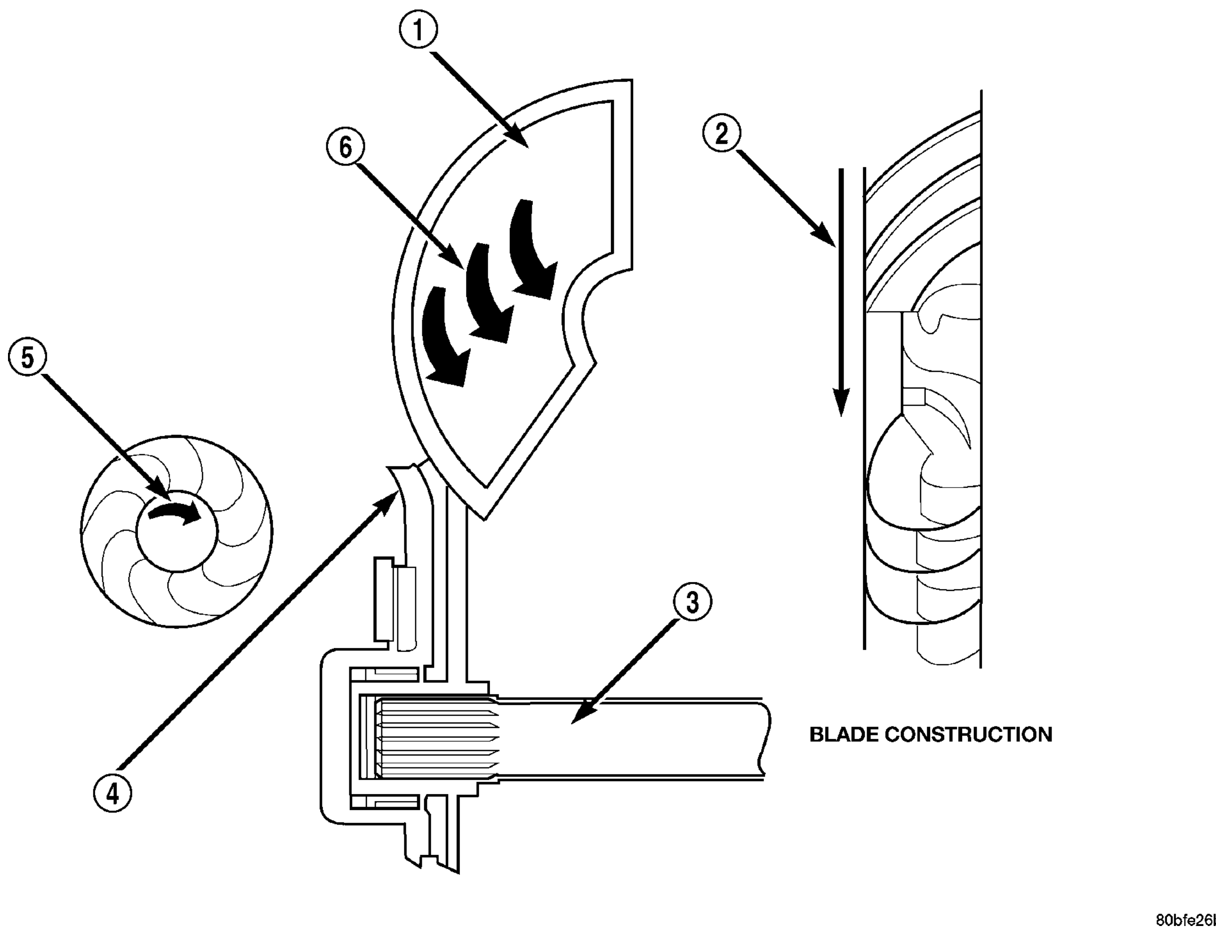


Fig. 119 Turbine

1 - TURBINE VANE
2 - ENGINE ROTATION
3 - INPUT SHAFT
4 - PORTION OF TORQUE CONVERTER COVER
5 - ENGINE ROTATION
6 - OIL FLOW WITHIN TURBINE SECTION

TORQUE CONVERTER (Continued)

STATOR

The stator assembly (Fig. 120) is mounted on a stationary shaft which is an integral part of the oil pump. The stator is located between the impeller and turbine within the torque converter case (Fig. 121). The stator contains an over-running clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the over-running clutch, the torque multiplication feature of the torque converter is operational.

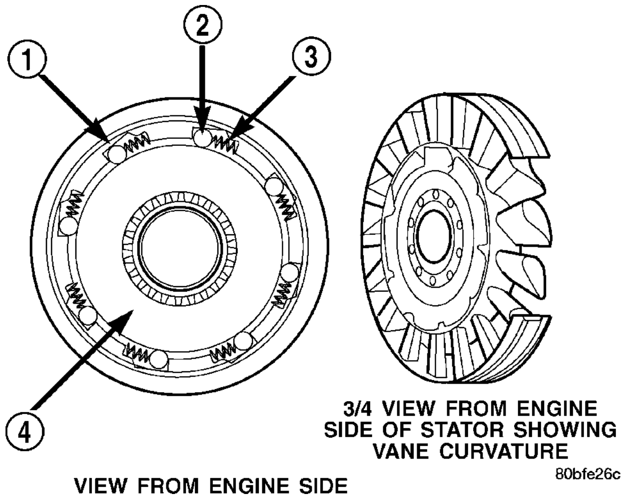


Fig. 120 Stator Components

1 - CAM (OUTER RACE)
2 - ROLLER
3 - SPRING
4 - INNER RACE

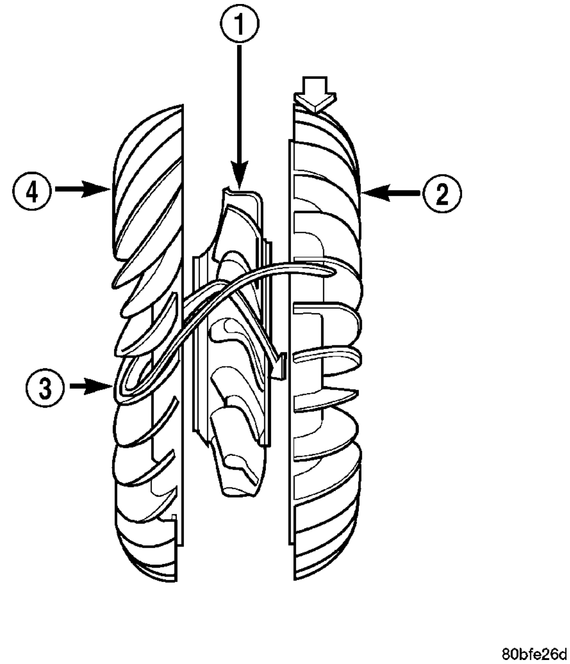


Fig. 121 Stator Location

1 - STATOR
2 - IMPELLER
3 - FLUID FLOW
4 - TURBINE

TORQUE CONVERTER CLUTCH (TCC)

The TCC (Fig. 122) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston with friction material was added to the turbine assembly to provide this mechanical lock-up.

In order to reduce heat build-up in the transmission and buffer the powertrain against torsional vibrations, the TCM can duty cycle the L/R-CC Solenoid to achieve a smooth application of the torque converter clutch. This function, referred to as Electronically Modulated Converter Clutch (EMCC) can occur at various times depending on the following variables:

- Shift lever position
- Current gear range
- Transmission fluid temperature
- Engine coolant temperature
- Input speed
- Throttle angle
- Engine speed

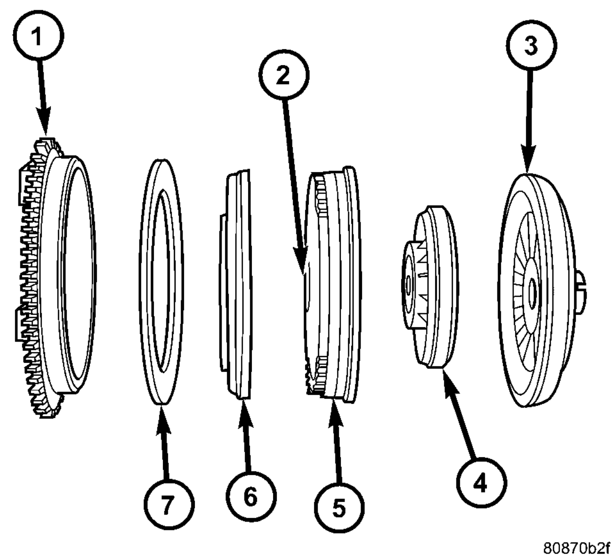


Fig. 122 Torque Converter Clutch (TCC)

1 - IMPELLER FRONT COVER
2 - THRUST WASHER ASSEMBLY
3 - IMPELLER
4 - STATOR
5 - TURBINE
6 - PISTON
7 - FRICTION DISC

TORQUE CONVERTER (Continued)

OPERATION

The converter impeller (Fig. 123) (driving member), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft.

TURBINE

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a “hindering” direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in such a direction that it would tend to slow it down.

STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft (Fig. 124). Under stall conditions (the turbine is stationary), the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counterclockwise direction. When this happens the over-running clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a “helping” direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 2.4:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such as way as to cause it to lock-up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.

TORQUE CONVERTER CLUTCH (TCC)

In a standard torque converter, the impeller and turbine are rotating at about the same speed and the stator is freewheeling, providing no torque multiplication. By applying the turbine's piston and friction material to the front cover, a total converter engagement can be obtained. The result of this engagement is a direct 1:1 mechanical link between the engine and the transmission.

The clutch can be engaged in second, third, fourth, and fifth (if appicable) gear ranges depending on overdrive control switch position. If the overdrive control switch is in the normal ON position, the clutch will engage after the shift to fourth gear. If the

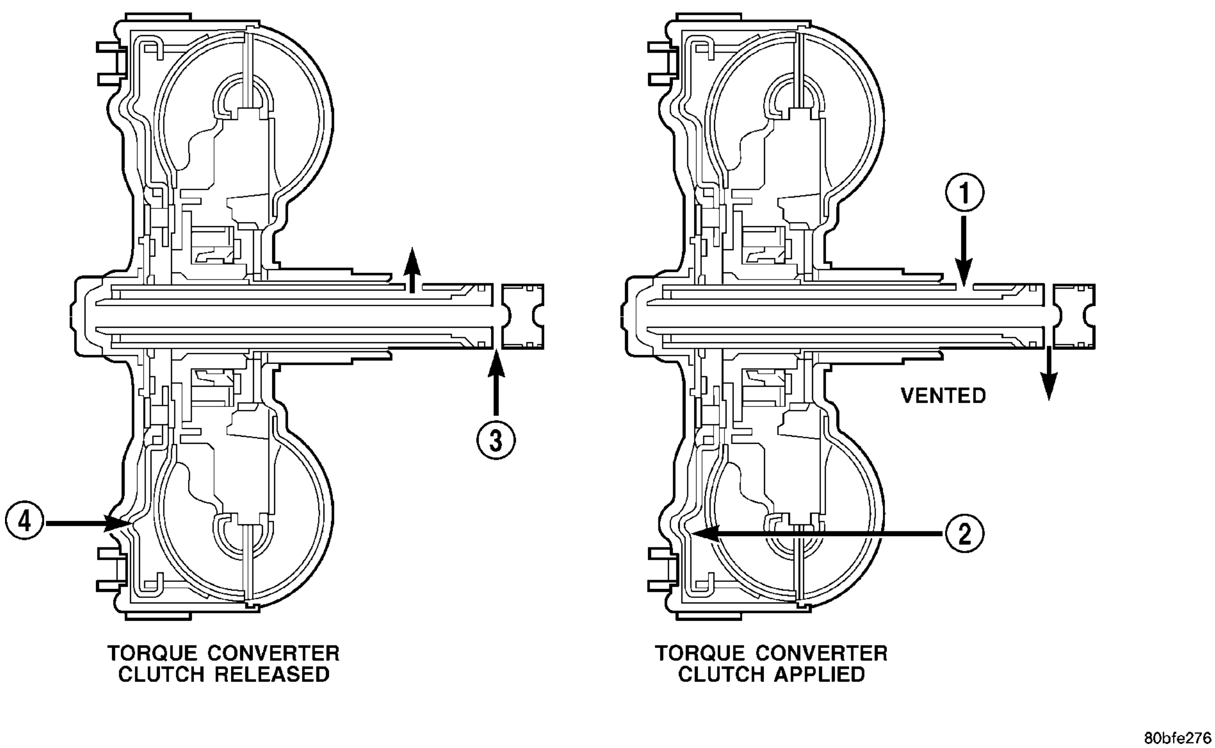


Fig. 123 Torque Converter Fluid Operation - Typical

1 - APPLY PRESSURE
2 - THE PISTON MOVES SLIGHTLY FORWARD
3 - RELEASE PRESSURE
4 - THE PISTON MOVES SLIGHTLY REARWARD

TORQUE CONVERTER (Continued)

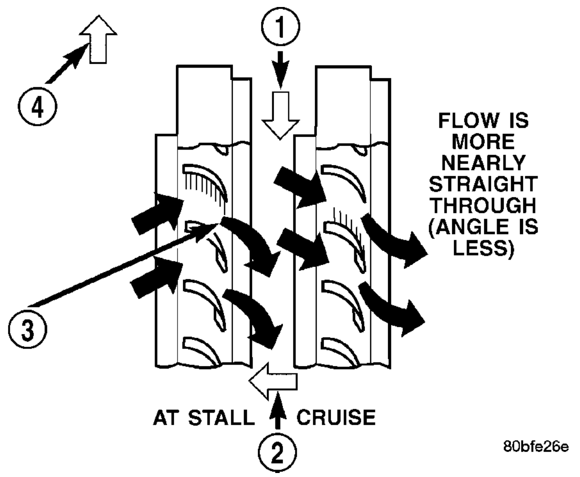


Fig. 124 Stator Operation

1 - DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
2 - FRONT OF ENGINE
3 - INCREASED ANGLE AS OIL STRIKES VANES
4 - DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

control switch is in the OFF position, the clutch will engage after the shift to third gear.

The TCM controls the torque converter by way of internal logic software. The programming of the software provides the TCM with control over the L/R-CC Solenoid. There are four output logic states that can be applied as follows:

- No EMCC
- Partial EMCC
- Full EMCC
- Gradual-to-no EMCC

NO EMCC

Under No EMCC conditions, the L/R Solenoid is OFF. There are several conditions that can result in NO EMCC operations. No EMCC can be initiated due to a fault in the transmission or because the TCM does not see the need for EMCC under current driving conditions.

PARTIAL EMCC

Partial EMCC operation modulates the L/R Solenoid (duty cycle) to obtain partial torque converter clutch application. Partial EMCC operation is maintained until Full EMCC is called for and actuated. During Partial EMCC some slip does occur. Partial EMCC will usually occur at low speeds, low load and light throttle situations.

FULL EMCC

During Full EMCC operation, the TCM increases the L/R Solenoid duty cycle to full ON after Partial EMCC control brings the engine speed within the desired slip range of transmission input speed relative to engine rpm.

GRADUAL-TO-NO EMCC

This operation is to soften the change from Full or Partial EMCC to No EMCC. This is done at mid-throttle by decreasing the L/R Solenoid duty cycle.

REMOVAL

(1) Remove transmission and torque converter from vehicle.

(2) Place a suitable drain pan under the converter housing end of the transmission.

CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition. The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.

(3) Pull the torque converter forward until the center hub clears the oil pump seal.

(4) Separate the torque converter from the transmission.

INSTALLATION

Check converter hub and drive flats for sharp edges, burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper or crocus cloth if necessary. Verify that the converter hub o-ring is properly installed and is free from debris. The hub must be smooth to avoid damaging the pump seal at installation.

(1) Lubricate oil pump seal lip with transmission fluid.

(2) Place torque converter in position on transmission.

CAUTION: Do not damage oil pump seal or converter hub o-ring while inserting torque converter into the front of the transmission.

(3) Align torque converter to oil pump seal opening.

(4) Insert torque converter hub into oil pump.

(5) While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.

(6) Check converter seating with a scale and straightedge (Fig. 125). Surface of converter lugs should be at least 13 mm (1/2 in.) to rear of straightedge when converter is fully seated.

(7) If necessary, temporarily secure converter with C-clamp attached to the converter housing.

(8) Install the transmission in the vehicle.

TORQUE CONVERTER (Continued)

(9) Fill the transmission with the recommended fluid.

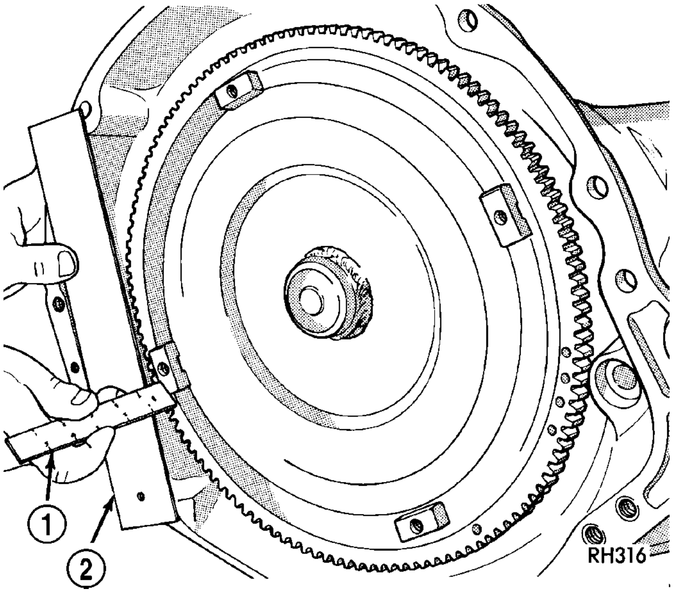


Fig. 125 Checking Torque Converter Seating-Typical

1 - SCALE
2 - STRAIGHTEDGE

TRANSMISSION CONTROL RELAY

DESCRIPTION

The relay is supplied fused B+ voltage, energized by the TCM, and is used to supply power to the solenoid pack when the transmission is in normal operating mode.

OPERATION

When the relay is "off", no power is supplied to the solenoid pack and the transmission is in "limp-in" mode. After a controller reset, the TCM energizes the relay. Prior to this, the TCM verifies that the contacts are open by checking for no voltage at the switched battery terminals. After this is verified, the voltage at the solenoid pack pressure switches is checked. After the relay is energized, the TCM monitors the terminals to verify that the voltage is greater than 3 volts.

TRANSMISSION RANGE SENSOR

DESCRIPTION

The Transmission Range Sensor (TRS) is part of the solenoid module, which is mounted to the top of the valve body inside the transmission.

The Transmission Range Sensor (TRS) has five switch contact pins that:

- Determine shift lever position
- Supply ground to the Starter Relay in Park and Neutral only.
- Supply +12 V to the backup lamps in Reverse only.

The TRS also has an integrated temperature sensor (thermistor) that communicates transmission temperature to the TCM and PCM.

OPERATION

The Transmission Range Sensor (TRS) communicates shift lever position to the TCM as a combination of open and closed switches. Each shift lever position has an assigned combination of switch states (open/closed) that the TCM receives from four sense circuits. The TCM interprets this information and determines the appropriate transmission gear position and shift schedule.

There are many possible combinations of open and closed switches (codes). Seven of these possible codes are related to gear position and five are recognized as "between gear" codes. This results in many codes which should **never occur**. These are called "invalid" codes. An invalid code will result in a DTC, and the TCM will then determine the shift lever position based on pressure switch data. This allows reasonably normal transmission operation with a TRS failure.

GEAR	C5	C4	C3	C2	C1
Park	CL	OP	OP	CL	CL
Temp 1	CL	OP	OP	CL	OP
Reverse	OP	OP	OP	CL	OP
Temp 2	OP	OP	CL	CL	OP
Neutral 1	OP	OP	CL	CL	CL
Neutral 2	OP	CL	CL	CL	CL
Temp 3	OP	CL	CL	CL	OP
Drive	OP	CL	CL	OP	OP
Temp 4	OP	CL	OP	OP	OP
Manual 2	CL	CL	OP	OP	OP
Temp 5	CL	OP	OP	OP	OP
Manual 1	CL	OP	CL	OP	OP

TRANSMISSION SOLENOID/ TRS ASSEMBLY

DESCRIPTION

The transmission solenoid/TRS assembly is internal to the transmission and mounted on the valve body assembly (Fig. 126). The assembly consists of six solenoids that control hydraulic pressure to the six friction elements (transmission clutches), and the torque converter clutch. The pressure control solenoid is located on the side of the solenoid/TRS assembly. The solenoid/TRS assembly also contains five pressure switches that feed information to the TCM.

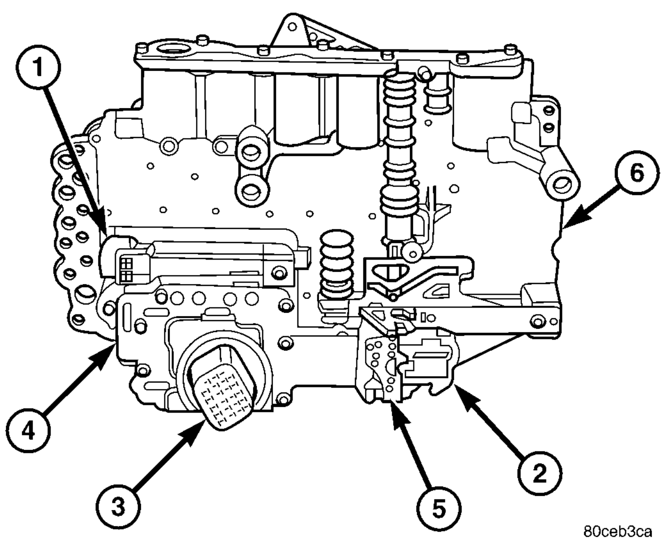


Fig. 126 Transmission Solenoid/TRS Assembly

1 - PRESSURE CONTROL SOLENOID
2 - TRANSMISSION RANGE SELECTOR PLATE
3 - 23-WAY CONNECTOR
4 - SOLENOID PACK
5 - TRANSMISSION RANGE SENSOR
6 - VALVE BODY

OPERATION

SOLENOIDS

Solenoids are used to control the L/R, 2C, 4C, OD, and UD friction elements. The reverse clutch is controlled by line pressure and the position of the manual valve in the valve body. All the solenoids are contained within the Solenoid and Pressure Switch Assembly. The solenoid and pressure switch assembly contains one additional solenoid, Multi-Select (MS), which serves primarily to provide 2nd and 3rd gear limp-in operation.

The solenoids receive electrical power from the Transmission Control Relay through a single wire. The TCM energizes or operates the solenoids individually by grounding the return wire of the solenoid as necessary. When a solenoid is energized, the solenoid valve shifts, and a fluid passage is opened or closed (vented or applied), depending on its default operating state. The result is an apply or release of a frictional element.

The MS and UD solenoids are normally applied to allow transmission limp-in in the event of an electrical failure.

The continuity of the solenoids and circuits are periodically tested. Each solenoid is turned on or off depending on its current state. An inductive spike should be detected by the TCM during this test. If no spike is detected, the circuit is tested again to verify the failure. In addition to the periodic testing, the solenoid circuits are tested if a speed ratio or pressure switch error occurs.

PRESSURE SWITCHES

The TCM relies on five pressure switches to monitor fluid pressure in the L/R, 2C, 4C, UD, and OD hydraulic circuits. The primary purpose of these switches is to help the TCM detect when clutch circuit hydraulic failures occur. The switches close at 23 psi and open at 11 psi, and simply indicate whether or not pressure exists. The switches are continuously monitored by the TCM for the correct states (open or closed) in each gear as shown in the following charts 45RFE PRESSURE SWITCH STATES and 545RFE PRESSURE SWITCH STATES :

45RFE PRESSURE SWITCH STATES

GEAR	L/R	2C	4C	UD	OD
R	OP	OP	OP	OP	OP
P/N	CL	OP	OP	OP	OP
1ST	CL*	OP	OP	CL	OP
2ND	OP	CL	OP	CL	OP
2ND PRIME	OP	OP	CL	CL	OP
D	OP	OP	OP	CL	CL
FOURTH	OP	OP	CL	OP	CL

*L/R is closed if output speed is below 100 rpm in Drive and Manual 2. L/R is open in Manual 1.

TRANSMISSION SOLENOID/TRS ASSEMBLY (Continued)

545RFE PRESSURE SWITCH STATES

GEAR	L/R	2C	4C	UD	OD
R	OP	OP	OP	OP	OP
P/N	CL	OP	OP	OP	OP
1ST	CL*	OP	OP	CL	OP
2ND	OP	CL	OP	CL	OP
2ND PRIME	OP	OP	CL	CL	OP
D	OP	OP	OP	CL	CL
4TH	OP	OP	CL	OP	CL
5TH	OP	CL	OP	OP	CL

*L/R is closed if output speed is below 100 rpm in Drive and Manual 2. L/R is open in Manual 1.

A Diagnostic Trouble Code (DTC) will set if the TCM senses any switch open or closed at the wrong time in a given gear.

REMOVAL

(1) Remove the valve body from the transmission (Fig. 127).

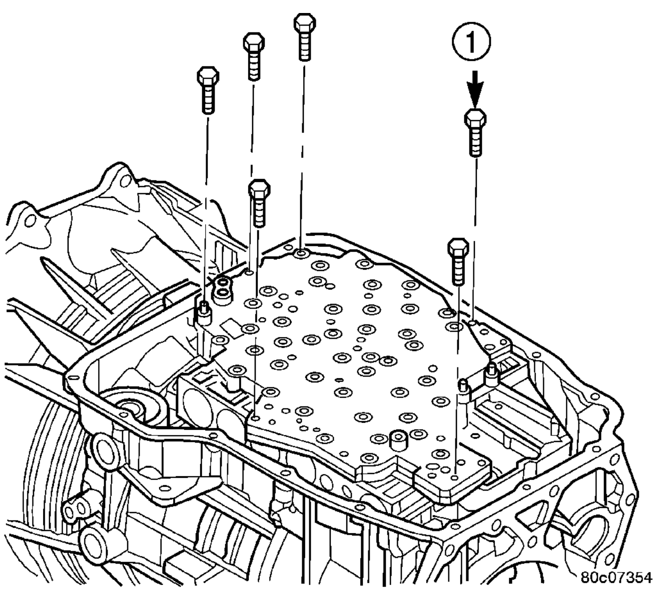


Fig. 127 Valve Body Bolts

1 - VALVE BODY TO CASE BOLT (6)

(2) Remove the screws holding the transmission solenoid/TRS assembly onto the valve body (Fig. 128).

(3) Separate the transmission solenoid/TRS assembly from the valve body.

INSTALLATION

(1) Place TRS selector plate in the PARK position.

(2) Position the transmission solenoid/TRS assembly onto the valve body. Be sure that both alignment dowels are fully seated in the valve body and that the TRS switch contacts are properly positioned in the selector plate

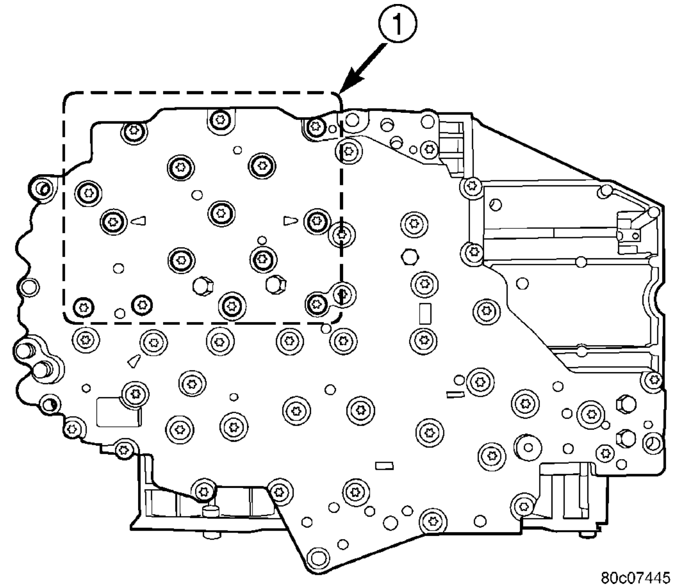


Fig. 128 Ttransmission Solenoid/TRS Assembly Screws

1 - SOLENOID PACK BOLTS (15)

(3) Install the screws to hold the transmission solenoid/TRS assembly onto the valve body.

(4) Tighten the solenoid assembly screws adjacent to the arrows cast into the bottom of the valve body first. Tighten the screws to 5.7 N·m (50 in.lbs.).

(5) Tighten the remainder of the solenoid assembly screws to 5.7 N·m (50 in.lbs.).

(6) Install the valve body into the transmission.

TRANSMISSION TEMPERATURE SENSOR

DESCRIPTION

The transmission temperature sensor is a thermistor that is integral to the Transmission Range Sensor (TRS).

OPERATION

The transmission temperature sensor is used by the TCM to sense the temperature of the fluid in the sump. Since fluid temperature can affect transmission shift quality and convertor lock up, the TCM requires this information to determine which shift schedule to operate in.

Calculated Temperature

A failure in the temperature sensor or circuit will result in calculated temperature being substituted for actual temperature. Calculated temperature is a pre-

TRANSMISSION TEMPERATURE SENSOR (Continued)

dicted fluid temperature which is calculated from a combination of inputs:
- Battery (ambient) temperature
- Engine coolant temperature
- In-gear run time since start-up

VALVE BODY

DESCRIPTION

The valve body consists of a cast aluminum valve body, a separator plate, and a transfer plate. The valve body contains valves and check balls that control fluid delivery to the torque converter clutch, bands, and frictional clutches. The valve body contains the following components (Fig. 129) and (Fig. 130):
- Solenoid switch valve
- Manual valve
- Low/reverse switch valve
- 5 Accumulators
- 7 check balls

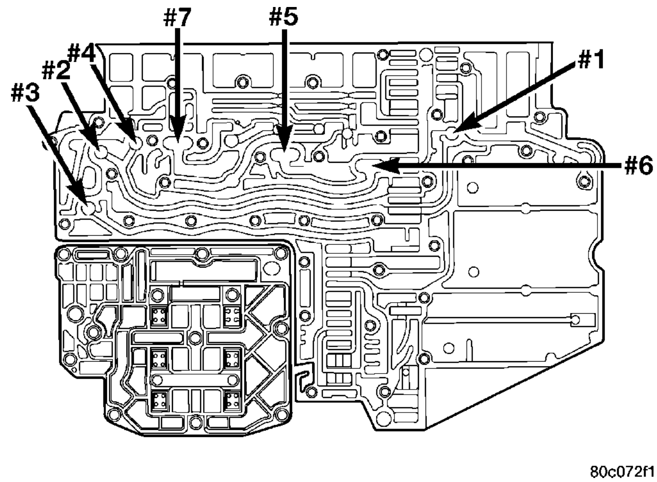


Fig. 130 Check Ball Locations

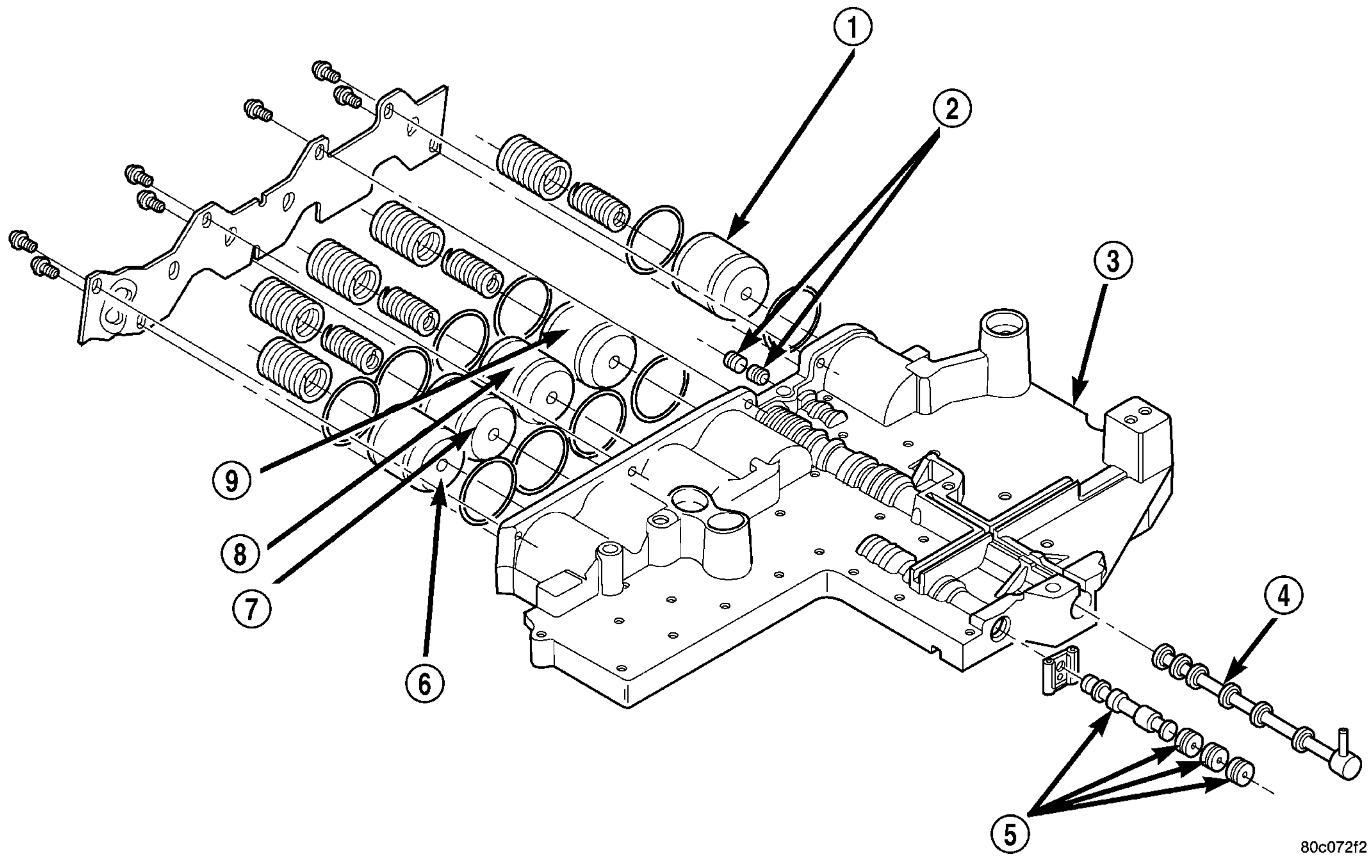


Fig. 129 Valve Body Components

1 - LOW/REVERSE ACCUMULATOR
2 - LOW/REVERSE SWITCH VALVE
3 - UPPER VALVE BODY
4 - MANUAL VALVE
5 - SOLENOID SWITCH VALVE
6 - OVERDRIVE ACCUMULATOR
7 - UNDERDRIVE ACCUMULATOR
8 - 4C ACCUMULATOR
9 - 2C ACCUMULATOR

VALVE BODY (Continued)

OPERATION

NOTE: Refer to the Hydraulic Schematics for a visual aid in determining valve location, operation and design.

SOLENOID SWITCH VALVE

The Solenoid Switch Valve (SSV) controls the direction of the transmission fluid when the L/R-TCC solenoid is energized.

When shifting into 1st gear, a special hydraulic sequence is performed to ensure SSV movement into the downshifted position. The L/R pressure switch is monitored to confirm SSV movement. If the movement is not confirmed (the L/R pressure switch does not close), 2nd gear is substituted for 1st. A DTC will be set after three unsuccessful attempts are made to get into 1st gear in one given key start.

MANUAL VALVE

The manual valve is a relay valve. The purpose of the manual valve is to direct fluid to the correct circuit needed for a specific gear or driving range. The manual valve, as the name implies, is manually operated by the driver with a lever located on the top of the valve body. The valve is connected mechanically by a cable to the gearshift mechanism. The valve is held in each of its positions by a roller detent spring (Fig. 131) that engages the “roostercomb” of the TRS selector plate.

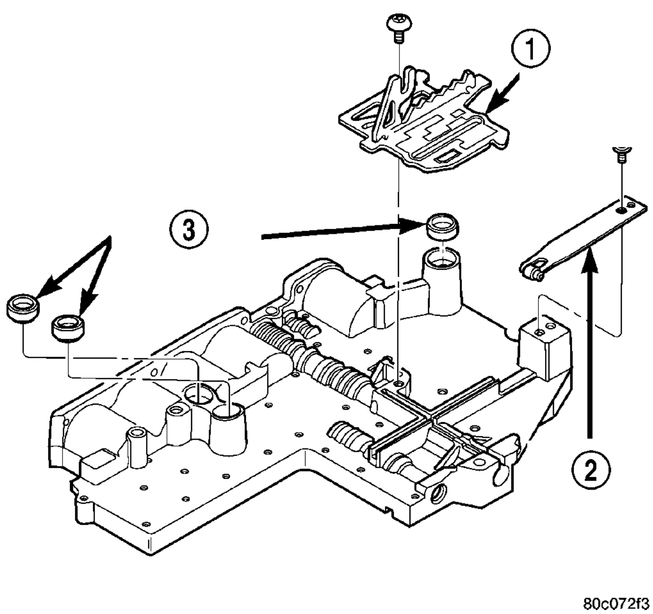


Fig. 131 TRS Selector Plate and Detent Spring

1 - TRS SELECTOR PLATE
2 - DETENT SPRING
3 - CLUTCH PASSAGE SEALS

LOW/REVERSE SWITCH VALVE

The low/reverse switch valve allows the low/reverse clutch to be operated by either the LR/CC solenoid or the MS solenoid.

REMOVAL

The valve body can be removed for service without having to remove the transmission assembly.

The valve body can be disassembled for cleaning and inspection of the individual components. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 45RFE/VALVE BODY - DISASSEMBLY)

(1) Shift transmission into PARK.

(2) Raise vehicle.

(3) Disconnect wires at the solenoid and pressure switch assembly connector.

(4) Position drain pan under transmission oil pan.

(5) Remove transmission oil pan.

(6) Remove the primary oil filter from valve body. (Fig. 132)

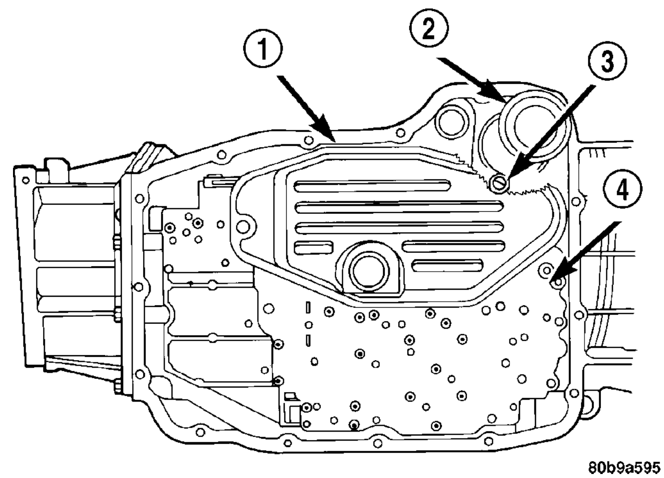


Fig. 132 Remove Primary Oil Filter

1 - PRIMARY OIL FILTER
2 - COOLER RETURN FILTER
3 - COOLER RETURN FILTER BYPASS VALVE
4 - VALVE BODY

VALVE BODY (Continued)

(7) Remove bolts attaching valve body to transmission case (Fig. 133).

(8) Lower the valve body and work the electrical connector out of transmission case.

(9) Separate the valve body from the transmission.

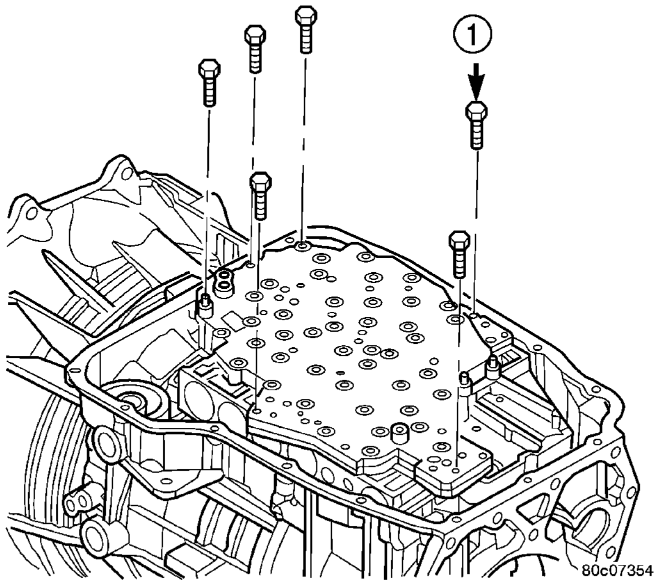


Fig. 133 Valve Body Bolts

1 - VALVE BODY TO CASE BOLT (6)

DISASSEMBLY

(1) Remove the screws holding the solenoid and pressure switch assembly to the valve body (Fig. 134). Do not remove the screws on the top of the solenoid and pressure switch assembly.

(2) Separate the solenoid and pressure switch assembly from the valve body.

(3) Remove the screw holding the detent spring (Fig. 135) onto the valve body.

(4) Remove the detent spring from the valve body.

(5) Remove the TRS selector plate from the valve body and the manual valve.

(6) Remove the clutch passage seals from the valve body, if necessary.

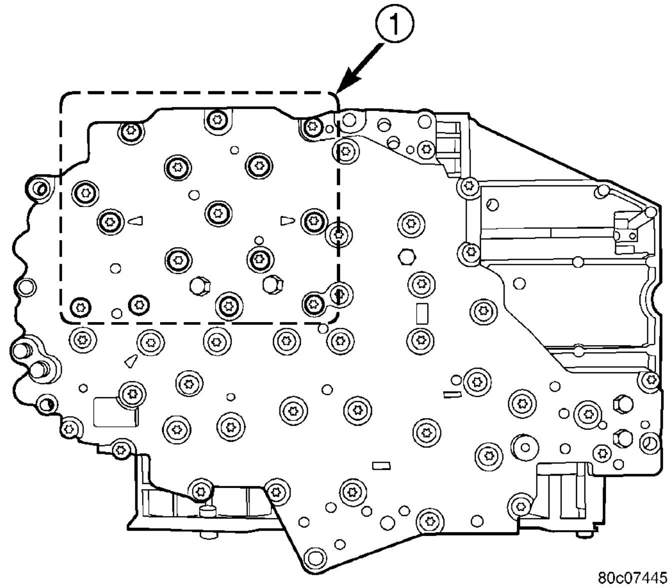


Fig. 134 Solenoid and Pressure Switch Assembly Screws

1 - SOLENOID PACK BOLTS (15)

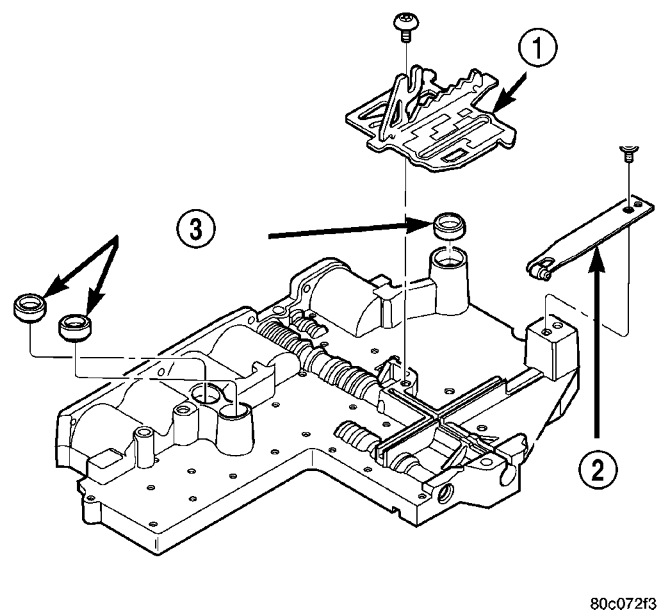


Fig. 135 Valve Body External Components

1 - TRS SELECTOR PLATE
2 - DETENT SPRING
3 - CLUTCH PASSAGE SEALS

VALVE BODY (Continued)

(7) Remove the screws holding the accumulator cover onto the valve body (Fig. 136).

(8) Remove the accumulator springs and pistons from the valve body. Note which accumulator piston and spring belong in each location.

(9) Place the valve body on the bench with the transfer plate upward.

NOTE: The valve body contains seven check balls. The transfer plate must be placed upward to prevent losing the check balls when the transfer plate is removed from the valve body.

(10) Remove the screws holding the valve body to the valve body transfer plate.

(11) Remove the transfer plate from the valve body. Note the location of all check balls (Fig. 137).

(12) Remove the check balls from the valve body.

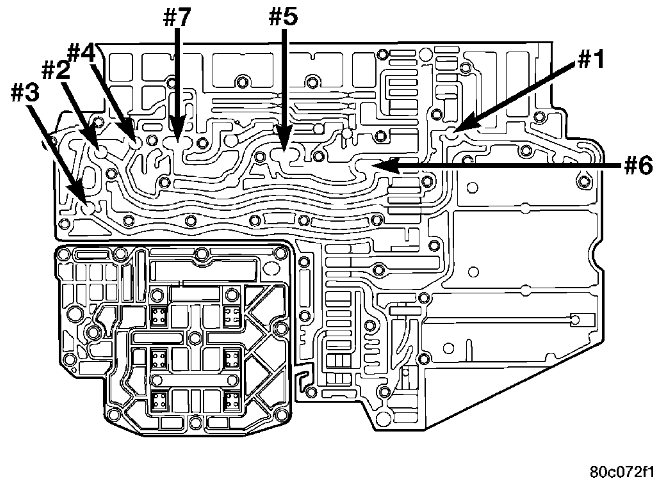


Fig. 137 Check Ball Locations

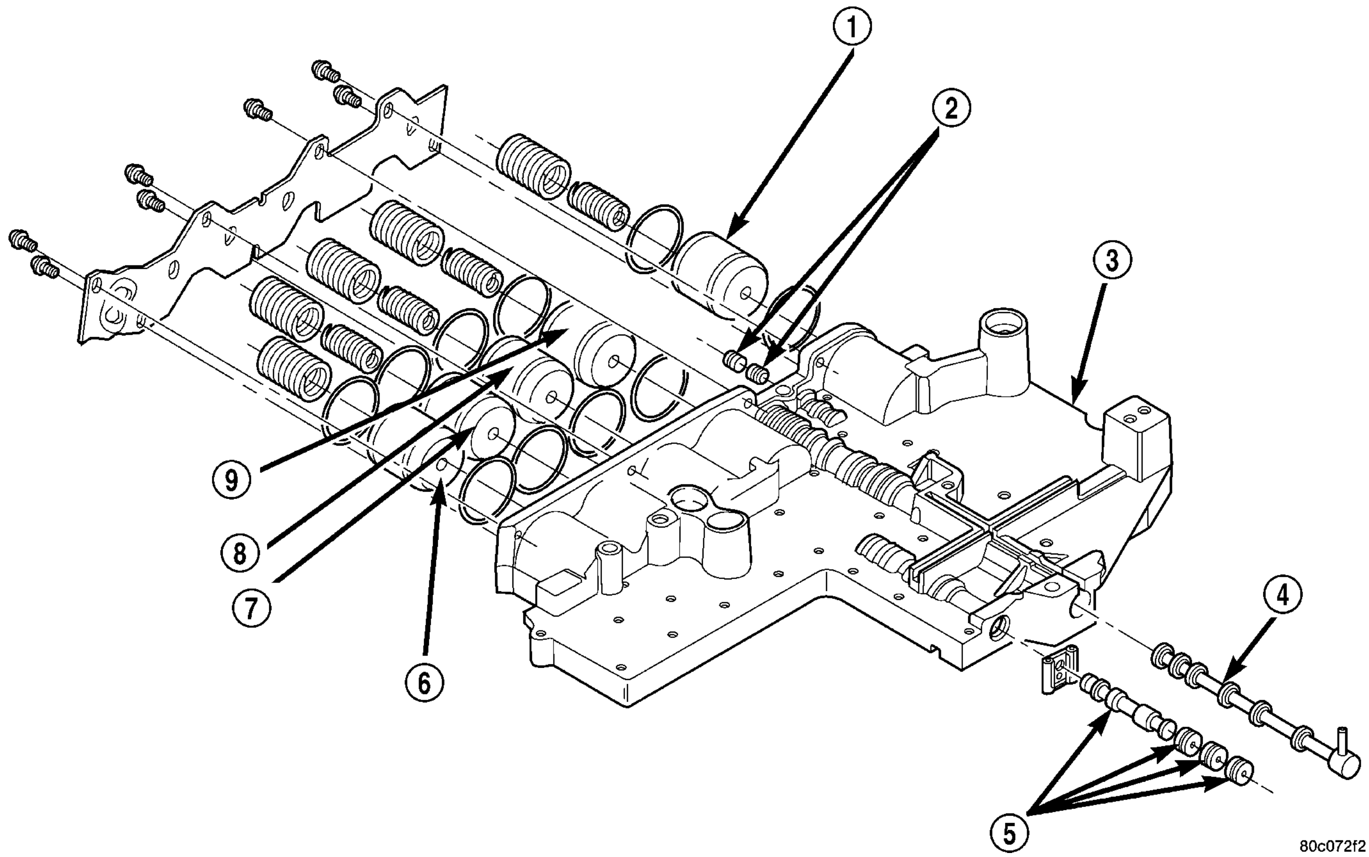


Fig. 136 Valve Body Components

1 - LOW/REVERSE ACCUMULATOR
2 - LOW/REVERSE SWITCH VALVE
3 - UPPER VALVE BODY
4 - MANUAL VALVE
5 - SOLENOID SWITCH VALVE
6 - OVERDRIVE ACCUMULATOR
7 - UNDERDRIVE ACCUMULATOR
8 - 4C ACCUMULATOR
9 - 2C ACCUMULATOR

VALVE BODY (Continued)

(13) Remove the retainers securing the solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body and remove the associated valve and spring. Tag each valve and spring combination with location information to aid in assembly. (Fig. 138)

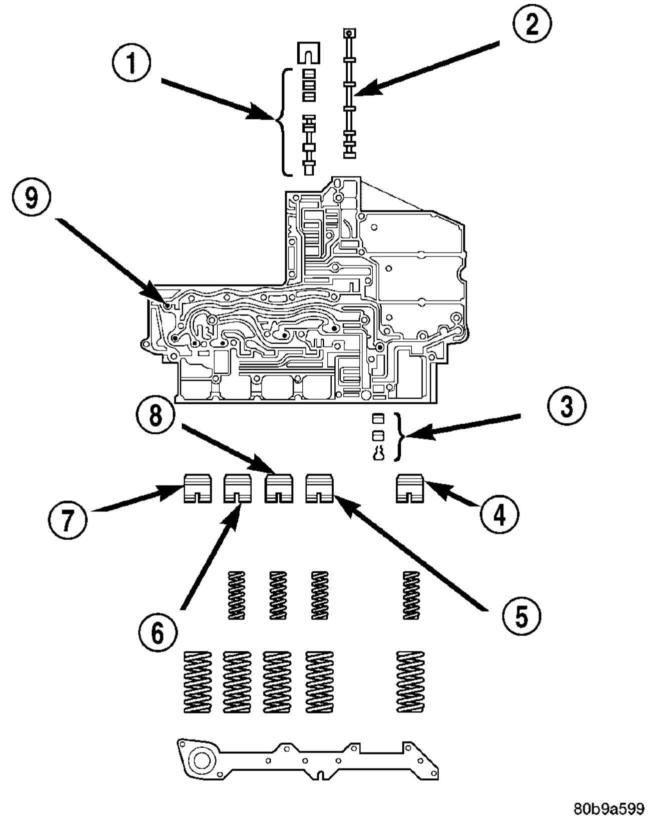


Fig. 138 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

CLEANING

Clean the valve housings, valves, plugs, springs, and separator plates with a standard parts cleaning solution only. Do not use gasoline, kerosene, or any type of caustic solution. (Fig. 139)

Do not immerse any of the electrical components in cleaning solution. Clean the electrical components by wiping them off with dry shop towels only.

Dry all except the electrical parts with compressed air. Make sure all passages are clean and free from obstructions. **Do not use rags or shop towels to dry or wipe off valve body components. Lint from these materials can stick to valve body parts, interfere with valve operation, and clog filters and fluid passages.**

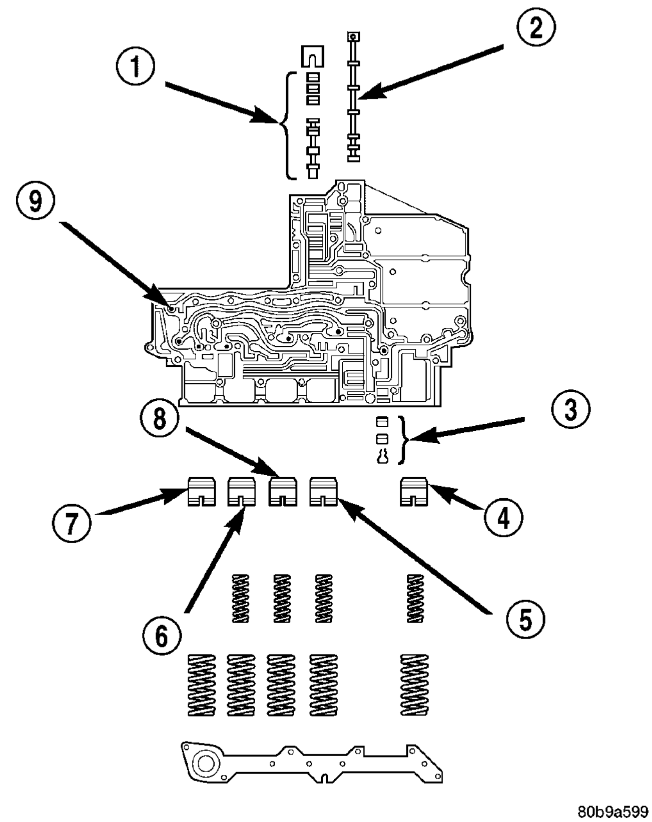


Fig. 139 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

INSPECTION

Inspect all of the valve body mating surfaces for scratches, nicks, burrs, or distortion. Use a straight-edge to check surface flatness. Minor scratches may be removed with crocus cloth using only very light pressure.

Minor distortion of a valve body mating surface may be corrected by smoothing the surface with a sheet of crocus cloth. Position the crocus cloth on a surface plate, sheet of plate glass or equally flat surface. If distortion is severe or any surfaces are heavily scored, the valve body will have to be replaced.

VALVE BODY (Continued)

Inspect the valves and plugs (Fig. 140) for scratches, burrs, nicks, or scores. Minor surface scratches on steel valves and plugs can be removed with crocus cloth but **do not round off the edges of the valve or plug lands.** Maintaining sharpness of these edges is vitally important. The edges prevent foreign matter from lodging between the valves and plugs and the bore.

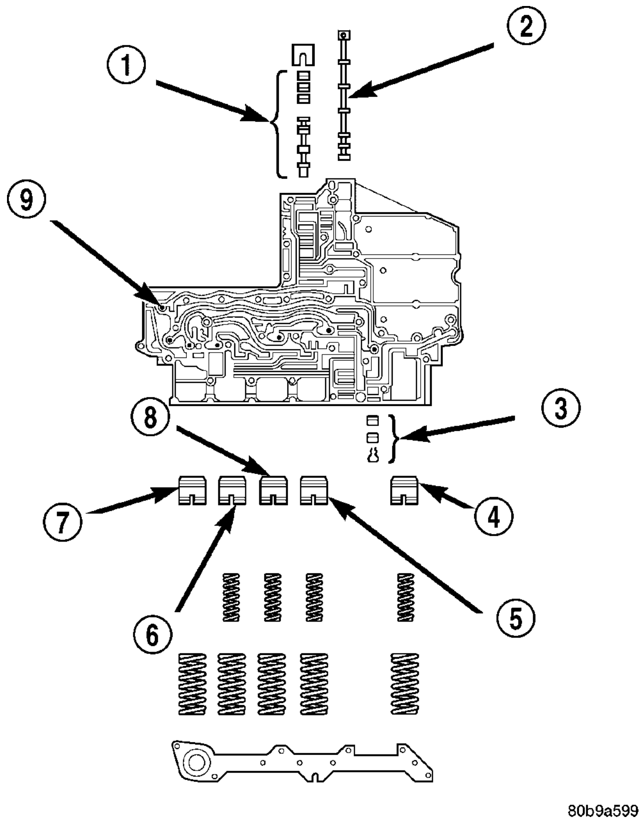


Fig. 140 Valve Body Components

1 - SOLENOID SWITCH VALVE
2 - MANUAL VALVE
3 - LOW REVERSE SWITCH VALVE
4 - LOW REVERSE ACCUMULATOR
5 - 2ND CLUTCH ACCUMULATOR
6 - UNDERDRIVE ACCUMULATOR
7 - OVERDRIVE ACCUMULATOR
8 - 4TH CLUTCH ACCUMULATOR
9 - CHECK BALLS (7)

Inspect all the valve and plug bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the valve body springs. The springs must be free of distortion, warpage or broken coils.

Trial fit each valve and plug in its bore to check freedom of operation. When clean and dry, the valves and plugs should drop freely into the bores.

Valve body bores do not change dimensionally with use. If the valve body functioned correctly when new, it will continue to operate properly after cleaning and inspection. It should not be necessary to replace a valve body assembly unless it is damaged in handling.

Inspect all the accumulator bores in the valve body. Use a penlight to view the bore interiors. Replace the valve body if any bores are distorted or scored. Inspect all of the accumulator springs. The springs must be free of distortion, warpage or broken coils.

Inspect all the fluid seals on the valve body (Fig. 141). Replace any seals that are cracked, distorted, or damaged in any way. These seals pass fluid pressure directly to the clutches. Any pressure leak at these points, may cause transmission performance problems.

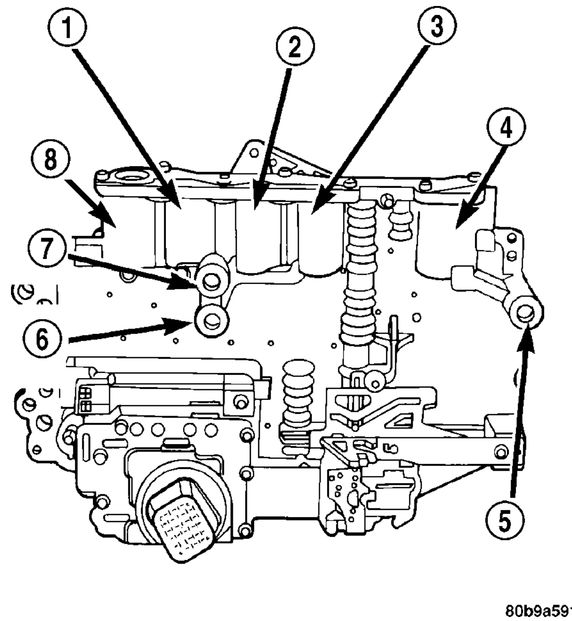


Fig. 141 Valve Body Seals

1 - UNDERDRIVE ACCUMULATOR (2 SPRINGS)
2 - 4TH CLUTCH ACCUMULATOR (2 SPRINGS)
3 - 2ND CLUTCH ACCUMULATOR (2 SPRINGS)
4 - LOW REVERSE ACCUMULATOR (2 SPRINGS)
5 - LOW/REVERSE PASSAGE SEAL
6 - 2ND CLUTCH PASSAGE SEAL
7 - 4TH CLUTCH PASSAGE SEAL
8 - OVERDRIVE ACCUMULATOR (1 SPRING)

VALVE BODY (Continued)

ASSEMBLY

(1) Lubricate valves, springs, and the housing valve bores with clean transmission fluid.

(2) Install solenoid switch valve, manual valve, and the low/reverse switch valve into the valve body.

(3) Install the retainers to hold each valve into the valve body.

(4) Install the valve body check balls into their proper locations.

(5) Position the transfer plate onto the valve body.

(6) Install the screws to hold the transfer plate to the valve body. Tighten the screws to 5.6 N·m (50 in. lbs.).

(7) Install the accumulator pistons and springs into the valve body in the location from which they were removed. Note that all accumulators except the overdrive have two springs. The overdrive accumulator piston has only one spring.

(8) Position the accumulator cover onto the valve body.

(9) Install the screws to hold the accumulator cover onto the valve body. Tighten the screws to 4.5 N·m (40 in. lbs.).

(10) Install the TRS selector plate onto the valve body and the manual valve.

(11) Install the solenoid and pressure switch assembly onto the valve body.

(12) Install the screws to hold the solenoid and pressure switch assembly onto the valve body. Tighten the screws to 5.7 N·m (50 in. lbs.). Tighten the screws adjacent to the arrows cast into the bottom of the transfer plate first.

(13) Position the detent spring onto the valve body.

(14) Install the screw to hold the detent spring onto the valve body. Tighten the screw to 4.5 N·m (40 in. lbs.).

(15) Install new clutch passage seals onto the valve body, if necessary

INSTALLATION

(1) Check condition of seals on valve body and the solenoid and pressure switch assembly. Replace seals if cut or worn.

(2) Place TRS selector plate in the PARK position.

(3) Place the transmission in the PARK position.

(4) Lubricate seal on the solenoid and pressure switch assembly connector with petroleum jelly.

(5) Position valve body in transmission and align the manual lever on the valve body to the pin on the transmission manual shift lever.

(6) Seat valve body in case and install one or two bolts to hold valve body in place.

(7) Tighten valve body bolts alternately and evenly to 12 N·m (105 in. lbs.) torque.

(8) Install a new primary oil filter seal in the oil pump inlet bore. Seat the seal in the bore with the butt end of a hammer, or other suitable tool.

CAUTION: The primary oil filter seal MUST be fully installed flush against the oil pump body. DO NOT install the seal onto the filter neck and attempt to install the filter and seal as an assembly. Damage to the transmission will result.

(9) Place replacement filter in position on valve body and into the oil pump.

(10) Install screw to hold filter to valve body. Tighten screw to 4.5 N·m (40 in. lbs.) torque.

(11) Connect the solenoid and pressure switch assembly connector.

(12) Install oil pan. Tighten pan bolts to 12 N·m (105 in. lbs.) torque.

(13) Lower vehicle and fill transmission with Mopar® ATF +4.

(14) Check and adjust gearshift cable, if necessary.

TRANSFER CASE - NV241 GENII

TABLE OF CONTENTS

TRANSFER CASE - NV241 GENII

DESCRIPTION

The NV241 GENII transfer case is a part-time transfer case with a low-range gear system. It provides three operating ranges plus a NEUTRAL position. The low range position provides a gear reduction ratio of 2.72:1 for increased low speed torque capability.

The gear cases and extension are all of aluminum (Fig. 1). Drive sprockets and an interconnecting drive chain are used to transmit engine torque to the front/rear propeller shafts. The mainshaft, input gear and front output shaft are supported by ball and needle bearings.

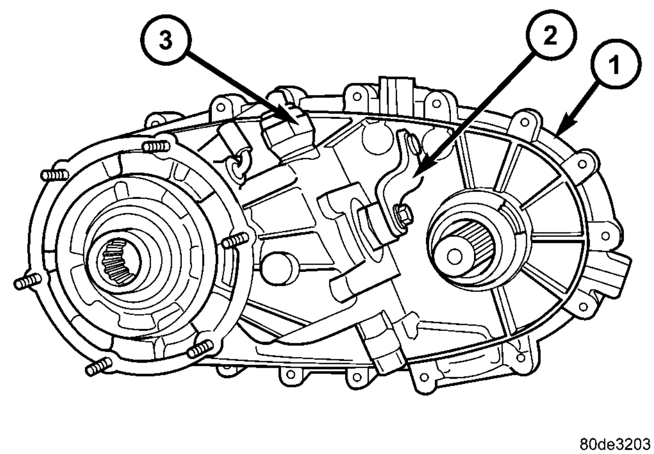


Fig. 1 Transfer Case - Front View

1 - TRANSFER CASE
2 - MANUAL LEVER
3 - POSITION SENSOR

IDENTIFICATION

An identification tag (Fig. 2) is attached to the rear case of every transfer case. The tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

OPERATION

OPERATING RANGE

Transfer case operating ranges are:

- 2H (2-wheel drive)
- 4H (4-wheel drive)
- 4LO (4-wheel drive low range

The 2H range is for use on any road surface at any time.

The 4H and 4LO ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is covered by ice and snow.

The low range reduction gear system is operative in 4LO range only. This range is for extra pulling

TRANSFER CASE - NV241 GENII (Continued)

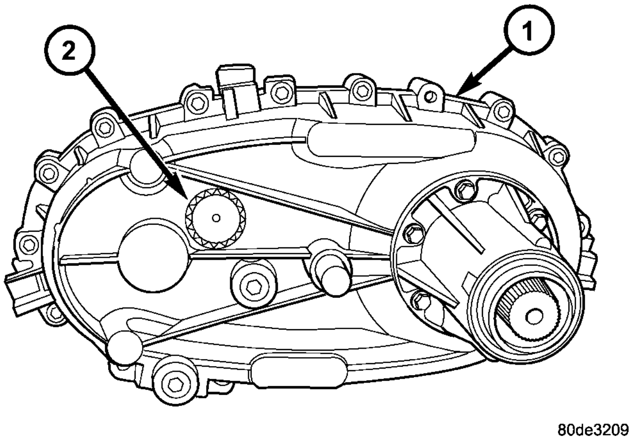


Fig. 2 Transfer Case - Rear View

1 - TRANSFER CASE
2 - IDENTIFICATION TAG

power in off road situations. Low range reduction ratio is 2.72:1.

SHIFT MECHANISM

The transfer case is operated by an adjustable floor mounted shift linkage. The transfer case shift lever is directly attached to the shift sector. The sector operates the range and mode forks within the transfer case.

A straight line shift pattern is used with a NEUTRAL detent. Lever range positions are imprinted in the shift knob.

SHIFTING

The transfer case can be shifted between the 2H and 4H operating ranges while the vehicle is in motion. The vehicle must have the transmission placed in NEUTRAL, or the clutch depressed in the case of a manual transmission, and be moving less than 2-3 MPH when shifting into and out of the 4L operating range.

DIAGNOSIS AND TESTING - TRANSFER CASE - NV241 GENII

Before beginning repair on a suspected transfer case malfunction, check all other driveline components beforehand.

The actual cause of a problem may be related to such items as: front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Diagnosis Chart for further information.

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer Case difficult to shift or will not shift into desired range.	1) Vehicle speed too great to permit shifting.	1) Stop vehicle and shift into desired range. Or, reduce speed to below 3-4 km/h (2-3 mph) before attempting the shift.
	2) If vehicle was operated for an extended period in 4H on a dry paved surface, the driveline torque load may be causing a bind.	2) Stop vehicle and shift the transmission into neutral. Shift the transfer case to 2H and operate vehicle in 2H on dry paved surfaces.
	3) Transfer case external shift linkage binding.	3) Lubricate, repair, or replace linkage bushings, or tighten loose components as necessary.
	4) Insufficient or incorrect lubricant.	4) Drain and refill to edge of fill hole with Mopar® ATF +4, Automatic Transmission fluid.
	5) Internal components binding, worn, or damaged.	5) Disassemble the transfer case and replace worn or damaged components as necessary.
Transfer Case noisy in all operating ranges.	1) Insufficient or incorrect lubricant.	1) Drain and refill to edge of fill hole with Mopar® ATF +4, Automatic Transmission fluid.

TRANSFER CASE - NV241 GENII (Continued)

Condition	Possible Cause	Correction
Noisy in, or jumps out of, four wheel drive low range.	1) Transfer case not completely engaged in 4L position.	1) With the transmission in NEUTRAL, or the clutch depressed in the case of a manual transmission and the vehicle moving under 3-4 km/h (2-3 mph), shift the transfer case to NEUTRAL and then shift into the 4L position.
	2) Shift linkage out of adjustment.	2) Adjust linkage.
	3) Shift linkage loose or binding.	3) Tighten, lubricate, or repair linkage as necessary.
	4) Range fork damaged, inserts worn, or fork is binding on the shift rail.	4) Disassemble unit and repair as necessary.
	5) Low range gear worn or damaged.	5) Disassemble unit and repair as necessary.
Lubricant leaking from output shaft seal or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Vent closed or restricted.	2) Clear or replace vent as necessary.
	3) Output shaft seals damaged or installed incorrectly.	3) Replace seal as necessary. Check to ensure that another component, the propeller shaft slip yoke for example, is not causing damage to seal.
Abnormal tire wear.	1) Extended operation on hard, dry surfaces in the 4H position.	1) Operate vehicle in the 2H position on hard, dry surfaces.

REMOVAL

(1) Raise and support vehicle.

(2) Remove skid plate, if equipped. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)

(3) Position drain oil container under transfer case.

(4) Remove transfer case drain plug and drain lubricant into container.

(5) Disconnect vent hose and transfer case position sensor connector.

(6) Disconnect shift rod from grommet in transfer case shift lever, or from floor shift arm whichever provides easy access. Use channel lock style pliers to press rod out of lever grommet.

(7) Support transmission with jack stand.

(8) Mark front and rear propeller shafts for assembly reference.

(9) Remove front and rear propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(10) Support transfer case with suitable jack. Secure transfer case to jack with safety chains.

(11) Remove nuts attaching transfer case to transmission.

(12) Move transfer case assembly rearward until free of transmission output shaft.

(13) Lower jack and move transfer case from under vehicle.

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

TRANSFER CASE - NV241 GENII (Continued)

SHIFT LEVER AND FRONT OUTPUT SHAFT SEAL

(1) Shift transfer case into NEUTRAL.

(2) Remove nut that retains the shift lever to sector shaft. Then remove shift lever from shaft (Fig. 3).

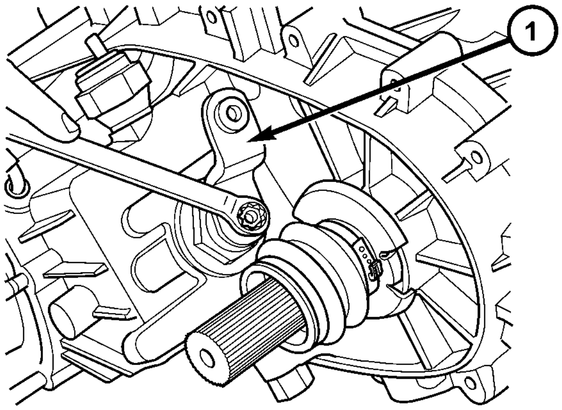


Fig. 3 Remove Range Lever Nut

1 - RANGE LEVER

(3) Remove the front propeller shaft seal boot retaining clamp (Fig. 4).

(4) Remove the front propeller shaft seal boot (Fig. 5).

(5) Remove the front output shaft seal slinger by bending (Fig. 6) the slinger ears away from the transfer case.

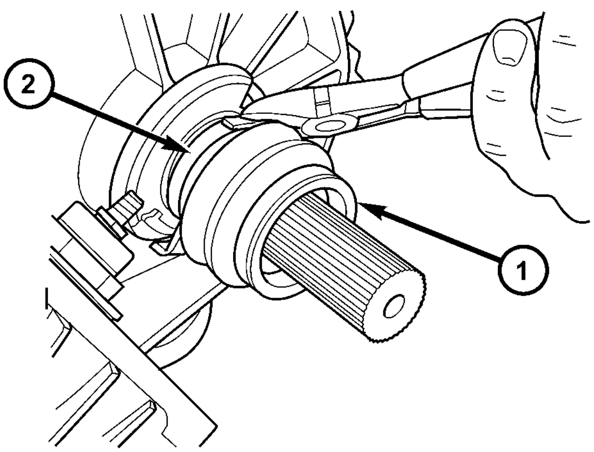


Fig. 4 Remove Boot Clamp

1 - SEAL BOOT
2 - BOOT CLAMP

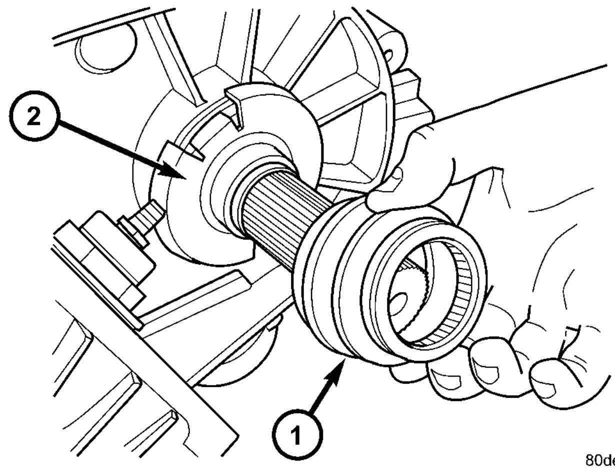


Fig. 5 Remove Seal Boot

1 - SEAL BOOT
2 - SEAL SLINGER

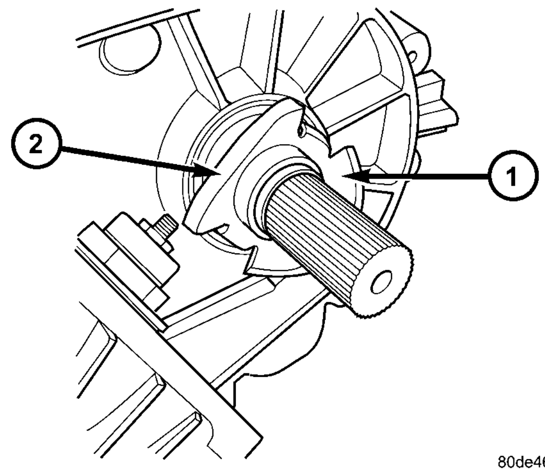


Fig. 6 Bend Slinger Ears

1 - SLINGER
2 - BEND UPWARD

TRANSFER CASE - NV241 GENII (Continued)

(6) Using a suitable pry tool (Fig. 7), remove the slinger from the output shaft using care not to damage the shaft.

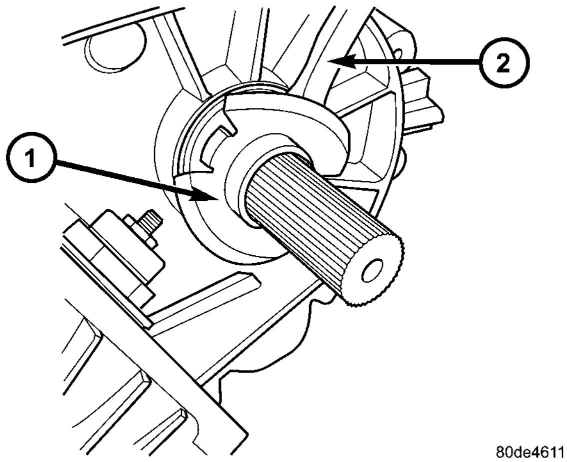


Fig. 7 Remove Slinger From Shaft

1 - SLINGER
2 - PRY TOOL

(7) Using a screw and a slide hammer, remove the front output shaft seal.

REAR EXTENSION

(1) Remove rear extension bolts (Fig. 8).

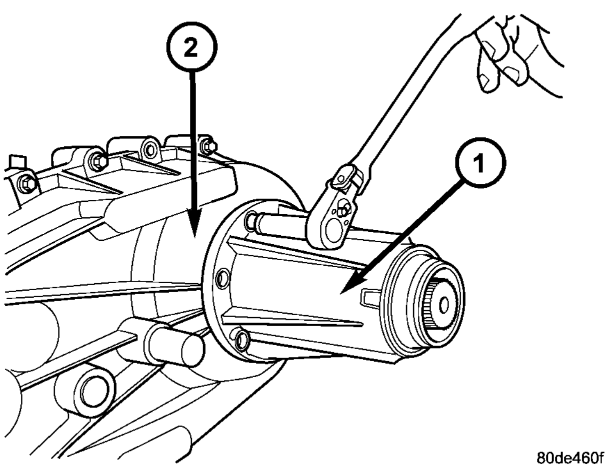


Fig. 8 Remove Rear Extension Bolts

1 - EXTENSION HOUSING
2 - TRANSFER CASE

(2) Remove rear extension housing (Fig. 9). Tap extension once or twice with a plastic mallet to break sealer bead and loosen it.

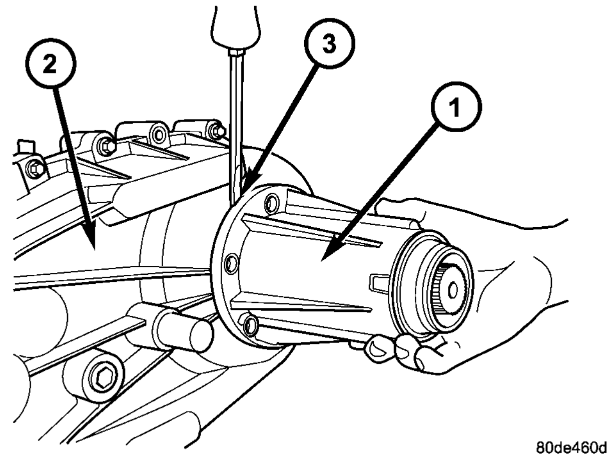


Fig. 9 Remove Rear Extension

1 - EXTENSION HOUSING
2 - TRANSFER CASE
3 - PRY SLOT

(3) Remove output bearing retaining ring with heavy duty snap-ring pliers (Fig. 10).

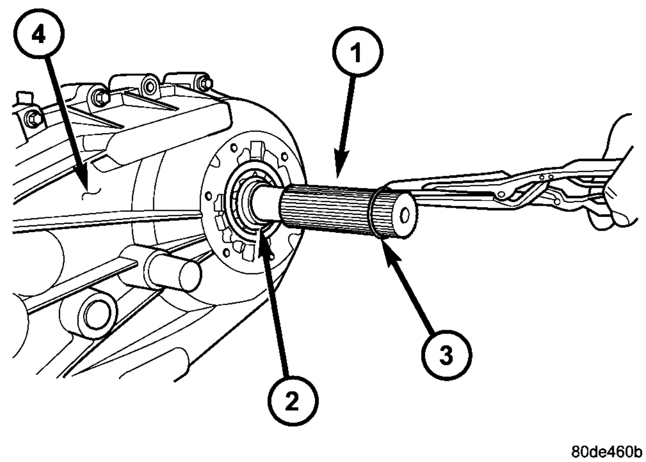


Fig. 10 Remove Output Shaft Retaining Ring

1 - REAR OUTPUT SHAFT
2 - OUTPUT SHAFT BEARING
3 - RETAINING RING
4 - TRANSFER CASE

OIL PUMP AND REAR CASE

(1) Remove rear case-to-front case bolts (Fig. 11).

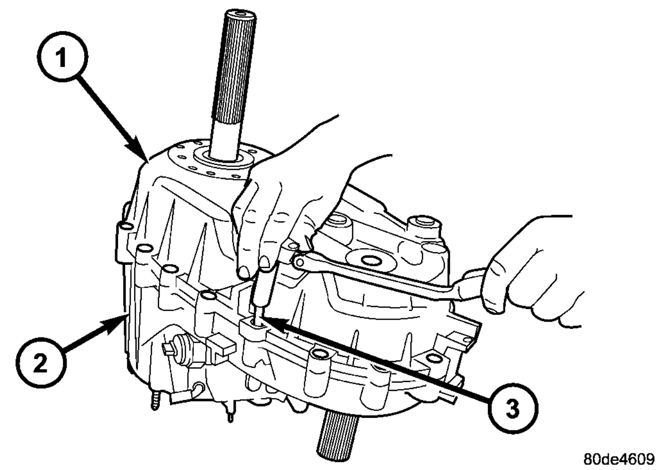


Fig. 11 Remove Case Bolts

1 - REAR CASE
2 - FRONT CASE
3 - BOLT

(2) Loosen rear case with pry tool to break sealer bead. Insert tool in slot at each end of case (Fig. 12).

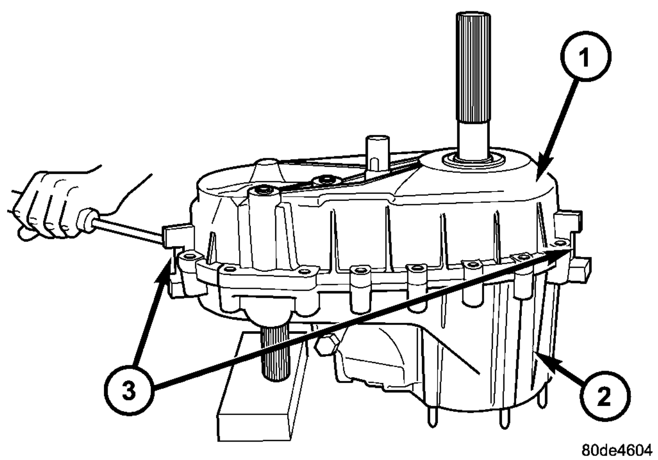


Fig. 12 Loosen Case Halves

1 - REAR CASE
2 - FRONT CASE
3 - PRY SLOTS

(3) Unseat rear case from alignment dowels.

(4) Remove rear case and oil pump assembly from front case (Fig. 13).

CAUTION: Do not remove the bolts holding the oil pump cover to the rear case half. The oil pump cover is aligned to the rear output shaft bearing inner race and will become mis-aligned if the bolts are loosened. If the transfer case failure has generated any debris which may have become trapped in the oil pump, the rear case and oil pump assembly MUST be replaced.

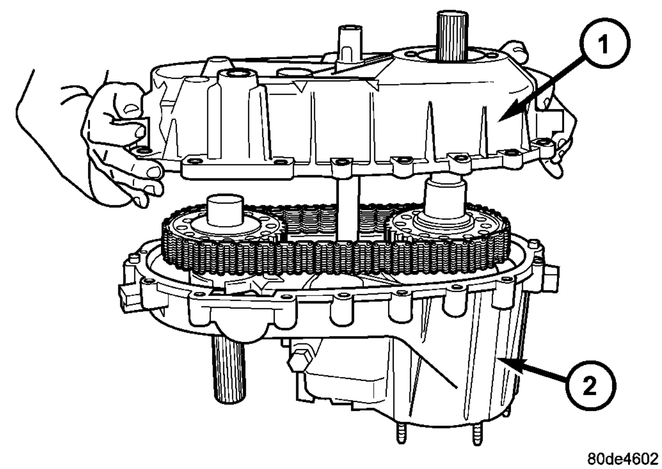


Fig. 13 Remove Rear Case

1 - REAR CASE
2 - FRONT CASE

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Remove shift rail cup and spring (Fig. 14).

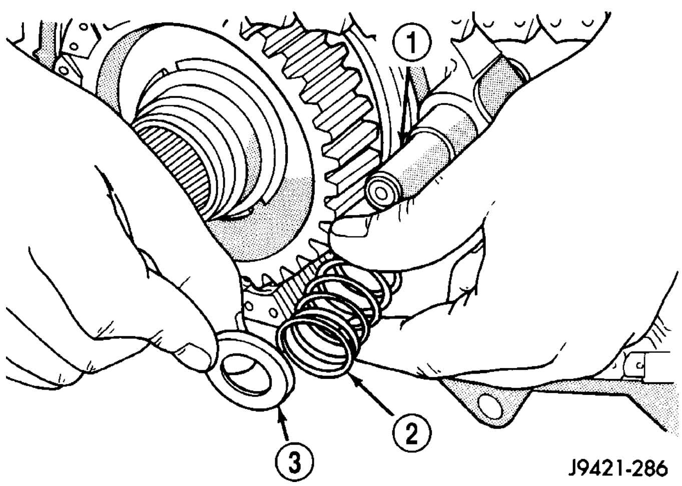


Fig. 14 Shift Rail Cup And Spring Removal

1 - SHIFT RAIL
2 - SPRING
3 - CUP

TRANSFER CASE - NV241 GENII (Continued)

(2) Remove front sprocket retaining ring (Fig. 15).

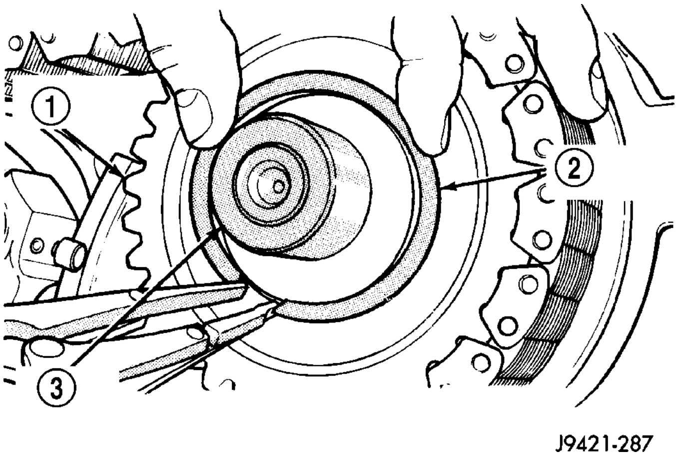


Fig. 15 Removing Front Sprocket Retaining Ring

1 - FRONT SPROCKET
2 - RETAINING RING
3 - FRONT OUTPUT SHAFT

(3) Pull mainshaft, front sprocket and chain outward about 25.4 mm (1-inch) simultaneously (Fig. 16).

(4) Remove chain from mainshaft drive sprocket and remove front sprocket and chain as assembly.

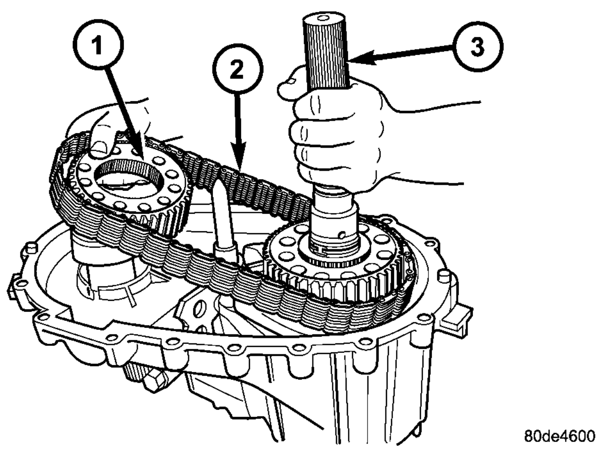


Fig. 16 Remove Front Sprocket and Drive Chain

1 - FRONT DRIVE SPROCKET
2 - DRIVE CHAIN
3 - MAINSHAFT

SHIFT FORKS AND MAINSHAFT

(1) Remove the transfer case position sensor (Fig. 17).

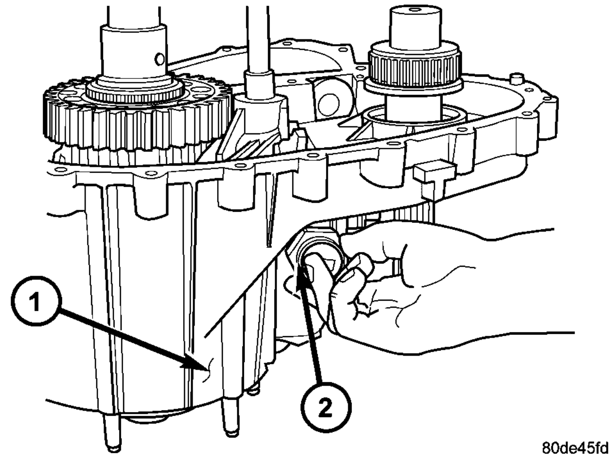


Fig. 17 Remove Position Sensor

1 - FRONT CASE
2 - POSITION SENSOR

(2) Loosen detent plug.

(3) Remove detent plug, spring, and plunger (Fig. 18). Note that the plug has an O-ring seal. Remove and discard this seal.

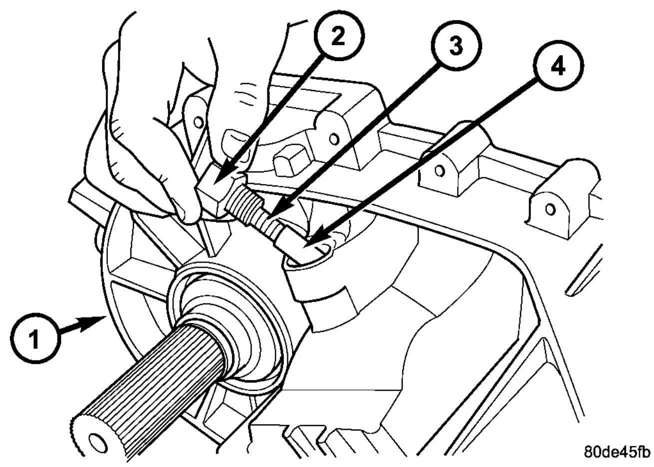


Fig. 18 Remove Detent Plug, Spring, and Plunger

1 - FRONT CASE
2 - DETENT PLUG
3 - DETENT SPRING
4 - DETENT PLUNGER

(4) Remove the front output shaft snap-ring (Fig. 19).

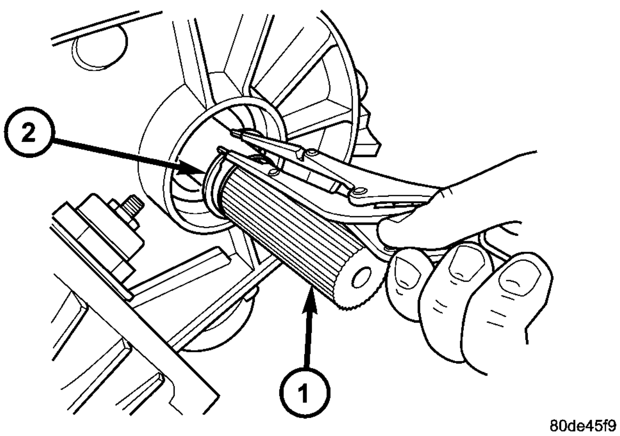


Fig. 19 Remove Front Output Shaft Snap-ring

1 - FRONT OUTPUT SHAFT
2 - SNAP-RING

(5) Remove front output shaft from bearing in case (Fig. 20).

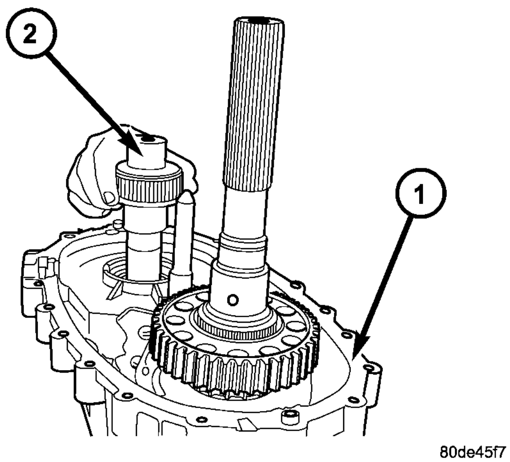


Fig. 20 Remove Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

(6) Pull mainshaft assembly out of input gear, mode sleeve, and case (Fig. 21).

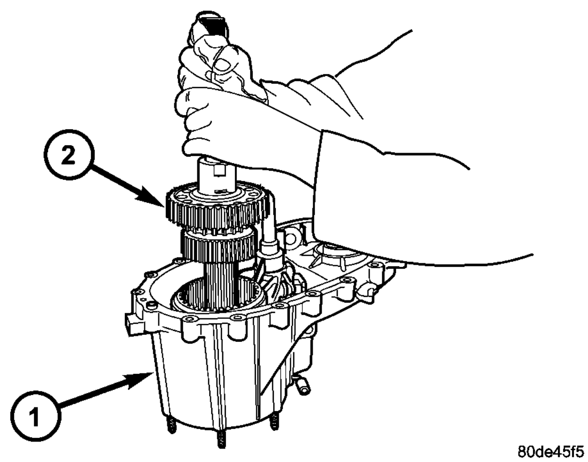


Fig. 21 Remove Mainshaft

1 - FRONT CASE
2 - MAINSHAFT

(7) Remove mode fork, mode sleeve, and shift rail as assembly (Fig. 22). Note which way the sleeve fits in the fork (long side of sleeve goes to front).

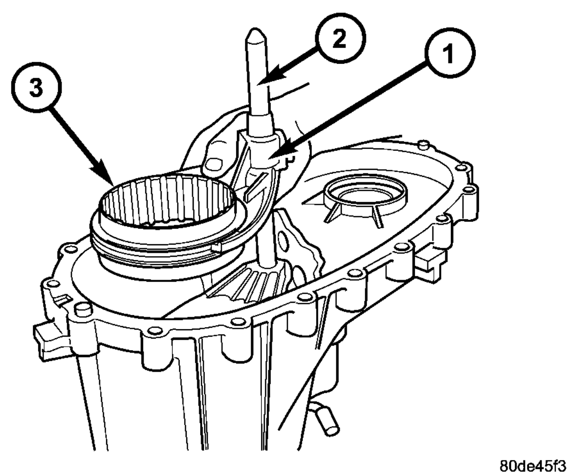


Fig. 22 Remove Mode Fork and Shift Rail

1 - MODE FORK
2 - SHIFT RAIL
3 - MODE SLEEVE

TRANSFER CASE - NV241 GENII (Continued)

(8) Remove range fork retaining ring.

(9) Remove range fork and hub as an assembly (Fig. 23). Note fork position for installation reference.

(10) Remove the shift sector support (Fig. 24).

(11) Remove shift sector (Fig. 25).

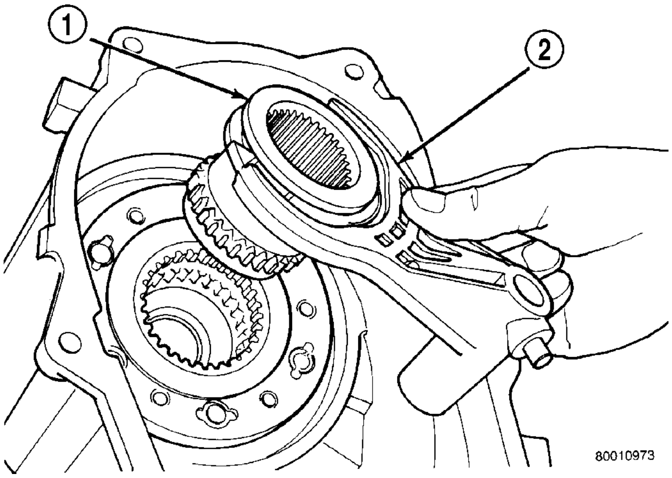


Fig. 23 Range Fork And Hub Removal

1 - RANGE HUB
2 - RANGE FORK

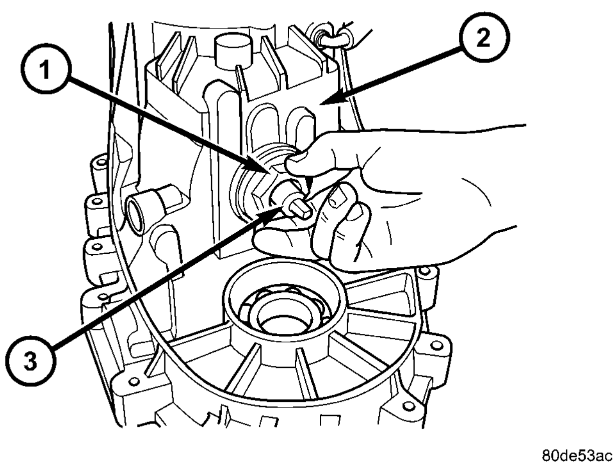


Fig. 24 Remove Sector Support

1 - SECTOR SUPPORT
2 - FRONT CASE
3 - SECTOR SHAFT

MAINSHAFT

(1) Remove the drive sprocket retaining ring (Fig. 26) from the output shaft.

(2) Remove the drive sprocket thrust washer (Fig. 27) from the output shaft.

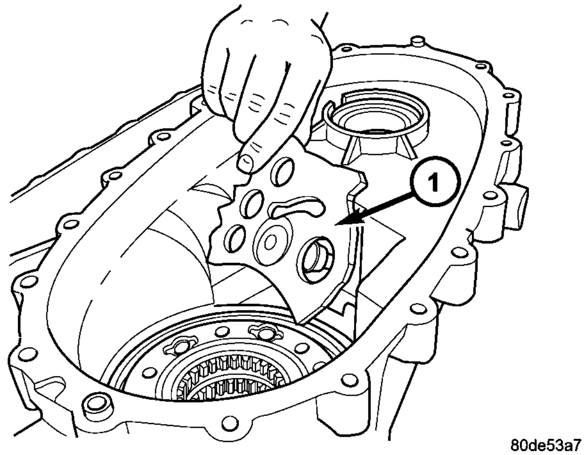


Fig. 25 Remove Shift Sector

1 - SHIFT SECTOR

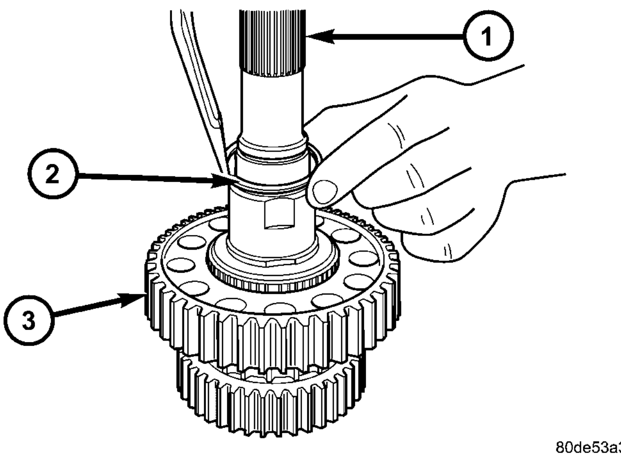


Fig. 26 Remove The Drive Sprocket Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - DRIVE SPROCKET

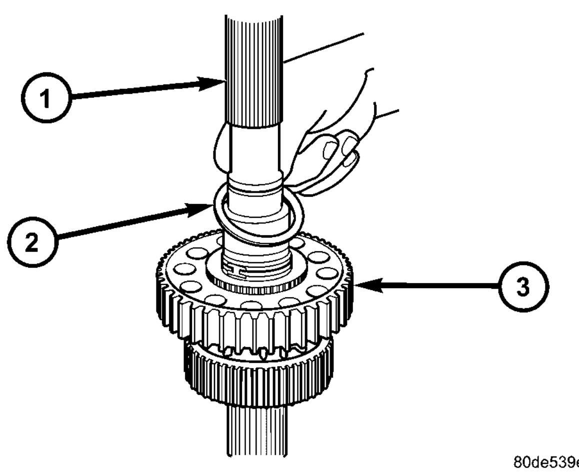


Fig. 27 Remove Drive Sprocket Thrust Washer

1 - OUTPUT SHAFT
2 - THRUST WASHER
3 - DRIVE SPROCKET

TRANSFER CASE - NV241 GENII (Continued)

(3) Remove drive sprocket (Fig. 28) from the output shaft.

(4) Remove the clutch gear (Fig. 29) and hub (Fig. 30) from the output shaft.

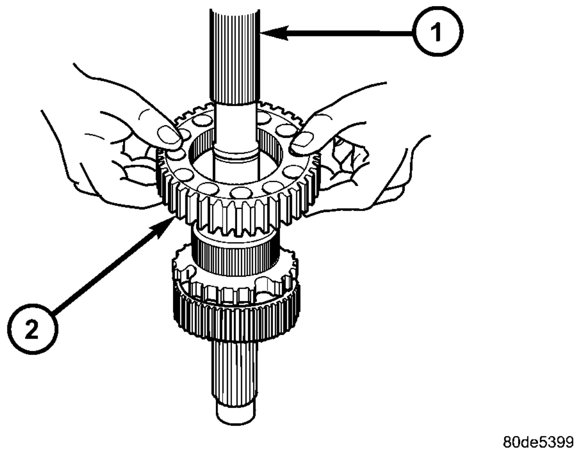


Fig. 28 Remove Drive Sprocket

1 - OUTPUT SHAFT
2 - DRIVE SPROCKET

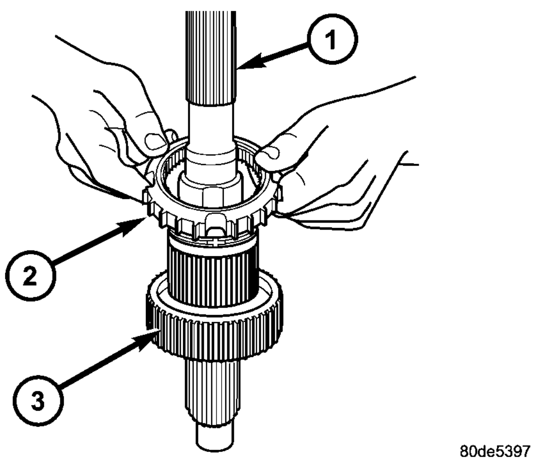


Fig. 29 Remove Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

(5) Remove the mode hub retaining ring (Fig. 31) from the output shaft.

(6) Remove the mode hub (Fig. 32) from the output shaft.

INPUT AND PLANETARY GEAR

(1) Remove input gear seal with suitable screw and slide hammer.

(2) Remove input gear retaining ring (Fig. 33) with heavy duty snap-ring pliers.

(3) Place front case in horizontal position. Then remove input gear and low range gear as an assem-

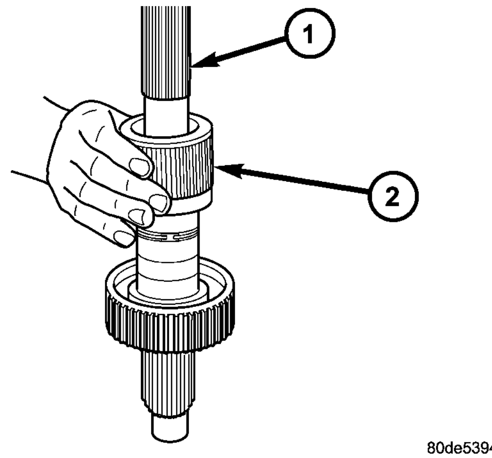


Fig. 30 Remove Sprocket Hub

1 - OUTPUT SHAFT
2 - SPROCKET HUB

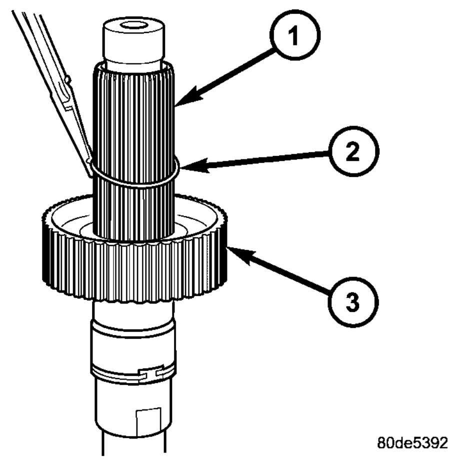


Fig. 31 Remove Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - MODE HUB

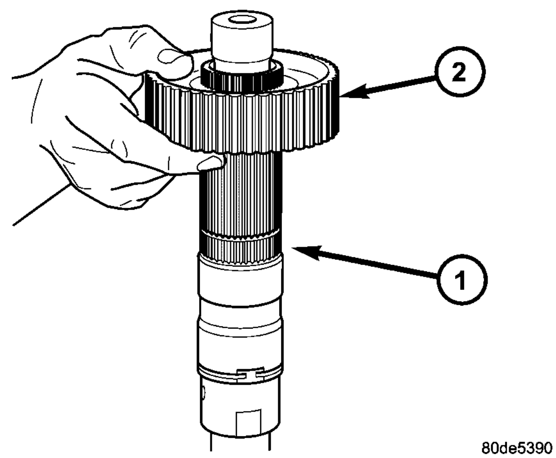


Fig. 32 Remove Mode Hub

1 - OUTPUT SHAFT
2 - MODE HUB

TRANSFER CASE - NV241 GENII (Continued)

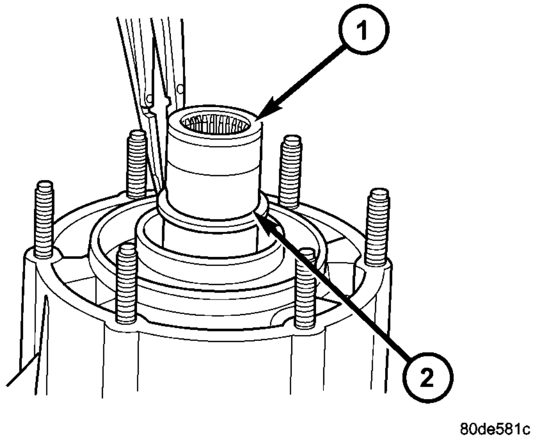


Fig. 33 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

bly (Fig. 34). Tap gear out of bearing with plastic mallet, if necessary.

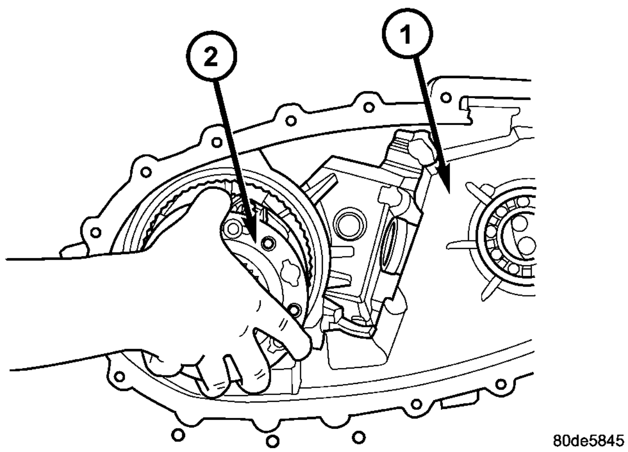


Fig. 34 Remove Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

INPUT AND PLANETARY GEAR

(1) Remove snap-ring that retains input gear in low range gear (Fig. 35).

(2) Remove retainer (Fig. 36).

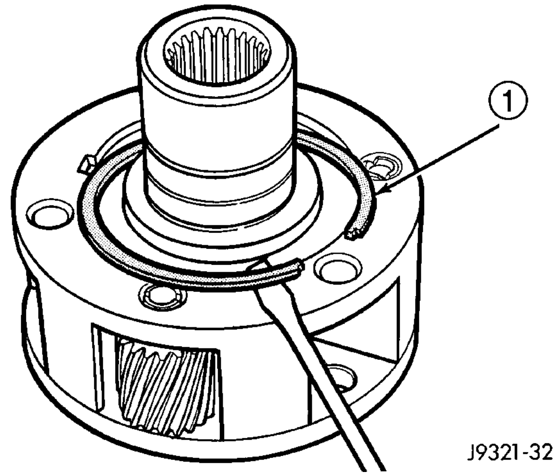


Fig. 35 Input Gear Snap-Ring Removal

1 - INPUT GEAR SNAP-RING

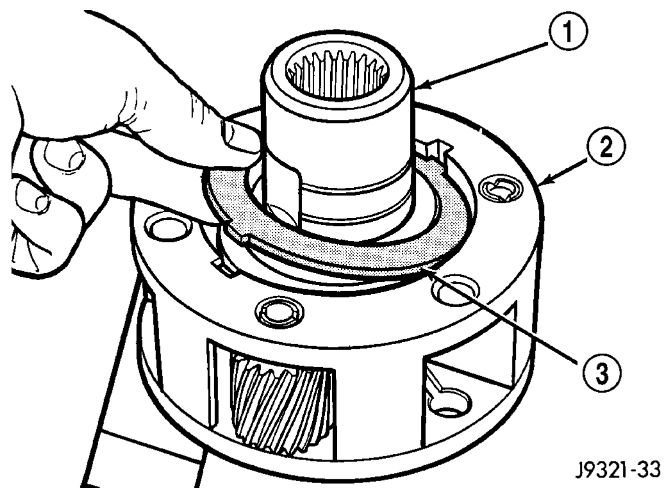


Fig. 36 Input Gear Retainer Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR
3 - RETAINER

TRANSFER CASE - NV241 GENII (Continued)

(3) Remove front tabbed thrust washer (Fig. 37).

(4) Remove input gear (Fig. 38).

(5) Remove rear tabbed thrust washer from low range gear (Fig. 39).

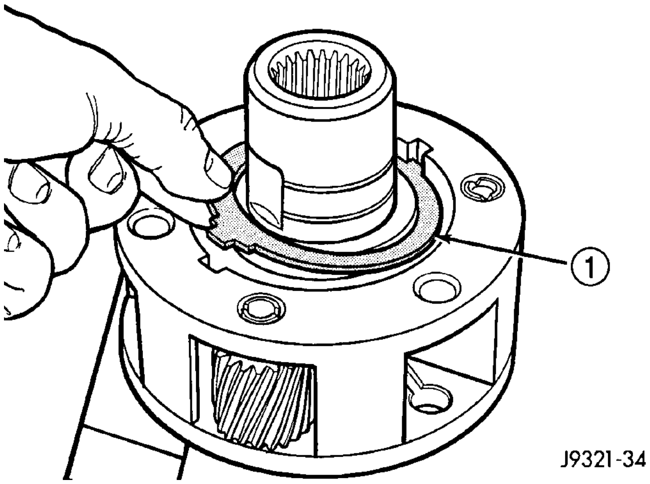


Fig. 37 Front Tabbed Thrust Washer Removal

1 - FRONT TABBED THRUST WASHER

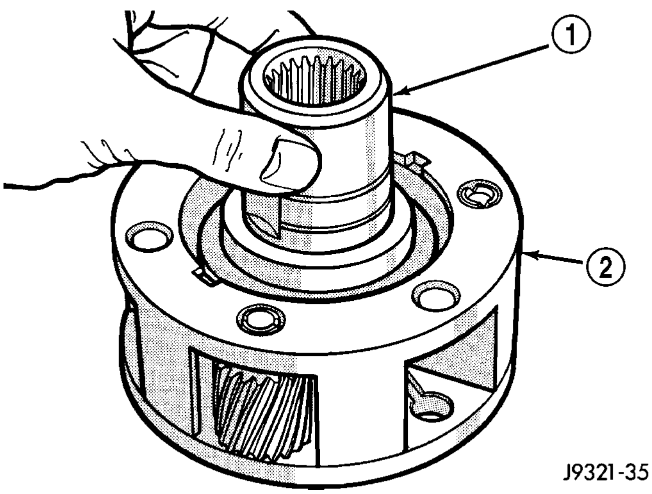


Fig. 38 Input Gear Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR

CLEANING

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M™ all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

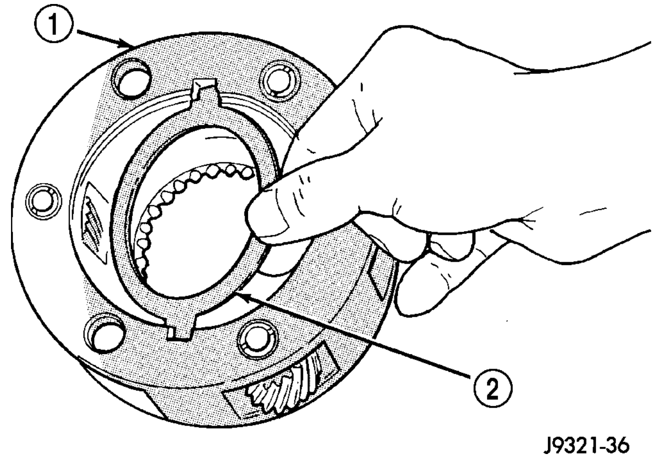


Fig. 39 Rear Tabbed Thrust Washer Removal

1 - LOW RANGE GEAR
2 - REAR TABBED THRUST WASHER

INSPECTION

MAINSHAFT/SPROCKET/HUB

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone, however, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320-400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 40). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 41). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

Inspect the shift fork wear pads (Fig. 42). The mode fork pads are serviceable and can be replaced if necessary. The range fork pads are not serviceable. The fork must be replaced as an assembly if the pads are worn or damaged.

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

TRANSFER CASE - NV241 GENII (Continued)

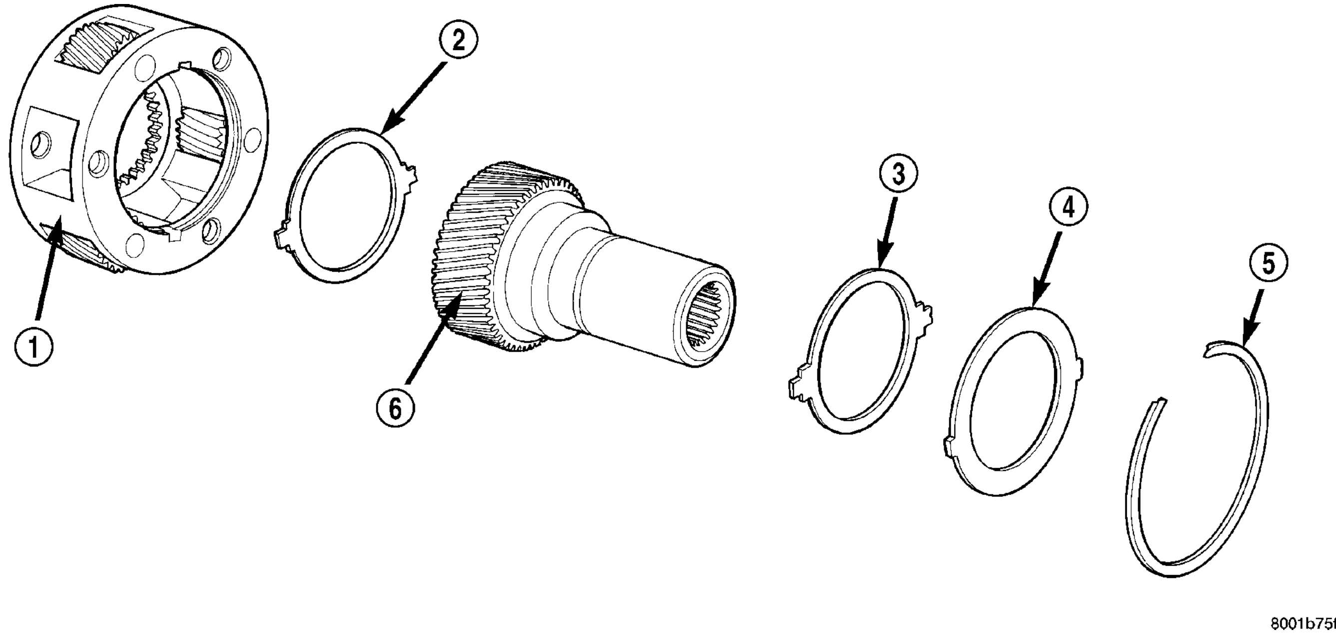


Fig. 40 Input Gear And Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

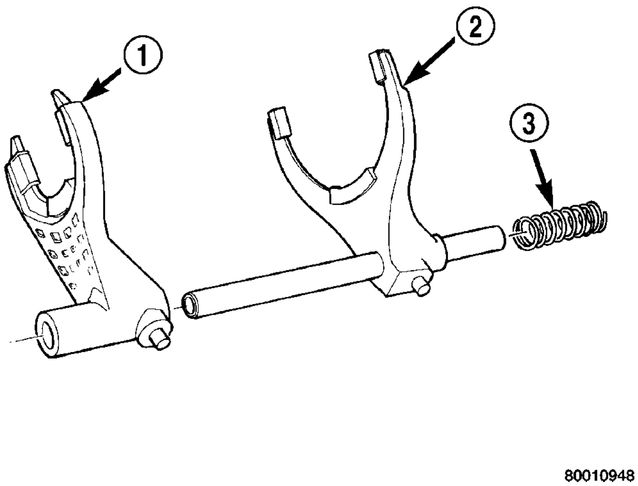


Fig. 41 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

REAR RETAINER COMPONENTS

Inspect the retainer components. Replace the bearing if rough or noisy. Check the retainer for cracks or wear in the bearing bore.

Inspect the retaining rings and washers. Replace any part if distorted, bent, or broken. Reuse is not recommended.

Inspect rear extension bushing. Replace if worn or scored.

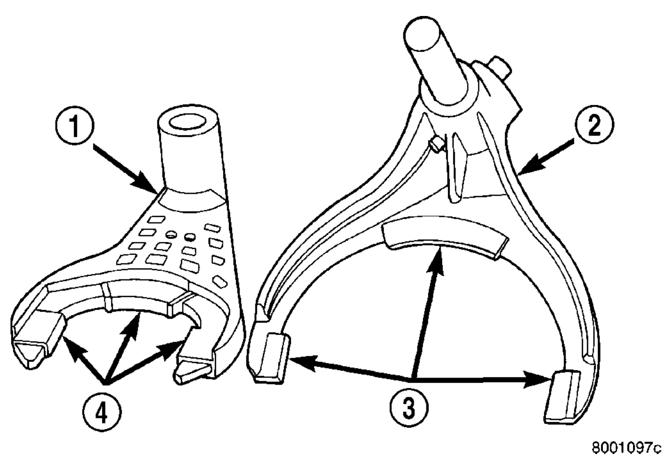


Fig. 42 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

DRIVE CHAIN

Examine the drive chain and shaft bearings. replace the chain if stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

TRANSFER CASE - NV241 GENII (Continued)

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 43)

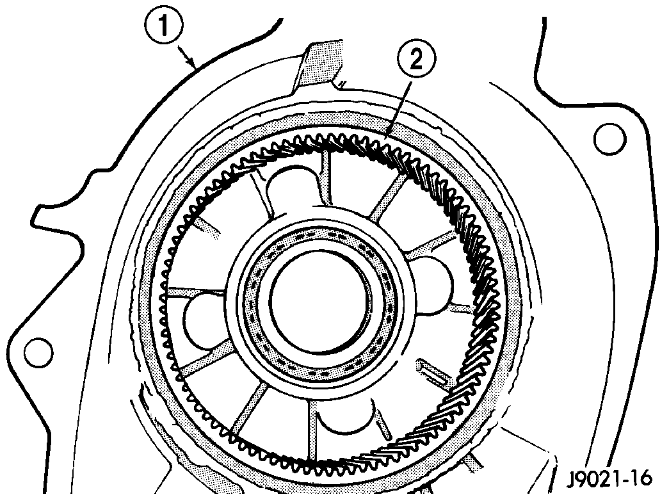


Fig. 43 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

FRONT CASE AND REAR CASE

Inspect the cases for wear and damage.

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite™ 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/ drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil™ stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ASSEMBLY

BEARINGS AND SEALS

(1) Remove the input shaft bearing (Fig. 44) from the front case with suitable snap-ring pliers.

(2) Transfer the retaining ring to the new bearing if necessary and install the bearing into the front case.

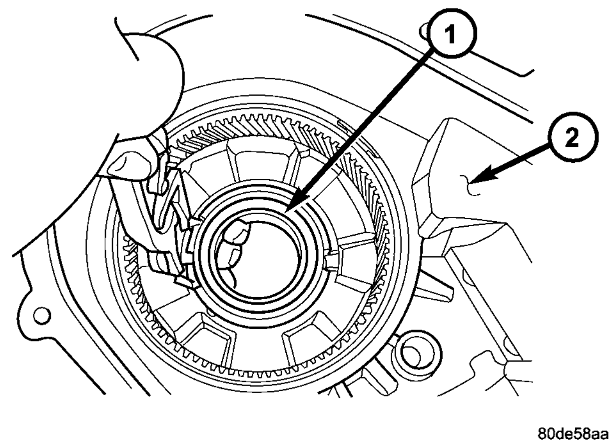


Fig. 44 Remove Input Gear Bearing

1 - INPUT GEAR BEARING
2 - FRONT CASE

(3) Using Installer 6436 and Handle C-4171 (Fig. 45), remove front output shaft bearing.

(4) Start front output shaft bearing in case. Then seat bearing with Handle C-4171 and Installer 6953.

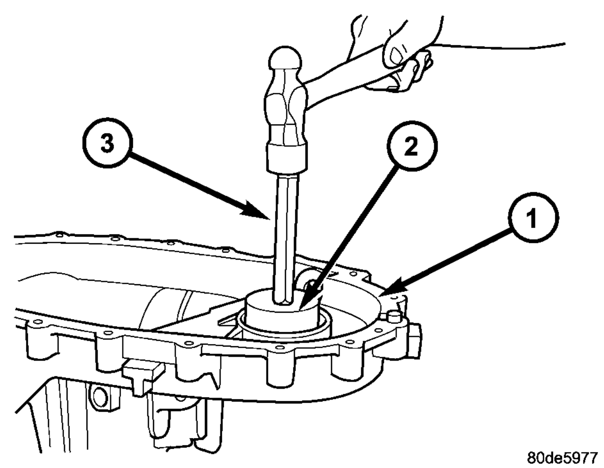


Fig. 45 Remove Front Output Shaft Bearing

1 - FRONT CASE
2 - INSTALLER 6436
3 - HANDLE C-4171

TRANSFER CASE - NV241 GENII (Continued)

(5) Install front output shaft bearing retaining ring.

(6) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 46).

(7) Install new pilot bearing with Remover/Installer 8684.

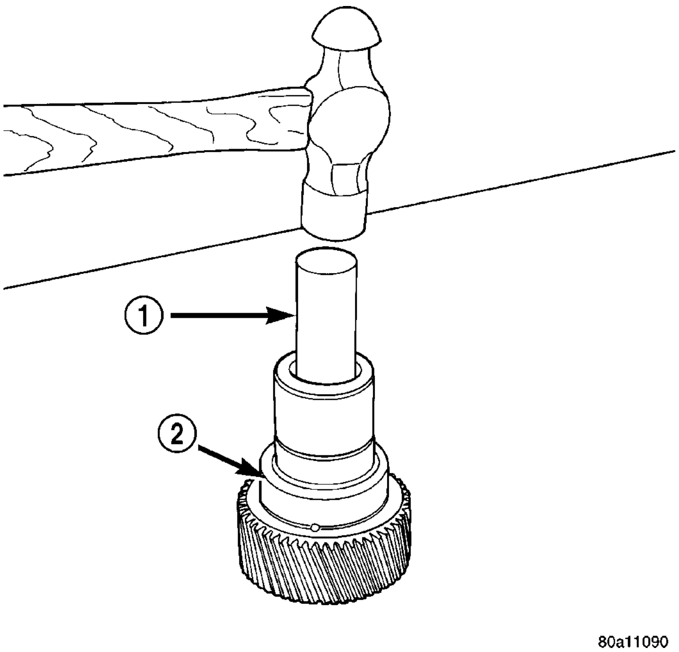


Fig. 46 Remove Input Gear Cup Plug

1 - DRIFT
2 - INPUT GEAR

(8) Remove the front output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 47).

(9) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 48). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 49).

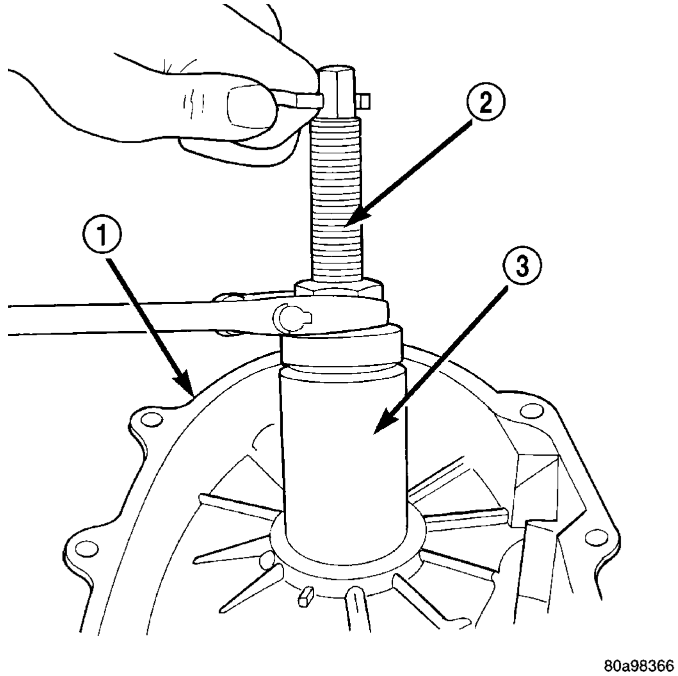


Fig. 47 Front Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

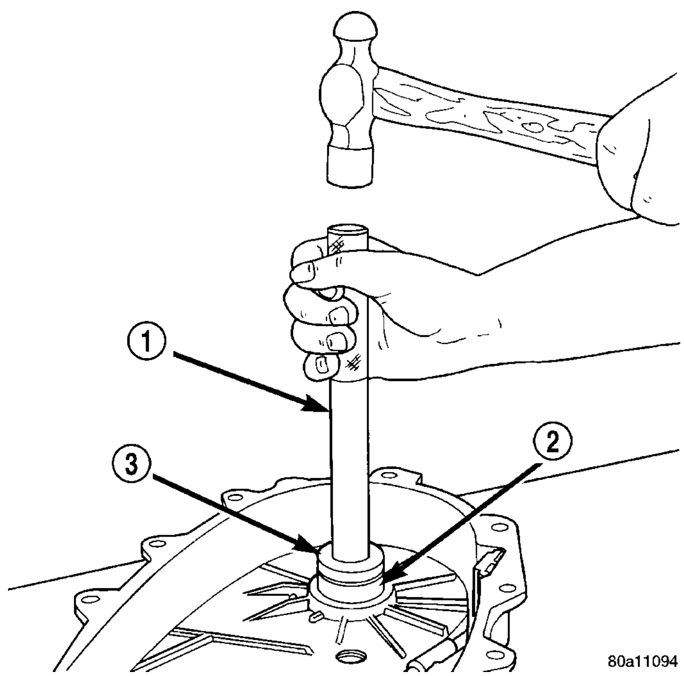


Fig. 48 Output Shaft Rear Bearing Installation

1 - HANDLE C-4171
2 - OUTPUT SHAFT INNER BEARING
3 - INSTALLER 5066

TRANSFER CASE - NV241 GENII (Continued)

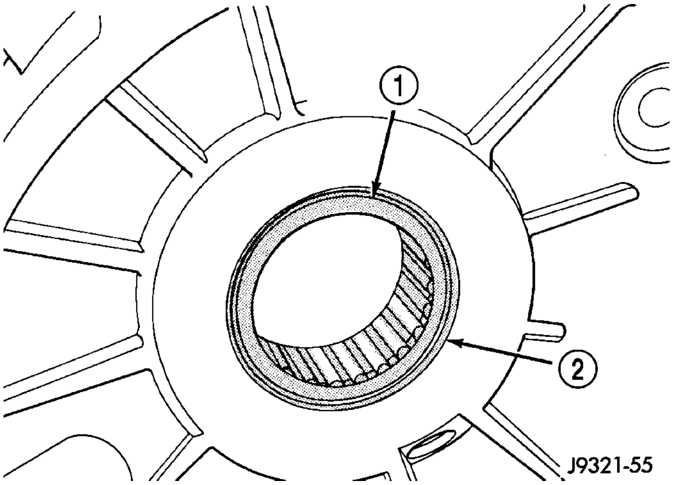


Fig. 49 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

(10) Remove the rear output shaft bearing from the rear case using Remover/Installer 8684 and Handle C-4171 (Fig. 50).

(11) Install the rear output shaft bearing (Fig. 51) into the rear case using Remover/Installer 6953 and Handle C-4171.

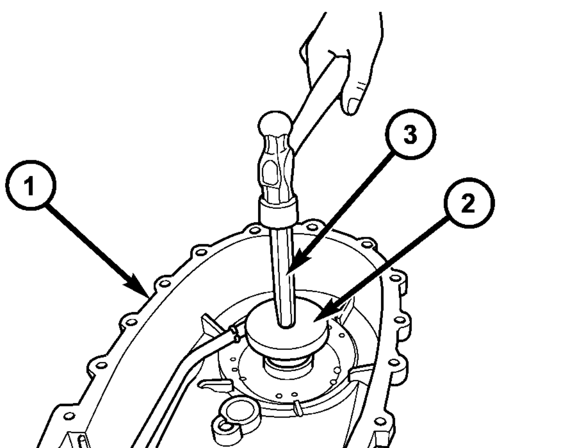


Fig. 50 Remove Rear Output Shaft Bearing

1 - REAR CASE
2 - REMOVER/INSTALLER 8684
3 - HANDLE C-4171

INPUT AND PLANETARY GEAR

(1) Lubricate gears and thrust washers (Fig. 52) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 52). Be sure washer tabs are properly aligned in gear notches.

(3) Install input gear in low range gear. Be sure input gear is fully seated.

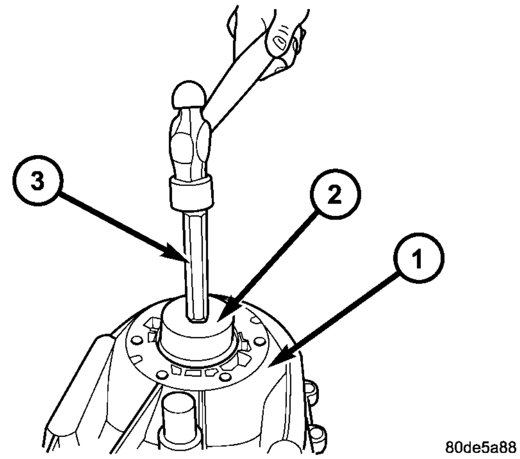


Fig. 51 Install Rear Output Shaft Bearing

1 - REAR CASE
2 - REMOVER/INSTALLER 6953
3 - HANDLE C-4171

(4) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap-ring.

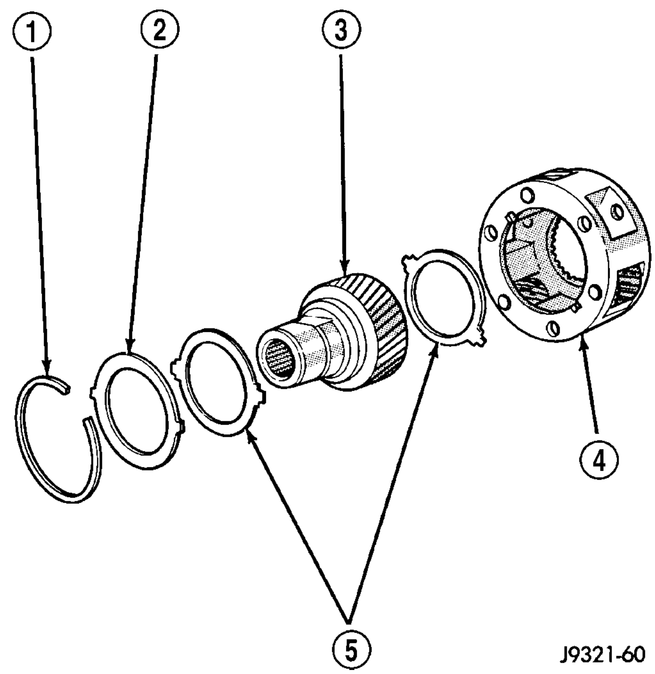


Fig. 52 Input/Low Range Gear Components

1 - SNAP-RING
2 - RETAINER PLATE
3 - INPUT GEAR
4 - LOW RANGE GEAR
5 - THRUST WASHERS

TRANSFER CASE - NV241 GENII (Continued)

(6) Align and install low range/input gear assembly in front case (Fig. 53). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(7) Install snap-ring to hold input/low range gear into front bearing (Fig. 54).

(8) Install a new input gear seal using Installer 8841 and Handle C-4171.

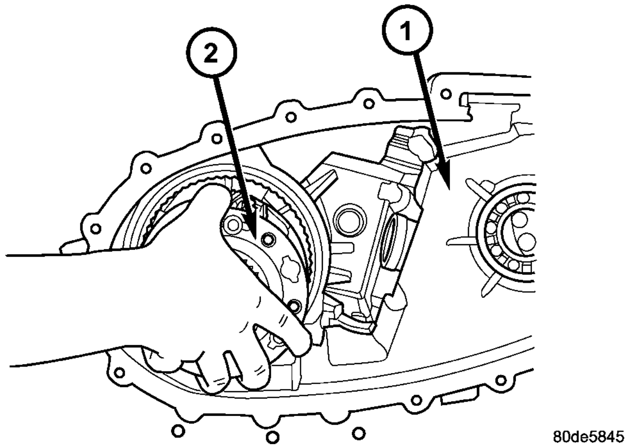


Fig. 53 Install Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

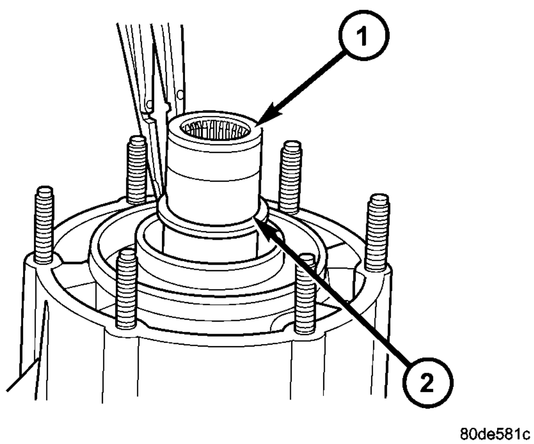


Fig. 54 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

SHIFT FORKS AND MAINSHAFT

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Install the mode hub (Fig. 55) onto the output shaft.

(3) Install the mode hub retaining ring (Fig. 56) onto the output shaft.

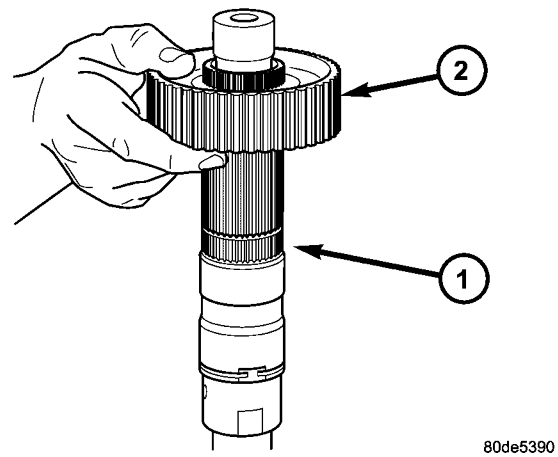


Fig. 55 Install Mode Hub

1 - OUTPUT SHAFT
2 - MODE HUB

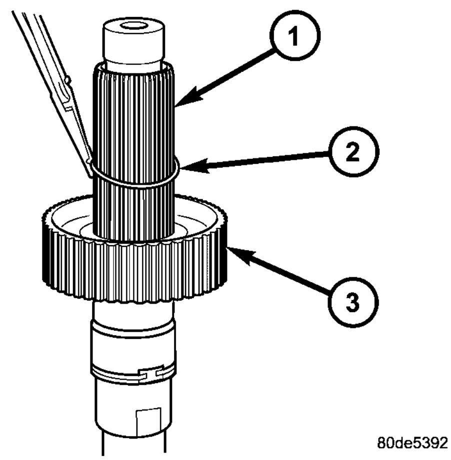


Fig. 56 Install Mode Hub Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - MODE HUB

(4) Install the sprocket hub (Fig. 57) onto the output shaft.

(5) Install the clutch gear (Fig. 58) onto the output shaft.

(6) Install the drive sprocket (Fig. 59) onto the output shaft.

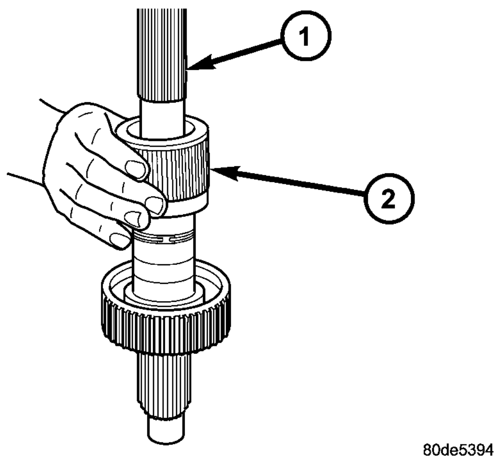


Fig. 57 Install Sprocket Hub

1 - OUTPUT SHAFT
2 - SPROCKET HUB

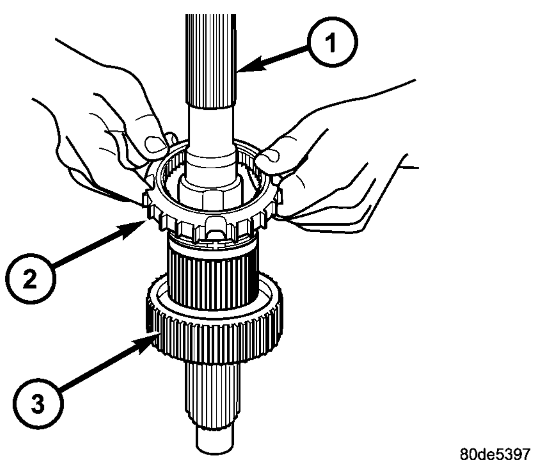


Fig. 58 Install Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

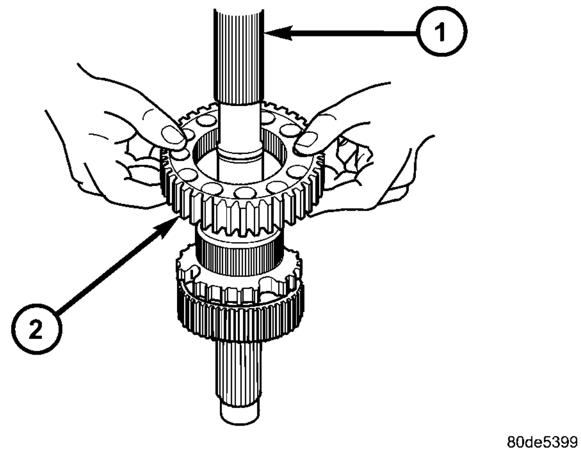


Fig. 59 Install Drive Sprocket

1 - OUTPUT SHAFT
2 - DRIVE SPROCKET

(7) Install the drive sprocket thrust washer (Fig. 60) onto the output shaft.

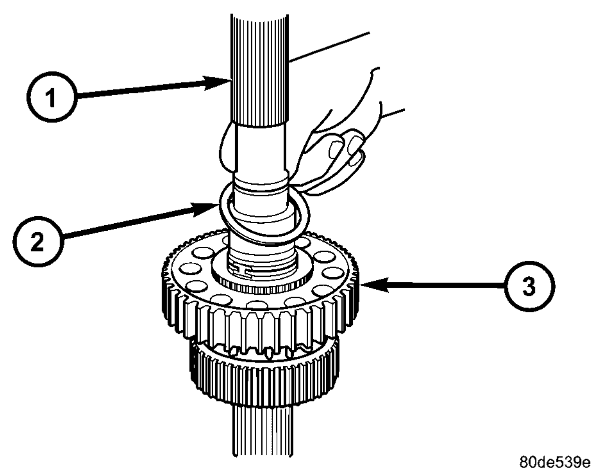


Fig. 60 Install Drive Sprocket Thrust Washer

1 - OUTPUT SHAFT
2 - THRUST WASHER
3 - DRIVE SPROCKET

TRANSFER CASE - NV241 GENII (Continued)

(8) Install the drive sprocket retaining ring (Fig. 61) onto the output shaft.

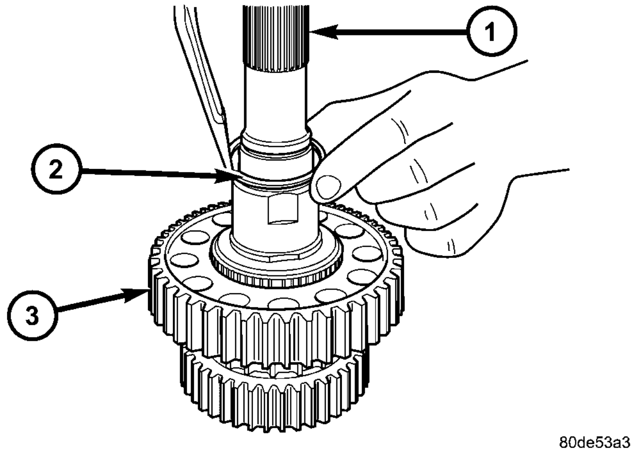


Fig. 61 Install The Drive Sprocket Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - DRIVE SPROCKET

(9) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 62). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

(10) Install the shift sector support (Fig. 63). Tighten the sector support to 27-42 N·m (20-30 ft.lbs.).

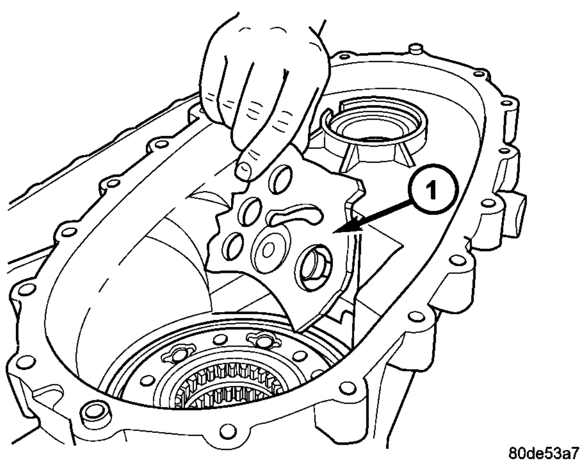


Fig. 62 Install Shift Sector

1 - SHIFT SECTOR

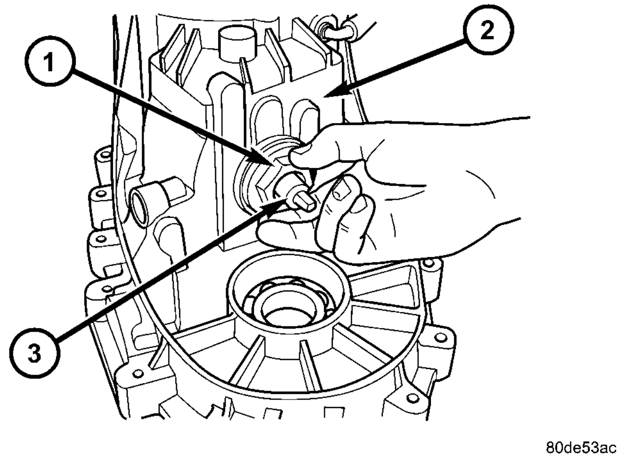


Fig. 63 Install Sector Support

1 - SECTOR SUPPORT
2 - FRONT CASE
3 - SECTOR SHAFT

(11) Assemble and install range fork and hub (Fig. 64). Be sure hub is properly seated in low range gear and engaged to the input gear.

(12) Align and insert range fork pin in shift sector slot.

(13) Install the range fork retaining ring.

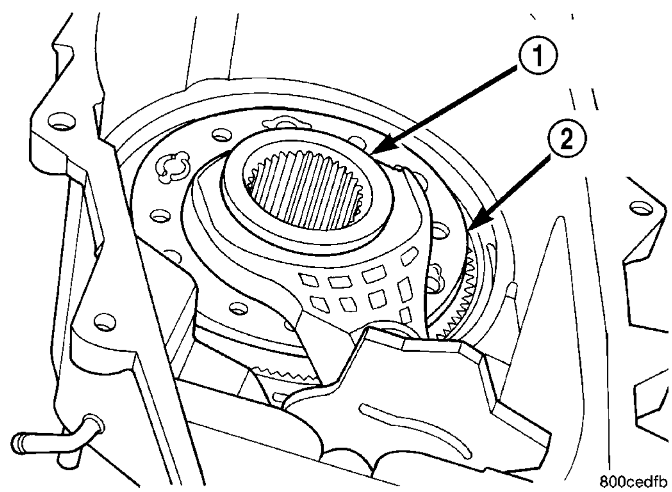


Fig. 64 Install Range Fork And Hub Assembly

1 - RANGE HUB
2 - RANGE FORK

TRANSFER CASE - NV241 GENII (Continued)

(14) Install mode fork and shift rail onto the mode sleeve.

(15) Install the mode fork, sleeve, and shift rail into the transfer case (Fig. 65).

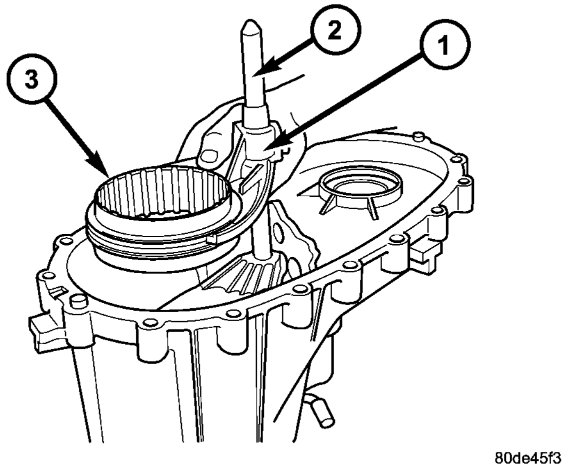


Fig. 65 Install Mode Fork and Shift Rail

1 - MODE FORK
2 - SHIFT RAIL
3 - MODE SLEEVE

(16) Install mainshaft into the transfer case (Fig. 66). Guide mainshaft through the mode and range sleeves and into the input gear.

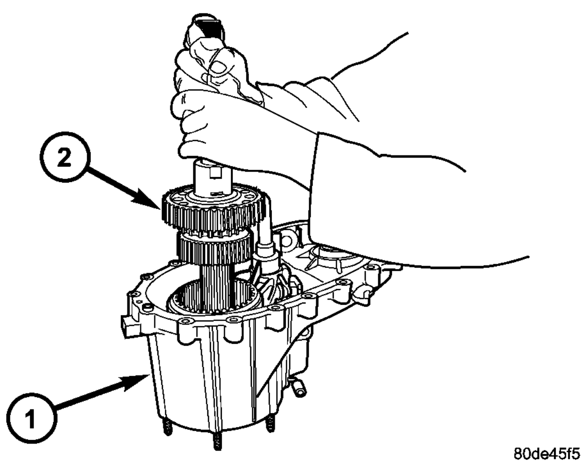


Fig. 66 Install Mainshaft

1 - FRONT CASE
2 - MAINSHAFT

(17) Install the transfer case position sensor (Fig. 67). Tighten the sensor to 20-34 N·m (16-25 ft. lbs.) torque.

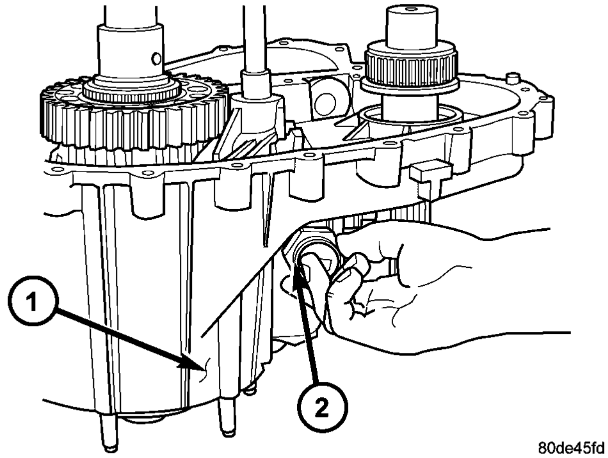


Fig. 67 Install Position Sensor

1 - FRONT CASE
2 - POSITION SENSOR

(18) Install range lever on sector shaft (Fig. 68).

(19) Install washer and nut on sector shaft to secure shift lever. Apply 1-2 drops Mopar® Lock N' Seal, or equivalent, to nut threads before installation. Then tighten nut to 27-34 N·m (20-25 ft. lbs.) torque.

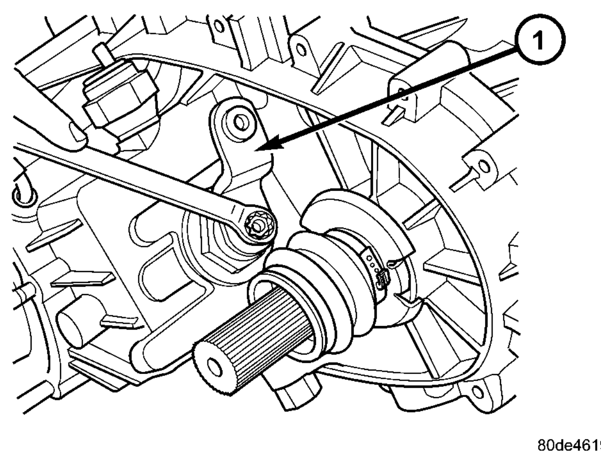


Fig. 68 Install Range Lever Nut

1 - RANGE LEVER

TRANSFER CASE - NV241 GENII (Continued)

(20) Install new o-ring on detent plug (Fig. 69).

(21) Install detent plunger, spring, and plug (Fig. 70). Tighten the plug to 16-25 N·m (12-18 ft. lbs.).

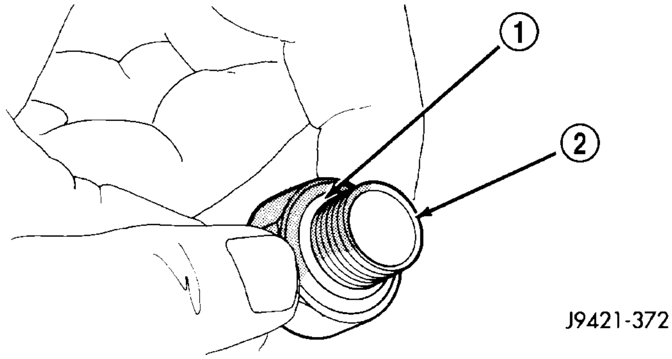


Fig. 69 O-Ring Installation On Detent Plug

1 - O-RING
2 - DETENT PLUG

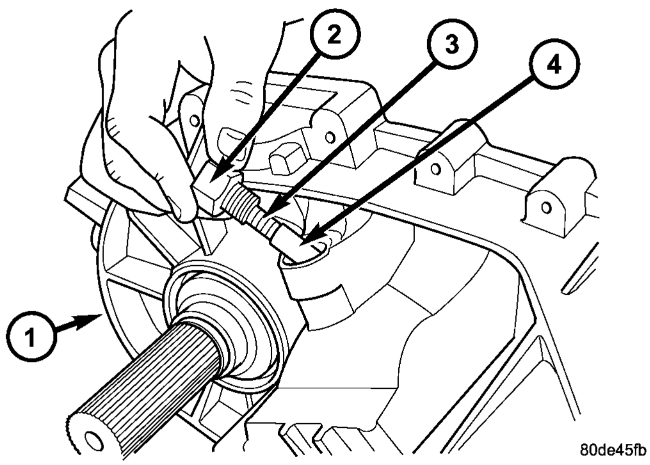


Fig. 70 Install Detent Plug, Spring, and Plunger

1 - FRONT CASE
2 - DETENT PLUG
3 - DETENT SPRING
4 - DETENT PLUNGER

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Install the front output shaft (Fig. 71) into the front output shaft bearing.

(2) Install the front output shaft retaining ring (Fig. 72) onto the output shaft.

(3) Install the new front output shaft seal with Installer MB991168A

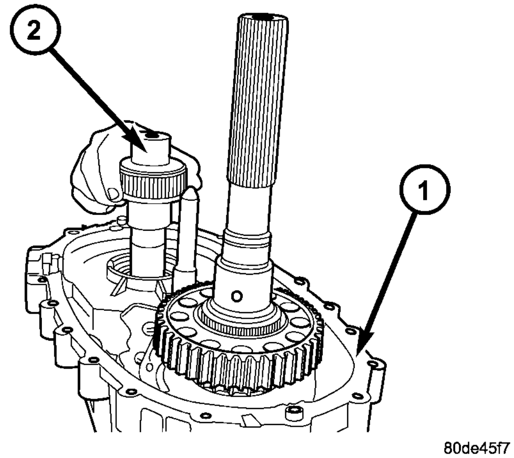


Fig. 71 Install Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

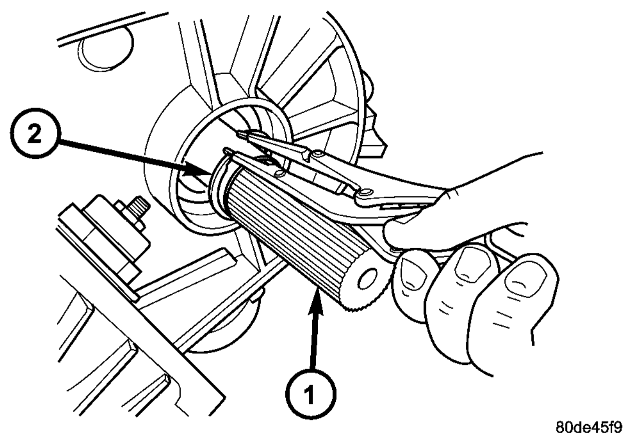


Fig. 72 Install Front Output Shaft Snap-ring

1 - FRONT OUTPUT SHAFT
2 - SNAP-RING

TRANSFER CASE - NV241 GENII (Continued)

(4) Insert front sprocket in drive chain.

(5) Install drive chain around mainshaft sprocket (Fig. 73). Then position front sprocket over front shaft.

(6) Raise mainshaft about 2.54 cm (one inch) and seat front sprocket on front output shaft.

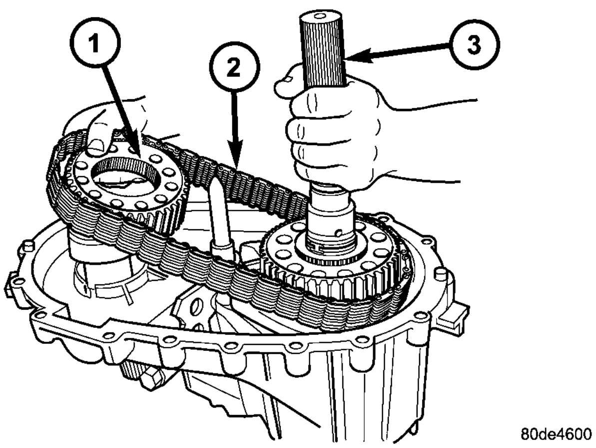


Fig. 73 Install Front Sprocket and Drive Chain

1 - FRONT DRIVE SPROCKET
2 - DRIVE CHAIN
3 - MAINSHAFT

(7) If mainshaft and mode sleeve were unseated during chain installation, align and reseat mainshaft in input gear and hub.

(8) Install front sprocket retaining ring (Fig. 74).

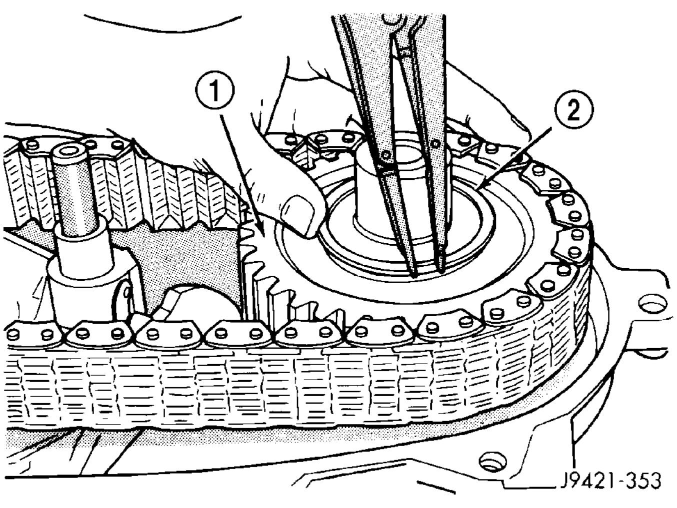


Fig. 74 Front Sprocket Retaining Ring Installation

1 - FRONT SPROCKET
2 - RETAINING RING

(9) Install spring and cup on shift rail (Fig. 75).

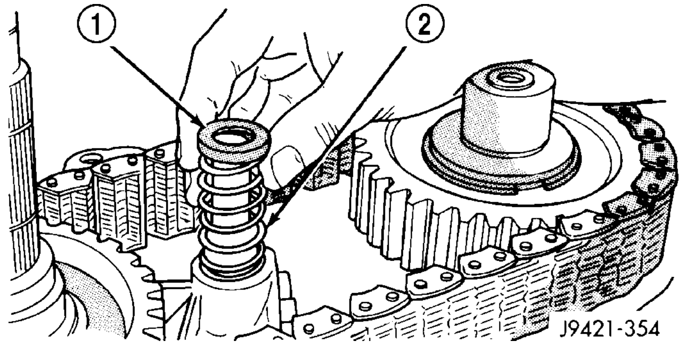


Fig. 75 Shift Rail Spring And Cup Installation

1 - CUP
2 - SPRING

(10) Insert magnet in front case pocket (Fig. 76).

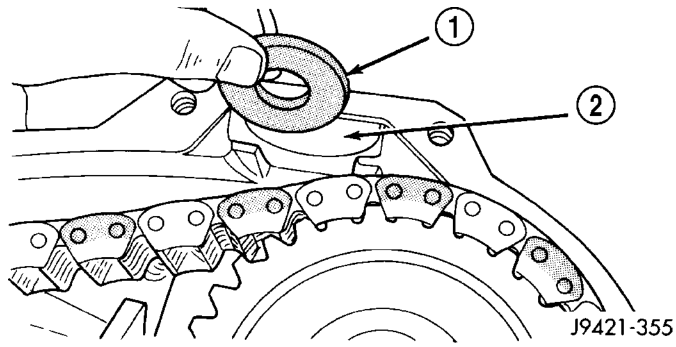


Fig. 76 Case Magnet Installation

1 - MAGNET
2 - CASE POCKET

OIL PUMP AND REAR CASE

CAUTION: Do not remove the bolts holding the oil pump cover to the rear case half. The oil pump cover is aligned to the rear output shaft inner bearing race and will become mis-aligned if the bolts are loosened. If the transfer case failure has generated any debris which may have become trapped in the oil pump. the rear case and oil pump assembly MUST be replaced.

(1) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

TRANSFER CASE - NV241 GENII (Continued)

(2) Align oil pump with mainshaft and align shift rail with bore in rear case. Then install rear case and oil pump assembly (Fig. 77).

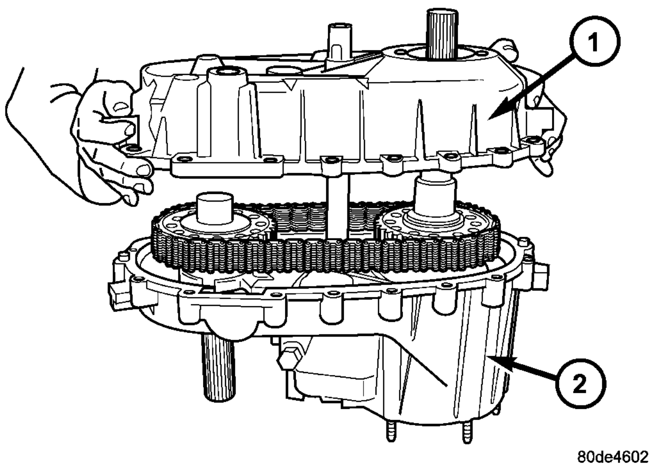


Fig. 77 Install Rear Case

1 - REAR CASE
2 - FRONT CASE

(3) Install 4-5 rear case-to front case bolts (Fig. 78) to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail, and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are misaligned.

(4) Apply Loctite™ 242 to remainder of rear case-to-front case bolt threads and install bolts. Tighten bolts to 20-27 N·m (15-24 ft. lbs.),

(5) Install rear output bearing snap-ring (Fig. 79) to output shaft.

SEAL BOOT

(1) Install the front output shaft seal slinger with Installer 8840. Install the slinger onto the shaft until the tool contacts the rear of the output shaft.

(2) Install a new seal boot clamp onto the seal boot.

(3) Install the seal boot and clamp onto the slinger hub and tighten the clamp with Crimp Tool C-4975-A.

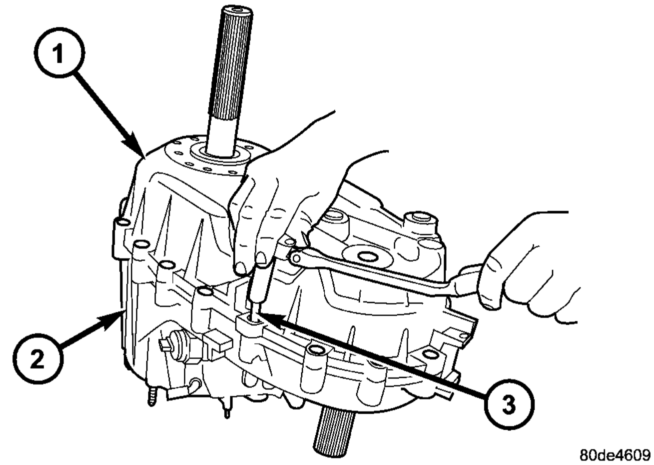


Fig. 78 Install Case Bolts

1 - REAR CASE
2 - FRONT CASE
3 - BOLT

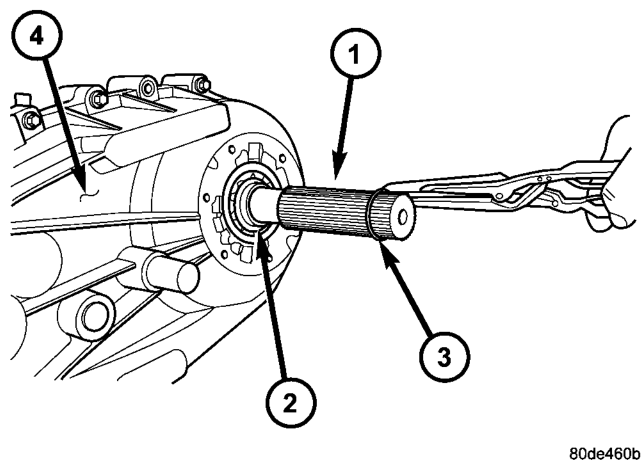


Fig. 79 Install Output Shaft Retaining Ring

1 - REAR OUTPUT SHAFT
2 - OUTPUT SHAFT BEARING
3 - RETAINING RING
4 - TRANSFER CASE

TRANSFER CASE - NV241 GENII (Continued)

REAR EXTENSION

(1) Install new seal in rear extension housing seal with Installer D-163 and Handle C-4171..

(2) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of rear extension housing. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into output bearing.

(3) Align and install rear extension on retainer (Fig. 80).

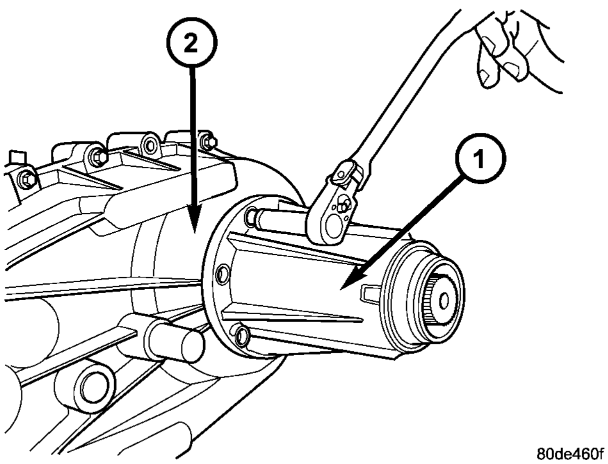


Fig. 80 Install Rear Extension Bolts

1 - EXTENSION HOUSING
2 - TRANSFER CASE

(4) Apply Mopar® Silicone Sealer to threads of rear extension housing bolts. Then install and tighten bolts to 16-24 N·m (12-18 ft. lbs.) torque.

INSTALLATION

(1) Align and seat transfer case on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary. Do not install any transfer case attaching nuts until the transfer case is completely seated against the transmission.

(2) Install and tighten transfer case attaching nuts. Tighten nuts to 30-41 N·m (20-30 ft.lbs.).

(3) Remove jack stand from under transmission.

(4) Align and connect propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(5) Connect vent hose and transfer case position sensor connector.

(6) Connect shift rod to transfer case lever or floor shift arm. Use channel lock style pliers to press rod back into lever grommet.

(7) Adjust shift linkage, if necessary.

(8) Fill transfer case with recommended transmission fluid and install fill plug.

(9) Install skid plate, if equipped. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)

(10) Lower vehicle

SPECIFICATIONS

TRANSFER CASE - NV241 GENII

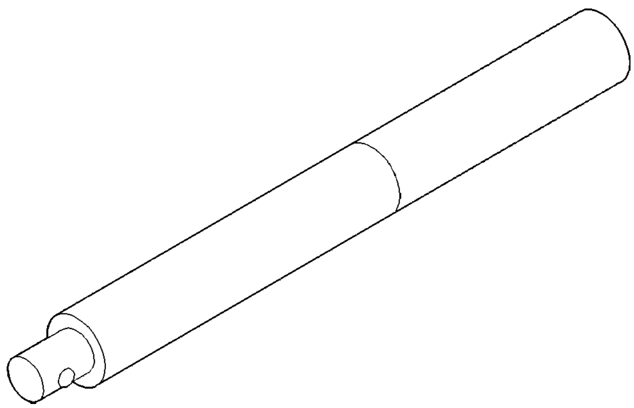
TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	40-45	30-40	-
Bolt, Extension Housing	16-24	12-18	-
Bolt, Case Half	20-27	15-24	-
Screw, Oil Pump	12-16	8-12	-
Nut, Range Lever	27-34	20-25	-
Sector Support	27-42	20-30	-
Nuts, Mounting	30-41	20-30	-
Position Sensor	20-34	16-25	-

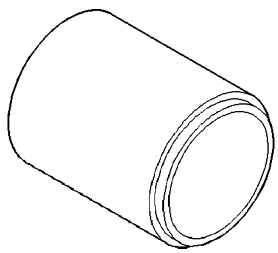
TRANSFER CASE - NV241 GENII (Continued)

SPECIAL TOOLS

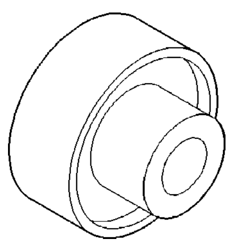
TRANSFER CASE - NV241/NV243



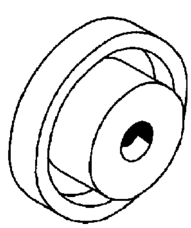
Handle, Universal - C-4171



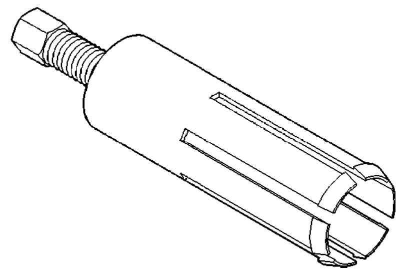
Installer, Seal - 6888



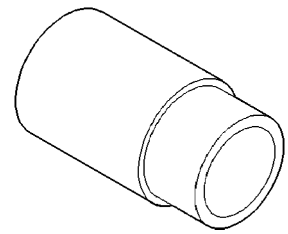
Installer, Bearing - 6953



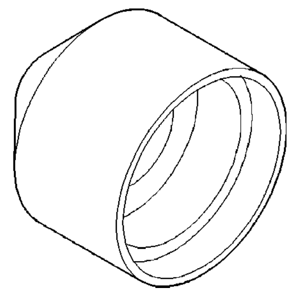
Installer, Seal - C-4210



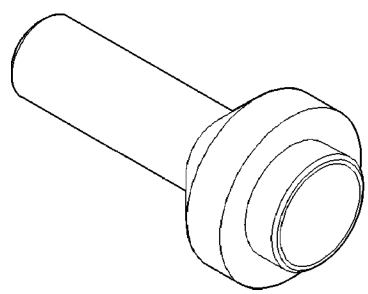
Remover, Bushing - 6957



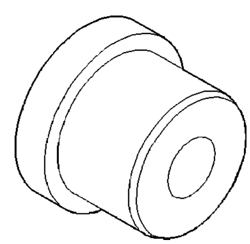
Installer, Bushing - 8157



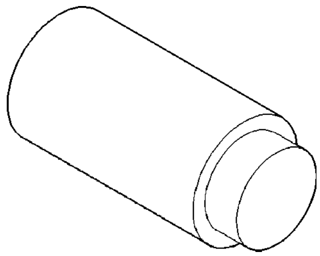
Installer, Seal - D-163



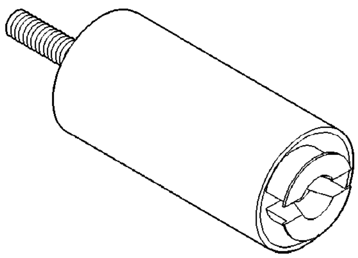
Installer, Seal - 7884



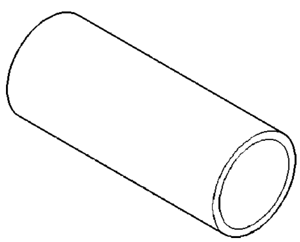
Installer, Bushing - 5066



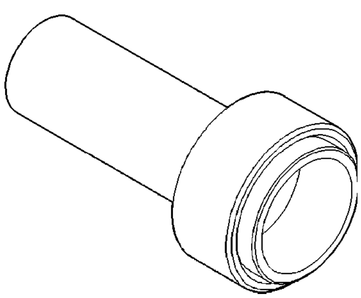
Plug, Extension - C-293-3



Remover - L-4454



Cup - 8148



Installer, Pump Housing Seal - 7888

EXTENSION HOUSING BUSHING AND SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the extension housing seal.

(4) Using Remover 8158, remove bushing from extension housing.

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in extension housing with fluid port in bushing aligned with slot in housing.

(3) Using Installer 8157, drive bushing into housing until installer seats against case.

(4) Using Installer D-163, install seal in extension housing (Fig. 81).

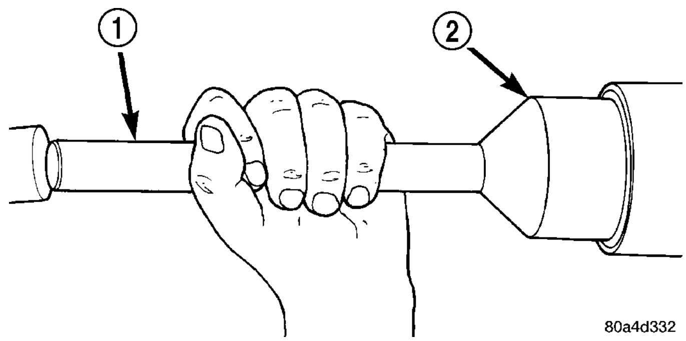


Fig. 81 Install Rear Seal in Extension Housing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL D-163

(5) Install propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(6) Verify proper transfer case fluid level.

(7) Lower vehicle.

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 82).

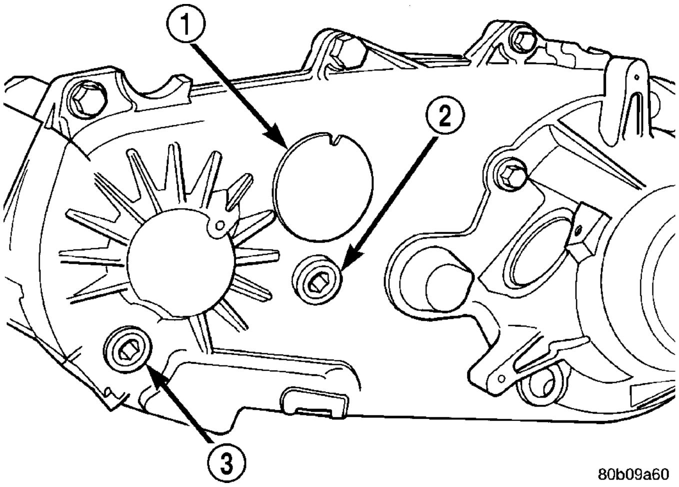


Fig. 82 Fill/Drain Plug and I.D. Tag Location - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

(1) Raise vehicle.

(2) Position drain pan under transfer case.

(3) Remove drain and fill plugs and drain lubricant completely.

(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).

(5) Remove drain pan.

(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, Automatic Transmission fluid.

(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).

(8) Lower vehicle.

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Remove the front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL).

(2) Remove the front propeller shaft seal boot retaining clamp (Fig. 83).

(3) Remove the front propeller shaft seal boot (Fig. 84).

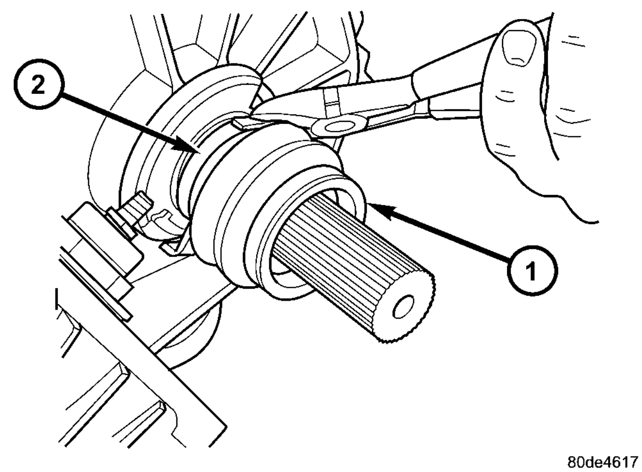


Fig. 83 Remove Boot Clamp

1 - SEAL BOOT
2 - BOOT CLAMP

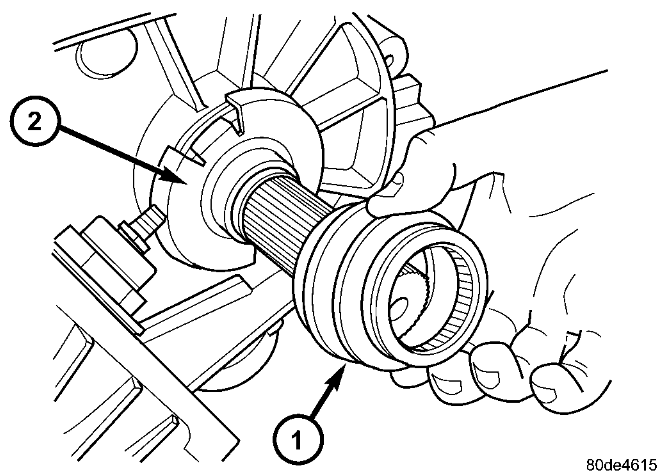


Fig. 84 Remove Seal Boot

1 - SEAL BOOT
2 - SEAL SLINGER

FRONT OUTPUT SHAFT SEAL (Continued)

(4) Remove the front output shaft seal slinger by bending (Fig. 85) the slinger ears away from the transfer case.

(5) Using a suitable pry tool (Fig. 86), remove the slinger from the output shaft using care not to damage the shaft.

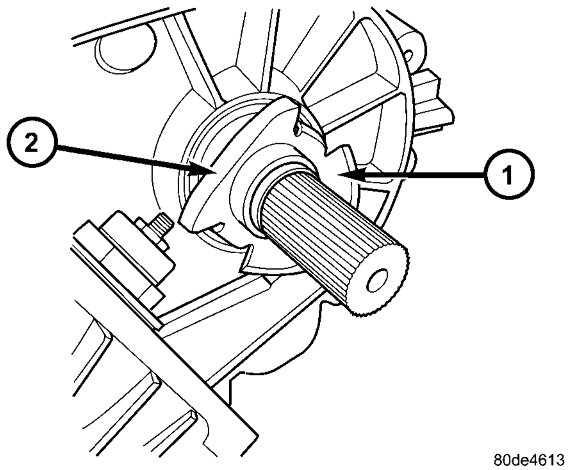


Fig. 85 Bend Slinger Ears

1 - SLINGER
2 - BEND UPWARD

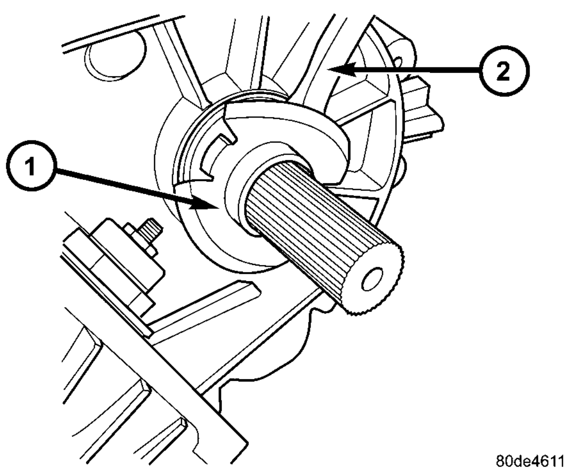


Fig. 86 Remove Slinger From Shaft

1 - SLINGER
2 - PRY TOOL

(6) Using a screw and a slide hammer, remove the front output shaft seal.

INSTALLATION

(1) Install the new front output shaft seal with Installer MB991168A

(2) Install the front output shaft seal slinger with Installer 8840. Install the slinger onto the shaft until the tool contacts the rear of the output shaft.

(3) Install a new seal boot clamp onto the seal boot.

(4) Install the seal boot and clamp onto the slinger hub and tighten the clamp with Crimp Tool C-4975-A.

(5) Install front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).

POSITION SENSOR

DESCRIPTION

The transfer case position sensor is an electronic device whose output can be interpreted to indicate the transfer case's current operating mode. The sensor consists of a five position, resistive multiplexed circuit which returns a specific resistance value to the Powertrain Control Module (PCM) for each transfer case operating mode. The sensor is located on the top of the transfer case, just left of the transfer case centerline and rides against the sector plate roostercomb. The PCM supplies 5VDC (+/- 0.5V) to the sensor and monitors the return voltage to determine the sector plate, and therefore the transfer case, position.

POSITION SENSOR (Continued)

OPERATION

During normal vehicle operation, the Powertrain Control Module (PCM) monitors the transfer case position sensor return voltage to determine the operating mode of the transfer case. Refer to the Operating Mode Versus Resistance table for the correct resistance for each position (Fig. 87).

OPERATING MODE VERSUS RESISTANCE

SENSOR POSITION	OPERATING MODE	SENSOR RESISTANCE (ohms)
1	2H	1124-1243
2	4H	650-719
3	NEUTRAL	389-431
4	4L	199-221
5	NOT USED	57-64

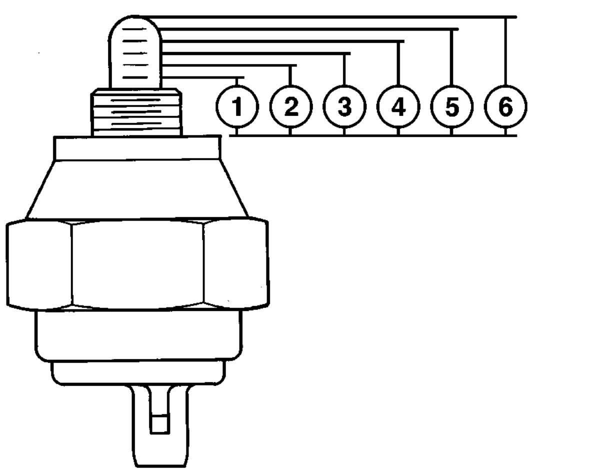


Fig. 87 Position Sensor Linear Movement

1 - POSITION 1 - 10mm ±0.5mm
2 - POSITION 2 - 12mm ±0.5mm
3 - POSITION 3 - 14mm ±0.5mm
4 - POSITION 4 - 16mm ±0.5mm
5 - POSITION 5 - 18mm ±0.5mm
6 - POSITION 6 - 20mm±0.5mm - FULL EXTENSION

REMOVAL

(1) Raise and support the vehicle.

(2) Disengage the transfer case position sensor connector from the position sensor.

(3) Remove the position sensor from the transfer case.

INSTALLATION

(1) Inspect the o-ring seal on the transfer case position sensor. Replace the o-ring if necessary.

(2) Install the transfer case position sensor into the transfer case. Torque the sensor to 20-34 N·m (15-25 ft.lbs.).

(3) Engage the transfer case position sensor connector to the position sensor.

(4) Lower vehicle.

(5) Verify proper sensor operation.

SHIFT LEVER

REMOVAL

(1) Shift transfer case into 2H.
(2) Raise and support the vehicle.
(3) Loosen adjusting trunnion lock bolt and slide shift rod out of trunnion. If rod lacks enough travel to come out of trunnion, push trunnion out of shift lever.
(4) Lower vehicle.
(5) Remove transfer case shifter knob cap.
(6) Remove nut holding shifter knob to shift lever.
(7) Remove shifter knob.
(8) Remove the shift boot from the shifter console.
(9) Remove the bolts securing the shifter mechanism to the floor pan (Fig. 88).
(10) Separate shift lever mechanism from the vehicle.

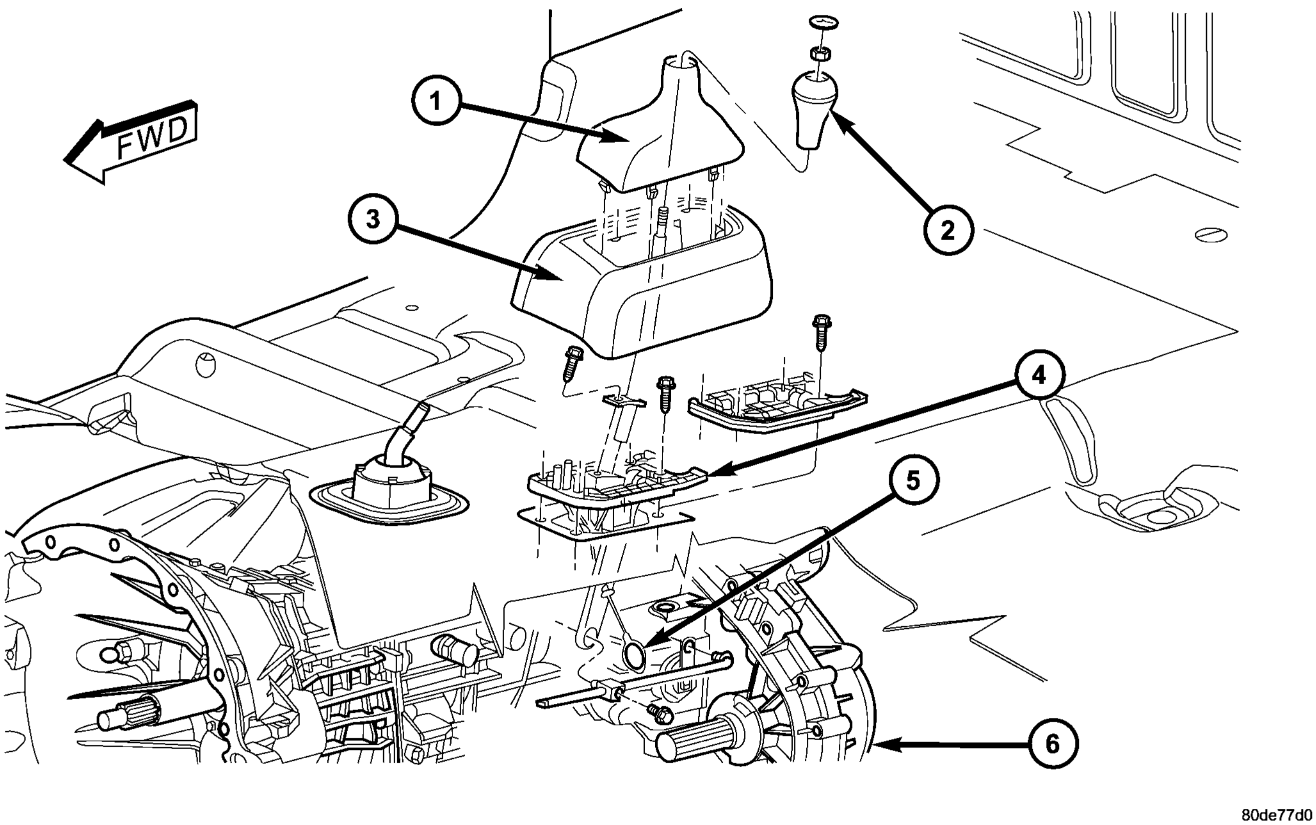


Fig. 88 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

SHIFT LEVER (Continued)

INSTALLATION

(1) If the shifter mechanism does not have a adjustment locating pin installed, align the adjustment channel on the shifter assembly to the locating hole in the lower shift lever and install an appropriately sized pin to retain the position (Fig. 89).

(2) Position shift lever in vehicle.

(3) Install the bolts to hold the shifter mechanism to the floor pan.

(4) Raise vehicle.

(5) Verify that the transfer case is still in the 2H position. The 2H detent position on the transfer case shift arm is the second position from full forward.

(6) Install trunnion to shift lever, if necessary.

(7) Install shift rod to trunnion, if necessary.

(8) Tighten the shift rod lock bolt to 10 N·m (90 in.lbs.).

(9) Remove the shifter adjustment locating pin from the adjustment channel and the locating hole.

(10) Lower vehicle.

(11) Install the transfer case shifter console.

(12) Install the shifter boot and the shifter knob onto the shifter lever.

(13) Install nut to hold shifter knob to shift lever.

(14) Install shifter knob cap.

(15) Verify transfer case operation.

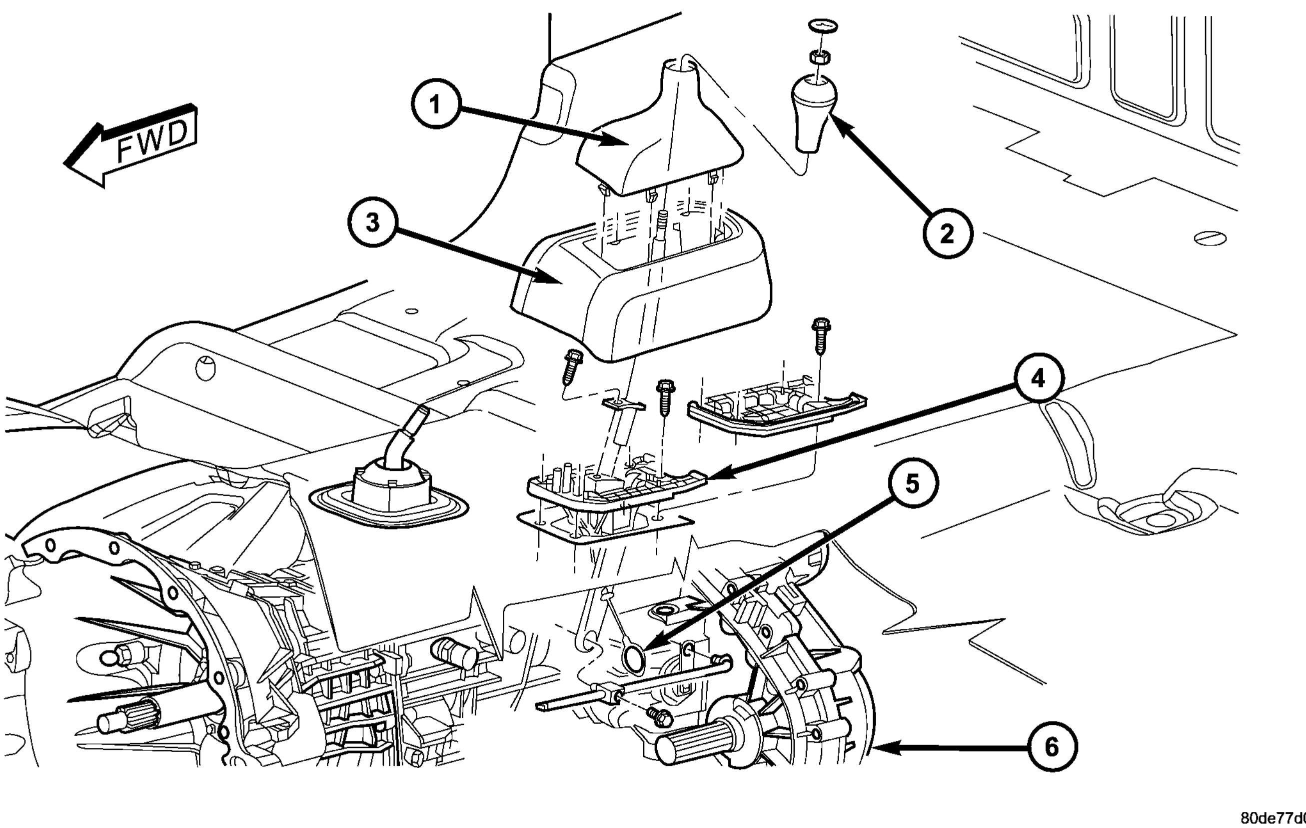


Fig. 89 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

SHIFT LEVER (Continued)

ADJUSTMENTS

ADJUSTMENT - SHIFT LEVER

(1) Move shift lever into 2H position.

(2) Raise vehicle.

(3) Loosen shift rod lock bolt at trunnion.

(4) Check shift rod fit in trunnion. Be sure rod does not bind in trunnion. Lubricate the shift rod and trunnion if necessary.

(5) Verify that transfer case shift lever is in 2H detent position. The 2H detent position on the transfer case shift arm is the second position from full forward.

(6) Align the adjustment locating hole on the lower shifter lever with the adjustment channel on the shifter bracket assembly (Fig. 90).

(7) Insert an appropriately sized pin through into the adjustment channel and through the locating hole to hold the shifter in the correct position.

(8) Tighten shift rod lock bolt to 10 N·m (90 in. lbs.) torque.

(9) Remove the locating pin from the adjustment channel and locating hole.

(10) Check shift linkage operation. Be sure transfer case shifts into and operates properly in all ranges.

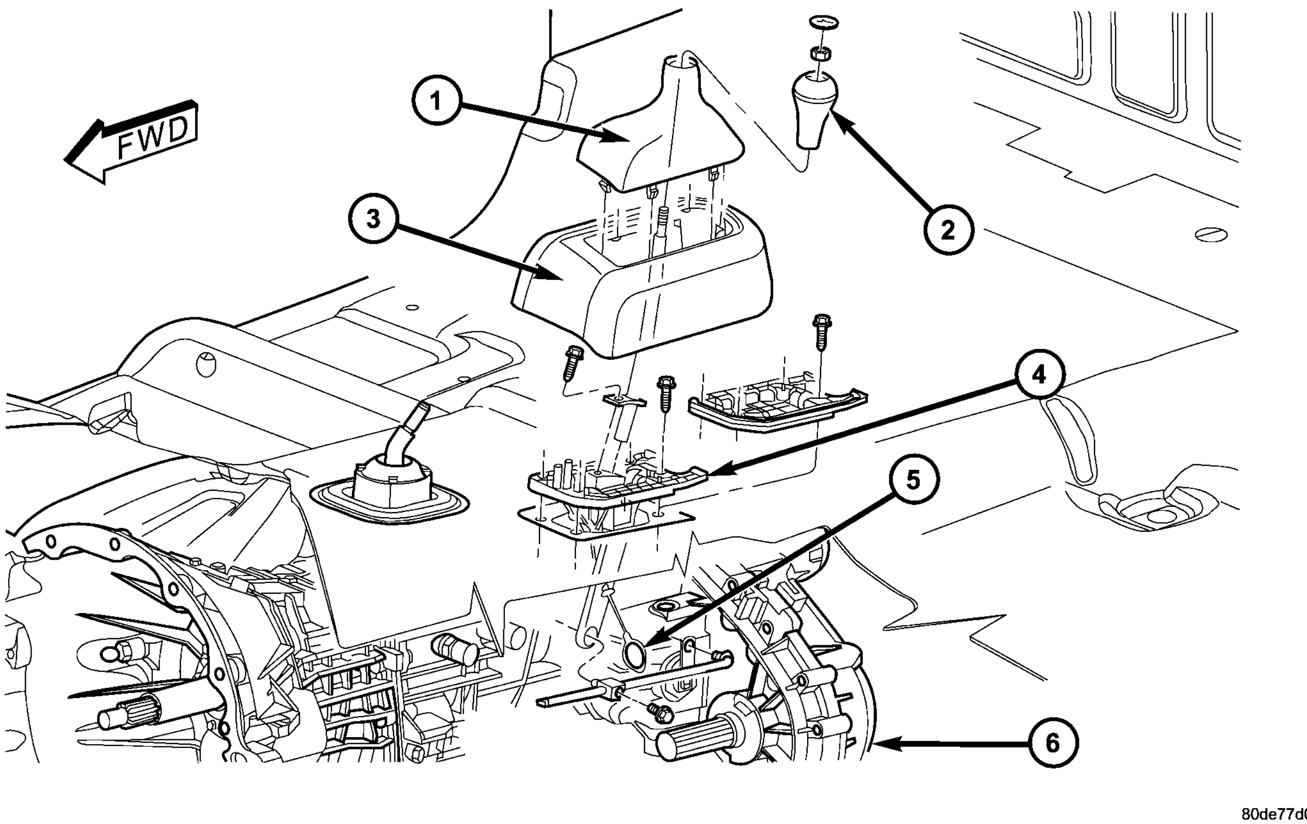


Fig. 90 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

TRANSFER CASE - NV271

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TRANSFER CASE - NV271

DESCRIPTION

The NV271 transfer case is a part-time transfer case with a low-range gear system. It provides three operating ranges plus a NEUTRAL position. The low range position provides a gear reduction ratio of 2.72:1 for increased low speed torque capability.

The gear cases and extension are all of aluminum (Fig. 1). Drive sprockets and an interconnecting drive chain are used to transmit engine torque to the front/rear propeller shafts. The mainshaft, input gear and front output shaft are supported by ball and needle bearings.

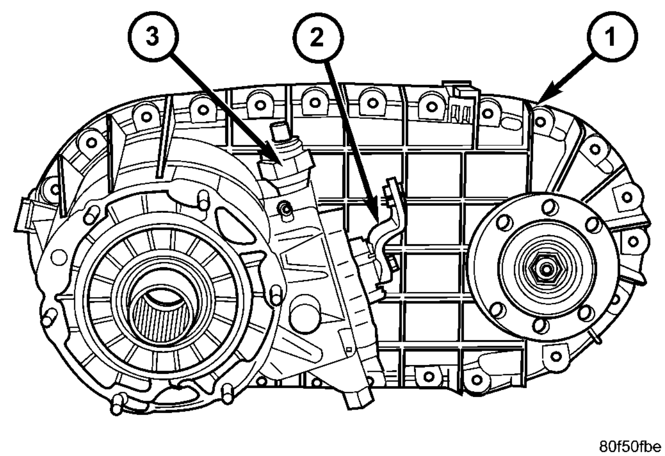


Fig. 1 Transfer Case - Front View

1 - TRANSFER CASE
2 - MANUAL LEVER
3 - POSITION SENSOR

IDENTIFICATION

An identification tag (Fig. 2) is attached to the rear case of every transfer case. The tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

OPERATION

OPERATING RANGE

Transfer case operating ranges are:

- 2H (2-wheel drive)
- 4H (4-wheel drive)
- 4LO (4-wheel drive low range

The 2H range is for use on any road surface at any time.

The 4H and 4LO ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is covered by ice and snow.

The low range reduction gear system is operative in 4LO range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

TRANSFER CASE - NV271 (Continued)

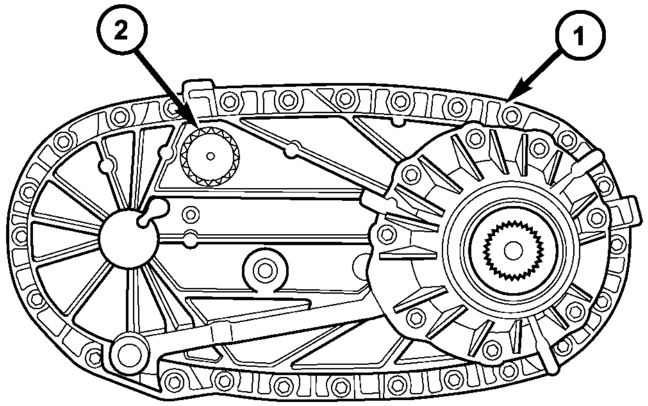


Fig. 2 Transfer Case - Rear View

1 - TRANSFER CASE
2 - IDENTIFICATION TAG

SHIFT MECHANISM

The transfer case is operated by an adjustable floor mounted shift linkage. The transfer case shift lever is directly attached to the shift sector. The sector operates the range and mode forks within the transfer case.

A straight line shift pattern is used with a NEUTRAL detent. Lever range positions are imprinted in the shift knob.

SHIFTING

The transfer case can be shifted between the 2H and 4H operating ranges while the vehicle is in motion. The vehicle must have the transmission placed in NEUTRAL, or the clutch depressed in the case of a manual transmission, and be moving less than 2-3 MPH when shifting into and out of the 4L operating range.

DIAGNOSIS AND TESTING - TRANSFER CASE - NV271

Before beginning repair on a suspected transfer case malfunction, check all other driveline components beforehand.

The actual cause of a problem may be related to such items as: front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Diagnosis Chart for further information.

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer Case difficult to shift or will not shift into desired range.	1) Vehicle speed too great to permit shifting.	1) Stop vehicle and shift into desired range. Or, reduce speed to below 3-4 km/h (2-3 mph) before attempting the shift.
	2) If vehicle was operated for an extended period in 4H on a dry paved surface, the driveline torque load may be causing a bind.	2) Stop vehicle and shift the transmission into neutral. Shift the transfer case to 2H and operate vehicle in 2H on dry paved surfaces.
	3) Transfer case external shift linkage binding.	3) Lubricate, repair, or replace linkage bushings, or tighten loose components as necessary.
	4) Insufficient or incorrect lubricant.	4) Drain and refill to edge of fill hole with Mopar® ATF +4, Automatic Transmission fluid.
	5) Internal components binding, worn, or damaged.	5) Disassemble the transfer case and replace worn or damaged components as necessary.
Transfer Case noisy in all operating ranges.	1) Insufficient or incorrect lubricant.	1) Drain and refill to edge of fill hole with Mopar® ATF +4, Automatic Transmission fluid.

TRANSFER CASE - NV271 (Continued)

Condition	Possible Cause	Correction
Noisy in, or jumps out of, four wheel drive low range.	1) Transfer case not completely engaged in 4L position.	1) With the transmission in NEUTRAL, or the clutch depressed in the case of a manual transmission and the vehicle moving under 3-4 km/h (2-3 mph), shift the transfer case to NEUTRAL and then shift into the 4L position.
	2) Shift linkage out of adjustment.	2) Adjust linkage.
	3) Shift linkage loose or binding.	3) Tighten, lubricate, or repair linkage as necessary.
	4) Range fork damaged, inserts worn, or fork is binding on the shift rail.	4) Disassemble unit and repair as necessary.
	5) Low range gear worn or damaged.	5) Disassemble unit and repair as necessary.
Lubricant leaking from output shaft seal or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Vent closed or restricted.	2) Clear or replace vent as necessary.
	3) Output shaft seals damaged or installed incorrectly.	3) Replace seal as necessary. Check to ensure that another component, the propeller shaft slip yoke for example, is not causing damage to seal.
Abnormal tire wear.	1) Extended operation on hard, dry surfaces in the 4H position.	1) Operate vehicle in the 2H position on hard, dry surfaces.

REMOVAL

(1) Raise and support vehicle.

(2) Remove skid plate, if equipped. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - REMOVAL)

(3) Position drain oil container under transfer case.

(4) Remove transfer case drain plug and drain lubricant into container.

(5) Disconnect vent hose and transfer case position sensor connector.

(6) Disconnect shift rod from grommet in transfer case shift lever, or from floor shift arm whichever provides easy access. Use channel lock style pliers to press rod out of lever grommet.

(7) Support transmission with jack stand.

(8) Mark front and rear propeller shafts for assembly reference.

(9) Remove front and rear propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(10) Support transfer case with suitable jack. Secure transfer case to jack with safety chains.

(11) Remove nuts attaching transfer case to transmission.

(12) Move transfer case assembly rearward until free of transmission output shaft.

(13) Lower jack and move transfer case from under vehicle.

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

COMPANION FLANGE AND EXTENSION HOUSING

(1) Install two bolts 180° apart into the front output shaft companion flange.

(2) Place holder over the bolts and against the companion flange (Fig. 3).

(3) Remove and discard the front companion flange nut.

TRANSFER CASE - NV271 (Continued)

(4) Remove the companion flange from the front output shaft. It may be necessary to use Flange puller 8992 to remove the companion flange.

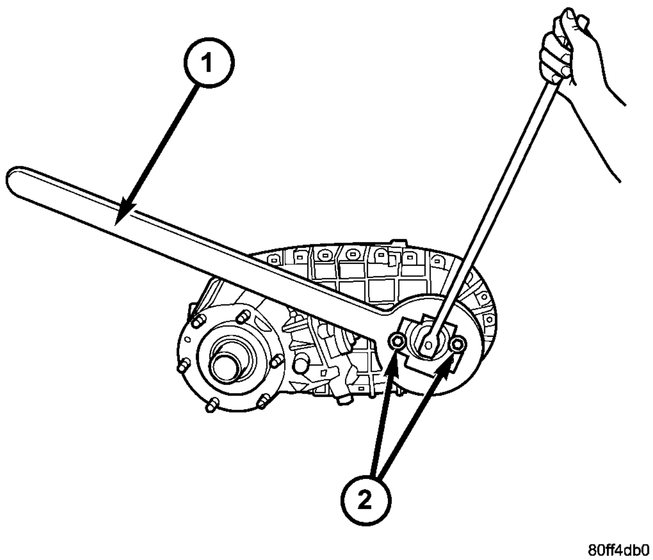


Fig. 3 Remove Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(5) Use a suitable chisel or pry tool to remove the rear extension housing dust boot (Fig. 4).

(6) Use a suitable chisel or pry tool to remove the rear extension housing seal.

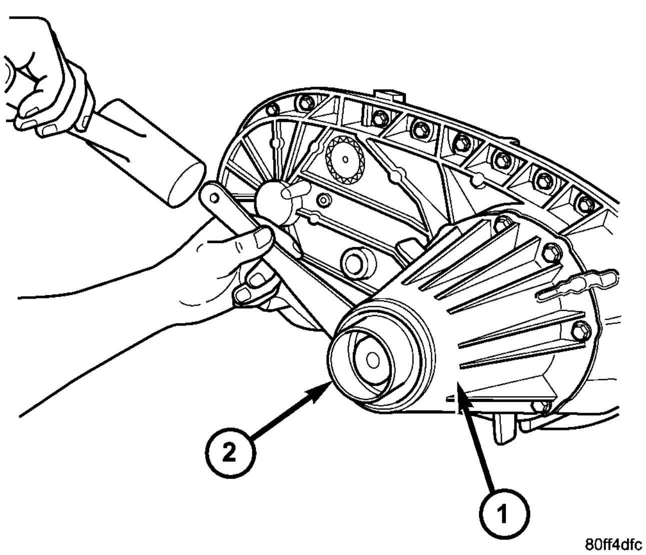


Fig. 4 Remove Extension Housing Dust Boot

1 - EXTENSION HOUSING
2 - DUST BOOT

(7) Remove rear extension bolts (Fig. 5).

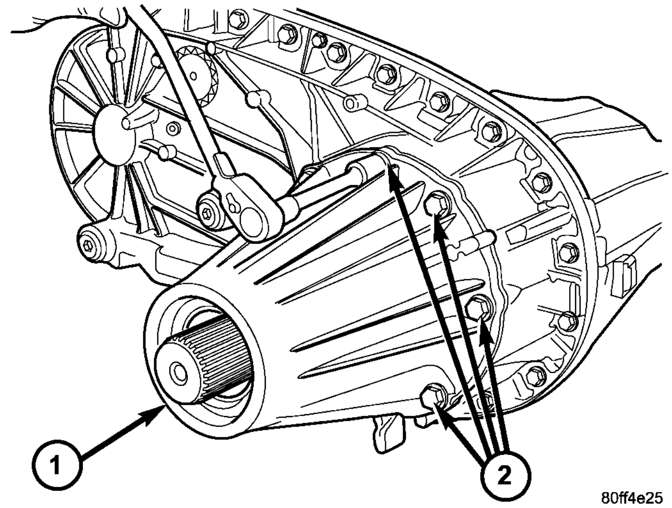


Fig. 5 Remove Extension Housing Bolts

1 - EXTENSION HOUSING
2 - BOLTS

(8) Remove rear extension housing (Fig. 6). Tap extension once or twice with a plastic mallet to break sealer bead and loosen it.

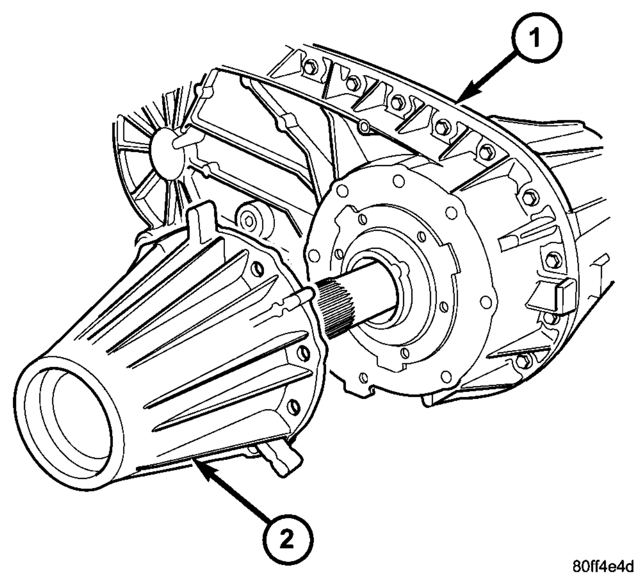


Fig. 6 Remove Extension Housing

1 - REAR CASE HALF
2 - EXTENSION HOUSING

TRANSFER CASE - NV271 (Continued)

OIL PUMP AND REAR CASE

(1) Disengage the oil pump pick-up tube (Fig. 7) from the oil pump.

NOTE: The oil pump pick-up tube seals to the oil pump with an o-ring. Verify that the o-ring was removed with the tube and is in good condition. Replace the o-ring if necessary.

(2) Remove the oil pump (Fig. 8).

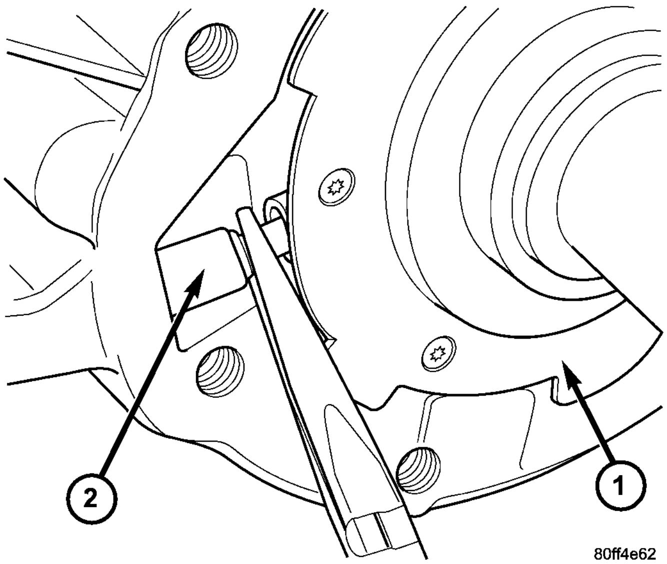


Fig. 7 Disengage The Oil Pick-up From Oil Pump

1 - OIL PUMP
2 - OIL PICK-UP TUBE

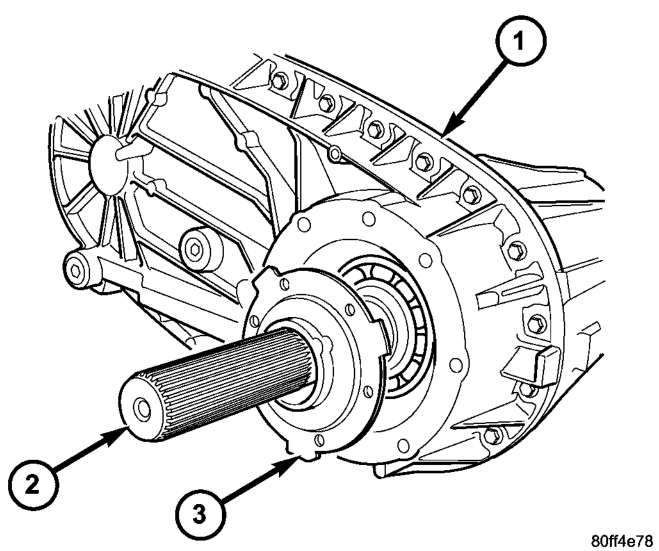


Fig. 8 Remove Oil Pump

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT
3 - OIL PUMP

(3) Remove rear case-to-front case bolts (Fig. 9).

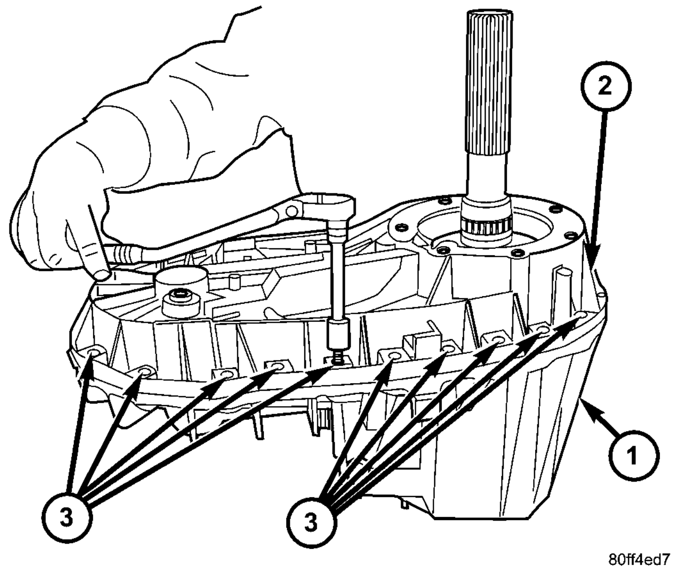


Fig. 9 Remove Case Half Bolts

1 - FRONT CASE HALF
2 - REAR CASE HALF
3 - BOLTS

(4) Remove the rear output shaft bearing inner snap-ring (Fig. 10) from the output shaft using suitable snap-ring pliers.

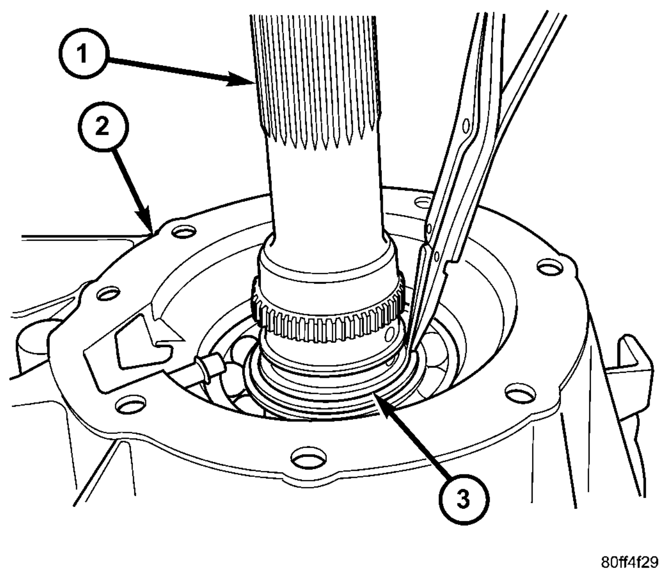


Fig. 10 Remove Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

(5) Remove the rear output shaft bearing inner snap-ring (Fig. 11) from the output shaft.

(6) Loosen rear case with pry tool to break sealer bead. Insert tool at each end of case (Fig. 12).

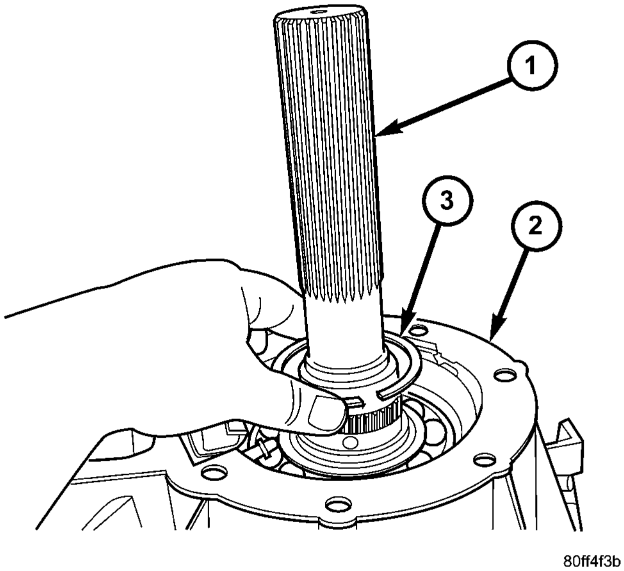


Fig. 11 Remove Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

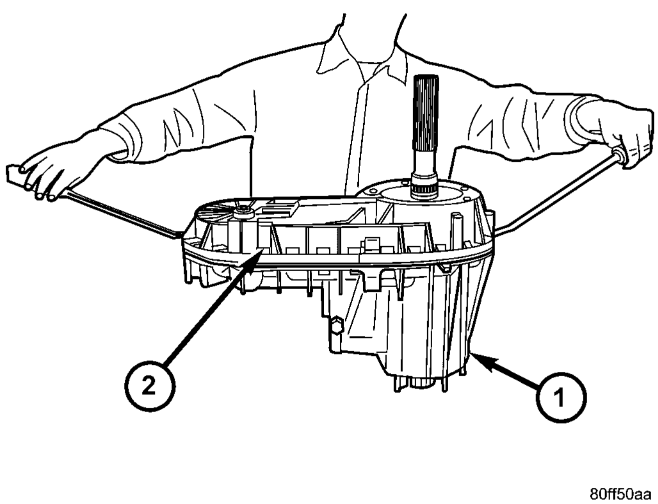


Fig. 12 Separate Front and Rear Case Halves

1 - FRONT CASE HALF
2 - REAR CASE HALF

(7) Unseat rear case from alignment dowels.

(8) Remove the rear case from the front case (Fig. 13).

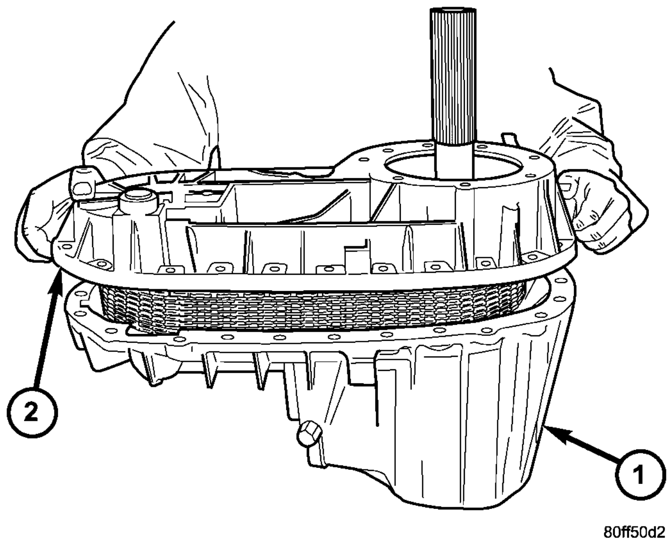


Fig. 13 Remove Rear Case Half

1 - FRONT CASE HALF
2 - REAR CASE HALF

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Remove the oil pick-up tube (Fig. 14) and screen from the front case half.

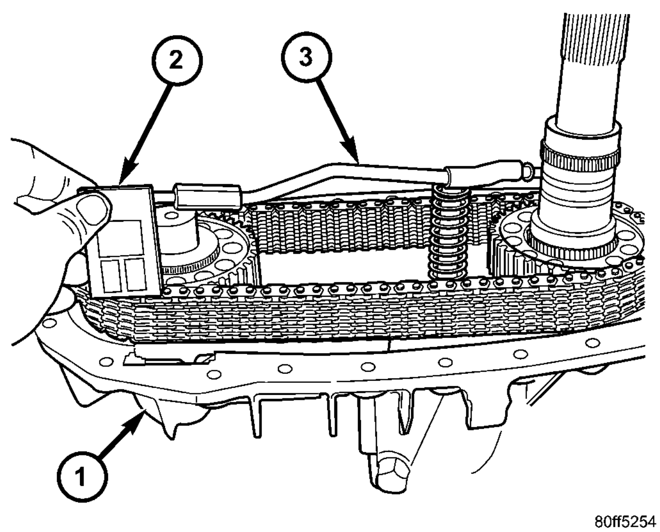


Fig. 14 Remove Oil Pick-Up Tube and Screen

1 - FRONT CASE HALF
2 - OIL SCREEN
3 - PICK-UP TUBE

TRANSFER CASE - NV271 (Continued)

(2) Remove the shift rail spring (Fig. 15).

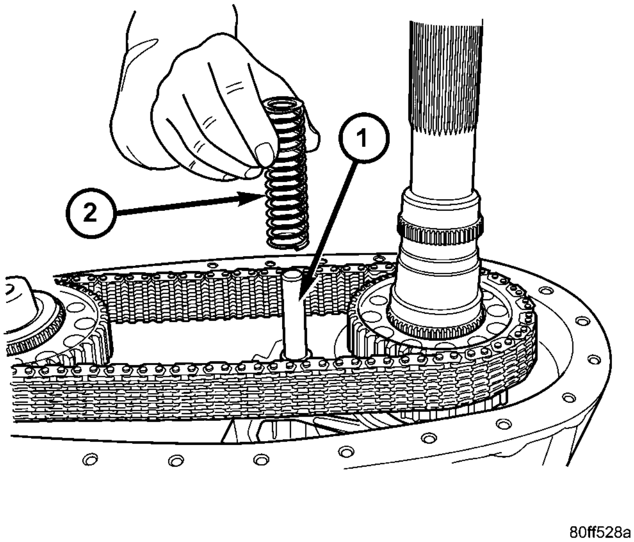


Fig. 15 Remove Shift Rail Spring

1 - SHIFT RAIL
2 - SPRING

(3) Remove the front output shaft drive sprocket retaining ring (Fig. 16).

(4) Remove the rear output shaft drive sprocket retaining ring (Fig. 17).

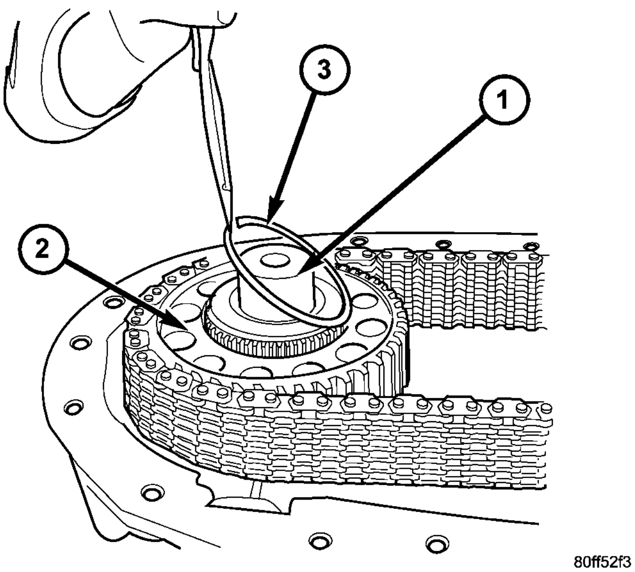


Fig. 16 Remove Front Output Shaft Sprocket Retaining Ring

1 - FRONT OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

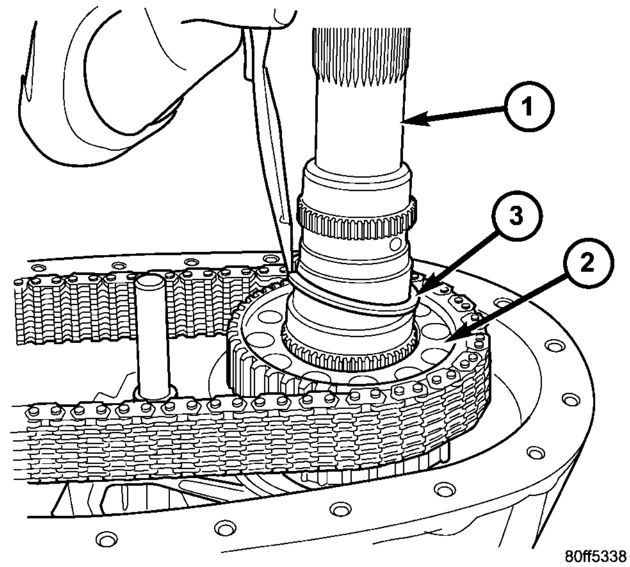


Fig. 17 Remove Rear Output Shaft Sprocket Retaining Ring

1 - REAR OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

(5) Pull front sprocket (Fig. 18), rear sprocket, and chain upward until clear of the front and rear output shaft sprocket splines.

(6) Remove chain and sprockets as an assembly.

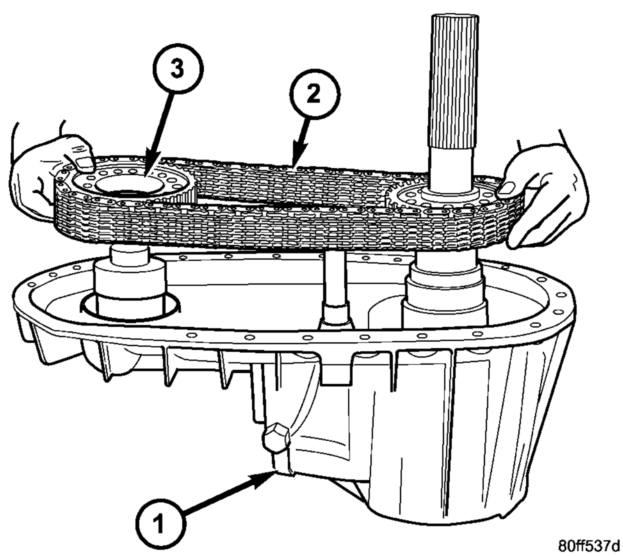


Fig. 18 Remove Drive Chain and Sprockets

1 - FRONT CASE HALF
2 - CHAIN
3 - DRIVE SPROCKETS

SHIFT FORKS AND MAINSHAFT

(1) Shift transfer case into NEUTRAL.

(2) Remove nut that retains the shift lever to sector shaft. Then remove shift lever (Fig. 19) and spacer from the shaft.

(3) Remove the sector support with Socket 9033.

(4) Remove the transfer case position sensor (Fig. 20).

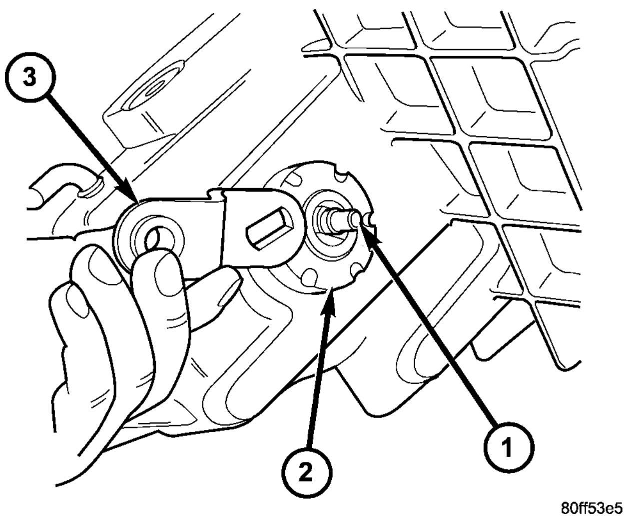


Fig. 19 Remove Manual Shift Lever

1 - SHIFT SECTOR
2 - SECTOR SUPPORT
3 - MANUAL SHIFT LEVER

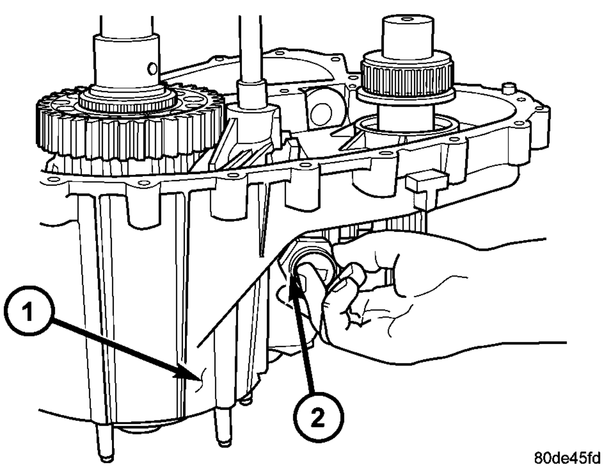


Fig. 20 Remove Position Sensor

1 - FRONT CASE
2 - POSITION SENSOR

(5) Loosen detent plug (Fig. 21).

(6) Remove detent plug, spring, and plunger (Fig. 22). Note that the plug has an O-ring seal. Remove and discard this seal.

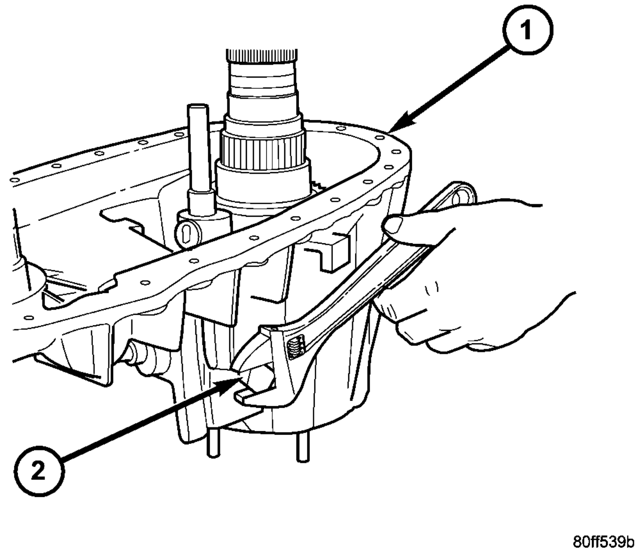


Fig. 21 Loosen the Detent Plug

1 - FRONT CASE HALF
2 - DETENT PLUG

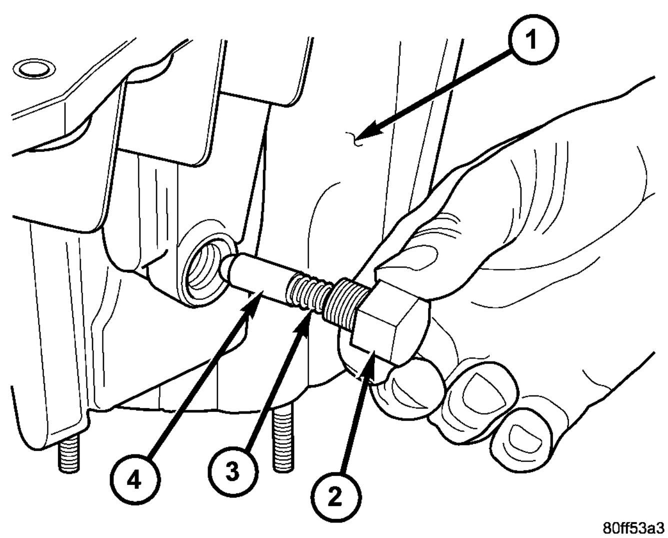


Fig. 22 Remove Detent plug, Spring, and Plunger

1 - FRONT CASE HALF
2 - DETENT PLUG
3 - SPRING
4 - PLUNGER

TRANSFER CASE - NV271 (Continued)

(7) Using a screw mounted in a slide hammer, remove the front output shaft seal.

(8) Remove the front output shaft snap-ring (Fig. 23).

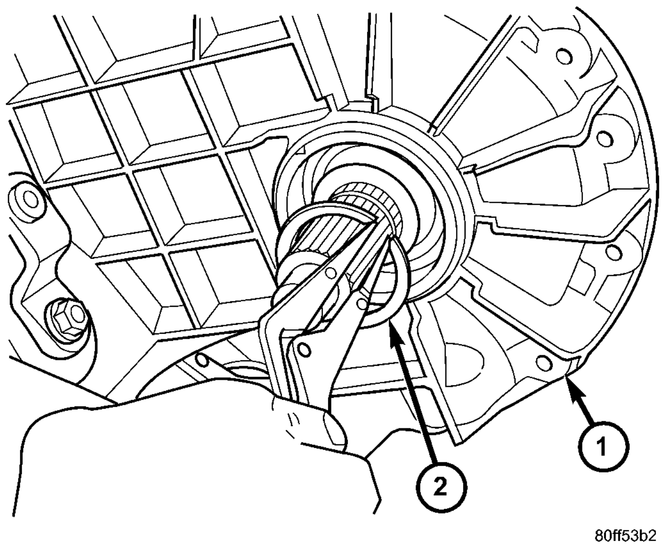


Fig. 23 Remove Front Output Shaft Bearing Inner Snap-Ring

1 - FRONT CASE HALF
2 - SNAP-RING

(9) Remove front output shaft from bearing in case (Fig. 24).

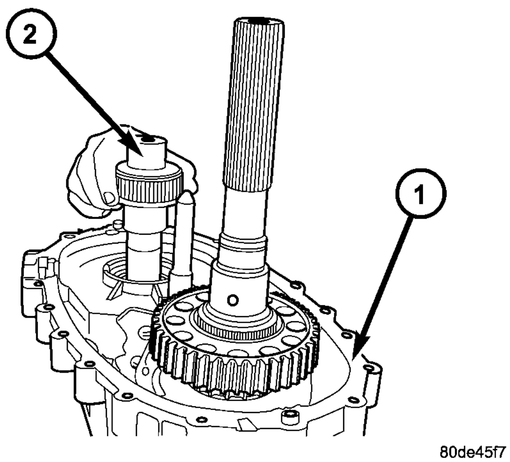


Fig. 24 Remove Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

(10) Pull mainshaft assembly out of input gear, mode sleeve, and case (Fig. 25).

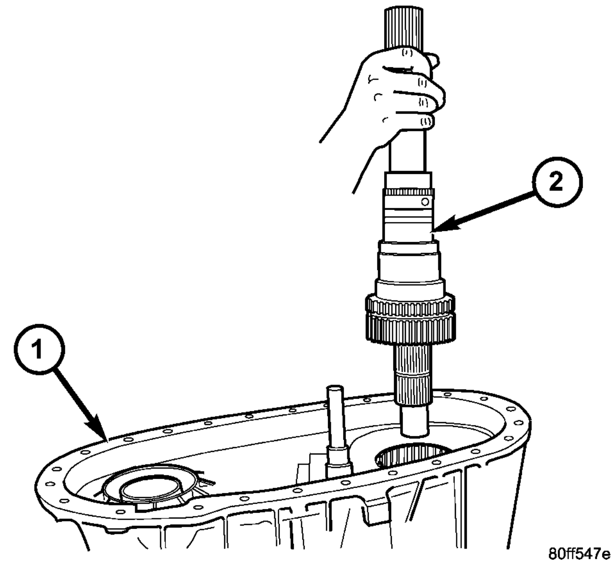


Fig. 25 Remove Mainshaft Assembly

1 - FRONT CASE HALF
2 - MAINSHAFT ASSEMBLY

(11) Remove mode fork, mode sleeve, and shift rail as assembly (Fig. 26). Note which way the sleeve fits in the fork (long side of sleeve goes to front or the points on the sleeve teeth go to the rear of case).

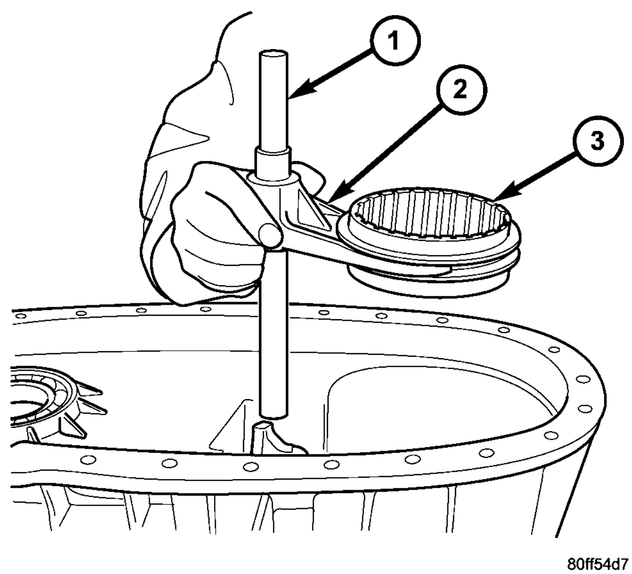


Fig. 26 Remove Mode Fork, Sleeve, and Shift Rail Assembly

1 - SHIFT RAIL
2 - MODE FORK
3 - MODE SLEEVE

(12) Remove range fork and hub as an assembly (Fig. 27). Note fork position for installation reference.

(13) Remove shift sector (Fig. 28).

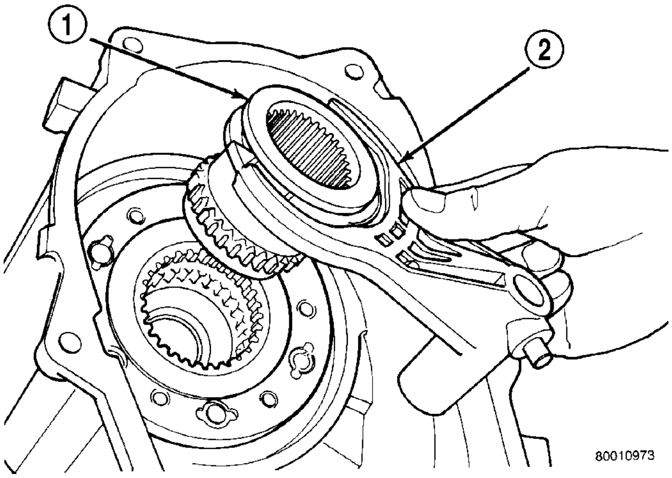


Fig. 27 Range Fork And Hub Removal

1 - RANGE HUB
2 - RANGE FORK

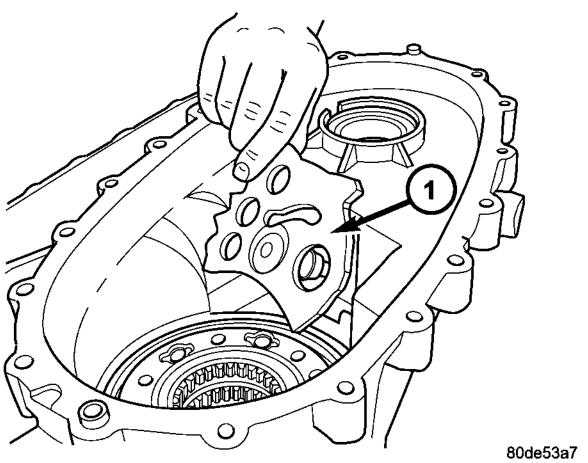


Fig. 28 Remove Shift Sector

1 - SHIFT SECTOR

MAINSHAFT

(1) Remove the clutch gear (Fig. 29) from the output shaft.

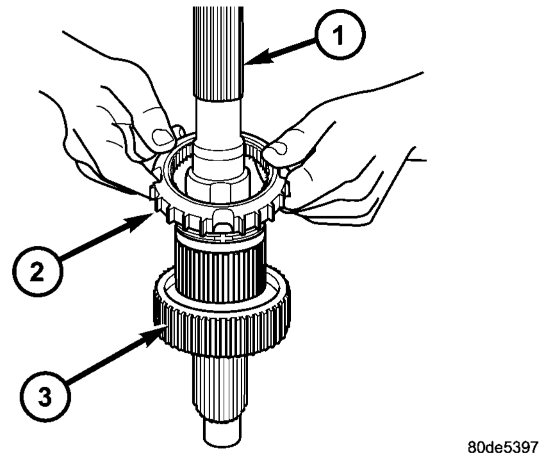


Fig. 29 Remove Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

(2) Remove the mode hub retaining ring (Fig. 30) from the mainshaft.

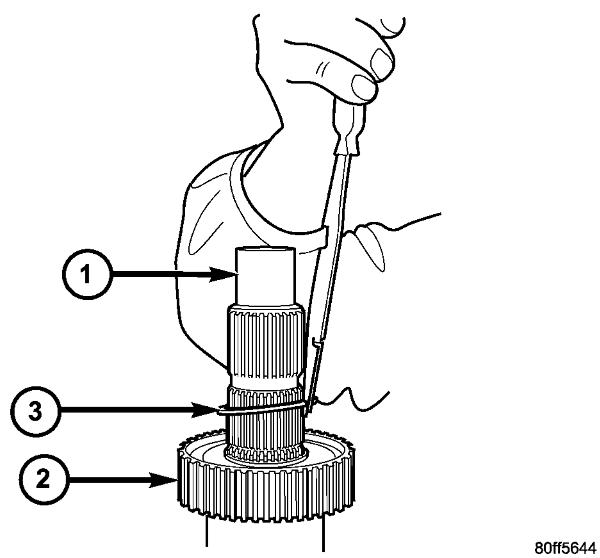


Fig. 30 Remove Mode Hub Retaining Ring

1 - MAINSHAFT
2 - MODE HUB
3 - RETAINING RING

TRANSFER CASE - NV271 (Continued)

(3) Remove the mode hub (Fig. 31) from the mainshaft.

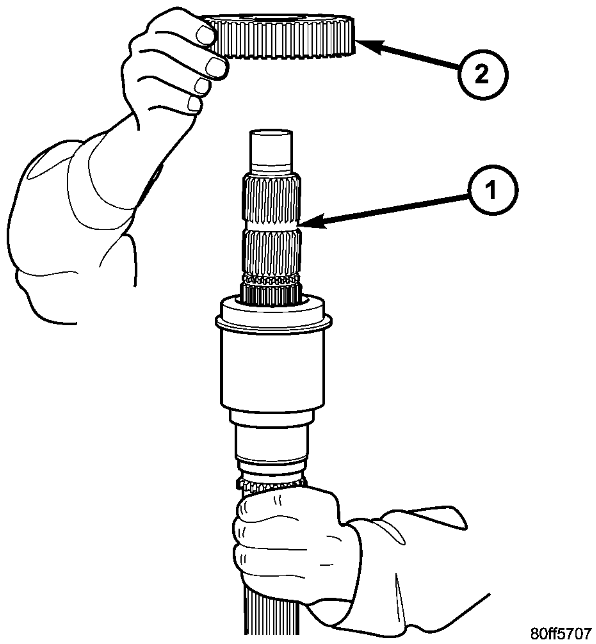


Fig. 31 Remove Mode Hub

1 - MAINSHAFT
2 - MODE HUB

(4) Remove the drive sprocket drive hub (Fig. 32) from the mainshaft.

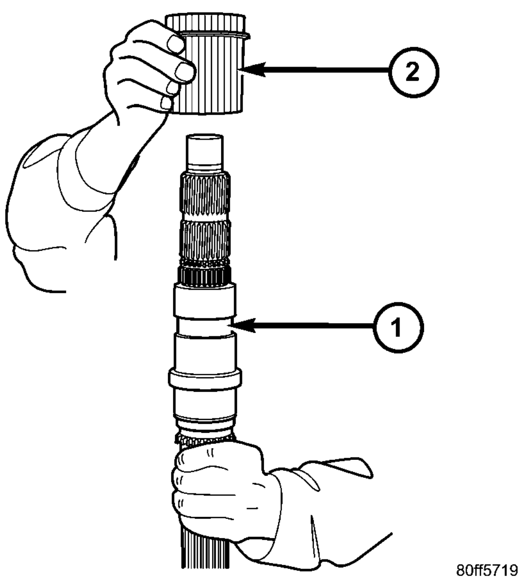


Fig. 32 Remove the Drive Sprocket Drive Hub

1 - MAINSHAFT
2 - DRIVE SPROCKET DRIVE HUB

INPUT AND PLANETARY GEAR

(1) Remove input gear seal with suitable screw and slide hammer.

(2) Remove input gear retaining ring (Fig. 33) with heavy duty snap-ring pliers.

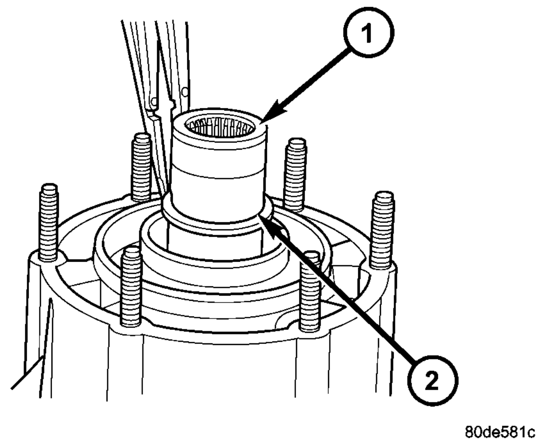


Fig. 33 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(3) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 34). Tap gear out of bearing with plastic mallet, if necessary.

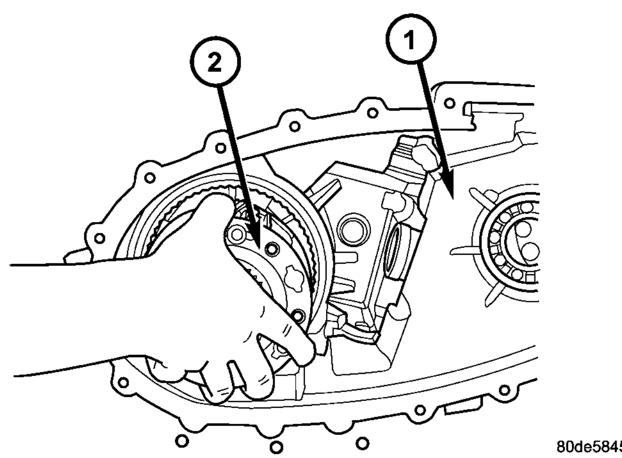


Fig. 34 Remove Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

TRANSFER CASE - NV271 (Continued)

(4) Remove snap-ring that retains input gear in the low range gear (Fig. 35).

(5) Remove retainer (Fig. 36).

(6) Remove front thrust plate (Fig. 37).

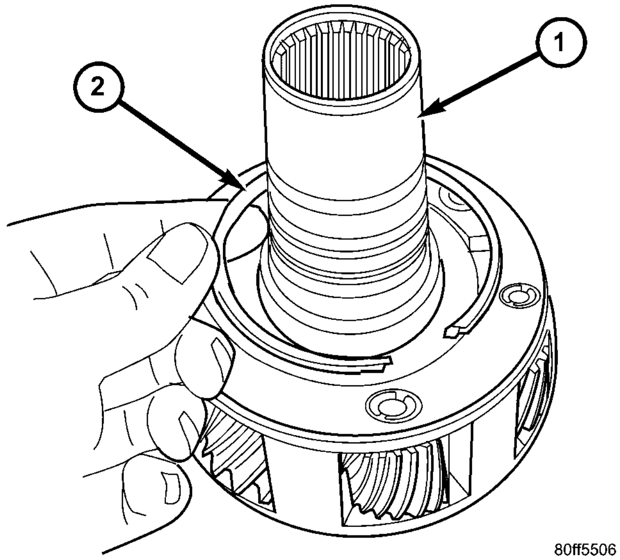


Fig. 35 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

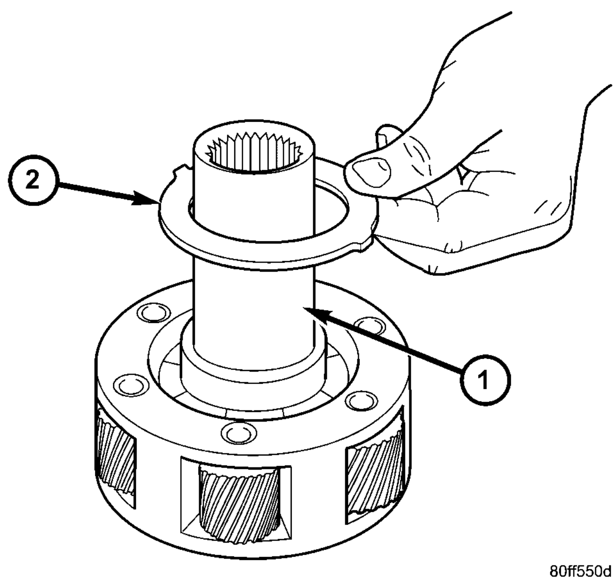


Fig. 36 Remove Input Gear Retainer

1 - INPUT GEAR
2 - RETAINER

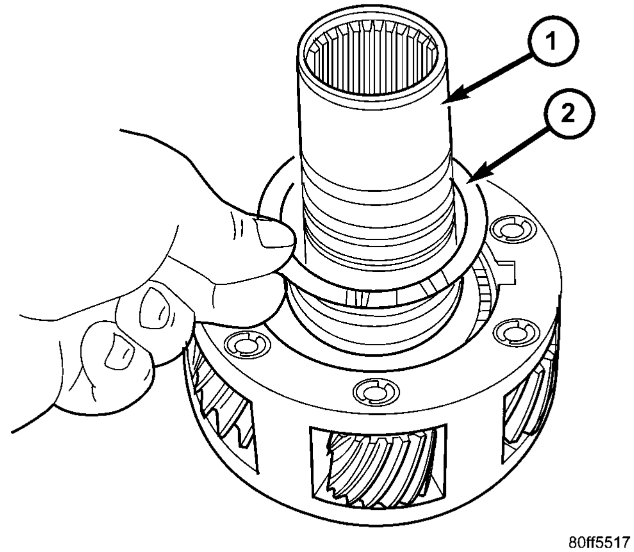


Fig. 37 Remove Input Gear Thrust Plate

1 - INPUT GEAR
2 - THRUST PLATE

(7) Remove input gear (Fig. 38).

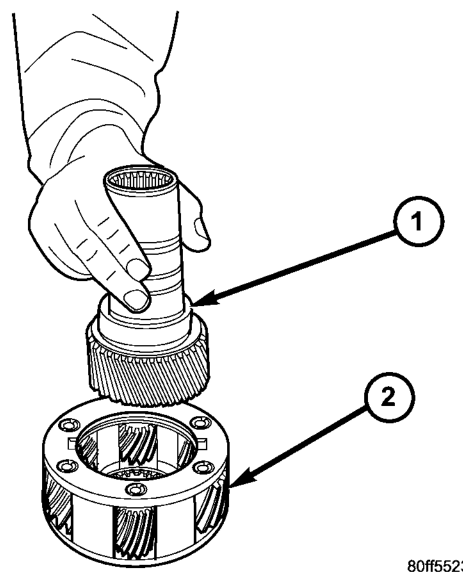


Fig. 38 Remove Input Gear From Planetary

1 - INPUT GEAR
2 - LOW RANGE PLANETARY

TRANSFER CASE - NV271 (Continued)

(8) Remove bottom tabbed thrust washer from low range planetary (Fig. 39).

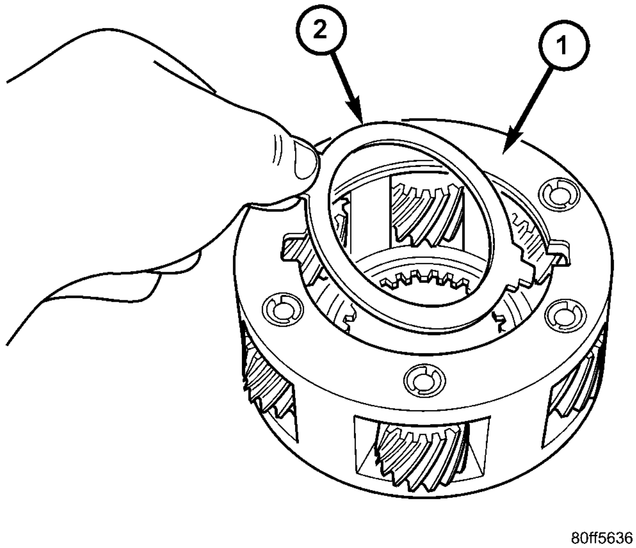


Fig. 39 Remove Bottom Input Gear Thrust Plate

1 - PLANETARY
2 - THRUST PLATE

CLEANING

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M™ all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

INSPECTION

MAINSHAFT/SPROCKET/HUB

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone, however, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320-400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 40). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

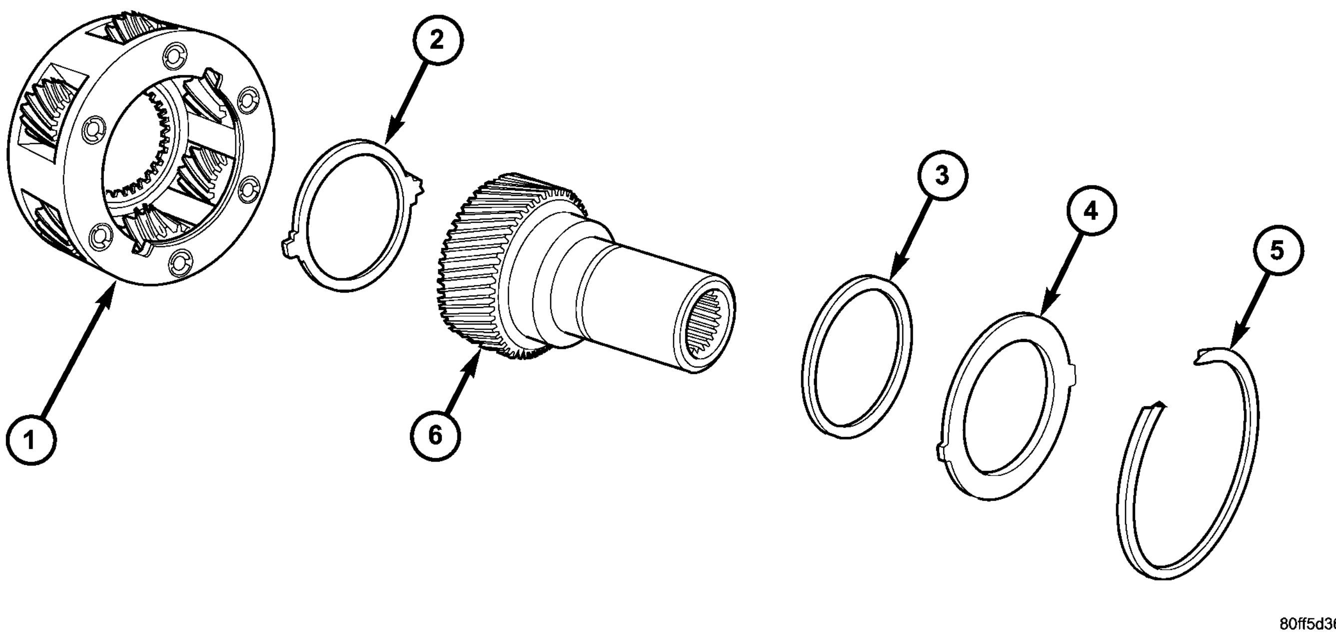


Fig. 40 Input Gear And Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

TRANSFER CASE - NV271 (Continued)

Examine the carrier body and pinion gears for wear or damage. Check the pinion gear thrust washers on the pinon pins for damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 41). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

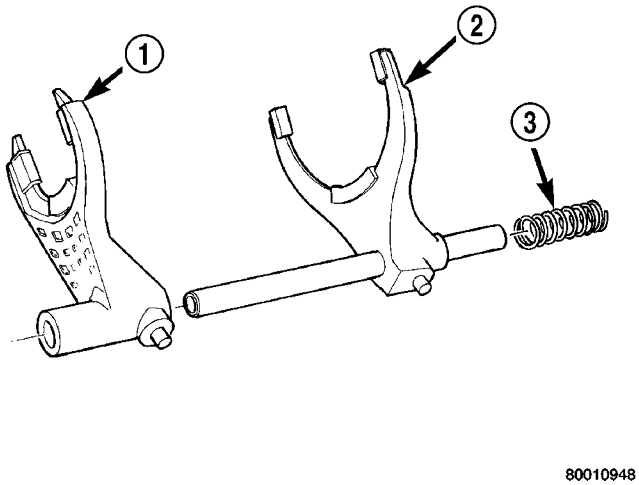


Fig. 41 Shift forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

Inspect the shift fork wear pads (Fig. 42). The mode and range fork pads are serviceable and can be replaced if necessary.

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

DRIVE CHAIN

Examine the drive chain and shaft bearings. replace the chain if stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 43)

FRONT CASE AND REAR CASE

Inspect the cases for wear and damage.

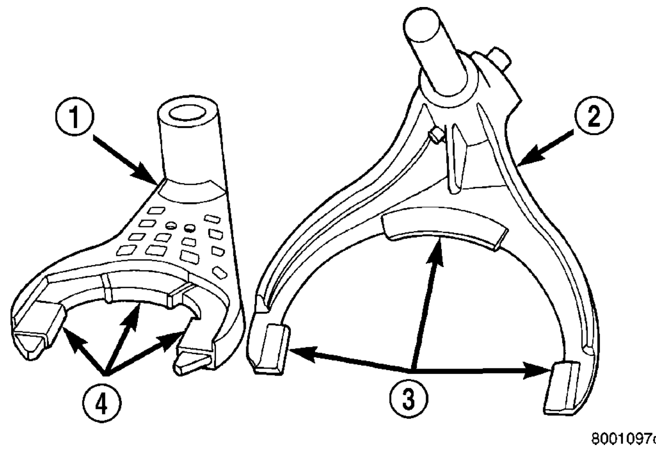


Fig. 42 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

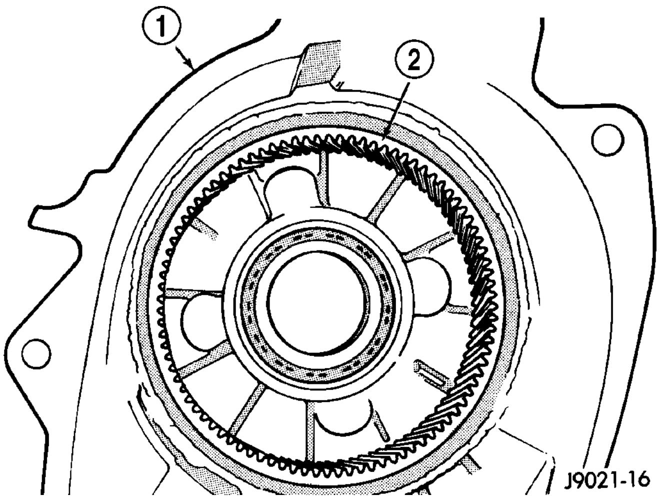


Fig. 43 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite™ 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/ drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil™ stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ASSEMBLY

BEARINGS AND SEALS

(1) Remove the input shaft bearing snap-ring from the front case half with suitable snap-ring pliers.

(2) Remove the input shaft bearing from the front case half with Installer 6953 and Handle C-4171 (Fig. 44).

(3) Install the input shaft bearing into the front case half with Installer 8151 inverted on Handle C-4171 (Fig. 45).

(4) Install the input shaft bearing snap-ring into the front case half with suitable snap-ring pliers.

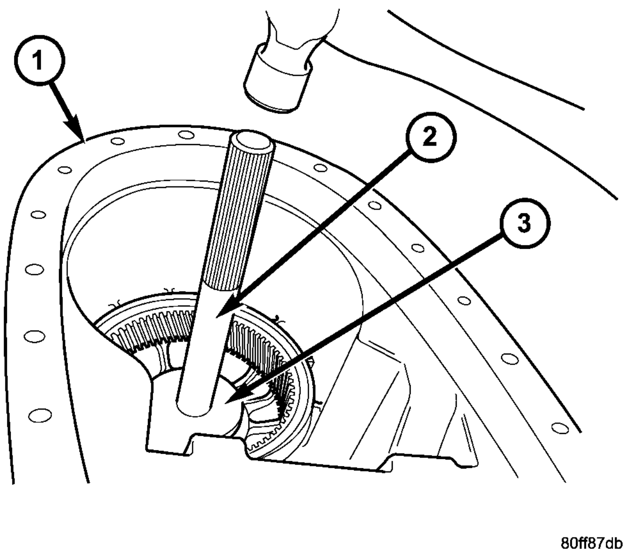


Fig. 44 Remove Input Gear Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 6953

(5) Remove the front output shaft front bearing snap-ring from the front case half.

(6) Using Installer 6953 and Handle C-4171 (Fig. 46), remove the front output shaft front bearing.

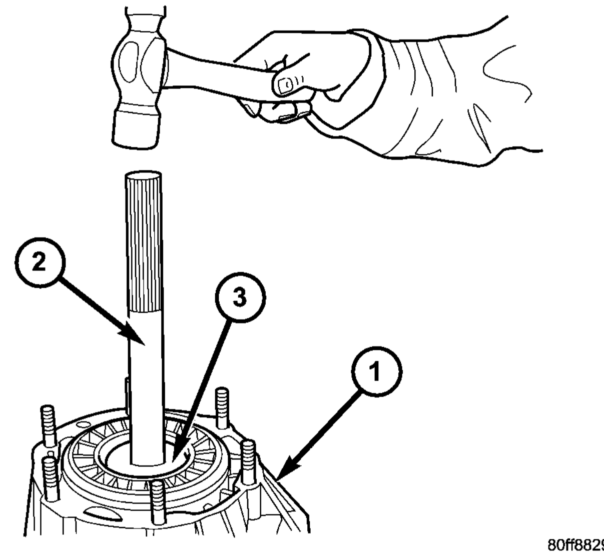


Fig. 45 Install Input Gear Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8151 (INVERTED)

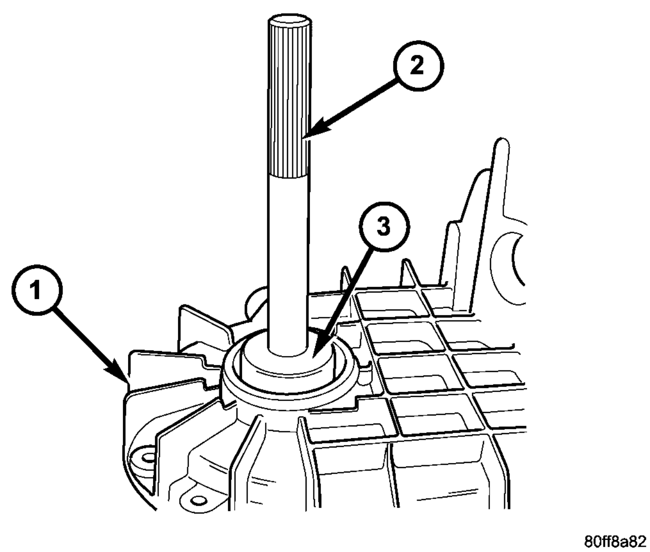


Fig. 46 Remove Front Output Shaft Front Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 6953

TRANSFER CASE - NV271 (Continued)

(7) Start front output shaft front bearing in case. Then seat bearing with Installer 8891 (Fig. 47).

(8) Install front output shaft bearing retaining ring.

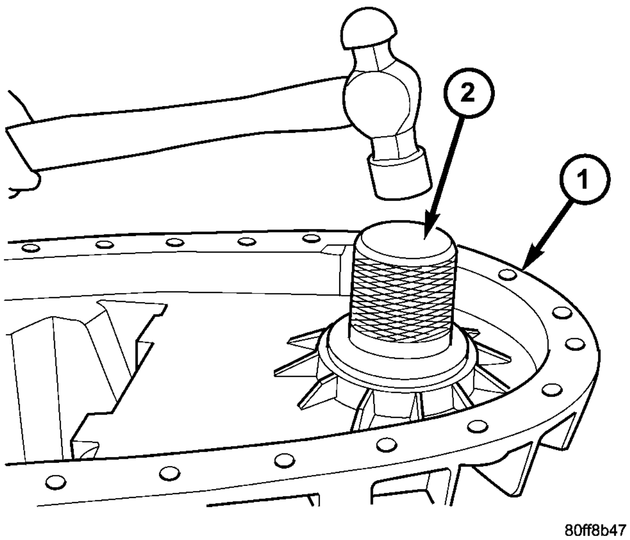


Fig. 47 Install Front Output Shaft Front Bearing

1 - FRONT CASE HALF
2 - INSTALLER 8891

(9) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 48).

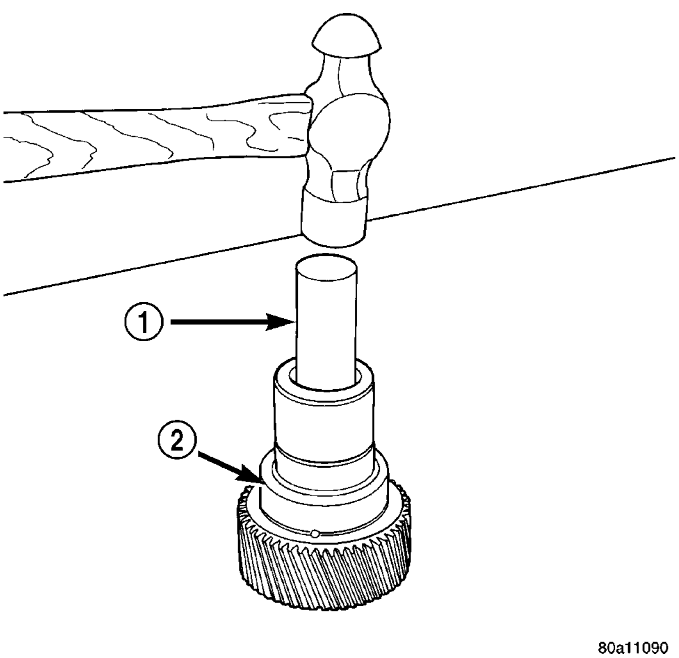


Fig. 48 Remove Input Gear Cup Bearing

1 - DRIFT
2 - INPUT GEAR

(10) Install new pilot bearing with Installer 9035.

(11) Remove the front output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 49).

(12) Install new bearing with Tool Handle C-4171 and Installer 8128 (Fig. 50). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 51).

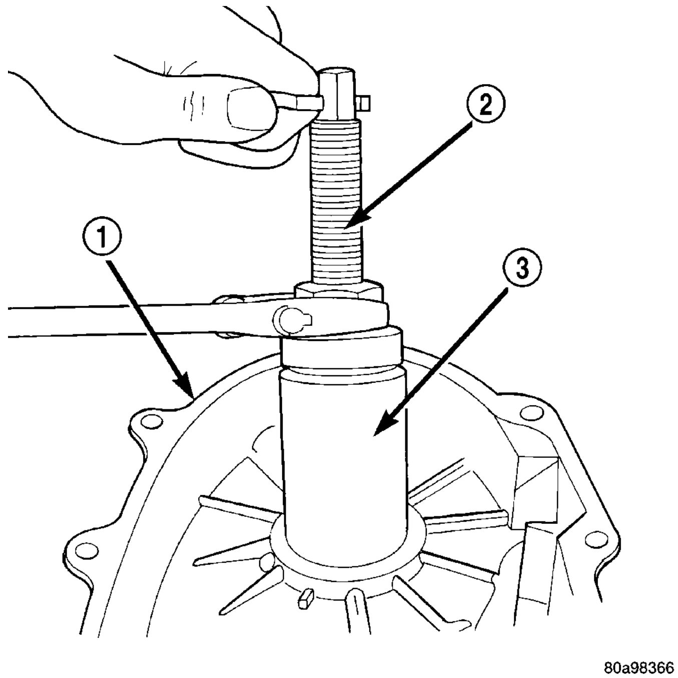


Fig. 49 Front Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

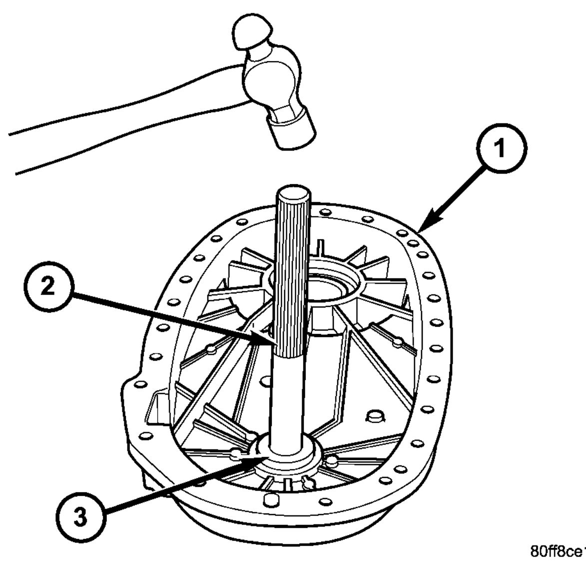


Fig. 50 Install Front Output Shaft Rear Bearing

1 - REAR CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8128

TRANSFER CASE - NV271 (Continued)

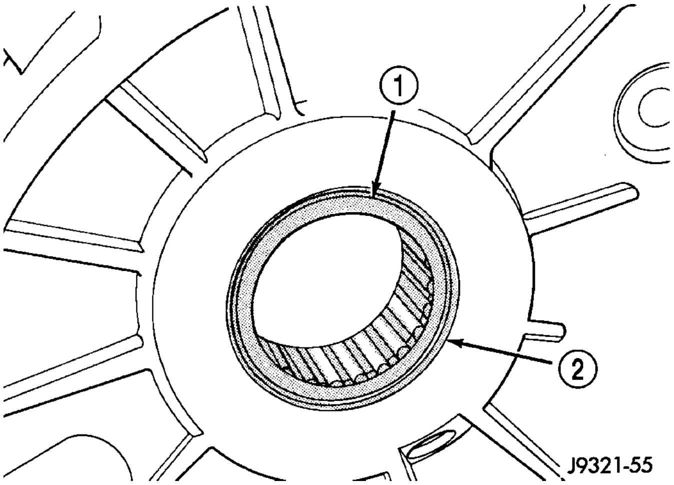


Fig. 51 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

(13) Remove seal from oil pump with suitable pry tool.

(14) Install new seal in oil pump with Installer 7888 (Fig. 52).

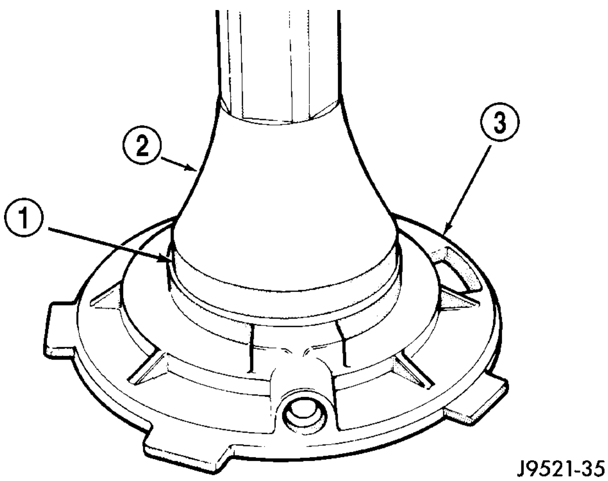


Fig. 52 Oil Pump Seal Installation

1 - HOUSING SEAL
2 - SPECIAL TOOL 7888
3 - OIL PUMP FEED HOUSING

(15) Remove the rear output shaft bearing snap-ring (Fig. 53) from the rear case half.

(16) Remove the rear output shaft bearing from the rear case using Installer 7888 (Fig. 54).

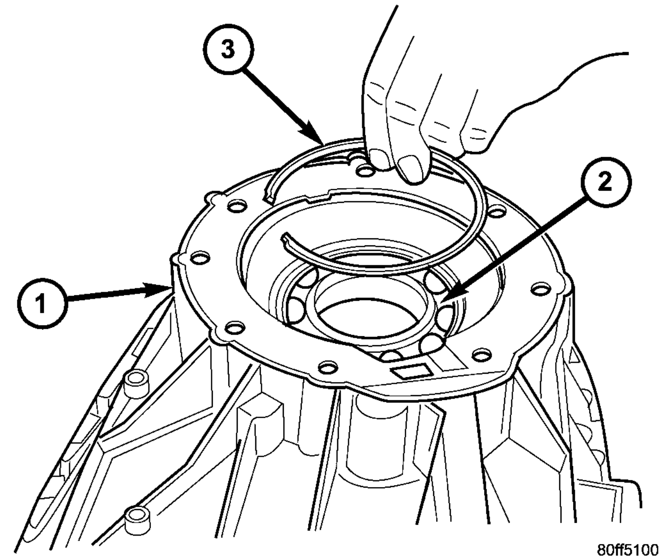


Fig. 53 Remove Rear Output Bearing Outer Snap-Ring

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT BEARING
3 - SNAP-RING

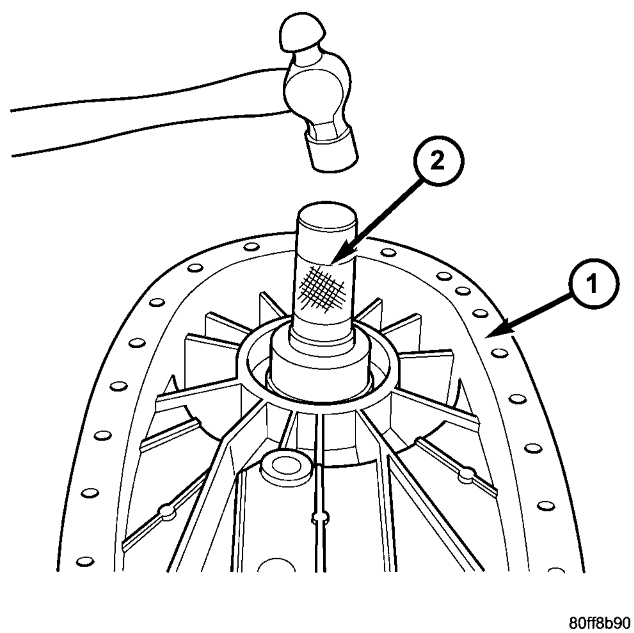


Fig. 54 Remove Rear Output Shaft Bearing

1 - REAR CASE HALF
2 - INSTALLER 7888

TRANSFER CASE - NV271 (Continued)

(17) Install the rear output shaft bearing (Fig. 55) into the rear case using Installer 8152 and Handle C-4171.

(18) Install the rear output shaft bearing snap-ring into the rear case half.

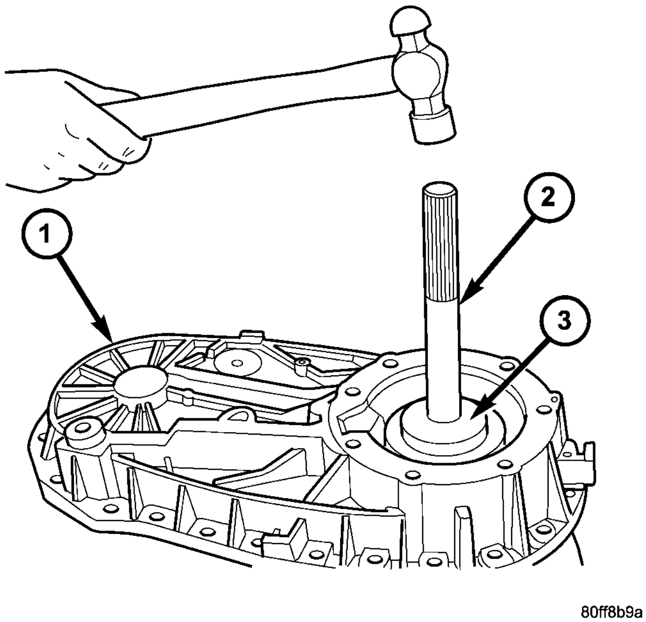


Fig. 55 Install Rear Output Shaft Bearing

1 - REAR CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8152

INPUT AND PLANETARY GEAR

(1) Lubricate gears and thrust washers with recommended transmission fluid.

(2) Install bottom thrust washer (Fig. 56) in low range gear planetary. Be sure washer tabs are properly aligned in gear notches.

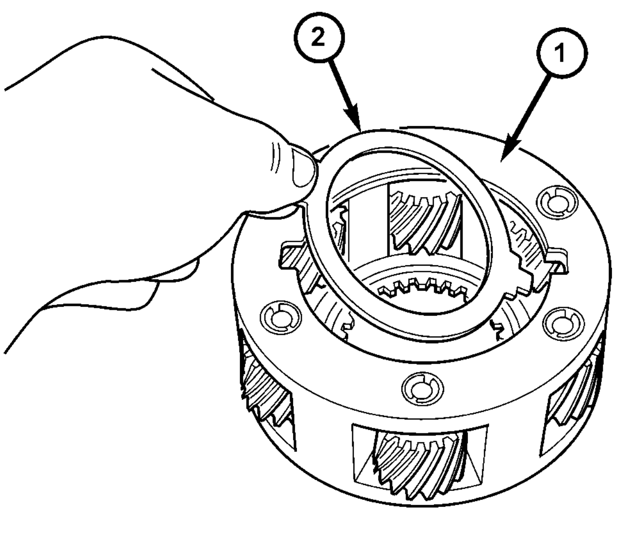


Fig. 56 Install Bottom Input Gear Thrust Plate

1 - PLANETARY
2 - THRUST PLATE

(3) Install input gear in low range gear (Fig. 57). Be sure input gear is fully seated.

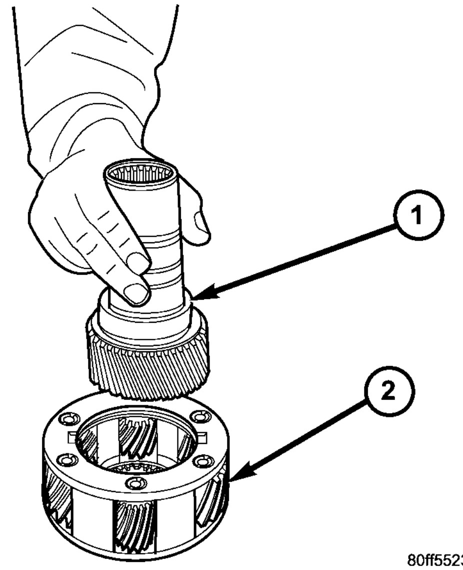


Fig. 57 Install Input Gear From Planetary

1 - INPUT GEAR
2 - LOW RANGE PLANETARY

(4) Install remaining thrust washer (Fig. 58) in low range gear and on top of input gear.

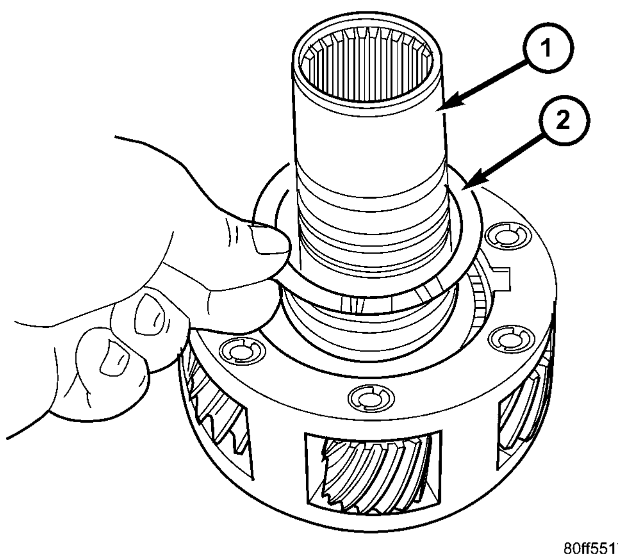


Fig. 58 Install Input Gear Thrust Plate

1 - INPUT GEAR
2 - THRUST PLATE

TRANSFER CASE - NV271 (Continued)

(5) Install retainer (Fig. 59) on input gear and install snap-ring (Fig. 60).

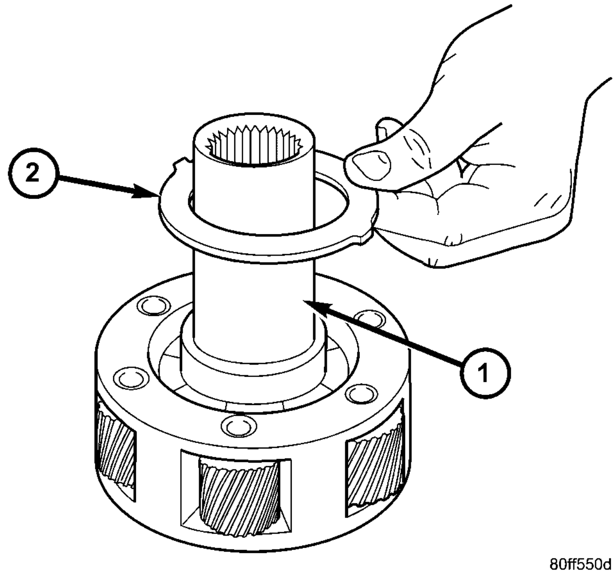


Fig. 59 Install Input Gear Retainer

1 - INPUT GEAR
2 - RETAINER

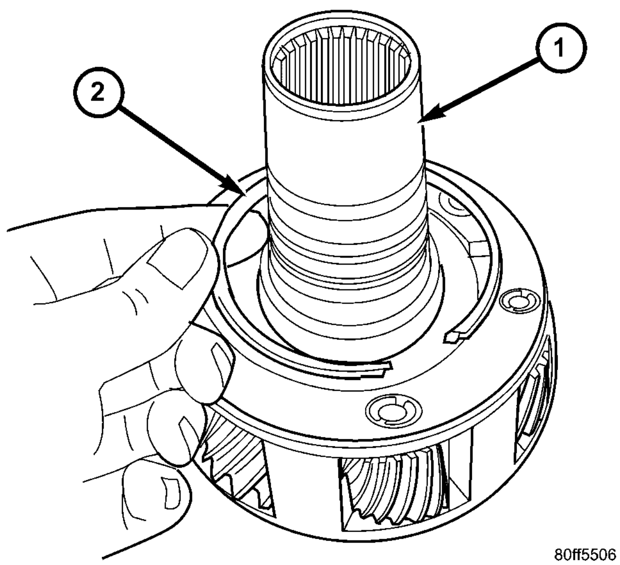


Fig. 60 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(6) Align and install low range/input gear assembly in front case (Fig. 61). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(7) Install snap-ring to hold input/low range gear into front bearing (Fig. 62).

(8) Install a new input gear seal using Installer 8841 and Handle C-4171.

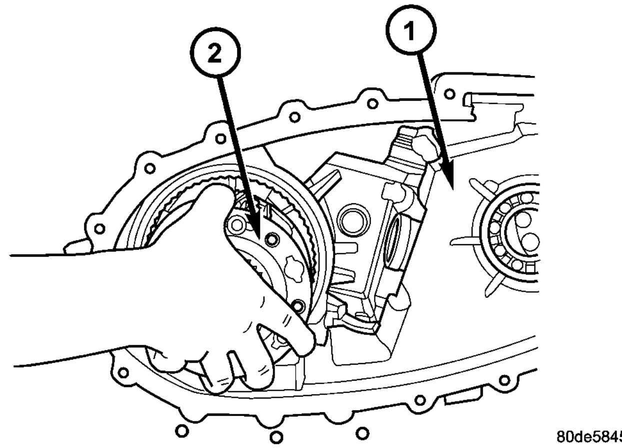


Fig. 61 Install Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

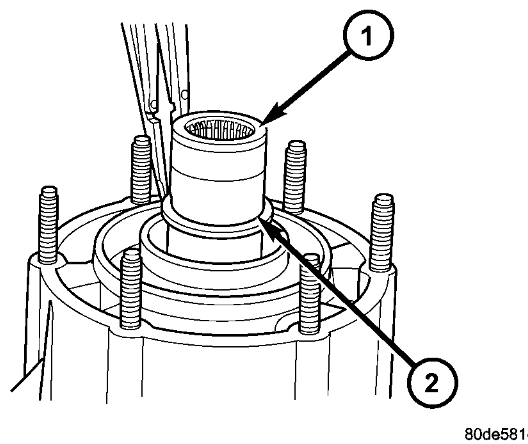


Fig. 62 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(9) Install a new input gear oil seal with Installer 9036 and Handle C-4171.

TRANSFER CASE - NV271 (Continued)

SHIFT FORKS AND MAINSHAFT

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Coat the interior of the drive sprocket hub with ATF+4 and install the drive sprocket drive hub (Fig. 63) onto the mainshaft.

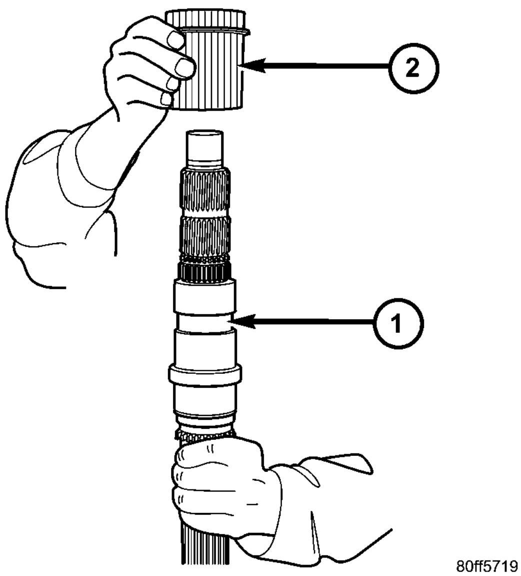


Fig. 63 Install the Drive Sprocket Drive Hub

1 - MAINSHAFT
2 - DRIVE SPROCKET DRIVE HUB

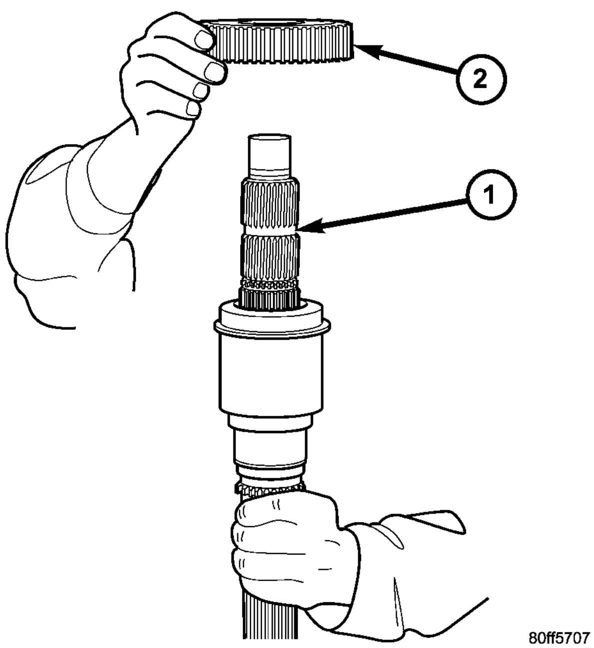


Fig. 64 Install Mode Hub

1 - MAINSHAFT
2 - MODE HUB

(3) Install the mode hub (Fig. 64) onto the mainshaft.

(4) Install the mode hub retaining ring (Fig. 65) onto the mainshaft.

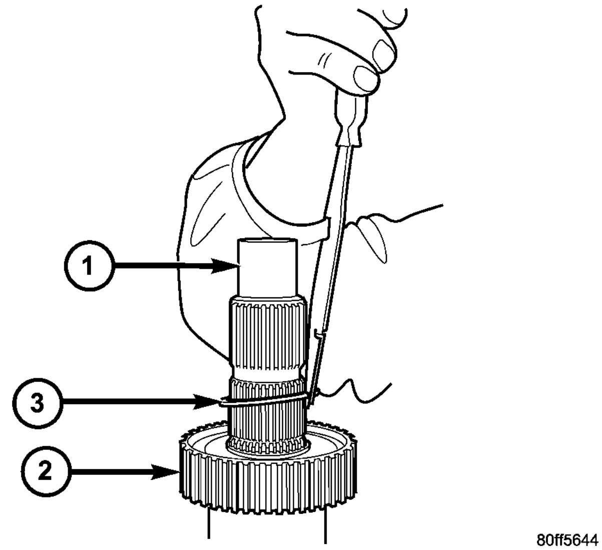


Fig. 65 Install Mode Hub Retaining Ring

1 - MAINSHAFT
2 - MODE HUB
3 - RETAINING RING

(5) Install the clutch gear (Fig. 66) onto the output shaft. Verify that the pointed ends of the clutch gear teeth are pointing to the front of the mainshaft.

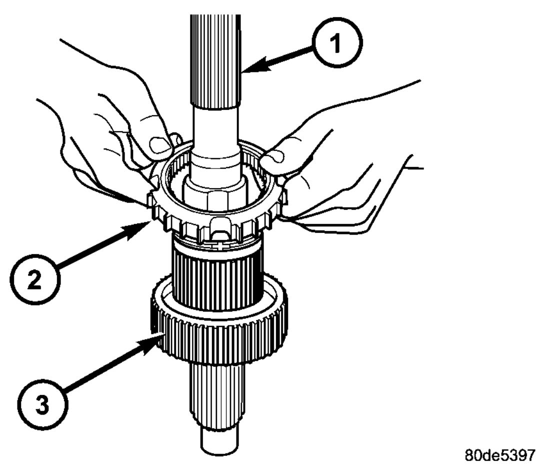


Fig. 66 Install Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

TRANSFER CASE - NV271 (Continued)

(6) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 67). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

(7) Apply Loctite™ 242, or equivalent, to the threads of the sector support to replentish the factory applied patch. Install the shift sector support. Tighten the sector support with Socket 9033 to 27-34 N·m (20-25 ft.lbs.).

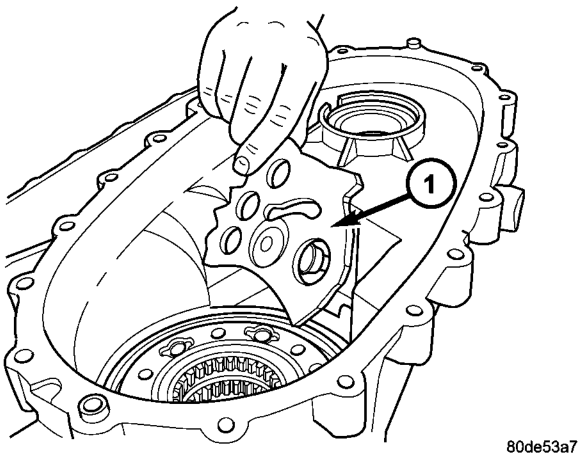


Fig. 67 Install Shift Sector

1 - SHIFT SECTOR

(8) Assemble and install range fork and hub (Fig. 68). Be sure hub is properly seated in low range gear and engaged to the input gear.

(9) Align and insert range fork pin in shift sector slot.

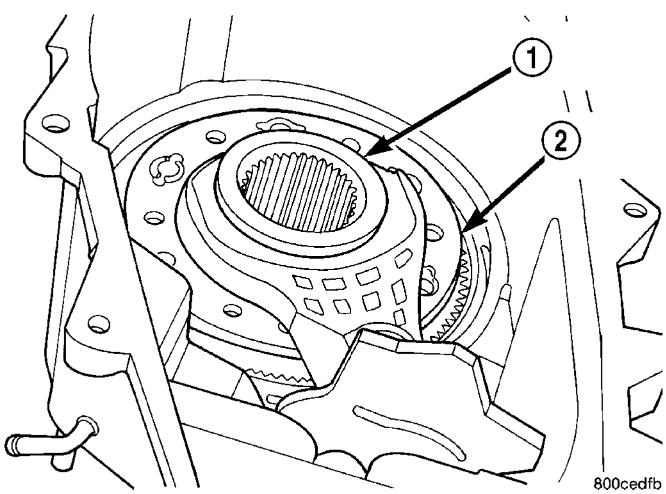


Fig. 68 Install Range Fork And Hub Assembly

1 - RANGE HUB
2 - RANGE FORK

(10) Install mode fork and shift rail onto the mode sleeve.

(11) Install the mode fork, sleeve, and shift rail into the transfer case (Fig. 69).

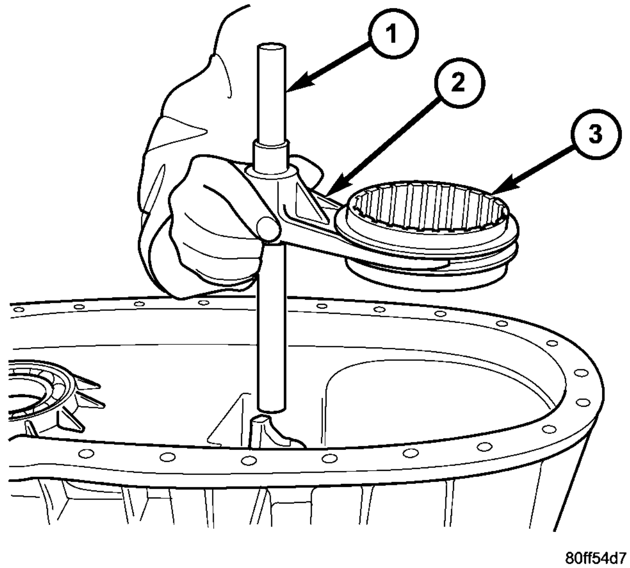


Fig. 69 Install Mode Fork, Sleeve, and Shift Rail Assembly

1 - SHIFT RAIL
2 - MODE FORK
3 - MODE SLEEVE

(12) Install mainshaft into the transfer case (Fig. 70). Guide mainshaft through the mode and range sleeves and into the input gear.

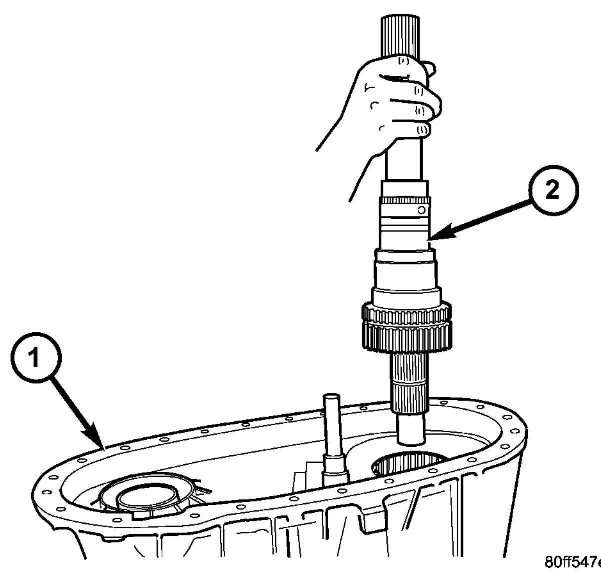


Fig. 70 Install Mainshaft Assembly

1 - FRONT CASE HALF
2 - MAINSHAFT ASSEMBLY

TRANSFER CASE - NV271 (Continued)

(13) Install the transfer case position sensor (Fig. 71). Tighten the sensor to 20-34 N·m (15-25 ft. lbs.) torque.

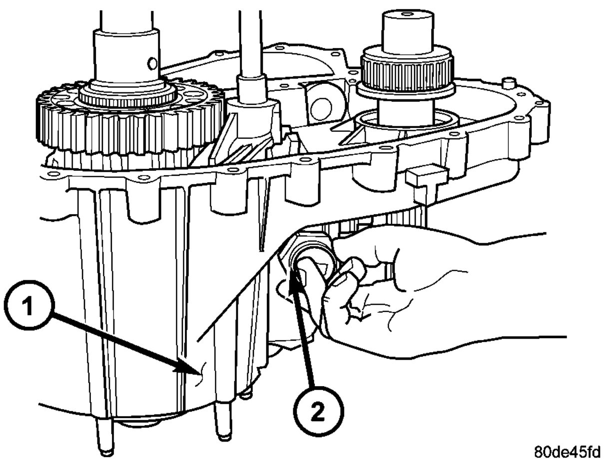


Fig. 71 Install Position Sensor

1 - FRONT CASE
2 - POSITION SENSOR

(14) Install manual shift lever and spacer onto sector shaft (Fig. 72).

(15) Install washer and nut on sector shaft to secure shift lever. Apply 1-2 drops Mopar® Lock N' Seal, or equivalent, to nut threads before installation. Then tighten nut to 27-34 N·m (20-25 ft. lbs.) torque.

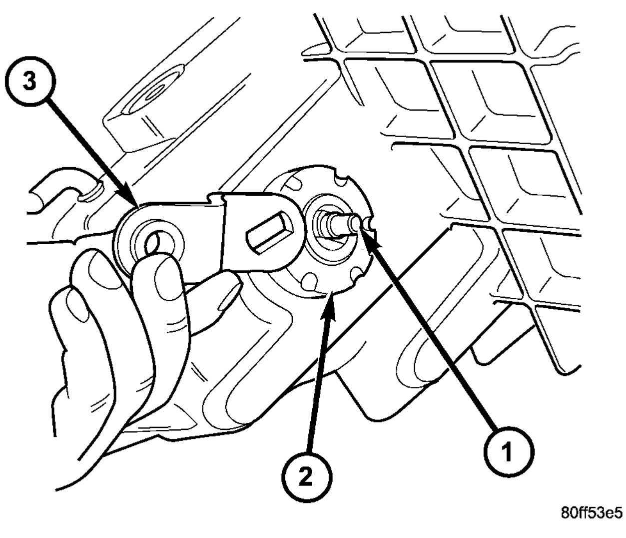


Fig. 72 Install Manual Shift Lever

1 - SHIFT SECTOR
2 - SECTOR SUPPORT
3 - MANUAL SHIFT LEVER

(16) Install new o-ring on detent plug (Fig. 73).

(17) Install detent plunger, spring, and plug (Fig. 74). Tighten the plug to 16-25 N·m (12-18 ft. lbs.).

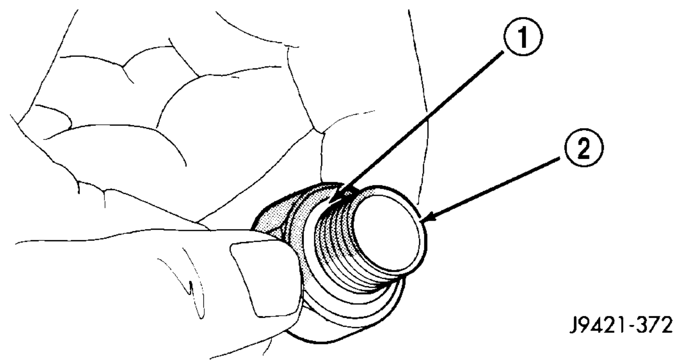


Fig. 73 O-Ring Installation On Detent Plug

1 - O-RING
2 - DETENT PLUG

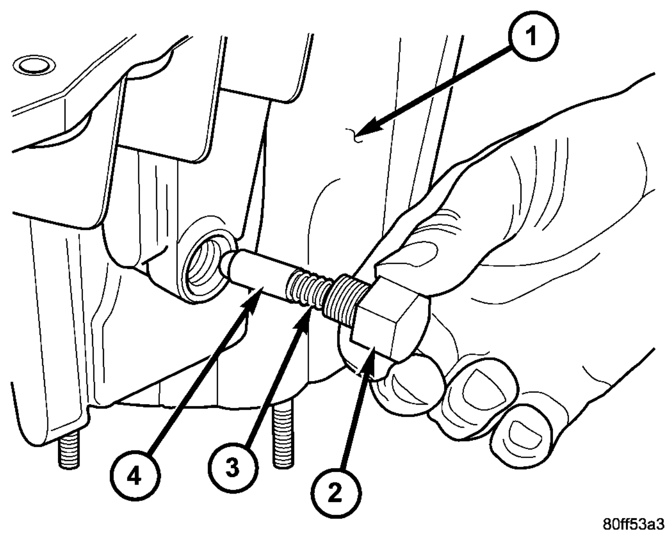


Fig. 74 Install Detent plug, Spring, and Plunger

1 - FRONT CASE HALF
2 - DETENT PLUG
3 - SPRING
4 - PLUNGER

TRANSFER CASE - NV271 (Continued)

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Install the front output shaft (Fig. 75) into the front output shaft front bearing.

(2) Install the front output shaft bearing inner snap-ring (Fig. 76) onto the output shaft.

(3) Install the new front output shaft seal with Installer MB991168A

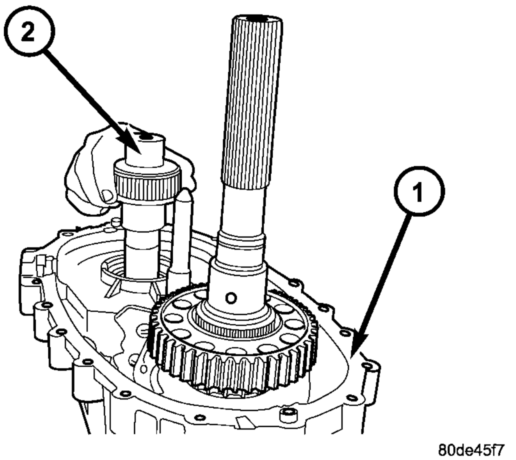


Fig. 75 Install Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

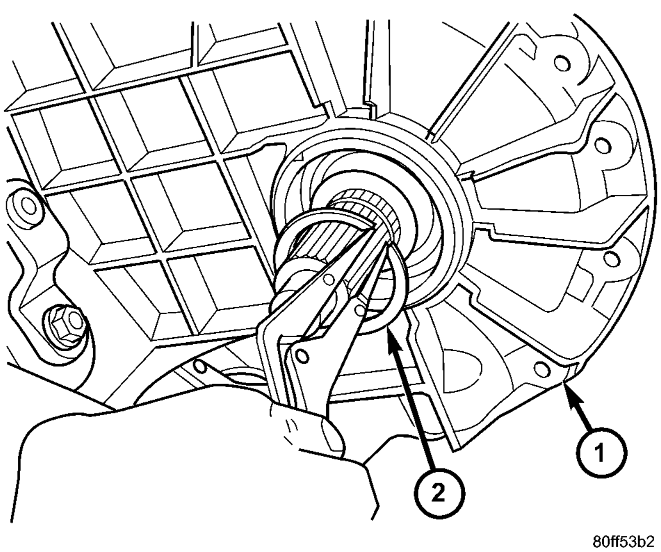


Fig. 76 Install Front Output Shaft Bearing Inner Snap-Ring

1 - FRONT CASE HALF
2 - SNAP-RING

(4) Insert front drive sprocket in drive chain.

(5) Install drive chain around rear drive sprocket.

(6) Position rear drive sprocket (Fig. 77) over the output shaft and lower the sprocket and chain assembly until the front sprocket is positioned over the front output shaft.

(7) Align the splines in the sprockets to the splines on the output shafts and install the sprockets onto the output shafts.

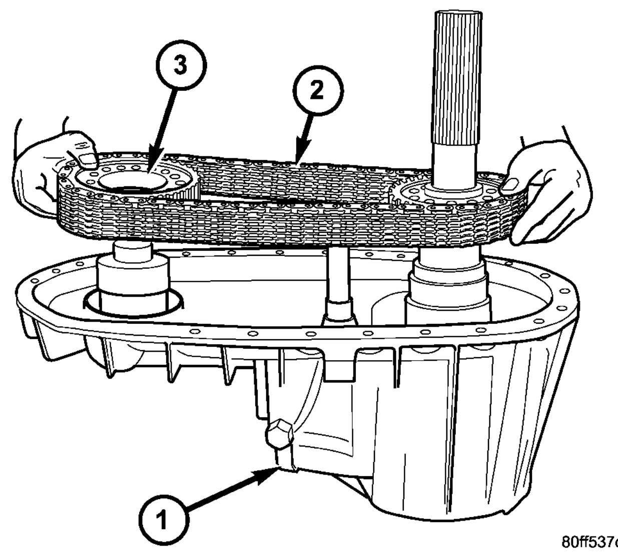


Fig. 77 Install Drive Chain and Sprockets

1 - FRONT CASE HALF
2 - CHAIN
3 - DRIVE SPROCKETS

(8) Install front sprocket retaining ring (Fig. 78).

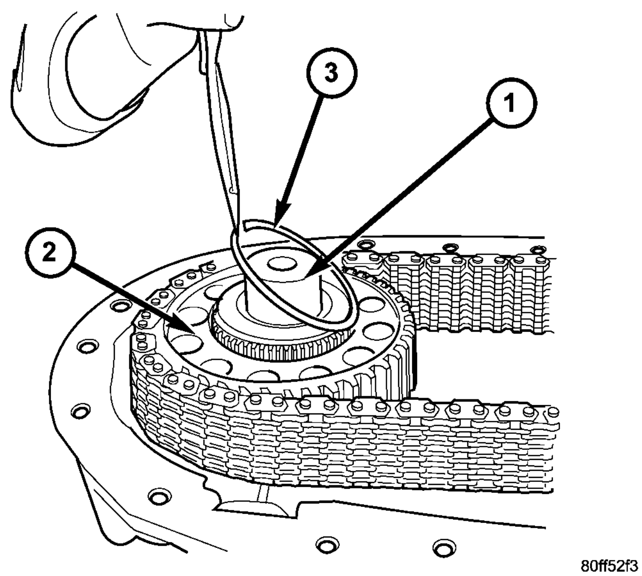


Fig. 78 Install Front Output Shaft Sprocket Retaining Ring

1 - FRONT OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

TRANSFER CASE - NV271 (Continued)

(9) Install rear sprocket retaining ring (Fig. 79).

(10) Install spring onto shift rail (Fig. 80).

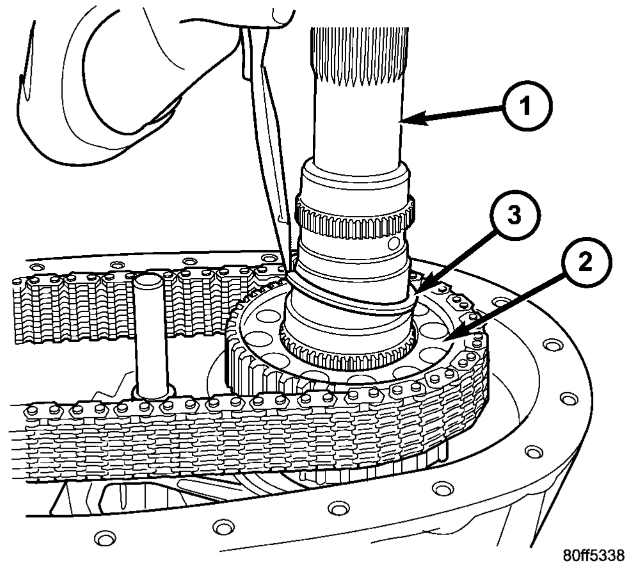


Fig. 79 Install Rear Output Shaft Sprocket Retaining Ring

1 - REAR OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

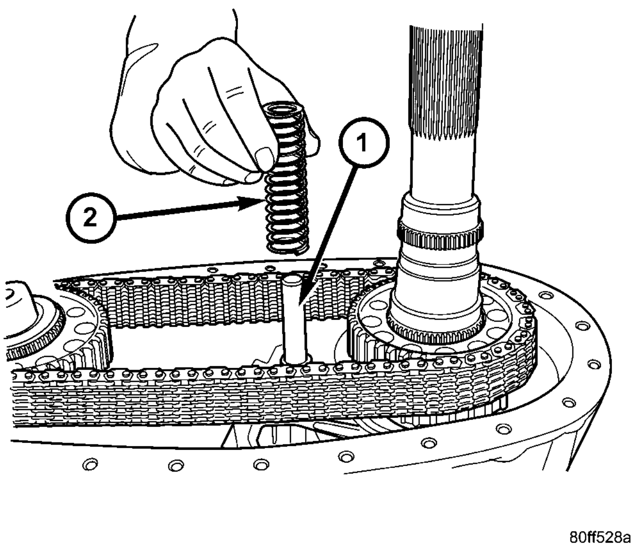


Fig. 80 Install Shift Rail Spring

1 - SHIFT RAIL
2 - SPRING

(11) Insert magnet in front case pocket (Fig. 81).

REAR CASE

(1) Install the oil pick-up tube and screen into the rear case half.

(2) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer

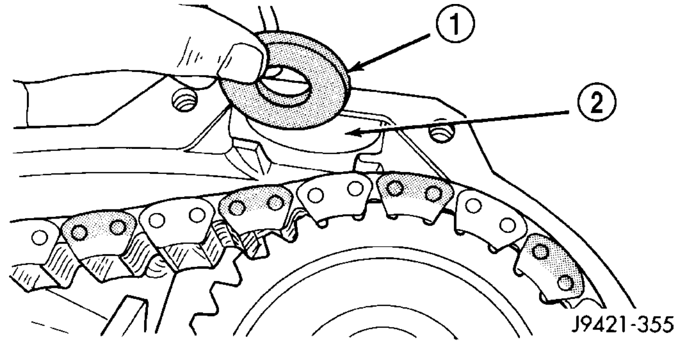


Fig. 81 Case Magnet Installation

1 - MAGNET
2 - CASE POCKET

bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

(3) Align mainshaft with he rear output shaft bearing and align shift rail with bore in rear case. Then install rear case (Fig. 82). Verify that the case alignment dowels correctly seat into their mating recesses.

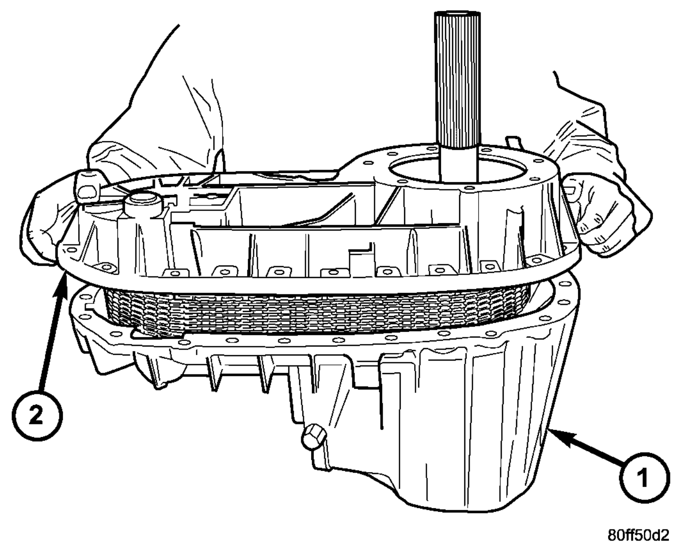


Fig. 82 Install Rear Case Half

1 - FRONT CASE HALF
2 - REAR CASE HALF

(4) Install 4-5 rear case-to front case bolts (Fig. 83) to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail, and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are misaligned.

(5) Tighten bolts to 27-34 N·m (20-25 ft. lbs.),

TRANSFER CASE - NV271 (Continued)

(6) Install rear output bearing inner snap-ring (Fig. 84) to output shaft.

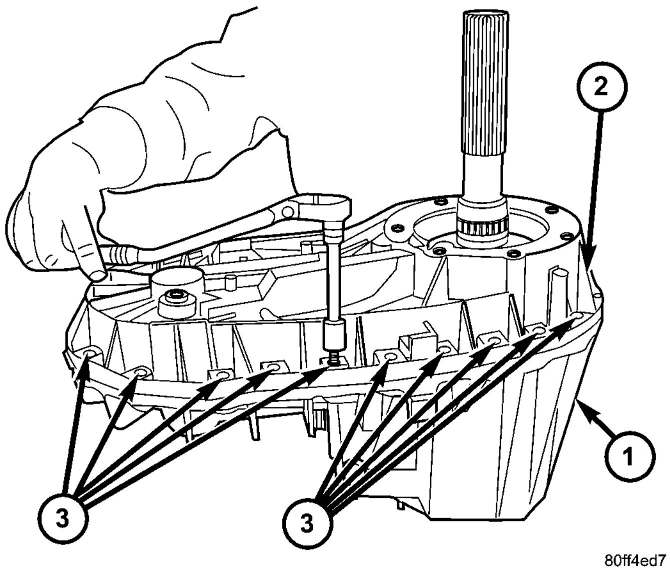


Fig. 83 Install Case Half Bolts

1 - FRONT CASE HALF
2 - REAR CASE HALF
3 - BOLTS

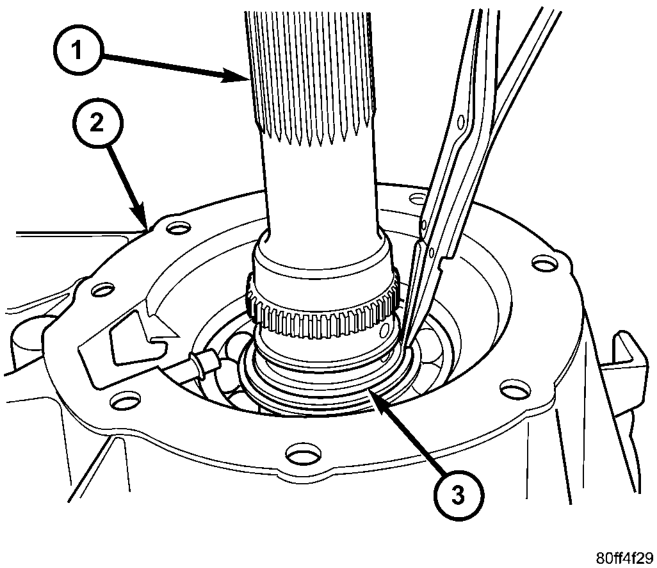


Fig. 84 Install Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

OIL PUMP AND REAR EXTENSION

(1) Install the oil pump (Fig. 85) onto the output shaft.

(2) Engage the oil pump pick-up tube (Fig. 86) into the oil pump. Verify that the pick-up tube o-ring is on the tube and is correctly installed to the oil pump.

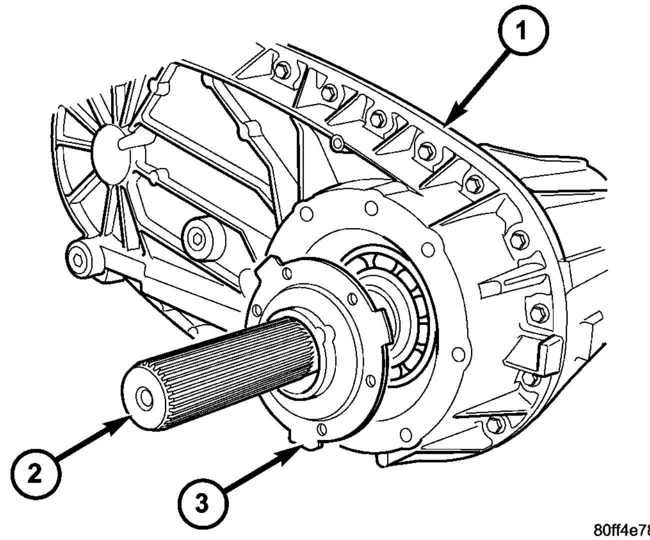


Fig. 85 Install Oil Pump

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT
3 - OIL PUMP

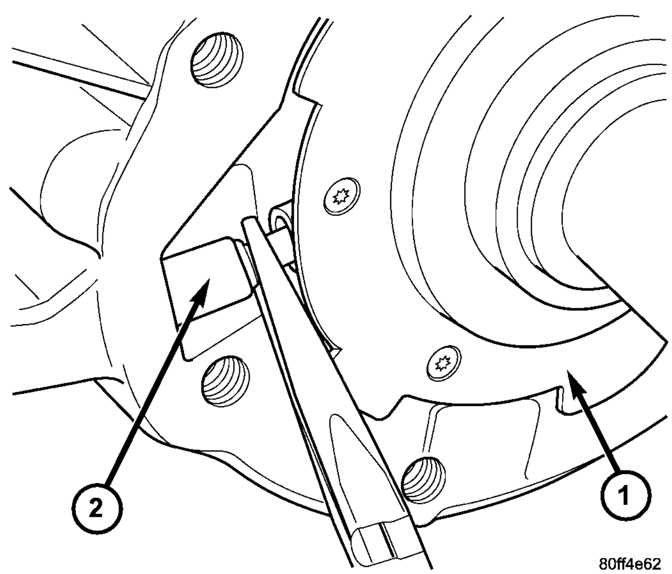


Fig. 86 Engage The Oil Pick-up To Oil Pump

1 - OIL PUMP
2 - OIL PICK-UP TUBE

TRANSFER CASE - NV271 (Continued)

(3) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of rear extension housing. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into output bearing.

(4) Install extension housing (Fig. 87) onto the rear case half.

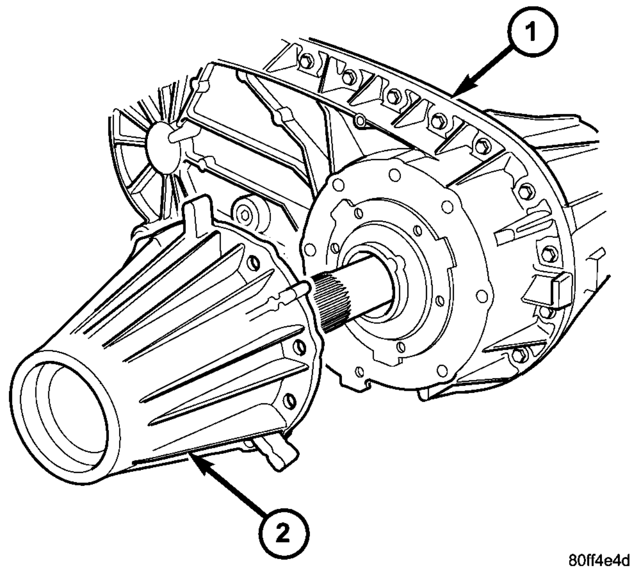


Fig. 87 Install Extension Housing

1 - REAR CASE HALF
2 - EXTENSION HOUSING

(5) Install rear extension bolts (Fig. 88). Tighten the bolts to 27-34 N·m (20-25 ft.lbs.).

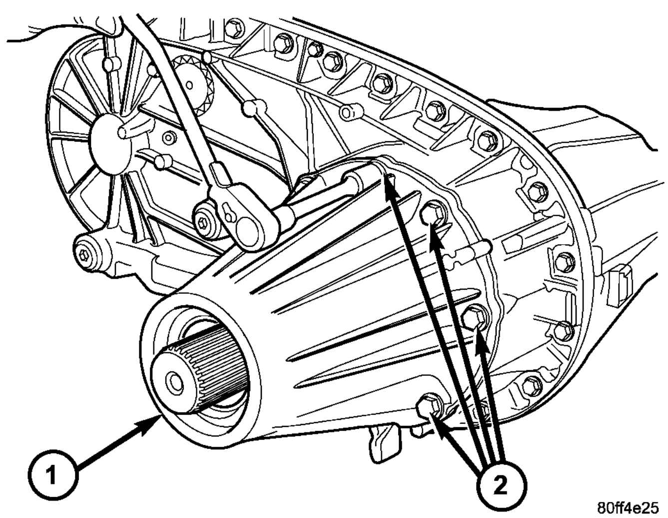


Fig. 88 Install Extension Housing Bolts

1 - EXTENSION HOUSING
2 - BOLTS

(6) Install the extension housing boot and seal assembly with Installer 9037 and Handle C-4171 (Fig. 89).

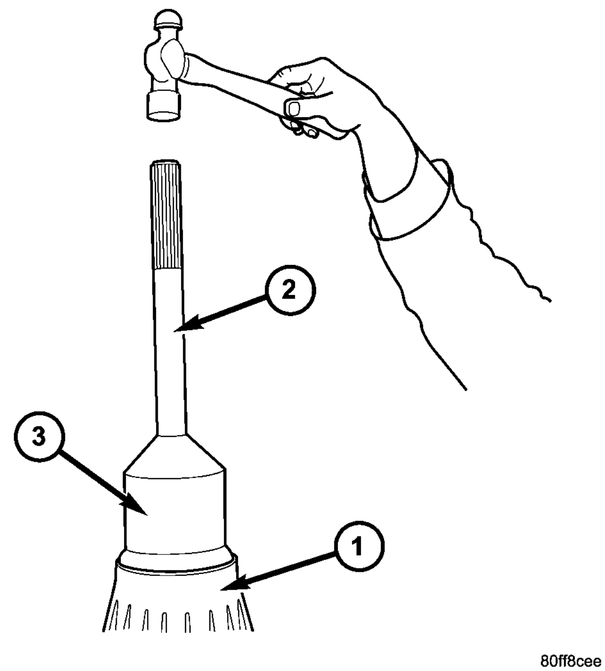


Fig. 89 Install Extension Housing Seal

1 - EXTENSION HOUSING
2 - HANDLE C-4171
3 - INSTALLER 9037

TRANSFER CASE - NV271 (Continued)

(7) Install the front companion flange onto the front output shaft.

(8) Install two bolts 180° apart into the front output shaft companion flange.

(9) Place holder over the bolts and against the companion flange (Fig. 90).

(10) Install a new front companion flange nut. Tighten the companion flange nut to 176-271 N·m (130-200 ft.lbs.).

INSTALLATION

(1) Align and seat transfer case on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke if necessary. Do not install any transfer case attaching nuts until the transfer case is completely seated against the transmission.

(2) Install and tighten transfer case attaching nuts. Tighten nuts to 30-41 N·m (20-30 ft.lbs.).

(3) Remove jack stand from under transmission.

(4) Align and connect propeller shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(5) Connect vent hose and transfer case position sensor connector.

(6) Connect shift rod to transfer case lever or floor shift arm. Use channel lock style pliers to press rod back into lever grommet.

(7) Adjust shift linkage, if necessary.

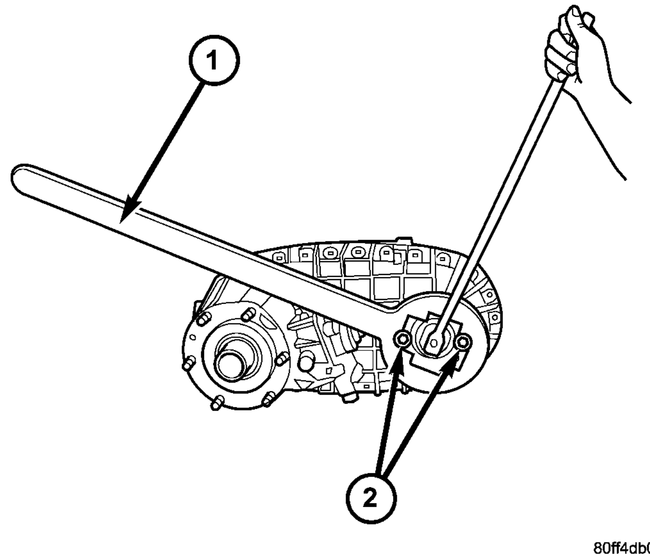


Fig. 90 Install Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(8) Fill transfer case with recommended transmission fluid and install fill plug.

(9) Install skid plate, if equipped. (Refer to 13 - FRAMES & BUMPERS/FRAME/TRANSFER CASE SKID PLATE - INSTALLATION)

(10) Lower vehicle

SPECIFICATIONS

TRANSFER CASE - NV271

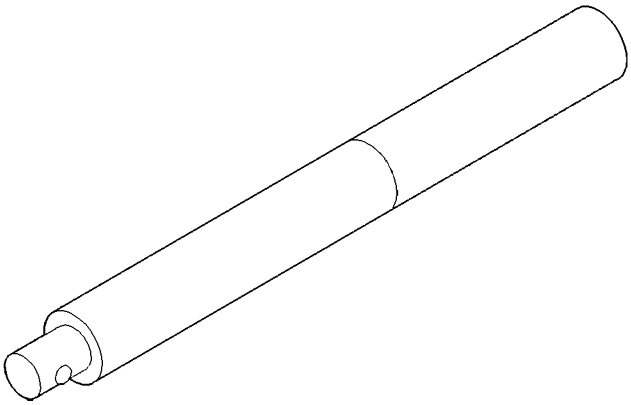
TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-25	12-18	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Extension Housing	27-34	20-25	-
Bolt, Case Half	27-34	20-25	-
Nut, Range Lever	27-34	20-25	-
Sector Support	27-34	20-25	-
Nuts, Mounting	30-41	20-30	-
Position Sensor	20-34	15-25	-
Nut, Companion Flange	176-271	130-200	-

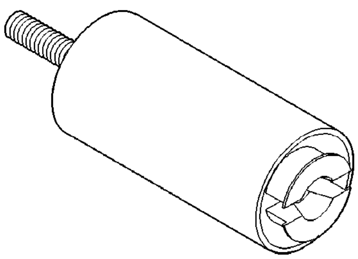
TRANSFER CASE - NV271 (Continued)

SPECIAL TOOLS

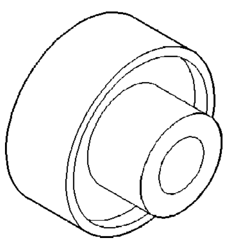
TRANSFER CASE NV271/NV273



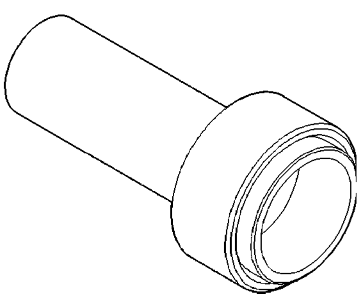
Handle, Universal - C-4171



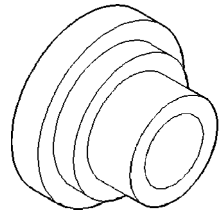
Remover - L-4454



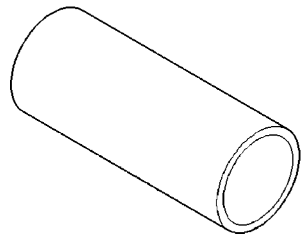
Installer, Bearing - 6953



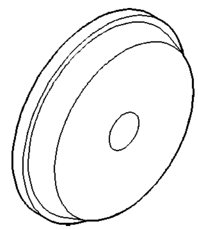
Installer, Pump Housing Seal - 7888



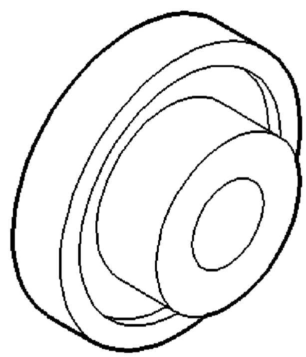
Installer, Bearing - 8128



Cup - 8148

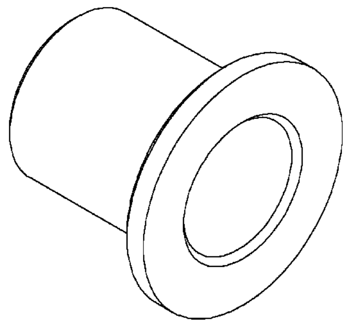


Installer - 8151

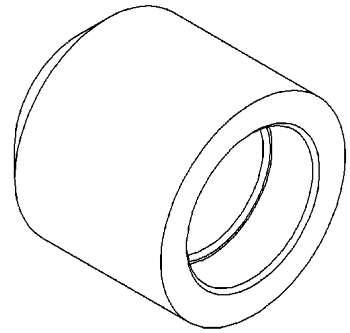


Installer - 8152

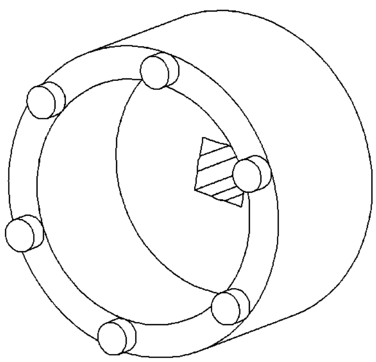
TRANSFER CASE - NV271 (Continued)



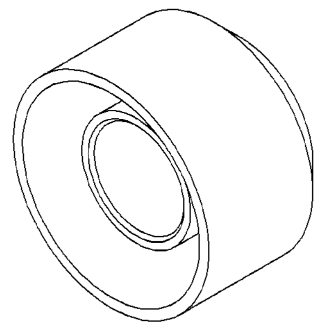
Installer - 8891



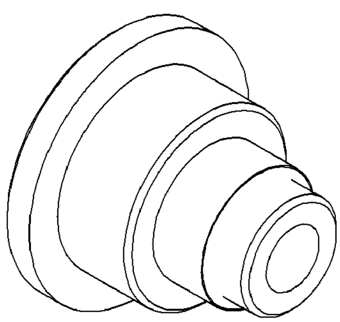
Installer, Seal - 9036



Socket - 9033



Installer, Seal - 9037



Installer, Bearing - 9035

EXTENSION HOUSING SEAL AND DUST BOOT

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Use a suitable chisel or pry tool to remove the rear extension housing dust boot (Fig. 91).

(4) Use a suitable chisel or pry tool to remove the rear extension housing seal.

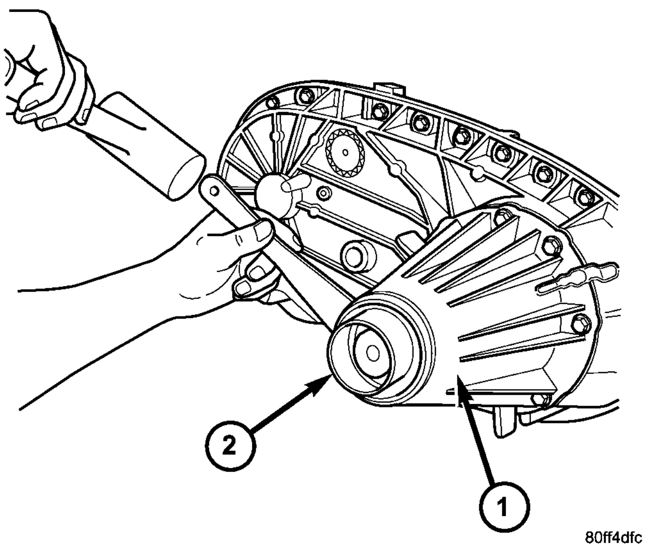


Fig. 91 Remove Extension Housing Dust Boot

1 - EXTENSION HOUSING
2 - DUST BOOT

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Install the extension housing dust boot and seal assembly with Installer 9037 and Handle C-4171 (Fig. 92).

(3) Install propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(4) Verify proper transfer case fluid level.

(5) Lower vehicle.

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 93).

(1) Raise vehicle.

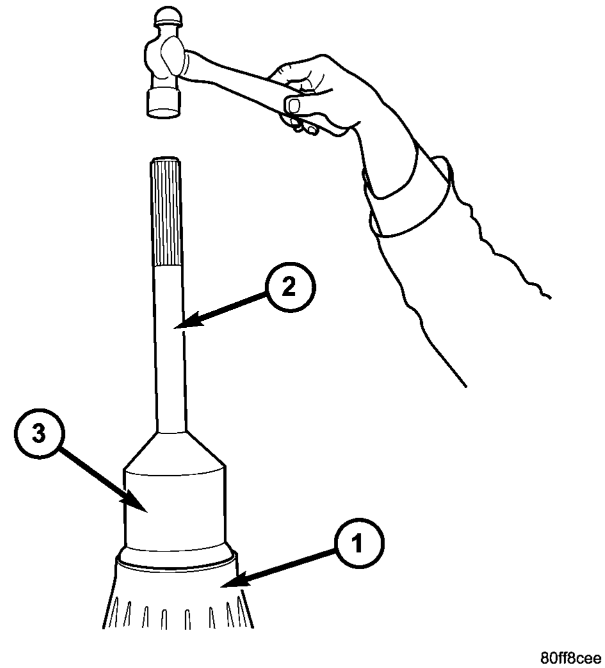


Fig. 92 Install Extension Housing Seal

1 - EXTENSION HOUSING
2 - HANDLE C-4171
3 - INSTALLER 9037

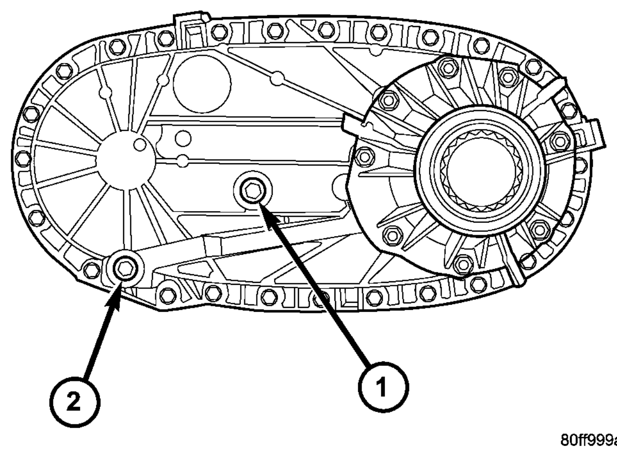


Fig. 93 Drain and Fill Locations

1 - FILL HOLE
2 - DRAIN HOLE

(2) Position drain pan under transfer case.

(3) Remove drain and fill plugs and drain lubricant completely.

(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).

(5) Remove drain pan.

(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, Automatic Transmission fluid.

(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).

(8) Lower vehicle.

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Remove the front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL).

(2) Install two bolts 180° apart into the front output shaft companion flange.

(3) Place holder over the bolts and against the companion flange (Fig. 94).

(4) Remove and discard the front companion flange nut.

(5) Remove the companion flange from the front output shaft. It may be necessary to use Flange puller 8992 to remove the companion flange.

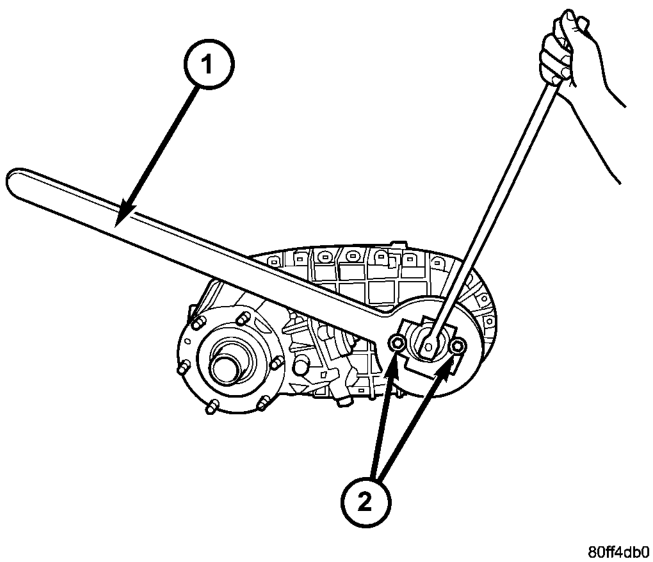


Fig. 94 Remove Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(6) Using a screw and a slide hammer, remove the front output shaft seal.

INSTALLATION

(1) Install the new front output shaft seal with Installer MB991168A.

(2) Install the front companion flange onto the front output shaft.

(3) Install two bolts 180° apart into the front output shaft companion flange.

(4) Place holder over the bolts and against the companion flange (Fig. 95).

(5) Install a new front companion flange nut. Tighten the companion flange nut to 258-312 N·m (190-230 ft.lbs.).

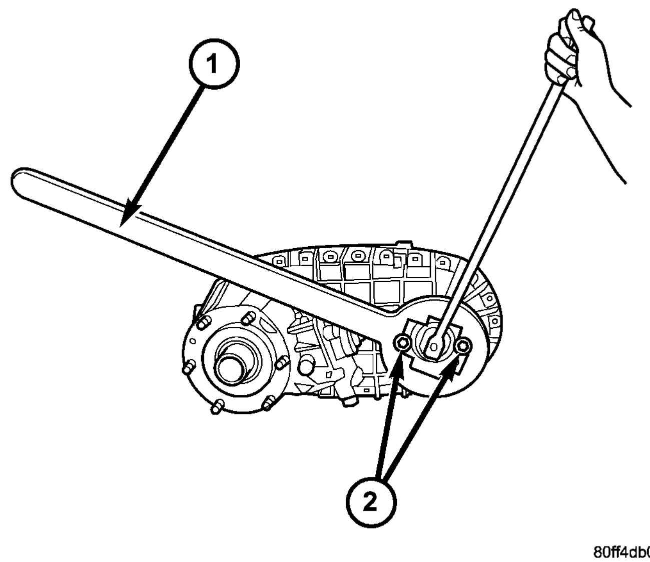


Fig. 95 Install Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(6) Install front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).

POSITION SENSOR

DESCRIPTION

The transfer case position sensor is an electronic device whose output can be interpreted to indicate the transfer case's current operating mode. The sensor consists of a five position, resistive multiplexed circuit which returns a specific resistance value to the Powertrain Control Module (PCM) for each transfer case operating mode. The sensor is located on the top of the transfer case, just left of the transfer case centerline and rides against the sector plate roostercomb. The PCM supplies 5VDC (+/- 0.5V) to the sensor and monitors the return voltage to determine the sector plate, and therefore the transfer case, position.

OPERATION

During normal vehicle operation, the Powertrain Control Module (PCM) monitors the transfer case position sensor return voltage to determine the operating mode of the transfer case. Refer to the Operating Mode Versus Resistance table for the correct resistance for each position (Fig. 96).

OPERATING MODE VERSUS RESISTANCE

SENSOR POSITION	OPERATING MODE	SENSOR RESISTANCE (ohms)
1	2H	1172-1195
2	4H	677-691
3	NEUTRAL	406-415
4	4L	208-213
5	NOT USED	60-61

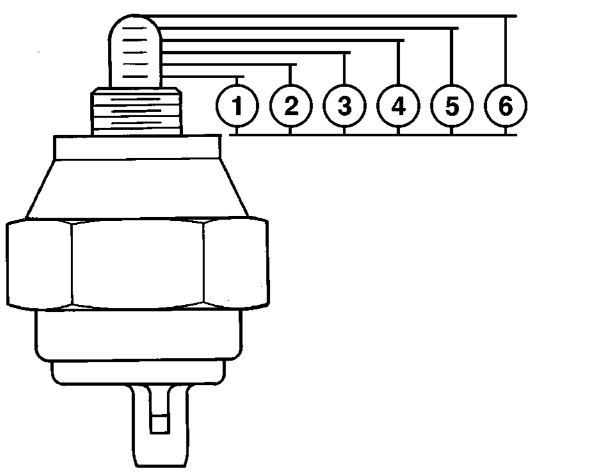


Fig. 96 Position Sensor Linear Movement

1 - POSITION 1 - 10mm ±0.5mm
2 - POSITION 2 - 12mm ±0.5mm
3 - POSITION 3 - 14mm ±0.5mm
4 - POSITION 4 - 16mm ±0.5mm
5 - POSITION 5 - 18mm ±0.5mm
6 - POSITION 6 - 20mm±0.5mm - FULL EXTENSION

REMOVAL

(1) Raise and support the vehicle.
(2) Disengage the transfer case position sensor connector from the position sensor.
(3) Remove the position sensor from the transfer case.

INSTALLATION

(1) Inspect the o-ring seal on the transfer case position sensor. Replace the o-ring if necessary.
(2) Install the transfer case position sensor into the transfer case. Torque the sensor to 20-34 N·m (15-25 ft.lbs.).
(3) Engage the transfer case position sensor connector to the position sensor.
(4) Lower vehicle.
(5) Verify proper sensor operation.

SHIFT LEVER

REMOVAL

(1) Shift transfer case into 2H.
(2) Raise and support the vehicle.
(3) Loosen adjusting trunnion lock bolt and slide shift rod out of trunnion. If rod lacks enough travel to come out of trunnion, push trunnion out of shift lever.
(4) Lower vehicle.
(5) Remove transfer case shifter knob cap.
(6) Remove nut holding shifter knob to shift lever.
(7) Remove shifter knob.
(8) Remove the shift boot from the shifter console.
(9) Remove the bolts securing the shifter mechanism to the floor pan (Fig. 97).
(10) Separate shift lever mechanism from the vehicle.

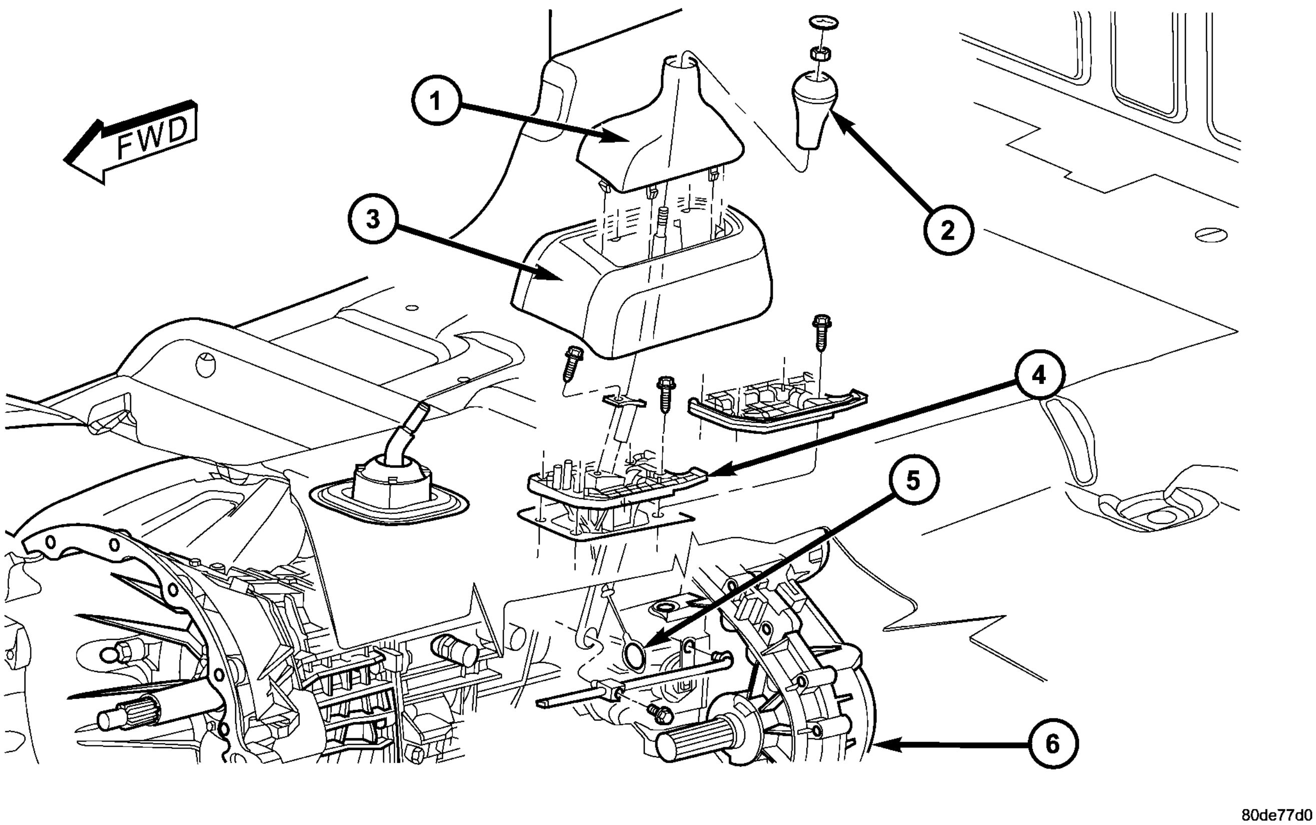


Fig. 97 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

SHIFT LEVER (Continued)

INSTALLATION

(1) If the shifter mechanism does not have a adjustment locating pin installed, align the adjustment channel on the shifter assembly to the locating hole in the lower shift lever and install an appropriately sized pin to retain the position (Fig. 98).

(2) Position shift lever in vehicle.

(3) Install the bolts to hold the shifter mechanism to the floor pan.

(4) Raise vehicle.

(5) Verify that the transfer case is still in the 2H position. The 2H detent position on the transfer case shift arm is the second position from full forward.

(6) Install trunnion to shift lever, if necessary.

(7) Install shift rod to trunnion, if necessary.

(8) Tighten the shift rod lock bolt to 10 N·m (90 in.lbs.).

(9) Remove the shifter adjustment locating pin from the adjustment channel and the locating hole.

(10) Lower vehicle.

(11) Install the transfer case shifter console.

(12) Install the shifter boot and the shifter knob onto the shifter lever.

(13) Install nut to hold shifter knob to shift lever.

(14) Install shifter knob cap.

(15) Verify transfer case operation.

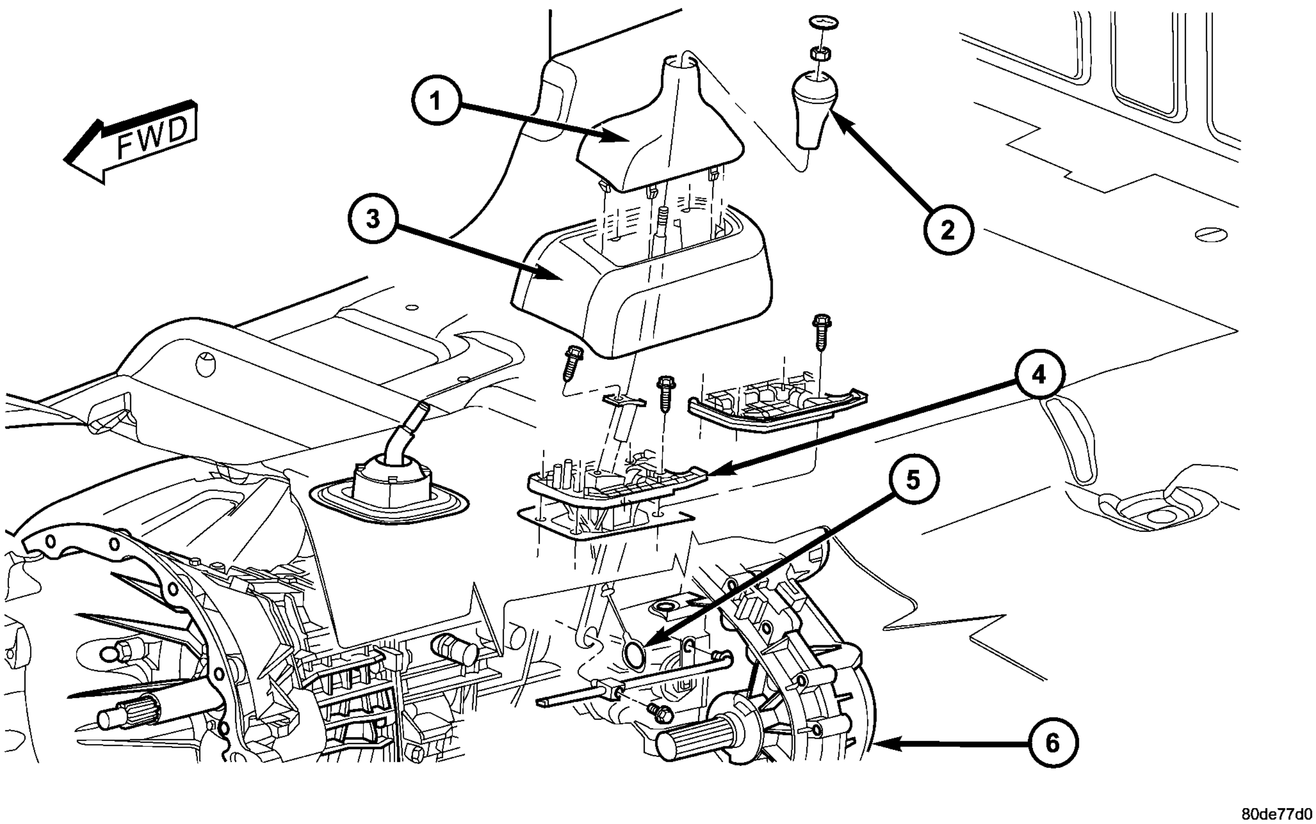


Fig. 98 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

SHIFT LEVER (Continued)

ADJUSTMENTS

ADJUSTMENT - SHIFT LEVER

(1) Move shift lever into 2H position.

(2) Raise vehicle.

(3) Loosen shift rod lock bolt at trunnion.

(4) Check shift rod fit in trunnion. Be sure rod does not bind in trunnion. Lubricate the shift rod and trunnion if necessary.

(5) Verify that transfer case shift lever is in 2H detent position. The 2H detent position on the transfer case shift arm is the second position from full forward.

(6) Align the adjustment locating hole on the lower shifter lever with the adjustment channel on the shifter bracket assembly (Fig. 99).

(7) Insert an appropriately sized pin through into the adjustment channel and through the locating hole to hold the shifter in the correct position.

(8) Tighten shift rod lock bolt to 10 N·m (90 in. lbs.) torque.

(9) Remove the locating pin from the adjustment channel and locating hole.

(10) Check shift linkage operation. Be sure transfer case shifts into and operates properly in all ranges.

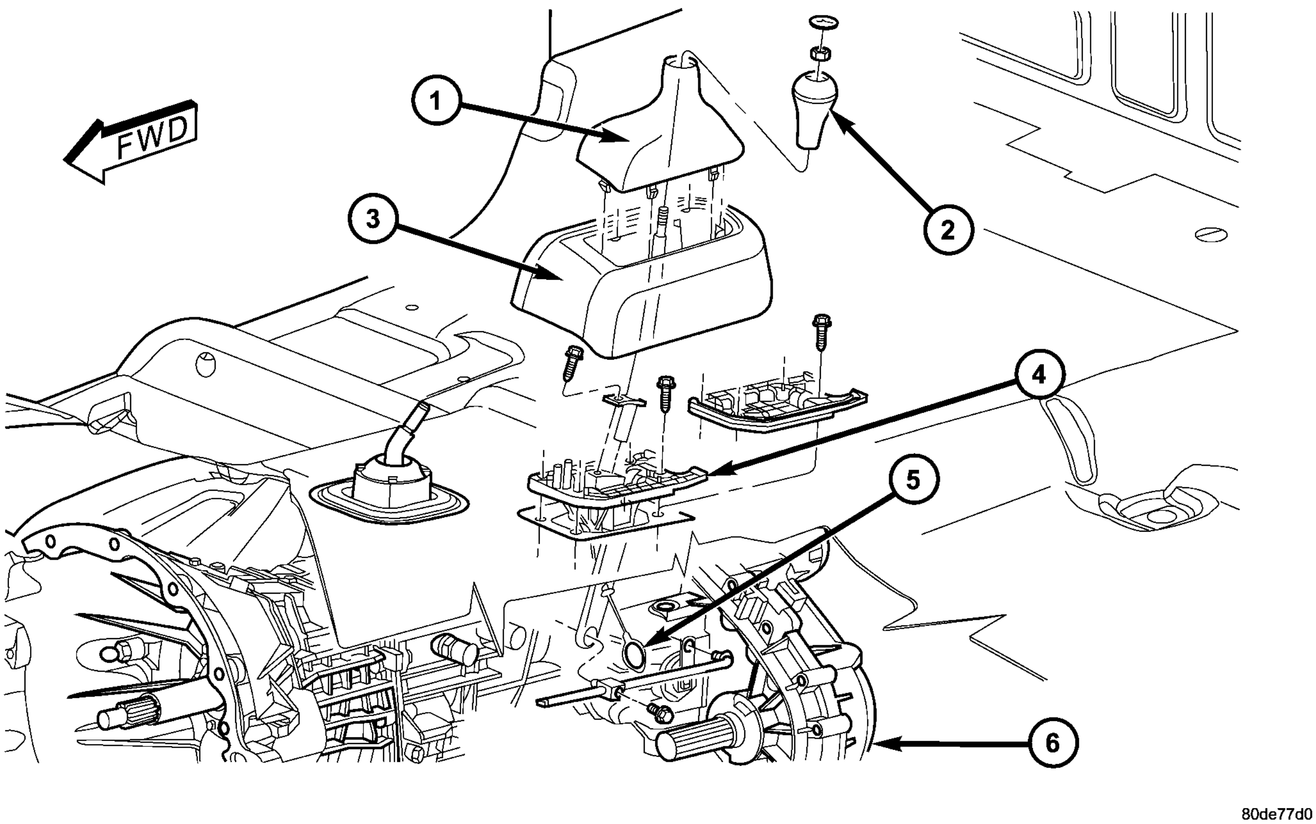


Fig. 99 Transfer Case Shifter

1 - SHIFTER BOOT
2 - SHIFTER KNOB
3 - SHIFTER CONSOLE
4 - SHIFTER MECHANISM
5 - ALIGNMENT PIN
6 - TRANSFER CASE

TRANSFER CASE - NV243

TABLE OF CONTENTS

TRANSFER CASE - NV243

DESCRIPTION

The NV243 is an electronically controlled part-time transfer case with a low range gear reduction system. The NV243 has three operating ranges plus a NEUTRAL position. The low range system provides a gear reduction ratio for increased low speed torque capability.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum retainer housings bolted to the case halves.

OPERATING RANGES

Transfer case operating ranges are:

- 2WD (2-wheel drive)
- 4HI (4-wheel drive)
- 4LO (4-wheel drive low range)
- NEUTRAL

The 2WD range is for use on any road surface at any time.

The 4HI and 4LO ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is wet or slippery or covered by ice and snow.

The low range reduction gear system is operative in 4LO range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

SHIFT MECHANISM

Operating ranges are selected with a dash mounted shift selector switch. The shift selector switch provides a input to the Transfer Case Control Module (TCCM) to indicate the driver’s desire to change operating ranges. The TCCM uses this input, along with input from the transfer case mounted mode sensor and information from the vehicle’s bus, to determine if a shift is permitted. If the TCCM decides the shift is permitted, the TCCM controls the shift motor, mounted to the exterior of the transfer case, to perform the shift.

TRANSFER CASE - NV243 (Continued)

IDENTIFICATION

A circular ID tag is attached to the rear case of each transfer case (Fig. 1). The ID tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

OPERATION

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range sleeve. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.

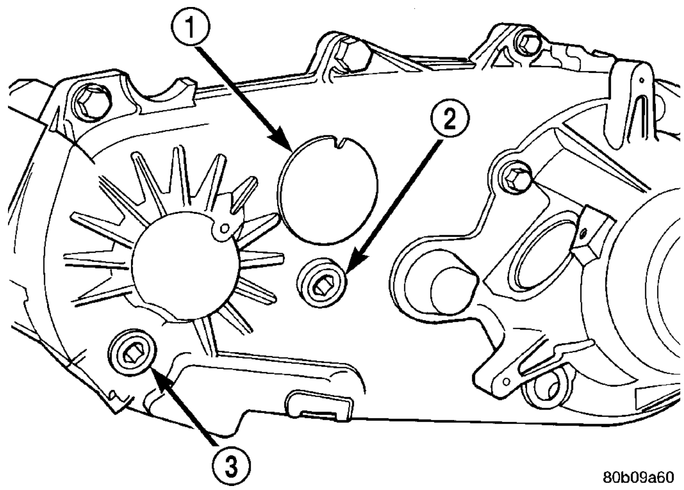


Fig. 1 Fill/Drain Plug And I.D. Tag Locations - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

DIAGNOSIS AND TESTING - TRANSFER CASE - NV243

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case electronically controlled shift system malfunction.	1) Verify proper operation per the appropriate diagnostic manual.
	2) If vehicle was operated for an extended period in 4HI mode on dry surface, driveline torque load may cause difficulty.	2) Drive the vehicle in a straight line and momentarily release the accelerator. The transfer case can then be shifted to the desired mode.
	3) Insufficient or incorrect lubricant.	3) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, Automatic Transmission Fluid.
	4) Internal transfer case components binding, worn, or damaged.	4) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	2) Internal transfer case components binding, worn, or damaged.	2) Repair or replace components as necessary.

TRANSFER CASE - NV243 (Continued)

Condition	Possible Cause	Correction
Transfer case noisy while in, or jumps out of, 4LO mode.	1) Transfer case not completely engaged in 4LO position.	1) While rolling 2-3 MPH and the transmission in NEUTRAL, or clutch depressed on vehicles equipped with a manual transmission, shift transfer case to the 2WD or 4HI position, and then back into the 4LO position.
	2) Range fork damaged, inserts worn, or fork is binding on the shift rail.	2) Repair or replace components as necessary.
	3) Low range gear worn or damaged.	3) Repair or replace components as necessary.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Transfer case vent closed or restricted.	2) Clean or replace vent as necessary.
	3) Transfer case seals damaged or installed incorrectly.	3) Replace suspect seal.
Abnormal tire wear.	1) Extended operation in 4HI mode on dry surfaces,	1) Operate vehicle in 2WD mode on dry surfaces.

REMOVAL

(1) Shift transfer case into 2WD.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shafts for alignment reference.
(5) Support transmission with jack stand.
(6) Remove the transfer case skid plate, if equipped.
(7) Disconnect front and rear propeller shafts at transfer case.
(8) Disconnect transfer case shift motor and mode sensor wire connectors.
(9) Disconnect transfer case vent hose.
(10) Support transfer case with transmission jack.
(11) Secure transfer case to jack with chains.
(12) Remove nuts attaching transfer case to transmission (Fig. 2).
(13) Pull transfer case and jack rearward to disengage transfer case.
(14) Remove transfer case from under vehicle.

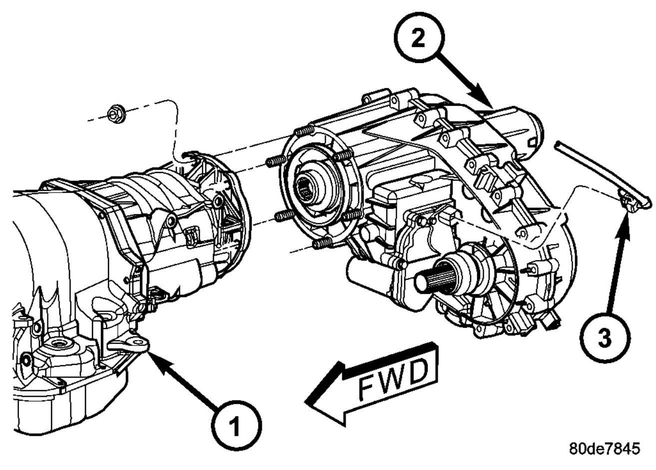


Fig. 2 Remove Transfer Case - Typical

1 - TRANSMISSION
2 - TRANSFER CASE
3 - MODE SENSOR CONNECTOR

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

TRANSFER CASE - NV243 (Continued)

SHIFT MOTOR ASSEMBLY AND FRONT OUTPUT SHAFT SEAL

(1) Remove the bolts (Fig. 3) which hold the shift motor and mode sensor assembly to the transfer case.

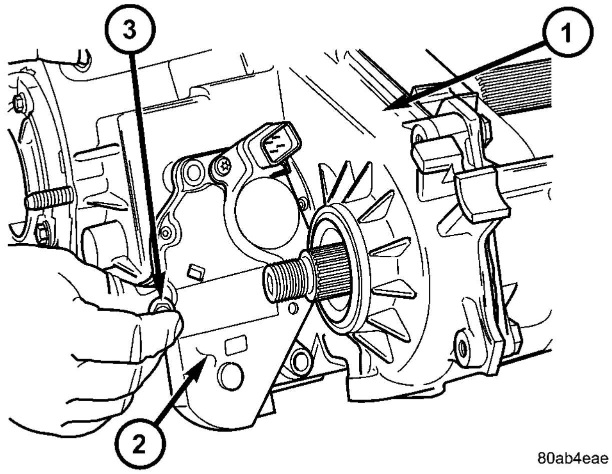


Fig. 3 Remove the Shift Motor and Mode Sensor Assembly Bolts - Typical

1 - TRANSFER CASE
2 - SHIFT MOTOR AND MODE SENSOR ASSEMBLY
3 - BOLT

(2) Remove the shift motor and mode sensor assembly from the transfer case.

(3) Remove the front propeller shaft seal boot retaining clamp (Fig. 4).

(4) Remove the front propeller shaft seal boot (Fig. 5).

(5) Remove the front output shaft seal slinger by bending (Fig. 6) the slinger ears away from the transfer case.

(6) Using a suitable pry tool (Fig. 7), remove the slinger from the output shaft using care not to damage the shaft.

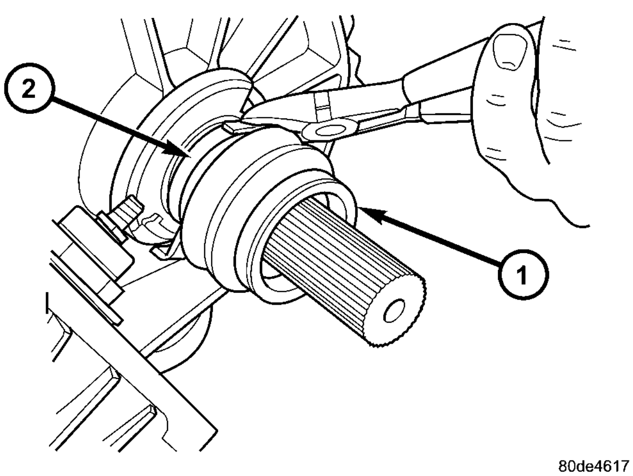


Fig. 4 Remove Boot Clamp - Typical

1 - SEAL BOOT
2 - BOOT CLAMP

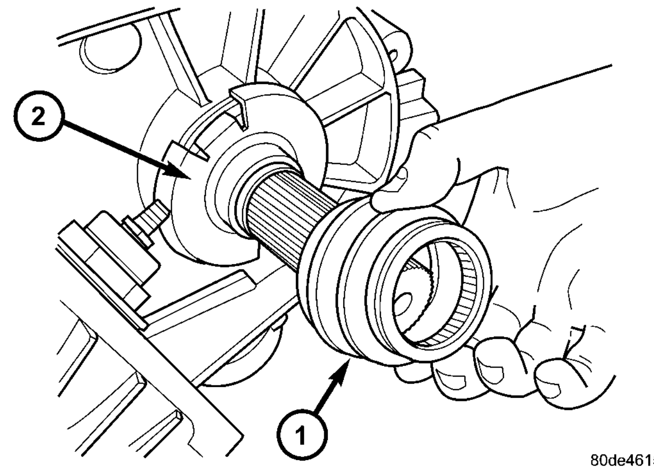


Fig. 5 Remove Seal Boot - Typical

1 - SEAL BOOT
2 - SEAL SLINGER

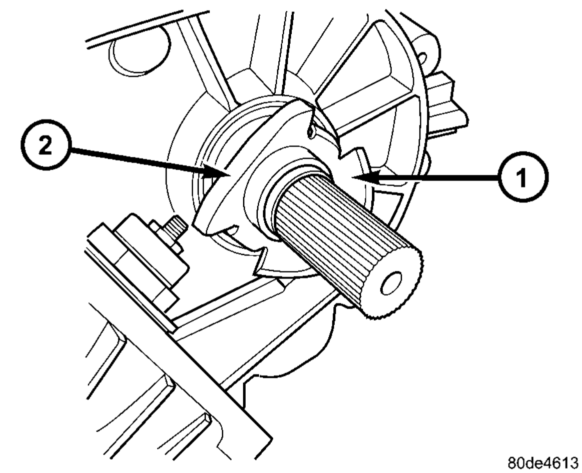


Fig. 6 Bend Slinger Ears - Typical

1 - SLINGER
2 - BEND UPWARD

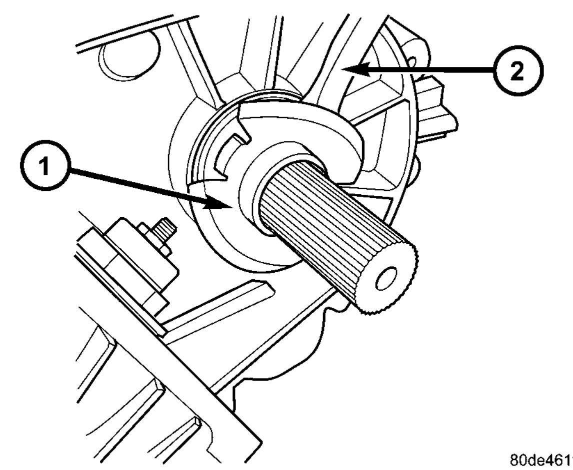


Fig. 7 Remove Slinger From Shaft - Typical

1 - SLINGER
2 - PRY TOOL

(7) Using a screw and a slide hammer, remove the front output shaft seal.

REAR EXTENSION

(1) Remove rear extension bolts (Fig. 8).

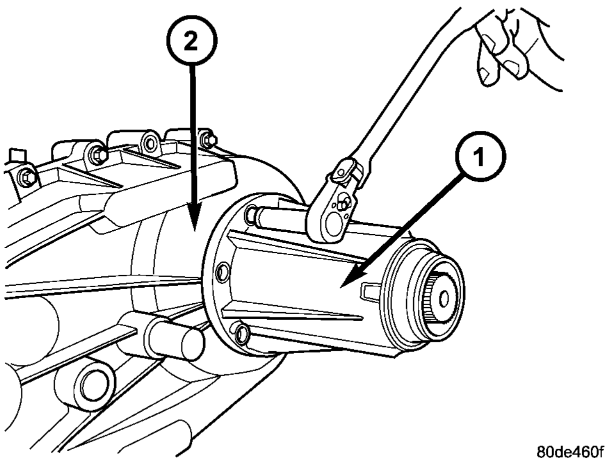


Fig. 8 Remove Rear Extension Bolts

1 - EXTENSION HOUSING
2 - TRANSFER CASE

(2) Remove rear extension housing (Fig. 9). Tap extension once or twice with a plastic mallet to break sealer bead and loosen it.

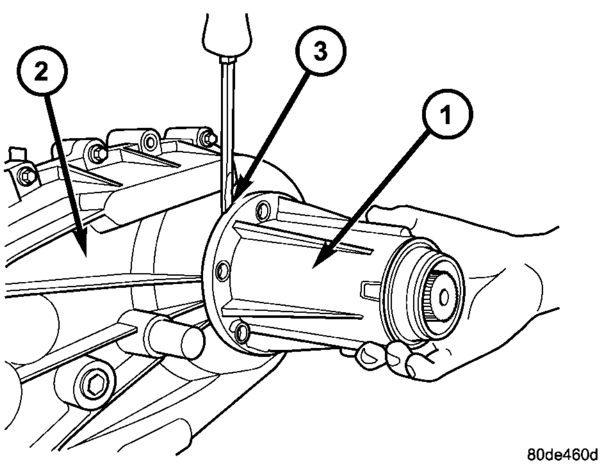


Fig. 9 Remove Rear Extension

1 - EXTENSION HOUSING
2 - TRANSFER CASE
3 - PRY SLOT

(3) Remove output bearing retaining ring with heavy duty snap-ring pliers (Fig. 10).

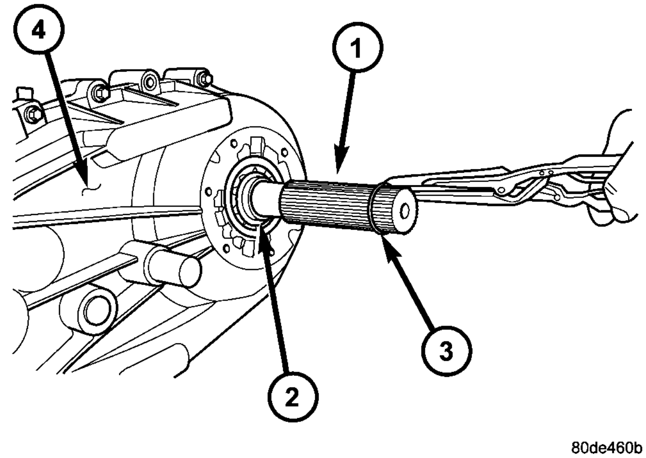


Fig. 10 Remove Output Shaft Retaining Ring

1 - REAR OUTPUT SHAFT
2 - OUTPUT SHAFT BEARING
3 - RETAINING RING
4 - TRANSFER CASE

OIL PUMP AND REAR CASE

(1) Remove rear case-to-front case bolts (Fig. 11).

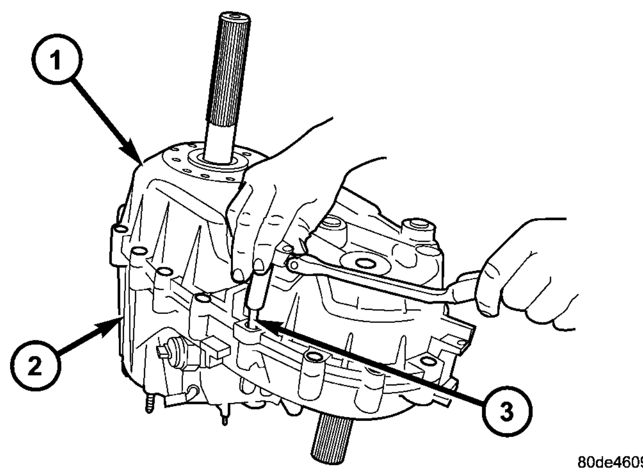


Fig. 11 Remove Case Bolts

1 - REAR CASE
2 - FRONT CASE
3 - BOLT

TRANSFER CASE - NV243 (Continued)

(2) Loosen rear case with pry tool to break sealer bead. Insert tool in slot at each end of case (Fig. 12).

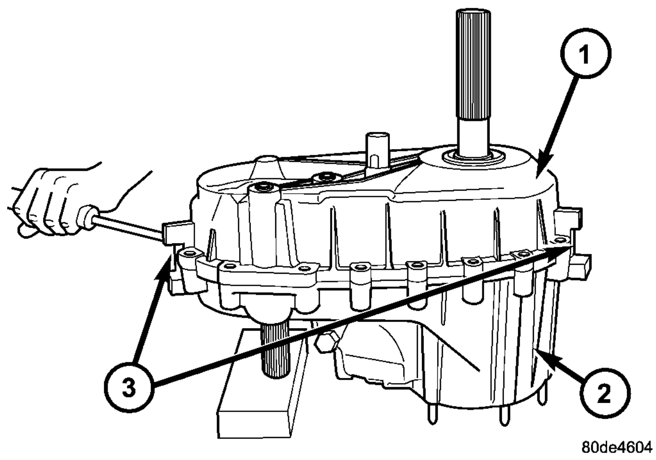


Fig. 12 Loosen Case Halves

1 - REAR CASE
2 - FRONT CASE
3 - PRY SLOTS

(3) Unseat rear case from alignment dowels.

(4) Remove rear case and oil pump assembly from front case (Fig. 13).

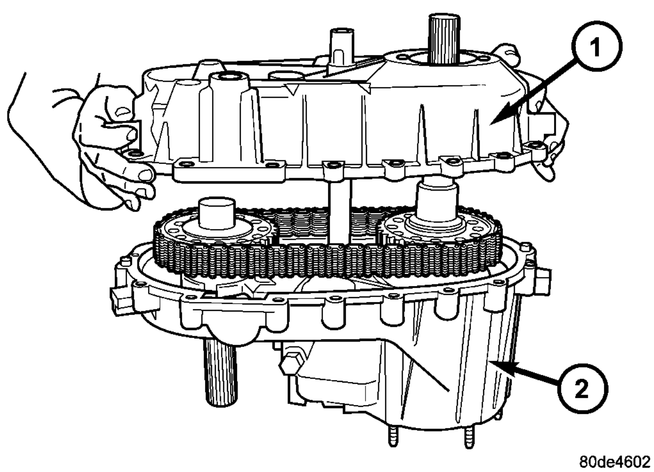


Fig. 13 Remove Rear Case

1 - REAR CASE
2 - FRONT CASE

CAUTION: Do not remove the bolts holding the oil pump cover to the rear case half. The oil pump cover is aligned to the rear output shaft inner bearing race and will become mis-aligned if the bolts are loosened. If the transfer case failure has generated any debris which may have become trapped in the oil pump. the rear case and oil pump assembly MUST be replaced.

(5) Remove the oil pump pickup tube.

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Remove shift rail cup and spring (Fig. 14).

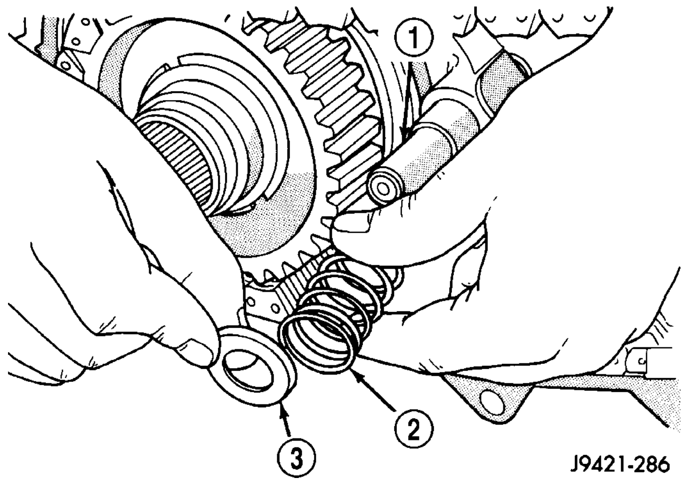


Fig. 14 Shift Rail Cup And Spring Removal

1 - SHIFT RAIL
2 - SPRING
3 - CUP

(2) Remove front sprocket retaining ring (Fig. 15).

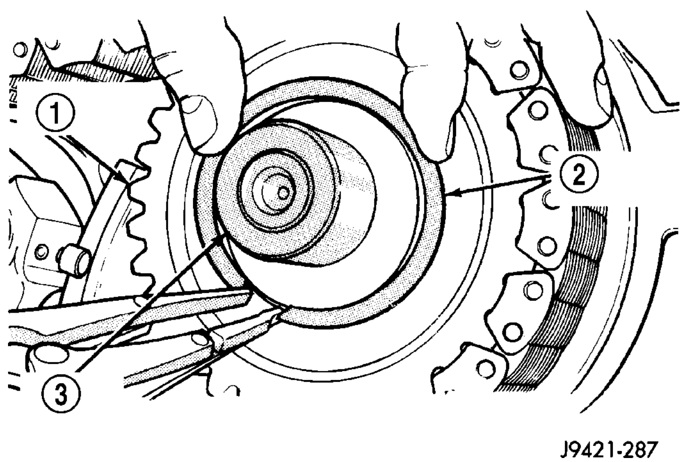


Fig. 15 Removing Front Sprocket Retaining Ring

1 - FRONT SPROCKET
2 - RETAINING RING
3 - FRONT OUTPUT SHAFT

TRANSFER CASE - NV243 (Continued)

(3) Pull mainshaft, front sprocket and chain outward about 25.4 mm (1-inch) simultaneously (Fig. 16).

(4) Remove chain from mainshaft drive sprocket and remove front sprocket and chain as assembly.

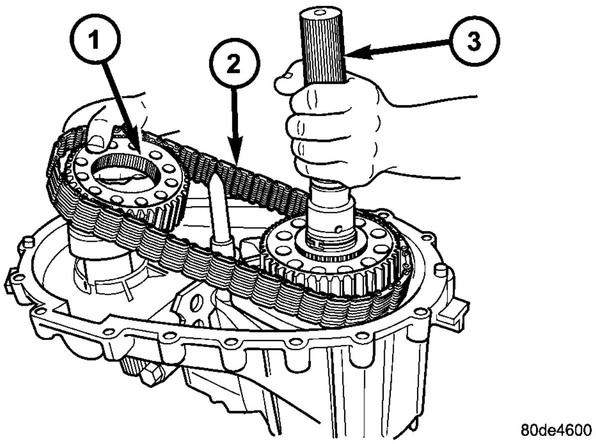


Fig. 16 Remove Front Sprocket and Drive Chain

1 - FRONT DRIVE SPROCKET
2 - DRIVE CHAIN
3 - MAINSHAFT

SHIFT FORKS AND MAINSHAFT

(1) Loosen detent plug.

(2) Remove detent plug, spring, and plunger (Fig. 17). Note that the plug has an O-ring seal. Remove and discard this seal.

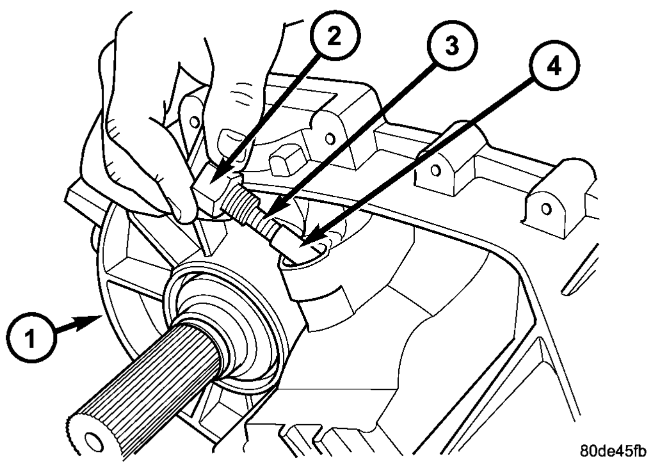


Fig. 17 Remove Detent Plug, Spring, and Plunger

1 - FRONT CASE
2 - DETENT PLUG
3 - DETENT SPRING
4 - DETENT PLUNGER

(3) Remove the front output shaft snap-ring (Fig. 18).

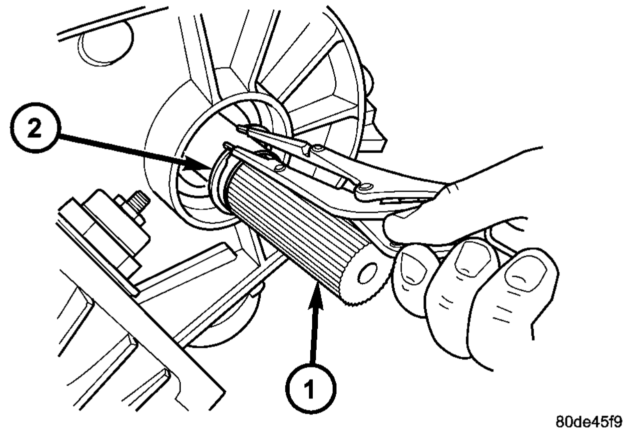


Fig. 18 Remove Front Output Shaft Snap-ring - Typical

1 - FRONT OUTPUT SHAFT
2 - SNAP-RING

(4) Remove front output shaft from bearing in case (Fig. 19).

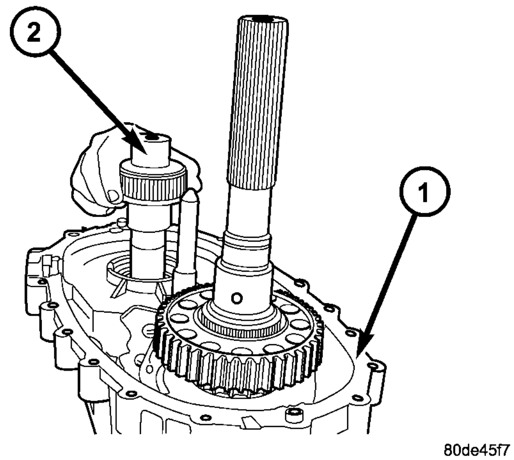


Fig. 19 Remove Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

TRANSFER CASE - NV243 (Continued)

(5) Pull mainshaft assembly out of input gear, mode sleeve, and case (Fig. 20).

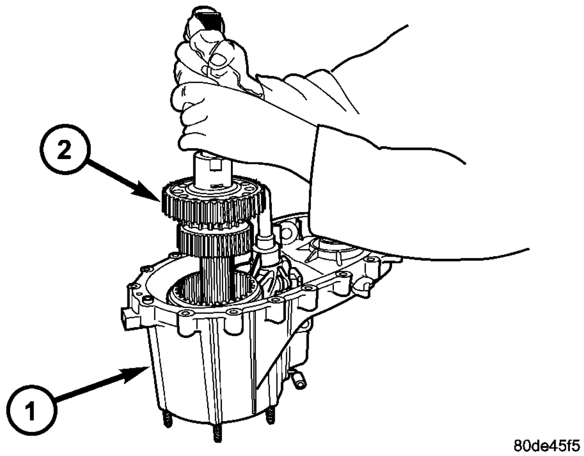


Fig. 20 Remove Mainshaft

1 - FRONT CASE
2 - MAINSHAFT

(6) Remove mode fork, mode sleeve, and shift rail as assembly (Fig. 21). Note which way the sleeve fits in the fork (long side of sleeve goes to front).

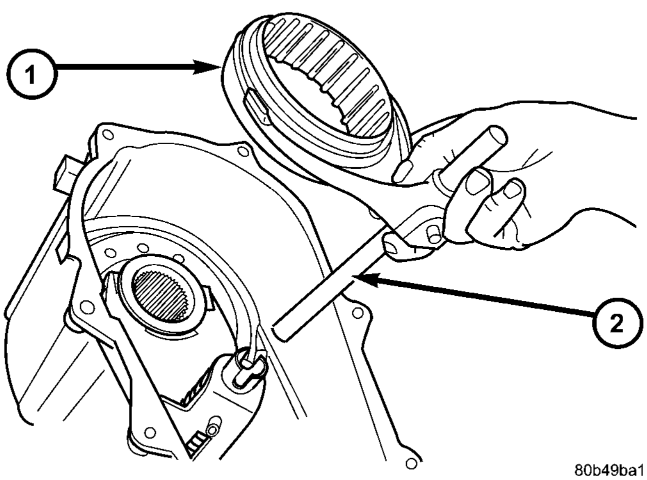


Fig. 21 Mode Fork And Sleeve Removal

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

(7) Remove range fork retaining ring.
(8) Remove range fork and hub as an assembly (Fig. 22). Note fork position for installation reference.
(9) Remove shift sector (Fig. 23).
(10) Remove the shift sector o-ring (Fig. 24).

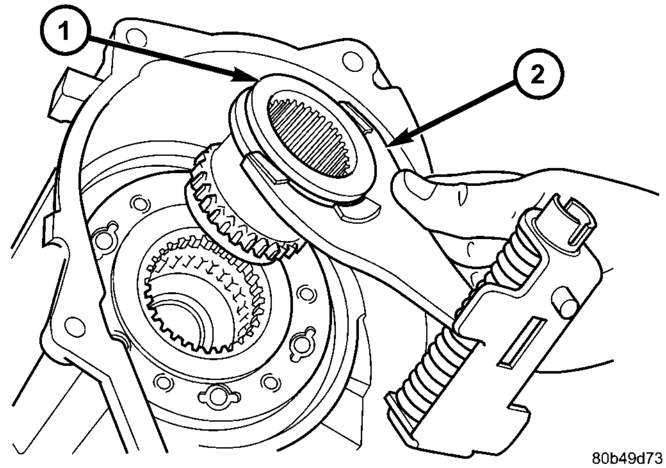


Fig. 22 Range Fork And Hub Removal

1 - RANGE HUB
2 - RANGE FORK

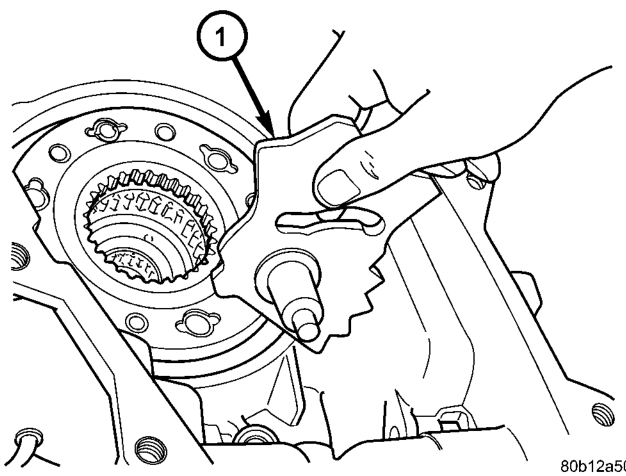


Fig. 23 Shift Sector Removal

1 - SHIFT SECTOR

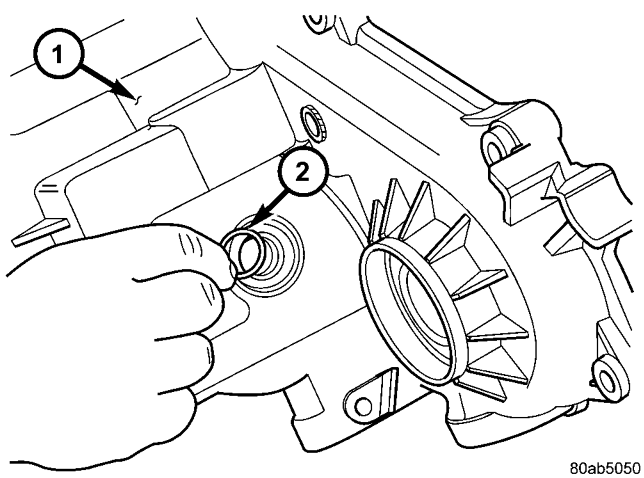


Fig. 24 Remove the Shift Sector O-Ring

1 - TRANSFER CASE FRONT HOUSING
2 - SHIFT SECTOR O-RING

TRANSFER CASE - NV243 (Continued)

MAINSHAFT

(1) Remove the drive sprocket retaining ring (Fig. 25) from the output shaft.

(2) Remove the drive sprocket thrust washer (Fig. 26) from the output shaft.

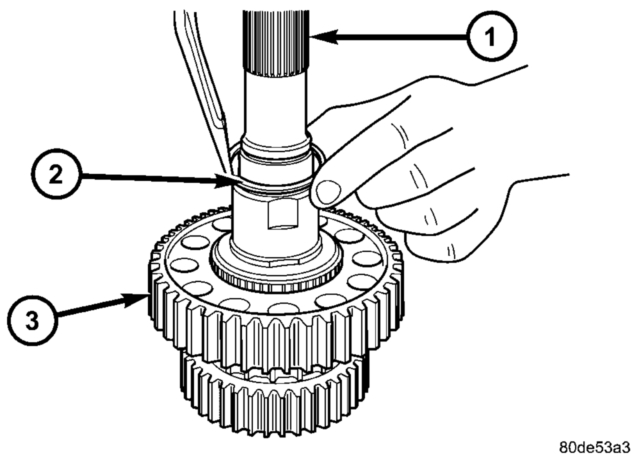


Fig. 25 Remove The Drive Sprocket Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - DRIVE SPROCKET

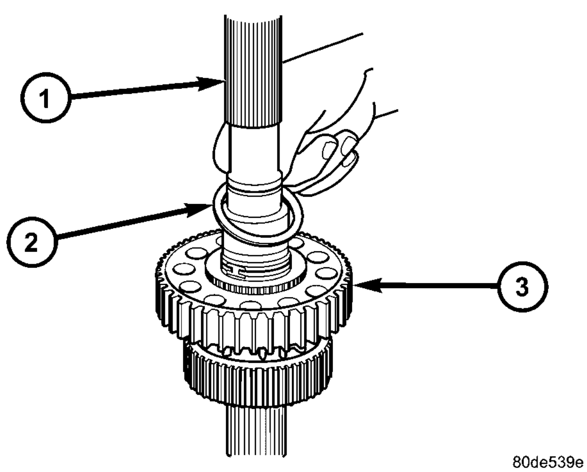


Fig. 26 Remove Drive Sprocket Thrust Washer

1 - OUTPUT SHAFT
2 - THRUST WASHER
3 - DRIVE SPROCKET

(3) Remove drive sprocket (Fig. 27) from the output shaft.

(4) Remove the clutch gear (Fig. 28) and hub (Fig. 29) from the output shaft.

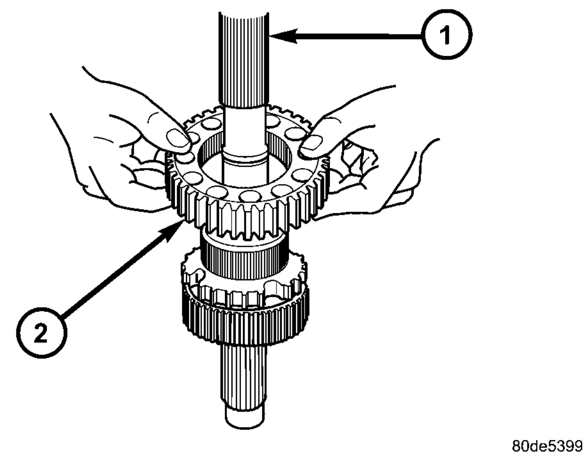


Fig. 27 Remove Drive Sprocket

1 - OUTPUT SHAFT
2 - DRIVE SPROCKET

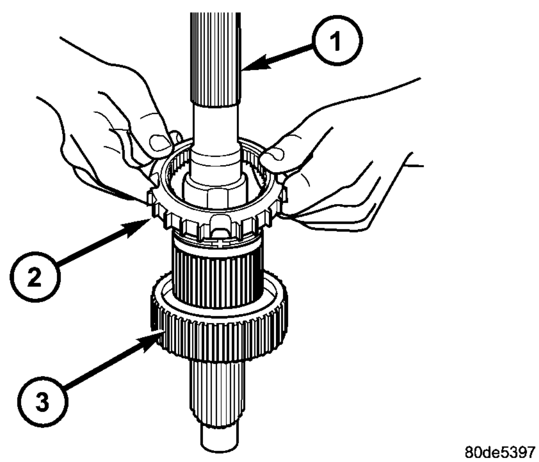


Fig. 28 Remove Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

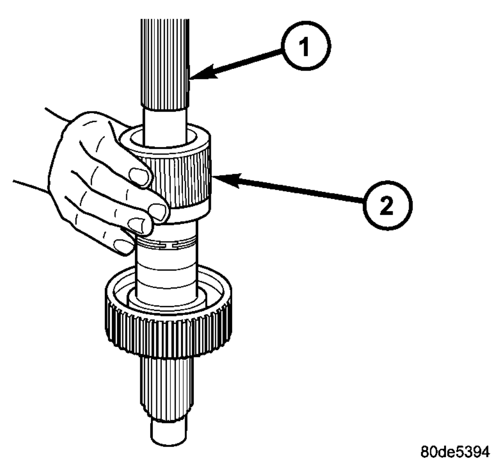


Fig. 29 Remove Sprocket Hub

1 - OUTPUT SHAFT
2 - SPROCKET HUB

TRANSFER CASE - NV243 (Continued)

(5) Remove the mode hub retaining ring (Fig. 30) from the output shaft.

(6) Remove the mode hub (Fig. 31) from the output shaft.

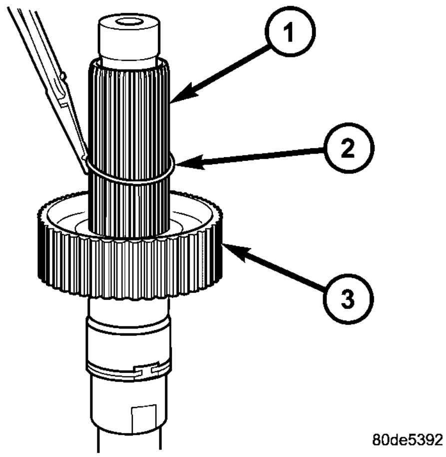


Fig. 30 Remove Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - MODE HUB

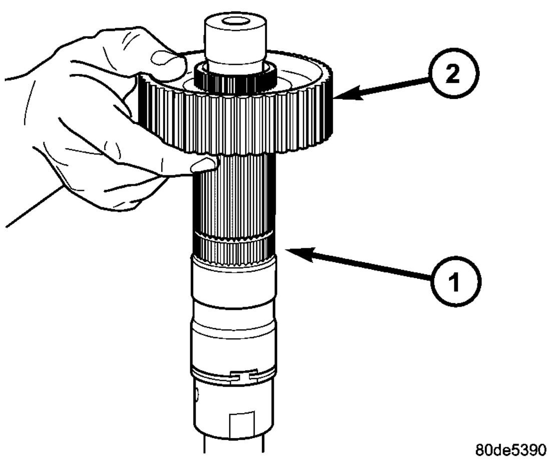


Fig. 31 Remove Mode Hub

1 - OUTPUT SHAFT
2 - MODE HUB

INPUT AND PLANETARY GEAR

(1) Remove input gear seal with suitable screw and slide hammer.

(2) Remove input gear retaining ring (Fig. 32) with heavy duty snap-ring pliers.

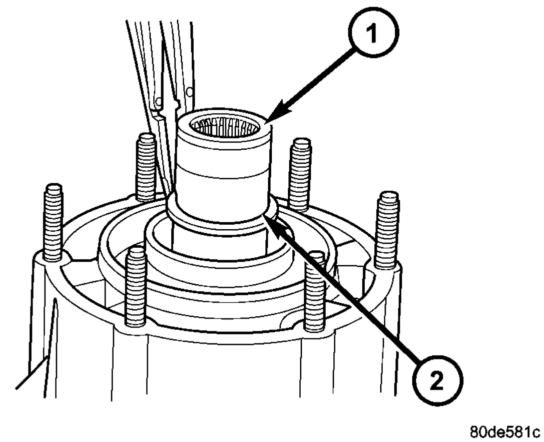


Fig. 32 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(3) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 33). Tap gear out of bearing with plastic mallet, if necessary.

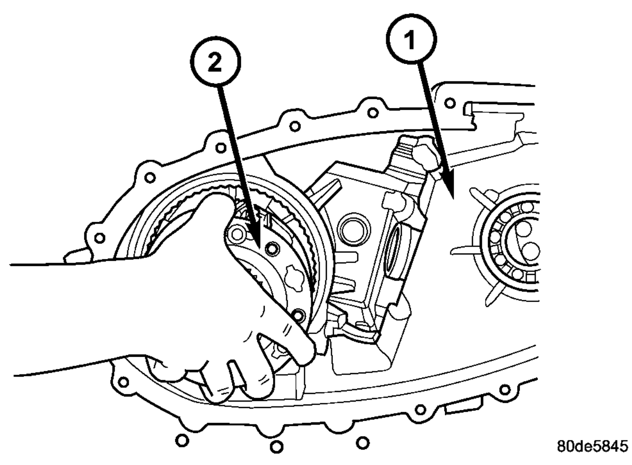


Fig. 33 Remove Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

TRANSFER CASE - NV243 (Continued)

INPUT AND PLANETARY GEAR

(1) Remove snap-ring that retains input gear in low range gear (Fig. 34).
(2) Remove retainer (Fig. 35).
(3) Remove front tabbed thrust washer (Fig. 36).
(4) Remove input gear (Fig. 37).
(5) Remove rear tabbed thrust washer from low range gear (Fig. 38).

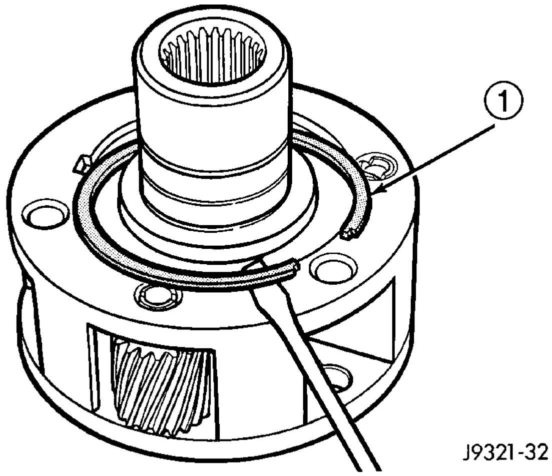


Fig. 34 Input Gear Snap-Ring Removal

1 - INPUT GEAR SNAP-RING

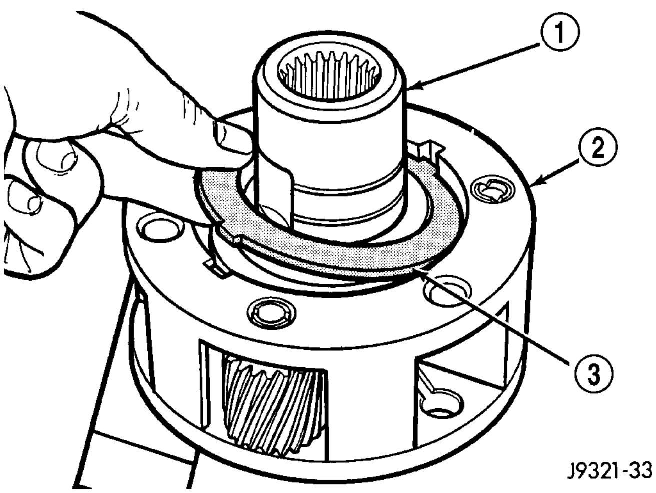


Fig. 35 Input Gear Retainer Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR
3 - RETAINER

CLEANING

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M™ all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

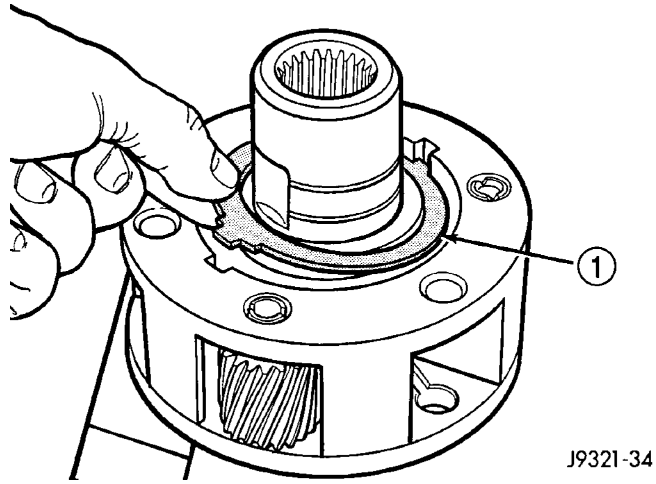


Fig. 36 Front Tabbed Thrust Washer Removal

1 - FRONT TABBED THRUST WASHER

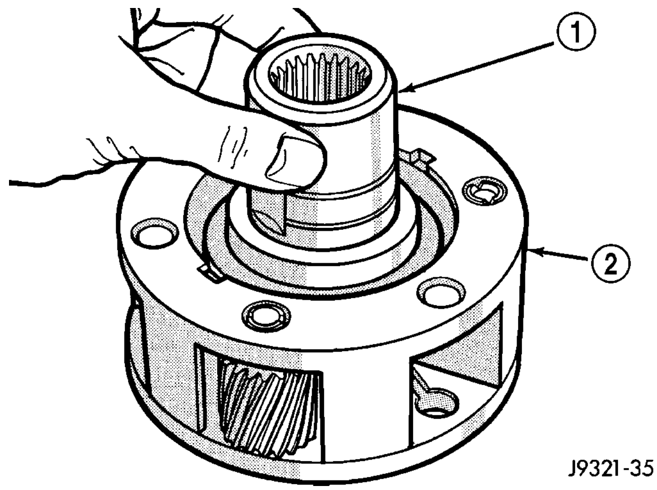


Fig. 37 Input Gear Removal

1 - INPUT GEAR
2 - LOW RANGE GEAR

INSPECTION

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320-400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 39). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

TRANSFER CASE - NV243 (Continued)

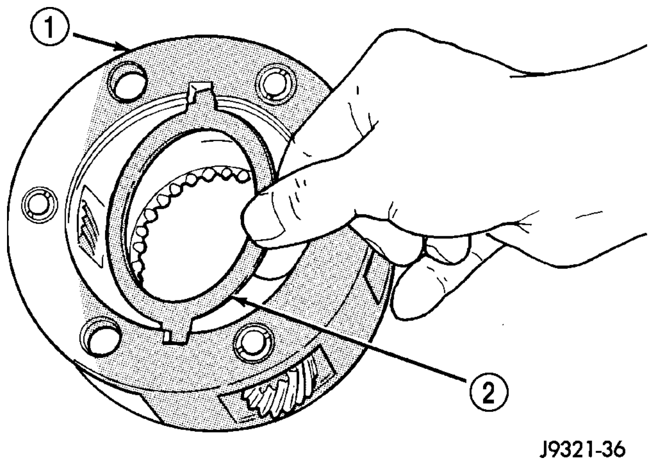


Fig. 38 Rear Tabbed Thrust Washer Removal

1 - LOW RANGE GEAR
2 - REAR TABBED THRUST WASHER

Examine the carrier body and pinion gears for wear or damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 40). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

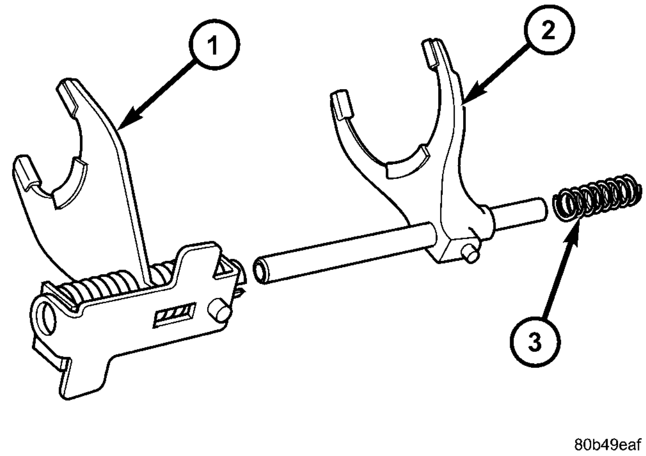


Fig. 40 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

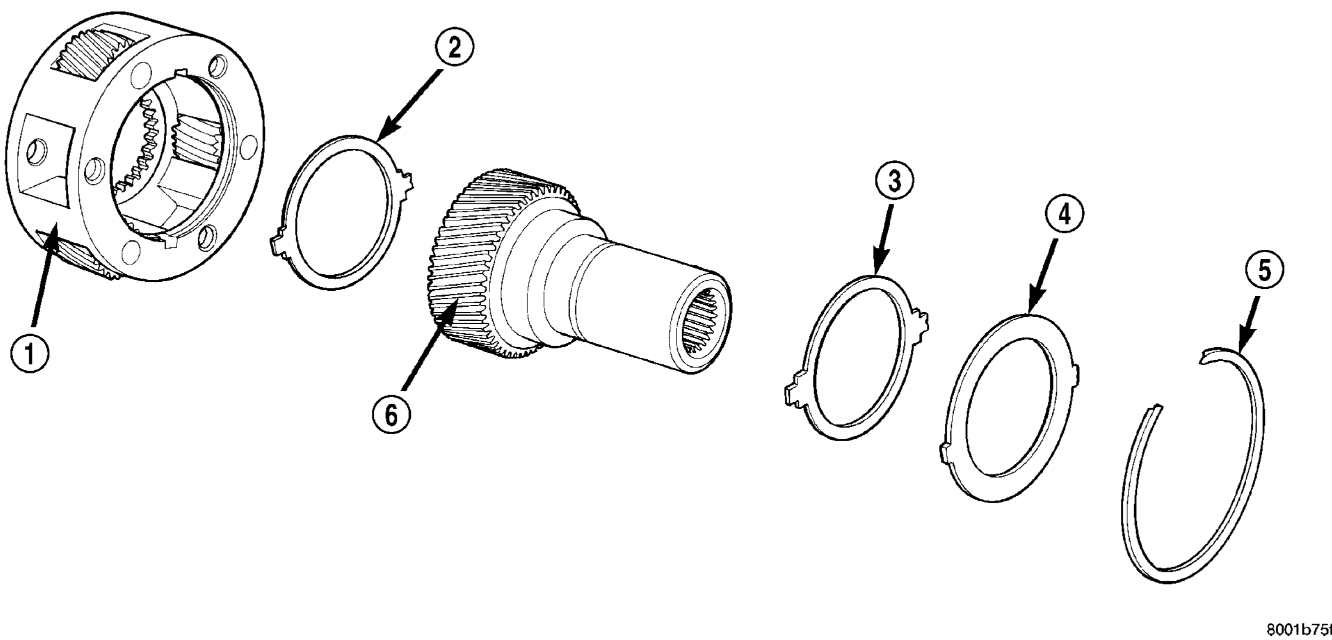


Fig. 39 Input Gear and Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

TRANSFER CASE - NV243 (Continued)

Inspect the shift fork wear pads (Fig. 41). The mode and range fork pads are serviceable and can be replaced if necessary.

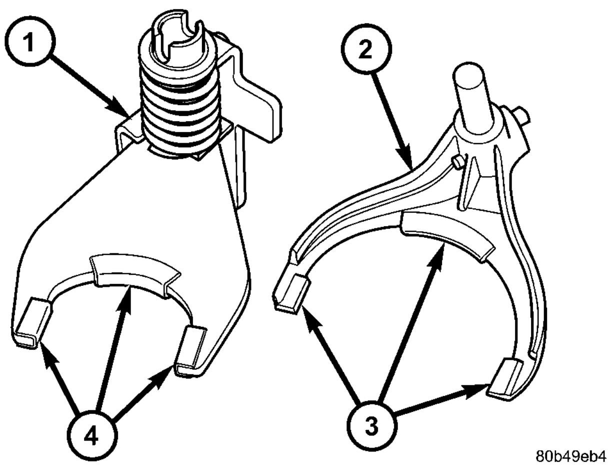


Fig. 41 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR EXTENSION HOUSING

Inspect the extension housing seal and bushing. Replace both components if either show any sign of wear or damage.

FRONT OUTPUT SHAFT AND DRIVE CHAIN

Inspect the shaft threads, sprocket teeth, and bearing surfaces. Minor nicks on the teeth can be smoothed with an oilstone. Use 320-400 grit emery to smooth minor scratches on the shaft bearing surfaces. Rough threads on the shaft can be chased if necessary. Replace the shaft if the threads are damaged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 42)

FRONT AND REAR CASES

Inspect the cases for wear and damage.

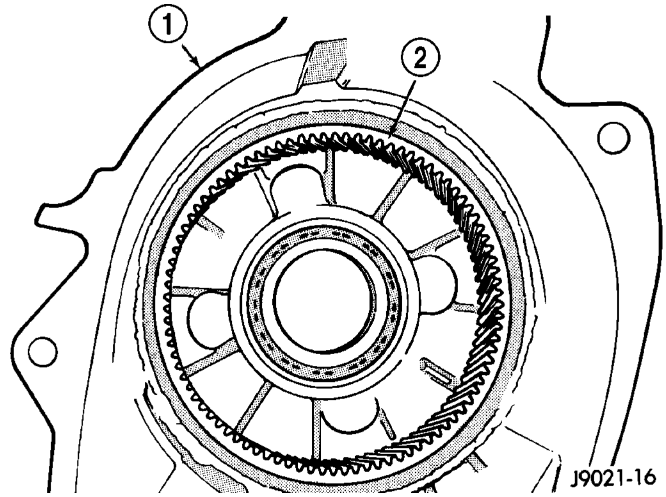


Fig. 42 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite™ 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/drain plug threads in the rear case. The threads can be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil® stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ASSEMBLY

BEARINGS AND SEALS

(1) Remove the input shaft bearing (Fig. 43) from the front case with suitable snap-ring pliers.

(2) Transfer the retaining ring to the new bearing if necessary and install the bearing into the front case.

(3) Using Installer 6436 and Handle C-4171 (Fig. 44), remove front output shaft bearing.

(4) Start front output shaft bearing in case. Then seat bearing with Handle C-4171 and Installer 6953.

(5) Install front output shaft bearing retaining ring.

TRANSFER CASE - NV243 (Continued)

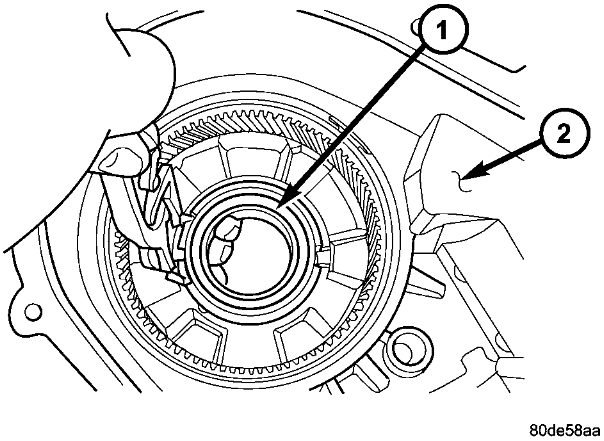


Fig. 43 Remove Input Gear Bearing

1 - INPUT GEAR BEARING
2 - FRONT CASE

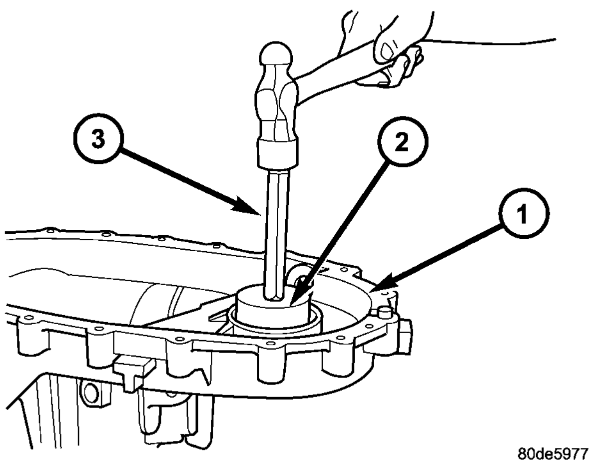


Fig. 44 Remove Front Output Shaft Bearing

1 - FRONT CASE
2 - INSTALLER 6436
3 - HANDLE C-4171

(6) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 45).

(7) Install new pilot bearing with Remover/Installer 8684.

(8) Remove the front output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 46).

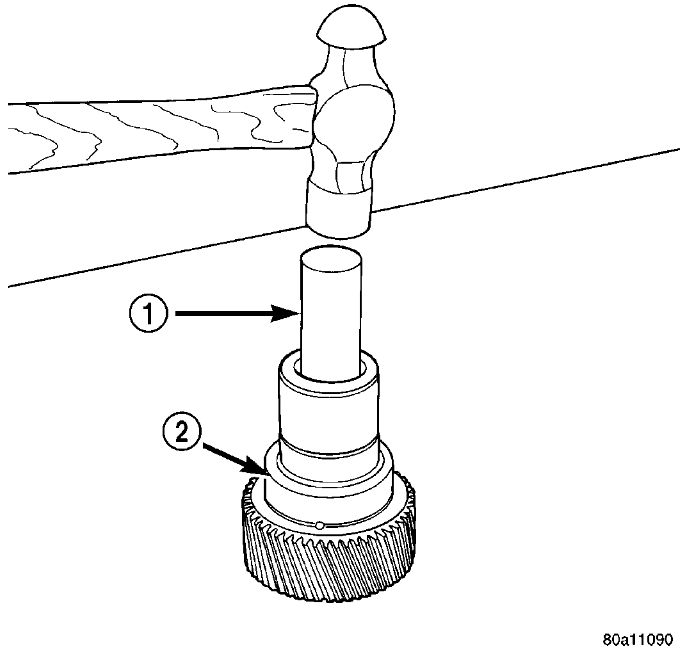


Fig. 45 Remove Input Gear Pilot Bearing

1 - DRIFT
2 - INPUT GEAR

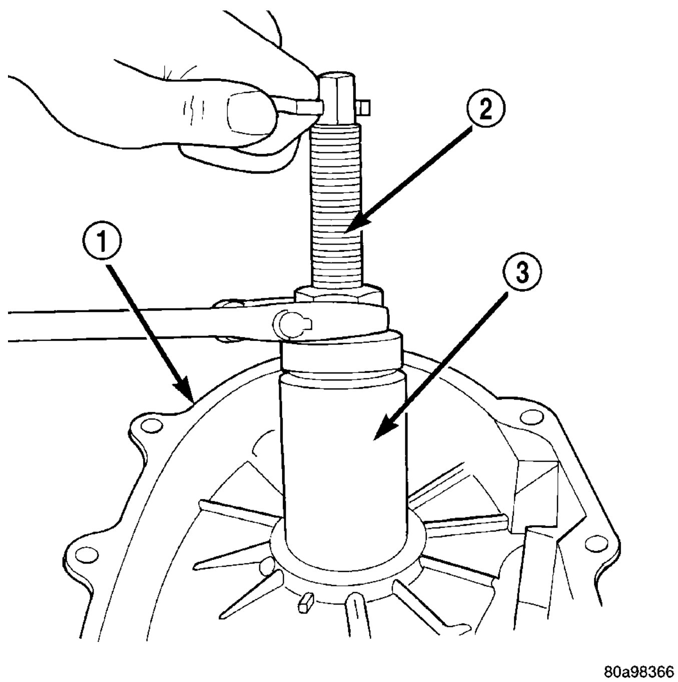


Fig. 46 Front Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

TRANSFER CASE - NV243 (Continued)

(9) Install new bearing with Tool Handle C-4171 and Installer 5066 (Fig. 47). The bearing bore is chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 48).

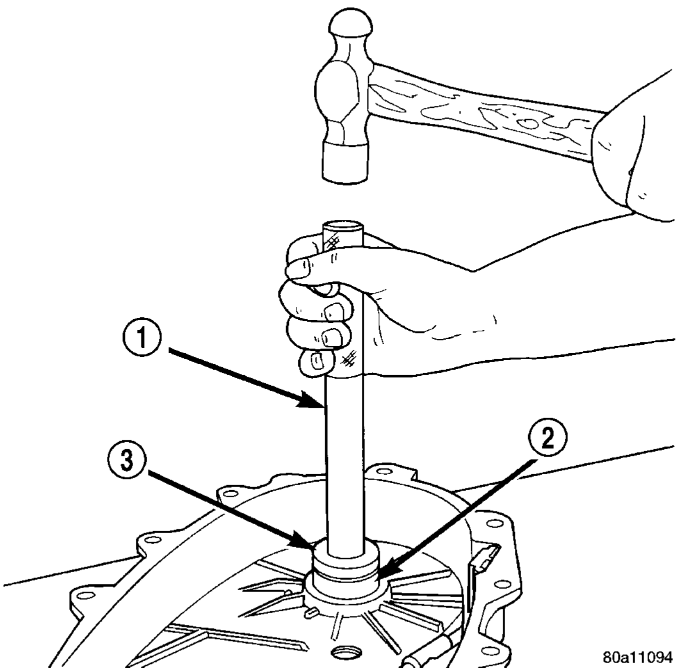


Fig. 47 Output Shaft Rear Bearing Installation

1 - HANDLE C-4171
2 - OUTPUT SHAFT INNER BEARING
3 - INSTALLER 5066

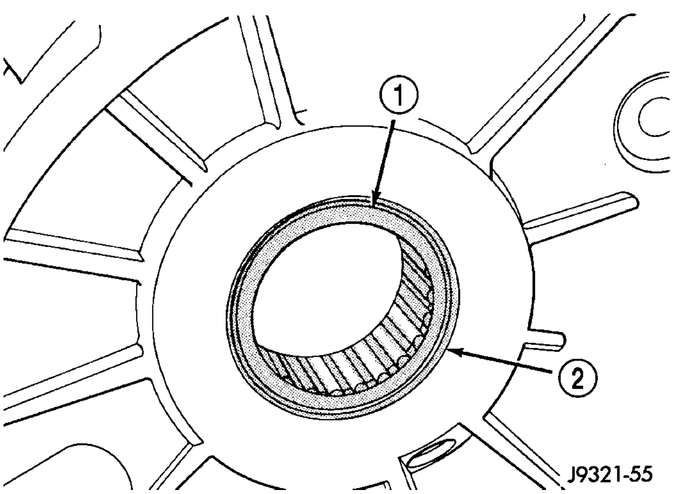


Fig. 48 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

(10) Remove the rear output shaft bearing from the rear case using Remover/Installer 8684 and Handle C-4171 (Fig. 49).

(11) Install the rear output shaft bearing (Fig. 50) into the rear case using Remover/Installer 6953 and Handle C-4171.

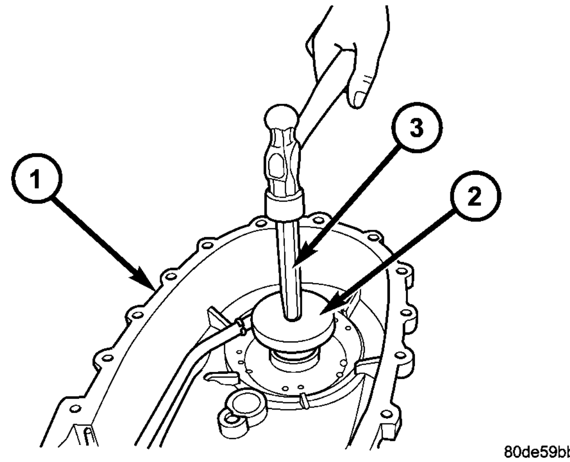


Fig. 49 Remove Rear Output Shaft Bearing

1 - REAR CASE
2 - REMOVER/INSTALLER 8684
3 - HANDLE C-4171

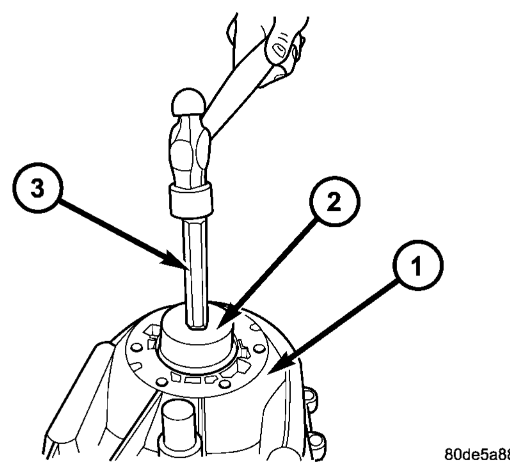


Fig. 50 Install Rear Output Shaft Bearing

1 - REAR CASE
2 - REMOVER/INSTALLER 6953
3 - HANDLE C-4171

TRANSFER CASE - NV243 (Continued)

INPUT AND PLANETARY GEAR

(1) Lubricate gears and thrust washers (Fig. 51) with recommended transmission fluid.

(2) Install first thrust washer in low range gear (Fig. 51). Be sure washer tabs are properly aligned in gear notches.

(3) Install input gear in low range gear. Be sure input gear is fully seated.

(4) Install remaining thrust washer in low range gear and on top of input gear. Be sure washer tabs are properly aligned in gear notches.

(5) Install retainer on input gear and install snap-ring.

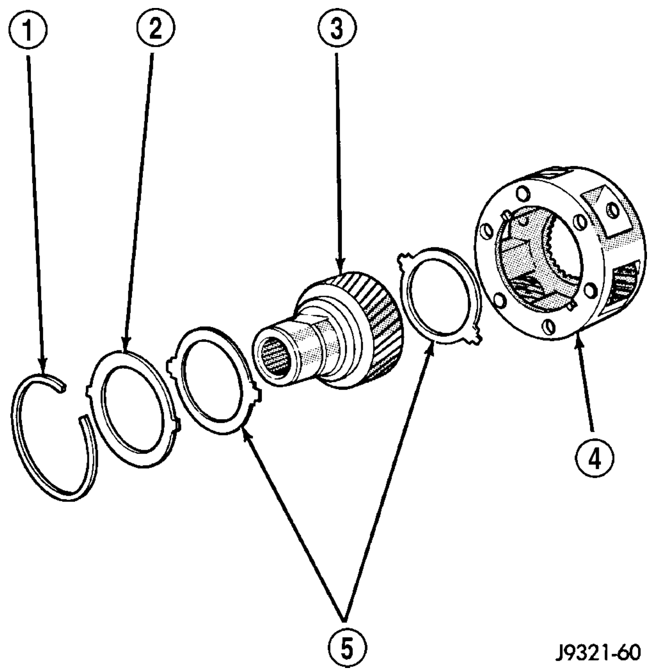


Fig. 51 Input/Low Range Gear Components

1 - SNAP-RING
2 - RETAINER PLATE
3 - INPUT GEAR
4 - LOW RANGE GEAR
5 - THRUST WASHERS

(6) Align and install low range/input gear assembly in front case (Fig. 52). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

(7) Install snap-ring to hold input/low range gear into front bearing (Fig. 53).

(8) Install a new input gear seal using Installer 8841 and Handle C-4171.

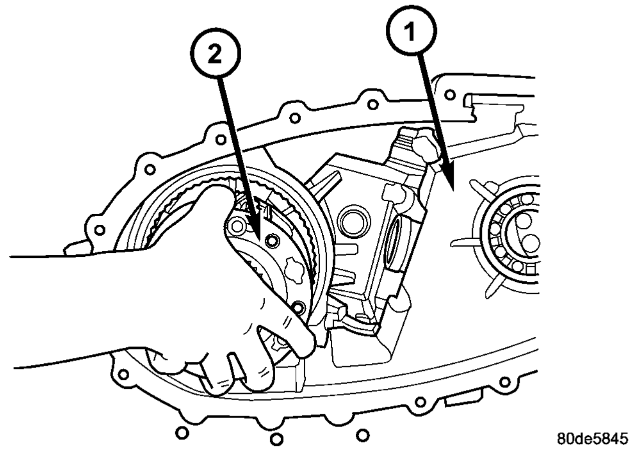


Fig. 52 Install Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

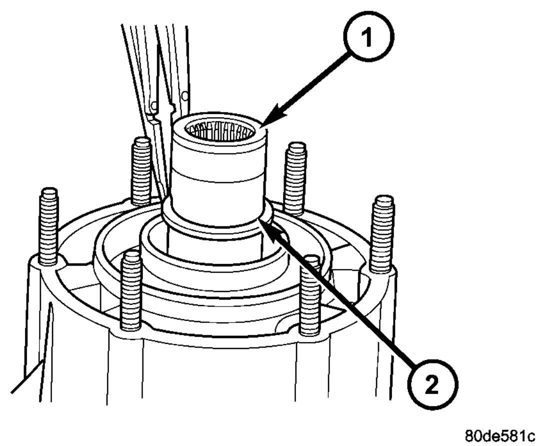


Fig. 53 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

TRANSFER CASE - NV243 (Continued)

SHIFT FORKS AND MAINSHAFT

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Install the mode hub (Fig. 54) onto the output shaft.

(3) Install the mode hub retaining ring (Fig. 55) onto the output shaft.

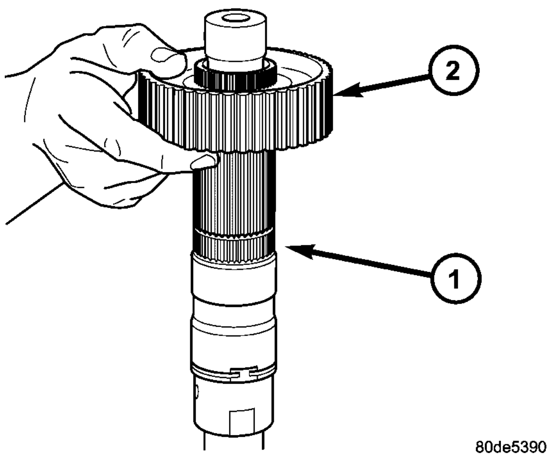


Fig. 54 Install Mode Hub

1 - OUTPUT SHAFT
2 - MODE HUB

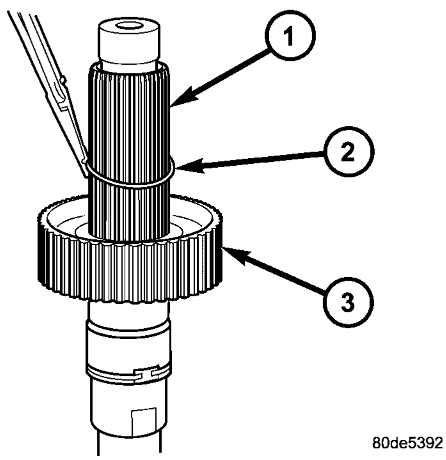


Fig. 55 Install Mode Hub Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - MODE HUB

(4) Install the sprocket hub (Fig. 56) onto the output shaft.

(5) Install the clutch gear (Fig. 57) onto the output shaft.

(6) Install the drive sprocket (Fig. 58) onto the output shaft.

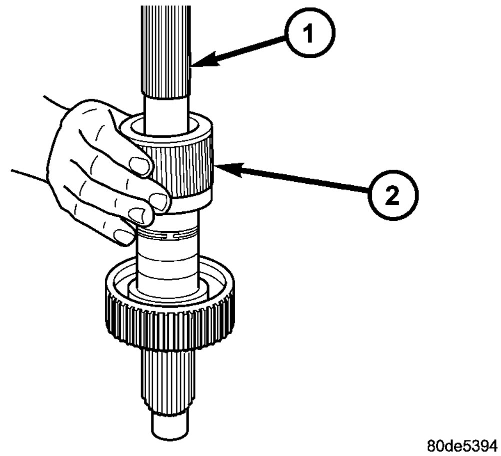


Fig. 56 Install Sprocket Hub

1 - OUTPUT SHAFT
2 - SPROCKET HUB

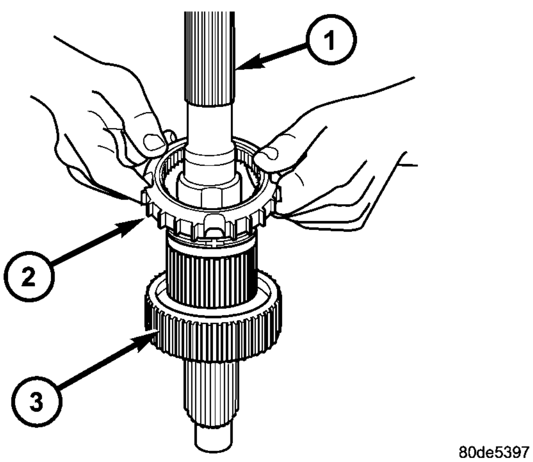


Fig. 57 Install Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

TRANSFER CASE - NV243 (Continued)

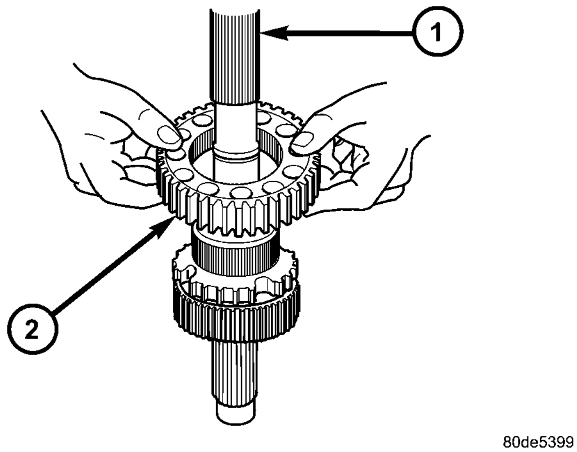


Fig. 58 Install Drive Sprocket

1 - OUTPUT SHAFT
2 - DRIVE SPROCKET

(7) Install the drive sprocket thrust washer (Fig. 59) onto the output shaft.

(8) Install the drive sprocket retaining ring (Fig. 60) onto the output shaft.

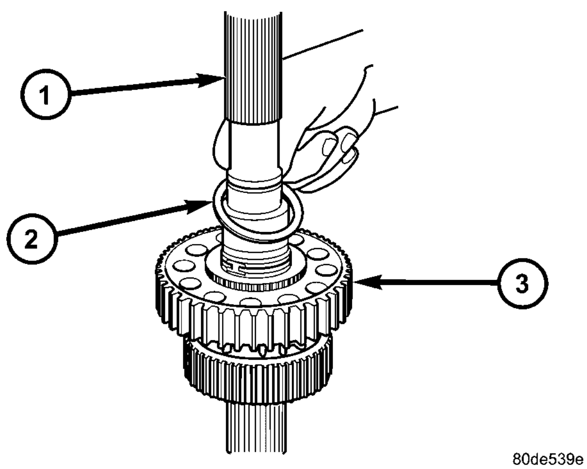


Fig. 59 Install Drive Sprocket Thrust Washer

1 - OUTPUT SHAFT
2 - THRUST WASHER
3 - DRIVE SPROCKET

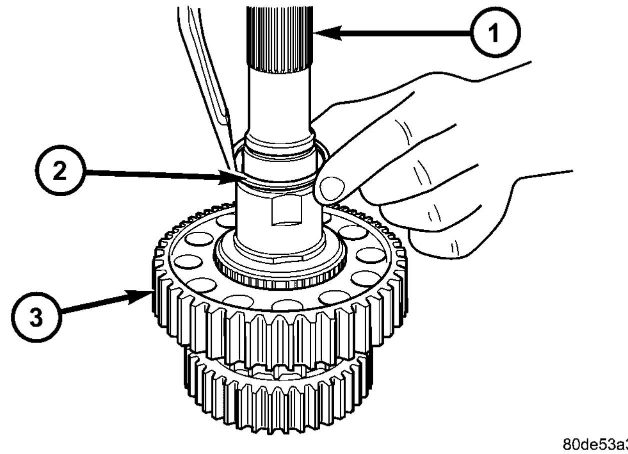


Fig. 60 Install The Drive Sprocket Retaining Ring

1 - OUTPUT SHAFT
2 - RETAINING RING
3 - DRIVE SPROCKET

(9) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 61). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

(10) Install the shift sector o-ring.

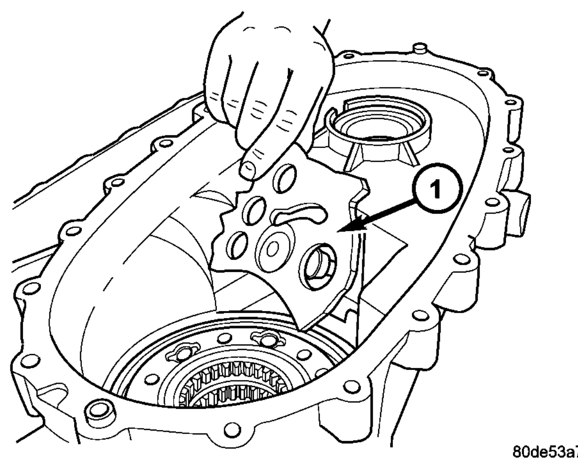


Fig. 61 Install Shift Sector

1 - SHIFT SECTOR

TRANSFER CASE - NV243 (Continued)

(11) Assemble and install range fork and hub (Fig. 62). Be sure hub is properly seated in low range gear and engaged to the input gear.

(12) Align and insert range fork pin in shift sector slot.

(13) Install the range fork retaining ring.

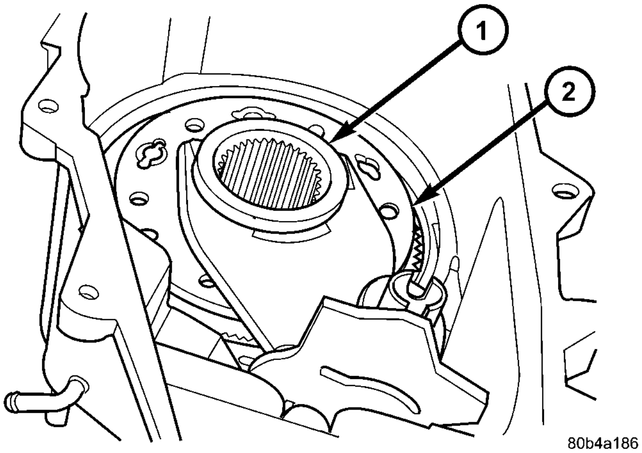


Fig. 62 Install Range Fork And Hub Assembly

1 - RANGE HUB
2 - RANGE FORK

(14) Install mode fork and shift rail onto the mode sleeve.

(15) Install the mode fork, sleeve, and shift rail into the transfer case (Fig. 63).

(16) Install mainshaft into the transfer case (Fig. 64). Guide mainshaft through the mode and range sleeves and into the input gear.

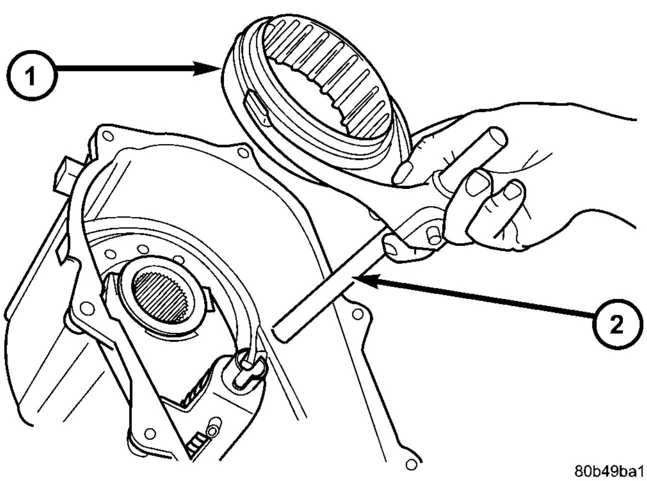


Fig. 63 Mode Fork And Sleeve Installation

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

(17) Install new o-ring on detent plug (Fig. 65).

(18) Install detent plunger, spring, and plug (Fig. 66). Tighten the plug to 16-25 N·m (12-18 ft. lbs.).

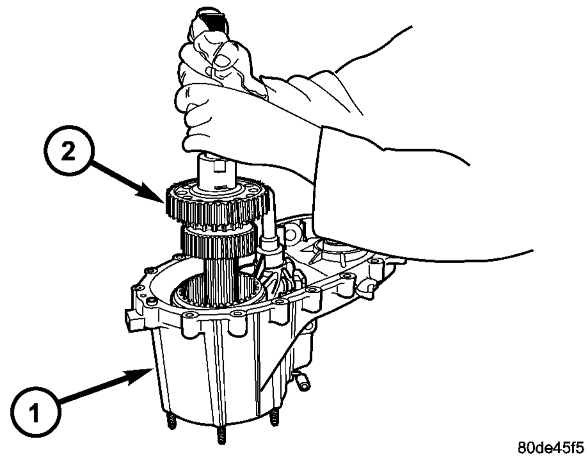


Fig. 64 Install Mainshaft

1 - FRONT CASE
2 - MAINSHAFT

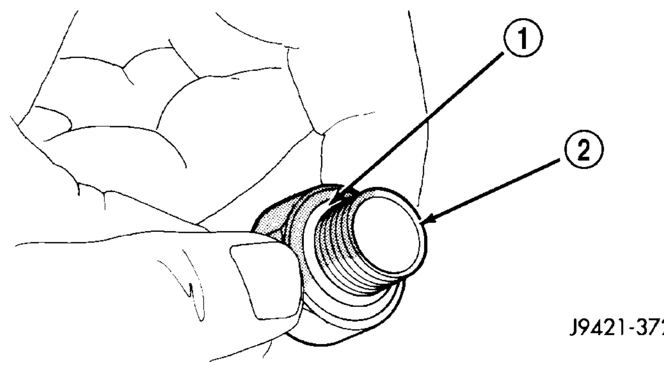


Fig. 65 O-Ring Installation On Detent Plug

1 - O-RING
2 - DETENT PLUG

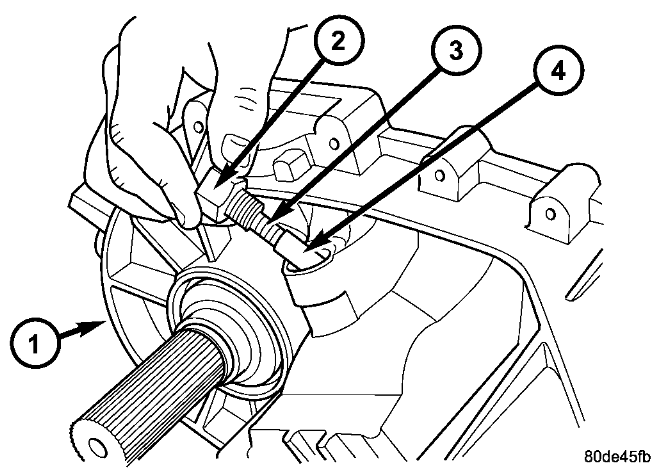


Fig. 66 Install Detent Plug, Spring, and Plunger

1 - FRONT CASE
2 - DETENT PLUG
3 - DETENT SPRING
4 - DETENT PLUNGER

TRANSFER CASE - NV243 (Continued)

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Install the front output shaft (Fig. 67) into the front output shaft bearing.

(2) Install the front output shaft retaining ring (Fig. 68) onto the output shaft.

(3) Install the new front output shaft seal with Installer MB991168A

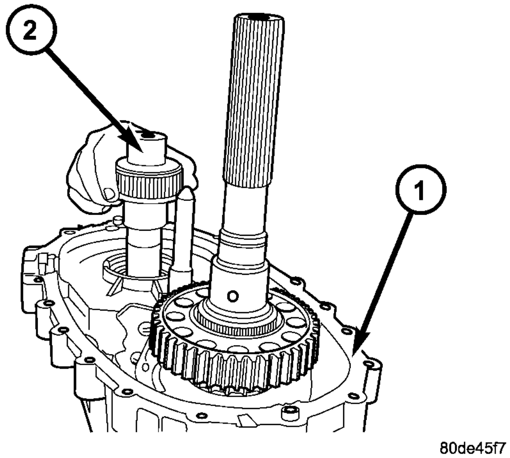


Fig. 67 Install Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

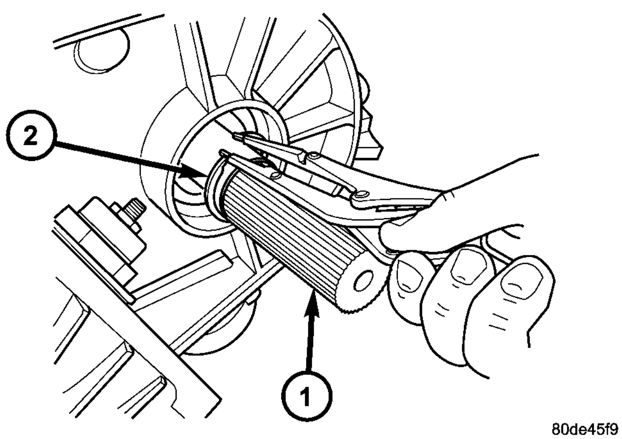


Fig. 68 Install Front Output Shaft Snap-ring - Typical

1 - FRONT OUTPUT SHAFT
2 - SNAP-RING

(4) Insert front sprocket in drive chain.

(5) Install drive chain around mainshaft sprocket (Fig. 69). Then position front sprocket over front shaft.

(6) Raise mainshaft about 2.54 cm (one inch) and seat front sprocket on front output shaft.

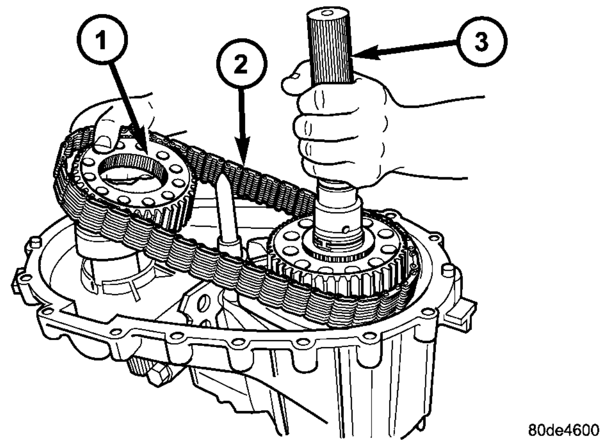


Fig. 69 Install Front Sprocket and Drive Chain

1 - FRONT DRIVE SPROCKET
2 - DRIVE CHAIN
3 - MAINSHAFT

(7) If mainshaft and mode sleeve were unseated during chain installation, align and reseat mainshaft in input gear and hub.

(8) Install front sprocket retaining ring (Fig. 70).

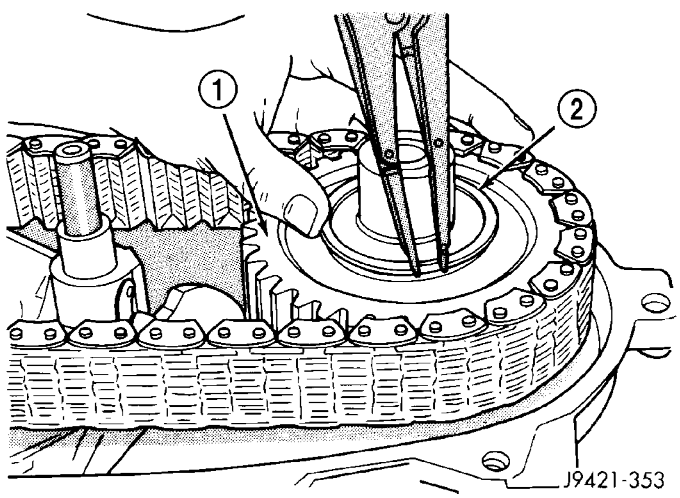


Fig. 70 Front Sprocket Retaining Ring Installation

1 - FRONT SPROCKET
2 - RETAINING RING

TRANSFER CASE - NV243 (Continued)

(9) Install spring and cup on shift rail (Fig. 71).

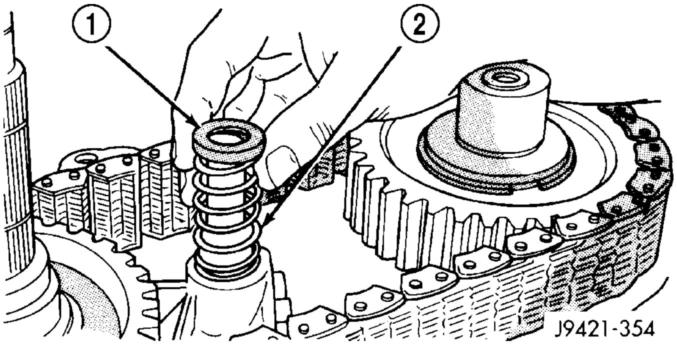


Fig. 71 Shift Rail Spring And Cup Installation

1 - CUP
2 - SPRING

(10) Insert magnet in front case pocket (Fig. 72).

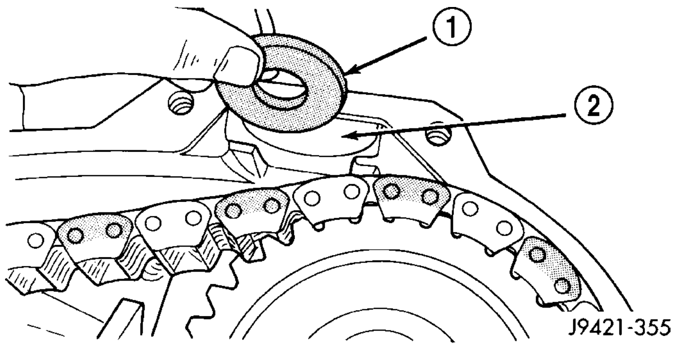


Fig. 72 Case Magnet Installation

1 - MAGNET
2 - CASE POCKET

OIL PUMP AND REAR CASE

Lubricate the oil pump components with transmission fluid before installation. Prime the oil pickup tube by pouring a little oil into the tube before installation.

CAUTION: Do not remove the bolts holding the oil pump cover to the rear case half. The oil pump cover is aligned to the rear output shaft inner bearing race and will become mis-aligned if the bolts are loosened. If the transfer case failure has generated any debris which may have become trapped in the oil pump. the rear case and oil pump assembly MUST be replaced.

(1) Install new o-ring in pickup tube inlet of oil pump.

(2) Insert oil pickup tube into the oil pump.

(3) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

(4) Align oil pump with mainshaft and align shift rail with bore in rear case. Then install rear case and oil pump assembly (Fig. 73).

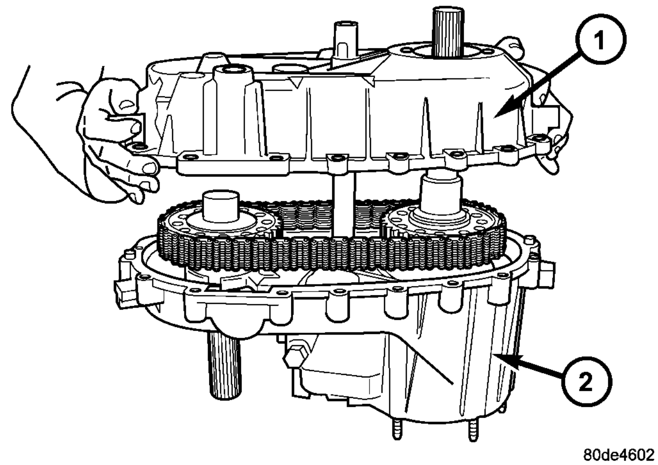


Fig. 73 Install Rear Case

1 - REAR CASE
2 - FRONT CASE

(5) Install 4-5 rear case-to front case bolts (Fig. 74) to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail, and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are mis-aligned.

(6) Apply Loctite™ 242 to remainder of rear case-to-front case bolt threads and install bolts. Tighten bolts to 20-27 N·m (15-24 ft. lbs.),

(7) Install rear output bearing snap-ring (Fig. 75) to output shaft.

SEAL BOOT AND SHIFT MOTOR ASSEMBLY

(1) Install the front output shaft seal slinger with Installer 8840. Install the slinger onto the shaft until the tool contacts the rear of the output shaft.

(2) Install a new seal boot clamp onto the seal boot.

(3) Install the seal boot and clamp onto the slinger hub and tighten the clamp with Crimp Tool C-4975-A.

(4) Position the shift motor and mode sensor assembly onto the transfer case.

(5) Install the bolts to hold the shift motor and mode sensor assembly to the transfer case. Tighten the bolts to 16-25 N·m (12-18 ft. lbs.).

REAR EXTENSION

(1) Install new seal in rear extension housing seal with Installer D-163 and Handle C-4171..

TRANSFER CASE - NV243 (Continued)

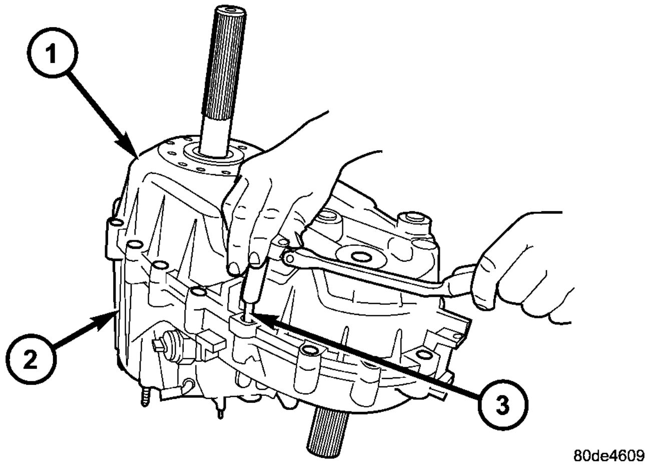


Fig. 74 Install Case Bolts - Typical

1 - REAR CASE
2 - FRONT CASE
3 - BOLT

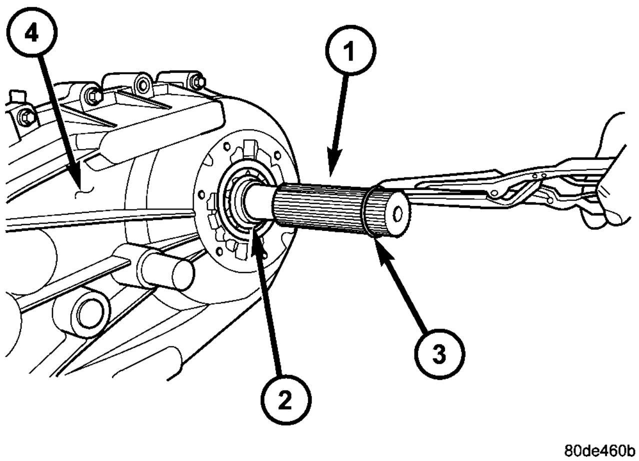


Fig. 75 Install Output Shaft Retaining Ring

1 - REAR OUTPUT SHAFT
2 - OUTPUT SHAFT BEARING
3 - RETAINING RING
4 - TRANSFER CASE

(2) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of rear extension housing. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into output bearing.

(3) Align and install rear extension on retainer (Fig. 76).

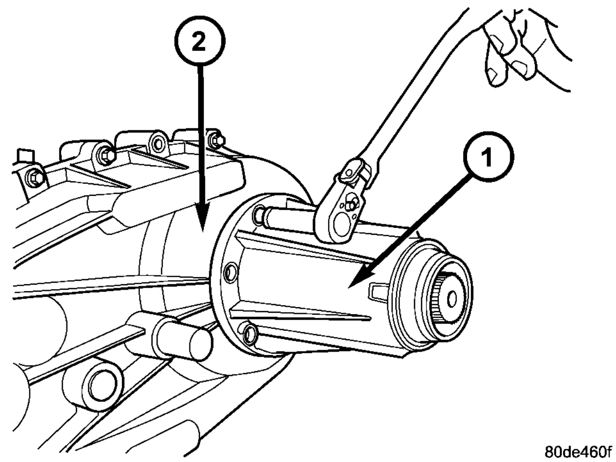


Fig. 76 Install Rear Extension Bolts

1 - EXTENSION HOUSING
2 - TRANSFER CASE

(4) Apply Mopar® Silicone Sealer to threads of rear extension housing bolts. Then install and tighten bolts to 16-24 N·m (12-18 ft. lbs.) torque.

INSTALLATION

(1) Mount transfer case on a transmission jack.
(2) Secure transfer case to jack with chains.
(3) Position transfer case under vehicle.
(4) Align transfer case and transmission shafts and install transfer case onto the transmission.
(5) Install and tighten transfer case attaching nuts to 27-34 N·m (20-25 ft. lbs.) torque.
(6) Connect the vent hose.
(7) Connect the shift motor and mode sensor wiring connectors. Secure wire harness to clips on transfer case.
(8) Align and connect the propeller shafts.
(9) Fill transfer case with correct fluid. (Refer to 21 - TRANSMISSION/TRANSFER CASE/FLUID - STANDARD PROCEDURE)
(10) Install skid plate, if equipped.
(11) Remove transmission jack and support stand.
(12) Lower vehicle and verify transfer case shift operation.

TRANSFER CASE - NV243 (Continued)

SPECIFICATIONS

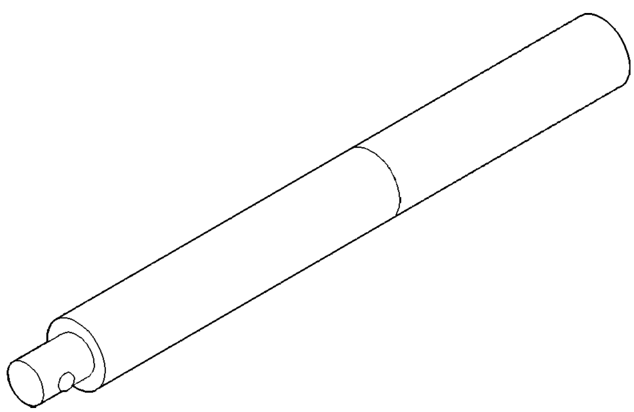
TRANSFER CASE - NV243

TORQUE SPECIFICATIONS

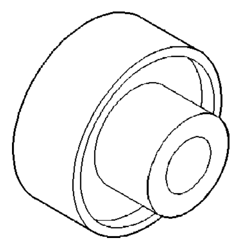
DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	40-45	30-40	-
Bolt, Extension Housing	16-24	12-18	-
Bolt, Case Half	20-27	15-24	-
Screw, Oil Pump	12-16	8-12	-
Nuts, Mounting	30-41	20-30	-
Bolts, Shift Motor and Mode Sensor Assembly	16-24	12-18	-

SPECIAL TOOLS

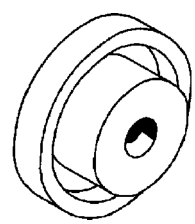
TRANSFER CASE - NV241/NV243



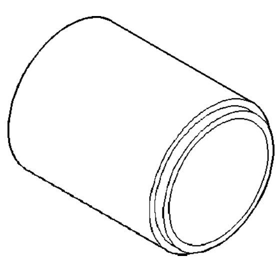
Handle, Universal - C-4171



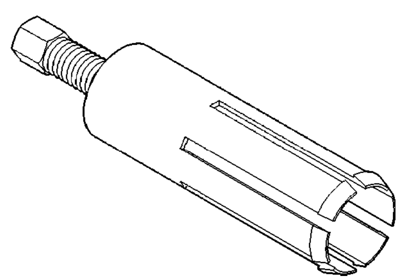
Installer, Bearing - 6953



Installer, Seal - C-4210

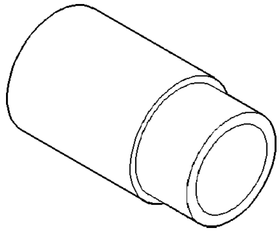


Installer, Seal - 6888

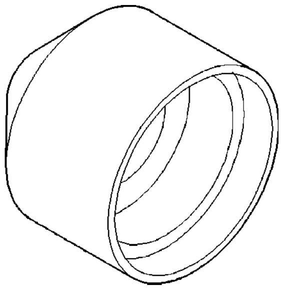


Remover, Bushing - 6957

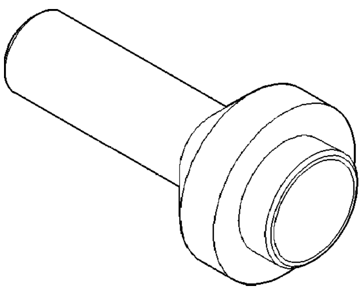
TRANSFER CASE - NV243 (Continued)



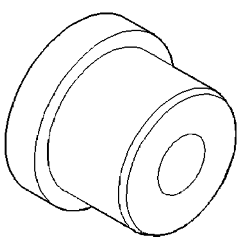
Installer, Bushing - 8157



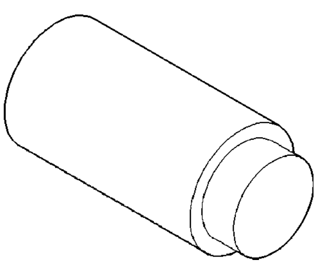
Installer, Seal - D-163



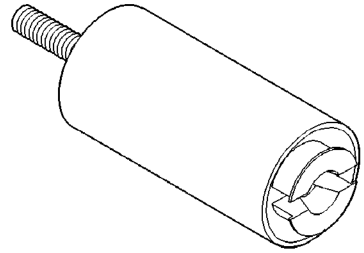
Installer, Seal - 7884



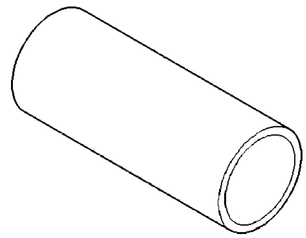
Installer, Bushing - 5066



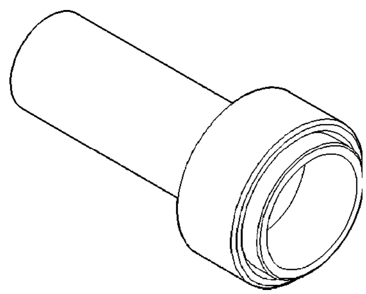
Plug, Extension - C-293-3



Remover - L-4454



Cup - 8148



Installer, Pump Housing Seal - 7888

EXTENSION HOUSING BUSHING AND SEAL

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL)

(3) Using a suitable pry tool or slide-hammer mounted screw, remove the extension housing seal.

(4) Using Remover 8158, remove bushing from extension housing.

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Position replacement bushing in extension housing with fluid port in bushing aligned with slot in housing.

(3) Using Installer 8157, drive bushing into housing until installer seats against case.

(4) Using Installer D-163, install seal in extension housing (Fig. 77).

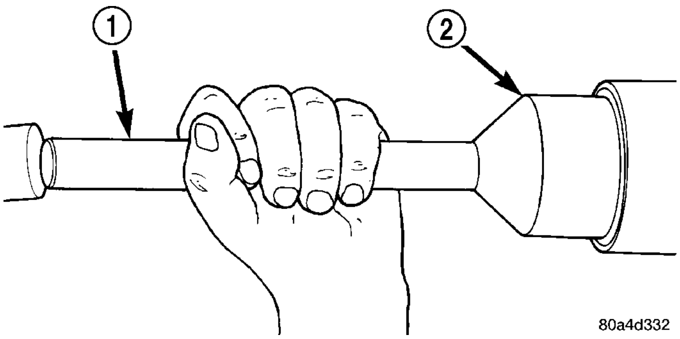


Fig. 77 Install Rear Seal in Extension Housing

1 - SPECIAL TOOL C-4171
2 - SPECIAL TOOL D-163

(5) Install propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(6) Verify proper transfer case fluid level.

(7) Lower vehicle.

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 78).

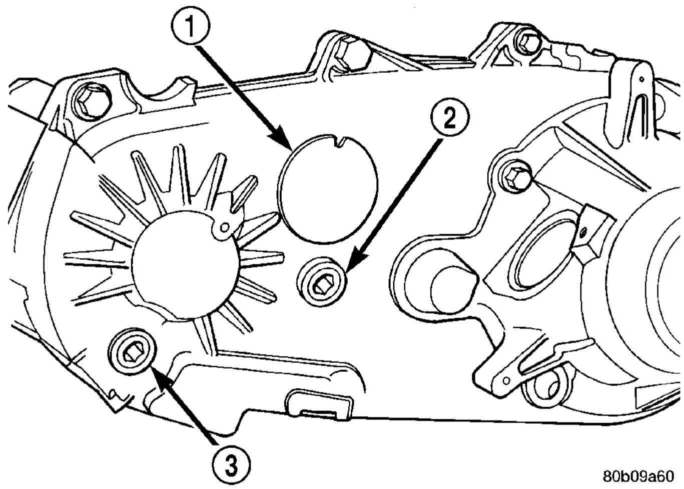


Fig. 78 Fill/Drain Plug and I.D. Tag Location - Typical

1 - I.D. TAG
2 - FILL PLUG
3 - DRAIN PLUG

(1) Raise vehicle.

(2) Position drain pan under transfer case.

(3) Remove drain and fill plugs and drain lubricant completely.

(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).

(5) Remove drain pan.

(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, Automatic Transmission fluid.

(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).

(8) Lower vehicle.

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Remove the front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL).

(2) Remove the front propeller shaft seal boot retaining clamp (Fig. 79).

(3) Remove the front propeller shaft seal boot (Fig. 80).

(4) Remove the front output shaft seal slinger by bending (Fig. 81) the slinger ears away from the transfer case.

(5) Using a suitable pry tool (Fig. 82), remove the slinger from the output shaft using care not to damage the shaft.

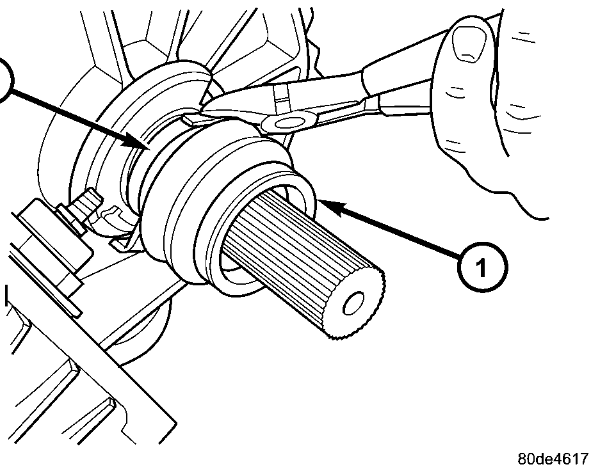


Fig. 79 Remove Boot Clamp

1 - SEAL BOOT
2 - BOOT CLAMP

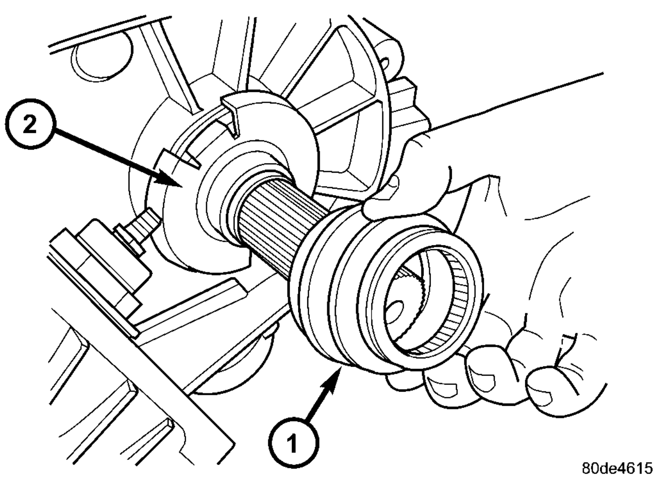


Fig. 80 Remove Seal Boot

1 - SEAL BOOT
2 - SEAL SLINGER

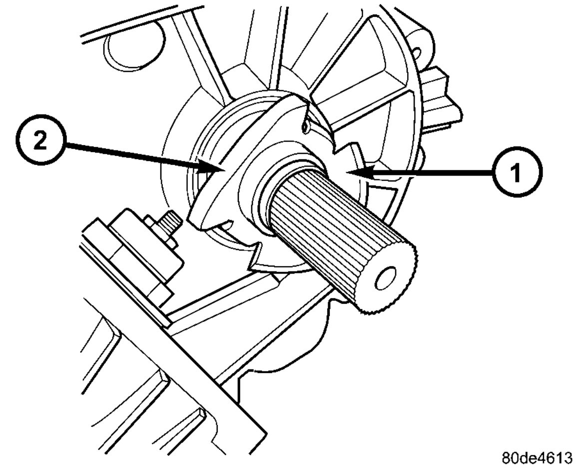


Fig. 81 Bend Slinger Ears

1 - SLINGER
2 - BEND UPWARD

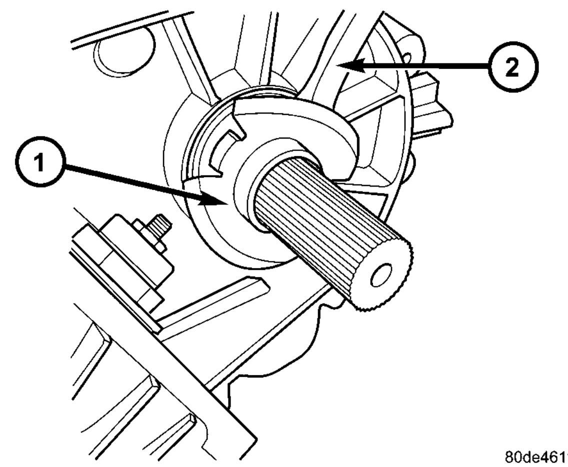


Fig. 82 Remove Slinger From Shaft

1 - SLINGER
2 - PRY TOOL

(6) Using a screw and a slide hammer, remove the front output shaft seal.

INSTALLATION

(1) Install the new front output shaft seal with Installer MB991168A

(2) Install the front output shaft seal slinger with Installer 8840. Install the slinger onto the shaft until the tool contacts the rear of the output shaft.

(3) Install a new seal boot clamp onto the seal boot.

(4) Install the seal boot and clamp onto the slinger hub and tighten the clamp with Crimp Tool C-4975-A.

(5) Install front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).

MODE SENSOR

DESCRIPTION

The transfer case mode sensor (Fig. 83) is an electronic device whose output can be interpreted to indicate the shift motor shaft's rotary position. The sensor consists of a magnetic ring and four Hall Effect Transistors to create a 4 channel digital device (non-contacting) whose output converts the motor shaft position into a coded signal. The TCCM must supply 5VDC (+/- 0.5v) to the sensor and monitor the shift motor position. The four channels are denoted A, B, C, and D. The sensor is mechanically linked to the shaft of the cam which causes the transfer case shifting. The mode sensor draws less than 53 mA.

OPERATION

During normal vehicle operation, the Transfer Case Control Module (TCCM) monitors the mode sensor outputs at least every 250 (+/-50) milliseconds when the shift motor is stationary and 400 microseconds when the shift motor is active. A mode sensor signal between 3.8 Volts and 0.8 Volts is considered to be undefined.

Refer to SECTOR ANGLES vs. TRANSFER CASE POSITION for the relative angles of the transfer case shift sector versus the interpreted transfer case gear operating mode. Refer to MODE SENSOR CHANNEL STATES for the sensor codes returned to the TCCM for each transfer case mode sensor position. The various between gears positions can also be referred as the transfer case's coarse position. These coarse positions come into play during shift attempts.

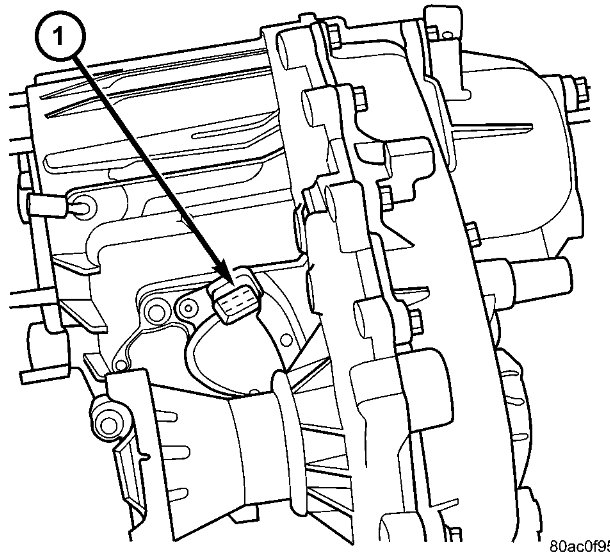


Fig. 83 Mode Sensor

1 - MODE SENSOR

SECTOR ANGLES VS. TRANSFER CASE POSITION

Shaft Angle (Degrees)	Transfer Case Position
+40	4LO
+20	N
0	2WD/AWD
-20	4HI

MODE SENSOR CHANNEL STATES

Transfer Case Angle (degrees)	Sensor Channel A	Sensor Channel B	Sensor Channel C	Sensor Channel D
Between Gears	H	H	L	H
+40 (4LO)	H	H	L	L
Between Gears	H	H	L	H
Between Gears	H	L	L	H
+20 (NEUTRAL)	H	L	L	L
Between Gears	H	L	L	H
Between Gears	H	L	H	H
0 (2WD/AWD)	H	L	H	L
Between Gears	H	L	H	H
Between Gears	L	L	H	H
-20 (4HI)	L	L	H	L
Between Gears	L	L	H	H
Between Gears	L	H	H	H

SELECTOR SWITCH

DESCRIPTION

The selector switch assembly (Fig. 84) is mounted in the left side of the vehicle's Instrument Panel (IP) and consists of a rotary knob connected to a resistive network for the mode and range shift selections. Also located in this assembly is a recessed, normally open momentary switch for making shifts into and out of transfer case NEUTRAL. A pen, or similar instrument, is used to make a NEUTRAL shift selection, thus reducing the likelihood of an inadvertent shift request.

The selector switch also contains four light emitting diode's (LED's) to indicate the transfer case position and whether a shift is in progress.

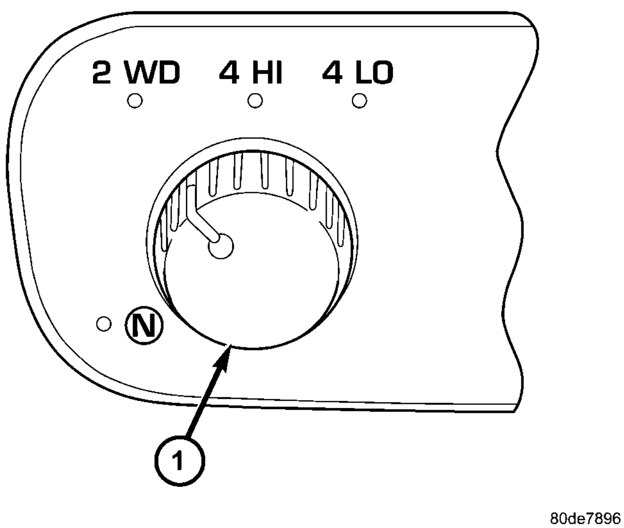


Fig. 84 Transfer Case Selector Switch

1 - SELECTOR SWITCH

OPERATION

As the position of the selector switch varies, the resistance between the Mode Sensor supply voltage pin and the Mode Sensor output will vary. Hardware, software, and calibrations within the Transfer Case Control Module (TCCM) are provided that interpret the selector switch resistance as given in the table below: SELECTOR SWITCH INTERPRETATION

SELECTOR SWITCH INTERPRETATION

Step	Resistance Range (ohms)	Required Interpretation
A	<200	Shorted
B	400-700	NEUTRAL
C	1050-1450	4LO
D	1850-2300	4HI
E	3050-5950	2WD (Default)
F	9.5-12.5K	In between positions
G	>15.5K	Open

For resistances between the ranges B-E shown for each valid position (T-Case NEUTRAL, 4LO, 4HI, 2WD), the TCCM may interpret the resistance as:

- either of the neighboring valid positions.
- as an invalid fault position.

For resistances between the ranges E and F shown for 2WD and in-between positions, the TCCM may interpret the resistance as:

- the 2WD position.
- an invalid fault position.
- a valid in-between position.

For resistances between the ranges F and G shown for in-between positions and fault condition (open), the TCCM may interpret the resistance as:

- a valid in-between position.
- an invalid fault position.

For resistances between the ranges A and B shown for the fault condition (short) and , T-Case NEUTRAL, the TCCM may interpret the resistance as:

- the T-Case NEUTRAL position.
- an invalid fault position.

The LED's in the selector assembly are illuminated/flashed in the following manner to indicate a particular condition or state.

- A solidly illuminated LED indicates a successfully completed shift and the current operating mode of the transfer case. While a shift has been requested but not yet completed, the LED for the desired transfer case position is flashed.

SELECTOR SWITCH (Continued)

• A flashing operating mode LED for the desired gear indicates that a shift to that position has been requested, but all of the driver controllable conditions have not been met. This is in an attempt to notify the driver that the transmission needs to be put into NEUTRAL, the vehicle speed is too great, or some other condition outlined (other than a diagnostic failure that would prevent this shift) elsewhere (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSFER CASE CONTROL MODULE - OPERATION) is not met. Note that this flashing will continue indefinitely until the conditions are eventually met, or the selector switch position is changed, or if diagnostic routines no longer allow the requested shift.

• If the driver attempts to make a shift into transfer case NEUTRAL, and any of the driver controllable conditions are not met, the request will be ignored until all of the conditions are met or until the NEUTRAL select button is released. Additionally the neutral lamp will flash, or begin to flash while the button is depressed and operator controllable conditions are not being met. All of the LED's except the Neutral will flash if any of the operator controllable conditions for shifting are not met while the Neutral button is depressed. This ″toggle″ type of feature is necessary because the TCCM would interpret another request immediately after the shift into transfer case NEUTRAL has completed.

• No LED's illuminated indicate a fault in the transfer case control system.

SHIFT MOTOR

DESCRIPTION

The shift motor (Fig. 85) consists of a permanent magnet D.C. motor with gear reduction to convert a high speed-low torque device into a low speed-high torque device. The output of the device is coupled to a shaft which internally moves the mode and range forks that change the transfer case operating ranges. The motor is rated at 25 amps maximum at 72° F with 10 volts at the motor leads.

OPERATION

The transfer case shift motor responds to the Transfer Case Control Module (TCCM) commands to move the transfer case shift sector bi-directionally, as required, to obtain the transfer case operating mode indicated by the instrument panel mounted selector switch.

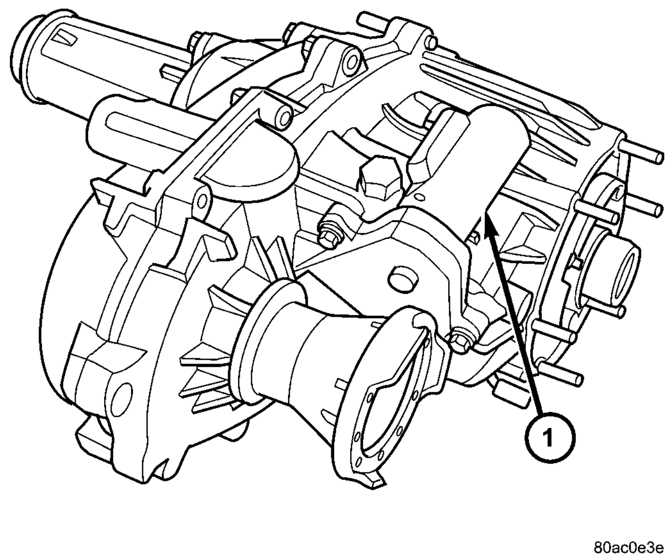


Fig. 85 Shift Motor - Shown Inverted - Typical

1 - SHIFT MOTOR

REMOVAL

(1) Raise the vehicle on a suitable hoist.

(2) Disengage the wiring connectors from the shift motor and mode sensor.

(3) Remove the bolts holding the shift motor and mode sensor assembly onto the transfer case.

(4) Separate the shift motor and mode sensor assembly from the transfer case.

INSTALLATION

(1) Verify that the shift sector o-ring is clean and properly positioned over the shift sector and against the transfer case.

(2) Position the shift motor and mode sensor assembly onto the transfer case.

(3) Install the bolts to hold the assembly onto the transfer case. Tighten the bolts to 16-24 N·m (12-18 ft.lbs.).

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

(4) Engage the wiring connectors to the shift motor and mode sensor.

(5) Refill the transfer case as necessary.

(6) Lower vehicle and verify transfer case operation.

TRANSFER CASE - NV273

TABLE OF CONTENTS

TRANSFER CASE - NV273

DESCRIPTION

The NV273 is an electronically controlled part-time transfer case with a low range gear reduction system. The NV273 has three operating ranges plus a NEUTRAL position. The low range system provides a gear reduction ratio for increased low speed torque capability.

The geartrain is mounted in two aluminum case halves attached with bolts. The mainshaft front and rear bearings are mounted in aluminum case halves.

OPERATING RANGES

Transfer case operating ranges are:
- 2WD (2-wheel drive)
- 4HI (4-wheel drive)
- 4LO (4-wheel drive low range)
- NEUTRAL

The 2WD range is for use on any road surface at any time.

The 4HI and 4LO ranges are for off road use only. They are not for use on hard surface roads. The only exception being when the road surface is wet or slippery or covered by ice and snow.

The low range reduction gear system is operative in 4LO range only. This range is for extra pulling power in off road situations. Low range reduction ratio is 2.72:1.

SHIFT MECHANISM

Operating ranges are selected with a dash mounted shift selector switch. The shift selector switch provides a input to the Transfer Case Control Module (TCCM) to indicate the driver's desire to change operating ranges. The TCCM uses this input, along with input from the transfer case mounted mode sensor and information from the vehicle's bus, to determine if a shift is permitted. If the TCCM decides the shift is permitted, the TCCM controls the shift motor, mounted to the exterior of the transfer case, to perform the shift.

TRANSFER CASE - NV273 (Continued)

IDENTIFICATION

A circular ID tag is attached to the rear case of each transfer case (Fig. 1). The ID tag provides the transfer case model number, assembly number, serial number, and low range ratio.

The transfer case serial number also represents the date of build.

OPERATION

The input gear is splined to the transmission output shaft. The input gear drives the mainshaft through the planetary assembly and range sleeve. The front output shaft is operated by a drive chain that connects the shaft to a drive sprocket on the mainshaft. The drive sprocket is engaged/disengaged by the mode fork, which operates the mode sleeve and hub. The sleeve and hub are not equipped with a synchronizer mechanism for shifting.

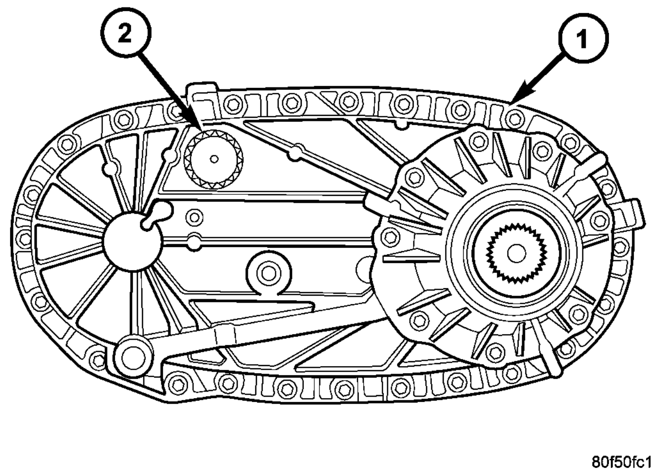


Fig. 1 Transfer Case - Rear View

1 - TRANSFER CASE
2 - IDENTIFICATION TAG

DIAGNOSIS AND TESTING - TRANSFER CASE - NV273

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Transfer case difficult to shift or will not shift into desired range.	1) Transfer case electronically controlled shift system malfunction.	1) Verify proper operation per the appropriate diagnostic manual.
	2) If vehicle was operated for an extended period in 4HI mode on dry surface, driveline torque load may cause difficulty.	2) Drive the vehicle in a straight line and momentarily release the accelerator. The transfer case can then be shifted to the desired mode.
	3) Insufficient or incorrect lubricant.	3) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, Automatic Transmission Fluid.
	4) Internal transfer case components binding, worn, or damaged.	4) Repair or replace components as necessary.
Transfer case noisy in all drive modes.	1) Insufficient or incorrect lubricant.	1) Drain and refill transfer case with the correct quantity of Mopar® ATF +4, type 9602, Automatic Transmission Fluid.
	2) Internal transfer case components binding, worn, or damaged.	2) Repair or replace components as necessary.

TRANSFER CASE - NV273 (Continued)

Condition	Possible Cause	Correction
Transfer case noisy while in, or jumps out of, 4LO mode.	1) Transfer case not completely engaged in 4LO position.	1) While rolling 2-3 MPH and the transmission in NEUTRAL, or clutch depressed on vehicles equipped with a manual transmission, shift transfer case to the 2WD or 4HI position, and then back into the 4LO position.
	2) Range fork damaged, inserts worn, or fork is binding on the shift rail.	2) Repair or replace components as necessary.
	3) Low range gear worn or damaged.	3) Repair or replace components as necessary.
Lubricant leaking from transfer case seals or vent.	1) Transfer case overfilled.	1) Drain lubricant to the correct level.
	2) Transfer case vent closed or restricted.	2) Clean or replace vent as necessary.
	3) Transfer case seals damaged or installed incorrectly.	3) Replace suspect seal.
Abnormal tire wear.	1) Extended operation in 4HI mode on dry surfaces,	1) Operate vehicle in 2WD mode on dry surfaces.

REMOVAL

(1) Shift transfer case into 2WD.
(2) Raise vehicle.
(3) Drain transfer case lubricant.
(4) Mark front and rear propeller shafts for alignment reference.
(5) Support transmission with jack stand.
(6) Remove the transfer case skid plate, if equipped.
(7) Disconnect front and rear propeller shafts at transfer case.
(8) Disconnect transfer case shift motor and mode sensor wire connectors.
(9) Disconnect transfer case vent hose.
(10) Support transfer case with transmission jack.
(11) Secure transfer case to jack with chains.
(12) Remove nuts attaching transfer case to transmission (Fig. 2).
(13) Pull transfer case and jack rearward to disengage transfer case.
(14) Remove transfer case from under vehicle.

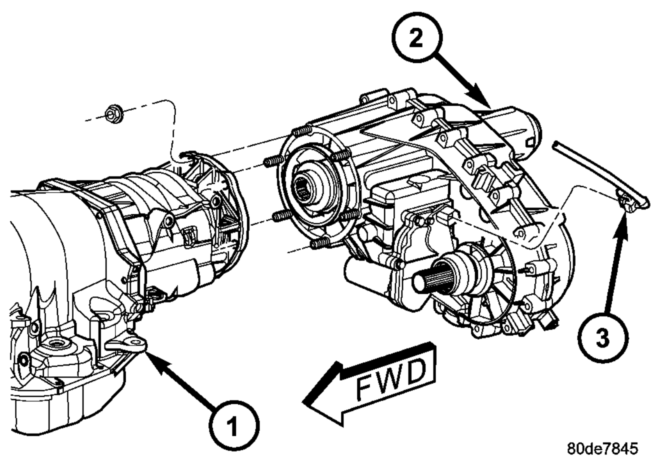


Fig. 2 Remove Transfer Case - Typical

1 - TRANSMISSION
2 - TRANSFER CASE
3 - MODE SENSOR CONNECTOR

DISASSEMBLY

Position transfer case in a shallow drain pan. Remove drain plug and drain any remaining lubricant remaining in case.

TRANSFER CASE - NV273 (Continued)

COMPANION FLANGE AND EXTENSION HOUSING

(1) Install two bolts 180° apart into the front output shaft companion flange.

(2) Place holder over the bolts and against the companion flange (Fig. 3).

(3) Remove and discard the front companion flange nut.

(4) Remove the companion flange from the front output shaft. It may be necessary to use Flange puller 8992 to remove the companion flange.

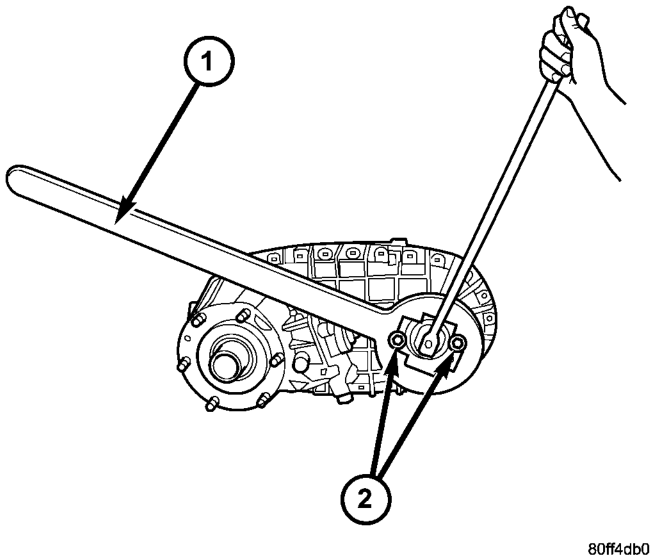


Fig. 3 Remove Companion Flange Nut - Typical

1 - HOLDER 6719
2 - BOLTS

(5) Use a suitable chisel or pry tool to remove the rear extension housing dust boot (Fig. 4).

(6) Use a suitable chisel or pry tool to remove the rear extension housing seal.

(7) Remove rear extension bolts (Fig. 5).

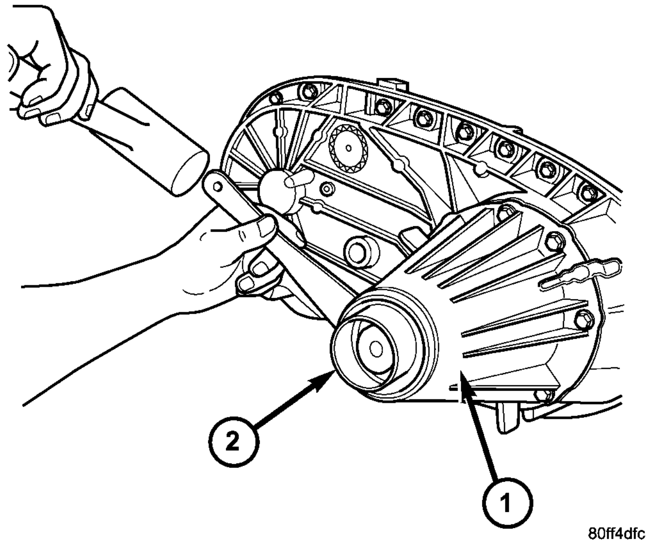


Fig. 4 Remove Extension Housing Dust Boot

1 - EXTENSION HOUSING
2 - DUST BOOT

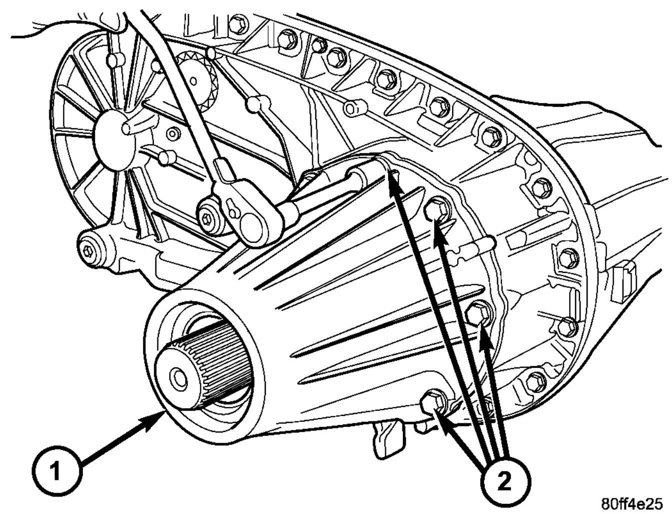


Fig. 5 Remove Extension Housing Bolts

1 - EXTENSION HOUSING
2 - BOLTS

TRANSFER CASE - NV273 (Continued)

(8) Remove rear extension housing (Fig. 6). Tap extension once or twice with a plastic mallet to break sealer bead and loosen it.

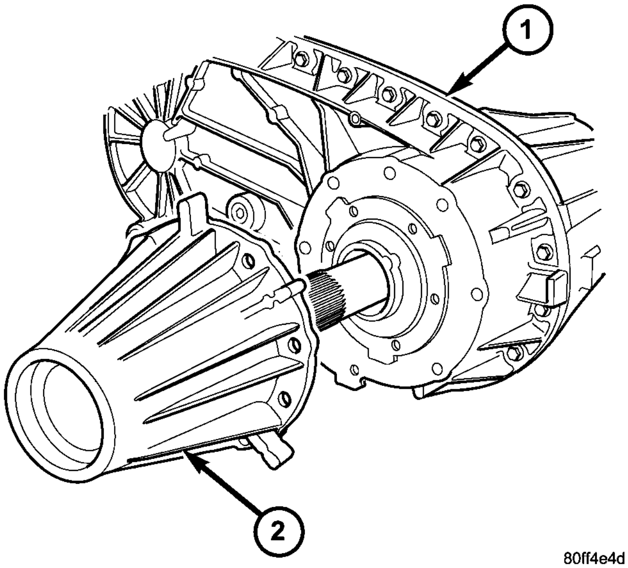


Fig. 6 Remove Extension Housing

1 - REAR CASE HALF
2 - EXTENSION HOUSING

OIL PUMP AND REAR CASE

(1) Disengage the oil pump pick-up tube (Fig. 7) from the oil pump.

NOTE: The oil pump pick-up tube seals to the oil pump with an o-ring. Verify that the o-ring was removed with the tube and is in good condition. Replace the o-ring if necessary.

(2) Remove the oil pump (Fig. 8).

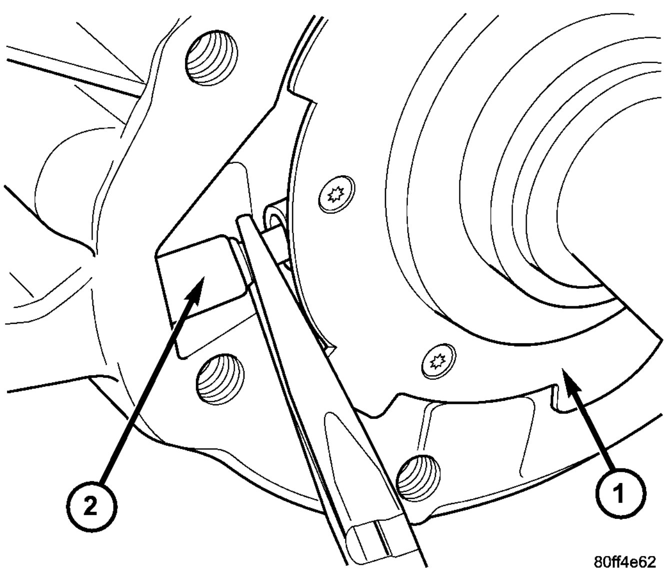


Fig. 7 Disengage The Oil Pick-up From Oil Pump

1 - OIL PUMP
2 - OIL PICK-UP TUBE

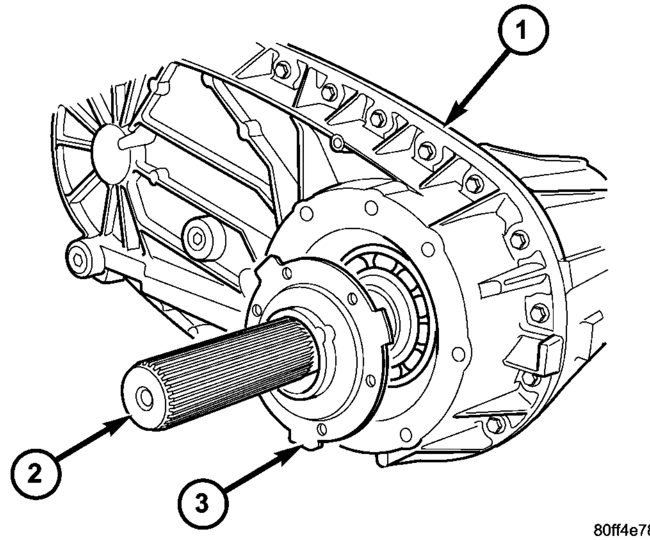


Fig. 8 Remove Oil Pump

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT
3 - OIL PUMP

(3) Remove rear case-to-front case bolts (Fig. 9).

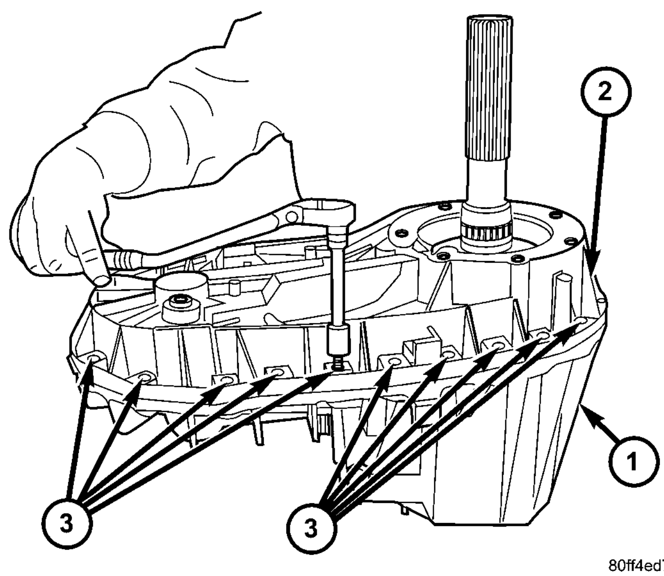


Fig. 9 Remove Case Half Bolts

1 - FRONT CASE HALF
2 - REAR CASE HALF
3 - BOLTS

TRANSFER CASE - NV273 (Continued)

(4) Remove the rear output shaft bearing inner snap-ring (Fig. 10) from the output shaft using suitable snap-ring pliers.

(5) Remove the rear output shaft bearing inner snap-ring (Fig. 11) from the output shaft.

(6) Loosen rear case with pry tool to break sealer bead. Insert tool at each end of case (Fig. 12).

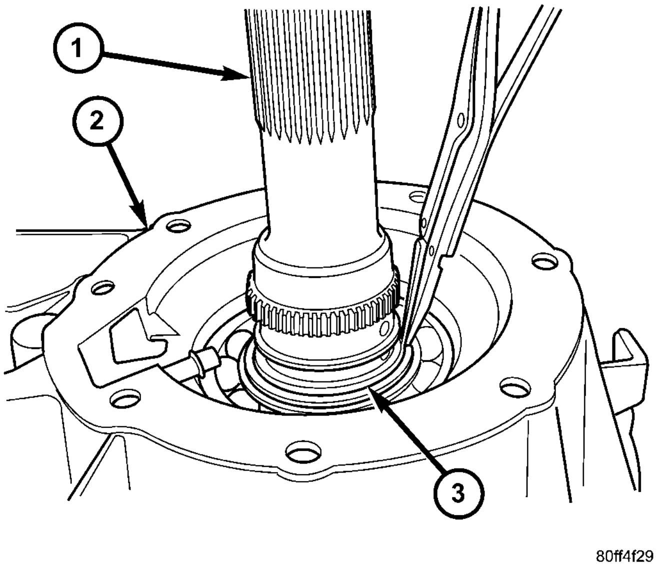


Fig. 10 Remove Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

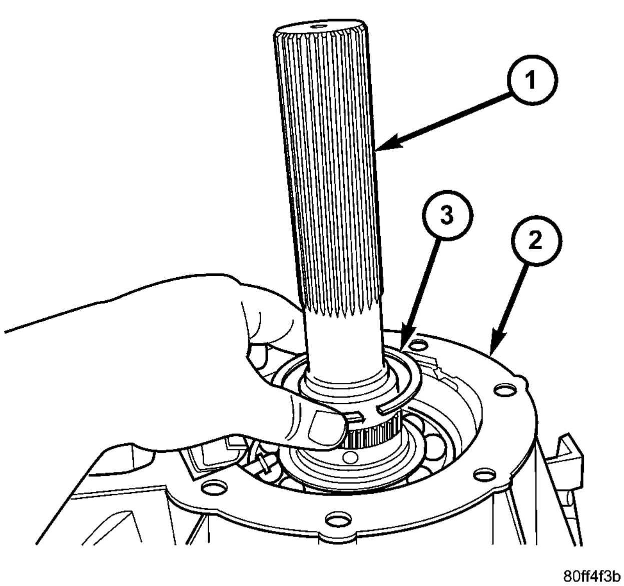


Fig. 11 Remove Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

(7) Unseat rear case from alignment dowels.

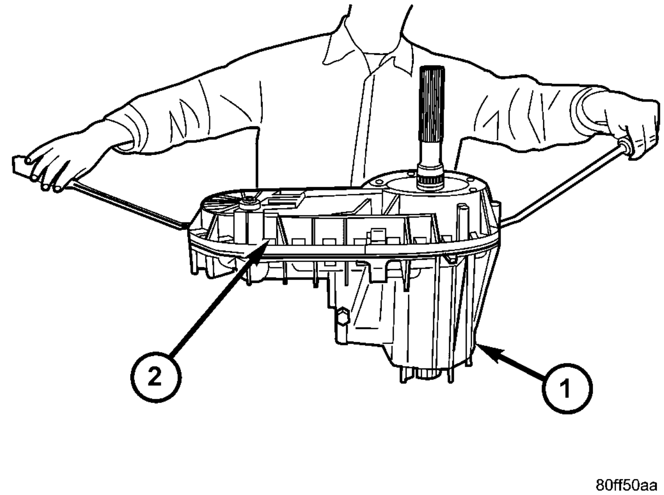


Fig. 12 Separate Front and Rear Case Halves

1 - FRONT CASE HALF
2 - REAR CASE HALF

(8) Remove the rear case from the front case (Fig. 13).

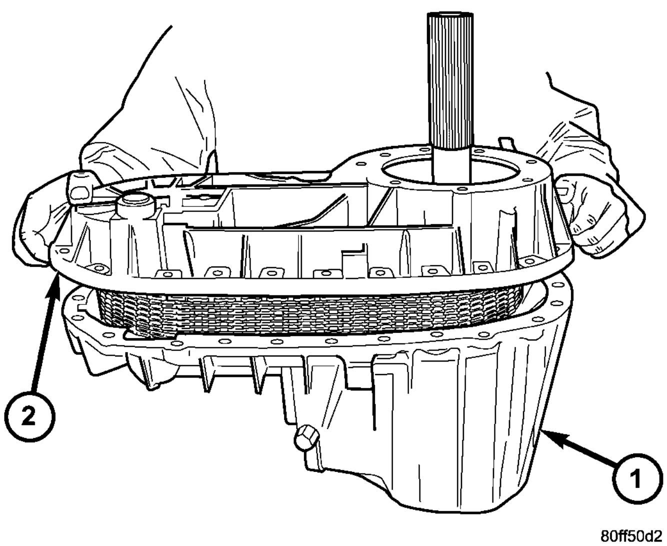


Fig. 13 Remove Rear Case Half

1 - FRONT CASE HALF
2 - REAR CASE HALF

TRANSFER CASE - NV273 (Continued)

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Remove the oil pick-up tube (Fig. 14) and screen from the front case half.

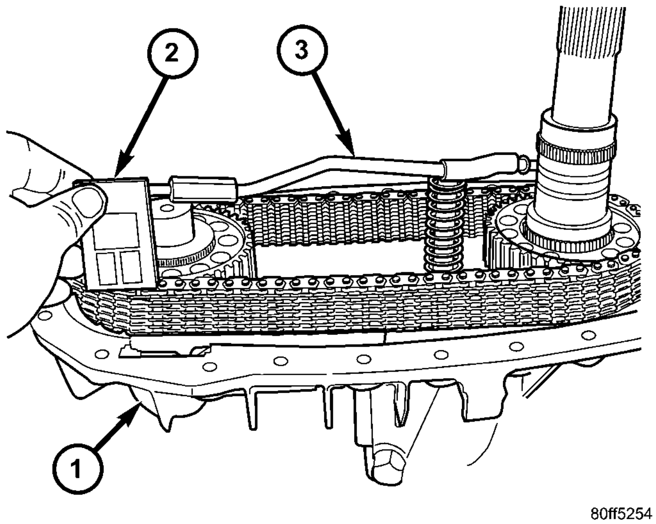


Fig. 14 Remove Oil Pick-Up Tube and Screen

1 - FRONT CASE HALF
2 - OIL SCREEN
3 - PICK-UP TUBE

(2) Remove the front output shaft drive sprocket retaining ring (Fig. 15).

(3) Remove the rear output shaft drive sprocket retaining ring (Fig. 16).

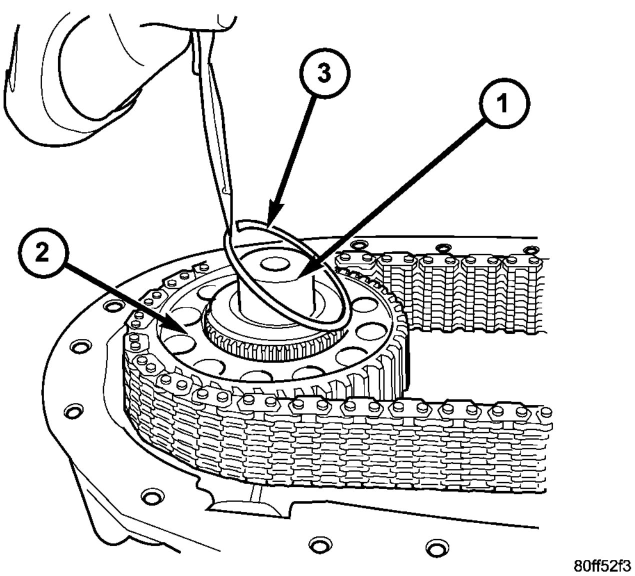


Fig. 15 Remove Front Output Shaft Sprocket Retaining Ring

1 - FRONT OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

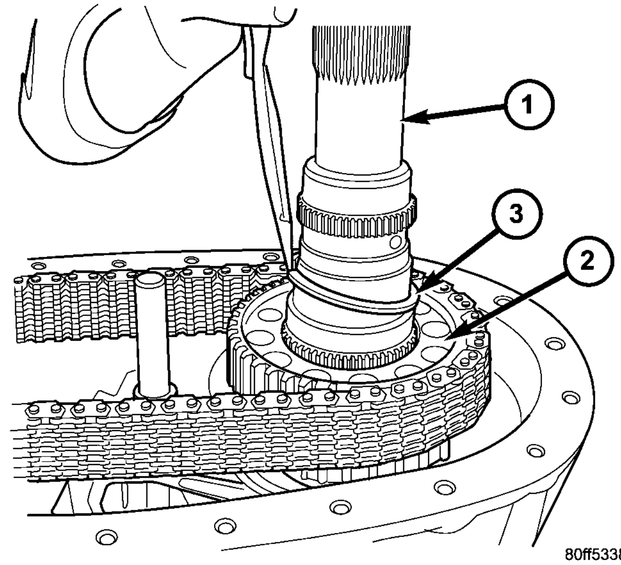


Fig. 16 Remove Rear Output Shaft Sprocket Retaining Ring

1 - REAR OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

(4) Pull front sprocket (Fig. 17), rear sprocket, and chain upward until clear of the front and rear output shaft sprocket splines.

(5) Remove chain and sprockets as an assembly.

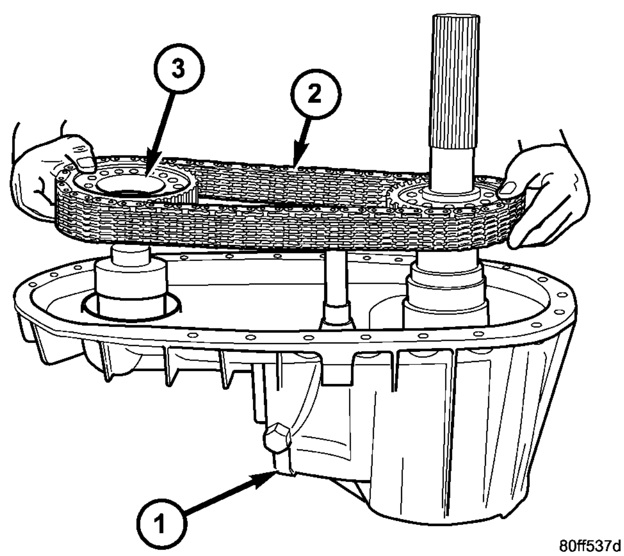


Fig. 17 Remove Drive Chain and Sprockets

1 - FRONT CASE HALF
2 - CHAIN
3 - DRIVE SPROCKETS

TRANSFER CASE - NV273 (Continued)

SHIFT FORKS AND MAINSHAFT

(1) Remove the bolts (Fig. 18) that hold the shift motor assembly to the transfer case.

(2) Remove the shift motor assembly (Fig. 19) from the transfer case.

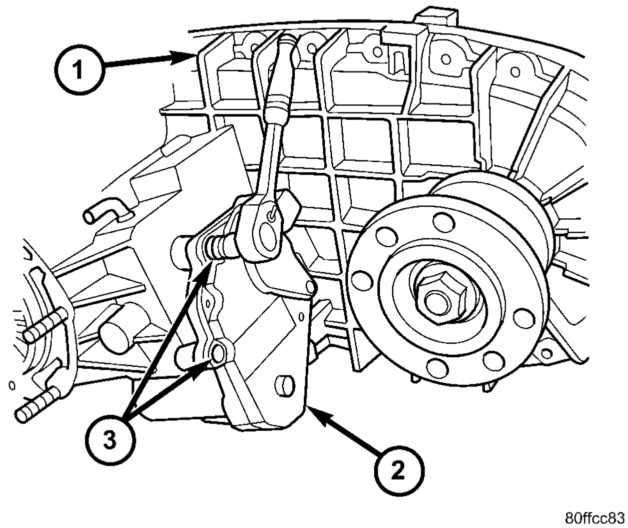


Fig. 18 Remove Shift Motor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR ASSEMBLY
3 - BOLTS

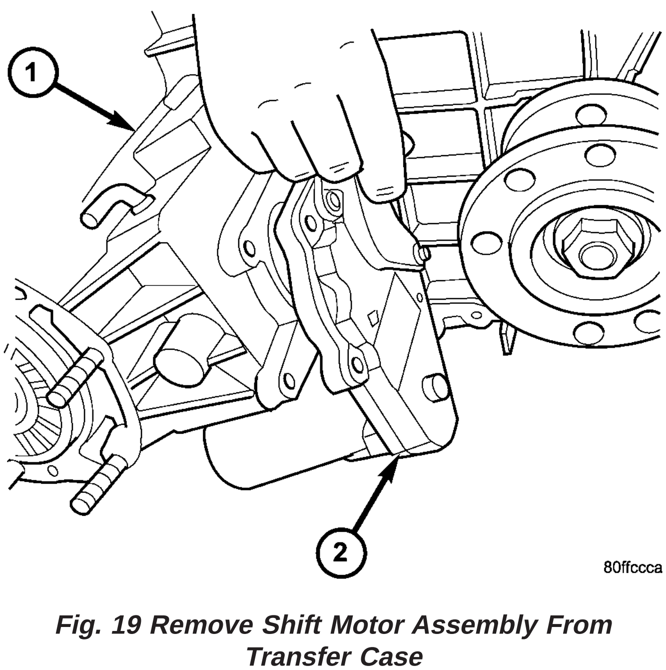


Fig. 19 Remove Shift Motor Assembly From Transfer Case

1 - TRANSFER CASE
2 - SHIFT MOTOR ASSEMBLY

(3) Remove the sector support with Socket 9033.

(4) Loosen detent plug (Fig. 20).

(5) Remove detent plug, spring, and plunger (Fig. 21). Note that the plug has an O-ring seal. Remove and discard this seal.

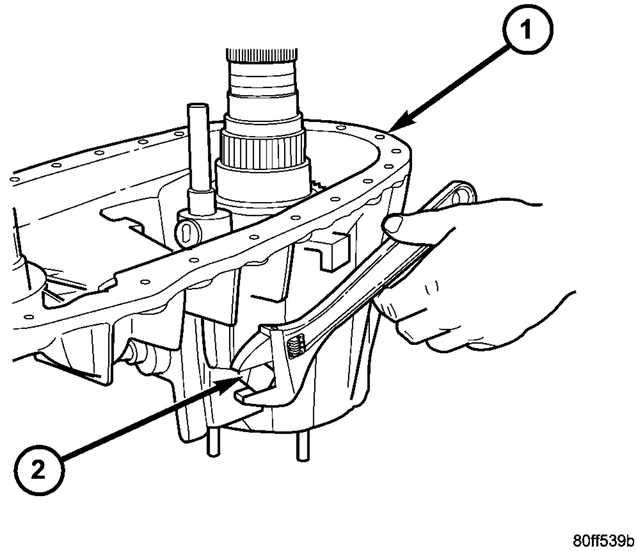


Fig. 20 Loosen the Detent Plug

1 - FRONT CASE HALF
2 - DETENT PLUG

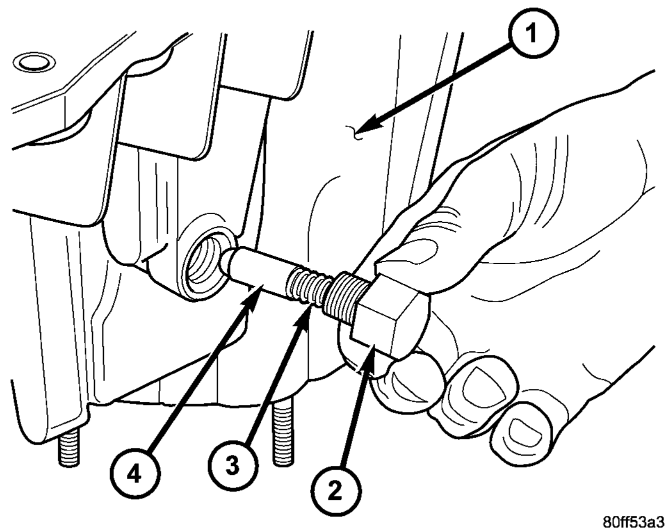


Fig. 21 Remove Detent plug, Spring, and Plunger

1 - FRONT CASE HALF
2 - DETENT PLUG
3 - SPRING
4 - PLUNGER

TRANSFER CASE - NV273 (Continued)

(6) Using a screw mounted in a slide hammer, remove the front output shaft seal.

(7) Remove the front output shaft snap-ring (Fig. 22).

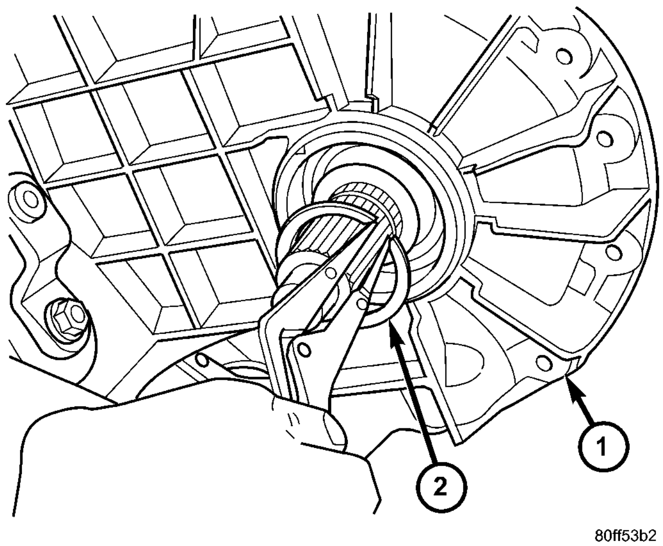


Fig. 22 Remove Front Output Shaft Bearing Inner Snap-Ring

1 - FRONT CASE HALF
2 - SNAP-RING

(8) Remove front output shaft from bearing in case (Fig. 23).

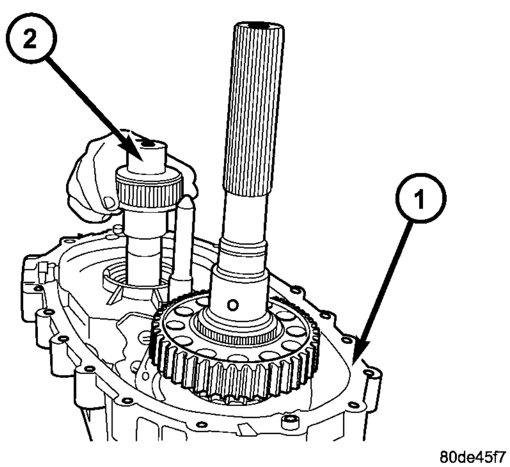


Fig. 23 Remove Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

(9) Pull mainshaft assembly out of input gear, mode sleeve, and case (Fig. 24).

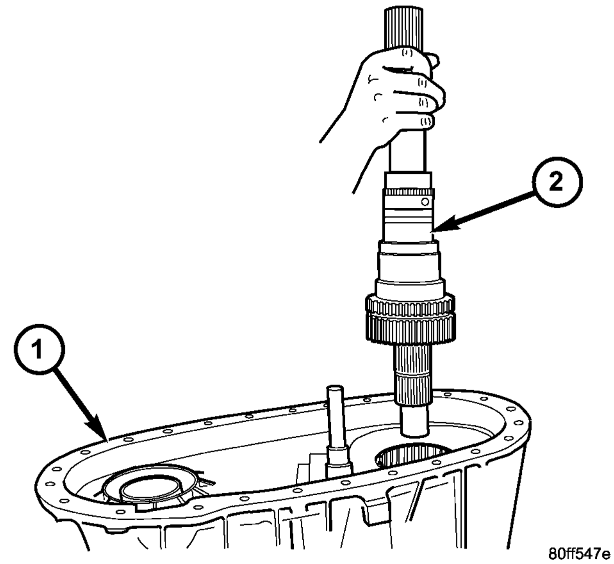


Fig. 24 Remove Mainshaft Assembly

1 - FRONT CASE HALF
2 - MAINSHAFT ASSEMBLY

(10) Remove mode fork, mode sleeve, and shift rail as assembly (Fig. 25). Note which way the sleeve fits in the fork (long side of sleeve goes to front or the points on the sleeve teeth go to the rear of case).

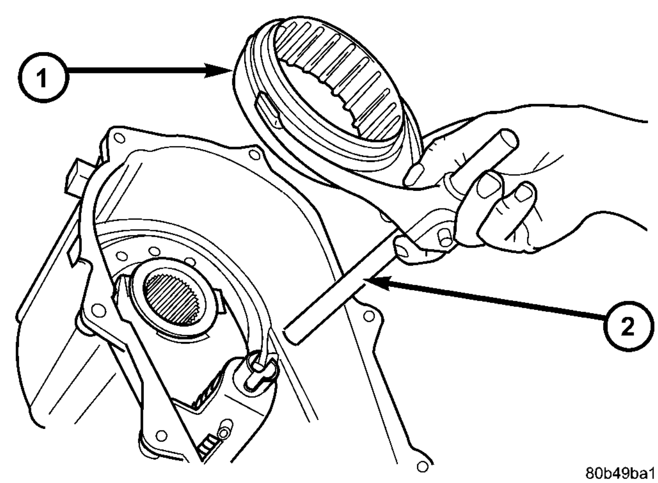


Fig. 25 Mode Fork And Sleeve Removal

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

(11) Remove range fork and hub as an assembly (Fig. 26). Note fork position for installation reference.

(12) Remove the shift sector (Fig. 27).

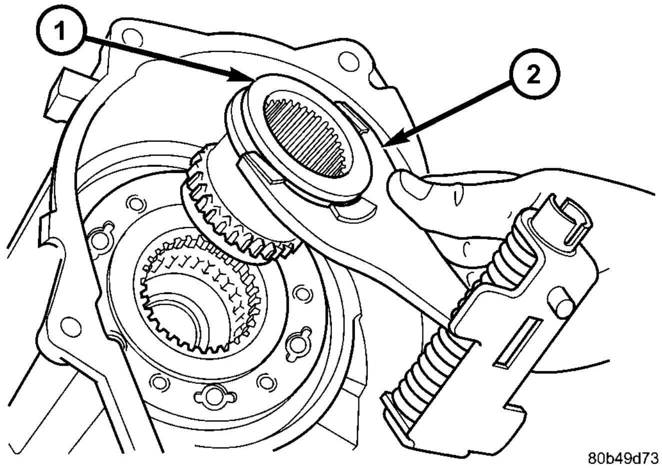


Fig. 26 Range Fork And Hub Removal

1 - RANGE HUB
2 - RANGE FORK

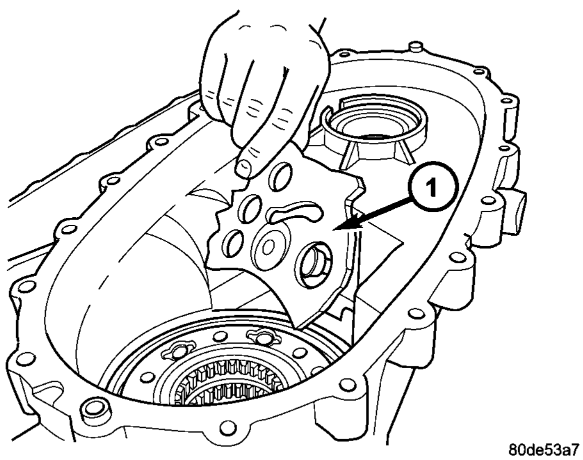


Fig. 27 Remove Shift Sector

1 - SHIFT SECTOR

MAINSHAFT

(1) Remove the clutch gear (Fig. 28) from the output shaft.

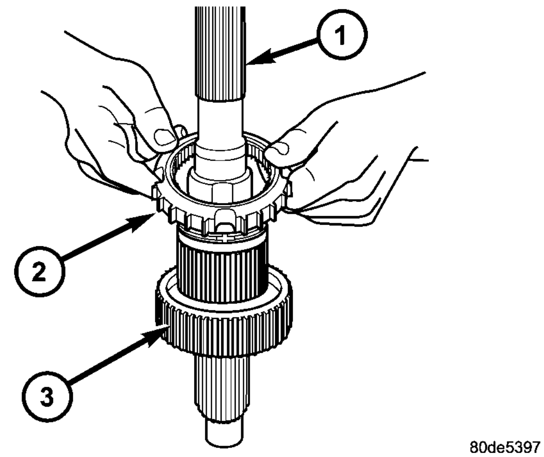


Fig. 28 Remove Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

(2) Remove the mode hub retaining ring (Fig. 29) from the mainshaft.

(3) Remove the mode hub (Fig. 30) from the mainshaft.

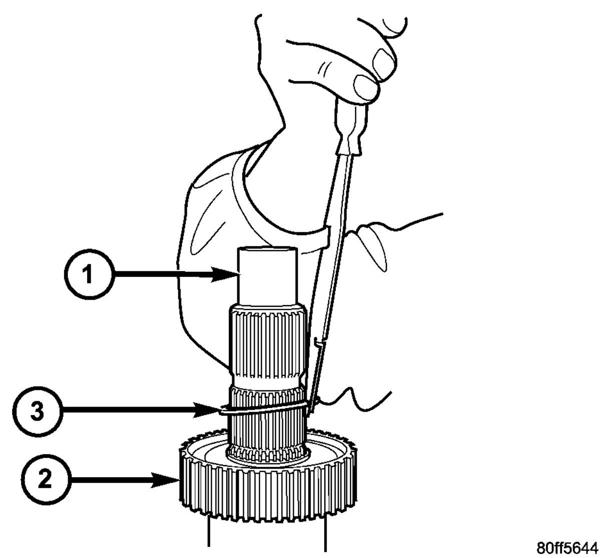


Fig. 29 Remove Mode Hub Retaining Ring

1 - MAINSHAFT
2 - MODE HUB
3 - RETAINING RING

TRANSFER CASE - NV273 (Continued)

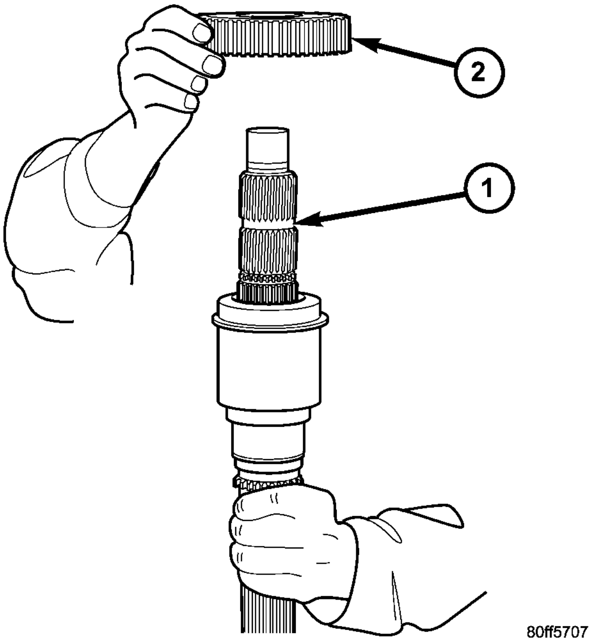


Fig. 30 Remove Mode Hub

1 - MAINSHAFT
2 - MODE HUB

(4) Remove the drive sprocket drive hub (Fig. 31) from the mainshaft.

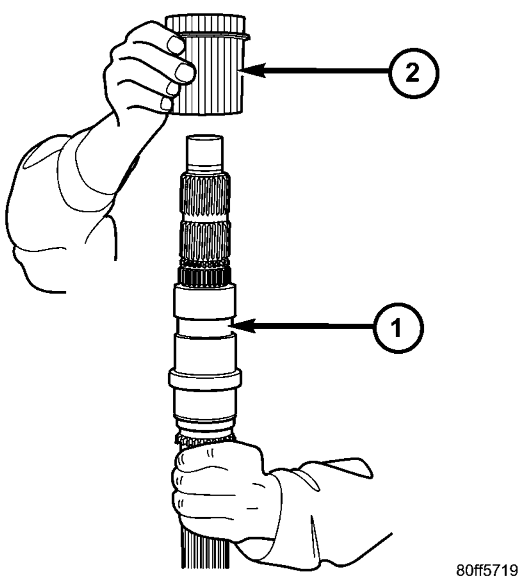


Fig. 31 Remove the Drive Sprocket Drive Hub

1 - MAINSHAFT
2 - DRIVE SPROCKET DRIVE HUB

INPUT AND PLANETARY GEAR

(1) Remove input gear seal with suitable screw and slide hammer.

(2) Remove input gear retaining ring (Fig. 32) with heavy duty snap-ring pliers.

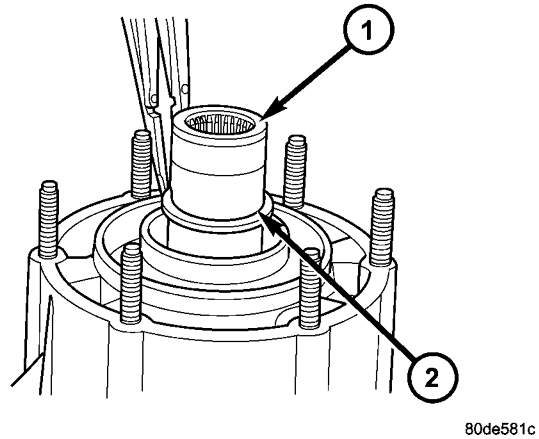


Fig. 32 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(3) Place front case in horizontal position. Then remove input gear and low range gear as an assembly (Fig. 33). Tap gear out of bearing with plastic mallet, if necessary.

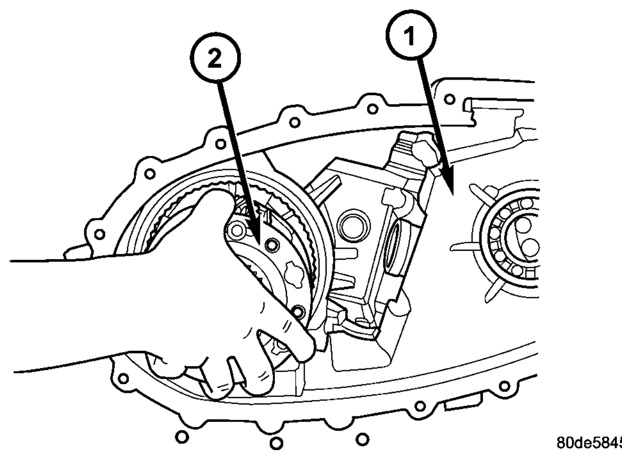


Fig. 33 Remove Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

TRANSFER CASE - NV273 (Continued)

(4) Remove snap-ring that retains input gear in the low range gear (Fig. 34).

(5) Remove retainer (Fig. 35).

(6) Remove front thrust plate (Fig. 36).

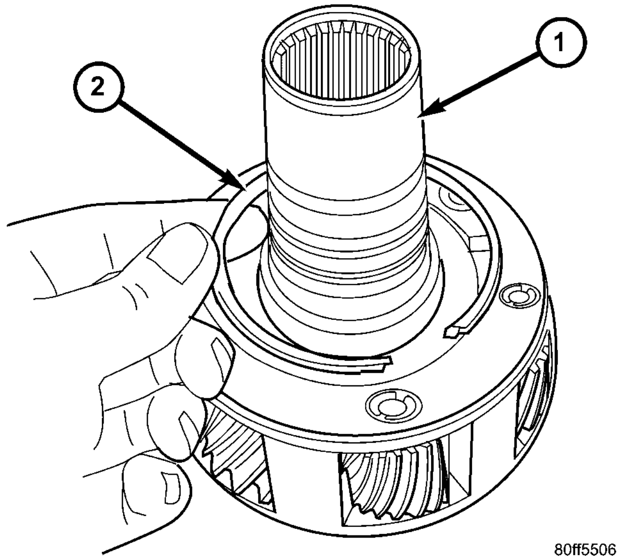


Fig. 34 Remove Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

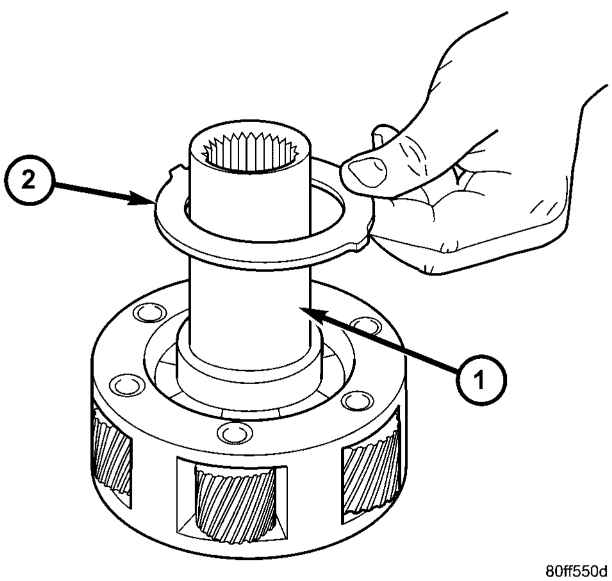


Fig. 35 Remove Input Gear Retainer

1 - INPUT GEAR
2 - RETAINER

(7) Remove input gear (Fig. 37).

(8) Remove bottom tabbed thrust washer from low range planetary (Fig. 38).

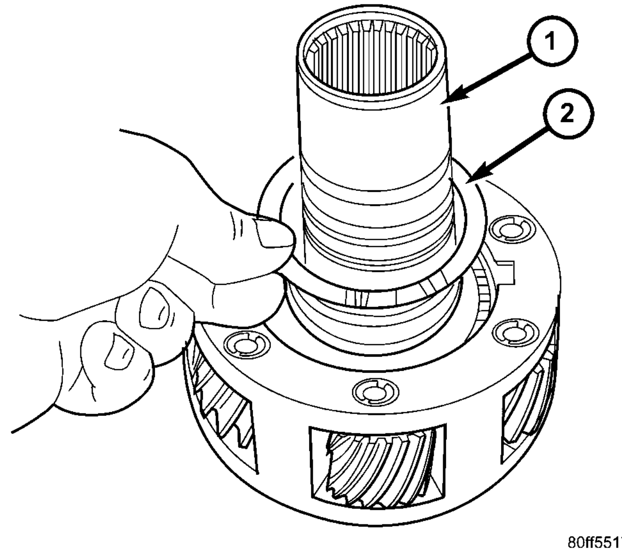


Fig. 36 Remove Input Gear Thrust Plate

1 - INPUT GEAR
2 - THRUST PLATE

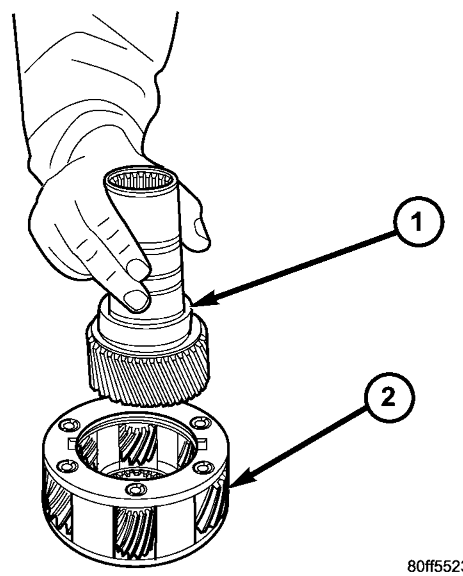


Fig. 37 Remove Input Gear From Planetary

1 - INPUT GEAR
2 - LOW RANGE PLANETARY

CLEANING

Clean the transfer case parts with a standard parts cleaning solvent. Remove all traces of sealer from the cases and retainers with a scraper and 3M™ all purpose cleaner. Use compressed air to remove solvent residue from oil feed passages in the case halves, retainers, gears, and shafts.

TRANSFER CASE - NV273 (Continued)

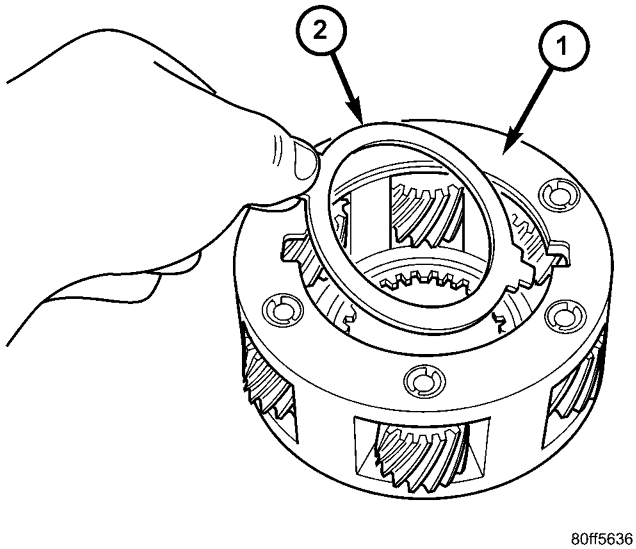


Fig. 38 Remove Bottom Input Gear Thrust Plate

1 - PLANETARY
2 - THRUST PLATE

INSPECTION

MAINSHAFT/SPROCKET/HUB INSPECTION

Inspect the splines on the hub and shaft and the teeth on the sprocket. Minor nicks and scratches can be smoothed with an oilstone. However, replace any part that is damaged.

Check the contact surfaces in the sprocket bore and on the mainshaft. Minor nicks and scratches can be smoothed with 320-400 grit emery cloth but do not try to salvage the shaft if nicks or wear is severe.

INPUT GEAR AND PLANETARY CARRIER

Check the teeth on the gear (Fig. 39). Minor nicks can be dressed off with an oilstone but replace the gear if any teeth are broken, cracked, or chipped. The bearing surface on the gear can be smoothed with 300-400 grit emery cloth if necessary.

Examine the carrier body and pinion gears for wear or damage. Check the pinion gear thrust washers on the pinon pins for damage. The carrier will have to be replaced as an assembly if the body, pinion pins, or pinion gears are damaged.

Check the lock ring and both thrust washers for wear or cracks. Replace them if necessary. Also replace the lock retaining ring if bent, distorted, or broken.

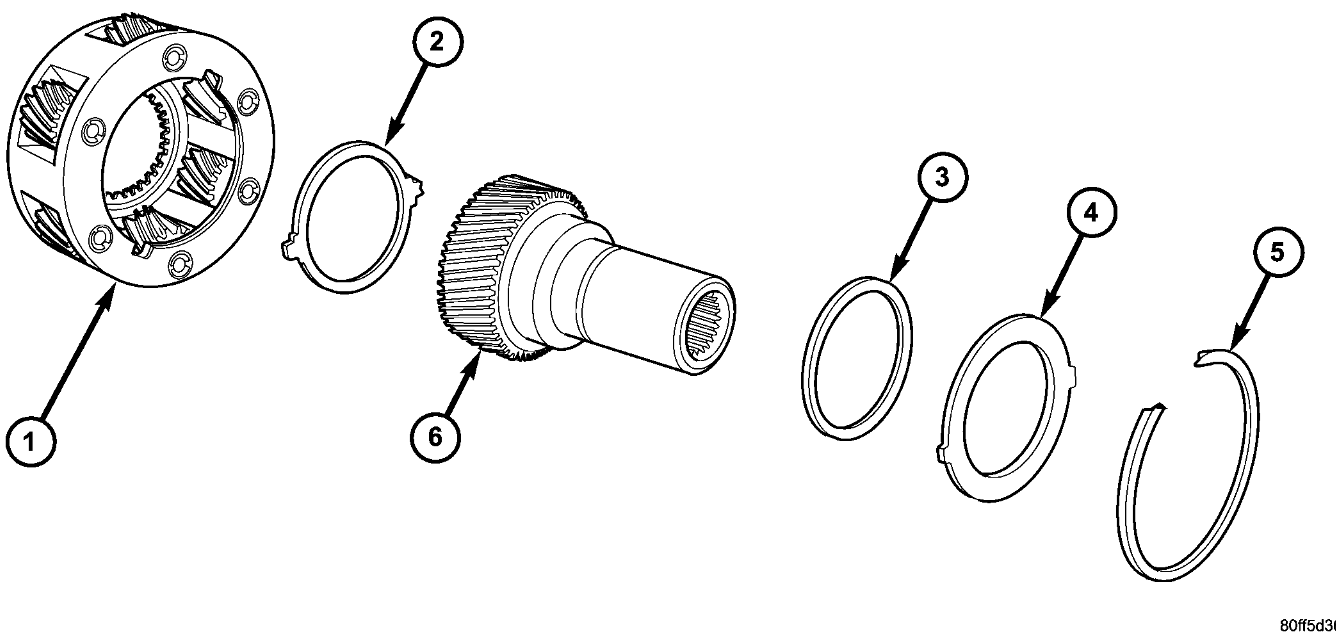


Fig. 39 Input Gear And Carrier Components

1 - PLANETARY CARRIER
2 - REAR THRUST WASHER
3 - FRONT THRUST WASHER
4 - CARRIER LOCK RING
5 - CARRIER LOCK RETAINING RING
6 - INPUT GEAR

SHIFT FORKS/HUBS/SLEEVES

Check condition of the shift forks and mode fork shift rail (Fig. 40). Minor nicks on the shift rail can be smoothed with 320-400 grit emery cloth.

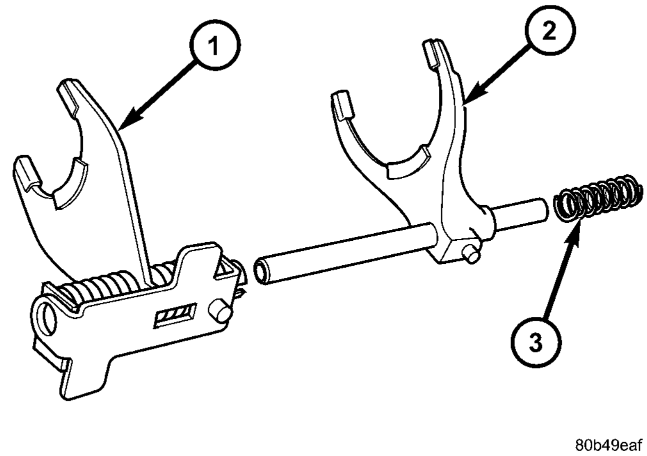


Fig. 40 Shift Forks

1 - RANGE FORK
2 - MODE FORK AND RAIL
3 - MODE SPRING

Inspect the shift fork wear pads (Fig. 41). The mode and range fork pads are serviceable and can be replaced if necessary.

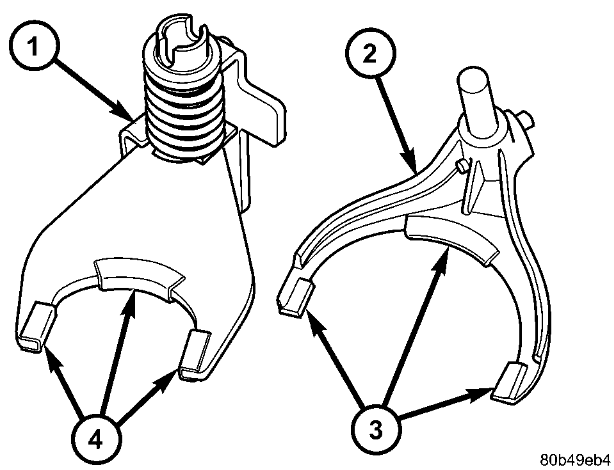


Fig. 41 Shift Fork And Wear Pad Locations

1 - RANGE FORK
2 - MODE FORK
3 - WEAR PADS (SERVICEABLE)
4 - WEAR PADS (SERVICEABLE)

Check both of the sleeves for wear or damage, especially on the interior teeth. Replace the sleeves if wear or damage is evident.

REAR EXTENSION HOUSING

Inspect the extension housing seal and bushing. Replace both components if either show any sign of wear or damage.

FRONT OUTPUT SHAFT AND DRIVE CHAIN

Inspect the shaft threads, sprocket teeth, and bearing surfaces. Minor nicks on the teeth can be smoothed with an oilstone. Use 320-400 grit emery to smooth minor scratches on the shaft bearing surfaces. Rough threads on the shaft can be chased if necessary. Replace the shaft if the threads are damaged, bearing surfaces are scored, or if any sprocket teeth are cracked or broken.

Examine the drive chain and shaft bearings. Replace the chain and both sprockets if the chain is stretched, distorted, or if any of the links bind. Replace the bearings if rough, or noisy.

LOW RANGE ANNULUS GEAR

Inspect annulus gear condition carefully. The gear is only serviced as part of the front case. If the gear is damaged, it will be necessary to replace the gear and front case as an assembly. Do not attempt to remove the gear (Fig. 42)

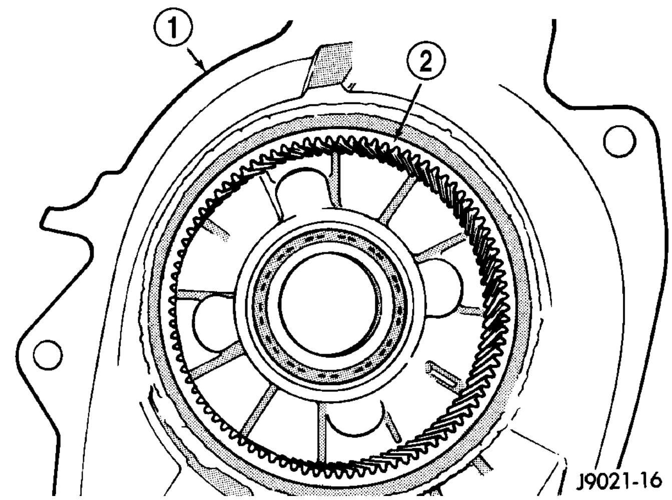


Fig. 42 Low Range Annulus Gear

1 - FRONT CASE
2 - LOW RANGE ANNULUS GEAR

FRONT AND REAR CASES

Inspect the cases for wear and damage.

Check case condition. If leaks were a problem, look for gouges and severe scoring of case sealing surfaces. Also make sure the front case mounting studs are in good condition.

Check the front case mounting studs and vent tube. The tube can be secured with Loctite™ 271 or 680 if loose. The stud threads can be cleaned up with a die if necessary. Also check condition of the fill/drain plug threads in the rear case. The threads can

TRANSFER CASE - NV273 (Continued)

be repaired with a thread chaser or tap if necessary. Or the threads can be repaired with Helicoil® stainless steel inserts if required.

OIL PUMP/OIL PICKUP

Examine the oil pump pickup parts. Replace the pump if any part appears to be worn or damaged. Do not disassemble the pump as individual parts are not available. The pump is only available as a complete assembly. The pickup screen, hose, and tube are the only serviceable parts and are available separately.

ASSEMBLY

BEARINGS AND SEALS

(1) Remove the input shaft bearing snap-ring from the front case half with suitable snap-ring pliers.

(2) Remove the input shaft bearing from the front case half with Installer 6953 and Handle C-4171 (Fig. 43).

(3) Install the input shaft bearing into the front case half with Installer 8151 inverted on Handle C-4171 (Fig. 44).

(4) Install the input shaft bearing snap-ring into the front case half with suitable snap-ring pliers.

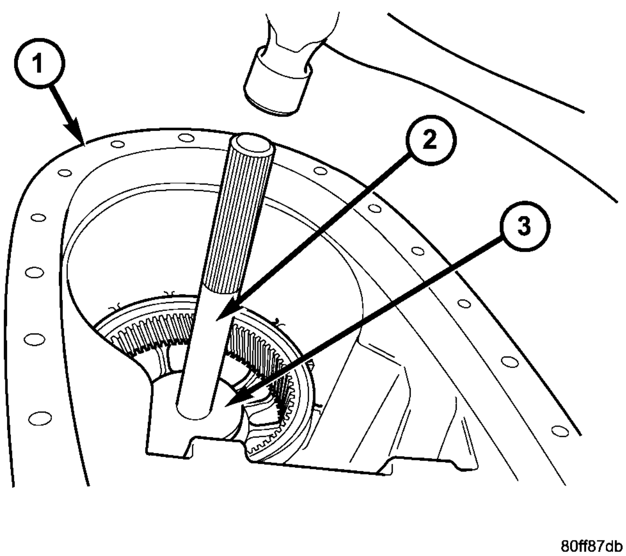


Fig. 43 Remove Input Gear Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 6953

(5) Remove the front output shaft front bearing snap-ring from the front case half.

(6) Using Installer 6953 and Handle C-4171 (Fig. 45), remove the front output shaft front bearing.

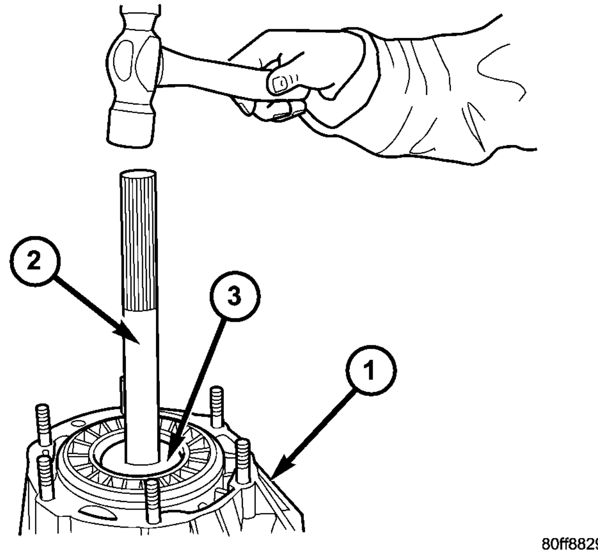


Fig. 44 Install Input Gear Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8151 (INVERTED)

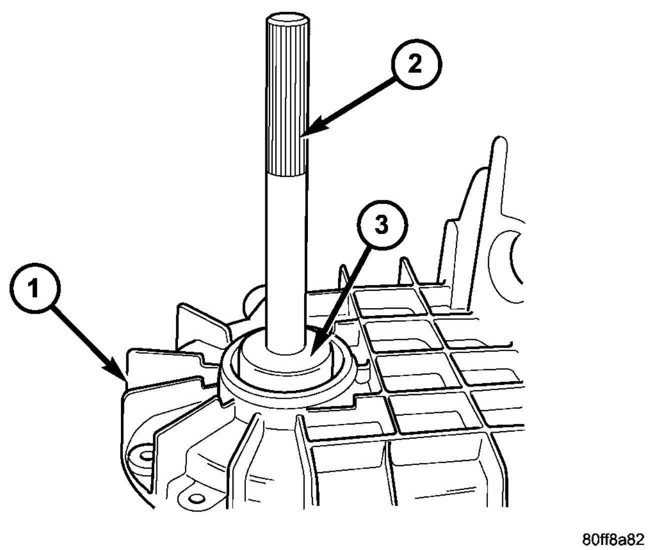


Fig. 45 Remove Front Output Shaft Front Bearing

1 - FRONT CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 6953

(7) Start front output shaft front bearing in case. Then seat bearing with Installer 8891 (Fig. 46).

(8) Install front output shaft bearing retaining ring.

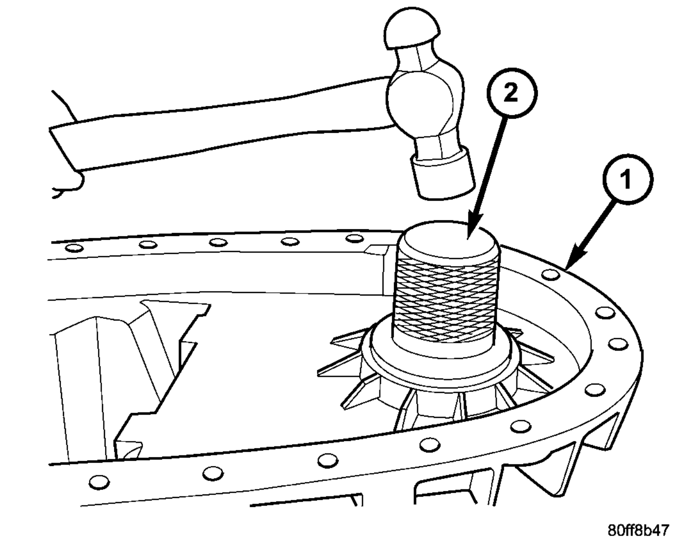


Fig. 46 Install Front Output Shaft Front Bearing

1 - FRONT CASE HALF
2 - INSTALLER 8891

(9) Remove input gear pilot bearing by inserting a suitably sized drift into the splined end of the input gear and driving the bearing out with the drift and a hammer (Fig. 47).

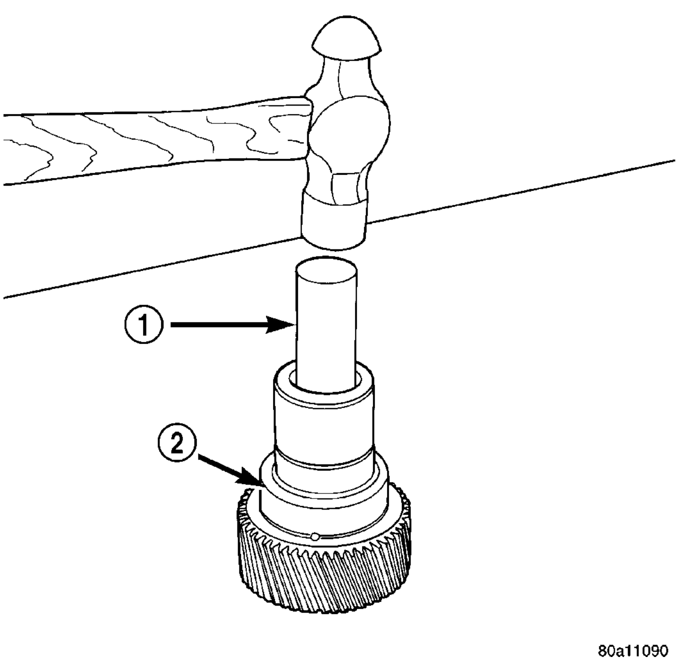


Fig. 47 Remove Input Gear Cup Bearing

1 - DRIFT
2 - INPUT GEAR

(10) Install new pilot bearing with Installer 9035.

(11) Remove the front output shaft rear bearing with the screw and jaws from Remover L-4454 and Cup 8148 (Fig. 48).

(12) Install new bearing with Tool Handle C-4171 and Installer 8128 (Fig. 49). The bearing bore is

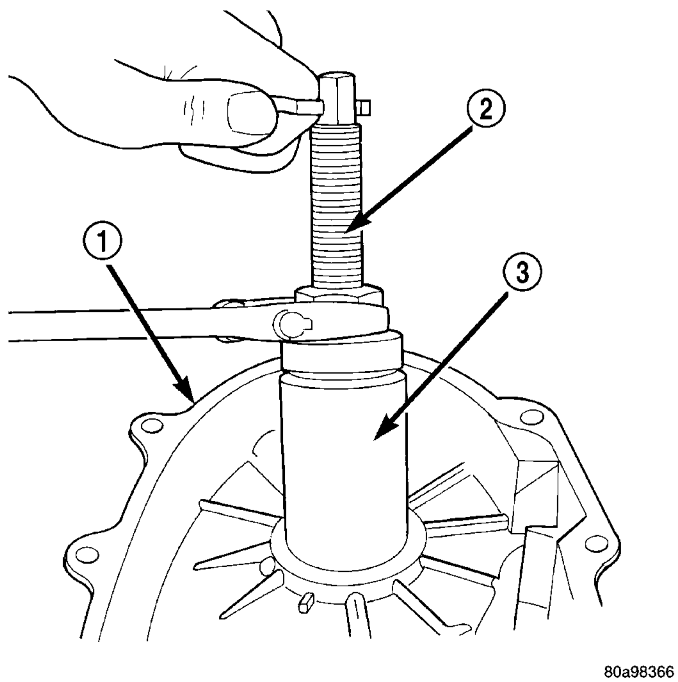


Fig. 48 Front Output Shaft Rear Bearing Removal

1 - REAR CASE
2 - SPECIAL TOOL L-4454-1 AND L-4454-3
3 - SPECIAL TOOL 8148

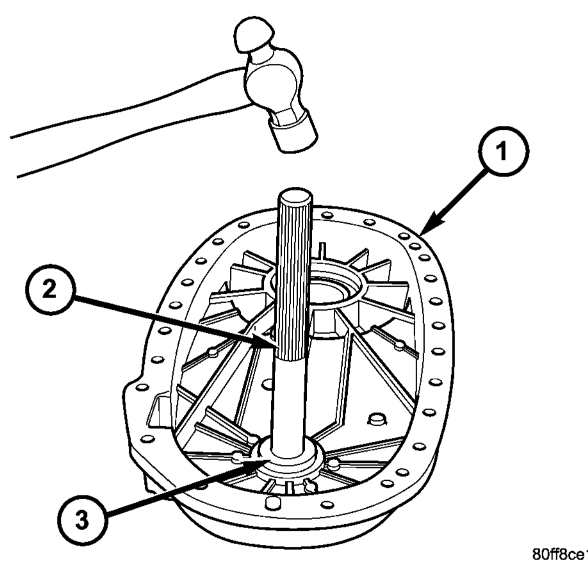


Fig. 49 Install Front Output Shaft Rear Bearing

1 - REAR CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8128

TRANSFER CASE - NV273 (Continued)

chamfered at the top. Install the bearing so it is flush with the lower edge of this chamfer (Fig. 50).

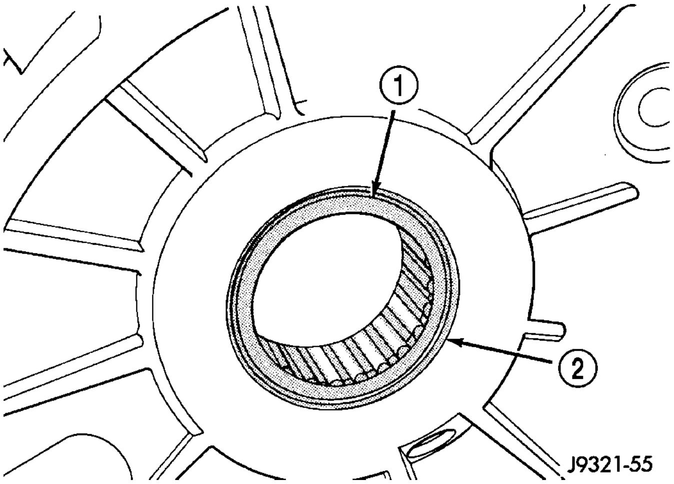


Fig. 50 Output Shaft Rear Bearing Installation Depth

1 - BEARING (SEATED) AT LOWER EDGE OF CHAMFER
2 - CHAMFER

(13) Remove seal from oil pump with suitable pry tool.

(14) Install new seal in oil pump with Installer 7888 (Fig. 51).

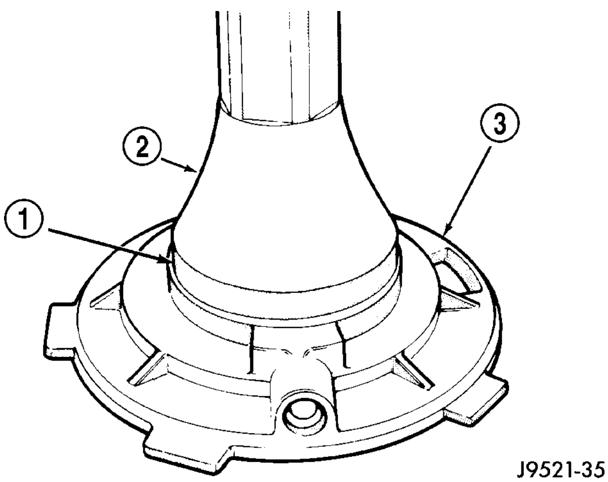


Fig. 51 Oil Pump Seal Installation

1 - HOUSING SEAL
2 - SPECIAL TOOL 7888
3 - OIL PUMP FEED HOUSING

(15) Remove the rear output shaft bearing snap-ring (Fig. 52) from the rear case half.

(16) Remove the rear output shaft bearing from the rear case using Installer 7888 (Fig. 53).

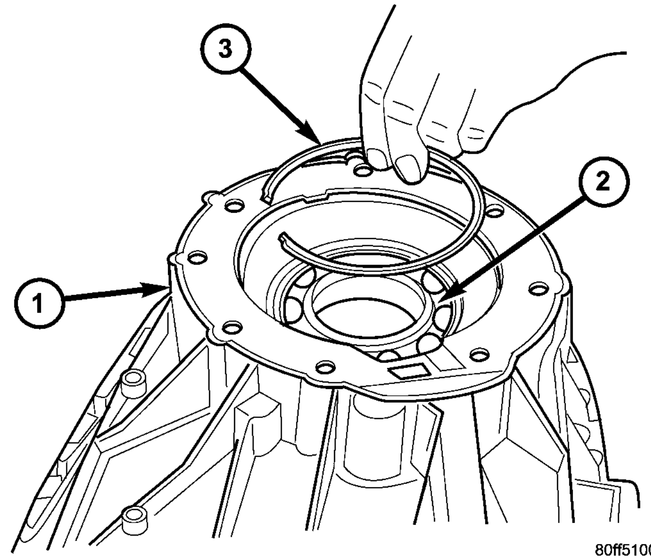


Fig. 52 Remove Rear Output Bearing Outer Snap-Ring

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT BEARING
3 - SNAP-RING

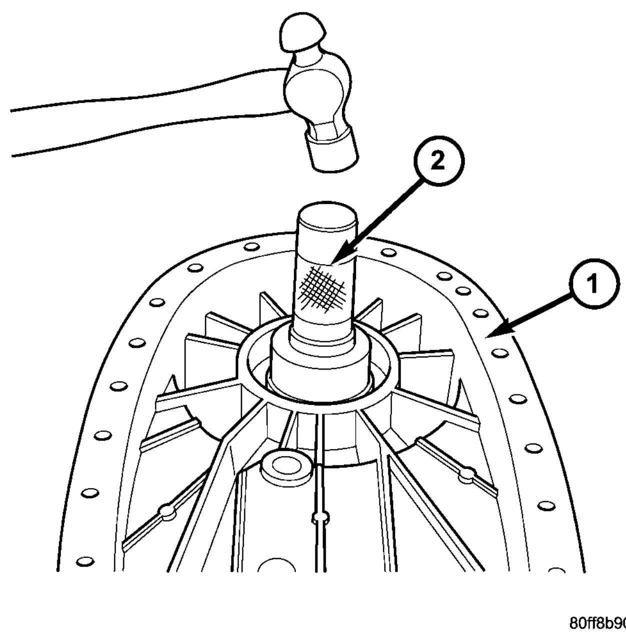


Fig. 53 Remove Rear Output Shaft Bearing

1 - REAR CASE HALF
2 - INSTALLER 7888

TRANSFER CASE - NV273 (Continued)

(17) Install the rear output shaft bearing (Fig. 54) into the rear case using Installer 8152 and Handle C-4171.

(18) Install the rear output shaft bearing snap-ring into the rear case half.

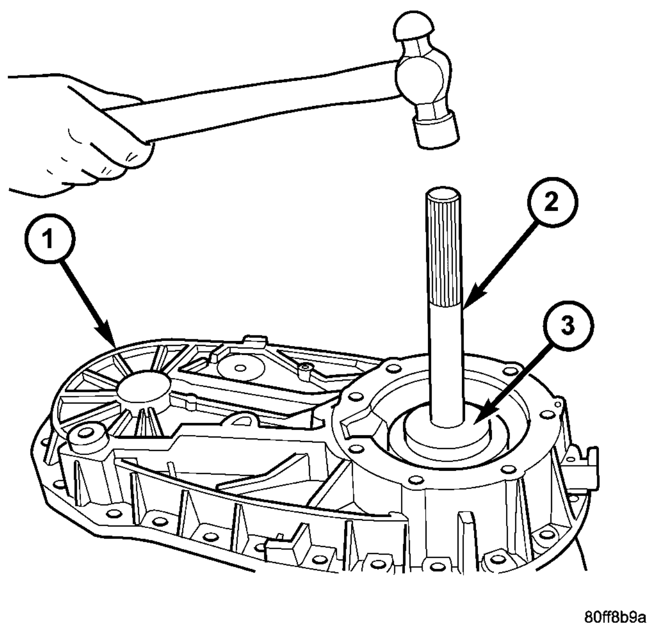


Fig. 54 Install Rear Output Shaft Bearing

1 - REAR CASE HALF
2 - HANDLE C-4171
3 - INSTALLER 8152

INPUT AND PLANETARY GEAR

(1) Lubricate gears and thrust washers with recommended transmission fluid.

(2) Install bottom thrust washer (Fig. 55) in low range gear planetary. Be sure washer tabs are properly aligned in gear notches.

(3) Install input gear in low range gear (Fig. 56). Be sure input gear is fully seated.

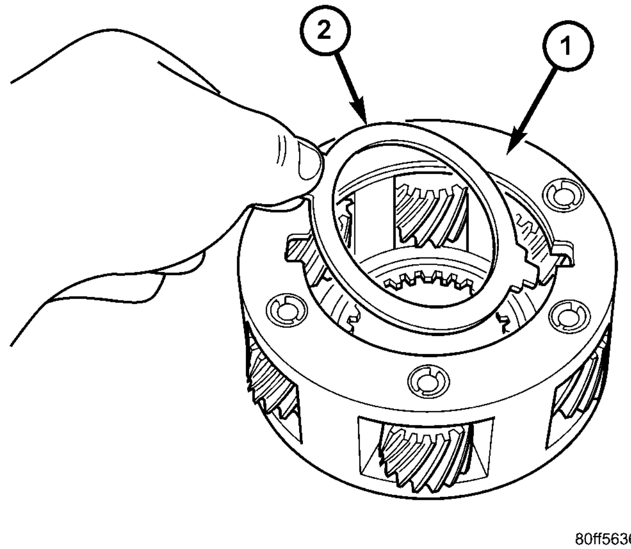


Fig. 55 Install Bottom Input Gear Thrust Plate

1 - PLANETARY
2 - THRUST PLATE

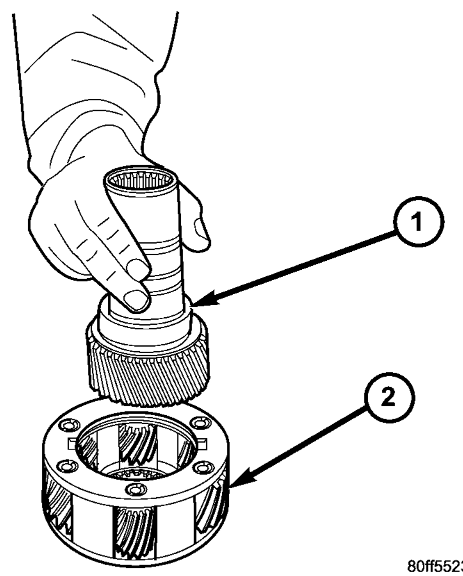


Fig. 56 Install Input Gear From Planetary

1 - INPUT GEAR
2 - LOW RANGE PLANETARY

TRANSFER CASE - NV273 (Continued)

(4) Install remaining thrust washer (Fig. 57) in low range gear and on top of input gear.

(5) Install retainer (Fig. 58) on input gear and install snap-ring (Fig. 59).

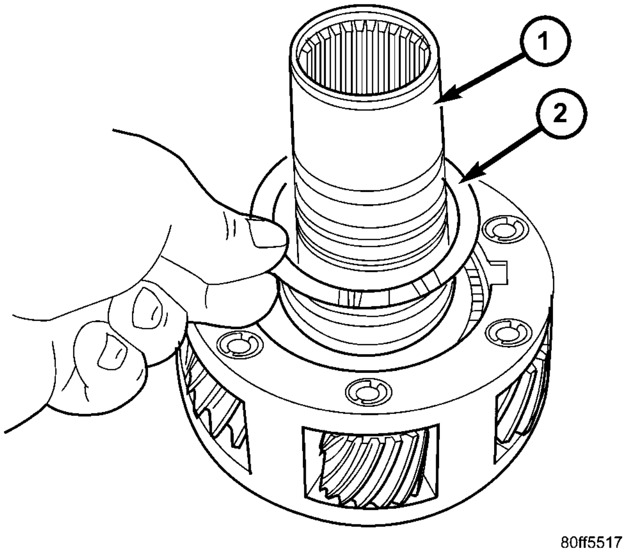


Fig. 57 Install Input Gear Thrust Plate

1 - INPUT GEAR
2 - THRUST PLATE

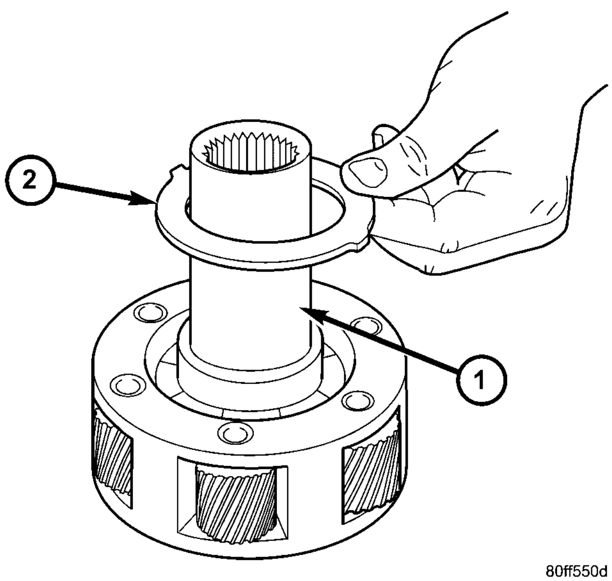


Fig. 58 Install Input Gear Retainer

1 - INPUT GEAR
2 - RETAINER

(6) Align and install low range/input gear assembly in front case (Fig. 60). Be sure low range gear pinions are engaged in annulus gear and that input gear shaft is fully seated in front bearing.

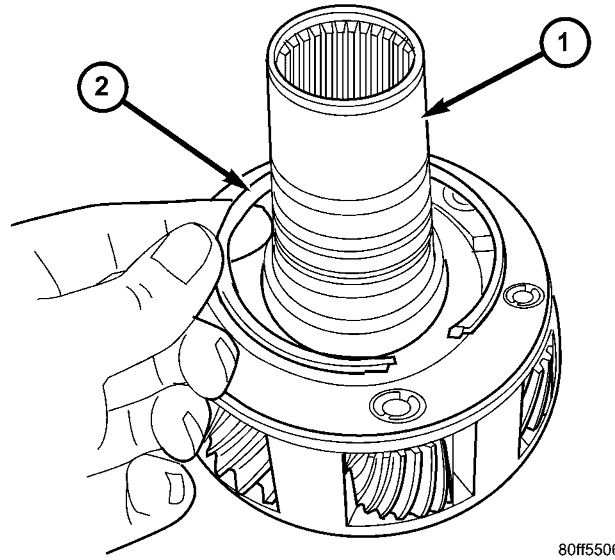


Fig. 59 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

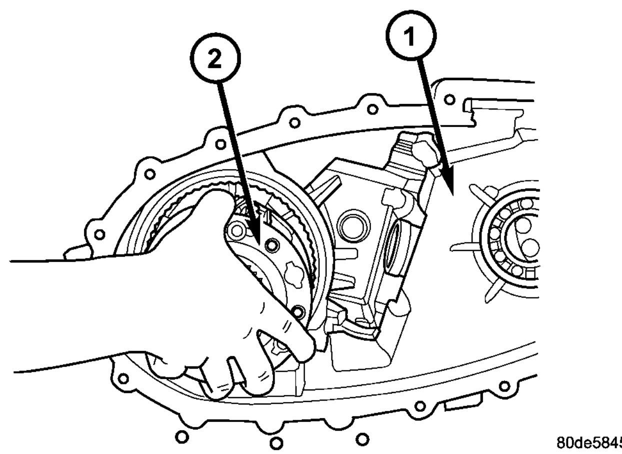


Fig. 60 Install Input Planetary Assembly

1 - FRONT CASE
2 - INPUT PLANETARY ASSEMBLY

TRANSFER CASE - NV273 (Continued)

(7) Install snap-ring to hold input/low range gear into front bearing (Fig. 61).

(8) Install a new input gear seal using Installer 8841 and Handle C-4171.

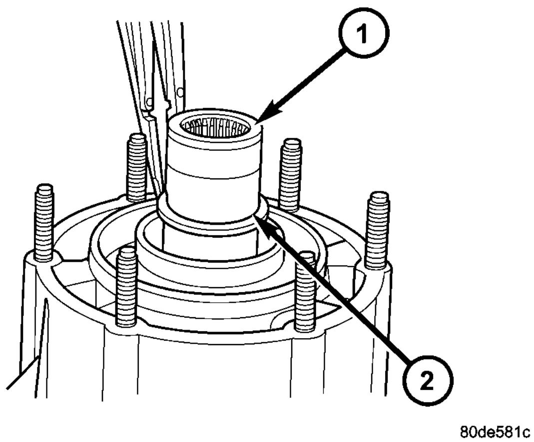


Fig. 61 Install Input Gear Retaining Ring

1 - INPUT GEAR
2 - RETAINING RING

(9) Install a new input gear oil seal with Installer 9036 and Handle C-4171.

SHIFT FORKS AND MAINSHAFT

(1) Lubricate mainshaft splines with recommended transmission fluid.

(2) Coat the interior of the drive sprocket hub with ATF+4 and install the drive sprocket drive hub (Fig. 62) onto the mainshaft.

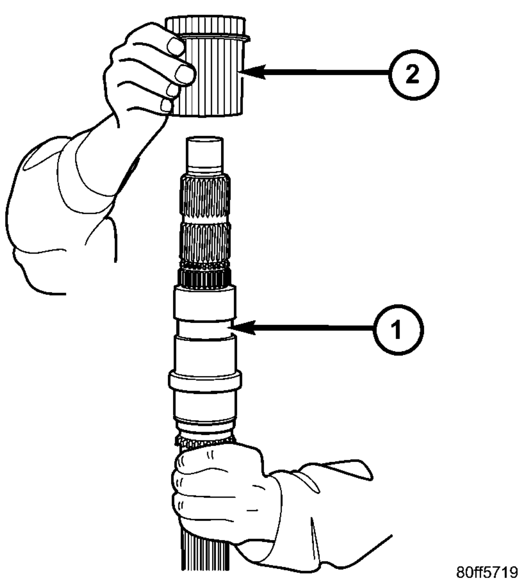


Fig. 62 Install the Drive Sprocket Drive Hub

1 - MAINSHAFT
2 - DRIVE SPROCKET DRIVE HUB

(3) Install the mode hub (Fig. 63) onto the main-shaft.

(4) Install the mode hub retaining ring (Fig. 64) onto the mainshaft.

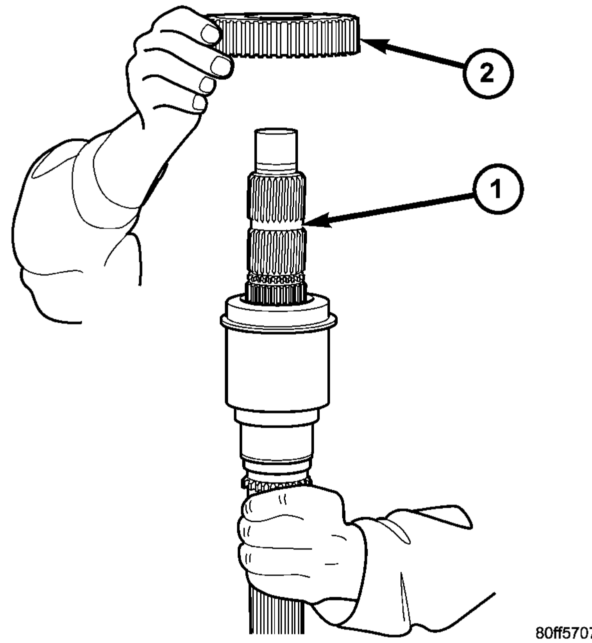


Fig. 63 Install Mode Hub

1 - MAINSHAFT
2 - MODE HUB

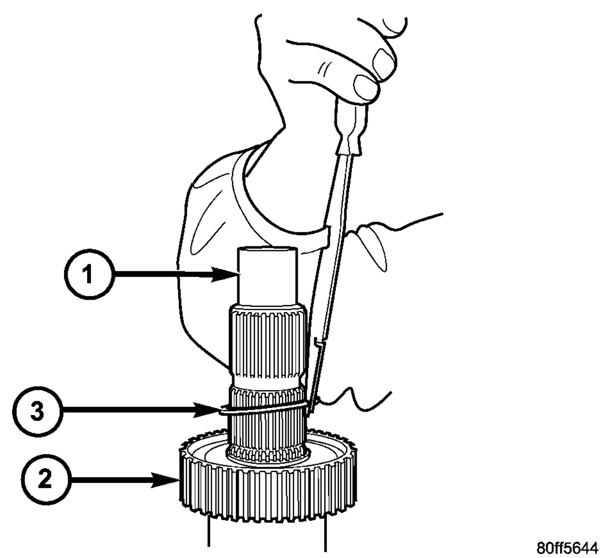


Fig. 64 Install Mode Hub Retaining Ring

1 - MAINSHAFT
2 - MODE HUB
3 - RETAINING RING

TRANSFER CASE - NV273 (Continued)

(5) Install the clutch gear (Fig. 65) onto the output shaft. Verify that the pointed ends of the clutch gear teeth are pointing to the front of the mainshaft.

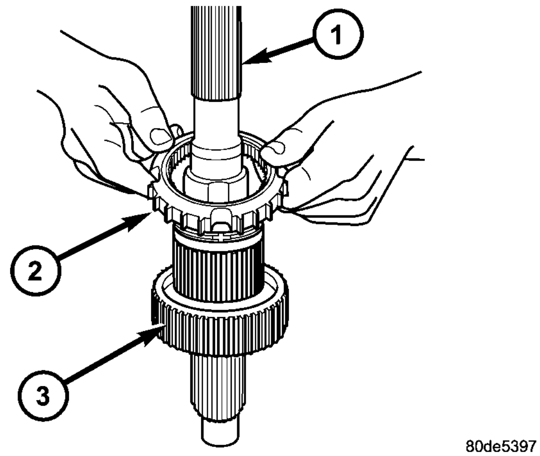


Fig. 65 Install Clutch Gear

1 - OUTPUT SHAFT
2 - CLUTCH GEAR
3 - MODE HUB

(6) Lubricate sector shaft with transmission fluid and install shift sector in case (Fig. 66). Position slot in sector so it will be aligned with shift fork pin when shift forks are installed.

(7) Apply Loctite™ 242, or equivalent, to the threads of the sector support to replentish the factory applied patch. Install the shift sector support. Tighten the sector support with Socket 9033 to 27-34 N·m (20-25 ft.lbs.).

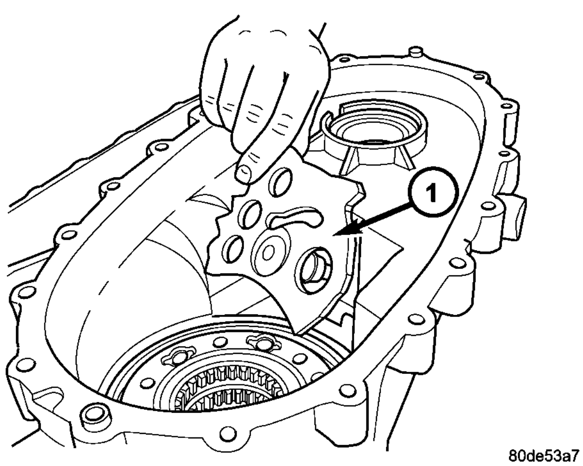


Fig. 66 Install Shift Sector

1 - SHIFT SECTOR

(8) Assemble and install range fork and hub (Fig. 67). Be sure hub is properly seated in low range gear and engaged to the input gear.

(9) Align and insert range fork pin in shift sector slot.

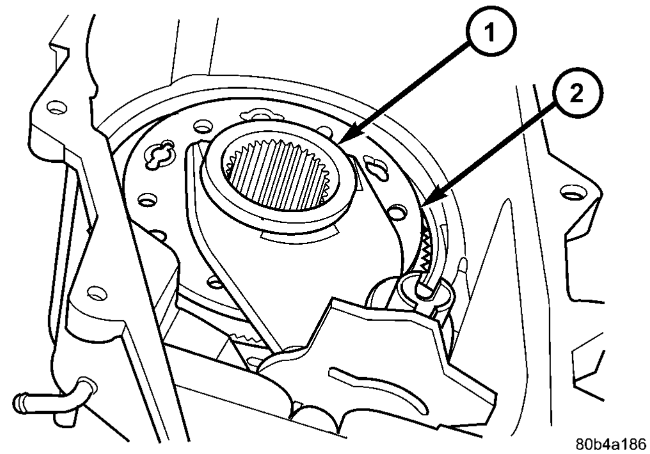


Fig. 67 Install Range Fork And Hub Assembly

1 - RANGE HUB
2 - RANGE FORK

(10) Install mode fork and shift rail onto the mode sleeve.

(11) Install the mode fork, sleeve, and shift rail into the transfer case (Fig. 68).

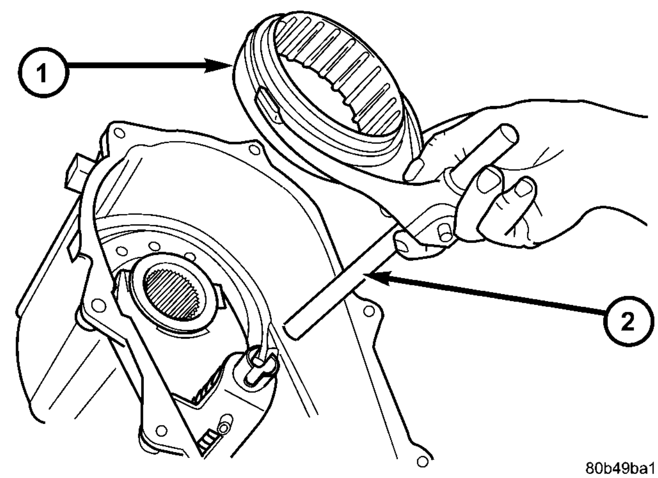


Fig. 68 Mode Fork And Sleeve Installation

1 - MODE SLEEVE
2 - MODE FORK AND RAIL

TRANSFER CASE - NV273 (Continued)

(12) Install new o-ring on detent plug (Fig. 69).

(13) Install detent plunger, spring, and plug (Fig. 70). Tighten the plug to 16-25 N·m (12-18 ft. lbs.).

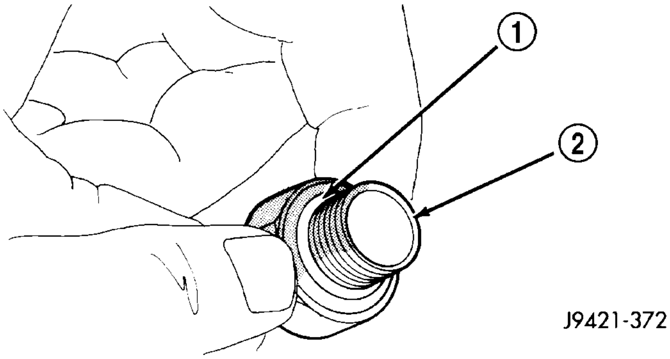


Fig. 69 O-Ring Installation On Detent Plug

1 - O-RING
2 - DETENT PLUG

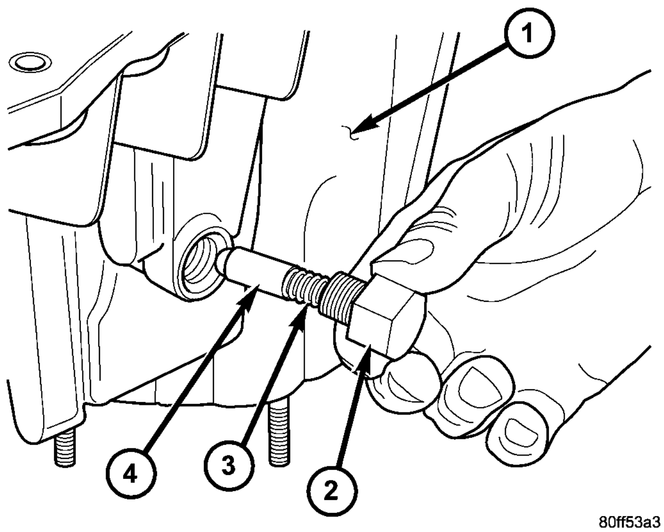


Fig. 70 Install Detent plug, Spring, and Plunger

1 - FRONT CASE HALF
2 - DETENT PLUG
3 - SPRING
4 - PLUNGER

(1) Position the shift motor and mode sensor assembly (Fig. 71) onto the transfer case.

(2) Install the bolts (Fig. 72) to hold the shift motor and mode sensor assembly to the transfer case. Tighten the bolts to 16-25 N·m (12-18 ft. lbs.).

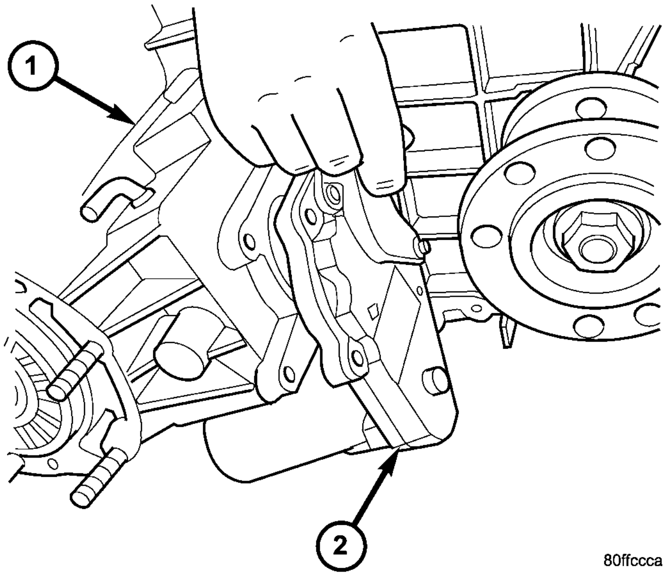


Fig. 71 Install Shift Motor Assembly Onto Transfer Case

1 - TRANSFER CASE
2 - SHIFT MOTOR ASSEMBLY

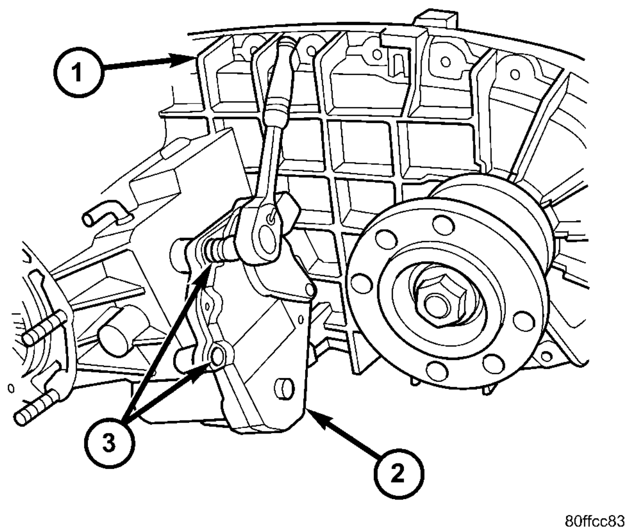


Fig. 72 Install Shift Motor Assembly Bolts

1 - TRANSFER CASE
2 - SHIFT MOTOR ASSEMBLY
3 - BOLTS

TRANSFER CASE - NV273 (Continued)

(3) Install mainshaft into the transfer case (Fig. 73). Guide mainshaft through the mode and range sleeves and into the input gear.

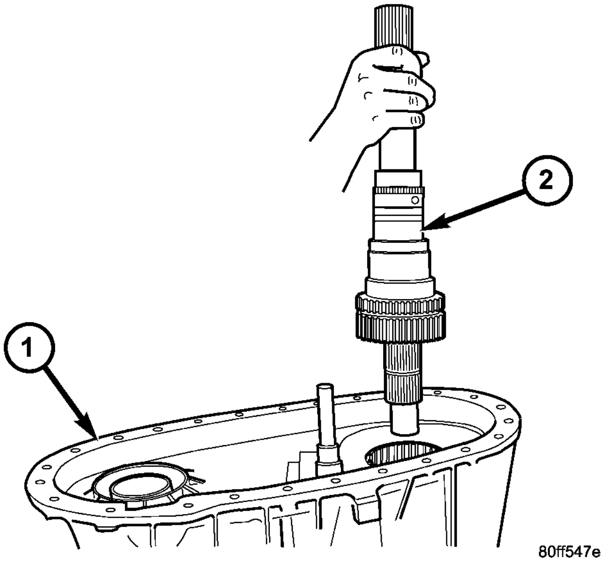


Fig. 73 Install Mainshaft Assembly

1 - FRONT CASE HALF
2 - MAINSHAFT ASSEMBLY

FRONT OUTPUT SHAFT AND DRIVE CHAIN

(1) Install the front output shaft (Fig. 74) into the front output shaft front bearing.

(2) Install the front output shaft bearing inner snap-ring (Fig. 75) onto the output shaft.

(3) Install the new front output shaft seal with Installer MB991168A

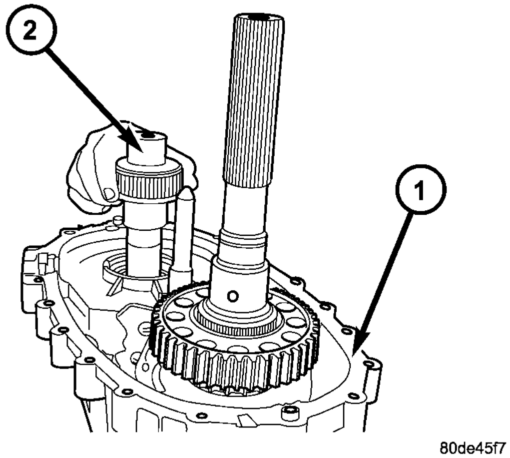


Fig. 74 Install Front Output Shaft

1 - FRONT CASE
2 - FRONT OUTPUT SHAFT

(4) Insert front drive sprocket in drive chain.

(5) Install drive chain around rear drive sprocket.

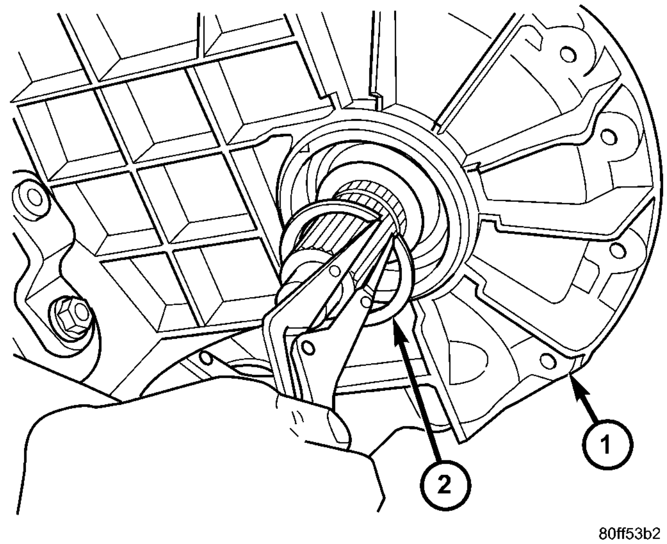


Fig. 75 Install Front Output Shaft Bearing Inner Snap-Ring

1 - FRONT CASE HALF
2 - SNAP-RING

(6) Position rear drive sprocket (Fig. 76) over the output shaft and lower the sprocket and chain assembly until the front sprocket is positioned over the front output shaft.

(7) Align the splines in the sprockets to the splines on the output shafts and install the sprockets onto the output shafts.

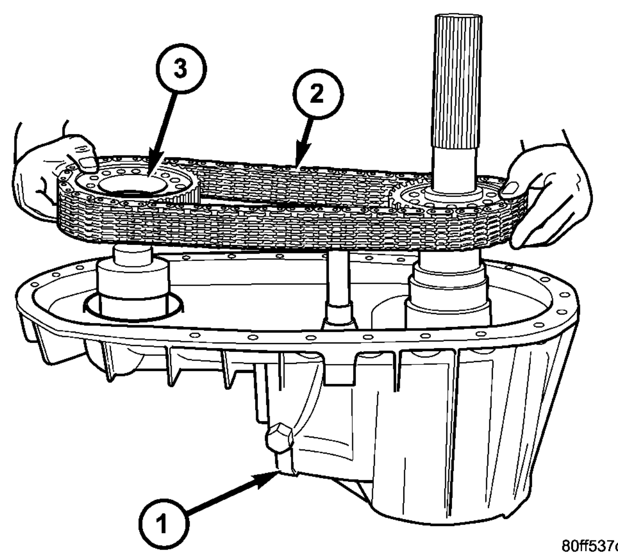


Fig. 76 Install Drive Chain and Sprockets

1 - FRONT CASE HALF
2 - CHAIN
3 - DRIVE SPROCKETS

TRANSFER CASE - NV273 (Continued)

(8) Install front sprocket retaining ring (Fig. 77).
(9) Install rear sprocket retaining ring (Fig. 78).

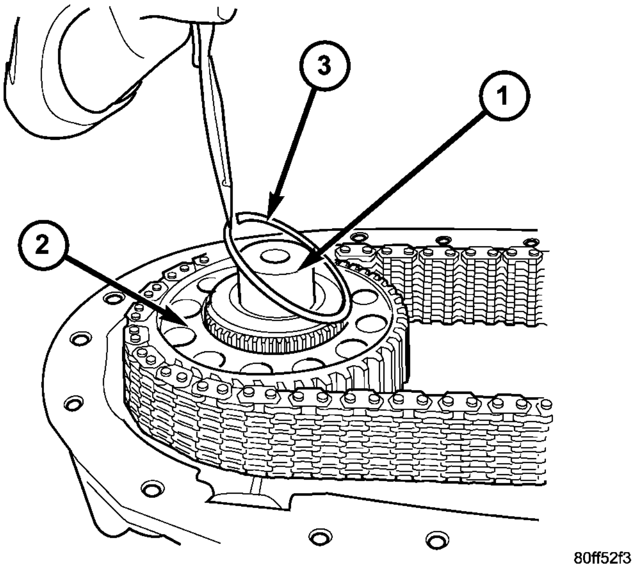


Fig. 77 Install Front Output Shaft Sprocket Retaining Ring

1 - FRONT OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

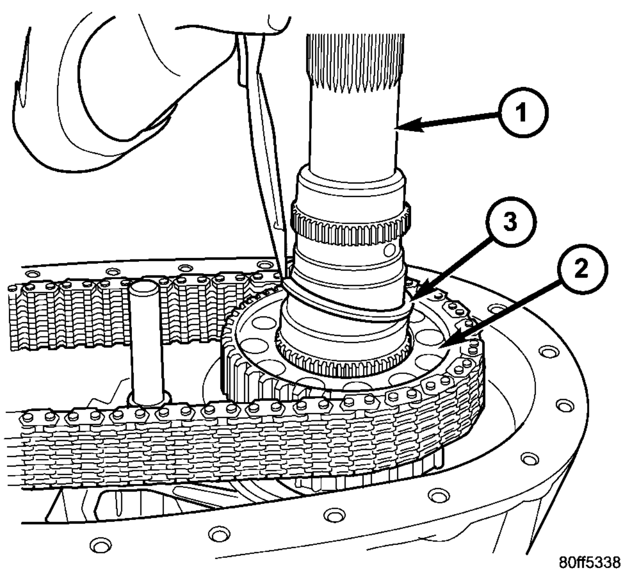


Fig. 78 Install Rear Output Shaft Sprocket Retaining Ring

1 - REAR OUTPUT SHAFT
2 - DRIVE SPROCKET
3 - RETAINING RING

(10) Insert magnet in front case pocket (Fig. 79).

REAR CASE

(1) Install the oil pick-up tube and screen into the rear case half.

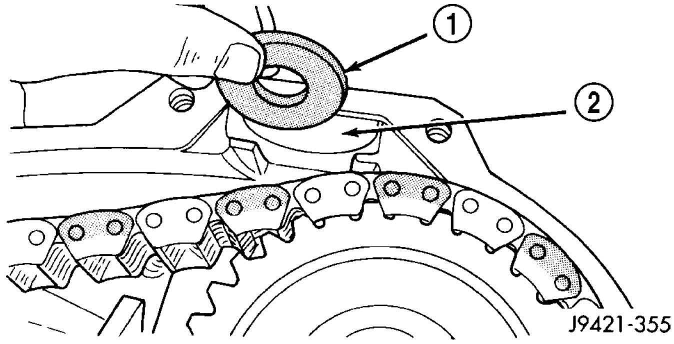


Fig. 79 Case Magnet Installation

1 - MAGNET
2 - CASE POCKET

(2) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of front case. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess will be displaced into case interior.

(3) Align mainshaft with the rear output shaft bearing and align shift rail with bore in rear case. Then install rear case (Fig. 80). Verify that the case alignment dowels correctly seat into their mating recesses.

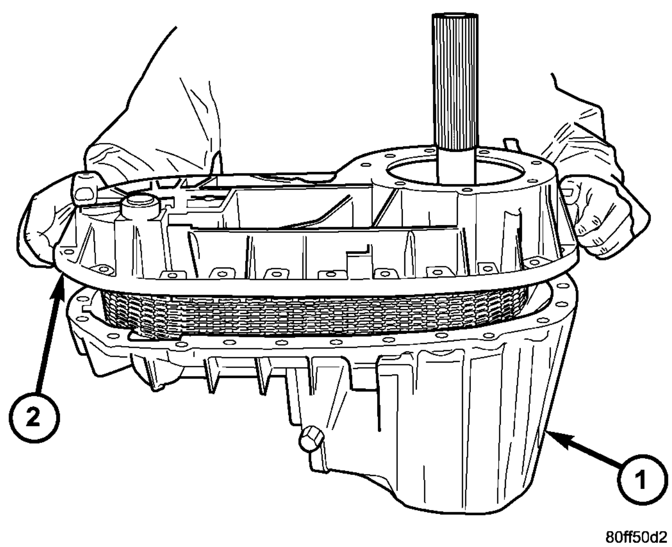


Fig. 80 Install Rear Case Half

1 - FRONT CASE HALF
2 - REAR CASE HALF

TRANSFER CASE - NV273 (Continued)

(4) Install 4-5 rear case-to front case bolts (Fig. 81) to hold rear case in position. Tighten bolts snug but not to specified torque at this time.

CAUTION: Verify that shift rail, and case alignment dowels are seated before installing any bolts. Case could be cracked if shaft rail or dowels are misaligned.

(5) Tighten bolts to 27-34 N·m (20-25 ft. lbs.),

(6) Install rear output bearing inner snap-ring (Fig. 82) to output shaft.

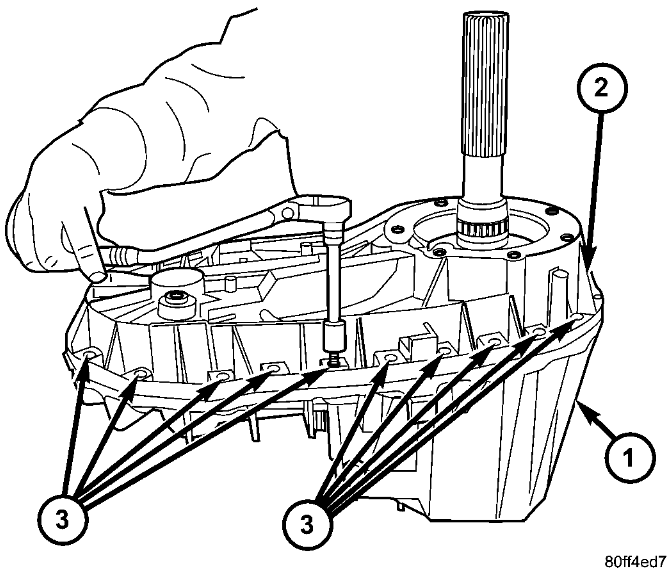


Fig. 81 Install Case Half Bolts

1 - FRONT CASE HALF
2 - REAR CASE HALF
3 - BOLTS

OIL PUMP AND REAR EXTENSION

(1) Install the oil pump (Fig. 83) onto the output shaft.

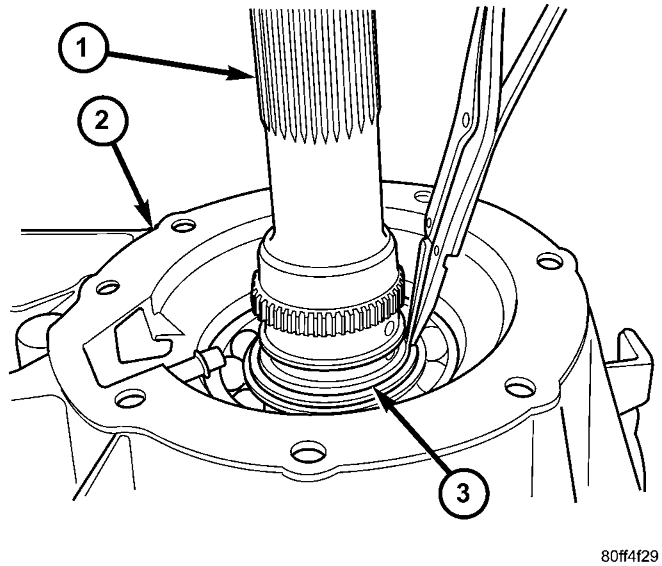


Fig. 82 Install Rear Bearing Inner Snap-Ring

1 - OUTPUT SHAFT
2 - REAR CASE HALF
3 - SNAP-RING

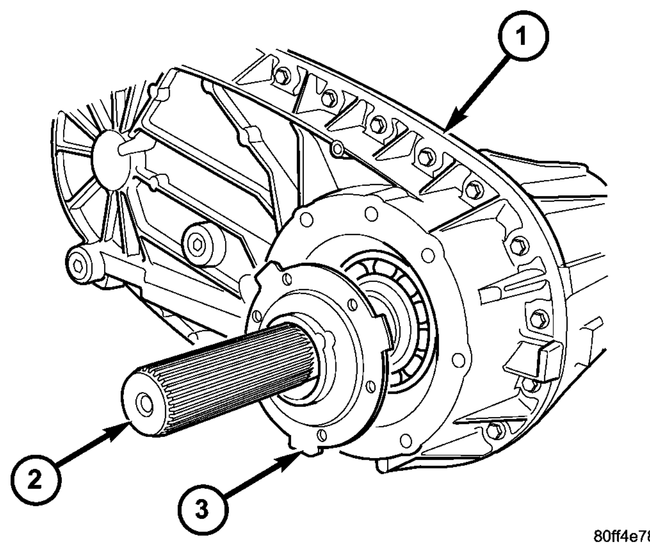


Fig. 83 Install Oil Pump

1 - REAR CASE HALF
2 - REAR OUTPUT SHAFT
3 - OIL PUMP

TRANSFER CASE - NV273 (Continued)

(2) Engage the oil pump pick-up tube (Fig. 84) into the oil pump. Verify that the pick-up tube o-ring is on the tube and is correctly installed to the oil pump.

(3) Apply bead of Mopar® Gasket Maker, or equivalent, to mating surface of rear extension housing. Keep sealer bead width to maximum of 3/16 inch. Do not use excessive amount of sealer as excess could be displaced into output bearing.

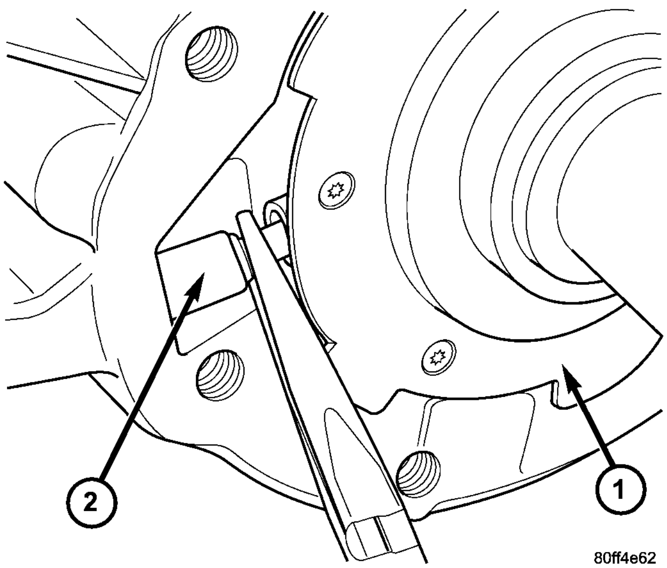


Fig. 84 Engage The Oil Pick-up To Oil Pump

1 - OIL PUMP
2 - OIL PICK-UP TUBE

(4) Install extension housing (Fig. 85) onto the rear case half.

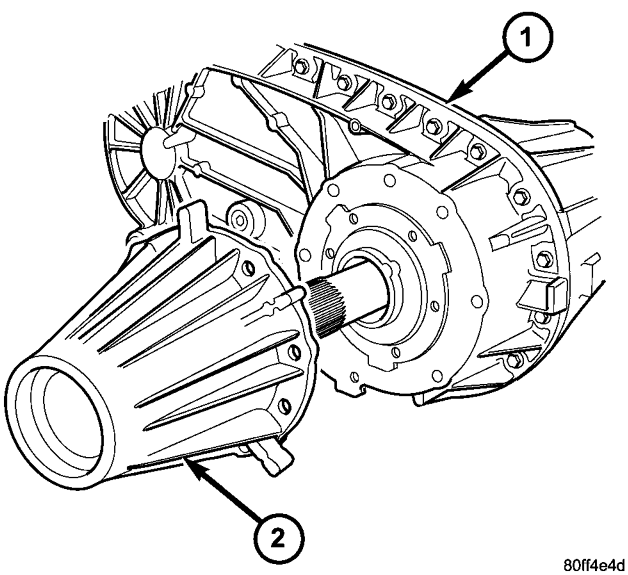


Fig. 85 Install Extension Housing

1 - REAR CASE HALF
2 - EXTENSION HOUSING

(5) Install rear extension bolts (Fig. 86). Tighten the bolts to 27-34 N·m (20-25 ft.lbs.).

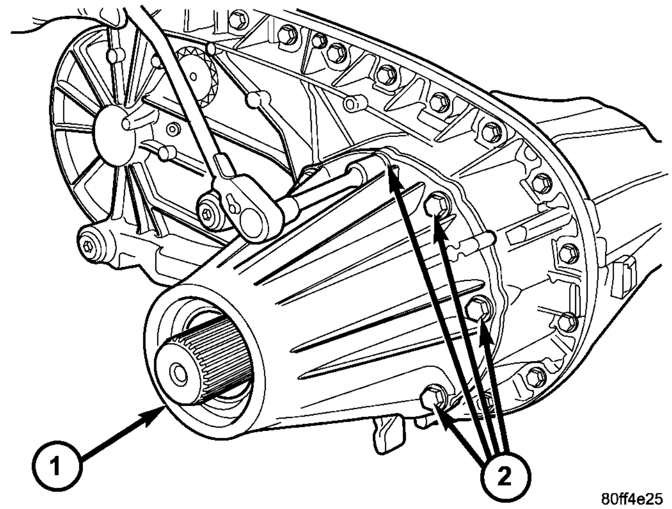


Fig. 86 Install Extension Housing Bolts

1 - EXTENSION HOUSING
2 - BOLTS

(6) Install the extension housing dust boot and seal assembly with Installer 9037 and Handle C-4171 (Fig. 87).

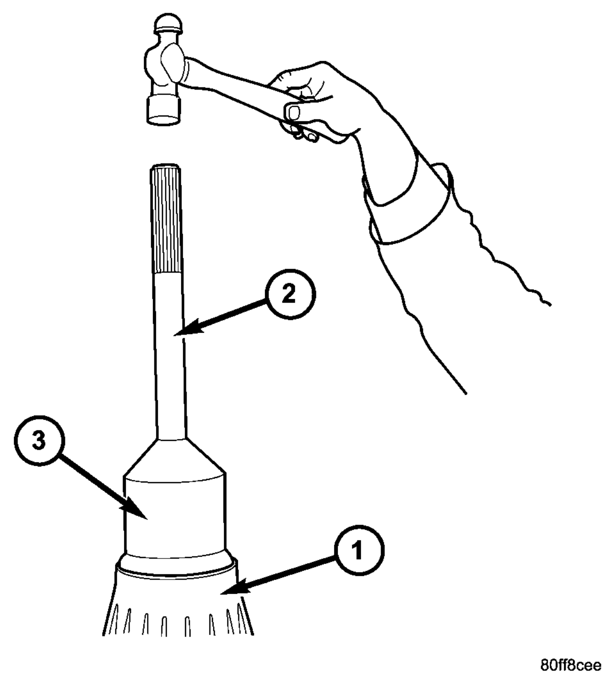


Fig. 87 Install Extension Housing Seal

1 - EXTENSION HOUSING
2 - HANDLE C-4171
3 - INSTALLER 9037

TRANSFER CASE - NV273 (Continued)

(7) Install the front companion flange onto the front output shaft.

(8) Install two bolts 180° apart into the front output shaft companion flange.

(9) Place holder over the bolts and against the companion flange (Fig. 88).

(10) Install a new front companion flange nut. Tighten the companion flange nut to 176-271 N·m (130-200 ft.lbs.).

INSTALLATION

(1) Mount transfer case on a transmission jack.

(2) Secure transfer case to jack with chains.

(3) Position transfer case under vehicle.

(4) Align transfer case and transmission shafts and install transfer case onto the transmission.

(5) Install and tighten transfer case attaching nuts to 27-34 N·m (20-25 ft. lbs.) torque.

(6) Connect the vent hose.

(7) Connect the shift motor and mode sensor wiring connectors. Secure wire harness to clips on transfer case.

(8) Align and connect the propeller shafts.

(9) Fill transfer case with correct fluid. (Refer to 21 - TRANSMISSION/TRANSFER CASE/FLUID - STANDARD PROCEDURE)

(10) Install skid plate, if equipped.

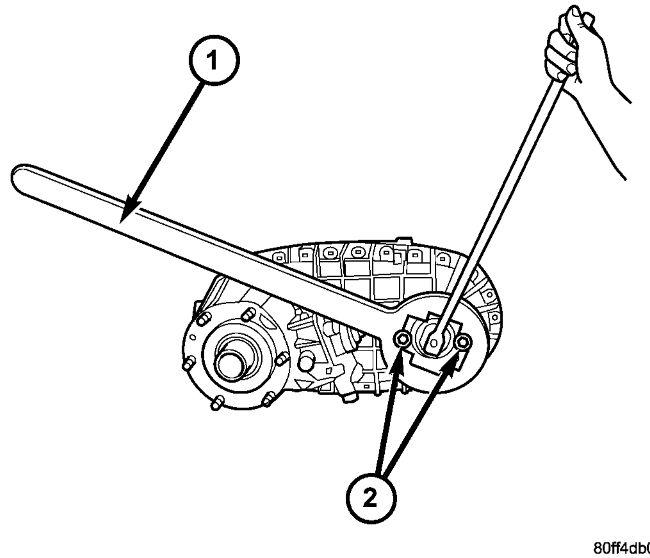


Fig. 88 Install Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(11) Remove transmission jack and support stand.

(12) Lower vehicle and verify transfer case shift operation.

SPECIFICATIONS

TRANSFER CASE - NV273

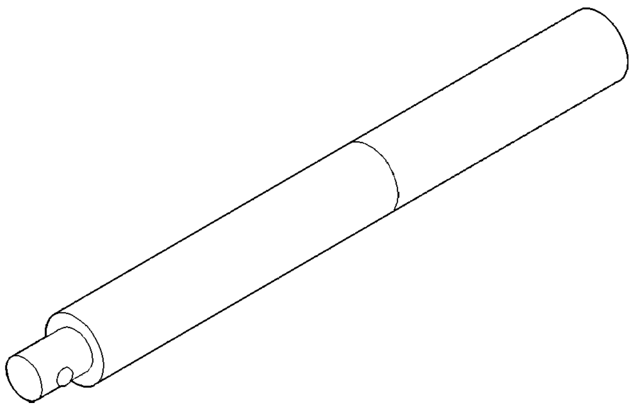
TORQUE SPECIFICATIONS

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Plug, Detent	16-24	12-18	-
Plug, Drain/Fill	20-34	15-25	-
Bolt, Extension Housing	27-34	20-25	-
Bolt, Case Half	27-34	20-25	-
Support, Sector	27-34	20-25	-
Nuts, Mounting	30-41	20-30	-
Bolts, Shift Motor and Mode Sensor Assembly	16-25	12-18	-
Nut, Companion Flange	176-271	130-200	-

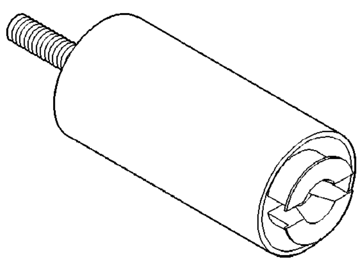
TRANSFER CASE - NV273 (Continued)

SPECIAL TOOLS

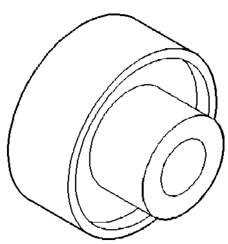
TRANSFER CASE NV271/NV273



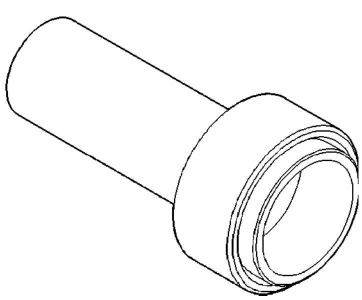
Handle, Universal - C-4171



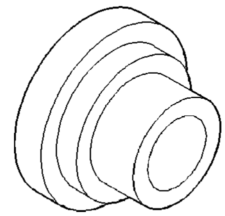
Remover - L-4454



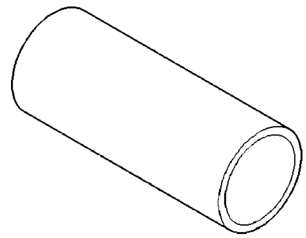
Installer, Bearing - 6953



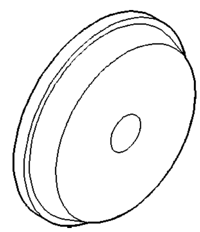
Installer, Pump Housing Seal - 7888



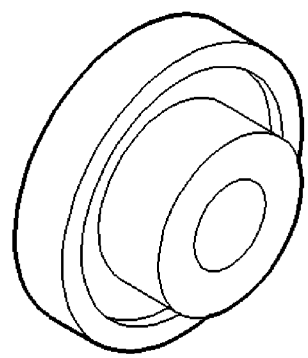
Installer, Bearing - 8128



Cup - 8148

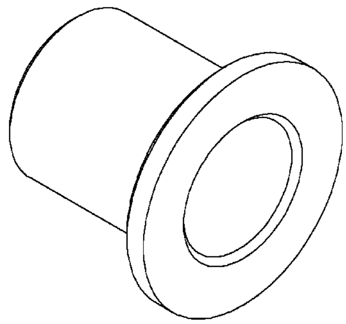


Installer - 8151



Installer - 8152

TRANSFER CASE - NV273 (Continued)



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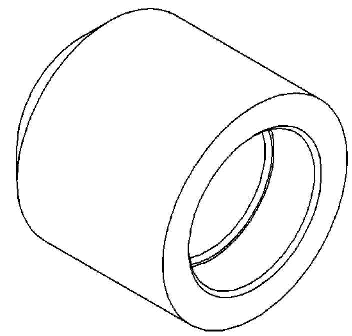
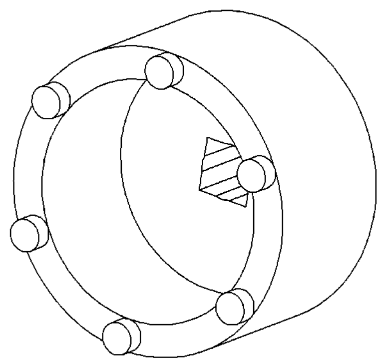
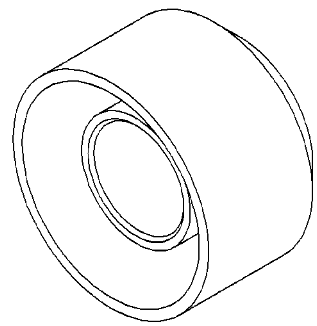


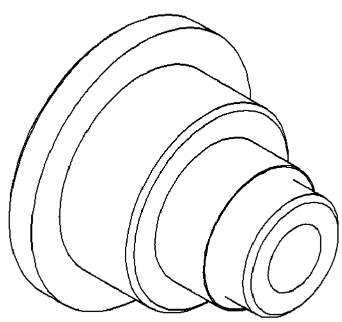
Installer, Seal - 9036



Socket - 9033



Installer, Seal - 9037



Installer, Bearing - 9035

EXTENSION HOUSING SEAL AND DUST BOOT

REMOVAL

(1) Raise and support vehicle.

(2) Remove rear propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/ PROPELLER SHAFT - REMOVAL)

(3) Use a suitable chisel or pry tool to remove the rear extension housing dust boot (Fig. 89).

(4) Use a suitable chisel or pry tool to remove the rear extension housing seal.

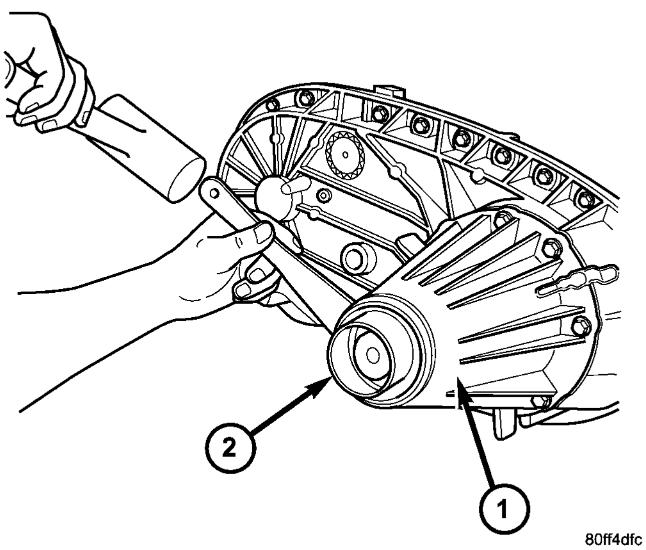


Fig. 89 Remove Extension Housing Dust Boot

1 - EXTENSION HOUSING
2 - DUST BOOT

INSTALLATION

(1) Clean fluid residue from sealing surface and inspect for defects.

(2) Install the extension housing dust boot and seal assembly with Installer 9037 and Handle C-4171 (Fig. 90).

(3) Install propeller shaft. (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION)

(4) Verify proper transfer case fluid level.

(5) Lower vehicle.

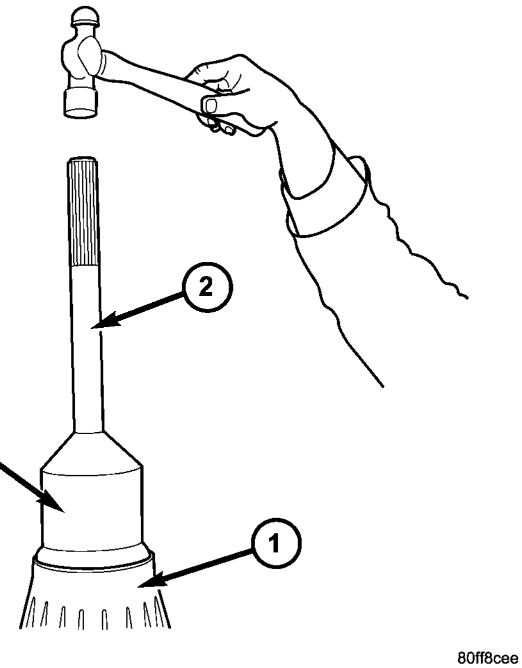


Fig. 90 Install Extension Housing Seal

1 - EXTENSION HOUSING
2 - HANDLE C-4171
3 - INSTALLER 9037

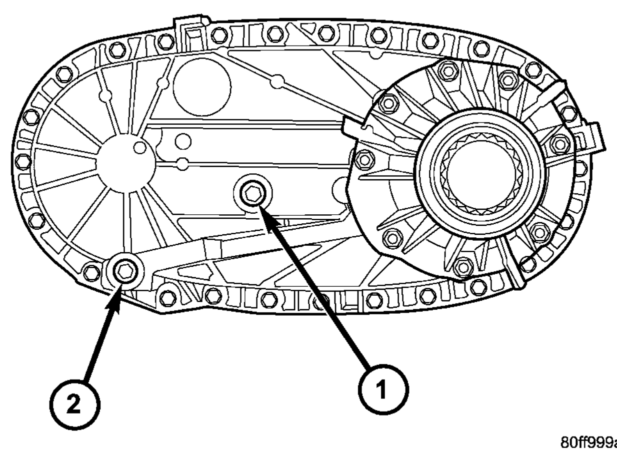


Fig. 91 Drain and Fill Locations

1 - FILL HOLE
2 - DRAIN HOLE

FLUID

STANDARD PROCEDURE - FLUID DRAIN AND REFILL

The fill and drain plugs are both in the rear case (Fig. 91).

(1) Raise vehicle.

(2) Position drain pan under transfer case.

(3) Remove drain and fill plugs and drain lubricant completely.

(4) Install drain plug. Tighten plug to 41-54 N·m (30-40 ft. lbs.).

(5) Remove drain pan.

FLUID (Continued)

(6) Fill transfer case to bottom edge of fill plug opening with Mopar® ATF +4, Automatic Transmission fluid.

(7) Install and tighten fill plug to 41-54 N·m (30-40 ft. lbs.).

(8) Lower vehicle.

FRONT OUTPUT SHAFT SEAL

REMOVAL

(1) Remove the front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL).

(2) Install two bolts 180° apart into the front output shaft companion flange.

(3) Place holder over the bolts and against the companion flange (Fig. 92).

(4) Remove and discard the front companion flange nut.

(5) Remove the companion flange from the front output shaft. It may be necessary to use Flange puller 8992 to remove the companion flange.

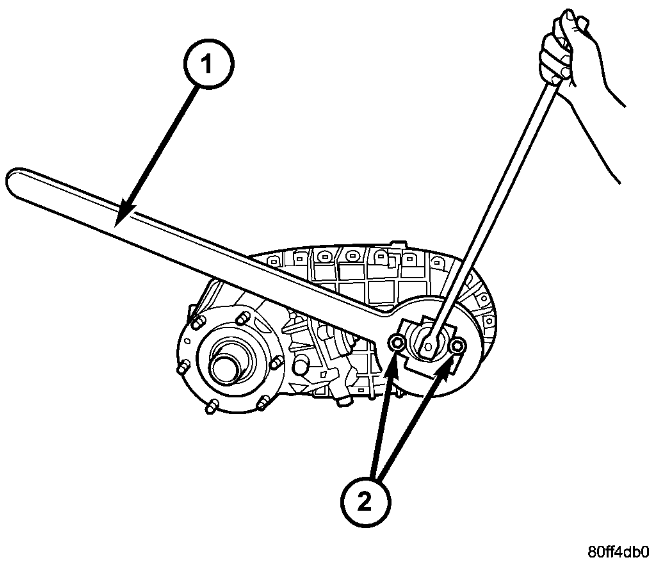


Fig. 92 Remove Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(6) Using a screw and a slide hammer, remove the front output shaft seal.

INSTALLATION

(1) Install the new front output shaft seal with Installer MB991168A.

(2) Install the front companion flange onto the front output shaft.

(3) Install two bolts 180° apart into the front output shaft companion flange.

(4) Place holder over the bolts and against the companion flange (Fig. 93).

(5) Install a new front companion flange nut. Tighten the companion flange nut to 258-312 N·m (190-230 ft.lbs.).

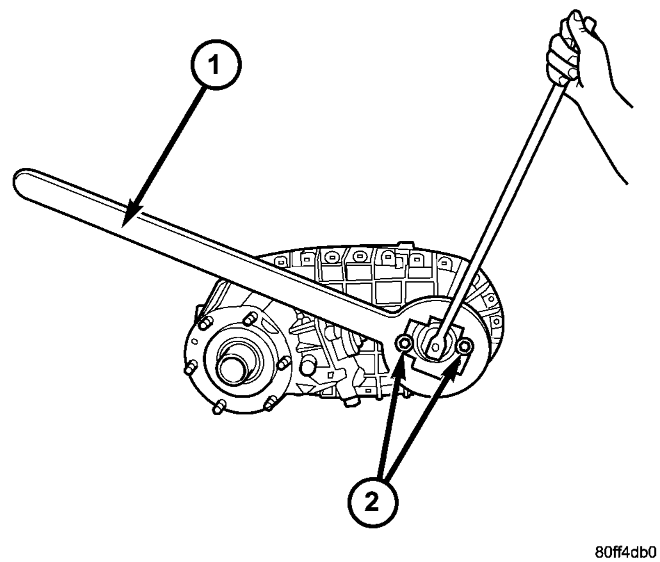


Fig. 93 Install Companion Flange Nut

1 - HOLDER 6719
2 - BOLTS

(6) Install front propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).

MODE SENSOR

DESCRIPTION

The transfer case mode sensor (Fig. 94) is an electronic device whose output can be interpreted to indicate the shift motor shaft's rotary position. The sensor consists of a magnetic ring and four Hall Effect Transistors to create a 4 channel digital device (non-contacting) whose output converts the motor shaft position into a coded signal. The TCCM must supply 5VDC (+/- 0.5v) to the sensor and monitor the shift motor position. The four channels are denoted A, B, C, and D. The sensor is mechanically linked to the shaft of the cam which causes the transfer case shifting. The mode sensor draws less than 53 mA.

OPERATION

During normal vehicle operation, the Transfer Case Control Module (TCCM) monitors the mode sensor outputs at least every 250 (+/-50) milliseconds when the shift motor is stationary and 400 microseconds when the shift motor is active. A mode sensor signal between 3.8 Volts and 0.8 Volts is considered to be undefined.

Refer to SECTOR ANGLES vs. TRANSFER CASE POSITION for the relative angles of the transfer case shift sector versus the interpreted transfer case gear operating mode. Refer to MODE SENSOR CHANNEL STATES for the sensor codes returned to the TCCM for each transfer case mode sensor position. The various between gears positions can also be referred as the transfer case's coarse position. These coarse positions come into play during shift attempts.

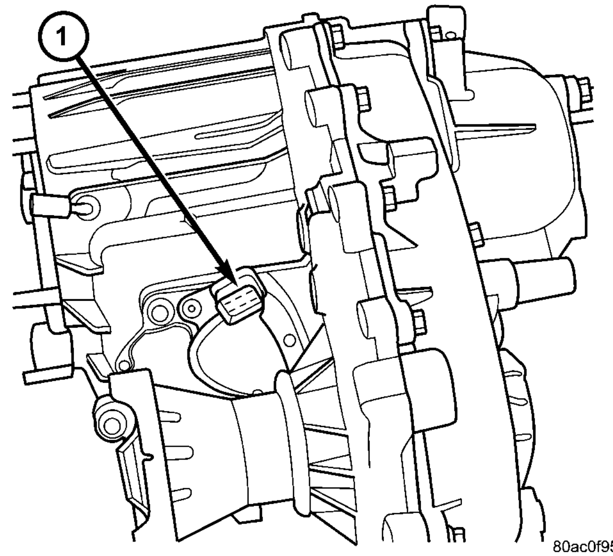


Fig. 94 Mode Sensor

1 - MODE SENSOR

SECTOR ANGLES VS. TRANSFER CASE POSITION

Shaft Angle (Degrees)	Transfer Case Position
+40	4LO
+20	N
0	2WD/AWD
-20	4HI

MODE SENSOR CHANNEL STATES

Transfer Case Angle (degrees)	Sensor Channel A	Sensor Channel B	Sensor Channel C	Sensor Channel D
Between Gears	H	H	L	H
+40 (4LO)	H	H	L	L
Between Gears	H	H	L	H
Between Gears	H	L	L	H
+20 (NEUTRAL)	H	L	L	L
Between Gears	H	L	L	H
Between Gears	H	L	H	H
0 (2WD/AWD)	H	L	H	L
Between Gears	H	L	H	H
Between Gears	L	L	H	H
-20 (4HI)	L	L	H	L
Between Gears	L	L	H	H
Between Gears	L	H	H	H

SELECTOR SWITCH

DESCRIPTION

The selector switch assembly (Fig. 95) is mounted in the left side of the vehicle's Instrument Panel (IP) and consists of a rotary knob connected to a resistive network for the mode and range shift selections. Also located in this assembly is a recessed, normally open momentary switch for making shifts into and out of transfer case NEUTRAL. A pen, or similar instrument, is used to make a NEUTRAL shift selection, thus reducing the likelihood of an inadvertent shift request.

The selector switch also contains four light emitting diode's (LED's) to indicate the transfer case position and whether a shift is in progress.

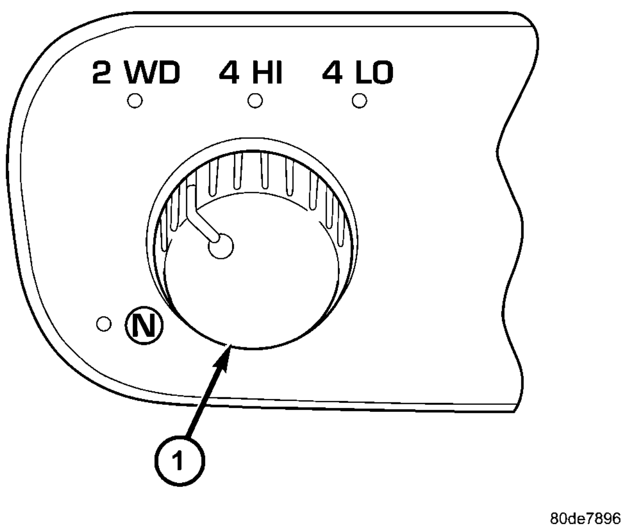


Fig. 95 Transfer Case Selector Switch

1 - SELECTOR SWITCH

OPERATION

As the position of the selector switch varies, the resistance between the Mode Sensor supply voltage pin and the Mode Sensor output will vary. Hardware, software, and calibrations within the Transfer Case Control Module (TCCM) are provided that interpret the selector switch resistance as given in the table below: SELECTOR SWITCH INTERPRETATION

SELECTOR SWITCH INTERPRETATION

Step	Resistance Range (ohms)	Required Interpretation
A	<200	Shorted
B	400-700	NEUTRAL
C	1050-1450	4LO
D	1850-2300	4HI
E	3050-5950	2WD (Default)
F	9.5-12.5K	In between positions
G	>15.5K	Open

For resistances between the ranges B-E shown for each valid position (T-Case NEUTRAL, 4LO, 4HI, 2WD), the TCCM may interpret the resistance as:

- either of the neighboring valid positions.
- as an invalid fault position.

For resistances between the ranges E and F shown for 2WD and in-between positions, the TCCM may interpret the resistance as:

- the 2WD position.
- an invalid fault position.
- a valid in-between position.

For resistances between the ranges F and G shown for in-between positions and fault condition (open), the TCCM may interpret the resistance as:

- a valid in-between position.
- an invalid fault position.

For resistances between the ranges A and B shown for the fault condition (short) and , T-Case NEUTRAL, the TCCM may interpret the resistance as:

- the T-Case NEUTRAL position.
- an invalid fault position.

The LED's in the selector assembly are illuminated/flashed in the following manner to indicate a particular condition or state.

- A solidly illuminated LED indicates a successfully completed shift and the current operating mode of the transfer case. While a shift has been requested but not yet completed, the LED for the desired transfer case position is flashed.

SELECTOR SWITCH (Continued)

• A flashing operating mode LED for the desired gear indicates that a shift to that position has been requested, but all of the driver controllable conditions have not been met. This is in an attempt to notify the driver that the transmission needs to be put into NEUTRAL, the vehicle speed is too great, or some other condition outlined (other than a diagnostic failure that would prevent this shift) elsewhere (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSFER CASE CONTROL MODULE - OPERATION) is not met. Note that this flashing will continue indefinitely until the conditions are eventually met, or the selector switch position is changed, or if diagnostic routines no longer allow the requested shift.

• If the driver attempts to make a shift into transfer case NEUTRAL, and any of the driver controllable conditions are not met, the request will be ignored until all of the conditions are met or until the NEUTRAL select button is released. Additionally the neutral lamp will flash, or begin to flash while the button is depressed and operator controllable conditions are not being met. All of the LED's except the Neutral will flash if any of the operator controllable conditions for shifting are not met while the Neutral button is depressed. This ″toggle″ type of feature is necessary because the TCCM would interpret another request immediately after the shift into transfer case NEUTRAL has completed.

• No LED's illuminated indicate a fault in the transfer case control system.

SHIFT MOTOR

DESCRIPTION

The shift motor (Fig. 96) consists of a permanent magnet D.C. motor with gear reduction to convert a high speed-low torque device into a low speed-high torque device. The output of the device is coupled to a shaft which internally moves the mode and range forks that change the transfer case operating ranges. The motor is rated at 25 amps maximum at 72° F with 10 volts at the motor leads.

OPERATION

The transfer case shift motor responds to the Transfer Case Control Module (TCCM) commands to move the transfer case shift sector bi-directionally, as required, to obtain the transfer case operating mode indicated by the instrument panel mounted selector switch.

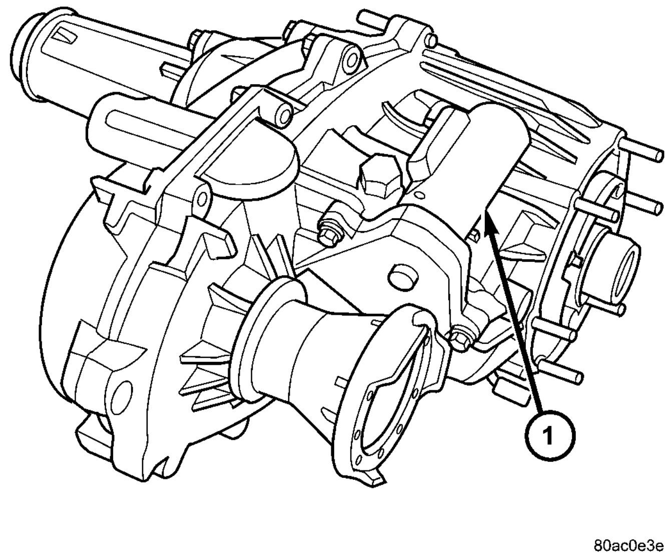


Fig. 96 Shift Motor - Shown Inverted - Typical

1 - SHIFT MOTOR

REMOVAL

(1) Raise the vehicle on a suitable hoist.

(2) Disengage the wiring connectors from the shift motor and mode sensor.

(3) Remove the bolts holding the shift motor and mode sensor assembly onto the transfer case.

(4) Separate the shift motor and mode sensor assembly from the transfer case.

INSTALLATION

(1) Verify that the shift sector o-ring is clean and properly positioned over the shift sector and against the transfer case.

(2) Position the shift motor and mode sensor assembly onto the transfer case.

(3) Install the bolts to hold the assembly onto the transfer case. Tighten the bolts to 16-24 N·m (12-18 ft.lbs.).

CAUTION: If the original shift motor and mode sensor assembly bolts are reused, be sure to use Mopar® Lock & Seal or Loctite™ 242 to replenish the lock patch material originally found on the bolts

(4) Engage the wiring connectors to the shift motor and mode sensor.

(5) Refill the transfer case as necessary.

(6) Lower vehicle and verify transfer case operation.

TIRES/WHEELS

TABLE OF CONTENTS

TIRES/WHEELS

DIAGNOSIS AND TESTING - TIRE AND WHEEL RUNOUT

Radial runout is the difference between the high and low points on the tire or wheel (Fig. 1).

Lateral runout is the **wobble** of the tire or wheel.

Radial runout of more than 1.5 mm (.060 inch) measured at the center line of the tread may cause the vehicle to shake.

Lateral runout of more than 2.0 mm (.080 inch) measured near the shoulder of the tire may cause the vehicle to shake.

Sometimes radial runout can be reduced. Relocate the wheel and tire assembly on the mounting studs (See Method 1). If this does not reduce runout to an acceptable level, the tire can be rotated on the wheel. (See Method 2).

METHOD 1 (RELOCATE WHEEL ON HUB)

(1) Drive vehicle a short distance to eliminate tire flat spotting from a parked position.

(2) Check wheel bearings and adjust if adjustable or replace if necessary.

(3) Check the wheel mounting surface.

(4) Relocate wheel on the mounting, two studs over from the original position.

(5) Tighten wheel nuts until all are properly torqued, to eliminate brake distortion.

(6) Check radial runout. If still excessive, mark tire sidewall, wheel, and stud at point of maximum runout and proceed to Method 2.

TIRES/WHEELS (Continued)

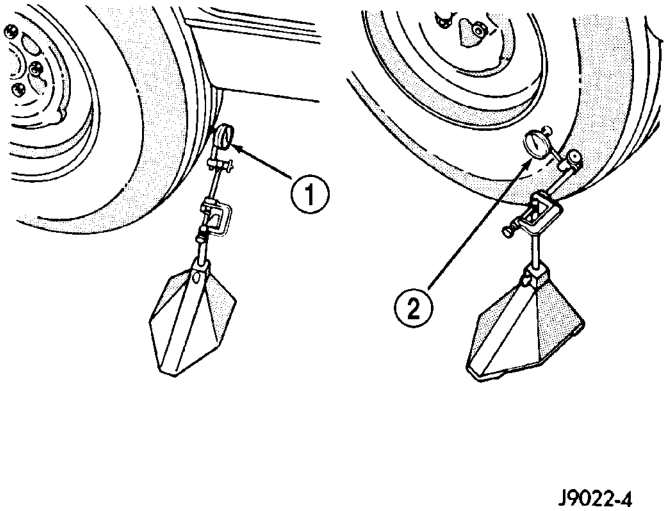


Fig. 1 Checking Tire/Wheel/Hub Runout

1 - RADIAL RUNOUT
2 - LATERAL RUNOUT

METHOD 2 (RELOCATE TIRE ON WHEEL)

NOTE: Rotating the tire on wheel is particularly effective when there is runout in both tire and wheel.

(1) Remove tire from wheel and mount wheel on service dynamic balance machine.

(2) Check wheel radial runout (Fig. 2) and lateral runout (Fig. 3).

• STEEL WHEELS: Radial runout 0.031 in., Lateral runout 0.031 in. (maximum)

• ALUMINUM WHEELS: Radial runout 0.020 in., Lateral runout 0.025 in. (maximum)

(3) If point of greatest wheel lateral runout is near original chalk mark, remount tire 180 degrees. Recheck runout, Refer to match mounting procedure.

STANDARD PROCEDURE

STANDARD PROCEDURE - TIRE ROTATION

Tires on the front and rear axles operate at different loads and perform different steering, driving, and braking functions. For these reasons, the tires wear at unequal rates. They may also develop irregular wear patterns. These effects can be reduced by rotating the tires according to the maintenance schedule in the Owners Manual. This will improve tread life, traction and maintain a smooth quiet ride.

The recommended method of tire rotation is (Fig. 4) & (Fig. 5). Other methods can be used, but may not provide the same tire longevity benefits.

CAUTION: 3500 Dual rear tires have a new tire rotation pattern. This is to accommodate the asymmetrical design of the ON/OFF road tires and the use of the outlined white letter (OWL) tires. When replacing a flat, the spare tire may have to be remounted on the rim or installed at a different location to maintain the correct placement of the asymmetrical design or the (OWL).

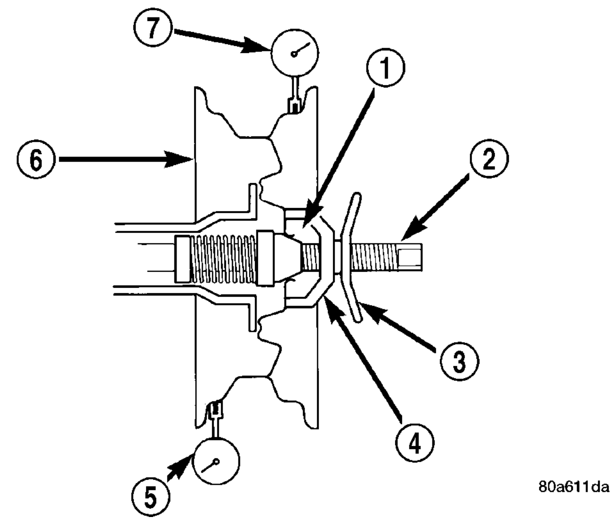


Fig. 2 Radial Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

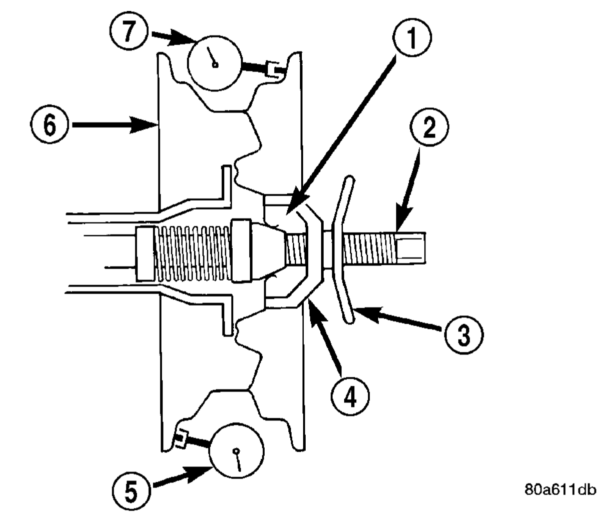


Fig. 3 Lateral Runout

1 - MOUNTING CONE
2 - SPINDLE SHAFT
3 - WING NUT
4 - PLASTIC CUP
5 - DIAL INDICATOR
6 - WHEEL
7 - DIAL INDICATOR

TIRES/WHEELS (Continued)

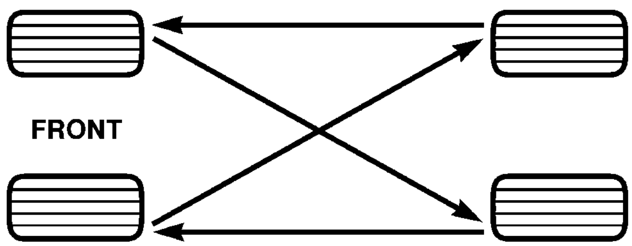


Fig. 4 TIRE ROTATION PATTERN - SINGLE REAR WHEEL (SRW)

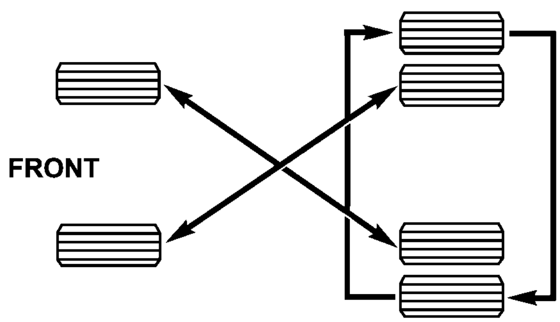


Fig. 5 TIRE ROTATION PATTERN - DUAL REAR WHEELS (DRW)

STANDARD PROCEDURE - MATCH MOUNTING

Wheels and tires are match mounted at the factory. This means that the high spot of the tire is matched to the low spot on the wheel rim. Each are marked with a bright colored temporary label on the outboard surface for alignment. The wheel is also marked permanently on the inside of the rim in the tire well. This permanent mark may be a paint dot or line, a permanent label or a stamped impression such as an X. An optional location mark is a small spherical indentation on the vertical face of the outboard flange on some non styled base steel wheels. The tire must be removed to locate the permanent mark on the inside of the wheel.

Before dismounting a tire from its wheel, a reference mark should be placed on the tire at the valve stem location. This reference will ensure that it is remounted in the original position on the wheel.

(1) Remove the tire and wheel assembly from the vehicle and mount on a service dynamic balance machine.

(2) Measure the total runout on the center of the tire tread rib with a dial indicator. Record the indicator reading. Mark the tire to indicate the high spot. Place a mark on the tire at the valve stem location (Fig. 6).

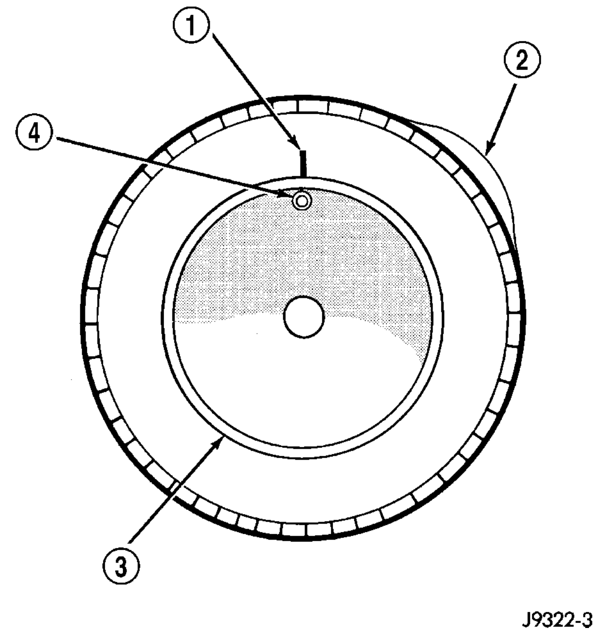


Fig. 6 First Measurement On Tire

1 - REFERENCE MARK
2 - 1ST MEASUREMENT HIGH SPOT MARK TIRE AND RIM
3 - WHEEL
4 - VALVE STEM

(3) Break down the tire and remount it 180 degrees on the rim (Fig. 7).

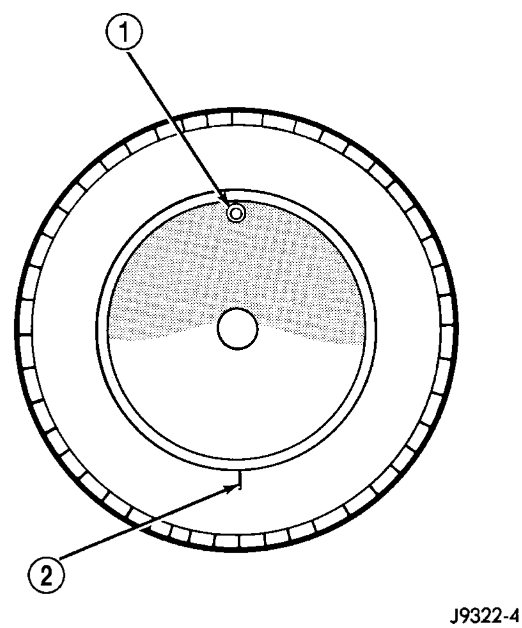


Fig. 7 Remount Tire 180 Degrees

1 - VALVE STEM
2 - REFERENCE MARK

(4) Measure the total indicator runout again. Mark the tire to indicate the high spot.

(5) If runout is still excessive, the following procedures must be done.

TIRES/WHEELS (Continued)

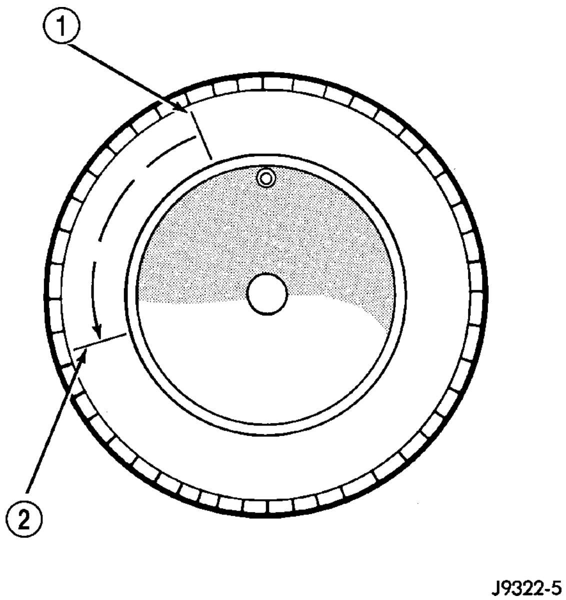


Fig. 8 Remount Tire 90 Degrees In Direction of Arrow

1 - 2ND HIGH SPOT ON TIRE
2 - 1ST HIGH SPOT ON TIRE

- If the high spot is within 101.6 mm (4.0 in.) of the first spot and is still excessive, replace the tire.
- If the high spot is within 101.6 mm (4.0 in.) of the first spot on the wheel, the wheel may be out of specifications. Refer to Wheel and Tire Runout.
- If the high spot is NOT within 101.6 mm (4.0 in.) of either high spot, draw an arrow on the tread from second high spot to first. Break down the tire and remount it 90 degrees on rim in that direction (Fig. 8).

This procedure will normally reduce the runout to an acceptable amount, if not replace the rim.

STANDARD PROCEDURE - TIRE AND WHEEL BALANCE

It is recommended that a two plane service dynamic balancer be used when a tire and wheel assembly require balancing. Refer to balancer operation instructions for proper cone mounting procedures. Typically use front cone mounting method for steel wheels. For aluminum wheel use back cone mounting method without cone spring.

NOTE: Static should be used only when a two plane balancer is not available.

NOTE: Cast aluminum and forged aluminum wheels require coated balance weights and special alignment equipment.

Wheel balancing can be accomplished with either on or off vehicle equipment. When using on-vehicle balancing equipment, remove the opposite wheel/tire. Off-vehicle balancing is recommended.

For static balancing, find the location of the heavy spot causing the imbalance. Counter balance wheel directly opposite the heavy spot. Determine weight required to counter balance the area of imbalance. Place half of this weight on the **inner** rim flange and the other half on the **outer** rim flange (Fig. 9).

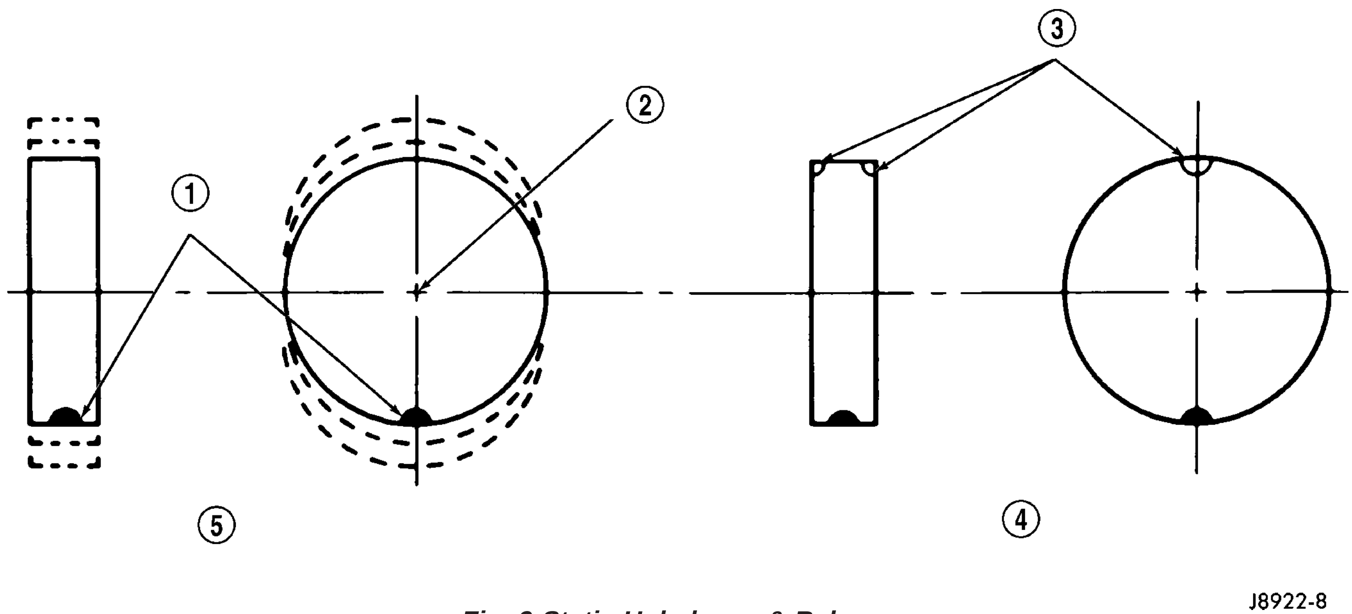


Fig. 9 Static Unbalance & Balance

1 - HEAVY SPOT
2 - CENTER LINE OF SPINDLE
3 - ADD BALANCE WEIGHTS HERE
4 - CORRECTIVE WEIGHT LOCATION
5 - TIRE OR WHEEL TRAMP, OR WHEEL HOP

TIRES/WHEELS (Continued)

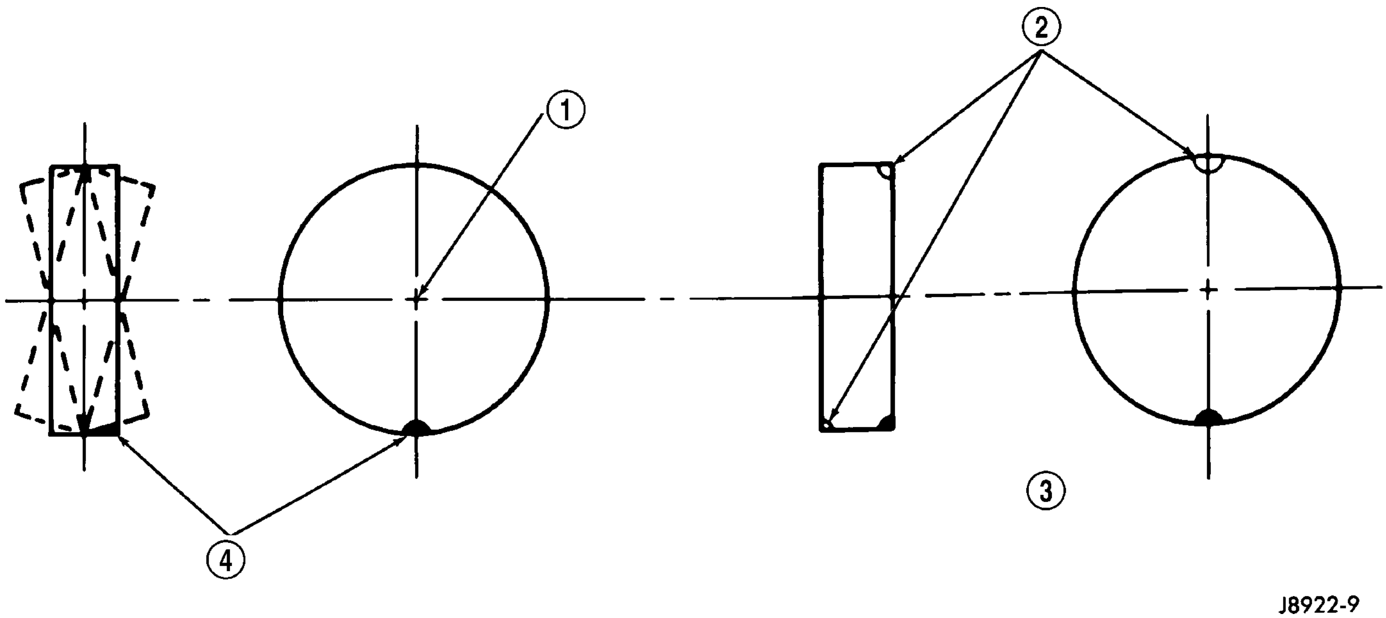


Fig. 10 Dynamic Unbalance & Balance

1 - CENTER LINE OF SPINDLE
2 - ADD BALANCE WEIGHTS HERE
3 - CORRECTIVE WEIGHT LOCATION
4 - HEAVY SPOT WHEEL SHIMMY AND VIBRATION

For dynamic balancing, the balancing equipment is designed to locate the amount of weight to be applied to both the inner and outer rim flange (Fig. 10).

TIRES

DESCRIPTION

DESCRIPTION - SPARE TIRE / TEMPORARY

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity, then reinstalled. Do not exceed speeds of 50 M.P.H. when using the temporary spare tire. Refer to Owner's Manual for complete details.

DESCRIPTION - TIRES

Tires are designed and engineered for each specific vehicle. They provide the best overall performance for normal operation. The ride and handling characteristics match the vehicle's requirements. With proper care they will give excellent reliability, traction, skid resistance, and tread life.

Driving habits have more effect on tire life than any other factor. Careful drivers will obtain in most cases, much greater mileage than severe use or careless drivers. A few of the driving habits which will shorten the life of any tire are:

- Rapid acceleration
- Severe brake applications
- High speed driving
- Excessive speeds on turns
- Striking curbs and other obstacles

Radial-ply tires are more prone to irregular tread wear. It is important to follow the tire rotation interval shown in the section on Tire Rotation, (Refer to 22 - TIRES/WHEELS - STANDARD PROCEDURE). This will help to achieve a greater tread life.

TIRE IDENTIFICATION

Tire type, size, aspect ratio and speed rating are encoded in the letters and numbers imprinted on the side wall of the tire. Refer to the chart to decipher the tire identification code (Fig. 11).

Performance tires have a speed rating letter after the aspect ratio number. The speed rating is not always printed on the tire sidewall. These ratings are:

- **Q** up to 100 mph
- **R** up to 106 mph
- **S** up to 112 mph
- **T** up to 118 mph
- **U** up to 124 mph
- **H** up to 130 mph
- **V** up to 149 mph
- **Z** more than 149 mph (consult the tire manufacturer for the specific speed rating)

An All Season type tire will have either **M + S, M & S or M–S** (indicating mud and snow traction) imprinted on the side wall.

TIRES (Continued)

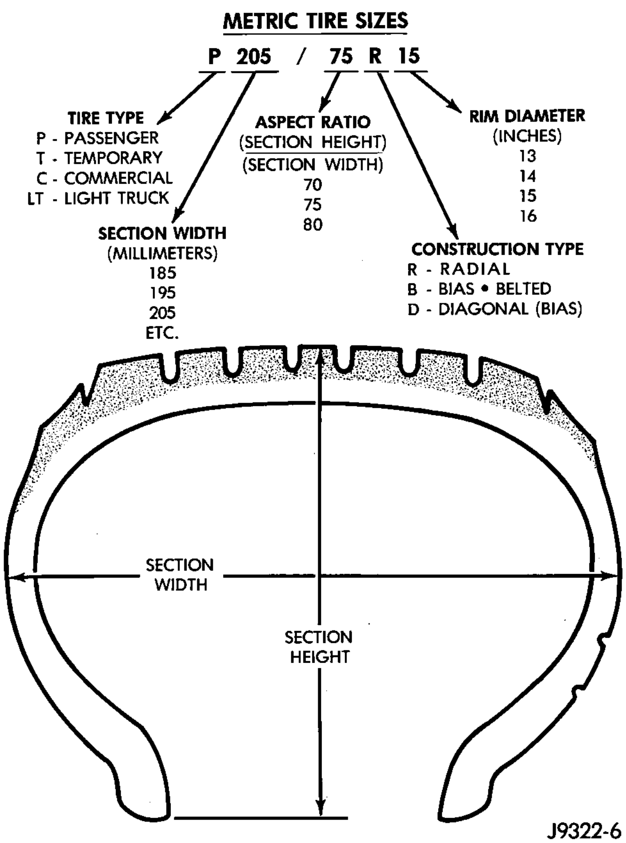


Fig. 11 Tire Identification

TIRE CHAINS

Tire snow chains may be used on **certain** models. Refer to the Owner's Manual for more information.

DESCRIPTION - RADIAL – PLY TIRES

Radial-ply tires improve handling, tread life and ride quality, and decrease rolling resistance.

Radial-ply tires must always be used in sets of four. Under no circumstances should they be used on the front only. They may be mixed with temporary spare tires when necessary. A maximum speed of 50 MPH is recommended while a temporary spare is in use.

Radial-ply tires have the same load-carrying capacity as other types of tires of the same size. They also use the same recommended inflation pressures.

The use of oversized tires, either in the front or rear of the vehicle, can cause vehicle drive train failure. This could also cause inaccurate wheel speed signals when the vehicle is equipped with Anti-Lock Brakes.

The use of tires from different manufactures on the same vehicle is NOT recommended. The proper tire pressure should be maintained on all four tires.

DESCRIPTION - TIRE PRESSURE FOR HIGH SPEEDS

Where speed limits allow the vehicle to be driven at high speeds, correct tire inflation pressure is very important. For speeds up to and including 120 km/h (75 mph), tires must be inflated to the pressures shown on the tire placard. For continuous speeds in excess of 120 km/h (75 mph), tires must be inflated to the maximum pressure specified on the tire sidewall.

Vehicles loaded to the maximum capacity should not be driven at continuous speeds above 75 mph (120 km/h).

For emergency vehicles that are driven at speeds over 90 mph (144 km/h), special high speed tires must be used. Consult tire manufacturer for correct inflation pressure recommendations.

DESCRIPTION - REPLACEMENT TIRES

The original equipment tires provide a proper balance of many characteristics such as:
- Ride
- Noise
- Handling
- Durability
- Tread life
- Traction
- Rolling resistance
- Speed capability

It is recommended that tires equivalent to the original equipment tires be used when replacement is needed.

Failure to use equivalent replacement tires may adversely affect the safety and handling of the vehicle.

The use of oversize tires may cause interference with vehicle components. Under extremes of suspension and steering travel, interference with vehicle components may cause tire damage.

WARNING: FAILURE TO EQUIP THE VEHICLE WITH TIRES HAVING ADEQUATE SPEED CAPABILITY CAN RESULT IN SUDDEN TIRE FAILURE.

DESCRIPTION - TIRE INFLATION PRESSURES

Under inflation will cause rapid shoulder wear, tire flexing, and possible tire failure (Fig. 12).

Over inflation will cause rapid center wear and loss of the tire's ability to cushion shocks (Fig. 13).

Improper inflation can cause:
- Uneven wear patterns
- Reduced tread life
- Reduced fuel economy
- Unsatisfactory ride
- Vehicle drift

For proper tire pressure specification refer to the Tire Inflation Pressure Chart provided with the vehicles

TIRES (Continued)

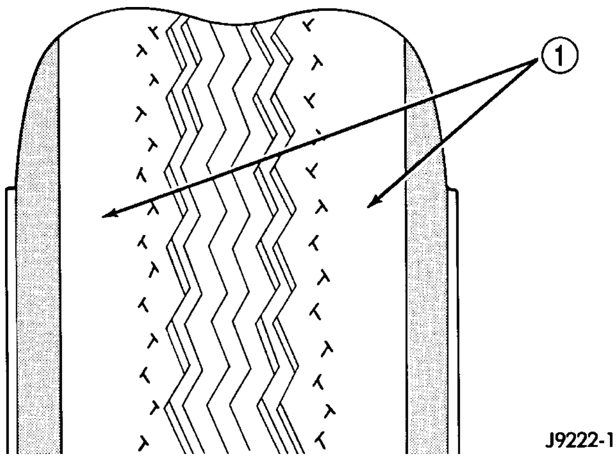


Fig. 12 Under Inflation Wear

1 - THIN TIRE THREAD AREAS

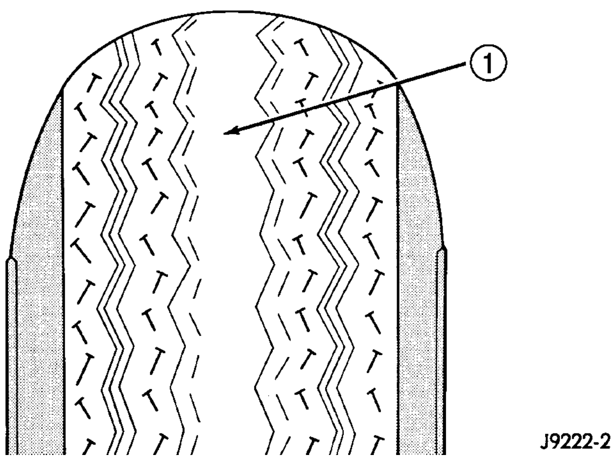


Fig. 13 Over Inflation Wear

1 - THIN TIRE THREAD AREA

Owners Manual. A Certification Label on the drivers side door pillar provides the minimum tire and rim size for the vehicle. The label also list the cold inflation pressure for these tires at full load operation

Tire pressures have been chosen to provide safe operation, vehicle stability, and a smooth ride. Tire pressure should be checked cold once a month. Tire pressure decreases as the ambient temperature drops. Check tire pressure frequently when ambient temperature varies widely.

Tire inflation pressures are cold inflation pressure. The vehicle must sit for at least 3 hours to obtain the correct cold inflation pressure reading. Or be driven less than one mile after sitting for 3 hours. Tire inflation pressures may increase from 2 to 6 pounds per square inch (psi) during operation. Do not reduce this normal pressure build-up.

WARNING: OVER OR UNDER INFLATED TIRES CAN AFFECT VEHICLE HANDLING AND TREAD WEAR. THIS MAY CAUSE THE TIRE TO FAIL SUDDENLY, RESULTING IN LOSS OF VEHICLE CONTROL.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - PRESSURE GAUGES

A quality air pressure gauge is recommended to check tire pressure. After checking the air pressure, replace valve cap finger tight.

DIAGNOSIS AND TESTING - TIRE NOISE OR VIBRATION

Radial-ply tires are sensitive to force impulses caused by improper mounting, vibration, wheel defects, or possibly tire imbalance.

To find out if tires are causing the noise or vibration, drive the vehicle over a smooth road at varying speeds. Note the noise level during acceleration and deceleration. The engine, differential and exhaust noises will change as speed varies, while the tire noise will usually remain constant.

DIAGNOSIS AND TESTING - TREAD WEAR INDICATORS

Tread wear indicators are molded into the bottom of the tread grooves. When tread depth is 1.6 mm (1/16 in.), the tread wear indicators will appear as a 13 mm (1/2 in.) band (Fig. 14).

Tire replacement is necessary when indicators appear in two or more grooves or if localized balding occurs.

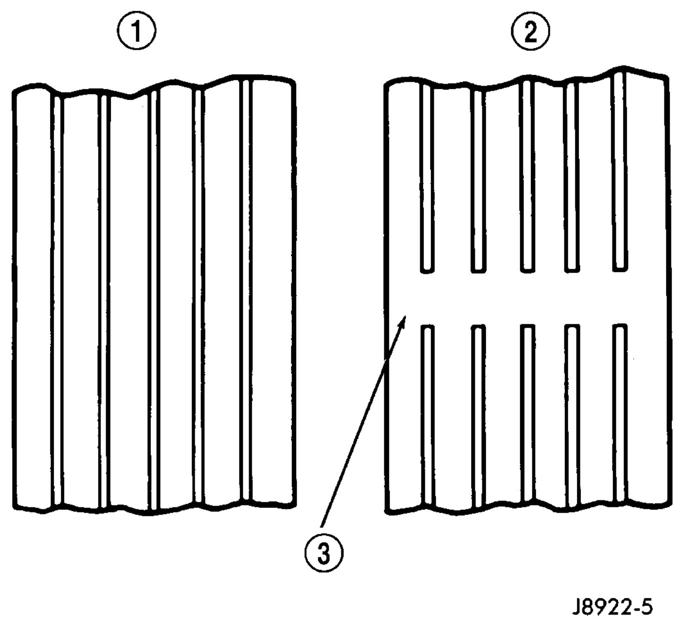


Fig. 14 Tread Wear Indicators

1 - TREAD ACCEPTABLE
2 - TREAD UNACCEPTABLE
3 - WEAR INDICATOR

TIRES (Continued)

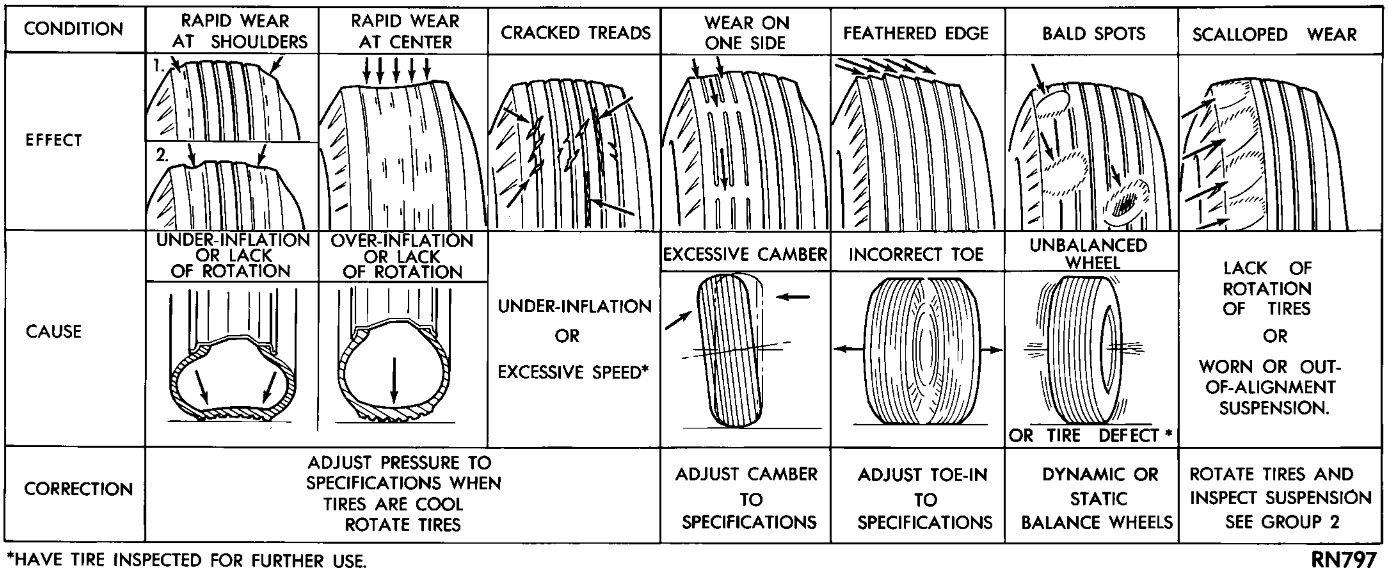


Fig. 15 Tire Wear Patterns

DIAGNOSIS AND TESTING - TIRE WEAR PATTERNS

Under inflation will cause wear on the shoulders of tire. Over inflation will cause wear at the center of tire.

Excessive camber causes the tire to run at an angle to the road. One side of tread is then worn more than the other (Fig. 15).

Excessive toe-in or toe-out causes wear on the tread edges and a feathered effect across the tread (Fig. 15).

DIAGNOSIS AND TESTING - TIRE/VEHICLE LEAD

Use the following Vehicle Lead Diagnosis And Correction Chart to diagnose and correct a vehicle lead or drift problem (Fig. 16).

TIRES (Continued)

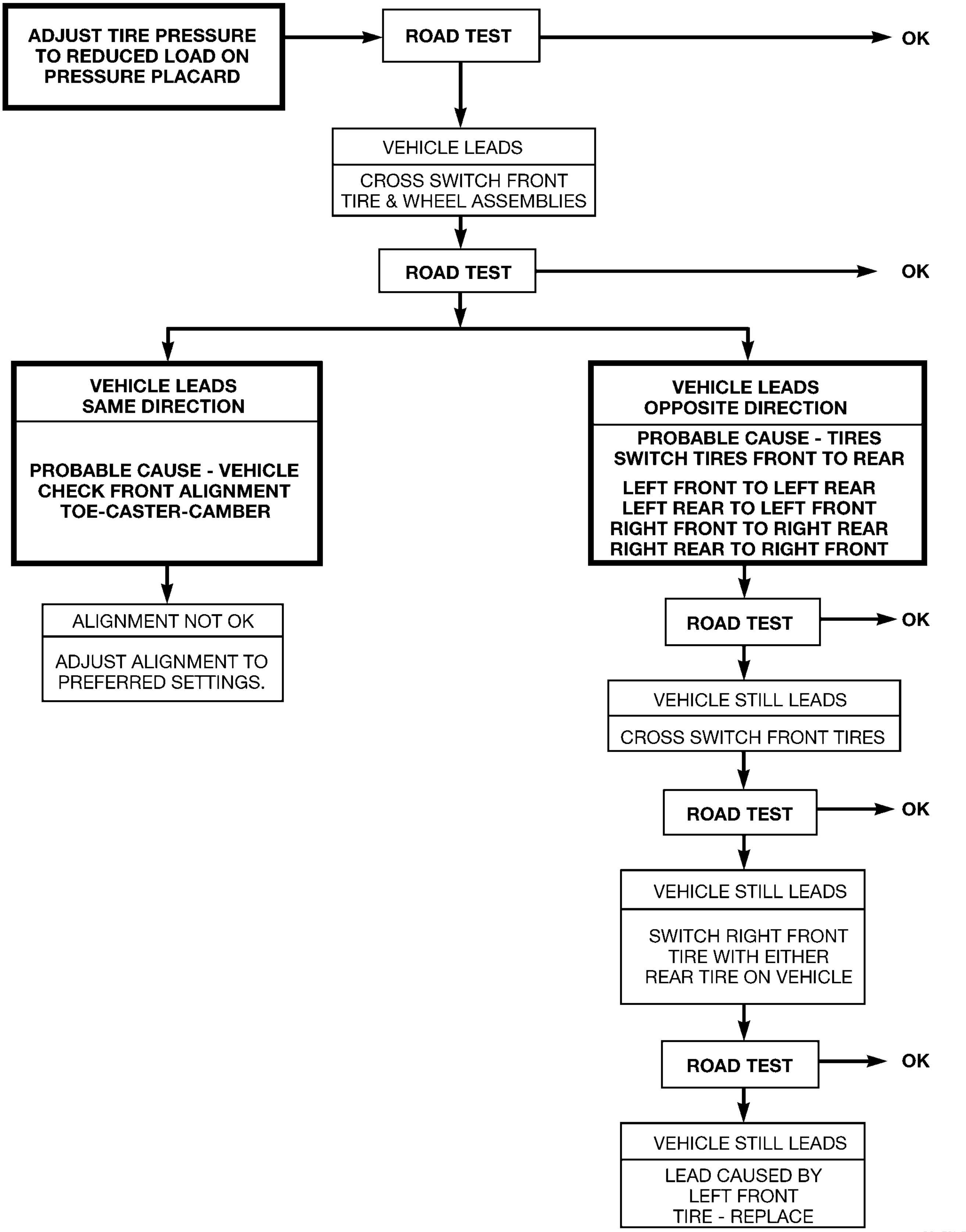


Fig. 16 VEHICLE LEAD DIAGNOSIS AND CORRECTION CHART

TIRES (Continued)

STANDARD PROCEDURE - REPAIRING LEAKS

For proper repairing, a radial tire must be removed from the wheel. Repairs should only be made if the defect, or puncture, is in the tread area (Fig. 17). The tire should be replaced if the puncture is located in the sidewall.

Deflate tire completely before removing the tire from the wheel. Use lubrication such as a mild soap solution when dismounting or mounting tire. Use tools free of burrs or sharp edges which could damage the tire or wheel rim.

Before mounting tire on wheel, make sure all rust is removed from the rim bead and repaint if necessary.

Install wheel on vehicle, and tighten to proper torque specification, (Refer to 22 - TIRES/WHEELS/WHEELS - SPECIFICATIONS).

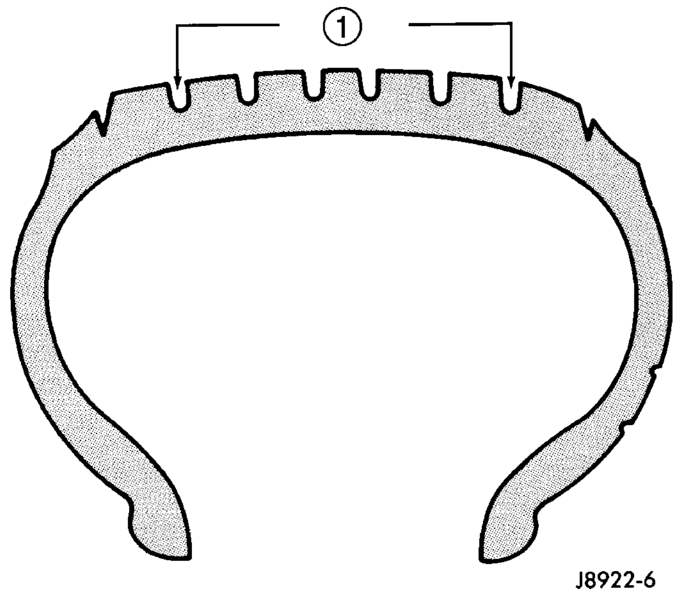


Fig. 17 TIRE REPAIR AREA

1 - TIRE REPAIR AREA

SPECIFICATIONS

TIRE REVOLUTIONS PER MILE

TIRE SIZE	SUPPLIER	REVOLUTIONS PER MILE
P245/70R17 LTX A/S	MICHELIN®	686
LT245/70R17 LTX A/S	MICHELIN®	675
LT265/70R17 LTX A/S	MICHELIN®	657
LT245/70R17 RUGGED TRAIL T/A	BF GOODRICH®	684
LT265/70R17 RUGGED TRAIL T/A	BF GOODRICH®	658
P265/70R17 WRANGLER SR/A	GOODYEAR®	656
P265/70R17 WRANGLER GS/A	GOODYEAR®	663
LT275/70R17 WRANGLER AT/S	GOODYEAR®	640
P275/55R20 EAGLE LS	GOODYEAR®	655
P275/60R20 WRANGLER HP	GOODYEAR®	636
LT235/80R17 WRANGLER SRA	GOODYEAR®	649
LT235/80R17 WRANGLER GSA	GOODYEAR®	649

WHEELS

DESCRIPTION

Original equipment wheels are designed for the specified Maximum Vehicle Capacity.

All models use steel or aluminum drop center wheels.

Aluminum wheels require special balance weights and alignment equipment.

(1) On vehicles equipped with dual rear wheels, The rim is an eight stud hole pattern wheel. The wheels have a flat mounting surface (Fig. 18). The slots in the wheel must be aligned to provide access to the valve stem (Fig. 19).

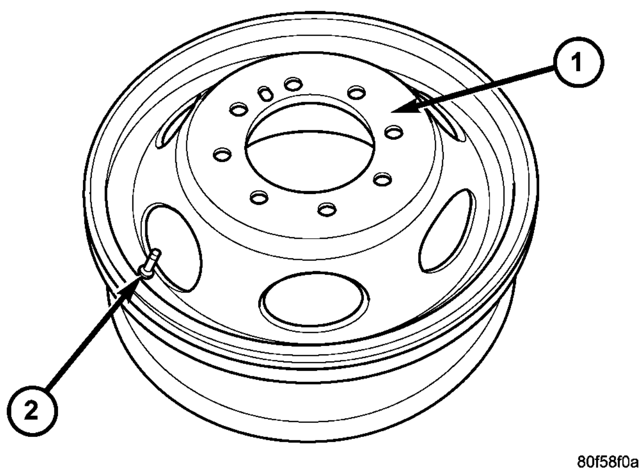


Fig. 18 FLAT FACE WHEEL

1 - FLAT FACE
2 - VALVE STEM

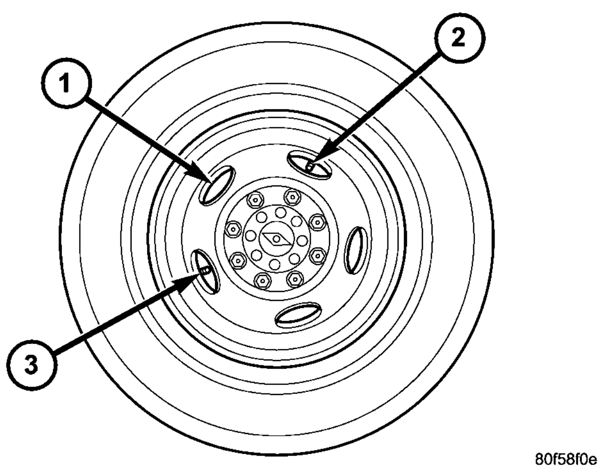


Fig. 19 DUAL REAR WHEELS

1 - WINDOW OPENINGS (5)
2 - INBOARD VALVE STEM
3 - OUTBOARD VALVE STEM

OPERATION

The wheel (Fig. 20) has raised sections between the rim flanges and the rim well. Initial inflation of the tire forces the bead over these raised sections. In case of tire failure, the raised sections hold the tire in position on the wheel until the vehicle can be brought to a safe stop.

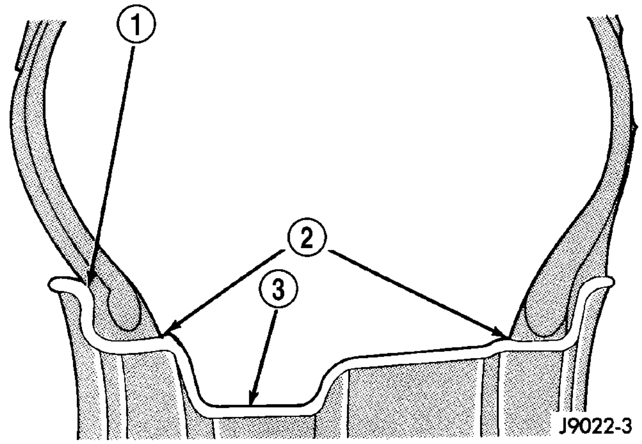


Fig. 20 Safety Rim

1 - FLANGE
2 - RIDGE
3 - WELL

DIAGNOSIS AND TESTING

WHEEL INSPECTION

Inspect wheels for:

- Excessive run out
- Dents or cracks
- Damaged wheel lug nut holes
- Air Leaks from any area or surface of the rim

NOTE: Do not attempt to repair a wheel by hammering, heating or welding.

If a wheel is damaged an original equipment replacement wheel should be used. When obtaining replacement wheels, they should be equivalent in load carrying capacity. The diameter, width, offset, pilot hole and bolt circle of the wheel should be the same as the original wheel.

WARNING: FAILURE TO USE EQUIVALENT REPLACEMENT WHEELS MAY ADVERSELY AFFECT THE SAFETY AND HANDLING OF THE VEHICLE. USED WHEELS ARE NOT RECOMMENDED. THE SERVICE HISTORY OF THE WHEEL MAY HAVE INCLUDED SEVERE TREATMENT OR VERY HIGH MILEAGE. THE RIM COULD FAIL WITHOUT WARNING.

WHEELS (Continued)

STANDARD PROCEDURE

STANDARD PROCEDURE - WHEEL REPLACEMENT

The wheel studs and nuts are designed for specific applications. They must be replaced with equivalent parts. Do not use replacement parts of lesser quality or a substitute design. All aluminum and some steel wheels have wheel stud nuts which feature an enlarged nose. This enlarged nose is necessary to ensure proper retention of the aluminum wheels.

NOTE: Do not use chrome plated lug nuts with chrome plated wheels.

Before installing the wheel, be sure to remove any build up of corrosion on the wheel mounting surfaces. Ensure wheels are installed with good metal-to-metal contact. Improper installation could cause loosening of wheel nuts (Fig. 21). This could affect the safety and handling of your vehicle.

To install the wheel, first position it properly on the mounting surface (Fig. 21). All wheel nuts should then be tightened just snug. Gradually tighten them in sequence to the proper torque specification, (Fig. 22) (Fig. 23). **Never use oil or grease on studs or nuts.**

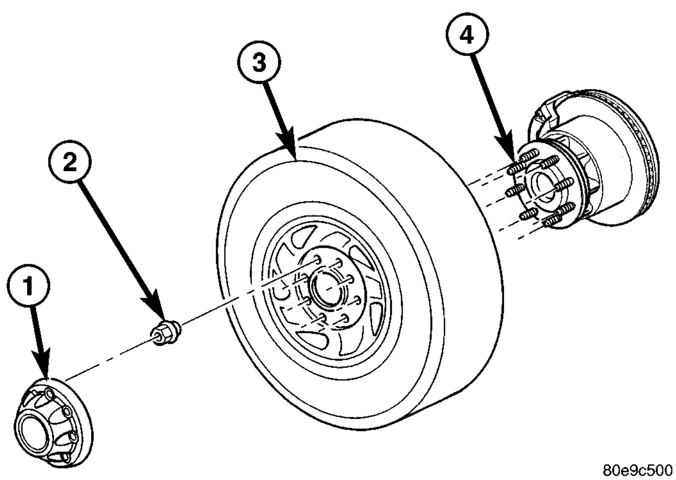


Fig. 21 WHEEL INSTALLATION 8-LUG SHOWN

1 - CENTER CAP
2 - LUG NUT
3 - TIRE/WHEEL ASSEMBLY
4 - WHEEL STUDS

Wheels must be replaced if they have:
- Excessive runout
- Bent or dented
- Leak air through welds
- Have damaged bolt holes

Wheel repairs employing hammering, heating, or welding are not allowed.

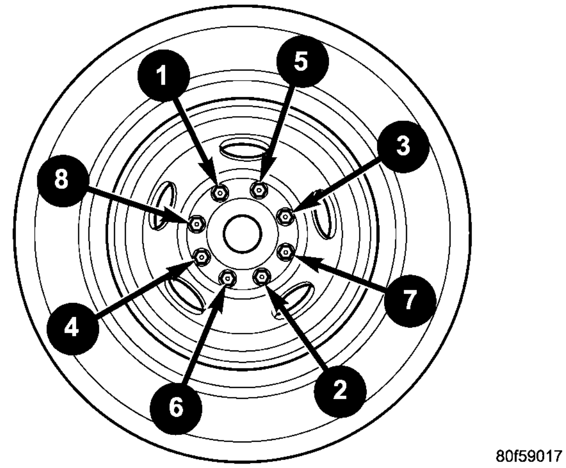


Fig. 22 8-LUG TIGHTENING PATTERN

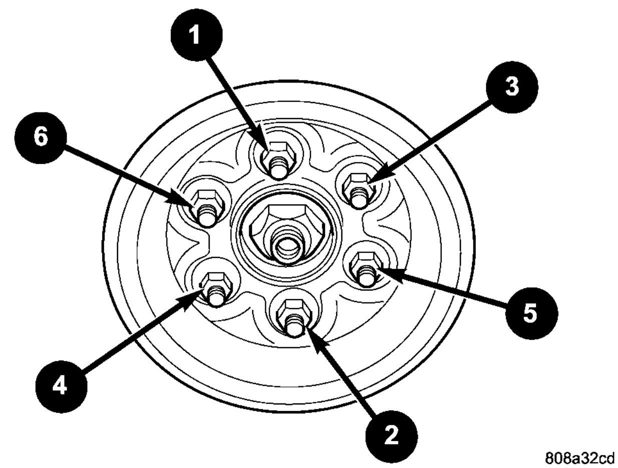


Fig. 23 TYPICAL 6 - LUG NUT TIGHTENING PATTERN

Original equipment wheels are available through your dealer. Replacement wheels from any other source should be equivalent in:
- Load carrying capacity
- Diameter
- Width
- Offset
- Mounting configuration

Failure to use equivalent replacement wheels may affect the safety and handling of your vehicle. Replacement with **used** wheels is not recommended. Their service history may have included severe treatment.

STANDARD PROCEDURE - DUAL REAR WHEEL INSTALLATION

Dual rear wheels use a special heavy duty lug nut wrench. It is recommended to remove and install dual rear wheels only when the proper wrench is available. The wrench is also use to remove wheel

WHEELS (Continued)

center caps for more information refer to Owner's Manual.

The tires on both wheels must be completely raised off the ground when tightening the lug nuts. This will ensure correct wheel centering and maximum wheel clamping.

A two piece flat face lug nut with right-hand threads is used for retaining the wheels on the hubs (Fig. 24).

The dual rear wheel lug nuts should be tightened according to the following procedure:

- Place two drops of oil to the interface of the nut/washer (Fig. 24) before installing on the wheel stud.

NOTE: Do not use more then two drops of oil on the nut/washer, since the center caps attach in this area.

- Tighten the wheel lug nuts in the numbered sequential pattern until they are snug tight. Then tighten lug nut to specified torque following same number sequence, (Refer to 22 - TIRES/WHEELS/WHEELS - SPECIFICATIONS).
- Tighten lug nuts in same numbered sequence a second time to the specified torque. This will ensure that the wheels are thoroughly mated.

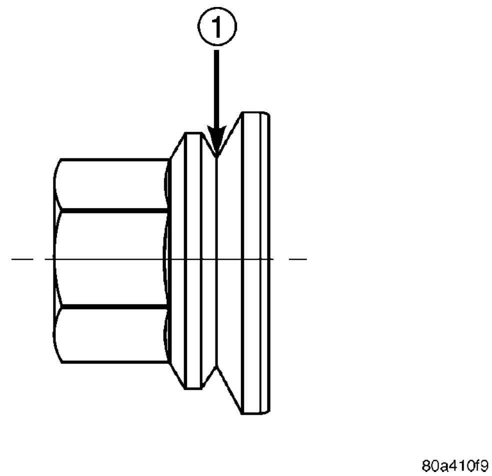


Fig. 24 Oil Location

1 - PLACE TWO DROPS OF OIL HERE

- Check lug nut specified torque after 100 miles (160 kilometers). Also after 500 miles (800 kilometers) of vehicle operation.

NOTE: Wheel lug nuts should be tightened to specified torque at every maintenance interval thereafter.

SPECIFICATIONS

TORQUE CHART

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
1500 Series Lug Nut 9/16 X 18 with 60° Cone	180	135	—
2500 Series Lug Nut 9/16 X 18 with 60° Cone	180	135	—
3500 Series Lug Nut 9/16 X 18 with Flat Washer	195	145	—

STUDS

REMOVAL

(1) Raise and support the vehicle.

(2) Remove the wheel and tire assembly.

(3) Remove the brake caliper, caliper adapter and rotor, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - REMOVAL).

(4) Remove the stud from the hub with Remover C-4150A (Fig. 25).

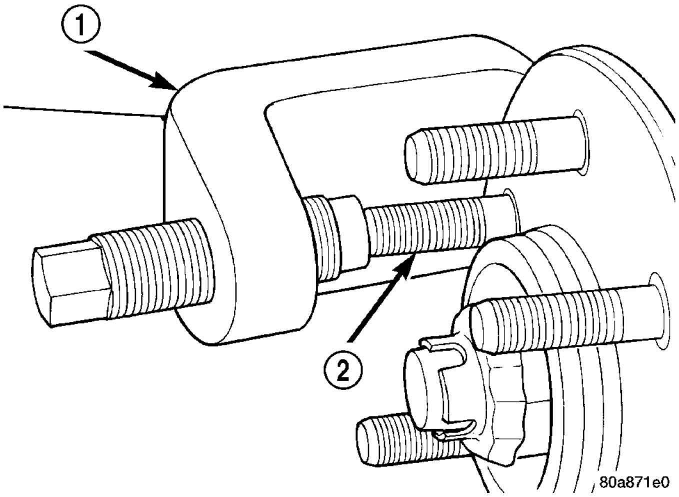


Fig. 25 Wheel Stud Removal

1 - REMOVER
2 - WHEEL STUD

INSTALLATION

(1) Install the new stud into the hub flange.

(2) Install the three washers onto the stud, then install the lug nut with the flat side of the nut against the washers.

(3) Tighten the lug nut until the stud is pulled into the hub flange. Verify that the stud is properly seated into the flange.

(4) Remove the lug nut and washers.

(5) Install the brake rotor, caliper adapter, and caliper, (Refer to 5 - BRAKES/HYDRAULIC/MECHANICAL/ROTORS - INSTALLATION).

(6) Install the wheel and tire assembly, (Refer to 22 - TIRES/WHEELS/WHEELS - STANDARD PROCEDURE), use new the lug nut on stud or studs that were replaced.

(7) Remove the support and lower vehicle.

WHEEL COVER

REMOVAL

NOTE: The hub caps must be removed before raising the vehicle off the ground.

NOTE: You must use the flat end of the hub/cap remover/installer combination tool to pry off the wheel skins. Insert the flat tip completely and using a back and forth motion, loosen the wheel skin. repeat this procedure around the tire until the wheel skin pops off.

(1) On 2500/3500 single rear wheel (SRW) models, insert a hub/cap remover/installer combination tool using the blade on the end of the tool to pry the cap off in a back and forth motion.

(2) On 3500 models with dual rear wheels (DRW), you must first remove the hub caps. The hub/cap remover/installer combination tool must be inserted in the pry off notch of the rear hub caps.

(3) Position the hub/cap remover/installer combination tool and pull out on the tool firmly. The cap should come off.

(4) The wheel skins can now be removed from the wheel.

(5) On 3500 models front hub caps use the hub/cap remover/installer combination tool to pry off the cap in a back and forth motion. The wheel skins can now be removed.

INSTALLATION

INSTALLATION - REAR

(1) Install one 1 1/2 in. valve stem extension on each rear inner wheel.

NOTE: A 3/8 in. drive 10mm deep wheel socket with a 10 in. or greater extension can be used to remove the existing valve stem cap and install the extension.

(2) Install one 1 in. valve stem extension on each outer wheel.

(3) Align the cooling windows of the wheel skin with the cooling windows of the wheel. Seat one side of the wheel skin's retainer onto the wheel. Using a rubber mallet, strike thew wheel skin on the outer circumference. Strike at several locations around the circumference until the skin is fully seated.

NOTE: The wheel skin and the hub cap are fully seated when there is a consistent gap between the skin/cap and the wheel.

WHEEL COVER (Continued)

(4) Tug on the hub/cap wheel skin to ensure that they are properly installed.

INSTALLATION - FRONT

(1) Align the valve stem with the notch in the wheel skin.

(2) Seat on side of the wheel skin's wire retainer on to the wheel.

(3) Using a rubber mallet, strike the opposite side of the wheel skin until the skin is properly seated.

NOTE: The wheel skin and the hub cap are fully seated when there is a consistant gap between the skin/ cap and the wheel.

(4) Tug on the hub cap/wheel skin to ensure that they are properly installed.

SPARE TIRE

DESCRIPTION

DESCRIPTION - SPARE / TEMPORARY TIRE

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity, then reinstalled. Do not exceed speeds of 50 M.P.H. when using the temporary spare tire. Refer to Owner's Manual for complete details.

DESCRIPTION - FULL SIZE, SPARE WHEEL WITH MATCHING TIRE

The spare is a full usage wheel with a matching tire, It can be used within the (posted legal) speed limits or distance limitations as of the rest of the vehicles four tires. Refer to Owner's Manual for complete details.

BODY

TABLE OF CONTENTS

BODY

WARNING

SAFETY PRECAUTIONS AND WARNINGS

WARNING: USE AN OSHA APPROVED BREATHING FILTER WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

- **AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.**
- **DO NOT STAND UNDER A HOISTED VEHICLE THAT IS NOT PROPERLY SUPPORTED ON SAFETY STANDS. PERSONAL INJURY CAN RESULT.**

CAUTION: When holes must be drilled or punched in an inner body panel, verify depth of space to the outer body panel, electrical wiring, or other components. Damage to vehicle can result.

- **Do not weld exterior panels unless combustible material on the interior of vehicle is removed from the repair area. Fire or hazardous conditions, can result.**
- **Always have a fire extinguisher ready for use when welding.**
- **Disconnect the negative (-) cable clamp from the battery when servicing electrical components that are live when the ignition is OFF. Damage to electrical system can result.**
- **Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result.**
- **Do not use harsh alkaline based cleaning solvents on painted or upholstered surfaces. Damage to finish or color can result.**
- **Do not hammer or pound on plastic trim panel when servicing interior trim. Plastic panels can break.**

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - WATER LEAKS

Water leaks can be caused by poor sealing, improper body component alignment, body seam porosity, missing plugs, or blocked drain holes. Centrifugal and gravitational force can cause water to drip from a location away from the actual leak point, making leak detection difficult. All body sealing points should be water tight in normal wet-driving conditions. Water flowing downward from the front of the vehicle should not enter the passenger or luggage compartment. Moving sealing surfaces will not always seal water tight under all conditions. At times, side glass or door seals will allow water to enter the passenger compartment during high pressure washing or hard driving rain (severe) conditions. Overcompensating on door or glass adjustments to stop a water leak that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After completing a repair, water test vehicle to verify leak has stopped before returning vehicle to use.

BODY (Continued)

VISUAL INSPECTION BEFORE WATER LEAK TESTS

Verify that floor and body plugs are in place, body drains are clear, and body components are properly aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

WATER LEAK TESTS

WARNING: DO NOT USE ELECTRIC SHOP LIGHTS OR TOOLS IN WATER TEST AREA. PERSONAL INJURY CAN RESULT.

When the conditions causing a water leak have been determined, simulate the conditions as closely as possible.

- If a leak occurs with the vehicle parked in a steady light rain, flood the leak area with an open-ended garden hose.
- If a leak occurs while driving at highway speeds in a steady rain, test the leak area with a reasonable velocity stream or fan spray of water. Direct the spray in a direction comparable to actual conditions.
- If a leak occurs when the vehicle is parked on an incline, hoist the end or side of the vehicle to simulate this condition. This method can be used when the leak occurs when the vehicle accelerates, stops or turns. If the leak occurs on acceleration, hoist the front of the vehicle. If the leak occurs when braking, hoist the back of the vehicle. If the leak occurs on left turns, hoist the left side of the vehicle. If the leak occurs on right turns, hoist the right side of the vehicle. For hoisting recommendations (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE).

WATER LEAK DETECTION

To detect a water leak point-of-entry, do a water test and watch for water tracks or droplets forming on the inside of the vehicle. If necessary, remove interior trim covers or panels to gain visual access to the leak area. If the hose cannot be positioned without being held, have someone help do the water test.

Some water leaks must be tested for a considerable length of time to become apparent. When a leak appears, find the highest point of the water track or drop. The highest point usually will show the point of entry. After leak point has been found, repair the leak and water test to verify that the leak has stopped.

Locating the entry point of water that is leaking into a cavity between panels can be difficult. The trapped water may splash or run from the cavity, often at a distance from the entry point. Most water leaks of this type become apparent after accelerating, stopping, turning, or when on an incline.

MIRROR INSPECTION METHOD

When a leak point area is visually obstructed, use a suitable mirror to gain visual access. A mirror can also be used to deflect light to a limited-access area to assist in locating a leak point.

BRIGHT LIGHT LEAK TEST METHOD

Some water leaks in the luggage compartment can be detected without water testing. Position the vehicle in a brightly lit area. From inside the darkened luggage compartment inspect around seals and body seams. If necessary, have a helper direct a drop light over the suspected leak areas around the luggage compartment. If light is visible through a normally sealed location, water could enter through the opening.

PRESSURIZED LEAK TEST METHOD

When a water leak into the passenger compartment cannot be detected by water testing, pressurize the passenger compartment and soap test exterior of the vehicle. To pressurize the passenger compartment, close all doors and windows, start engine, and set heater control to high blower in HEAT position. If engine can not be started, connect a charger to the battery to ensure adequate voltage to the blower. With interior pressurized, apply dish detergent solution to suspected leak area on the exterior of the vehicle. Apply detergent solution with spray device or soft bristle brush. If soap bubbles occur at a body seam, joint, seal or gasket, the leak entry point could be at that location.

DIAGNOSIS AND TESTING - WIND NOISE

Wind noise is the result of most air leaks. Air leaks can be caused by poor sealing, improper body component alignment, body seam porosity, or missing plugs in the engine compartment or door hinge pillar areas. All body sealing points should be airtight in normal driving conditions. Moving sealing surfaces will not always seal airtight under all conditions. At times, side glass or door seals will allow wind noise to be noticed in the passenger compartment during high cross winds. Over compensating on door or glass adjustments to stop wind noise that occurs under severe conditions can cause premature seal wear and excessive closing or latching effort. After a repair procedure has been performed, test vehicle to verify noise has stopped before returning vehicle to use.

VISUAL INSPECTION BEFORE TESTS

Verify that floor and body plugs are in place and body components are aligned and sealed. If component alignment or sealing is necessary, refer to the appropriate section of this group for proper procedures.

BODY (Continued)

ROAD TESTING WIND NOISE

(1) Drive the vehicle to verify the general location of the wind noise.

(2) Apply 50 mm (2 in.) masking tape in 150 mm (6 in.) lengths along weatherstrips, weld seams or moldings. After each length is applied, drive the vehicle. If noise goes away after a piece of tape is applied, remove tape, locate, and repair defect.

POSSIBLE CAUSE OF WIND NOISE

- Moldings standing away from body surface can catch wind and whistle.
- Gaps in sealed areas behind overhanging body flanges can cause wind-rushing sounds.
- Misaligned movable components.
- Missing or improperly installed plugs in pillars.
- Weld burn through holes.

STANDARD PROCEDURE

STANDARD PROCEDURE - BODY LUBRICATION

All mechanisms and linkages should be lubricated when necessary. This will maintain ease of operation and provide protection against rust and excessive wear. The weatherstrip seals should be lubricated to prolong their life as well as to improve door sealing.

All applicable exterior and interior vehicle operating mechanisms should be inspected and cleaned. Pivot/sliding contact areas on the mechanisms should then be lubricated.

(1) When necessary, lubricate the operating mechanisms with the specified lubricants.

(2) Apply silicone lubricant to a cloth and wipe it on door seals to avoid over-spray that can soil passenger's clothing.

(3) Before applying lubricant, the component should be wiped clean. After lubrication, any excess lubricant should be removed.

(4) The hood latch, latch release mechanism, latch striker, and safety latch should be lubricated periodically.

(5) The door lock cylinders should be lubricated twice each year (preferably autumn and spring).

- Spray a small amount of lock cylinder lubricant directly into the lock cylinder.
- Apply a small amount to the key and insert it into the lock cylinder.
- Rotate it to the locked position and then back to the unlocked position several times.
- Remove the key. Wipe the lubricant from it with a clean cloth to avoid soiling of clothing.

STANDARD PROCEDURE - HEAT STAKING

(1) Remove trim panel.

(2) Bend or move the trim panel components at the heat staked joints. Observe the heat staked locations and/or component seams for looseness.

(3) Heat stake the components.

(a) If the heat staked or component seam location is loose, hold the two components tightly together and using a soldering gun with a flat tip, melt the material securing the components together. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(b) If the heat staked material is broken or missing, use a hot glue gun to apply new material to the area to be repaired. The panels that are being heat staked must be held together while the applying the glue. Once the new material is in place, it may be necessary to use a soldering gun to melt the newly applied material. Do not over heat the affected area, damage to the exterior of the trim panel may occur.

(4) Allow the repaired area to cool and verify the repair.

(5) Install trim panel.

STANDARD PROCEDURE - PLASTIC BODY PANEL REPAIR

There are many different types of plastics used in today's automotive environment. We group plastics in three different categories: Rigid, Semi-Rigid, and Flexible. Any of these plastics may require the use of an adhesion promoter for repair. These types of plastic are used extensively on DaimlerChrysler Motors vehicles. Always follow repair material manufacturer's plastic identification and repair procedures.

Rigid Plastics:

Examples of rigid plastic use: Fascias, Hoods, Doors, and other Body Panels, which include SMC, ABS, and Polycarbonates.

Semi-Rigid Plastics:

Examples of semi-rigid plastic use: Interior Panels, Under Hood Panels, and other Body Trim Panels.

Flexible Plastics:

Examples of flexible plastic use: Fascias, Body Moldings, and upper and lower Fascia Covers.

Repair Procedure:

The repair procedure for all three categories of plastics is basically the same. The one difference is the material used for the repair. The materials must be specific for each substrate, rigid repair material for rigid plastic repair, semi-rigid repair material for semi-rigid plastic repair and flexible repair material for flexible plastic repair.

BODY (Continued)

Adhesion Promoter/Surface Modifier:

Adhesion Promoters/Surface Modifiers are required for certain plastics. All three categories may have plastics that require the use of adhesion promoter/ surface modifiers. Always follow repair material manufacturer's plastic identification and repair procedures.

SAFETY PRECAUTION AND WARNINGS

WARNING:

- **EYE PROTECTION SHOULD BE USED WHEN SERVICING COMPONENTS. PERSONAL INJURY CAN RESULT.**
- **USE AN OSHA APPROVED BREATHING MASK WHEN MIXING EPOXY, GRINDING, AND SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.**
- **AVOID PROLONGED SKIN CONTACT WITH RESIN, PETROLEUM, OR ALCOHOL BASED SOLVENTS. PERSONAL INJURY CAN RESULT.**
- **DO NOT VENTURE UNDER A HOISTED VEHICLE THAT IS NOT PROPERLY SUPPORTED ON SAFETY STANDS. PERSONAL INJURY CAN RESULT.**

NOTE:

- **When holes must be drilled or cut in body panels, verify locations of internal body components and electrical wiring. Damage to vehicle can result.**
- **Do not use abrasive chemicals or compounds on undamaged painted surfaces around repair areas. Damage to finish can result.**

RIGID, SEMI-RIGID, AND FLEXIBLE PLASTIC PARTS TYPES

CODE	FAMILY NAME	COMMON TRADE NAME	TYPICAL APPLICATION
ASA	ACRYLONITRILE STYRENE ACRYLITE	LURAN S	CONSOLES, GRILLES
ABS	ACRYLONITRILE BUTADIENE STYRENE	TERLURAN	"A" PILLARS, CONSOLES, GRILLES
ABS/PC	ABS/PC ALLOY	PULSE, PROLOY, BAYBLEND	DOORS, INSTRUMENT PANELS
ABS/PVC	ABS/PV ALLOY	PROLOY, PULSE, LUSTRAN, CYCLOVIN	DOOR PANELS, GRILLES, TRIM
BMC	BULK MOLDING COMPOUND	BMC	FENDER EXTENSIONS
EMA	EHTYLENE METHYL ACRYLATE/IONOMER	SURLYN, EMA, IONOMER	BUMPER GUARDS, PADS
METTON	METTON	METTON	GRILLES, KICK PANELS, RUNNING BOARDS
MPPO	MODIFIED POLYPHENYLENE OXIDE	MPPO	SPOILER ASSEMBLY
PA	POLYAMID	ZYTEL, VYDYNE, PA, MINLON	FENDERS, QUARTER PANELS
PET	THERMOPLASTIC POLYESTER	RYNITE	TRIM
PBT/PPO	PBT/PPO ALLOY	GERMAX	CLADDINGS
PBTP	POLYBUTYLENE THEREPTHALATE	PBT, PBTP, POCAN, VALOX	WHEEL COVERS, FENDERS, GRILLES
PBTP/EEBC	POLYBUTYLENE THEREPTHALATE/EEBC ALLOY	BEXLOY, "M", PBTP/EEBC	FASCIAS, ROCKER PANEL, MOLDINGS
PC	POLYCARBONATE	LEXAN, MERLON, CALIBRE, MAKROLON PC	TAIL LIGHT LENSES, IP TRIM, VALANCE PANELS

BODY (Continued)

CODE	FAMILY NAME	COMMON TRADE NAME	TYPICAL APPLICATION
PC/ABS	PC/ABS ALLOY	GERMAX, BAY BLENDS, PULSE	DOORS, INSTRUMENT PANELS
PPO	POLYPHENYLENE OXIDE	AZDEL, HOSTALEN, MARLEX, PRFAX, NORYL, GTX, PPO	INTERIOR TRIM, DOOR PANELS, SPLASH SHIELDS, STEERING COLUMN SHROUD
PPO/PA	POLYPHENYLENE/ POLYAMID	PPO/PA, GTX 910	FENDERS, QUARTER PANELS
PR/FV	FIBERGLASS REINFORCED PLASTIC	FIBERGLASS, FV, PR/FV	BODY PANELS
PS	POLYSTYRENE	LUSTREX, STYRON, PS	DOOR PANELS, DASH PANELS
RTM	RESIN TRANSFER MOLDING COMPOUND	RTM	BODY PANELS
SMC	SHEET MOLDED COMPOUND	SMC	BODY PANELS
TMC	TRANSFER MOLDING COMPOUND	TMC	GRILLES
UP	UNSATURATED POLYESTER (THERMOSETTING)	SMC, BMC, TMC, ZMC, IMC, XSMC, UP	GRILLE OPENING PANEL, LIFTGATES, FLARESIDE FENDERS, FENDER EXTENSIONS
EEBC	ETHER/ESTER BLOCKED CO-POLYMER	EEBC	BUMPERS
EEBC/PBTP	EEBC/POLYBUTYLENE TEREPTHALATE	EEBC, PBTP, BEXLOY	BUMPER, ROCKER PANELS
EMPP	ETHYLENE MODIFIED POLYPROPYLENE	EMPP	BUMPER COVERS
EPDM	ETHYLENE/ PROPROPYLENE DIENE MONOMER	EPDM, NORDEL, VISTALON	BUMPERS
EPM	ETHYLENE/ PROPROPYLENE CO-POLYMER	EPM	FENDERS
MPU	FOAM POLYURETHANE	MPU	SPOILERS
PE	POLYETHYLENE	ALATHON, DYLAN, LUPOLEN, MARLEX	-
PP	POLYPROPYLENE (BLENDS)	NORYL, AZDEL, MARLOX, DYLON, PRAVEX	INNER FENDER, SPOILERS, KICK PANELS
PP/EPDM	PP/EPDM ALLOY	PP/EPDM	SPOILERS, GRILLES
PUR	POLYURETHANE	COLONELS, PUR, PU	FASCIAS, BUMPERS
PUR/PC	PUR/PC ALLOY	TEXIN	BUMPERS
PVC	POLYVINYL CHLORIDE	APEX, GEON, VINYLITE	BODY MOLDINGS, WIRE INSULATION, STEERING WHEELS
RIM	REACTION INJECTED MOLDED POLYURETHANE	RIM, BAYFLEX	FRONT FASCIAS, MODULAR WINDOWS
RRIM	REINFORCED REACTION INJECTED MOLDED	PUR, RRIM	FASCIAS, BODY PANELS, BODY TRIMS

BODY (Continued)

CODE	FAMILY NAME	COMMON TRADE NAME	TYPICAL APPLICATION
TPE	THERMO POLYETHYLENE	TPE, HYTREL, BEXLOY-V	FASCIAS, BUMPERS, CLADDINGS
TPO	THERMOPOLYOLEFIN	POLYTROPE, RENFLEX, SANTOPRENE, VISAFLEX, ETA, APEX, TPO, SHIELDS, CLADDINGS	BUMPERS, END CAPS, TELCAR, RUBBER, STRIPS, SIGHT, INTERIOR B POST
TPP	THERMO-POLYPROPYLENE	TPP	BUMPERS
TPU	THERMOPOLYURETHANE, POLYESTER	TPU, HYTREL, TEXIN, ESTANE	BUMPERS, BODY SIDE, MOLDINGS, FENDERS, FASCIAS

PANEL SECTIONING

If it is required to section a large panel for a plastic repair, it will be necessary to reinforce the panel (Fig. 1). To bond two plastic panels together, a reinforcement must overlap both panels. The panels must be “V’d” at a 20 degree angle. The area to be reinforced should be washed, then sanded. Be sure to wipe off any excess soap and water when finished. Lightly sand or abrade the plastic with an abrasive pad or sandpaper. Blow off any dust with compressed air or wipe with a clean dry rag.

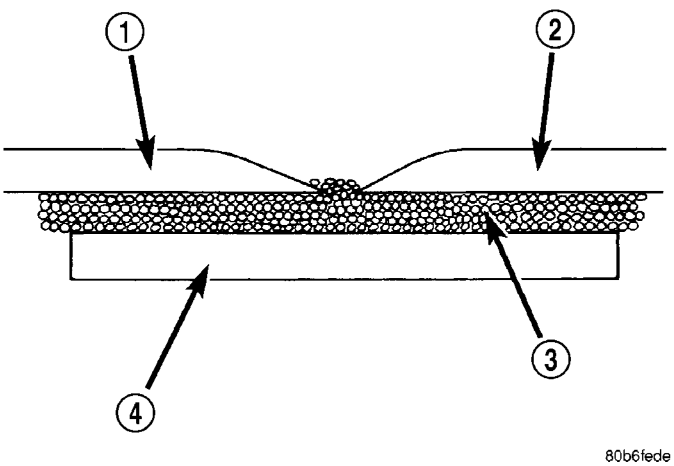


Fig. 1 PANEL SECTIONING

1 - EXISTING PANEL
2 - NEW PANEL
3 - PANEL ADHESIVE
4 - BONDING STRIP

When bonding plastic panels, Follow repair material manufacturers recommendations. Be sure that enough adhesive has been applied to allow squeeze out and to fill the full bond line. Once the pieces have been brought together, do not move them until the adhesive is cured. The assembly can be held together with clamps, rivets, etc. A faster cure can be obtained by heating with a heat lamp or heat gun. After the parts have been bonded and have had time to cure, rough sand the seam and apply the final adhesive filler to the area being repaired. Smooth the filler with a spreader, wooden tongue depressor, or squeegee. For fine texturing, a small amount of water can be applied to the filler surface while smoothing. The cured filler can be sanded as necessary and, as a final step, cleanup can be done with soapy water. Wipe the surface clean with a dry cloth allowing time for the panel to dry before moving on with the repair.

PANEL REINFORCEMENT

Structural repair procedures for rigid panels with large cracks and holes will require a reinforcement backing. Reinforcements can be made with several applications of glass cloth saturated with structural adhesive. Semi-rigid or flexible repair materials should be used for semi-rigid or flexible backing reinforcement (Fig. 2) and (Fig. 3). Open meshed fiberglass dry wall tape can be used to form a reinforcement. The dry wall tape allows the resin to penetrate through and make a good bond between the panel and the adhesive. Structurally, the more dry wall tape used, the stronger the repair.

Another kind of repair that can be done to repair large cracks and holes is to use a scrap piece of similar plastic and bond with structural adhesive. The reinforcement should cover the entire break and should have a generous amount of overlap on either side of the cracked or broken area.

When repairing plastic, the damaged area is first “V’d” out, or beveled. Large bonding areas are desirable when repairing plastic because small repairs are less likely to hold permanently. Beveling the area around a crack at a 20 degree angle will increase the bonding surface for a repair (Fig. 4). It is recommended that sharp edges be avoided because the joint may show through after the panel is refinished.

BODY (Continued)

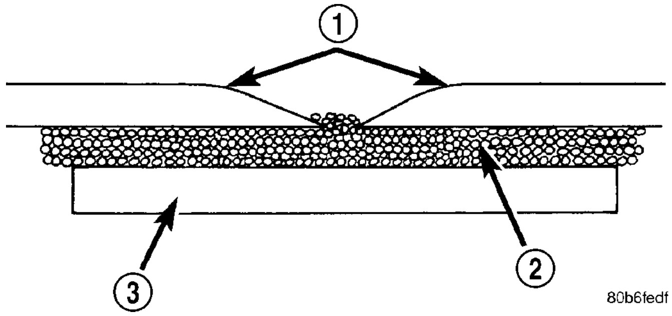


Fig. 2 SOFTENED EDGES

1 - SOFTENED EDGES
2 - PANEL ADHESIVE
3 - BONDING STRIP

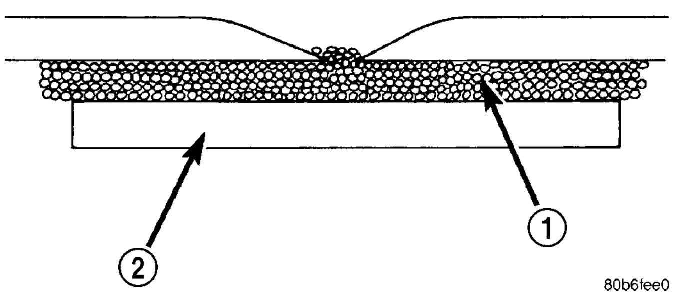


Fig. 3 PANEL REINFORCEMENT

1 - PANEL ADHESIVE
2 - REINFORCEMENT

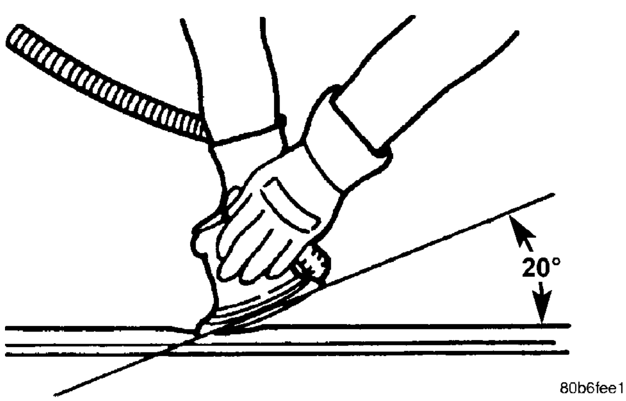


Fig. 4 BEVELING ANGLE - 20 DEGREE

- Panel repair for both flexible and rigid panels are basically the same. The primary difference between flexible panel repair and rigid panel repair is in the adhesive materials used (Fig. 5).
- The technician should first decide what needs to be done when working on any type of body panel. One should determine if it is possible to return the damage part to its original strength and appearance without exceeding the value of the replacement part.
- When plastic repairs are required, it is recommended that the part be left on the vehicle when every possible. That will save time, and the panel will remain stationary during the repair. Misalignment can cause stress in the repair areas and can result in future failure.

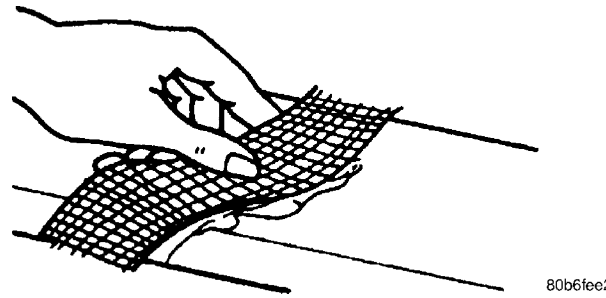


Fig. 5 FIBERGLASS TAPE

VISUAL INSPECTION

Composite materials can mask the severity of an accident. Adhesive bond lines, interior structure of the doors, and steel structures need to be inspected carefully to get a true damage assessment. Close inspection may require partial removal of interior trim or inner panels.

Identify the type of repair: Puncture or Crack - Damage that has penetrated completely through the panel. Damage is confined to one general area; a panel section is not required. However, a backer panel, open fiberglass tape, or matted material must be bonded from behind (Fig. 7) (Fig. 6).

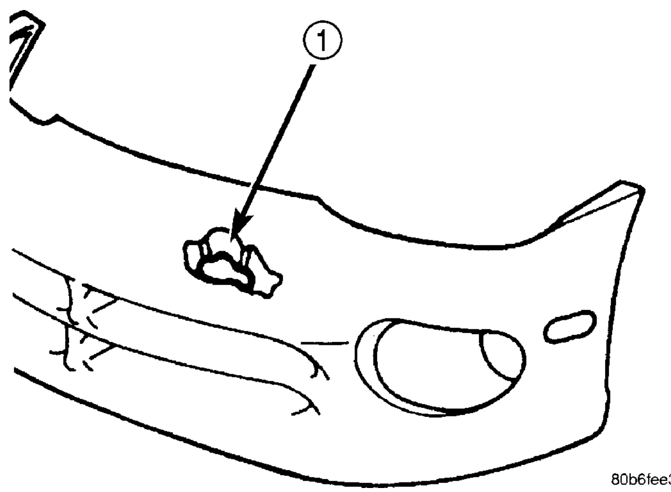


Fig. 6 DAMAGE COMPONENT

1 - PUNCTURE

PANEL SURFACE PREPARATION

If a body panel has been punctured, cracked, or crushed, the damaged area must be removed from the panel to achieve a successful repair. All spider web cracks leading away from a damaged area must be stopped or removed. To stop a running crack in a panel, drill a 6 mm (0.250 in.) hole at the end of the crack farthest away from the damage. If spider web cracks can not be stopped, the panel would require replacement. The surfaces around the damaged area

BODY (Continued)

should be stripped of paint and freed from wax and oil. Scuff surfaces around repair area with 360 grit wet/dry sandpaper, or equivalent, to assure adhesion of repair materials.

PATCHING PANELS

An panel that has extensive puncture type damage can be repaired by cutting out the damaged material (Fig. 7). Use a suitable reciprocating saw or cut off wheel to remove the section of the panel that is damaged. The piece cut out can be used as a template to shape the new patch. It is not necessary to have access to the back of the panel to install a patch. Bevel edges of cutout at 20 degrees to expose a larger bonding area on the outer side. This will allow for an increased reinforcement areas.

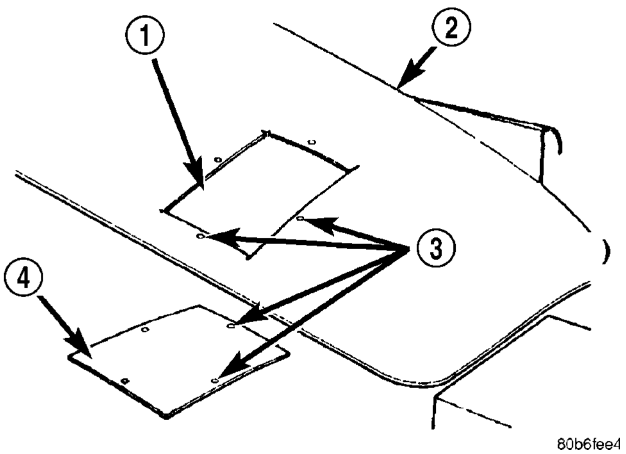


Fig. 7 DAMAGED PANEL CUTOUT AND PATCH

1 - CUTOUT
2 - DAMAGED BODY PANEL
3 - 4 MM (0.160 IN.) HOLES
4 - PATCH CUT TO SIZE

PANEL PATCH FABRICATIONS

A patch can be fabricated from any rigid fiberglass panel that has comparable contour with the repair area. Lift gates and fenders can be used to supply patch material. If existing material is not available or compatible, a patch can be constructed with adhesive and reinforcement mesh (dry wall tape). Perform the following operation if required:

(1) Cover waxed paper or plastic with adhesive backed nylon mesh (dry wall tape) larger than the patch required (Fig. 8).

(2) Tape waxed paper or plastic sheet with mesh to a surface that has a compatible contour to the repair area.

(3) Apply a liberal coat of adhesive over the reinforcement mesh (Fig. 8). If necessary apply a second or third coat of adhesive and mesh after firs coat has cured. The thickness of the patch should be the same as the repair area.

(4) After patch has cured, peel waxed paper or plastic from the back of the patch.

(5) If desired, a thin film coat of adhesive can be applied to the back of the patch to cover mesh for added strength.

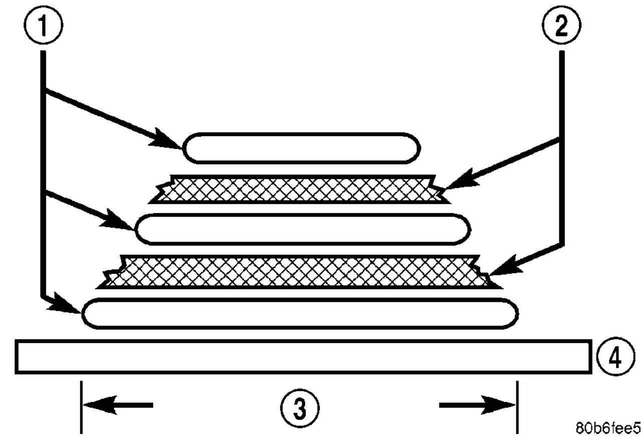


Fig. 8 FABRICATED PANEL

1 - STRUCTURAL ADHESIVE
2 - FIBERGLASS CLOTH OR FIBERGLASS MESH TAPE
3 - WIDTH OF V-GROOVE
4 - WAXED PAPER

PANEL PATCH INSTALLATION

(1) Make a paper or cardboard pattern the size and shape of the cutout hole in the panel.

(2) Trim 3 mm (0.125 in.) from edges of pattern so patch will have a gap between connecting surfaces.

(3) Using the pattern as a guide, cut the patch to size.

(4) Cut scrap pieces of patch material into 50 mm (2 in.) squares to use as patch supports to sustain the patch in the cutout.

(5) Drill 4 mm (0.160 in.) holes 13 mm (0.5 in.) in from edge of cutout hole (Fig. 7).

(6) Drill 4 mm (0.160 in.) holes 13 mm (0.5 in.) away from edge of patch across from holes drilled around cutout.

(7) Drill 3 mm (0.125 in.) holes in the support squares 13 mm (0.5 in.) from the edge in the center of one side.

(8) Scuff the backside of the body panel around the cutout hole with a scuff pad or sandpaper.

(9) Mix enough adhesive to cover one side of all support squares.

(10) Apply adhesive to cover one side of all support squares.

(11) Using number 8 sheet metal screws, secure support squares to back side of body panel with adhesive sandwiched between the panel and squares (Fig. 9).

(12) Position patch in cutout against support squares and adjust patch until the gap is equal along all sides (Fig. 10).

BODY (Continued)

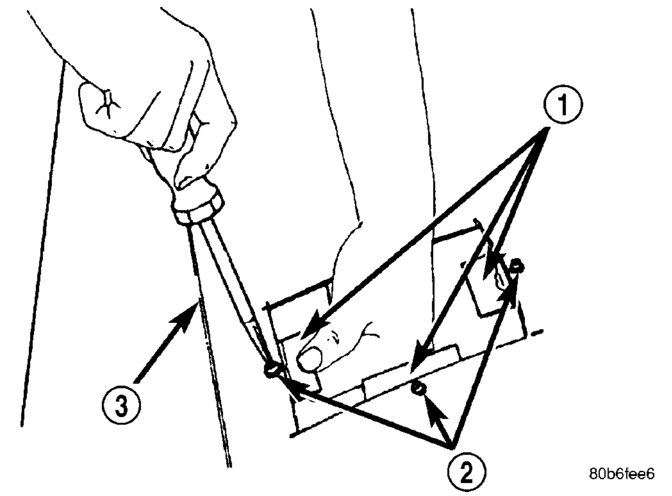


Fig. 9 SECURE SUPPORT SQUARES TO BODY PANEL

1 - SUPPORT SQUARES
2 - SCREWS
3 - DAMAGED BODY PANEL

(13) Drill 3 mm (0.125 in.) holes in the support squares through the pre-drilled holes in the patch.

(14) Apply a coat of adhesive to the exposed ends of the support squares (Fig. 11).

(15) Install screws to hold the patch to support squares (Fig. 12). Tighten screws until patch surface is flush with panel surface.

(16) Allow adhesive to cure, and remove all screws.

(17) Using a 125 mm (5 in.) 24 grit disc grinder, grind a 50 mm (2 in.) to 75 mm (3 in.) wide and 2 mm (0.080 in.) deep path across the gaps around the patch (Fig. 13). With compressed air, blow dust from around patch.

(18) Apply adhesive backed nylon mesh (dry wall tape) over gaps around patch (Fig. 14).

(19) Mix enough adhesive to cover the entire patch area.

(20) Apply adhesive over the mesh around patch, and smooth epoxy with a wide spreader to reduce finish grinding. Use two to three layers of mesh and adhesive to create a stronger repair (Fig. 15).

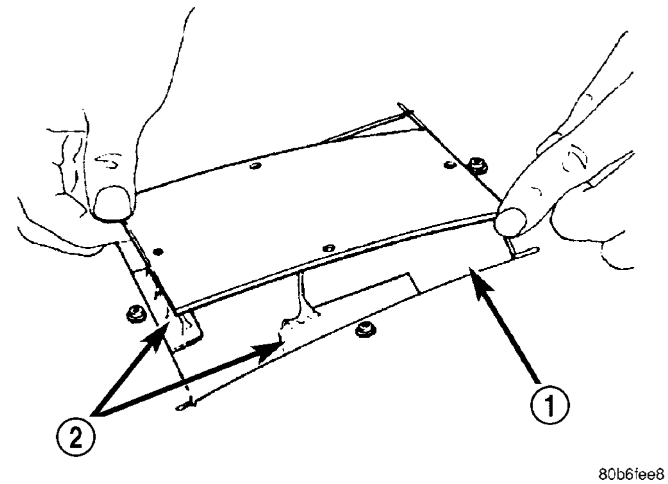


Fig. 10 POSITION PATCH IN CUTOUT AND ALIGN

1 - CUTOUT
2 - SUPPORT SQUARES

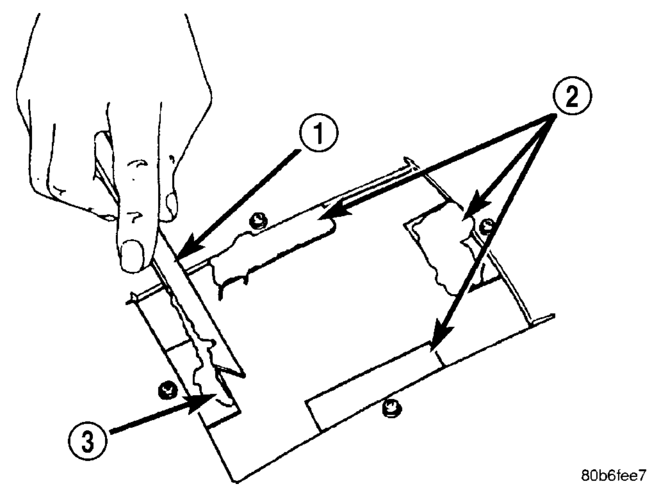


Fig. 11 APPLY ADHESIVE TO SUPPORT SQUARES

1 - APPLICATOR
2 - SUPPORT SQUARES
3 - ADHESIVE

BODY (Continued)

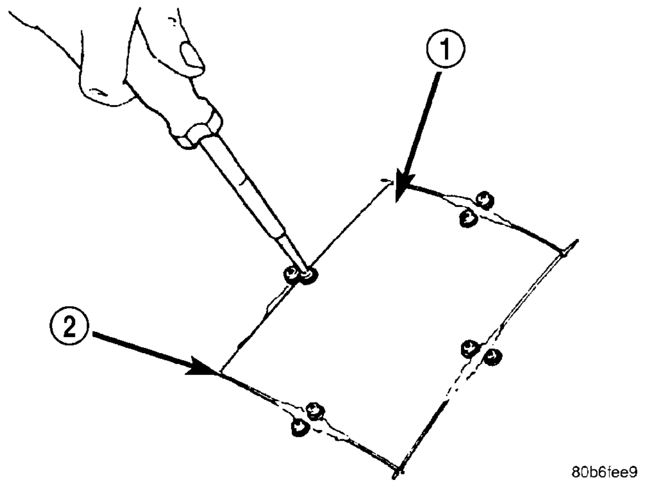


Fig. 12 INSTALL SCREWS

1 - PATCH
2 - GAP

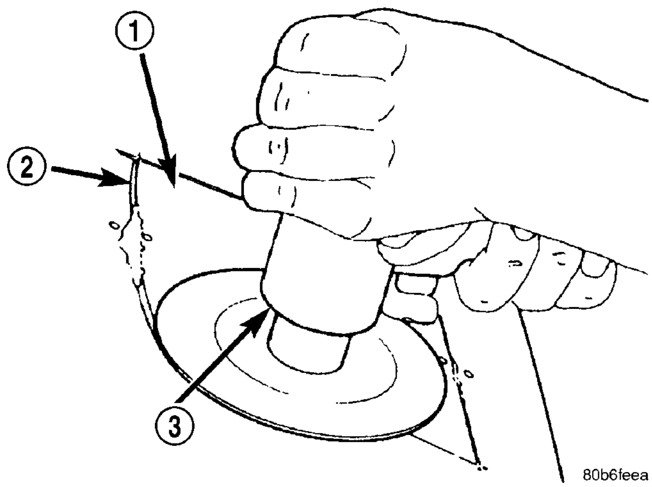


Fig. 13 GRIND SURFACE

1 - PATCH
2 - GAP
3 - DISC GRINDER

PATCHED PANEL SURFACING

After patch panel is installed, the patch area can be finished using the same methods as finishing other types of body panels. If mesh material is exposed in the patched area, grind surface down, and apply a coat of high quality rigid plastic body filler. Prime, block sand, and paint as required.

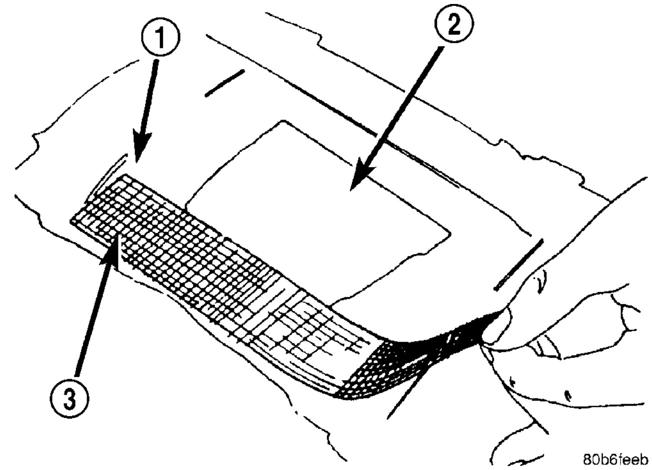


Fig. 14 COVER GAPS WITH MESH

1 - GROUND DOWN AREA
2 - PATCH
3 - MESH

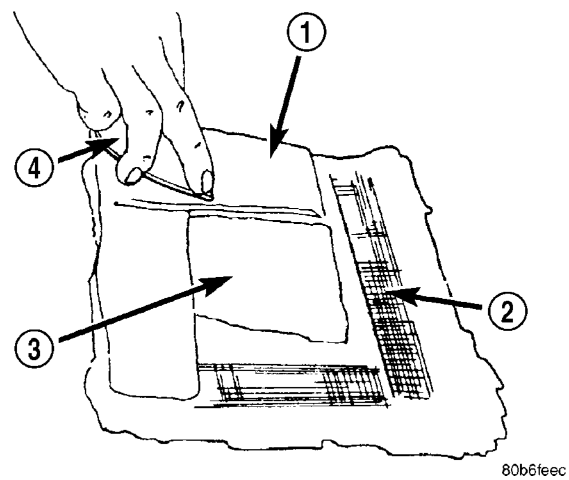


Fig. 15 COVER MESH WITH ADHESIVE

1 - ADHESIVE
2 - MESH
3 - PATCH
4 - SPREADER

BODY (Continued)

STANDARD PROCEDURE - BUZZ, SQUEAK & RATTLE

Buzz, Squeak & Rattles (BSR) may be caused by any one or more of the following and may be corrected as indicated:

- Loose fasteners should be tightened to specifications.
- Damaged or missing clips should be replaced.
- Damaged trim panels should be replaced.
- Incorrectly installed trim panels should be reinstalled properly.

Many BSR complaints such as loose trim, can be serviced using the Mopar® Parts BSR Noise Reduction Kit. This kit contains various tapes including foam, flock and anti-squeak used to eliminate noises caused by metal, plastic and vinyl components. Long life lubricants and greases can also be used on a variety of components. Refer to the Buzz, Squeak & Rattle Kit table for material contents and usage.

BUZZ, SQUEAK & RATTLE KIT

ITEM	FEATURES	APPLICATIONS	SERVICE TEMP
Itch And Squeak Tape	An abrasion resistant material thin enough to conform to most irregular surfaces. Stops most itches and squeaks.	Between metal and metal, metal and plastic, metal and vinyl, vinyl and plastic. Interior. Examples: Trim panels and bezels.	-40° to 225° Fahrenheit (-40° to 107° Celsius)
Black Nylon Flock	Nylon Flock with an aggressive acrylic adhesive. Provides for cushioning and compression fit, also isolates components. Water-resistant.	Between metal and metal, metal and plastic, vinyl and plastic. Examples: Pull cups, bezels, clips, ducts, top cover to glass, cowl panel.	-40° to 180° Fahrenheit (-40° to 82° Celsius)
High Density Urethane Foam	Tear resistant, highly resilient and durable.	Between metal and metal, metal and plastic. Water-resistant. Examples: I/P, heavy metal rattles, isolating brackets.	-40° to 180° Fahrenheit (-40° to 82° Celsius)
Open Cell Foam Tape	Soft foam conforms to irregular surfaces.	Wire harness and connector wrap. Examples: Seals, gasket, wiring, heat ducts.	-40° to 180° Fahrenheit (-40° to 82° Celsius)
Closed Cell Low Density Foam Tape	Soft, conformable. Water-resistant.	Wherever bulk is needed. Prevents closing flutters and rattles when applied to door watershield. Examples: Door, I/P.	-40° to 180° Fahrenheit (-40° to 82° Celsius)
NYE® Grease 880	Long life.	Suspensions. Examples: Strut busings, sway bars.	-40° to 390° Fahrenheit (-40° to 200° Celsius)
Krytox® Oil	Long life. Will not dry out or harm plastics or rubber.	When access is not possible, oil will migrate to condition. Vinyl, rubber, plastic, metal. Examples: Convertible top bushings, pull cups trim panel inserts.	-30° to 400° Fahrenheit (-34° to 205° Celsius)
Krytox® Grease	Long life. Will not dry out or harm plastics or rubber.	Vinyl, rubber, plastic, metal, glass. Examples: Weather-strips, backlite and windshield moldings.	-30° to 400° Fahrenheit (-34° to 205° Celsius)

BODY (Continued)

SPECIFICATIONS - TORQUE

TORQUE SPECIFICATIONS

Description	N·m	Ft. Lbs.	In. Lbs.
A-pillar trim/grab handle bolts	6	—	55
Body Isolator/cab bolts	81	60	—
Cargo box bolts	108	80	—
Cargo box tie down/cleat bolts	34	25	—
Center seat assembly nuts*	25	18	—
Center seat cushion/hinge bolts*	20	15	—
Center seat back hinge to storage bin bolts*	25	18	—
Center seat back free pivot hinge bolt*	25	18	—
Center seat back inertia hinge pivot bolt*	10	—	89
Center seat inertia hinge to seat back bolts*	25	18	—
Fender bolts - front lower	9	—	80
Fender bolts - lower inside	17	13	—
Fender to hinge support bolts	11	8	—
Fender to upper fender rail bolts	9	—	80
Footmans loop bolts	12	9	—
Front center seat nuts*	25	18	—
Front door glass lift plate nuts	10	—	89
Front door hinge to a-pillar nuts	28	21	—
Front door hinge to door nuts/bolts	28	21	—
Front door inside handle bolt	9	—	80
Front door latch adjustment screw	3	—	30
Front door latch assembly bolts	10	—	89
Front door latch striker bolts	28	21	—
Front door latch striker bolts	28	21	—
Front door regulator bolts	10	—	89
Front door regulator stabilizer nuts	10	—	89
Front door remote handle actuator nuts	10	—	89
Front door run channel screws	10	—	89
Front seat assembly front bolts*	28	30	—
Front seat assembly rear bolts*	40	30	—
Front seat track nuts*	25	18	—
Fuel fill door bolts	9	—	80
Hood hinge to fender rail bolts	20	15	—
Hood latch bolts	11	8	—
Hood latch striker/safety catch bolts	11	8	—
Hood hinge to hood nuts	23	17	—
Instrument panel center bracket bolts	12	9	—
Instrument panel column support bolts	14	10	—
Instrument panel side mounting bolts	12	9	—

BODY (Continued)

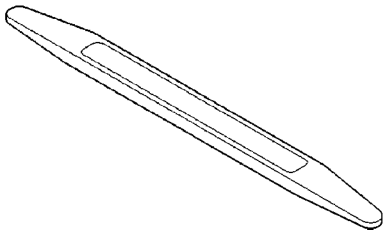
Description	N·m	Ft. Lbs.	In. Lbs.
Instrument panel top bolts	12	9	—
Load floor nuts	25	18	—
Load floor/rear seat bolts	40	30	—
Overhead/b-pillar grab handle bolts	6	—	55
Radiator and condenser to radiator crossmember bolts	8	—	75
Radiator upper crossmember bolts	28	21	—
Rear door glass lift plate nuts	10	—	89
Rear door glass run channels	10	—	89
Rear door hinge to b-pillar bolts	28	21	—
Rear door hinge to door bolts/nuts	28	21	—
Rear door inside handle bolt	9	—	80
Rear door latch adjustment screw	3	—	30
Rear door latch bolts	10	—	89
Rear door latch striker bolts	28	21	—
Rear door regulator bolts	10	—	89
Rear door regulator stabilizer nuts	10	—	89
Rear door remote handle actuator nuts	10	—	89
Rear fender bottom screws	7	—	60
Rear fender nuts	7	—	60
Rear fender support bracket bolts	11	8	—
Rear seat assembly bolts*	40	30	—
Rear seat back hinge bolts*	25	18	—
Rear seat cushion hinge bolts*	32	24	—
Rear shoulder belt anchor bolts	40	30	—
Rear view mirror set screw	1	—	15
Shifter knob nut	27	20	—
Side view mirror nuts	7	—	60
Tailgate check cable bolt	23	17	—
Tailgate hinge/pivot screws	34	25	—
Tailgate latch bolts	23	17	—
Tailgate latch striker	34	25	—
Tailgate release handle nuts	7	—	60

NOTE: *Seat fasteners should be discarded and replaced with new fasteners during assembly.

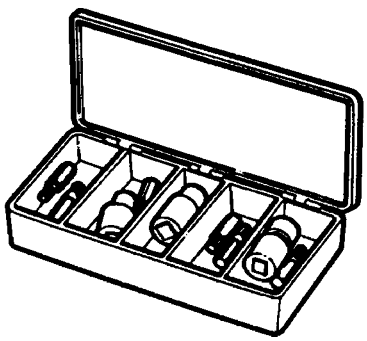
BODY (Continued)

SPECIAL TOOLS

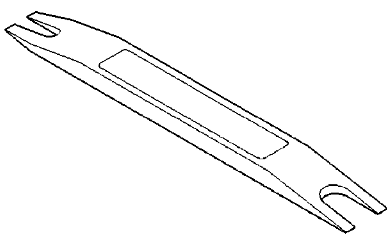
BODY



Trim Stick C-4755



Torx Bit Set C-4794-B



Molding Remover C-4829

TAILGATE

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CHECK CABLE

REMOVAL

(1) Open tailgate.
(2) Pry lock tab outward to clear stud head on cargo box (Fig. 1).
(3) Push cable end forward until stud head is in clearance hole portion of cable end.
(4) Separate cable end from stud.
(5) Remove screw attaching cable to tailgate. (Fig. 2)
(6) Separate check cable from tailgate.

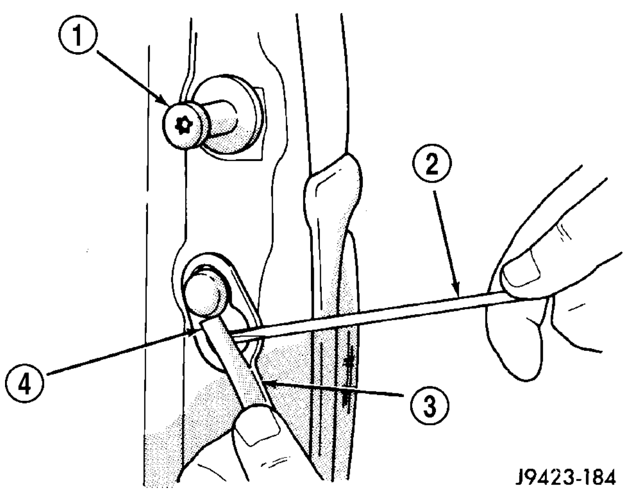

Fig. 1 Tailgate Check

1 - TAILGATE STRIKER
2 - SCREW DRIVER
3 - TAILGATE CHECK CABLE
4 - LOCK TAB

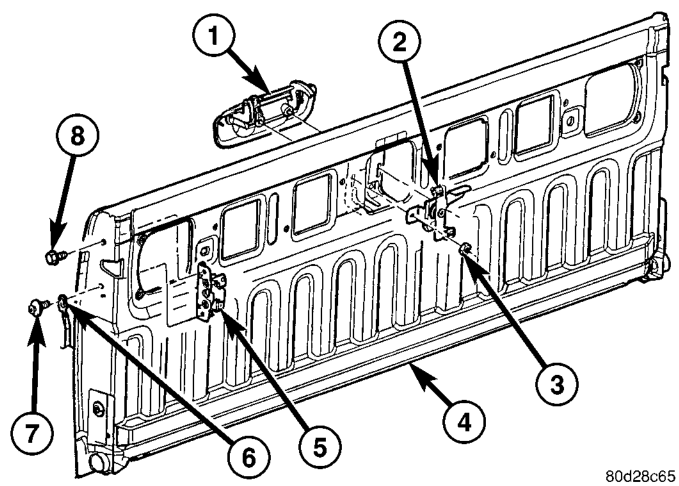

Fig. 2 LATCH HANDLE - LATCH

1 - EXTERIOR HANDLE
2 - CONTROL ASSEMBLY
3 - NUTS (2)
4 - TAILGATE
5 - LATCH
6 - CHECK CABLE
7 - CHECK/LATCH BOLT
8 - LATCH BOLT

INSTALLATION

(1) Position check cable on tailgate.
(2) Install bolt attaching small end of cable to tailgate.
(3) Tighten tailgate check cable bolt to 23 N·m (17 ft. lbs.).
(4) Position large end of cable onto stud head and slide downward to secure lock tab.

COVER

REMOVAL

(1) Open the tailgate.

(2) Remove the eight screws and remove tailgate liner, if equipped.

(3) Remove the bolts and remove the cover. (Fig. 3)

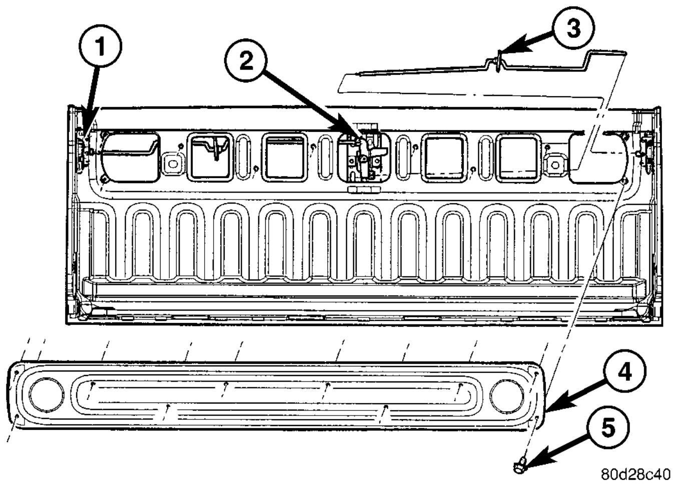

Fig. 3 TAILGATE ASSEMBLY

1 - LATCH ASSEMBLY
2 - CONTROL ASSEMBLY
3 - ACTUATOR ROD (2)
4 - COVER
5 - BOLTS (10)

INSTALLATION

(1) Install the cover and install the bolts and tighten by hand.

(2) Install the liner and install the screws, if equipped.

HINGE

REMOVAL

(1) Remove the tailgate. (Refer to 23 - BODY/TAILGATE/TAILGATE - REMOVAL)

(2) Remove the two screws and remove the hinge/pivot. (Fig. 4)

INSTALLATION

(1) Install the hinge/pivot and install the screws.

(2) Tighten the screws to 34 N·m (25 ft. lbs.).

(3) Install the tailgate. (Refer to 23 - BODY/TAILGATE/TAILGATE - INSTALLATION)

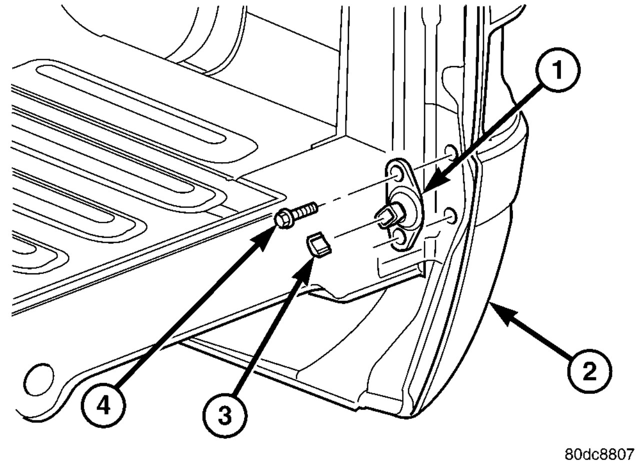

Fig. 4 TAILGATE HINGE

1 - HINGE/PIVOT
2 - TAILGATE PILLAR
3 - CLIP/BUSHING
4 - BOLTS (2)

LATCH

REMOVAL

(1) Remove the cover. (Refer to 23 - BODY/TAILGATE/COVER - REMOVAL)

(2) Using a grease pencil or equivalent, mark the actuator rod for installation.

(3) Disconnect the actuator rod at the control assembly. (Fig. 3)

(4) Remove the latch bolt and the check cable bolt. (Fig. 5)

(5) Remove the latch and actuator rod assembly.

INSTALLATION

(1) Install the latch and actuator rod assembly.

(2) Install the latch and the check cable bolts and tighten to 23 N·m (17 ft. lbs.).

(3) Connect the actuator rod to the control assembly line up the marks made during removal.

(4) Install the cover. (Refer to 23 - BODY/TAILGATE/COVER - INSTALLATION)

LATCH STRIKER

REMOVAL

(1) Open tailgate.

(2) Using a grease pencil or equivalent, mark outline of striker on cargo box jamb to aid installation.

(3) Using a Torx drive wrench, remove striker and washer from cargo box.

INSTALLATION

(1) Position striker and washer on jamb using alignment outline as reference and install with Torx drive wrench.

(2) Tighten the striker to 34 N·m (25 ft. lbs.).

RELEASE HANDLE/LATCH REMOTE

REMOVAL

(1) Remove the tailgate cover. (Refer to 23 - BODY/TAILGATE/COVER - REMOVAL)

(2) Using a grease pencil or equivalent, mark the latch actuator rods for ease of installation.

(3) Disconnect the latch actuator rods. (Fig. 3)

(4) Remove the control assembly nuts and remove the control assembly and the exterior handle. (Fig. 5)

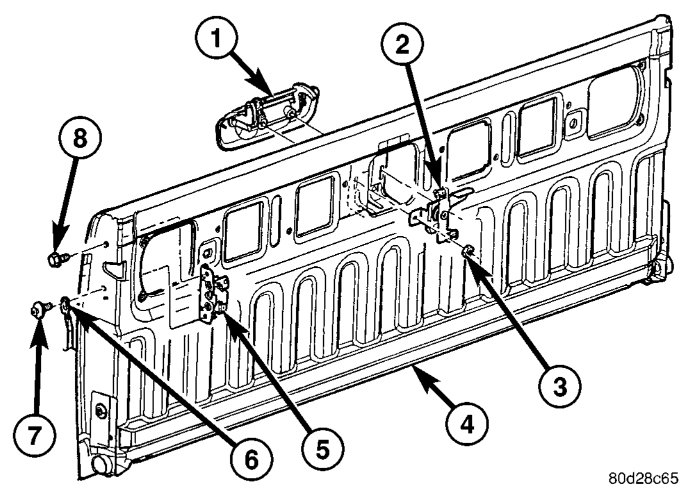

Fig. 5 LATCH HANDLE - LATCH

1 - EXTERIOR HANDLE
2 - CONTROL ASSEMBLY
3 - NUTS (2)
4 - TAILGATE
5 - LATCH
6 - CHECK CABLE
7 - CHECK/LATCH BOLT
8 - LATCH BOLT

INSTALLATION

(1) Install the handle and the control assembly.

(2) Install the nuts and tighten to 7 N·m (60 in. lbs.).

(3) Connect the actuator rods using the marks made during removal.

(4) Install the cover. (Refer to 23 - BODY/TAILGATE/COVER - INSTALLATION)

TAILGATE

REMOVAL

(1) Open the tailgate.

(2) Disconnect the tailgate check cables (Fig. 6). (Refer to 23 - BODY/TAILGATE/CHECK CABLE - REMOVAL)

(3) Close tailgate until the notch in the right hand collar aligns with the pivot pin.

(4) Slip tailgate hinge collar from pivot pins.

(5) Slide tailgate to the right and separate left hand collar from the pivot pin.

(6) Separate tailgate from vehicle.

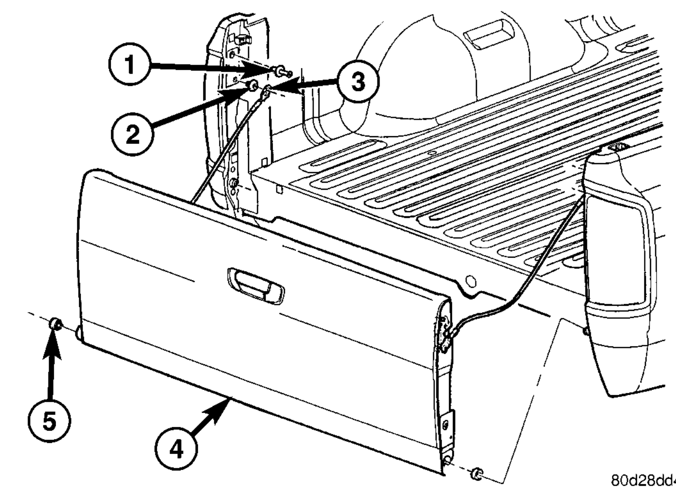

Fig. 6 TAILGATE ASSEMBLY

1 - LATCH STRIKER
2 - CHECK CABLE BOLT
3 - CHECK CABLE
4 - TAILGATE
5 - HINGE BUSHING

INSTALLATION

(1) Position tailgate collar on left hand pivot pin and slide tailgate to the left.

(2) Raise tailgate until the notch in the right hand collar aligns with the pivot pin.

(3) Connect the tailgate check cables. (Refer to 23 - BODY/TAILGATE/CHECK CABLE - INSTALLATION)

DOOR - FRONT

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DOOR

REMOVAL

(1) Disconnect the door wire harness electrical connector at the A-pillar. (Fig. 1)

(2) Using a grease pencil or equivalent, mark the outline of the door hinges on the door to aid in installation.

(3) Support the door with a suitable lifting device.

NOTE: The epoxy bonded washers should not be seperated from the hinge. If the washers are removed the door may have to be re-adjusted.

(4) Remove the nuts and bolts attaching the door hinges to the door.

INSTALLATION

(1) Support the door with a suitable lifting device and install the door onto the hinges.

(2) Install the washers, if there were removed previously, nuts and tighten to 28 N·m (21 ft. lbs.).

(3) Connect the electrical connectors.

(4) Adjust the door as necessary. (Refer to 23 - BODY/DOOR - FRONT/DOOR - ADJUSTMENTS)

DOOR (Continued)

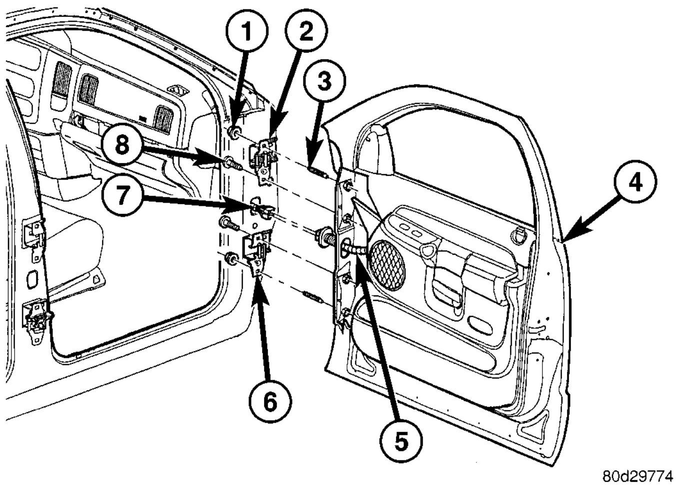

Fig. 1 FRONT DOOR

1 - NUTS (2)
2 - UPPER HINGE
3 - STUDS
4 - FRONT DOOR
5 - WIRE HARNESS
6 - LOWER HINGE
7 - ELECTRICAL CONNECTORS (2)
8 - BOLTS (2)

ADJUSTMENTS

ADJUSTMENT

NOTE: For vehicles with four doors, it is recommended that you adjust the rear door before adjusting the front door. (Refer to 23 - BODY/DOORS - REAR/DOOR - ADJUSTMENTS)

- **Door adjustment measurements should be taken from stationary or welded body panels like the roof, rocker or quarter panels.**
- **During adjustment procedures, it is recommended that all the hinge fasteners be loosened except for the upper most fasteners. Adjustments can be made using the upper bolts to hold the door with final torque of the fasteners occurring after correct door positioning is achieved.**
- **A suitable body sealant should be used when removing or moving the hinges.**

FORE/AFT

NOTE: Fore/aft (lateral) door adjustment is done by loosening the hinge to the hinge pillar fasteners one hinge at a time and moving the door to the correct position.

(1) Support the door with a suitable lifting device.
(2) Loosen the hinge to hinge pillar fasteners. (Refer to 23 - BODY/DOOR - FRONT/HINGE - REMOVAL)
(3) Adjust the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(4) Tighten the hinge pillar fasteners to 28 N·m (21 ft. lbs.).

UP/DOWN

NOTE: Up/down door adjustment is done by loosening either the hinge to the hinge pillar fasteners or the hinge to door fasteners and moving the door to the correct position.

NOTE: When adjustment of the door requires the loosening of the door to hinge fasteners, it will be necessary to separate the epoxy bonded washers with a chisel or other suitable tool.

NOTE: When the up/down adjustments are done correctly, the top of the door is positioned over flush to the roof. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

(1) Support the door with a suitable lifting device.
(2) Loosen the latch striker bolts. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - REMOVAL)
(3) Loosen the hinge to door fasteners (Refer to 23 - BODY/DOOR - FRONT/DOOR - REMOVAL) or loosen the hinge to hinge pillar fasteners (Refer to 23 - BODY/DOOR - FRONT/HINGE - REMOVAL).
(4) Adjust the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(5) Tighten the hinge pillar fasteners or the door to hinges fasteners to 28 N·m (21 ft. lbs.).
(6) Tighten the latch striker bolts. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - INSTALLATION)

IN/OUT

NOTE: In/out door adjustment is done by loosening the hinge to door fasteners one hinge at a time and moving the door to the correct position.

NOTE: When adjustment of the door requires the loosening of the door to hinge fasteners, it will be necessary to separate the epoxy bonded washers with a chisel or other suitable tool.

(1) Support the door with a suitable lifting device.
(2) Loosen the latch striker bolts. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - REMOVAL)

DOOR (Continued)

(3) Loosen the hinge to door fasteners. (Refer to 23 - BODY/DOOR - FRONT/DOOR - REMOVAL)

(4) Adjust the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

(5) Tighten the door to hinges fasteners to 28 N·m (21 ft. lbs.).

(6) Tighten the latch striker bolts. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - INSTALLATION)

DOOR GLASS

REMOVAL

(1) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)

(2) Reinstall the window handle, if equipped.

(3) Remove the window switch from the door trim panel and reconnect it to the door wire harness, if equipped.

(4) Raise the window to the position shown and remove the two nuts attaching the glass to the window regulator. (Fig. 2)

(5) Remove the two front run channel screws. (Refer to 23 - BODY/DOOR - FRONT/GLASS RUN CHANNEL - REMOVAL)

(6) Remove the inner belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR INNER BELT WEATHERSTRIP - REMOVAL)

(7) Disengage the glass from the regulator and lower into the door.

(8) Twist the glass forward in the door window opening and remove.

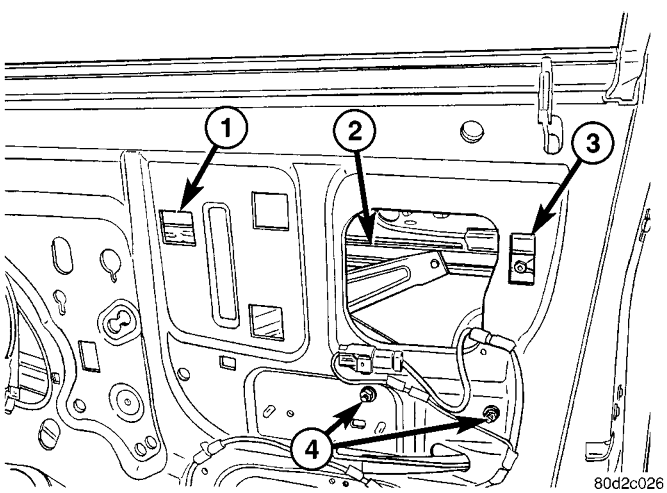

Fig. 2 DOOR GLASS POSITIONING

1 - SIGHT WINDOW
2 - WIDOW REGULATOR
3 - SIGHT WINDOW
4 - REGULATOR STABILIZER

INSTALLATION

(1) Position the glass into the window opening.

(2) Engage the glass into the glass run weatherstrip.

(3) Raise the glass within the door opening and connect the window regulator to the lift plate.

(4) Install the nuts and tighten to 10 N·m (89 in. lbs.).

(5) Install the inner belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR INNER BELT WEATHERSTRIP - INSTALLATION)

(6) Position the front run channel and install the screws. (Refer to 23 - BODY/DOOR - FRONT/GLASS RUN CHANNEL - INSTALLATION)

(7) Remove the window switch from the wire harness, if equipped.

(8) Remove the window handle, if equipped.

(9) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)

EXTERIOR HANDLE

REMOVAL

(1) Remove the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - REMOVAL)

(2) Disconnect the lock switch electrical connector, if equipped. (Fig. 3)

(3) Disconnect the actuator rods at the handle.

(4) Remove the nuts and remove the handle.

INSTALLATION

(1) Install the exterior handle and install the nuts.

(2) Connect the actuator rods at the handle

(3) Connect the lock switch electrical connector, if equipped.

(4) Install the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - INSTALLATION)

EXTERIOR HANDLE (Continued)

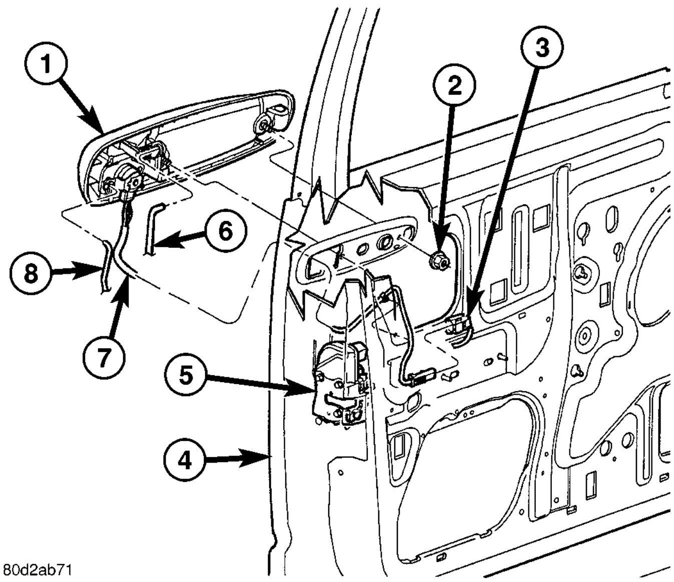

Fig. 3 EXTERIOR HANDLE

1 - EXTERIOR HANDLE
2 - NUTS (2)
3 - ELECTRICAL CONNECTOR
4 - FRONT DOOR
5 - DOOR LATCH ASSEMBLY
6 - LATCH ACTUATOR ROD
7 - LOCK SWITCH WIRE HARNESS
8 - KEY CYLINDER ACTUATOR ROD

GLASS RUN CHANNEL

REMOVAL

(1) Raise glass into the full up position.

(2) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)

FRONT RUN CHANNEL

(1) Remove the window regulator. (Refer to 23 - BODY/DOOR - FRONT/WINDOW REGULATOR - REMOVAL)

(2) Loosen the front run channel screws, slide up and disengage from the door. (Fig. 4)

(3) Separate the glass run weatherstrip from the channel and remove the front channel.

REAR RUN CHANNEL

(1) On standard cab models, remove the screws from the side of the door. (Fig. 5)

(2) On quad cab models, remove the lower screw from the side of the door, loosen the upper screw and disengage from the door. (Fig. 6)

(3) Separate the glass run weatherstrip from the rear channel and remove the channel.

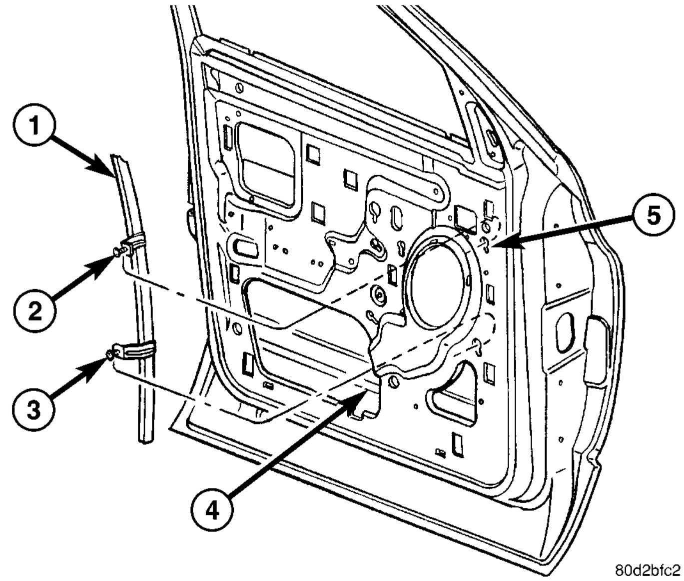

Fig. 4 FRONT RUN CHANNEL

1 - FRONT GLASS RUN CHANNEL
2 - UPPER SCREW
3 - LOWER SCREW
4 - DOOR PANEL OPENING
5 - RUN CHANNEL MOUNTING SLOTS (2)

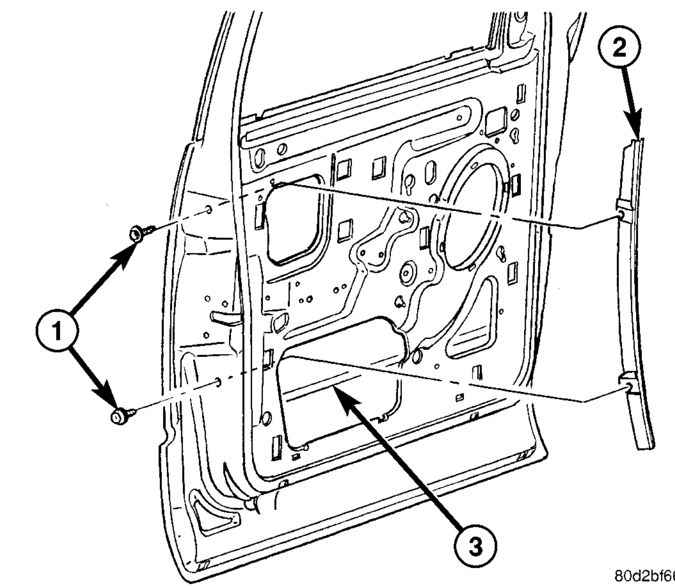

Fig. 5 REAR RUN CHANNEL - QUAD CAB

1 - SCREWS
2 - REAR GLASS RUN CHANNEL
3 - DOOR PANEL OPENING

INSTALLATION

FRONT RUN CHANNEL

(1) Install the channel, position the screws in the door panel slots and slide into place.

(2) Tighten the screws to 10 N·m (89 in. lbs.).

GLASS RUN CHANNEL (Continued)

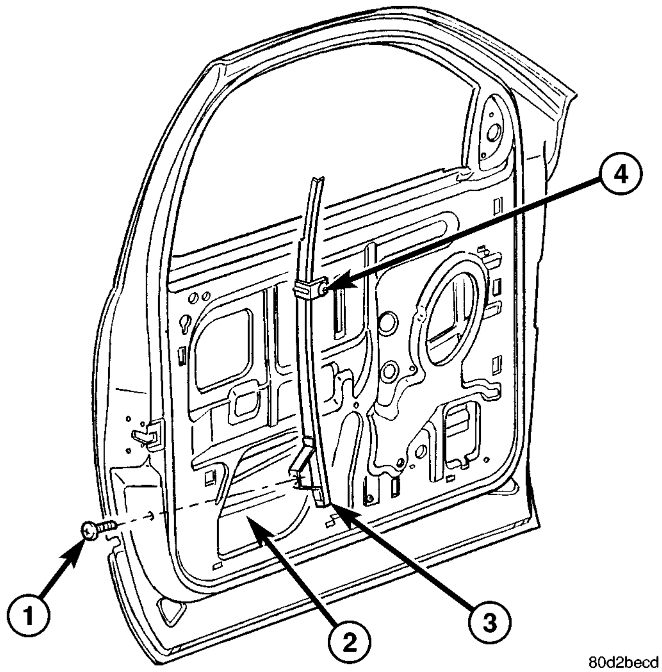

Fig. 6 REAR RUN CHANNEL - STANDARD CAB

1 - LOWER SCREW
2 - DOOR PANEL OPENING
3 - REAR GLASS RUN CHANNEL
4 - UPPER SCREW

(3) Install the window regulator. (Refer to 23 - BODY/DOOR - FRONT/WINDOW REGULATOR - INSTALLATION)

REAR RUN CHANNEL

(1) On quad cab models, install the channel and slide the upper screw into the slot.

(2) Install the lower screw and tighten both upper and lower screws to 10 N·m (89 in. lbs.).

(3) On standard cab models, install the channel and install the screws.

(4) Tighten the screws to 10 N·m (89 in. lbs.).

BOTH CHANNELS

(1) Stuff the glass run weatherstrip into the channels.

(2) Verify correct window operation.

(3) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - INSTALLATION)

HINGE

REMOVAL

(1) Remove the door. (Refer to 23 - BODY/DOOR - FRONT/DOOR - REMOVAL)

(2) Using a grease pencil or equivalent, mark the hinge location and remove the bolts.

INSTALLATION

(1) Install the hinges and bolts.

(2) Tighten bolts to 28 N·m (21 ft. lbs.).

(3) Install the door. (Refer to 23 - BODY/DOOR - FRONT/DOOR - INSTALLATION)

INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the screw and remove the inside handle. (Fig. 7)

(2) Remove the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)

(3) Disconnect the latch actuator rod. (Fig. 8)

(4) Remove the nuts and remove the remote handle actuator.

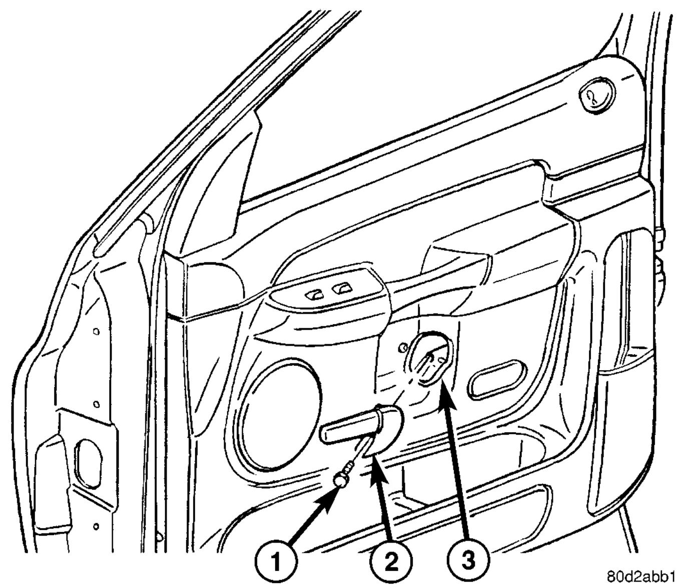

Fig. 7 INSIDE HANDLE ACTUATOR

1 - BOLT
2 - HANDLE
3 - TRIM PANEL OPENING

INSTALLATION

(1) Install the remote handle actuator and install the nuts.

(2) Tighten the nuts to 10 N·m (89 in. lbs.).

(3) Connect the latch actuator rod.

(4) Install the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)

(5) Install the inside handle and install the bolt.

(6) Tighten the bolt to 9 N·m (80 in. lbs.).

INSIDE HANDLE ACTUATOR (Continued)

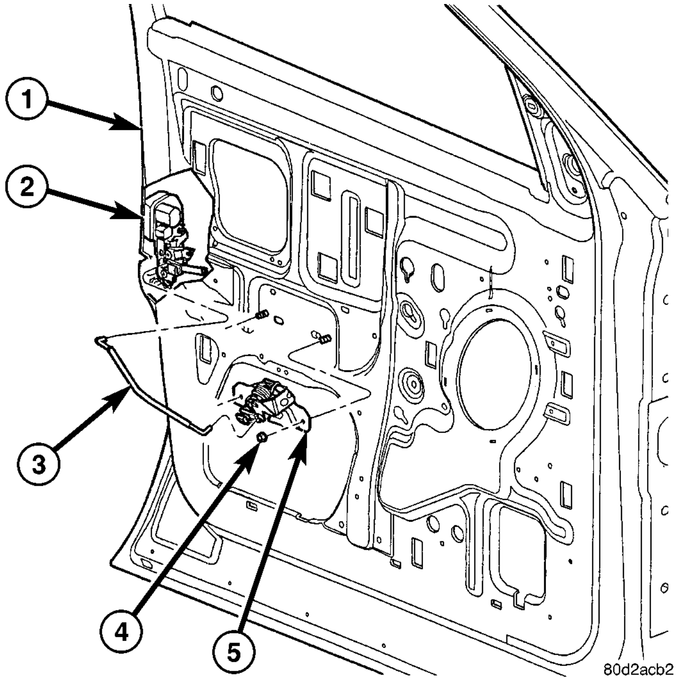

Fig. 8 REMOTE HANDLE ACTUATOR

1 - DOOR
2 - LATCH ASSEMBLY
3 - LATCH ACTUATOR ROD
4 - NUTS (2)
5 - HANDLE REMOTE

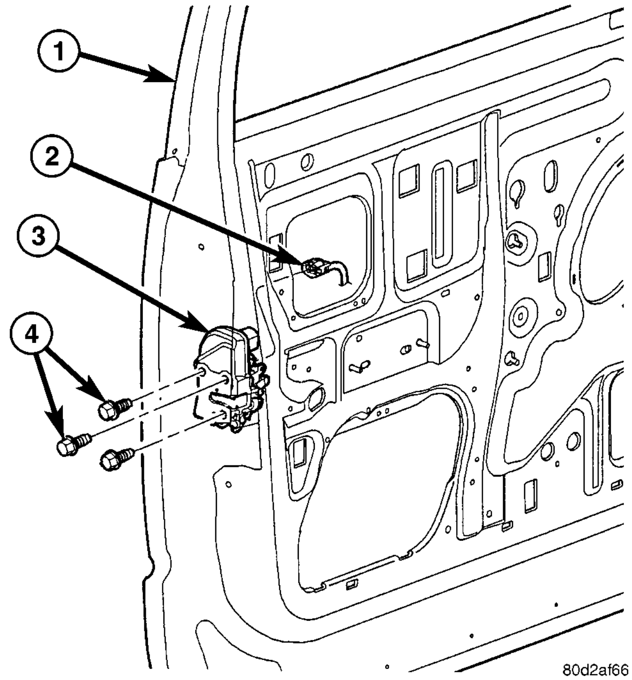

Fig. 9 LATCH ASSEMBLY

1 - DOOR
2 - ELECTRICAL CONNECTOR
3 - LATCH ASSEMBLY
4 - BOLTS

LATCH

REMOVAL

(1) Raise the window to the full up position.
(2) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)
(3) Disconnect the actuator rods.
(4) Remove the bolts. (Fig. 9)
(5) Disconnect the electrical connector and remove the latch.

INSTALLATION

(1) Connect the electrical connector and install the latch assembly.
(2) Install the bolts and tighten to 10 N·m (89 in. lbs.).
(3) Connect the actuator rods.
(4) Adjust the latch as needed. (Refer to 23 - BODY/DOOR - FRONT/LATCH - ADJUSTMENTS)
(5) Install the waterdam. (Refer to 23 - BODY/DOOR - FRONT/LATCH - INSTALLATION)

ADJUSTMENTS

ADJUSTMENT

(1) Locate access hole and remove the mylar tape covering it. (Fig. 10)
(2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw. Loosen screw.
(3) Operate outside handle several times to release any restriction because of mis-alignment.
(4) Tighten adjustment screw to 3 N·m (30 in. lbs.).
(5) Test handle for proper operation.

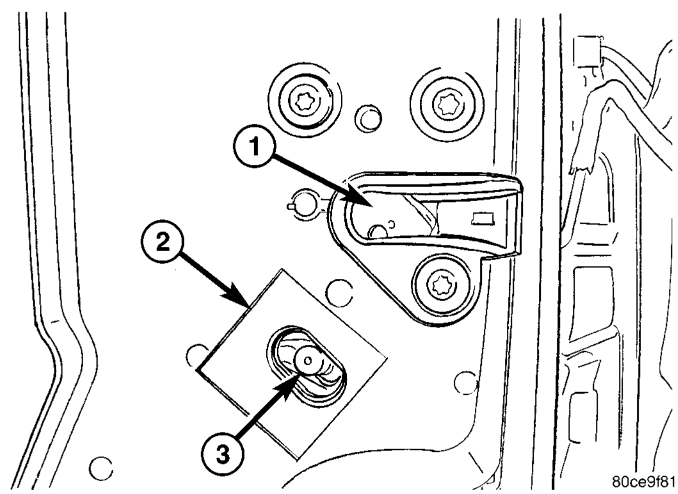

Fig. 10 LATCH ADJUSTMENT SCREW - TYPICAL

1 - DOOR LATCH
2 - MYLAR TAPE
3 - ADJUSTMENT SCREW

LATCH STRIKER

REMOVAL

(1) Using a grease pencil or equivalent, mark the position of the striker.
(2) Remove the bolts and remove the striker.

INSTALLATION

(1) Install the striker and install the bolts.
(2) Tighten the bolts to 28 N·m (21 ft. lbs.).
(3) Adjust the striker if needed. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - ADJUSTMENTS)

ADJUSTMENTS

ADJUSTMENT

(1) Using a grease pencil or equivalent, mark the position of the striker to aid in adjustment.
(2) Loosen the striker bolts.
(3) Change the striker position to adjust the rear gap and flush measurement. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(4) Tighten the bolts to 28 N·m (21 ft. lbs.).

LOCK CYLINDER

REMOVAL

(1) Remove the exterior handle. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - REMOVAL)
(2) Remove the clip and remove the lock cylinder lever and switch, if equipped.
(3) Remove the screw and remove the lock cylinder. (Fig. 11)

INSTALLATION

(1) Install the lock cylinder and install the screw.
(2) Install the lock cylinder switch, if equipped, lever and retaining clip.
(3) Install the exterior handle. (Refer to 23 - BODY/DOOR - FRONT/EXTERIOR HANDLE - INSTALLATION)

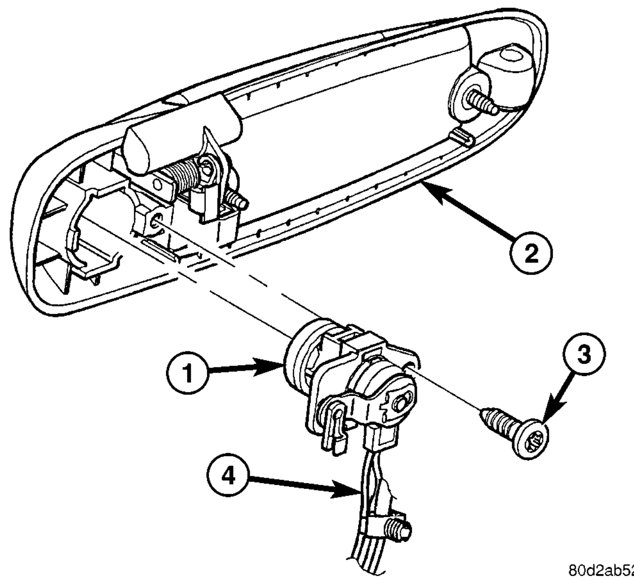

Fig. 11 LOCK CYLINDER

1 - LOCK CYLINDER
2 - EXTERIOR HANDLE
3 - SCREW
4 - LOCK SWITCH WIRE HARNESS

TRIM PANEL

REMOVAL

(1) Remove the window crank, if equipped. (Fig. 13)
(2) Remove the interior handle. (Refer to 23 - BODY/DOOR - FRONT/INSIDE HANDLE ACTUATOR - REMOVAL)
(3) Remove the screws at the mirror flag and near the inside handle. (Fig. 12)

CAUTION: Trim panel is attached to the door using hooks molded into the panel. Do not pull the trim panel straight off or damage to the panel and/or power switch assembly may occur.

(4) Lift the trim panel up off the belt seal and attachment hooks and separate the panel from the door slightly.
(5) Disconnect the power window switch electrical connector, if equipped, and remove the trim panel.

INSTALLATION

(1) Install the window switch into the trim panel, if equipped.
(2) Position the trim panel onto the lower hooks and connect the power window switch electrical connector, if equipped.
(3) Position the remaining trim panel attachment hooks into the door panel and seat the trim panel into the belt seal fully.

TRIM PANEL (Continued)

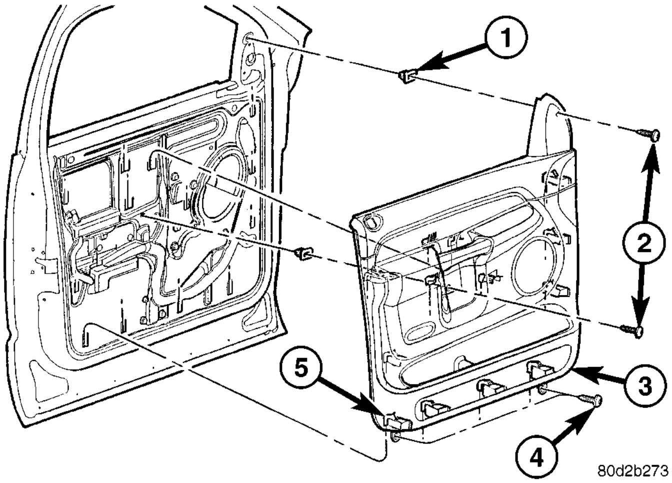

Fig. 12 TRIM PANEL ASSEMBLY

1 - SCREW INSERT (2)
2 - SCREWS (2)
3 - DOOR TRIM PANEL
4 - LOWER SCREWS (3)
5 - ATTACHMENT HOOKS

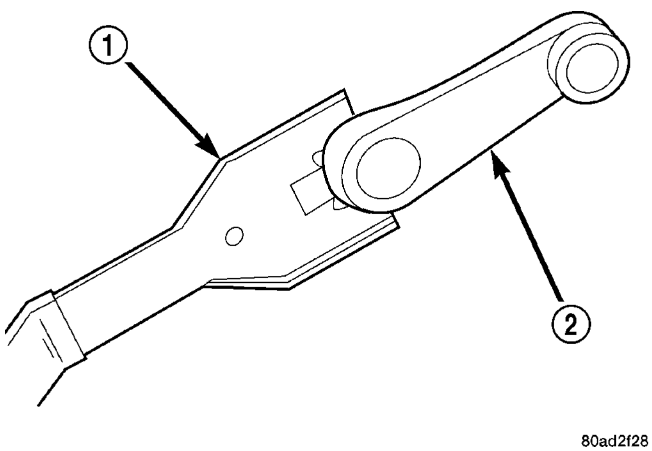

Fig. 13 WINDOW CRANK REMOVAL TOOL

1 - WINDOW CRANK REMOVAL TOOL
2 - WINDOW CRANK

(4) Install the screws near the inside handle and at the mirror flag.

(5) Install the interior handle. (Refer to 23 - BODY/DOOR - FRONT/INSIDE HANDLE ACTUATOR - INSTALLATION)

(6) Install the window crank, if equipped.

WATERDAM

REMOVAL

CAUTION: Do not allow the waterdam or adhesive to become contaminated with dirt or other foreign substances.
Do not damage the waterdam during removal and installation.
If the waterdam becomes contaminated or damaged, replace the waterdam.

(1) Remove the inside handle actuator. (Refer to 23 - BODY/DOOR - FRONT/INSIDE HANDLE ACTUATOR - REMOVAL)

(2) Remove the speaker. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - REMOVAL)

(3) Separate the waterdam from the inner door panel and off of the latch linkages.

INSTALLATION

CAUTION: Do not allow the waterdam or adhesive to become contaminated with dirt or other foreign substances.
Do not damage the waterdam during removal and installation.
If the waterdam becomes contaminated or damaged, replace the waterdam.

(1) Position the wire harness and actuator rods through the holes in the waterdam.

(2) Secure the waterdam to the inner door panel.

(3) Install the speaker. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - INSTALLATION)

(4) Install the inside handle actuator. (Refer to 23 - BODY/DOOR - FRONT/INSIDE HANDLE ACTUATOR - INSTALLATION)

WINDOW REGULATOR - POWER

REMOVAL

(1) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)

(2) Remove the window switch from the door trim panel and reconnect it to the door harness.

(3) Raise the window to the position shown and remove the nuts. (Fig. 14)

(4) Disengage the door glass from the regulator lift plate and position into the full up position.

(5) Secure the glass in the up position using a wood wedge or equivalent.

(6) Lower the regulator.

(7) Remove the stabilizer nuts.

(8) Remove the forward regulator bolt and loosen the other two. (Fig. 15)

(9) Slide the regulator up and out of the keyhole slots in the door panel.

(10) Disconnect the electrical connector and remove the regulator.

INSTALLATION

(1) Install the regulator through the door panel opening and connect the electrical connector.

WINDOW REGULATOR - POWER (Continued)

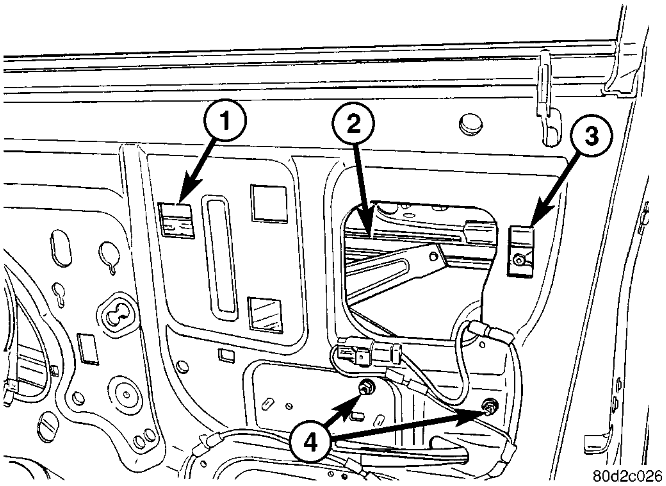

Fig. 14 DOOR GLASS POSITIONING

1 - SIGHT WINDOW
2 - WIDOW REGULATOR
3 - SIGHT WINDOW
4 - REGULATOR STABILIZER

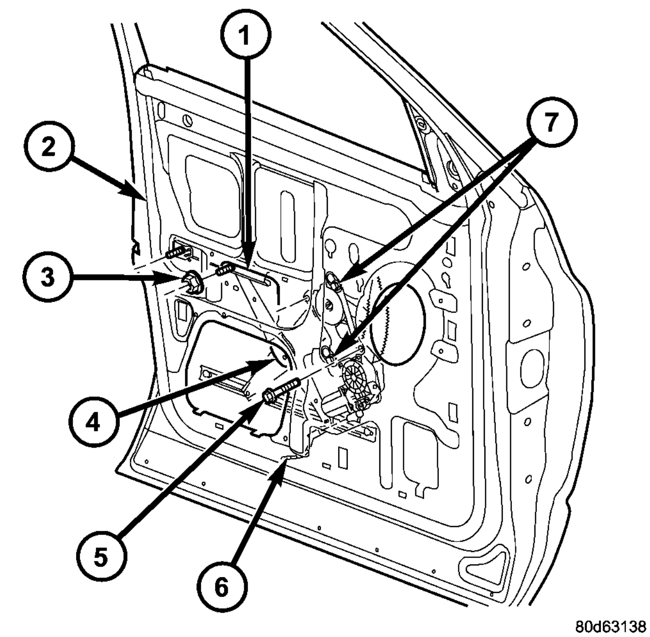

Fig. 15 WINDOW REGULATOR - POWER

1 - REGULATOR STABILIZER
2 - INNER DOOR PANEL
3 - STABILIZER NUTS (2)
4 - REGULATOR
5 - FORWARD BOLT
6 - WIRE HARNESS
7 - BOLTS (2)

(2) Position the regulator bolts into the keyhole slots and slide into place.

(3) Install the forward bolt and tighten all three to 10 N·m (89 in. lbs.).

(4) Position the stabilizer, install the nuts and tighten to 10 N·m (89 in. lbs.).

(5) Raise the regulator to the position shown in (Fig. 14).

(6) Remove the glass support and connect to the regulator lift plate.

(7) Install the glass nuts and tighten to 10 N·m (89 in. lbs.).

(8) Disconnect the window switch and install into the door trim panel.

(9) Install the waterdam. (Refer to 23 - BODY/ DOOR - FRONT/WATERDAM - INSTALLATION)

WINDOW REGULATOR - MANUAL

REMOVAL

(1) Remove the waterdam. (Refer to 23 - BODY/ DOOR - FRONT/WATERDAM - REMOVAL)

(2) Reinstall the window handle and raise the window to the position shown and remove the nuts. (Fig. 14)

(3) Disengage the door glass from the regulator lift plate and position into the full up position.

(4) Secure the glass in the up position using a wood wedge or equivalent.

(5) Lower the regulator.

(6) Remove the stabilizer nuts.

(7) Remove the two lower and loosen the two upper bolts. (Fig. 16)

(8) Slide the regulator up and out of the keyhole slot.

(9) Remove the regulator from the door panel opening.

INSTALLATION

(1) Install the regulator through the hole in the inner door panel.

(2) Position the regulator and slide the upper bolts into the keyhole slots.

(3) Install the lower two bolts.

(4) Tighten the regulator bolts to 10 N·m (89 in. lbs.).

(5) Position the stabilizer, install the nuts and tighten to 10 N·m (89 in. lbs.).

(6) Using the window handle raise the regulator to the position shown in (Fig. 14).

(7) Remove the glass support and connect to the regulator lift plate.

(8) Install the glass nuts and tighten to 10 N·m (89 in. lbs.).

(9) Remove the window handle and install the waterdam.

WINDOW REGULATOR - MANUAL (Continued)

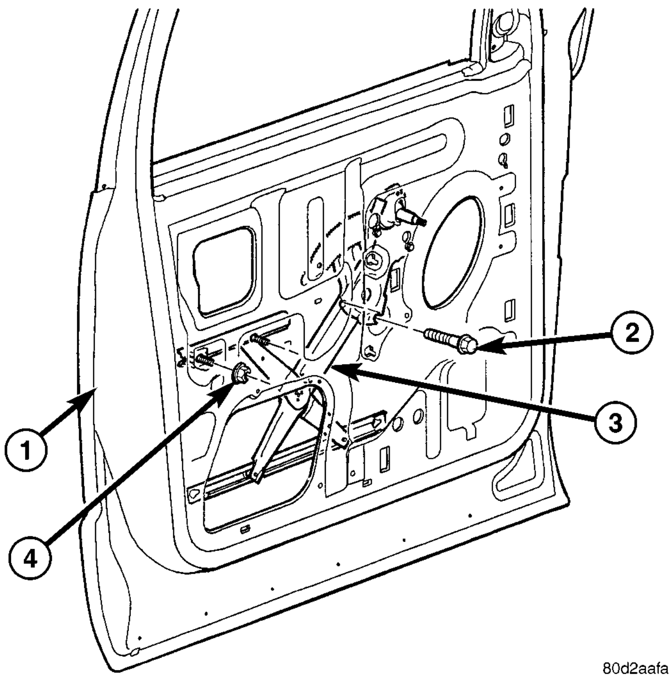

Fig. 16 WINDOW REGULATOR - MANUAL

1 - DOOR
2 - REGULATOR BOLTS (4)
3 - REGULATOR
4 - STABILIZER NUTS (2)

SIDE VIEW MIRROR FLAG

REMOVAL

(1) Remove the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)

CAUTION: Do not use a drill to remove the heat stakes.

(2) Remove the heat stakes using a razor knife or equivalent.
(3) Release the tabs and remove the mirror flag.

INSTALLATION

NOTE: Clean the excess heat staking off of the studs to aid installation.

(1) Install the new mirror flag over the tabs and install the screws into the heat stake studs.
(2) Install the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)

DOORS - REAR

TABLE OF CONTENTS

DOOR

REMOVAL

(1) Disconnect the door wire harness electrical connector at the b-pillar. (Fig. 1)

(2) Using a grease pencil or equivalent, mark the outline of the door hinges on the door to aid in installation.

(3) Support the door with a suitable lifting device.

NOTE: The epoxy bonded washers should not be seperated from the hinge. If the washers are removed the door may have to be re-adjusted.

(4) Remove the nuts and bolts attaching the door hinges to the door.

INSTALLATION

(1) Support the door with a suitable lifting device and install the door onto the hinges.

(2) Install the bolts, nuts and washers, if there were removed previously, and tighten to 28 N·m (21 ft. lbs.).

(3) Connect the electrical connector.

(4) Adjust the door as necessary. (Refer to 23 - BODY/DOORS - REAR/DOOR - ADJUSTMENTS)

ADJUSTMENTS

ADJUSTMENT

NOTE: For vehicles equipped with four doors, it is recommended that you adjust the rear door before adjusting the front door.

- **Door adjustment measurements should be taken from stationary or welded body panels like the roof, rocker or quarter panels.**
- **During adjustment procedures, it is recommended that all the hinge fasteners be loosened except for the upper most fasteners. Adjustments can be made using the upper fasteners to hold the door with final torque of the fasteners occurring after correct door positioning is achieved.**

DOOR (Continued)

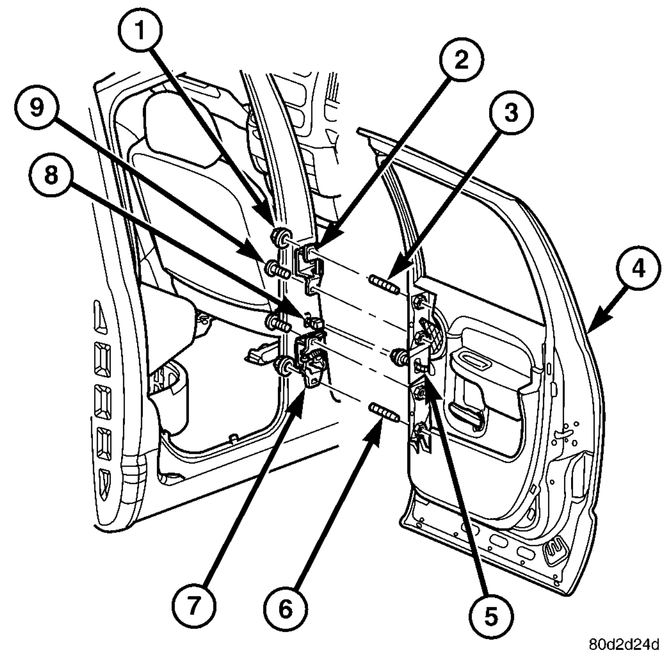

Fig. 1 DOOR ASSEMBLY

1 - NUTS (2)
2 - UPPER HINGE
3 - UPPER STUD
4 - REAR DOOR
5 - WIRE HARNESS
6 - LOWER STUD
7 - LOWER HINGE
8 - ELECTRICAL CONNECTOR
9 - BOLTS (2)

FORE/AFT

NOTE: Fore/aft (lateral) door adjustment is done by loosening the hinge to the hinge pillar fasteners one hinge at a time and moving the door to the correct position.

(1) Support the door with a suitable lifting device.
(2) Loosen the hinge to hinge pillar fasteners. (Refer to 23 - BODY/DOORS - REAR/HINGE - REMOVAL)
(3) Adjust the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(4) Tighten to hinge pillar fasteners to 28 N·m (21 ft. lbs.). (Refer to 23 - BODY/DOORS - REAR/HINGE - INSTALLATION)

NOTE: Use a suitable body sealer on the hinge to body mating surfaces.

UP/DOWN

NOTE: Up/down door adjustment is done by loosening either the hinge to the hinge pillar fasteners or the hinge to door fasteners and moving the door to the correct position.

NOTE: When adjustment of the door requires the loosening of the door to hinge fasteners, it will be necessary to separate the epoxy bonded washers with a chisel or other suitable tool.

NOTE: When the up/down adjustments are done correctly, the top of the door is positioned over flush to the roof. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

(1) Support the door with a suitable lifting device.
(2) Remove the latch striker. (Refer to 23 - BODY/DOORS - REAR/LATCH STRIKER - REMOVAL)
(3) Loosen the hinge to hinge pillar fasteners (Refer to 23 - BODY/DOORS - REAR/HINGE - REMOVAL) or loosen the hinge to door fasteners (Refer to 23 - BODY/DOORS - REAR/DOOR - REMOVAL).
(4) Adjust the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(5) Tighten to hinge pillar fasteners or the door to hinges fasteners and fasteners to 28 N·m (21 ft. lbs.). (Refer to 23 - BODY/DOORS - REAR/HINGE - INSTALLATION)
(6) Install the latch striker. (Refer to 23 - BODY/DOORS - REAR/LATCH STRIKER - INSTALLATION)

IN/OUT

NOTE: In/out door adjustment is done by loosening the hinge to door fasteners one hinge at a time and moving the door to the correct position.

NOTE: When adjustment of the door requires the loosening of the door to hinge fasteners, it will be necessary to separate the epoxy bonded washers with a chisel or other suitable tool.

(1) Support the door with a suitable lifting device.
(2) Remove the latch striker. (Refer to 23 - BODY/DOORS - REAR/LATCH STRIKER - REMOVAL)
(3) Loosen the hinge to door fasteners. (Refer to 23 - BODY/DOORS - REAR/DOOR - REMOVAL)
(4) Adjust the front of the door to the correct position. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(5) Tighten the door to hinges fasteners to 28 N·m (21 ft. lbs.).
(6) Install the latch striker. (Refer to 23 - BODY/DOORS - REAR/LATCH STRIKER - INSTALLATION)

DOOR GLASS

REMOVAL

(1) Remove the glass run channels. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - REMOVAL)

(2) Remove the glass support and place the glass into the bottom of the door.

(3) Separate the glass run weatherstrip from the rear of the window opening.

(4) Remove the inner belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR INNER BELT WEATHERSTRIP - REMOVAL)

(5) Remove the glass from the window opening.

INSTALLATION

(1) Install the glass through the window opening and pace the glass into the bottom of the door.

(2) Install the inner belt molding. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/FRONT DOOR INNER BELT WEATHERSTRIP - INSTALLATION)

(3) Stuff the glass run weatherstrip into the window frame.

(4) Secure the glass in the up position using a wood wedge or equivalent.

(5) Install the glass run channels. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - INSTALLATION)

EXTERIOR HANDLE

REMOVAL

(1) Remove the front glass run channel. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - REMOVAL)

(2) Disconnect the latch actuator rod. (Fig. 2)

(3) Remove the nuts and remove the handle.

INSTALLATION

(1) Install the latch and install the nuts.

(2) Connect the latch actuator rod.

(3) Install the front glass run channel. (Refer to 23 - BODY/DOORS - REAR/GLASS RUN CHANNEL - INSTALLATION)

GLASS RUN CHANNEL

REMOVAL

(1) Remove the window regulator. (Refer to 23 - BODY/DOORS - REAR/WINDOW REGULATOR - REMOVAL)

(2) Remove the bottom screws and loosen the top screws from bolt channels. (Fig. 3) and (Fig. 4)

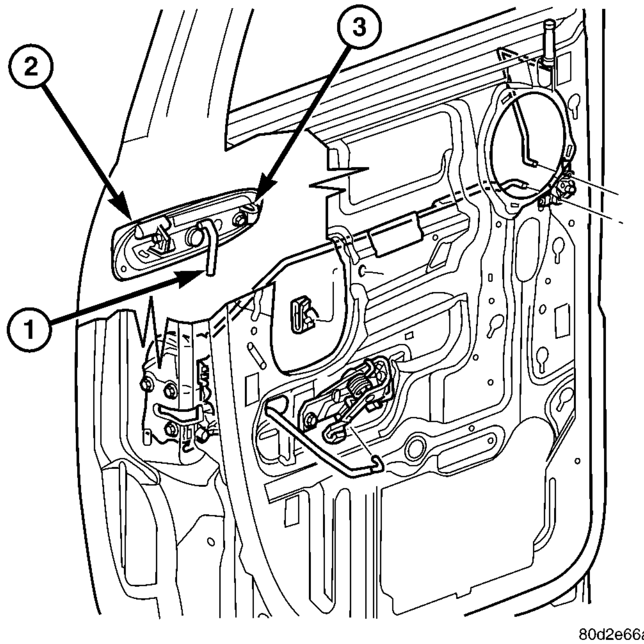

Fig. 2 EXTERIOR HANDLE

1 - LATCH ACTUATOR ROD
2 - LATCH
3 - NUTS (2)

(3) Slide the channels up to disengage from the keyhole slots.

(4) Separate the glass run weatherstrip from the channel and remove the channels.

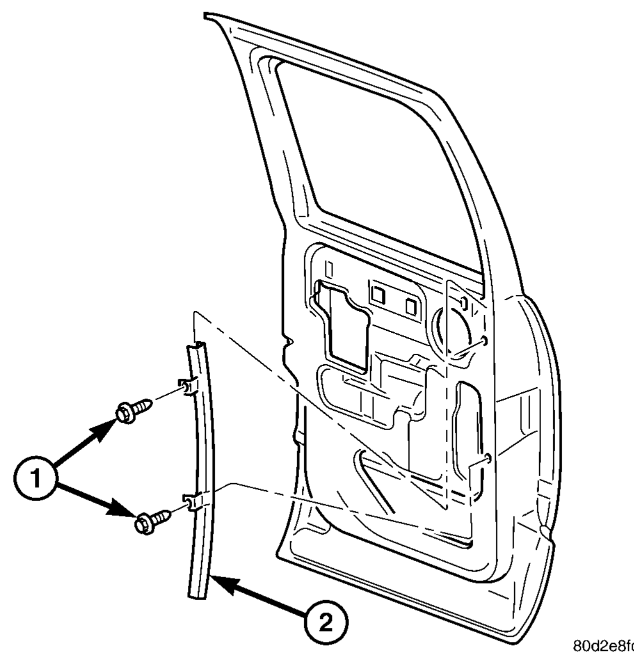

Fig. 3 FRONT RUN CHANNEL

1 - BOLTS
2 - FRONT RUN CHANNEL

GLASS RUN CHANNEL (Continued)

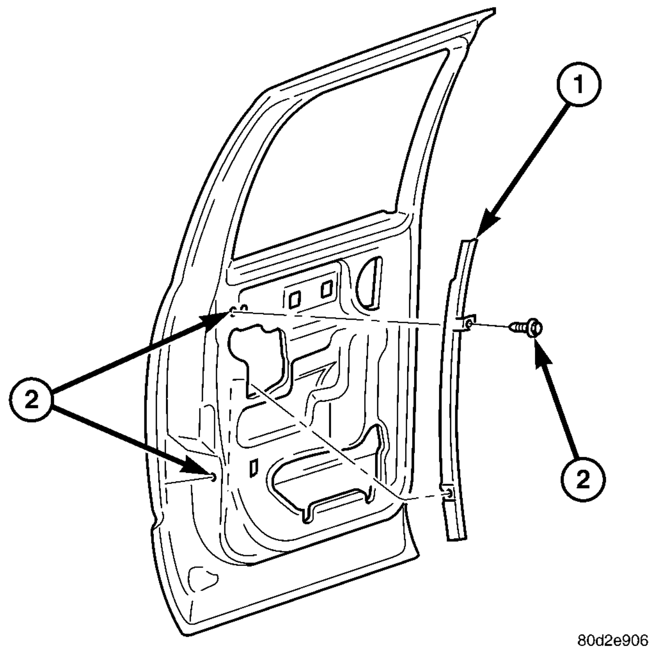

Fig. 4 REAR RUN CHANNEL

1 - REAR RUN CHANNEL
2 - SCREW LOCATIONS

INSTALLATION

(1) Position the run channels into the door and engage the upper screws into the keyhole slots.

(2) Install the lower screws and tighten to 10 N·m (89 in. lbs.).

(3) Tighten the upper screws to 10 N·m (89 in. lbs.).

(4) Stuff the glass run weatherstrip into the channels.

(5) Verify correct window operation.

(6) Install the window regulator. (Refer to 23 - BODY/DOORS - REAR/WINDOW REGULATOR - INSTALLATION)

HINGE

REMOVAL

NOTE: It is not necessary to remove the door to replace the hinges if they are replaced one at a time.

NOTE: The epoxy coated washers should not be removed from the hinge. If the washers are removed the door may have to be re-adjusted.

(1) Open the front door

UPPER HINGE

(1) Using a grease pencil or equivalent, mark the position of the hinge on the door and b-pillar.

(2) Remove the nut and bolt attaching the hinge to the door.

(3) Remove the three bolts attaching the hinge to the b-pillar and remove the hinge.

LOWER HINGE

(1) Using a grease pencil or equivalent, mark the position of the hinge on the door and b-pillar.

(2) Remove the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(3) Remove the nut and bolt attaching the hinge to the door.

(4) Remove the two bolts attaching the hinge to the b-pillar.

(5) From the inside of the vehicle remove the remaining bolt attaching the hinge to the b-pillar and remove the hinge.

INSTALLATION

UPPER HINGE

(1) Install the hinge to door washers, if there were removed previously, nut and bolt and tighten to 28 N·m (21 ft. lbs.).

(2) Install the three hinge to b-pillar bolts and tighten to 28 N·m (21 ft. lbs.).

(3) Adjust the door if needed. (Refer to 23 - BODY/DOORS - REAR/DOOR - ADJUSTMENTS)

LOWER HINGE

(1) Install the hinge and install the b-pillar bolts.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Install the hinge to door washers, if there were removed previously, nut and bolt and tighten to 28 N·m (21 ft. lbs.).

(4) Adjust the door if needed. (Refer to 23 - BODY/DOORS - REAR/DOOR - ADJUSTMENTS)

(5) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

INSIDE HANDLE ACTUATOR

REMOVAL

(1) Remove the screw and remove the inside handle. (Fig. 5)

(2) Remove the door trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL)

(3) Disconnect the latch actuator rod. (Fig. 6)

(4) Remove the nuts and remove the remote handle actuator.

INSIDE HANDLE ACTUATOR (Continued)

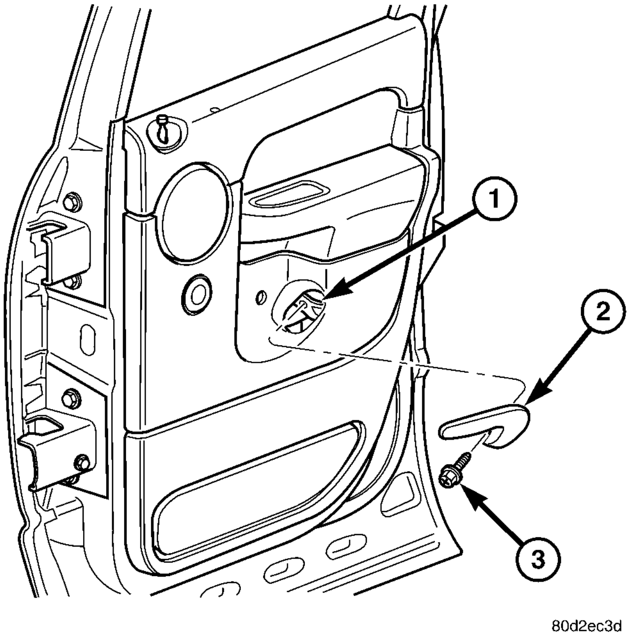

Fig. 5 INSIDE HANDLE ACTUATOR

1 - TRIM PANEL OPENING
2 - INSIDE LATCH HANDLE
3 - BOLT

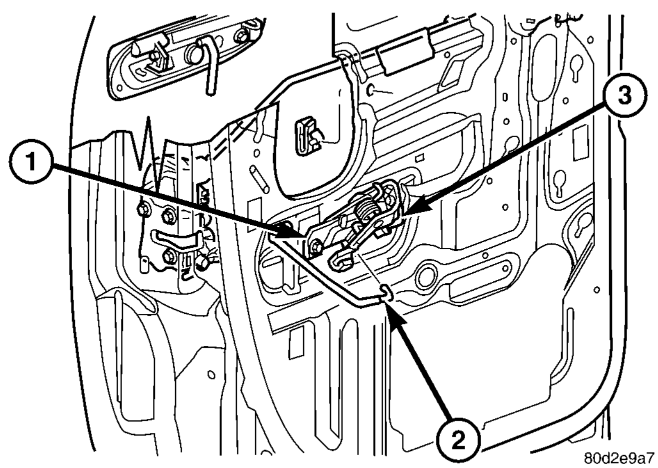

Fig. 6 REMOTE HANDLE ACTUATOR

1 - NUTS (2)
2 - LATCH ACTUATOR ROD
3 - HANDLE REMOTE

INSTALLATION

(1) Install the remote handle actuator and install the nuts.

(2) Tighten the nuts to 10 N·m (89 in. lbs.).

(3) Connect the latch actuator rod.

(4) Install the door trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION)

(5) Install the inside handle and install the bolt.

(6) Tighten the bolt to 9 N·m (80 in. lbs.).

LATCH

REMOVAL

(1) Raise the window to the full up position.

(2) Remove the waterdam. (Refer to 23 - BODY/DOOR - FRONT/WATERDAM - REMOVAL)

(3) Disconnect the actuator rods.

(4) Remove the bolts. (Fig. 7)

(5) Disconnect the electrical connector and remove the latch.

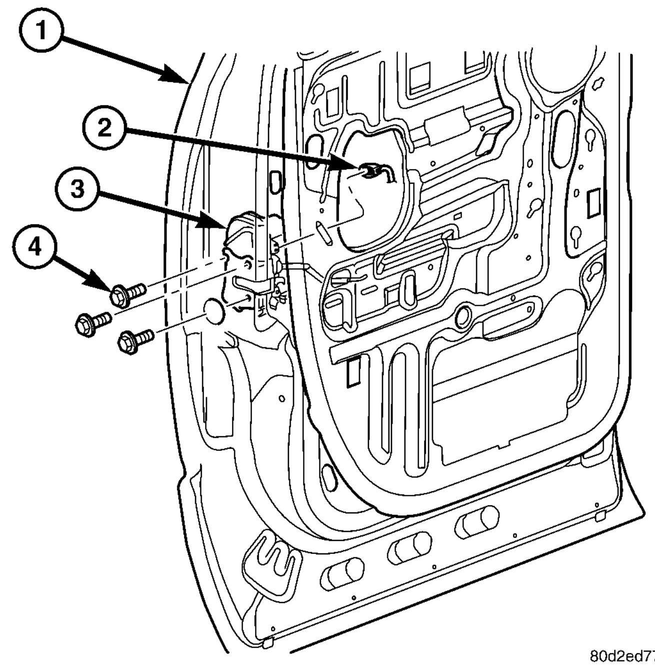

Fig. 7 LATCH ASSEMBLY

1 - DOOR
2 - ELECTRICAL CONNECTOR
3 - LATCH ASSEMBLY
4 - BOLTS

INSTALLATION

(1) Connect the electrical connector and install the latch assembly.

(2) Install the bolts and tighten to 10 N·m (89 in. lbs.).

(3) Connect the actuator rods.

(4) Adjust the latch as needed. (Refer to 23 - BODY/DOORS - REAR/LATCH - ADJUSTMENTS)

(5) Install the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)

ADJUSTMENTS

ADJUSTMENT

(1) Locate access hole and remove the mylar tape covering it. (Fig. 8)

LATCH (Continued)

(2) Insert a 5/32-inch hex-wrench through hole and into adjustment screw. Loosen screw.

(3) Operate outside handle several times to release any restriction because of mis-alignment.

(4) Tighten adjustment screw to 3 N·m (30 in. lbs.).

(5) Test handle for proper operation.

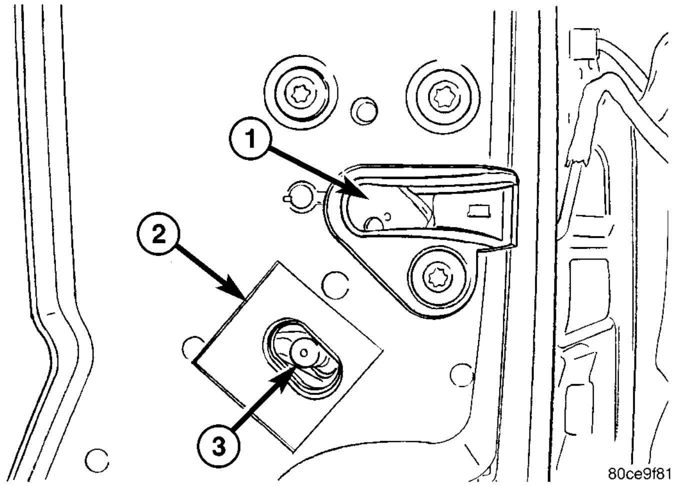

Fig. 8 LATCH ADJUSTMENT SCREW - TYPICAL

1 - DOOR LATCH
2 - MYLAR TAPE
3 - ADJUSTMENT SCREW

LATCH STRIKER

REMOVAL

(1) Using a grease pencil or equivalent, mark the position of the striker.

(2) Remove the bolts and remove the striker.

INSTALLATION

(1) Install the striker and install the bolts.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Adjust the striker if needed. (Refer to 23 - BODY/DOOR - FRONT/LATCH STRIKER - ADJUSTMENTS)

ADJUSTMENTS

ADJUSTMENT

(1) Using a grease pencil or equivalent, mark the position of the striker to aid in adjustment.

(2) Loosen the striker bolts.

(3) Change the striker position to adjust the rear gap and flush measurement. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

(4) Tighten the bolts to 28 N·m (21 ft. lbs.).

TRIM PANEL

REMOVAL

(1) Remove the window crank, if equipped. (Fig. 10)

(2) Remove the interior handle. (Refer to 23 - BODY/DOORS - REAR/INSIDE HANDLE ACTUATOR - REMOVAL)

(3) Remove the screw near the inside handle. (Fig. 9)

CAUTION: Trim panel is attached to the door using hooks molded into the panel. Do not pull the trim panel straight off or damage to the panel and/or power switch assembly may occur.

(4) Lift the trim panel up off the belt seal and attachment hooks and separate the panel from the door slightly.

(5) Disconnect the power window switch electrical connector, if equipped, and remove the trim panel.

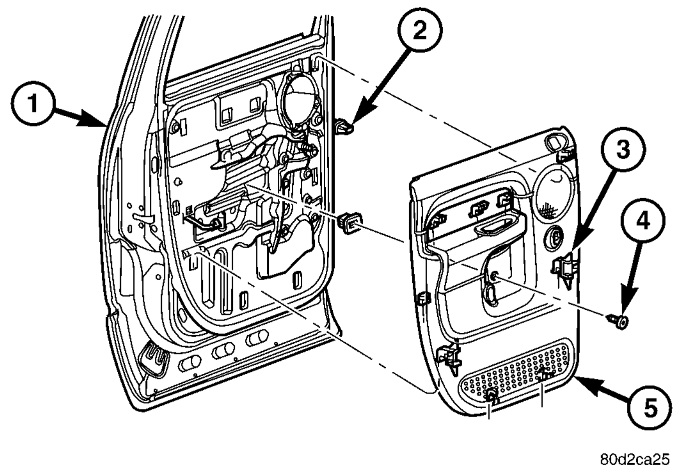

Fig. 9 TRIM PANEL

1 - DOOR
2 - ELECTRICAL CONNECTOR
3 - ATTACHMENT HOOKS
4 - SCREW
5 - TRIM PANEL

INSTALLATION

(1) Position the trim panel onto the lower hooks and connect the power window switch electrical connector, if equipped.

(2) Position the remaining trim panel attachment hooks into the door panel and seat the trim panel into the belt seal fully.

(3) Install the screw near the inside handle.

(4) Install the interior handle. (Refer to 23 - BODY/DOORS - REAR/INSIDE HANDLE ACTUATOR - INSTALLATION)

(5) Install the window crank, if equipped.

TRIM PANEL (Continued)

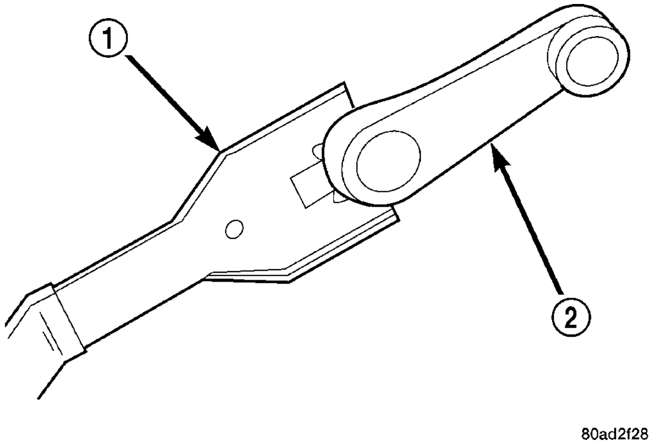

Fig. 10 WINDOW CRANK REMOVAL TOOL

1 - WINDOW CRANK REMOVAL TOOL
2 - WINDOW CRANK

WATERDAM

REMOVAL

(1) Remove the inside handle actuator. (Refer to 23 - BODY/DOORS - REAR/INSIDE HANDLE ACTUATOR - REMOVAL)

(2) Remove the speaker. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - REMOVAL)

(3) Separate the waterdam from the inner door panel and off of the latch linkages.

INSTALLATION

(1) Position the wire harness and actuator rods through the holes in the waterdam.

(2) Secure the waterdam to the inner door panel.

(3) Install the speaker. (Refer to 8 - ELECTRICAL/AUDIO/SPEAKER - INSTALLATION)

(4) Install the inside handle actuator. (Refer to 23 - BODY/DOORS - REAR/INSIDE HANDLE ACTUATOR - INSTALLATION)

WINDOW REGULATOR - POWER

REMOVAL

(1) Remove the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - REMOVAL)

(2) Remove the window switch from the door trim panel and reconnect it to the door wire harness.

(3) Raise the window to the position shown and remove the two nuts attaching the glass to the window regulator. (Fig. 11)

(4) Remove the stabilizer nut.

(5) Disengage the door glass from the regulator lift plate and position into the full up position.

(6) Secure the glass in the up position using a wood wedge or equivalent.

(7) Lower the regulator.

(8) Disconnect the electrical connector. (Fig. 12)

(9) Remove the lower regulator bolt and loosen the upper two. (Fig. 12)

(10) Slide the regulator up and out of the keyhole slots in the door panel.

(11) Remove the regulator through the hole in the inner door panel.

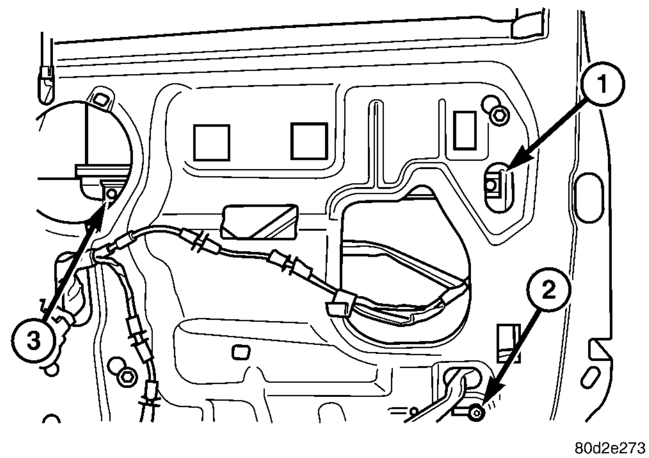

Fig. 11 GLASS POSITIONING

1 - SIGHT WINDOW
2 - STABILIZER NUT
3 - GLASS LIFT PLATE

INSTALLATION

(1) Install the regulator through the hole in the inner door panel.

(2) Position the regulator bolts into the keyhole slots and slide into place.

(3) Install the lower regulator bolt and tighten all three to 10 N·m (89 in. lbs.).

(4) Connect the electrical connector.

(5) Position the stabilizer, install the nut and tighten to 10 N·m (89 in. lbs.).

(6) Raise the regulator to the position shown in (Fig. 11).

(7) Remove the glass support and connect to the regulator lift plate.

(8) Install the glass nuts and tighten to 10 N·m (89 in. lbs.).

(9) Disconnect the window switch and install into the door trim panel.

(10) Install the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)

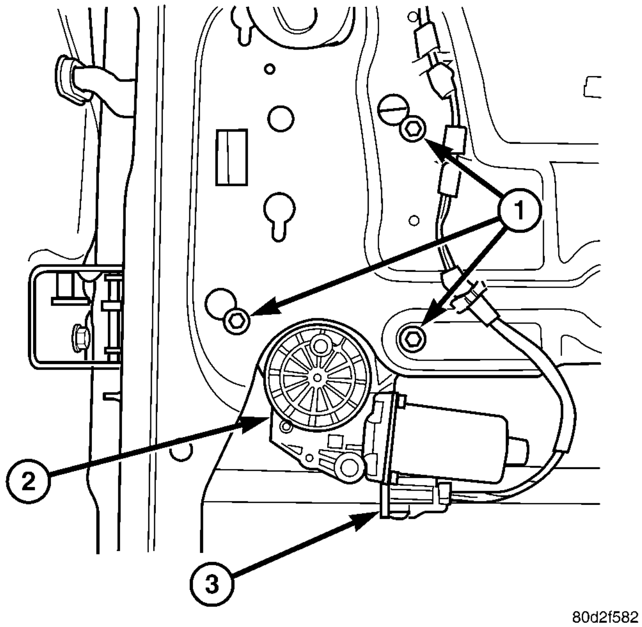

Fig. 12 WINDOW REGULATOR MOTOR

1 - REGULATOR BOLTS
2 - REGULATOR MOTOR
3 - ELECTRICAL CONNECTOR.

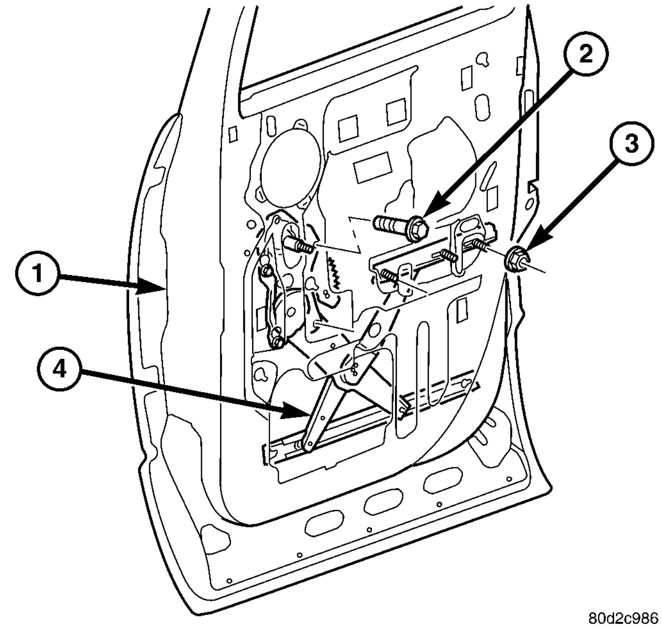

Fig. 13 WINDOW REGULATOR - MANUAL

1 - DOOR
2 - REGULATOR BOLTS (4)
3 - STABILIZER NUTS (2)
4 - REGULATOR

WINDOW REGULATOR - MANUAL

REMOVAL

(1) Remove the waterdam. (Refer to 23 - BODY/DOORS - REAR/WATERDAM - REMOVAL)

(2) Reinstall the window handle and raise the window to the position shown and remove the nuts. (Fig. 11)

(3) Remove the stabilizer nuts. (Fig. 13)

(4) Disengage the door glass from the regulator lift plate and position into the full up position.

(5) Secure the glass in the up position using a wood wedge or equivalent.

(6) Lower the regulator.

(7) Remove the two back regulator bolts and loosen the front two.

(8) Slide the regulator up and out of the keyhole slots in the door panel.

(9) Remove the regulator through the hole in the inner door panel.

INSTALLATION

(1) Install the regulator through the hole in the inner door panel.

(2) Position the regulator bolts into the keyhole slots and slide into place.

(3) Install the back regulator bolts and tighten all four to 10 N·m (89 in. lbs.).

(4) Position the stabilizer, install the nuts and tighten to 10 N·m (89 in. lbs.).

(5) Using the window handle raise the regulator to the position shown in (Fig. 11).

(6) Remove the glass support and connect to the regulator lift plate.

(7) Install the glass nuts and tighten to 10 N·m (89 in. lbs.).

(8) Disconnect the window switch and install into the door trim panel.

(9) Using the window handle raise the regulator to the position shown in (Refer to 23 - BODY/DOORS - REAR/WATERDAM - INSTALLATION)

EXTERIOR

TABLE OF CONTENTS

BODY SIDE MOLDINGS

REMOVAL

NOTE: Body side moldings are attached to the body panels with adhesive tape.

(1) Apply a length of masking tape on the body panel, parallel to the top edge of the molding and to one end to use as a guide for installation, if necessary.

(2) If temperature is below 21°C (70°F) warm molding with a heat lamp or gun. Do not exceed 52°C (120°F) when heating molding.

(3) Using a trim stick C-4755 or equivalent, remove and discard the molding from the outside of the body panel.

INSTALLATION

(1) Thoroughly clean all residue from the body side molding attachment area of the body panel.

(2) Wipe area with a clean lint free cloth moistened with a 50% solution of water and alcohol and wipe dry immediately with a dry lint free cloth.

(3) Apply new body side molding using the guide tape on the body panel and apply consistent and uniform pressure of approximately 40 p.s.i. over the entire surface of the molding.

BODY ISOLATORS

REMOVAL

(1) Loosen all cab to frame mounting bolts (six standard cab, eight quad cab). (Fig. 1)

(2) Remove the mounting bolts and rebound cushions

(3) Using a floor jack and block of wood under the cab sill, lift the body to gain access to the isolators.

(4) Remove the isolators.

(5) Install new isolators and repeat steps one through 4, for the opposite side.

BODY ISOLATORS (Continued)

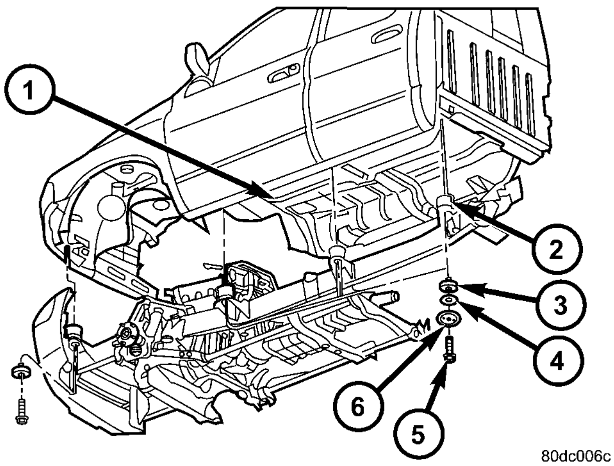

Fig. 1 BODY ISOLATORS - TYPICAL

1 - CAB SILL
2 - ISOLATORS
3 - REBOUND CUSHION
4 - WASHER (REAR ISOLATOR ONLY)
5 - BOLTS
6 - REINFORCEMENT PLATE (REAR ISOLATOR ONLY)

INSTALLATION

(1) For the rear isolators install the rebound cushions, washers, reinforcement plates and bolts. (Fig. 1)

(2) Install the remaining rebound cushions and bolts.

(3) Tighten the bolts to 81 N·m (60 ft. lbs.).

CARGO BOX

REMOVAL

(1) Disconnect the fuel fill hose and vent hose. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL TANK - REMOVAL)

(2) Disconnect the tail lamp wire harness.

(3) Remove the cargo box bolts. (Fig. 2) or (Fig. 3)

(4) Remove the cargo box.

INSTALLATION

(1) Install the cargo box and install the bolts.

(2) Tighten the bolts to 108 N·m (80 ft. lbs.).

(3) Connect the fuel fill and vent hoses. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL TANK - INSTALLATION)

(4) Connect the tail lamp wire harness.

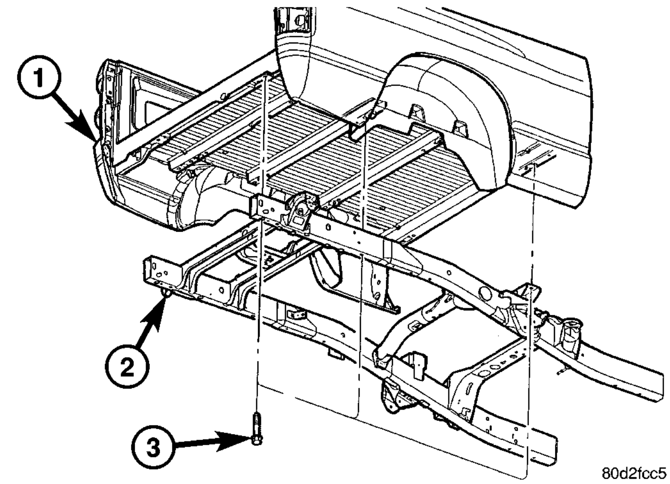

Fig. 2 SHORT CARGO BOX

1 - CARGO BOX
2 - FRAME
3 - BOLTS (3 PER SIDE)

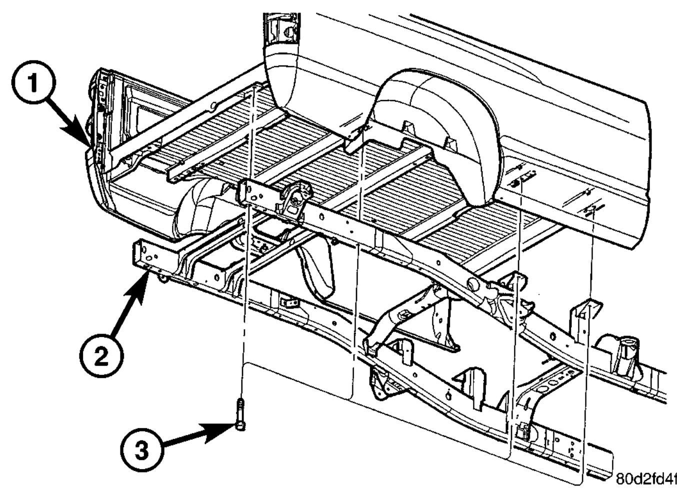

Fig. 3 LONG CARGO BOX

1 - CARGO BOX
2 - FRAME
3 - BOLTS (4 PER SIDE)

CARGO BOX - TIE DOWN

REMOVAL

(1) Remove the bolts and remove the tie down cleat. (Fig. 4)

INSTALLATION

(1) Install the tie down cleat and install the bolts.

(2) Tighten the bolts to 34 N·m (25 ft. lbs.).

CARGO BOX - TIE DOWN (Continued)

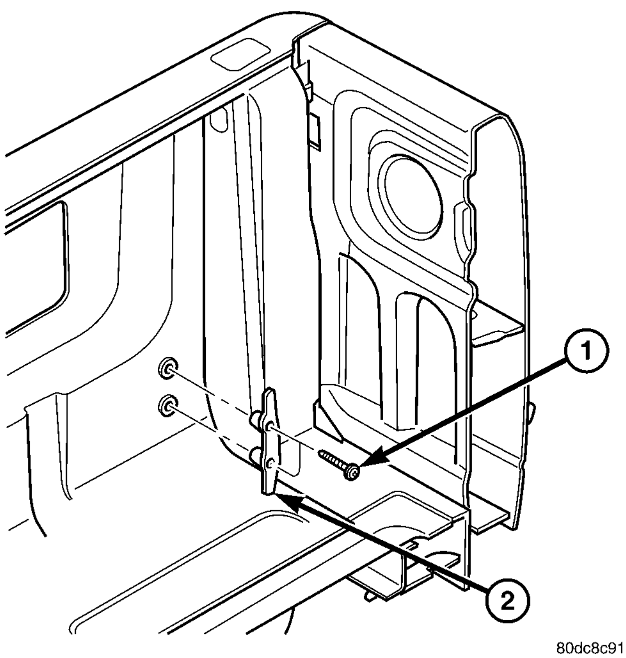

Fig. 4 TIE DOWN CLEAT

1 - BOLTS (2)
2 - CLEAT

COWL GRILLE

REMOVAL

(1) Remove the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(2) Disconnect the washer hose.

(3) Remove the hood seal.

(4) Remove the six push pin fasteners from the front of the grille. (Fig. 5)

(5) Remove the two rear corner screws and remove the grilles.

INSTALLATION

(1) Install the grill and install the two rear corner screws.

(2) Install the six push pin fasteners along the front of the grille.

(3) Install the hood seal.

(4) Connect the washer hose.

(5) Install the wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)

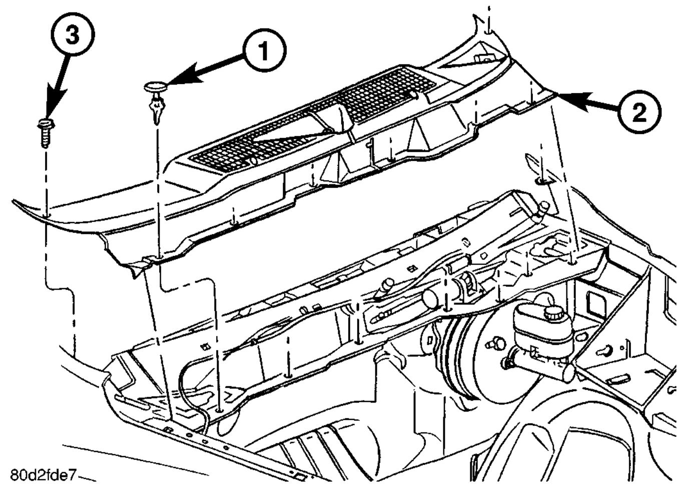

Fig. 5 COWL GRILLE

1 - PUSH PIN FASTENERS (6)
2 - COWL GRILLE
3 - SCREWS (2)

EXTERIOR NAME PLATES

REMOVAL

NOTE: Exterior name plates are attached to body panels with adhesive tape.

(1) Apply a length of masking tape on the body, parallel to the top edge and one end of the name plate to use as a guide for installation, if necessary.

(2) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun. Do not exceed 52°C (120°F) when heating name plate.

(3) Using a trim stick C-4755 or equivalent, remove and discard the name plate.

INSTALLATION

(1) Thoroughly clean all residue from the name plate attachment area of the body panel.

(2) Wipe area with a clean lint free cloth moistened with a 50% solution of water and alcohol and wipe dry immediately with a dry lint free cloth.

(3) Remove protective cover from adhesive tape on back of name plate.

(4) Position name plate properly on the body panel.

(5) Apply consistent and uniform pressure over the entire surface of the name plate, with palm of hand.

(6) If temperature is below 21°C (70°F) warm emblem with a heat lamp or gun to assure adhesion. Do not exceed 52°C (120°F) when heating name plate.

FRONT FENDER

REMOVAL

(1) Remove the antenna, if equipped. (Refer to 8 - ELECTRICAL/AUDIO/ANTENNA BODY & CABLE - REMOVAL)

(2) Remove the battery tray, if required. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL)

(3) Remove the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL)

(4) Remove the headlamp unit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - REMOVAL)

(5) Remove the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL)

(6) Remove the inside and lower bolts. (Fig. 6)

(7) Remove the two bolts below the headlamp.

(8) Remove the hinge support bolt at the cowl.

(9) Remove the three bolts along the fender rail.

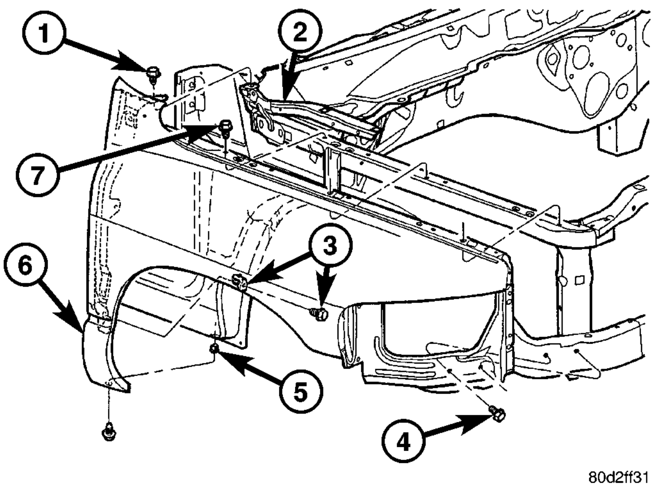

Fig. 6 FRONT FENDER

1 - HOOD HINGE SUPPORT BOLT (1)
2 - HOOD HINGE
3 - INNER BOLT (1)
4 - FRONT BOLTS (2)
5 - LOWER BOLT INSERT
6 - FENDER
7 - UPPER BOLTS (3)

INSTALLATION

(1) Install the three bolts along the upper fender rail and tighten to 9 N·m (80 in. lbs.).

(2) Install the upper hinge support bolt at the cowl and tighten to 17 N·m (13 ft. lbs.).

(3) Install the two bolts below the headlamp and tighten to 9 N·m (80 in. lbs.).

(4) Install the inside and lower bolts and tighten to 17 N·m (13 ft. lbs.).

(5) Check the fender positioning and adjust as required by adding shims. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

(6) Install the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION)

(7) Install the headlamp unit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/HEADLAMP UNIT - INSTALLATION)

(8) Install the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION)

(9) Install the battery tray, if required. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION)

(10) Install the antenna, if required. (Refer to 8 - ELECTRICAL/AUDIO/ANTENNA BODY & CABLE - INSTALLATION)

FUEL FILL DOOR

REMOVAL

(1) Open fill door and remove the bolts. (Fig. 7)

(2) Remove the door.

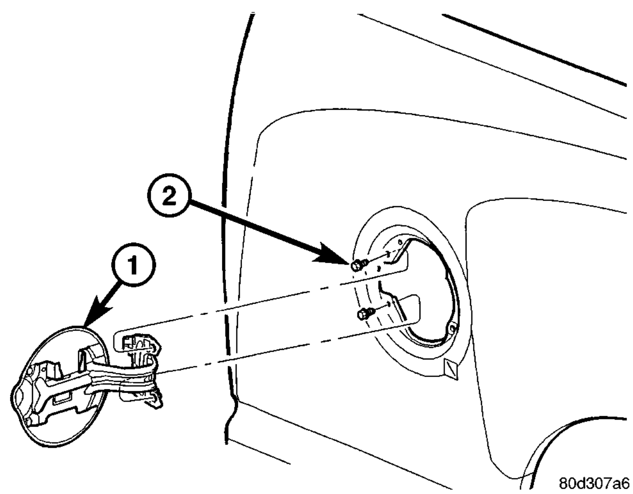

Fig. 7 FUEL FILL DOOR

1 - FUEL FILL DOOR
2 - BOLTS (2)

INSTALLATION

(1) Install the fuel fill door.

(2) Install the bolts and tighten to 9 N·m (80 in. lbs.).

GRILLE

REMOVAL

(1) Open the hood.

(2) Remove the six lower screws. (Fig. 8)

(3) Remove the six upper nuts and separate the grille from the grille frame.

GRILLE (Continued)

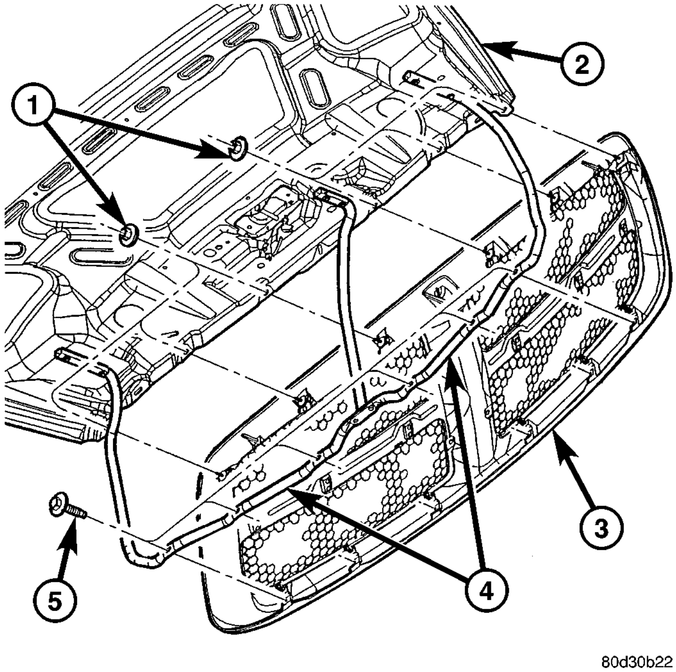

Fig. 8 GRILLE

1 - NUTS (6)
2 - HOOD
3 - GRILLE
4 - GRILLE FRAME
5 - SCREWS (6)

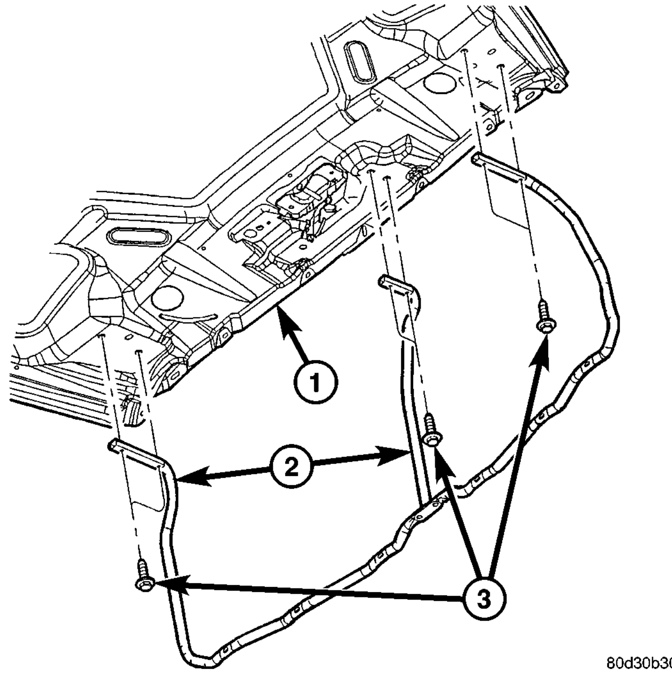

Fig. 9 GRILLE FRAME

1 - HOOD
2 - GRILLE FRAME
3 - SCREWS (6)

INSTALLATION

(1) Position the grille onto the grille frame.
(2) Install the six upper nuts.
(3) Install the six lower screws.

GRILLE FRAME

REMOVAL

(1) Remove the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)
(2) Remove the screws and remove the grille frame. (Fig. 9)

INSTALLATION

(1) Install the grille frame and install the six screws.
(2) Install the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)

FRONT WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove the three screws at the fender. (Fig. 10)
(2) Remove the electrical connector push pin fastener.
(3) Remove the five inside screws and remove the splash shield.

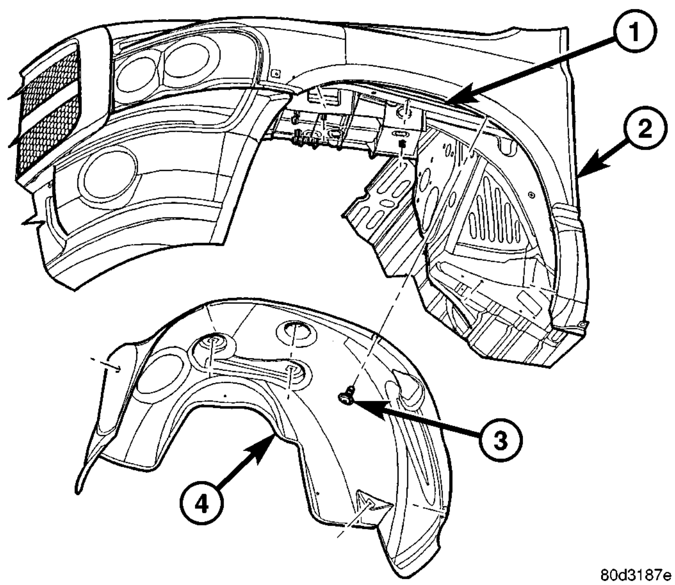

Fig. 10 FRONT SPLASH SHIELD

1 - FENDER RAIL
2 - FENDER
3 - SCREWS (8)
4 - WHEELHOUSE SPLASH SHIELD

FRONT WHEELHOUSE SPLASH SHIELD (Continued)

INSTALLATION

(1) Install the splash shield and position the front edge into the support bracket on the bumper.

(2) Install the five inner screws.

(3) Install the three screws at the fender.

(4) Install the electrical connector push pin fastener.

REAR WHEELHOUSE SPLASH SHIELD

REMOVAL

(1) Remove the screws and remove the shield. (Fig. 11)

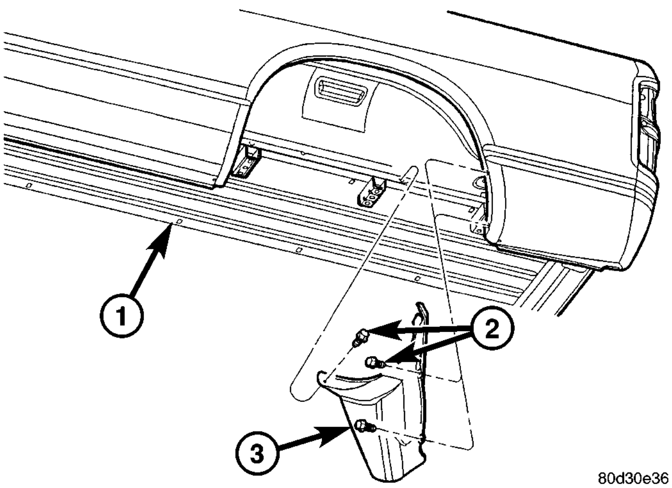

Fig. 11 REAR SPLASH SHIELD

1 - CARGO BOX
2 - SCREWS (3)
3 - SPLASH SHIELD

INSTALLATION

(1) Install the splash shield and install the screws.

SIDE VIEW MIRROR

REMOVAL

(1) Remove the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)

(2) Disconnect the electrical connector and remove the nuts. (Fig. 12)

(3) Squeeze the electrical connector tabs and remove the mirror. (Fig. 13)

INSTALLATION

(1) Install the mirror onto the door and engage the electrical connector tabs. (Fig. 13)

(2) Install the nuts and tighten to 7 N·m (60 in. lbs.).

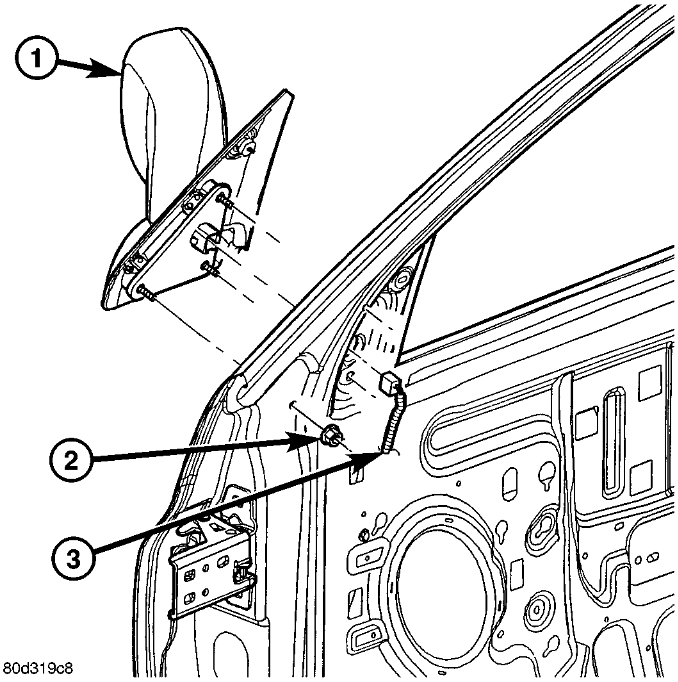

Fig. 12 SIDE VIEW MIRROR

1 - MIRROR
2 - NUTS (3)
3 - ELECTRICAL CONNECTOR

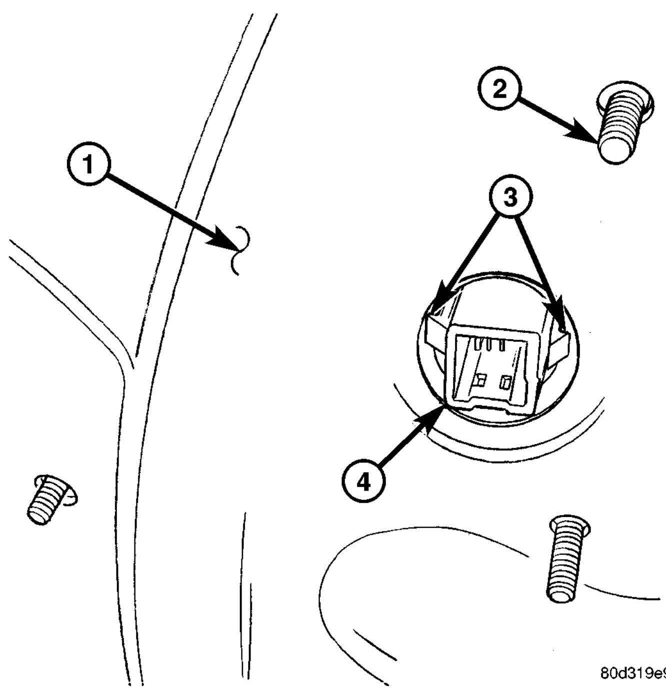

Fig. 13 MIRROR ELECTRICAL CONNECTOR

1 - DOOR
2 - MIRROR STUDS
3 - CONNECTOR TABS
4 - ELECTRICAL CONNECTOR

(3) Install the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)

UPPER RADIATOR CROSSMEMBER

REMOVAL

(1) Remove the hood latch. (Refer to 23 - BODY/HOOD/LATCH - REMOVAL)

(2) Remove the radiator and condenser bolts. (Fig. 14)

(3) Remove the bolts and remove the crossmember. (Fig. 15)

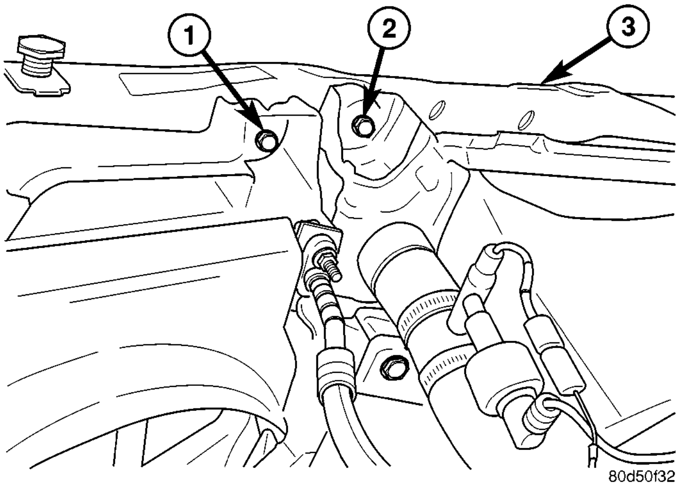

Fig. 14 CONDENSER/RADIATOR FASTENERS

1 - CONDENSER BOLT
2 - RADIATOR BOLT
3 - RADIATOR CROSSMEMBER

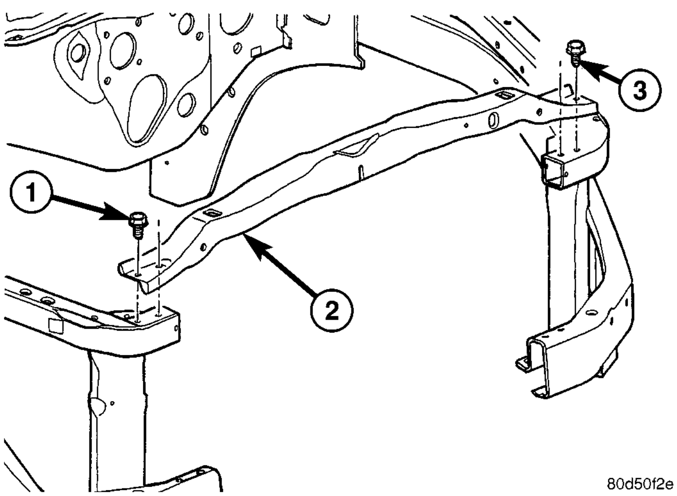

Fig. 15 RADIATOR CROSSMEMBER

1 - BOLTS (2)
2 - CROSSMEMBER
3 - BOLTS (2)

INSTALLATION

(1) Install the crossmember and install the bolts.

(2) Tighten the bolts to 28 N·m (21 ft. lbs.).

(3) Install the radiator and condenser bolts and tighten to 8 N·m (75 in. lbs.).

(4) Install the hood latch. (Refer to 23 - BODY/HOOD/LATCH - INSTALLATION)

SIDE VIEW MIRROR GLASS

REMOVAL

WARNING: ALWAYS WEAR EYE AND HAND PROTECTION WHEN SERVICING THE MIRROR ASSEMBLY. FAILURE TO OBSERVE THESE WARNINGS MAY RESULT IN PERSONAL INJURY FROM BROKEN GLASS.

Standard Mirror

(1) Position the mirror glass so that it's facing in toward the vehicle as far as possible. (Fig. 16)

(2) Disengage the rear housing cover retaining tabs and remove the cover. (Fig. 17)

(3) Disengage the lower glass retaining tab to motor. (Fig. 18)

(4) Slide glass up and remove from motor.

(5) Disconnect the two heated mirror electrical connectors, if equipped.

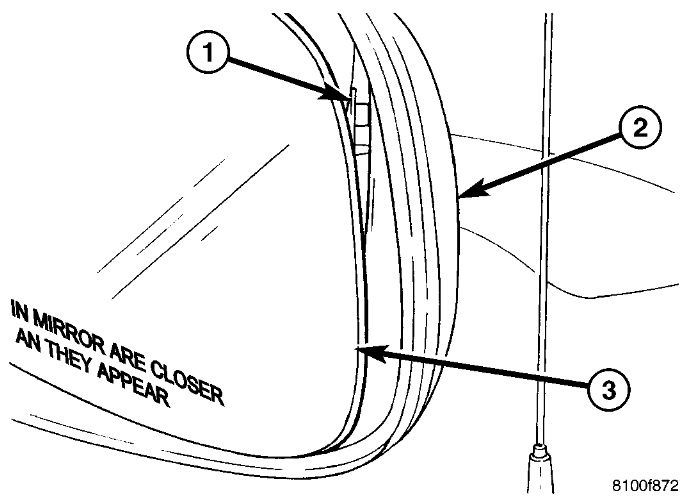

Fig. 16 STANDARD MIRROR POSITION

1 - RETAINING TABS (2)
2 - MIRROR HOUSING
3 - MIRROR GLASS

SIDE VIEW MIRROR GLASS (Continued)

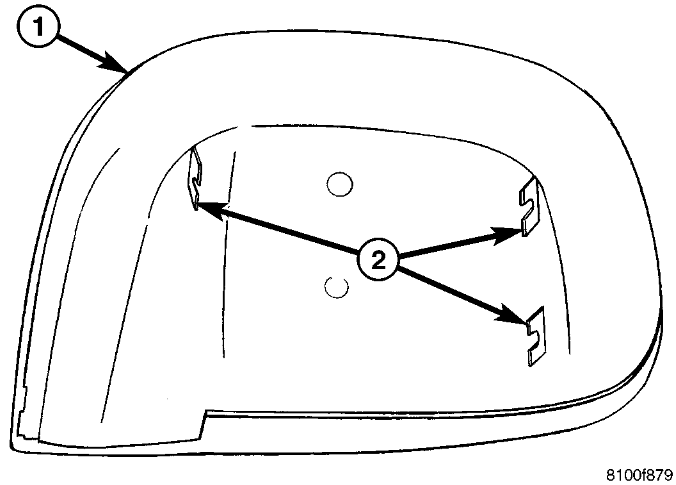

Fig. 17 STANDARD MIRROR HOUSING COVER

1 - MIRROR HOUSING COVER
2 - RETAINING TABS (3)

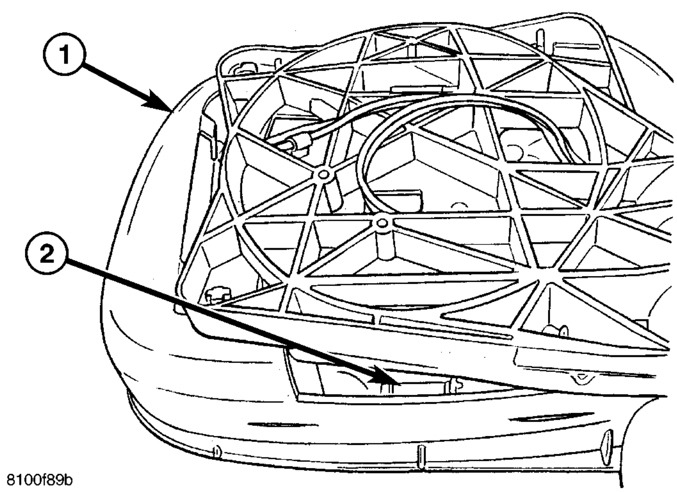

Fig. 18 STANDARD MIRROR RETAINING TAB

1 - MIRROR ASSEMBLY
2 - MIRROR GLASS LOWER RETAINING TAB

Tow Package Mirror

(1) Position the mirror in the out position. (Fig. 19)

(2) Release the retaining clip and separate the glass.

(3) Disconnect the four heated glass electrical connectors, if equipped. (Fig. 20)

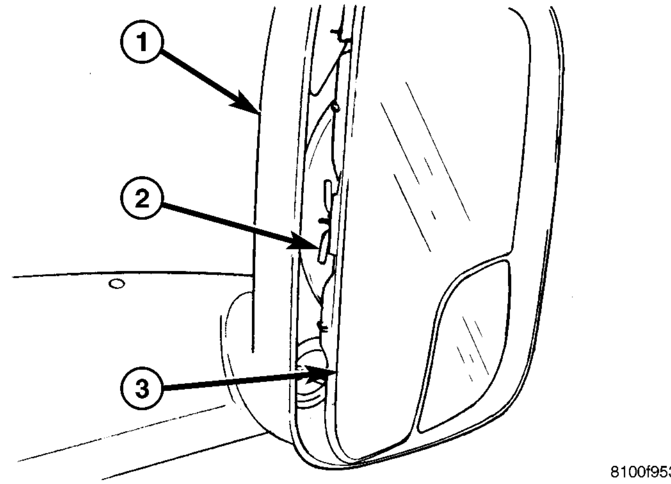

Fig. 19 TOW PACKAGE MIRROR POSITION

1 - MIRROR HOUSING ASSEMBLY
2 - MIRROR GLASS RETAINING CLIP
3 - MIRROR GLASS

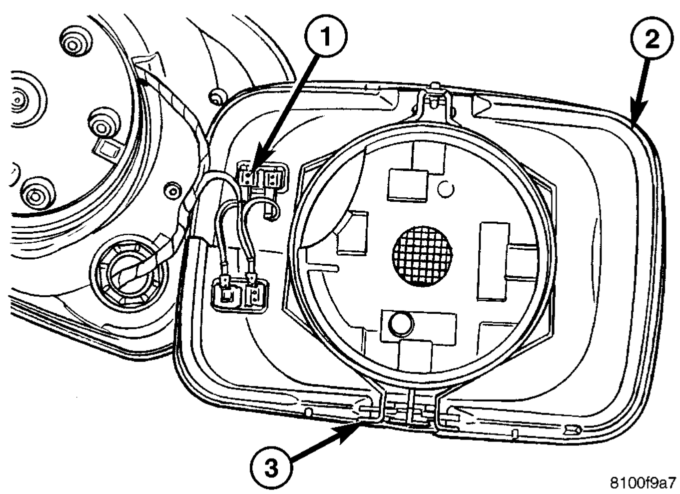

Fig. 20 TOW PACKAGE MIRROR GLASS

1 - HEATED GLASS ELECTRICAL CONNECTORS (IF EQUIPPED)
2 - MIRROR GLASS
3 - RETAINING CLIP

SIDE VIEW MIRROR GLASS (Continued)

INSTALLATION

Standard Mirror

(1) Connect the two heated mirror electrical connectors, if equipped. (Fig. 21)

(2) Position the mirror glass mounting holes over the four feet of the mirror motor and slide down. (Fig. 22)

(3) Engage the lower glass retaining tab to the motor. (Fig. 18)

(4) Position the rear housing cover and seat the retaining tabs fully. (Fig. 17)

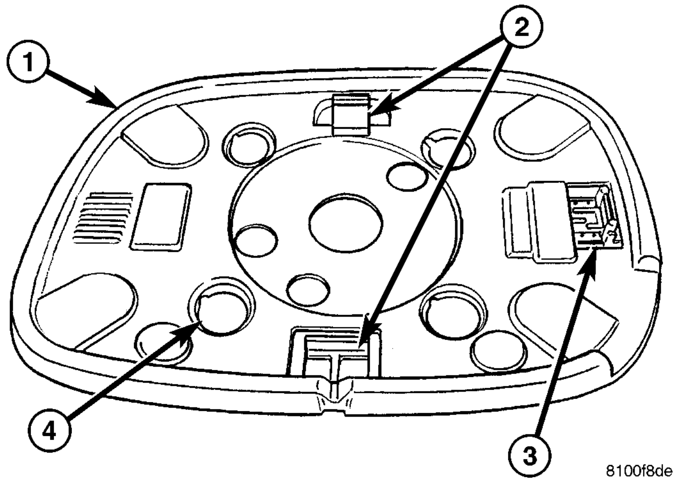

Fig. 21 STANDARD MIRROR INSTALLATION

1 - MIRROR GLASS
2 - UPPER AND LOWER RETAINING CLIPS
3 - HEATED MIRROR ELECTRICAL CONNECTORS (IF EQUIPPED)
4 - MIRROR GLASS MOUNTING HOLES (4)

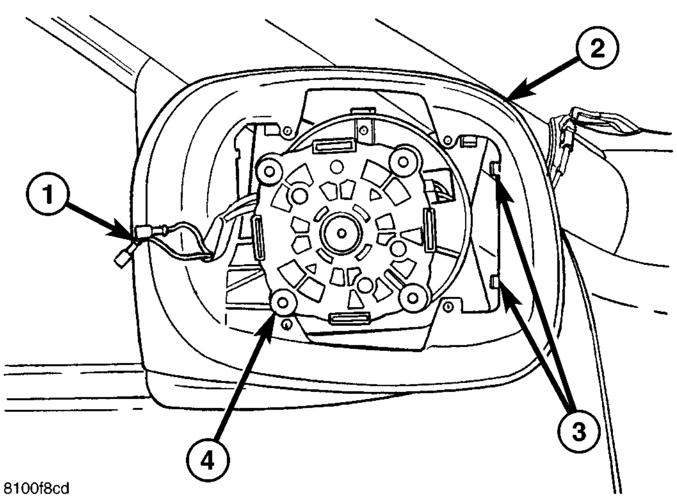

Fig. 22 STANDARD MIRROR ASSEMBLY

1 - HEATED MIRROR ELECTRICAL CONNECTORS (IF EQUIPPED)
2 - MIRROR HOUSING
3 - HOUSING COVER LOCKING TABS
4 - MIRROR GLASS MOUNTING FEET (4)

Tow Package Mirror

(1) Make sure the retaining clip is seated in the closed position on the mirror glass.

(2) Connect the heated mirror electrical connectors, if equipped.

NOTE: Pressure must be applied equally over the center portion of the mirror to engage the mirror glass retaining clip fully.

(3) Position the glass over the motor mounting and seat fully. Make sure the retaining clip seats fully.

REAR FENDER

REMOVAL

(1) Remove the wheel house splash shield. (Refer to 23 - BODY/EXTERIOR/REAR WHEELHOUSE SPLASH SHIELD - REMOVAL)

(2) Disconnect the marker lamps electrical connectors.

(3) Remove the tail lamp units. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/ TAIL LAMP UNIT - REMOVAL)

(4) Remove the two fender nuts. (Fig. 23)

(5) Remove the rear inner nuts below the tail lamp. (Fig. 24)

(6) Remove the two bolts at the rear bottom edge.

(7) Remove the two bolts at the front bottom edge.

(8) Remove the four inner nuts front edge. (Fig. 25)

(9) Loosen bolts and loosen the two fender support brackets. (Fig. 26)

CAUTION: Mask off the surrounding box area to avoid damage to the painted surfaces.

(10) Lift the fender up off the support brackets and remove the fender.

INSTALLATION

CAUTION: Mask off the surrounding box area to avoid damage to the painted surfaces during installation.

(1) Carefully position the fender over the support brackets.

(2) Install the four inner nuts along the front edge of the fender and tighten to 7 N·m (60 in. lbs.).

(3) Install the two inner nuts along the rear edge of the fender below the tail lamp unit and tighten to 7 N·m (60 in. lbs.).

(4) Tighten the six support bracket bolts and tighten to 11 N·m (8 ft. lbs.).

REAR FENDER (Continued)

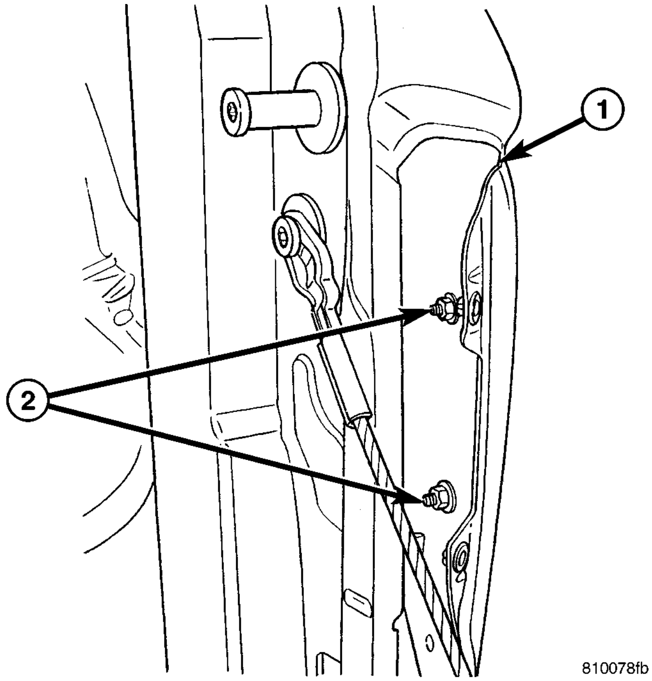

Fig. 23 TAIL LAMP OPENING

1 - TAIL LAMP OPENING
2 - FENDER NUTS (2)

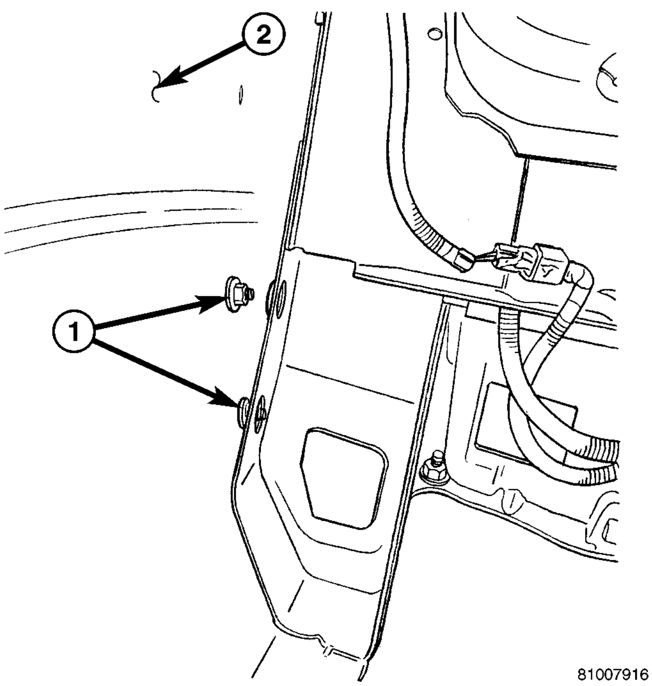

Fig. 24 LOWER REAR FASTENERS

1 - REAR FENDER NUTS (2)
2 - PICK-UP BOX INNER PANEL

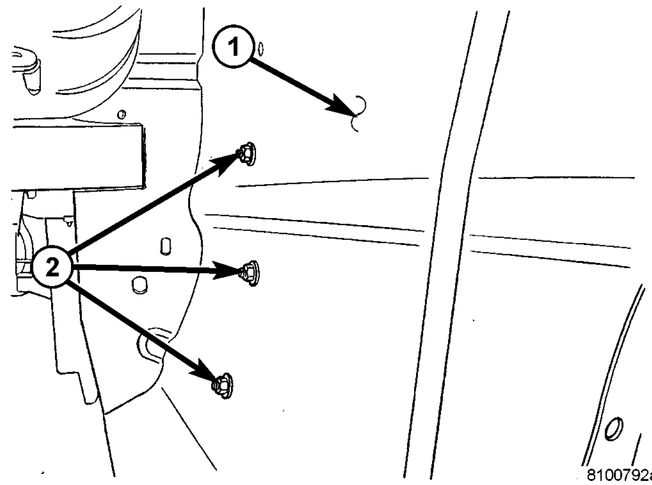

Fig. 25 LOWER FRONT FASTENERS

1 - PICK-UP BOX INNER PANEL
2 - FRONT FENDER NUTS (4)

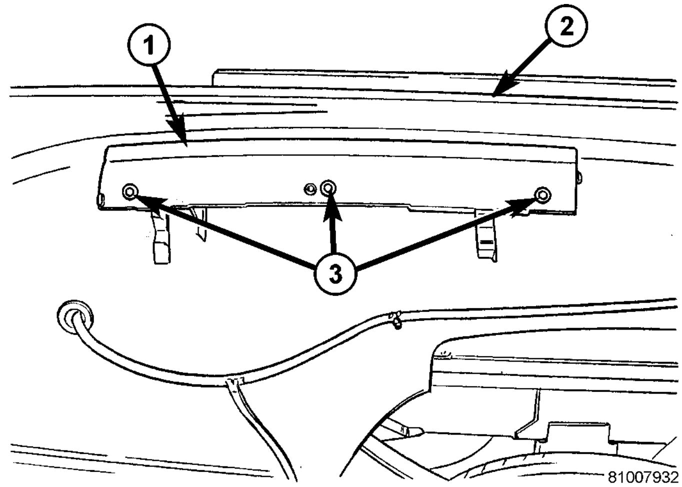

Fig. 26 SUPPORT BRACKET

1 - FENDER SUPPORT BRACKET (2)
2 - PICK-UP BOX
3 - BOLTS (3 PER BRACKET)

(5) Install the bolts along lower edge of the fender and tighten to 7 N·m (60 in. lbs.).

(6) Connect the marker lamps electrical connectors.

(7) Install the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/REAR WHEELHOUSE SPLASH SHIELD - INSTALLATION)

(8) Install the two nuts from within the tail lamp opening and tighten to 7 N·m (60 in. lbs.).

(9) Install the tail lamp unit. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - EXTERIOR/TAIL LAMP UNIT - INSTALLATION)

HOOD

TABLE OF CONTENTS

HINGE

REMOVAL

NOTE: It is not necessary to remove the hood to replace one or both hinges. The hinges can be replaced one at a time.

(1) Remove the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL)
(2) Using a grease pencil or equivalent, mark the position of the hinge on the hood.
(3) Remove the fender support bolt. (Fig. 1)
(4) Remove the support cylinder. (Refer to 23 - BODY/HOOD/SUPPORT CYLINDER - REMOVAL)
(5) Remove the hood nuts.
(6) Remove the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - REMOVAL)
(7) From inside the fender, remove the two hinge bolts. (Fig. 2)
(8) Slide the hinge forward and remove from the fender rail.

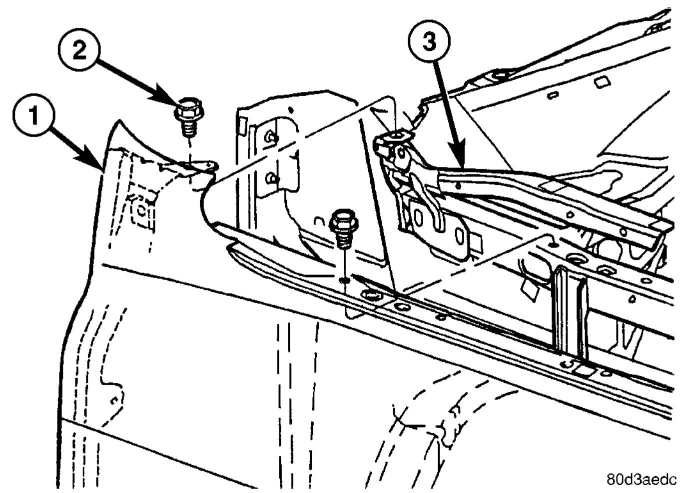

Fig. 1 HINGE/FENDER BOLT

1 - FENDER
2 - FENDER SUPPORT BOLT
3 - HINGE

INSTALLATION

(1) Install the hinge and slide back into position on the fender rail.
(2) From inside the fender, install the two hinge bolts and tighten to 20 N·m (15 ft. lbs.).
(3) Install the hood nuts and line up the marks made previously.
(4) Tighten the nuts to 23 N·m (17 ft. lbs.).
(5) Install the support cylinder. (Refer to 23 - BODY/HOOD/SUPPORT CYLINDER - INSTALLATION)
(6) Install the fender support bolt and tighten to 11 N·m (8 ft. lbs.).
(7) Check hood fit and adjust if required. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)
(8) Install the cowl grille. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION)
(9) Install the wheelhouse splash shield. (Refer to 23 - BODY/EXTERIOR/FRONT WHEELHOUSE SPLASH SHIELD - INSTALLATION)

HINGE (Continued)

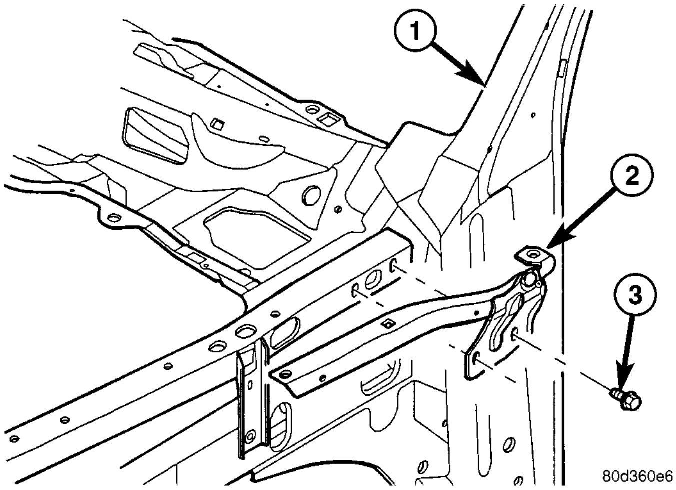

Fig. 2 HINGE

1 - A-PILLAR
2 - HINGE
3 - BOLTS (2)

HOOD

REMOVAL

(1) Open the hood.

(2) Using a grease pencil or equivalent, mark the position of the hinges on the hood.

(3) Remove the hood hinge nuts and remove the hood.

(4) Remove the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - REMOVAL)

(5) Remove the hood lamp and ambient temperature sensor.

INSTALLATION

(1) Install the hood lamp and ambient temperature sensor.

(2) Install the grille. (Refer to 23 - BODY/EXTERIOR/GRILLE - INSTALLATION)

(3) Install the hood and install the nuts.

(4) Line up the marks made previously and tighten the nuts to 23 N·m (17 ft. lbs.).

(5) Check the hood fit and adjust if required. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

LATCH

REMOVAL

(1) Open the hood.

(2) Using a grease pencil or equivalent, mark the position of the latch on the radiator crossmember.

(3) Remove the bolts. (Fig. 3)

(4) Disconnect the hood latch cable and remove the latch.

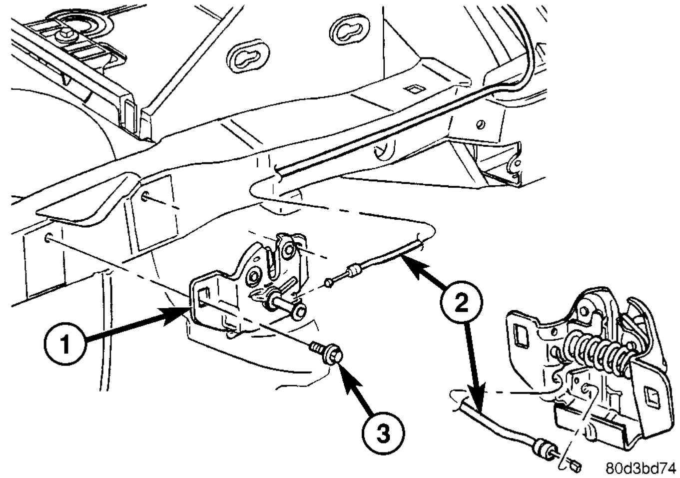

Fig. 3 LATCH

1 - HOOD LATCH
2 - HOOD LATCH CABLE
3 - BOLTS (2)

INSTALLATION

(1) Connect the hood latch cable.

(2) Install the latch lining up the marks made previously and install the bolts.

(3) Tighten the bolts to 11 N·m (8 ft. lbs.).

(4) Check hood fit and adjust if required. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

LATCH RELEASE CABLE/ HANDLE ASSEMBLY

REMOVAL

(1) Remove the hood latch. (Refer to 23 - BODY/HOOD/LATCH - REMOVAL)

(2) Remove the batter tray. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL)

(3) Disconnect the three cable push pin fasteners.

(4) From inside the cab loosen the two handle screws and disconnect the handle from the instrument panel bracket.

(5) Separate the grommet at the cowl panel and remove cable through the cab.

INSTALLATION

(1) Route the cable/handle assembly through the cowl panel and install the grommet.

(2) Position the handle onto the instrument panel bracket and tighten the screws.

(3) Route the cable along the fender rails and install the three push pin fasteners.

(4) Install the latch. (Refer to 23 - BODY/HOOD/LATCH - INSTALLATION)

(5) Install the battery tray. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION)

LATCH STRIKER / SECONDARY CATCH

REMOVAL

(1) Disconnect and remove the secondary release handle. (Fig. 4)

(2) Remove the two bolts and remove the striker/catch assembly.

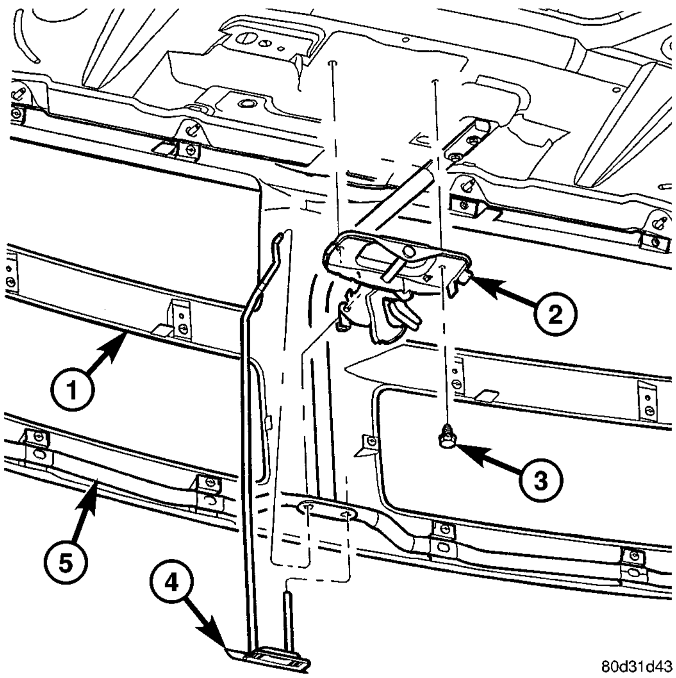

Fig. 4 HOOD LATCH STRIKER/SECONDARY CATCH

1 - GRILLE
2 - LATCH STRIKER/SECONDARY CATCH
3 - BOLTS (2)
4 - SECONDARY CATCH RELEASE HANDLE
5 - GRILLE FRAME

INSTALLATION

(1) Install the latch striker/secondary catch and install the bolts.

(2) Tighten the bolts to 11 N·m (8 ft. lbs.).

(3) Install the release handle and connect to the secondary catch.

(4) Check the hood fit and adjust if required. (Refer to 23 - BODY/BODY STRUCTURE/GAP AND FLUSH - SPECIFICATIONS)

SUPPORT CYLINDER

REMOVAL

NOTE: The support cylinders can be replaced one at a time.

(1) Open the hood and support.

NOTE: Lift the clips only enough to release the ball studs. (Fig. 6)

(2) Using a small flat bladed tool, or equivalent, release the upper retaining clips while pulling the ball socket away from the ball stud. (Fig. 5)

CAUTION: Do not pull the supports from the middle while removing.

(3) Pulling at the ends only, remove the support cylinder.

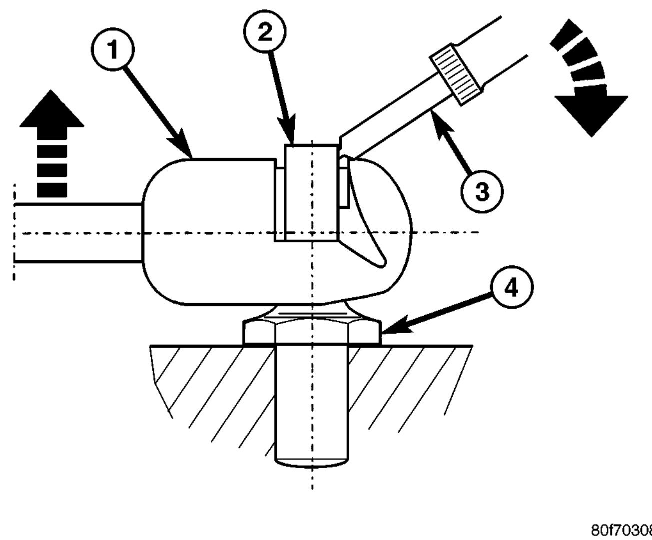

Fig. 5 UPPER SUPPORT CYLINDER REMOVAL - TYPICAL

1 - BALL SOCKET
2 - RETAINING CLIP
3 - FLAT BLADED TOOL
4 - BALL STUD

SUPPORT CYLINDER (Continued)

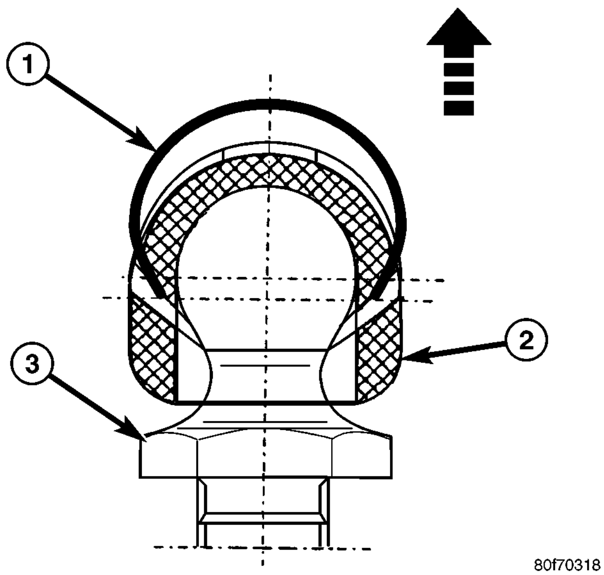

Fig. 6 UPPER SUPPORT CYLINDER RETAINING CLIP

1 - RETAINING CLIP
2 - BALL SOCKET
3 - BALL STUD

INSTALLATION

(1) Make sure the retaining clips are seated into the ball socket fully.

CAUTION: Do not install the support cylinders by pressing at the center of the cylinder. Press the ends only.

(2) Install the support cylinder over the ball studs with the thin end connected to the body side of the hinge and the retaining clips snapping into place.

INSTRUMENT PANEL

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CLUSTER BEZEL

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the headlamp switch bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SWITCH BEZEL - REMOVAL)

(2) Remove the center bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL)

(3) Remove the two top screws. (Fig. 1)

(4) Using a trim stick C-4755 or equivalent, separate the two lower clips.

(5) Disengage the two top attachment bosses and remove the bezel.

INSTALLATION

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(1) Position the cluster bezel over the cluster and seat the outer bosses over the posts on the left and right sides.

CLUSTER BEZEL (Continued)

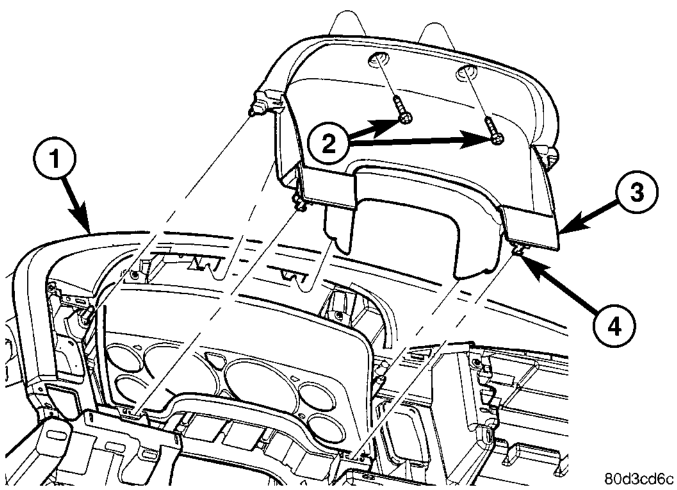

Fig. 1 CLUSTER BEZEL

1 - DASH PANEL
2 - SCREWS (2)
3 - CLUSTER BEZEL
4 - CLIP FASTENERS (2)

(2) Snap the top edge of the bezel into place fully.

(3) Seat the two bottom clips fully.

(4) Install the two top screws.

(5) Install the center bezel (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION)

(6) Install the headlamp switch bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL SWITCH BEZEL - INSTALLATION)

ASH RECEIVER

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Open ash receiver and place hand inside. (Fig. 2)

(2) Apply force with an **abrupt** downward motion and roll rearward. (Fig. 3)

(3) Dislodge and roll ash receiver out of panel to remove.

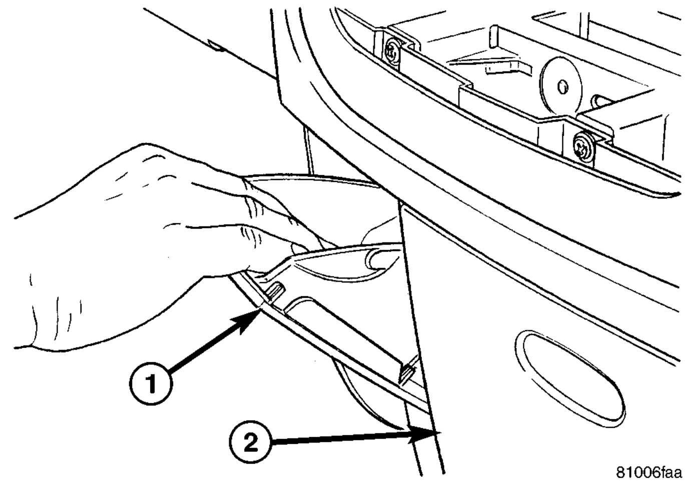

Fig. 2 ASH RECEIVER

1 - ASH RECEIVER
2 - CUP HOLDER

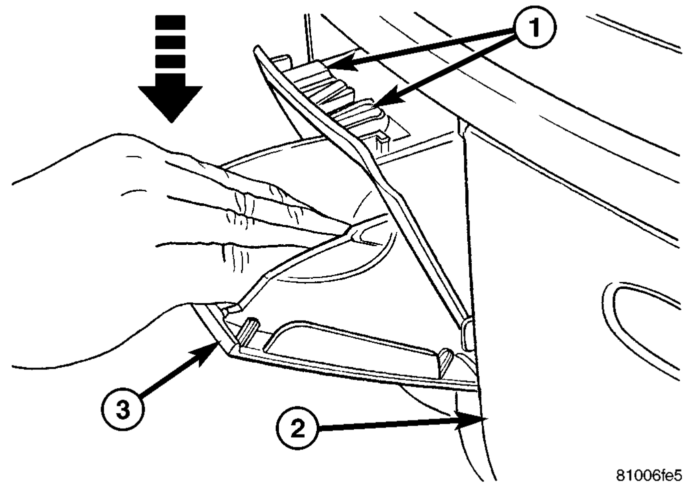

Fig. 3 ASH RECEIVER REMOVAL

1 - LOCKING TABS
2 - ASH RECEIVER
3 - CUP HOLDER

ASH RECEIVER (Continued)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Seat the bottom of the receiver into position.

(2) Pivot the receiver forward and seat the retaining clips fully.

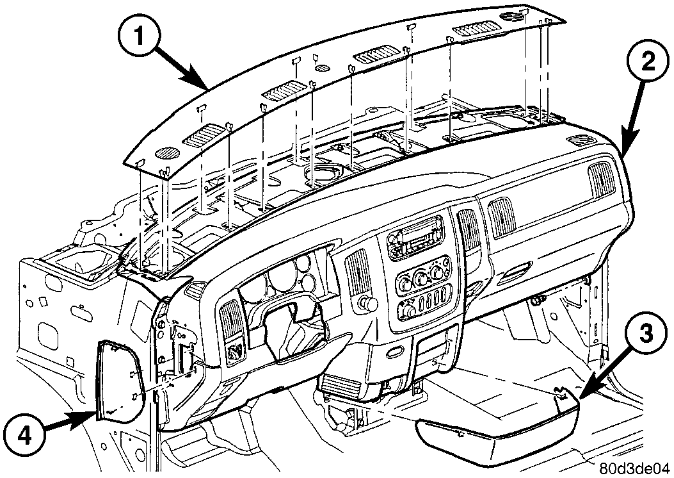

Fig. 4 INSTRUMENT PANEL COVERS

1 - TOP COVER
2 - INSTRUMENT PANEL
3 - AIR BAG MODULE COVER
4 - SIDE COVER

CUP HOLDER

REMOVAL

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(1) Remove the center bezel.(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL)

(2) Remove the airbag control module trim cover. (Fig. 4)

(3) Open the cupholder and fold down the inner panel.

(4) Remove the two inner screws. (Fig. 5)

(5) Remove the remaining four screws and remove the cup holder. (Fig. 6)

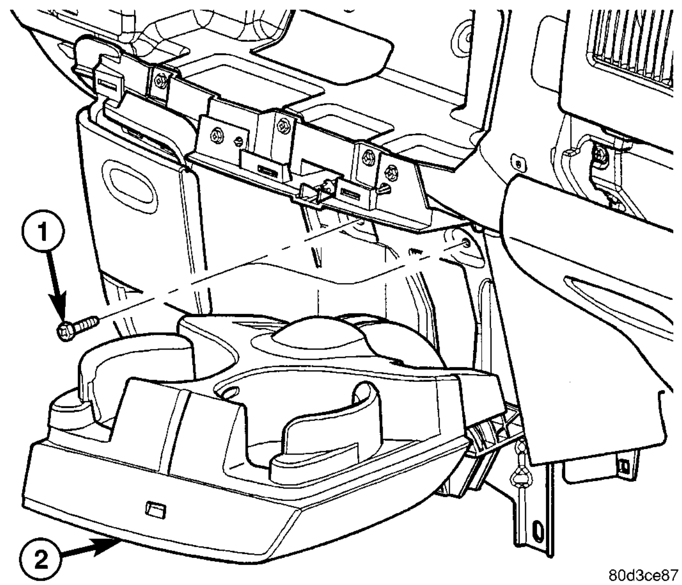

Fig. 5 CUPHOLDER - INNER FASTENERS

1 - CUPHOLDER
2 - INNER SCREWS (2)

INSTALLATION

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CUP HOLDER (Continued)

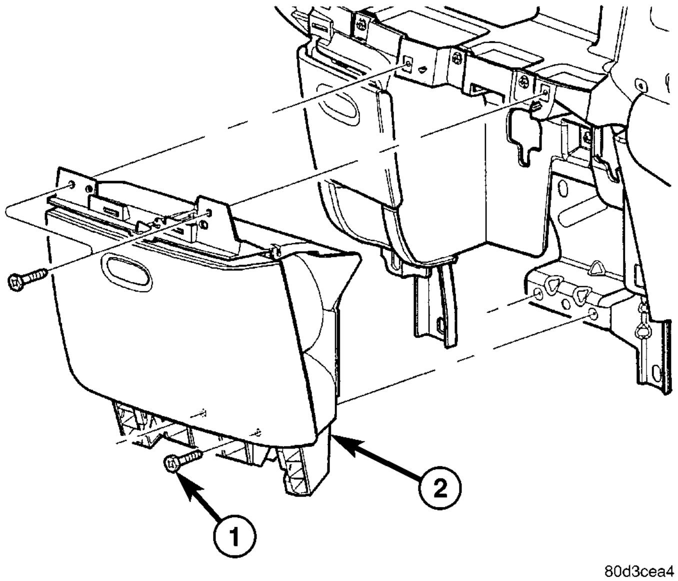

Fig. 6 CUPHOLDER - OUTER FASTENERS

1 - SCREWS (4)
2 - CUPHOLDER

(1) Install the cupholder and install the two upper screws.
(2) Install the lower two screws
(3) Fold down the inner cover and install the two inner screws.
(4) Install the center bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION)
(5) Install the airbag control module trim cover.

GLOVE BOX

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Partially open the glove box.
(2) From the inside of the box press down on the rearward edge of the bin and lower the glove box fully past the stops.
(3) Lift the box assembly off of the hinges and remove.

INSTALLATION

(1) Engage the glove box hinges and partially close.
(2) From the inside of the box press down on the rearward edge of the bin and raise the glove box fully past the stops.
(3) Check for proper glove box operation.

GLOVE BOX LATCH

REMOVAL

(1) Remove the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL)
(2) Remove the 11 screws and separate the box and inner panel from the outer door.
(3) Remove the two latch screws and remove the latch.

INSTALLATION

(1) Install the latch and install the two screws.
(2) Install the door inner cover and box and install the 11 screws.
(3) Install the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION)

INSTRUMENT PANEL ASSEMBLY

REMOVAL

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(1) Remove the left a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM/GRAB HANDLE - REMOVAL)

INSTRUMENT PANEL ASSEMBLY (Continued)

(2) Remove the top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - REMOVAL)

(3) Disconnect the headliner harness electrical connector at the a-pillar.

(4) Using a trim stick C-4755 or equivalent, from the notch on the bottom, remove the left side cover. (Fig. 20)

(5) Remove the steering column. (Refer to 19 - STEERING/COLUMN - REMOVAL)

(6) Remove the two bolts at the column support bracket. (Fig. 7)

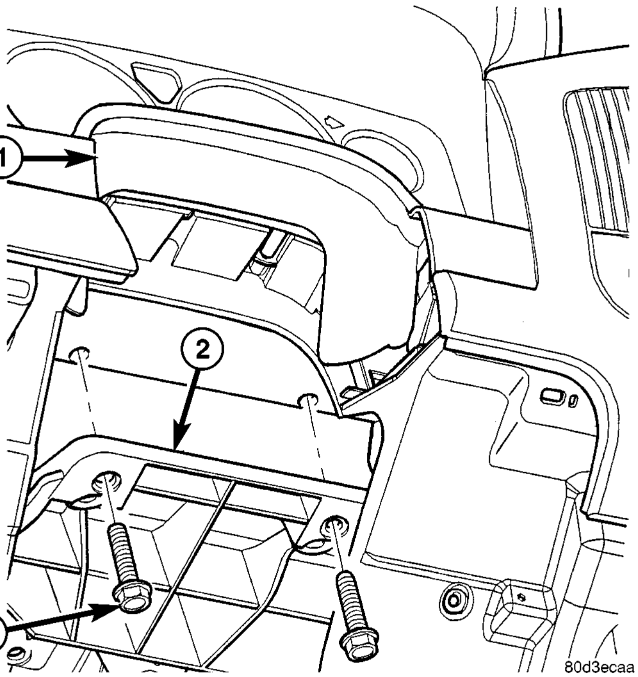

Fig. 7 COLUMN SUPPORT

1 - INSTRUMENT PANEL CLUSTER BEZEL
2 - STEERING COLUMN SUPPORT BRACKET
3 - BOLTS

(7) Remove the left cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)

(8) Remove the instrument panel drivers side bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL DRIVERS SIDE BEZEL - REMOVAL)

(9) Remove the left side mounting bolts. (Fig. 8)

(10) Disconnect the wire harness electrical connectors above the brake pedal. (Fig. 9)

(11) Loosen the screws and remove the hood release handle from the bracket.

(12) Disconnect the park brake release handle actuator rod.

(13) Remove the air bag control module trim cover, if equipped. (Fig. 20)

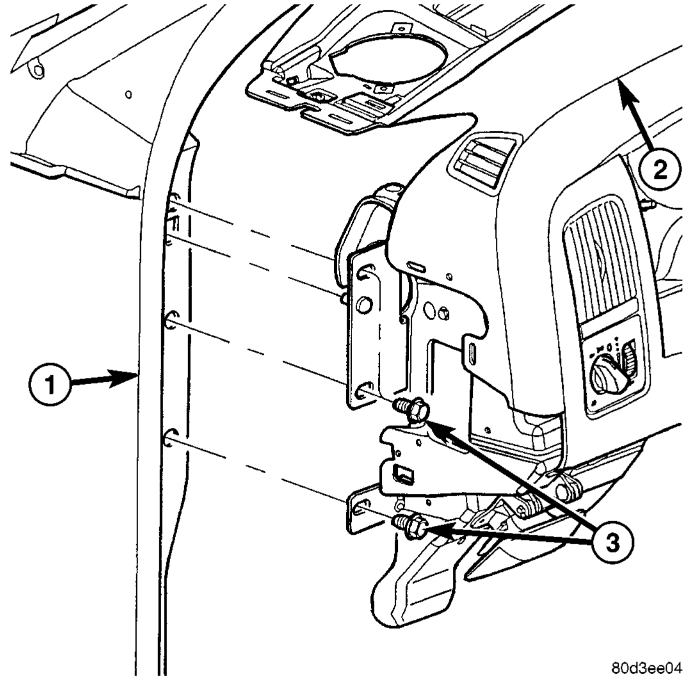

Fig. 8 LEFT SIDE MOUNTING

1 - A-PILLAR
2 - DASH PANEL
3 - MOUNTING BOLTS (3)

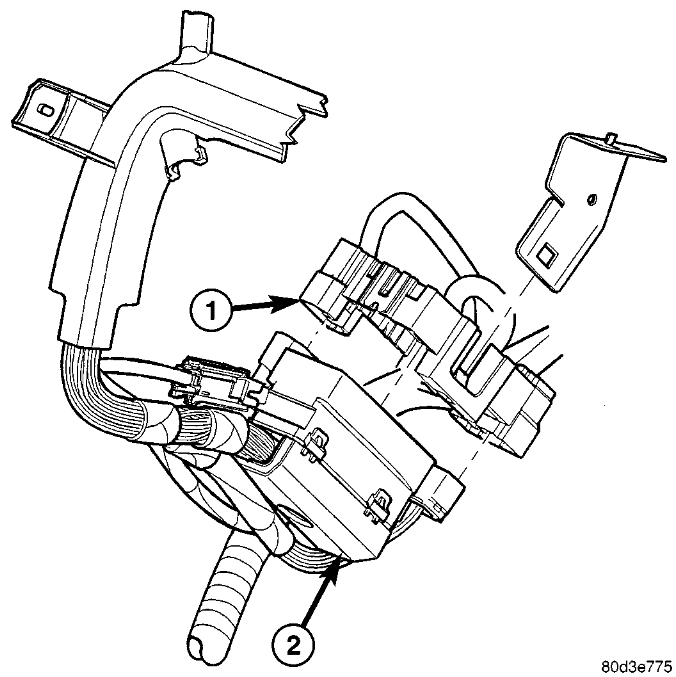

Fig. 9 WIRE HARNESS CONNECTORS

1 - BULKHEAD CONNECTORS
2 - INSTRUMENT PANEL HARNESS CONNECTORS

(14) Remove the floor console, if equipped. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(15) Remove the center bracket bolts. (Fig. 10)

INSTRUMENT PANEL ASSEMBLY (Continued)

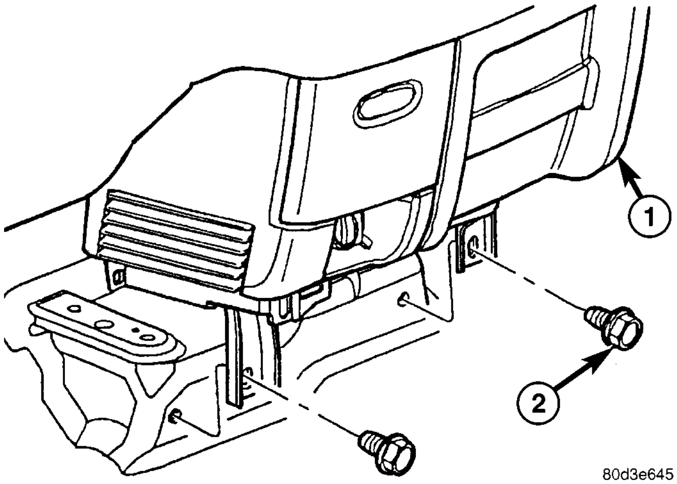

Fig. 10 CENTER MOUNTING BOLTS

1 - INSTRUMENT PANEL
2 - BOLTS

(16) Disconnect the air bag control module electrical connector.

(17) Remove the right cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)

(18) Disconnect the two electrical connectors. (Fig. 11)

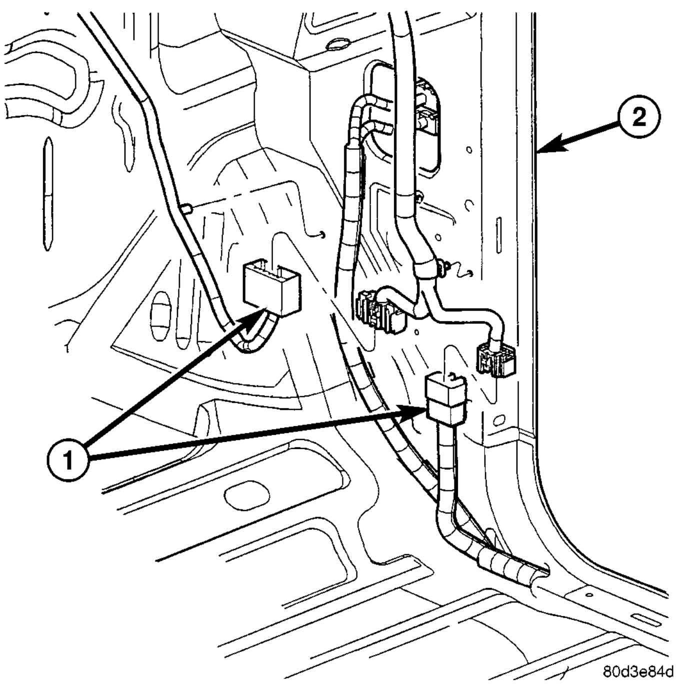

Fig. 11 RIGHT WIRE HARNESS CONNECTIONS

1 - COWL SIDE PANEL
2 - ELECTRICAL CONNECTORS

(19) Disconnect the radio antenna. (Fig. 12)

(20) Remove the one HVAC screw. (Fig. 13)

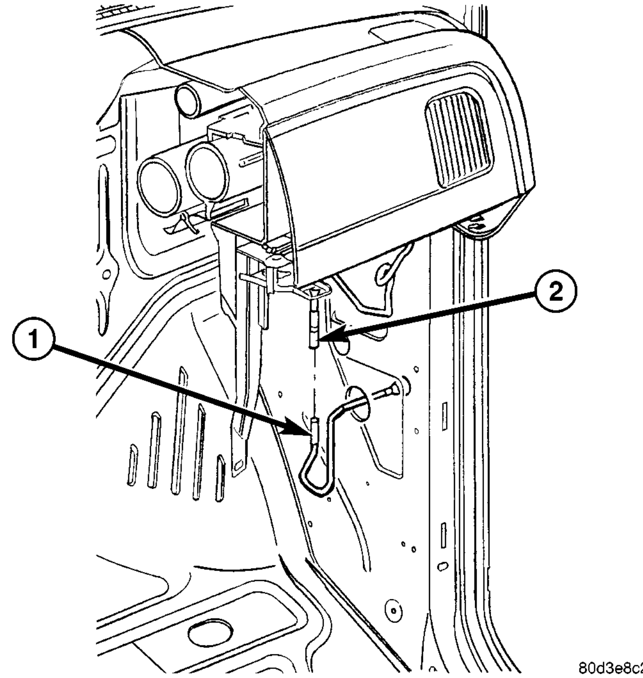

Fig. 12 ANTENNA CONNECTION

1 - ANTENNA CABLE
2 - RADIO CABLE

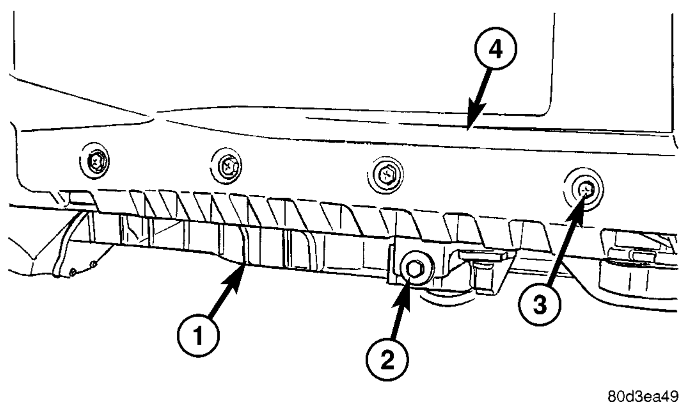

Fig. 13 HVAC/INSTRUMENT PANEL MOUNTING

1 - HVAC
2 - MOUNTING SCREW
3 - LOWER SURROUND SCREWS
4 - GLOVE BOX OPENING

(21) Using a trim stick C-4755 or equivalent, from the notch on the bottom, remove the right end cap. (Fig. 14)

(22) Remove the right a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM/GRAB HANDLE - REMOVAL)

(23) Remove the two right side mounting bolts on the a-pillar and one right mounting bolt on the cowl side panel. (Fig. 14)

INSTRUMENT PANEL ASSEMBLY (Continued)

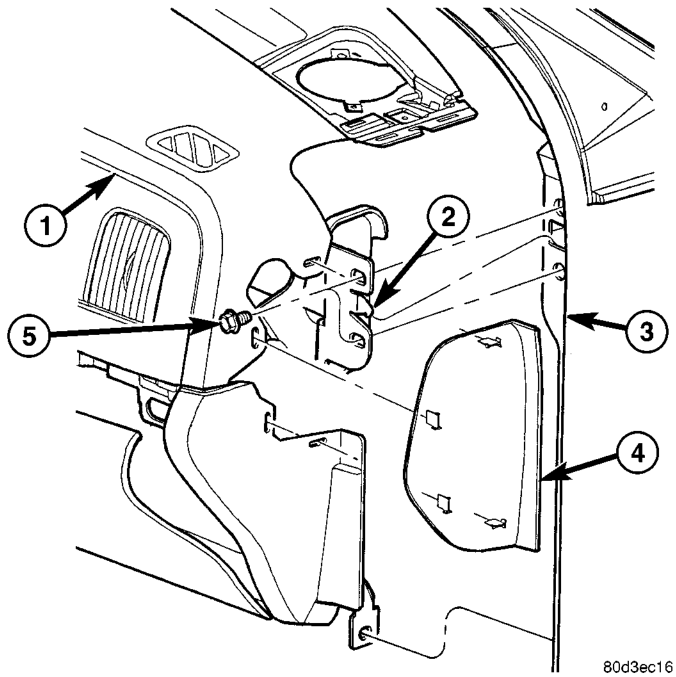

Fig. 14 PASSENGER SIDE MOUNTING

1 - DASH PANEL
2 - RIGHT SIDE MOUNTING HOOK
3 - A-PILLAR
4 - END CAP
5 - MOUNTING BOLTS (3)

(24) Remove the four top instrument panel screws. (Fig. 15)

(25) Remove the two top instrument panel bolts and remove the instrument panel.

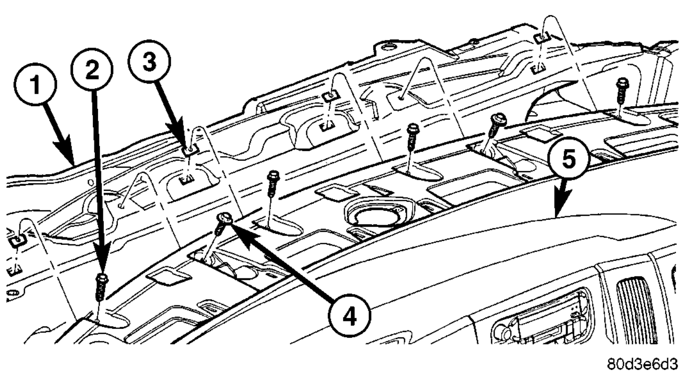

Fig. 15 UPPER COWL PANEL BOLTS

1 - COWL PANEL
2 - FORWARD MOST SCREWS (4)
3 - BOLT INSERTS (6)
4 - REARWARD BOLTS (2)
5 - DASH PANEL

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the instrument panel assembly in vehicle.

(2) Route the park brake release rod through the instrument panel. (Fig. 16)

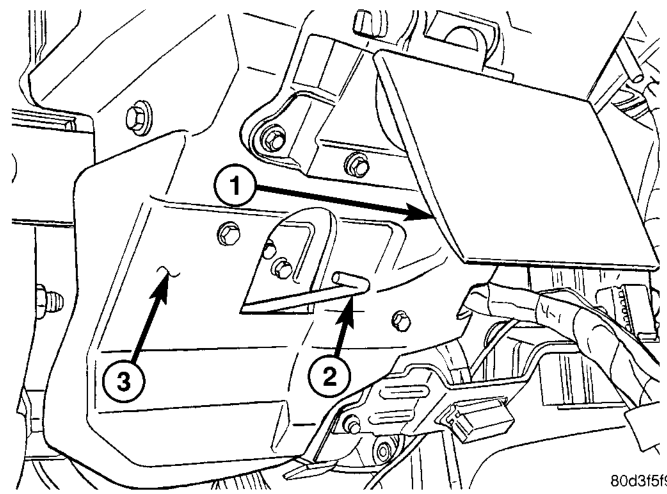

Fig. 16 BRAKE RELEASE ROD

1 - PARK BRAKE RELEASE HANDLE
2 - PARK BRAKE RELEASE ROD
3 - INSTRUMENT PANEL

(3) Install the instrument panel onto the left side guide pin and the right side guide hook.

(4) Install the left side mounting bolts and tighten to 12 N·m (9 ft. lbs.).

(5) Install the instrument panel drivers side bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL DRIVERS SIDE BEZEL - INSTALLATION)

(6) Install the left cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)

(7) Connect the headliner harness electrical connector at the a-pillar.

(8) Install the left a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION)

(9) Position the left end cap and seat the attachment clips fully.

(10) Install the right side mounting bolts on the a-pillar and one right mounting bolt on the cowl side panel and tighten to 12 N·m (9 ft. lbs.).

INSTRUMENT PANEL ASSEMBLY (Continued)

(11) Install the right a-pillar trim panel. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION)

(12) Position the right end cap and seat the attachment clips fully.

(13) Install the one HVAC mounting screw.

(14) Connect the radio antenna.

(15) Connect the two electrical connectors at the right cowl panel.

(16) Install the right cowl trim cover. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)

(17) Connect the air bag control module electrical connector.

(18) Install the center bracket bolts and tighten to 12 N·m (9 ft. lbs.).

(19) Install the floor console, if equipped. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(20) Install the air bag control module cover, if equipped.

(21) Connect the park brake release handle actuator rod.

(22) Install the hood release handle and tighten the screws.

(23) Install the two bolts at the column support bracket and tighten to 14 N·m (10 ft. lbs.).

(24) Install the steering column. (Refer to 19 - STEERING/COLUMN - INSTALLATION)

(25) Connect the wire harness electrical connectors above the brake pedal.

(26) Install the two top instrument panel bolts and tighten to 12 N·m (9 ft. lbs.).

(27) Install the four top instrument panel screws.

(28) Install the instrument panel top cover. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL TOP COVER - INSTALLATION)

INSTRUMENT PANEL HEADLAMP SWITCH BEZEL

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Using a trim stick C-4755 or equivalent, release the top clips on the steering column opening cover and the lower drivers side bezel.

(2) Using a trim stick C-4755 or equivalent, release the switch bezel. (Fig. 17)

(3) Disconnect the electrical connector and remove the bezel.

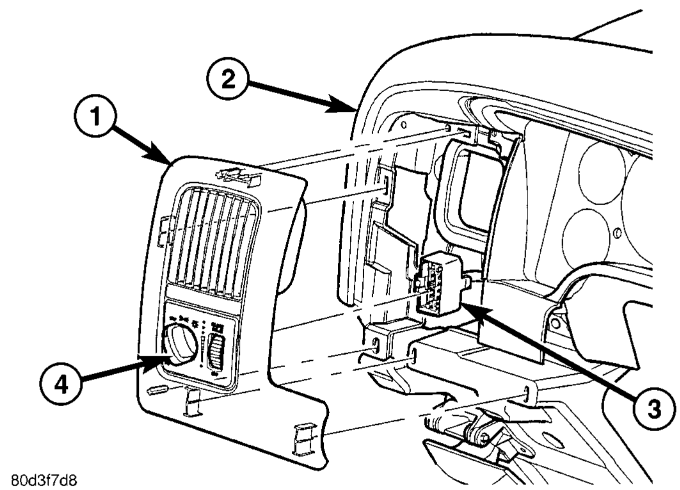

Fig. 17 HEADLIGHT SWITCH BEZEL

1 - SWITCH BEZEL
2 - INSTRUMENT PANEL
3 - ELECTRICAL CONNECTOR
4 - HEADLIGHT SWITCH

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Connect the electrical connector.

(2) Position the switch bezel and seat the attachment clips fully.

(3) Seat the clips on the steering column opening cover and the lower drivers side bezel fully.

INSTRUMENT PANEL CENTER BEZEL

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: When removing and installing the center bezel, use tape or other suitable material to protect the cupholder and ash receiver from damage.

(1) Disconnect and isolate the negative battery cable.
(2) Open the ashtray and cup holder.
(3) Remove the one center bezel retaining screw (Fig. 18).

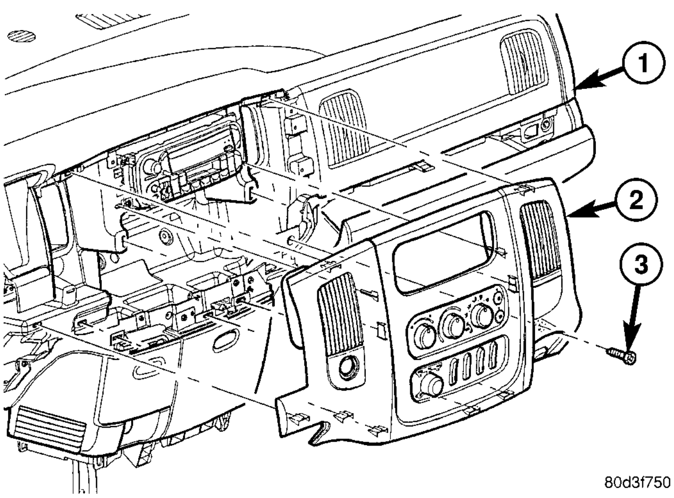

Fig. 18 CENTER BEZEL

1 - INSTRUMENT PANEL
2 - CENTER BEZEL
3 - SCREW

CAUTION: Extreme care must be taken not to scratch the ashtray door while removing the instrument panel center bezel. Apply masking tape to the ashtray door if the center bezel is not being completely removed from the instrument panel.

(4) Using a trim stick C-4755 or equivalent, gently pry the center bezel free from the instrument panel.
(5) Working behind the center bezel, disconnect all electrical connectors and remove the bezel.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CAUTION: When removing and installing the center bezel, use tape or other suitable material to protect the cupholder and ash receiver from damage.

(1) Working behind the center bezel, connect all electrical connectors.
(2) Gently install the center bezel on the instrument panel by pushing straight in and seat the attachment clips fully.
(3) Install the one center bezel screw.
(4) Connect the negative battery cable.

INSTRUMENT PANEL DRIVER SIDE BEZEL

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

INSTRUMENT PANEL DRIVER SIDE BEZEL (Continued)

(1) Using a trim stick C-4755 or equivalent, at notch in the bottom, remove the drivers side endcap.

(2) Remove the drivers side cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)

(3) Remove the two screws. (Fig. 19)

(4) Using a trim stick C-4755 or equivalent, release the top clips and tilt the bezel down.

(5) Disconnect the adjustable pedal switch electrical connector, if equipped.

(6) Lower the bezel down fully and remove from the lower hooks.

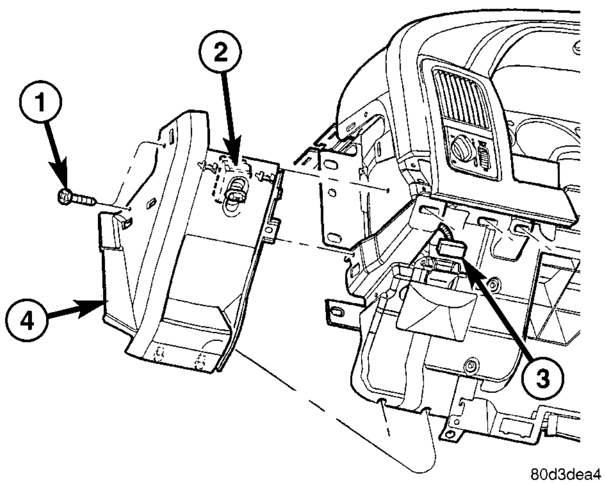

Fig. 19 LOWER DRIVERS SIDE BEZEL

1 - SCREWS (2)
2 - ADJUSTABLE PEDAL SWITCH
3 - PEDAL SWITCH ELECTRICAL CONNECTOR
4 - BEZEL

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the bezel onto the lower hooks and lift up.

(2) Connect the adjustable pedal switch electrical connector, if equipped.

(3) Seat the upper attachment clips fully.

(4) Install the two screws.

(5) Position the endcap and seat fully.

(6) Install the drivers side cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)

INSTRUMENT PANEL TOP COVER

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Using a trim stick C-4755 or equivalent, pry up on the rear of the top cover and release the attachment clips.

(2) Pull the top cover backwards to release the remaining clips and remove the cover.

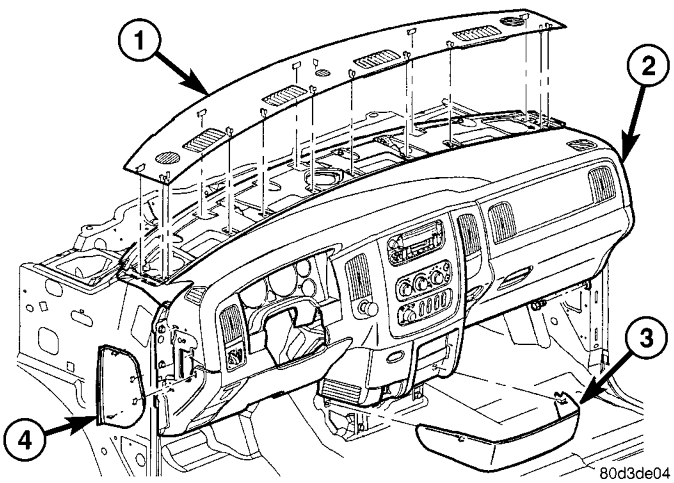

Fig. 20 INSTRUMENT PANEL COVERS

1 - TOP COVER
2 - INSTRUMENT PANEL
3 - AIR BAG MODULE COVER
4 - SIDE COVER

INSTRUMENT PANEL TOP COVER (Continued)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the top cover and fully seat the front clips by pushing the cover forward and down.
(2) Fully seat the rear clips.

INSTRUMENT PANEL LOWER SURROUND

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Using a trim stick C-4755 or equivalent, at notch in the bottom, remove the passenger side end-cap.
(2) Remove the passenger side cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)
(3) Remove the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - REMOVAL)
(4) Remove the cup holder, if equipped. (Refer to 23 - BODY/INSTRUMENT PANEL/CUP HOLDER - REMOVAL)
(5) Remove the storage bin, if equipped. (Refer to 23 - BODY/INSTRUMENT PANEL/STORAGE BIN - REMOVAL)
(6) Remove the ash receiver. (Refer to 23 - BODY/INSTRUMENT PANEL/ASH RECEIVER - REMOVAL)
(7) Remove the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL)
(8) Remove the 14 screws around the glove box opening.
(9) Remove the nine remaining screws around the cup holder/storage bin and ash receiver area and remove the surround.
(10) Disconnect the 12v power outlet electrical connector.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install the surround and install all 23 screws.
(2) Install the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION)
(3) Install the storage bin, if equipped. (Refer to 23 - BODY/INSTRUMENT PANEL/STORAGE BIN - INSTALLATION)
(4) Install the cup holder, if equipped. (Refer to 23 - BODY/INSTRUMENT PANEL/CUP HOLDER - INSTALLATION)
(5) Install the glove box. (Refer to 23 - BODY/INSTRUMENT PANEL/GLOVE BOX - INSTALLATION)
(6) Install the ash receiver. (Refer to 23 - BODY/INSTRUMENT PANEL/ASH RECEIVER - INSTALLATION)
(7) Install the passenger side cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)
(8) Position the passenger side end cap and seat fully.

STEERING COLUMN OPENING COVER

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the two lower screws. (Fig. 21)

(2) Using a trim stick C-4755 or equivalent, release the upper clips and remove the cover.

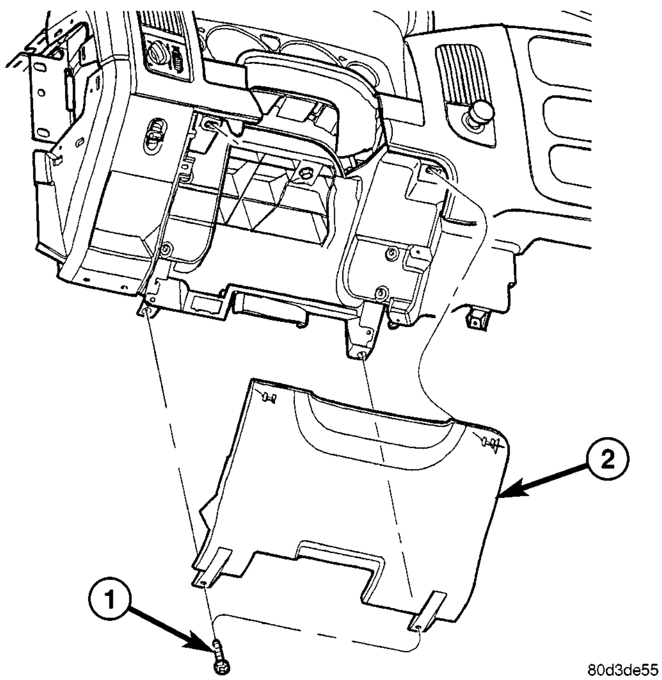

Fig. 21 STEERING COLUMN OPENING COVER

1 - SCREWS (2)
2 - COVER

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the cover and seat the upper clips fully.

(2) Install the two lower screws.

STEERING COLUMN OPENING SUPPORT BRACKET

REMOVAL

(1) Remove the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - REMOVAL)

(2) Remove the two screws and remove the diagnostic connector.

(3) Loosen the screws and remove the hood release handle from the bracket.

(4) Remove the two bracket screws and slide upward off the locating tabs to remove. (Fig. 22)

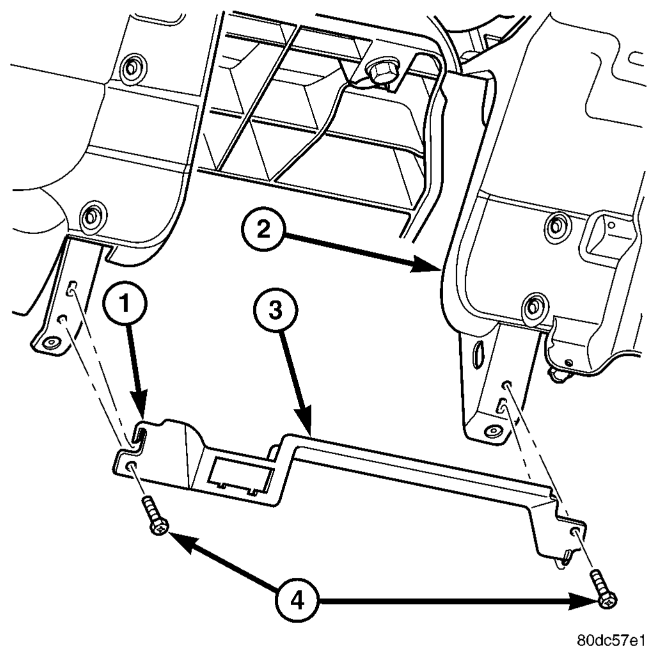

Fig. 22 COLUMN OPENING BRACKET

1 - LOCATING TABS
2 - INSTRUMENT PANEL
3 - REINFORCEMENT BRACKET
4 - SCREWS (2)

STEERING COLUMN OPENING SUPPORT BRACKET (Continued)

INSTALLATION

(1) Position the bracket onto the locating tabs and slide down.

(2) Install the two screws.

(3) Install the diagnostic connector and install the two screws.

(4) Install the hood release handle and tighten the screws.

(5) Install the steering column opening cover. (Refer to 23 - BODY/INSTRUMENT PANEL/STEERING COLUMN OPENING COVER - INSTALLATION)

STORAGE BIN

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the center bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL)

(2) Remove the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(3) Remove the four screws and remove the bin. (Fig. 23)

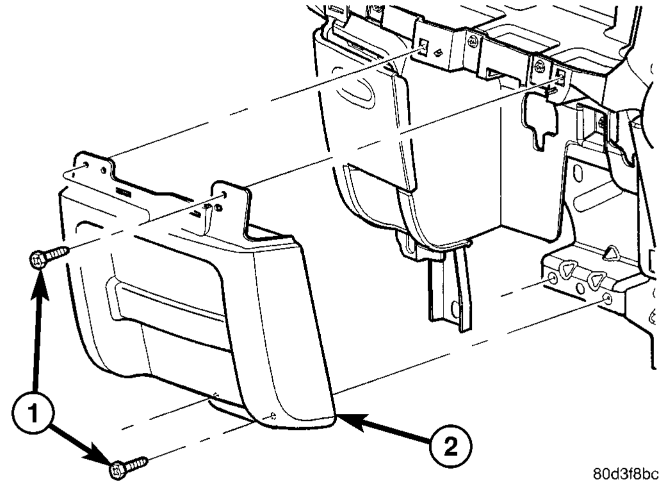

Fig. 23 STORAGE BIN

1 - SCREWS (4)
2 - STORAGE BIN

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, SEAT BELT TENSIONER, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Install the storage bin and install the four screws.

(2) Install the floor console. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(3) Install the center bezel. (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION)

INTERIOR

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INTERIOR

CAUTION

CAUTION:: Do not attempt to remove interior trim panels/moldings without first removing the necessary adjacent panels. To avoid damaging the panels, ensure that all the screws and clips are removed before attempting to remove an interior trim panel/molding. Trim panels are somewhat flexible but can be damaged if handled improperly.

4WD FLOOR SHIFT BOOT

REMOVAL

(1) Using a small pry bar or equivalent, remove the insert, the nut and remove the shifter knob. (Fig. 2)

(2) Using a trim stick C-4755 or equivalent, pry up the boot from the console. (Fig. 1)

4WD FLOOR SHIFT BOOT (Continued)

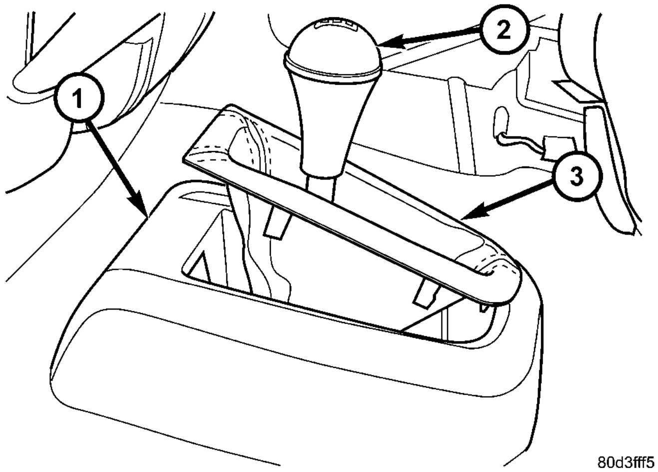

Fig. 1 SHIFTER BOOT

1 - CONSOLE
2 - SHIFTER KNOB
3 - SHIFTER BOOT

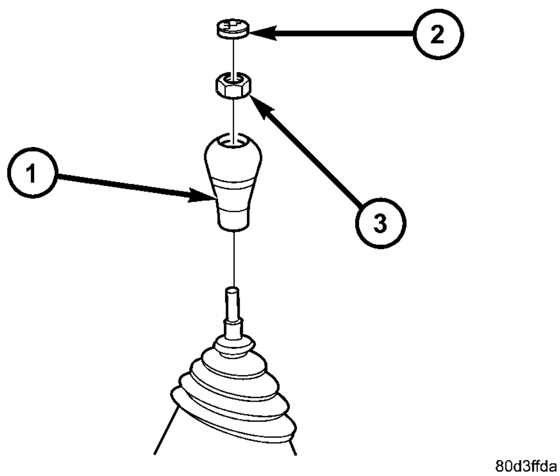

Fig. 2 SHIFTER KNOB

1 - SHIFTER KNOB
2 - INSERT
3 - NUT

INSTALLATION

(1) Position the shift boot over the shifter lever fully seat onto the console.

(2) Install the shifter knob and nut and tighten to 27 N·m (20 ft. lbs.).

(3) Position the insert and seat into the knob fully.

A-PILLAR TRIM/GRAB HANDLE

REMOVAL

(1) Open the trim plugs and remove the bolts. (Fig. 3)

(2) Remove the a-pillar trim/grab handle from the a-pillar.

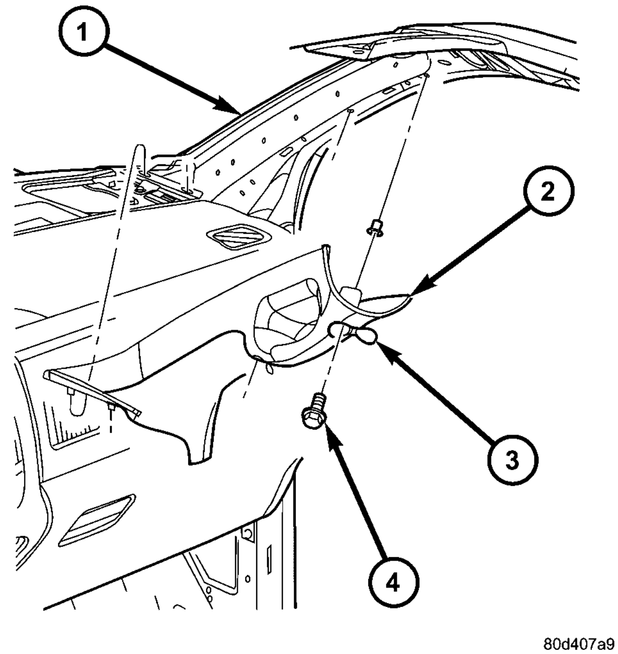

Fig. 3 A-PILLAR TRIM/GRAB HANDLE

1 - A-PILLAR
2 - A-PILLAR TRIM
3 - TRIM PLUG
4 - BOLTS (2)

INSTALLATION

(1) Position the bottom a-pillar locating tabs and install the a-pillar trim.

(2) Install the bolts and tighten to 6 N·m (55 in. lbs.).

(3) Close the trim plugs.

B-PILLAR LOWER TRIM

REMOVAL

(1) Remove the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL)

(2) Remove the cowl trim. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)

STANDARD CAB

(1) Remove the shoulder belt anchor bolt.

(2) Using a trim stick C-4755 or equivalent, remove the lower b-pillar trim. (Fig. 4)

QUAD CAB

(1) Remove the rear door sill trim. (Refer to 23 - BODY/INTERIOR/REAR DOOR SILL TRIM COVER - REMOVAL)

(2) Using a trim stick C-4755 or equivalent, remove the lower b-pillar trim.

B-PILLAR LOWER TRIM (Continued)

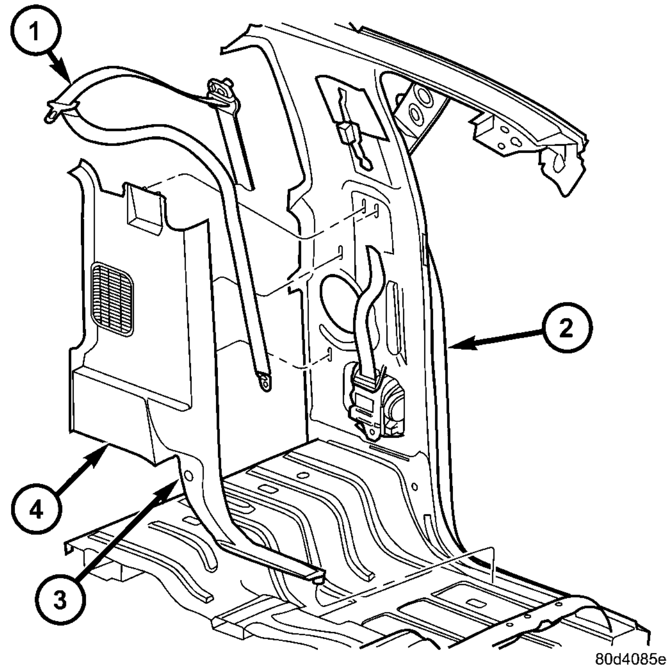

Fig. 4 LOWER B-PILLAR TRIM - STANDARD CAB

1 - SEAT BELT
2 - B-PILLAR
3 - SEAT BELT ANCHOR HOLE
4 - LOWER B-PILLAR TRIM

(3) Pull seat belt out of the trim panel through the slot provided. (Fig. 5)

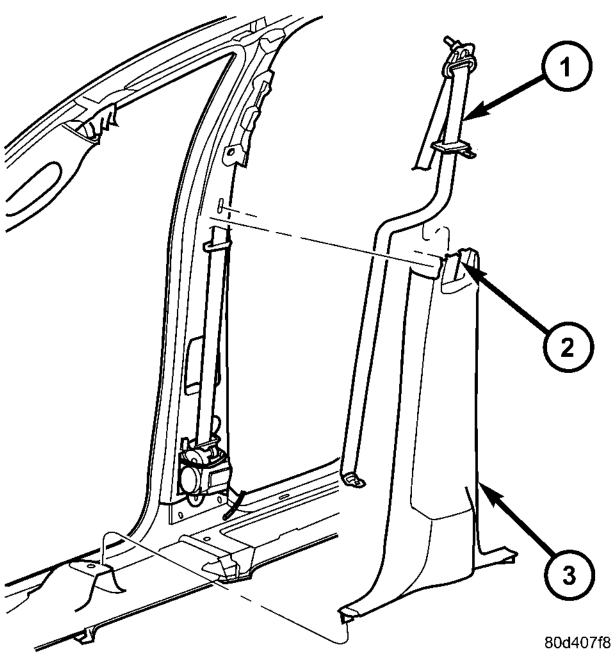

Fig. 5 LOWER B-PILLAR TRIM - QUAD CAB

1 - SEAT BELT
2 - SEAT BELT SLOT
3 - LOWER B-PILLAR TRIM

INSTALLATION

QUAD CAB

(1) Route the shoulder belt through the slot in the trim.

(2) Position the trim and seat the attachment clips fully.

(3) Install the rear door sill trim. (Refer to 23 - BODY/INTERIOR/DOOR SILL TRIM COVER - INSTALLATION)

STANDARD CAB

(1) Position the trim and seat the attachment clips fully.

(2) Install the seat belt anchor and bolt and tighten to 40 N·m (30 ft. lbs.).

BOTH BODY STYLES

(1) Install the cowl trim. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)

(2) Install the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION)

B-PILLAR UPPER TRIM

REMOVAL

(1) Remove the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TURNING LOOP ADJUSTER - REMOVAL)

(2) Open the trim plugs and remove the grab handle bolts, if equipped. (Fig. 6)

(3) Using a trim stick C-4755 or equivalent, remove the upper b-pillar trim. (Fig. 7) or (Fig. 8)

INSTALLATION

(1) Position the upper b-pillar trim and seat the attachment clips fully.

(2) Install the grab handle bolts and tighten to 6 N·m (55 in. lbs.).

(3) Close the grab handle trim plugs.

(4) Install the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TURNING LOOP ADJUSTER - INSTALLATION)

B-PILLAR UPPER TRIM (Continued)

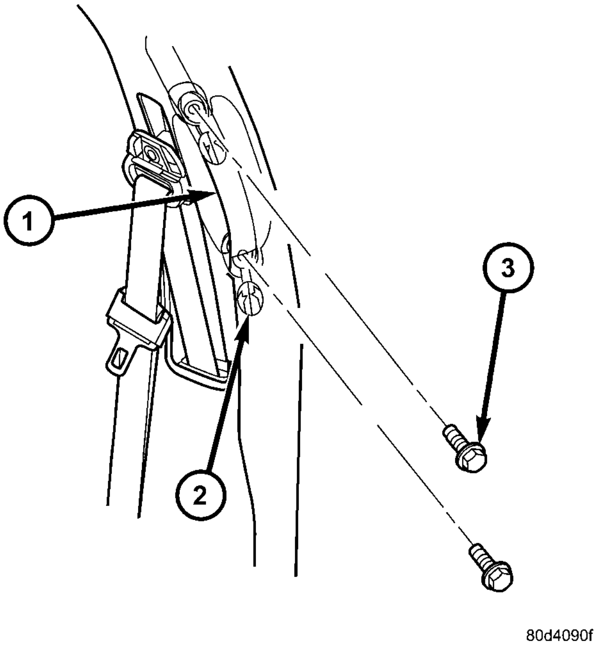

Fig. 6 GRAB HANDLE

1 - GRAB HANDLE
2 - TRIM PLUGS
3 - BOLTS

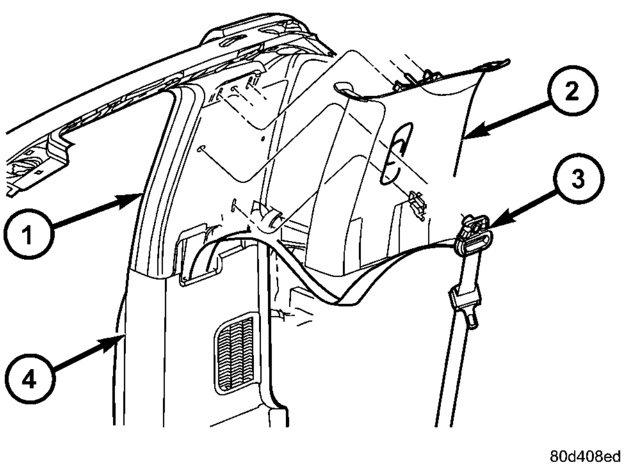

Fig. 7 UPPER B-PILLAR TRIM - STANDARD CAB

1 - B-PILLAR
2 - UPPER B-PILLAR TRIM
3 - SEAT BELT TURNING LOOP
4 - LOWER B-PILLAR TRIM

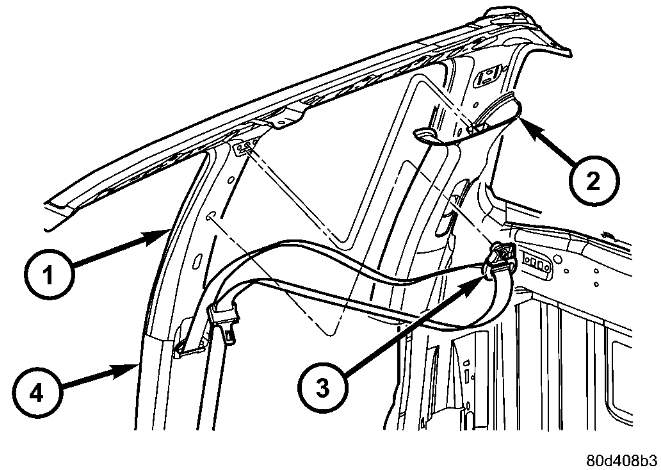

Fig. 8 UPPER B-PILLAR TRIM - QUAD CAB

1 - B-PILLAR
2 - UPPER B-PILLAR TRIM
3 - TURNING LOOP
4 - LOWER B-PILLAR TRIM

CARPETS AND FLOOR MATS

REMOVAL

(1) Remove the front seats. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)

(2) Remove the rear seats, if equipped. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)

(3) Remove the floor console, if equipped. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)

(4) Remove the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(5) Using a trim stick C-4755 or equivalent, remove the rear cup holder, if equipped.

(6) Remove the jack assembly.

(7) Remove the carpet.

INSTALLATION

(1) Install the carpet.

(2) Install the jack assembly.

(3) Install the rear cup holder, if equipped.

(4) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

(5) Install the floor console, if equipped. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

(6) Install the rear seats, if equipped. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)

(7) Install the front seats. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

COAT HOOK

REMOVAL

(1) Using a trim stick C-4755 or equivalent, pry down the release clip and remove the hook. (Fig. 9)

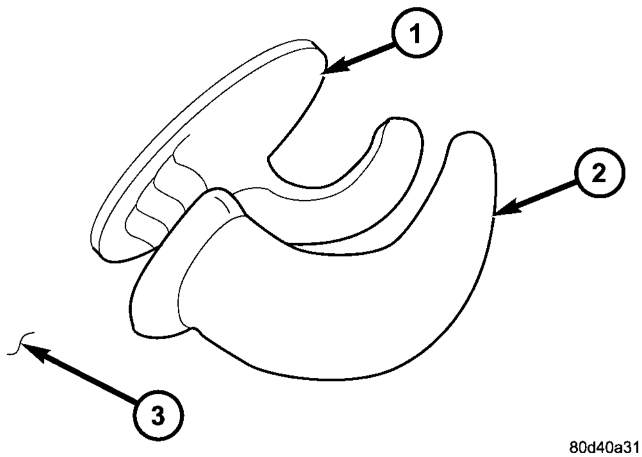

Fig. 9 COAT HOOK

1 - COAT HOOK
2 - RELEASE CLIP
3 - HEADLINER

INSTALLATION

(1) Snap the coat hook into the sheet metal and seat the base of the coat hook fully.

(2) Push the upper portion in until it snaps or seats to the base.

COWL TRIM

REMOVAL

(1) Using a trim stick C-4755 or equivalent, remove the cowl trim panel. (Fig. 10)

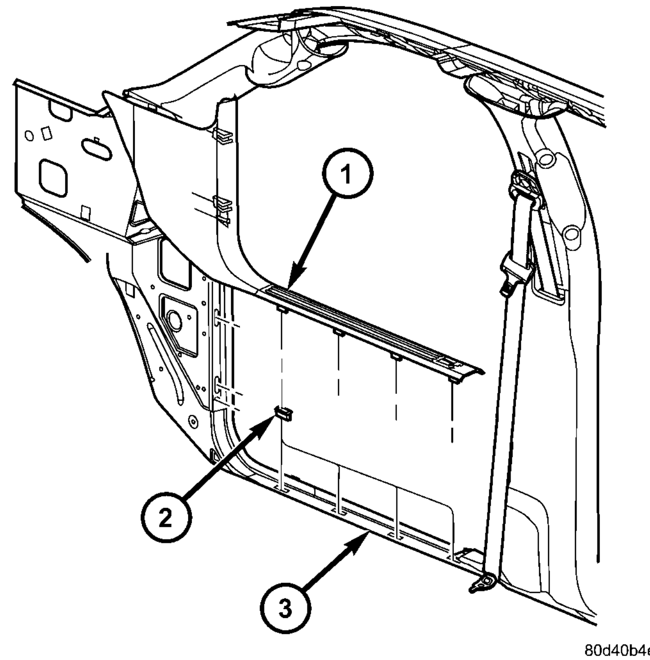

Fig. 10 COWL/SILL TRIM PANEL

1 - COWL TRIM PANEL
2 - CLIP INSERTS
3 - DOOR SILL

INSTALLATION

(1) Position the cowl trim and seat the attachment clips fully.

C-PILLAR LOWER TRIM

REMOVAL

(1) Remove the upper c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - REMOVAL)

(2) Remove the seat belt anchor bolt. (Fig. 11)

(3) Using a trim stick C-4755 or equivalent, remove the lower c-pillar trim.

(4) Pull seat belt out of the trim panel through the slot provided.

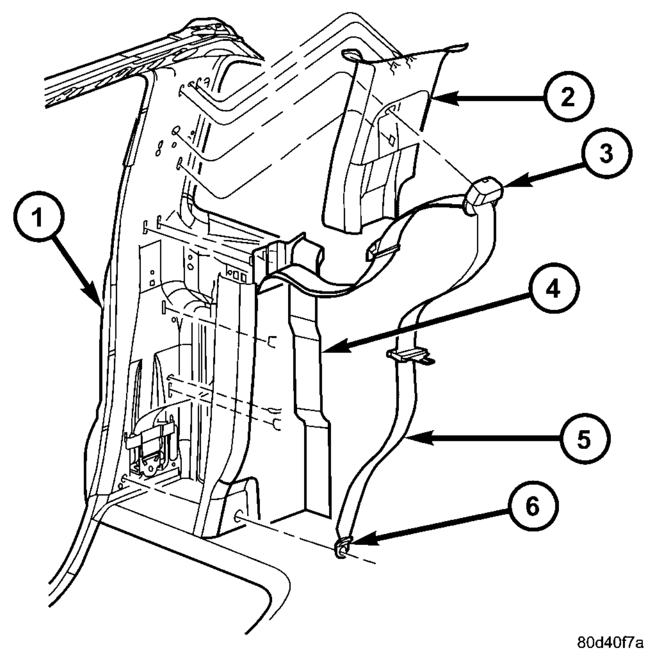

Fig. 11 C-PILLAR TRIM

1 - C-PILLAR
2 - UPPER C-PILLAR TRIM
3 - SEAT BELT TURNING LOOP
4 - LOWER C-PILLAR TRIM
5 - SEAT BELT
6 - SEAT BELT ANCHOR

C-PILLAR LOWER TRIM (Continued)

INSTALLATION

(1) Route the shoulder belt through the slot in the trim.

(2) Position the trim and seat the attachment clips fully.

(3) Install the seat belt anchor bolt and tighten to 40 N·m (30 ft. lbs.).

(4) Install the upper c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR UPPER TRIM - INSTALLATION)

C-PILLAR UPPER TRIM

REMOVAL

(1) Remove the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TURNING LOOP ADJUSTER - REMOVAL)

(2) Using a trim stick C-4755 or equivalent, remove the upper c-pillar trim. (Fig. 11)

INSTALLATION

(1) Position the upper c-pillar trim and seat the attachment clips fully.

(2) Install the seat belt turning loop. (Refer to 8 - ELECTRICAL/RESTRAINTS/SEAT BELT TURNING LOOP ADJUSTER - INSTALLATION)

FLOOR CONSOLE

REMOVAL

(1) Remove the 4WD shifter boot. (Refer to 23 - BODY/INTERIOR/4WD FLOOR SHIFT BOOT - REMOVAL)

(2) Using a trim stick C-4755 or equivalent, pry up the transmission shifter boot from the console.

(3) Remove the transmission shifter extension.

(4) Remove the console inserts. (Fig. 12)

(5) Remove and discard the three bolts. (Fig. 13)

(6) Lift up on the back and remove the console.

INSTALLATION

(1) Position the front of the console up under the instrument panel.

(2) Lower the back of the console and install three new screws.

(3) Install the inserts.

(4) Install the transmission shifter extension.

(5) Position the transmission shifter boot in place and seat the attachment clips fully.

(6) Install the 4WD shifter boot. (Refer to 23 - BODY/INTERIOR/4WD FLOOR SHIFT BOOT - INSTALLATION)

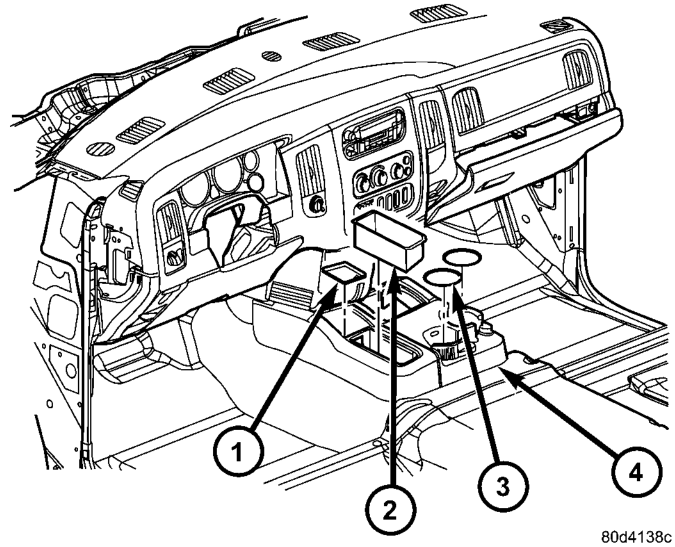

Fig. 12 FLOOR CONSOLE INSERTS

1 - BIN PAD INSERT
2 - STORAGE BIN/SHIFT BOOT
3 - CUP HOLDER INSERT
4 - FLOOR CONSOLE

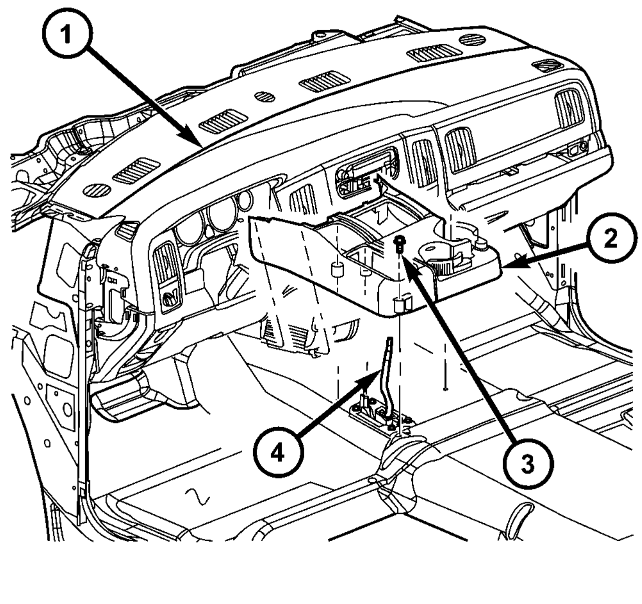

Fig. 13 FLOOR CONSOLE

1 - INSTRUMENT PANEL
2 - FLOOR CONSOLE
3 - BOLTS (3)
4 - SHIFTER LEVER

HEADLINER

REMOVAL

(1) Remove the a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - REMOVAL)

(2) Remove the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL)

(3) Remove the upper c-pillar trim, if equipped. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - REMOVAL)

(4) Remove the coat hooks. (Refer to 23 - BODY/INTERIOR/COAT HOOK - REMOVAL)

(5) Disconnect the headliner harness electrical connector at the left a-pillar.

(6) Remove the dome lamp. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOME LAMP - REMOVAL)

(7) Remove the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - REMOVAL)

(8) Remove the sun visors. (Refer to 23 - BODY/INTERIOR/SUN VISOR - REMOVAL)

(9) Remove the sun visor supports. (Refer to 23 - BODY/INTERIOR/SUN VISOR SUPPORT - REMOVAL)

(10) Lower the headliner and disconnect the center high mounted stop light.

(11) Lower the front of the headliner down to the floor just in front of the instrument panel and remove through the passenger door.

INSTALLATION

(1) Install the headliner into the vehicle through the passenger door.

(2) Raise the headliner and insert the right side above right side pillar trim pieces.

(3) Connect the center high mounted stop light electrical connector.

(4) Install the sun visor supports. (Refer to 23 - BODY/INTERIOR/SUN VISOR SUPPORT - INSTALLATION)

(5) Install the coat hooks. (Refer to 23 - BODY/INTERIOR/COAT HOOK - INSTALLATION)

(6) Install the sun visors. (Refer to 23 - BODY/INTERIOR/SUN VISOR - INSTALLATION)

(7) Install the overhead console. (Refer to 8 - ELECTRICAL/OVERHEAD CONSOLE - INSTALLATION)

(8) Install the dome lamp. (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOME LAMP - INSTALLATION)

(9) Connect the headliner harness electrical connector at the left a-pillar.

(10) Install the upper c-pillar trim, if equipped. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - INSTALLATION)

(11) Install the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION)

(12) Install the upper a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION)

B-PILLAR GRAB HANDLE

REMOVAL

(1) Open the trim plugs and remove the bolts. (Fig. 14)

(2) Remove the grab handle.

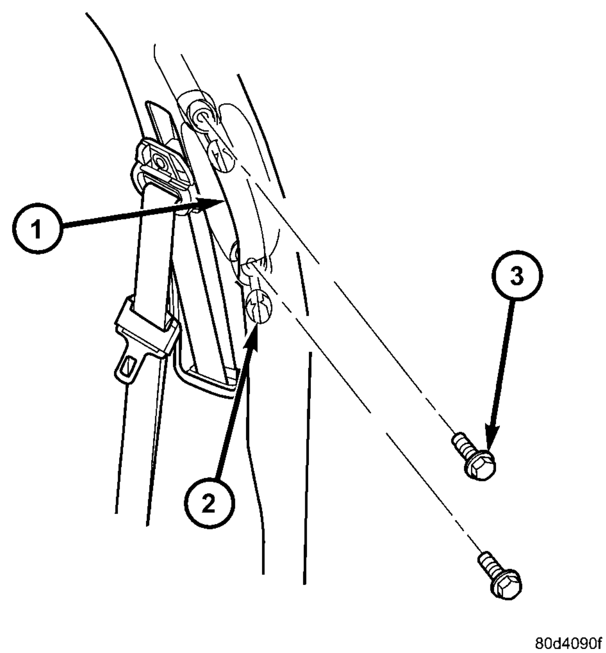

Fig. 14 GRAB HANDLE

1 - GRAB HANDLE
2 - TRIM PLUGS
3 - BOLTS

INSTALLATION

(1) Install the grab handle and install the bolts.

(2) Tighten the bolts to 6 N·m (55 in. lbs.) and install the trim plugs.

REAR CAB BACK PANEL TRIM

REMOVAL

(1) Remove the child seat tethers, if equipped. (Refer to 8 - ELECTRICAL/RESTRAINTS/CHILD TETHER - REMOVAL)

(2) Remove the screws and remove the utility hooks/bin latch, if equipped. (Fig. 15)

(3) Using a trim stick C-4755 or equivalent, remove the center seat belt trim bezel, if equipped.

(4) On quad cab models, remove the left lower c-pillar trim panel. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - REMOVAL)

(5) On standard cab models, remove the left lower b-pillar trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(6) Remove the push pin fasteners, if equipped, and remove the back panel trim. (Fig. 16) or (Fig. 17)

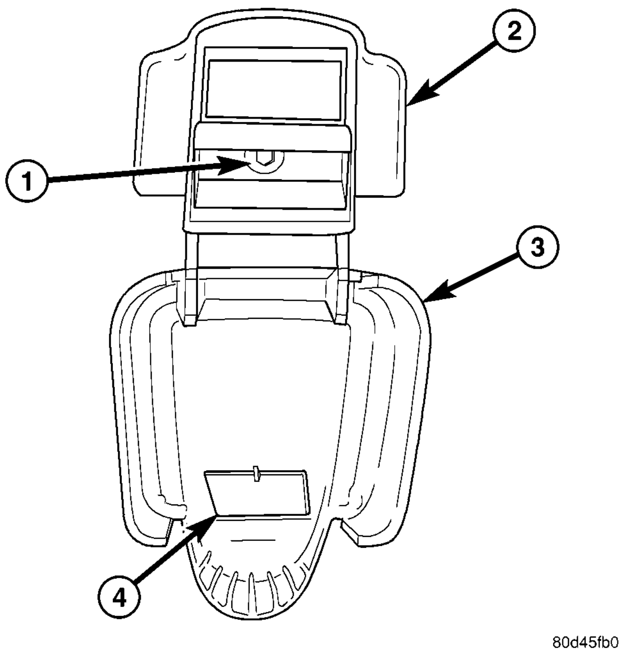

Fig. 15 UTILITY HOOK/STORAGE BIN LATCH

1 - SCREW
2 - UTILITY HOOK
3 - UTILITY HOOK COVER
4 - COVER LOCK TAB

INSTALLATION

(1) Position the back panel trim behind the right pillar trim.

(2) Route the center belt and trim bezel through the back panel, if equipped.

(3) On standard cab models, install the left lower b-pillar trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

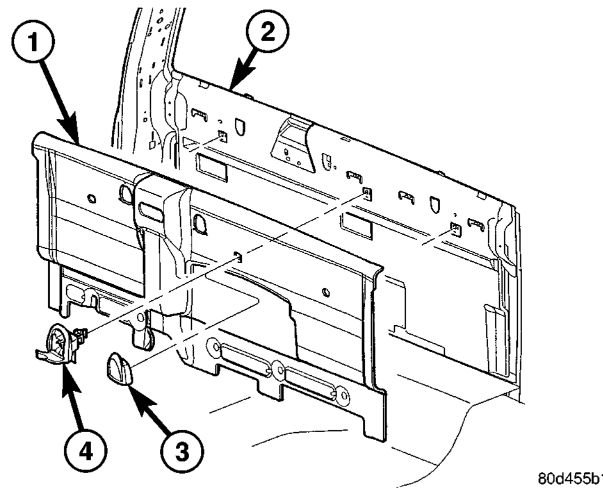

Fig. 16 CAB BACK PANEL - STANDARD CAB

1 - CAB BACK PANEL
2 - CAB BACK
3 - UTILITY HOOK
4 - STORAGE BIN LATCH

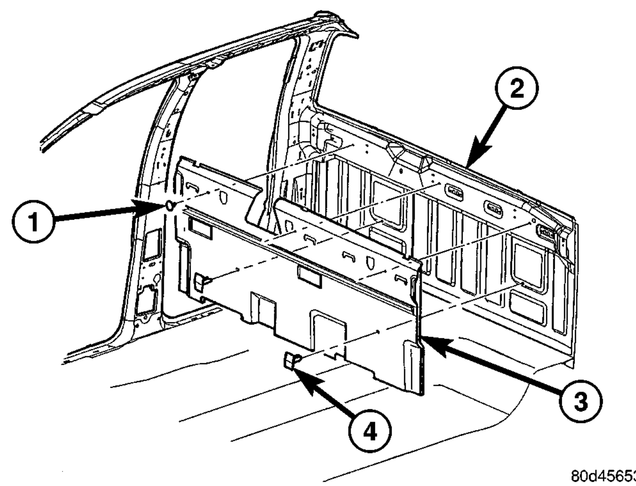

Fig. 17 CAB BACK PANEL - QUAD CAB

1 - PUSH PIN FASTENER
2 - CAB BACK
3 - CAB BACK PANEL
4 - PUSH PIN FASTENER

(4) On quad cab models, install the left lower c-pillar trim panel. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - INSTALLATION)

(5) Position the center belt trim bezel, if equipped, and seat the attachment clips fully.

(6) Install the utility hooks/bin latch and screws, if equipped.

(7) Install the child seat tethers, if equipped. (Refer to 8 - ELECTRICAL/RESTRAINTS/CHILD TETHER - INSTALLATION)

REAR VIEW MIRROR

REMOVAL

(1) If equipped, disconnect mirror harness connector.

(2) Loosen the mirror base setscrew (Fig. 18).

(3) Slide the mirror base upward and off the bracket.

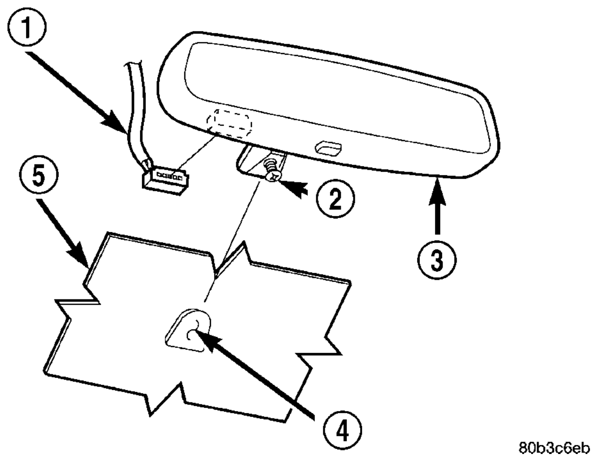

Fig. 18 REAR VIEW MIRROR

1 - CONNECTOR
2 - SCREW
3 - REAR VIEW MIRROR
4 - SUPPORT BUTTON
5 - WINDSHIELD

INSTALLATION

INSTALLATION

(1) Position the mirror base at the bracket and slide it downward onto the support bracket (Fig. 18).

(2) Tighten the setscrew 1 N·m (15 in. lbs.) torque.

(3) If equipped, connect mirror harness connector.

INSTALLATION - REARVIEW MIRROR SUPPORT BRACKET

(1) Mark the position for the mirror bracket on the outside of the windshield glass with a wax pencil.

(2) Clean the bracket contact area on the glass. Use a mild powdered cleanser on a cloth saturated with isopropyl (rubbing) alcohol. Finally, clean the glass with a paper towel dampened with alcohol.

(3) Sand the surface on the support bracket with fine grit-sandpaper. Wipe the bracket surface clean with a paper towel.

(4) Apply accelerator to the surface on the bracket according to the following instructions:

(a) Crush the vial to saturate the felt applicator.

(b) Remove the paper sleeve.

(c) Apply accelerator to the contact surface on the bracket.

(d) Allow the accelerator to dry for five minutes.

(e) Do not touch the bracket contact surface after the accelerator has been applied.

(5) Apply adhesive accelerator to the bracket contact surface on the windshield glass. Allow the accelerator to dry for one minute. Do not touch the glass contact surface after the accelerator has been applied.

(6) Install the bracket according to the following instructions:

(a) Apply one drop of adhesive at the center of the bracket contact-surface on the windshield glass.

(b) Apply an even coat of adhesive to the contact surface on the bracket.

(c) Align the bracket with the marked position on the windshield glass.

(d) Press and hold the bracket in place for at least one minute.

NOTE: Verify that the mirror support bracket is correctly aligned, because the adhesive will cure rapidly.

(7) Allow the adhesive to cure for 8-10 minutes. Remove any excess adhesive with an alcohol-dampened cloth.

(8) Allow the adhesive to cure for an additional 8-10 minutes before installing the mirror.

SUN VISOR

REMOVAL

(1) Remove the screws at the visor pivot and remove the visor.

INSTALLATION

(1) Install the visor and install the screws at the visor pivots.

SUN VISOR SUPPORT

REMOVAL

(1) Using a trim stick C-4755 or equivalent, pry down the release clip and remove the hook. (Fig. 19)

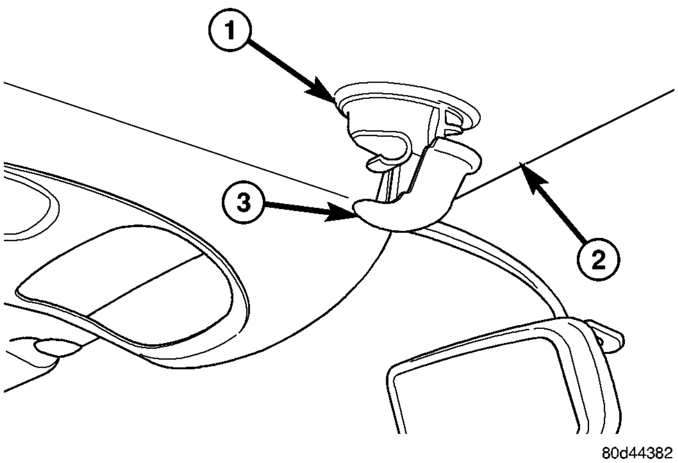

Fig. 19 VISOR SUPPORT

1 - VISOR SUPPORT
2 - HEADLINER
3 - RELEASE CLIP

INSTALLATION

(1) Snap the visor support into the sheet metal and seat the release clip fully.

BODY VENT

REMOVAL

(1) Remove the cab back panel trim. (Refer to 23 - BODY/INTERIOR/REAR CAB BACK PANEL TRIM - REMOVAL)

(2) While holding the vent, press the tabs to release the vent into the cab back panel. (Fig. 20)

(3) Twist the vent and remove through the vent hole.

INSTALLATION

(1) Position the vent into the vent hole in the cab back panel.

(2) Twist the vent and pull it into the hole frame and seat the tabs fully.

(3) Install the cab back panel trim. (Refer to 23 - BODY/INTERIOR/REAR CAB BACK PANEL TRIM - INSTALLATION)

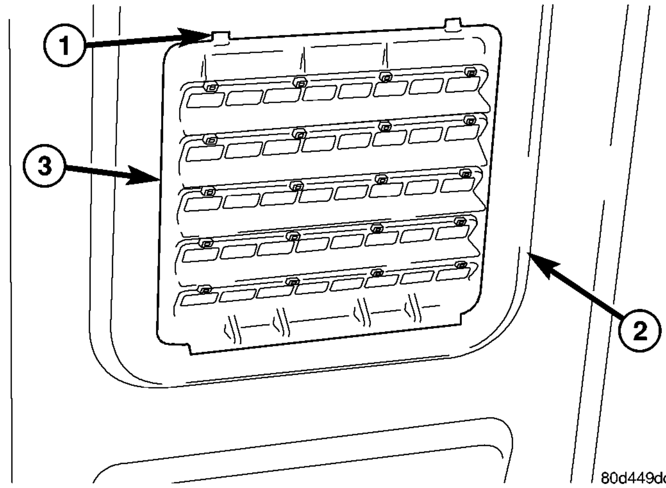

Fig. 20 BODY VENT

1 - RETAINER TABS
2 - BODY VENT
3 - CAB BACK PANEL

REAR DOOR SILL TRIM COVER

REMOVAL

(1) Using a trim stick C-4755 or equivalent, pry up the sill trim and remove. (Fig. 21)

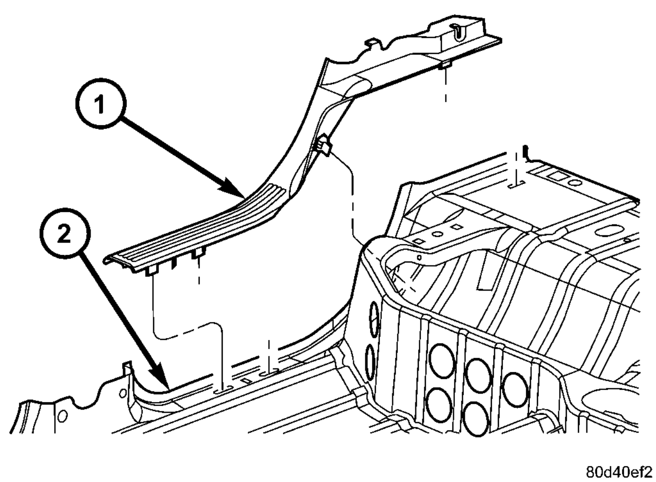

Fig. 21 REAR DOOR SILL TRIM

1 - SILL TRIM
2 - REAR DOOR SILL

INSTALLATION

(1) Position the sill trim and seat the attachment clips fully.

LOAD FLOOR

REMOVAL

(1) Fold the rear seat cushion up.

(2) Remove the rear nuts in each corner. (Fig. 22)

(3) Fold the load floor up, remove the front bolts and remove the tray. (Fig. 23)

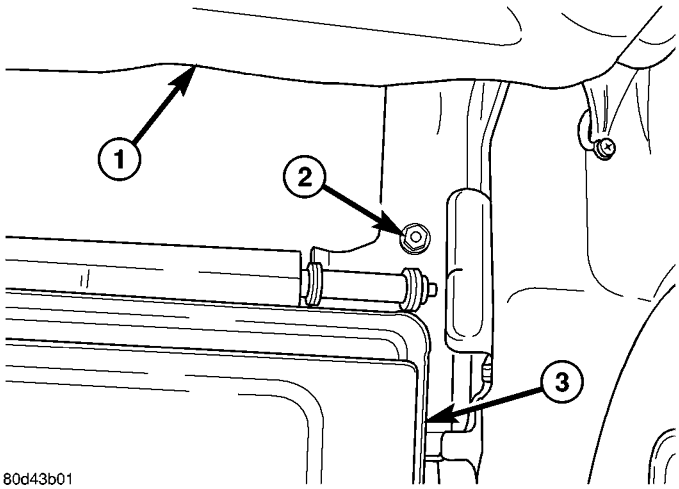

Fig. 22 REAR LOAD FLOOR - REAR FASTENERS

1 - REAR SEAT CUSHION
2 - NUTS (2)
3 - STOWAGE TRAY

INSTALLATION

(1) Install the load floor and install the bolts.

(2) Tighten the bolts to 40 N·m (30 ft. lbs.).

(3) Fold the load floor down and install the nuts.

(4) Tighten the nuts to 25 N·m (18 ft. lbs.).

LOAD FLOOR SUPPORT CYLINDER

REMOVAL

(1) Open the load floor.

(2) Remove the snap clips and retaining pins. (Fig. 24)

(3) Remove the support cylinder.

INSTALLATION

(1) Install the support cylinder with the thin end down.

(2) Install the retaining pins and clips.

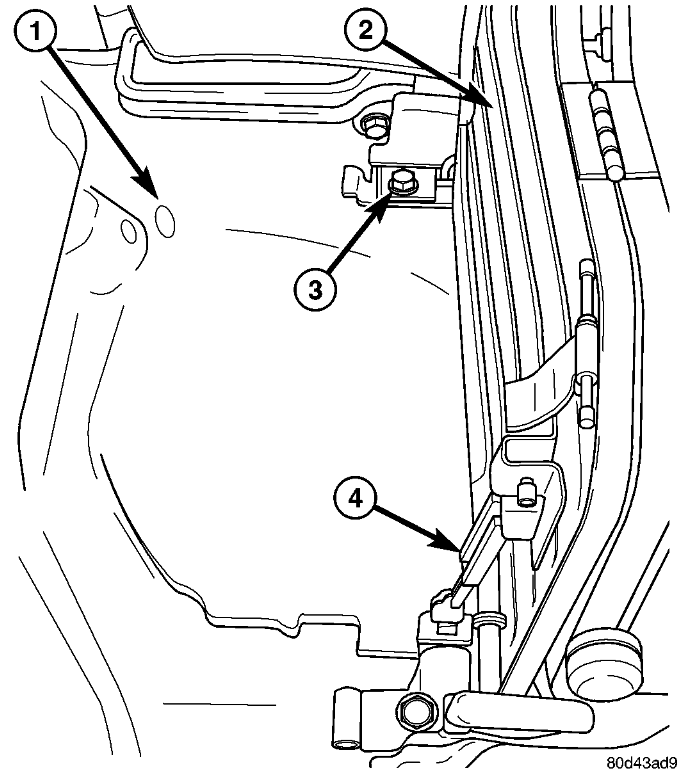

Fig. 23 REAR LOAD FLOOR - TYPICAL

1 - REAR STORAGE BIN
2 - LOAD FLOOR
3 - BOLTS (2)
4 - SUPPORT CYLINDER

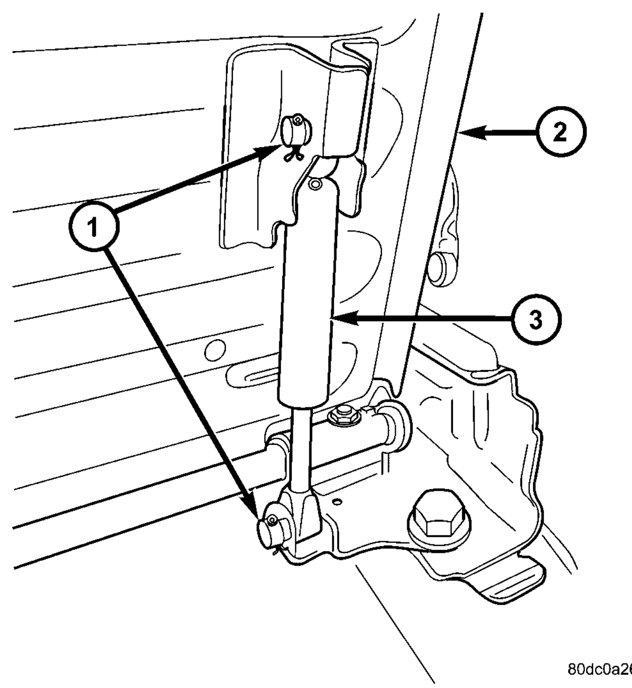

Fig. 24 LOAD FLOOR SUPPORT CYLINDER

1 - RETAINING PINS/CLIPS (2)
2 - LOAD FLOOR
3 - SUPPORT CYLINDER

PAINT

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PAINT

SPECIFICATIONS - PAINT CODES

NOTE: Because of late model changes to the available paint colors (Refer to VEHICLE DATA/VEHICLE INFORMATION/VEHICLE SAFETY CERT LABEL - DESCRIPTION) or (Refer to VEHICLE DATA/VEHICLE INFORMATION/BODY CODE PLATE - DESCRIPTION) for the correct paint codes for each vehicle. (Refer to 23 - BODY/PAINT/PAINT CODE - DESCRIPTION)

EXTERIOR COLORS

EXTERIOR COLOR	DAIMLERCHRYSLER CODE
Dark Garnet Red Pearl Coat	XRV
Flame Red Clear Coat	PR4
Light Almond Pearl Metallic Clear Coat	ZKJ
Atlantic Blue Pearl Coat	ZBJ
Patriot Blue Pearl Coat	WBT/WB7
Graphite Metallic Clear Coat	ZDR
Bright Silver Metallic Clear Coat	WSB/WS2
Black Clear Coat	DX8
Bright White Clear Coat	GW7
Timberline Green	AGW

INTERIOR COLORS

INTERIOR COLOR	DAIMLERCHRYSLER CODE
Taupe	L5
Dark Slate Gray	DV

PAINT CODE

DESCRIPTION

Exterior vehicle body colors are identified on the Vehicle Safety Certification Label (Refer to VEHICLE DATA/VEHICLE INFORMATION/VEHICLE SAFETY CERTIFICATION LABEL - DESCRIPTION) or the Body Code Plate (Refer to VEHICLE DATA/VEHICLE INFORMATION/BODY CODE PLATE - DESCRIPTION). The first digit of the paint code listed on the vehicle indicates the sequence of application, i.e.: P = primary coat, Q = secondary coat. The color names provided in the Paint and Trim Code Description chart are the color names used on most repair product containers. (Refer to 23 - BODY/PAINT - SPECIFICATIONS)

BASECOAT/CLEARCOAT FINISH

DESCRIPTION

The original equipment finish is a multi step process that involves cleaning, applying electro de-position (E-coat), anti-chip primer, basecoat, and clearcoat steps.

On most vehicles a two-part paint application (basecoat/clearcoat) is used. Color paint that is applied to primer is called basecoat. The clearcoat protects the basecoat from ultraviolet light and provides a durable high-gloss finish.

BASECOAT/CLEARCOAT FINISH (Continued)

CAUTION: Do not use abrasive chemicals or compounds on painted surfaces. Damage to finish can result.
Do not use harsh alkaline based cleaning solvents on painted surfaces. Damage to finish or color can result.

PAINT TOUCH-UP

DESCRIPTION

When a painted metal surface has been scratched or chipped, it should be touched-up as soon as possible to avoid corrosion. For best results, use MOPAR® Scratch Filler/Primer, Touch-Up Paints and Clear Top Coat. (Refer to VEHICLE DATA/VEHICLE INFORMATION/BODY CODE PLATE - DESCRIPTION) for Body Code Plate information.

WARNING: USE AN OSHA APPROVED RESPIRATOR AND SAFETY GLASSES WHEN SPRAYING PAINT OR SOLVENTS IN A CONFINED AREA. PERSONAL INJURY CAN RESULT.

STANDARD PROCEDURE - PAINT TOUCH-UP

(1) Scrape loose paint and corrosion from inside scratch or chip.

(2) Clean affected area with MOPAR® Tar/Road Oil Remover or equivalent, and allow to dry.

(3) Fill the inside of the scratch or chip with a coat of filler/primer. Do not overlap primer onto good surface finish. The applicator brush should be wet enough to puddle-fill the scratch or chip without running. Do not stroke brush applicator on body surface. Allow the filler/primer to dry hard.

(4) Cover the filler/primer with color touch-up paint. Do not overlap touch-up color onto the original color coat around the scratch or chip. Butt the new color to the original color, if possible. Do not stroke applicator brush on body surface. Allow touch-up paint to dry hard.

(5) On vehicles without clearcoat, the touch-up color can be lightly finesse sanded (1500 grit) and polished with rubbing compound.

(6) On vehicles with clearcoat, apply clear top coat to touch-up paint with the same technique as described in Step 4. Allow clear top coat to dry hard. If desired, Step 5 can be performed on clear top coat.

WARNING: AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT. AVOID PROLONGED SKIN CONTACT WITH PETROLEUM OR ALCOHOL – BASED CLEANING SOLVENTS. PERSONAL INJURY CAN RESULT.

FINESSE SANDING/BUFFING & POLISHING

DESCRIPTION

CAUTION: Do not remove more than .5 mils of clearcoat finish, if equipped. Basecoat paint must retain clearcoat for durability.
Use a Paint Thickness Gauge #PR-ETG-2X or equivalent to determine film thickness before and after the repair.

Minor acid etching, orange peel, or smudging in clearcoat or single-stage finishes can be reduced with light finesse sanding, hand buffing, and polishing. **If the finish has been finesse sanded in the past, it cannot be repeated. Finesse sanding operation should be performed by a trained automotive paint technician.**

SEATS

TABLE OF CONTENTS

CENTER SEAT

REMOVAL

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Remove and discard the front bolts. (Fig. 1)

(2) Position the seats forward, remove the rear bolts and discard.

(3) Disconnect the 12v power supply electrical connector, if equipped. (Fig. 2)

(4) Fold the seat backs forward and roll the seat assembly back in the vehicle.

(5) Remove the nuts attaching the center seat to the drivers seat and the passenger seat and discard. (Fig. 3)

(6) Roll the seat assembly forward and remove the center seat portion.

CENTER SEAT (Continued)

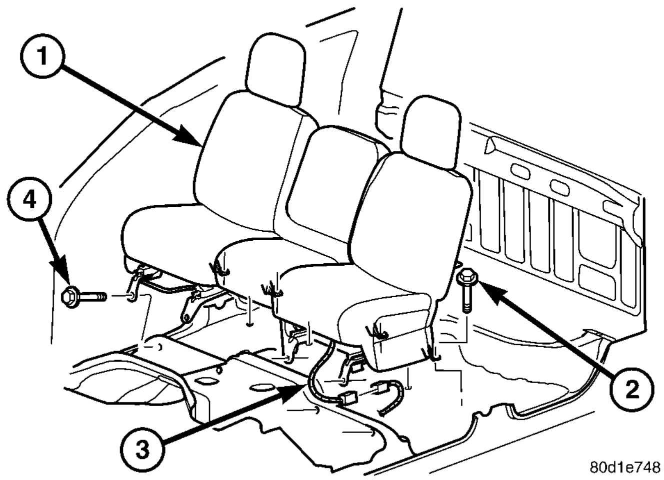

Fig. 1 FRONT SEAT ASSEMBLY

1 - FRONT SEAT ASSEMBLY
2 - REAR BOLTS (4)
3 - ELECTRICAL CONNECTOR
4 - FRONT BOLTS (4)

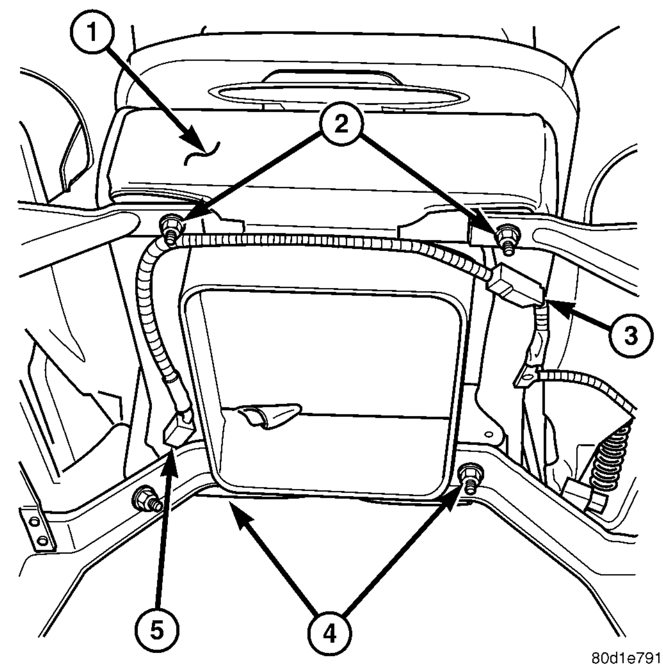

Fig. 2 CENTER SEAT ATTACHMENTS

1 - CENTER SEAT ASSEMBLY
2 - FRONT NUTS (2)
3 - POWER SUPPLY ELECTRICAL CONNECTOR
4 - REAR NUTS (4)
5 - 12V POWER SUPPLY HARNESS

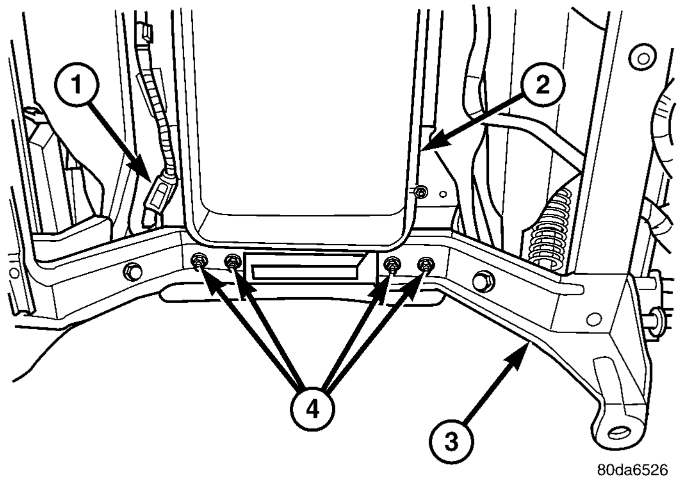

Fig. 3 REAR ATTACHMENTS

1 - 12V POWER SUPPLY HARNESS
2 - CENTER SEAT STORAGE BIN
3 - FRONT SEAT TRACKS
4 - REAR NUTS (4)

INSTALLATION

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Install the center seat and roll the seat assembly back in the vehicle.
(2) Install new nuts attaching the center seat to the drivers and passenger seat.
(3) Tighten the nuts to 25 N·m (18 ft. lbs.).
(4) Roll the seat assembly forward and install new rear bolts.
(5) Connect the 12v power supply electrical connector, if equipped.
(6) Tighten the rear bolts to 40 N·m (30 ft. lbs.).
(7) Fold the seat backs up and slide the seats to the rear.
(8) Install new front bolts and tighten to 28 N·m (21 ft. lbs.).

CENTER ARMREST / SEAT BACK

REMOVAL

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Remove the center seat. (Refer to 23 - BODY/SEATS/SEAT - CENTER - REMOVAL)
(2) Disconnect the storage bin cover j-straps and position aside.
(3) Remove and discard the hinge bolts and separate the seat back from the storage bin. (Fig. 4)

CENTER ARMREST / SEAT BACK (Continued)

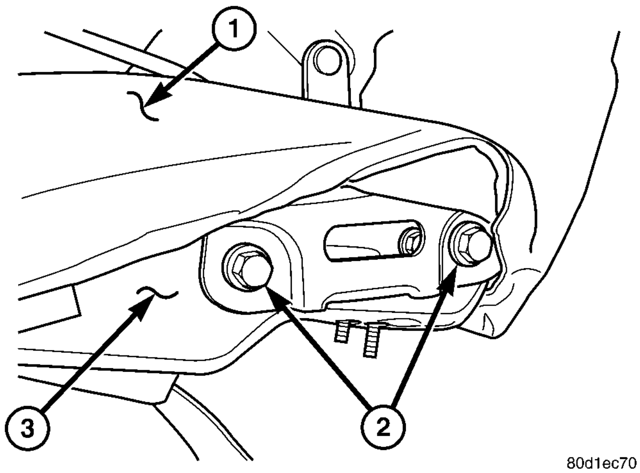

Fig. 4 CENTER SEAT BACK HINGES

1 - STORAGE BIN COVERING
2 - SEAT BACK HINGE BOLTS (4)
3 - STORAGE BIN FRAME

INSTALLATION

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Install the seat back onto the storage bin and install new hinge bolts.
(2) Tighten the hinge to storage bin bolts to 25 N·m (18 ft. lbs.).
(3) Connect the storage bin cover j-straps.
(4) Install the center seat. (Refer to 23 - BODY/SEATS/SEAT - CENTER - INSTALLATION)

CENTER SEAT BACK INERTIA HINGE COVER

REMOVAL

NOTE: Free pivot hinge cover is removed with the free pivot hinge. (Refer to 23 - BODY/SEATS/CENTER SEAT BACK HINGE - REMOVAL)

(1) For the inertia hinge cover disconnect the zip strip. (Fig. 5)
(2) Position aside the storage bin cover.
(3) Remove the pivot bolt.
(4) Open the hinge cover at the bottom and remove the hinge cover. (Fig. 6)

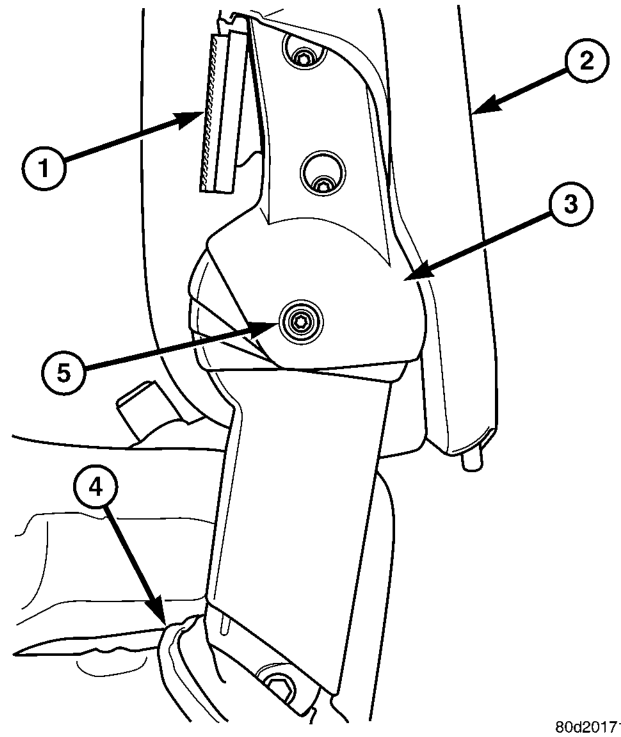

Fig. 5 HINGE COVER

1 - SEAT BACK COVER ZIP STRIP
2 - CENTER SEAT BACK
3 - HINGE COVER
4 - STORAGE BIN COVER
5 - PIVOT BOLT

INSTALLATION

NOTE: Free pivot hinge cover is installed with the free pivot hinge. (Refer to 23 - BODY/SEATS/CENTER SEAT BACK HINGE - INSTALLATION)

(1) Position the hinge cover over the hinge and close over the lock tabs.
(2) Install the pivot bolt and tighten to 10 N·m (89 in. lbs.).
(3) Reposition the storage bin cover.
(4) Connect the zip strip.

CENTER SEAT BACK INERTIA HINGE COVER (Continued)

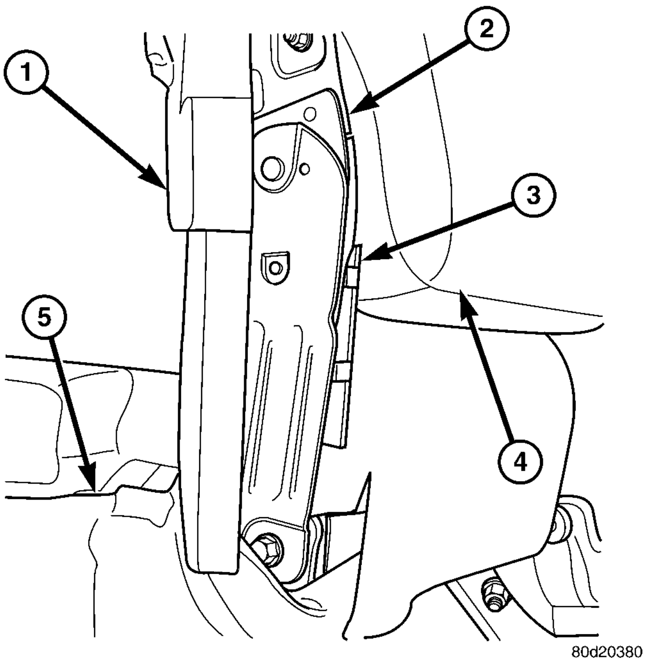

Fig. 6 HINGE COVER REMOVAL

1 - HINGE COVER
2 - HINGE
3 - HINGE COVER TABS
4 - CENTER SEAT BACK
5 - STORAGE BIN

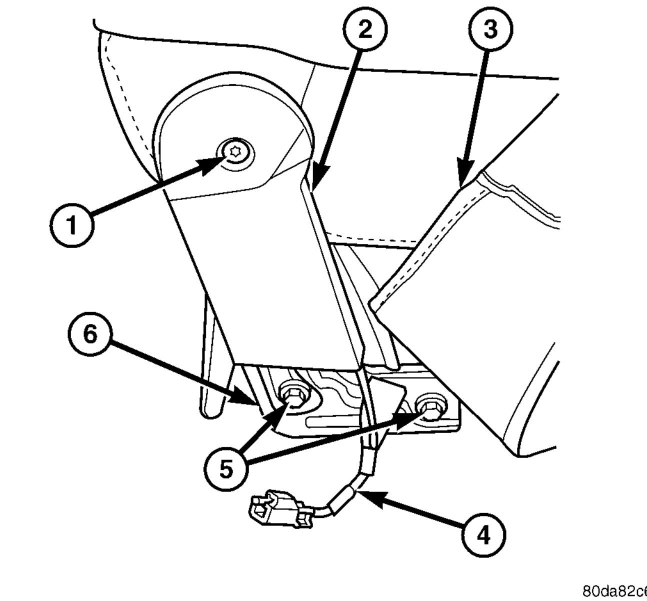

Fig. 7 PIVOT HINGE/COVER

1 - PIVOT BOLT
2 - HINGE COVER
3 - STORAGE BIN COVER
4 - 12V POWER SUPPLY HARNESS
5 - HINGE BOLTS (2)
6 - HINGE

CENTER SEAT BACK HINGE

REMOVAL

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Remove the seat back. (Refer to 23 - BODY/SEATS/CENTER ARMREST / SEAT BACK - REMOVAL)

Free Pivot Hinge/Cover

(1) Disconnect the storage bin cover j-strap and position aside.
(2) Remove and discard the pivot bolt. (Fig. 7)
(3) Remove the hinge spacer. (Fig. 8)
(4) Open the hinge cover flap and remove the wire harness. (Fig. 9)
(5) Remove the cover from the hinge.

Inertia Hinge

(1) Remove the seat back inertia hinge cover. (Refer to 23 - BODY/SEATS/CENTER SEAT BACK INERTIA HINGE COVER - REMOVAL)
(2) Remove and discard the inertia hinge bolts and remove the hinge. (Fig. 10)

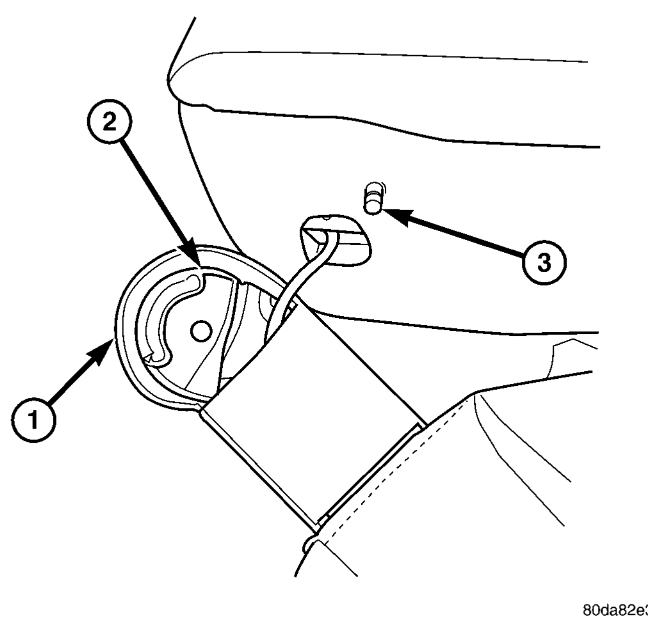

Fig. 8 PIVOT HINGE SPACER

1 - HINGE COVER
2 - SPACER
3 - STOP PIN

CENTER SEAT BACK HINGE (Continued)

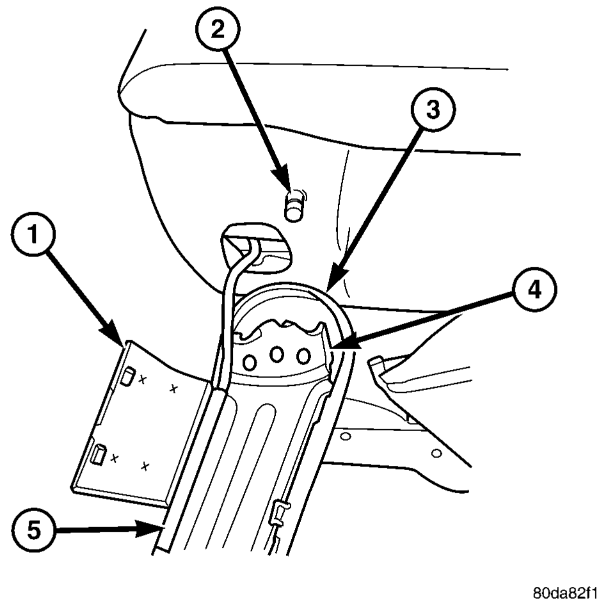

Fig. 9 PIVOT HINGE COVER

1 - HINGE COVER FLAP
2 - STOP PIN
3 - HINGE COVER
4 - HINGE
5 - 12V POWER SUPPLY HARNESS

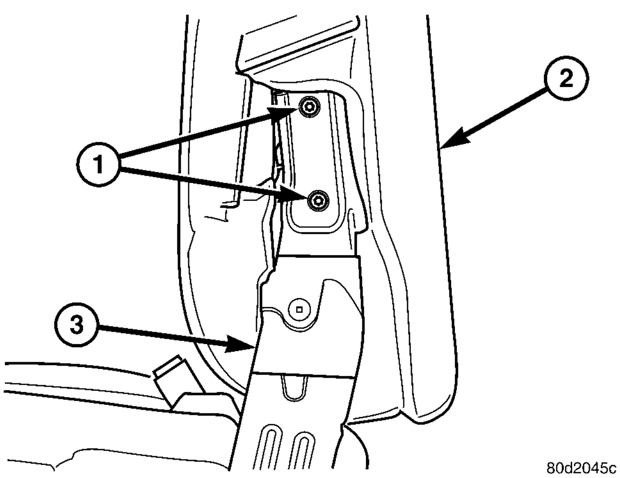

Fig. 10 INERTIA HINGE BOLTS

1 - SEAT BACK BOLTS
2 - CENTER SEAT BACK
3 - INERTIA HINGE

INSTALLATION

NOTE: Do not reuse the seat fasteners, always replace with new ones.

Free Pivot Hinge/Cover

(1) Position the pivot hinge cover over the pivot hinge and install the 12v power supply harness into the channel.

(2) Close the hinge cover flat and position the spacer into place.

(3) Align the stop pin with the spacer and hinge and install the assembly onto the seat back.

(4) Install a new pivot bolt and tighten to 25 N·m (18 ft. lbs.)

Inertia Hinge

(1) Install the inertia hinge onto the center seat back and install new bolts.

(2) Tighten the bolts to 25 N·m (18 ft. lbs.).

(3) Install the seat back inertia hinge covers. (Refer to 23 - BODY/SEATS/CENTER SEAT BACK INERTIA HINGE COVER - INSTALLATION)

(1) Install the center seat back. (Refer to 23 - BODY/SEATS/CENTER ARMREST / SEAT BACK - INSTALLATION)

CENTER SEAT BACK LID

REMOVAL

(1) Open the center armrest/seat back.

(2) Remove the four screws attaching the hinge to the storage bin and remove the lid.

INSTALLATION

(1) Position the center seat back lid onto the storage bin and install the screws.

CENTER SEAT CUSHION

REMOVAL

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Open the center seat cushion storage bin.

(2) Position the seat cushion cover aside, remove the hinge bolts and discard. (Fig. 11)

(3) Remove the seat cushion.

INSTALLATION

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Position the center seat cushion the hinges and install new bolts.

(2) Tighten the bolts to 20 N·m (15 ft. lbs.).

(3) Position the cushion cover back over the hinges.

CENTER SEAT CUSHION (Continued)

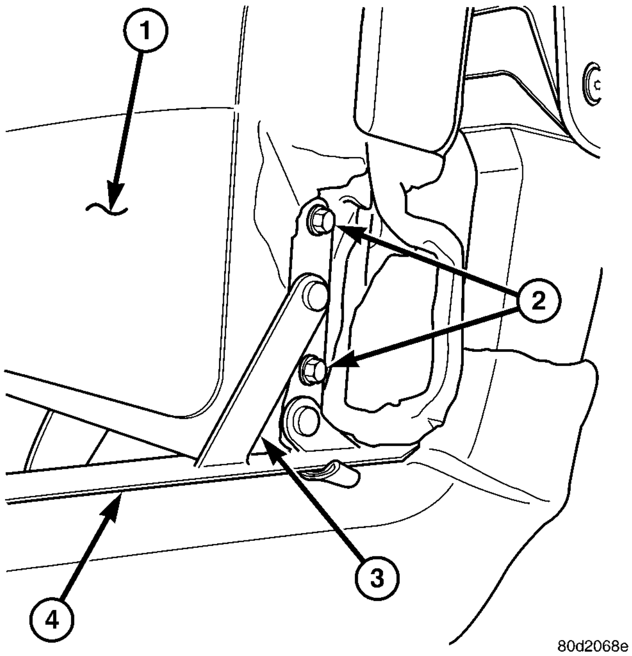

Fig. 11 CENTER SEAT CUSHION HINGE

1 - CENTER SEAT CUSHION
2 - HINGE BOLTS
3 - SEAT CUSHION HINGE
4 - STORAGE BIN

CENTER SEAT CUSHION COVER

REMOVAL

(1) Remove the center seat cushion. (Refer to 23 - BODY/SEATS/CENTER SEAT CUSHION - REMOVAL)

(2) Disconnect the zip strips and remove the cover from the cushion.

INSTALLATION

(1) Install the cover over the center seat cushion and connect the zip strips.

(2) Install the center seat. (Refer to 23 - BODY/SEATS/CENTER SEAT - INSTALLATION)

UNDER SEAT STORAGE BIN

REMOVAL

(1) Remove the center seat cushion. (Refer to 23 - BODY/SEATS/CENTER SEAT CUSHION - REMOVAL)

(2) Remove the six screws and remove the bin.

INSTALLATION

(1) Install the bin over the seat cushion hinges and install the six screws.

(2) Install the center seat cushion. (Refer to 23 - BODY/SEATS/CENTER SEAT CUSHION - INSTALLATION)

UNDER SEAT STORAGE BIN COVERING

REMOVAL

(1) Remove the under seat storage bin. (Refer to 23 - BODY/SEATS/UNDER SEAT STORAGE BIN - REMOVAL)

(2) Disconnect the j-straps and remove the cover.

INSTALLATION

(1) Install the storage bin cover and connect the j-straps.

(2) Install the under seat storage bin. (Refer to 23 - BODY/SEATS/UNDER SEAT STORAGE BIN - INSTALLATION)

UNDER SEAT STORAGE BIN LATCH

REMOVAL

(1) Open the under seat storage bin.

(2) Remove the two screws and remove the latch assembly.

INSTALLATION

(1) Install the latch assembly and install the screws.

HEADREST

REMOVAL

(1) Raise the headrest.
(2) Press the headrest release button and remove the headrest.

INSTALLATION

(1) Position the headrest.
(2) Press the release button and install the headrest.

HEADREST SLEEVE

REMOVAL

(1) Remove the headrest. (Refer to 23 - BODY/SEATS/HEADREST - REMOVAL)
(2) Grasp the sleeves and pull up and out of the seat back to remove.

INSTALLATION

(1) Position each headrest sleeve into correct seat back hole and press into place fully.
(2) Install the headrest. (Refer to 23 - BODY/SEATS/HEADREST - INSTALLATION)

SEAT - FRONT

REMOVAL

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Remove and discard the front bolts. (Fig. 12)
(2) Position the seats forward, remove the rear bolts and discard.
(3) Disconnect the 12v power supply electrical connector, if equipped. (Fig. 13)
(4) Fold the seat backs forward and roll the seat assembly back in the vehicle.
(5) Separate the seat assembly by removing and discarding the three nuts on either the drivers or passengers seat. (Fig. 14)
(6) Remove each section of the seat assembly from the vehicle.

INSTALLATION

NOTE: Do not reuse the seat fasteners, always replace with new ones.

(1) Position each seat section into the vehicle and tip back.

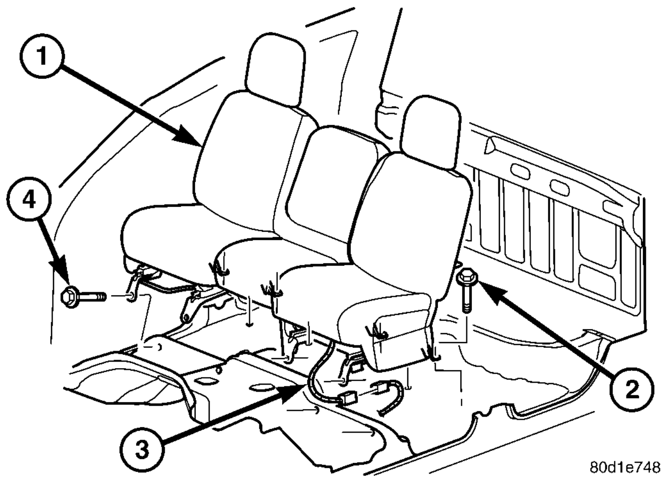

Fig. 12 FRONT SEAT ASSEMBLY

1 - FRONT SEAT ASSEMBLY
2 - REAR BOLTS (4)
3 - ELECTRICAL CONNECTOR
4 - FRONT BOLTS (4)

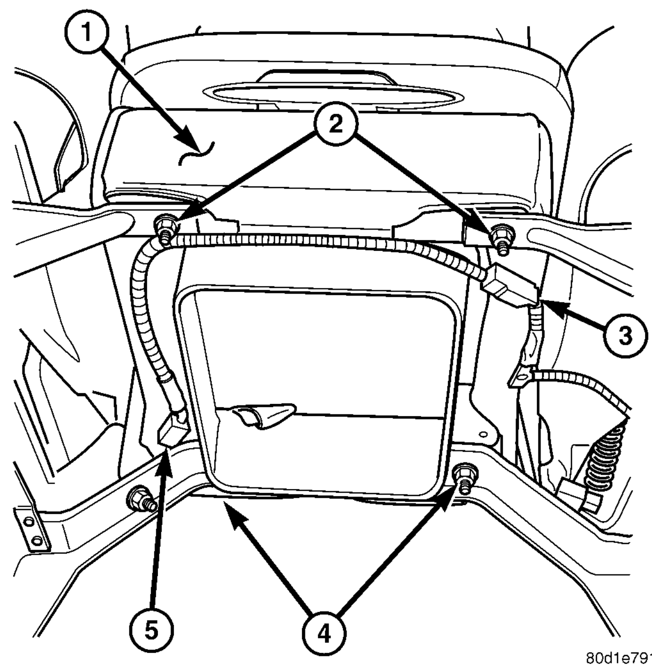

Fig. 13 CENTER SEAT ATTACHMENTS

1 - CENTER SEAT ASSEMBLY
2 - FRONT NUTS (2)
3 - POWER SUPPLY ELECTRICAL CONNECTOR
4 - REAR NUTS (4)
5 - 12V POWER SUPPLY HARNESS

(2) Install the three nuts attaching the center seat section to the other seat, and tighten to 25 N·m (18 ft. lbs.).
(3) Roll the seat assembly forward and install new rear bolts.
(4) Connect the 12v power supply electrical connector.

SEAT - FRONT (Continued)

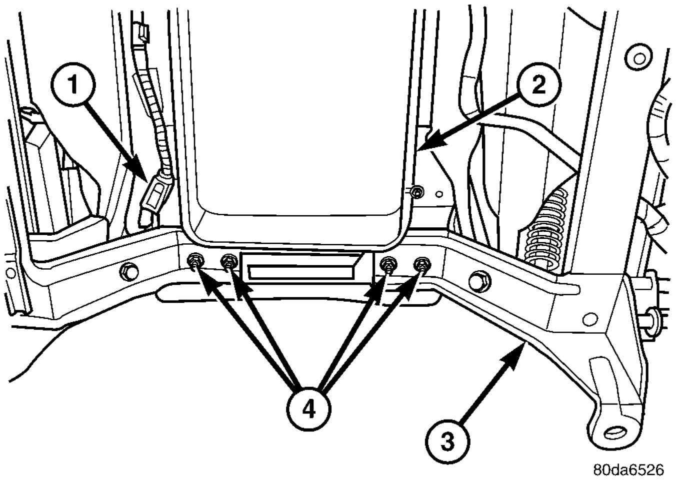

Fig. 14 REAR ATTACHMENTS

1 - 12V POWER SUPPLY HARNESS
2 - CENTER SEAT STORAGE BIN
3 - FRONT SEAT TRACKS
4 - REAR NUTS (4)

(5) Tighten the rear bolts to 40 N·m (30 ft. lbs.).

(6) Fold the seat backs up and slide the seats to the rear.

(7) Install new front bolts and tighten to 28 N·m (21 ft. lbs.).

SEAT BACK CUSHION / COVER - FRONT

REMOVAL

(1) Remove the front seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)

(2) Remove the headrest sleeves. (Refer to 23 - BODY/SEATS/HEADREST SLEEVE - REMOVAL)

(3) Unzip the zip strip at the lower end of the seat back and remove the seat back cover and cushion.

INSTALLATION

(1) Install the seat back cushion and cover onto the seat frame assembly.

(2) Connect the zip strip at the bottom of the seat back.

(3) Install the headrest sleeves. (Refer to 23 - BODY/SEATS/HEADREST SLEEVE - INSTALLATION)

(4) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

SEAT CUSHION / COVER - FRONT

REMOVAL

(1) Remove the front seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)

(2) Remove the screw and remove the recliner handle.

(3) Remove the two screws and remove the power seat controls, if equipped, and disconnect the electrical connector.

(4) Remove the seat track. (Refer to 23 - BODY/SEATS/SEAT TRACK - REMOVAL)

(5) Disconnect the j-straps and remove the seat cushion and cover.

INSTALLATION

(1) Position the seat cushion and cover onto the frame assembly and connect the j-straps.

(2) Install the seat track. (Refer to 23 - BODY/SEATS/SEAT TRACK - INSTALLATION)

(3) Connect the power seat control switch electrical connector, if equipped.

(4) Install the power seat control switch and install the two screws, if equipped.

(5) Install the recliner handle and install the screw.

(6) Install the front seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

SEAT TRACK

REMOVAL

(1) Remove the front seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - REMOVAL)

(2) Disconnect the power lumbar and/or the heated seat electrical connectors, if equipped.

(3) Remove the four nuts attaching the seat track to the seat and remove the track.

INSTALLATION

(1) Position the seat track onto the seat and install the four nuts.

(2) Tighten the four nuts to 25 N·m (18 ft. lbs.).

(3) Connect the power lumbar and/or heated seat electrical connectors, if equipped.

(4) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - FRONT - INSTALLATION)

SEAT - REAR

REMOVAL

(1) Remove the load floor. (Refer to 23 - BODY/INTERIOR/LOAD FLOOR - REMOVAL)

(2) Fold the rear seat cushions up and remove the rear bolts. (Fig. 15)

(3) Lift each seat assembly up and disengage the seat back frame hooks from the footmans loops bolted to the rear cab back. (Fig. 16)

(4) Remove the seats from the vehicle.

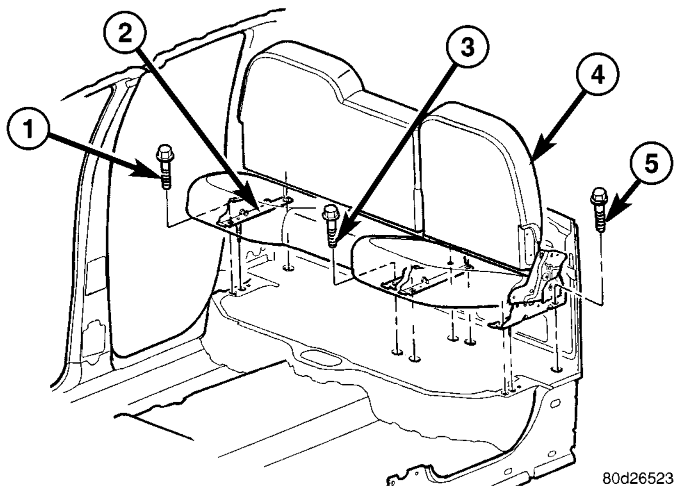

Fig. 15 SEAT ATTACHMENT

1 - OUTER BOLTS (2)
2 - REAR SEAT ASSEMBLY
3 - INNER BOLTS (4)
4 - REAR SEAT BACK
5 - OUTER BOLTS (2)

INSTALLATION

(1) Install the seats into the vehicle and engage the seat back frame hooks with the footmans loops in the cab back panel.

(2) Install the rear seat bolts and tighten to 40 N·m (30 ft. lbs.).

(3) Install the load floor. (Refer to 23 - BODY/INTERIOR/LOAD FLOOR - INSTALLATION)

SEAT BACK - REAR

REMOVAL

(1) Remove the rear seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)

(2) Remove the seat back bolts and remove the seat back. (Fig. 17)

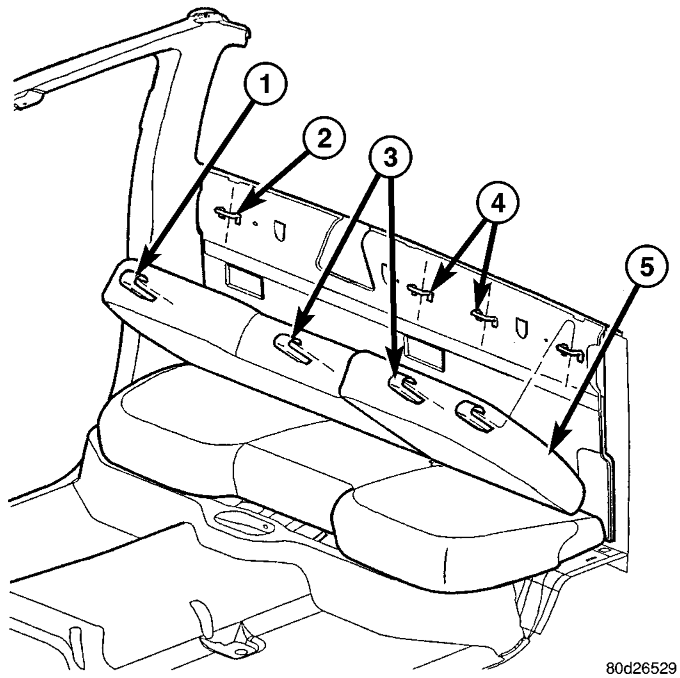

Fig. 16 SEAT BACK ATTACHMENT

1 - OUTER SEAT BACK FRAME HOOKS (2)
2 - OUTER FOOTMANS LOOP (2)
3 - INNER SEAT BACK FRAME HOOKS (2)
4 - INNER FOOTMANS LOOP (2)
5 - SEAT BACK

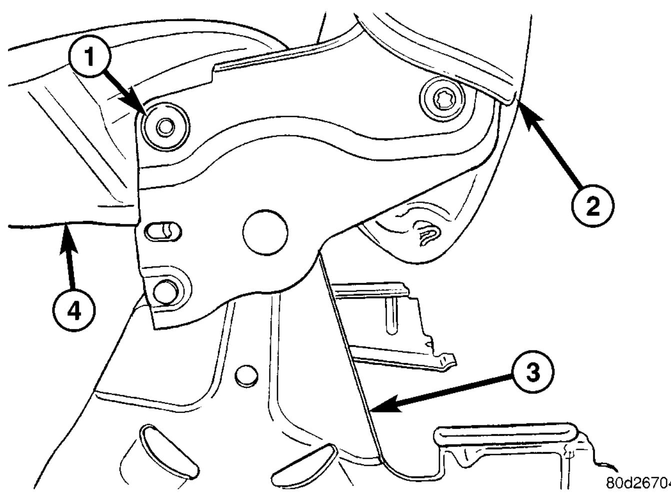

Fig. 17 REAR SEAT HINGE

1 - SEAT BACK BOLT (2)
2 - SEAT CUSHION
3 - SEAT BACK/CUSHION HINGE
4 - SEAT BACK

INSTALLATION

(1) Install the seat back and install the bolts.

(2) Tighten the bolts to 25 N·m (18 ft. lbs.).

(3) Install the rear seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)

SEAT BACK CUSHION / COVER - REAR

REMOVAL

(1) Remove the rear seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - REMOVAL)

(2) Unzip the zip strip at the bottom of the seat back and remove the cover and cushion.

INSTALLATION

(1) Install the seat back cushion and cover and connect the zip strip.

(2) Install the seat back. (Refer to 23 - BODY/SEATS/SEAT BACK - REAR - INSTALLATION)

SEAT CUSHION / COVER - REAR

REMOVAL

(1) Remove the rear seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)

(2) Remove the screws and remove the grocery bag hooks, if equipped.

(3) Separate the zip strip at the rear of the seat cushion and remove the cushion and cover.

INSTALLATION

(1) Install the seat cushion and cover over the cushion frame assembly and connect the zip strip.

(2) Install the grocery bag hooks and screws, if equipped.

(3) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)

SEAT CUSHION FRAME - REAR

REMOVAL

(1) Remove the seat cushion/cover. (Refer to 23 - BODY/SEATS/SEAT CUSHION / COVER - REAR - REMOVAL)

(2) Remove the bolts and remove the seat cushion frame. (Fig. 18)

INSTALLATION

(1) Install the seat cushion frame onto the rear seat hinges.

(2) Install the bolts and tighten to 32 N·m (24 ft. lbs.).

(3) Install the seat cushion/cover. (Refer to 23 - BODY/SEATS/SEAT CUSHION / COVER - REAR - INSTALLATION)

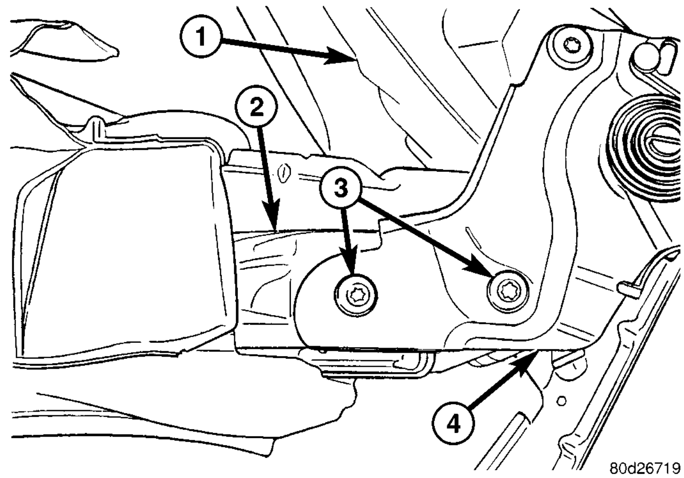

Fig. 18 SEAT CUSHION FRAME ATTACHMENT

1 - REAR SEAT BACK
2 - REAR SEAT CUSHION FRAME
3 - SEAT CUSHION FRAME BOLTS (4)
4 - SEAT CUSHION HINGE

SEAT BACK REAR - FOOTMANS LOOP BRACKETS

REMOVAL

(1) Remove the rear seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - REMOVAL)

(2) Remove bolts and remove the loop. (Fig. 19)

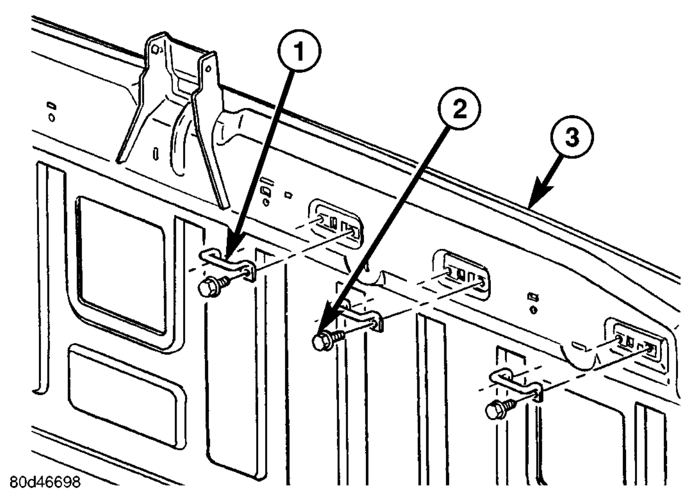

Fig. 19 FOOTMANS LOOP BRACKET

1 - FOOTMANS LOOP (4)
2 - BOLTS (2 PER LOOP)
3 - CAB BACK PANEL

INSTALLATION

(1) Install the loop and install the bolts.

(2) Tighten the bolts to 12 N·m (9 ft. lbs.).

(3) Install the seat. (Refer to 23 - BODY/SEATS/SEAT - REAR - INSTALLATION)

STATIONARY GLASS

TABLE OF CONTENTS

BACKLITE

REMOVAL

It is difficult to salvage the backlite during the removal operation. The backlite is part of the structural support for the roof. The urethane bonding used to secure the glass to the fence is difficult to cut or clean from any surface. Since the molding is set in urethane, it is unlikely it would be salvaged. Before removing the backlite, check the availability from the parts supplier.

The backlite is attached to the window frame with urethane adhesive. The urethane adhesive is applied cold and seals the surface area between the window opening and the glass. The primer adheres the urethane adhesive to the backlite.

(1) Roll down door glass.

(2) Remove headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL).

(3) On standard cab models remove the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - REMOVAL)

(4) On quad cab models remove the upper c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR UPPER TRIM - REMOVAL)

(5) Bend backlite retaining tabs (Fig. 1) inward against glass.

(6) Disconnect the rear window defogger electrical connector, if equipped.

(7) Using a suitable pneumatic knife from inside the vehicle, cut urethane holding backlite frame to opening fence.

(8) Separate glass from vehicle.

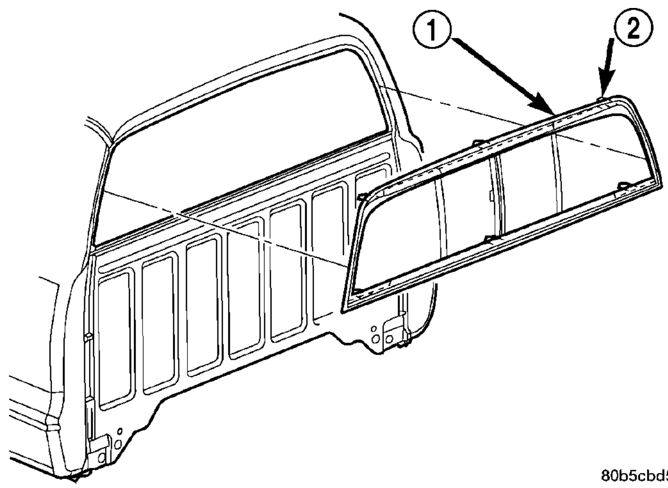

Fig. 1 Backlite Tabs

1 - BACKLITE
2 - TAB

INSTALLATION

(1) Clean urethane adhesive from around backlite opening fence.

(2) If necessary, apply black-out primer to outer edge of replacement backlite frame.

(3) If black-out primer was pre-applied on backlite, clean bonding surface with Isopropyl alcohol and clean lint free cloth. Allow 3 minutes for drying time.

(4) Apply black-out primer to backlite opening fence.

(5) Apply a 13 mm (0.5 in.) bead of urethane around the perimeter of the window frame bonding surface (Fig. 2).

(6) Set glass on lower fence and move glass forward into opening (Fig. 3).

(7) Firmly push glass against rear window glass opening fence.

(8) Bend tabs around edges of backlite opening fence to retain glass.

(9) Clean excess urethane from exterior with MOPAR®, Super Clean or equivalent.

(10) Allow urethane to cure at least 24 hours (full cure is 72 hours).

(11) Water test to verify repair before returning vehicle to service.

(12) Connect the rear window defogger electrical connector, if equipped.

BACKLITE (Continued)

(13) On standard cab models, install the upper b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR UPPER TRIM - INSTALLATION)

(14) On quad cab models, install the upper c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR UPPER TRIM - INSTALLATION)

(15) Install the headliner. (Refer to 23 - BODY/INTERIOR/HEADLINER - INSTALLATION).

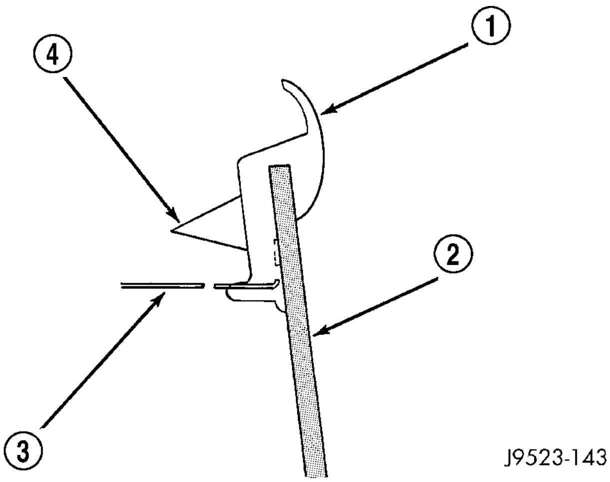

Fig. 2 Urethane Adhesive Application

1 - WINDOW FRAME
2 - GLASS
3 - RETAINER TAB
4 - URETHANE ADHESIVE

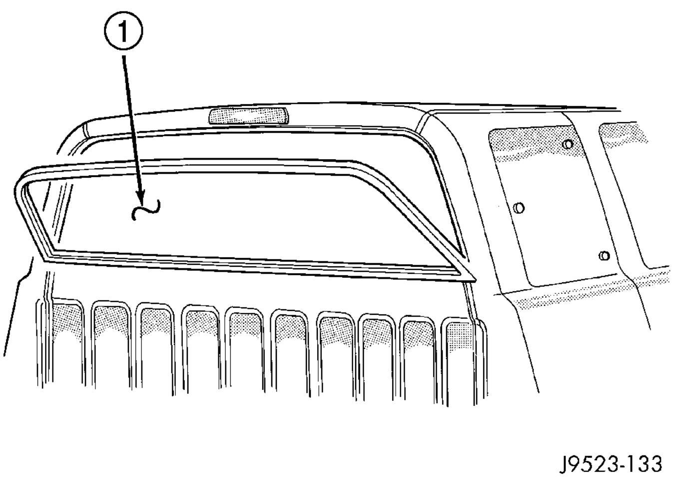

Fig. 3 Backlite Installation

1 - BACKLITE

BACKLITE VENT GLASS

REMOVAL

(1) Slide the upper run channel out of the window frame. (Fig. 4)

(2) Slide the vent glass upward to remove from the lower window frame.

(3) Lower the glass out of the upper window frame and remove.

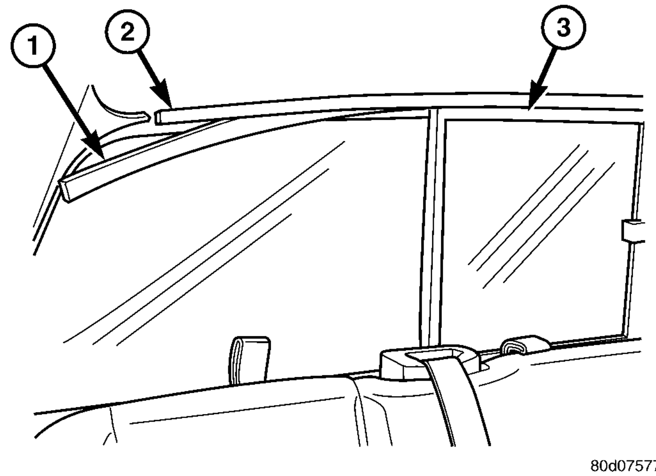

Fig. 4 UPPER GLASS RUN CHANNEL

1 - GLASS RUN CHANNEL
2 - VENT GLASS FRAME
3 - VENT GLASS

INSTALLATION

(1) Slide the vent glass upper edge into window frame and insert the lower edge into the lower molding.

(2) Position the upper run channel into the window frame and slide it into place.

(3) Verify vent glass operation.

WINDSHIELD

WARNING

WINDSHIELD SAFETY PRECAUTIONS

WARNING: DO NOT OPERATE THE VEHICLE WITHIN 24 HOURS OF WINDSHIELD INSTALLATION. IT TAKES AT LEAST 24 HOURS FOR URETHANE ADHESIVE TO CURE. IF IT IS NOT CURED, THE WINDSHIELD MAY NOT PERFORM PROPERLY IN AN ACCIDENT.

- **URETHANE ADHESIVES ARE APPLIED AS A SYSTEM. USE GLASS CLEANER, GLASS PREP SOLVENT, GLASS PRIMER, PVC (VINYL) PRIMER AND PINCH WELD (FENCE) PRIMER PROVIDED BY THE ADHESIVE MANUFACTURER. IF NOT, STRUCTURAL INTEGRITY COULD BE COMPROMISED.**
- **DAIMLERCHRYSLER DOES NOT RECOMMEND GLASS ADHESIVE BY BRAND. TECHNICIANS SHOULD REVIEW PRODUCT LABELS AND TECHNICAL DATA SHEETS, AND USE ONLY ADHESIVES THAT THEIR MANUFACTURES WARRANT WILL RESTORE A VEHICLE TO THE REQUIREMENTS OF FMVSS 212. TECHNICIANS SHOULD ALSO INSURE THAT PRIMERS AND CLEANERS ARE COMPATIBLE WITH THE PARTICULAR ADHESIVE USED.**
- **BE SURE TO REFER TO THE URETHANE MANUFACTURER'S DIRECTIONS FOR CURING TIME SPECIFICATIONS, AND DO NOT USE ADHESIVE AFTER ITS EXPIRATION DATE.**
- **VAPORS THAT ARE EMITTED FROM THE URETHANE ADHESIVE OR PRIMER COULD CAUSE PERSONAL INJURY. USE THEM IN A WELL-VENTILATED AREA.**
- **SKIN CONTACT WITH URETHANE ADHESIVE SHOULD BE AVOIDED. PERSONAL INJURY MAY RESULT.**
- **ALWAYS WEAR EYE AND HAND PROTECTION WHEN WORKING WITH GLASS.**

CAUTION: Protect all painted and trimmed surfaces from coming in contact with urethane or primers.
Be careful not to damage painted surfaces when removing moldings or cutting urethane around windshield.

REMOVAL

(1) Remove inside rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - REMOVAL).

(2) Remove cowl grill. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).

(3) Remove the a-pillar weatherstrip retainer. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/A-PILLAR WEATHERSTRIP RETAINER - REMOVAL)

(4) Remove the a-pillar trim panels. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - REMOVAL)

(5) Remove the headliner and from the inside of the vehicle, cut the upper urethane bonding from around windshield upper edge using a suitable sharp cold knife (C-4849). A pneumatic cutting device can be used but is not recommended. (Refer to 23 - BODY/INTERIOR/HEADLINER - REMOVAL)

(6) From the outside of the vehicle, cut urethane bonding from the remaining sides of the windshield using a suitable sharp cold knife (C-4849). A pneumatic cutting device can be used but is not recommended.

(7) Separate windshield from vehicle.

INSTALLATION

WARNING: Allow the urethane at least 24 hours to cure before returning the vehicle to use.

CAUTION: Roll down the left and right front door glass and open the rear glass slider (if available) before installing windshield to avoid pressurizing the passenger compartment if a door is slammed before urethane is cured. Water leaks can result.

The windshield fence should be cleaned of most of its old urethane bonding material. A small amount of old urethane, approximately 1-2 mm in height, should remain on the fence. Do not grind off or completely remove all old urethane from the fence, the paint finish and bonding strength will be adversely affected.

(1) Place replacement windshield into windshield opening and position glass in the center of the opening against the support spacers. Mark the outside surface of the glass at the support spacers with a grease pencil or pieces of masking tape and ink pen to use as a reference for installation. Remove replacement windshield from windshield opening (Fig. 5).

(2) Position the windshield inside up on a suitable work surface with two padded, wood 10 cm by 10 cm by 50 cm (4 in. by 4 in. by 20 in.) blocks, placed parallel 75 cm (2.5 ft.) apart (Fig. 6).

(3) Clean inside of windshield with MOPAR Glass Cleaner and lint-free cloth.

WINDSHIELD (Continued)

(4) Apply clear glass primer 25 mm (1 in.) wide around perimeter of windshield and wipe with a new clean and dry lint- free cloth.

(5) Apply black-out primer onto the glass using the windshield molding as a guide. The primer should be 15 mm (5/8 in.) wide on the top and sides of the glass and 25 mm (1 in.) on the bottom of windshield. Allow at least three minutes drying time.

(6) Locate **new** support spacers on support brackets and adjust to lowest height. (Fig. 5)

(7) Position seven new foam spacers on the inside surface of the windshield, flush with the lower and side edges. (Fig. 7)

(8) Position three new foam spacers on the inside surface of the windshield, at a minimum distance of 3 mm (0.12 in.) from the top edge of the windshield. (Fig. 7)

(9) Apply a 13 mm (1/2 in.) high and 10 mm (3/8 in.) wide bead of urethane around the perimeter of windshield. At the top, apply the bead 7 mm (1/4 in.) inboard from the glass edge. On the other three sides apply the bead 14 mm (0.55 in.) inboard from the glass edge. The urethane bead should be shaped in a triangular cross-section, this can be achieved by notching the tip of the applicator (Fig. 8).

(10) Install the a-pillar trim. (Refer to 23 - BODY/INTERIOR/A-PILLAR TRIM - INSTALLATION)

(11) With the aid of a helper, position the windshield over the windshield opening. Align the reference marks at the bottom of the windshield to the support spacers.

(12) Slowly lower windshield glass to the fence opening guiding the lower corners into proper position. Beginning at the bottom and continuing to the top, push glass onto fence along the A-Pillars. Push windshield inward to the fence at the bottom corners (Fig. 9).

(13) Push windshield upward, setting the windshield to roof gap to 1.5 mm (0.06 in.) to 3 mm (0.12 in.) and ratchet up the adjustable support brackets.

(14) Using clean water, lightly mist the support spacers.

(15) Clean excess urethane from exterior with MOPAR® Super Clean or equivalent.

(16) Install cowl grill. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).

(17) Install rear view mirror support bracket. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - INSTALLATION).

(18) Install rear view mirror. (Refer to 23 - BODY/INTERIOR/REAR VIEW MIRROR - INSTALLATION).

(19) Install the a-pillar weatherstrip retainer. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/A-PILLAR WEATHERSTRIP RETAINER - INSTALLATION)

(20) After urethane has cured, remove tape strips and water test windshield to verify repair.

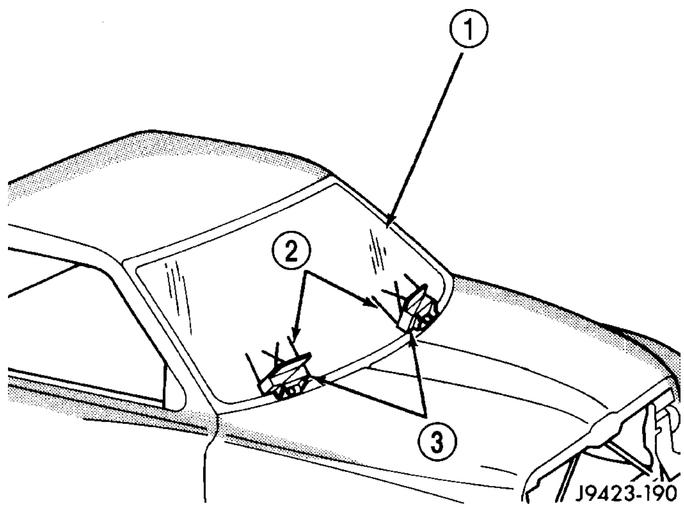

Fig. 5 CENTER WINDSHIELD AND MARK AT SUPPORT

1 - WINDSHIELD
2 - INDEX MARKS
3 - SUPPORT SPACERS

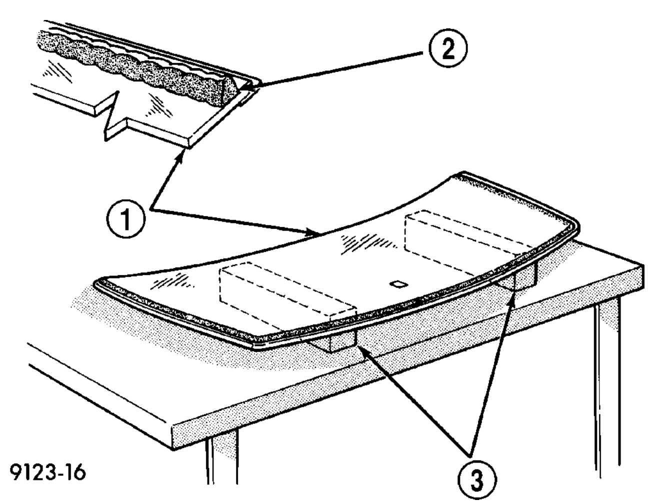

Fig. 6 WORK SURFACE SET UP

1 - WINDSHIELD AND MOLDINGS
2 - URETHANE BEAD AROUND GLASS 7mm (0.3 in.) FROM EDGE
3 - BLOCKS

WINDSHIELD (Continued)

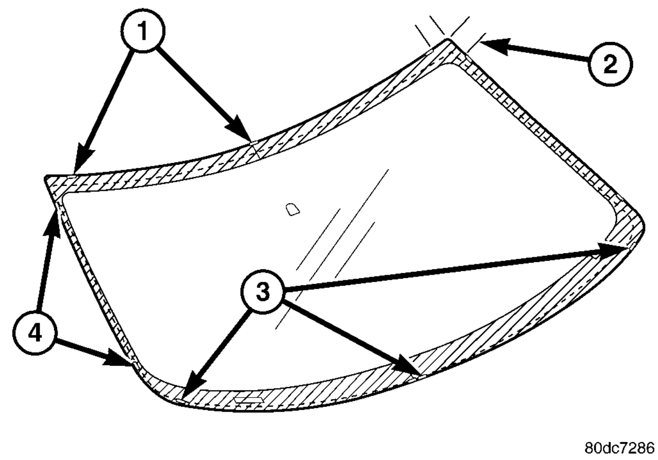

Fig. 7 WINDSHIELD FOAM SUPPORT SPACERS

1 - UPPER FOAM SPACERS (3)
2 - SPACER LOCATION 75 MM (2.95 IN)
3 - LOWER FOAM SPACERS (3)
4 - SIDE FOAM SPACERS (4)

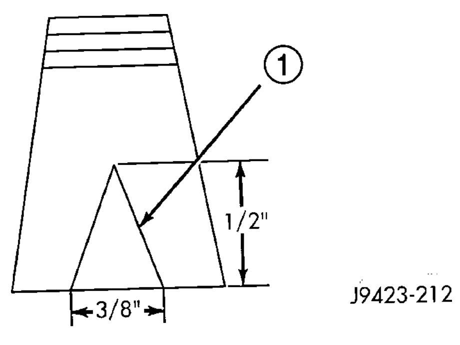

Fig. 8 APPLICATOR TIP

1 - APPLICATOR TIP

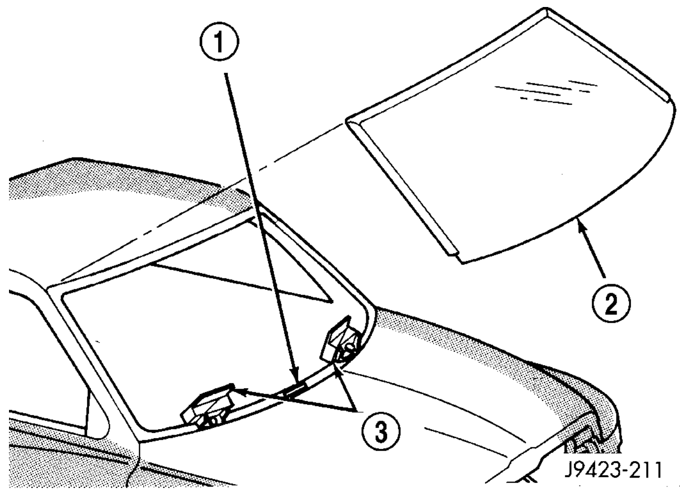

Fig. 9 LOWER WINDSHIELD INTO POSITION

1 - COMPRESSION SPACER
2 - WINDSHIELD
3 - ADJUSTABLE SUPPORT SPACERS

WEATHERSTRIP/SEALS

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A-PILLAR WEATHERSTRIP RETAINER

REMOVAL

(1) Remove the drip rail weatherstrip retainer. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/DRIP RAIL WEATHERSTRIP - REMOVAL)

(2) Remove the five screws and remove the weatherstip retainer. (Fig. 1)

INSTALLATION

(1) Install the weatherstip retainer and install the screws.

(2) Install the drip rail weatherstrip retainer. (Refer to 23 - BODY/WEATHERSTRIP/SEALS/DRIP RAIL WEATHERSTRIP - INSTALLATION)

DRIP RAIL WEATHERSTRIP

REMOVAL

(1) Open the doors and separate the weatherstrip from the drip rail and a-pillar retainers. (Fig. 1)

INSTALLATION

(1) Position the weatherstrip onto the drip rail and a-pillar retainers and seat fully.

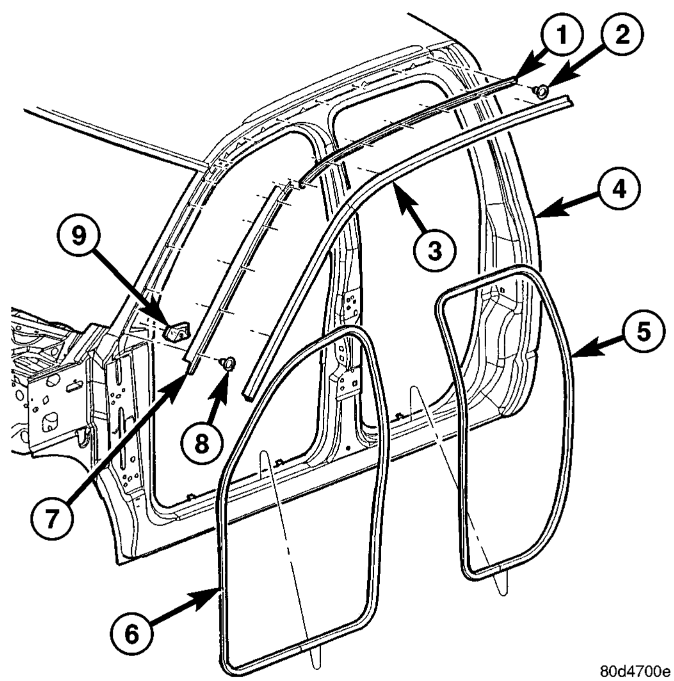

Fig. 1 DOOR OPENING WEATHERSTRIPS/SEALS

1 - DRIP RAIL WEATHERSTRIP RETAINER
2 - SCREWS (7)
3 - DRIP RAIL WEATHERSTRIP
4 - CAB
5 - REAR DOOR OPENING SEAL
6 - FRONT DOOR OPENING SEAL
7 - A-PILLAR WEATHERSTRIP RETAINER
8 - SCREWS (5)
9 - CORNER SEAL

DOOR OPENING SEAL

REMOVAL

FRONT DOOR SEAL

(1) Remove the cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - REMOVAL)

(2) Remove the lower b-pillar trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(3) Separate the door opening seal from the door opening flange. (Fig. 1)

REAR DOOR SEAL

(1) Remove the lower b-pillar trim panel. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - REMOVAL)

(2) Remove the lower c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - REMOVAL)

(3) Separate the door opening seal from the door opening flange. (Fig. 1)

INSTALLATION

FRONT DOOR SEAL

(1) Position the seal to the bottom of the door opening, with bulb facing outboard, starting the installation at the center of the lower flange. Press the seal onto the sill flange and work around the perimeter of the door opening until fully seated. Work in one direction, smoothing the seal to avoid puckers or wrinkles.

(2) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

(3) Install the cowl trim panel. (Refer to 23 - BODY/INTERIOR/COWL TRIM - INSTALLATION)

(4) When installing a new weatherstrip on the front door opening, remove the tear strip starting at the splice and moving around the front of the door to the back of the opening.

REAR DOOR SEAL

(1) Position the seal to the bottom of the door opening, with bulb facing outboard, starting the installation at the center of the lower flange. Press the seal onto the sill flange and work around the perimeter of the door opening until fully seated. Work in one direction, smoothing the seal to avoid puckers or wrinkles.

(2) Install the lower c-pillar trim. (Refer to 23 - BODY/INTERIOR/C-PILLAR TRIM - INSTALLATION)

(3) Install the lower b-pillar trim. (Refer to 23 - BODY/INTERIOR/B-PILLAR LOWER TRIM - INSTALLATION)

(4) When installing a new weatherstrip on the rear door opening, remove the tear strip starting at the splice and moving around the back of the door to the front of the opening.

DRIP RAIL WEATHERSTRIP RETAINER

REMOVAL

(1) Separate the drip rail weatherstrip from the weatherstrip retainer. (Fig. 1)

(2) Remove the seven screws and remove the retainer.

INSTALLATION

(1) Install the weatherstrip retainer and install the seven screws.

(2) Position the weatherstrip over the retainer flange and seat fully.

FRONT DOOR GLASS RUN WEATHERSTRIP

REMOVAL

(1) Remove the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - REMOVAL)

(2) Separate the weatherstrip out of the door frame and remove through the window opening. (Fig. 2)

INSTALLATION

NOTE: A mixture of soap and water may be used to aid installation of the weatherstrip into the corners.

(1) Position the glass run weatherstrip into the door through the window opening.

(2) Position the weatherstrip into the upper corners and seat firmly.

(3) From back to front, seat the weatherstrip between the corners and then down the sides firmly

(4) Install the door glass. (Refer to 23 - BODY/DOOR - FRONT/DOOR GLASS - INSTALLATION)

FRONT DOOR GLASS RUN WEATHERSTRIP (Continued)

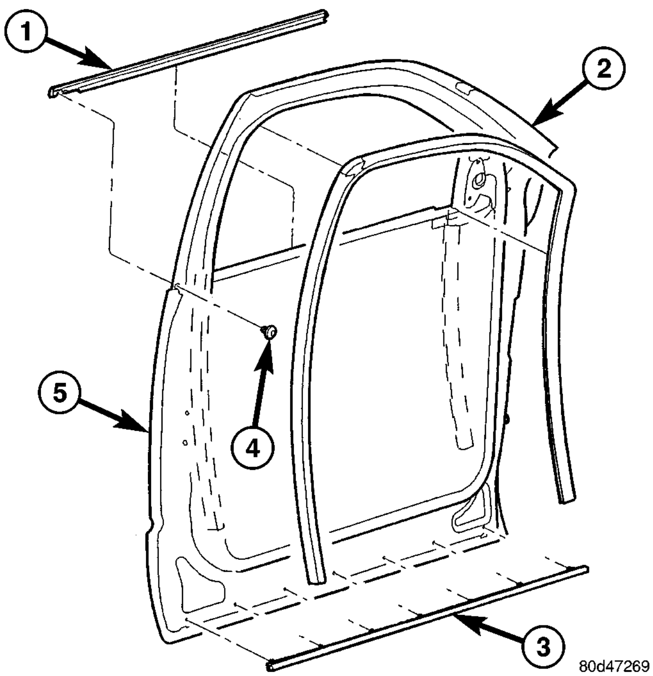

Fig. 2 FRONT DOOR GLASS SEALS

1 - OUTER BELT MOLDING
2 - FRONT DOOR GLASS RUN WEATHERSTRIP
3 - LOWER DOOR SEAL
4 - SCREW
5 - FRONT DOOR

FRONT DOOR OUTER BELT MOLDING

REMOVAL

(1) Remove the screw and separate the belt molding from the door flange from the back to the front. (Fig. 2)

INSTALLATION

(1) Position the belt molding onto the door flange and seat fully.
(2) Install the screw.

FRONT DOOR INNER BELT MOLDING

REMOVAL

(1) Remove the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - REMOVAL)
(2) Separate the belt molding from the mounting flange from the back to the front. (Fig. 3)

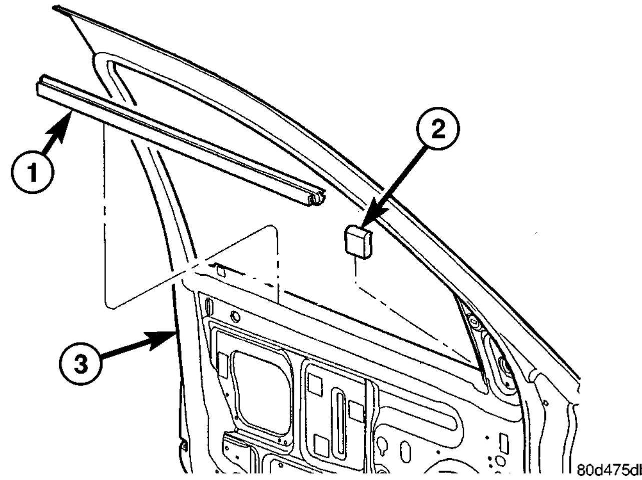

Fig. 3 INNER BELT MOLDING

1 - BELT MOLDING
2 - CORNER SEAL
3 - FRONT DOOR

INSTALLATION

(1) Position the belt molding and seat onto the mounting flange fully.
(2) Install the door trim panel. (Refer to 23 - BODY/DOOR - FRONT/TRIM PANEL - INSTALLATION)

REAR DOOR GLASS RUN WEATHERSTRIP

REMOVAL

(1) Lower the glass.
(2) Separate the weatherstrip out of the door frame and remove through the window opening. (Fig. 4)

INSTALLATION

NOTE: A mixture of soap and water may be used to aid installation of the weatherstrip into the corners.

(1) Position the glass run weatherstrip into the door through the window opening.
(2) Position the weatherstrip into the upper corners and seat firmly.
(3) From back to front, seat the weatherstrip between the corners and then down the sides firmly.

REAR DOOR GLASS RUN WEATHERSTRIP (Continued)

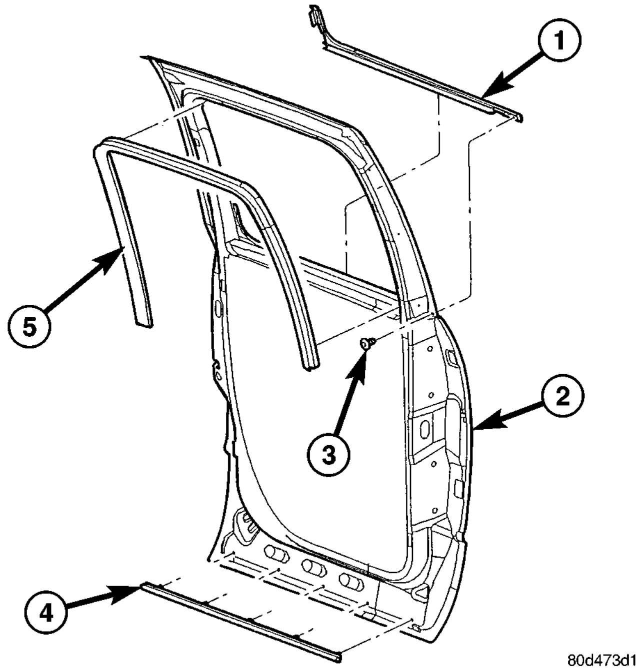

Fig. 4 REAR DOOR GLASS SEALS

1 - OUTER BELT MOLDING
2 - REAR DOOR
3 - SCREW
4 - LOWER DOOR SEAL
5 - GLASS RUN WEATHERSTRIP

REAR DOOR OUTER BELT MOLDING

REMOVAL

(1) Remove the screw and separate the belt molding from the door flange from the back to the front. (Fig. 4)

INSTALLATION

(1) Position the belt molding onto the door flange and seat fully.

(2) Install the screw.

REAR DOOR INNER BELT MOLDING

REMOVAL

(1) Remove the door trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - REMOVAL)

(2) Separate the belt molding from the mounting flange from the back to the front. (Fig. 5)

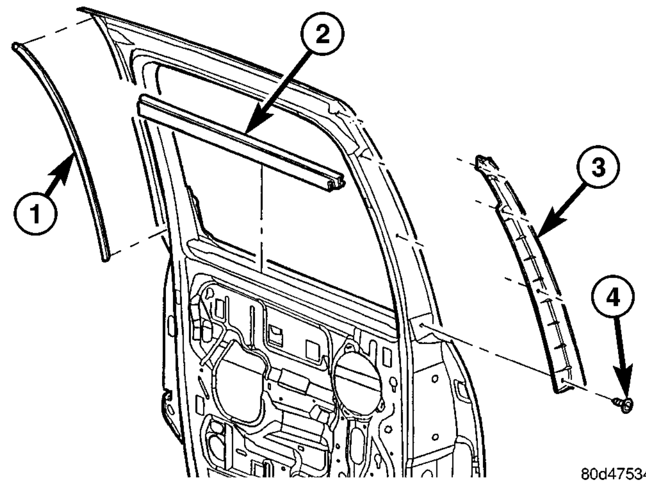

Fig. 5 REAR DOOR INNER SEALS

1 - REAR SECONDARY SEAL
2 - INNER BELT MOLDING
3 - FRONT SECONDARY SEAL
4 - SCREWS

INSTALLATION

(1) Position the belt molding and seat onto the mounting flange fully.

(2) Install the door trim panel. (Refer to 23 - BODY/DOORS - REAR/TRIM PANEL - INSTALLATION)

BODY STRUCTURE

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GAP AND FLUSH

SPECIFICATIONS

GAP & FLUSH DIMENSIONS INDEX

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PICKUP BOX	3

GAP AND FLUSH (Continued)

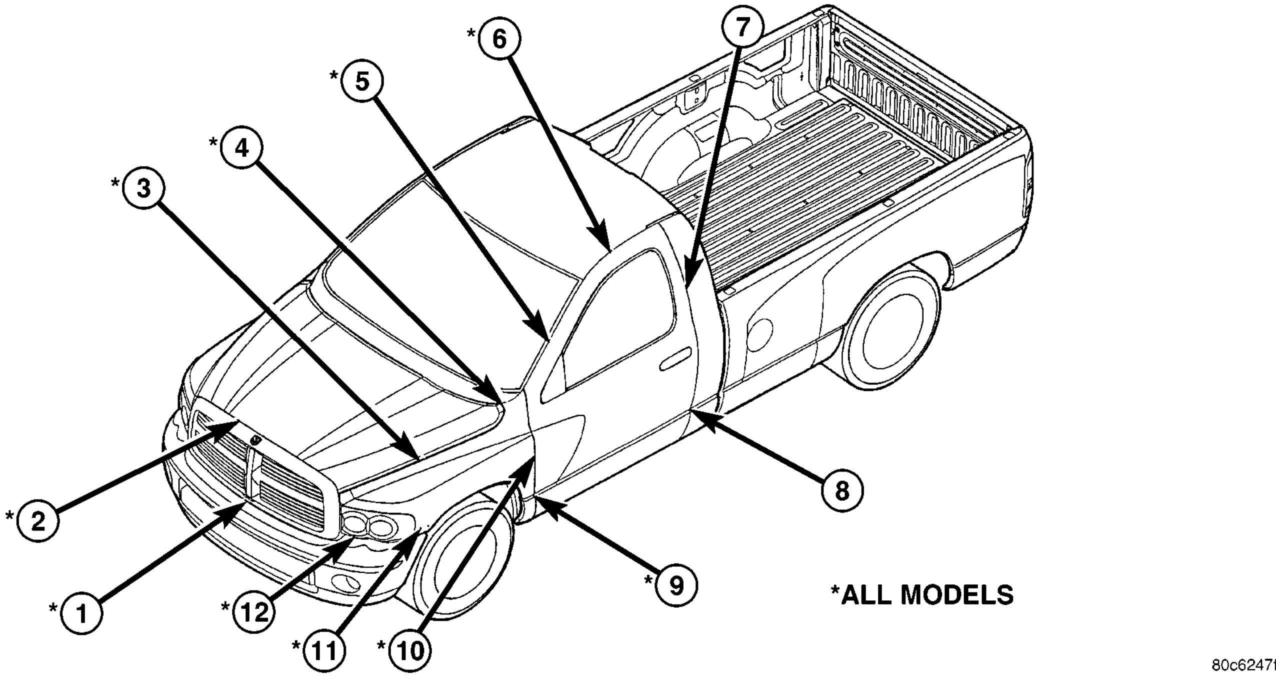

Fig. 1 GAP & FLUSH - STANDARD CAB

O/F = Over Flush
U/F = Under Flush

NOTE:
All measurements are in mm.

DIMENSION	DESCRIPTION	GAP	FLUSH
*****1	Bumper to grille	19.0 ± 3.0	—
*****2	Hood to grille	1.5 ± 1.0 Parallel within 2.0	U/F 0.75 ± 1.75
*****3	Fender to hood	6.0 ± 2.0 Parallel within 1.0	U/F 3.2 ± 1.5 (Underflush from front of hood to start of hockey stick area only)
*****4	Fender to hood (Up/Down surface only)	6.0 ± 1.5 Parallel within 1.0	0.0 ± 1.5
*****5	Front door to windshield	—	O/F 20.5 ± 1.5 (Base of windshield) O/F 9.0 ± 1.5 (Top of windshield)
*****6	Roof to front door	—	U/F 6.0 ± 1.5 Parallel within 1.5
7	Quarter to front door	5.0 ± 1.5 Parallel within 1.0	0.0 ± 1.5
8	Front door to quarter character line alignment	—	Up/Down 0.0 ± 1.5
*****9	Front door to fender character line alignment	—	Up/Down 0.0 ± 1.5
*****10	Front door to fender	5.0 ± 1.5 Parallel within 1.0	0.0 ± 1.5
*****11	Bumper to fender	19.0 ± 3.0 Parallel within 3.0	O/F 5.0 ± 5.0 (SLT) O/F 14.0 ± 5.0 (SPORT)
*****12	Bumper to headlamp	19.0 ± 4.0	—

* ALL MODELS

GAP AND FLUSH (Continued)

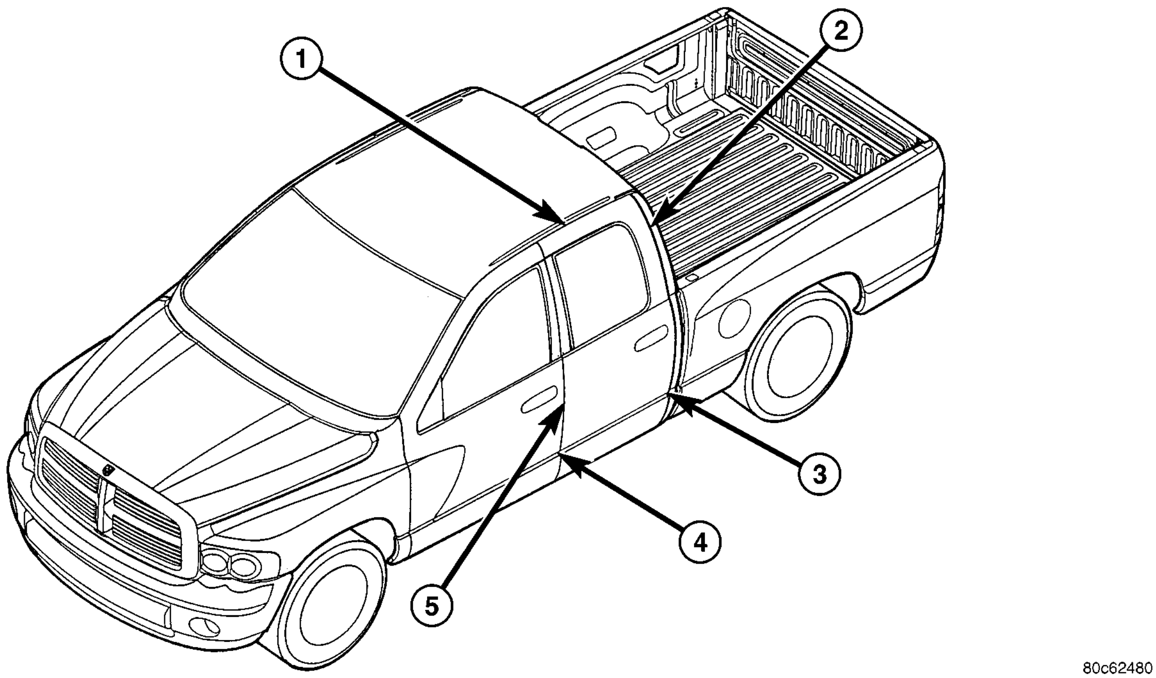

Fig. 2 GAP & FLUSH - QUAD CAB

NOTE:
All measurements are in mm.

O/F = Over Flush

U/F = Under Flush

DIMENSION	DESCRIPTION	GAP	FLUSH
1	Roof to rear door	—	U/F 6.0 ± 1.5 Parallel within 1.5
2	Quarter to rear door	5.0 ± 1.5 Parallel within 2.0	0.0 ± 1.5
3	Rear door to quarter character line alignment	—	Up/Down 0.0 ± 1.5
4	Rear door to front door character line alignment	—	Up/Down 0.0 ± 1.5
5	Rear door to front door	5.0 ± 1.5 Parallel within 2.0	0.0 ± 1.5

GAP AND FLUSH (Continued)

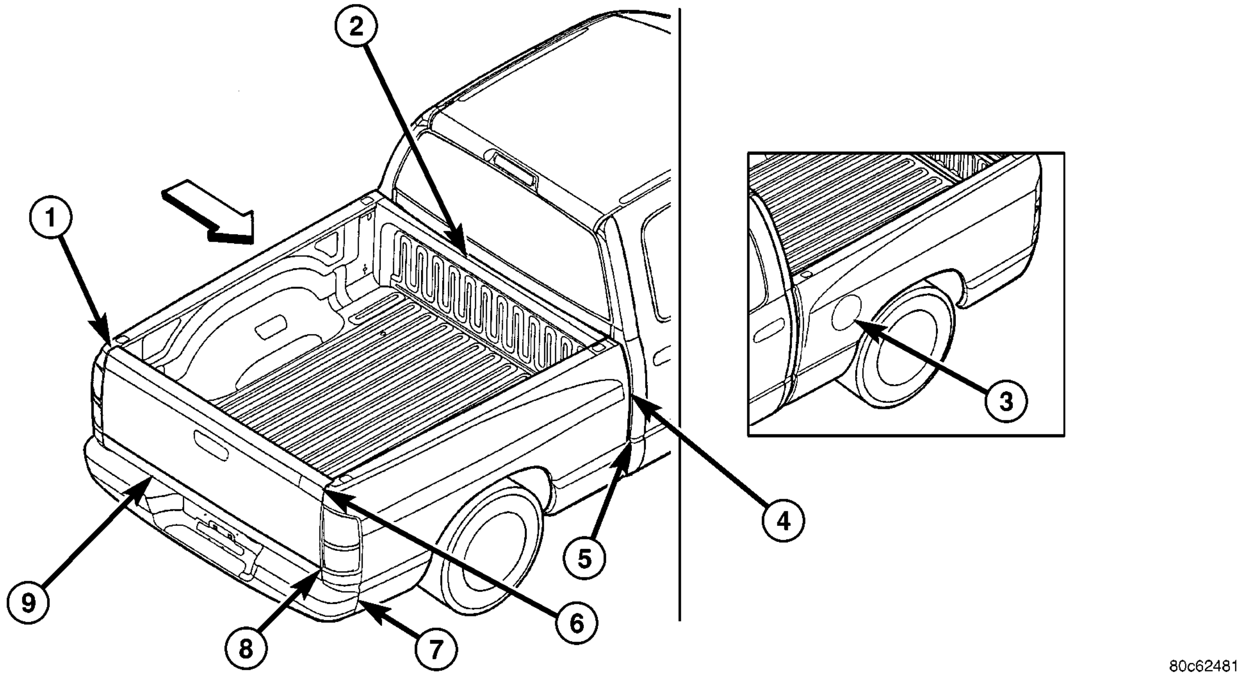

Fig. 3 GAP & FLUSH - PICKUP BOX

NOTE:
All measurements are in mm.

O/F = Over Flush

U/F = Under Flush

DIMENSION	DESCRIPTION	GAP	FLUSH
1	Tailgate to outer box (Up/Down surface only)	—	0.0 ± 1.5 Parallel within 1.0
2	Cab Back to box front	31.0 ± 5.0 Parallel within 3.0	—
3	Fuel door to outer box	5.0 ± 1.5 Parallel within 1.0	0.0 ± 1.5
4	Cab to box side	31.0 ± 5.0 Parallel within 3.0	4.0 ± 2.5 (Standard Cab) O/F 5.0 ± 2.5 (Quad Cab)
5	Cab to box character line alignment	—	Up/Down 0.0 ± 3.0
6	Tailgate to outer box	5.0 ± 2.0 Parallel within 1.0	U/F 1.5 ± 1.5
7	Bumper to outer box	24.75 ± 5.0 (F/A) 23.75 ± 5.0 (C/C) Parallel within 5.0	—
8	Tailgate to outer box character line adjustment	—	Up/Down 0.0 ± 1.5
9	Bumper to tailgate	30.25 ± 3.0 Parallel within 4.0	—

OPENING DIMENSIONS

SPECIFICATIONS - BODY OPENING DIMENSIONS

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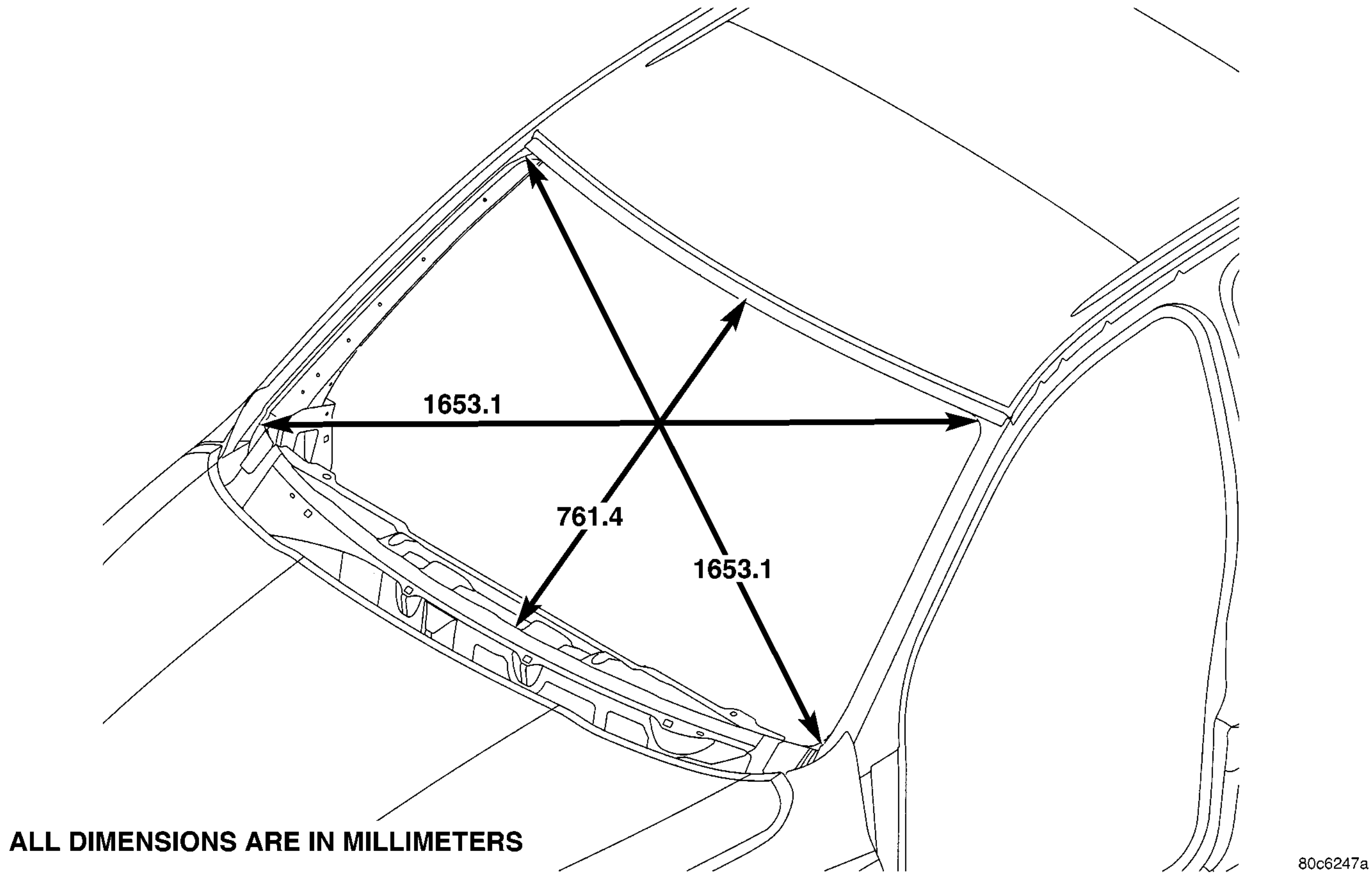

Fig. 4 WINDSHIELD OPENING

OPENING DIMENSIONS (Continued)

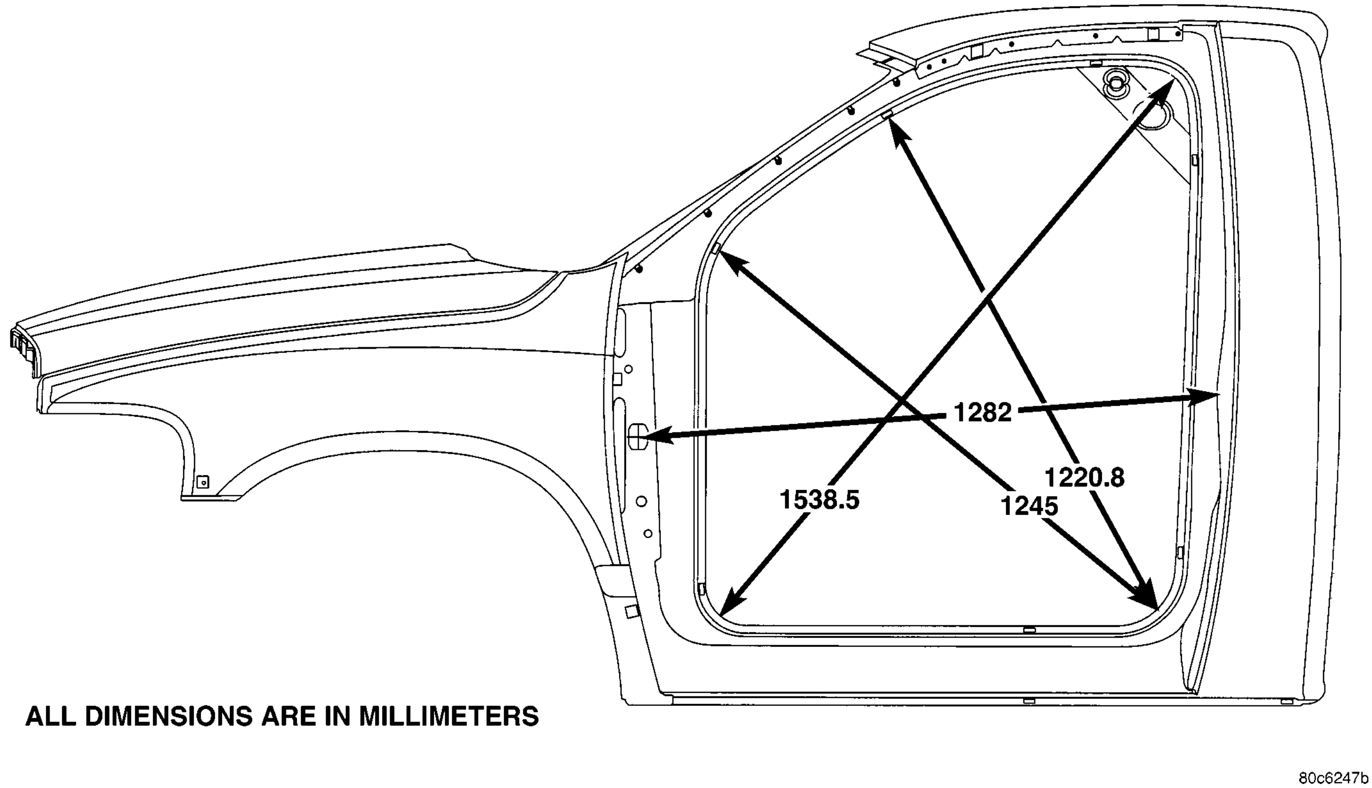

Fig. 5 DOOR OPENING - STANDARD CAB

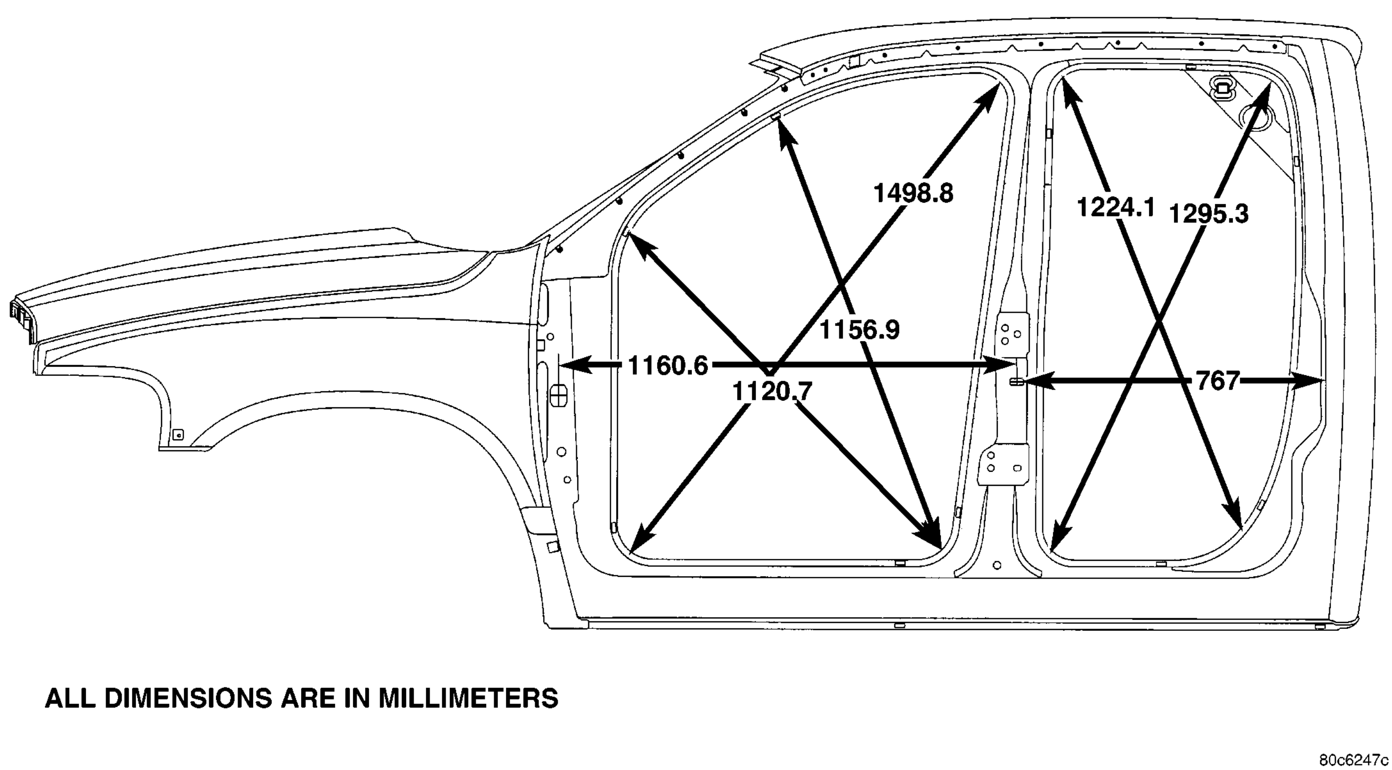

Fig. 6 DOOR OPENINGS - QUAD CAB

OPENING DIMENSIONS (Continued)

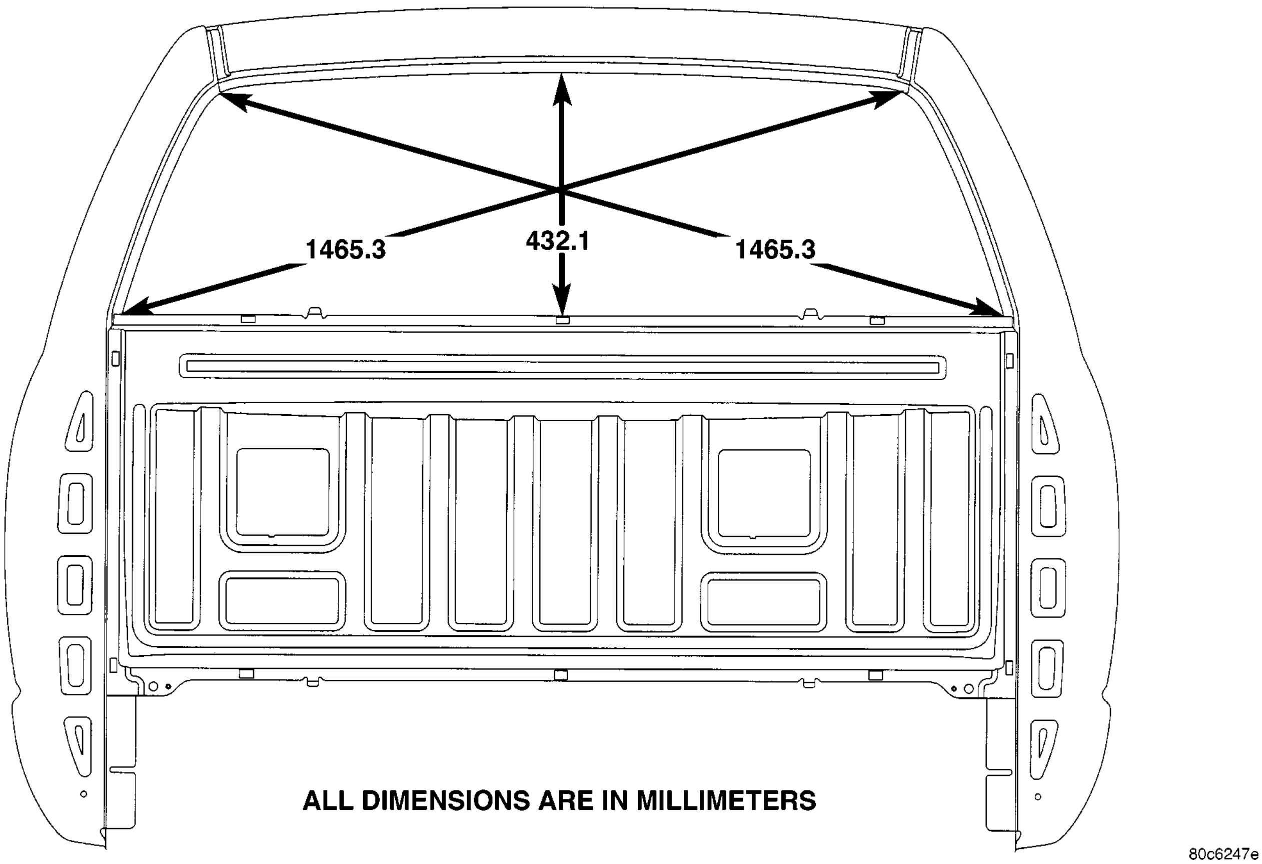

Fig. 7 REAR WINDOW OPENING

OPENING DIMENSIONS (Continued)

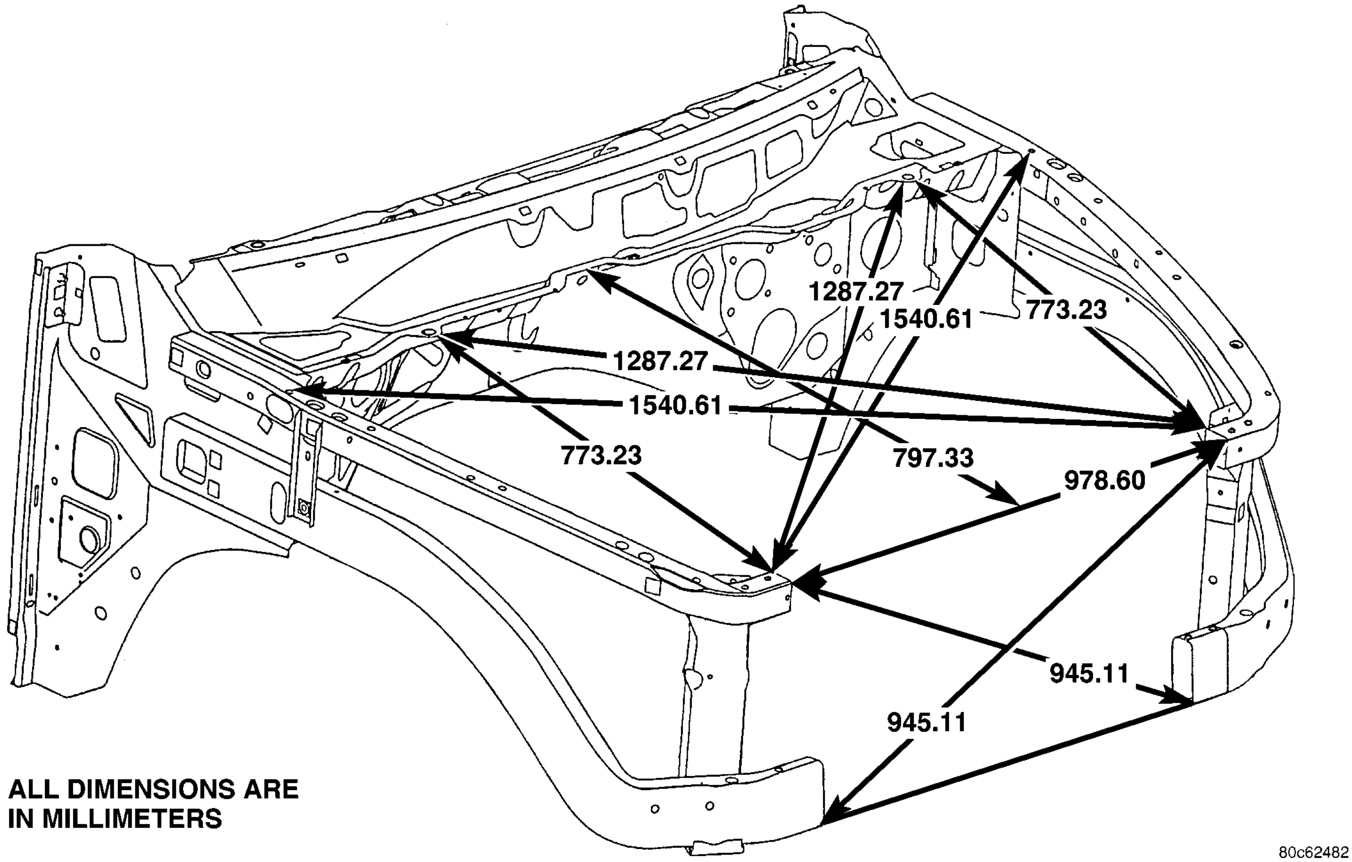

Fig. 8 ENGINE COMPARTMENT/FRONT STRUCTURE

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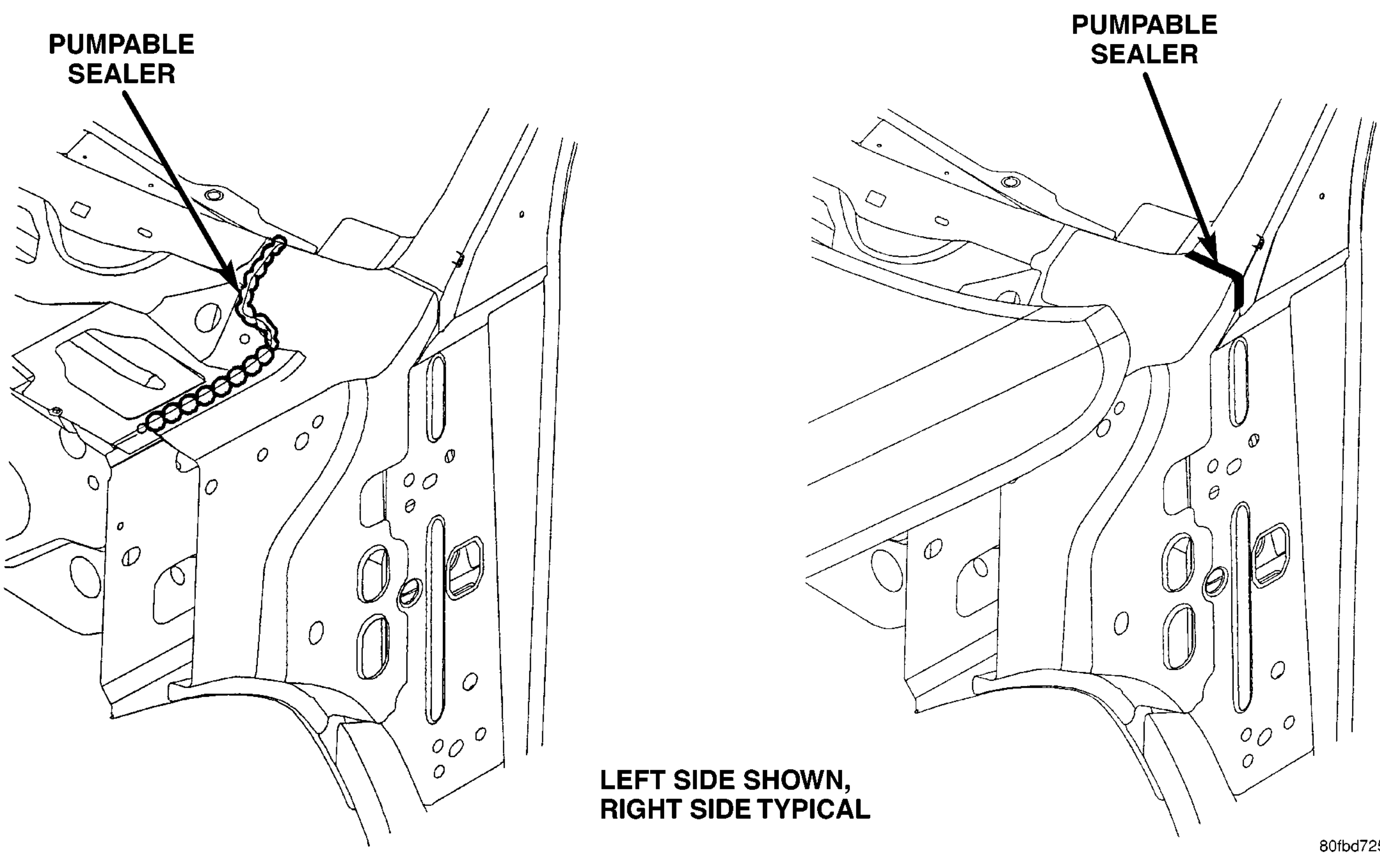


Fig. 9 LOWER WINDSHIELD PILLAR

SEALER LOCATIONS (Continued)

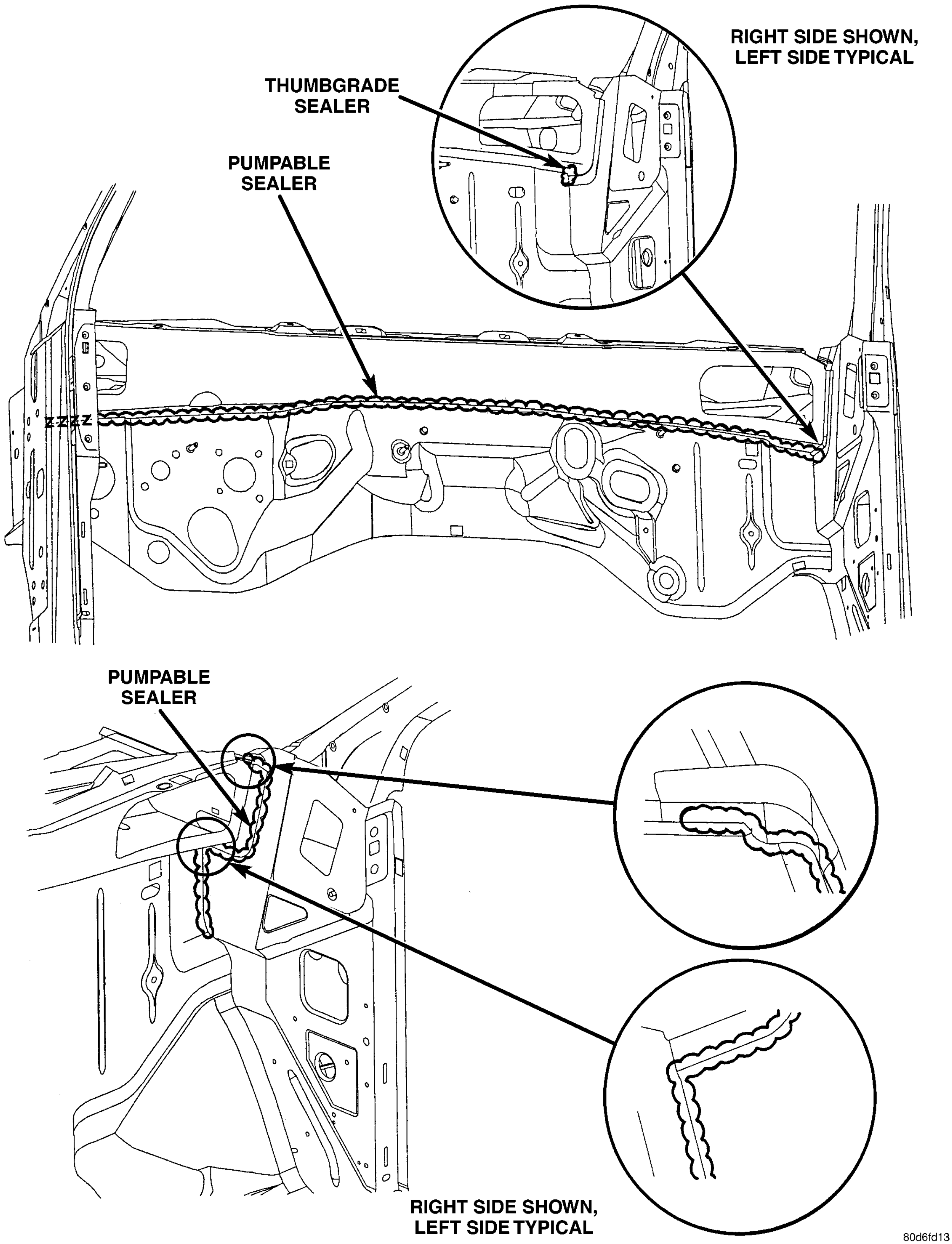


Fig. 10 DASH PANEL

SEALER LOCATIONS (Continued)

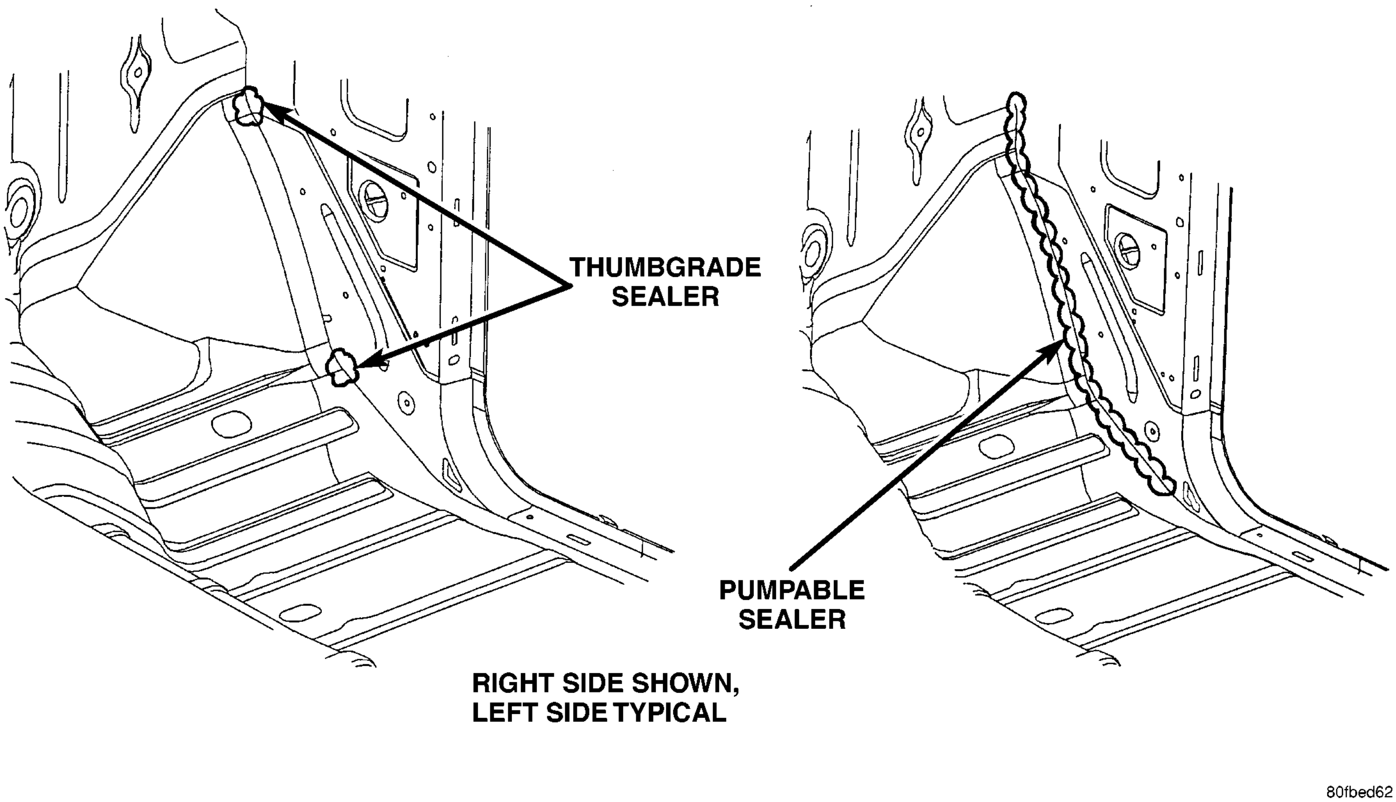


Fig. 11 LOWER DASH PANEL

SEALER LOCATIONS (Continued)

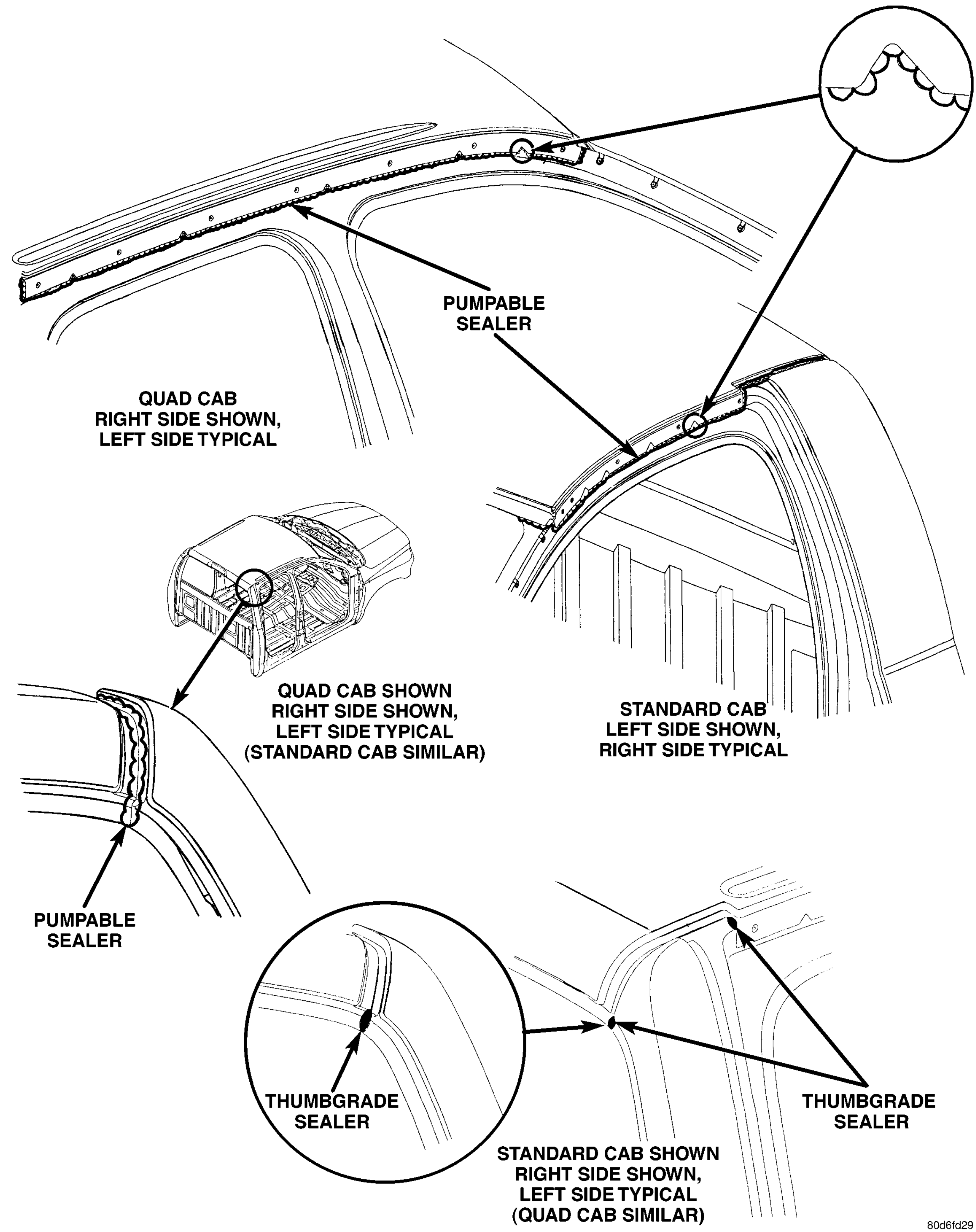


Fig. 12 ROOF PANEL

SEALER LOCATIONS (Continued)

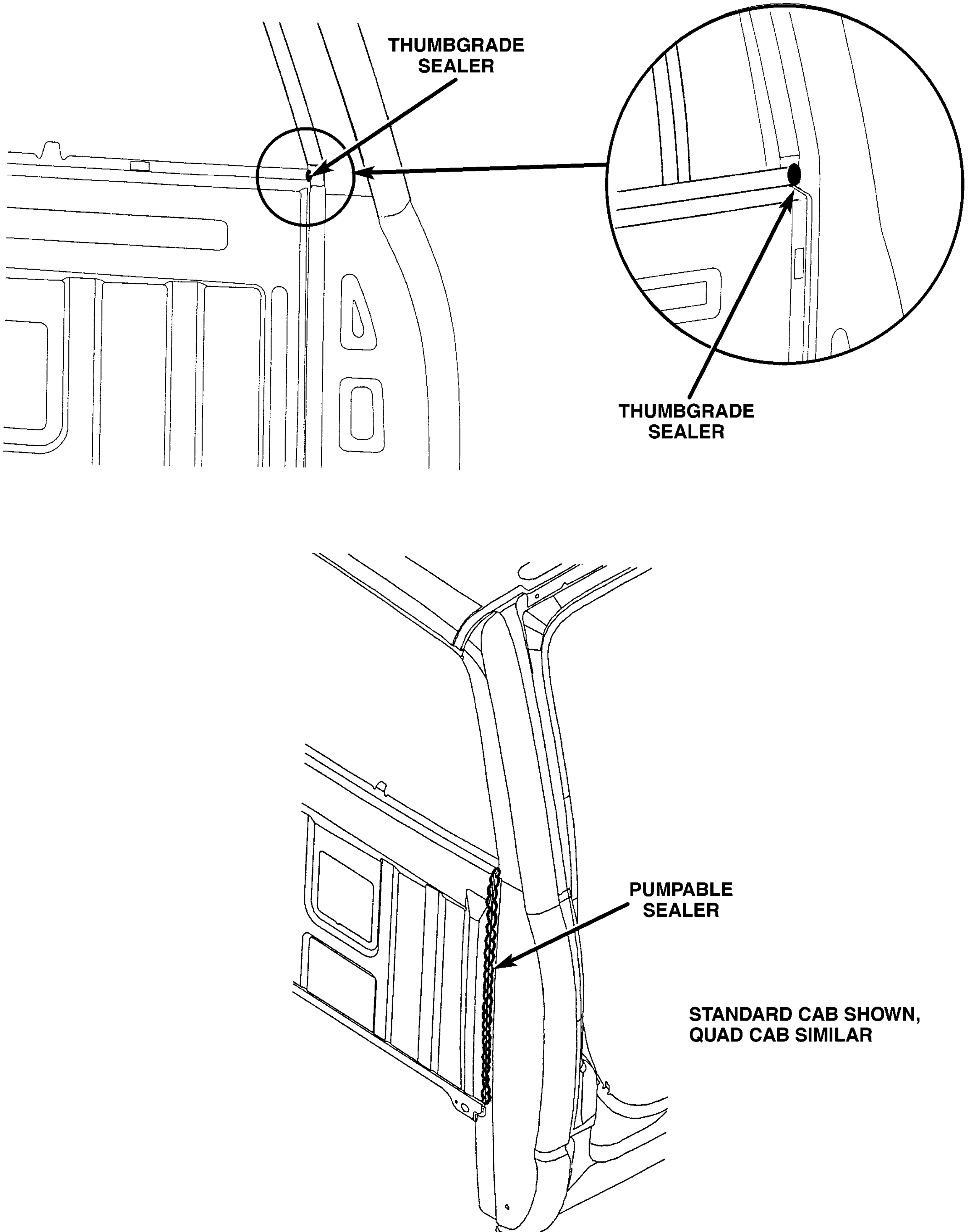


Fig. 13 CAB BACK PANEL

SEALER LOCATIONS (Continued)

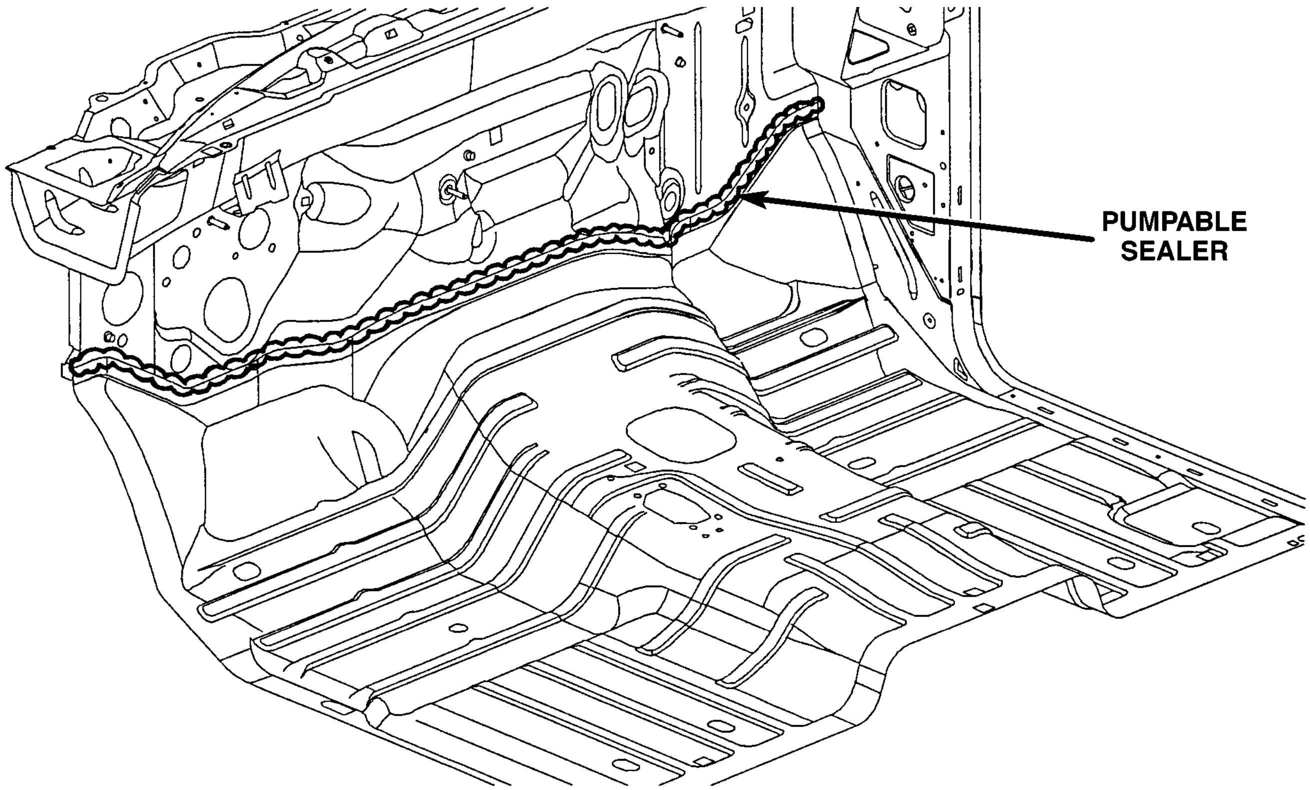


Fig. 14 LOWER DASH PANEL

SEALER LOCATIONS (Continued)

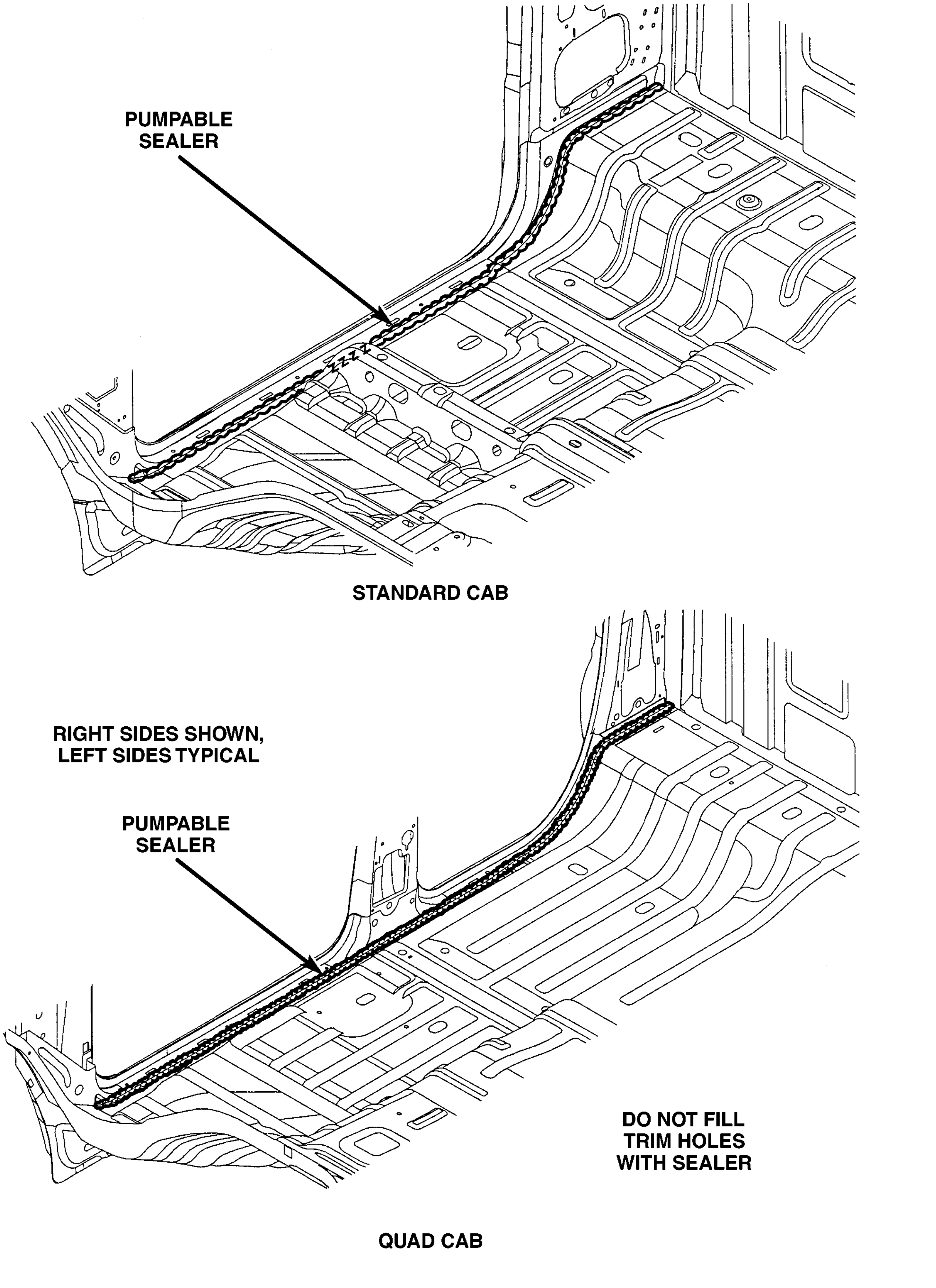


Fig. 15 FLOOR PAN

SEALER LOCATIONS (Continued)

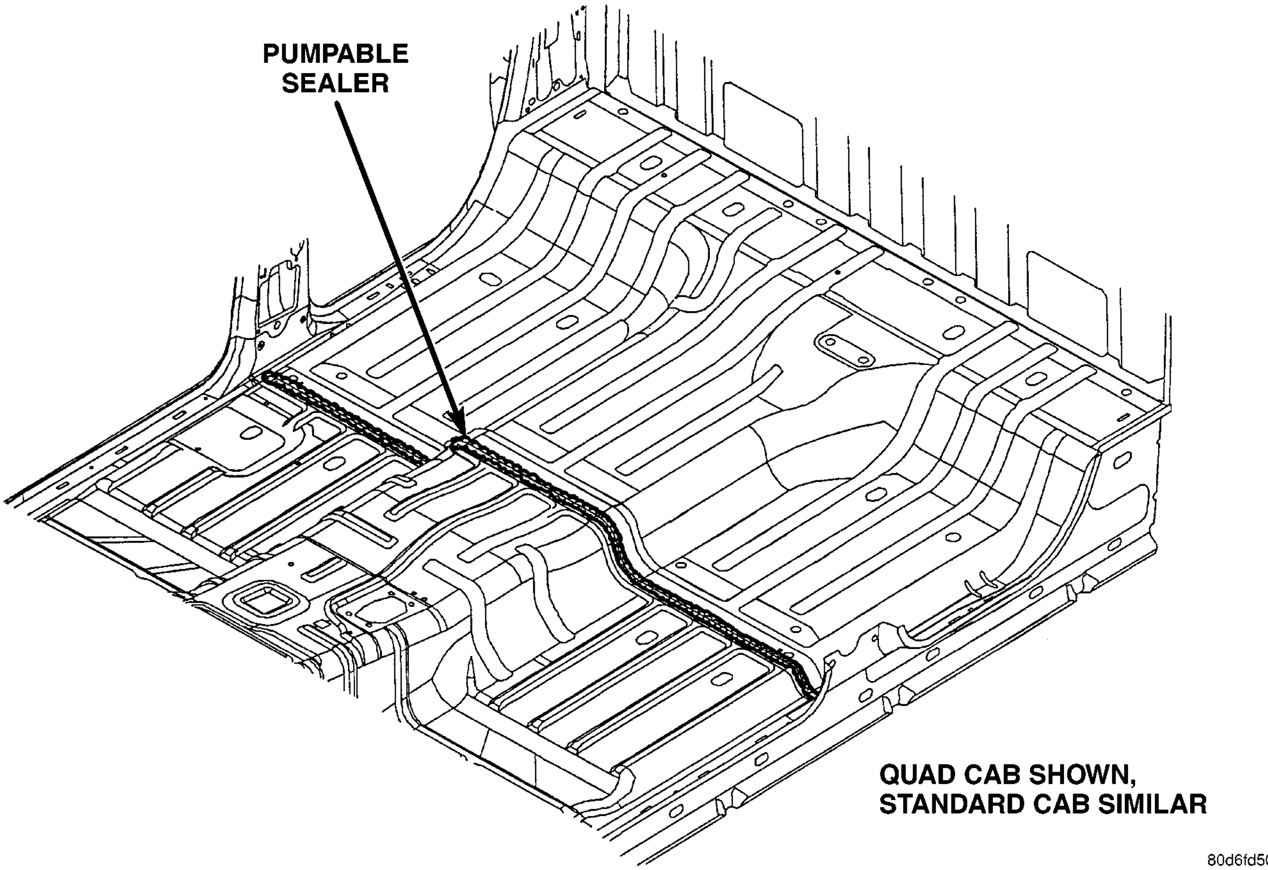


Fig. 16 FRONT FLOOR PAN

SEALER LOCATIONS (Continued)

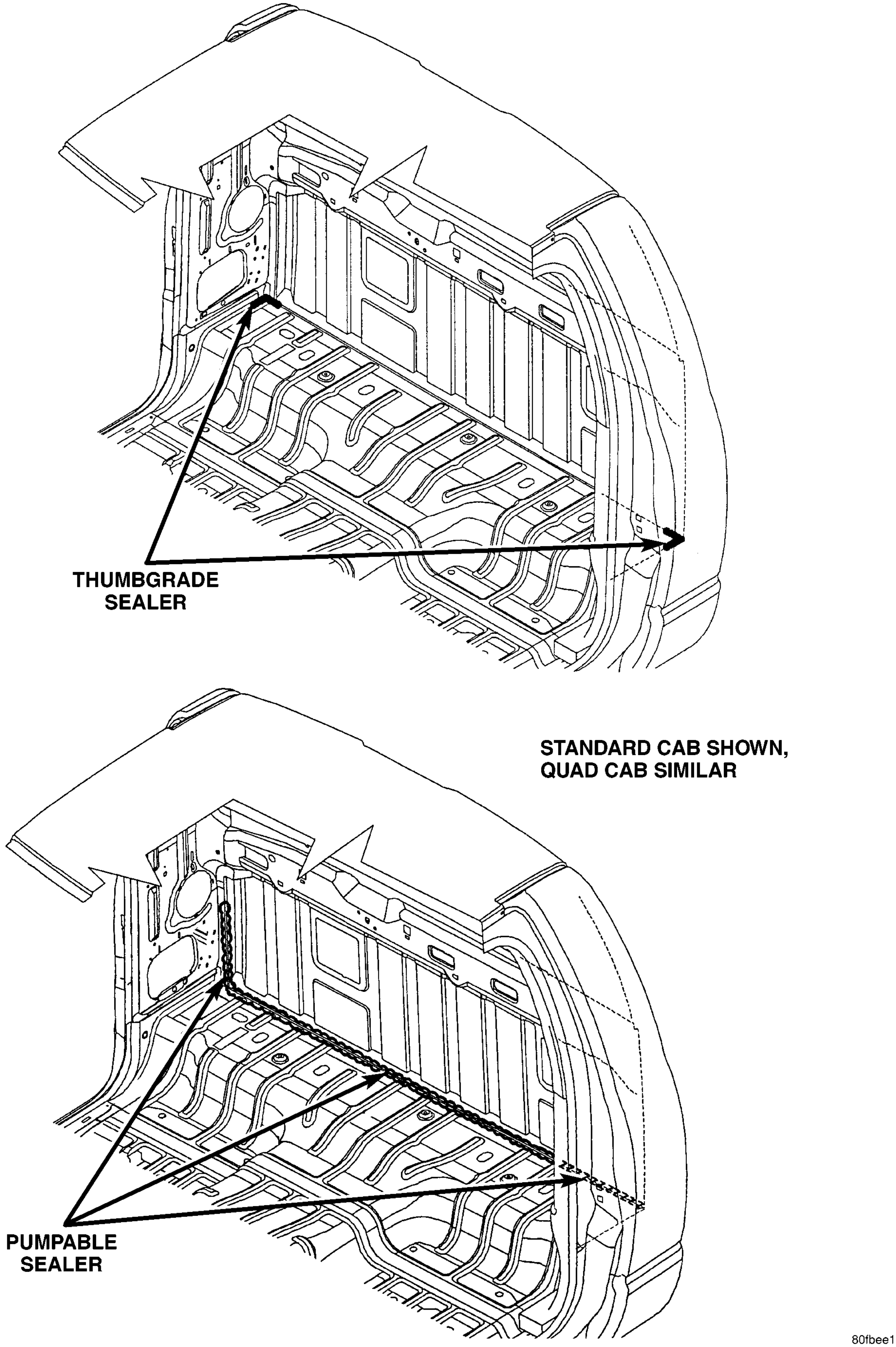
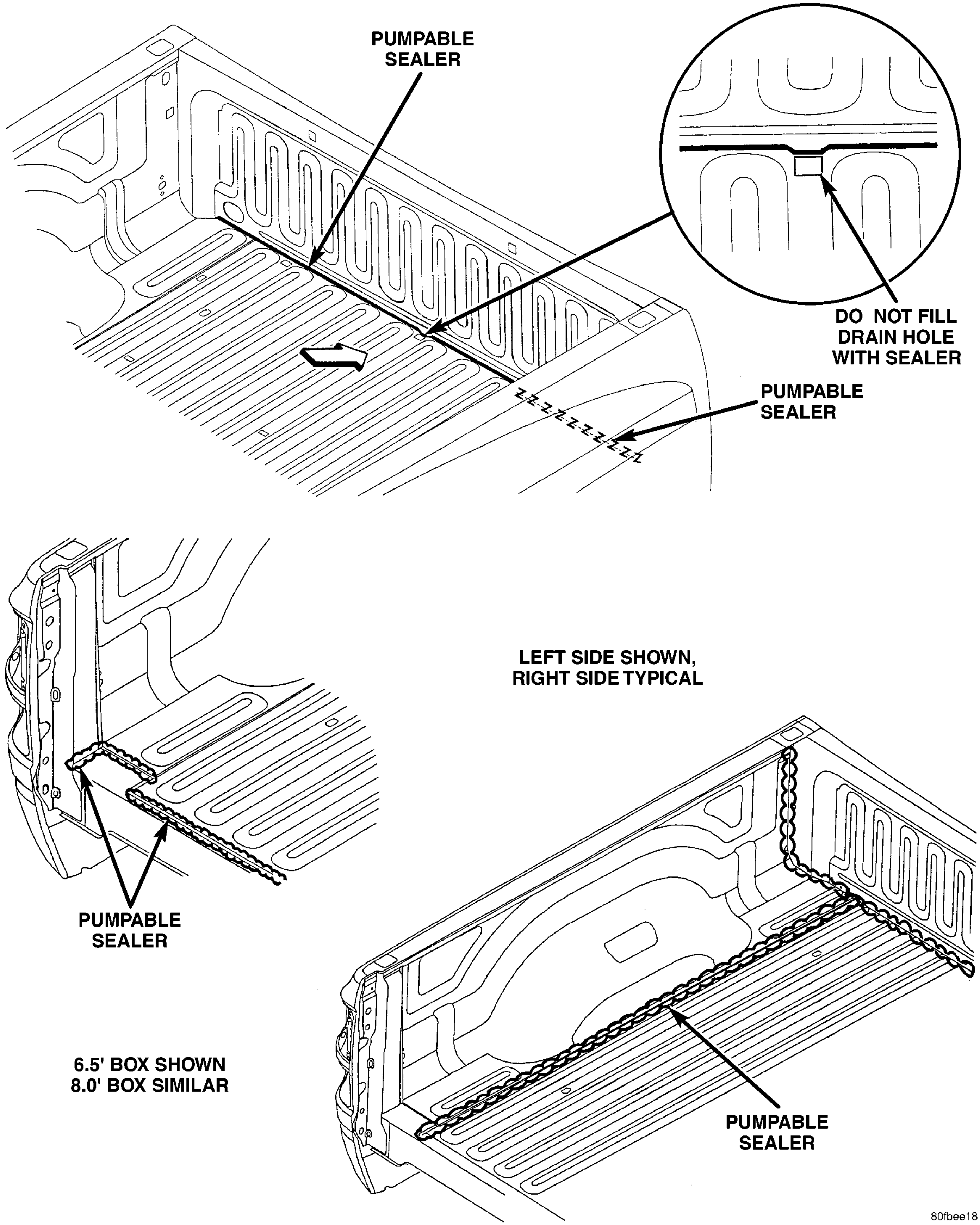


Fig. 17 FLOOR PAN

SEALER LOCATIONS (Continued)



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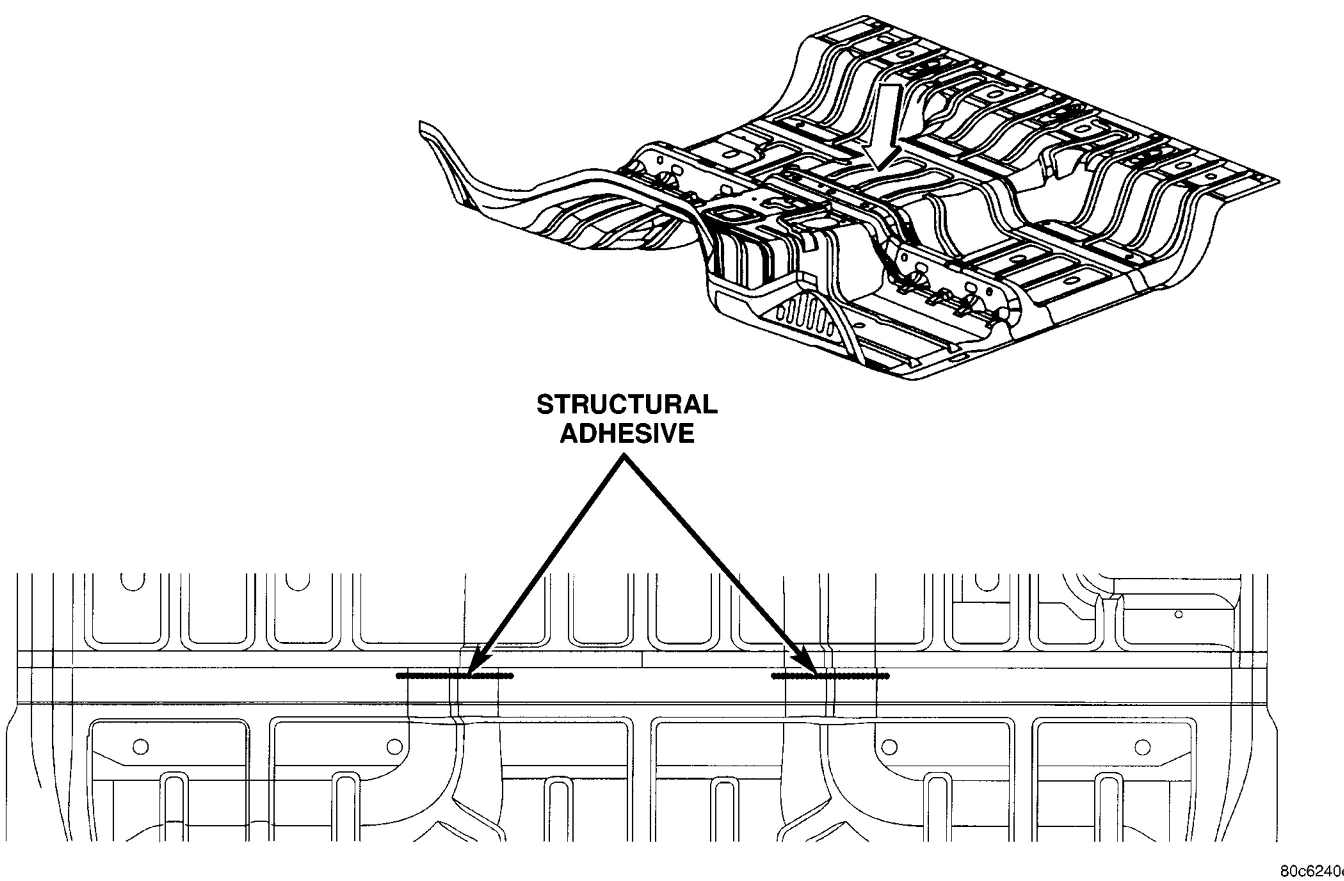

Fig. 19 FLOOR PAN

STRUCTURAL ADHESIVE LOCATIONS (Continued)

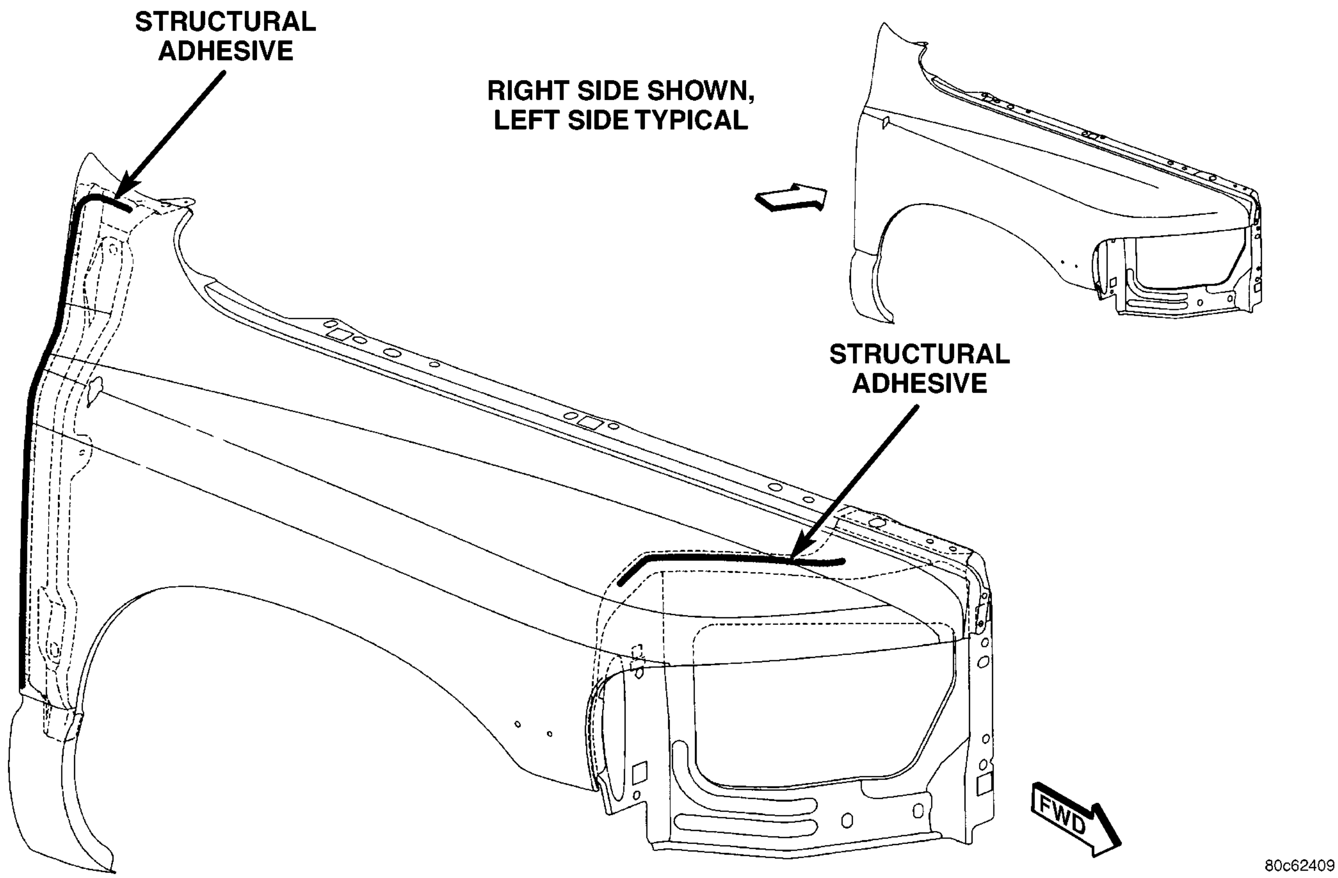

Fig. 20 FRONT FENDER

STRUCTURAL ADHESIVE LOCATIONS (Continued)

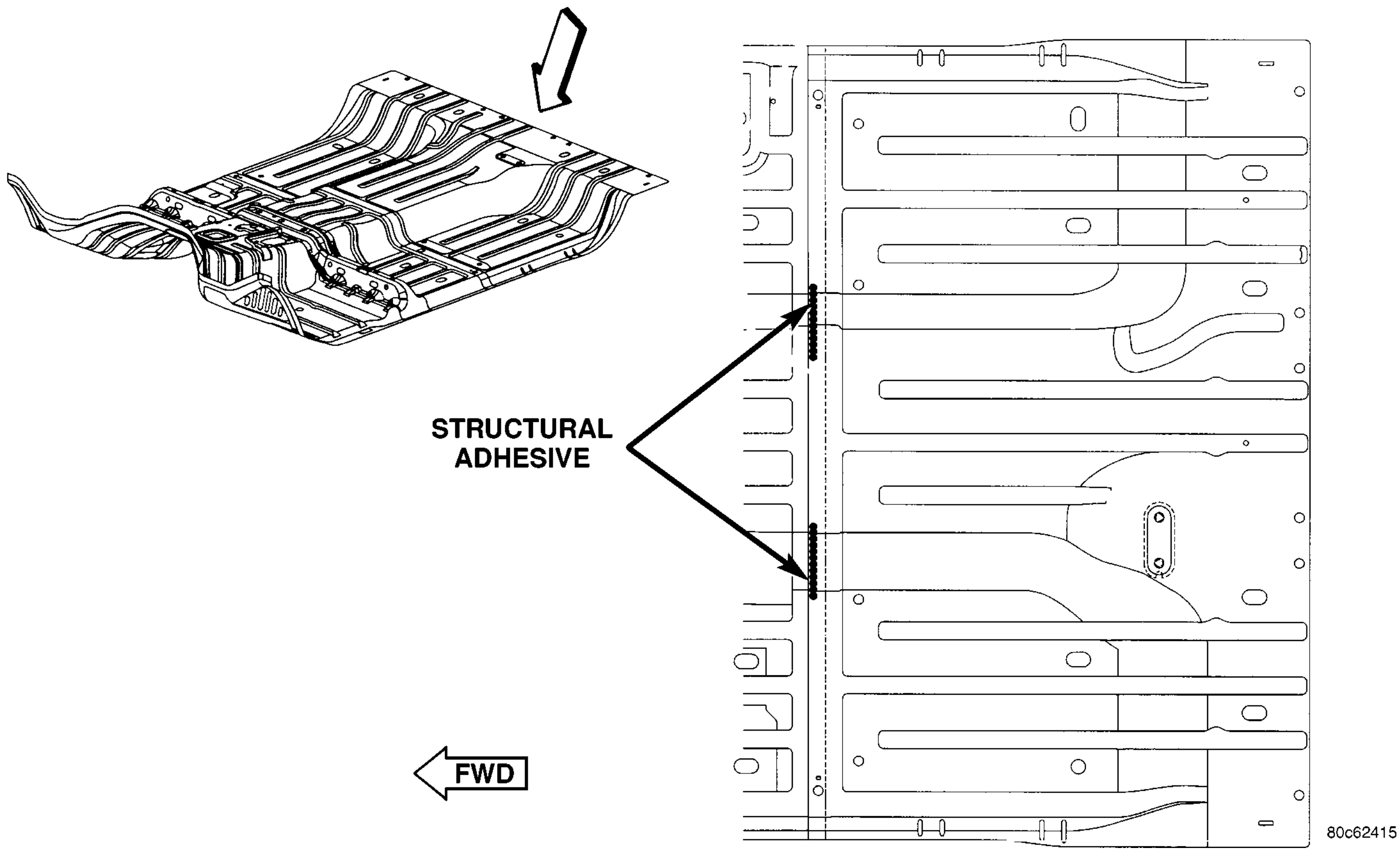

Fig. 21 FLOOR PAN

STRUCTURAL ADHESIVE LOCATIONS (Continued)

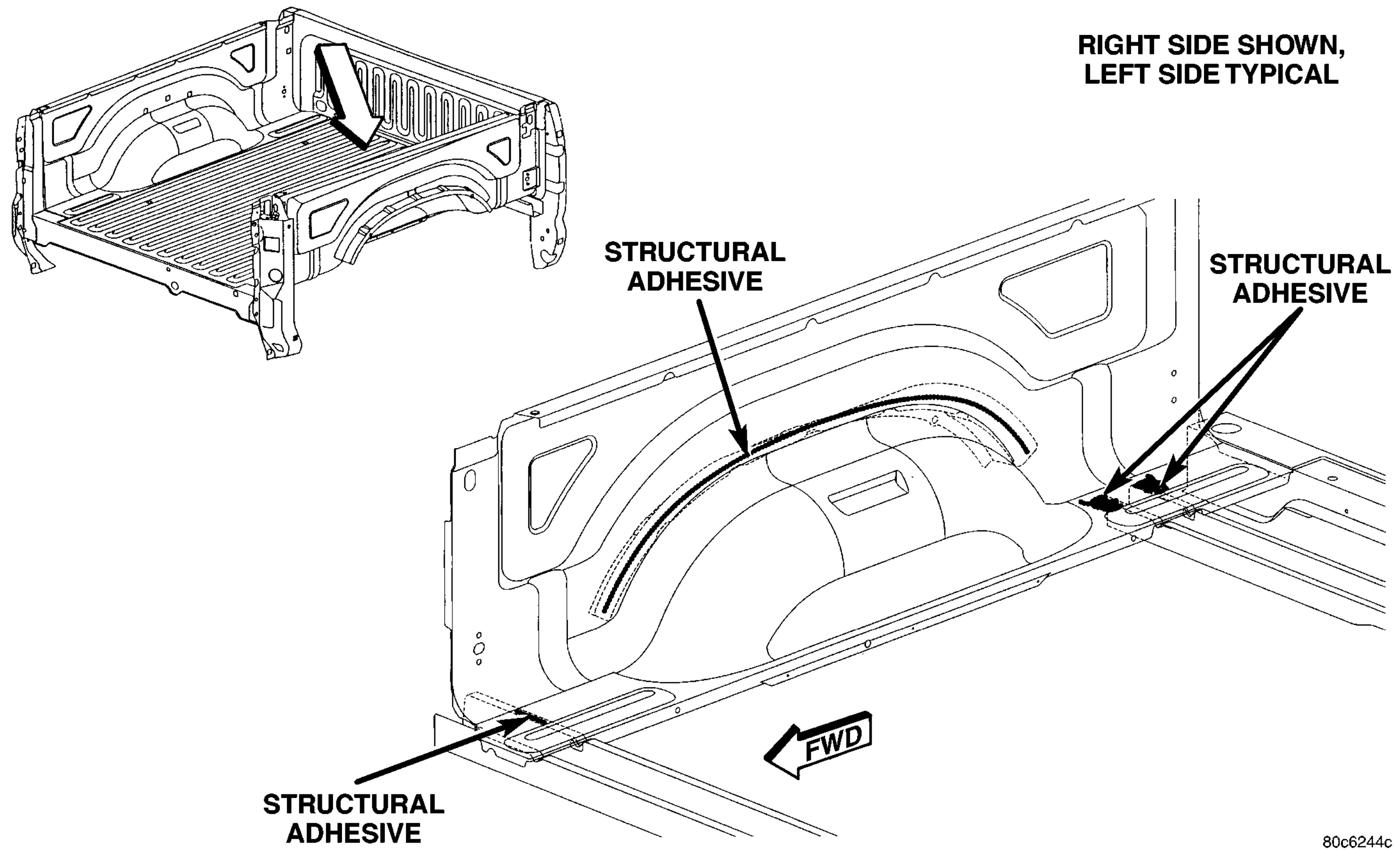

Fig. 22 INNER WHEELHOUSE

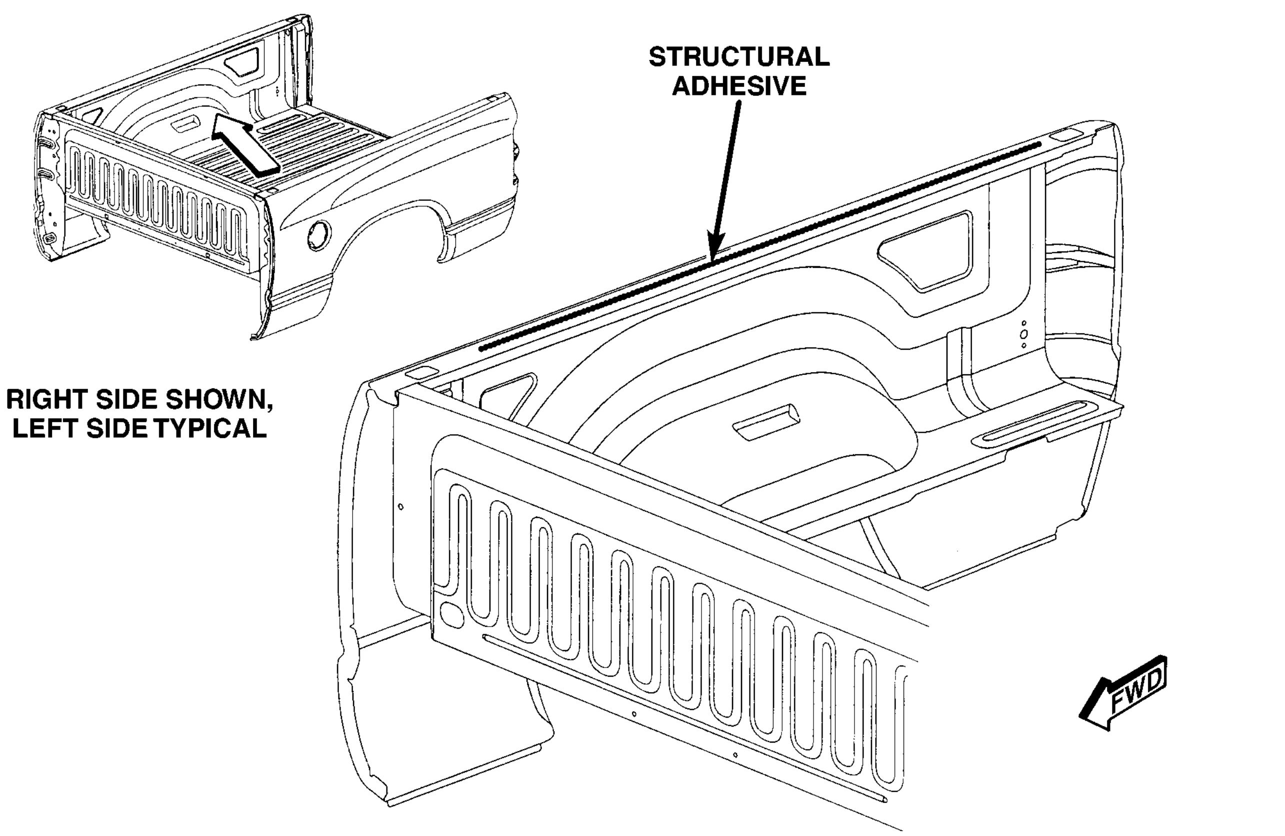

Fig. 23 INNER BOX SIDE PANEL

STRUCTURAL ADHESIVE LOCATIONS (Continued)

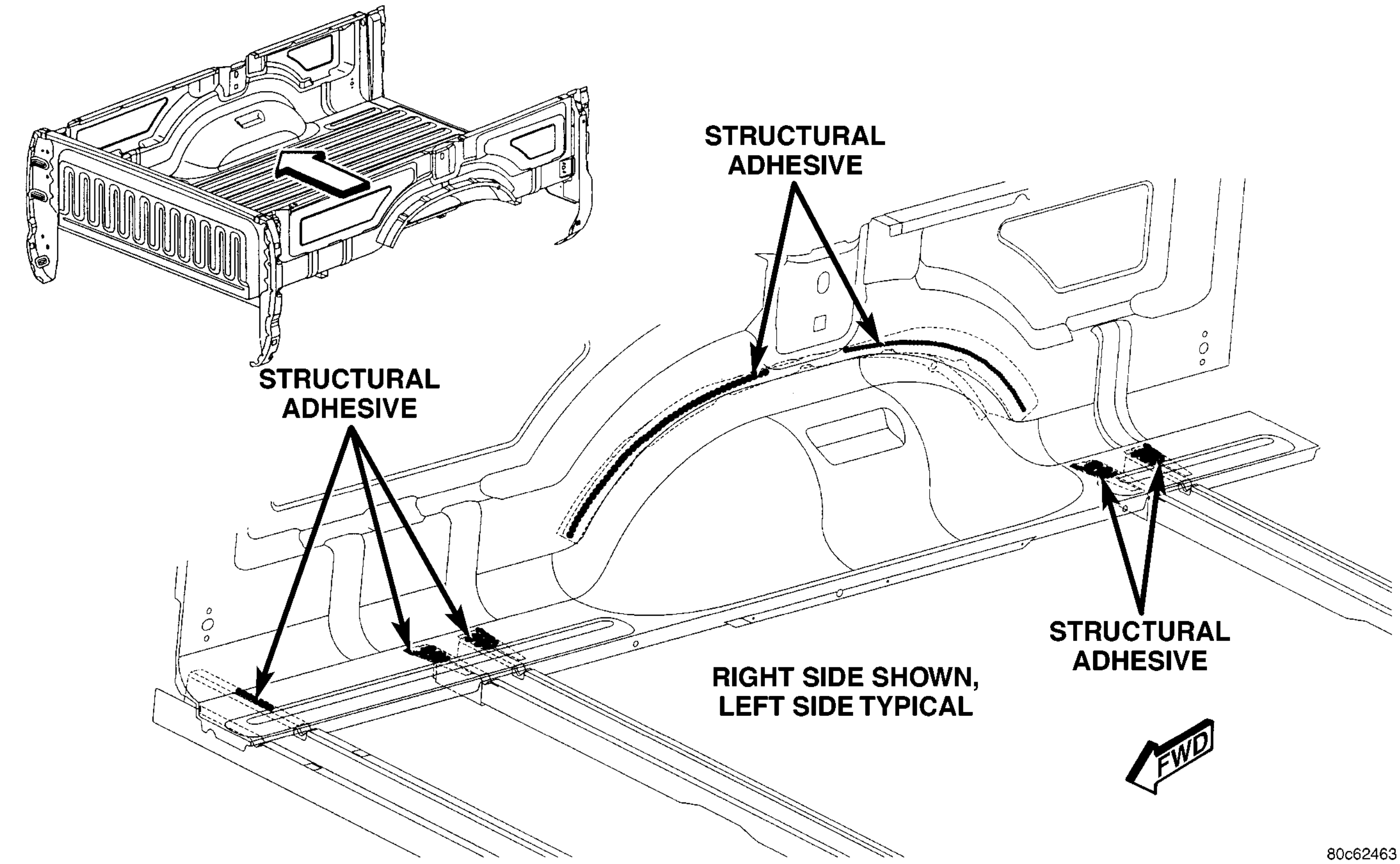

Fig. 24 INNER WHEELHOUSE

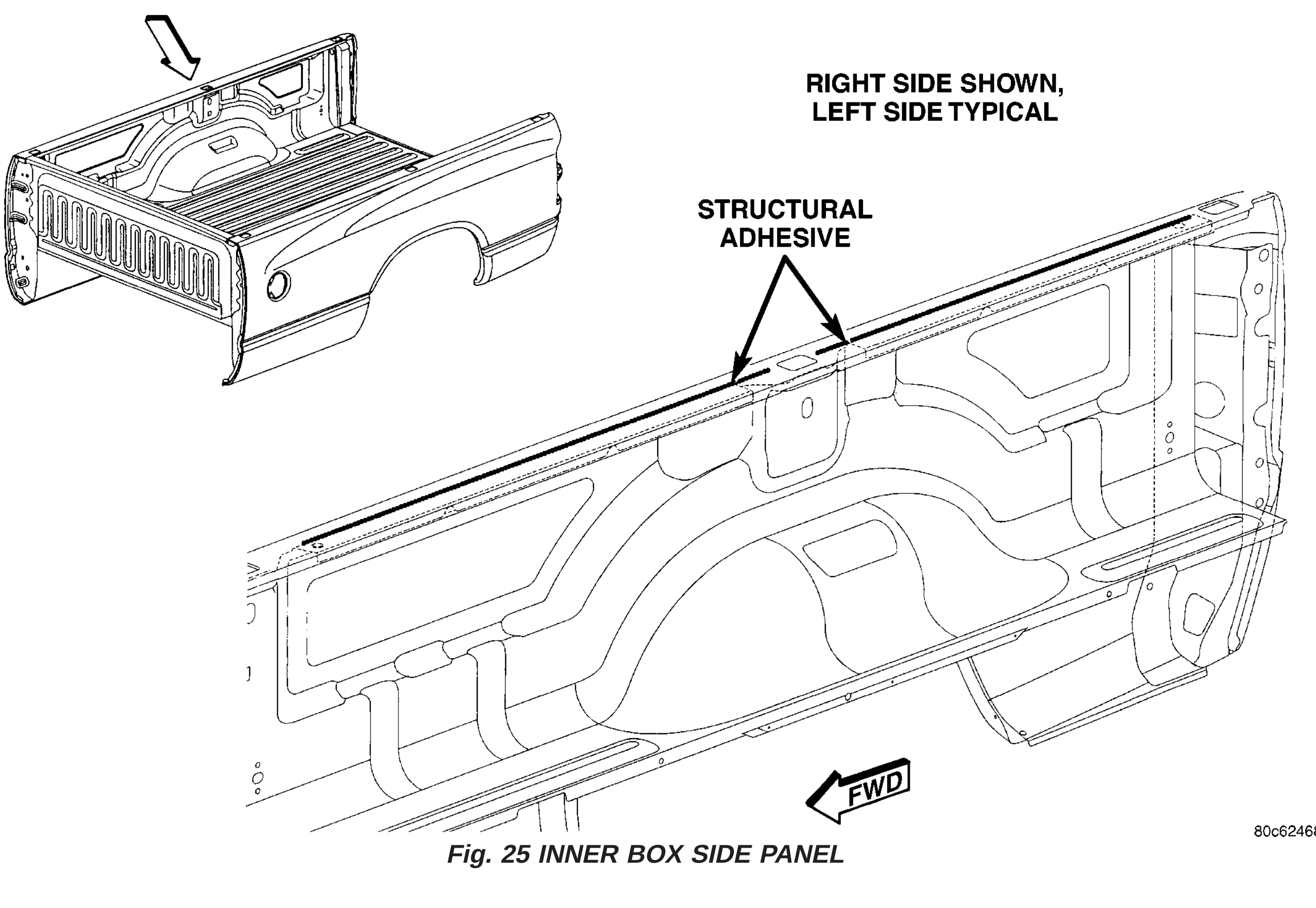

Fig. 25 INNER BOX SIDE PANEL

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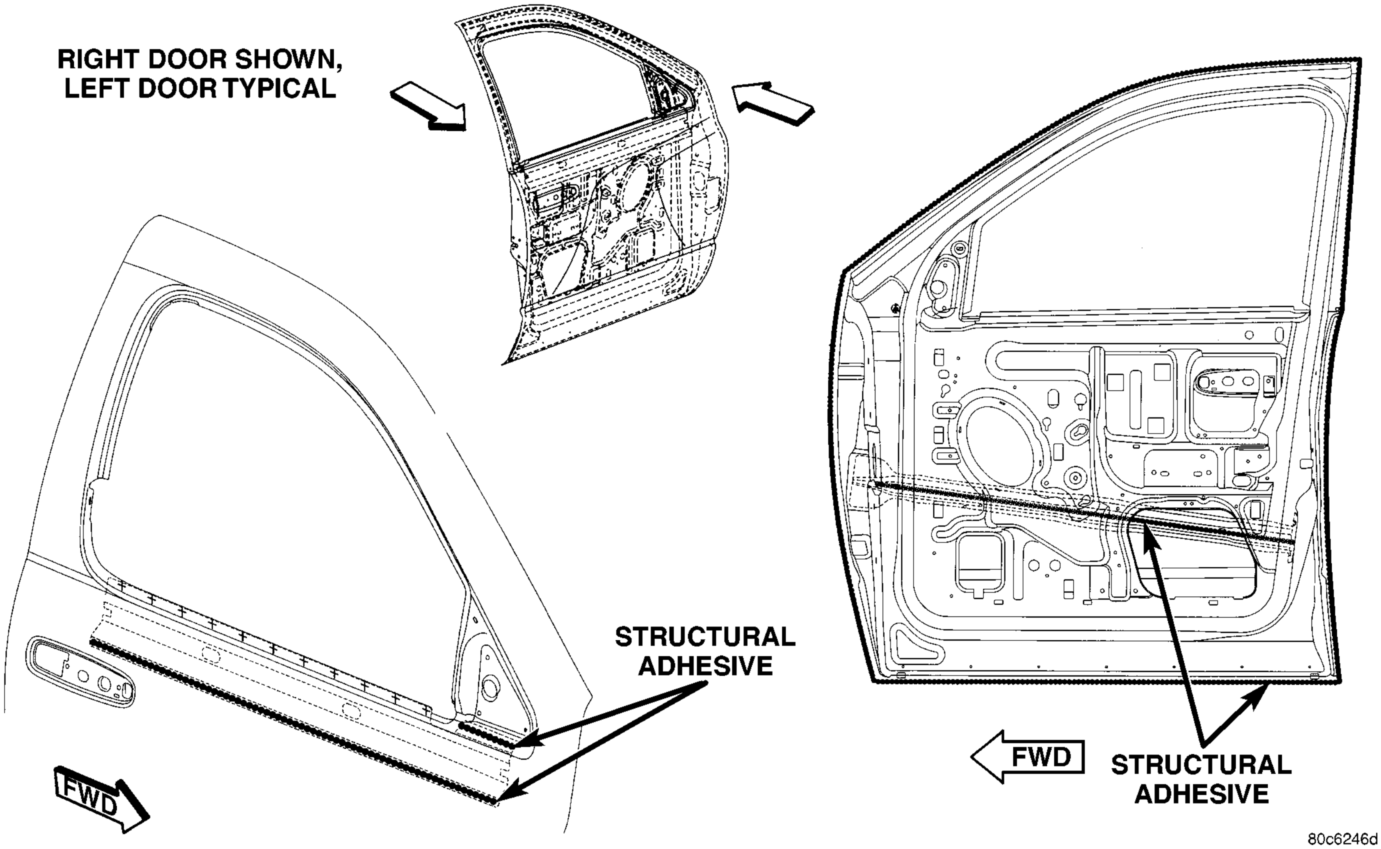

Fig. 26 INNER DOOR PANEL

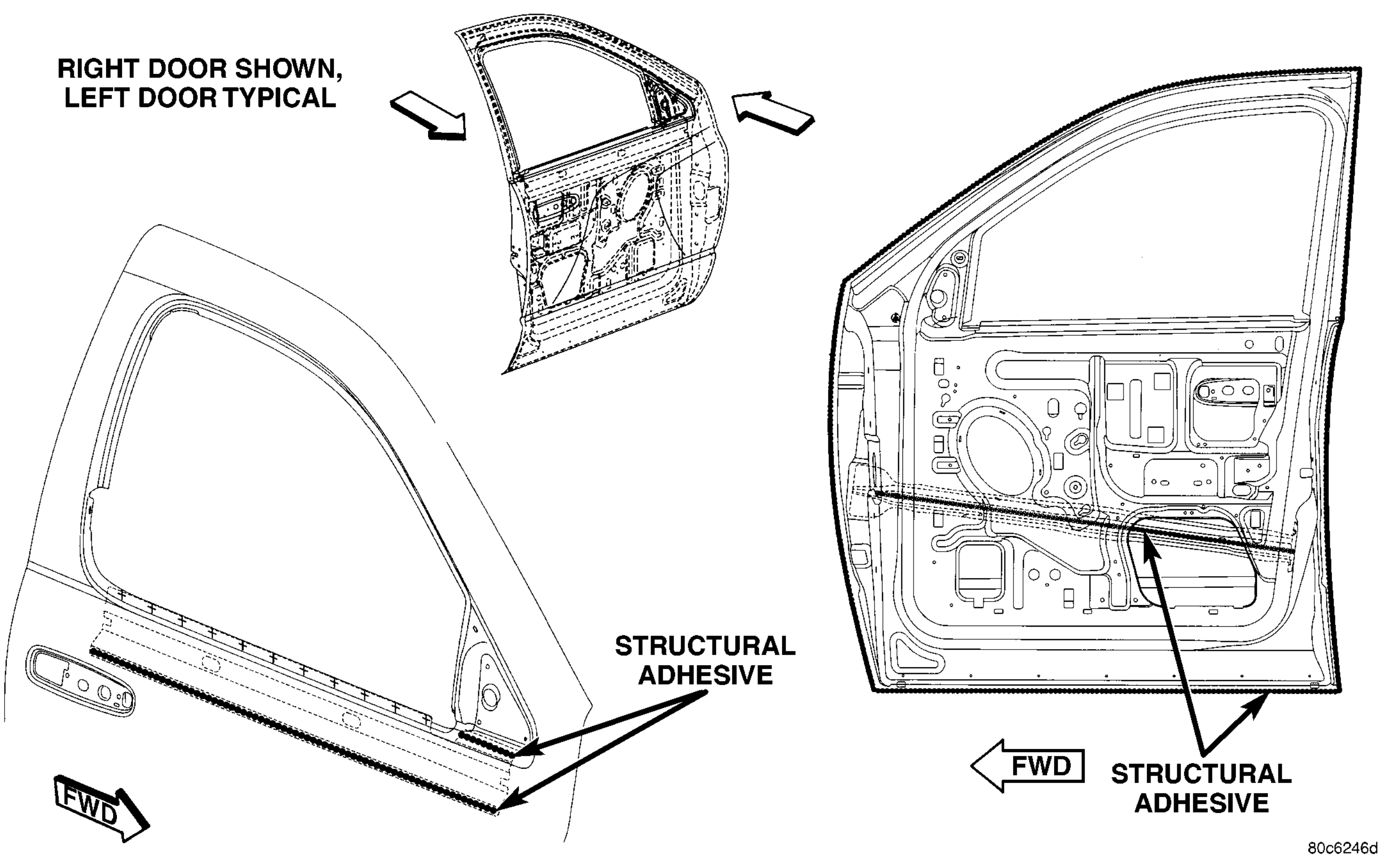

Fig. 27 INNER DOOR PANEL

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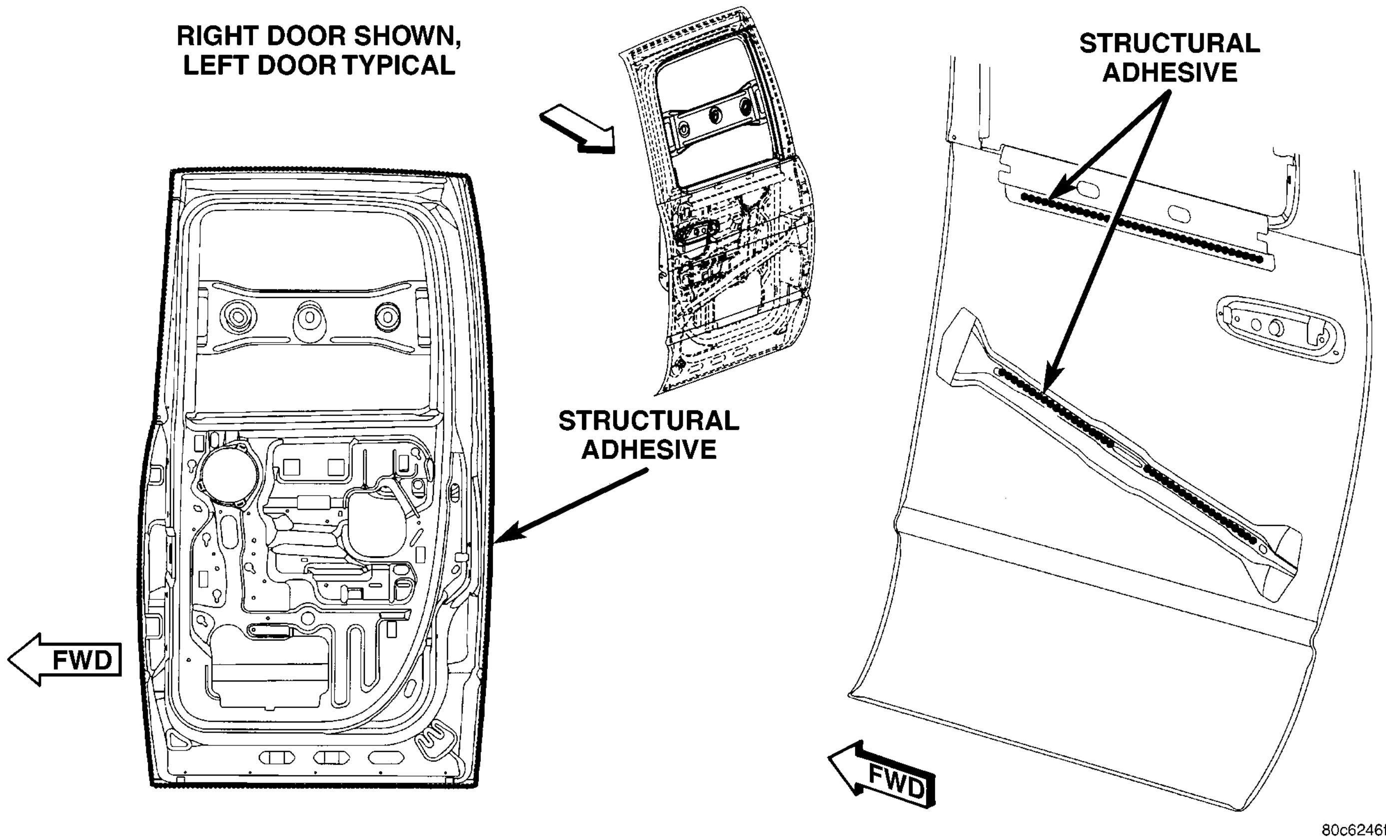

Fig. 28 REAR DOOR INNER PANEL

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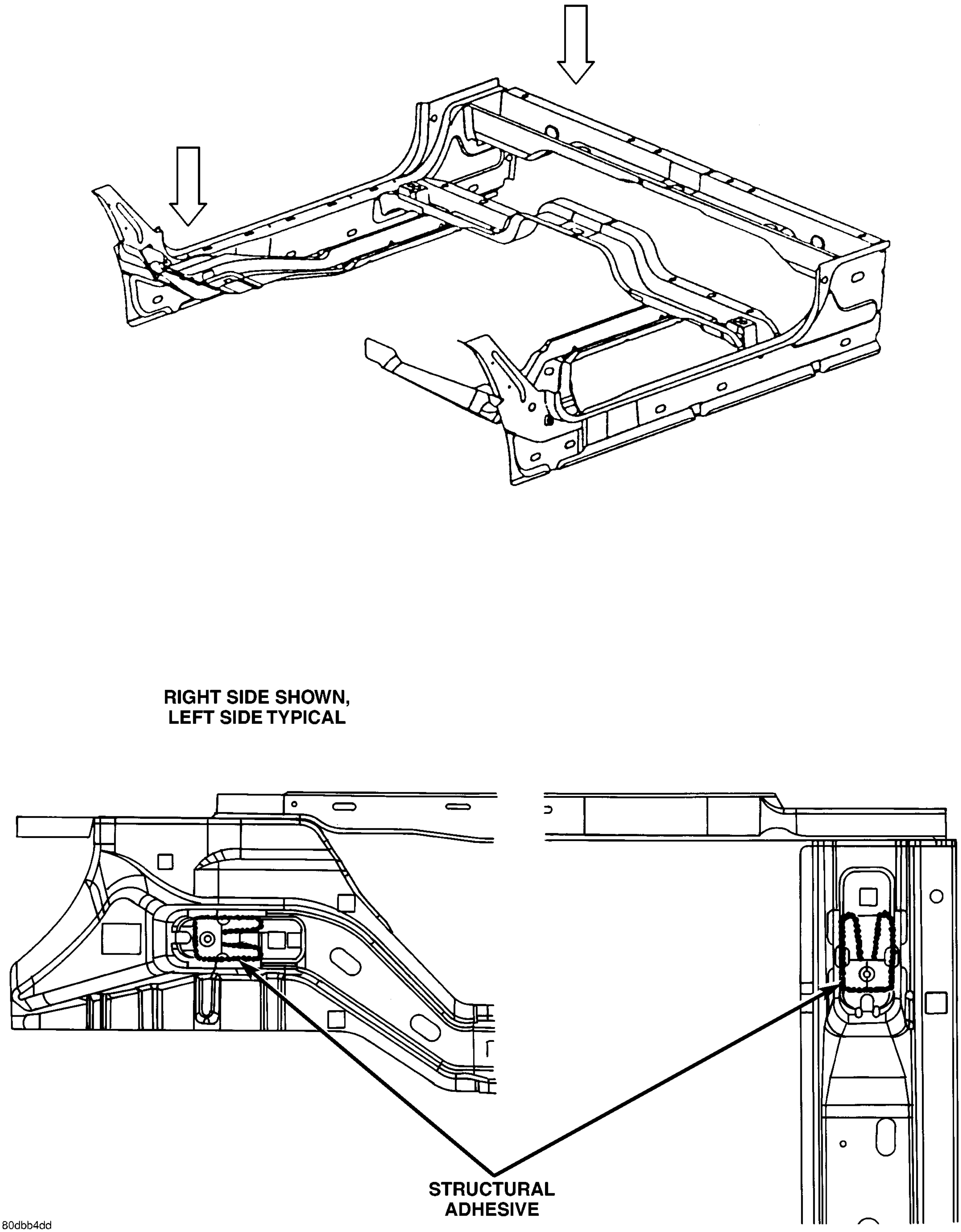
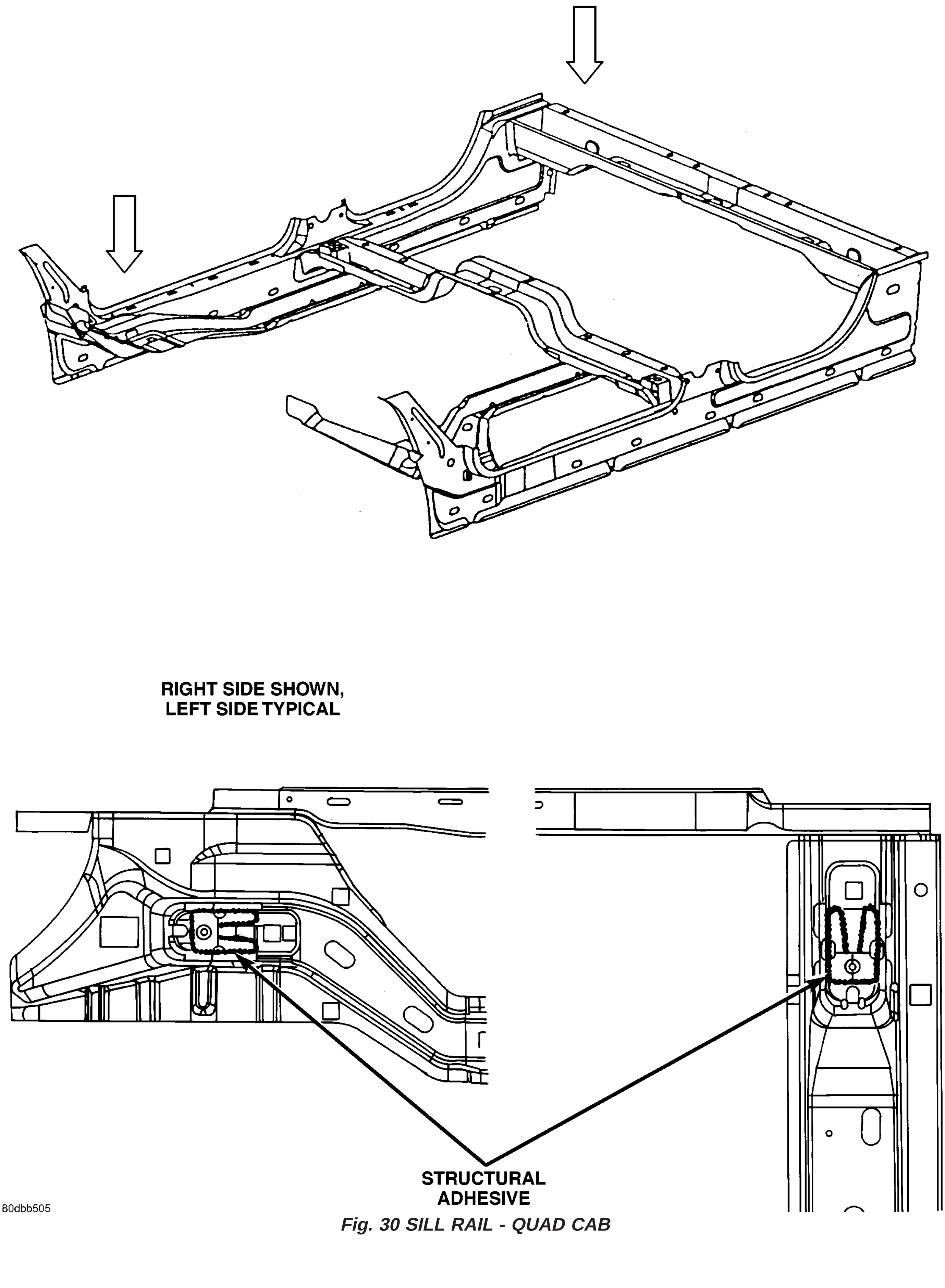


Fig. 29 SILL RAIL - STD CAB

STRUCTURAL ADHESIVE LOCATIONS (Continued)



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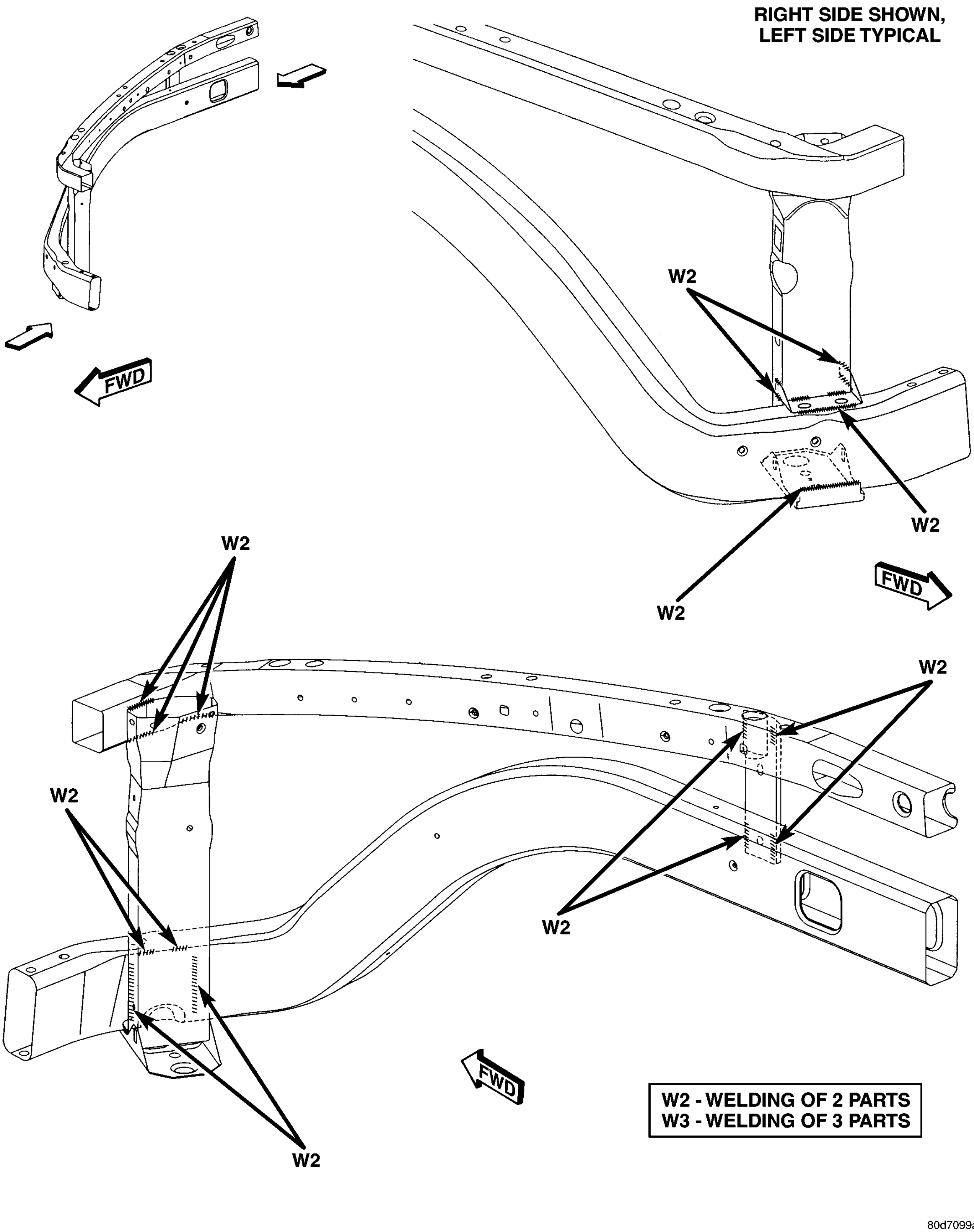

Fig. 31 FENDER BRACE

WELD LOCATIONS (Continued)

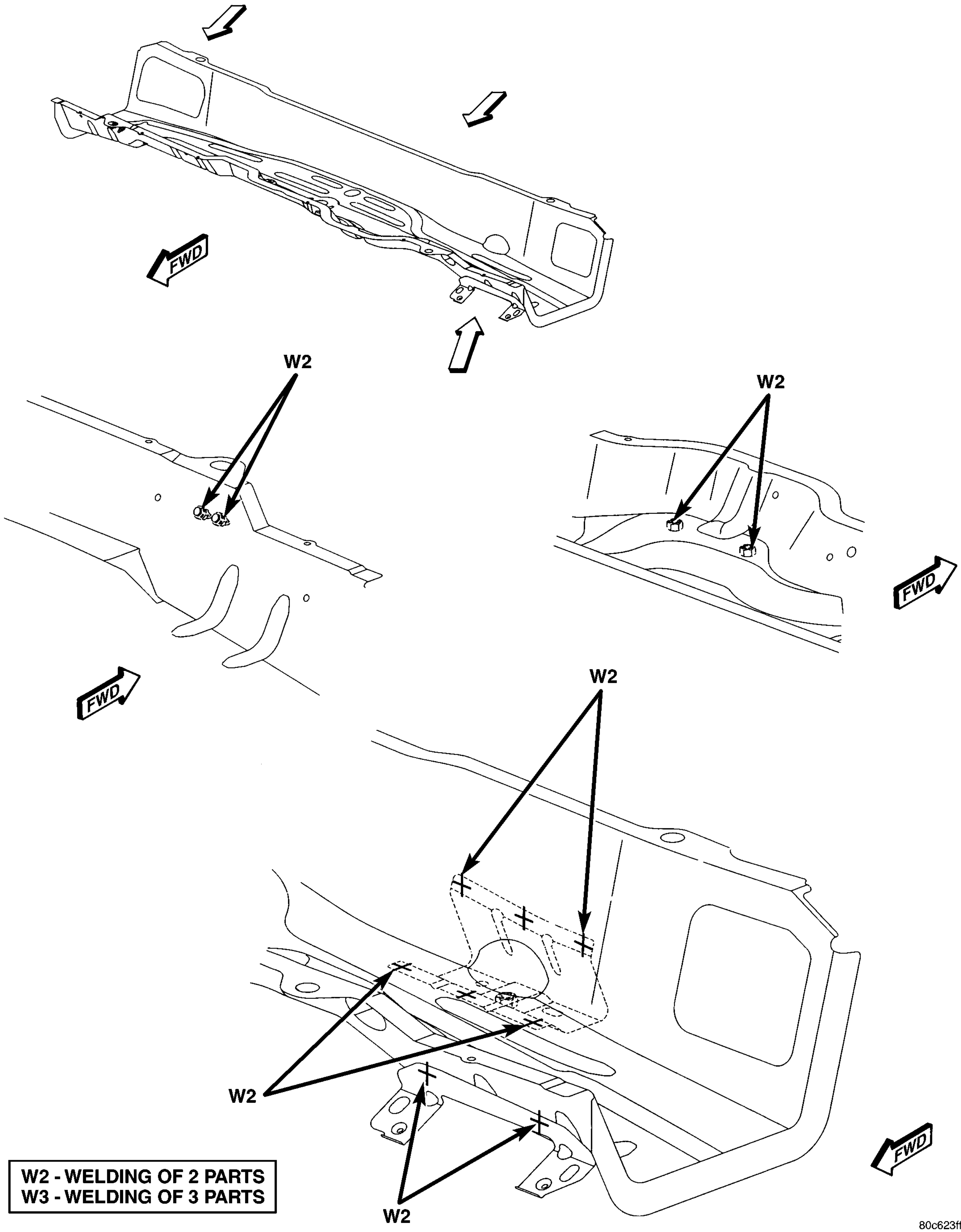

Fig. 32 STEERING COLUMN SUPPORT

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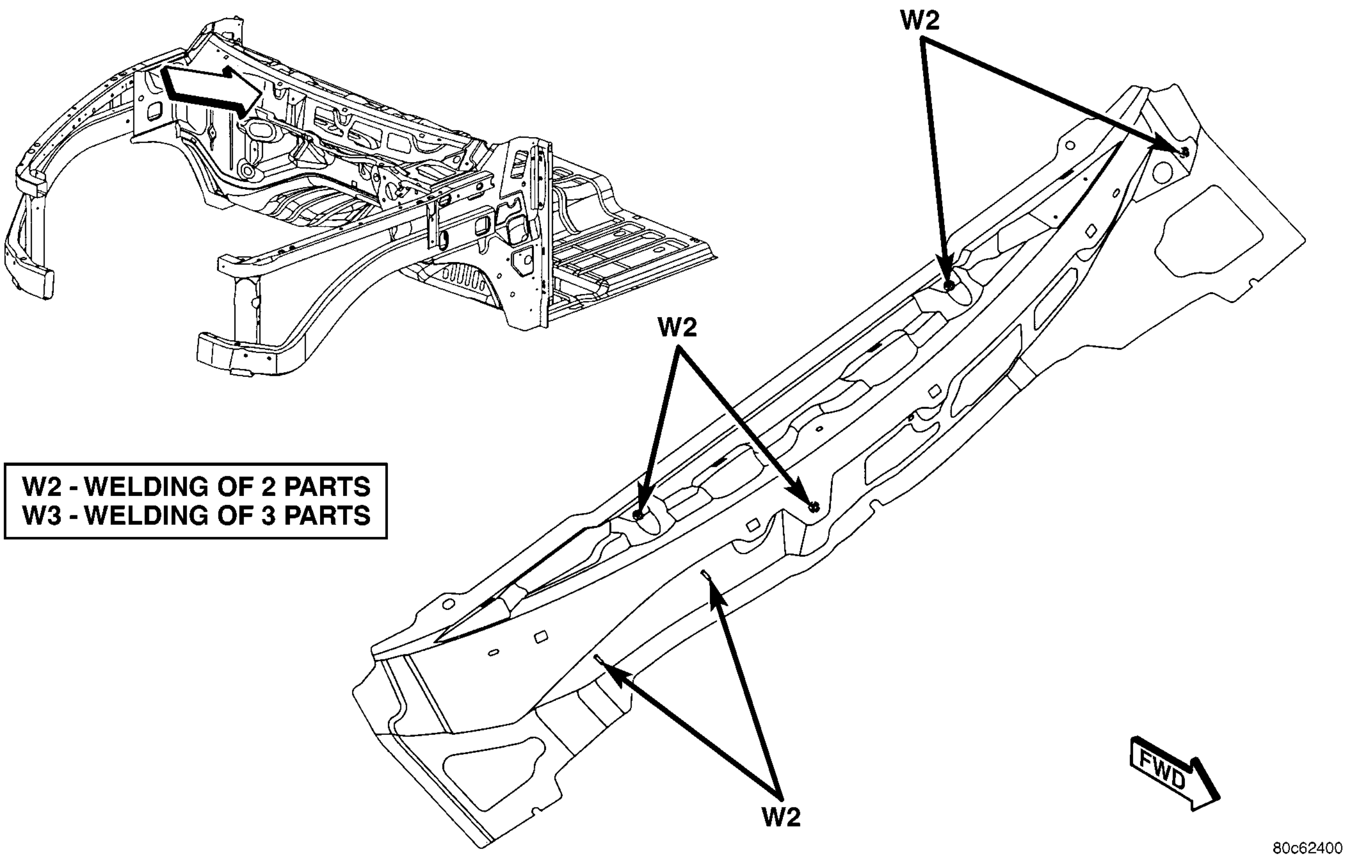

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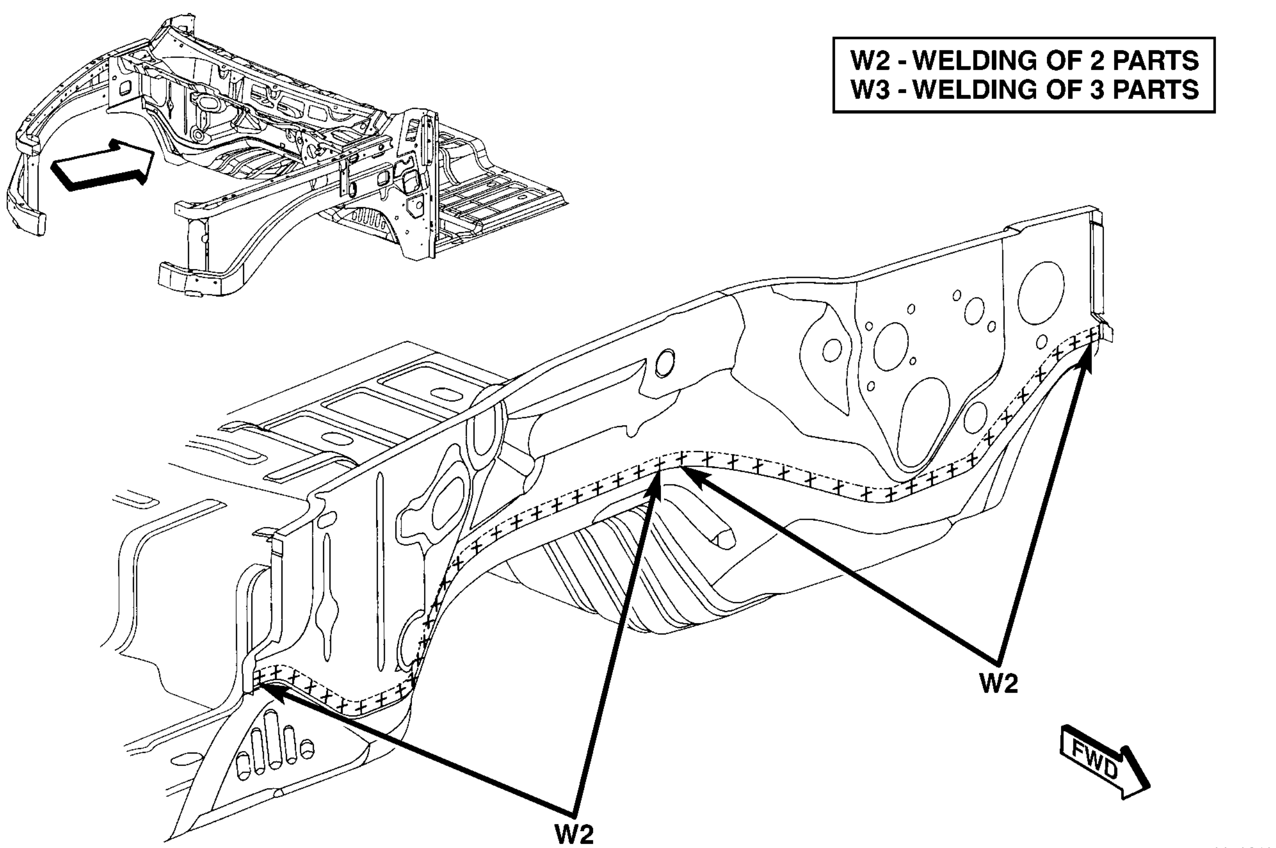


Fig. 34 DASH PANEL

WELD LOCATIONS (Continued)

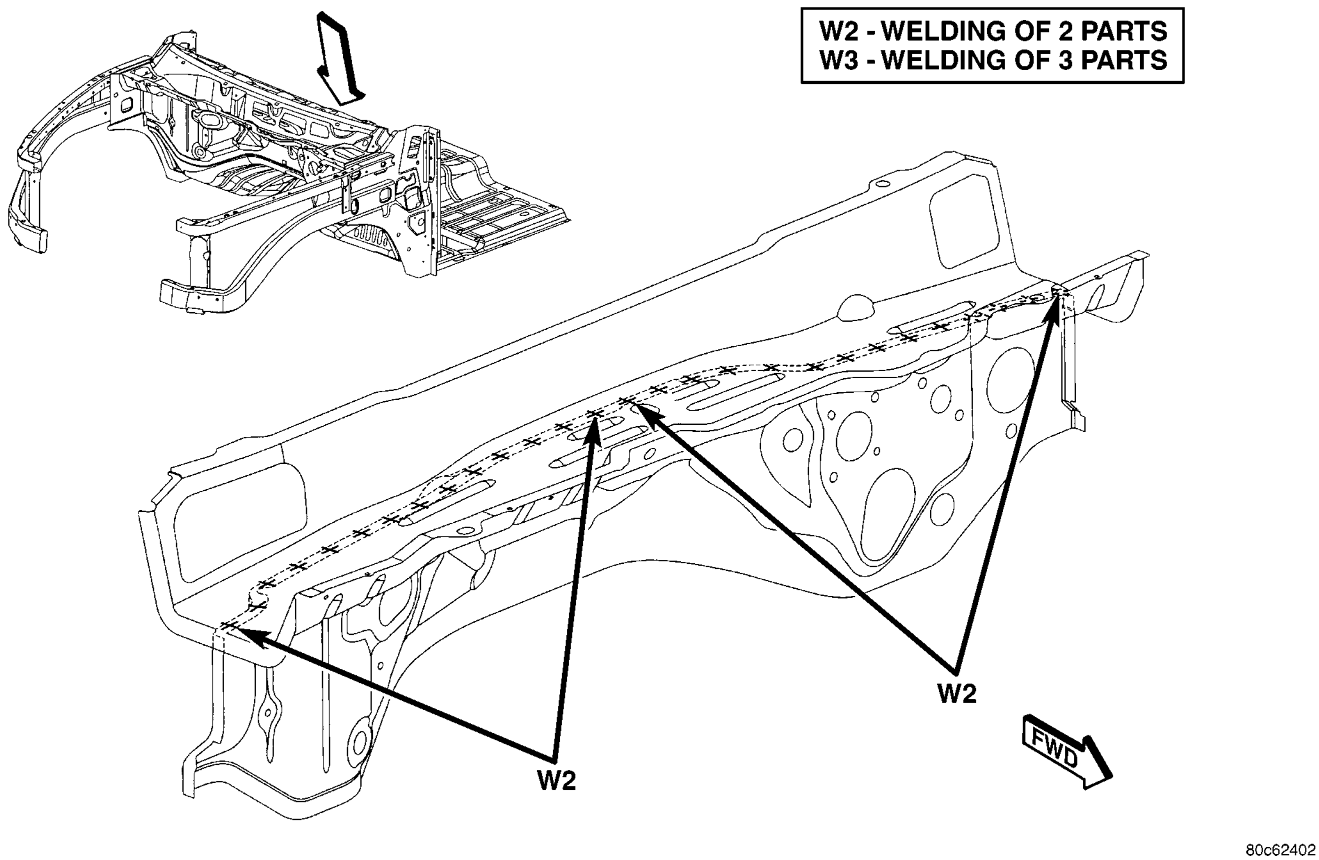


Fig. 35 DASH PANEL

WELD LOCATIONS (Continued)

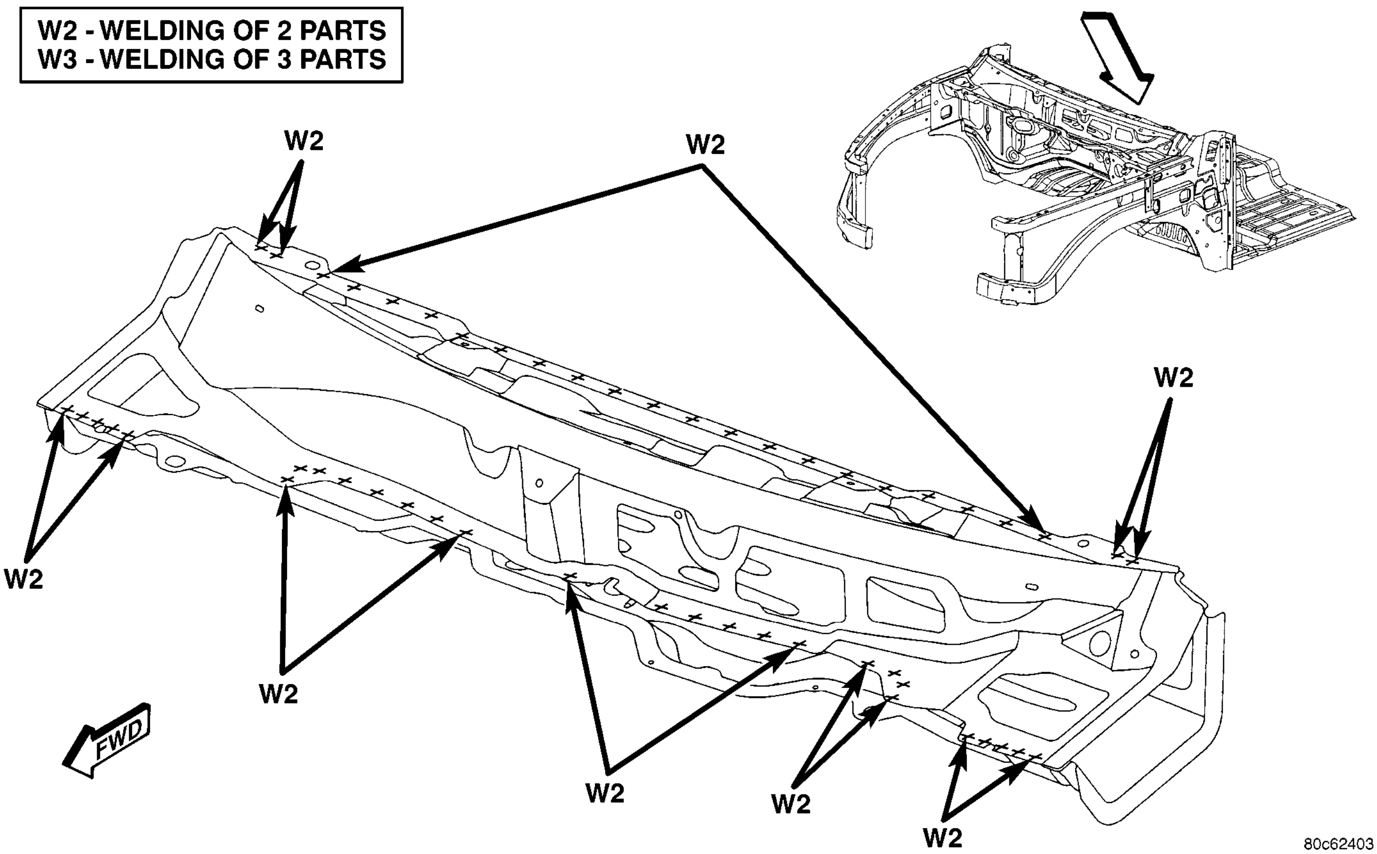
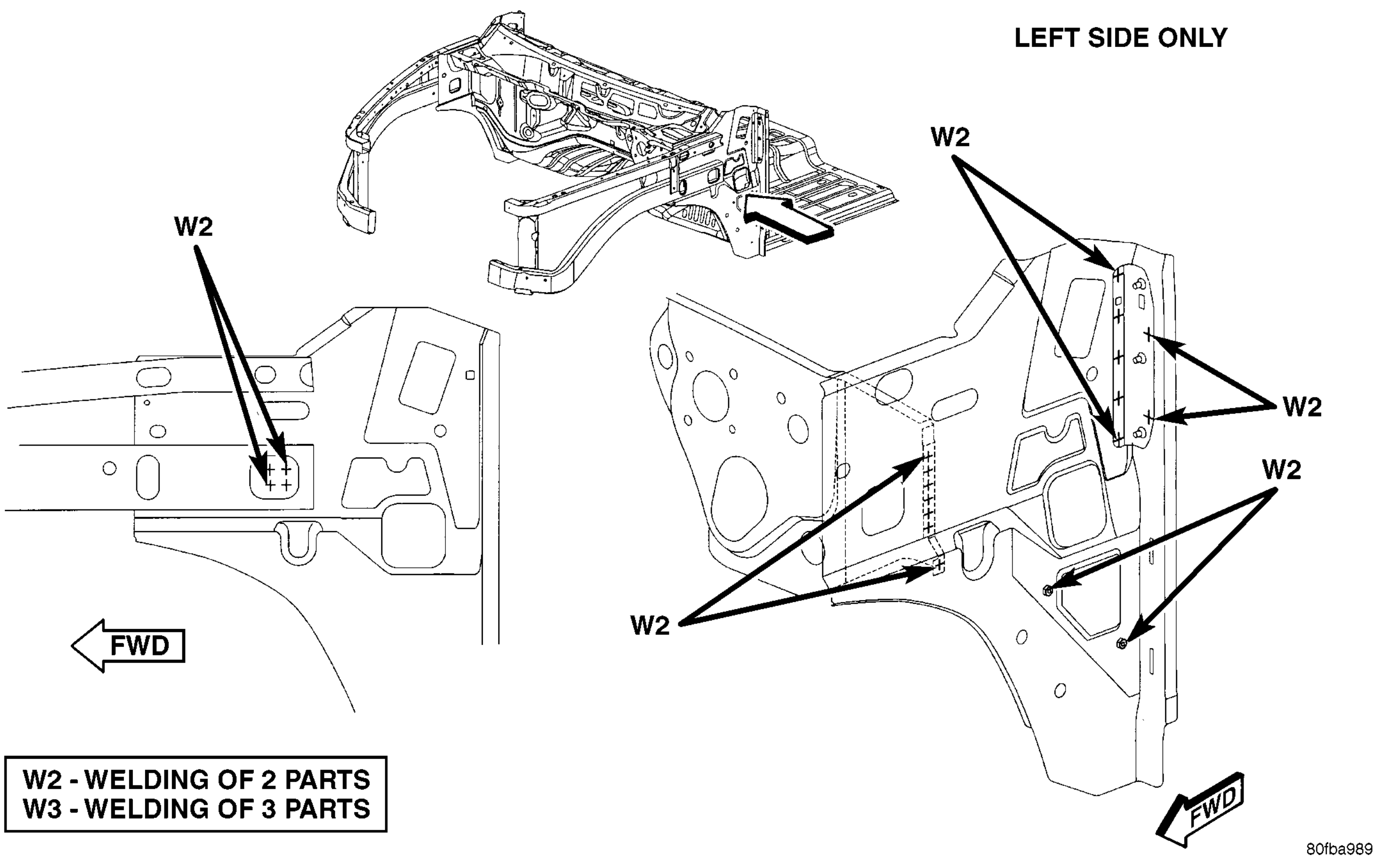


Fig. 36 LOWER PLENUM PANEL

WELD LOCATIONS (Continued)



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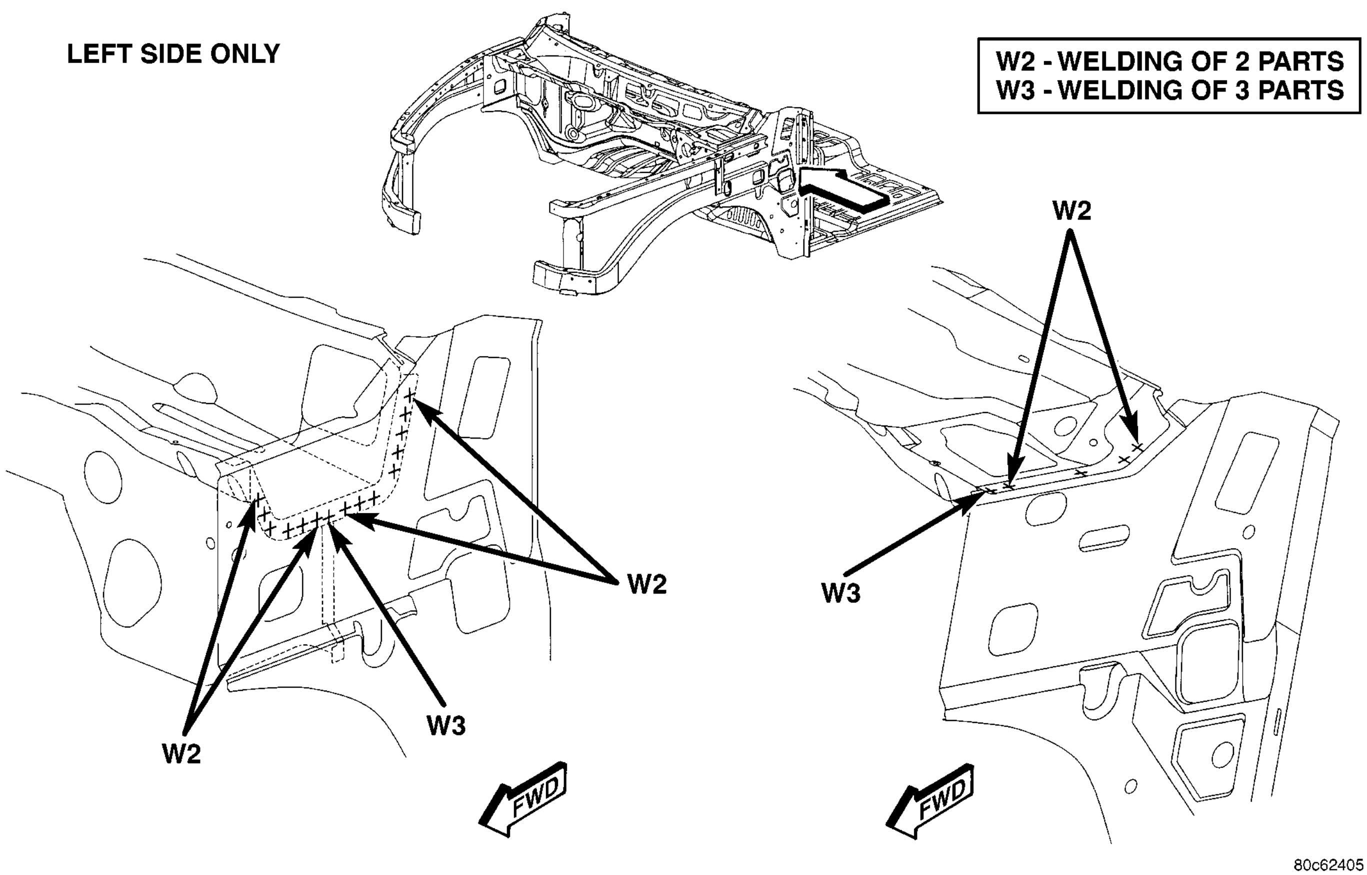


Fig. 38 DASH PANEL

WELD LOCATIONS (Continued)

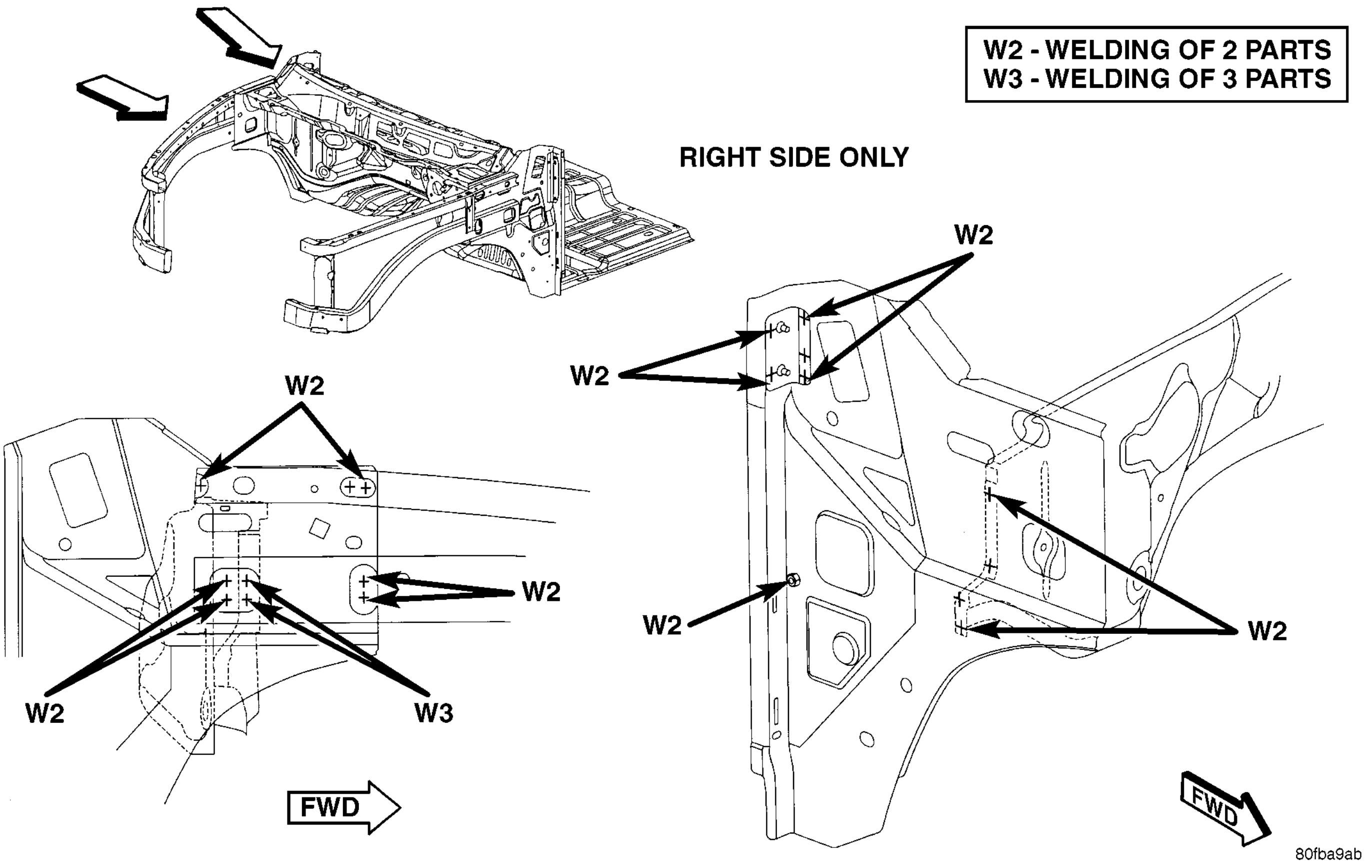


Fig. 39 FRONT FENDER

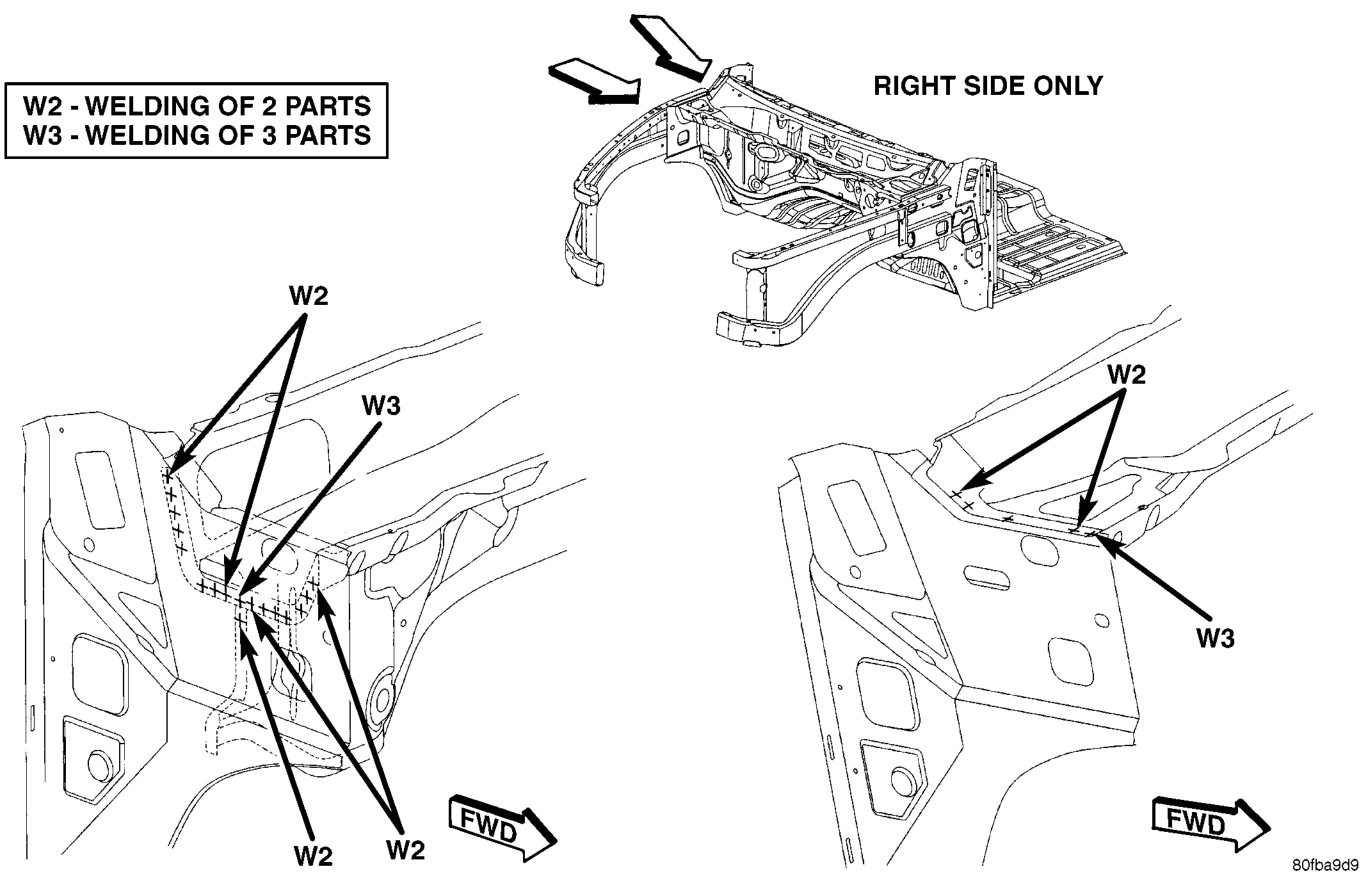


Fig. 40 DASH PANEL

WELD LOCATIONS (Continued)

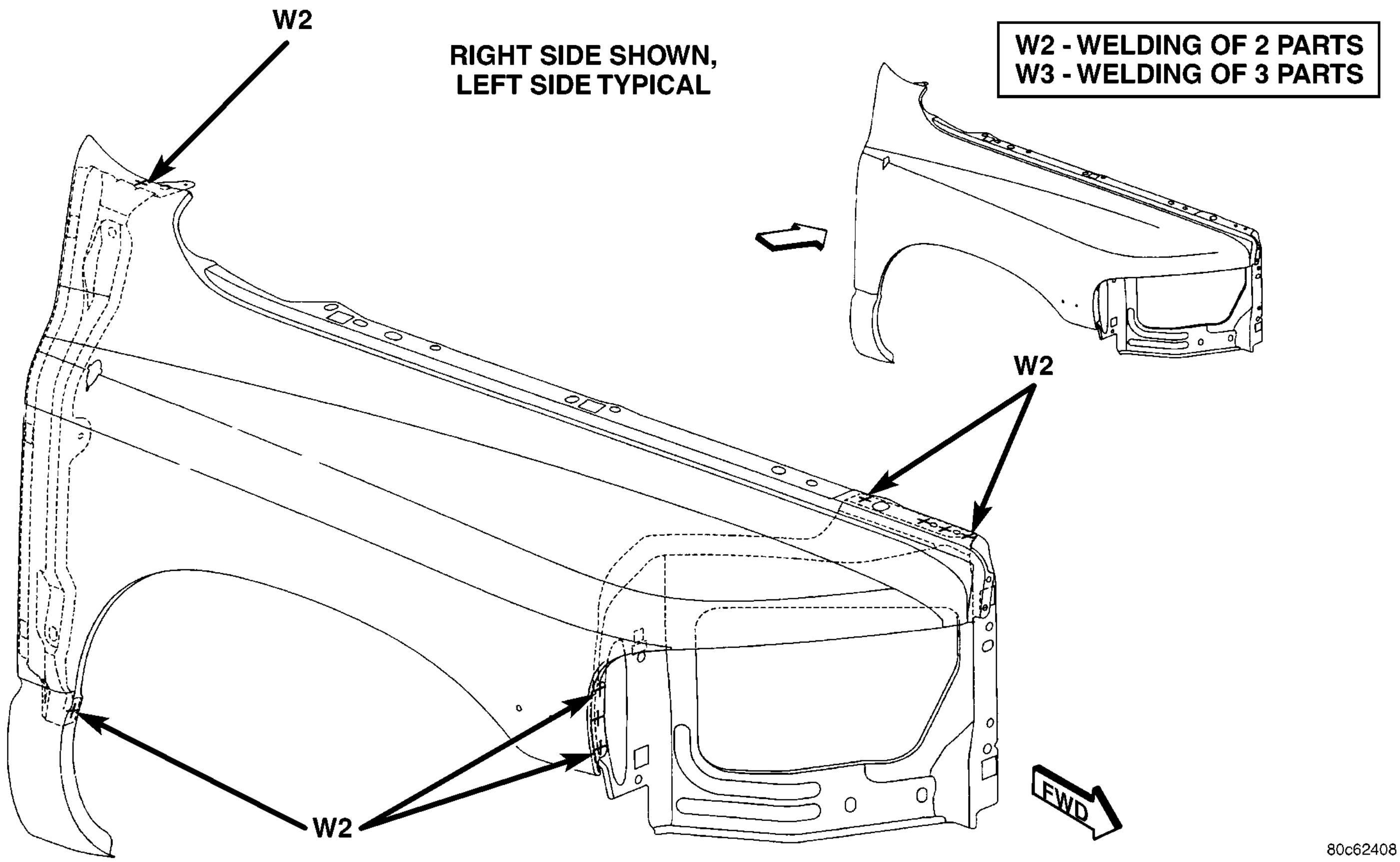


Fig. 41 HEADLAMP MOUNTING PANEL

WELD LOCATIONS (Continued)

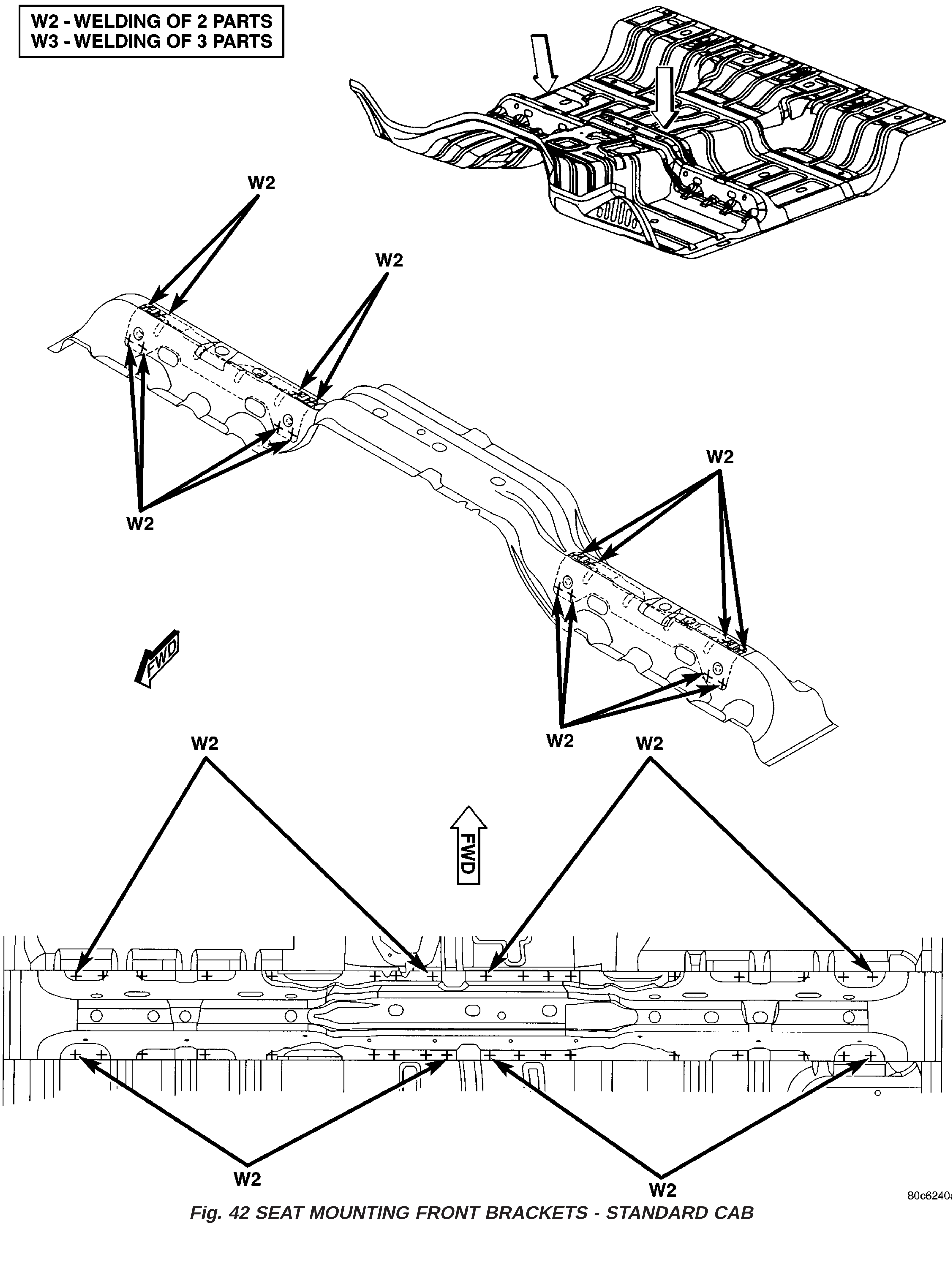


Fig. 42 SEAT MOUNTING FRONT BRACKETS - STANDARD CAB

WELD LOCATIONS (Continued)

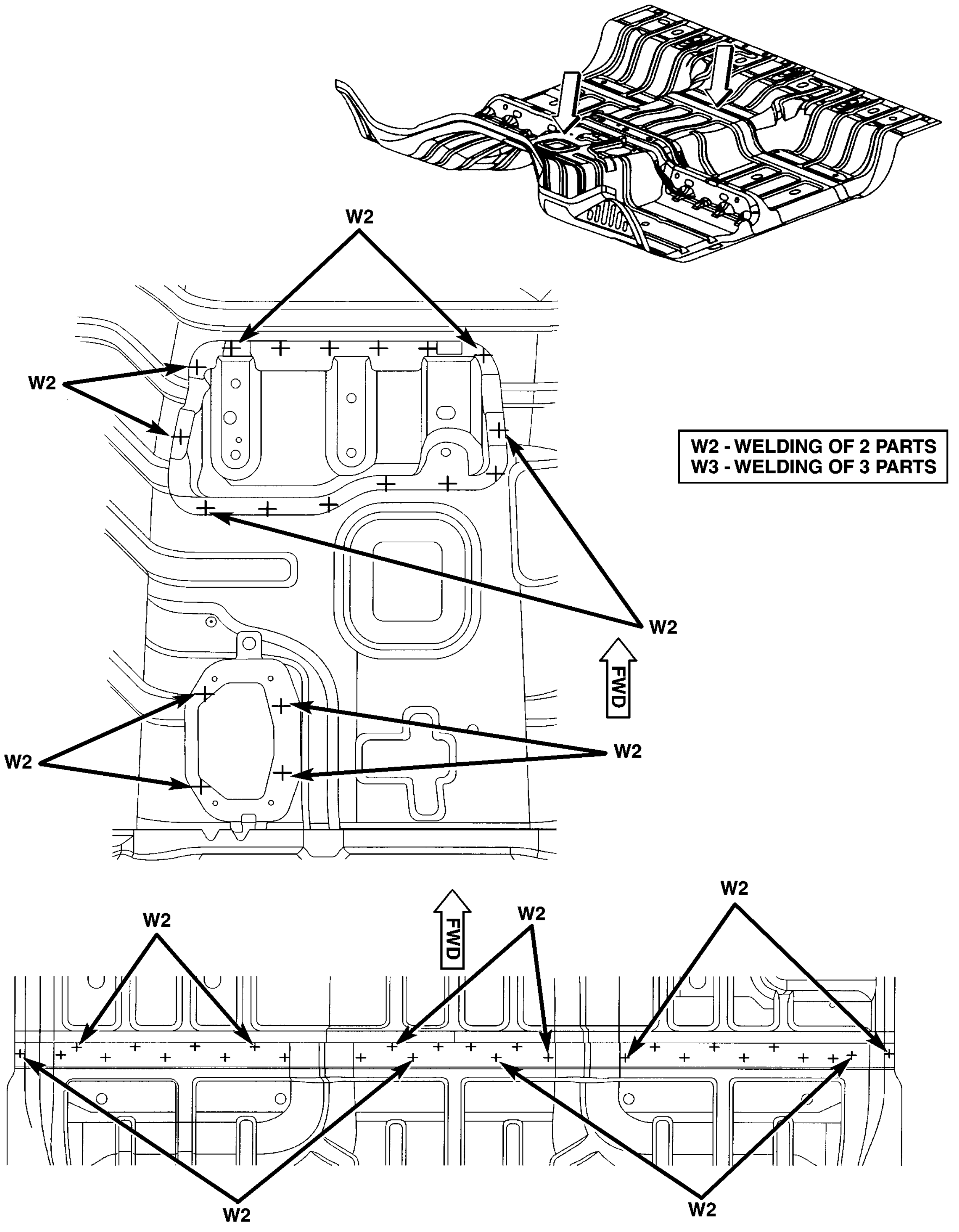


Fig. 43 AIR BAG MODULE BRACKET - STANDARD CAB

WELD LOCATIONS (Continued)

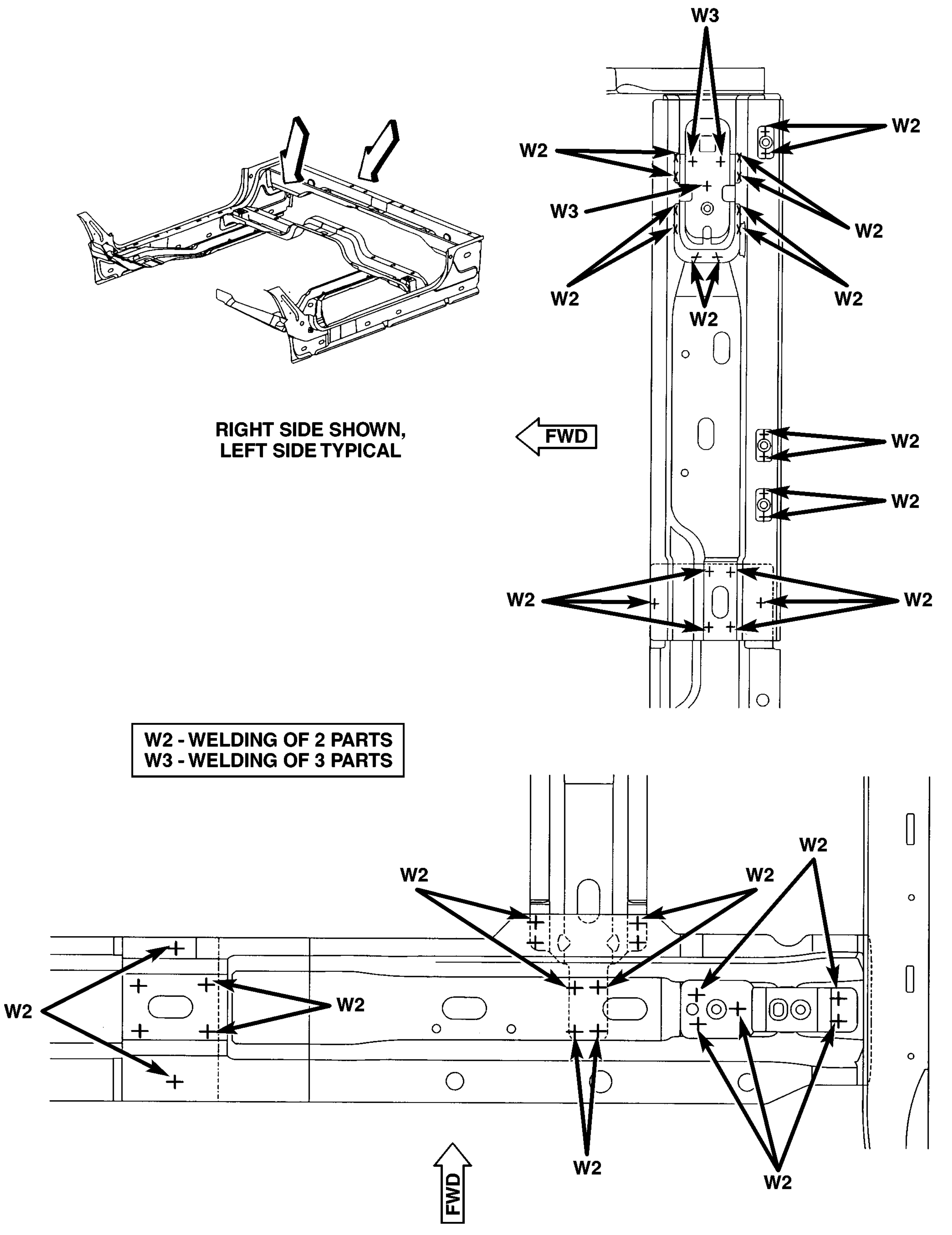


Fig. 44 RIGHT TO LEFT REAR FLOOR CROSSMEMBER - STANDARD CAB

WELD LOCATIONS (Continued)

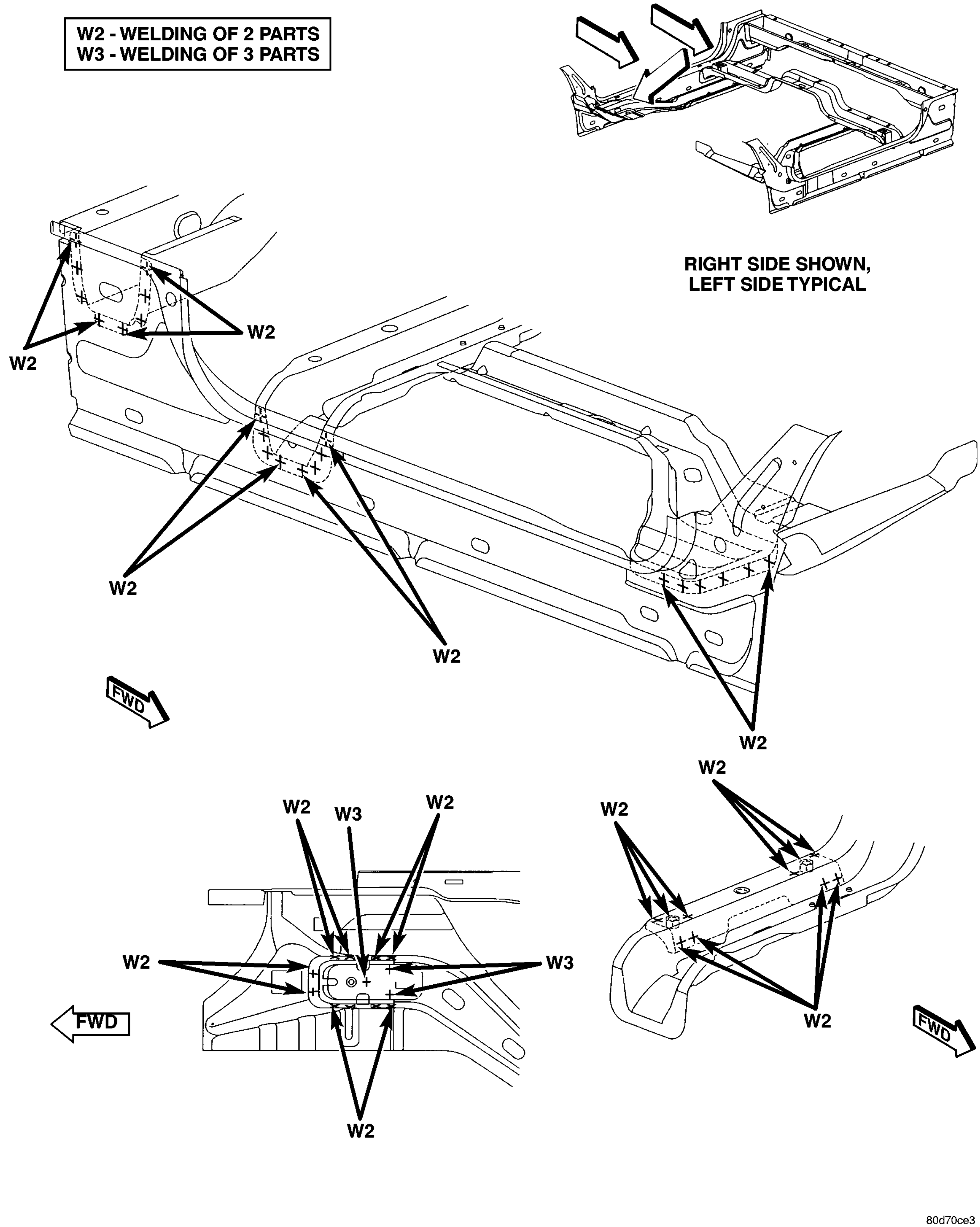


Fig. 45 REAR FLOOR CROSSMEMBER - STANDARD CAB

WELD LOCATIONS (Continued)

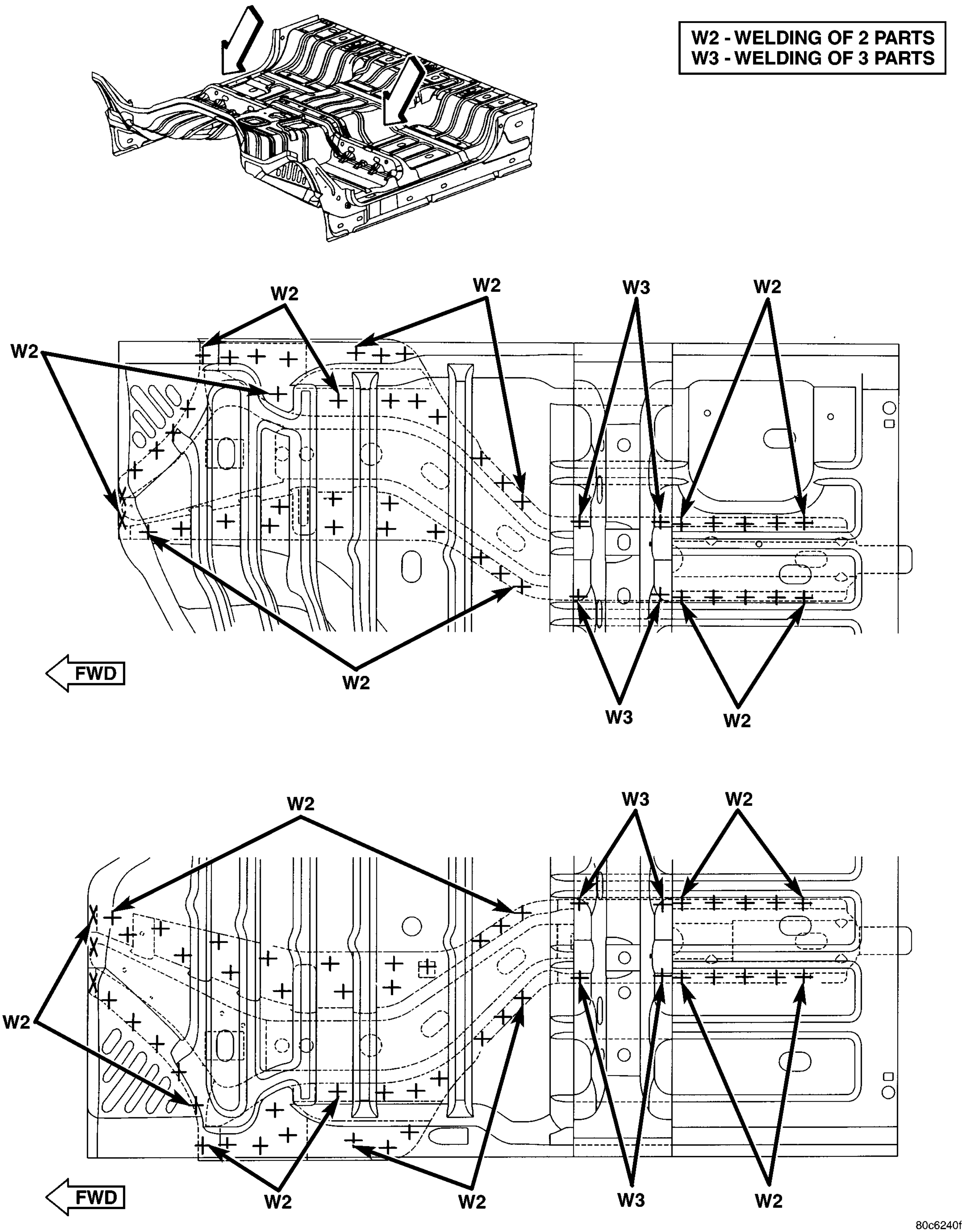


Fig. 46 SEAT MOUNTING FRONT CROSSMEMBER - STANDARD CAB

WELD LOCATIONS (Continued)

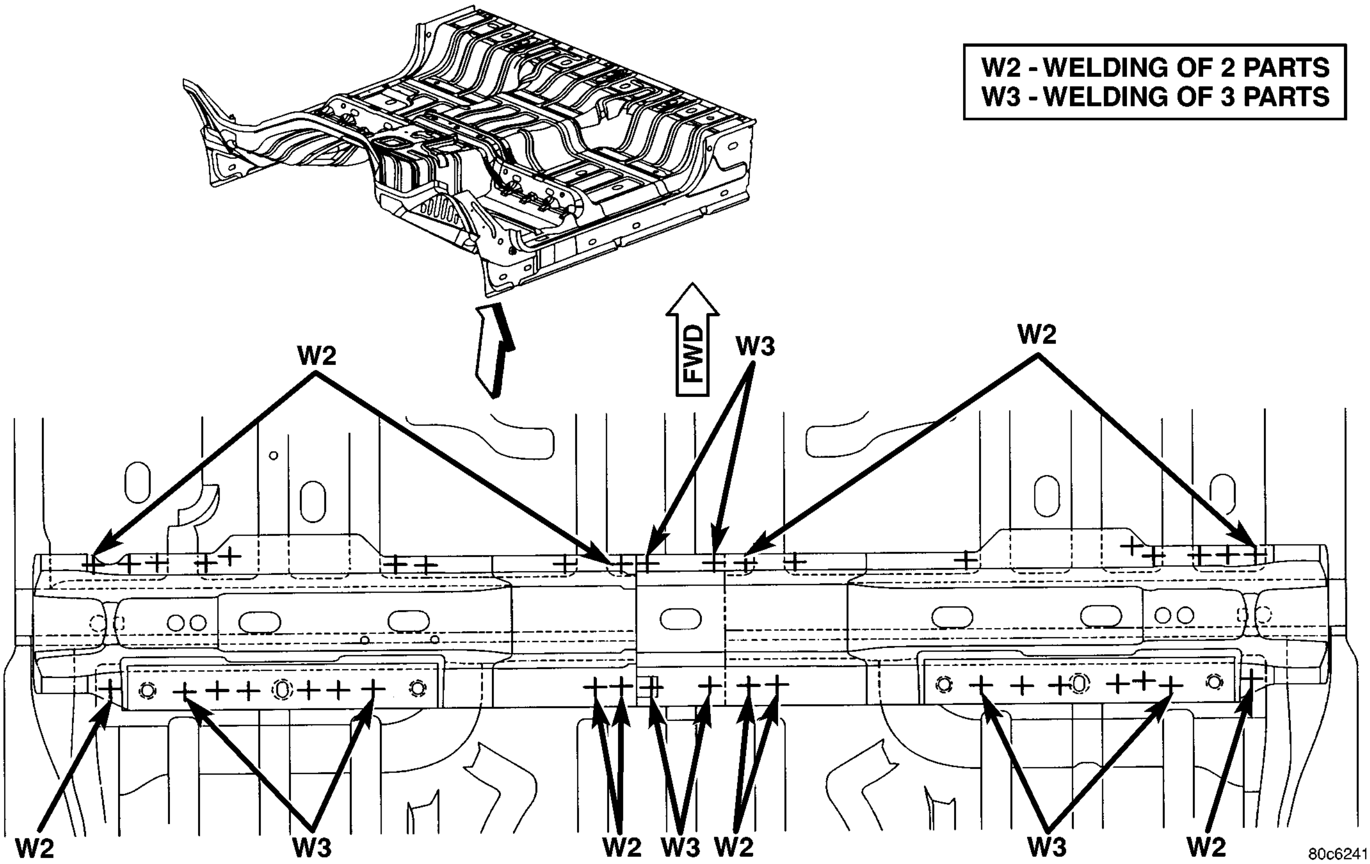


Fig. 47 FRONT SEAT MOUNTING CROSSMEMBERS - STANDARD CAB

WELD LOCATIONS (Continued)

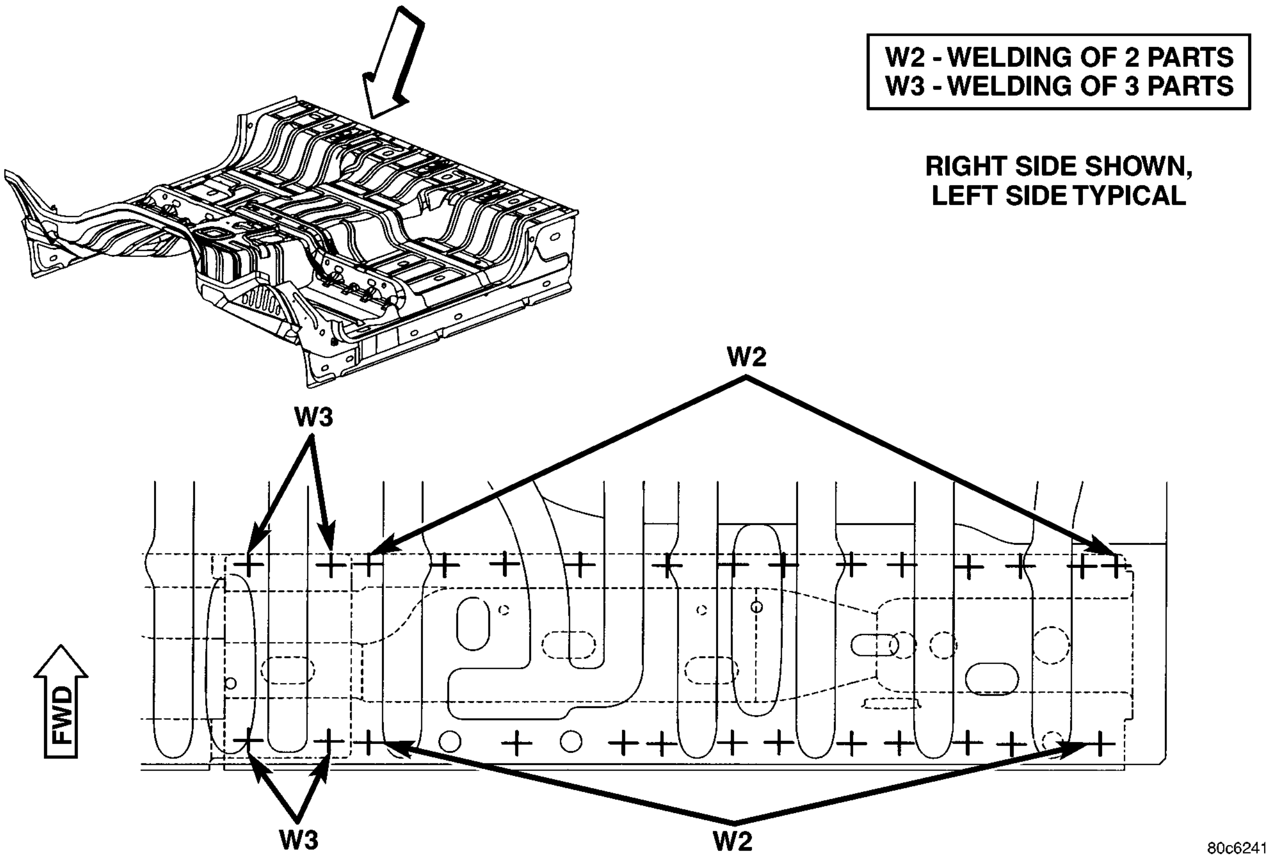


Fig. 48 REAR FLOOR CROSSMEMBERS - STANDARD CAB

WELD LOCATIONS (Continued)

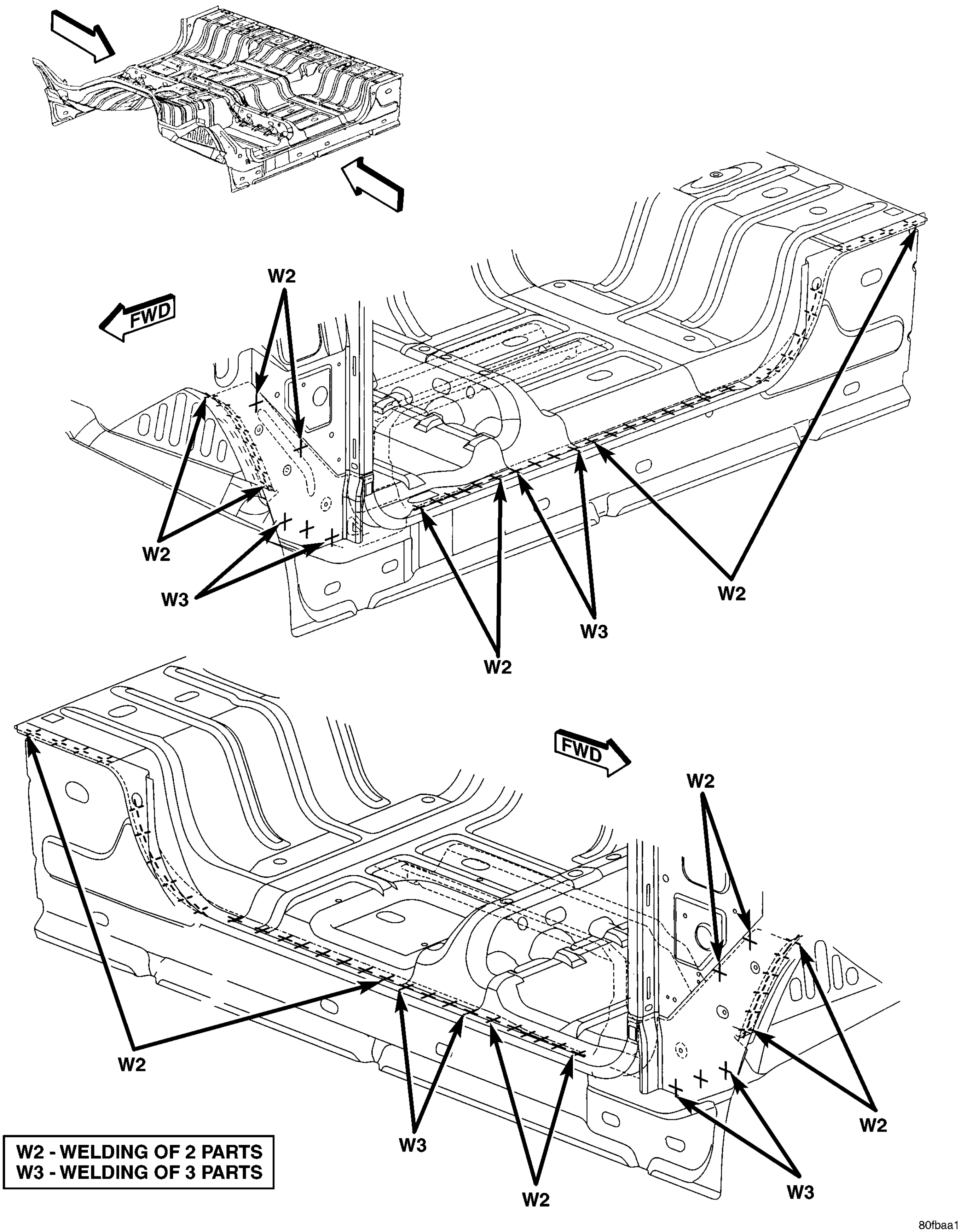


Fig. 49 FLOOR SILL - STANDARD CAB

WELD LOCATIONS (Continued)

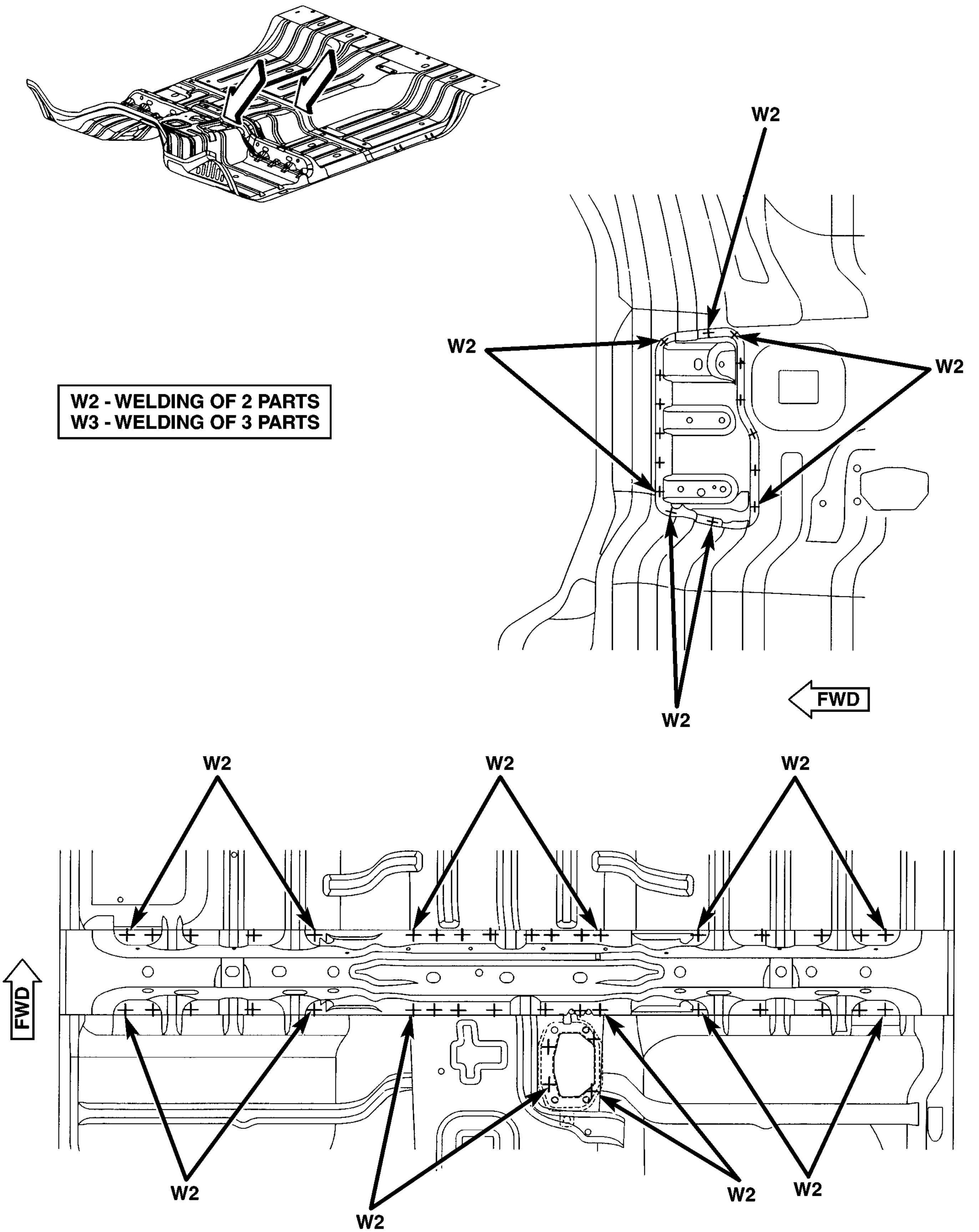


Fig. 50 AIR BAG MODULE BRACKET - QUAD CAB

WELD LOCATIONS (Continued)

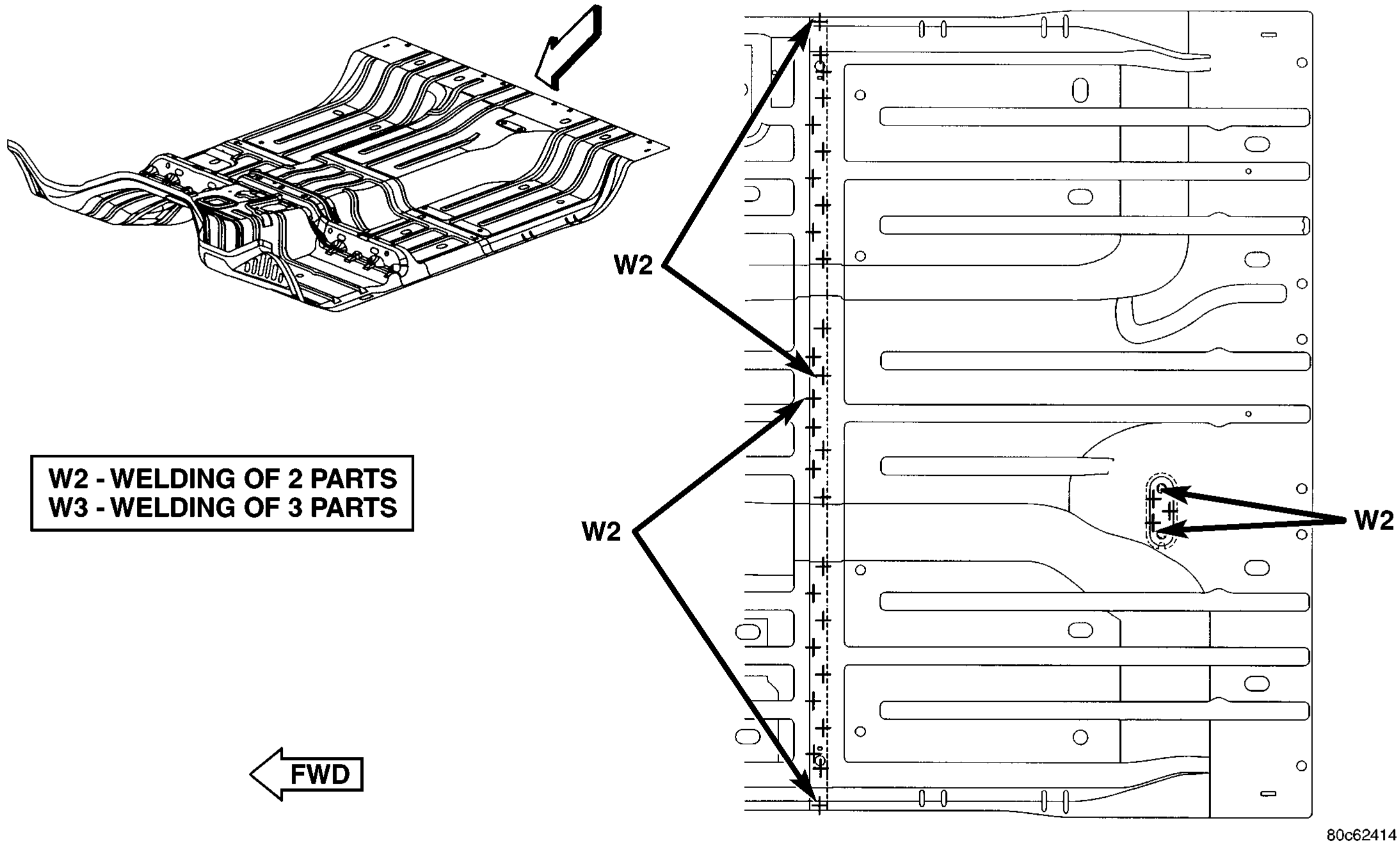


Fig. 51 REAR SEAT MIDDLE MOUNTING PLATE - QUAD CAB

WELD LOCATIONS (Continued)

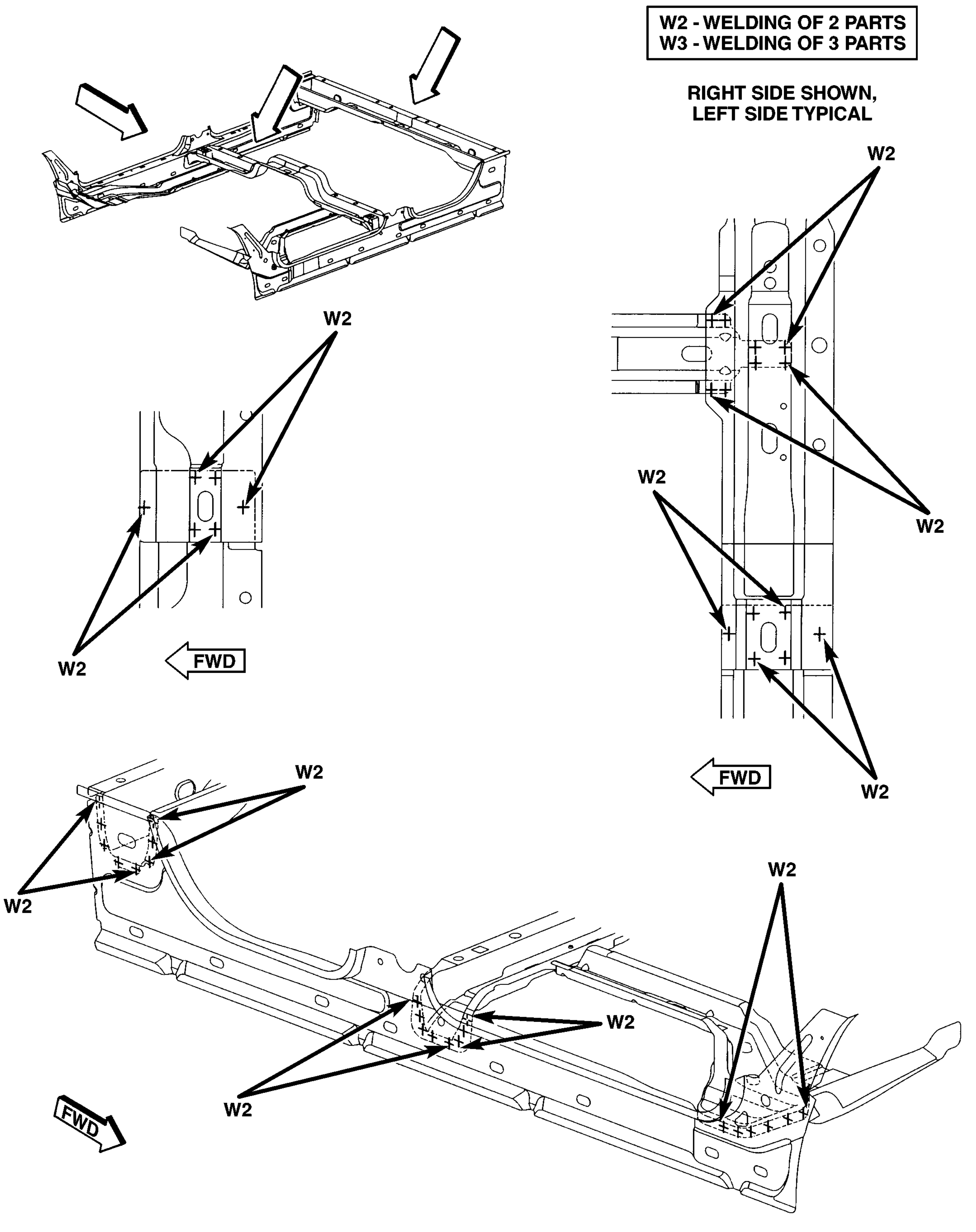


Fig. 52 REAR FLOOR CROSSMEMBER - QUAD CAB

WELD LOCATIONS (Continued)

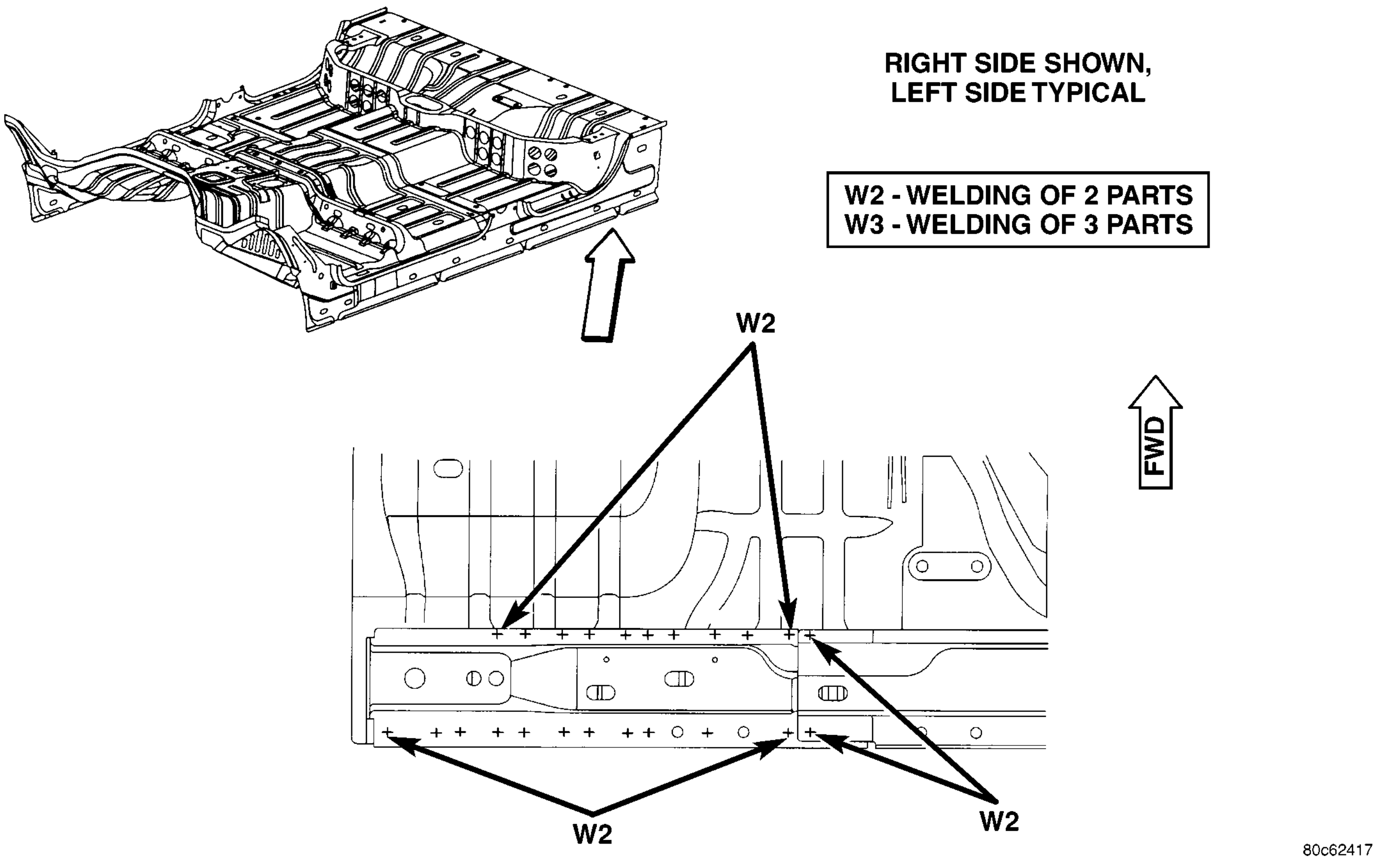


Fig. 53 LEFT REAR CROSSMEMBER - QUAD CAB

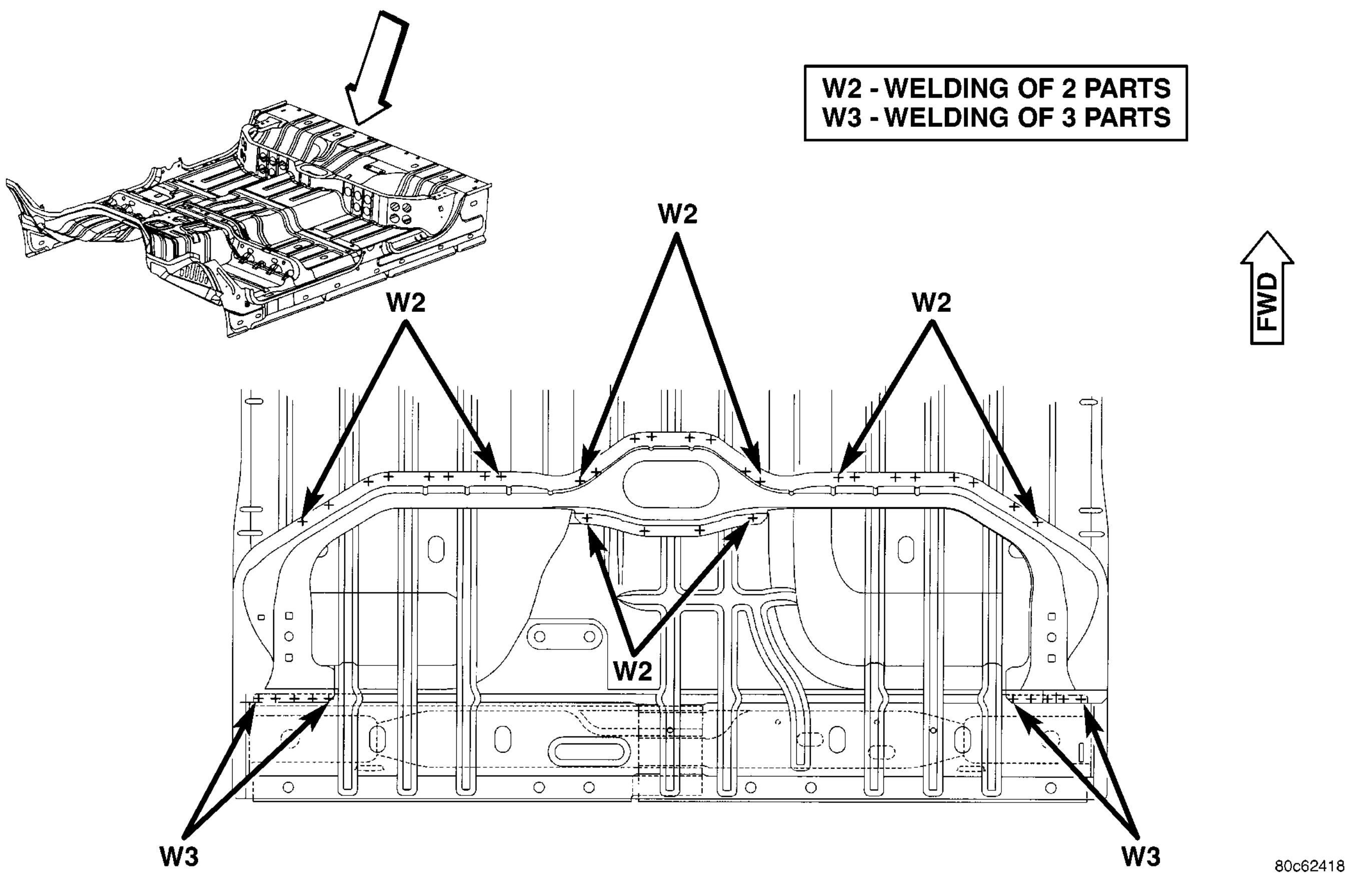


Fig. 54 STORAGE BIN - QUAD CAB

WELD LOCATIONS (Continued)

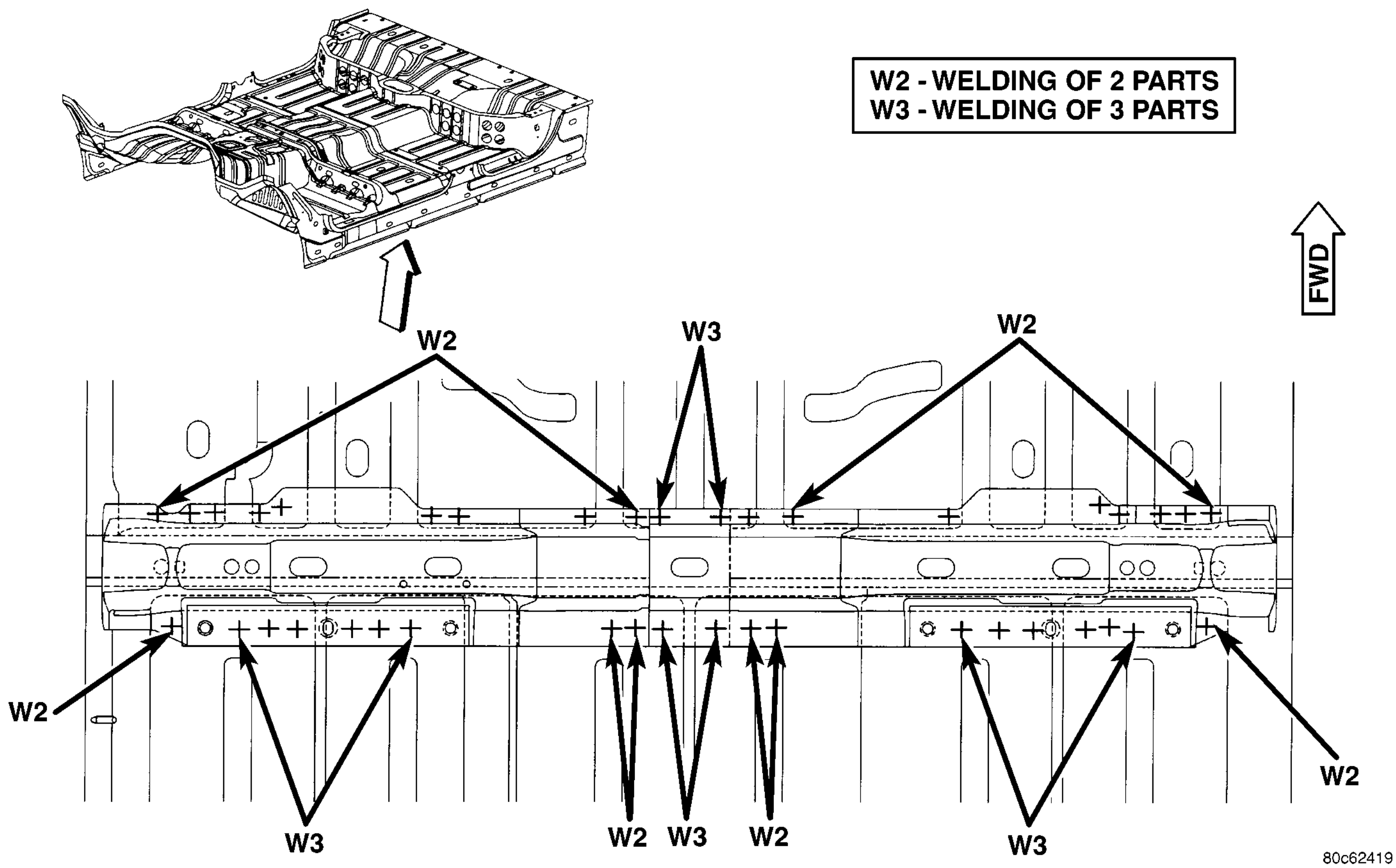


Fig. 55 RIGHT REAR FRONT SEAT MOUNTING CROSSMEMBER - QUAD CAB

WELD LOCATIONS (Continued)

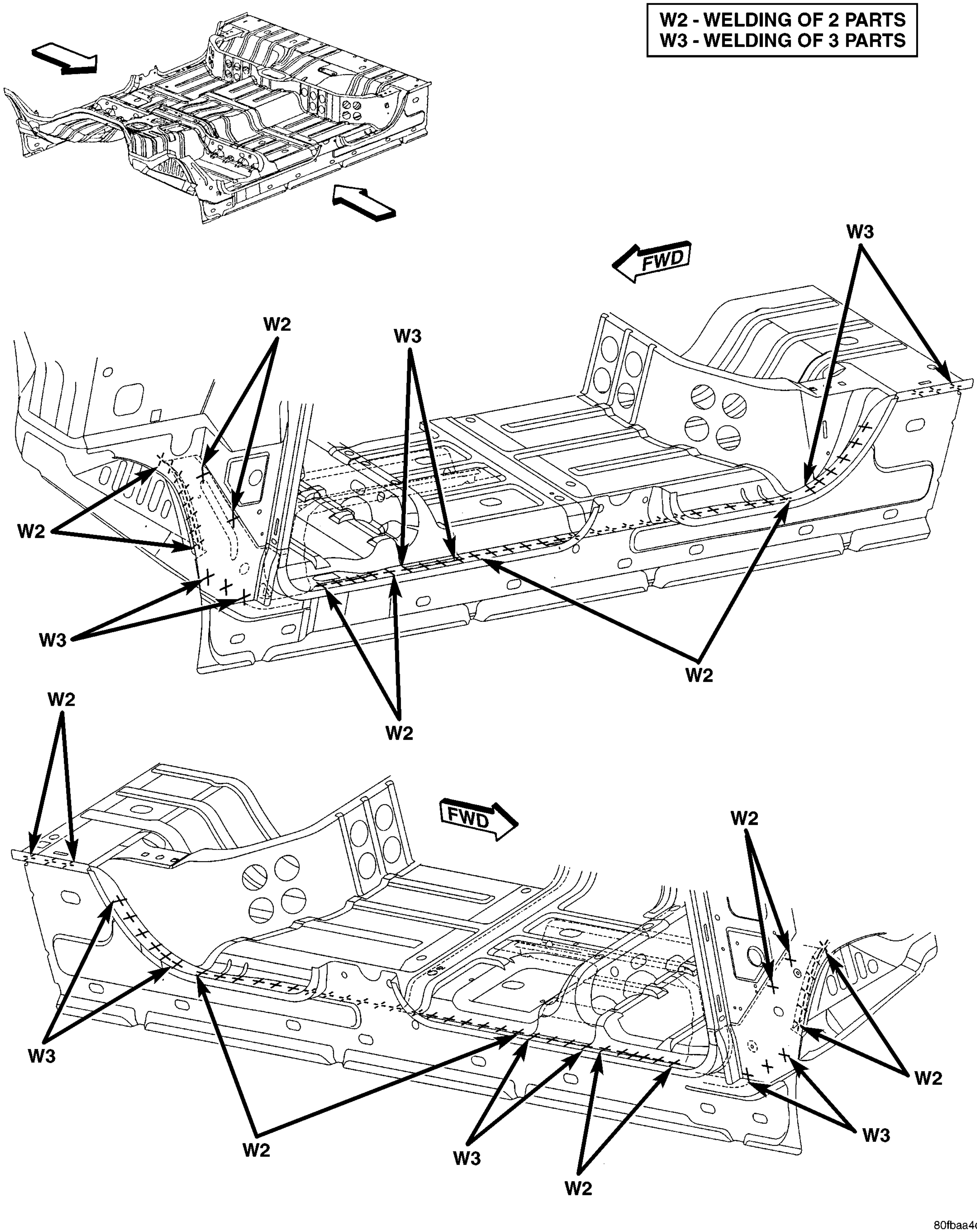


Fig. 56 FRONT SEAT MOUNTING FRONT CROSSMEMBER - QUAD CAB

WELD LOCATIONS (Continued)

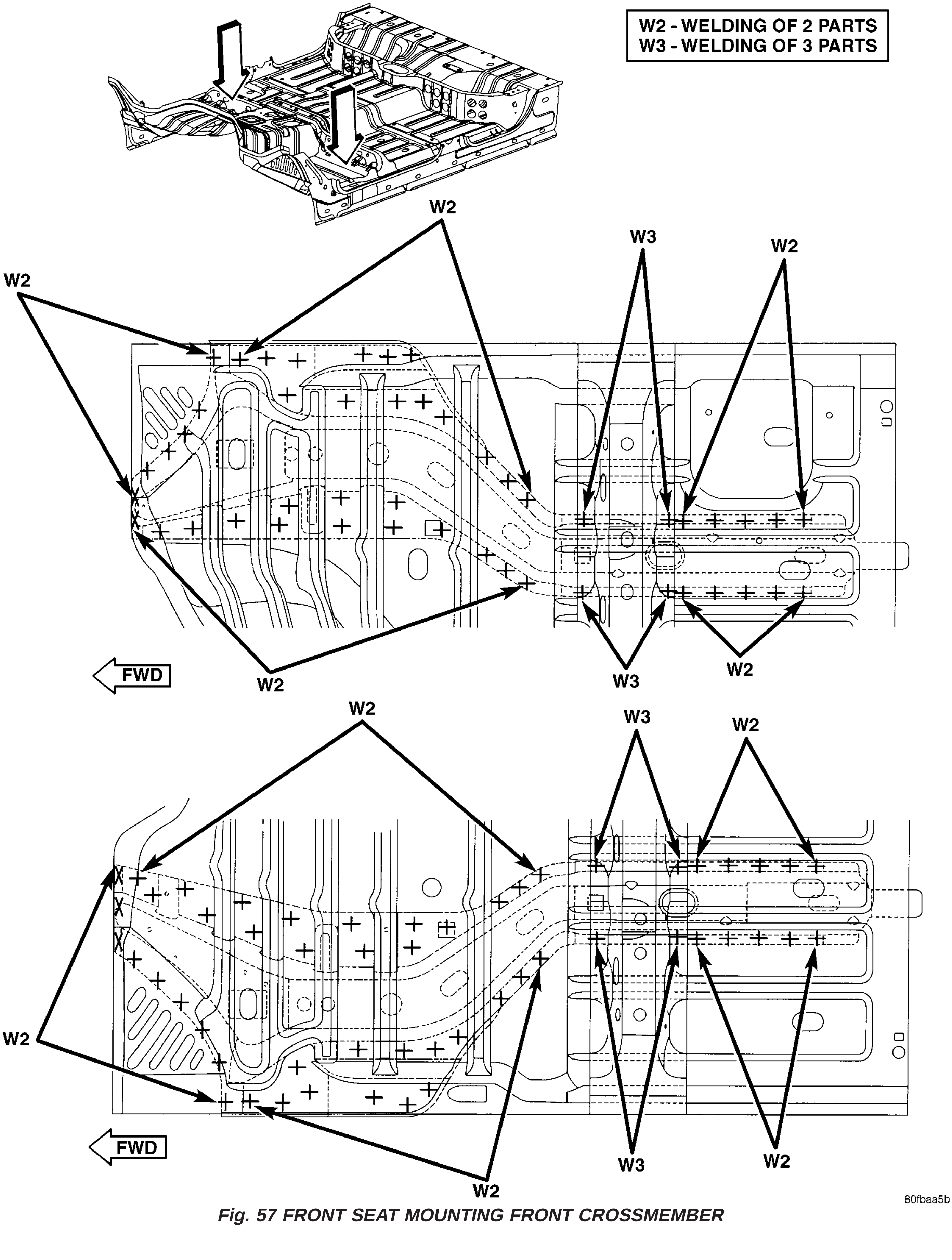


Fig. 57 FRONT SEAT MOUNTING FRONT CROSSMEMBER

WELD LOCATIONS (Continued)

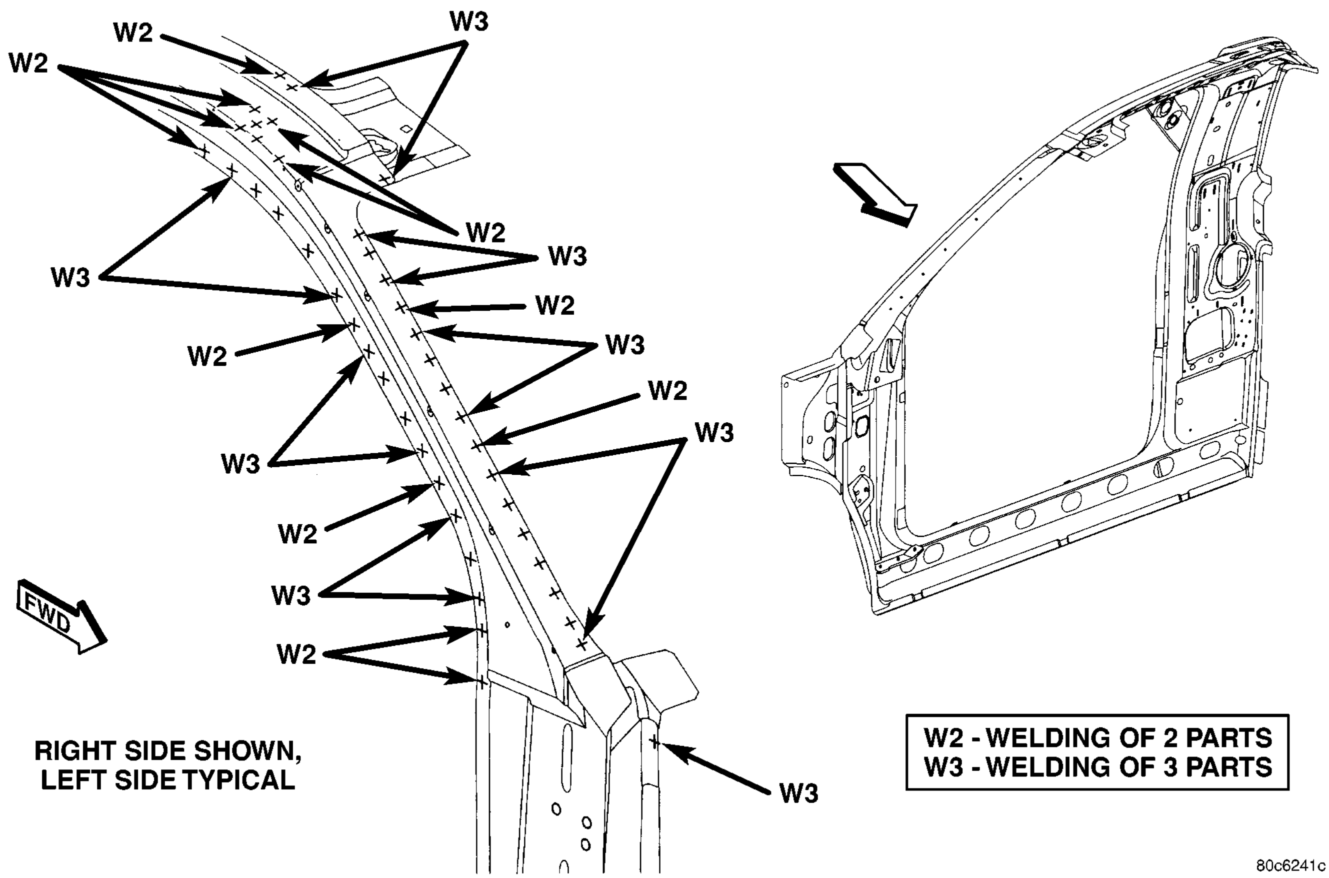


Fig. 58 A-PILLAR REINFORCEMENT - STANDARD CAB

WELD LOCATIONS (Continued)

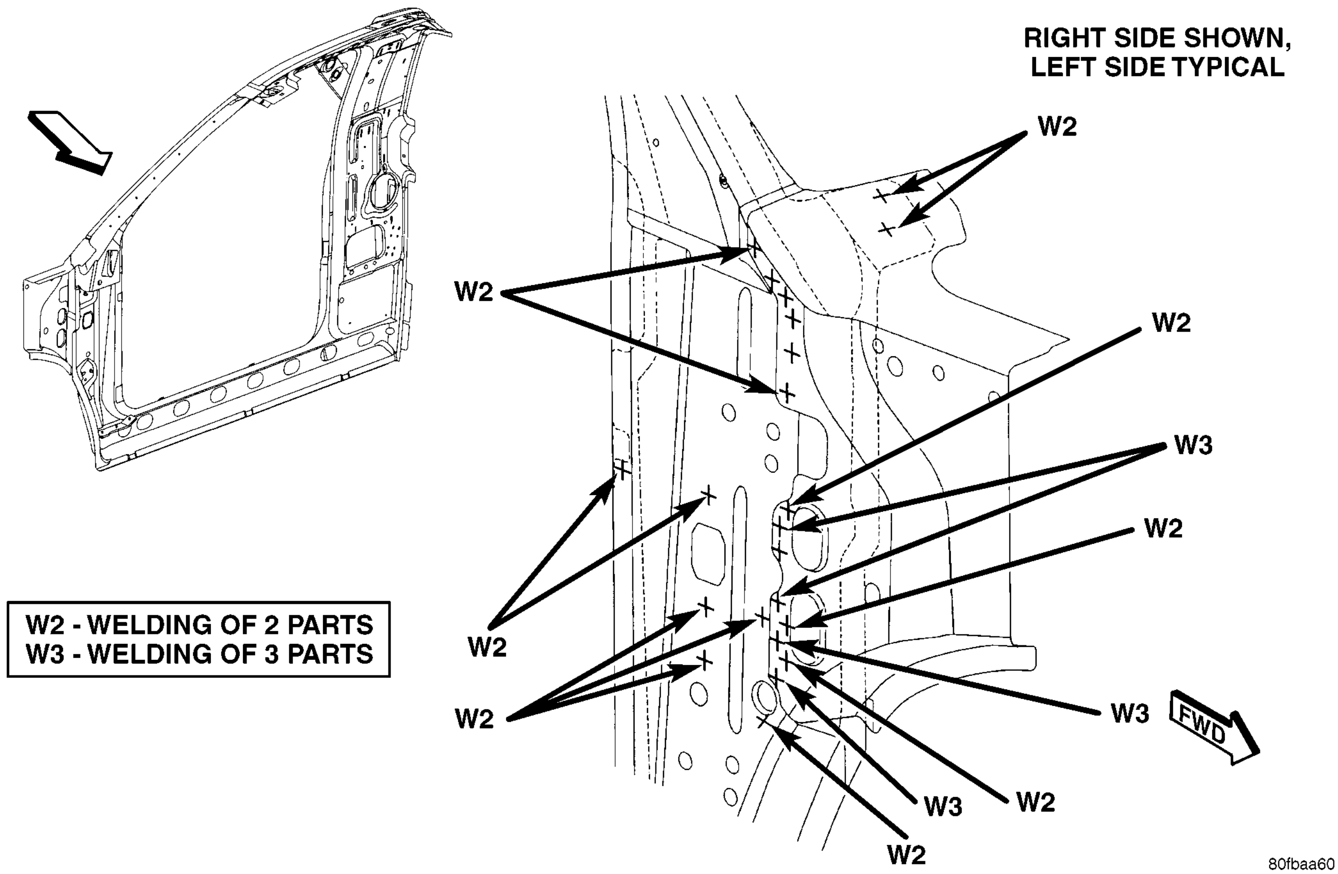


Fig. 59 A-PILLAR REINFORCEMENT - STANDARD CAB

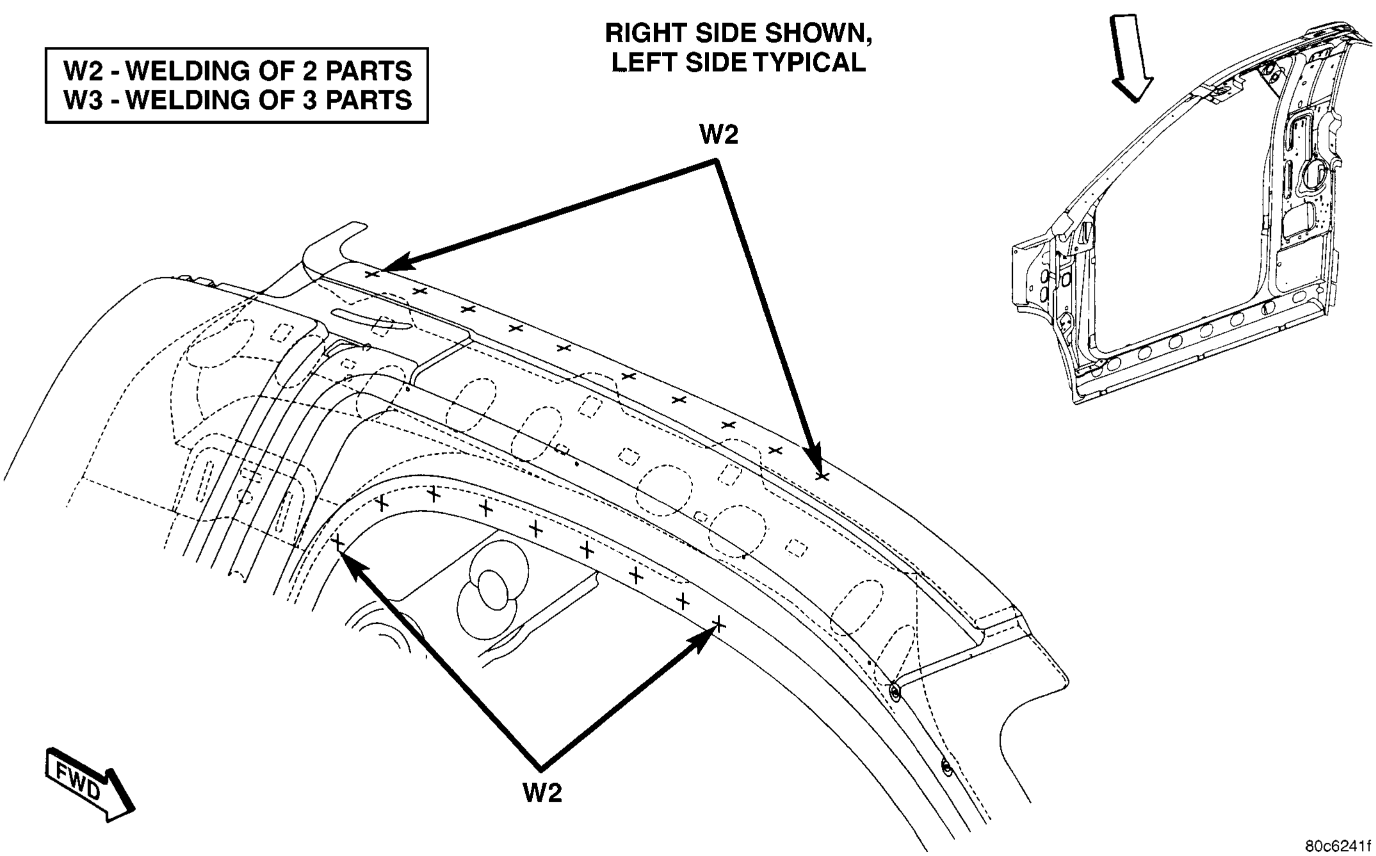


Fig. 60 INNER BODY SIDE APERTURE - STANDARD CAB

WELD LOCATIONS (Continued)

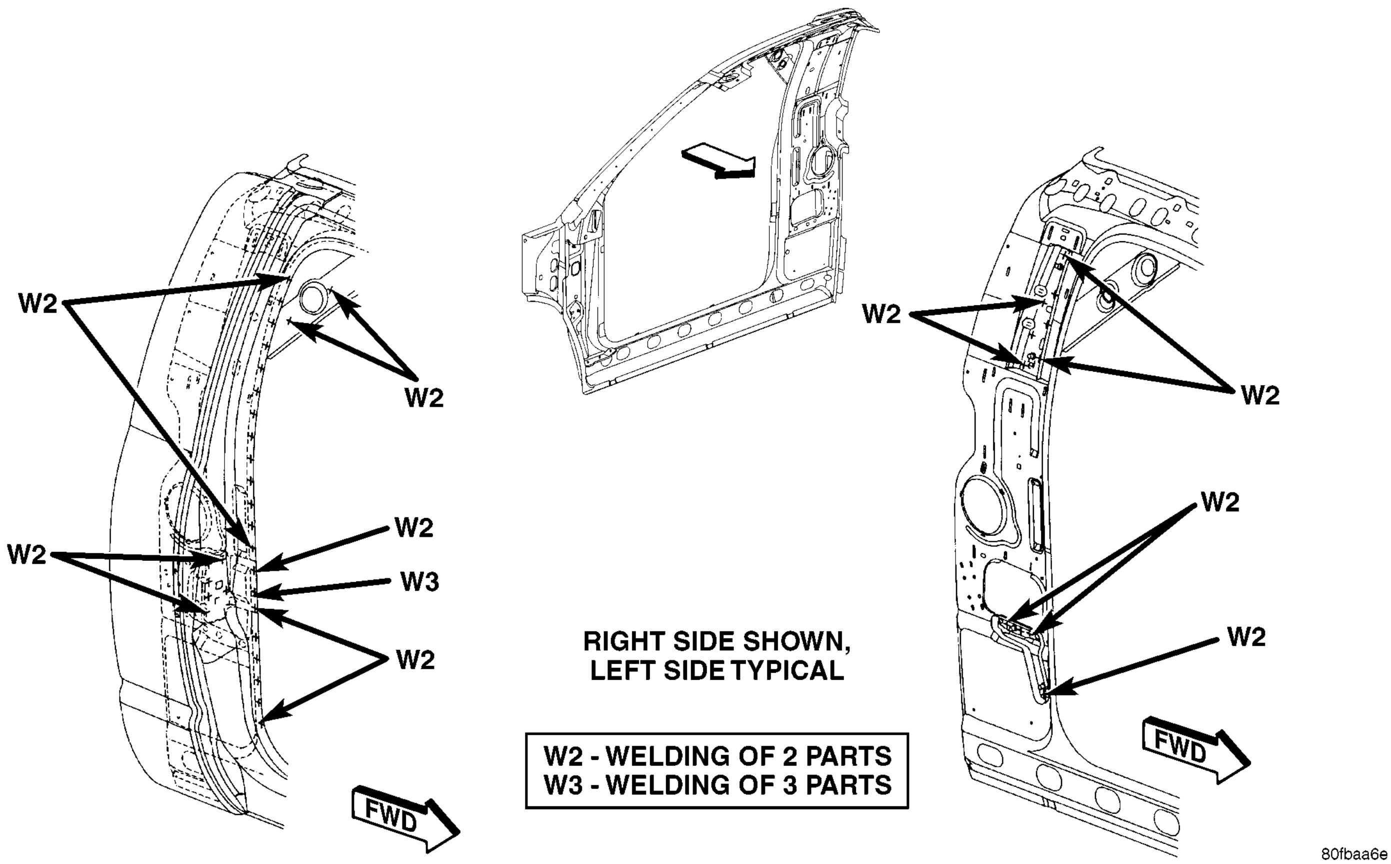


Fig. 61 SHOULDER BELT REINFORCEMENT - STANDARD CAB

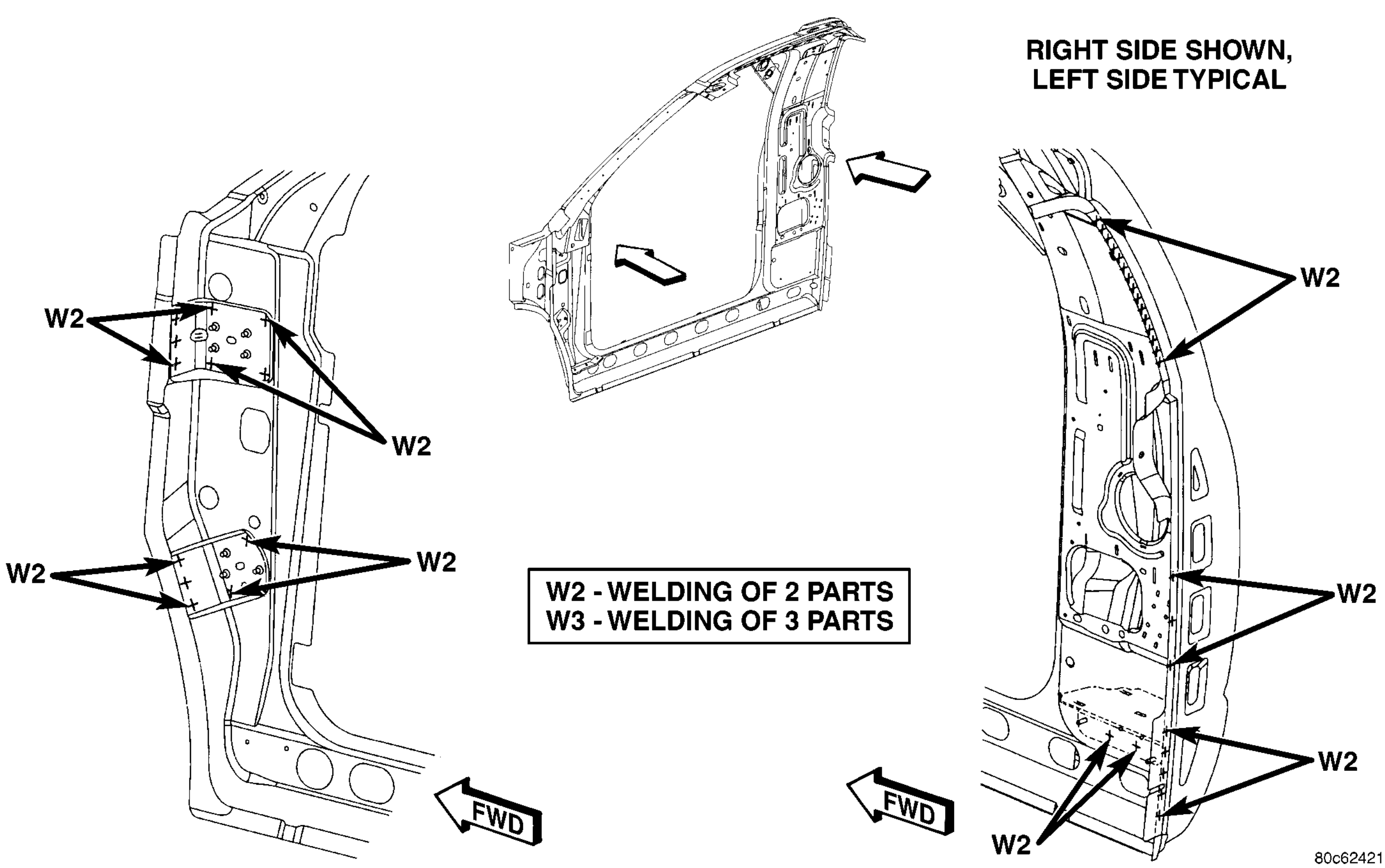


Fig. 62 FRONT PILLAR TAPPING PLATES - STANDARD CAB

WELD LOCATIONS (Continued)

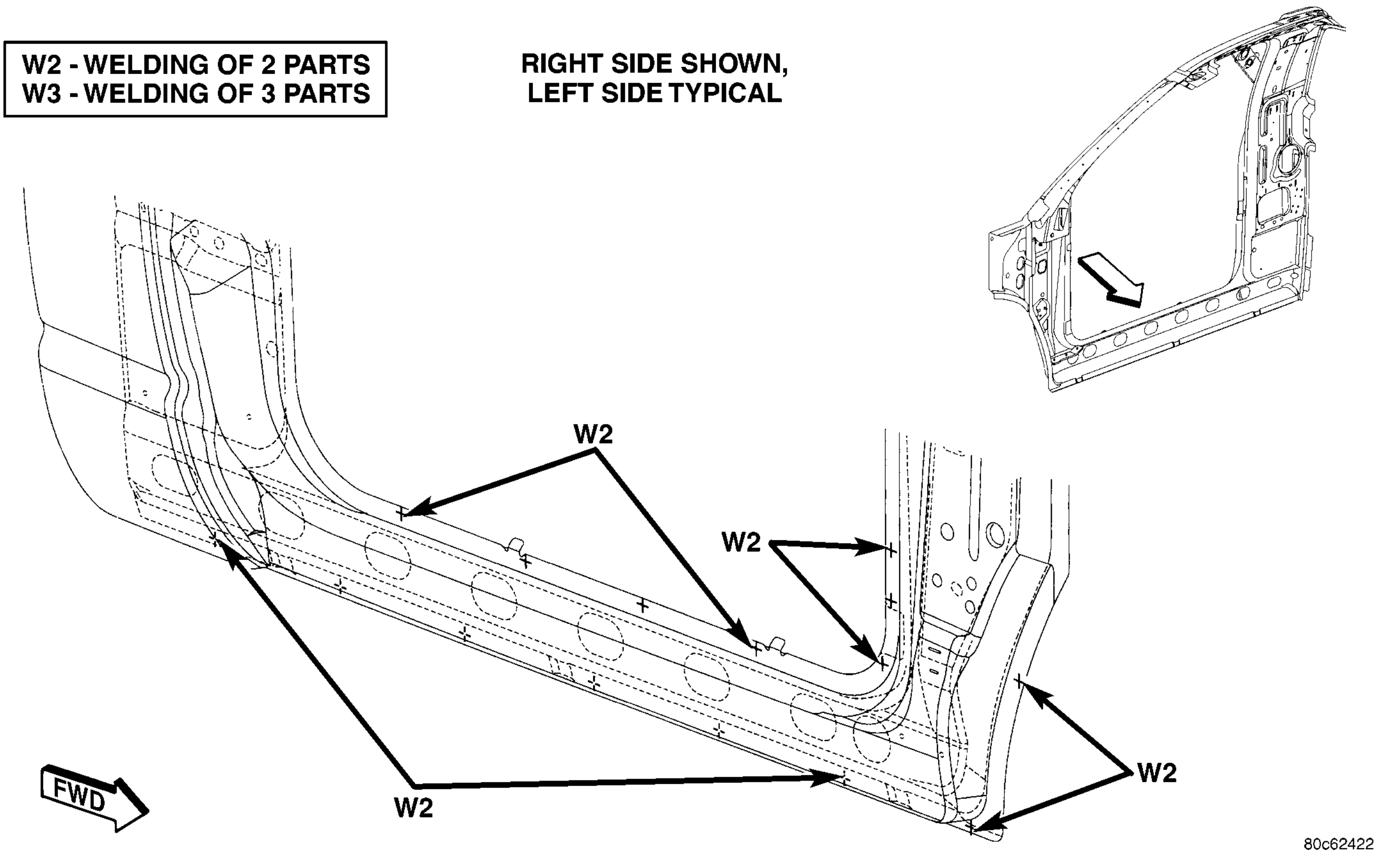


Fig. 63 INNER BODY SIDE APERTURE - STANDARD CAB

WELD LOCATIONS (Continued)

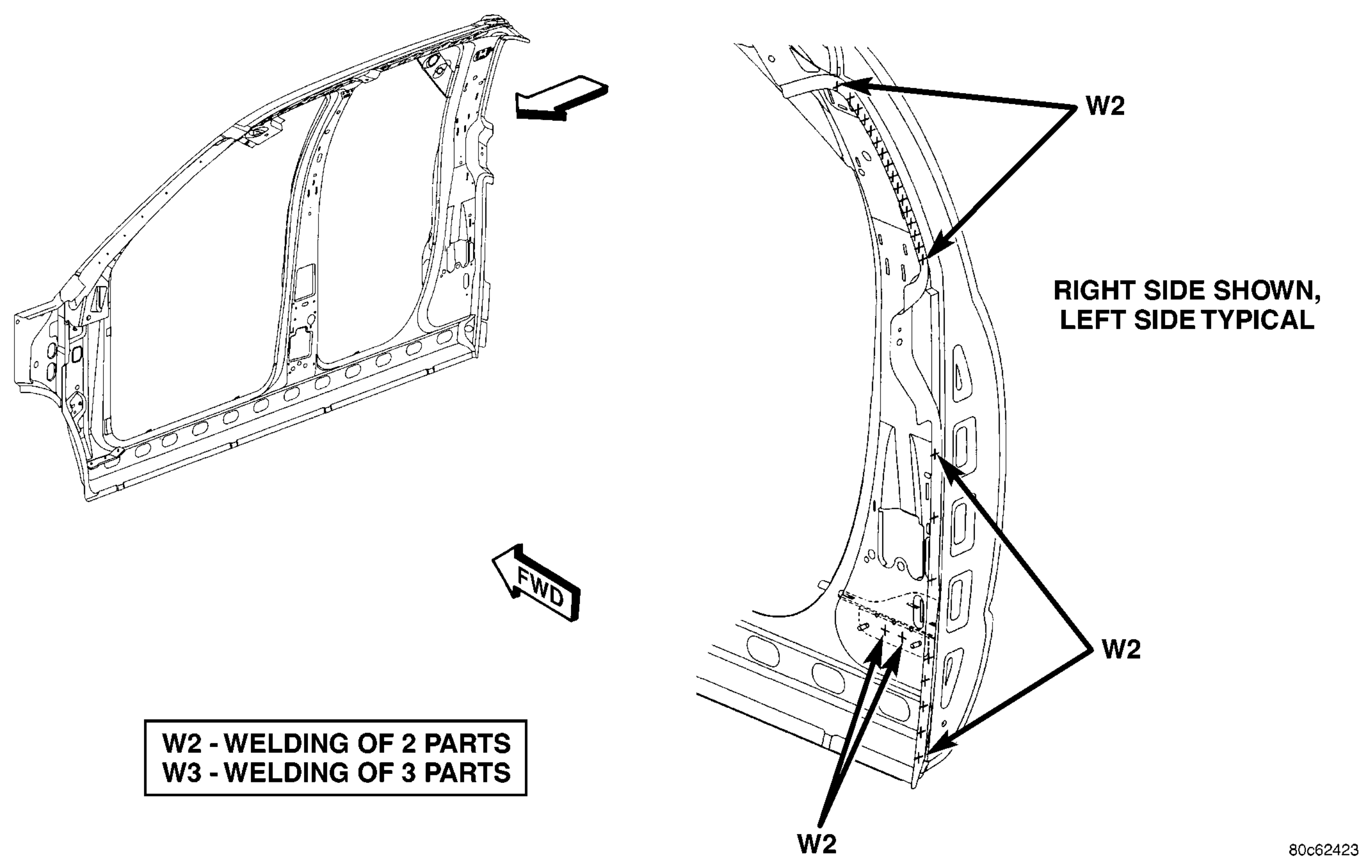


Fig. 64 C-PILLAR BAFFLE - QUAD CAB

WELD LOCATIONS (Continued)

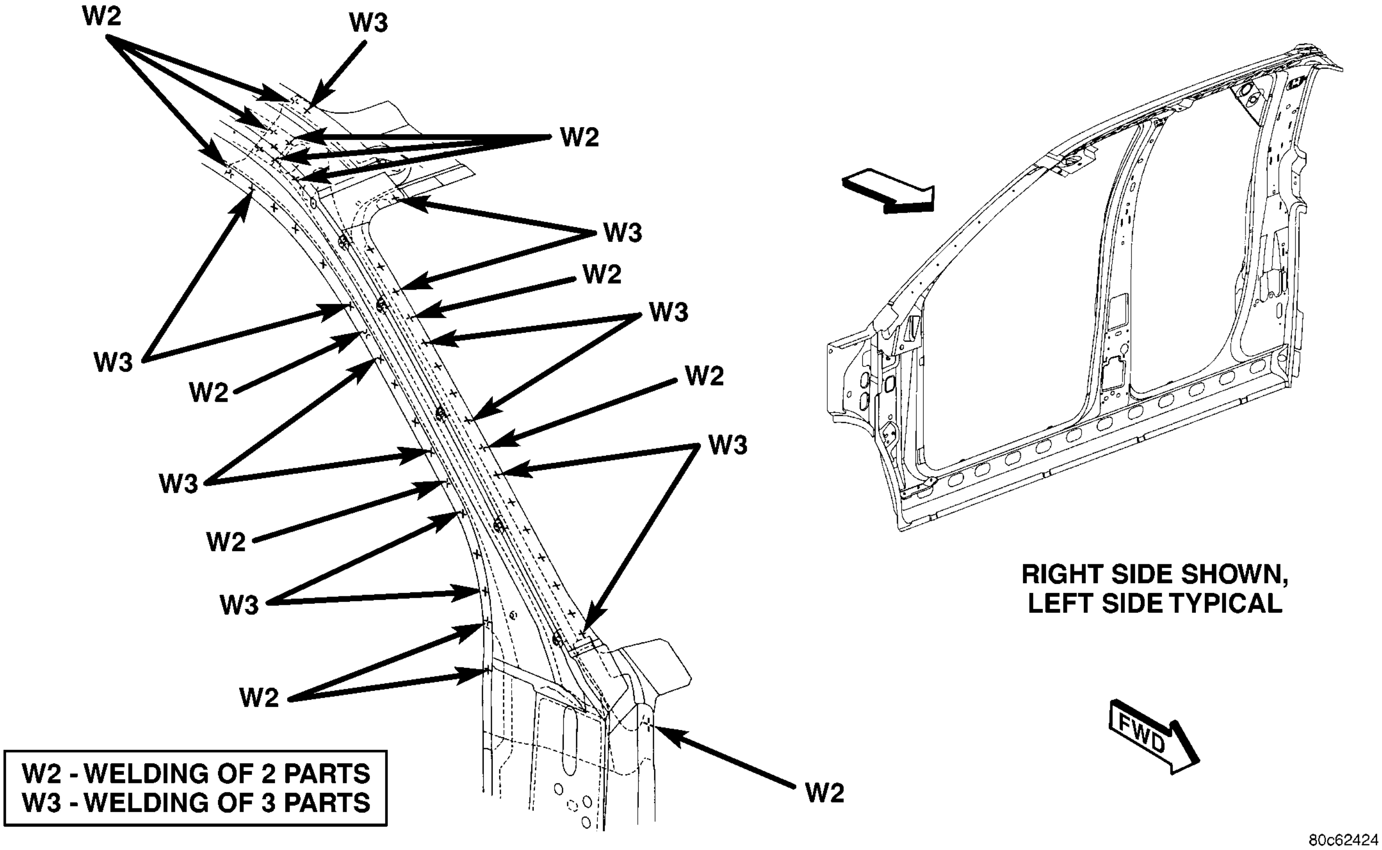


Fig. 65 A-PILLAR REINFORCEMENT - QUAD CAB

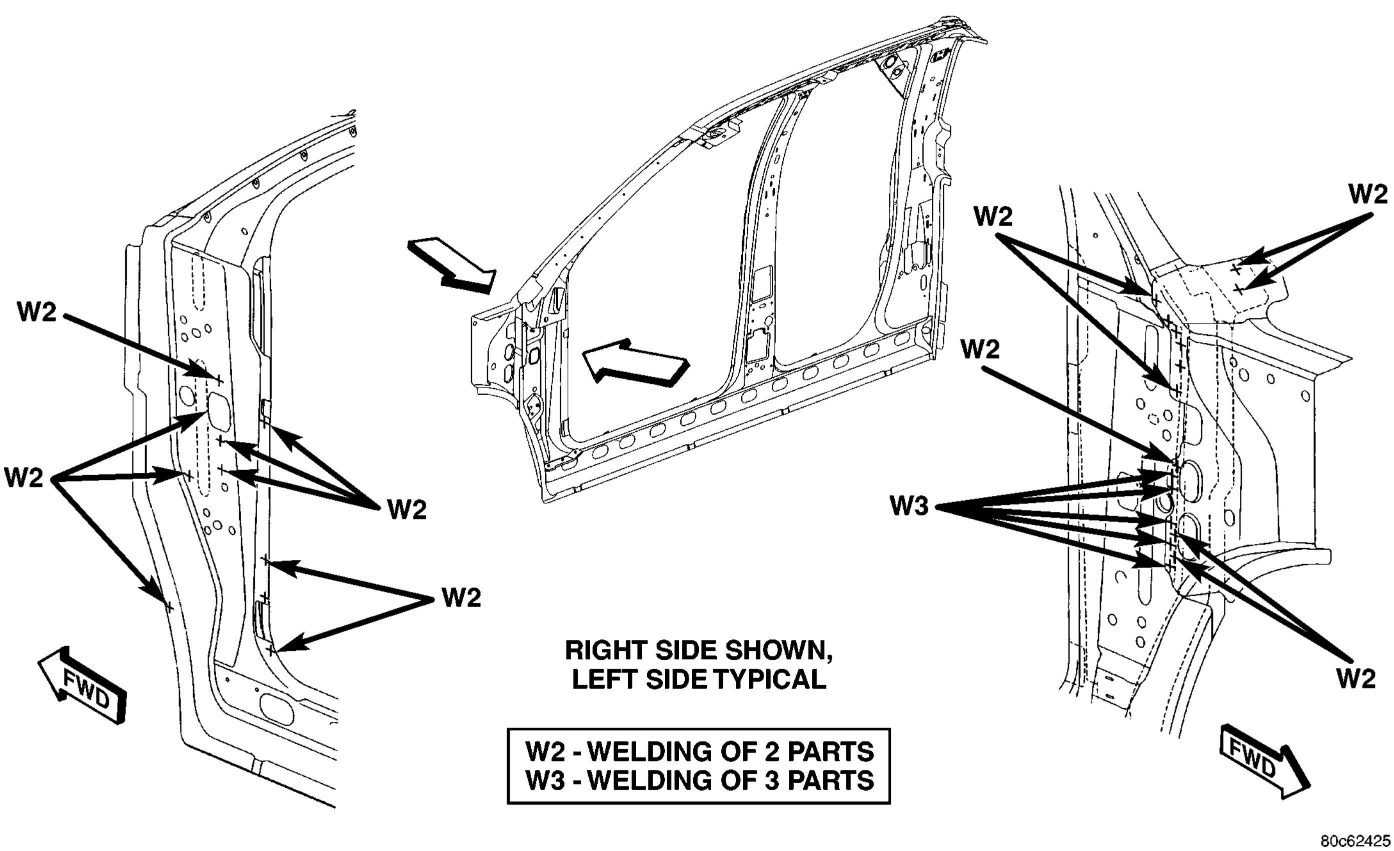


Fig. 66 FRONT EXTENSION PLATE - QUAD CAB

WELD LOCATIONS (Continued)

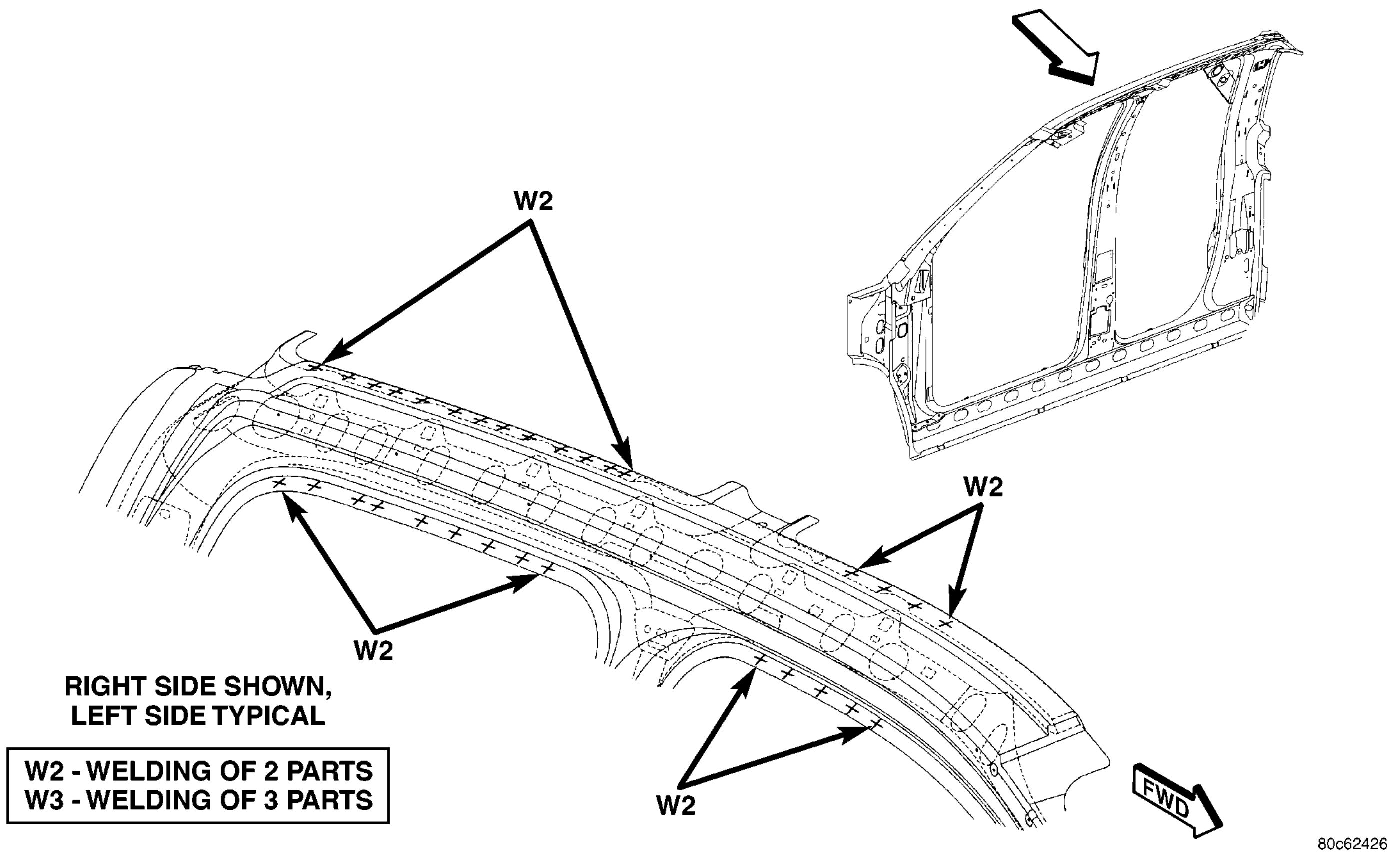


Fig. 67 OUTER BODY SIDE APERTURE - QUAD CAB

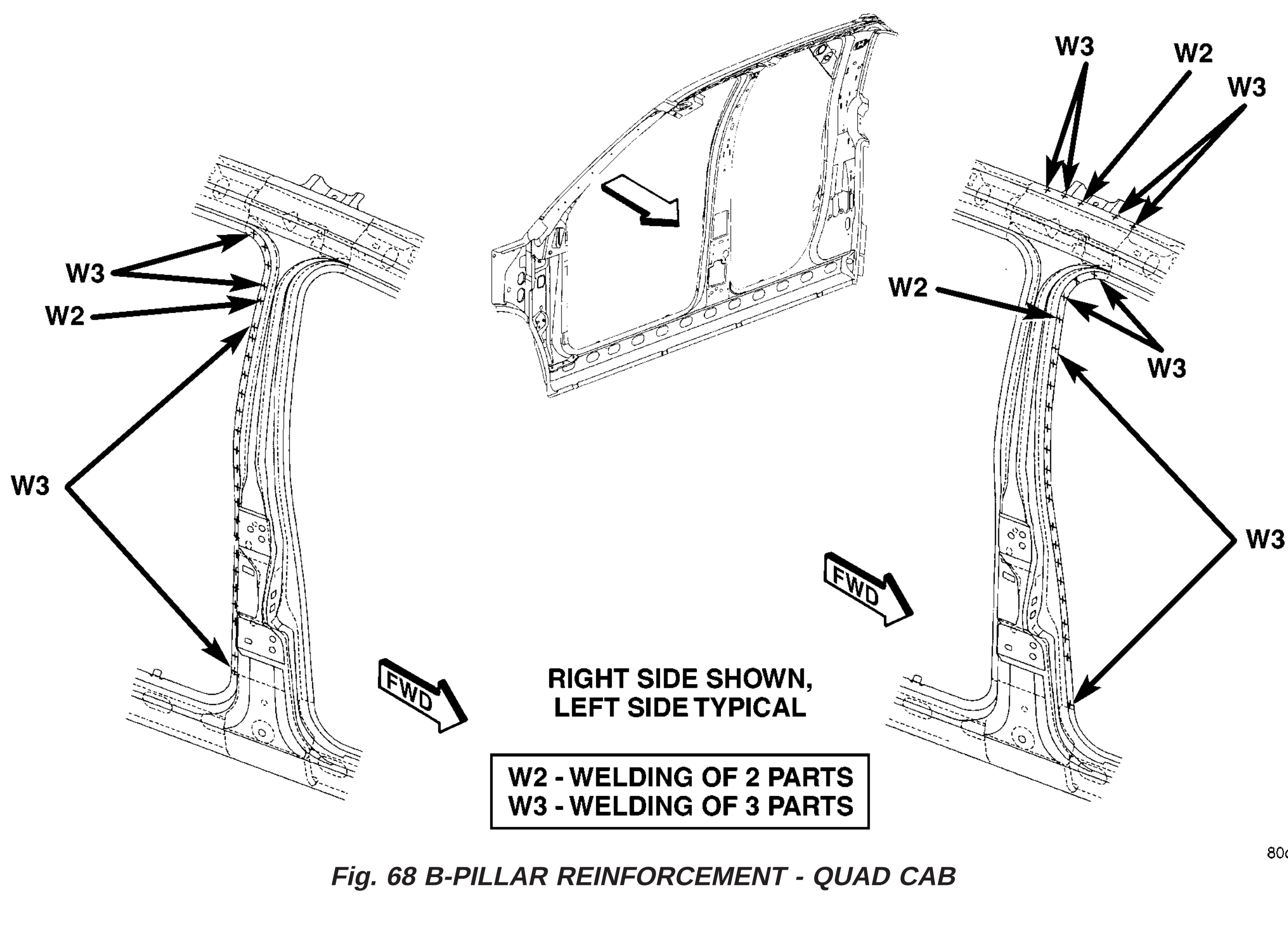


Fig. 68 B-PILLAR REINFORCEMENT - QUAD CAB

WELD LOCATIONS (Continued)

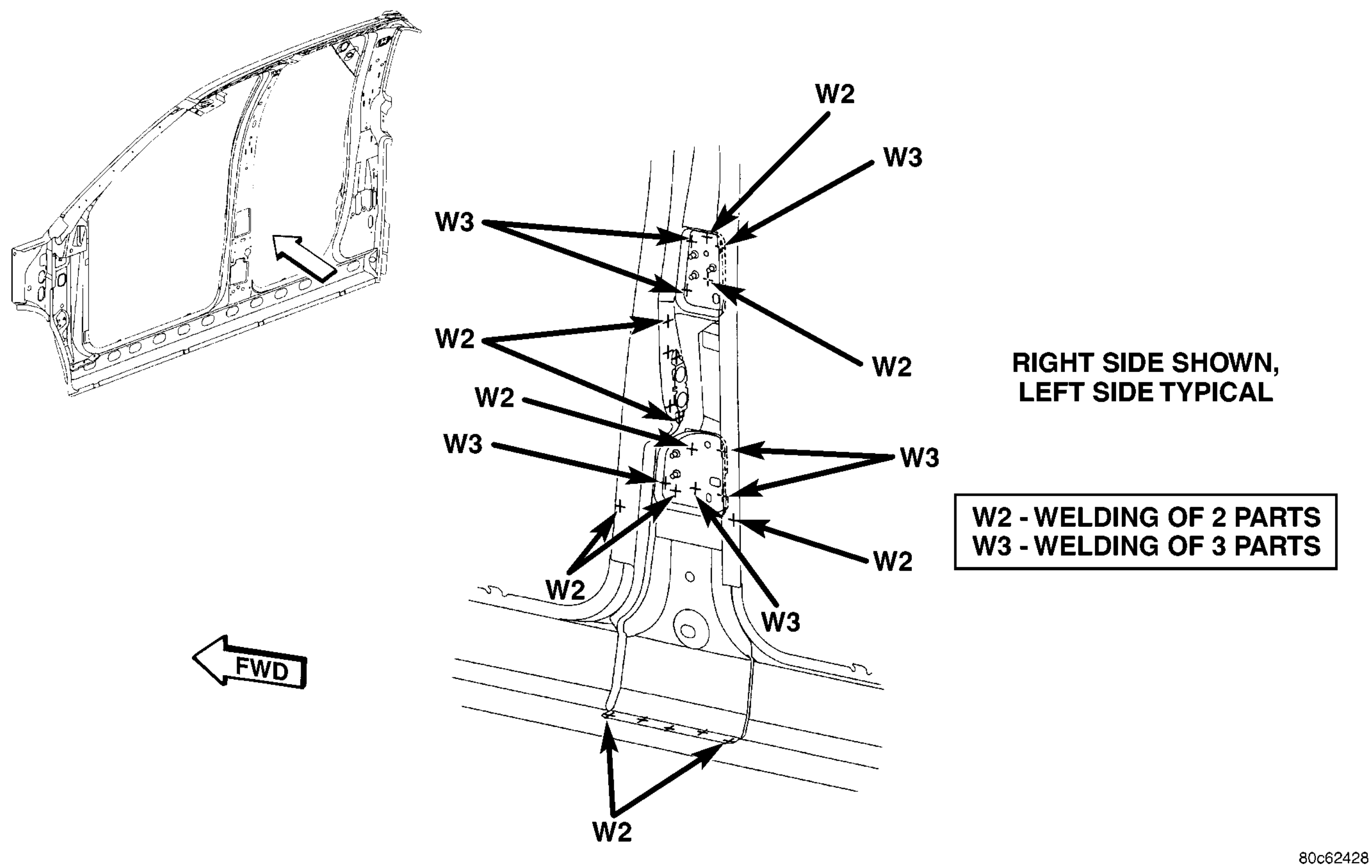


Fig. 69 UPPER TAPPING PLATE - QUAD CAB

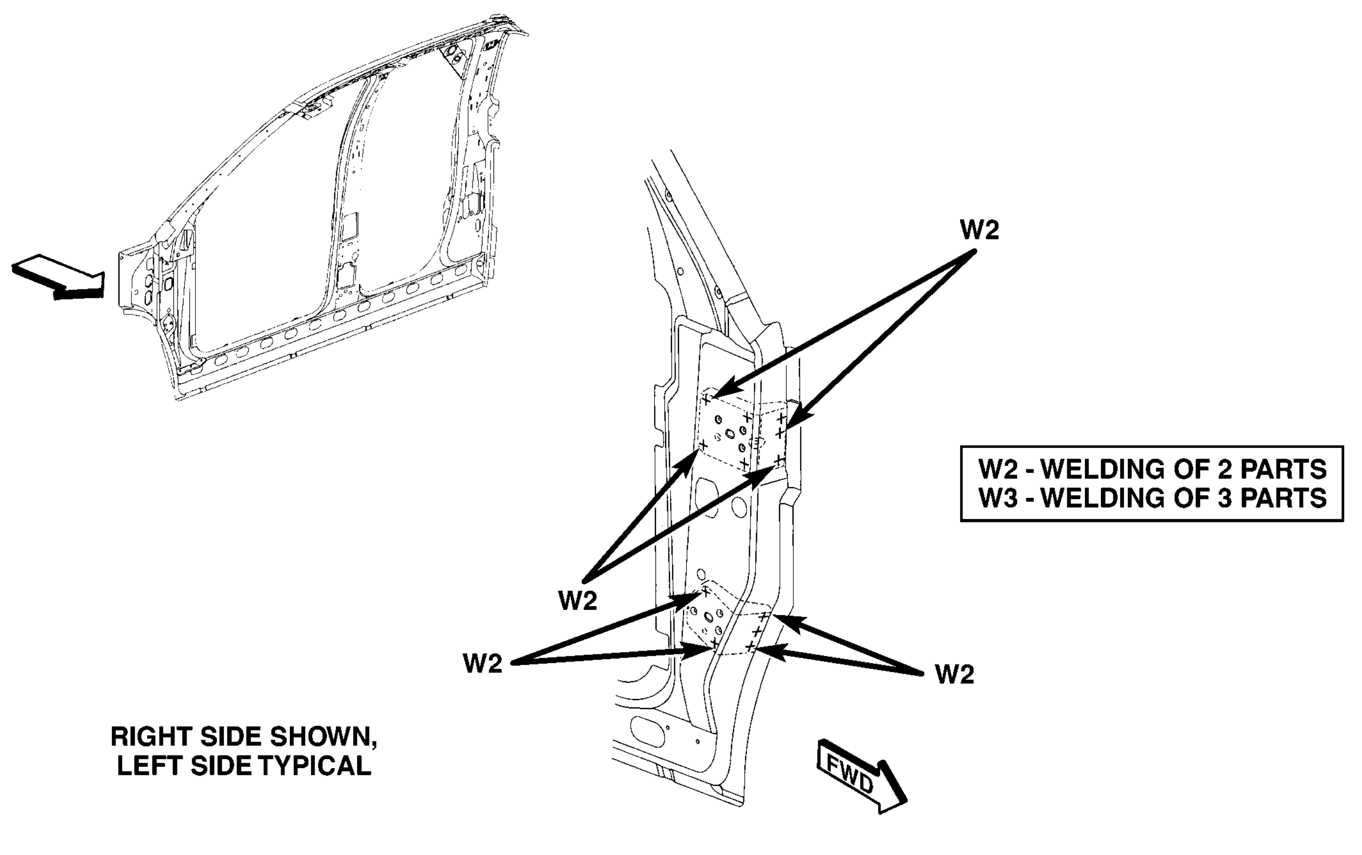


Fig. 70 UPPER A-PILLAR TAPPING PLATE - QUAD CAB

WELD LOCATIONS (Continued)

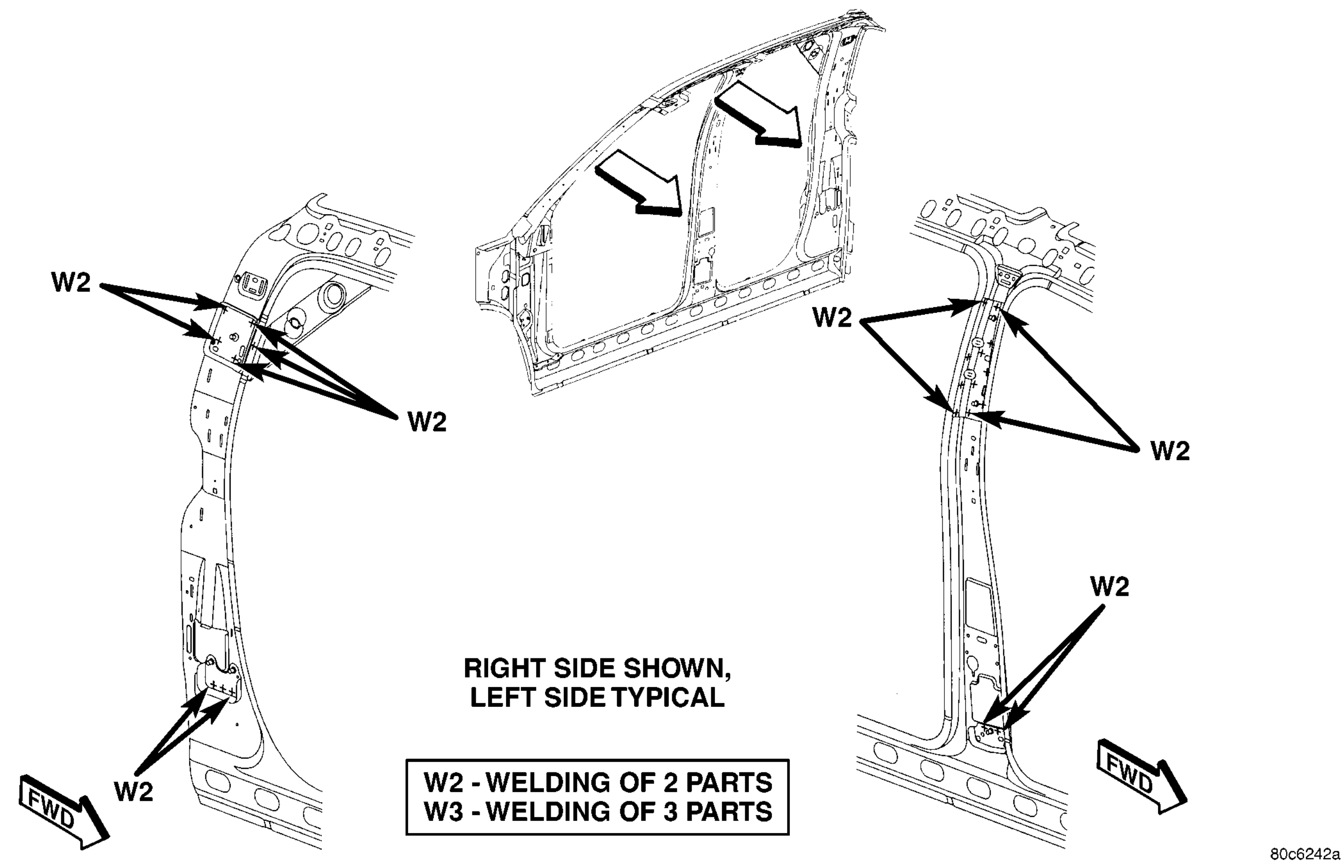


Fig. 71 SEAT BELT MOUNTING PLATES - QUAD CAB

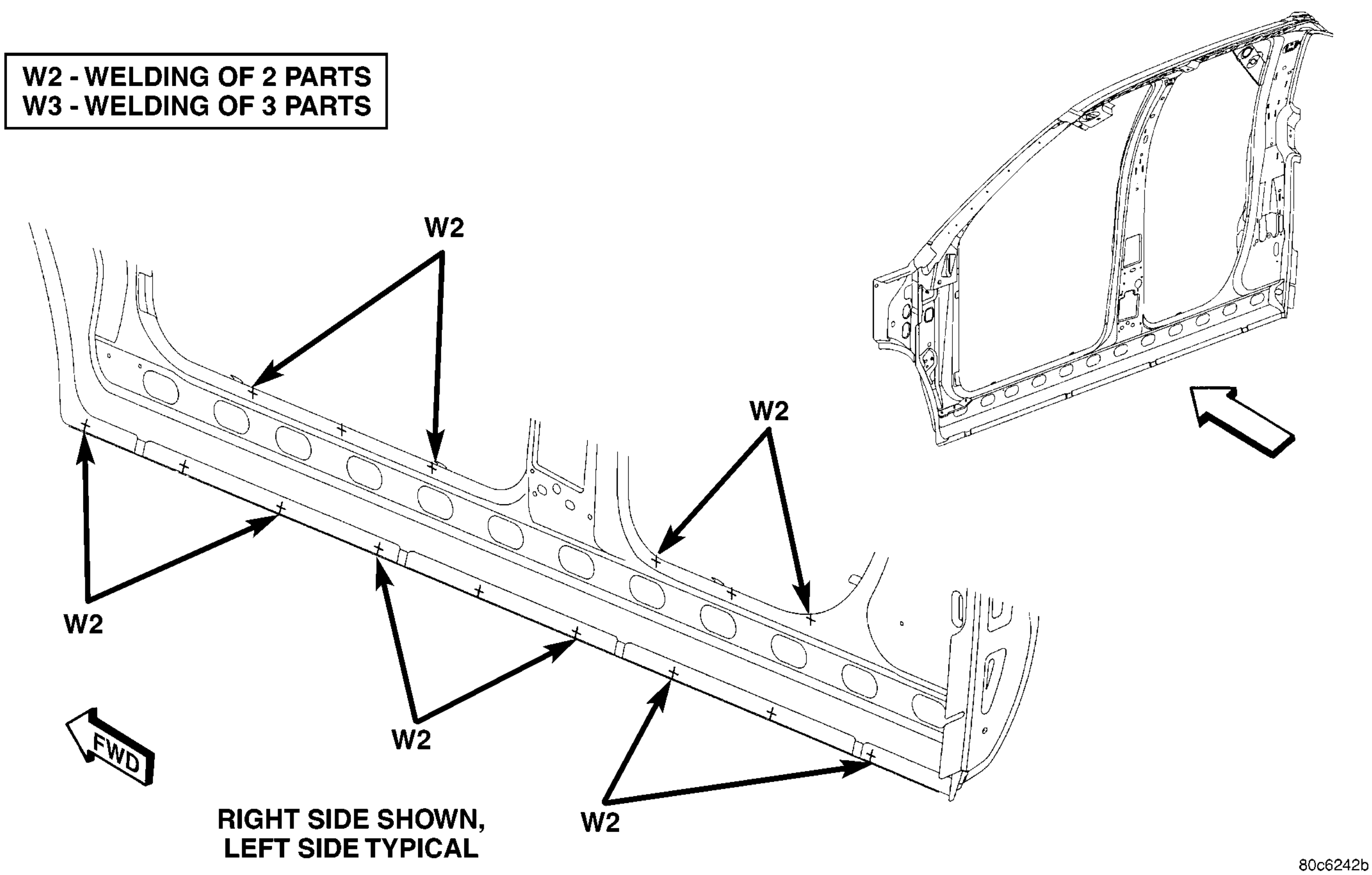


Fig. 72 OUTER BODY SIDE APERTURE - QUAD CAB

WELD LOCATIONS (Continued)

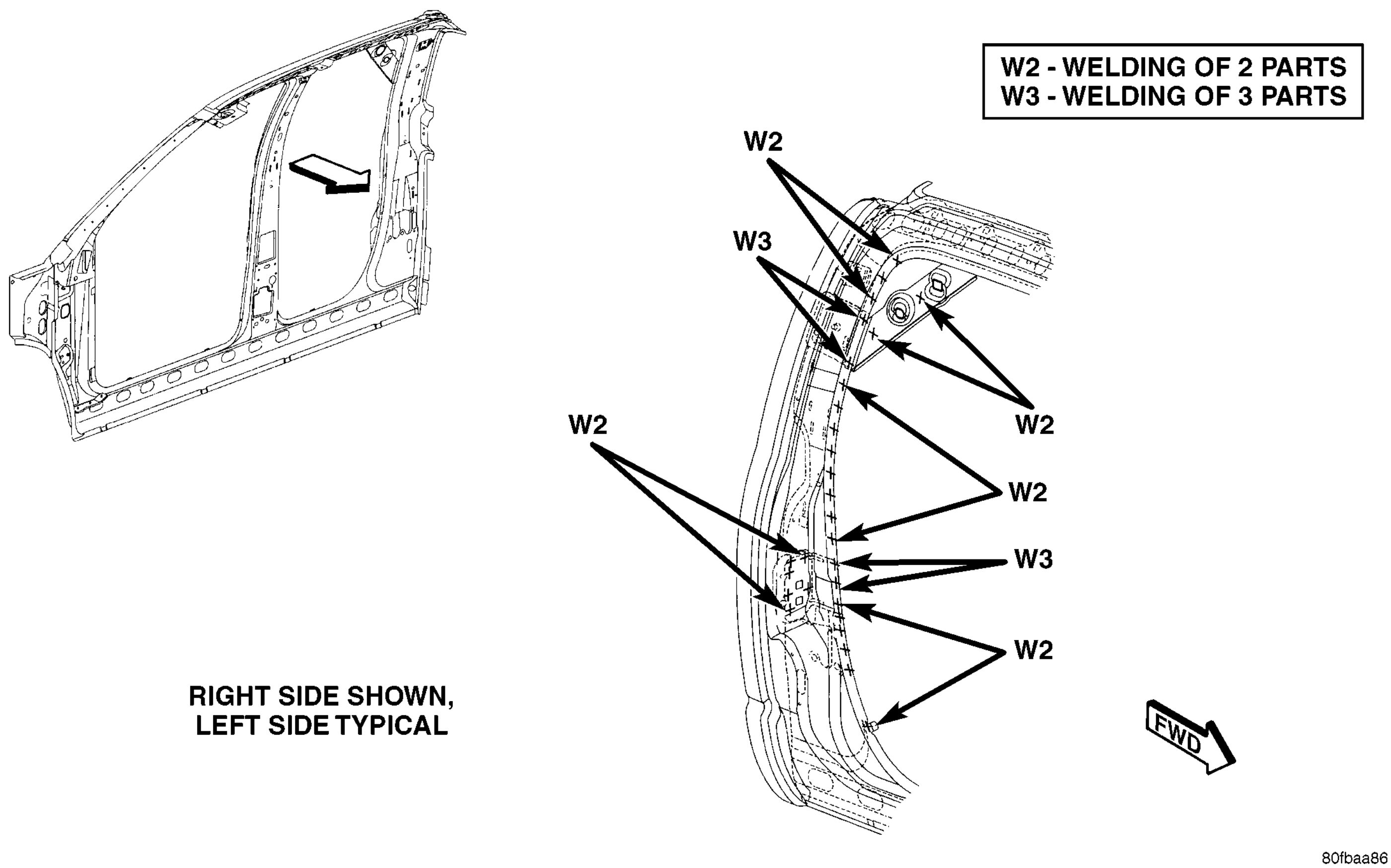


Fig. 73 C-PILLAR REINFORCEMENT - QUAD CAB

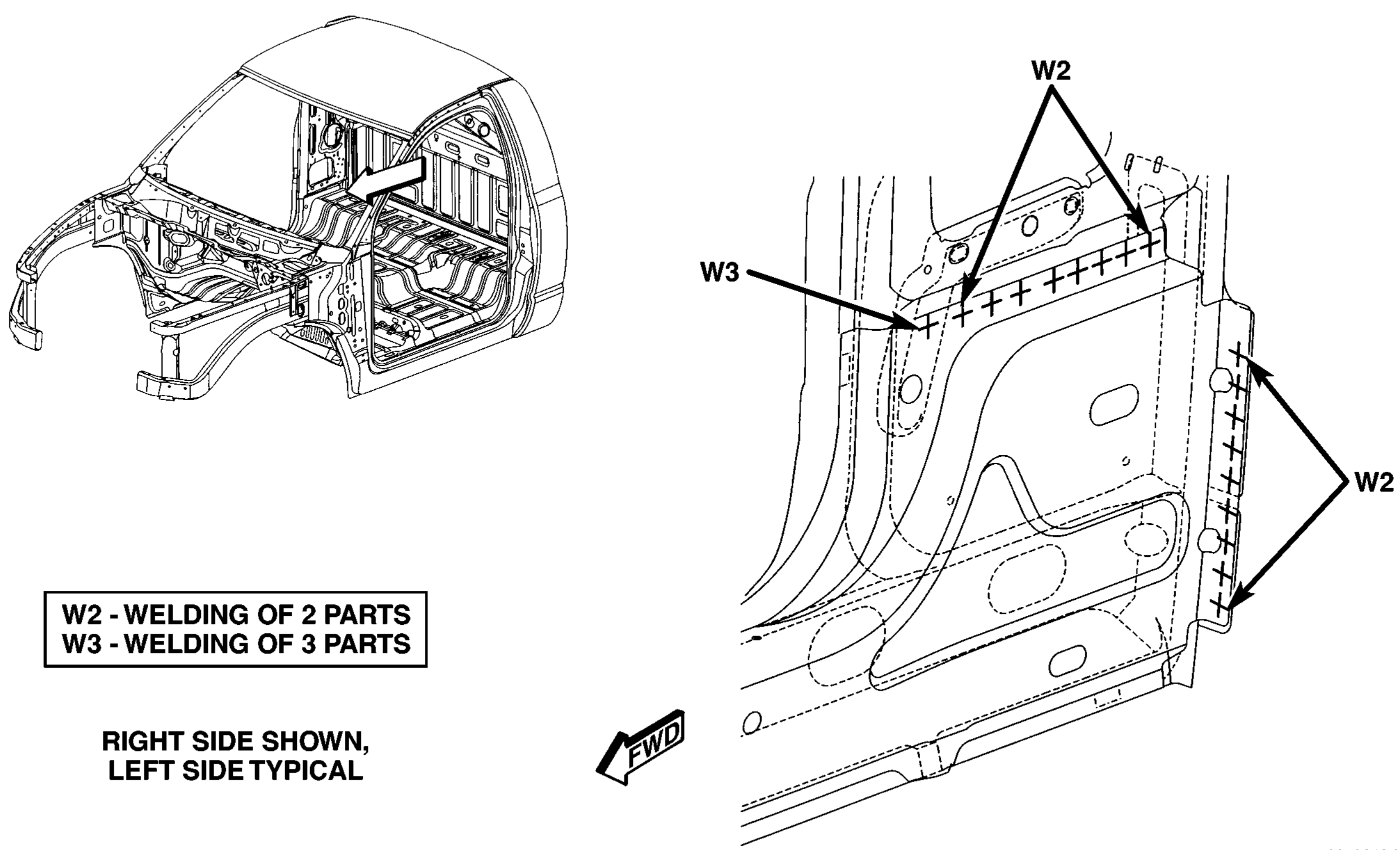


Fig. 74 SEAT BELT RETRACTOR PLATE - STANDARD CAB

WELD LOCATIONS (Continued)

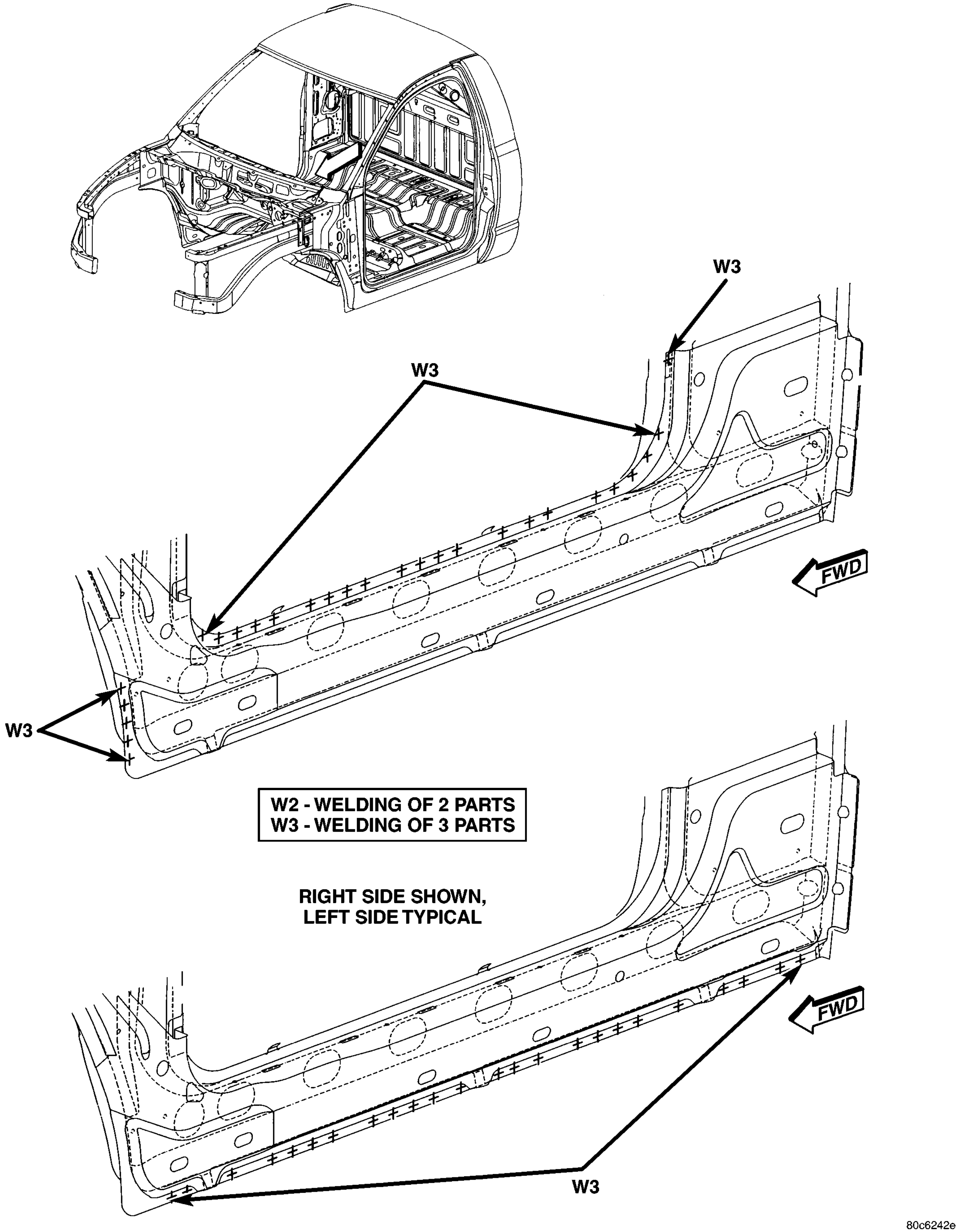


Fig. 75 FLOOR SILL - STANDARD CAB

WELD LOCATIONS (Continued)

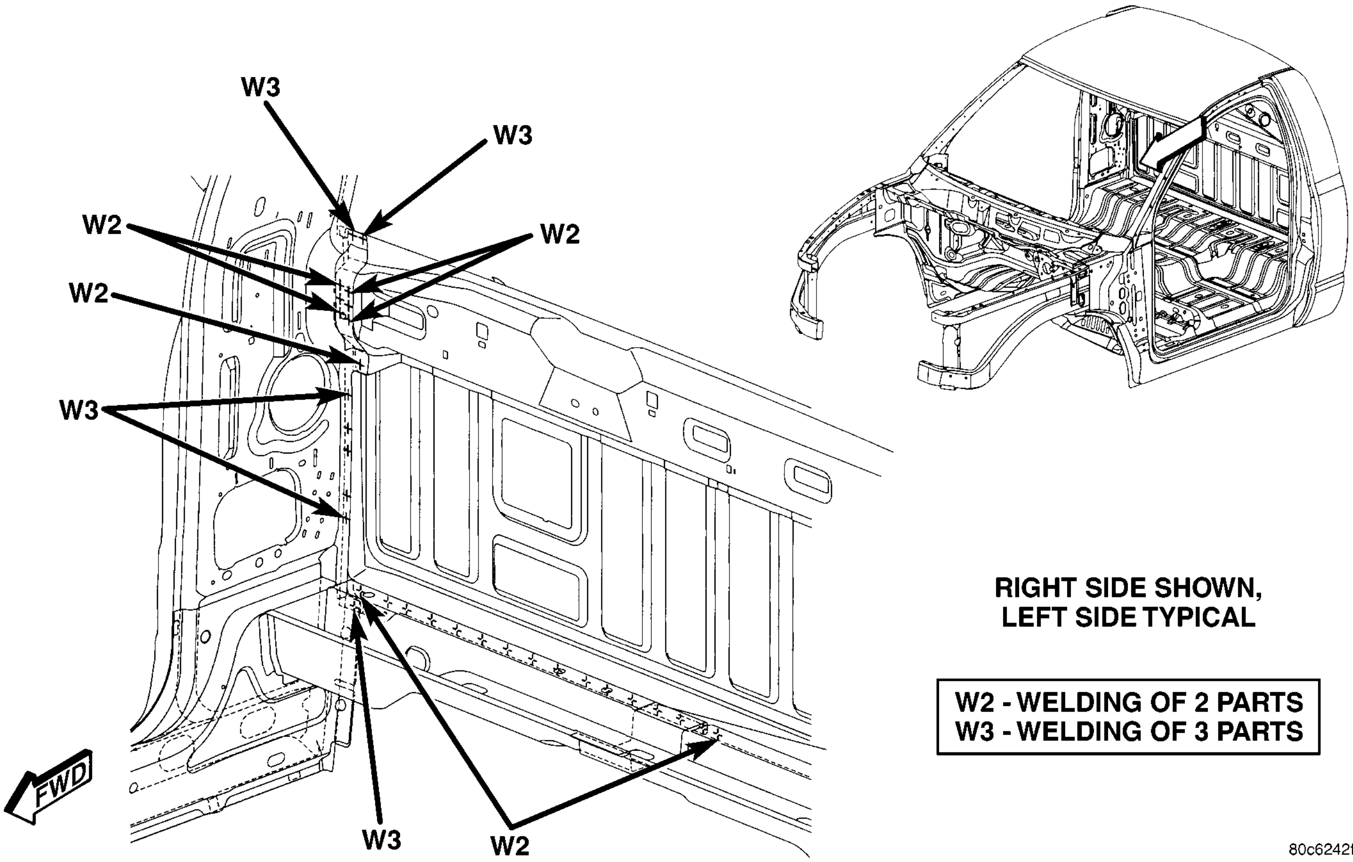


Fig. 76 BACK REINFORCEMENT - STANDARD CAB

WELD LOCATIONS (Continued)

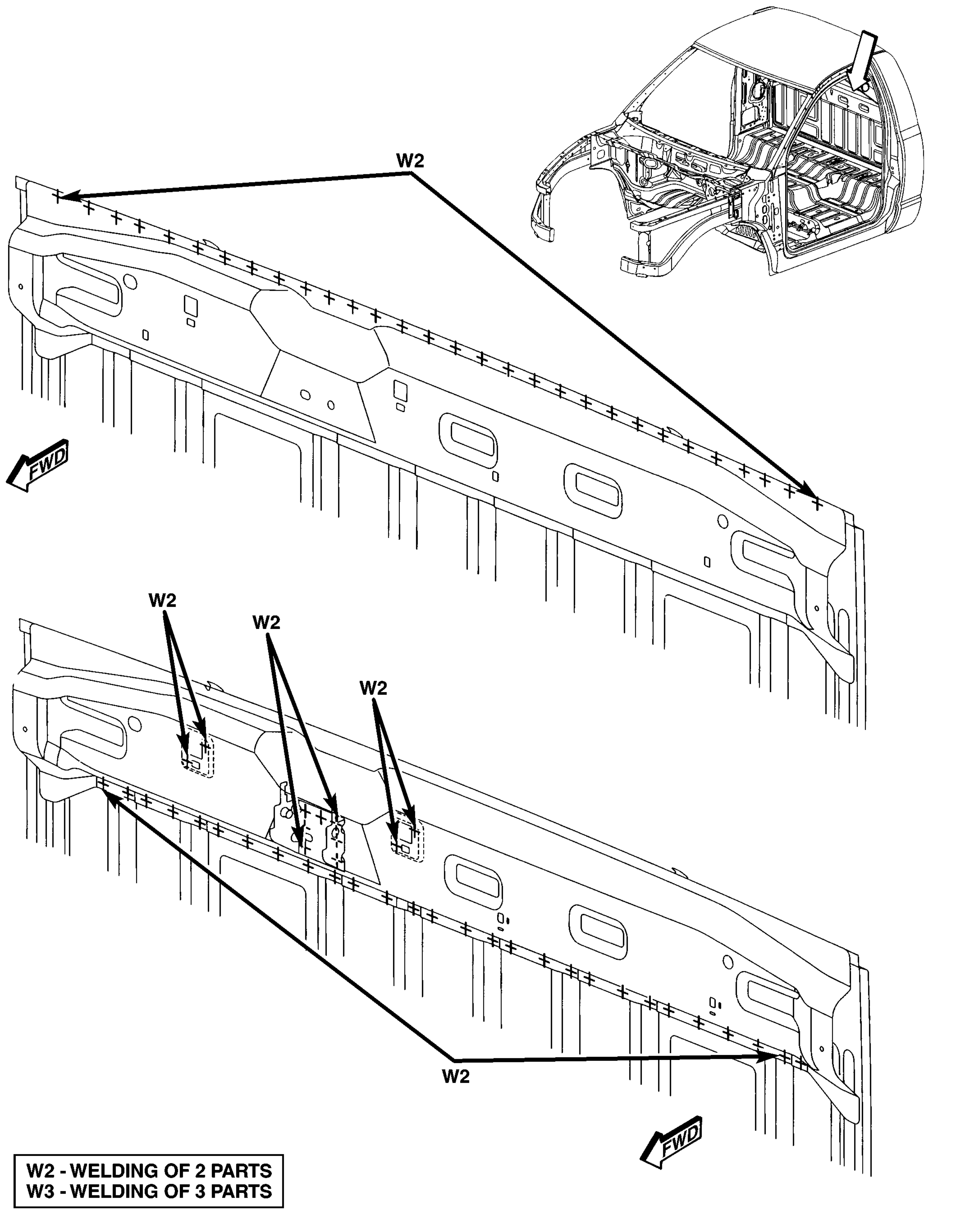


Fig. 77 CAB BACK REINFORCEMENT - STANDARD CAB

WELD LOCATIONS (Continued)

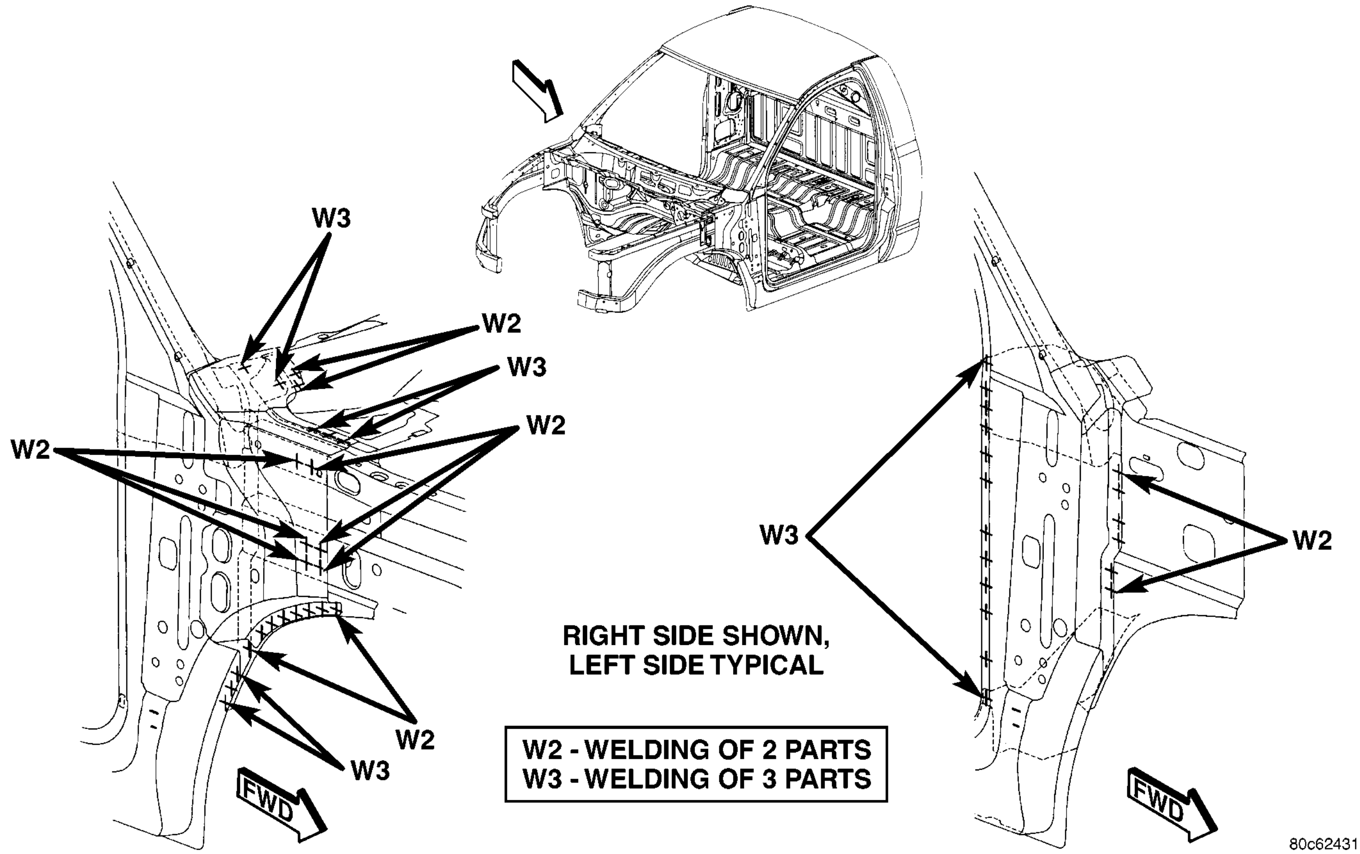


Fig. 78 COWL SIDE PANEL - STANDARD CAB

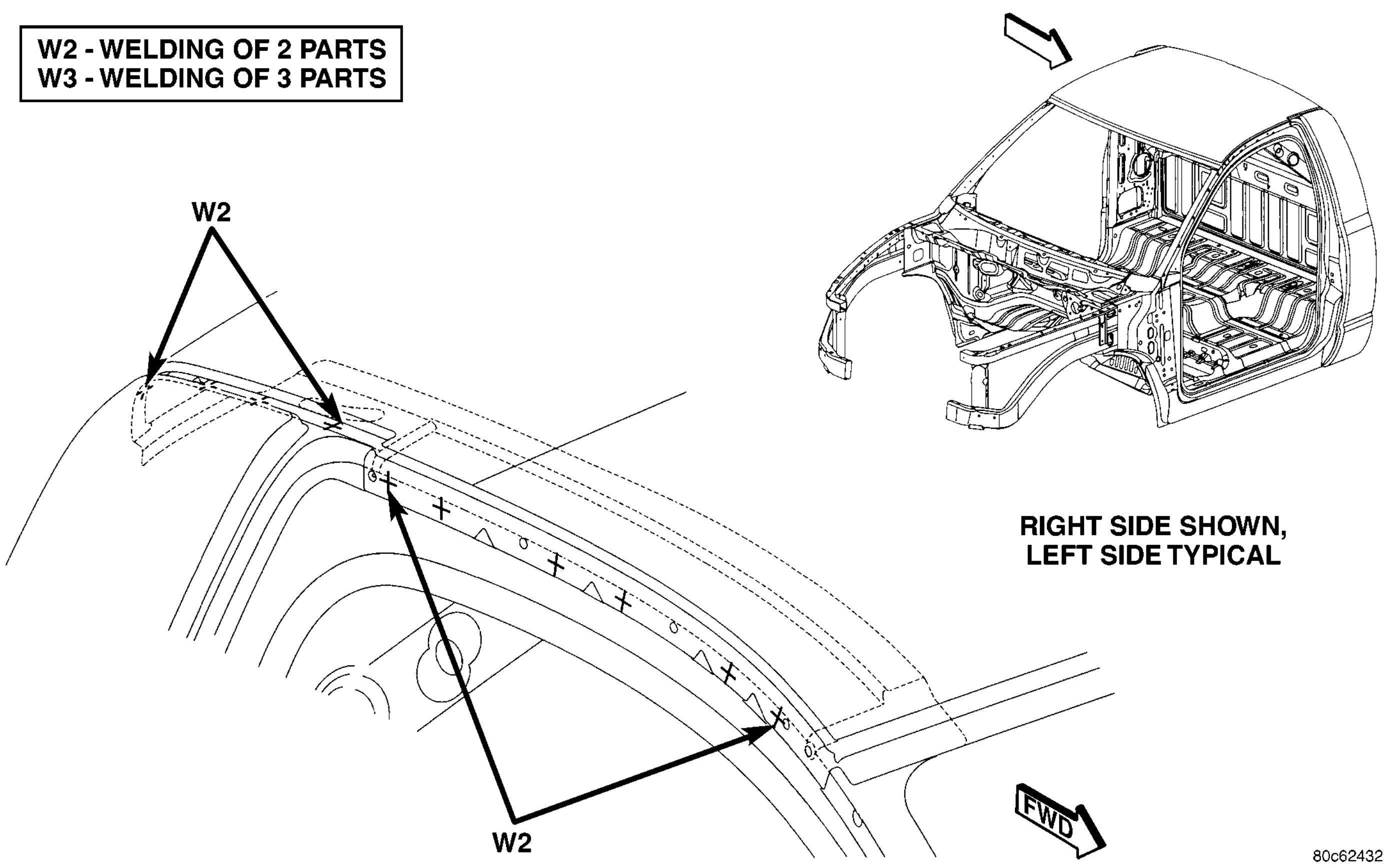


Fig. 79 OUTER ROOF PANEL - STANDARD CAB

WELD LOCATIONS (Continued)

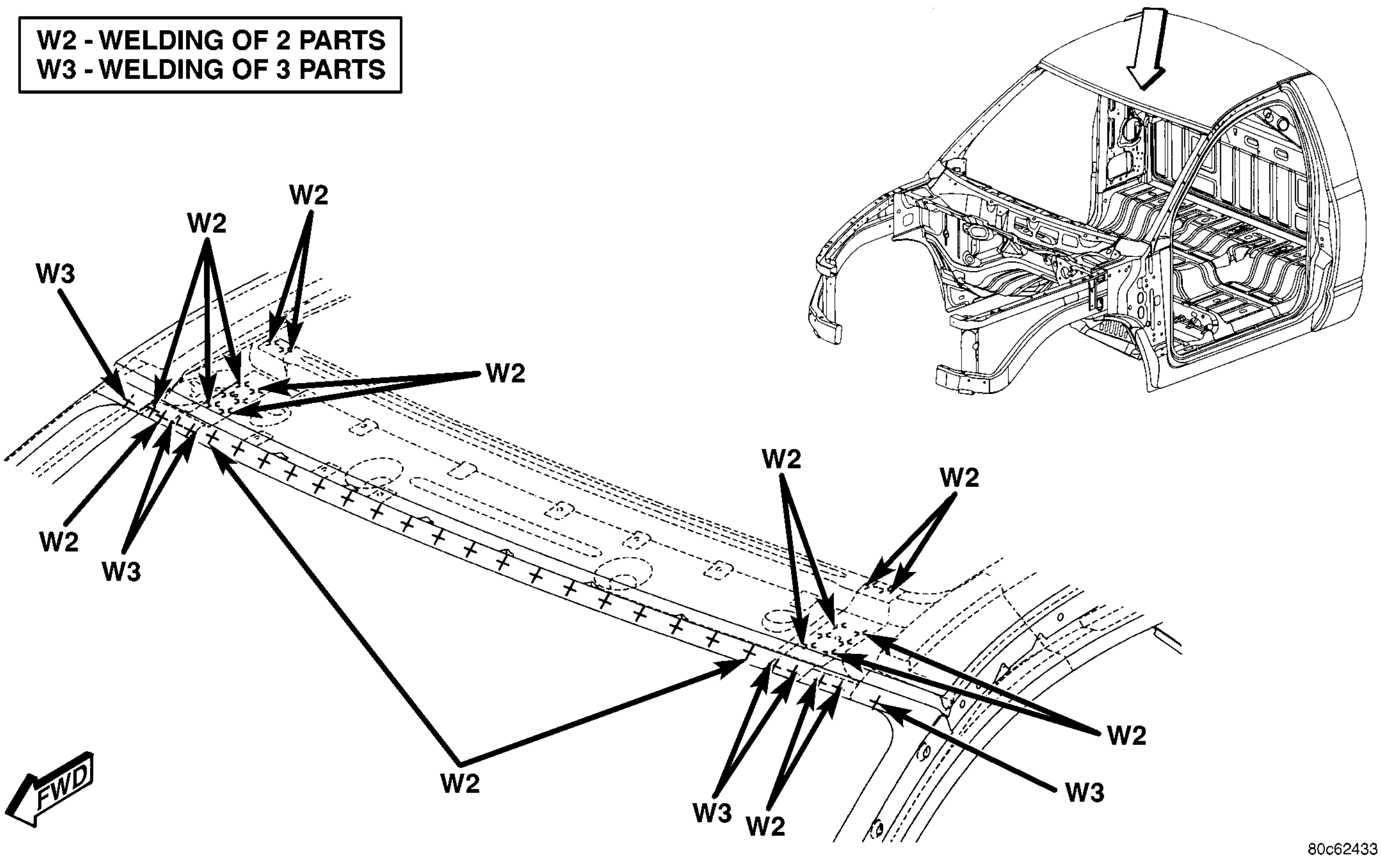


Fig. 80 FRONT ROOF HEADER - STANDARD CAB

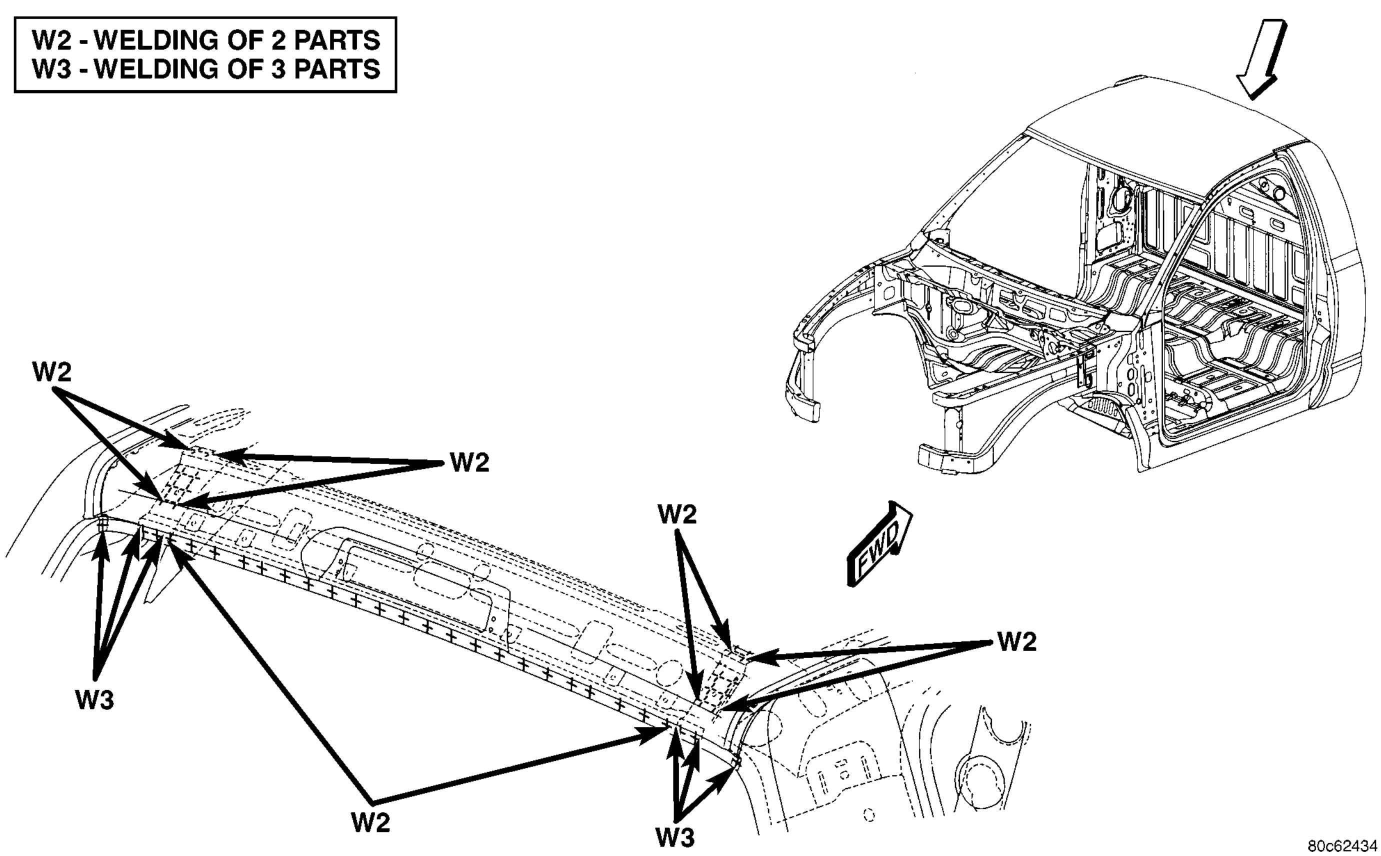


Fig. 81 REAR ROOF HEADER - STANDARD CAB

WELD LOCATIONS (Continued)

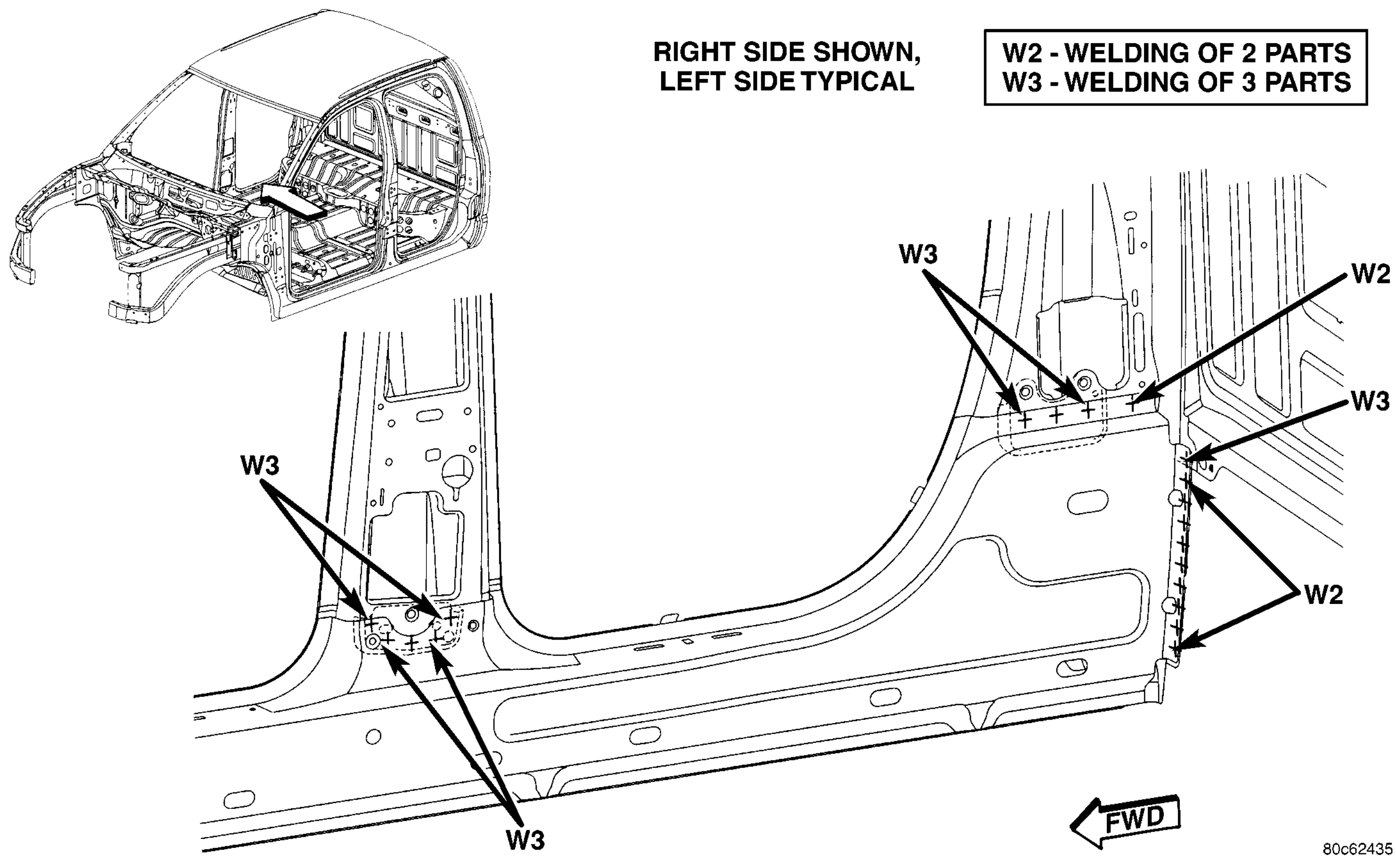


Fig. 82 OUTER BODY SIDE APERTURE - QUAD CAB

WELD LOCATIONS (Continued)

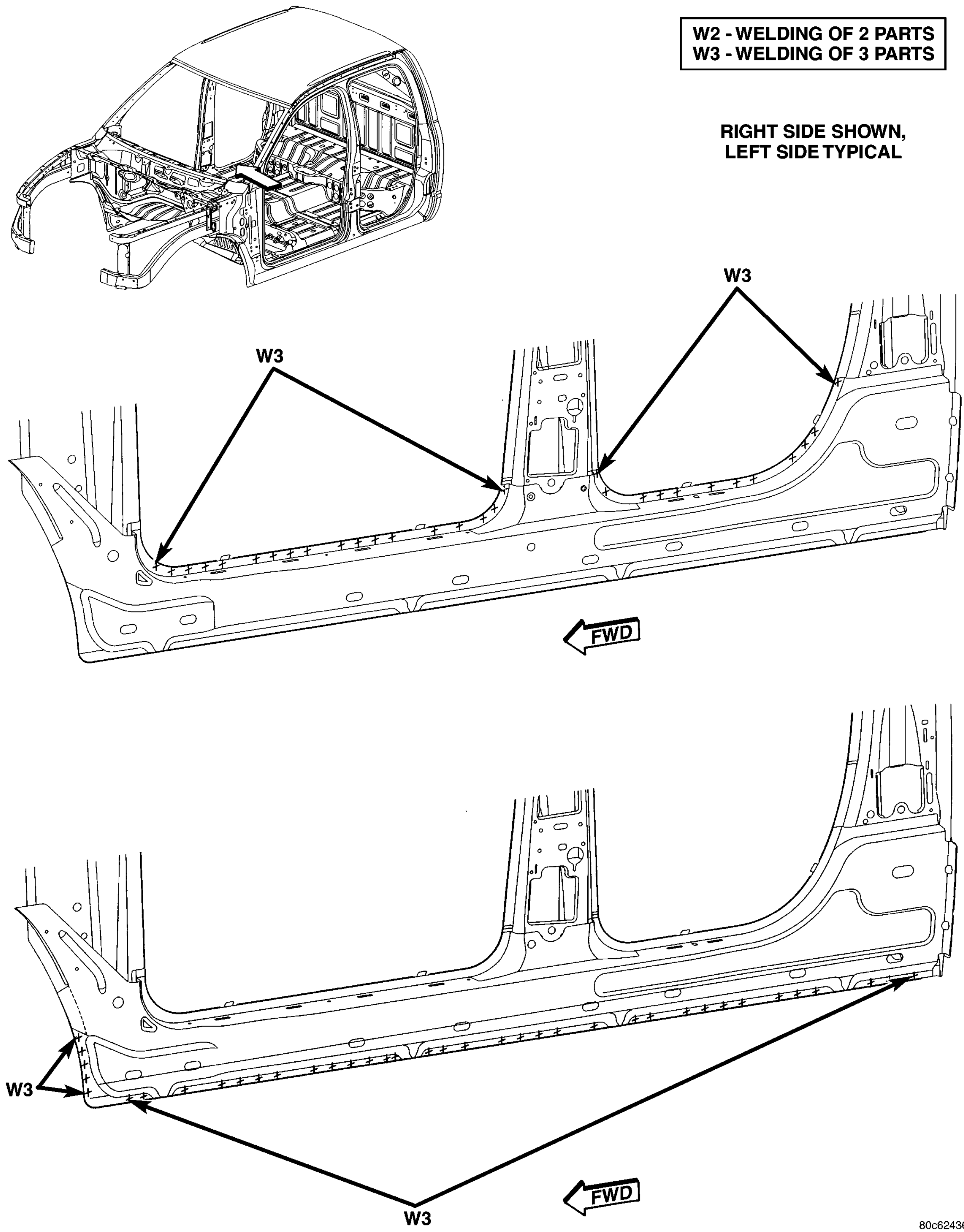


Fig. 83 OUTER BODY SIDE APERTURE- QUAD CAB

WELD LOCATIONS (Continued)

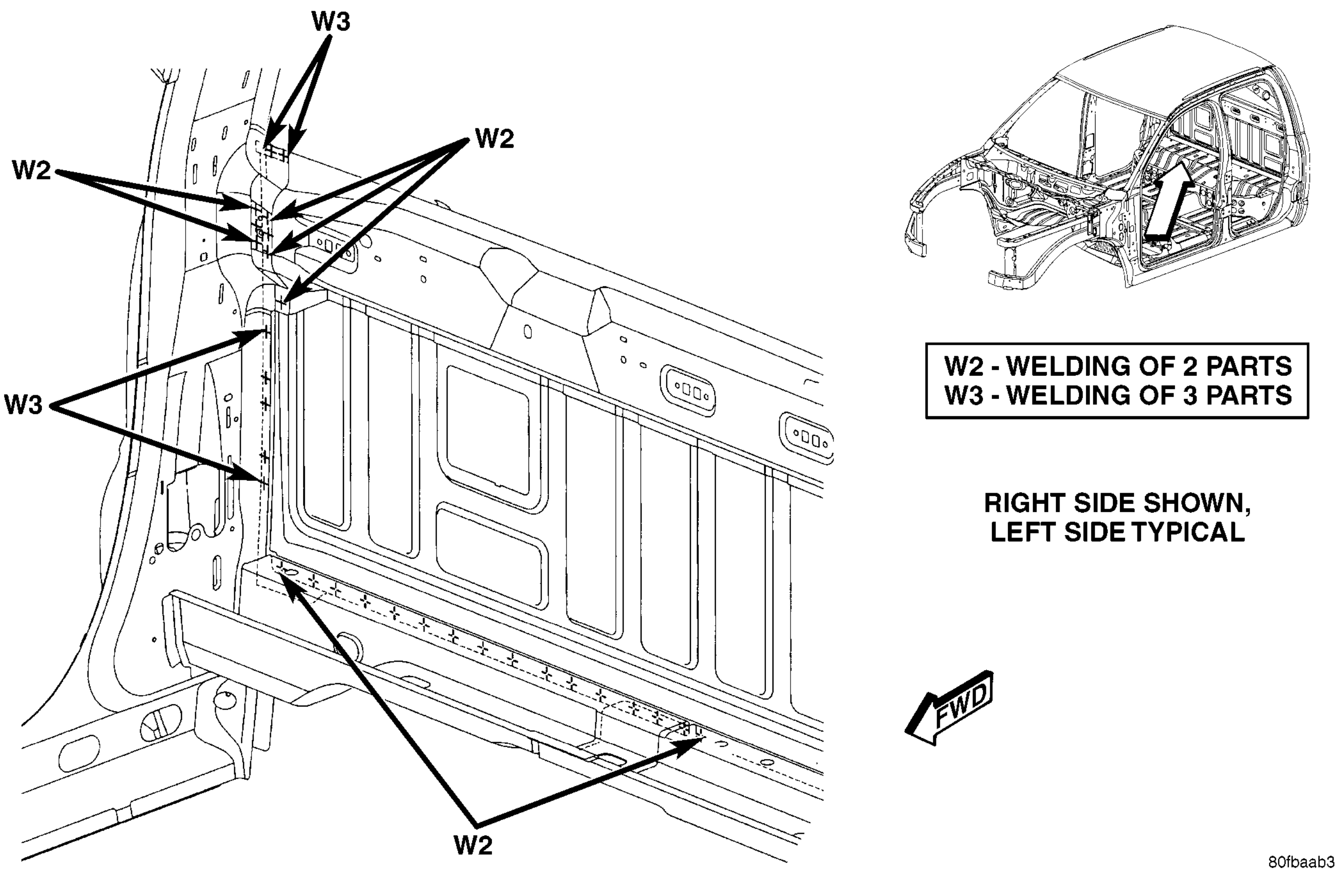


Fig. 84 REAR FLOOR CROSSMEMBER - QUAD CAB

WELD LOCATIONS (Continued)

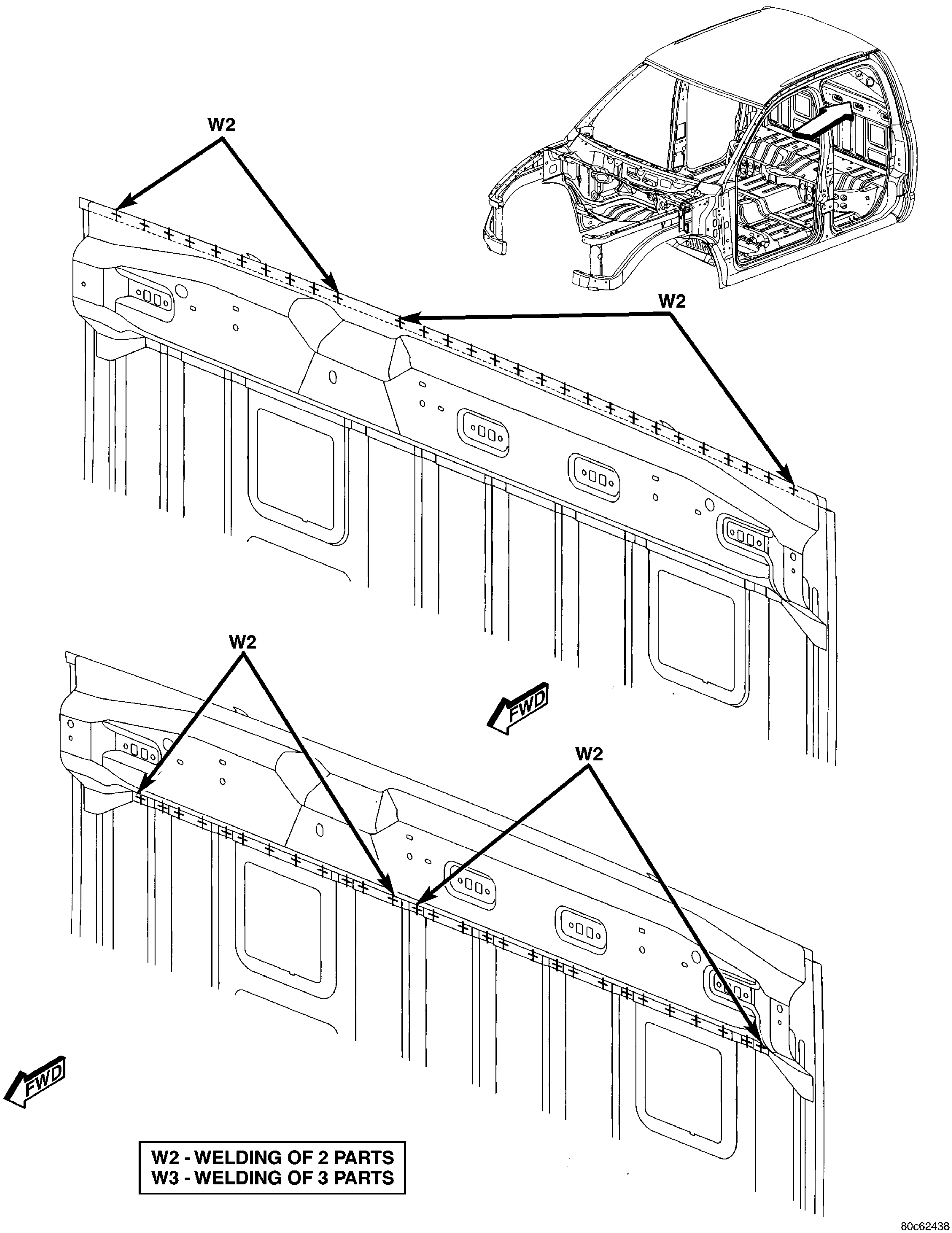


Fig. 85 CAB BACK REINFORCEMENT- QUAD CAB

WELD LOCATIONS (Continued)

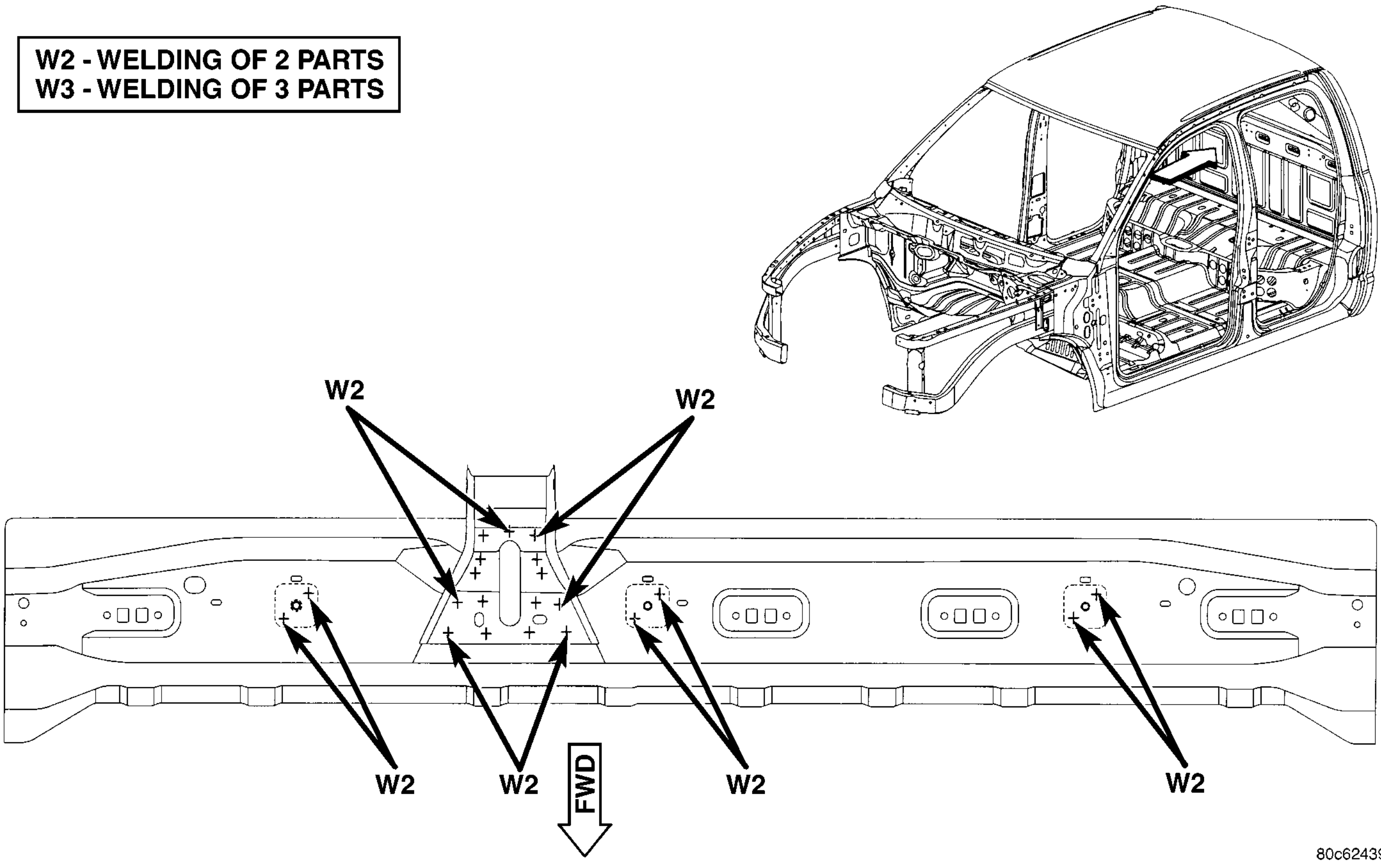


Fig. 86 CENTER SHOULDER BELT REINFORCEMENT- QUAD CAB

WELD LOCATIONS (Continued)

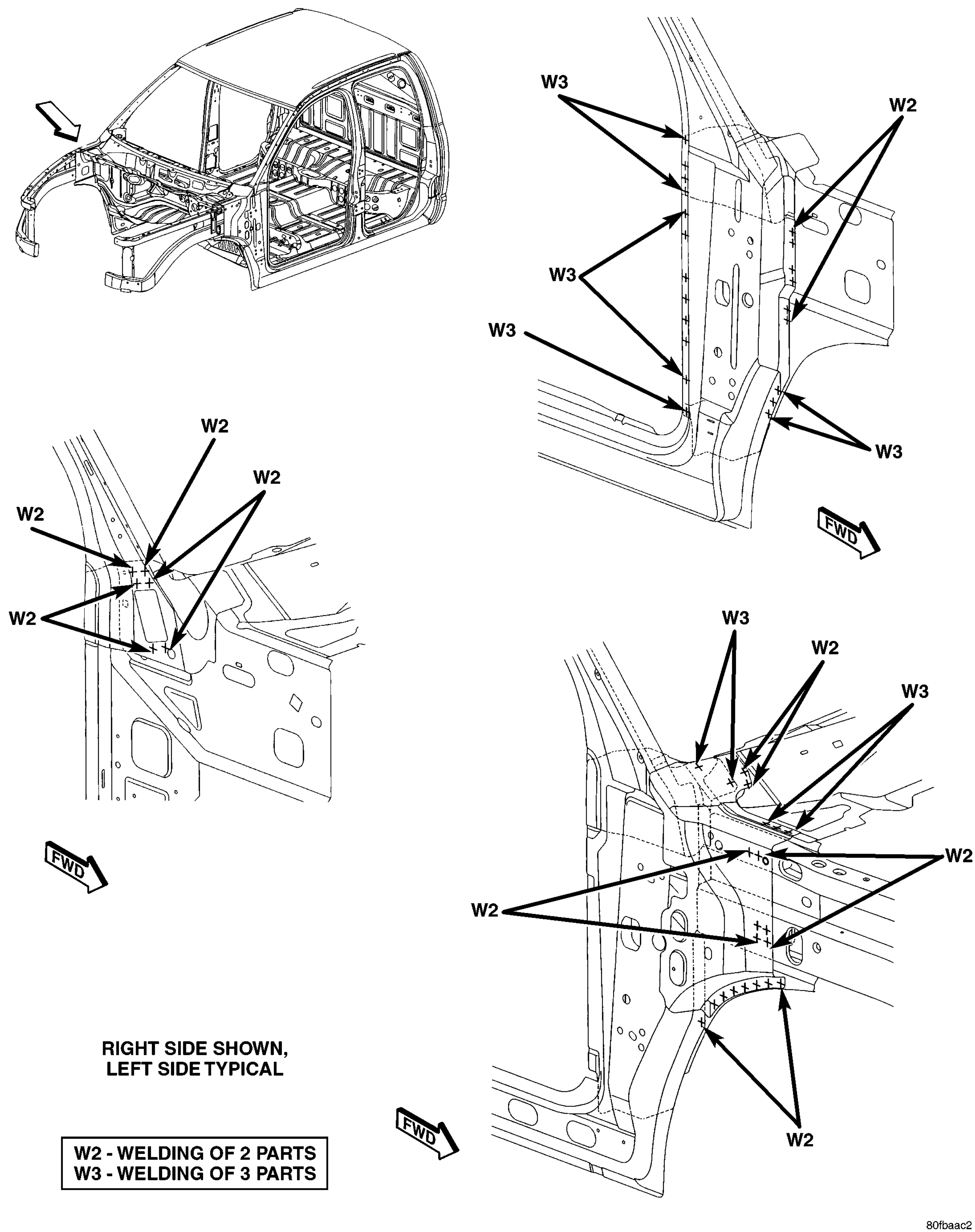


Fig. 87 A-PILLAR REINFORCEMENT - QUAD CAB

WELD LOCATIONS (Continued)

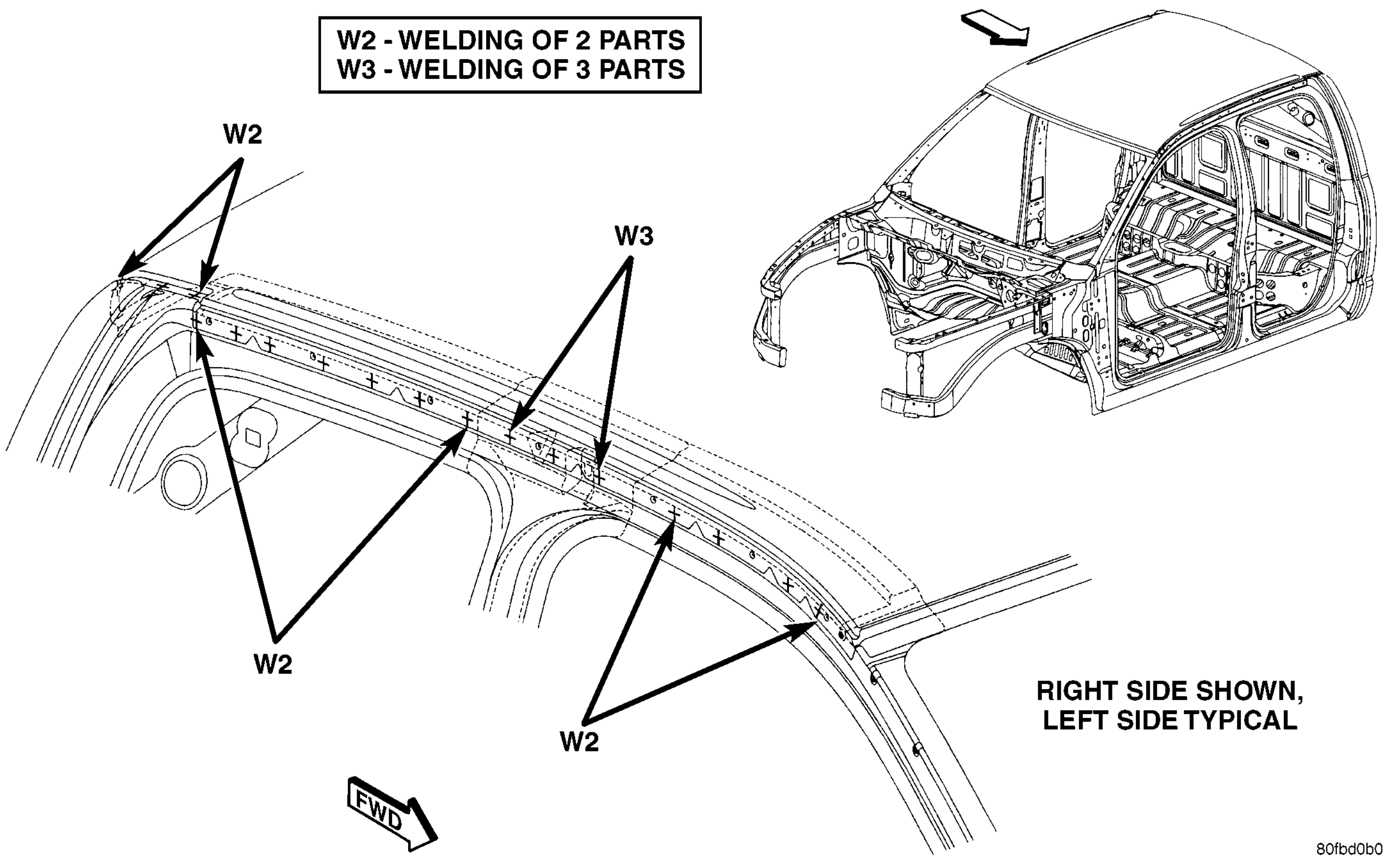


Fig. 88 B-PILLAR REINFORCEMENT - QUAD CAB

WELD LOCATIONS (Continued)

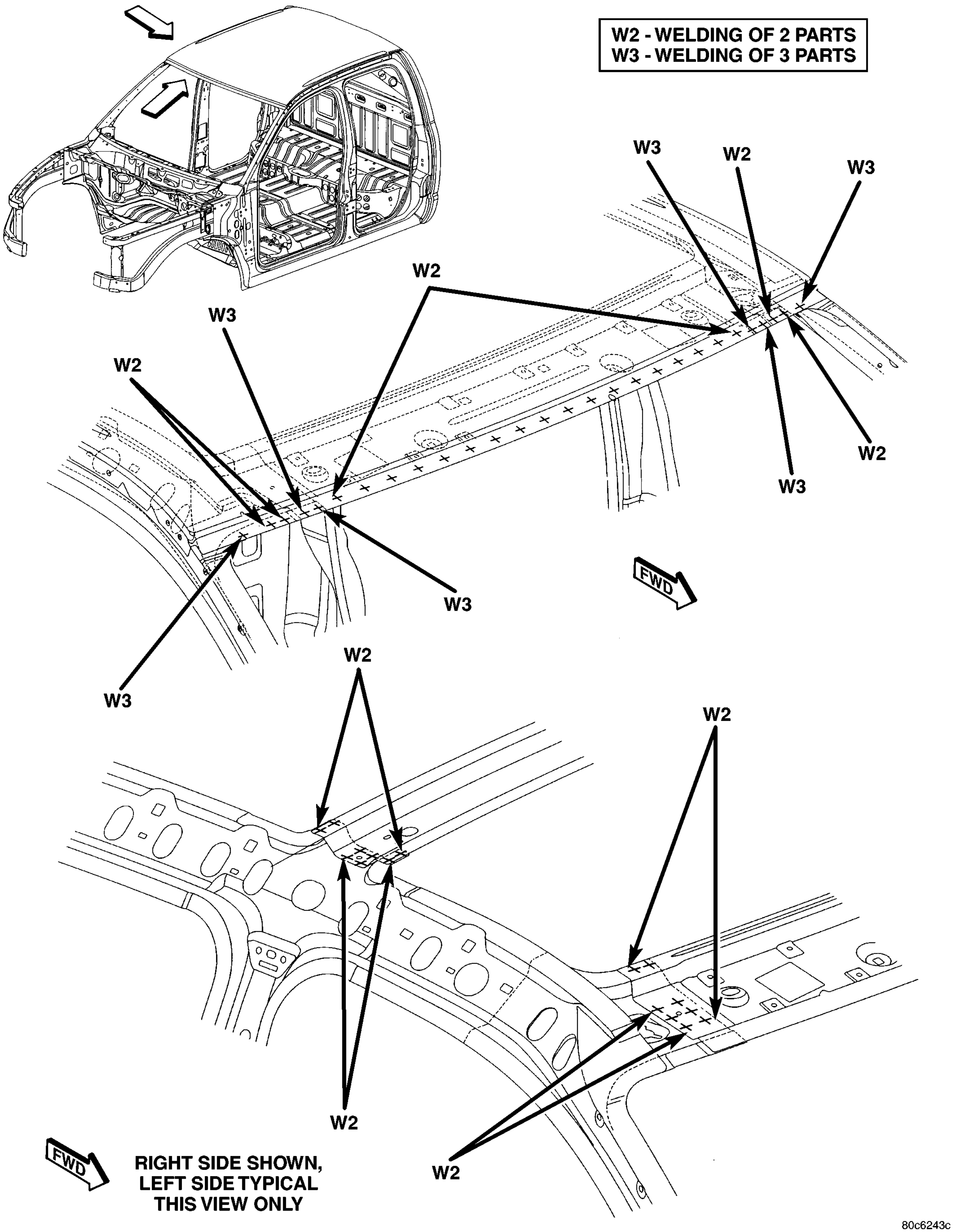


Fig. 89 FRONT ROOF HEADER- QUAD CAB

WELD LOCATIONS (Continued)

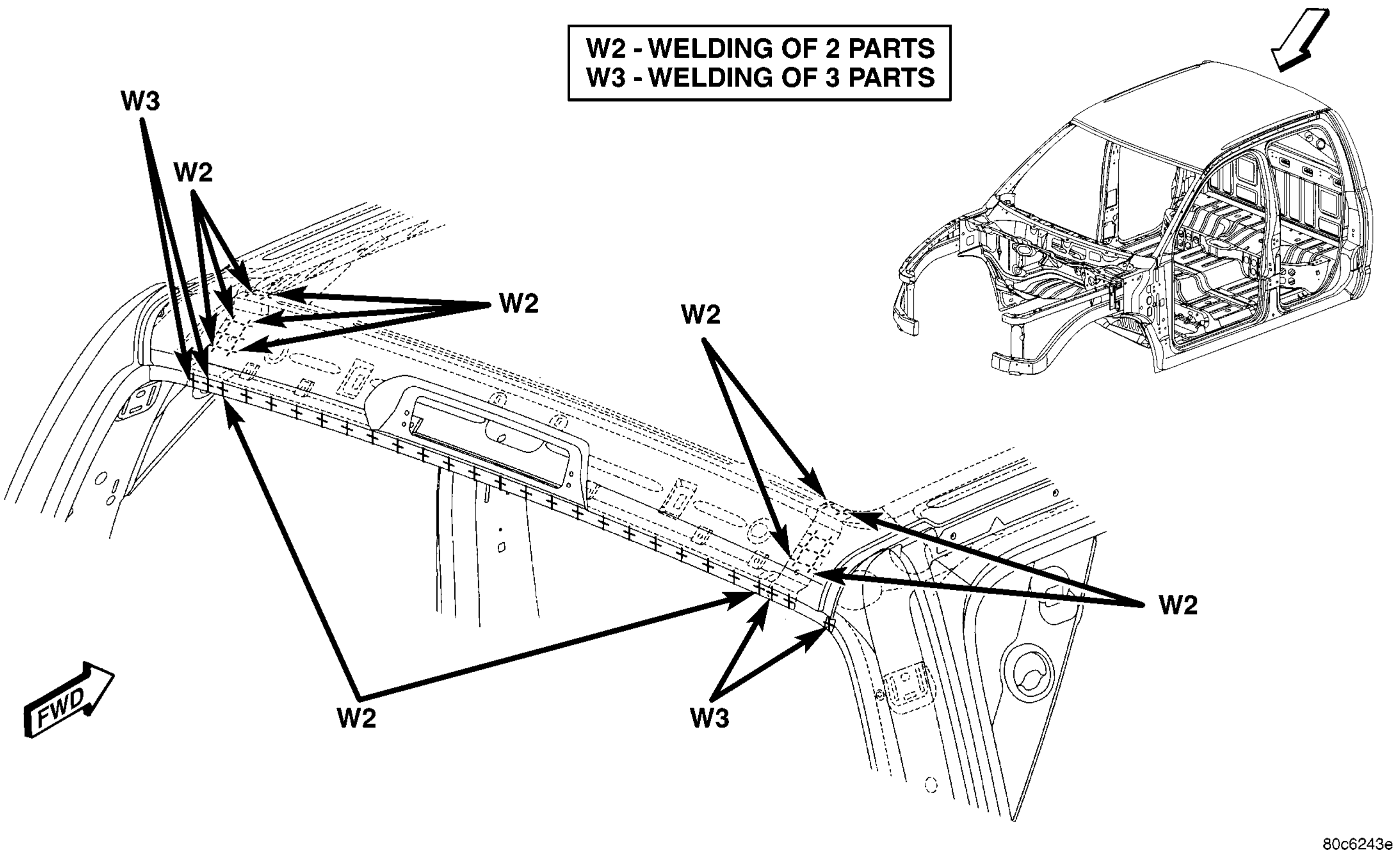


Fig. 90 INNER BODY SIDE APERTURE- QUAD CAB

WELD LOCATIONS (Continued)

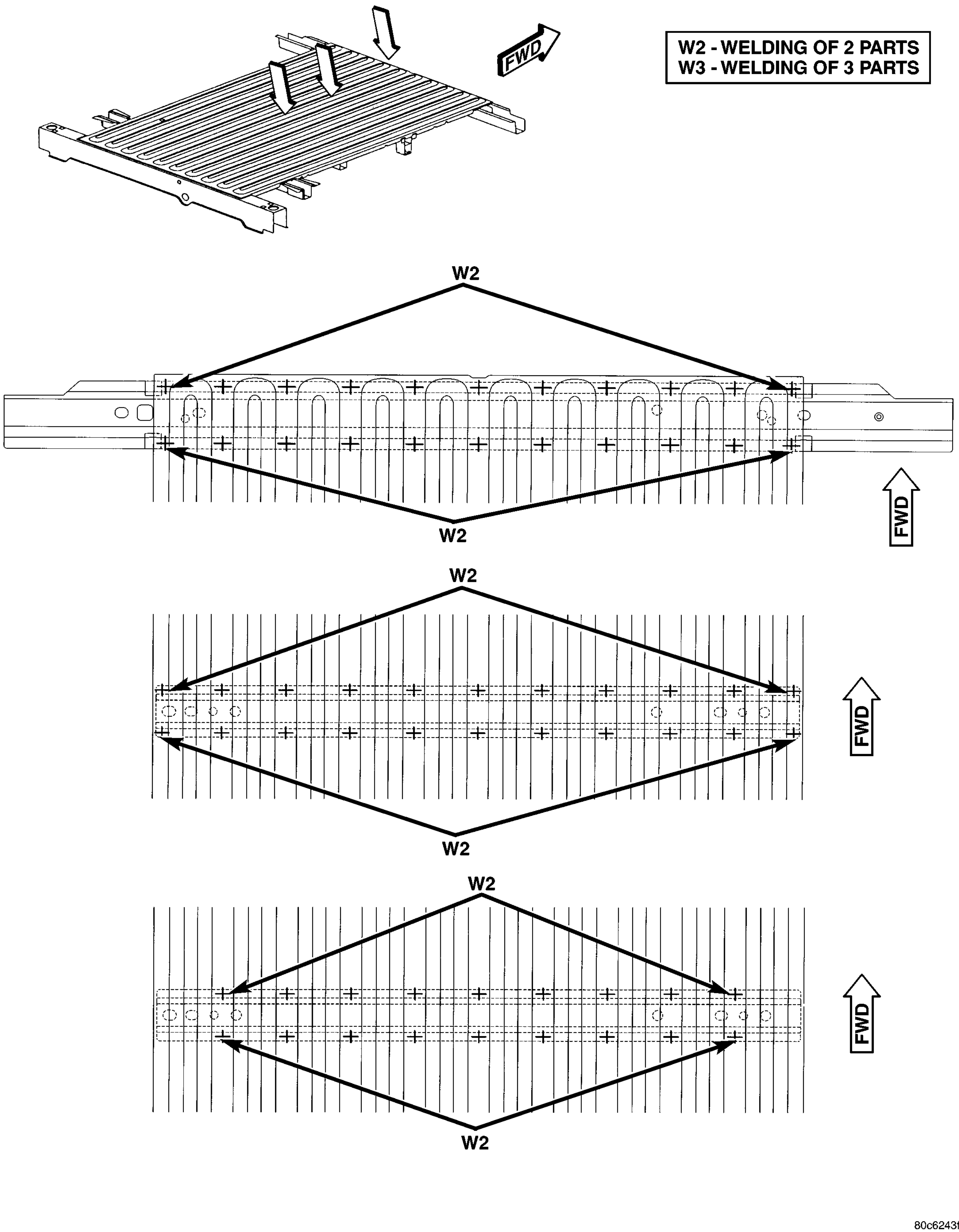
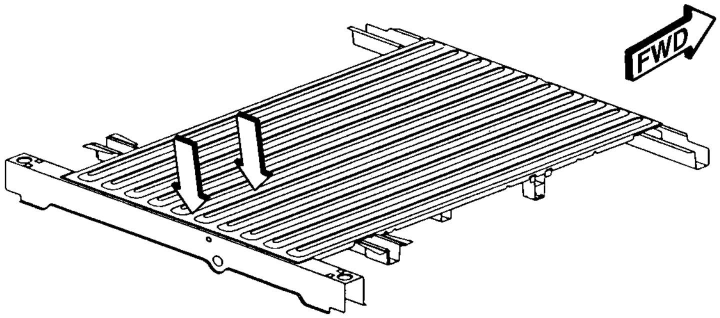
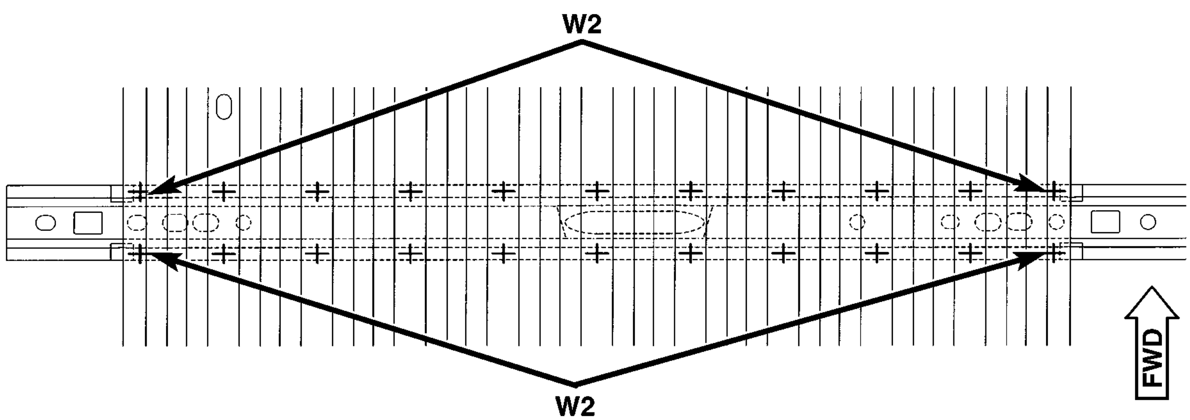


Fig. 91 FRONT CROSSMEMBER - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)



W2 - WELDING OF 2 PARTS
W3 - WELDING OF 3 PARTS



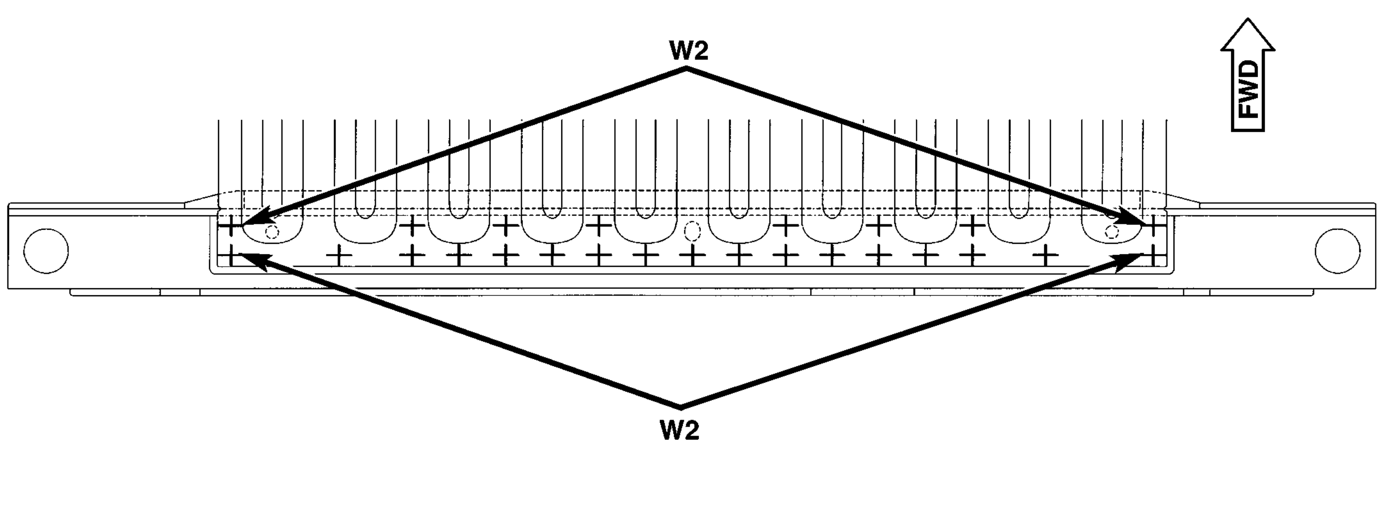


Fig. 92 LONG CROSSMEMBER - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

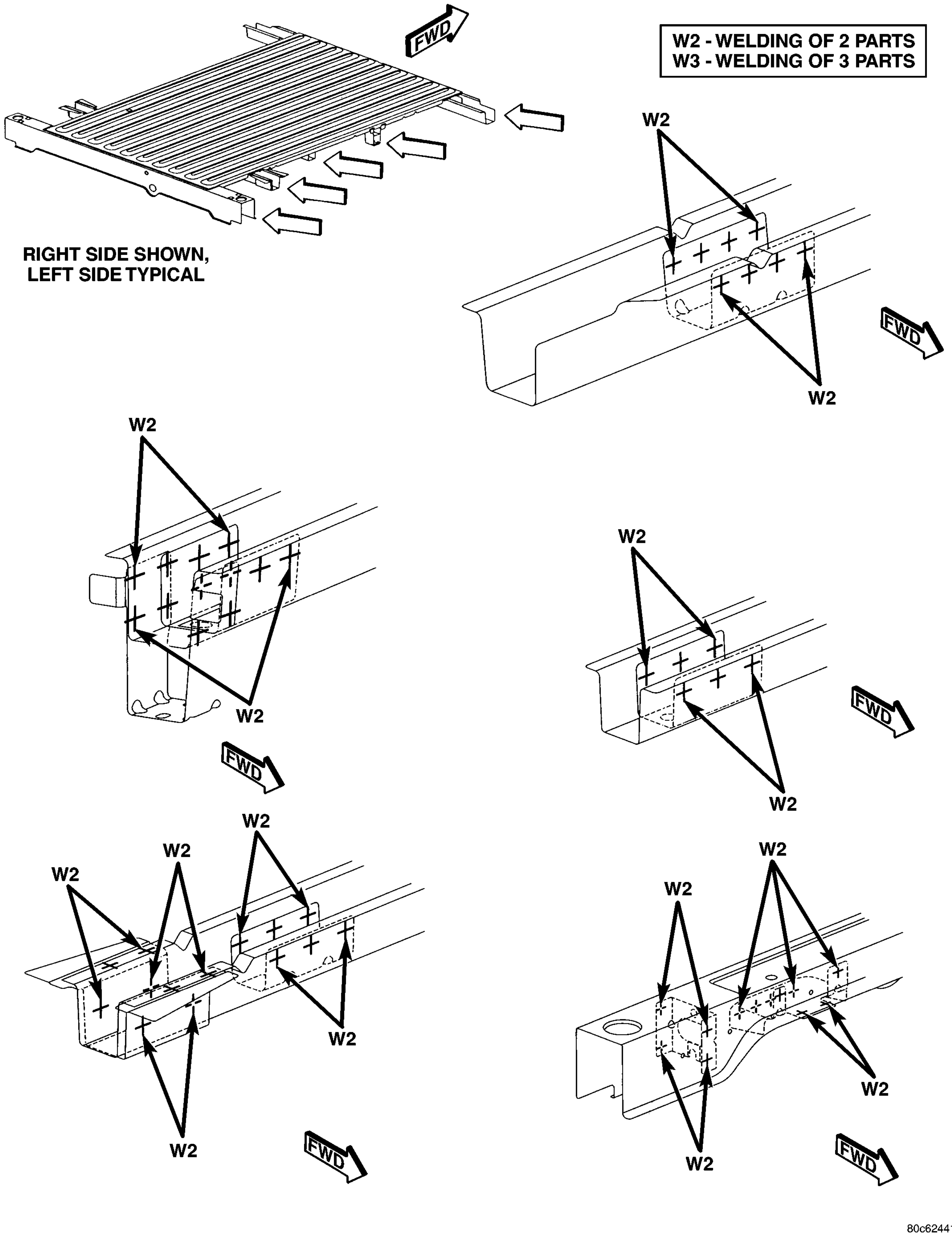


Fig. 93 TAPPING PLATES - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

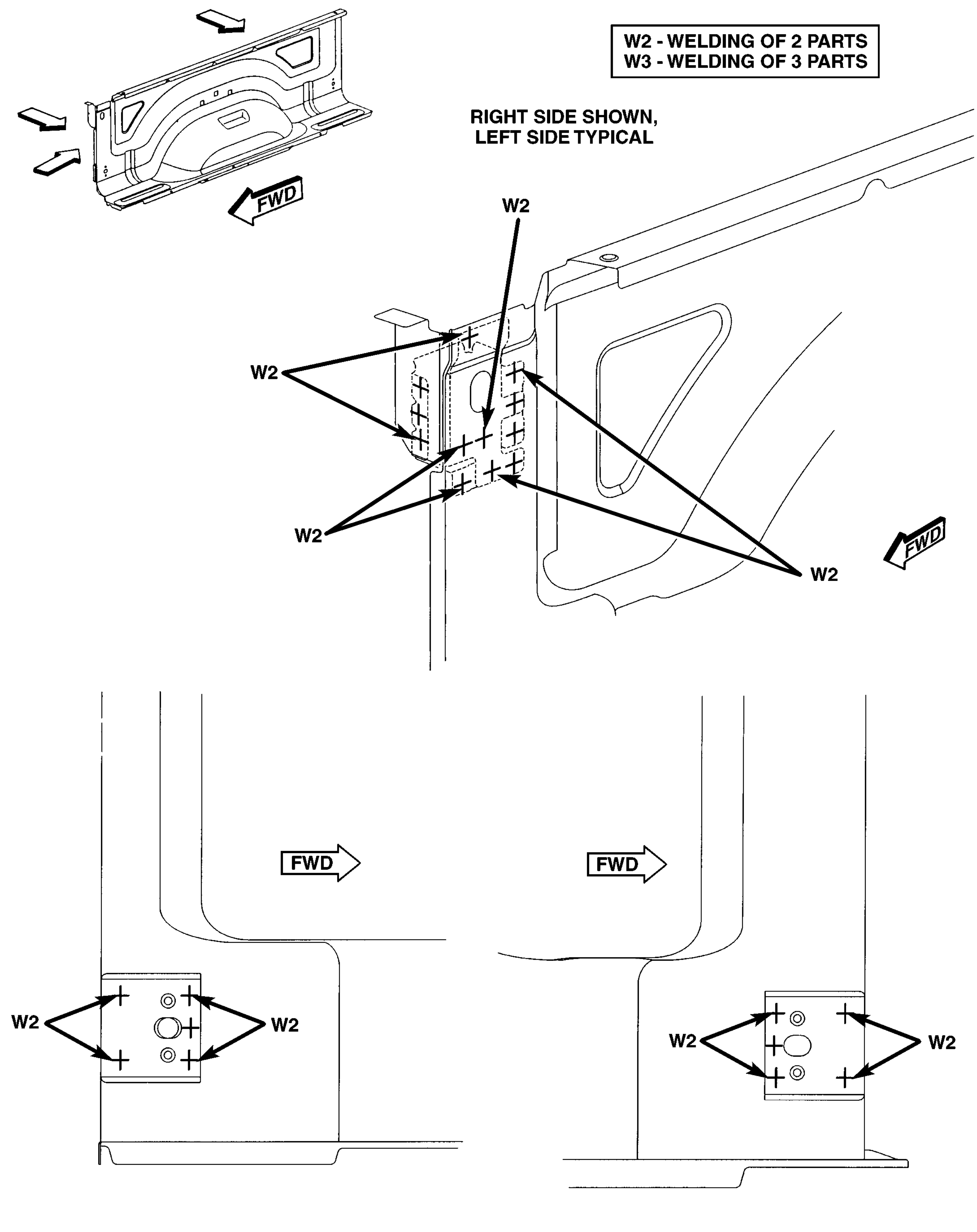


Fig. 94 STAKE POCKET REINFORCEMENTS - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

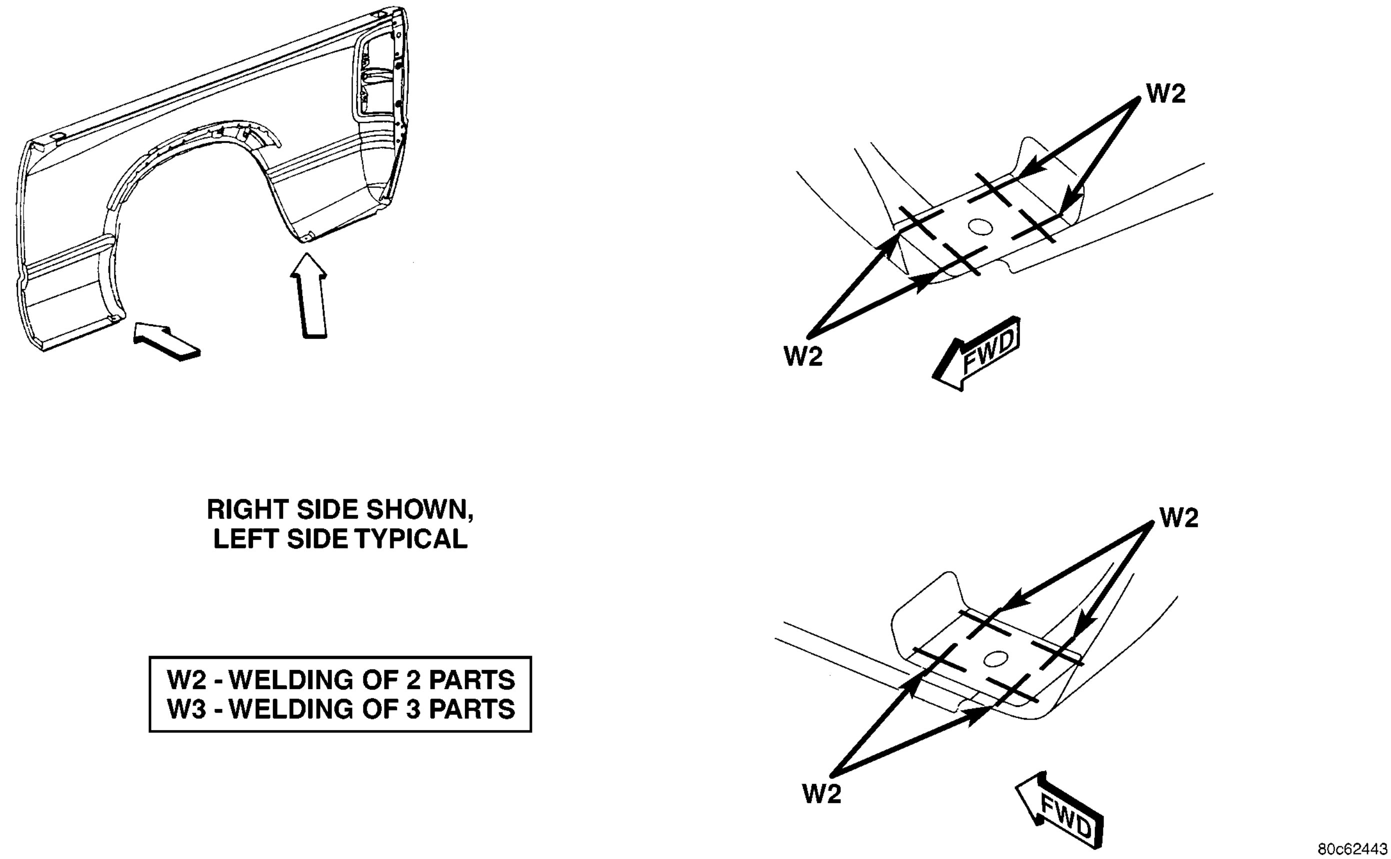


Fig. 95 OUTER BOX SIDE REINFORCEMENT BRACES - SHORT CARGO BOX ONLY

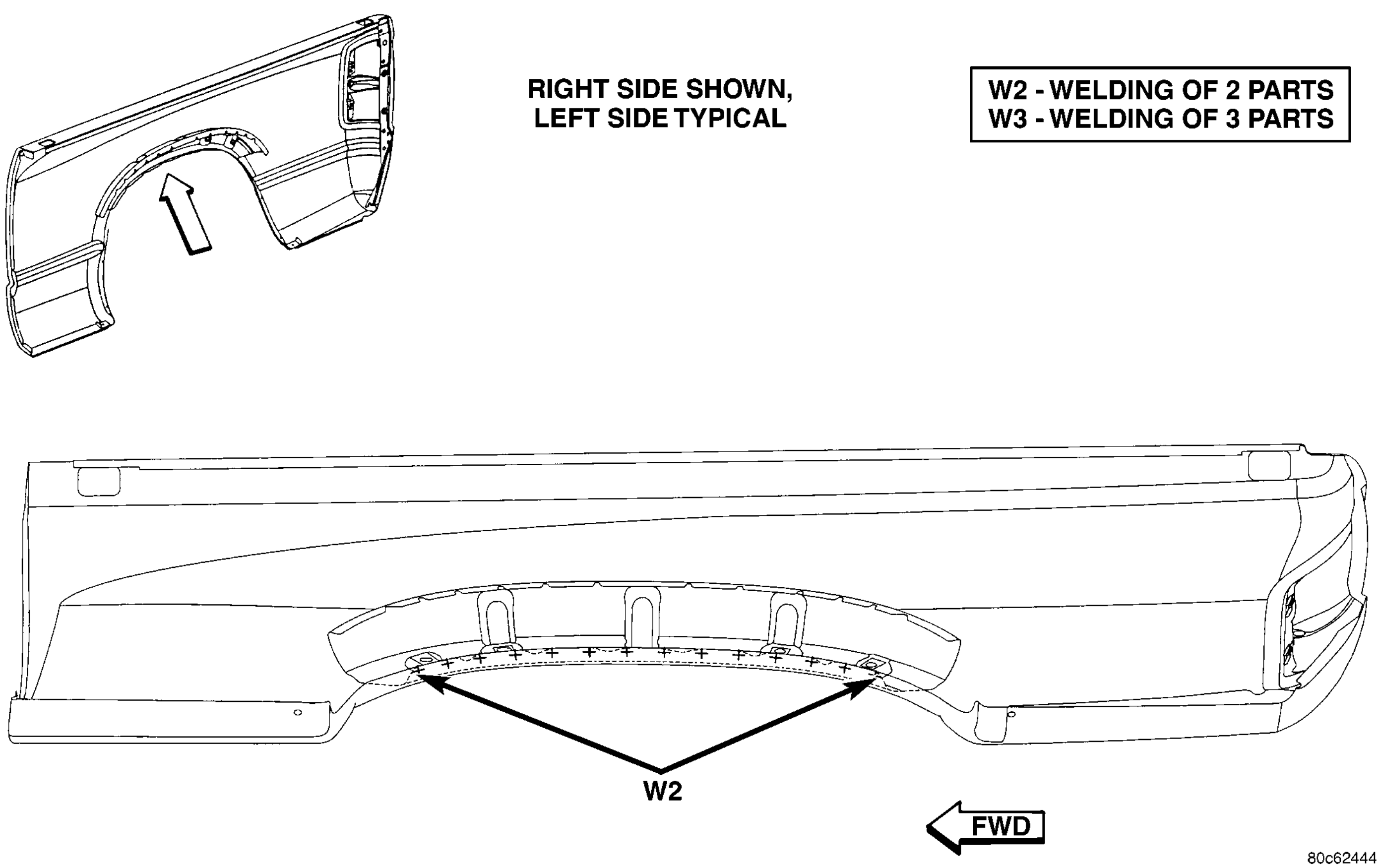


Fig. 96 OUTER WHEELHOUSE - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

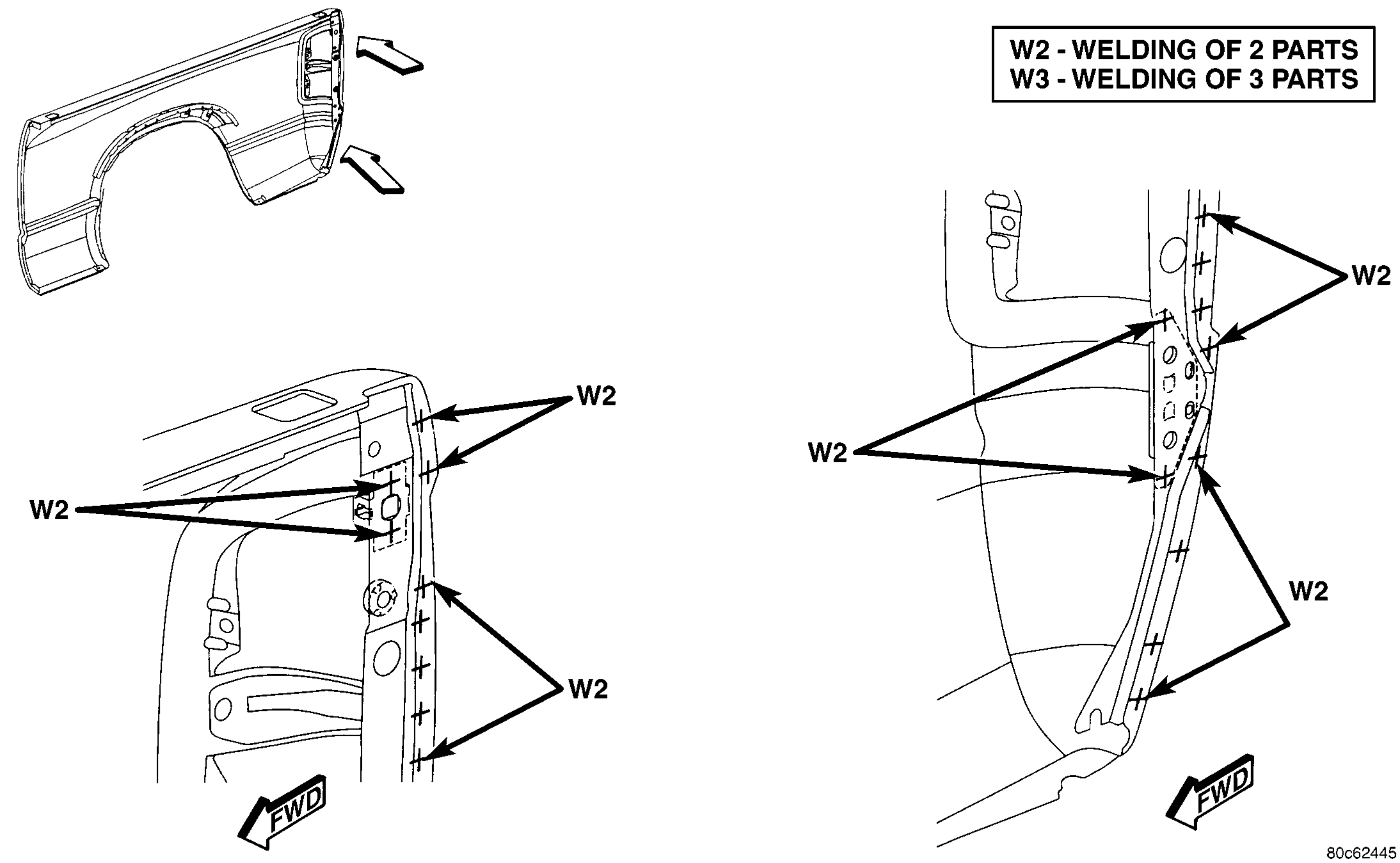


Fig. 97 WELD NUT - SHORT CARGO BOX ONLY - SHORT CARGO BOX ONLY

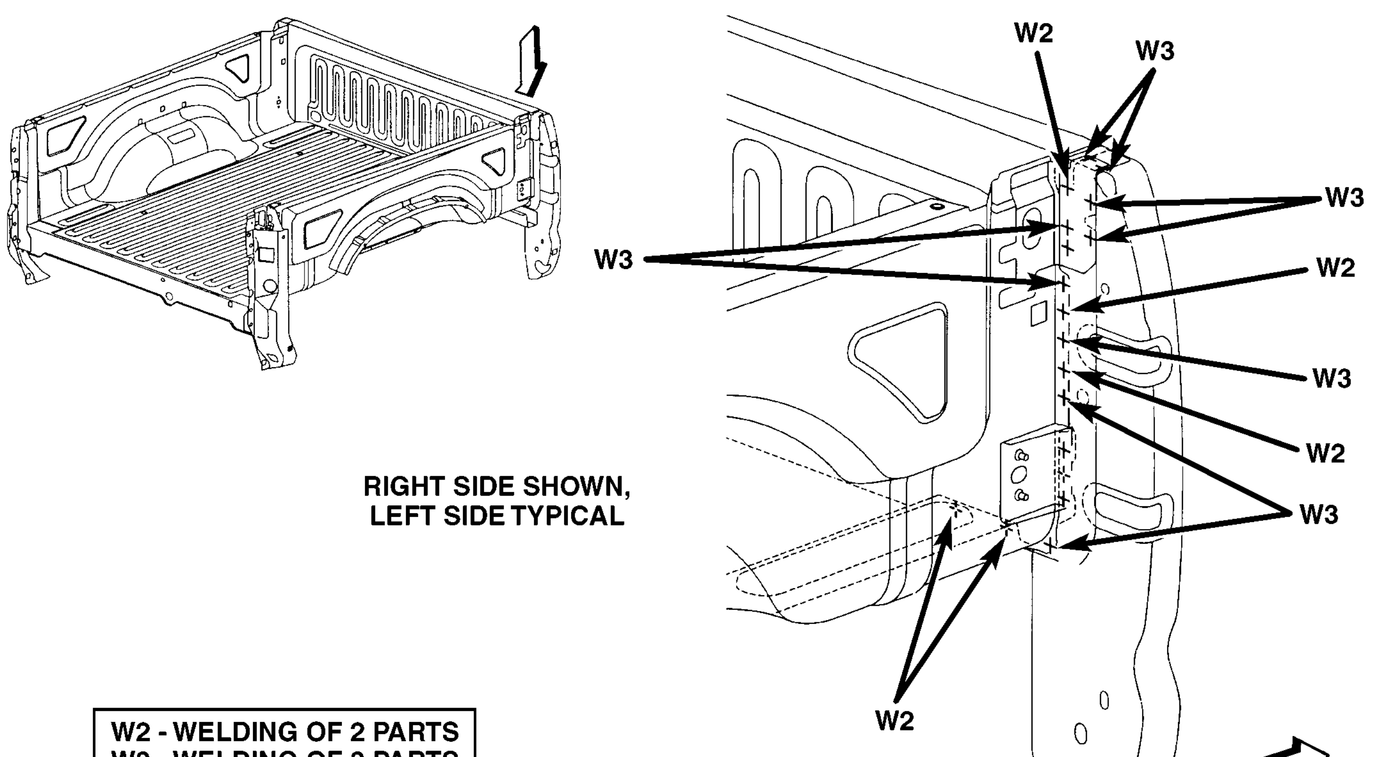


Fig. 98 FRONT BOX PANEL - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

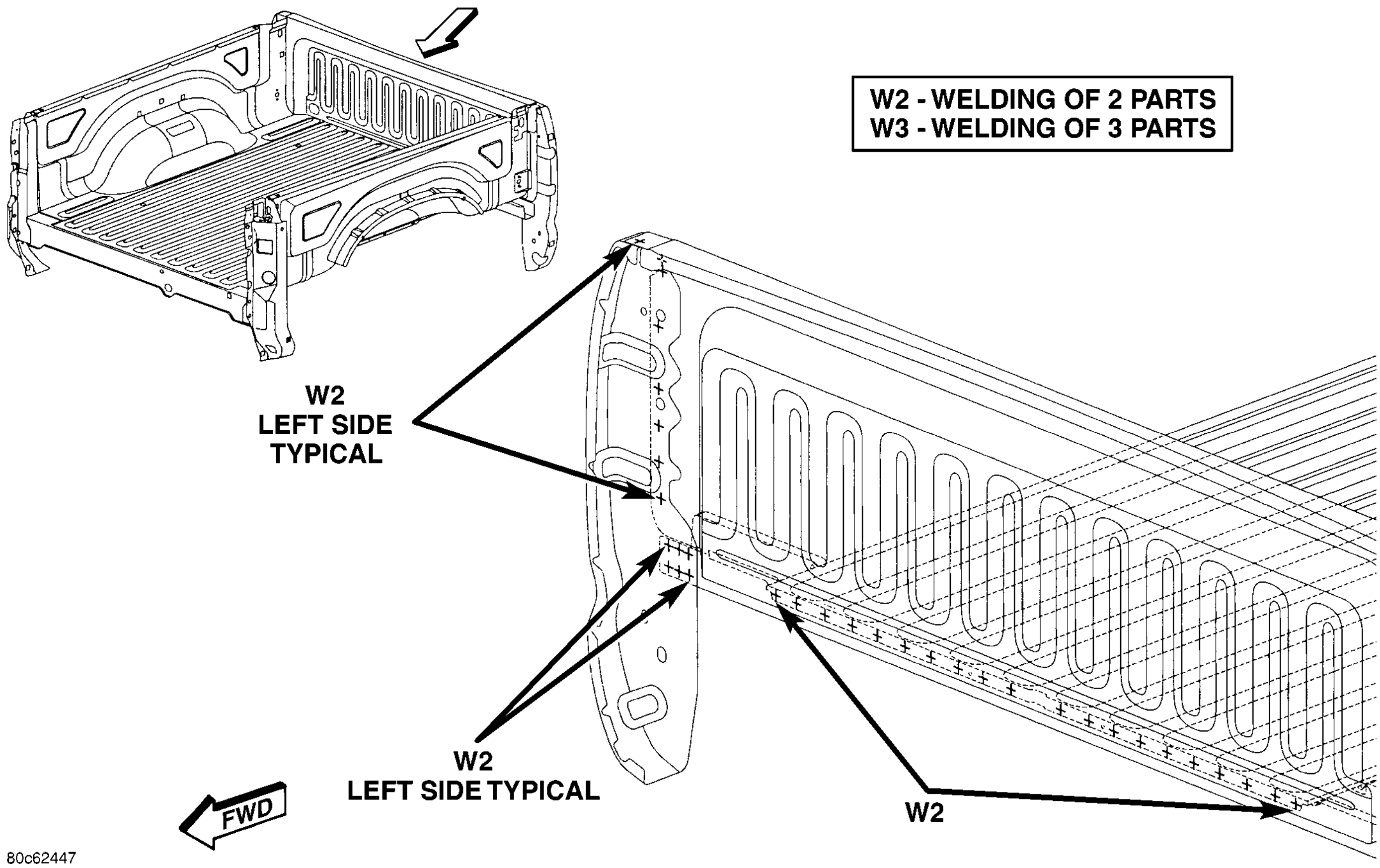


Fig. 99 FRONT CROSSMEMBER - SHORT CARGO BOX ONLY

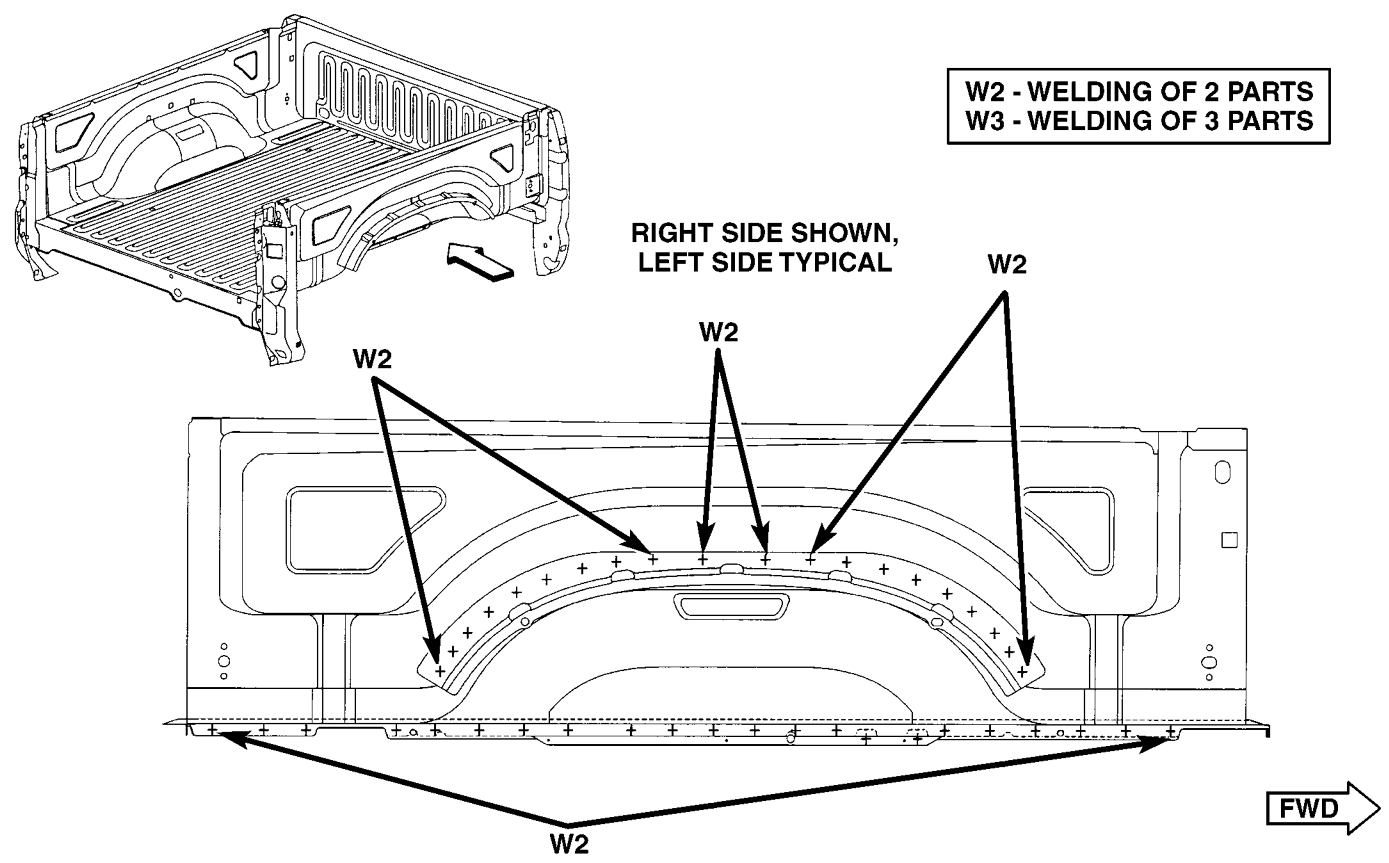


Fig. 100 BOX FLOOR PANEL - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

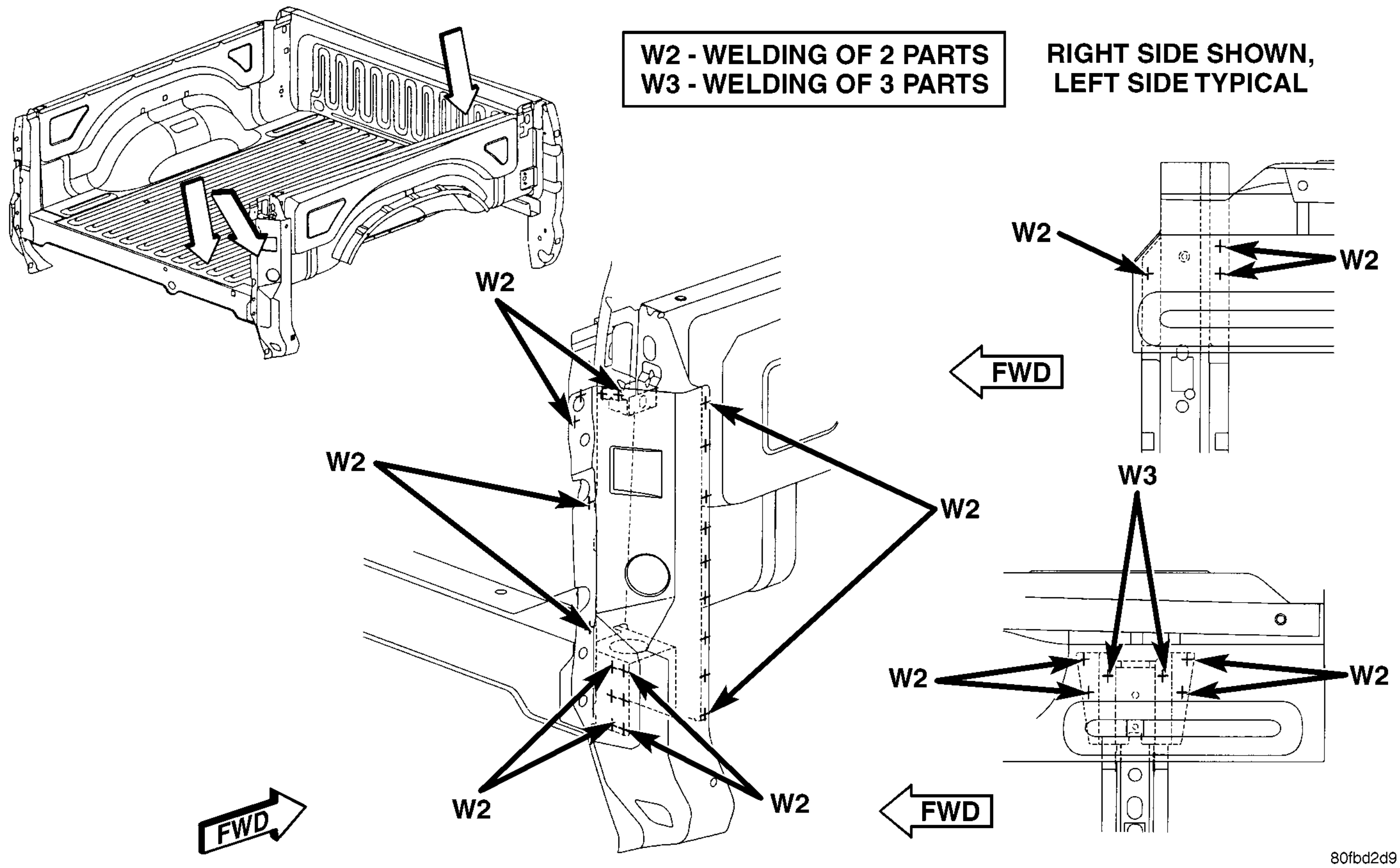


Fig. 101 FRONT CROSSMEMBER - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

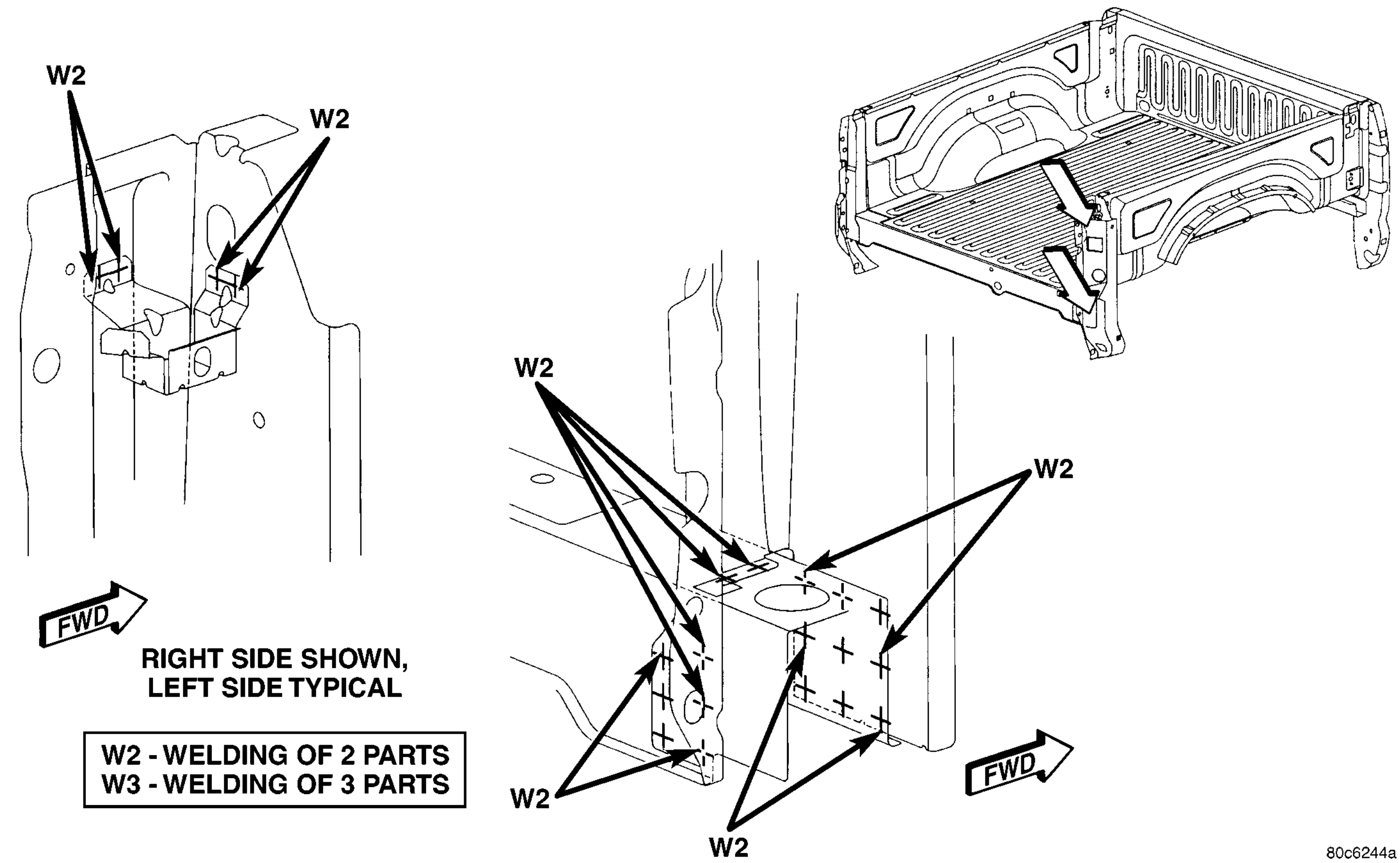


Fig. 102 STAKE POCKET REINFORCEMENT - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

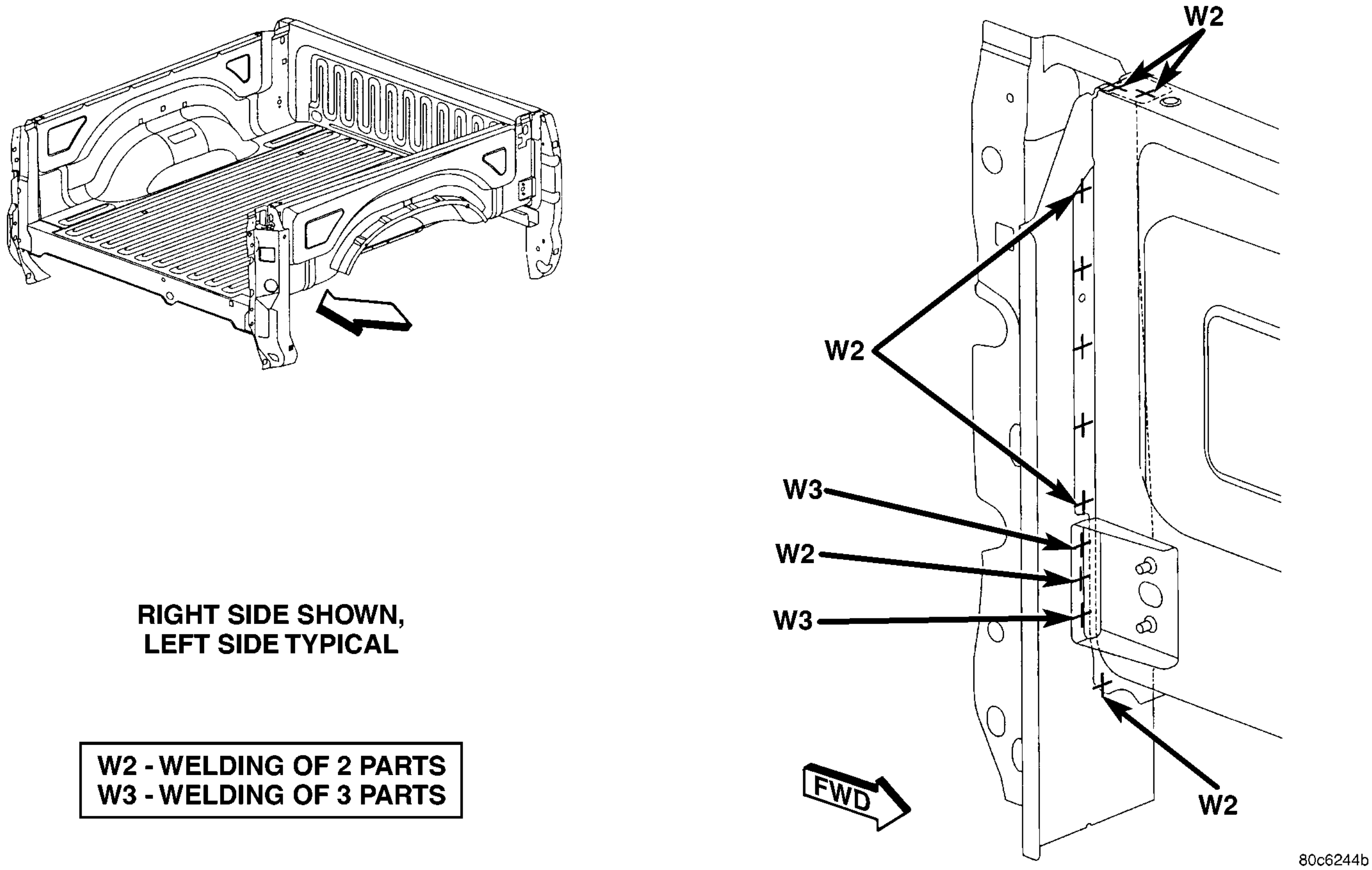


Fig. 103 INNER TAILGATE PILLAR PANEL - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

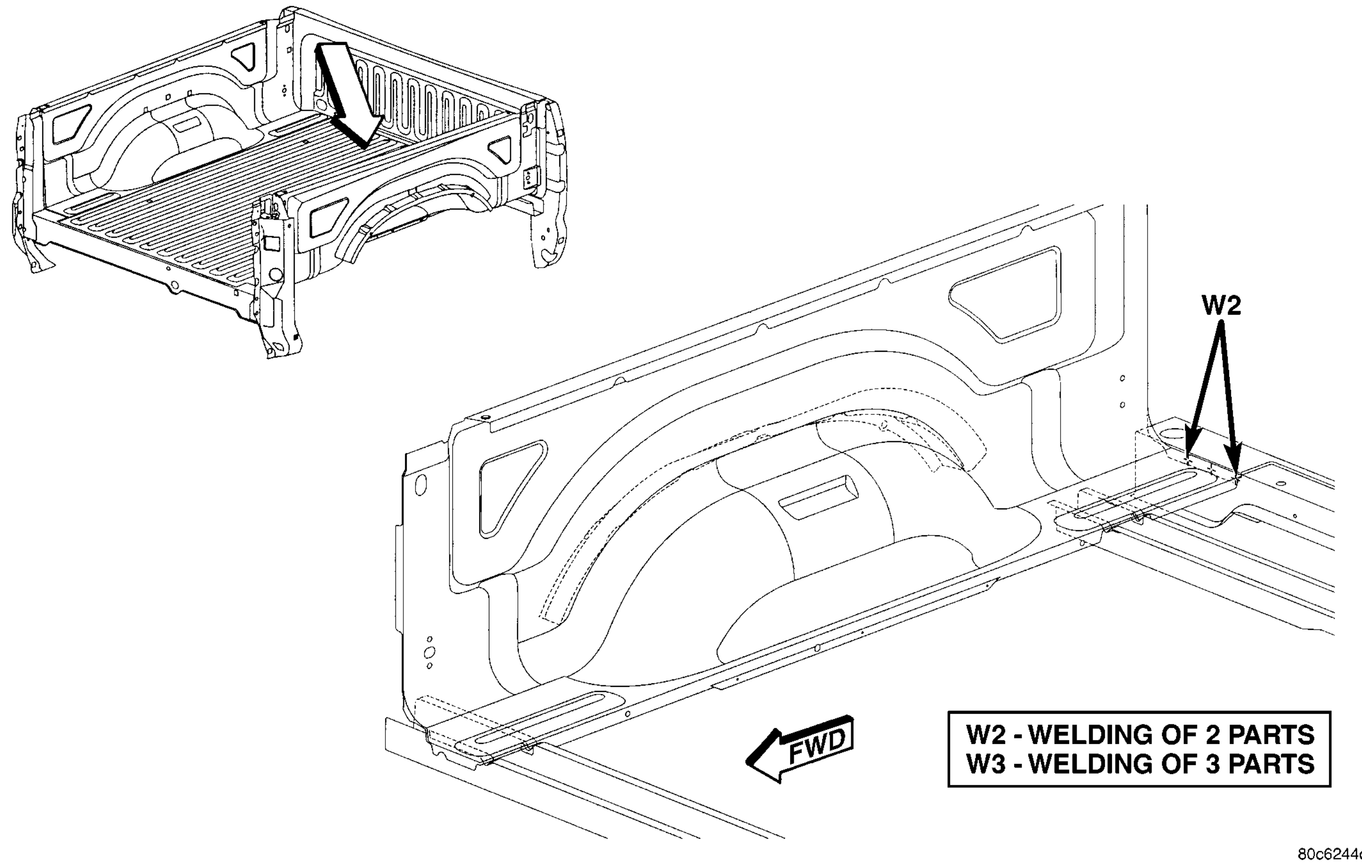


Fig. 104 BOX FLOOR SILL CROSSMEMBER - SHORT CARGO BOX ONLY

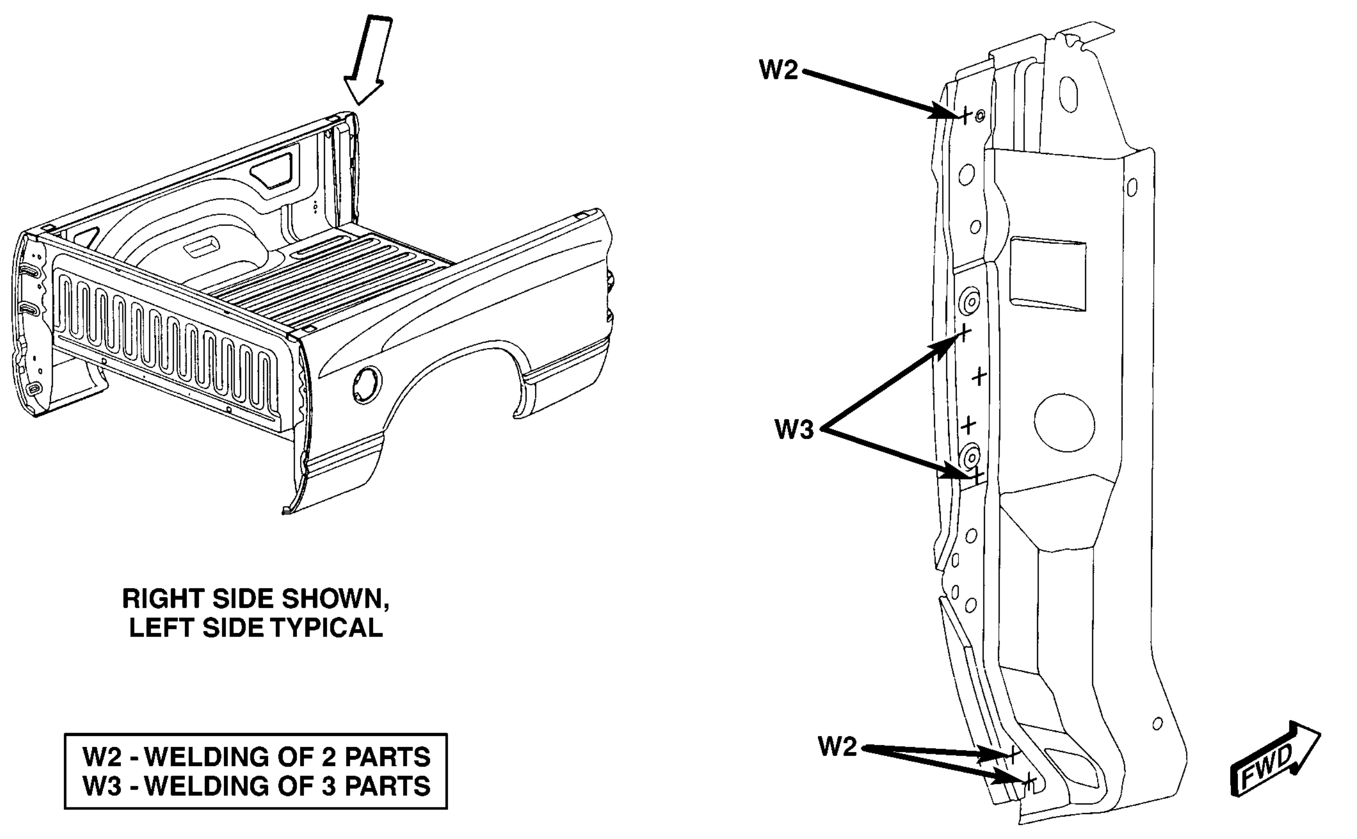


Fig. 105 INNER TAILGATE PILLAR - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

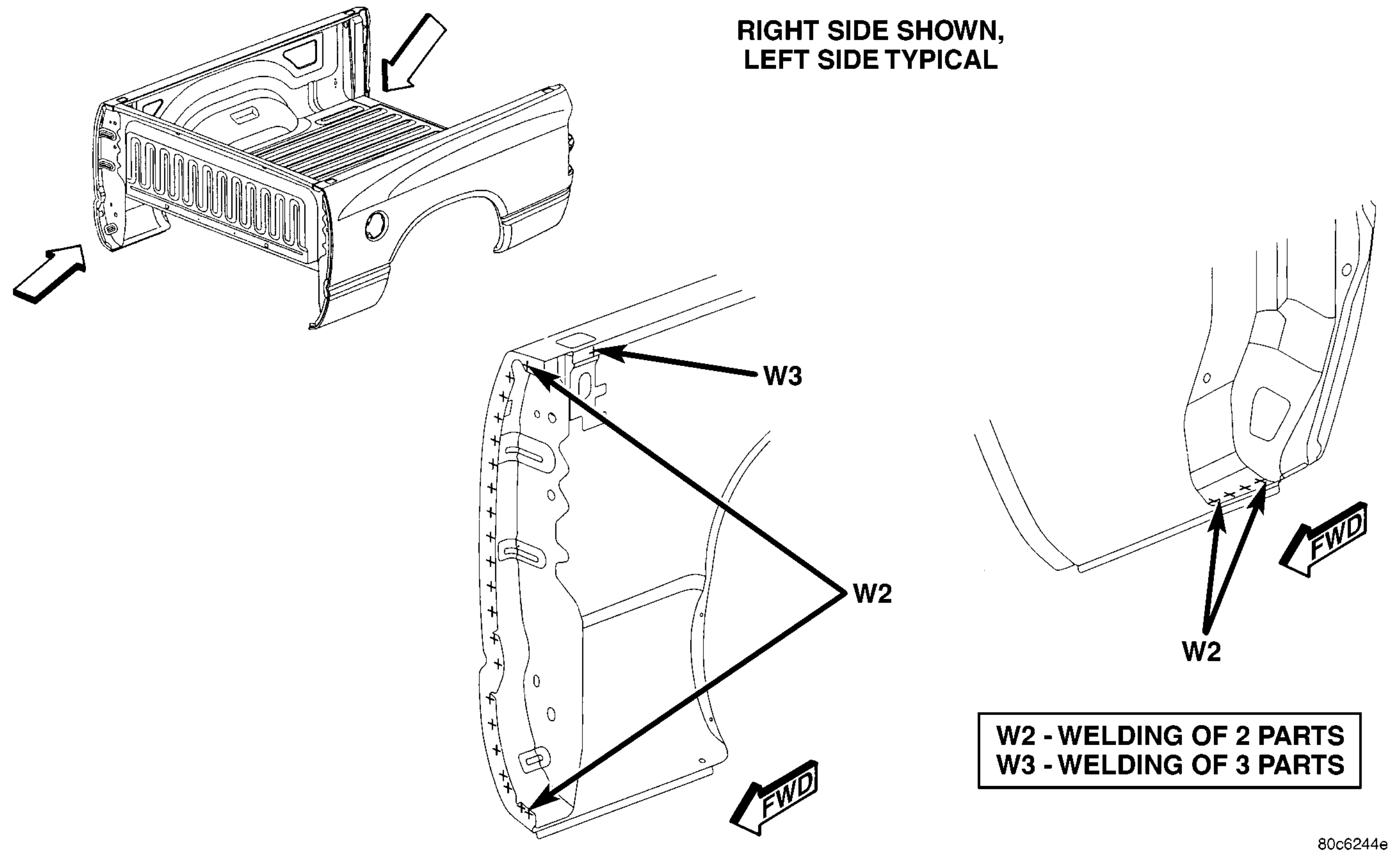


Fig. 106 BOX SIDE PANEL - SHORT CARGO BOX ONLY

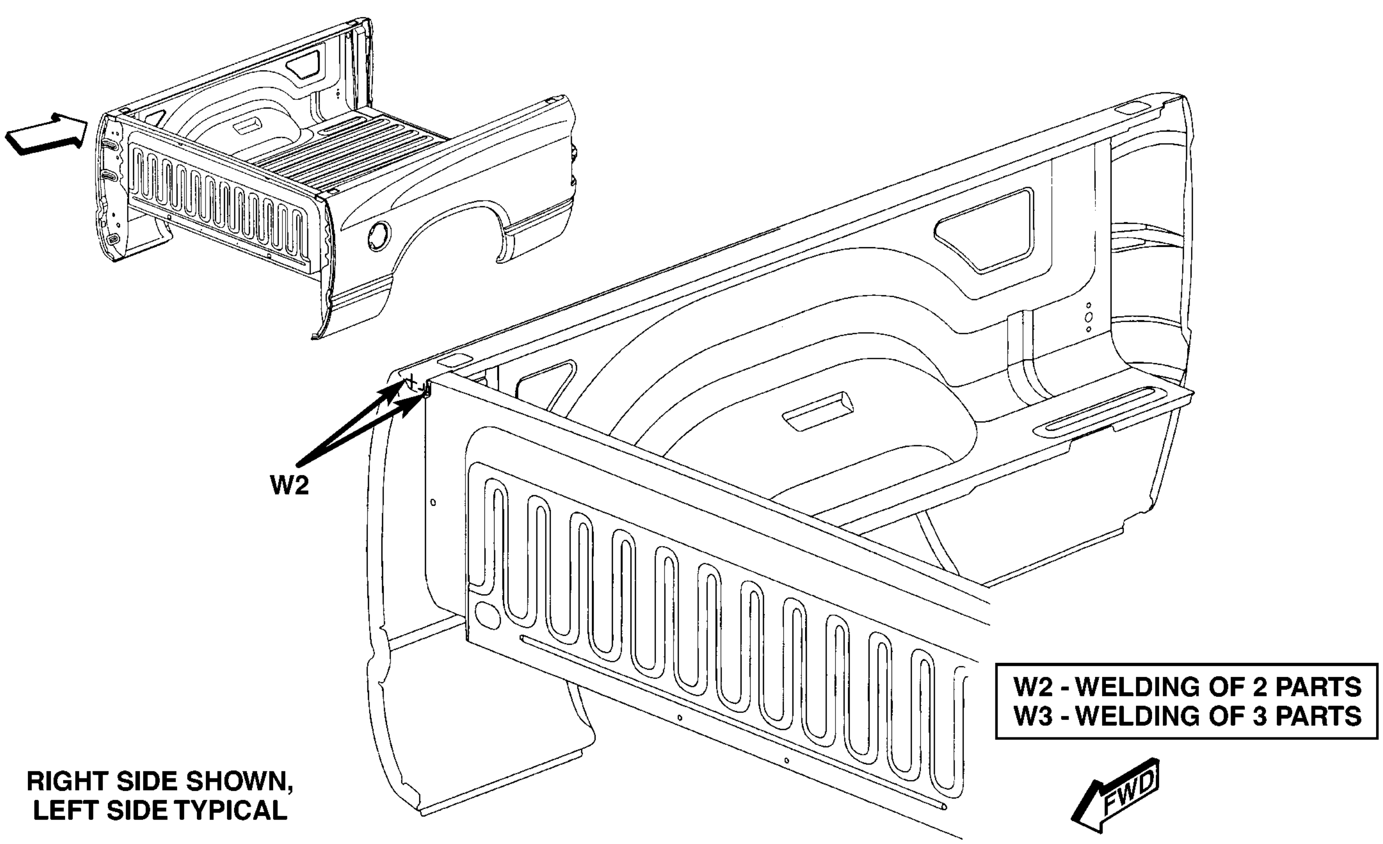


Fig. 107 FRONT BOX PANEL - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

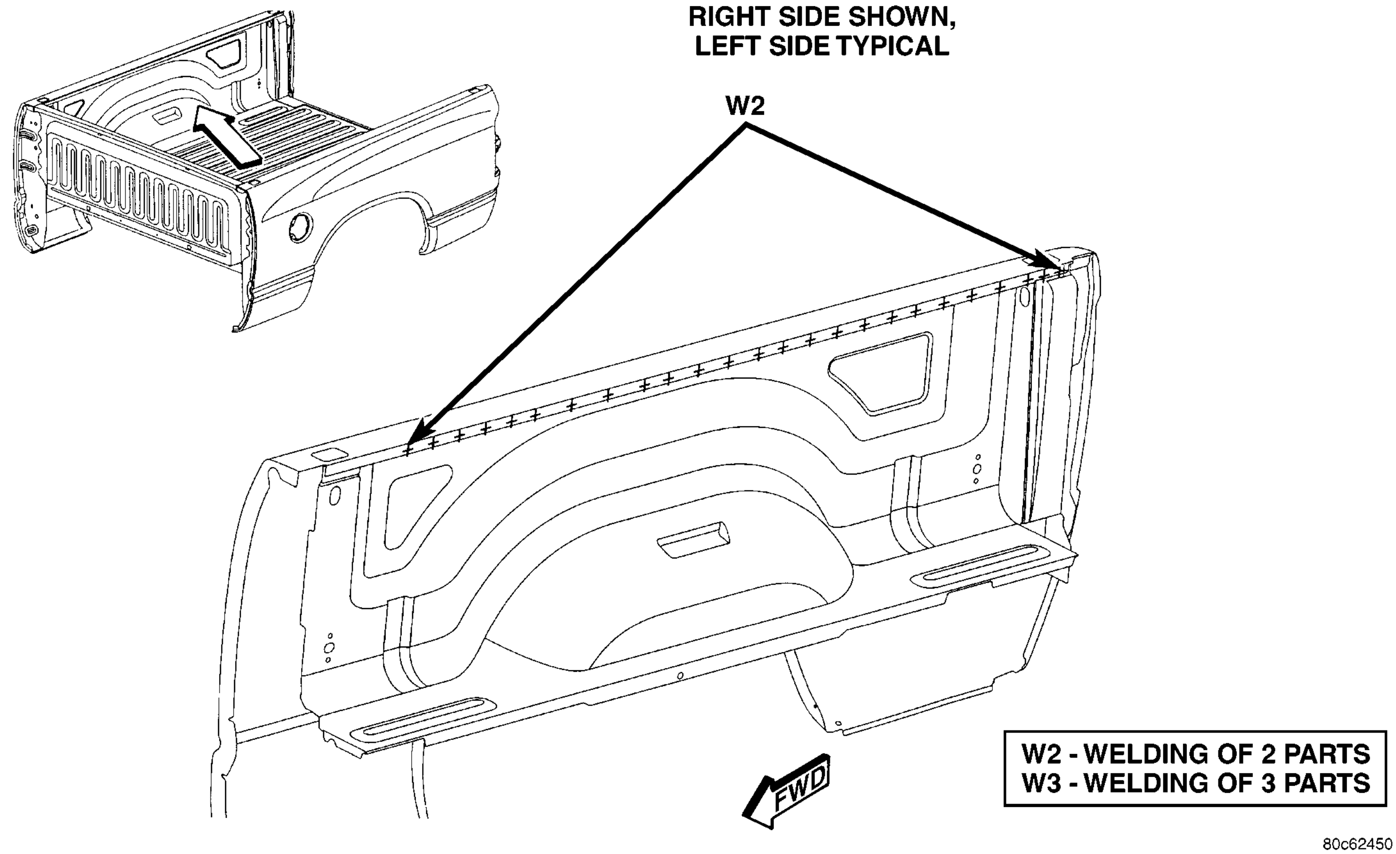


Fig. 108 INNER BOX SIDE PANEL - SHORT CARGO BOX ONLY

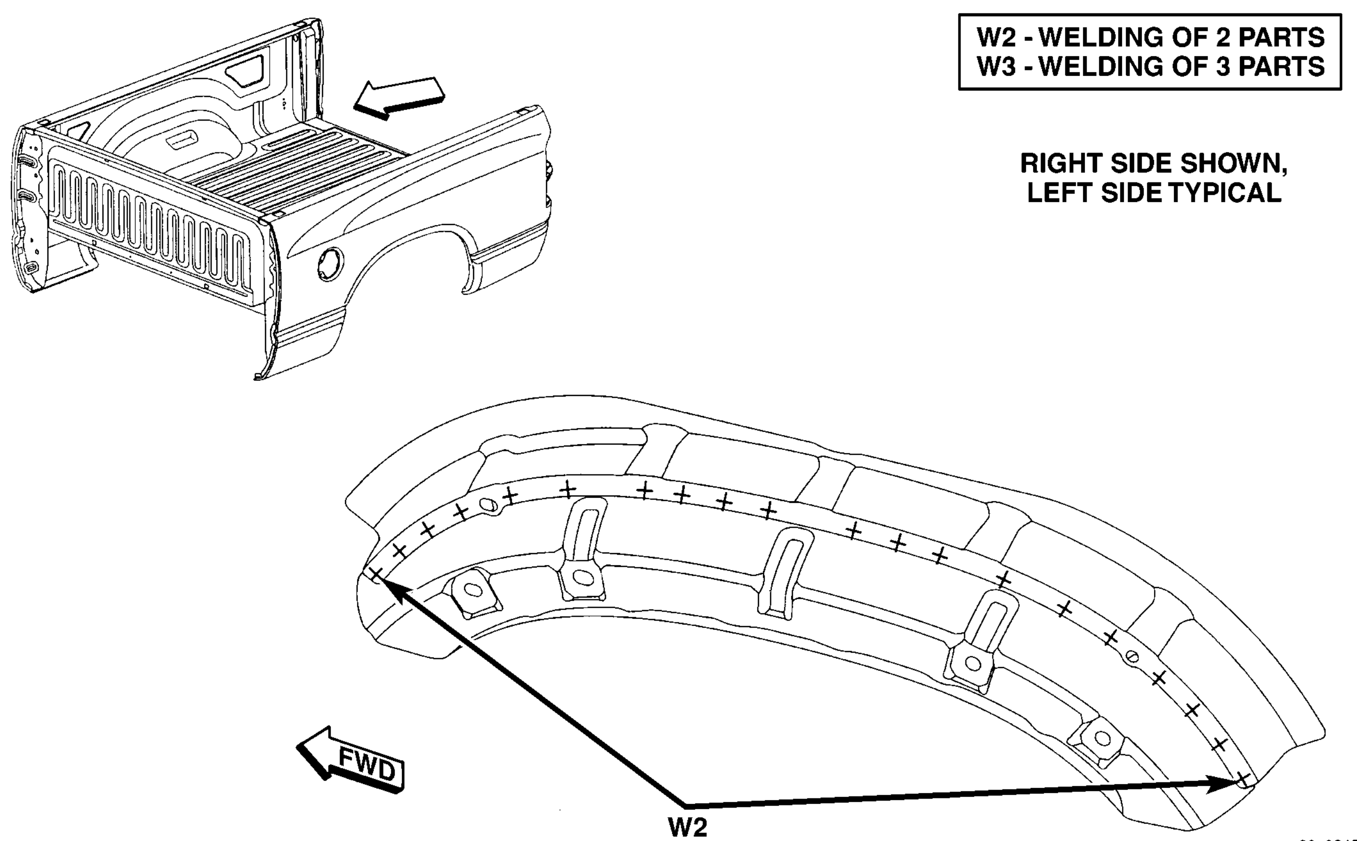


Fig. 109 OUTER WHEELHOUSE PANEL - SHORT CARGO BOX ONLY

WELD LOCATIONS (Continued)

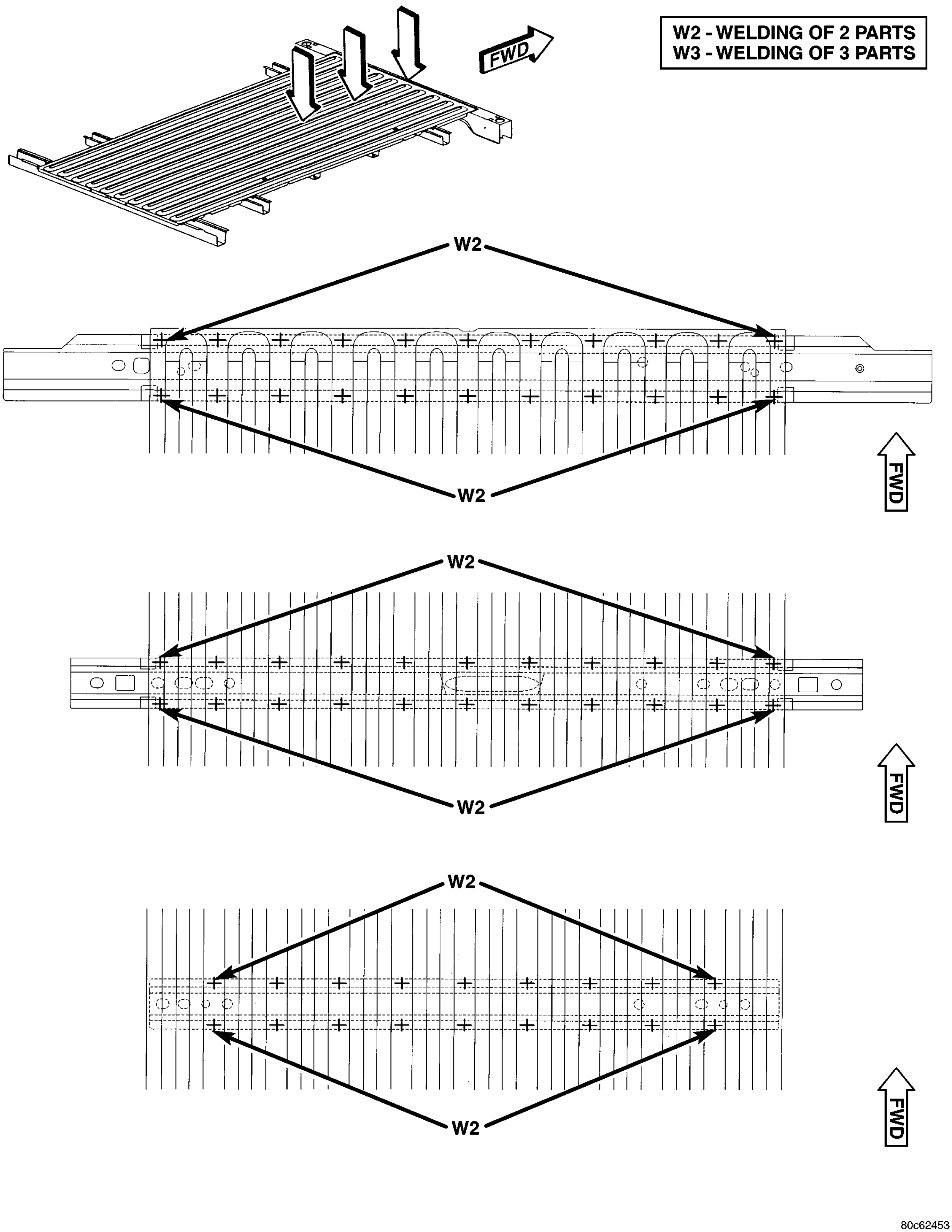


Fig. 110 FRONT CROSSMEMBER - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

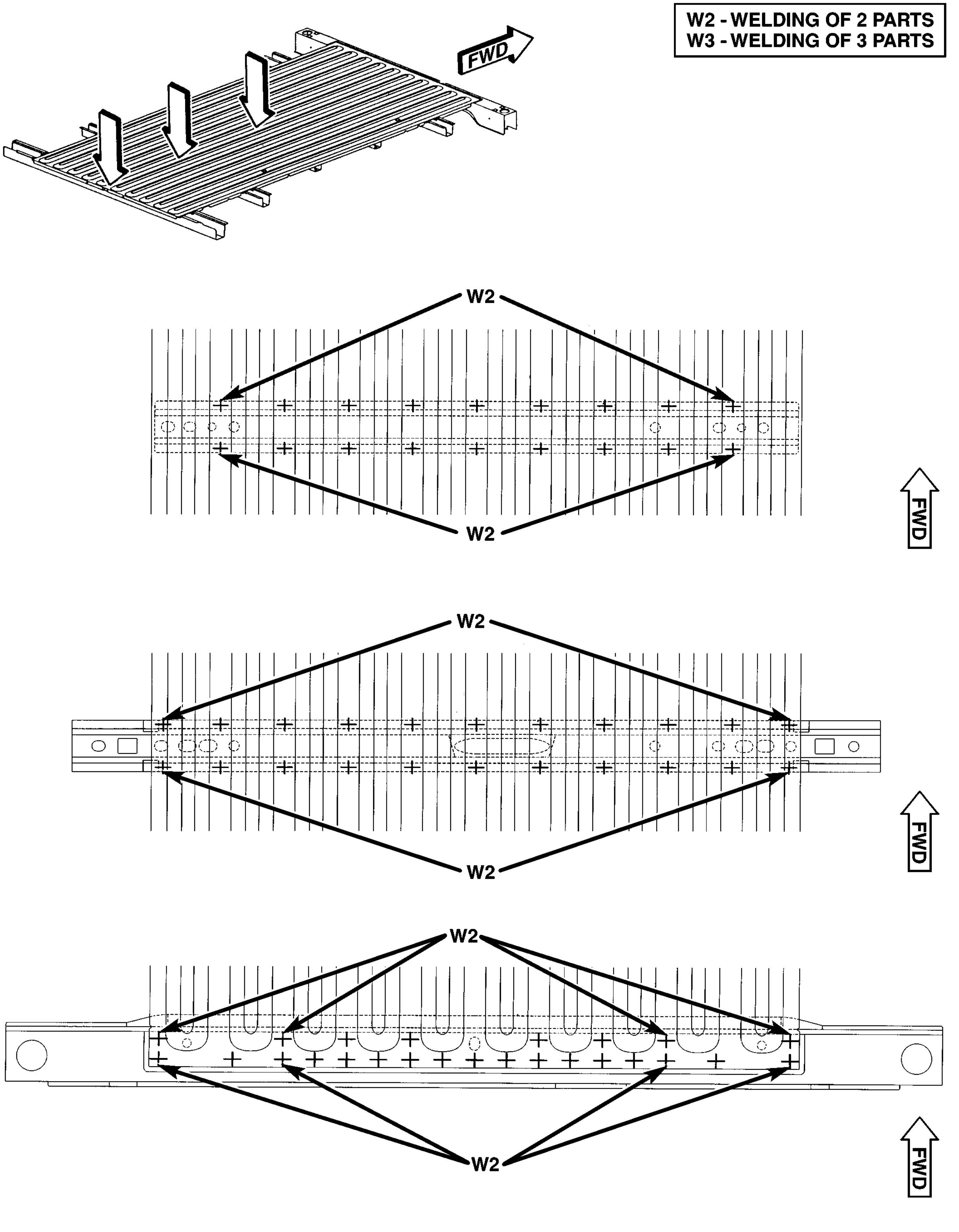


Fig. 111 WHEELHOUSE CROSSMEMBER - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

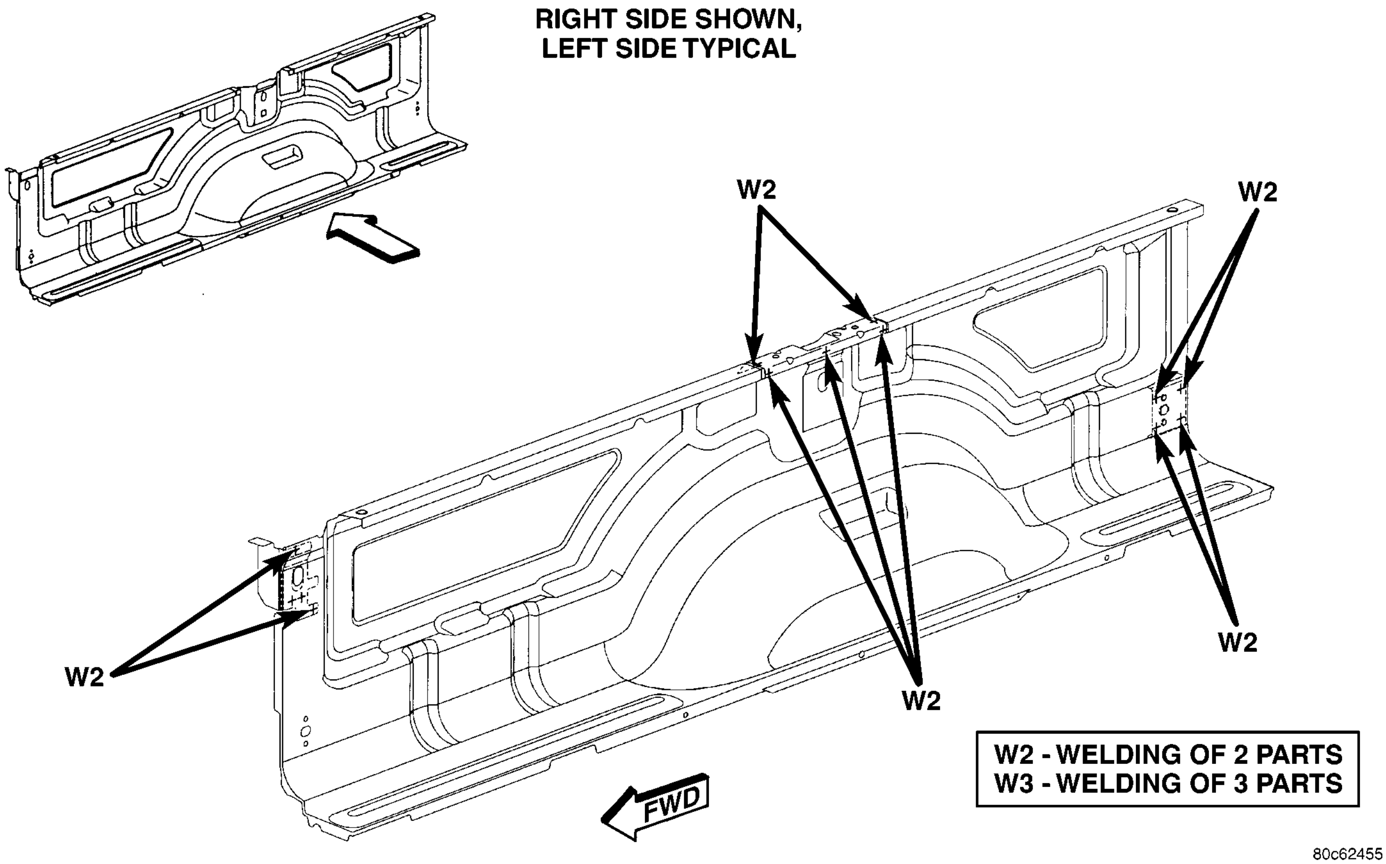


Fig. 112 FRONT AND CENTER STAKE POCKET REINFORCEMENTS - LONG CARGO BOX ONLY

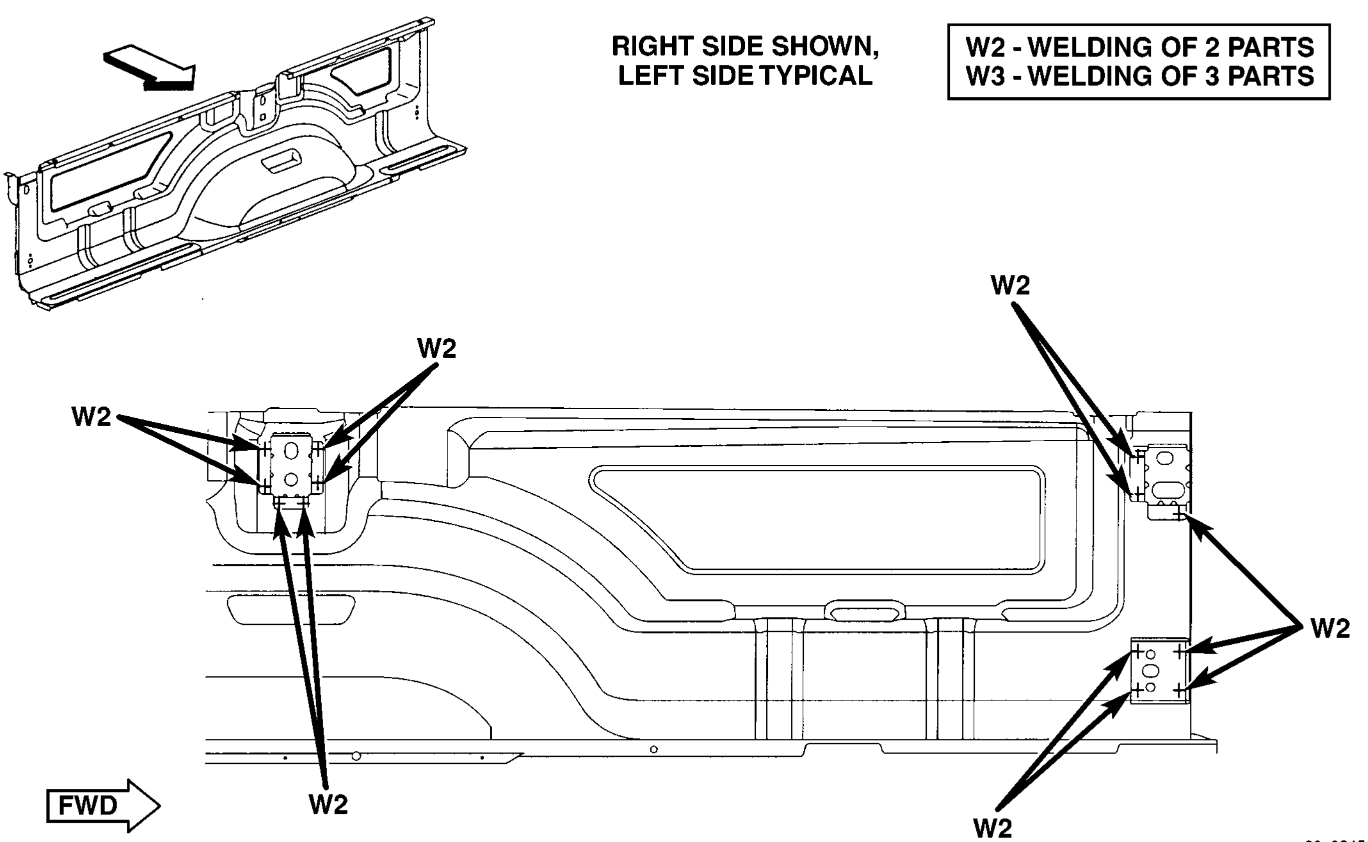


Fig. 113 OUTER FRONT AND CENTER STAKE POCKET REINFORCEMENT - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

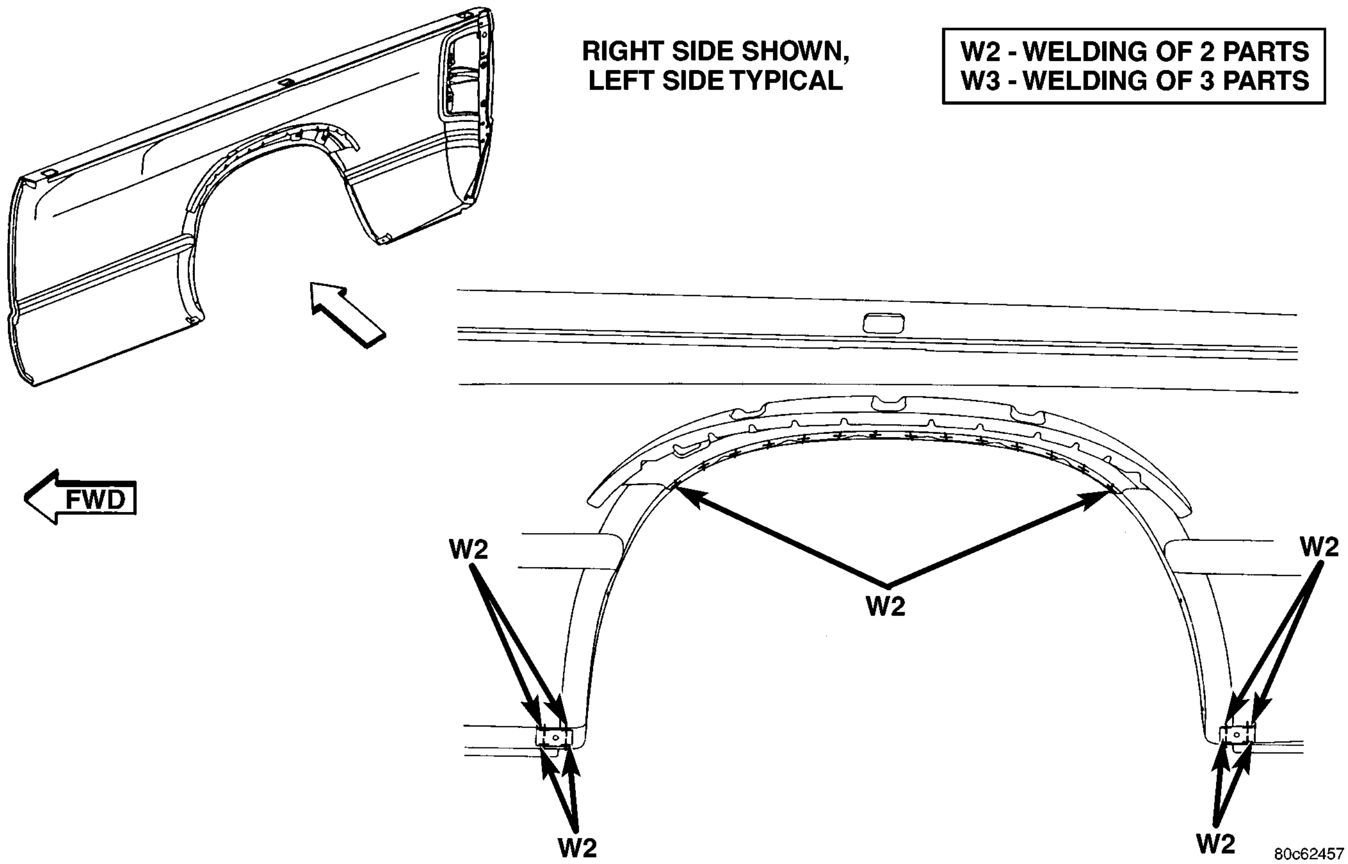


Fig. 114 OUTER WHEELHOUSE - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

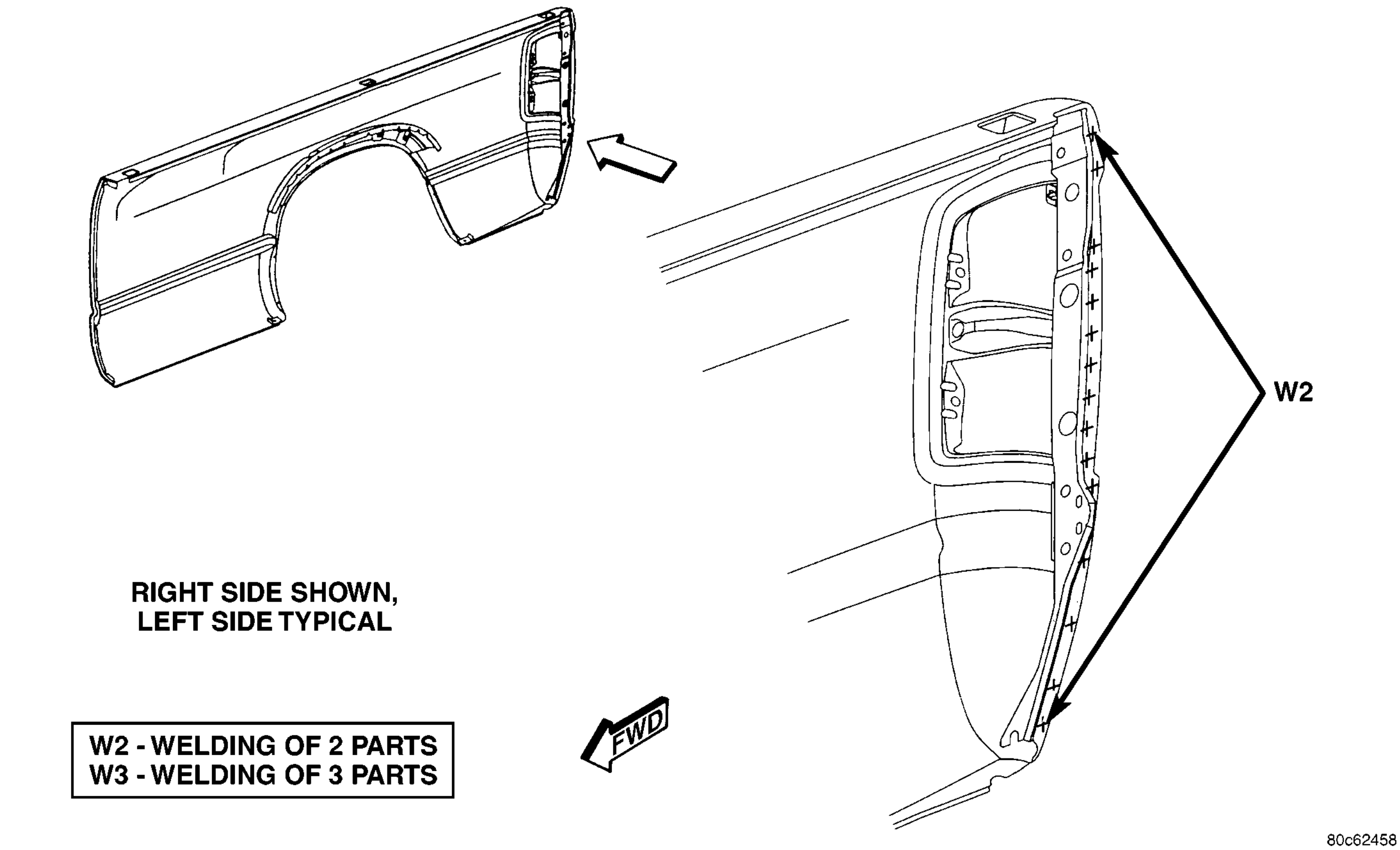


Fig. 115 TAILGATE BOX SIDE PIVOT REINFORCEMENT - LONG CARGO BOX ONLY

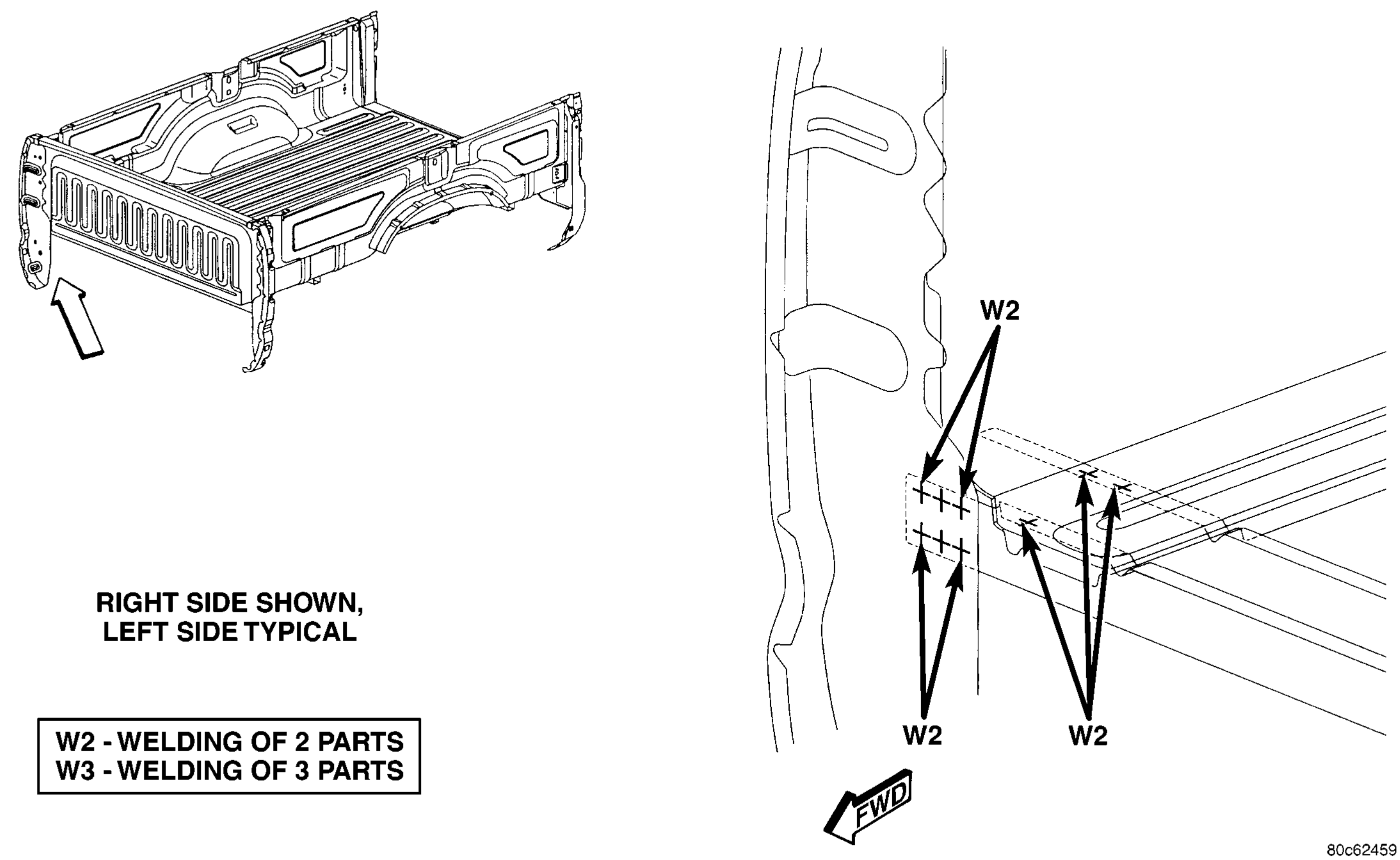


Fig. 116 FRONT BOX SIDE PANEL - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

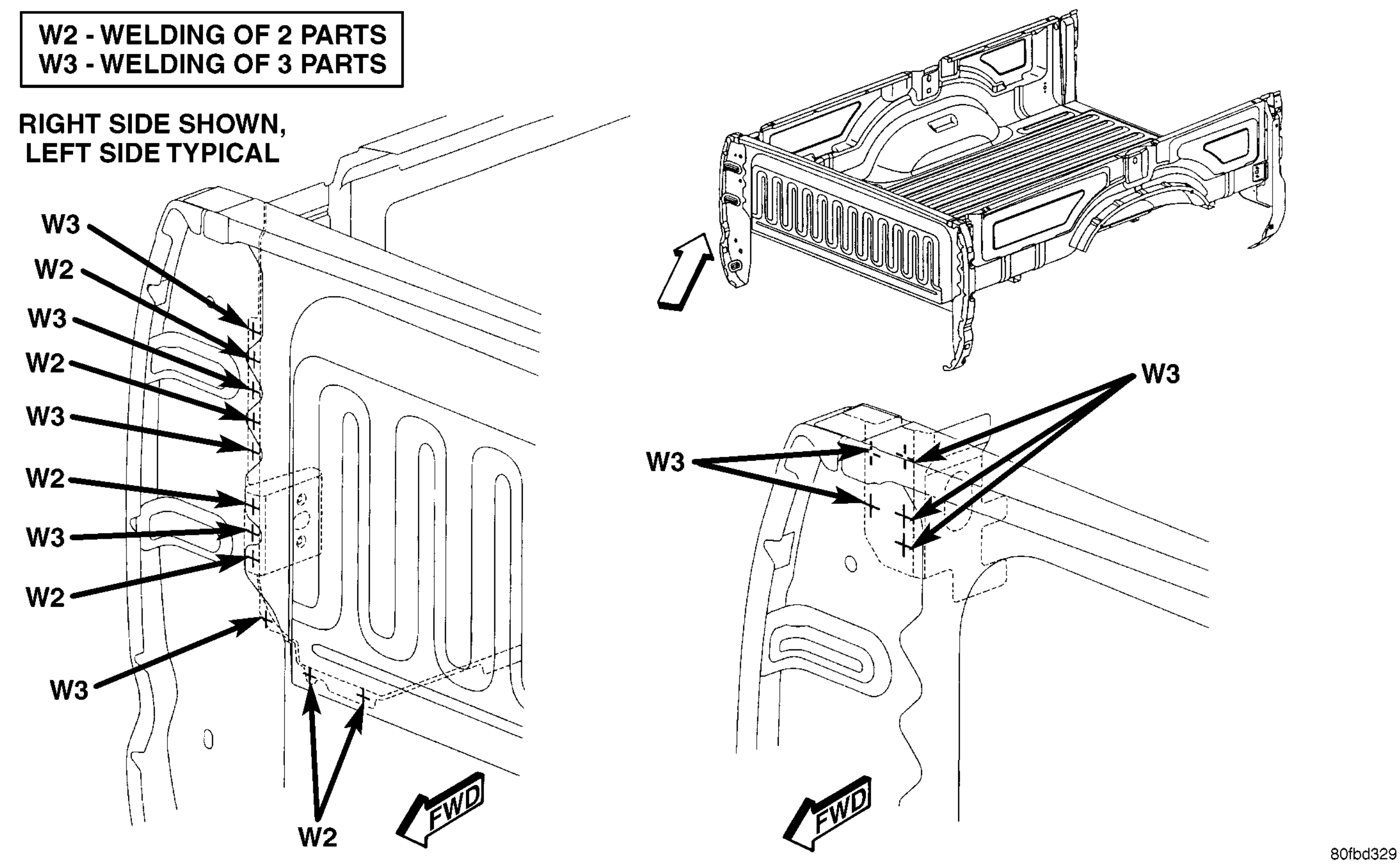


Fig. 117 FRONT BOX SIDE PANEL - LONG CARGO BOX ONLY

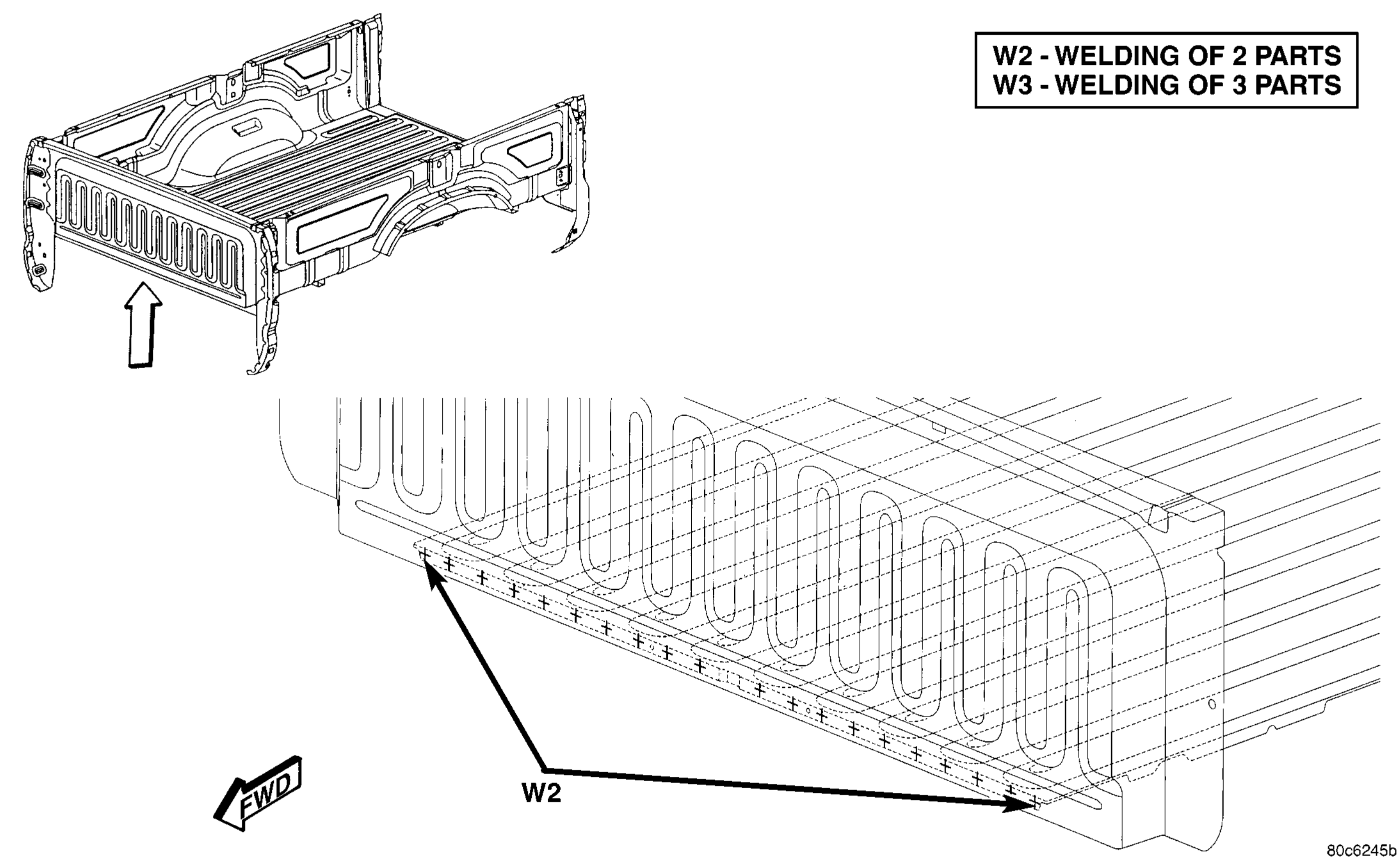


Fig. 118 BOX FRONT PANEL - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

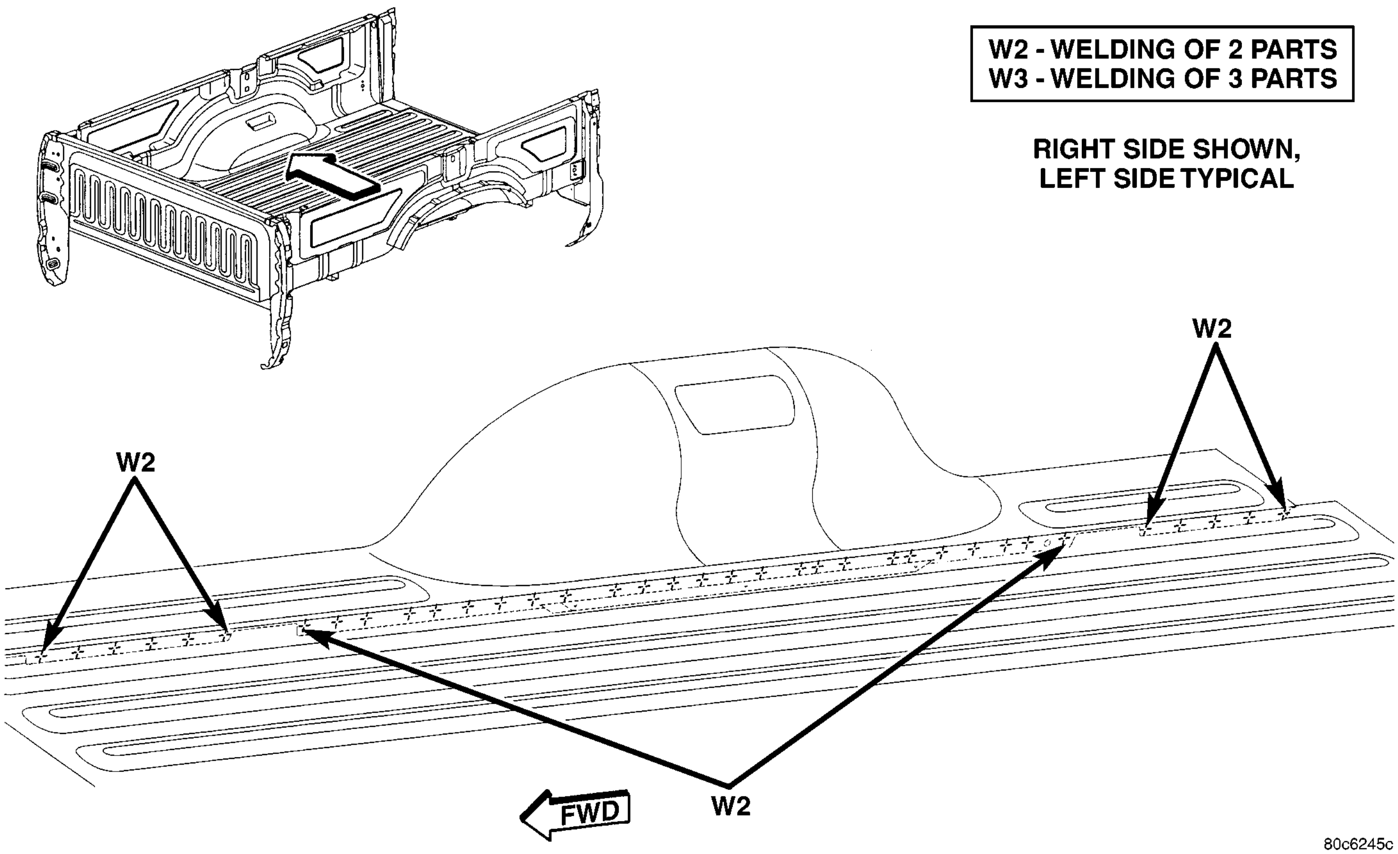


Fig. 119 BOX FLOOR PANEL - LONG CARGO BOX ONLY

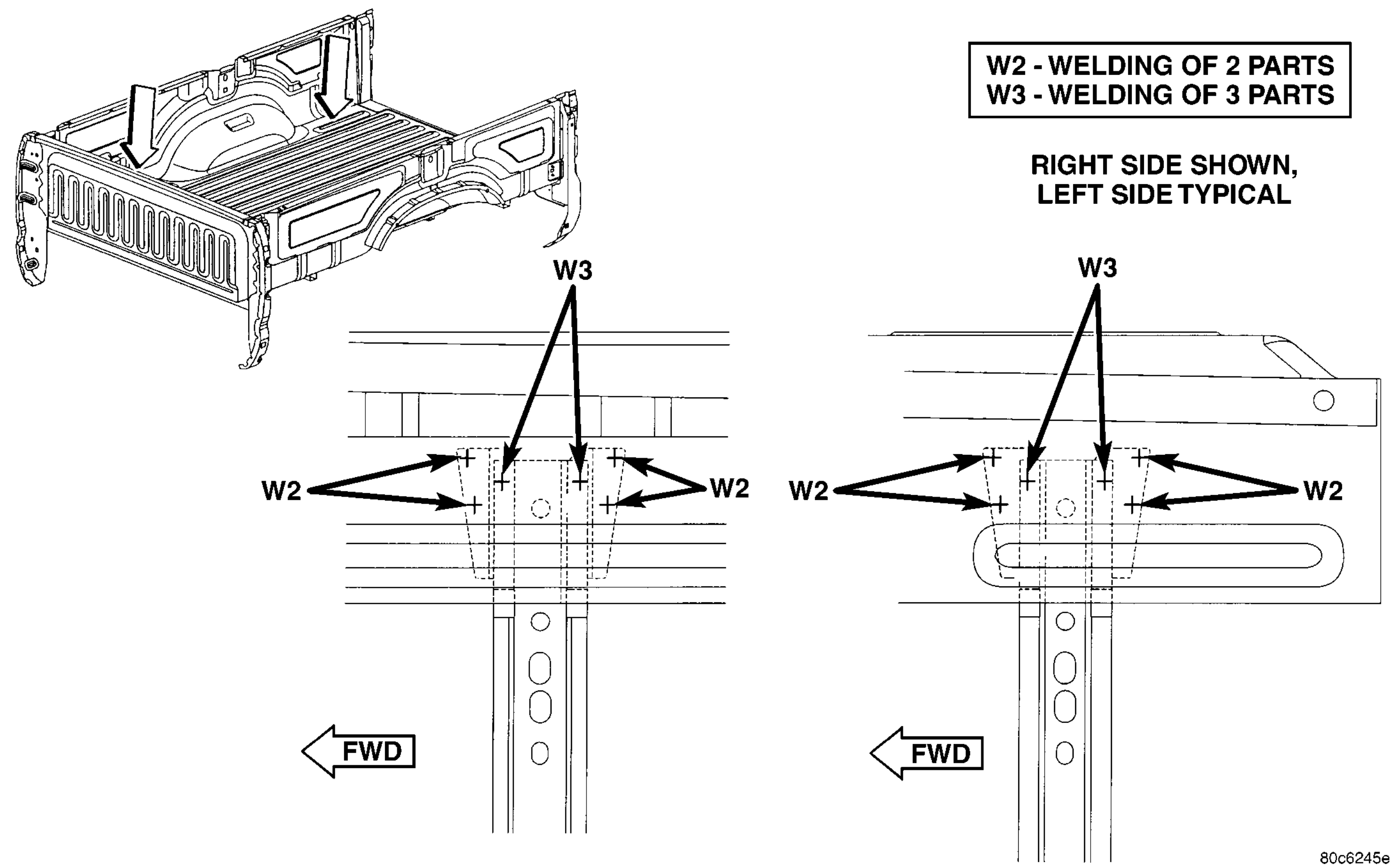


Fig. 120 LONG CROSSMEMBERS - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

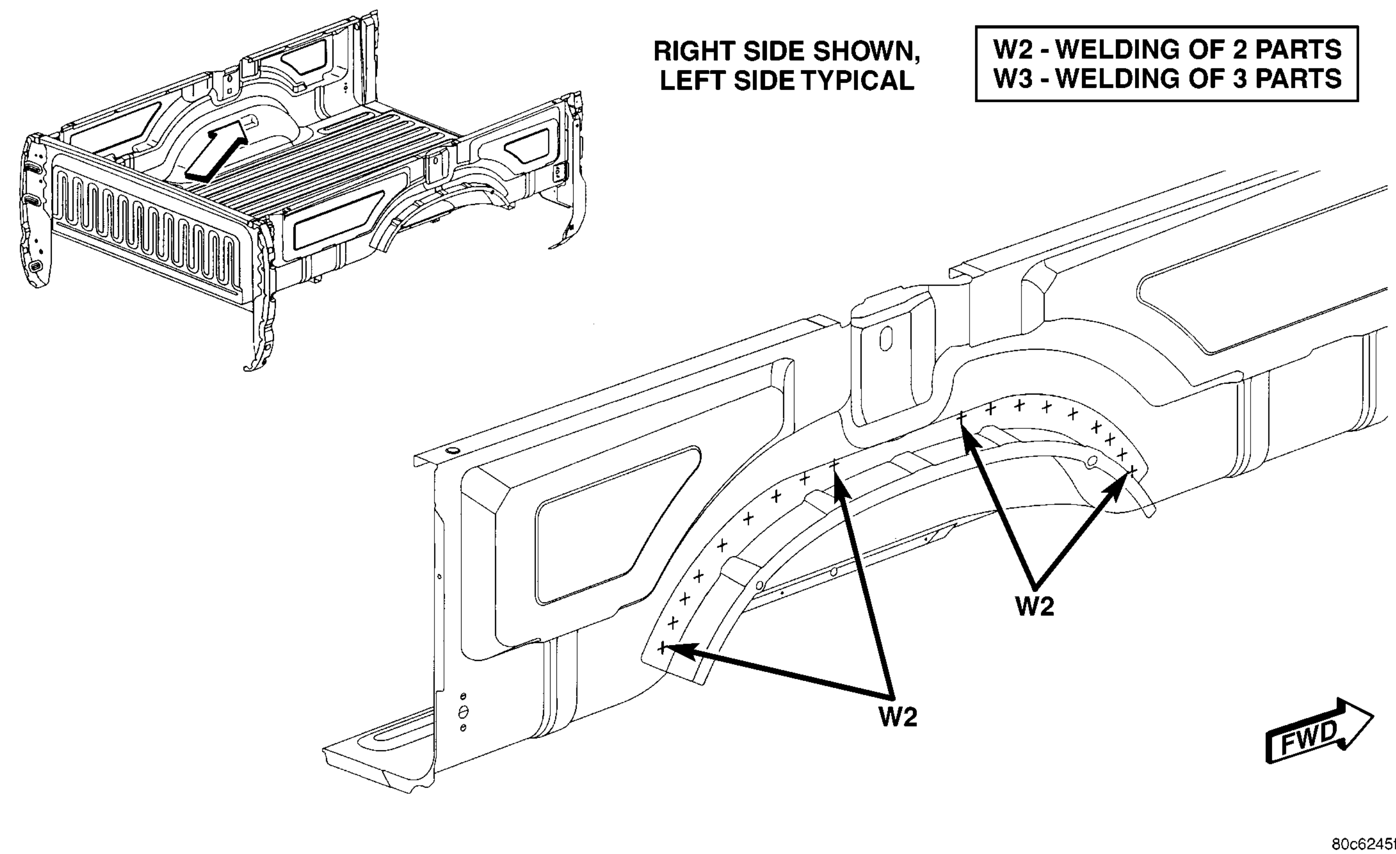


Fig. 121 INNER WHEELHOUSE PANEL - LONG CARGO BOX ONLY

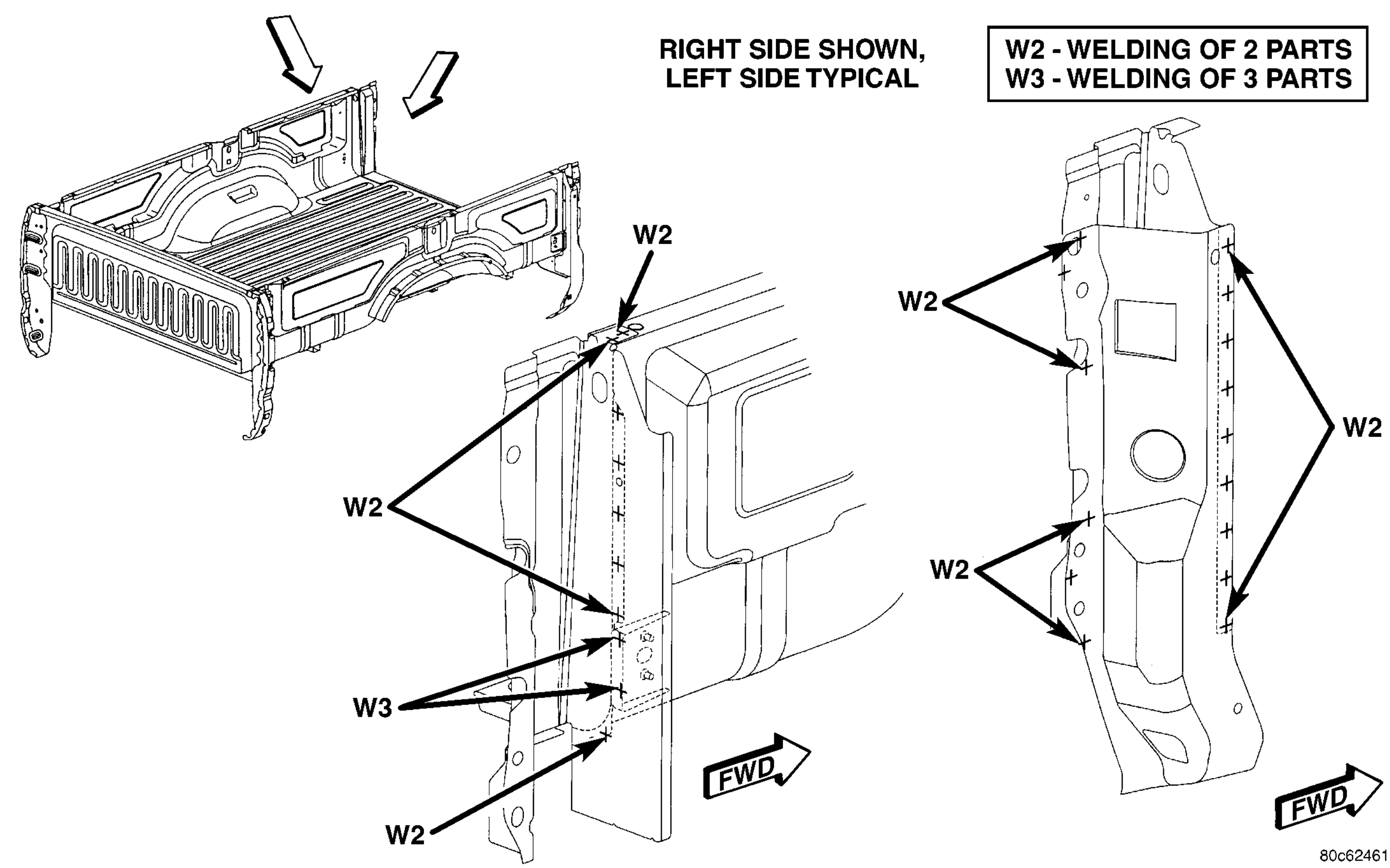


Fig. 122 TAILGATE PILLAR OUTER PANEL - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

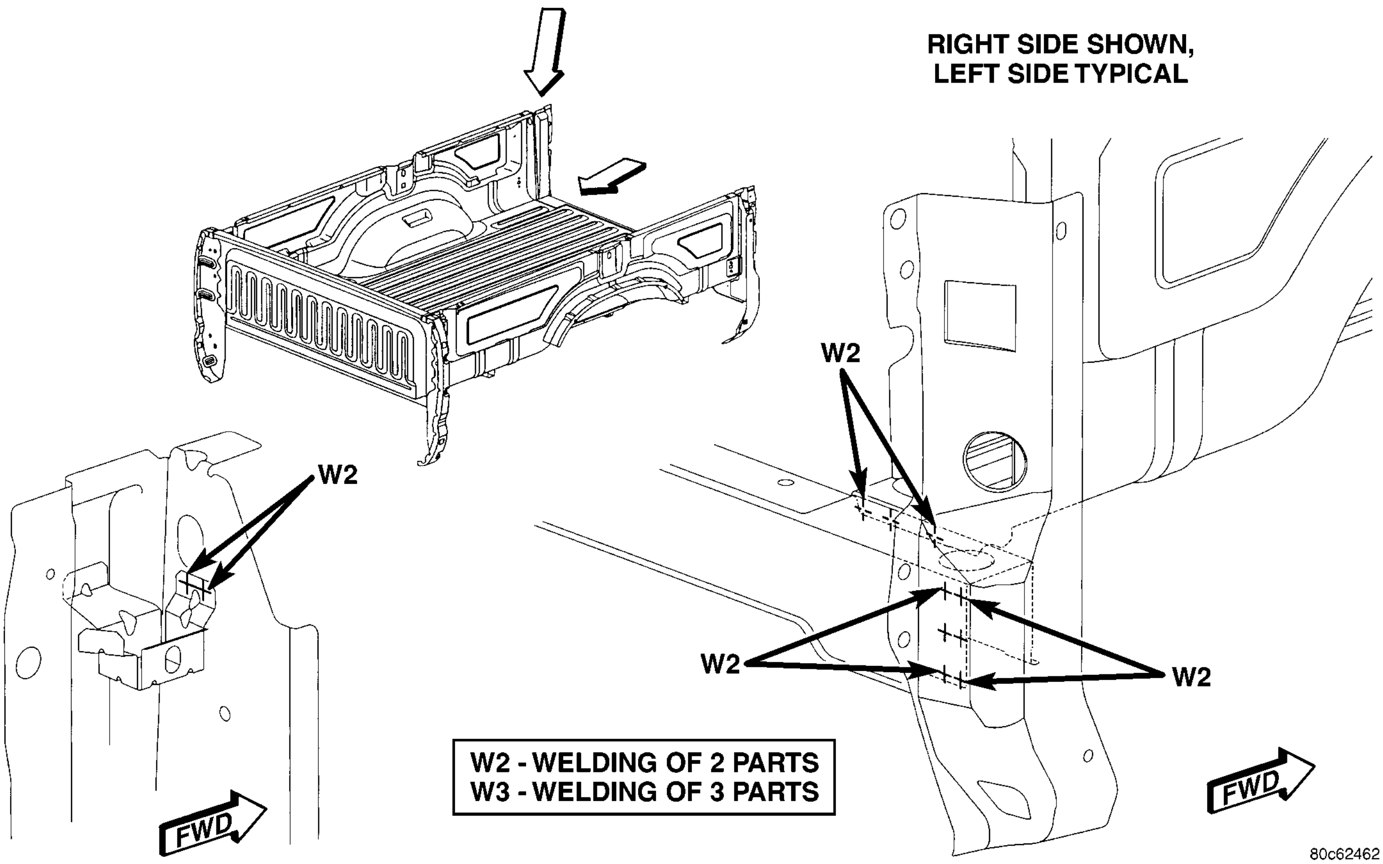


Fig. 123 REAR SILL CROSS BOX - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

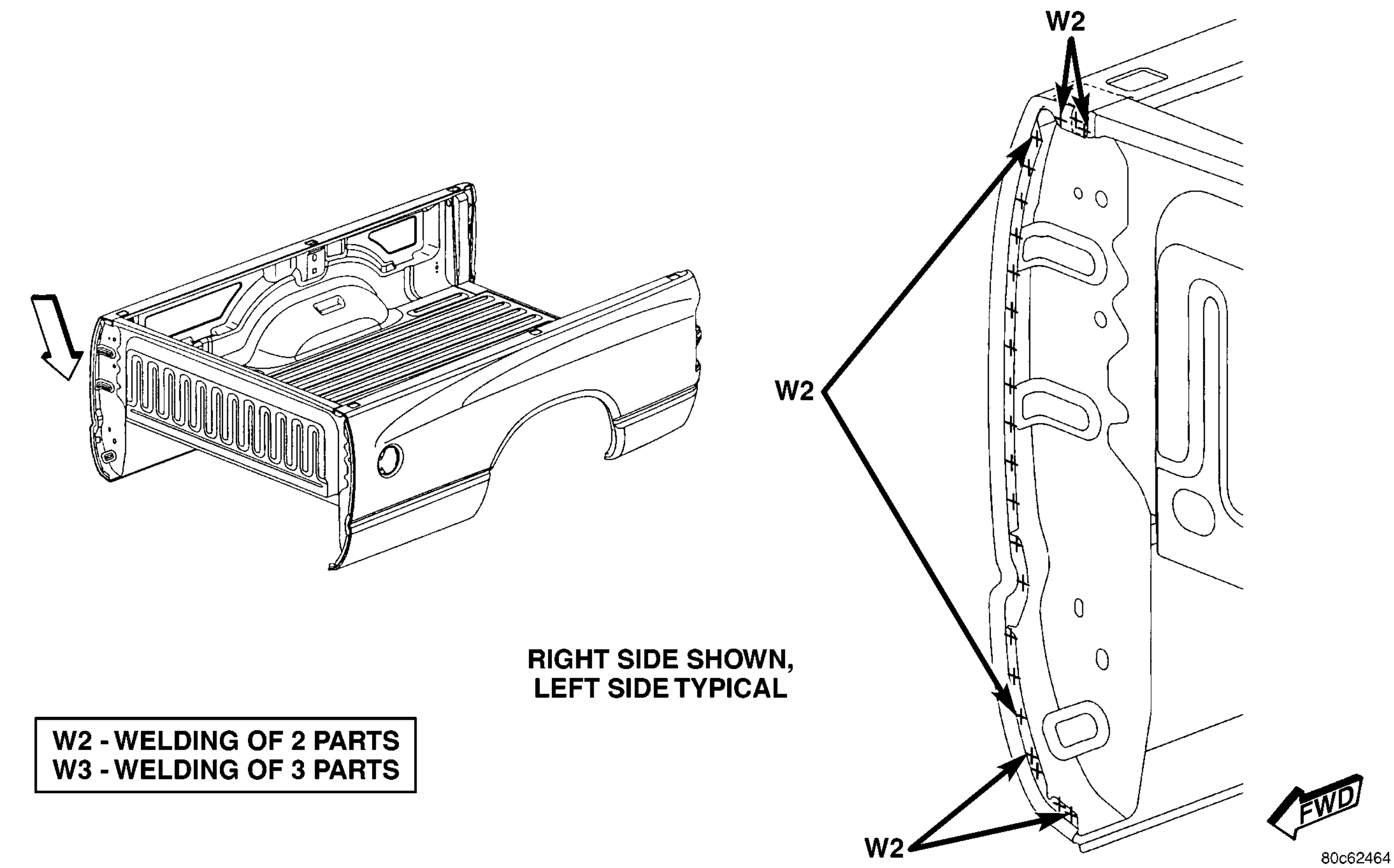


Fig. 124 OUTER BOX SIDE PANEL - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

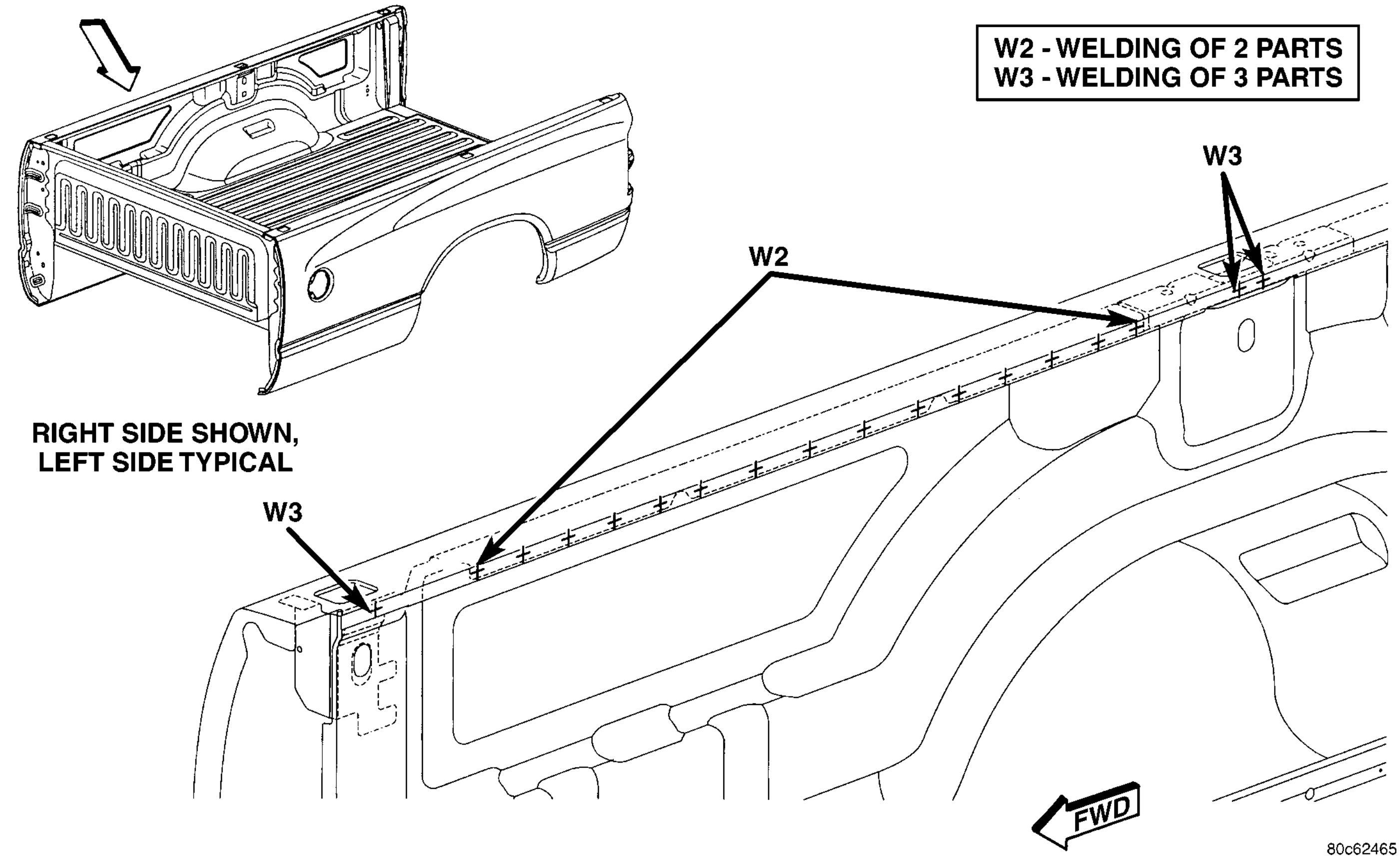


Fig. 125 STAKE POCKET REINFORCEMENTS - LONG CARGO BOX ONLY

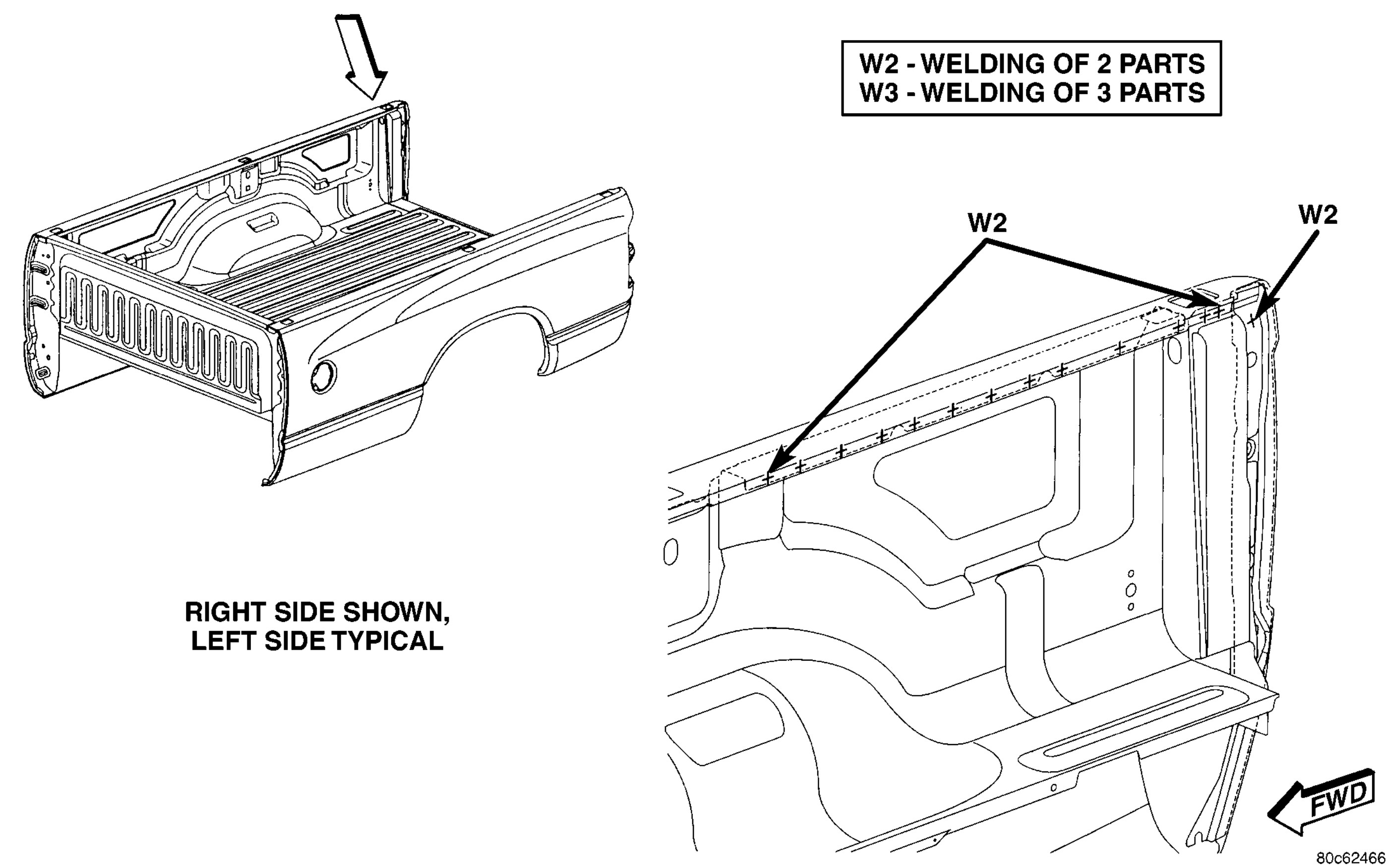


Fig. 126 TAILGATE PIVOT REINFORCEMENT - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

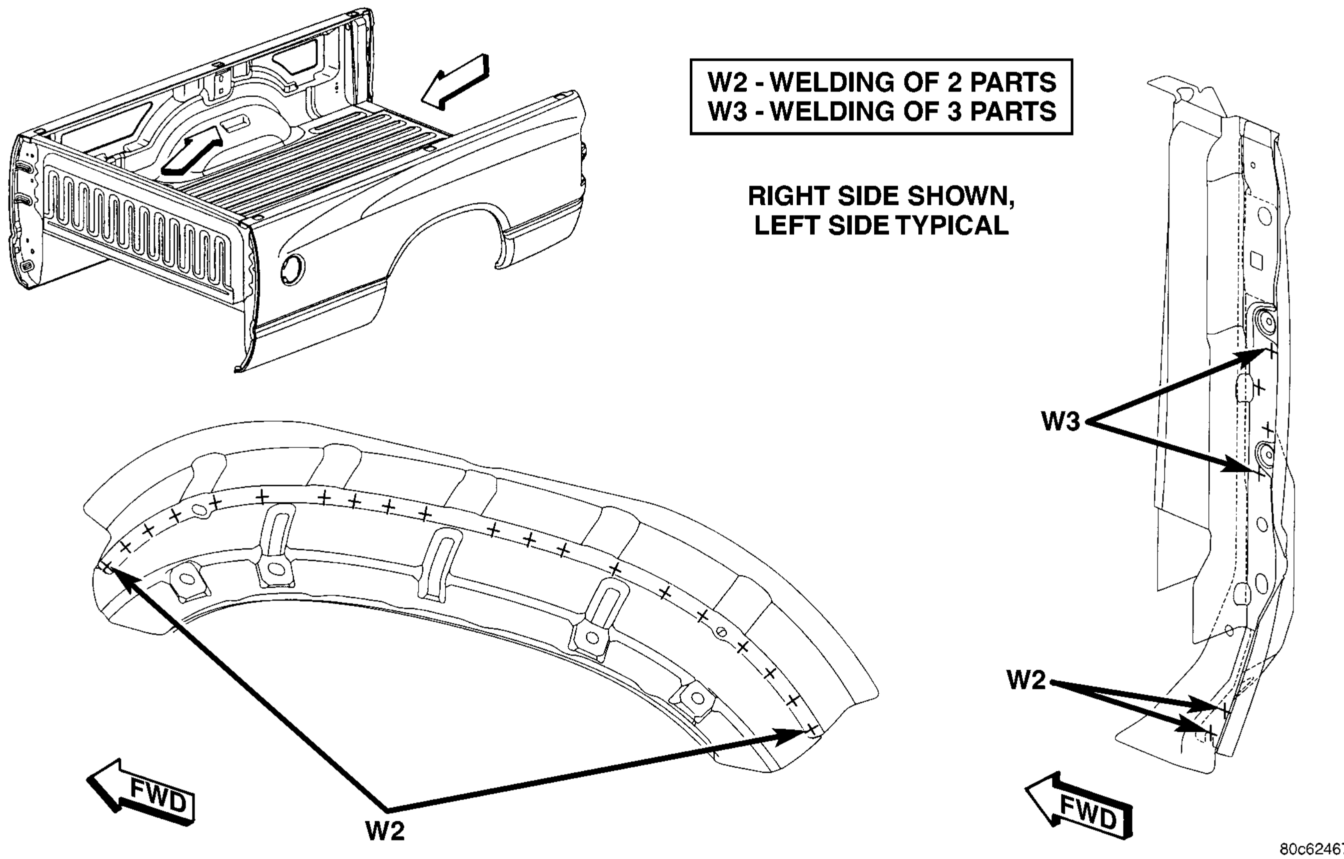


Fig. 127 INNER WHEELHOUSE - LONG CARGO BOX ONLY

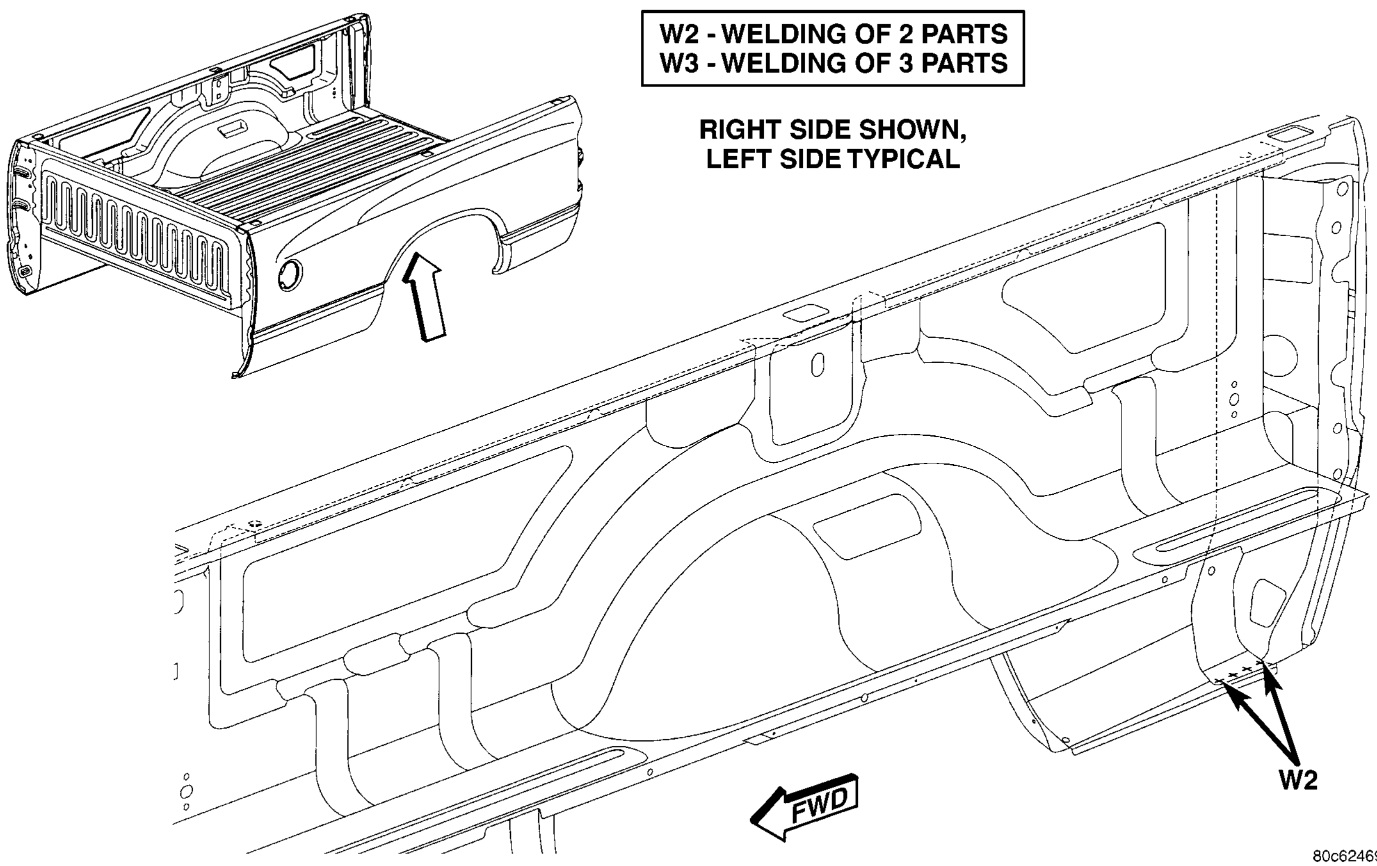


Fig. 128 OUTER TAILGATE PILLAR - LONG CARGO BOX ONLY

WELD LOCATIONS (Continued)

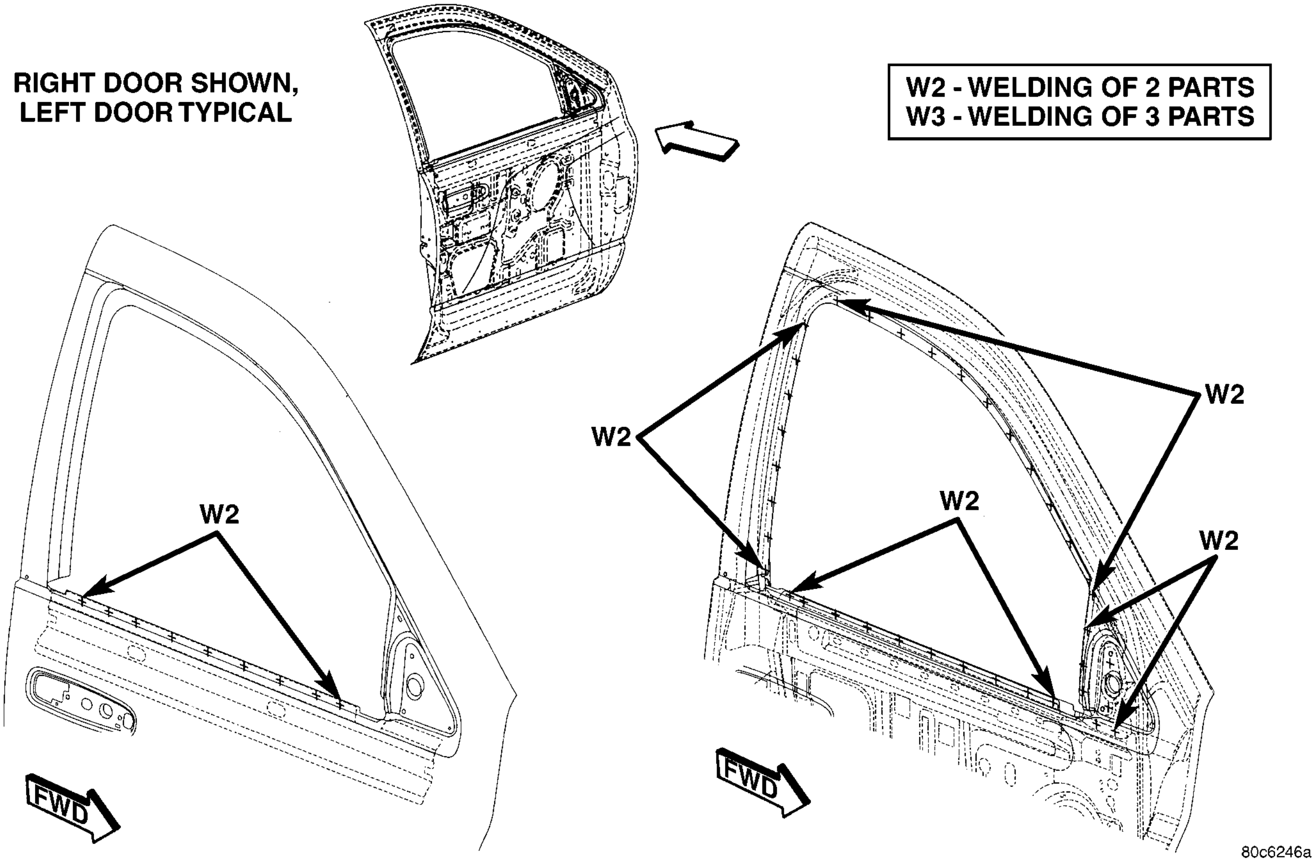


Fig. 129 INNER DOOR PANEL - QUAD CAB

WELD LOCATIONS (Continued)

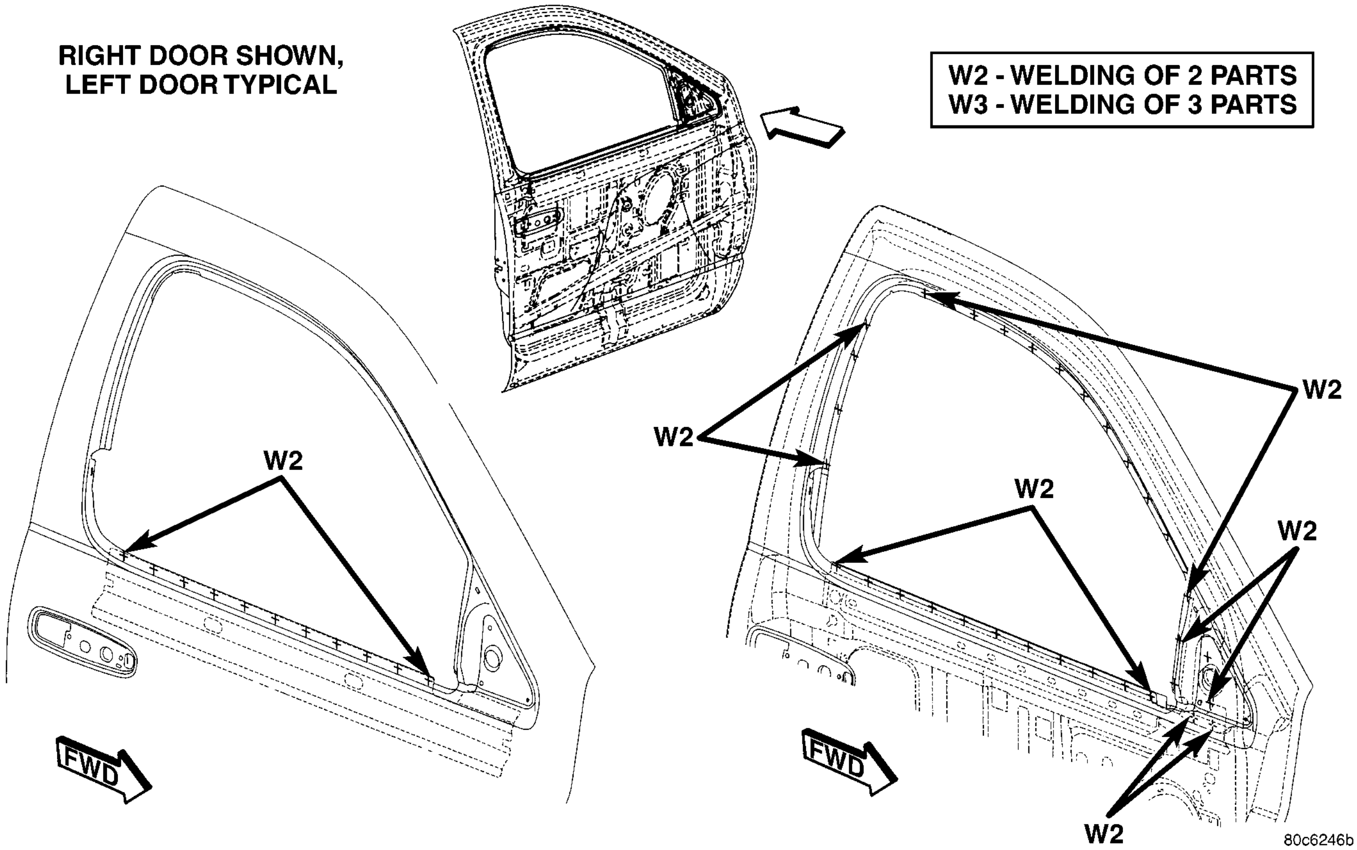


Fig. 130 INNER DOOR PANEL - STANDARD CAB

WELD LOCATIONS (Continued)

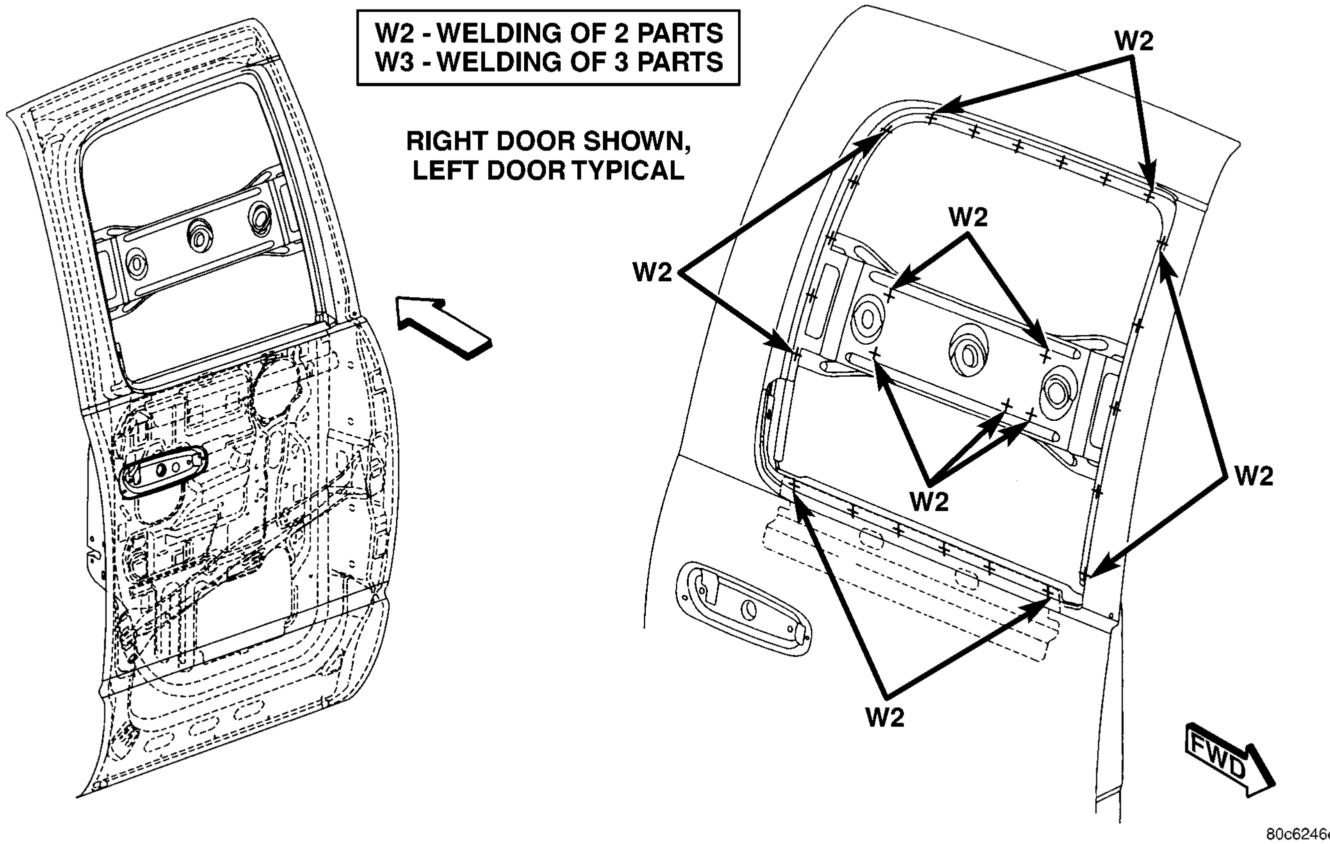


Fig. 131 INNER DOOR PANEL - QUAD CAB

HEATING & AIR CONDITIONING

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HEATING & AIR CONDITIONING

DESCRIPTION

DESCRIPTION - HEATER AND AIR CONDITIONER

All vehicles are equipped with a common HVAC housing assembly (Fig. 1). The system combines air conditioning, heating, and ventilating capabilities in a single unit housing mounted under the instrument panel.

DESCRIPTION - COOLING SYSTEM REQUIREMENTS

To maintain the performance level of the HVAC system, the engine cooling system must be properly maintained. The use of a bug screen is not recommended. Any obstructions in front of the radiator or condenser will reduce the performance of the air conditioning and engine cooling systems.

The engine cooling system includes the heater core and the heater hoses. Refer to Engine Cooling for more information before the opening of, or attempting any service to the engine cooling system.

DESCRIPTION - REFRIGERANT SYSTEM SERVICE PORT

The two refrigerant system service ports are used to charge, recover/recycle, evacuate, and test the air conditioning refrigerant system. Unique service port coupler sizes are used on the R-134a system, to ensure that the refrigerant system is not accidentally contaminated by the use of the wrong refrigerant (R-12), or refrigerant system service equipment.

OPERATION

OPERATION - HEATER AND AIR CONDITIONER

The heater air conditioner are blend-air type systems. In a blend-air system, a blend door controls the amount of unconditioned air (or cooled air from the evaporator on models with air conditioning) that is allowed to flow through, or around, the heater core. A temperature control knob on the A/C Heater control panel determines the discharge air temperature by controlling an electric actuator, which moves the blend door. This allows an almost immediate control of the output air temperature of the system.

The mode control knob on the A/C Heater control panel is used to direct the conditioned air to the selected system outlets. Both mode control switches use electric actuators to control the mode doors.

On all vehicles, the outside air intake can be shut off by selecting the Recirculation Mode with the mode control knob. This will operate a electric actuated recirculation door that closes off the outside fresh air intake and recirculates the air that is already inside the vehicle.

The air conditioner for all models is designed for the use of non-CFC, R-134a refrigerant. The air conditioning system has an evaporator to cool and dehumidify the incoming air prior to blending it with the heated air. This air conditioning system uses a fixed orifice tube in the liquid line near the condenser outlet tube to meter refrigerant flow to the evaporator

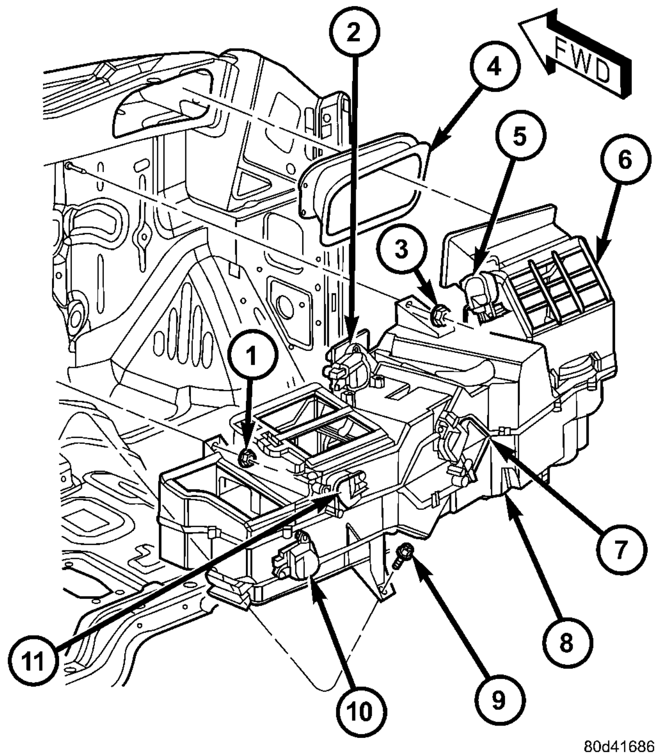

Fig. 1 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

coil. To maintain minimum evaporator temperature and prevent evaporator freezing, the A/C Fin Probe which is located in the evaporator cycles the compressor clutch by sending an A/C request to the JTEC which in turn processes this piece of information and if all conditions are met cycles the compressor clutch.

OPERATION - REFRIGERANT SYSTEM SERVICE PORT

The low pressure service port is located on the suction refrigerant line, near the accumulator. The high pressure service port is located on the liquid line at the passenger side of the engine compartment, near the condenser.

Each of the service ports has a threaded plastic protective cap installed over it from the factory. After servicing the refrigerant system, always reinstall both of the service port caps.

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - A/C PERFORMANCE

The air conditioning system is designed to provide the passenger compartment with low temperature and low humidity air. The evaporator, located in the HVAC housing on the dash panel below the instrument panel, is cooled to temperatures near the freezing point. As warm damp air passes through the cooled evaporator, the air transfers its heat to the refrigerant in the evaporator and the moisture in the air condenses on the evaporator fins. During periods of high heat and humidity, an air conditioning system will be more effective in the Recirculation Mode. With the system in the Recirculation Mode, only air from the passenger compartment passes through the evaporator. As the passenger compartment air dehumidifies, the air conditioning system performance levels improve.

Humidity has an important bearing on the temperature of the air delivered to the interior of the vehicle. It is important to understand the effect that humidity has on the performance of the air conditioning system. When humidity is high, the evaporator has to perform a double duty. It must lower the air temperature, and it must lower the temperature of the moisture in the air that condenses on the evaporator fins. Condensing the moisture in the air transfers heat energy into the evaporator fins and tubing. This reduces the amount of heat the evaporator can absorb from the air. High humidity greatly reduces the ability of the evaporator to lower the temperature of the air.

However, evaporator capacity used to reduce the amount of moisture in the air is not wasted. Removing some of the moisture out of the air entering the vehicle adds to the comfort of the passengers. Although, an owner may expect too much from the air conditioning system on humid days. A performance test is the best way to determine whether the system is performing up to standard. This test also provides valuable clues as to the possible cause of trouble with the air conditioning system.

Before proceeding, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION). The air temperature in the test room and in the vehicle must be a minimum of 21° C (70° F) for this test.

(1) Connect a tachometer and a manifold gauge set or A/C recycling/charging station.

(2) Set the A/C Heater mode control switch knob in the Recirculation Mode position, the temperature control knob in the full cool position, and the blower motor switch knob in the highest speed position.

HEATING & AIR CONDITIONING (Continued)

(3) Start the engine and hold the idle at 1,000 rpm with the compressor clutch engaged.

(4) The engine should be at operating temperature. The doors and windows must be closed.

(5) Insert a thermometer in the driver side center A/C (panel) outlet. Operate the engine for five minutes.

(6) The compressor clutch may cycle, depending upon the ambient temperature and humidity.

(7) With the compressor clutch engaged, record the discharge air temperature and the compressor discharge pressure.

(8) Compare the discharge air temperature to the Performance Temperature and Pressure chart. If the discharge air temperature is high, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY).

Performance Temperature and Pressure					
Ambient Air Temperature	21° C (70° F)	27° C (80° F)	32° C (90° F)	38° C (100° F)	43° C (110° F)
Air Temperature at Center Panel Outlet	7° C (45° F)	7° C (45° F)	13° C (55° F)	13° C (55° F)	18° C (64° F)
Compressor Inlet Pressure at Service Port (low Side)	138 to 207 kPa (20 to 30 psi)	172 to 241 kPa (25 to 35 psi)	207 to 276 kPa (30 to 40 psi)	241 to 310 kPa (35 to 45 psi)	276 to 345 kPa (40 to 50 psi)
Condensor Out Pressuree at Service Port (High Side)	1034 to 1724 kPa (150 to 250 psi)	1379 to 2068 kPa (200 to 300 psi)	1724 to 2413 kPa (250 to 350 psi)	1999 to 2689 kPa (290 to 390 psi)	2413 to 2965 kPa (350 to 430 psi)

(9) Compare the compressor discharge pressure to the Performance Temperature and Pressure chart. If the compressor discharge pressure is high, see the Pressure Diagnosis chart.

Pressure Diagnosis		
Condition	Possible Causes	Correction
Constant compressor engagement and warm air from passenger vents.	1. Low refrigerant system charge.	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
Equal pressures, but the compressor clutch does not engage.	1. No refrigerant in the refrigerant system.	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	2. Faulty fuse.	2. Check the fuses in the Power Distribution Center and the junction block. Repair the shorted circuit or component and replace the fuses, if required.
	3. Faulty a/c compressor clutch coil.	3. See A/C Compressor/Diagnosis and Testing - Compressor Clutch Coil in this group. Test the compressor clutch coil and replace, if required.

HEATING & AIR CONDITIONING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
	4. Faulty a/c compressor clutch relay.	4. See A/C Compressor Clutch Relay/Diagnosis and Testing - Compressor Clutch Relay in this group. Test the compressor clutch relay and relay circuits. Repair the circuits or replace the relay, if required.
	5. Improperly installed or faulty Fin Sensor.	5. See Fin Sensor/Diagnosis and Testing in this group. Reinstall or replace the Fin Sensor as required.
	6. Faulty a/c high pressure transducer.	6. See A/C High Pressure Transducer/Diagnosis and Testing in this group. Test the a/c high pressure transducer and replace, if required.
	7. Faulty Powertrain Control Module (PCM).	7. (Refer to Appropriate Diagnostic Information). Test the PCM and replace, if required.
Normal pressures, but A/C Performance Test air temperatures at center panel outlet are too high.	1. Excessive refrigerant oil in system.	1. See Refrigerant Oil/Standard Procedure - Refrigerant Oil Level in this group. Recover the refrigerant from the refrigerant system and inspect the refrigerant oil content. Restore the refrigerant oil to the proper level, if required.
	2. Blend door inoperative or sealing improperly.	2. See Blend Door in this group. Inspect the blend door for proper operation and sealing and correct, if required.
	3. Blend door actuator faulty or inoperative.	3. Perform blend door actuator diagnosis, replace if faulty.
The low side pressure is normal or slightly low, and the high side pressure is too low.	1. Low refrigerant system charge.	1. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	2. Refrigerant flow through the accumulator is restricted.	2. See Accumulator in this group. Replace the restricted accumulator, if required.
	3. Refrigerant flow through the evaporator coil is restricted.	3. See A/C Evaporator in this group. Replace the restricted evaporator coil, if required.
	4. Faulty compressor.	4. See A/C Compressor in this group. Replace the compressor, if required.
The low side pressure is normal or slightly high, and the high side pressure is too high.	1. Condenser air flow restricted.	1. Check the condenser for damaged fins, foreign objects obstructing air flow through the condenser fins, and missing or improperly installed air seals. Refer to Cooling for more information on air seals. Clean, repair, or replace components as required.
	2. Inoperative cooling fan.	2. Refer to Cooling for more information. Test the cooling fan and replace, if required.
	3. Refrigerant system overcharged.	3. See Plumbing/Standard Procedure - Refrigerant System Charge in this group. Recover the refrigerant from the refrigerant system. Charge the refrigerant system to the proper level, if required.

HEATING & AIR CONDITIONING (Continued)

Pressure Diagnosis		
Condition	Possible Causes	Correction
	4. Air in the refrigerant system.	4. See Plumbing/Diagnosis and Testing - Refrigerant System Leaks in this group. Test the refrigerant system for leaks. Repair, evacuate and charge the refrigerant system, if required.
	5. Engine overheating.	5. Refer to Cooling for more information. Test the cooling system and repair, if required.
The low side pressure is too high, and the high side pressure is too low.	1. Accessory drive belt slipping.	1. Refer to Cooling for more information. Inspect the accessory drive belt condition and tension. Tighten or replace the accessory drive belt, if required.
	2. Fixed orifice tube not installed.	2. See A/C Orifice Tube in this group. Replace the liquid line, if required.
	3. Faulty compressor.	3. See A/C Compressor in this group. Replace the compressor, if required.
The low side pressure is too low, and the high side pressure is too high.	1. Restricted refrigerant flow through the refrigerant lines.	1. See Liquid, Suction, and Discharge Line in this group. Inspect the refrigerant lines for kinks, tight bends or improper routing. Correct the routing or replace the refrigerant line, if required.
	2. Restricted refrigerant flow through the fixed orifice tube.	2. See A/C Orifice Tube in this group. Replace the liquid line, if required.
	3. Restricted refrigerant flow through the condenser.	3. See A/C Condenser in this group. Replace the restricted condenser, if required.

DIAGNOSIS AND TESTING - HEATER PERFORMANCE

Before performing the following tests, refer to Cooling for the procedures to check the engine coolant level and flow, engine coolant reserve/recovery system operation, accessory drive belt condition and tension, radiator air flow and the fan drive operation. Also be certain that the accessory vacuum supply line is connected at the engine vacuum source.

MAXIMUM HEATER OUTPUT

Engine coolant is delivered to the heater core through two heater hoses. With the engine idling at normal operating temperature, set the temperature control knob in the full hot position, the mode control switch knob in the floor position, and the blower motor switch knob in the highest speed position. Using a test thermometer, check the temperature of the air being discharged at the HVAC housing floor outlets. Compare the test thermometer reading to the Temperature Reference chart.

Temperature Reference				
Ambient Air Temperature	15.5° C (60° F)	21.1° C (70° F)	26.6° C (80° F)	32.2° C (90° F)
Minimum Air Temperature at Floor Outlet	62.2° C (144° F)	63.8° C (147° F)	65.5° C (150° F)	67.2° C (153° F)

HEATING & AIR CONDITIONING (Continued)

If the floor outlet air temperature is too low, refer to Cooling to check the engine coolant temperature specifications. Both of the heater hoses should be hot to the touch. The coolant return heater hose should be slightly cooler than the coolant supply heater hose. If the return hose is much cooler than the supply hose, locate and repair the engine coolant flow obstruction in the cooling system. Refer to Cooling for the procedures.

An alternate method of checking heater performance is to use a DRBIII® scan tool to monitor the engine coolant temperature. The floor outlet air temperature reading should be no more than 4.5° C (40° F) lower than the engine coolant temperature reading.

OBSTRUCTED COOLANT FLOW Possible locations or causes of obstructed coolant flow:

- Faulty water pump.
- Faulty thermostat.
- Pinched or kinked heater hoses.
- Improper heater hose routing.
- Plugged heater hoses or supply and return ports at the cooling system connections.
- A plugged heater core.

If proper coolant flow through the cooling system is verified, and heater outlet air temperature is still low, a mechanical problem may exist.

MECHANICAL PROBLEMS Possible locations or causes of insufficient heat:

- An obstructed cowl air intake.
- Obstructed heater system outlets.
- A faulty, obstructed or improperly installed blend door.
- A faulty blower system.
- A faulty a/c heater control.

TEMPERATURE CONTROL

If the heater outlet air temperature cannot be adjusted with the temperature control knob on the a/c heater control panel, the following could require service:

- A faulty a/c heater control.
- A faulty blend door actuator.
- A faulty, obstructed or improperly installed blend door.
- An obstructed cowl air intake.
- The engine cooling system.

Heater Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
INSUFFICIENT HEATER OUTPUT.	1. Incorrect engine coolant level.	1. Check the engine coolant level. Refer to Cooling for the procedures.
	2. Air trapped in engine cooling system.	2. Check the operation of the coolant reserve/recovery system. Refer to Cooling for the procedures.
	3. Incorrect engine coolant temperature.	3. Check the performance and operation of the engine cooling system including: thermostat, water pump, fan drive, accessory drive belt, coolant flow (plugged radiator or heater core, plugged or kinked coolant hoses), air flow (missing or improperly installed radiator air seals or fan shroud). Refer to Cooling for the procedures.
	4. Blend door actuator inoperative or defective.	4. (Refer to Controls/Blend Door Actuator) in this group.
	5. Blend door not operating properly.	5. Check for a damaged, obstructed or improperly installed blend door or seals. (Refer to Controls/Blend Door Actuator) in this group.
	6. Insufficient air flow through heater housing.	6. Remove foreign material or obstructions from cowl air intake.
	7. Improper blower motor operation.	7. (Refer to Distribution/Blower Motor/ Diagnosis and Testing) in this group.

HEATING & AIR CONDITIONING (Continued)

STANDARD PROCEDURE - DIODE REPLACEMENT

(1) Disconnect the battery negative cable and isolate it. If vehicle has a dual batterys remove both negative cables.

(2) Locate the diode in the harness, and remove the protective covering.

(3) Remove the diode from the harness, pay attention to the current flow direction (Fig. 2).

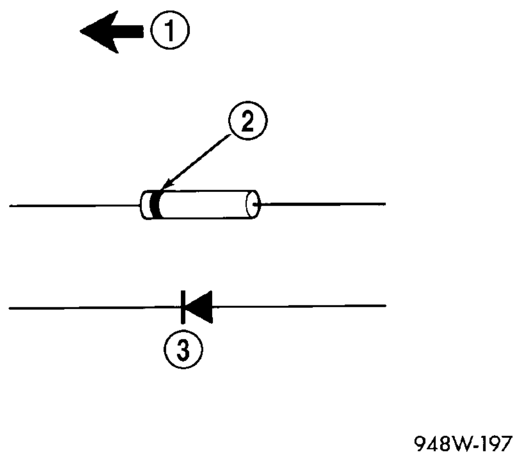

Fig. 2 DIODE IDENTIFICATION

1 - CURRENT FLOW
2 - BAND AROUND DIODE INDICATES CURRENT FLOW
3 - DIODE AS SHOWN IN THE DIAGRAMS

(4) Remove the insulation from the wires in the harness. Only remove enough insulation to solder in the new diode.

(5) Install the new diode in the harness, making sure current flow is correct. If necessary refer to the appropriate wiring diagram for current flow.

(6) Solder the connections together using rosin core type solder only. **Do not use acid core solder.**

(7) Tape the diode to the harness using electrical tape making, sure the diode is completely sealed from the elements.

(8) Re-connect the battery negative cable(s), and test affected systems.

SPECIFICATIONS

A/C APPLICATION TABLE

Item	Description	Notes
Vehicle	DR- Ram Truck	
System	R134a w/ fixed orifice tube	
Compressor	Saden SD-7	SP-15 PAG oil
Freeze–up Control	A/C Fin Sensor	Evaporator mounted
High psi Control	475 psi A/C cut out	discharge line
Control Head	electronic	Software - J2190
Mode Door	electric	
Blend Door	electric	
Recirculation Door	electric	
Blower Motor	hardwired to control head	resistor block
Cooling Fan	Viscous for cooling with a single speed electric for A/C for 3.7, 4.7 and 5.7L gas engines. Viscous for both cooling and A/C with 5.9L diesel engine and 8.0L gas engine.	
Clutch	Electro-mechanical	
Control	relay	PCM
Draw	2 - 3.7 amps @ 12V	± 0.5V @ 70° F
Gap	0.016″ - 0.031″	
DRB III®		
Reads	TPS, RPM, A/C switch test	
Actuators	clutch and fan relay	

HEATING & AIR CONDITIONING (Continued)

SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C COMPRESSOR CLUTCH PLATE NUT	14.4	10.5	127.4
A/C COMPRESOR LINE MANIFOLD FASTENER	28 (±6)	21 (±4)	250 (±50)
A/C COMPRESSOR TO MOUNTING BRACKET BOLTS	27	20	239
ACCUMULATOR RETAINING BOLT	5	3.7	44
BLEND DOOR ACTUATOR SCREWS	2.4 (±.34)	1.8 (±.25)	21 (±3)
HVAC HOUSING SCREWS	2.4 (±.34)	1.8 (±.25)	21 (±3)
HVAC HOUSING TO DASH PANEL NUTS	6.2	4.6	55
SUCTION LINE TO ACCUMULATOR FITTING	9	6.6	80

CONTROLS

TABLE OF CONTENTS

A/C COMPRESSOR CLUTCH

DESCRIPTION

The compressor clutch assembly consists of a stationary electromagnetic coil, a rotor bearing and rotor assembly, and a clutch plate (Fig. 1). The electromagnetic coil unit and the rotor bearing and rotor assembly are each retained on the nose of the compressor front housing with snap rings. The clutch plate is keyed to the compressor shaft and secured with a nut. These components provide the means to engage and disengage the compressor from the engine serpentine accessory drive belt.

OPERATION

When the clutch coil is energized, it magnetically draws the clutch into contact with the rotor and drives the compressor shaft. When the coil is not energized, the rotor freewheels on the clutch rotor bearing, which is part of the rotor. The compressor clutch and coil are the only serviced parts on the compressor.

The compressor clutch engagement is controlled by several components: the A/C Heater mode control switch, the A/C high pressure transducer, the compressor clutch relay, and the (JTEC). The JTEC may delay compressor clutch engagement for up to thirty

A/C COMPRESSOR CLUTCH (Continued)

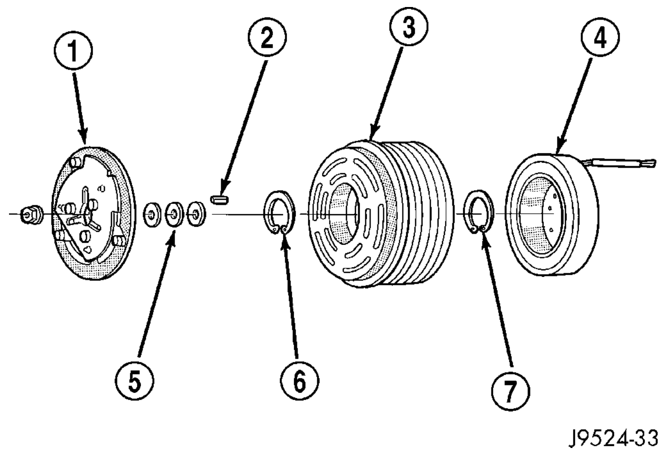

Fig. 1 COMPRESSOR CLUTCH - TYPICAL

1 - CLUTCH PLATE
2 - SHAFT KEY (not used on KJ)
3 - ROTOR
4 - COIL
5 - CLUTCH SHIMS
6 - SNAP RING
7 - SNAP RING

seconds. Refer to Electronic Control Modules for more information on the JTEC controls.

DIAGNOSIS AND TESTING - A/C COMPRESSOR CLUTCH COIL

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). The battery must be fully-charged before performing the following tests. Refer to Battery for more information.

(1) Connect an ammeter (0 to 10 ampere scale) in series with the clutch coil terminal. Use a voltmeter (0 to 20 volt scale) with clip-type leads for measuring the voltage across the battery and the compressor clutch coil.

(2) With the A/C Heater mode control switch in any A/C mode, and the blower motor switch in the lowest speed position, start the engine and run it at normal idle.

(3) The compressor clutch coil voltage should read within 0.2 volts of the battery voltage. If there is voltage at the clutch coil, but the reading is not within 0.2 volts of the battery voltage, test the clutch coil feed circuit for excessive voltage drop and repair as required. If there is no voltage reading at the clutch coil, use a DRB III ® scan tool and (Refer to Appropriate Diagnostic Information) for testing of the compressor clutch circuit and PCM control. The following components must be checked and repaired as required before you can complete testing of the clutch coil:

- Fuses in the junction block and the Power Distribution Center (PDC)
- A/C heater mode control switch
- Compressor clutch relay
- A/C high pressure transducer switch
- JTEC

(4) The compressor clutch coil is acceptable if the current draw measured at the clutch coil is 2.0 to 3.9 amperes with the electrical system voltage at 11.5 to 12.5 volts. This should only be checked with the work area temperature at 21° C (70° F). If system voltage is more than 12.5 volts, add electrical loads by turning on electrical accessories until the system voltage drops below 12.5 volts.

(a) If the clutch coil current reading is four amperes or more, the coil is shorted and should be replaced.

(b) If the clutch coil current reading is zero, the coil is open and should be replaced.

STANDARD PROCEDURE - A/C COMPRESSOR CLUTCH BREAK-IN

After a new compressor clutch has been installed, cycle the compressor clutch approximately twenty times (five seconds on, then five seconds off). During this procedure, set the A/C Heater control to the Recirculation Mode, the blower motor switch in the highest speed position, and the engine speed at 1500 to 2000 rpm. This procedure (burnishing) will seat the opposing friction surfaces and provide a higher compressor clutch torque capability.

REMOVAL

The refrigerant system can remain fully-charged during compressor clutch, rotor, or coil replacement. The compressor clutch can be serviced in the vehicle.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Unplug the compressor clutch coil wire harness connector.

(4) Remove the bolts that secure the compressor to the mounting bracket.

(5) Remove the compressor from the mounting bracket. Support the compressor in the engine compartment while servicing the clutch.

(6) Insert the two pins of the spanner wrench (Special Tool C-4489 or equivalent) into the holes of the clutch plate. Hold the clutch plate stationary and remove the hex nut (Fig. 2).

(7) Remove the clutch plate.

(8) Remove the compressor clutch shims.

(9) Remove the external front housing snap ring with snap ring pliers (Fig. 3).

(10) Install the lip of the rotor puller (Special Tool C-6141-1 or equivalent) into the snap ring groove exposed in the previous step, and install the shaft protector (Special Tool C-6141-2 or equivalent) (Fig. 4).

A/C COMPRESSOR CLUTCH (Continued)

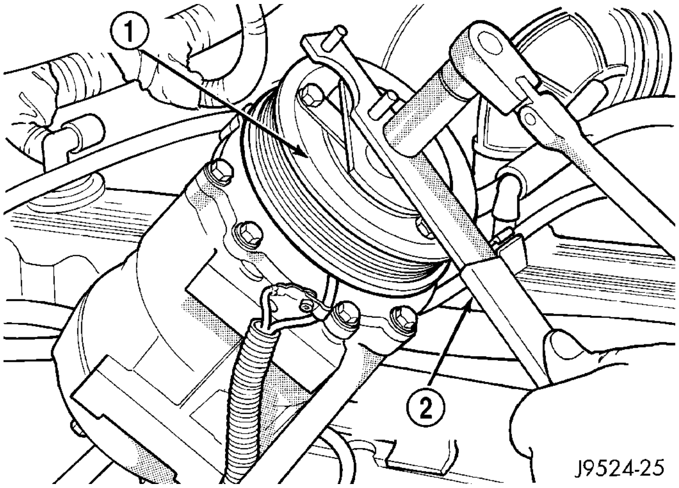

Fig. 2 CLUTCH NUT REMOVE - Typical

1 - CLUTCH PLATE
2 - SPANNER

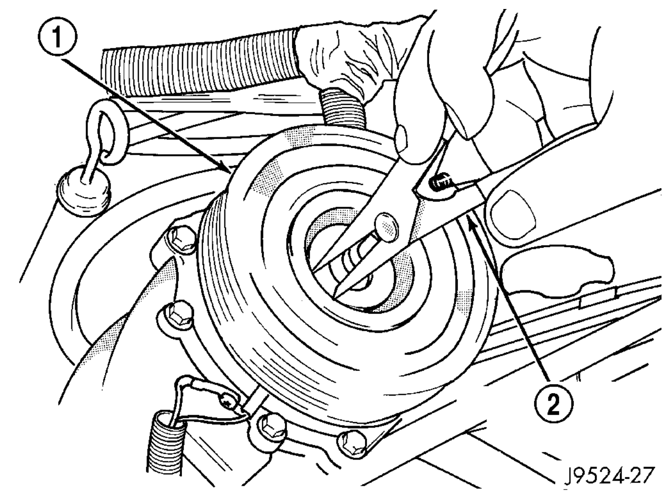

Fig. 3 EXTERNAL SNAP RING REMOVE - Typical

1 - PULLEY
2 - SNAP RING PLIERS

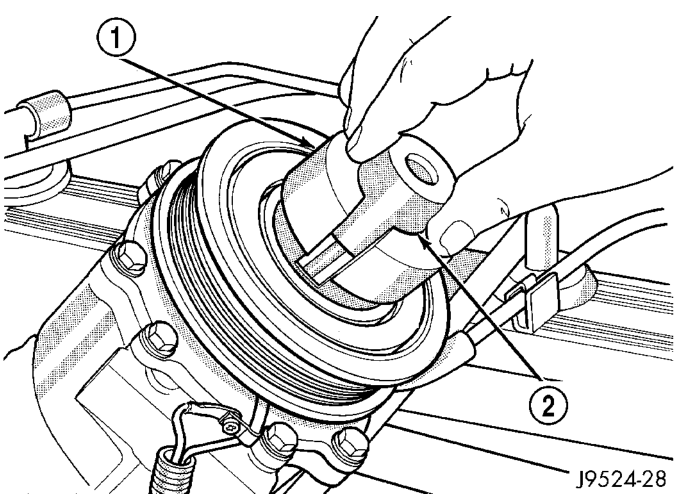

Fig. 4 SHAFT PROTECTOR AND PULLER - Typical

1 - PULLER JAW
2 - SHAFT PROTECTOR

(11) Install the puller through-bolts (Special Tool C-6461 or equivalent) through the puller flange and into the jaws of the rotor puller and tighten (Fig. 5). Turn the puller center bolt clockwise until the rotor is free.

CAUTION: DO NOT APPLY FORCE TO THE END OF THE COMPRESSOR SHAFT.

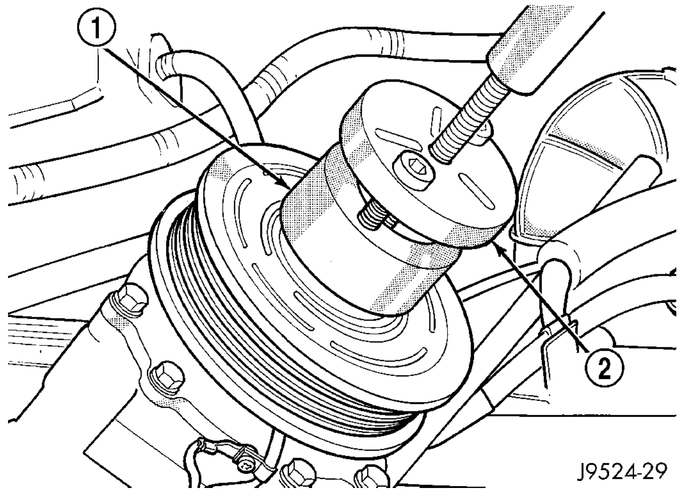

Fig. 5 INSTALL PULLER PLATE - Typical

1 - PULLER JAW
2 - PULLER

(12) Remove the screw and retainer from the clutch coil lead wire harness on the compressor front housing (Fig. 6).

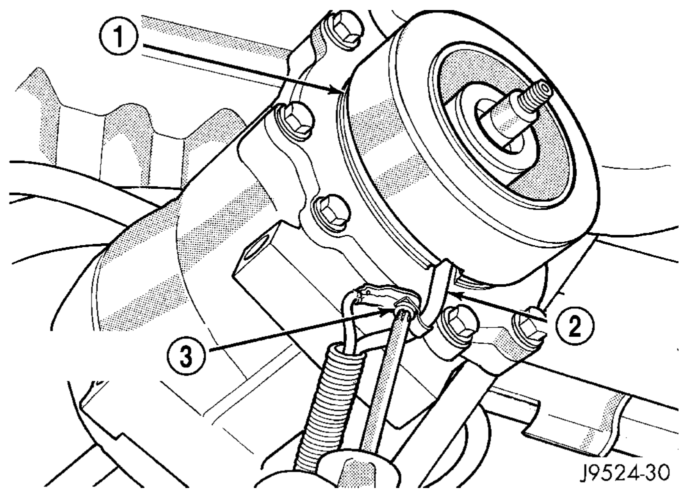

Fig. 6 CLUTCH COIL LEAD WIRE HARNESS - Typical

1 - COIL
2 - COIL WIRE
3 - RETAINER SCREW

(13) Remove the snap ring from the compressor hub and remove the clutch field coil (Fig. 7). Slide the clutch field coil off of the compressor hub.

A/C COMPRESSOR CLUTCH (Continued)

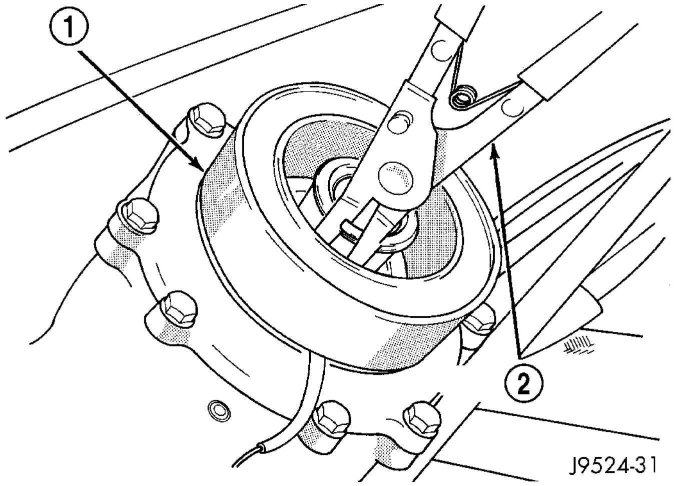

Fig. 7 CLUTCH FIELD COIL SNAP RING REMOVE - Typical

1 - COIL
2 - SNAP RING PLIERS

INSPECTION

Examine the friction surfaces of the clutch rotor and the clutch plate for wear. The rotor and clutch plate should be replaced if there is excessive wear or scoring.

If the friction surfaces are oily, inspect the shaft and nose area of the compressor for oil. Remove the felt from the front cover. If the felt is saturated with oil, the shaft seal is leaking and the compressor must be replaced.

Check the rotor bearing for roughness or excessive leakage of grease. Replace the rotor and clutch plate, if required.

INSTALLATION

(1) Install the clutch field coil and snap ring.

(2) Install the screw and retainer on the clutch coil lead wire harness on the compressor front housing. Tighten screw to 2.2 N·m (20 in. lbs.).

(3) Align the rotor assembly squarely on the front compressor housing hub.

(4) Install the rotor bearing assembly with the installer (Special Tool C-6871 or equivalent) (Fig. 8). Thread the installer on the shaft, then turn the nut until the rotor assembly is seated.

(5) Install the external front housing snap ring with snap ring pliers. The bevel side of the snap ring must be facing outward. Press the snap ring to make sure it is properly seated in the groove.

CAUTION: If the snap ring is not fully seated in the groove it will vibrate out, resulting in a clutch failure and severe damage to the front housing of the compressor.

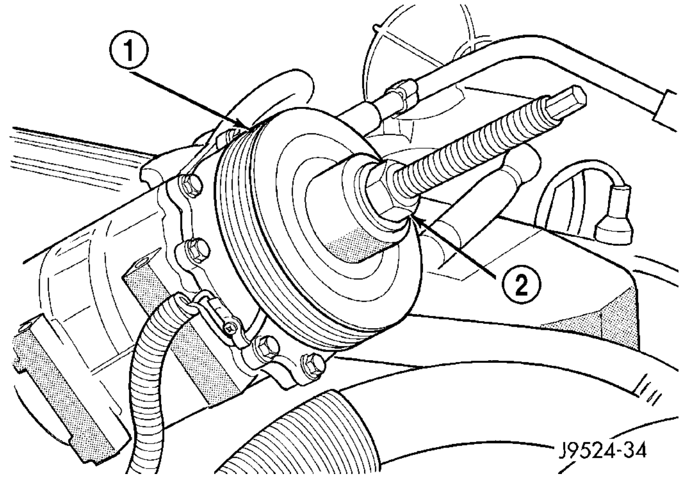

Fig. 8 CLUTCH PULLEY INSTALL - Typical

1 - ROTOR BEARING ASSEMBLY
2 - INSTALLER

(6) Install the original clutch shims on the compressor shaft.

(7) Install the clutch plate. Install the shaft hex nut and tighten to 15–20 N·m (11–15 ft. lbs.).

(8) Check the clutch air gap with a feeler gauge (Fig. 9). If the air gap does not meet the specification, add or subtract shims as required. The air gap specification is 0.41 to 0.79 millimeter (0.016 to 0.031 inch).

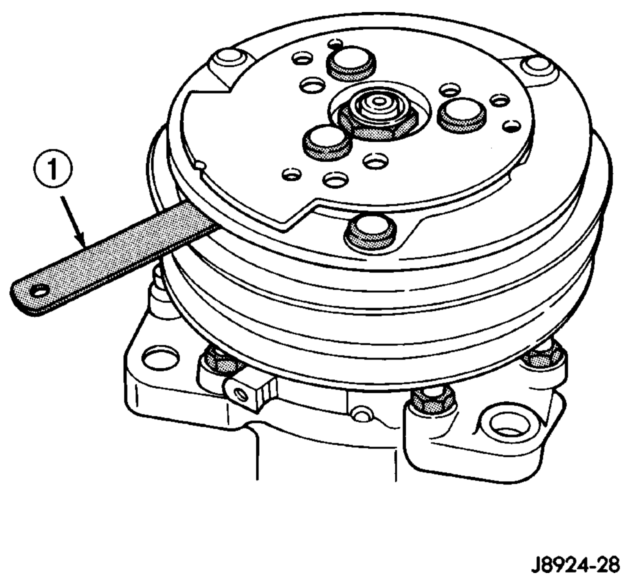

Fig. 9 CHECK CLUTCH AIR GAP - Typical

1 - FEELER GAUGE

A/C COMPRESSOR CLUTCH (Continued)

NOTE: The air gap is determined by the spacer shims. When installing an original, or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use a 1.0, 0.50, and 0.13 millimeter (0.040, 0.020, and 0.005 inch) shims from the new clutch hardware package that is provided with the new clutch.

(9) To complete the procedure, (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - INSTALLATION).

A/C COMPRESSOR CLUTCH RELAY

DESCRIPTION

The compressor clutch relay is a International Standards Organization (ISO) micro-relay. The terminal designations and functions are the same as a conventional ISO relay. However, the micro-relay terminal orientation (footprint) is different, the current capacity is lower, and the relay case dimensions are smaller than those of the conventional ISO relay.

The compressor clutch relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

OPERATION

The compressor clutch relay is a electromechanical device that switches battery current to the compressor clutch coil when the Powertrain Control Module (PCM) grounds the coil side of the relay. The PCM responds to inputs from the A/C Heater mode control switch, the A/C low pressure switch, and the A/C high pressure switch. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C COMPRESSOR CLUTCH RELAY - DIAGNOSIS AND TESTING)

The compressor clutch relay cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING - COMPRESSOR CLUTCH RELAY

RELAY TEST

The compressor clutch relay (Fig. 10) is located in the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location. Remove the relay from the PDC to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 67.5 to 82.5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery to terminals 85 and 86. There should now be continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, see Relay Circuit Test. If not OK, replace the faulty relay.

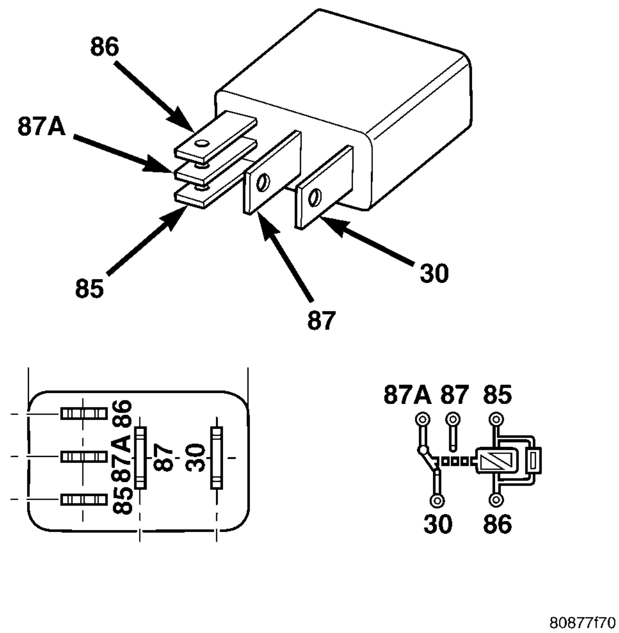

Fig. 10 COMPRESSOR CLUTCH RELAY

30 - COMMON FEED
85 - COIL GROUND
86 - COIL BATTERY
87 - NORMALLY OPEN
87A - NORMALLY CLOSED

RELAY CIRCUIT TEST

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

(1) The relay common feed terminal cavity (30) is connected to fused battery feed. There should be battery voltage at the cavity for relay terminal 30 at all times. If OK, go to Step 2. If not OK, repair the open circuit to the fuse in the PDC as required.

(2) The relay normally closed terminal (87A) is not used in this application. Go to Step 3.

(3) The relay normally open terminal cavity (87) is connected to the compressor clutch coil. There should be continuity between this cavity and the A/C compressor clutch relay output circuit cavity of the compressor clutch coil wire harness connector. If OK, go to Step 4. If not OK, repair the open circuit as required.

(4) The relay coil battery terminal (86) is connected to the fused ignition switch output (run/start) circuit. There should be battery voltage at the cavity

A/C COMPRESSOR CLUTCH RELAY (Continued)

for relay terminal 86 with the ignition switch in the On position. If OK, go to Step 5. If not OK, repair the open circuit to the fuse in the junction block as required.

(5) The coil ground terminal cavity (85) is switched to ground through the Powertrain Control Module (PCM). There should be continuity between this cavity and the A/C compressor clutch relay control circuit cavity of the PCM wire harness connector C (gray) at all times. If not OK, repair the open circuit as required.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cover from the Power Distribution Center (PDC).

(3) Refer to the label on the PDC for compressor clutch relay identification and location.

(4) Unplug the compressor clutch relay from the PDC.

INSTALLATION

(1) Install the compressor clutch relay by aligning the relay terminals with the cavities in the PDC and pushing the relay firmly into place.

(2) Install the PDC cover.

(3) Connect the battery negative cable.

(4) Test the relay operation.

A/C HEATER CONTROL

DESCRIPTION

The A/C heater system uses a seriers of electrical controls. These controls provide the vehicle operator with a number of setting options to help control the climate and comfort within the vehicle. Refer to the owner's manual in the vehicle glove box for more information on the features, use, and suggested operation of these controls.

The A/C heater control - (Single Zone) or (Dual Zone) panel is located to the right of the instrument cluster on the instrument panel.

The control panel contains a rotary-type temperature control, a rotary-type mode control switch knob, and a rotary-type blower motor speed switch knob. The control also has a push button to activate the Optional side view mirrors defroster elements and to turn the A/C on.

The Dual Zone HVAC control panel contains a pair of slider-type temperature controls, a rotary-type mode control switch knob and a rotary-type blower motor speed switch knob. The control also has buttons to turn the A/C ON, Set it on Max A/C and for the Optional Heated Sideview Mirrors.

The A/C heater control panel cannot be repaired. If faulty or damaged, the entire unit must be replaced. The illumination lamps are available for service replacement.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the center bezel from the instrument panel(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - REMOVAL).

(3) Remove the screws that secure the A/C Heater control to the instrument panel (Fig. 11) or (Fig. 12).

(4) Pull the A/C Heater control assembly away from the instrument panel far enough to access the connections on the back of the control.

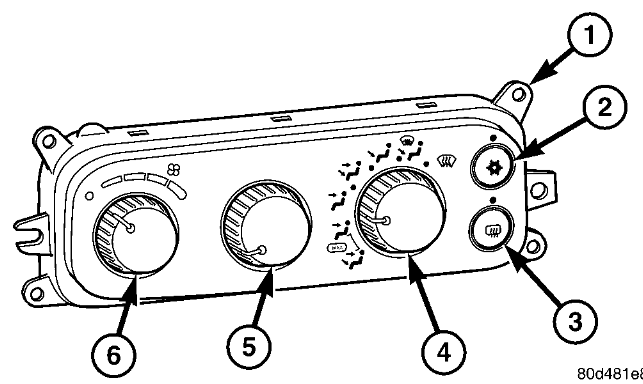

Fig. 11 Single Zone HVAC Control

1 - Mounting Tab (4)
2 - A/C Button
3 - Sideview Mirror Defroster Button (if equiped)
4 - Mode Control
5 - Blend Air Control
6 - Blower Motor Speed Control

(5) Unplug the wire harness connectors from the back of the A/C Heater control (Fig. 13).

A/C HEATER CONTROL (Continued)

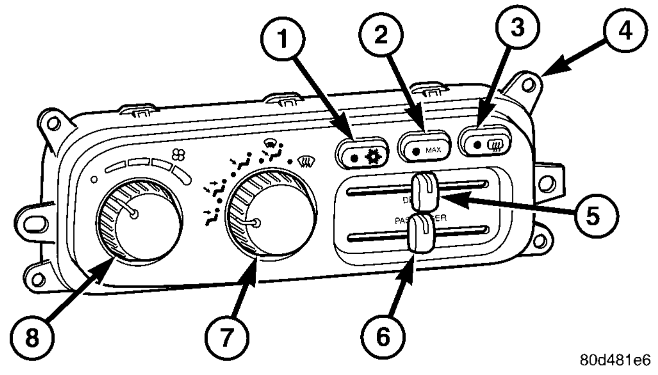

Fig. 12 Dual Zone A/C Control

1 - A/C Button
2 - Max. A/C Button
3 - Sideview Mirror Defrost Button (if equiped)
4 - Mounting Tabs (4)
5 - Driverside Temperature Control
6 - Passengerside Temperature Control
7 - Mode Control
8 - Blower Motor Speed Control

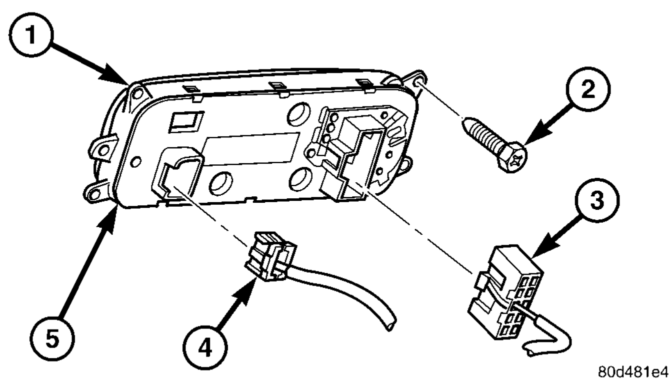

Fig. 13 HVAC Control - (Rear View- typical)

1 - Mounting Tabs (4)
2 - Mounting Screws (4)
3 - HVAC Control Connector
4 - Heated Sideview Mirror Connector
5 - HVAC Control Assembly

INSTALLATION

(1) Plug the two wire harness connectors into the back of the A/C Heater control.

(2) Position the A/C Heater control in the instrument panel bezel and secure it with four screws. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Reinstall the center bezel onto the instrument panel(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION).

(4) Connect the battery negative cable.

A/C PRESSURE TRANSDUCER

DESCRIPTION - A/C PRESSURE TRANSDUCER

The A/C pressure transducer is a switch that is installed on a fitting located on the refrigerant discharge line between the compressor and the condensor in the front corner of the engine compartment. An internally threaded hex fitting on the transducer connects it to the externally threaded Schrader-type fitting on the liquid line. A rubber O-ring seals the connection between the transducer and the discharge line fitting. Three terminals within a molded plastic connector receptacle on the top of the transducer connect it to the vehicle electrical system through a take out and connector of the headlamp and dash wire harness.

The A/C pressure transducer cannot be adjusted or repaired and, if faulty or damaged, it must be replaced.

OPERATION

The A/C pressure transducer monitors the pressures in the high side of the refrigerant system through its connection to a fitting on the discharge line. The transducer will change its internal resistance in response to the pressures it monitors. The Powertrain Control Module (PCM) provides a five volt reference signal and a sensor ground to the transducer, then monitors the output voltage of the transducer on a sensor return circuit to determine refrigerant pressure. The PCM is programmed to respond to this and other sensor inputs by controlling the operation of the air conditioning compressor clutch and the radiator cooling fan to help optimize air conditioning system performance and to protect the system components from damage. The A/C pressure transducer input to the PCM will also prevent the air conditioning compressor clutch from engaging when ambient temperatures are below about 10° C due to the pressure/temperature relationship of the refrigerant. The Schrader-type valve in the discharge line fitting permits the A/C pressure transducer to be removed or installed without disturbing the refrigerant in the system. The A/C pressure transducer is diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - A/C PRESSURE TRANSDUCER

The A/C pressure transducer is tested using a DRBIII® scan tool. Refer to the appropriate diagnostic information. Before testing the A/C pressure transducer, be certain that the transducer wire harness connection is clean of corrosion and properly connected. For the air conditioning system to operate, A/C PRESSURE TRANSDUCER (Continued)

an A/C pressure transducer voltage reading between 0.451 and 4.519 volts is required. Voltages outside this range indicate a low or high refrigerant system pressure condition to the Powertrain Control Module (PCM). The PCM is programmed to respond to a low or high refrigerant system pressure by suppressing operation of the compressor. Refer to the A/C Pressure Transducer Voltage table for the possible condition indicated by the transducer voltage readings.

A/C PRESSURE TRANSDUCER VOLTAGE	
VOLTAGE	POSSIBLE INDICATION
0.0	1. NO SENSOR SUPPLY VOLTAGE FROM PCM. 2. SHORTED SENSOR CIRCUIT. 3. FAULTY TRANSDUCER.
0.150 TO 0.450	1. AMBIENT TEMPERATURE BELOW 10° C (50° F). 2. LOW REFRIGERANT SYSTEM PRESSURE.
0.451 TO 4.519	1. NORMAL REFRIGERANT SYSTEM PRESSURE.
4.520 TO 4.850	1. HIGH REFRIGERANT SYSTEM PRESSURE.
5.0	1. OPEN SENSOR CIRCUIT. 2. FAULTY TRANSDUCER.

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Disconnect the wire harness connector for the A/C pressure transducer from the transducer connector receptacle.

(3) Using an open end wrench, unscrew the A/C pressure transducer from the fitting on the discharge line between the compressor and the condenser.

(4) Remove the seal from the A/C pressure transducer fitting and discard.

INSTALLATION

(1) Lubricate a new rubber O-ring seal with clean refrigerant oil and install it on the A/C pressure transducer fitting.

(2) Using an open end wrench, install and tighten the A/C pressure transducer onto the fitting on the discharge line between the compressor and the condenser.

(3) Reconnect the wire harness connector for the A/C pressure transducer to the transducer connector receptacle.

(4) Reconnect the battery negative cable.

BLEND DOOR ACTUATOR

DESCRIPTION

The blend door actuators are reversible, 12-volt Direct Current (DC), servo motors. Models with the single zone heater and air conditioner system have a single blend air door, which is controlled by a single blend door actuator. Models with the optional dual zone front heater and air conditioner system have dual blend air doors, which are controlled by two blend door actuators. The single zone blend door actuator is located on the driver side end of the heater-A/C housing unit, close to the dash panel. In the dual zone system, the same blend door actuator used for the single zone system becomes the driver side blend door actuator, and is mechanically connected to only the driver side blend air door. In the dual zone system, a second separate blend door actuator is also located on the top of the heater-A/C housing unit and is mechanically connected to only the passenger side blend air door.

The blend door actuators are interchangeable with each other, as well as with the actuators for the mode door and the recirculation air door. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the heater-A/C unit housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the proper blend air door. The blend door actuators do not require mechanical indexing to the blend door linkage, as they are electronically calibrated by the heater-A/C control module. The blend door actuators cannot be adjusted or repaired and, if damaged or faulty, they must be replaced.

OPERATION

Each blend door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The blend door actuator can move the blend air door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the blend air door will move in one direction. When the module reverses the polarity of the voltage to the motor, the blend air door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the blend air door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative positions of the blend door actuator and the blend air door. The heater-A/C con-

BLEND DOOR ACTUATOR (Continued)

trol module learns the blend air door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the blend door actuator circuits. The blend door actuator can be diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

The single zone heating and air conditioning system is equipped with a single blend door actuator. The dual zone system has two blend door actuators, one for the driver side blend air door and one for the passenger side blend air door. The same service procedures can be used for each of these actuators.

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(3) Disconnect the HVAC wire harness connector for the blend door actuator from the actuator connector receptacle. (Fig. 14)

(4) Remove the screws that secure the blend door actuator to the distribution housing.

(5) Remove the blend door actuator from the distribution housing.

INSTALLATION

(1) Position the blend door actuator into the heater/air conditioner housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the blend air door linkage.

(2) Install and tighten the three screws that secure the blend door actuator to the distribution housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the blend door actuator to the actuator connector receptacle.

(4) Install the instrument panel assembly(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

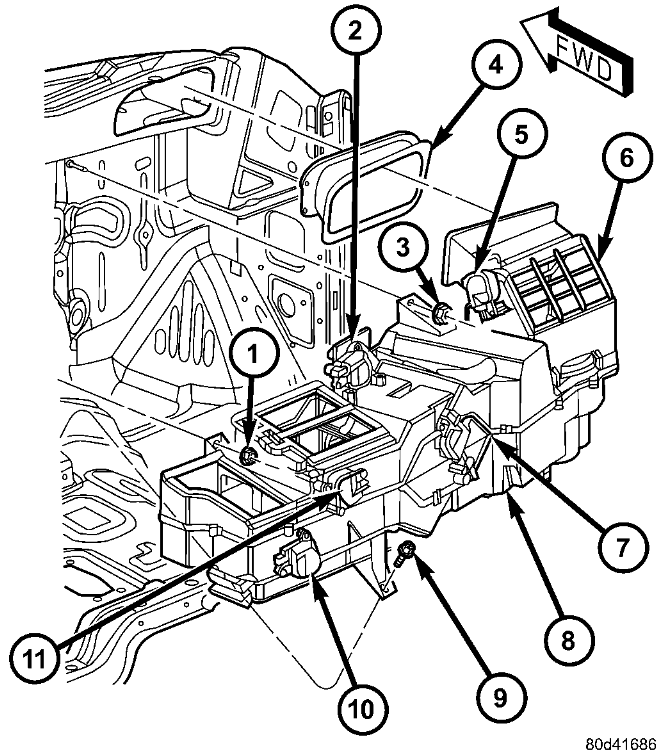

Fig. 14 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

(5) Reconnect the battery negative cable.

(6) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

BLOWER MOTOR RESISTOR BLOCK

DESCRIPTION

The blower motor resistor is mounted to the rear side of the HVAC housing on the passenger side of the vehicle.

OPERATION

The resistor is a ceramic resistor that utilizes resistor circuit tracers to reduce current flow to the

BLOWER MOTOR RESISTOR BLOCK (Continued)

blower. The blower motor switch directs the ground path through the correct resistor circuit to obtain the selected speed.

The blower motor resistor cannot be repaired and, if faulty or damaged, it must be replaced.

DIAGNOSIS AND TESTING - BLOWER MOTOR RESISTOR

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Reach under the passenger side bottom of the HVAC unit and unplug the wire harness connector from the blower motor resistor.

(3) Check for continuity between each of the blower motor switch input terminals of the resistor and the resistor output terminal. In each case there should be continuity. If OK, repair the wire harness circuits between the blower motor switch and the blower motor resistor or blower motor relay as required. If not OK, replace the faulty blower motor resistor.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) The blower motor resistor is accessable from the passenger side of the HVAC unit and is located on the bottom of the HVAC unit.

(3) Pull out the lock on the blower motor resistor wire harness connector to unlock the connector latch.

(4) Depress the latch on the blower motor resistor wire harness connector and unplug the connector from the resistor.

(5) Remove the two screws that secure the resistor to the HVAC housing.

(6) Remove the resistor from the HVAC housing.

INSTALLATION

(1) Install the new resistor in the HVAC housing.

(2) Install the two screws that secure the resistor to the HVAC housing and tighten to 2.2 N·m (20 in. lbs.).

(3) Plug in the blower motor harness connector.

(4) Push in the lock on the blower motor resistor harness connector.

(5) Close the glove box door.

(6) Connect the battery negative cable.

BLOWER MOTOR SWITCH

DESCRIPTION

The A/C Heater blower motor is controlled by a four position rotary-type blower motor switch, mounted in the A/C Heater control panel. The switch allows the selection of one of four blower motor speeds, but can only be turned off by selecting the Off position on the blower motor switch.

OPERATION

The blower motor switch directs the blower motor ground path through the mode control switch to the blower motor resistor, or directly to ground, as required to achieve the selected blower motor speed.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire A/C Heater control unit must be replaced.

DIAGNOSIS AND TESTING - BLOWER MOTOR SWITCH

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information).

BLOWER MOTOR SWITCH (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check for battery voltage at the fuse in the Power Distribution Center (PDC). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Turn the ignition switch to the Off position. Disconnect and isolate the battery negative cable. Remove the A/C Heater control from the instrument panel. Check for continuity between the ground circuit cavity of the A/C Heater control wire harness connector and a good ground. There should be continuity. If OK, go to Step 3. If not OK, repair the open circuit to ground as required.

(3) With the A/C Heater control wire harness connector unplugged, place the A/C Heater mode control switch knob in any position except the Off position. Check for continuity between the ground circuit terminal and each of the blower motor driver circuit terminals of the A/C Heater control as you move the blower motor switch knob to each of the four speed positions. There should be continuity at each driver circuit terminal in only one blower motor switch speed position. If OK, test and repair the blower driver circuits between the A/C Heater control connector and the blower motor resistor as required. If not OK, replace the faulty A/C Heater control unit.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The blower motor switch cannot be repaired and, if faulty or damaged, the entire A/C Heater control unit must be replaced. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - REMOVAL)

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) The blower motor switch cannot be repaired and, if faulty or damaged the entire A/C heater control unit must be replaced(Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C HEATER CONTROL - INSTALLATION).

DEFROST DOOR ACTUATOR

REMOVAL - FLOOR - DEFROST DOOR ACTUATOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly from the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

(3) Remove the electrical connector from the actuator (Fig. 15).

DEFROST DOOR ACTUATOR (Continued)

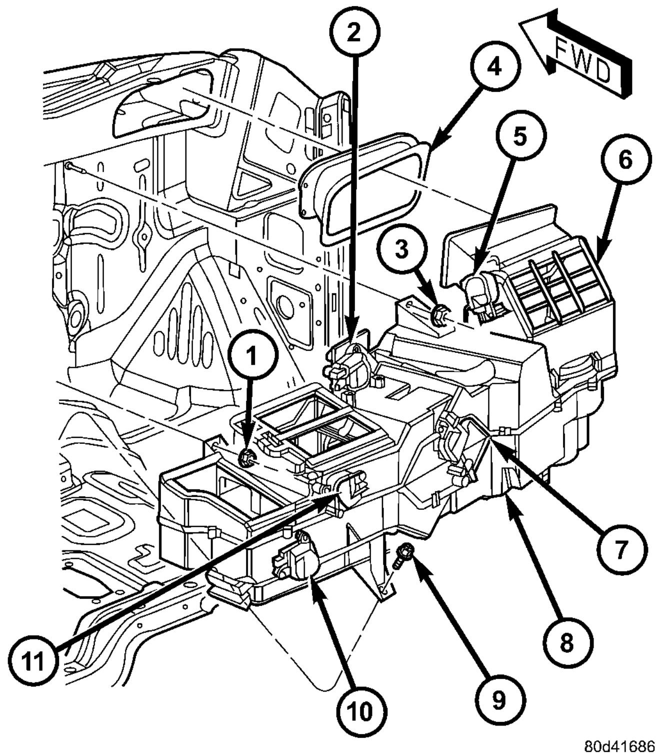

Fig. 15 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

(4) Remove the mounting screws from the actuator.

(5) Remove the actuator from the HVAC housing.

INSTALLATION - FLOOR - DEFROST DOOR ACTUATOR

(1) Install the floor-defrost door actuator to the HVAC assembly.

(2) Install the mounting screws and tighten to 2.2 N·m (20 in. lbs.).

(3) Install the actuator electrical connector.

(4) Install the instrument panel assembly into the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL/ INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Connect the battery negative cable.

MODE DOOR ACTUATOR

DESCRIPTION

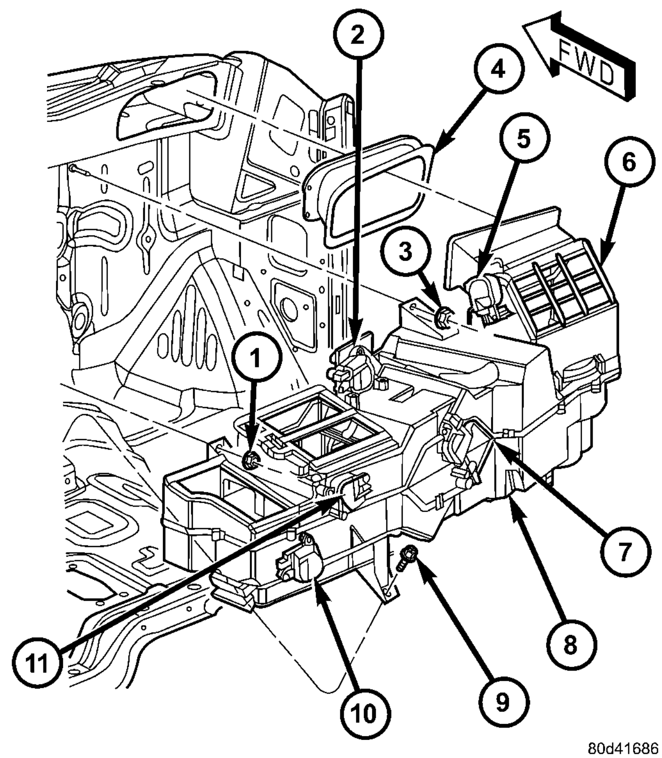

Fig. 16 HVAC Housing - Dual Zone Shown (Typical- Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

The mode door actuator is a reversible, 12-volt Direct Current (DC), servo motor (Fig. 16). The single mode door actuator is located on the driver side end of the heater-A/C housing unit, close to the top of the distribution housing. The mode door actuator is mechanically connected to the mode door. The mode door actuator is interchangeable with the actuators for the blend air door(s) and the recirculation air door. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the heater-A/C unit housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the mode door. The mode door actuator does not require mechanical indexing

MODE DOOR ACTUATOR (Continued)

to the mode door linkage, as it is electronically calibrated by the heater-A/C control module. The mode door actuator cannot be adjusted or repaired and, if damaged or faulty, it must be replaced.

OPERATION

The mode door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The mode door actuator can move the mode door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the mode door will move in one direction. When the module reverses the polarity of the voltage to the motor, the mode door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the mode door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative position of the mode door actuator and the mode door. The heater-A/C control module learns the mode door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the mode door actuator circuits. The mode door actuator can be diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel assembly(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - REMOVAL).

(3) Disconnect the electricial connector from the actuator (single or dual zone as required).

(4) Remove the two screws that secure the mode door actuators to the distribution housing. For single zone systems only lower actuator in present. For dual zone systems remove second actuator which is mounted on top of HVAC housing (Fig. 17).

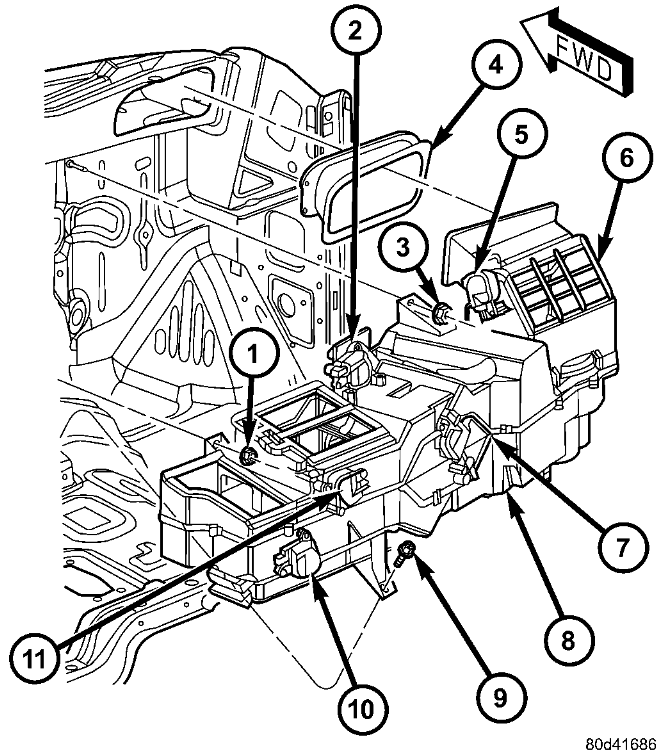

Fig. 17 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

(5) Remove the mode door actuators from the distribution housing.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the mode door actuators onto the heater/AC housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the mode door linkage.

(2) Install and tighten the two screws that secure the mode door actuators to the distribution housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the mode door actuators to the actuator connector receptacle.

(4) Install the instrument panel assembly(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Reconnect the battery negative cable.

(6) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

RECIRCULATION DOOR ACTUATOR

DESCRIPTION

The recirculation door actuator is a reversible, 12-volt Direct Current (DC), servo motor. The single recirculation door actuator is located on the passenger side end of the heater-A/C housing unit. The recirculation door actuator is mechanically connected to the recirculation air door. The recirculation door actuator is interchangeable with the actuators for the blend air door(s) and the mode doors. Each actuator is contained within an identical black molded plastic housing with an integral wire connector receptacle. Two integral mounting tabs allow the actuator to be secured with two screws to the intake air housing. Each actuator also has an identical output shaft with splines that connects it to the linkage that drives the recirculation air door. The recirculation door actuator does not require mechanical indexing to the recirculation air door, as it is electronically calibrated by the heater-A/C control module. The recirculation door actuator cannot be adjusted or repaired and, if damaged or faulty, it must be replaced.

OPERATION

The recirculation door actuator is connected to the heater-A/C control module through the vehicle electrical system by a dedicated two-wire take out and connector of the HVAC wire harness. The recirculation door actuator can move the recirculation door in two directions. When the heater-A/C control module pulls the voltage on one side of the motor connection high and the other connection low, the recirculation air door will move in one direction. When the module reverses the polarity of the voltage to the motor, the recirculation air door moves in the opposite direction. When the module makes the voltage to both connections high or both connections low, the recirculation air door stops and will not move. These same motor connections also provide a feedback signal to the heater-A/C control module. This feedback signal allows the module to monitor the operation and relative position of the recirculation door actuator and the recirculation air door. The heater-A/C control module learns the recirculation air door stop positions during the calibration procedure and will store a Diagnostic Trouble Code (DTC) for any problems it detects in the recirculation door actuator circuits. The recirculation door actuator can be diagnosed using a DRBIII® scan tool. Refer to the appropriate diagnostic information.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Pull the carpet on the passenger side front floor away from the dash panel far enough to access the recirculation door actuator.

RECIRCULATION DOOR ACTUATOR (Continued)

(3) Disconnect the HVAC wire harness connector for the recirculation door actuator from the actuator connector receptacle (Fig. 18).

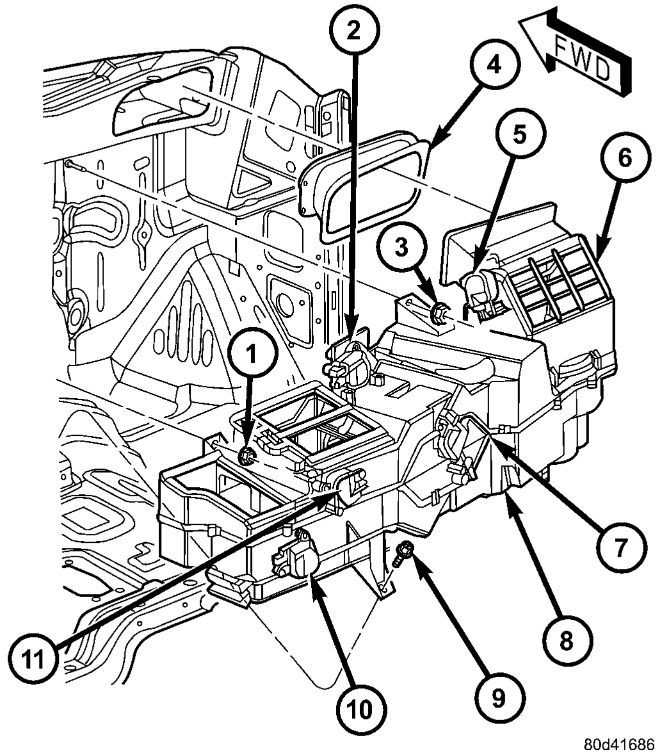

Fig. 18 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

(4) Remove the two screws that secure the recirculation door actuator to the intake air housing.

(5) Remove the recirculation door actuator from the intake air housing.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the recirculation door actuator onto the intake air housing. If necessary, rotate the actuator slightly to align the splines on the actuator output shaft with those in the recirculation air door.

(2) Install and tighten the two screws that secure the recirculation door actuator to the lower intake air housing. Tighten the screws to 2 N·m (17 in. lbs.).

(3) Reconnect the HVAC wire harness connector for the recirculation door actuator to the actuator connector receptacle.

(4) Install the Instrument Panel(Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL ASSEMBLY - INSTALLATION).

(5) Reconnect the battery negative cable.

(6) Perform the heater-A/C control calibration procedure. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS - FRONT/A/C-HEATER CONTROL - STANDARD PROCEDURE - HEATER-A/C CONTROL CALIBRATION).

DISTRIBUTION

TABLE OF CONTENTS

AIR OUTLETS

REMOVAL - PANEL OUTLETS

(1) Use a trim stick or another suitable wide flat-bladed tool to gently pry the panel outlet grill out of the panel outlet housing (Fig. 1). The panel outlet grill is retained by a light snap fit.

INSTALLATION - PANEL OUTLETS

To install, position the grill housing in the panel outlet housing and press firmly until it snaps into place.

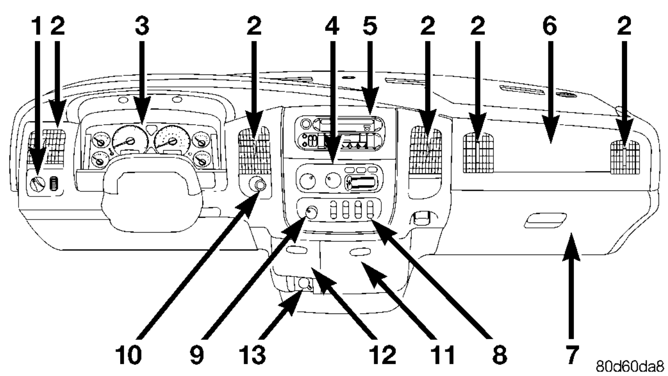

Fig. 1 Dash Panel

1 - Headlight Switch
2 - Air Outlets
3 - Instrument Cluster
4 - Climate Control
5 - Radio
6 - Airbag
7 - Glove Box
8 - Heated Seat Switch (if equipped)
9 - Transfer Case Control Switch (if equipped)
10 - Cigar Lighter
11 - Cup Holders
12 - Ash Tray (if equipped)
13 - Power Outlet

BLEND DOOR

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

BLEND DOOR (Continued)

(1) Recover refrigerant(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(2) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

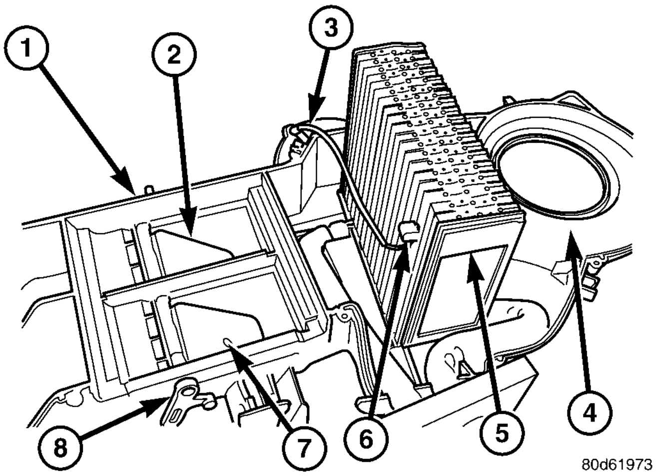

Fig. 2 Dual Zone HVAC Housing- (typical single zone)

1 - Passenger Side Blend Door Lever (if equipped)
2 - Passenger Side Blend Door (if equipped)
3 - Fin Sensor Wire
4 - Lower Blower Motor Mounting Housing
5 - HVAC Evaporator
6 - Fin Sensor
7 - Driver Side Blend Door
8 - Driver Side Blend Door Lever

(3) Remove the levers from the driver and passenger side blend air doors (Fig. 2).

(4) Gently slide the drivers or passenger side blend air door toward the out side of the case and tilt and lift the doors out of the case.

(5) Inspect doors, seals and case for damage or binding and repair or replace as required.

INSTALLATION

NOTE: Vehicles equiped with single zone HVAC systems will only have one blend air door, dual zone systems have two blend air doors.

(1) Place the blend door pivot shafts in to the pivot holes in the bottom of the lower half of the HVAC housing.

(2) Blend doors are installed by carefully tipping the doors in and then sliding each door into position.

(3) Install blend door levers to each door, position levers so that the doors are able to move smoothly without any binding. Adjust as required to insure proper operation.

(4) Check all sealing surfaces and reposition or replace any seals as required.

(5) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/ HVAC HOUSING - ASSEMBLY)

(6) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

(7) Run calibration test.

BLOWER MOTOR

DESCRIPTION

The blower motor and blower wheel are located in the passenger side end of the HVAC housing, below the glove box. The blower motor controls the velocity of air flowing through the HVAC housing by spinning a squirrel cage-type blower wheel within the housing at the selected speed. The blower motor and wheel can be removed from the housing inside the vehicle without removing the dash or HVAC housing assembly.

OPERATION

The blower motor will only operate when the ignition switch is in the On position, and the A/C Heater mode control switch knob is in any position, except Off. The blower motor receives a fused battery feed through the blower motor relay whenever the ignition switch is in the On position. The blower motor battery feed circuit is protected by a fuse in the Power Distribution Center (PDC). Blower motor speed is controlled by regulating the ground path through the A/C Heater control blower motor switch and the blower motor resistor.

The blower motor and blower motor wheel cannot be repaired and, if faulty or damaged, they must be replaced. The blower motor and blower wheel are serviced only as a unit.

BLOWER MOTOR (Continued)

DIAGNOSIS AND TESTING - BLOWER MOTOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

For circuit descriptions and diagrams, (Refer to Appropriate Wiring Information). Possible causes of an inoperative blower motor include:

- Faulty fuse
- Faulty blower motor circuit wiring or wire harness connectors
- Faulty blower motor resistor
- Faulty blower motor relay
- Faulty blower motor switch
- Faulty A/C Heater mode control switch
- Faulty blower motor.

Possible causes of the blower motor not operating in all speeds include:

- Faulty blower motor switch
- Faulty blower motor resistor
- Faulty blower motor circuit wiring or wire harness connectors.

VIBRATION

Possible causes of blower motor vibration include:

- Improper blower motor mounting
- Improper blower wheel mounting
- Blower wheel out of balance or bent
- Blower motor faulty.

NOISE

To verify that the blower is the source of the noise, unplug the blower motor wire harness connector and operate the HVAC system. If the noise goes away, possible causes include:

- Foreign material in the HVAC housing
- Improper blower motor mounting
- Improper blower wheel mounting
- Blower motor faulty.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The blower motor is located on the passenger side of the vehicle under the dash

(1) Disconnect and isolate the battery negative cable.

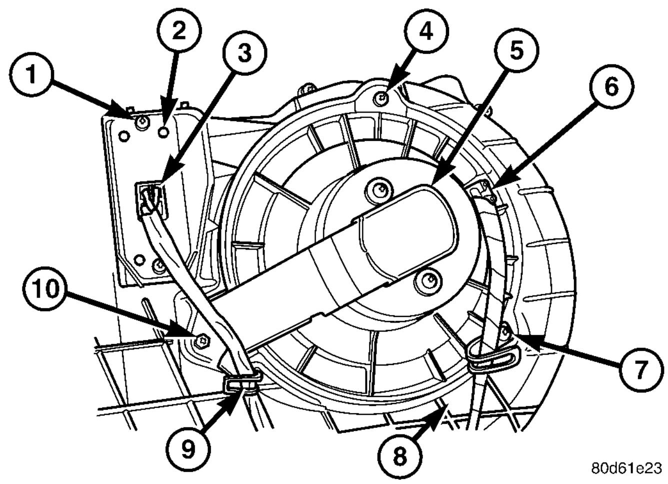

Fig. 3 Blower Motor Assembly- (Case Removed from vehicle for graphic)

1 - Blower Motor Resistor Mounting Screws (2)
2 - Blower Motor Resistor
3 - Blower Motor Resistor Connector
4 - Blower Motor Mounting Screw
5 - Blower Motor Assmebly
6 - Blower Motor Wire
7 - Blower Motor Mounting Screw
8 - HVAC Housing
9 - Blower Motor Wire Hold Down
10 - Blower Motor Mounting Screw

(2) Unplug the blower motor wire harness connector (Fig. 3).

(3) Remove the three screws that secure the blower motor and wheel assembly to the HVAC housing.

(4) Rotate and tilt the blower motor unit as needed for clearance to remove the blower motor and wheel from the HVAC housing.

INSTALLATION

(1) Align and install the blower motor and wheel assembly into the HVAC housing.

(2) Install the three mounting screws and tighten to 2.2 N·m (20 in. lbs.).

BLOWER MOTOR (Continued)

(3) Plug in the blower motor wire harness connector.

(4) Connect the battery negative cable.

DEFROST DOOR

REMOVAL - DEFROST DOOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) Recover refrigerant(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(2) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(3) Remove the defrost door actuator.

(4) Remove the defrost door from the HVAC housing, by first removing the actuator if not already removed. Then carefully move the door so that one pivot point cleans then tilt and lift the door out of the HVAC housing.

INSTALLATION - DEFROST DOOR

(1) Install the defrost door in the HVAC housing.

(2) Install the defrost door actuator.

(3) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY)

(4) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

(5) Run calibration test.

FLOOR DISTRIBUTION DUCTS

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Remove the screws that secure the floor duct to the HVAC housing.

(2) Remove the floor duct from the HVAC housing.

INSTALLATION

(1) Install the floor duct on the HVAC housing.

(2) Install the screws that secure the floor duct to the HVAC housing. Tighten the mounting screws to 2.2 N·m (20 in. lbs.).

(3) Install the battery negative cable.

HVAC HOUSING

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument panel from the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - REMOVAL).

HVAC HOUSING (Continued)

(3) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

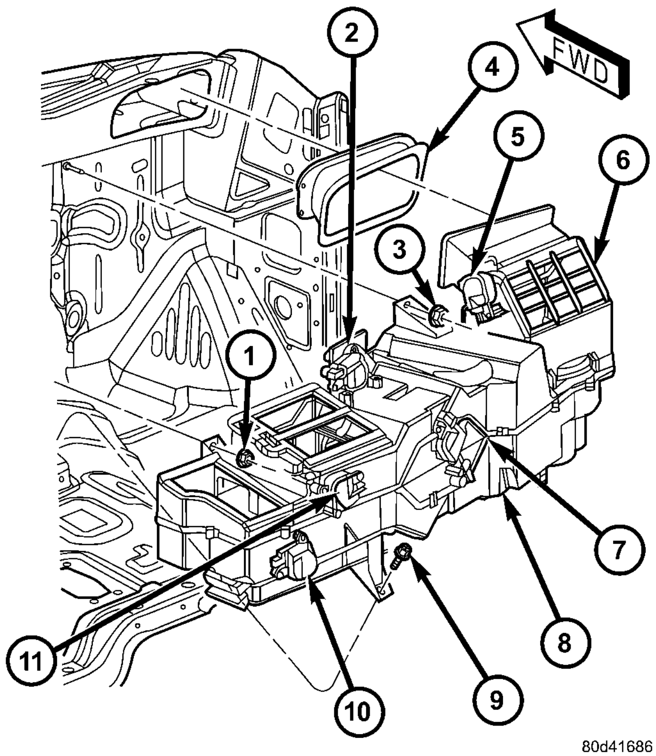

Fig. 4 HVAC Housing - Dual Zone Shown (Typical - Single Zone)

1 - Mounting Nut
2 - Passenger Blend Door Actuator (dual zone)
3 - Mounting Nut
4 - Air Intake Spacer
5 - Recirculation Door Actuator
6 - Recirculation Door Assembly
7 - Driver Side Blend Door Actuator
8 - HVAC Housing
9 - Mounting Screw
10 - Defroster Door Actuator
11 - Panel Actuator

(4) Disconnect the liquid line refrigerant line fitting from the evaporator inlet tube (Fig. 4). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(5) Disconnect the accumulator inlet tube refrigerant line fitting from the evaporator outlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Drain the engine cooling system(Refer to 7 - COOLING - STANDARD PROCEDURE).

(7) Disconnect the heater hoses from the heater core tubes. Install plugs in, or tape over the opened heater core tubes.

(8) Unplug all electrical connectors from the actuators and blower motor.

(9) Remove the nuts from the HVAC housing mounting studs.

(10) Remove the HVAC housing from inside the vehicle taking care not to allow any remaining coolant to drain on the vehicles interior.

DISASSEMBLY

(1) Remove the HVAC housing from the vehicle and place it on the workbench. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL)

(2) Unplug the electrical connectors from each actuator.

(3) Remove the HVAC assembly wiring harness from the HVAC case.

(4) Remove the blower motor and blower wheel unit from the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - REMOVAL)

(5) Remove the heater core mounting screws and carefully remove the heater core assembly(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/HEATER CORE - REMOVAL).

(6) Carefully remove the foam seals from the heater core and evaporator coil tube mounting flange of the HVAC housing. If the either seal is deformed or damaged it must be replaced.

(7) Use a screwdriver to pry off the four snap clips that help secure the upper and lower HVAC housing halves together.

(8) Remove the screws that secure the upper and lower HVAC housing halves together.

(9) Carefully separate the upper HVAC housing from the lower half.

ASSEMBLY

(1) Assemble the upper HVAC housing half to the lower half. During assembly, be certain of the following.

(a) That each of the mode door pivot shaft ends and the temperature blend door shafts are properly engaged in there pivot holes.

(b) That the blower motor is properly indexed and installed.

(c) If the unit is equipped with air conditioning, that the evaporator coil tube rubber seal is properly positioned in the grooves in both the upper and lower HVAC housing halves.

(d) That the evaporator drain opening is clean.

(e) That the evaporator drain shield is installed correctly.

HVAC HOUSING (Continued)

(2) Install the screws and snap clips that secure the upper and lower HVAC housing halves to each other. Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Install the blower motor and wheel unit in the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/BLOWER MOTOR - INSTALLATION)

(4) Install the foam seals on the flanges around the heater core and evaporator coil tube mounting flange of the HVAC housing. Repair or replace any seals as required.

(5) Install the electrical wiring harness for the acutators. Make sure the wires are routed through all wiring retainers, replace any retainers that are damaged or missing.

(6) Connect the wiring harness to each actuator, making sure each connector is securely attached.

INSTALLATION

WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN PLUMBING BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Position the HVAC housing to the dash panel. Be certain that the evaporator condensate drain tube and the housing mounting studs are inserted into their correct mounting holes.

(2) Install and tighten the nuts onto the HVAC housing mounting studs. Tighten the nuts to 6.2 N·m (55 in.lbs.).

(3) Connect the HVAC system electrical connectors.

(4) Unplug or remove the tape from the heater core tubes. Connect the heater hoses to the heater core tubes and fill the engine cooling system(Refer to 7 - COOLING/ENGINE - STANDARD PROCEDURE).

(5) Unplug or remove the tape from the liquid line and the evaporator inlet tube fittings. Connect the liquid line coupler to the evaporator inlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

(8) Install the instrument panel in the vehicle(Refer to 23 - BODY/INSTRUMENT PANEL - INSTALLATION).

(9) Connect the battery negative cable.

(10) Start the engine and check for proper operation of the heating and air conditioning systems.

(11) Run the calibration procedure.

INSTRUMENT PANEL DUCTS

REMOVAL

(1) Disconnect and isolate the battery negative cable.

(2) Remove the HVAC assembly from the vehicle(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL).

(3) Disasemble the HVAC housing(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY).

(4) Remove the panel door actuator from the housing if not already removed.

(5) With the actuator removed you can take the door and shift it so that one pivot point will clear the housing. You can then tilt the door and remove it from the housing.

INSTALLATION

(1) Take the door and tilt it so one pivot point is installed. The carfully install the second pivot point. Check to be sure no binding of the door is occuring, repair as required.

(2) Reassemble the HVAC housing(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY).

(3) Install the HVAC assembly into the vehicle(Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/INSTRUMENT PANEL DUCTS - INSTALLATION).

(4) Connect the battery negative cable.

MODE DOOR

REMOVAL - FLOOR - DEFROST DOOR

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) Remove and disassemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Remove the floor door actuator from the lower HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/MODE DOOR ACTUATOR - REMOVAL - FLOOR DOOR ACTUATOR)

(3) Take the defrost door and shift it so that one pivot point clears the door and remove from the HVAC housing.

INSTALLATION - FLOOR - DEFROST DOOR

(1) Install the floor-defrost door in the HVAC housing by placing the door in the lower housing.

(2) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/ HVAC HOUSING - ASSEMBLY)

(3) Install the floor door actuator to the lower HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/MODE DOOR ACTUATOR - INSTALLATION - FLOOR DOOR ACTUATOR)

(4) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

RECIRC DOOR

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE AIRBAG SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE AIRBAG SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE AIRBAG SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN AN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

WARNING: IF THE VEHICLE IS EQUIPPED WITH AIR CONDITIONING, REVIEW THE WARNINGS AND CAUTIONS IN PLUMBING BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - CAUTION)

(1) Remove the HVAC housing and disassemble. (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/ DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Remove the four screws to remove the recirculation door assembly. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/RECIRCULATION DOOR ACTUATOR - REMOVAL)

(3) With the actuator remove take the recirculation door and move it to one side so that one pivot point clears the housing. The tilt the recirculation door and remove from the assembly.

INSTALLATION

(1) Guide the recirculation door lever through the air intake grille of the HVAC housing while installing the door in the housing.

(2) Assemble the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/ HVAC HOUSING - ASSEMBLY)

(3) Install the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

(4) Install the recirculation door actuator on the HVAC housing. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/RECIRCULATION DOOR ACTUATOR - INSTALLATION)

PLUMBING

TABLE OF CONTENTS

PLUMBING

DESCRIPTION - REFRIGERANT LINE

The refrigerant lines and hoses are used to carry the refrigerant between the various air conditioning system components. A barrier hose design with a nylon tube, which is sandwiched between rubber layers, is used for the R-134a air conditioning system on this vehicle. This nylon tube helps to further contain the R-134a refrigerant, which has a smaller molecular structure than R-12 refrigerant. The ends of the refrigerant hoses are made from lightweight aluminum or steel, and commonly use braze-less fittings.

Any kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire air conditioning system. Kinks and sharp bends reduce the flow of refrigerant in the system. A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. In addition, the flexible hose refrigerant lines should be routed so they are at least 80 millimeters (3 inches) from an exhaust manifold.

OPERATION- REFRIGERANT LINES

High pressures are produced in the refrigerant system when the air conditioning compressor is operating. Extreme care must be exercised to make sure that each of the refrigerant system connections is pressure-tight and leak free. It is a good practice to inspect all flexible hose refrigerant lines at least once a year to make sure they are in good condition and properly routed.

The refrigerant lines and hoses are coupled with other components of the HVAC system with either 3 O-ring spring lock couplings or dual axes seals.

The refrigerant lines and hoses cannot be repaired and, if faulty or damaged, they must be replaced.

WARNING

SERVICE WARNINGS

WARNING: THE AIR CONDITIONING SYSTEM CONTAINS REFRIGERANT UNDER HIGH PRESSURE. SEVERE PERSONAL INJURY MAY RESULT FROM IMPROPER SERVICE PROCEDURES. REPAIRS SHOULD ONLY BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

AVOID BREATHING THE REFRIGERANT AND REFRIGERANT OIL VAPOR OR MIST. EXPOSURE MAY IRRITATE THE EYES, NOSE, AND/OR THROAT. WEAR EYE PROTECTION WHEN SERVICING THE AIR CONDITIONING REFRIGERANT SYSTEM. SERIOUS EYE INJURY CAN RESULT FROM DIRECT CONTACT WITH THE REFRIGERANT. IF EYE CONTACT OCCURS, SEEK MEDICAL ATTENTION IMMEDIATELY.

DO NOT EXPOSE THE REFRIGERANT TO OPEN FLAME. POISONOUS GAS IS CREATED WHEN REFRIGERANT IS BURNED. AN ELECTRONIC LEAK DETECTOR IS RECOMMENDED.

IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE. LARGE AMOUNTS OF REFRIGERANT RELEASED IN A CLOSED WORK AREA WILL DISPLACE THE OXYGEN AND CAUSE SUFFOCATION.

THE EVAPORATION RATE OF R-134a REFRIGERANT AT AVERAGE TEMPERATURE AND ALTITUDE IS EXTREMELY HIGH. AS A RESULT, ANYTHING THAT COMES IN CONTACT WITH THE REFRIGERANT WILL FREEZE. ALWAYS PROTECT THE SKIN OR DELICATE OBJECTS FROM DIRECT CONTACT WITH THE REFRIGERANT.

THE R-134a SERVICE EQUIPMENT OR THE VEHICLE REFRIGERANT SYSTEM SHOULD NOT BE PRESSURE TESTED OR LEAK TESTED WITH COMPRESSED AIR. SOME MIXTURES OF AIR AND R-134a HAVE BEEN SHOWN TO BE COMBUSTIBLE AT ELEVATED PRESSURES. THESE MIXTURES ARE POTENTIALLY DANGEROUS, AND MAY RESULT IN FIRE OR EXPLOSION CAUSING INJURY OR PROPERTY DAMAGE.

PLUMBING (Continued)

CAUTION

SERVICE CAUTIONS

CAUTION: Liquid refrigerant is corrosive to metal surfaces. Follow the operating instructions supplied with the service equipment being used.

Never add R-12 to a refrigerant system designed to use R-134a. Damage to the system will result.

R-12 refrigerant oil must not be mixed with R-134a refrigerant oil. They are not compatible.

Do not use R-12 equipment or parts on the R-134a system. Damage to the system will result.

Do not overcharge the refrigerant system. This will cause excessive compressor head pressure and can cause noise and system failure.

Recover the refrigerant before opening any fitting or connection. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

Do not remove the secondary retention clip from any spring-lock coupler connection while the refrigerant system is under pressure. Recover the refrigerant before removing the secondary retention clip. Open the fittings with caution, even after the system has been discharged. Never open or loosen a connection before recovering the refrigerant.

The refrigerant system must always be evacuated before charging.

Do not open the refrigerant system or uncap a replacement component until you are ready to service the system. This will prevent contamination in the system.

Before disconnecting a component, clean the outside of the fittings thoroughly to prevent contamination from entering the refrigerant system.

Immediately after disconnecting a component from the refrigerant system, seal the open fittings with a cap or plug.

Before connecting an open refrigerant fitting, always install a new seal or gasket. Coat the fitting and seal with clean refrigerant oil before connecting.

Do not remove the sealing caps from a replacement component until it is to be installed.

When installing a refrigerant line, avoid sharp bends that may restrict refrigerant flow. Position the refrigerant lines away from exhaust system components or any sharp edges, which may damage the line.

Tighten refrigerant fittings only to the specified torque. The aluminum fittings used in the refrigerant system will not tolerate overtightening.

When disconnecting a refrigerant fitting, use a wrench on both halves of the fitting. This will prevent twisting of the refrigerant lines or tubes.

Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open a container of refrigerant oil until you are ready to use it. Replace the cap on the oil container immediately after using. Store refrigerant oil only in a clean, airtight, and moisture-free container.

Keep service tools and the work area clean. Contamination of the refrigerant system through careless work habits must be avoided.

CAUTION - REFRIGERANT HOSES/LINES/ TUBES PRECAUTIONS

Kinks or sharp bends in the refrigerant plumbing will reduce the capacity of the entire system. High pressures are produced in the system when it is operating. Extreme care must be exercised to make sure that all refrigerant system connections are pressure tight.

A good rule for the flexible hose refrigerant lines is to keep the radius of all bends at least ten times the diameter of the hose. Sharp bends will reduce the flow of refrigerant. The flexible hose lines should be routed so they are at least 80 millimeters (3 inches) from the exhaust manifold. It is a good practice to inspect all flexible refrigerant system hose lines at least once a year to make sure they are in good condition and properly routed.

There are two types of refrigerant fittings:

- All fittings with O-rings need to be coated with refrigerant oil before installation. Use only O-rings that are the correct size and approved for use with R-134a refrigerant. Failure to do so may result in a leak.
- Unified plumbing connections with gaskets cannot be serviced with O-rings. The gaskets are not reusable and new gaskets do not require lubrication before installing.

Using the proper tools when making a refrigerant plumbing connection is very important. Improper tools or improper use of the tools can damage the refrigerant fittings. Always use two wrenches when loosening or tightening tube fittings. Use one wrench to hold one side of the connection stationary, while loosening or tightening the other side of the connection with a second wrench.

The refrigerant must be recovered completely from the system before opening any fitting or connection. Open the fittings with caution, even after the refrigerant has been recovered. If any pressure is noticed as a fitting is loosened, tighten the fitting and recover the refrigerant from the system again.

Do not discharge refrigerant into the atmosphere. Use an R-134a refrigerant recovery/recycling device that meets SAE Standard J2210.

PLUMBING (Continued)

The refrigerant system will remain chemically stable as long as pure, moisture-free R-134a refrigerant and refrigerant oil is used. Dirt, moisture, or air can upset this chemical stability. Operational troubles or serious damage can occur if foreign material is present in the refrigerant system.

When it is necessary to open the refrigerant system, have everything needed to service the system ready. The refrigerant system should not be left open to the atmosphere any longer than necessary. Cap or plug all lines and fittings as soon as they are opened to prevent the entrance of dirt and moisture. All lines and components in parts stock should be capped or sealed until they are to be installed.

All tools, including the refrigerant recycling equipment, the manifold gauge set, and test hoses should be kept clean and dry. All tools and equipment must be designed for R-134a refrigerant.

STANDARD PROCEDURE

STANDARD PROCEDURE - REFRIGERANT SYSTEM SERVICE EQUIPMENT

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

When servicing the air conditioning system, a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used. Contact an automotive service equipment supplier for refrigerant recovery/recycling/charging equipment. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

A manifold gauge set may be needed with some recovery/recycling/charging equipment (Fig. 1). The service hoses on the gauge set being used should have manual (turn wheel), or automatic back-flow valves at the service port connector ends. This will prevent refrigerant from being released into the atmosphere.

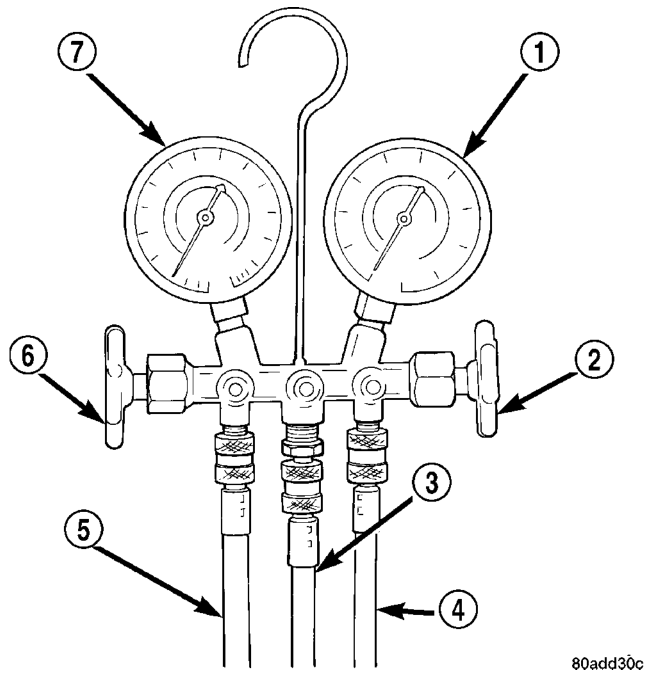

Fig. 1 MANIFOLD GAUGE SET - TYPICAL

1 - HIGH PRESSURE GAUGE
2 - VALVE
3 - VACUUM/REFRIGERANT HOSE (YELLOW W/ BLACK STRIPE)
4 - HIGH PRESSURE HOSE (RED W/ BLACK STRIPE)
5 - LOW PRESSURE HOSE (BLUE W/ BLACK STRIPE)
6 - VALVE
7 - LOW PRESSURE GAUGE

MANIFOLD GAUGE SET CONNECTIONS

CAUTION: Do not use an R-12 manifold gauge set on an R-134a system. The refrigerants are not compatible and system damage will result.

LOW PRESSURE GAUGE HOSE The low pressure hose (Blue with Black stripe) attaches to the suction service port. This port is located on the suction line between the accumulator outlet and the compressor.

HIGH PRESSURE GAUGE HOSE The high pressure hose (Red with Black stripe) attaches to the discharge service port. This port is located on the liquid line between the condenser outlet and the evaporator.

RECOVERY/RECYCLING/EVACUATION/CHARGING HOSE The center manifold hose (Yellow, or White, with Black stripe) is used to recover, evacuate, and charge the refrigerant system. When the low or high pressure valves on the manifold gauge set are opened, the refrigerant in the system will escape through this hose.

STANDARD PROCEDURE - REFRIGERANT RECOVERY

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to recover the refrigerant from an R-134a refrig-

PLUMBING (Continued)

erant system. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. If moisture and air enters the system and becomes mixed with the refrigerant, the compressor head pressure will rise above acceptable operating levels. This will reduce the performance of the air conditioner and damage the compressor. Evacuating the refrigerant system will remove the air and boil the moisture out of the system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 and a manifold gauge set to the refrigerant system of the vehicle.

(2) Recover the refrigerant(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(3) Open the low and high side valves and start the charging station vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump.

(a) If the refrigerant system fails to reach the specified vacuum, the system has a leak that must be corrected. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - DIAGNOSIS AND TESTING - REFRIGERANT SYSTEM LEAKS)

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(4) Close all of the valves, and turn off the charging station vacuum pump.

(5) The refrigerant system is now ready to be charged with R-134a refrigerant. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY)

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for proper care and use of this equipment.

The R-134a refrigerant charge capacity for this vehicle is 0.7371 Kg (26 oz.).

NOTE: Always refer to the HVAC underhood sticker for current refrigerant charge level and refrigerant oil specifications.

SPECIFICATIONS - CHARGE CAPACITY

The R-134a refrigerant system charge capacity for this vehicle is: 0.7371 Kg. (26 oz.).

A/C COMPRESSOR

DESCRIPTION

DESCRIPTION

The air conditioning system uses a Sanden SD-7 reciprocating swash plate-type compressor on all models. This compressor has a fixed displacement of 165 cubic centimeter and has both the suction and discharge ports located on the cylinder head. A label identifying the use of R-134a refrigerant is located on the compressor.

DESCRIPTION - HIGH PRESSURE RELIEF VALVE

A high pressure relief valve is located on the compressor cylinder head, which is on the rear of the compressor. This mechanical valve is designed to vent refrigerant from the system to protect against damage to the compressor and other system compo-

A/C COMPRESSOR (Continued)

nents, caused by condenser air flow restriction or an overcharge of refrigerant.

OPERATION

OPERATION

The compressor is driven by the engine through an electric clutch, drive rotor and belt arrangement. The compressor is lubricated by refrigerant oil that is circulated throughout the refrigerant system with the refrigerant.

The compressor draws in low-pressure refrigerant vapor from the evaporator through its suction port. It then compresses the refrigerant into a high-pressure, high-temperature refrigerant vapor, which is then pumped to the condenser through the compressor discharge port.

The compressor cannot be repaired. If faulty or damaged, the entire compressor assembly must be replaced. The compressor clutch, pulley and clutch coil are available for service.

OPERATION - HIGH PRESSURE RELIEF VALVE

The high pressure relief valve vents the system when a discharge pressure of 3445 to 4135 kPa (500 to 600 psi) or above is reached. The valve closes when a minimum discharge pressure of 2756 kPa (400 psi) is reached.

The high pressure relief valve vents only enough refrigerant to reduce the system pressure, and then re-seats itself. The majority of the refrigerant is conserved in the system. If the valve vents refrigerant, it does not mean that the valve is faulty.

The high pressure relief valve is a factory-calibrated unit. The valve cannot be adjusted or repaired, and must not be removed or otherwise disturbed. The valve is only serviced as a part of the compressor assembly.

DIAGNOSIS AND TESTING - A/C COMPRESSOR NOISE

When investigating an air conditioning related noise, you must first know the conditions under which the noise occurs. These conditions include: weather, vehicle speed, transmission in gear or neutral, engine speed, engine temperature, and any other special conditions. Noises that develop during air conditioning operation can often be misleading. For example: What sounds like a failed front bearing or connecting rod, may be caused by loose bolts, nuts, mounting brackets, or a loose compressor clutch assembly.

Drive belts are speed sensitive. At different engine speeds and depending upon belt tension, belts can develop noises that are mistaken for a compressor noise. Improper belt tension can cause a misleading noise when the compressor clutch is engaged, which may not occur when the compressor clutch is disengaged. Check the serpentine drive belt condition and tension as described in Cooling before beginning this procedure.

(1) Select a quiet area for testing. Duplicate the complaint conditions as much as possible. Switch the compressor on and off several times to clearly identify the compressor noise. Listen to the compressor while the clutch is engaged and disengaged. Probe the compressor with an engine stethoscope or a long screwdriver with the handle held to your ear to better localize the source of the noise.

(2) Loosen all of the compressor mounting hardware and retighten. Tighten the compressor clutch mounting nut. Be certain that the clutch coil is mounted securely to the compressor, and that the clutch plate and rotor are properly aligned and have the correct air gap. (Refer to 24 - HEATING & AIR CONDITIONING/CONTROLS/A/C COMPRESSOR CLUTCH - INSTALLATION)

(3) To duplicate a high-ambient temperature condition (high head pressure), restrict the air flow through the condenser. Install a manifold gauge set to be certain that the discharge pressure does not exceed 2760 kPa (400 psi).

(4) Check the refrigerant system plumbing for incorrect routing, rubbing or interference, which can cause unusual noises. Also check the refrigerant lines for kinks or sharp bends that will restrict refrigerant flow, which can cause noises. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(5) If the noise is from opening and closing of the high pressure relief valve, evacuate and recharge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE) If the high pressure relief valve still does not seat properly, replace the compressor.

(6) If the noise is from liquid slugging on the suction line. Check the refrigerant oil level and the refrigerant system charge. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - SPECIFICATIONS - CHARGE CAPACITY) If either is out of specification range reclaim, evacuate and recharge the refrigerent system(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE), (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/RE-

A/C COMPRESSOR (Continued)

FRIGERANT - STANDARD PROCEDURE) and (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING/REFRIGERANT - STANDARD PROCEDURE). If the liquid slugging condition continues replace the accumulator(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ACCUMULATOR - REMOVAL). If after replaceing the accumulator the slugging condition still exists then replace the compressor.(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C COMPRESSOR - REMOVAL)

(7) If the noise continues, replace the compressor and repeat Step 1.

REMOVAL

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

The compressor may be removed and repositioned without disconnecting the refrigerant lines or discharging the refrigerant system. Discharging is not necessary if servicing the compressor clutch or clutch coil, the engine, the cylinder head, or the generator.

(1) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the suction and discharge refrigerant line manifold from the compressor. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ SUCTION LINE - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - REMOVAL) Install plugs in, or tape over all of the opened refrigerant fittings.

(6) Remove the bolts that secure the compressor to the mounting bracket (Fig. 2).

(7) Remove the compressor from the mounting bracket.

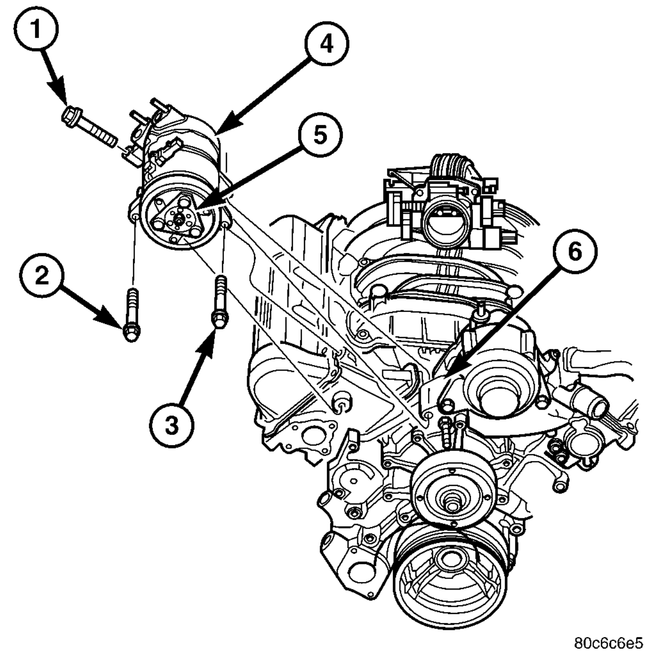

Fig. 2 A/C COMPRESSOR - 3.7L ENGINE- (typical 4.7, 5.7 & 8.0L)

1 - COMPRESSOR BOLT #1
2 - COMPRESSOR BOLT #2
3 - COMPRESSOR BOLT #3
4 - A/C COMPRESSOR
5 - A/C COMPRESSOR CLUTCH AND PULLEY
6 - COMPRESSOR MOUNT

REMOVAL - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

The compressor may be removed and repositioned without disconnecting the refrigerant lines or discharging the refrigerant system. Discharging is not necessary if servicing the compressor clutch or clutch coil, the engine, the cylinder head, or the generator.

(1) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(2) Disconnect and isolate the battery negative cable.

(3) Remove the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Unplug the compressor clutch coil wire harness connector.

(5) Remove the bolt that secures the refrigerant line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the four bolts that secure the compressor to the mounting bracket (Fig. 3).

(7) Remove the a/c compressor from the mounting bracket.

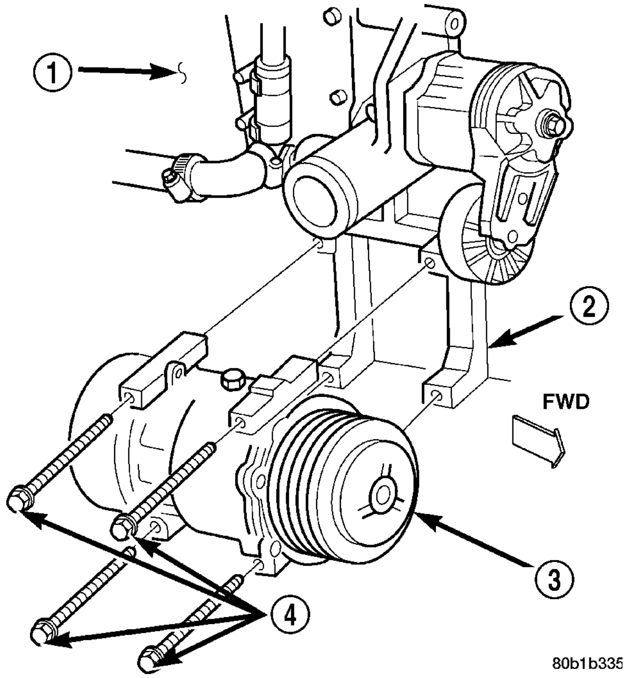

Fig. 3 COMPRESSOR REMOVE/INSTALL - DIESEL ENGINE

1 - ENGINE
2 - BRACKET
3 - A/C COMPRESSOR
4 - BOLTS

INSTALLATION

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

The compressor may be removed and repositioned without disconnecting the refrigerant lines or discharging the refrigerant system. Discharging is not necessary if servicing the compressor clutch or clutch coil, the engine, the cylinder head, or the generator.

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE - REFRIGERANT OIL LEVEL) Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

(1) Install the compressor to the mounting bracket.

(2) On the 3.7L, 4.7L, 5.7L and 8.0L gasoline engines install and tighten the bolts in the following sequence (Fig. 4):

- The number one bolt (rear) is hand tightened first then tightened to 55 N·m (41 ft. lbs.)
- The number three bolt is then hand tightened and torqued to 40 N·m (30 ft. lbs.)
- The number two bolt is also hand tightened and torqued to 55 N·m (41 ft. lbs.)

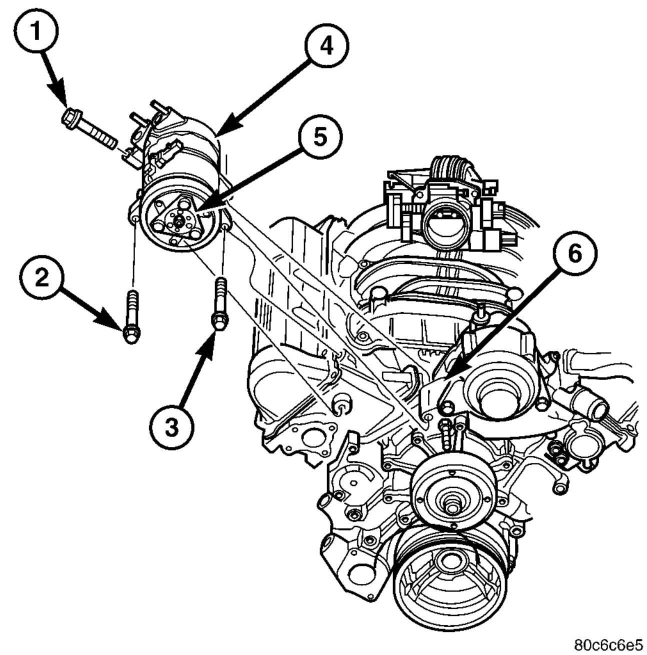

Fig. 4 A/C COMPRESSOR - 3.7L ENGINE- (typical 4.7, 5.7 & 8.0L)

1 - COMPRESSOR BOLT #1
2 - COMPRESSOR BOLT #2
3 - COMPRESSOR BOLT #3
4 - A/C COMPRESSOR
5 - A/C COMPRESSOR CLUTCH AND PULLEY
6 - COMPRESSOR MOUNT

(3) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. Tighten the fastener to 28 N·m (250 in. lbs.).(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - INSTALLATION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - INSTALLATION)

(4) Install the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(5) Plug in the compressor clutch coil wire harness connector.

(6) Connect the battery negative cable.

A/C COMPRESSOR (Continued)

(7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

INSTALLATION - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

NOTE: If a replacement compressor is being installed, be certain to check the refrigerant oil level. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - STANDARD PROCEDURE) Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

(1) Install the compressor to the mounting bracket. Tighten the four mounting bolts to 24 N·m (210 in. lbs.).

(2) Remove the tape or plugs from all of the opened refrigerant line fittings. Install the suction and discharge line manifold to the compressor. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C SUCTION AND DISCHARGE LINE - INSTALLATION)

(3) Install the serpentine drive belt(Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Plug in the compressor clutch coil wire harness connector.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

A/C CONDENSER

DESCRIPTION

The condenser is located in the air flow next to the engine cooling radiator. The condenser is a heat exchanger that allows the high-pressure refrigerant gas being discharged by the compressor to give up its heat to the air passing over the condenser fins.

OPERATION

When the refrigerant gas gives up its heat, it condenses. When the refrigerant leaves the condenser, it has become a high-pressure liquid refrigerant. The volume of air flowing over the condenser fins is critical to the proper cooling performance of the air conditioning system. Therefore, it is important that there are no objects placed in front of the radiator grille openings in the front of the vehicle or foreign material on the condenser fins that might obstruct proper air flow. Also, any factory-installed air seals or shrouds must be properly reinstalled following radiator or condenser service.

The condenser cannot be repaired and, if faulty or damaged, it must be replaced.

REMOVAL

REMOVAL - 3.7, 4.7 and 5.7L ENGINES

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Disconnect the discharge line refrigerant line fitting at the condenser inlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the liquid line refrigerant line fitting at the condenser outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

A/C CONDENSER (Continued)

(5) Disconnect the condenser cooling fan electric connector.

(6) Remove the two nuts that secure the condenser studs to the upper cross brace. (Fig. 5).

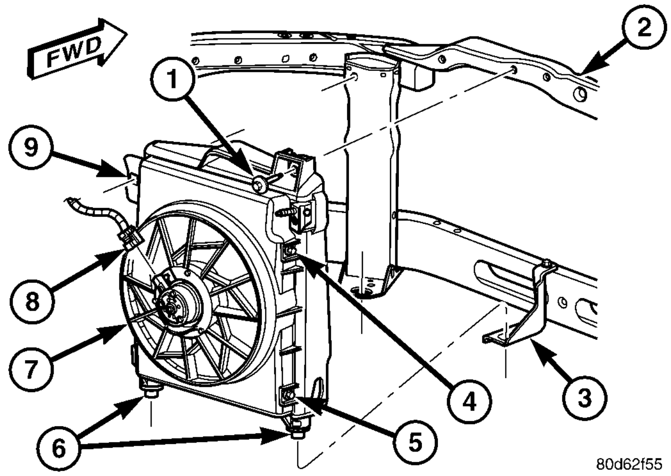

Fig. 5 Condenser Module

1 - Condensor Module Mounting Screw
2 - Front Cross Member
3 - Lower Module Mounting Flang
4 - Fan Assembly Mounting Screw
5 - Fan Assembly Mounting Screw
6 - Condensor Mounting Tabs
7 - Condensor Fan Assembly
8 - Fan Power Connector
9 - Condensor Module Mounting Screw

(7) Remove the condenser and fan assembly from the vehicle.

REMOVAL - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Remove the nut that secures the block fitting to the stud on the condenser inlet, and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(4) Disconnect the refrigerant line fitting that secures the liquid line to the condenser outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLER) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) On diesel engine models:

(a) Remove the two screws that secure the brackets on the passenger side end of the condenser to the charge air cooler (Fig. 6).

(b) Remove the two nuts that secure the driver side end of the condenser to the studs on the charge air cooler.

(c) Remove the condenser from the vehicle.

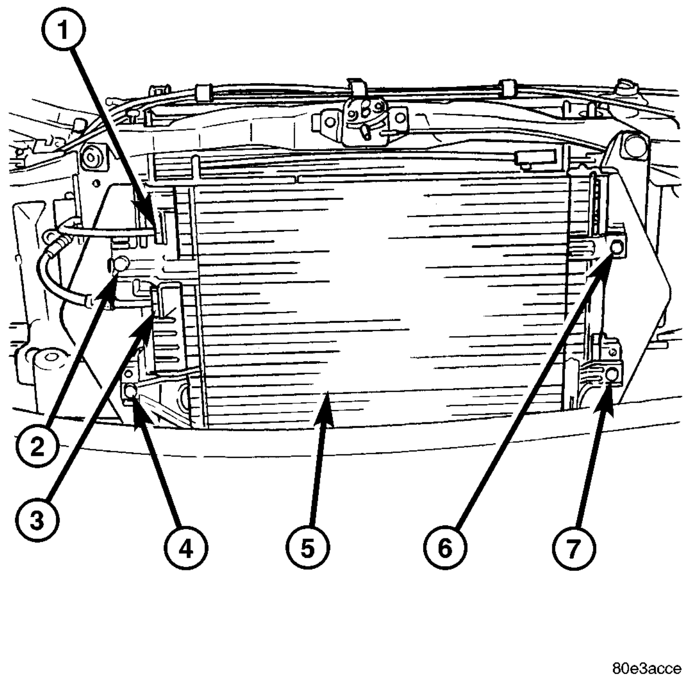

Fig. 6 CONDENSER - DIESEL ENGINE

1 - Discharge line to condenser
2 - Condensor mounting bolt
3 - Liquid Line
4 - Condenser mounting bolt
5 - A/C condenser
6 - Condenser mounting bolt
7 - Condenser mounting bolt

REMOVAL - 8.0L Engine

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN TEH FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) Remove battery negative cable.

(2) Recover refrigerant from a/c system(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

A/C CONDENSER (Continued)

NOTE: Removal of the front bumper on the V-10 is required, failure to do so could result in damage to the condenser assembly and the bumper.

(3) Remove the front bumper assembly from the vehicle(Refer to 13 - FRAME & BUMPERS/ BUMPERS/FRONT BUMPER - REMOVAL).

(4) Remove hood latch bolts and set hood latch assembly aside(Refer to 23 - BODY/HOOD/LATCH - REMOVAL).

(5) Remove a/c lines from condenser(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - REMOVAL) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/ SUCTION LINE - REMOVAL). Install plugs or tape over all open connections (Fig. 7).

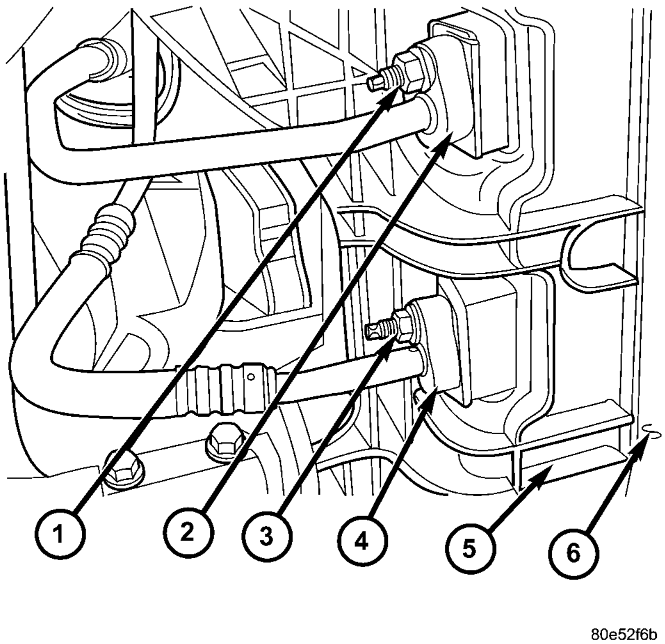

Fig. 7 CONDENSER LINES

1 - Discharge line to condenser
2 - Mounting nut
3 - Mounting nut
4 - Liquid line
5 - A/C condenser shroud
6 - A/C condenser

(6) Remove two bolts from top of condenser shroud assembly (Fig. 8).

(7) Lift condenser and shift assembly to passenger side of vehicle and remove from vehicle.

(8) With condenser and shroud on a clean flat work area remove condenser retainer screws and separate condenser from shroud.

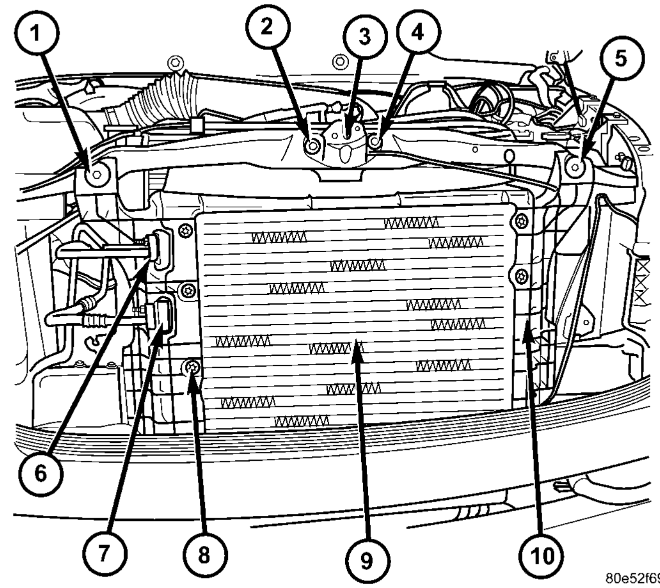

Fig. 8 A/C CONDENSER

1 -A/C shroud mounting bolt
2 - Hood latch bolt
3 - Hood latch assembly
4 - Hood latch bolt
5 - A/C shroud mounting bolt
6 - A/C discharge line
7 - A/C liquid line
8 - Condenser to shroud mounting bolts (5)
9 - A/C condenser
10 - Condenser to shroud mounting bolts (5)

INSTALLATION

INSTALLATION - 3.7, 4.7 and 5.7L ENGINES

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/ PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Install the condenser lower dowel pins to the bottom of the support rail.

(2) Position the condenser until both of the condenser studs are installed through the holes in the upper support rail. Tighten the mounting nuts to 5.3 N·m (47 in. lbs.).

(3) Remove the tape or plugs from the refrigerant line fittings on the condenser outlet and the liquid line. Install the liquid line or the liquid line jumper to the condenser outlet. (Refer to 24 - HEATING &

A/C CONDENSER (Continued)

AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(4) Remove the tape or plugs from the refrigerant line fittings on the condenser inlet and the discharge line. Connect the discharge line to the condenser inlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

INSTALLATION - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) On diesel engine models:

(a) Install the driver side condenser mounting brackets over the two studs on the charge air cooler.

(b) Install the two screws that secure the brackets on the passenger side end of the condenser to the charge air cooler. Tighten the mounting screws to 10.5 N·m (95 in. lbs.).

(c) Install the two nuts that secure the driver side end of the condenser to the studs on the charge air cooler. Tighten the mounting nuts to 10.5 N·m (95 in. lbs.).

(2) Remove the plugs or tape from the refrigerant line fittings on the liquid line and the condenser outlet. Connect the liquid line to the condenser outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(3) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(4) Check that all of the condenser and radiator air seals are in their proper locations.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION)

INSTALLATION - 8.0L Engine

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

(1) If the condenser was removed from the shroud, install it and tighten the mounting screws.

(2) Install the condenser and shroud in the vehicle. Make sure the lower mounting flanges are positioned correctly before installing the two mounting screws to the radiator brace. Tighten the screws to spec.

(3) Remove and plugs or tape installed over the condenser connections and the a/c lines.

(4) Install the lines to the condenser(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C DISCHARGE LINE - INSTALLATION) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/SUCTION LINE - INSTALLATION).

(5) Install the hood latch assembly(Refer to 23 - BODY/HOOD/LATCH - INSTALLATION).

(6) Install the front bumper assembly(Refer to 13 - FRAME & BUMPERS/BUMPERS/FRONT BUMPER - INSTALLATION).

(7) Evacuate the a/c system(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

A/C CONDENSER (Continued)

NOTE: If the condenser is replaced, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT OIL - DESCRIPTION).

(8) Charge the a/c system(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE).

(9) Install the battery negative cable.

A/C CONDENSER FAN

REMOVAL - CONDENSER FAN (GAS ENGINE ONLY - 3.7, 4.7 & 5.7L)

(1) Remove and isolate negative battery cable.

(2) Remove condenser assembly(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - REMOVAL).

(3) Place condenser assembly on a flat work area and remove screws holding fan assembly to condenser.

(4) Separate fan assembly from condenser noting location of all seals for reinstallation.

INSTALLATION - CONDENSER FAN (GAS ENGINE ONLY - 3.7, 4.7 & 5.7L)

(1) Position fan assembly on to the condenser.

(2) Check all fan shroud seals and replace as required then install retainer screws to hold fan assembly to condenser.

(3) Install condenser and fan assembly to vehicle(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/A/C CONDENSER - INSTALLATION).

(4) Install battery negative cable.

A/C DISCHARGE LINE

REMOVAL

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Unplug the wire harness connector from the high pressure transducer.

(4) Disconnect the discharge line refrigerant line fitting from the condenser inlet tube (Fig. 9). (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

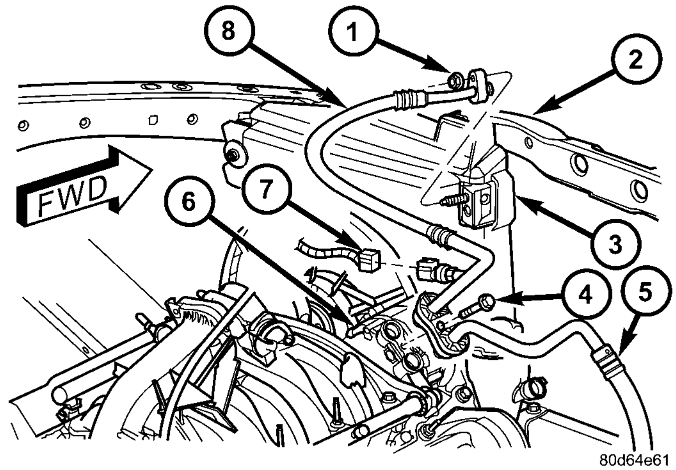

Fig. 9 A/C Discharge Line

1 - Discharge Line Retainer Nut
2 - Front Upper Cross Brace
3 - Condensor Module Port
4 - Suction and Discharge Line Retainer Screw
5 - Suction Line
6 - A/C Compressor
7 - High Pressure Transducer Connector
8 - Discharge Line

(5) Disconnect the connection that secures the suction line fitting to the accumulator outlet. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the screw that secures the suction and discharge line manifold to the compressor. Install plugs in, or tape over all of the opened refrigerant line fittings.

(7) Remove the suction and discharge line assembly from the vehicle.

REMOVAL - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

A/C DISCHARGE LINE (Continued)

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Unplug the wire harness connector from the a/c high pressure switch.

(4) Disconnect the suction line refrigerant line coupler at the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLER) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the block fitting to the stud on the condenser inlet and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the bolt that secures the refrigerant line manifold to the compressor (Fig. 10). Install plugs in, or tape over all of the opened refrigerant line fittings.

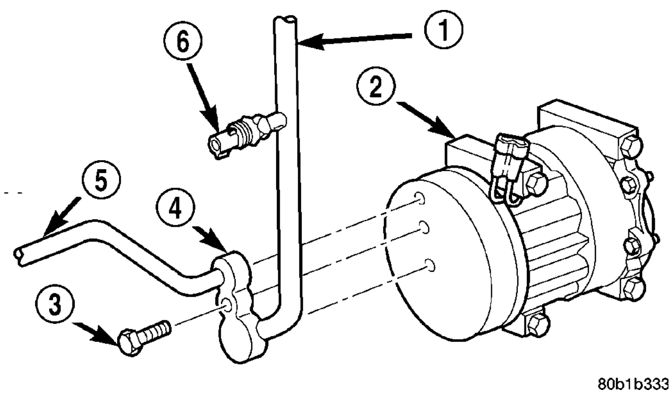

Fig. 10 SUCTION AND DISCHARGE LINE REMOVE/INSTALL - DIESEL ENGINE

1 - DISCHARGE LINE (TO CONDENSER)
2 - COMPRESSOR
3 - BOLT
4 - MANIFOLD
5 - SUCTION LINE (FROM ACCUMULATOR)
6 - A/C HIGH PRESSURE SWITCH

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Remove the tape or plugs from the suction and discharge line manifold and the compressor. Install the suction and discharge line manifold to the compressor. Tighten the fastener to 28 N·m (250 in. lbs.).

(2) Remove the tape or plugs from the suction line and the accumulator outlet fittings. Install the suction line to the accumulator outlet and install fastener.

(3) Remove the tape or plugs from the refrigerant line fittings on the discharge line and the condenser inlet tube. Connect the discharge line refrigerant line coupler to the condenser inlet tube. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(4) Plug in the wire harness connector to the high pressure transducer switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

INSTALLATION - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Remove the tape or plugs from all of the refrigerant line fittings. Connect the suction line refrigerant line coupler to the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(2) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(3) Install the refrigerant line manifold to the compressor. Tighten the mounting bolt to 22 N·m (200 in. lbs.).

(4) Plug in the wire harness connector to the a/c high pressure switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING -

A/C DISCHARGE LINE (Continued)

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

LIQUID LINE

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

NOTE: Removal of the second battery and battery tray is required on the diesel equipped vehicles.

(2) Remove rightside battery(Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - REMOVAL).

(3) Remove rightside battery tray(Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).

(4) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(5) Disconnect the liquid line refrigerant line couplers at the condenser outlet the mid point connection and the evaporator inlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Disengage any clips that secure the liquid line to the inner fender shield or cross brace. (Fig. 11).

(7) Remove the both sections of the liquid line from the vehicle.

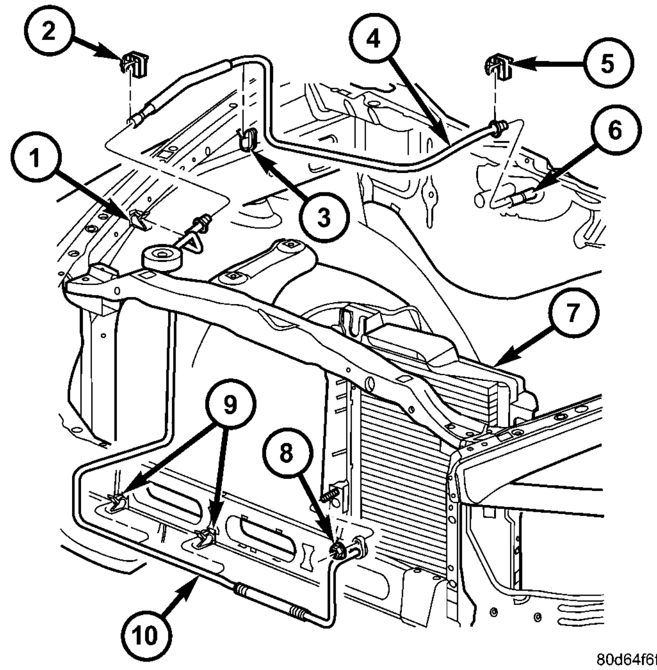

Fig. 11 A/C Liquid Line - Gas Engine shown

1 - A/C Line Retainer Clip
2 - A/C Line Retention Clip
3 - A/C Line Retainer Clip
4 - Liquid Line to Evaporator
5 - A/C Line Retention Clip
6 - Evaporator Ports
7 - A/C Condensor Modular
8 - A/C Jumper Line Retainer Nut
9 - A/C Line Retainer Clip
10 - A/C Liquid Jumper Line

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Install both sections of the liquid line into any clips on the inner fender shield and the dash panel.

(2) Remove the tape or plugs from the refrigerant line fittings on the liquid line, the condenser outlet, and the evaporator inlet. Connect the liquid line pieces together and to the condenser and the evaporator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

NOTE: Installation of the second battery and battery tray is required on the diesel equipped vehicles.

(3) Install the rightside battery tray(Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).

(4) Install the rightside battery(Refer to 8 - ELECTRICAL/BATTERY SYSTEM/BATTERY - INSTALLATION).

(5) Connect the battery positive cables.

(6) Connect the battery negative cables.

(7) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING -

LIQUID LINE (Continued)

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(8) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

SUCTION LINE

REMOVAL

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Unplug the wire harness connector from the a/c high pressure transducer.

(4) Disconnect the suction line refrigerant line coupler at the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLER) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the condenser inlet and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the suction and discharge line assembly from the vehicle.

REMOVAL - 5.9L DIESEL ENGINE

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

(3) Unplug the wire harness connector from the a/c high pressure switch.

(4) Disconnect the suction line refrigerant line coupler at the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLER) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Remove the nut that secures the block fitting to the stud on the condenser inlet and disconnect the discharge line from the condenser. Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the bolt that secures the refrigerant line manifold to the compressor (Fig. 12). Install plugs in, or tape over all of the opened refrigerant line fittings.

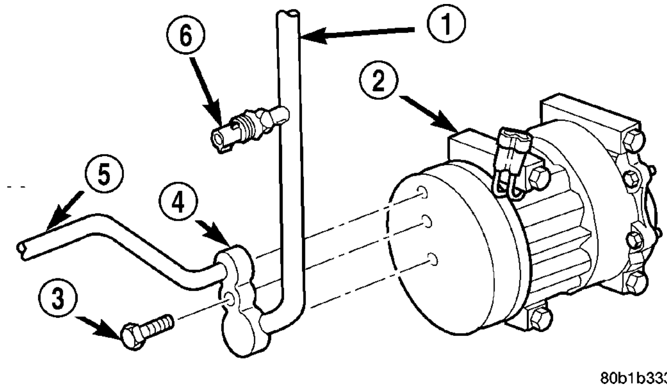

Fig. 12 SUCTION AND DISCHARGE LINE REMOVE/INSTALL - DIESEL ENGINE

1 - DISCHARGE LINE (TO CONDENSER)
2 - COMPRESSOR
3 - BOLT
4 - MANIFOLD
5 - SUCTION LINE (FROM ACCUMULATOR)
6 - A/C HIGH PRESSURE SWITCH

(7) Remove the suction and discharge line assembly from the vehicle.

INSTALLATION

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

SUCTION LINE (Continued)

(1) Remove the tape or plugs from all of the refrigerant line fittings. Connect the suction refrigerant line coupler to the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(2) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(3) Install the refrigerant line manifold to the compressor. Tighten the mounting bolt to 22 N·m (200 in. lbs.).

(4) Plug in the wire harness connector to the A/C high pressure transducer.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Remove the tape or plugs from all of the refrigerant line fittings. Connect the suction line refrigerant line coupler to the accumulator. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(2) Install a new gasket and the discharge line block fitting over the stud on the condenser inlet. Tighten the mounting nut to 20 N·m (180 in. lbs.).

(3) Install the refrigerant line manifold to the compressor. Tighten the mounting bolt to 22 N·m (200 in. lbs.).

(4) Plug in the wire harness connector to the a/c high pressure switch.

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

A/C EVAPORATOR

DESCRIPTION

The A/C evaporator is located in the HVAC housing, under the instrument panel. The evaporator coil is positioned in the HVAC housing so that all air that enters the housing must pass over the fins of the evaporator before it is distributed through the system ducts and outlets. However, air passing over the evaporator coil fins will only be conditioned when the compressor is engaged and circulating refrigerant through the evaporator coil tubes.

OPERATION

Refrigerant enters the evaporator from the fixed orifice tube as a low-temperature, low-pressure liquid. As air flows over the fins of the evaporator, the humidity in the air condenses on the fins, and the heat from the air is absorbed by the refrigerant. Heat absorption causes the refrigerant to boil and vaporize. The refrigerant becomes a low-pressure gas when it leaves the evaporator.

The evaporator coil cannot be repaired and, if faulty or damaged, it must be replaced.

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Remove the HVAC housing from the vehicle, and disassemble the housing halves. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - DISASSEMBLY)

(2) Lift the A/C evaporator out of the HVAC housing (Fig. 13).

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

A/C EVAPORATOR (Continued)

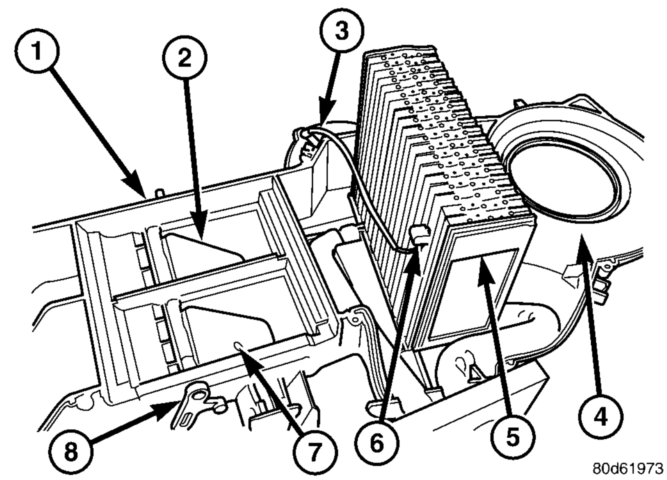

Fig. 13 Dual Zone HVAC Housing- (typical single zone)

1 - Passenger Side Blend Door Lever (if equipped)
2 - Passenger Side Blend Door (if equipped)
3 - Fin Sensor Wire
4 - Lower Blower Motor Mounting Housing
5 - HVAC Evaporator
6 - Fin Sensor
7 - Driver Side Blend Door
8 - Driver Side Blend Door Lever

(1) Insert the evaporator coil into the bottom of the HVAC housing. Make sure that the evaporator drain is clean and unrestricted and evaporator deflector shield is also installed.

(2) Reassemble and reinstall the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - ASSEMBLY) (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

NOTE: If the evaporator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system.

A/C ORIFICE TUBE

DESCRIPTION

The fixed orifice tube is installed in the liquid line between the outlet of the condenser and the inlet of the evaporator. The fixed orifice tube is only serviced as an integral part of the liquid line.

OPERATION

The inlet end of the fixed orifice tube has a nylon mesh filter screen, which filters the refrigerant and helps to reduce the potential for blockage of the metering orifice by refrigerant system contaminants (Fig. 14). The outlet end of the tube has a nylon mesh diffuser screen. The O-rings on the plastic body of the fixed orifice tube seal the tube to the inside of the liquid line and prevents the refrigerant from bypassing the fixed metering orifice.

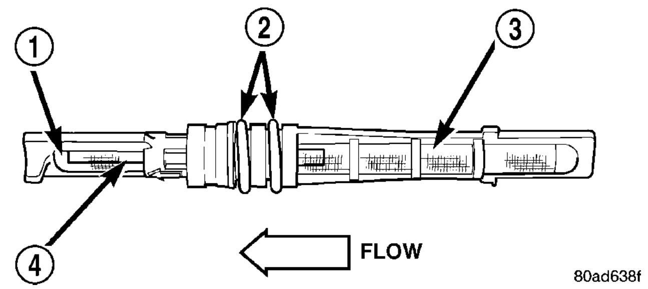

Fig. 14 FIXED ORIFICE TUBE - TYPICAL

1 - DIFFUSER SCREEN
2 - “O” RINGS
3 - INLET FILTER SCREEN
4 - ORIFICE

The fixed orifice tube is used to meter the flow of liquid refrigerant into the evaporator coil. The high-pressure liquid refrigerant from the condenser expands into a low-pressure liquid as it passes through the metering orifice and diffuser screen of the fixed orifice tube.

The fixed orifice tube cannot be repaired and, if faulty or plugged, the liquid line assembly must be replaced.

DIAGNOSIS AND TESTING - FIXED ORIFICE TUBE

The fixed orifice tube can be checked for proper operation using the following procedure. However, the fixed orifice tube is only serviced as a part of the liquid line unit. If the results of this test indicate that the fixed orifice tube is obstructed or missing, the entire liquid line unit must be replaced.

WARNING: THE LIQUID LINE BETWEEN THE CONDENSER OUTLET AND THE FIXED ORIFICE TUBE CAN BECOME HOT ENOUGH TO BURN THE SKIN. USE EXTREME CAUTION WHEN PERFORMING THE FOLLOWING TEST.

(1) Confirm that the refrigerant system is properly charged. (Refer to 24 - HEATING & AIR CONDITIONING - DIAGNOSIS AND TESTING - A/C PERFORMANCE)

(2) Start the engine. Turn on the air conditioning system and confirm that the compressor clutch is engaged.

(3) Allow the air conditioning system to operate for five minutes.

(4) Lightly and cautiously touch the liquid line near the condenser outlet at the front of the engine

A/C ORIFICE TUBE (Continued)

compartment. The liquid line should be hot to the touch.

(5) Touch the liquid line near the evaporator inlet at the rear of the engine compartment. The liquid line should be cold to the touch.

(6) If there is a distinct temperature differential between the two ends of the liquid line, the orifice tube is in good condition. If there is little or no detectable temperature differential between the two ends of the liquid line, the orifice tube is obstructed or missing and the liquid line must be replaced.

REMOVAL

The fixed orifice tube is located in the liquid line, between the condenser and the evaporator coil. The orifice has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is faulty or plugged, the liquid line assembly must be replaced(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - REMOVAL).

INSTALLATION

The fixed orifice tube is located in the liquid line, between the condenser and the evaporator coil. The orifice has filter screens on the inlet and outlet ends of the tube body. If the fixed orifice tube is faulty or plugged, the liquid line assembly must be replaced(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/LIQUID LINE - INSTALLATION).

ACCUMULATOR

DESCRIPTION

The accumulator is mounted in the engine compartment between the A/C evaporator outlet tube and the compressor inlet.

OPERATION

Refrigerant enters the accumulator canister as a low pressure vapor through the inlet tube. Any liquid, oil-laden refrigerant falls to the bottom of the canister, which acts as a separator. A desiccant bag is mounted inside the accumulator canister to absorb any moisture which may have entered and become trapped within the refrigerant system.

REMOVAL

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)

(1) Disconnect and isolate the battery negative cable.

(2) Recover the refrigerant from the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT RECOVERY)

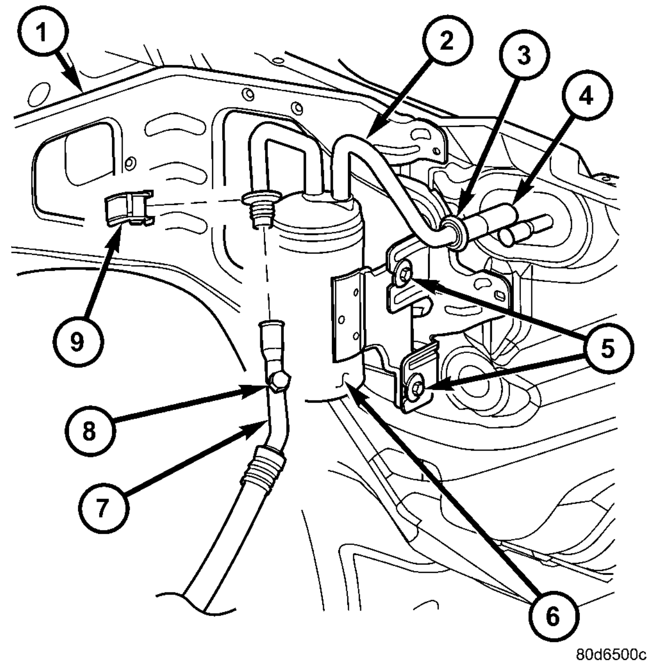

Fig. 15 A/C Accumulator

1 - Inner Fender
2 - Line from Accumulator to Evaporator
3 - A/C Line Rentention Clip
4 - Evaporator Ports
5 - Accumulator Mounting Screws
6 - Accumulator
7 - Suction Line
8 - A/C Charging Port
9 - A/C Line Rentention Clip

(3) Loosen the fasteners that secure the accumulator and support bracket to the dash panel (Fig. 15).

(4) Disconnect the suction line refrigerant line fitting from the accumulator outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS) Install plugs in, or tape over all of the opened refrigerant line fittings.

(5) Disconnect the accumulator inlet refrigerant line fitting from the evaporator outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE) Install plugs in, or tape over all of the opened refrigerant line fittings.

(6) Remove the accumulator assembly from the engine compartment.

ACCUMULATOR (Continued)

INSTALLATION

WARNING: REVIEW THE WARNINGS AND CAUTIONS IN THE FRONT OF THIS SECTION BEFORE PERFORMING THE FOLLOWING OPERATION. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION)(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION - REFRIGERANT HOSES/LINES/TUBES PRECAUTIONS)

(1) Install the accumulator to the bulkhead but do not tighten yet.

(2) Remove the tape or plugs from the refrigerant line fittings on the accumulator inlet and the evaporator outlet. Connect the accumulator inlet refrigerant line coupler to the evaporator outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(3) Remove the tape or plugs from the refrigerant line fittings on the suction line and the accumulator outlet. Connect the suction line refrigerant line coupler to the accumulator outlet. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - A/C LINE COUPLERS)

(4) Tighten the accumulator fasteners to 4.5 N·m (40 in. lbs.).

(5) Connect the battery negative cable.

(6) Evacuate the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE)

(7) Charge the refrigerant system. (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - STANDARD PROCEDURE - REFRIGERANT SYSTEM CHARGE)

NOTE: If the accumulator is replaced, add 60 milliliters (2 fluid ounces) of refrigerant oil to the refrigerant system. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

HEATER CORE

DESCRIPTION

The heater core is located in the HVAC housing, under the instrument panel. It is a heat exchanger made of rows of tubes and fins.

The heater core is not repairable and if damaged it must be replaced.

OPERATION

Engine coolant is circulated through heater hoses to the heater core at all times. As the coolant flows through the heater core, heat removed from the engine is transferred to the heater core fins and tubes. Air directed through the heater core picks up the heat from the heater core fins. The blend door allows control of the heater output air temperature by controlling how much of the air flowing through the HVAC housing is directed through the heater core. The blower motor speed controls the volume of air flowing through the HVAC housing.

The heater core cannot be repaired and, if faulty or damaged, it must be replaced.

REMOVAL

NOTE: Disassembly of the HVAC housing is not required to remove heater core.

(1) Remove the HVAC housing from the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - REMOVAL)

(2) Remove the screws and retainers that secure the heater core to the HVAC housing.

(3) Lift the heater core out of the heater-A/C housing.

(4) Inspect all seals and repair or replace as required.

INSTALLATION

(1) Place the heater core into the HVAC housing.

(2) Snap the retainers for the heater core to the housing. Install and tighten the screws that secure the heater core to the HVAC housing (if equipped). Tighten the screws to 2.2 N·m (20 in. lbs.).

(3) Reinstall the HVAC housing in the vehicle. (Refer to 24 - HEATING & AIR CONDITIONING/DISTRIBUTION/HVAC HOUSING - INSTALLATION)

REFRIGERANT

DESCRIPTION

The refrigerant used in this air conditioning system is a HydroFluoroCarbon (HFC), type R-134a. Unlike R-12, which is a ChloroFluoroCarbon (CFC), R-134a refrigerant does not contain ozone-depleting chlorine. R-134a refrigerant is a non-toxic, non-flammable, clear, and colorless liquefied gas.

Even though R-134a does not contain chlorine, it must be reclaimed and recycled just like CFC-type refrigerants. This is because R-134a is a greenhouse gas and can contribute to global warming.

OPERATION

R-134a refrigerant is not compatible with R-12 refrigerant in an air conditioning system. Even a

REFRIGERANT (Continued)

small amount of R-12 added to an R-134a refrigerant system will cause compressor failure, refrigerant oil sludge or poor air conditioning system performance. In addition, the PolyAlkylene Glycol (PAG) synthetic refrigerant oils used in an R-134a refrigerant system are not compatible with the mineral-based refrigerant oils used in an R-12 refrigerant system.

R-134a refrigerant system service ports, service tool couplers and refrigerant dispensing bottles have all been designed with unique fittings to ensure that an R-134a system is not accidentally contaminated with the wrong refrigerant (R-12). There are also labels posted in the engine compartment of the vehicle and on the compressor identifying to service technicians that the air conditioning system is equipped with R-134a.

DIAGNOSIS AND TESTING- REFRIGERANT SYSTEM LEAKS

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) and (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION).

If the air conditioning system does not cool properly, the A/C system performance should be tested. See A/C Performance in the Diagnosis and Testing section of this group for the procedures. If the A/C system refrigerant fill is found to be low or if the system is empty; a leak at a refrigerant line, connector fitting, component, or component seal is likely.

An electronic leak detector designed for R-134a refrigerant, or a fluorescent R-134a leak detection dye and a black light are recommended for locating and confirming refrigerant system leaks. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

An oily residue on or near refrigerant system lines, connector fittings, components, or component seals can indicate the general location of a possible refrigerant leak. However, the exact leak location should be confirmed with an electronic leak detector prior to component repair or replacement.

To detect a leak in the refrigerant system with an electronic leak detector, perform one of the following procedures:

SYSTEM EMPTY

(1) Evacuate the refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(2) Connect and dispense 0.283 kilograms (0.625 pounds or 10 ounces) of R-134a refrigerant into the evacuated refrigerant system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(3) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(4) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(5) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

SYSTEM LOW

(1) Position the vehicle in a wind-free work area. This will aid in detecting small leaks.

(2) Bring the refrigerant system up to operating temperature and pressure. This is done by allowing the engine to run with the air conditioning system turned on for five minutes.

(3) With the engine not running, use a electronic R-134a leak detector and search for leaks. Because R-134a refrigerant is heavier than air, the leak detector probe should be moved slowly along the bottom side of all refrigerant lines, connector fittings and components.

(4) To inspect the evaporator coil for leaks, insert the electronic leak detector probe into the center instrument panel outlet and the floor duct outlet. Set the blower motor switch to the lowest speed position, and the mode control switch in the recirculation mode (Max-A/C).

STANDARD PROCEDURE

STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

If the refrigerant system has been open to the atmosphere, it must be evacuated before the system can be charged. If moisture and air enters the system and becomes mixed with the refrigerant, the compressor head pressure will rise above acceptable operating levels. This will reduce the performance of the air conditioner and could damage the compressor. Evacuating the refrigerant system will remove the air and boil the moisture out of the system at near room temperature. To evacuate the refrigerant system, use the following procedure:

(1) Connect a R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 and a manifold gauge set (if required) to the refrigerant system of the vehicle and recover refrigerant.

(2) Open the low and high side valves and start the charging station vacuum pump. When the suction gauge reads 88 kPa (26 in. Hg.) vacuum or greater, close all of the valves and turn off the vacuum pump.

(a) If the refrigerant system fails to reach the specified vacuum, the system has a leak that must be corrected. See Refrigerant System Leaks in the Diagnosis and Testing section of this group for the procedures.

(b) If the refrigerant system maintains the specified vacuum for five minutes, restart the vacuum pump, open the suction and discharge valves and evacuate the system for an additional ten minutes.

(3) Close all of the valves, and turn off the charging station vacuum pump.

(4) The refrigerant system is now ready to be charged with R-134a refrigerant(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

STANDARD PROCEDURE- REFRIGERANT RECOVERY

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to recover the refrigerant from an R-134a refrigerant system. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

STANDARD PROCEDURE- REFRIGERANT SYSTEM CHARGE

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

After the refrigerant system has been tested for leaks and evacuated, a refrigerant charge can be injected into the system. See Refrigerant Charge Capacity in the Service Procedures section of this group for the proper amount of the refrigerant charge, this fill level can also be found on a label attached under the hood of the vehicle..

A R-134a refrigerant recovery/recycling/charging station that meets SAE Standard J2210 must be used to charge the refrigerant system with R-134a refrigerant. Refer to the operating instructions supplied by the equipment manufacturer for the proper care and use of this equipment.

The R-134a refrigerant system charge capacity for this vehicle is:

- If equipped with a 3.7L or a 4.7L engine charge to 0.6804 Kg. (24 oz.).
- If equipped with a 5.9L engine charge to 0.7371 Kg. (26 oz.).

REFRIGERANT LINE COUPLER

DESCRIPTION

Spring-lock type refrigerant line couplers are used to connect many of the refrigerant lines and other components to the refrigerant system. These couplers require a special tool for disengaging the two coupler halves.

OPERATION

The spring-lock coupler is held together by a garter spring inside a circular cage on the male half of the fitting (Fig. 16). When the two coupler halves are connected, the flared end of the female fitting slips behind the garter spring inside the cage on the male fitting. The garter spring and cage prevent the flared end of the female fitting from pulling out of the cage.

Three O-rings on the male half of the fitting are used to seal the connection. These O-rings are compatible with R-134a refrigerant and must be replaced with O-rings made of the same material.

Secondary clips are installed over the two connected coupler halves at the factory for added blowoff protection.

REMOVAL

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Recover the refrigerant from the refrigerant system(Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

REFRIGERANT LINE COUPLER (Continued)

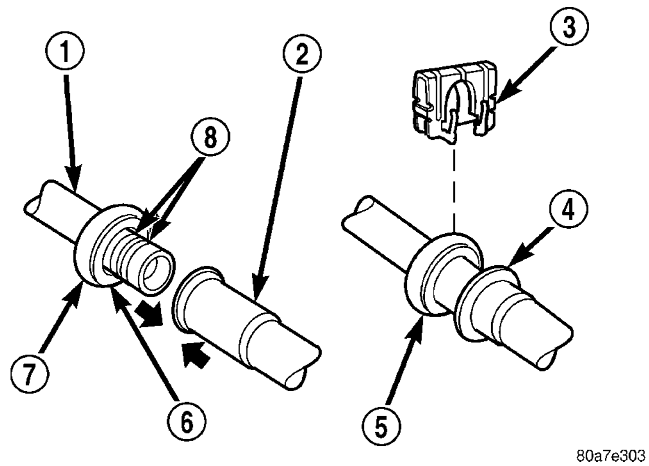

Fig. 16 Spring-Lock Coupler - Typical

1 - MALE HALF SPRING-LOCK COUPLER
2 - FEMALE HALF SPRING-LOCK COUPLER
3 - SECONDARY CLIP
4 - CONNECTION INDICATOR RING
5 - COUPLER CAGE
6 - GARTER SPRING
7 - COUPLER CAGE
8 - "O" RINGS

(2) Remove the secondary clip from the spring-lock coupler.

(3) Fit the proper size A/C line disconnect tool (Special Tool Kit 7193 or equivalent) over the spring-lock coupler cage (Fig. 17).

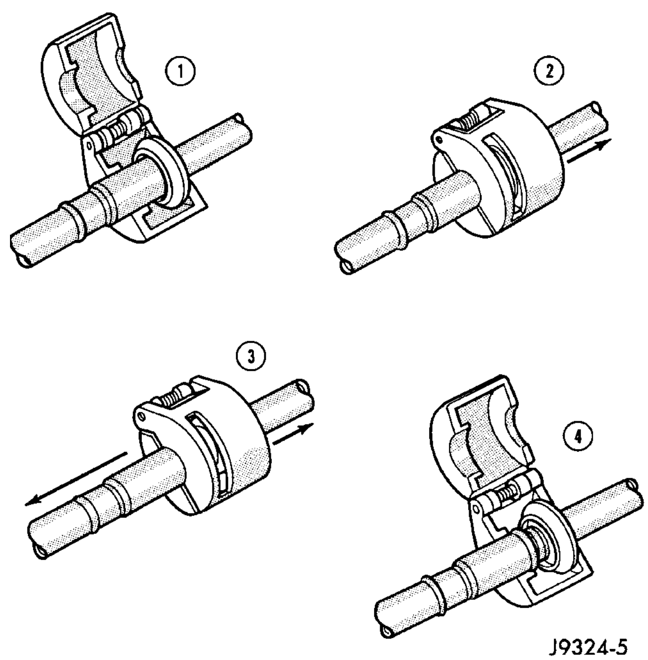

Fig. 17 Refrigerant Line Spring-Lock Coupler Disconnect

(4) Close the two halves of the A/C line disconnect tool around the spring-lock coupler.

(5) Push the A/C line disconnect tool into the open side of the coupler cage to expand the garter spring. Once the garter spring is expanded and while still pushing the disconnect tool into the open side of the coupler cage, pull on the refrigerant line attached to the female half of the coupler fitting until the flange on the female fitting is separated from the garter spring and cage on the male fitting within the disconnect tool.

NOTE: The garter spring may not release if the A/C line disconnect tool is cocked while pushing it into the coupler cage opening.

(6) Open and remove the A/C line disconnect tool from the disconnected spring-lock coupler.

(7) Complete the separation of the two halves of the coupler fitting. Inspect the O-ring seals and mating areas for damage.

INSTALLATION

WARNING: (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - WARNING) AND (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING - CAUTION) BEFORE PERFORMING THE FOLLOWING OPERATION.

(1) Check to ensure that the garter spring is located within the cage of the male coupler fitting, and that the garter spring is not damaged.

(a) If the garter spring is missing, install a new spring by pushing it into the coupler cage opening.

(b) If the garter spring is damaged, remove it from the coupler cage with a small wire hook (DO NOT use a screwdriver) and install a new garter spring.

(2) Clean any dirt or foreign material from both halves of the coupler fitting.

(3) Install new O-rings on the male half of the coupler fitting.

CAUTION: Use only the specified O-rings as they are made of a special material for the R-134a system. The use of any other O-rings may allow the connection to leak intermittently during vehicle operation.

(4) Lubricate the male fitting and O-rings, and the inside of the female fitting with clean R-134a refrigerant oil. Use only refrigerant oil of the type recommended for the compressor in the vehicle.

(5) Fit the female half of the coupler fitting over the male half of the fitting.

(6) Push together firmly on the two halves of the coupler fitting until the garter spring in the cage on the male half of the fitting snaps over the flanged end on the female half of the fitting.

REFRIGERANT LINE COUPLER (Continued)

(7) Ensure that the spring-lock coupler is fully engaged by trying to separate the two coupler halves. This is done by pulling the refrigerant lines on either side of the coupler away from each other.

(8) Reinstall the secondary clip over the spring-lock coupler cage.

REFRIGERANT OIL

DESCRIPTION

The refrigerant oil used in R-134a refrigerant systems is a synthetic-based, PolyAlkylene Glycol (PAG), wax-free lubricant. Mineral-based R-12 refrigerant oils are not compatible with PAG oils, and should never be introduced to an R-134a refrigerant system.

There are different PAG oils available, and each contains a different additive package. The SD–7 compressor used in this vehicle is designed to use an SP-15 PAG refrigerant oil. Use only refrigerant oil of this same type to service the refrigerant system.

OPERATION

After performing any refrigerant recovery or recycling operation, always replenish the refrigerant system with the same amount of the recommended refrigerant oil as was removed. Too little refrigerant oil can cause compressor damage, and too much can reduce air conditioning system performance.

PAG refrigerant oil is much more hygroscopic than mineral oil, and will absorb any moisture it comes into contact with, even moisture in the air. The PAG oil container should always be kept tightly capped until it is ready to be used. After use, recap the oil container immediately to prevent moisture contamination.

STANDARD PROCEDURE - REFRIGERANT OIL LEVEL

When an air conditioning system is assembled at the factory, all components except the compressor are refrigerant oil free. After the refrigerant system has been charged and operated, the refrigerant oil in the compressor is dispersed throughout the refrigerant system. The accumulator, evaporator, condenser, and compressor will each retain a significant amount of the needed refrigerant oil.

It is important to have the correct amount of oil in the refrigerant system. This ensures proper lubrication of the compressor. Too little oil will result in damage to the compressor. Too much oil will reduce the cooling capacity of the air conditioning system.

It will not be necessary to check the oil level in the compressor or to add oil, unless there has been an oil loss. An oil loss may occur due to a rupture or leak from a refrigerant line, a connector fitting, a component, or a component seal. If a leak occurs, add 30 milliliters (1 fluid ounce) of refrigerant oil to the refrigerant system after the repair has been made. Refrigerant oil loss will be evident at the leak point by the presence of a wet, shiny surface around the leak.

Refrigerant oil must be added when a accumulator, evaporator coil or condenser are replaced. See the Refrigerant Oil Capacities chart. When a compressor is replaced, the refrigerant oil must be drained from the old compressor and measured. Drain all of the refrigerant oil from the new compressor, then fill the new compressor with the same amount of refrigerant oil that was drained out of the old compressor.

Refrigerant Oil Capacities		
Component	ml	fl oz
Complete A/C System	180	6
Accumulator	60	2
Condenser	30	1
Evaporator	60	2
Compressor	drain and measure the oil from the old compressor - see text.	

EMISSIONS CONTROL

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EMISSIONS CONTROL

DESCRIPTION

DESCRIPTION - STATE DISPLAY TEST MODE

The switch inputs to the Powertrain Control Module (PCM) have two recognized states; HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the State Display screen shows the change from HIGH to LOW or LOW to HIGH, assume the entire switch circuit to the PCM functions properly. Connect the DRB scan tool to the data link connector and access the state display screen. Then access either State Display Inputs and Outputs or State Display Sensors.

DESCRIPTION - CIRCUIT ACTUATION TEST MODE

The Circuit Actuation Test Mode checks for proper operation of output circuits or devices the Powertrain Control Module (PCM) may not internally recognize. The PCM attempts to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, fuel spray, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit work correctly. Connect the DRB scan tool to the data link connector and access the Actuators screen.

DESCRIPTION - DIAGNOSTIC TROUBLE CODES

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

Remember that DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.

BULB CHECK

Each time the ignition key is turned to the ON position, the malfunction indicator (check engine) lamp on the instrument panel should illuminate for approximately 2 seconds then go out. This is done for a bulb check.

OBTAINING DTC'S USING DRB SCAN TOOL

(1) Obtain the applicable Powertrain Diagnostic Manual.
(2) Obtain the DRB Scan Tool.
(3) Connect the DRB Scan Tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.
(4) Turn the ignition switch on and access the "Read Fault" screen.
(5) Record all the DTC's and "freeze frame" information shown on the DRB scan tool.
(6) To erase DTC's, use the "Erase Trouble Code" data screen on the DRB scan tool. **Do not erase any DTC's until problems have been investigated and repairs have been performed.**

DESCRIPTION - TASK MANAGER

The PCM is responsible for efficiently coordinating the operation of all the emissions-related components. The PCM is also responsible for determining if the diagnostic systems are operating properly. The software designed to carry out these responsibilities is call the 'Task Manager'.

DESCRIPTION - MONITORED SYSTEMS

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator Lamp (MIL) will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the MIL or a scan tool.

The following is a list of the system monitors:

- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor
- Leak Detection Pump Monitor (if equipped)

All these system monitors require two consecutive trips with the malfunction present to set a fault.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

The following is an operation and description of each system monitor :

OXYGEN SENSOR (O2S) MONITOR

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the Catalyst and Fuel Monitors.

The O2S can fail in any or all of the following manners:

- slow response rate
- reduced output voltage
- dynamic shift
- shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

OXYGEN SENSOR HEATER MONITOR

If there is an oxygen sensor (O2S) shorted to voltage DTC, as well as a O2S heater DTC, the O2S fault MUST be repaired first. Before checking the O2S fault, verify that the heater circuit is operating correctly.

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572 ° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a 14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

The voltage readings taken from the O2S sensor are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S sensor is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the O2S sensor must be tested to ensure that it is heating the sensor properly.

The O2S sensor circuit is monitored for a drop in voltage. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S sensor output voltage from the other effects.

LEAK DETECTION PUMP MONITOR (IF EQUIPPED)

The leak detection assembly incorporates two primary functions: it must detect a leak in the evaporative system and seal the evaporative system so the leak detection test can be run.

The primary components within the assembly are: A three port solenoid that activates both of the functions listed above; a pump which contains a switch, two check valves and a spring/diaphragm, a canister vent valve (CVV) seal which contains a spring loaded vent seal valve.

Immediately after a cold start, between predetermined temperature thresholds limits, the three port solenoid is briefly energized. This initializes the

EMISSIONS CONTROL (Continued)

pump by drawing air into the pump cavity and also closes the vent seal. During non test conditions the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling due to the reed switch triggering of the three port solenoid that prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized allowing atmospheric pressure to enter the pump cavity, thus permitting the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

Pump Mode: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test length.

Test Mode: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the Switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5” H20. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040” orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP’s solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the 02 control system. If fuel vapor, indicated by a shift in the 02 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the Air Fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S sensor output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine specifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual fuel-air ratio with the O2S sensor (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

Normal vehicle miles or engine misfire can cause a catalyst to decay. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O2S’s) to monitor the efficiency of the converter. The dual O2S’s sensor strategy is based on the fact that as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream O2S is used to detect the amount of oxygen in the exhaust gas before the gas enters the catalytic con-

EMISSIONS CONTROL (Continued)

verter. The PCM calculates the A/F mixture from the output of the O2S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O2S detects a lean condition, there is an abundance of oxygen in the exhaust gas. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream O2S will indicate limited activity in this condition.

As the converter loses the ability to store oxygen, the condition can be detected from the behavior of the downstream O2S. When the efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream as upstream. The output voltage of the downstream O2S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O2S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O2S's is counted. The ratio of downstream switches to upstream switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer downstream switches than it has upstream switches i.e., a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one, indicating that no oxidation occurs in the device.

The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL will be illuminated.

DESCRIPTION - TRIP DEFINITION

The term "Trip" has different meanings depending on what the circumstances are. If the MIL (Malfunction Indicator Lamp) is OFF, a Trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.

When any Emission DTC is set, the MIL on the dash is turned ON. When the MIL is ON, it takes 3 good trips to turn the MIL OFF. In this case, it depends on what type of DTC is set to know what a "Trip" is.

For the Fuel Monitor or Mis-Fire Monitor (continuous monitor), the vehicle must be operated in the "Similar Condition Window" for a specified amount of time to be considered a Good Trip.

If a Non-Contiuous OBDII Monitor fails twice in a row and turns ON the MIL, re-running that monitor which previously failed, on the next start-up and passing the monitor, is considered to be a Good Trip. These will include the following:

- Oxygen Sensor
- Catalyst Monitor
- Purge Flow Monitor
- Leak Detection Pump Monitor (if equipped)
- EGR Monitor (if equipped)
- Oxygen Sensor Heater Monitor

If any other Emission DTC is set (not an OBDII Monitor), a Good Trip is considered to be when the Oxygen Sensor Monitor and Catalyst Monitor have been completed; or 2 Minutes of engine run time if the Oxygen Sensor Monitor or Catalyst Monitor have been stopped from running.

It can take up to 2 Failures in a row to turn on the MIL. After the MIL is ON, it takes 3 Good Trips to turn the MIL OFF. After the MIL is OFF, the PCM will self-erase the DTC after 40 Warm-up cycles. A Warm-up cycle is counted when the ECT (Engine Coolant Temperature Sensor) has crossed 160°F and has risen by at least 40°F since the engine has been started.

DESCRIPTION - COMPONENT MONITORS

There are several components that will affect vehicle emissions if they malfunction. If one of these components malfunctions the Malfunction Indicator Lamp (MIL) will illuminate.

Some of the component monitors are checking for proper operation of the part. Electrically operated components now have input (rationality) and output (functionality) checks. Previously, a component like the Throttle Position sensor (TPS) was checked by the PCM for an open or shorted circuit. If one of these conditions occurred, a DTC was set. Now there is a check to ensure that the component is working. This is done by watching for a TPS indication of a greater or lesser throttle opening than MAP and engine rpm indicate. In the case of the TPS, if engine vacuum is high and engine rpm is 1600 or greater, and the TPS indicates a large throttle opening, a DTC will be set. The same applies to low vacuum if the TPS indicates a small throttle opening.

All open/short circuit checks, or any component that has an associated limp-in, will set a fault after 1 trip with the malfunction present. Components without an associated limp-in will take two trips to illuminate the MIL.

OPERATION

OPERATION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the

EMISSIONS CONTROL (Continued)

problem is repaired or ceases to exist, the PCM cancels the code after 40 warm-up cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator Lamp (MIL). The MIL is displayed as an engine icon (graphic) on the instrument panel. Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example,** assume the diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

Technicians must retrieve stored DTC's by connecting the DRB scan tool (or an equivalent scan tool) to the 16–way data link connector. The connector is located on the bottom edge of the instrument panel near the steering column (Fig. 1).

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, connect the DRB scan tool to the 16–way data link connector to erase all DTC's and extinguish the MIL.

OPERATION - TASK MANAGER

The Task Manager determines which tests happen when and which functions occur when. Many of the diagnostic steps required by OBD II must be performed under specific operating conditions. The Task Manager software organizes and prioritizes the diagnostic procedures. The job of the Task Manager is to determine if conditions are appropriate for tests to be run, monitor the parameters for a trip for each test, and record the results of the test. Following are the responsibilities of the Task Manager software:

- Test Sequence
- MIL Illumination
- Diagnostic Trouble Codes (DTCs)
- Trip Indicator

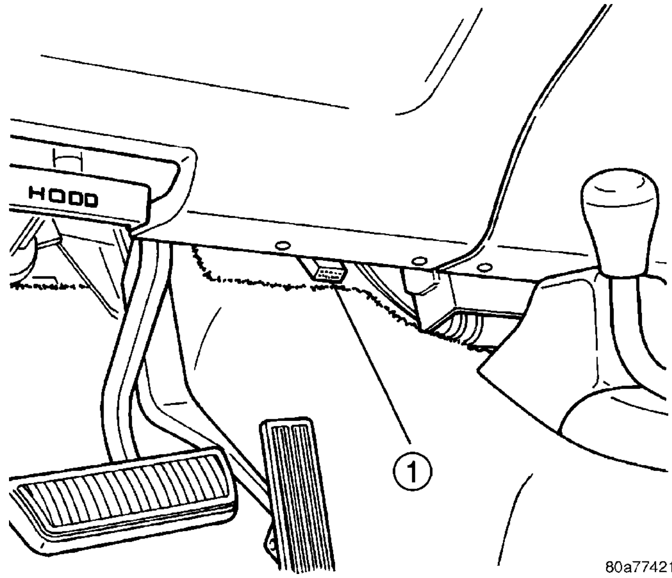

Fig. 1 DATA LINK CONNECTOR LOCATION - TYPICAL

1 - 16-WAY DATA LINK CONNECTOR

- Freeze Frame Data Storage
- Similar Conditions Window

Test Sequence

In many instances, emissions systems must fail diagnostic tests more than once before the PCM illuminates the MIL. These tests are know as 'two trip monitors.' Other tests that turn the MIL lamp on after a single failure are known as 'one trip monitors.' A trip is defined as 'start the vehicle and operate it to meet the criteria necessary to run the given monitor.'

Many of the diagnostic tests must be performed under certain operating conditions. However, there are times when tests cannot be run because another test is in progress (conflict), another test has failed (pending) or the Task Manager has set a fault that may cause a failure of the test (suspend).

- Pending

Under some situations the Task Manager will not run a monitor if the MIL is illuminated and a fault is stored from another monitor. In these situations, the Task Manager postpones monitors **pending** resolution of the original fault. The Task Manager does not run the test until the problem is remedied.

For example, when the MIL is illuminated for an Oxygen Sensor fault, the Task Manager does not run the Catalyst Monitor until the Oxygen Sensor fault is remedied. Since the Catalyst Monitor is based on signals from the Oxygen Sensor, running the test would produce inaccurate results.

- Conflict

There are situations when the Task Manager does not run a test if another monitor is in progress. In

EMISSIONS CONTROL (Continued)

these situations, the effects of another monitor running could result in an erroneous failure. If this **conflict** is present, the monitor is not run until the conflicting condition passes. Most likely the monitor will run later after the conflicting monitor has passed.

For example, if the Fuel System Monitor is in progress, the Task Manager does not run the EGR Monitor. Since both tests monitor changes in air/fuel ratio and adaptive fuel compensation, the monitors will conflict with each other.

- Suspend

Occasionally the Task Manager may not allow a two trip fault to mature. The Task Manager will **suspend** the maturing of a fault if a condition exists that may induce an erroneous failure. This prevents illuminating the MIL for the wrong fault and allows more precis diagnosis.

For example, if the PCM is storing a one trip fault for the Oxygen Sensor and the EGR monitor, the Task Manager may still run the EGR Monitor but will suspend the results until the Oxygen Sensor Monitor either passes or fails. At that point the Task Manager can determine if the EGR system is actually failing or if an Oxygen Sensor is failing.

MIL Illumination

The PCM Task Manager carries out the illumination of the MIL. The Task Manager triggers MIL illumination upon test failure, depending on monitor failure criteria.

The Task Manager Screen shows both a Requested MIL state and an Actual MIL state. When the MIL is illuminated upon completion of a test for a third trip, the Requested MIL state changes to OFF. However, the MIL remains illuminated until the next key cycle. (On some vehicles, the MIL will actually turn OFF during the third key cycle) During the key cycle for the third good trip, the Requested MIL state is OFF, while the Actual MILL state is ON. After the next key cycle, the MIL is not illuminated and both MIL states read OFF.

Diagnostic Trouble Codes (DTCs)

With OBD II, different DTC faults have different priorities according to regulations. As a result, the priorities determine MIL illumination and DTC erasure. DTCs are entered according to individual priority. DTCs with a higher priority overwrite lower priority DTCs.

Priorities

- Priority 0 —Non-emissions related trouble codes
- Priority 1 — One trip failure of a two trip fault for non-fuel system and non-misfire.
- Priority 2 — One trip failure of a two trip fault for fuel system (rich/lean) or misfire.
- Priority 3 — Two trip failure for a non-fuel system and non-misfire or matured one trip comprehensive component fault.
- Priority 4 — Two trip failure or matured fault for fuel system (rich/lean) and misfire or one trip catalyst damaging misfire.

Non-emissions related failures have no priority. One trip failures of two trip faults have low priority. Two trip failures or matured faults have higher priority. One and two trip failures of fuel system and misfire monitor take precedence over non-fuel system and non-misfire failures.

DTC Self Erasure

With one trip components or systems, the MIL is illuminated upon test failure and DTCs are stored.

Two trip monitors are components requiring failure in two consecutive trips for MIL illumination. Upon failure of the first test, the Task Manager enters a maturing code. If the component fails the test for a second time the code matures and a DTC is set.

After three good trips the MIL is extinguished and the Task Manager automatically switches the trip counter to a warm-up cycle counter. DTCs are automatically erased following 40 warm-up cycles if the component does not fail again.

For misfire and fuel system monitors, the component must pass the test under a Similar Conditions Window in order to record a good trip. A Similar Conditions Window is when engine RPM is within ±375 RPM and load is within ±10% of when the fault occurred.

NOTE: It is important to understand that a component does not have to fail under a similar window of operation to mature. It must pass the test under a Similar Conditions Window when it failed to record a Good Trip for DTC erasure for misfire and fuel system monitors.

DTCs can be erased anytime with a DRB III. Erasing the DTC with the DRB III erases all OBD II information. The DRB III automatically displays a warning that erasing the DTC will also erase all OBD II monitor data. This includes all counter information for warm-up cycles, trips and Freeze Frame.

Trip Indicator

The **Trip** is essential for running monitors and extinguishing the MIL. In OBD II terms, a trip is a set of vehicle operating conditions that must be met for a specific monitor to run. All trips begin with a key cycle.

Good Trip

The Good Trip counters are as follows:

EMISSIONS CONTROL (Continued)

- Specific Good Trip
- Fuel System Good Trip
- Misfire Good Trip
- Alternate Good Trip (appears as a Global Good Trip on DRB III)
  - Comprehensive Components
  - Major Monitor
- Warm-Up Cycles

Specific Good Trip

The term Good Trip has different meanings depending on the circumstances:

- If the MIL is OFF, a trip is defined as when the Oxygen Sensor Monitor and the Catalyst Monitor have been completed in the same drive cycle.
- If the MIL is ON and a DTC was set by the Fuel Monitor or Misfire Monitor (both continuous monitors), the vehicle must be operated in the Similar Condition Window for a specified amount of time.
- If the MIL is ON and a DTC was set by a Task Manager commanded once-per-trip monitor (such as the Oxygen Sensor Monitor, Catalyst Monitor, Purge Flow Monitor, Leak Detection Pump Monitor, EGR Monitor or Oxygen Sensor Heater Monitor), a good trip is when the monitor is passed on the next start-up.
- If the MIL is ON and any other emissions DTC was set (not an OBD II monitor), a good trip occurs when the Oxygen Sensor Monitor and Catalyst Monitor have been completed, or two minutes of engine run time if the Oxygen Sensor Monitor and Catalyst Monitor have been stopped from running.

Fuel System Good Trip

To count a good trip (three required) and turn off the MIL, the following conditions must occur:

- Engine in closed loop
- Operating in Similar Conditions Window
- Short Term multiplied by Long Term less than threshold
- Less than threshold for a predetermined time

If all of the previous criteria are met, the PCM will count a good trip (three required) and turn off the MIL.

Misfire Good Trip

If the following conditions are met the PCM will count one good trip (three required) in order to turn off the MIL:

- Operating in Similar Condition Window
- 1000 engine revolutions with no misfire

Warm-Up Cycles

Once the MIL has been extinguished by the Good Trip Counter, the PCM automatically switches to a Warm-Up Cycle Counter that can be viewed on the DRB III. Warm-Up Cycles are used to erase DTCs and Freeze Frames. Forty Warm-Up cycles must occur in order for the PCM to self-erase a DTC and Freeze Frame. A Warm-Up Cycle is defined as follows:

- Engine coolant temperature must start below and rise above 160° F
- Engine coolant temperature must rise by 40° F
- No further faults occur

Freeze Frame Data Storage

Once a failure occurs, the Task Manager records several engine operating conditions and stores it in a Freeze Frame. The Freeze Frame is considered one frame of information taken by an on-board data recorder. When a fault occurs, the PCM stores the input data from various sensors so that technicians can determine under what vehicle operating conditions the failure occurred.

The data stored in Freeze Frame is usually recorded when a system fails the first time for two trip faults. Freeze Frame data will only be overwritten by a different fault with a higher priority.

CAUTION: Erasing DTCs, either with the DRB III or by disconnecting the battery, also clears all Freeze Frame data.

Similar Conditions Window

The Similar Conditions Window displays information about engine operation during a monitor. Absolute MAP (engine load) and Engine RPM are stored in this window when a failure occurs. There are two different Similar conditions Windows: Fuel System and Misfire.

FUEL SYSTEM

- **Fuel System Similar Conditions Window** — An indicator that ’Absolute MAP When Fuel Sys Fail’ and ’RPM When Fuel Sys Failed’ are all in the same range when the failure occurred. Indicated by switching from ’NO’ to ’YES’.
- **Absolute MAP When Fuel Sys Fail** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.
- **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.
- **RPM When Fuel Sys Fail** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.
- **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.
- **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.

EMISSIONS CONTROL (Continued)

• **Upstream O2S Volts** — A live reading of the Oxygen Sensor to indicate its performance. For example, stuck lean, stuck rich, etc.

• **SCW Time in Window (Similar Conditions Window Time in Window)** — A timer used by the PCM that indicates that, after all Similar Conditions have been met, if there has been enough good engine running time in the SCW without failure detected. This timer is used to increment a Good Trip.

• **Fuel System Good Trip Counter** — A Trip Counter used to turn OFF the MIL for Fuel System DTCs. To increment a Fuel System Good Trip, the engine must be in the Similar Conditions Window, Adaptive Memory Factor must be less than calibrated threshold and the Adaptive Memory Factor must stay below that threshold for a calibrated amount of time.

• **Test Done This Trip** — Indicates that the monitor has already been run and completed during the current trip.

MISFIRE

• **Same Misfire Warm-Up State** — Indicates if the misfire occurred when the engine was warmed up (above 160° F).

• **In Similar Misfire Window** — An indicator that 'Absolute MAP When Misfire Occurred' and 'RPM When Misfire Occurred' are all in the same range when the failure occurred. Indicated by switching from 'NO' to 'YES'.

• **Absolute MAP When Misfire Occurred** — The stored MAP reading at the time of failure. Informs the user at what engine load the failure occurred.

• **Absolute MAP** — A live reading of engine load to aid the user in accessing the Similar Conditions Window.

• **RPM When Misfire Occurred** — The stored RPM reading at the time of failure. Informs the user at what engine RPM the failure occurred.

• **Engine RPM** — A live reading of engine RPM to aid the user in accessing the Similar Conditions Window.

• **Adaptive Memory Factor** — The PCM utilizes both Short Term Compensation and Long Term Adaptive to calculate the Adaptive Memory Factor for total fuel correction.

• **200 Rev Counter** — Counts 0–100 720 degree cycles.

• **SCW Cat 200 Rev Counter** — Counts when in similar conditions.

• **SCW FTP 1000 Rev Counter** — Counts 0–4 when in similar conditions.

• **Misfire Good Trip Counter** — Counts up to three to turn OFF the MIL.

• **Misfire Data**— Data collected during test.

• **Test Done This Trip**— Indicates YES when the test is done.

OPERATION - NON-MONITORED CIRCUITS

The PCM does not monitor the following circuits, systems and conditions that could have malfunctions causing driveability problems. The PCM might not store diagnostic trouble codes for these conditions. However, problems with these systems may cause the PCM to store diagnostic trouble codes for other systems or components. **EXAMPLE:** a fuel pressure problem will not register a fault directly, but could cause a rich/lean condition or misfire. This could cause the PCM to store an oxygen sensor or misfire diagnostic trouble code

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system, although it may set a fuel system fault.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIR FLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

EMISSIONS CONTROL (Continued)

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control system devices. However, these could cause the PCM to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

PCM CONNECTOR ENGAGEMENT

The PCM may not be able to determine spread or damaged connector pins. However, it might store diagnostic trouble codes as a result of spread connector pins.

EVAPORATIVE EMISSIONS

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EVAPORATIVE EMISSIONS

DESCRIPTION - EVAP SYSTEM

The evaporation control system prevents the emission of fuel tank vapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes into the two charcoal filled evaporative canisters. The canisters temporarily hold the vapors. The Powertrain Control Module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

All gasoline powered engines use a duty cycle purge system. The PCM controls vapor flow by operating the duty cycle EVAP purge solenoid. Refer to Duty Cycle EVAP Canister Purge Solenoid for additional information.

When equipped with certain emissions packages, a Leak Detection Pump (LDP) will be used as part of the evaporative system. This pump is used as a part of OBD II requirements. Refer to Leak Detection Pump for additional information. Other emissions packages will use a Natural Vacuum Leak Detection (NVLD) system in place of the LDP. Refer to NVLD for additional information.

NOTE: The hoses used in this system are specially manufactured. If replacement becomes necessary, it is important to use only fuel resistant hose.

EVAPORATIVE EMISSIONS (Continued)

Certain EVAP system components can be found in (Fig. 1).

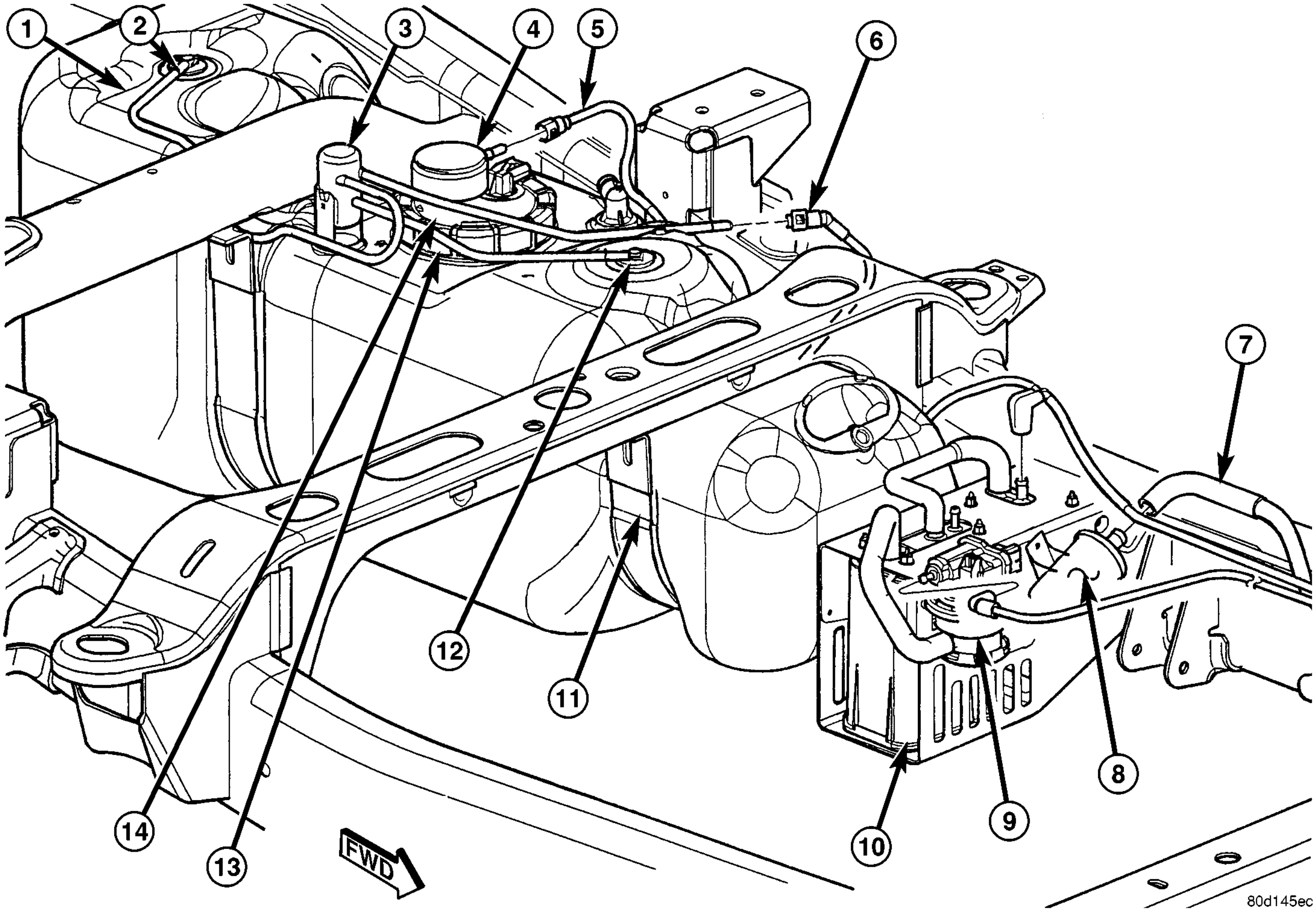

Fig. 1 FUEL DELIVERY COMPONENTS

1 - FUEL TANK
2 - CHECK VALVE
3 - LIQUID EXPANSION CHAMBER
4 - FUEL FILTER / FUEL PRESSURE REGULATOR
5 - QUICK-CONNECT FITTING AND FUEL LINE (TO ENGINE)
6 - EVAP LINE CONNECTION
7 - LEAK DETECTION PUMP FRESH AIR LINE
8 - LDP FRESH AIR FILTER
9 - LEAK DETECTION PUMP
10 - EVAP CANISTERS (2)
11 - FUEL TANK STRAPS (2)
12 - CHECK VALVE
13 - FUEL PUMP MODULE LOCK RING
14 - FUEL PUMP MODULE

EVAPORATIVE EMISSIONS (Continued)

SPECIFICATIONS

TORQUE - EVAP SYSTEM

DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
EVAP Canister Mounting Nuts	11	-	95
EVAP Canister Mounting Bracket-to-Frame Bolts	14	10	125
Leak Detection Pump Mounting Bolts	11	-	95
Leak Detection Pump Filter Mounting Bolt	11	-	95

CCV HOSE

DESCRIPTION - 8.0L V-10

The 8.0L V-10 engine is equipped with a Crankcase Ventilation (CCV) system. The CCV system performs the same function as a conventional PCV system, but does not use a vacuum controlled valve (PCV valve).

A molded vacuum tube connects manifold vacuum to the top of the right cylinder head (valve) cover. The vacuum tube connects to a fixed orifice fitting (Fig. 2) of a calibrated size 2.6 mm (0.10 inches).

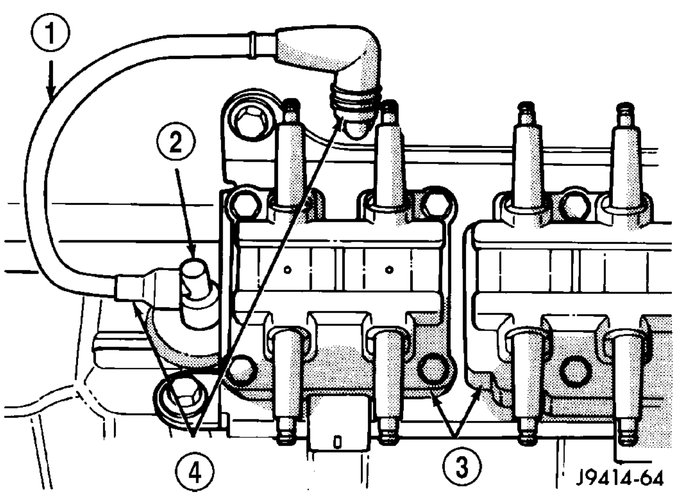

Fig. 2 FIXED ORIFICE FITTING - 8.0L V-10 ENGINE - TYPICAL

1 - VACUUM TUBE
2 - FIXED ORIFICE FITTING
3 - COIL PACKS
4 - ORIFICE FITTING HOSE CONNECTIONS

OPERATION - 8.0L V-10

A molded vacuum tube connects manifold vacuum to the top of the right cylinder head (valve) cover. The vacuum tube connects to a fixed orifice fitting (Fig. 2) of a calibrated size 2.6 mm (0.10 inches). The fitting meters the amount of crankcase vapors drawn out of the engine. **The fixed orifice fitting is grey in color.** A similar fitting (but does not contain a fixed orifice) is used on the left cylinder head (valve) cover. This fitting is black in color. Do not interchange these two fittings.

When the engine is operating, fresh air enters the engine and mixes with crankcase vapors. Manifold vacuum draws the vapor/air mixture through the fixed orifice and into the intake manifold. The vapors are then consumed during engine combustion.

EVAP/PURGE SOLENOID

DESCRIPTION

The duty cycle EVAP canister purge solenoid is located in the engine compartment. It is attached to the side of the Power Distribution Center (PDC).

OPERATION

The Powertrain Control Module (PCM) operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the time delay ends. During closed loop operation, the PCM energizes and de-energizes the solenoid 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid energizes. The PCM adjusts solenoid pulse width based on engine operating condition.

EVAP/PURGE SOLENOID (Continued)

REMOVAL

The duty cycle EVAP canister purge solenoid is located in the engine compartment. It is attached to the side of the Power Distribution Center (PDC) (Fig. 3).

(1) Disconnect electrical wiring connector at solenoid.

(2) Disconnect vacuum harness at solenoid (Fig. 3).

(3) Remove solenoid from mounting bracket.

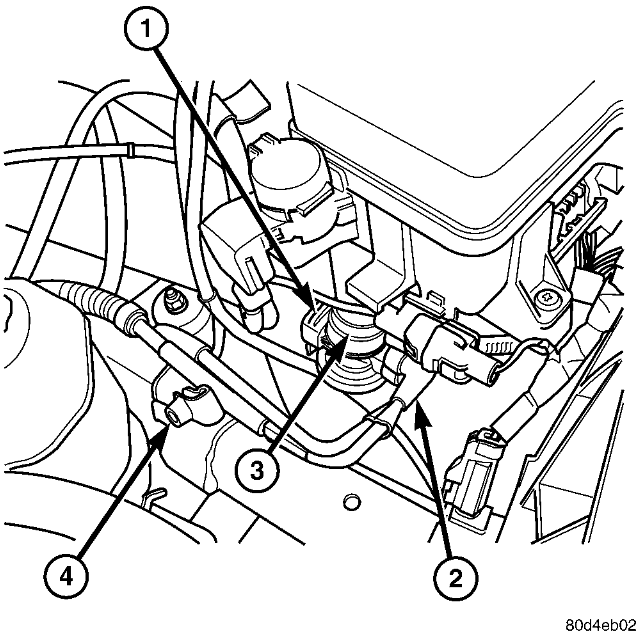

Fig. 3 EVAP / DUTY CYCLE PURGE SOLENOID

1 - MOUNTING BRACKET
2 - VACUUM HARNESS
3 - DUTY CYCLE SOLENOID
4 - TEST PORT CAP AND TEST PORT

INSTALLATION

(1) Install solenoid assembly to mounting bracket.

(2) Connect vacuum harness.

(3) Connect electrical connector.

FUEL FILLER CAP

DESCRIPTION

The plastic fuel tank filler tube cap is threaded onto the end of the fuel fill tube. Certain models are equipped with a 1/4 turn cap.

OPERATION

The loss of any fuel or vapor out of fuel filler tube is prevented by the use of a pressure-vacuum fuel fill cap. Relief valves inside the cap will release fuel tank pressure at predetermined pressures. Fuel tank vacuum will also be released at predetermined values. This cap must be replaced by a similar unit if replacement is necessary. This is in order for the system to remain effective.

CAUTION: Remove fill cap before servicing any fuel system component to relieve tank pressure. If equipped with a Leak Detection Pump (LDP), or NVLD system, the cap must be tightened securely. If cap is left loose, a Diagnostic Trouble Code (DTC) may be set.

REMOVAL

REMOVAL/INSTALLATION

If replacement of the 1/4 turn fuel tank filler tube cap is necessary, it must be replaced with an identical cap to be sure of correct system operation.

CAUTION: Remove the fuel tank filler tube cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or before draining the fuel tank.

LEAK DETECTION PUMP

DESCRIPTION

Vehicles equipped with JTEC engine control modules use a leak detection pump. Vehicles equipped with NGC engine control modules use an NVLD pump. Refer to Natural Vacuum - Leak Detection (NVLD) for additional information.

The evaporative emission system is designed to prevent the escape of fuel vapors from the fuel system (Fig. 4). Leaks in the system, even small ones, can allow fuel vapors to escape into the atmosphere. Government regulations require onboard testing to make sure that the evaporative (EVAP) system is functioning properly. The leak detection system tests for EVAP system leaks and blockage. It also performs self-diagnostics. During self-diagnostics, the Powertrain Control Module (PCM) first checks the Leak Detection Pump (LDP) for electrical and mechanical faults. If the first checks pass, the PCM then uses the LDP to seal the vent valve and pump air into the system to pressurize it. If a leak is present, the PCM will continue pumping the LDP to replace the air that leaks out. The PCM determines the size of the leak based on how fast/long it must pump the LDP as it tries to maintain pressure in the system.

LEAK DETECTION PUMP (Continued)

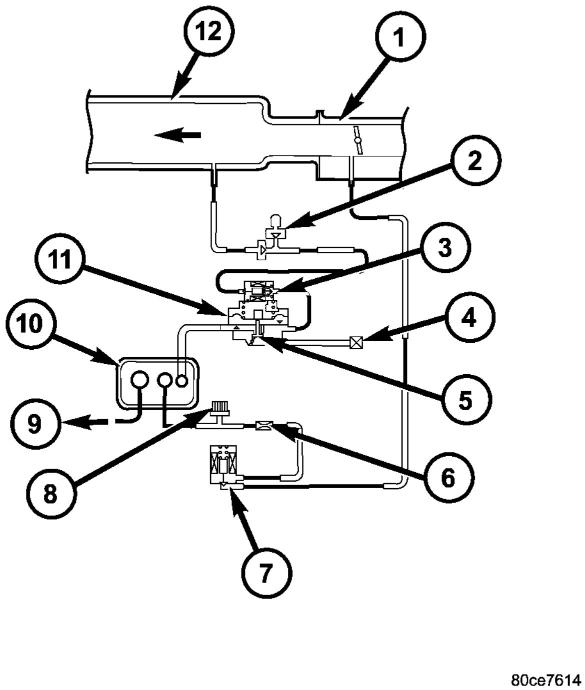

Fig. 4 TYPICAL SYSTEM COMPONENTS

1 - Throttle Body
2 - Service Vacuum Supply Tee (SVST)
3 - LDP Solenoid
4 - EVAP System Air Filter
5 - LDP Vent Valve
6 - EVAP Purge Orifice
7 - EVAP Purge Solenoid
8 - Service Port
9 - To Fuel Tank
10 - EVAP Canister
11 - LDP
12 - Intake Air Plenum

EVAP LEAK DETECTION SYSTEM COMPONENTS

Service Port: Used with special tools like the Miller Evaporative Emissions Leak Detector (EELD) to test for leaks in the system.

EVAP Purge Solenoid: The PCM uses the EVAP purge solenoid to control purging of excess fuel vapors stored in the EVAP canister. It remains closed during leak testing to prevent loss of pressure.

EVAP Canister: The EVAP canister stores fuel vapors from the fuel tank for purging.

EVAP Purge Orifice: Limits purge volume.

EVAP System Air Filter: Provides air to the LDP for pressurizing the system. It filters out dirt while allowing a vent to atmosphere for the EVAP system.

OPERATION

The main purpose of the LDP is to pressurize the fuel system for leak checking. It closes the EVAP system vent to atmospheric pressure so the system can be pressurized for leak testing. The diaphragm is powered by engine vacuum. It pumps air into the EVAP system to develop a pressure of about 7.5″ H2O (1/4) psi. A reed switch in the LDP allows the PCM to monitor the position of the LDP diaphragm. The PCM uses the reed switch input to monitor how fast the LDP is pumping air into the EVAP system. This allows detection of leaks and blockage. The LDP assembly consists of several parts (Fig. 5). The solenoid is controlled by the PCM, and it connects the upper pump cavity to either engine vacuum or atmospheric pressure. A vent valve closes the EVAP system to atmosphere, sealing the system during leak testing. The pump section of the LDP consists of a diaphragm that moves up and down to bring air in through the air filter and inlet check valve, and pump it out through an outlet check valve into the EVAP system. The diaphragm is pulled up by engine vacuum, and pushed down by spring pressure, as the LDP solenoid turns on and off. The LDP also has a magnetic reed switch to signal diaphragm position to the PCM. When the diaphragm is down, the switch is closed, which sends a 12 V (system voltage) signal to the PCM. When the diaphragm is up, the switch is open, and there is no voltage sent to the PCM. This allows the PCM to monitor LDP pumping action as it turns the LDP solenoid on and off.

LDP AT REST (NOT POWERED)

When the LDP is at rest (no electrical/vacuum) the diaphragm is allowed to drop down if the internal (EVAP system) pressure is not greater than the return spring. The LDP solenoid blocks the engine vacuum port and opens the atmospheric pressure port connected through the EVAP system air filter. The vent valve is held open by the diaphragm. This allows the canister to see atmospheric pressure (Fig. 6).

DIAPHRAGM UPWARD MOVEMENT

When the PCM energizes the LDP solenoid, the solenoid blocks the atmospheric port leading through the EVAP air filter and at the same time opens the engine vacuum port to the pump cavity above the diaphragm. The diaphragm moves upward when vacuum above the diaphragm exceeds spring force. This upward movement closes the vent valve. It also causes low pressure below the diaphragm, unseating the inlet check valve and allowing air in from the EVAP air filter. When the diaphragm completes its upward movement, the LDP reed switch turns from closed to open (Fig. 7).

DIAPHRAGM DOWNWARD MOVEMENT

Based on reed switch input, the PCM de-energizes the LDP solenoid, causing it to block the vacuum port, and open the atmospheric port. This connects

LEAK DETECTION PUMP (Continued)

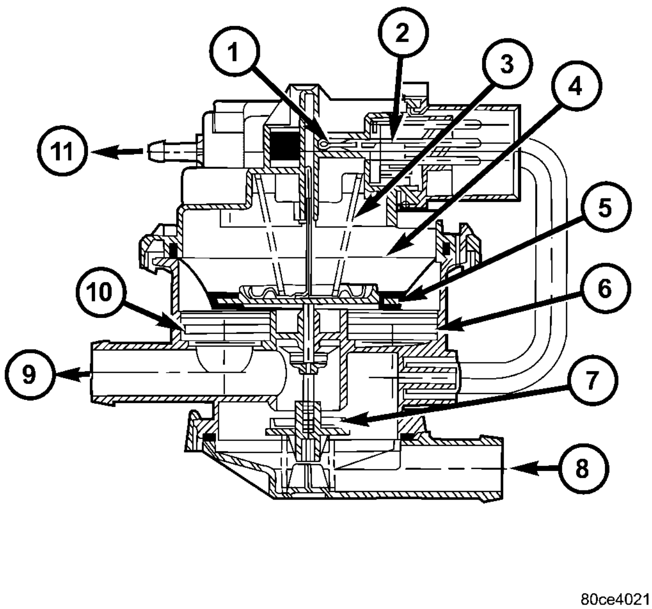

Fig. 5 EVAP LEAK DETECTION SYSTEM COMPONENTS

1 - Reed Switch
2 - Solenoid
3 - Spring
4 - Pump Cavity
5 - Diaphragm
6 - Inlet Check Valve
7 - Vent Valve
8 - From Air Filter
9 - To Canister
10 - Outlet Check Valve
11 - Engine Vacuum

the upper pump cavity to atmosphere through the EVAP air filter. The spring is now able to push the diaphragm down. The downward movement of the diaphragm closes the inlet check valve and opens the outlet check valve pumping air into the evaporative system. The LDP reed switch turns from open to closed, allowing the PCM to monitor LDP pumping (diaphragm up/down) activity (Fig. 8). During the pumping mode, the diaphragm will not move down far enough to open the vent valve. The pumping cycle is repeated as the solenoid is turned on and off. When the evaporative system begins to pressurize, the pressure on the bottom of the diaphragm will begin to oppose the spring pressure, slowing the pumping action. The PCM watches the time from when the solenoid is de-energized, until the diaphragm drops down far enough for the reed switch to change from opened to closed. If the reed switch changes too quickly, a leak may be indicated. The longer it takes the reed switch to change state, the tighter the evaporative system is sealed. If the system pressurizes too quickly, a restriction somewhere in the EVAP system may be indicated.

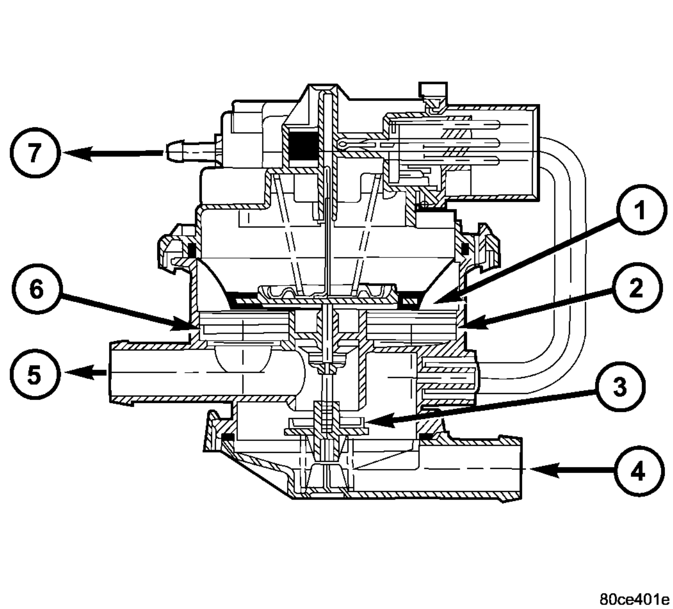

Fig. 6 LDP AT REST

1 - Diaphragm
2 - Inlet Check Valve (Closed)
3 - Vent Valve (Open)
4 - From Air Filter
5 - To Canister
6 - Outlet Check Valve (Closed)
7 - Engine Vacuum (Closed)

PUMPING ACTION

Action : During portions of this test, the PCM uses the reed switch to monitor diaphragm movement. The solenoid is only turned on by the PCM after the reed switch changes from open to closed, indicating that the diaphragm has moved down. At other times during the test, the PCM will rapidly cycle the LDP solenoid on and off to quickly pressurize the system. During rapid cycling, the diaphragm will not move enough to change the reed switch state. In the state of rapid cycling, the PCM will use a fixed time interval to cycle the solenoid. If the system does not pass the EVAP Leak Detection Test, the following DTCs may be set:

- P0442 - EVAP LEAK MONITOR 0.040″ LEAK DETECTED
- P0455 - EVAP LEAK MONITOR LARGE LEAK DETECTED
- P0456 - EVAP LEAK MONITOR 0.020″ LEAK DETECTED
- P1486 - EVAP LEAK MON PINCHED HOSE FOUND
- P1494 - LEAK DETECTION PUMP SW OR MECH FAULT
- P1495 - LEAK DETECTION PUMP SOLENOID CIRCUIT

LEAK DETECTION PUMP (Continued)

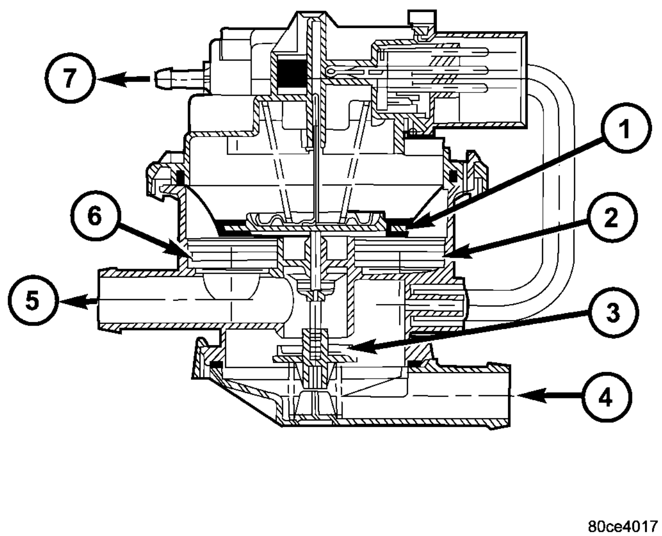

Fig. 7 DIAPHRAGM UPWARD MOVEMENT

1 - Diaphragm
2 - Inlet Check Valve (Open)
3 - Vent Valve (Closed)
4 - From Air Filter
5 - To Canister
6 - Outlet Check Valve (Closed)
7 - Engine Vacuum (Open)

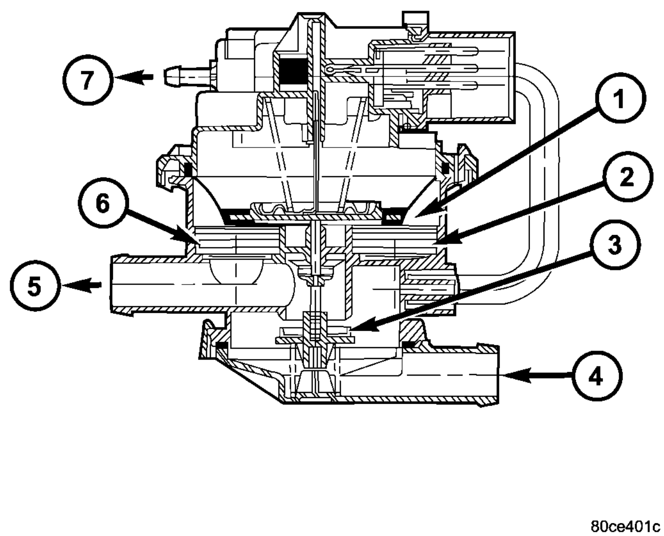

Fig. 8 DIAPHRAGM DOWNWARD MOVEMENT

1 - Diaphragm
2 - Inlet Check Valve (Closed)
3 - Vent Valve (Closed)
4 - From Air Filter
5 - To Canister
6 - Outlet Check Valve (Open)
7 - Engine Vacuum (Closed)

REMOVAL

The Leak Detection Pump (LDP) and LDP filter are attached to the front of the EVAP canister mounting bracket (Fig. 9). This is located near the front of the fuel tank. The LDP and LDP filter are replaced (serviced) as one unit.

(1) Raise and support vehicle.

(2) Carefully remove hose at LDP filter.

(3) Remove LDP filter mounting bolt and remove from vehicle.

(4) Carefully remove vapor/vacuum lines at LDP.

(5) Disconnect electrical connector at LDP.

(6) Remove LDP mounting bolt and remove LDP from vehicle.

INSTALLATION

The LDP and LDP filter are attached to the front of the EVAP canister mounting bracket. The LDP and LDP filter are replaced (serviced) as one unit.

(1) Install LDP to mounting bracket. Refer to Torque Specifications.

(2) Install LDP filter to mounting bracket. Refer to Torque Specifications.

(3) Carefully install vapor/vacuum lines to LDP, and install hose to LDP filter. **The vapor/vacuum lines and hoses must be firmly connected. Check the vapor/vacuum lines at the LDP, LDP filter and EVAP canister purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**

(4) Connect electrical connector to LDP.

PCV VALVE

DESCRIPTION

3.7L V-6 / 4.7L V-8

The 3.7L V-6 and 4.7L V-8 engines are equipped with a closed crankcase ventilation system and a Positive Crankcase Ventilation (PCV) valve.

This system consists of:

- a PCV valve mounted to the oil filler housing (Fig. 10). The PCV valve is sealed to the oil filler housing with an o-ring.
- the air cleaner housing
- two interconnected breathers threaded into the rear of each cylinder head (Fig. 11).
- tubes and hoses to connect the system components.

PCV VALVE (Continued)

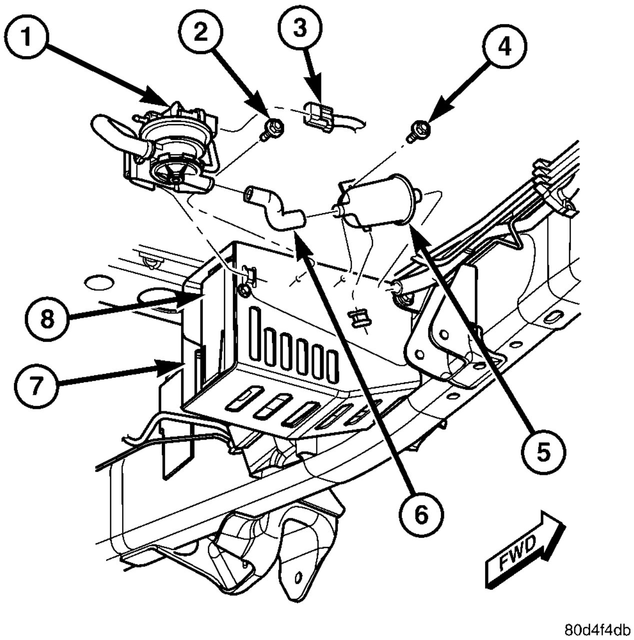

Fig. 9 LDP AND LDP FILTER LOCATION

1 - LDP
2 - LDP MOUNTING BOLT
3 - ELEC. CONNEC.
4 - FILTER MOUNTING BOLT
5 - LDP FILTER
6 - CONNECTING HOSE
7 - EVAP CANISTER MOUNTING BRACKET
8 - EVAP CANISTERS (2)

5.7L V-8

The 5.7L V-8 engine is equipped with a closed crankcase ventilation system and a Positive Crankcase Ventilation (PCV) valve.

This system consists of:

- a PCV valve mounted into the top of the intake manifold, located to the right / rear of the throttle body (Fig. 12). The PCV valve is sealed to the intake manifold with 2 o-rings (Fig. 13).
- passages in the intake manifold.
- tubes and hoses to connect the system components.

5.9L V-8

The 5.9L V-8 engine is equipped with a closed crankcase ventilation system and a positive crankcase ventilation (PCV) valve.

This system consists of a PCV valve mounted on the cylinder head (valve) cover with a hose extending from the valve to the intake manifold (Fig. 14). Another hose connects the opposite cylinder head (valve) cover to the air cleaner housing to provide a source of clean air for the system. A separate crankcase breather/filter is not used.

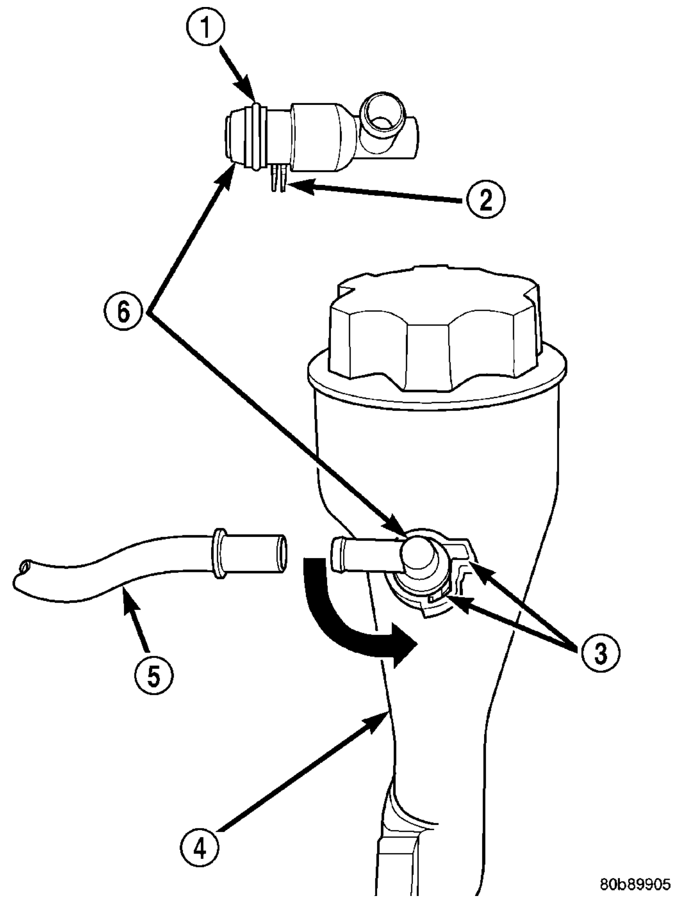

Fig. 10 PCV VALVE - 3.7L V-6 / 4.7L V-8

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

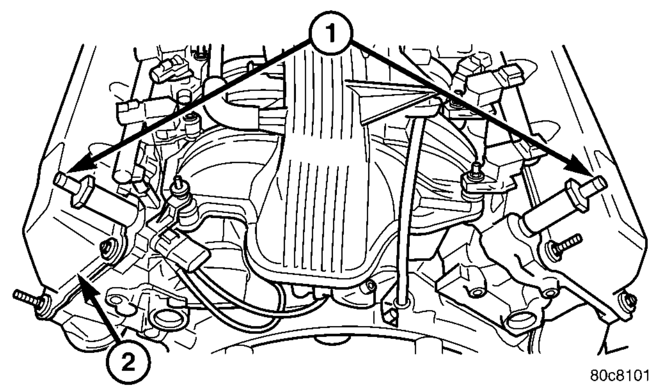

Fig. 11 CRANKCASE BREATHERS (2) - 3.7L V-6 / 4.7L V-8

1 - CRANKCASE BREATHERS (2)
2 - REAR OF ENGINE

OPERATION

The PCV system operates by engine intake manifold vacuum (Fig. 15). Filtered air is routed into the

PCV VALVE (Continued)

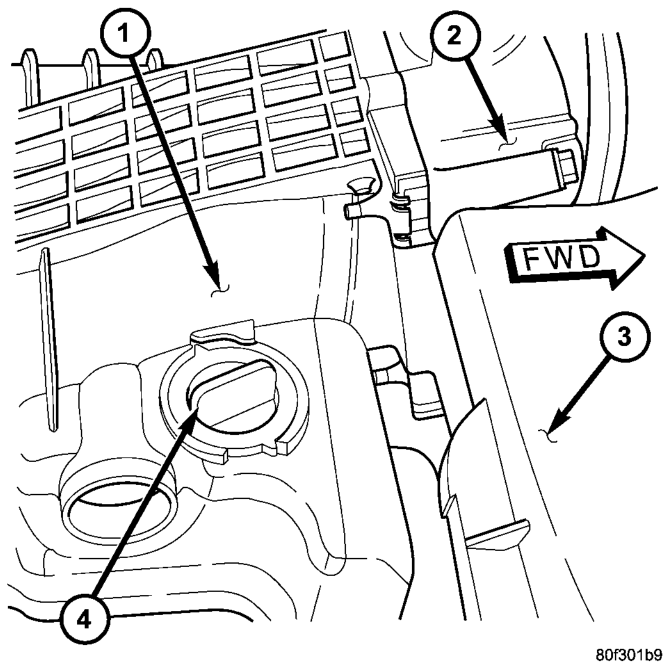

Fig. 12 LOCATION 5.7L PCV VALVE

1 - TOP OF INTAKE MANIFOLD
2 - THROTTLE BODY
3 - AIR RESONATOR
4 - PCV VALVE

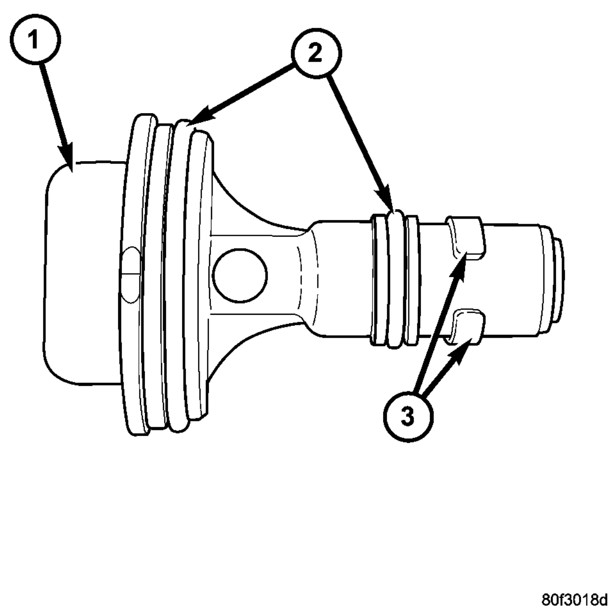

Fig. 13 5.7L PCV VALVE

1 - PCV VALVE
2 - O-RINGS
3 - ALIGNMENT TABS

crankcase through the air cleaner hose. The metered air, along with crankcase vapors, are drawn through the PCV valve and into a passage in the intake man-

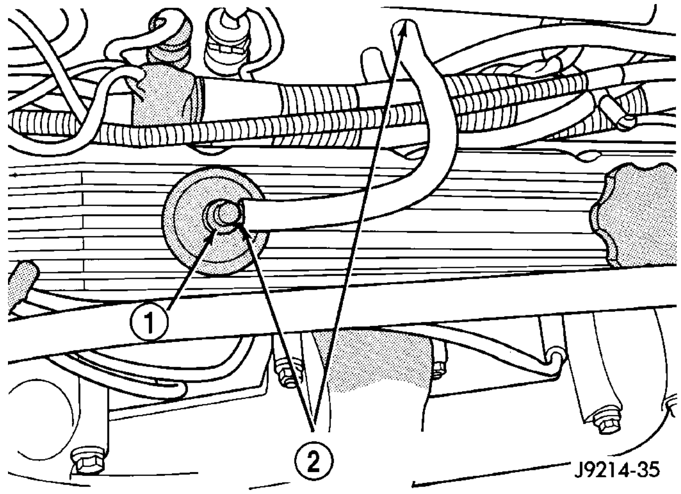

Fig. 14 PCV VALVE/HOSE - 5.9L V-8

1 - PCV VALVE
2 - PCV VALVE HOSE CONNECTIONS

ifold. The PCV system manages crankcase pressure and meters blow by gases to the intake system, reducing engine sludge formation.

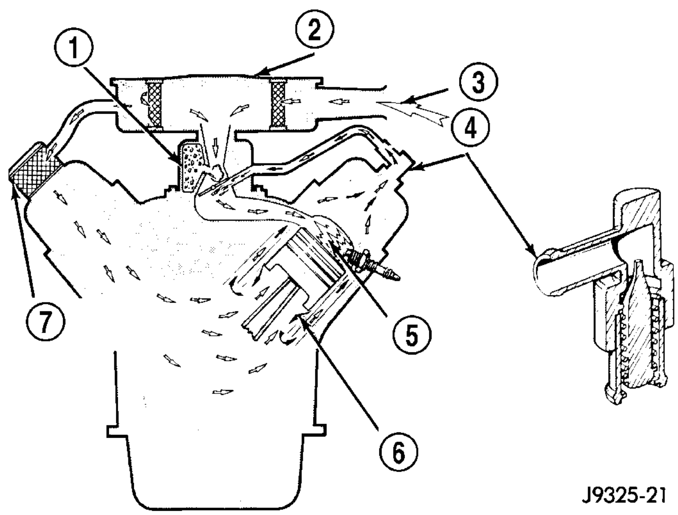

Fig. 15 TYPICAL CLOSED CRANKCASE VENTILATION SYSTEM

1 - THROTTLE BODY
2 - AIR CLEANER
3 - AIR INTAKE
4 - PCV VALVE
5 - COMBUSTION CHAMBER
6 - BLOW-BY GASES
7 - CRANKCASE BREATHER/FILTER

The PCV valve contains a spring loaded plunger. This plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

When the engine is not operating or during an engine pop-back, the spring forces the plunger back against the seat (Fig. 16). This will prevent vapors from flowing through the valve.

PCV VALVE (Continued)

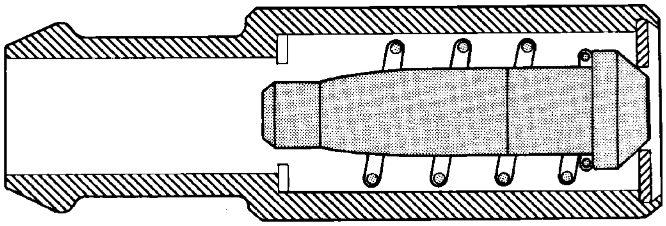

Fig. 16 ENGINE OFF OR ENGINE BACKFIRE - NO VAPOR FLOW

During periods of high manifold vacuum, such as idle or cruising speeds, vacuum is sufficient to completely compress spring. It will then pull the plunger to the top of the valve (Fig. 17). In this position there is minimal vapor flow through the valve.

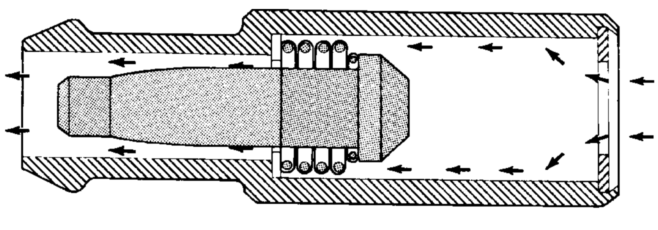

Fig. 17 HIGH INTAKE MANIFOLD VACUUM - MINIMAL VAPOR FLOW

During periods of moderate manifold vacuum, the plunger is only pulled part way back from inlet. This results in maximum vapor flow through the valve (Fig. 18).

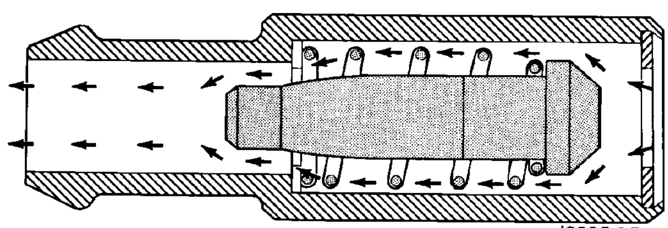

Fig. 18 MODERATE INTAKE MANIFOLD VACUUM - MAXIMUM VAPOR FLOW

DIAGNOSIS AND TESTING

DIAGNOSIS AND TESTING - PCV VALVE - 3.7L V-6/ 4.7L V-8

(1) Disconnect PCV line/hose (Fig. 19) by disconnecting rubber connecting hose at PCV valve fitting.

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward until locating tabs have been freed at cam lock (Fig. 19). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.**

(3) After valve is removed, check condition of valve o-ring (Fig. 19). Also, PCV valve should rattle when shaken.

(4) Reconnect PCV valve to its connecting line/ hose.

(5) Start engine and bring to idle speed.

(6) If valve is not plugged, a hissing noise will be heard as air passes through valve. Also, a strong vacuum should be felt with a finger placed at valve inlet.

(7) If vacuum is not felt at valve inlet, check line/ hose for kinks or for obstruction. If necessary, clean out intake manifold fitting at rear of manifold. Do this by turning a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

(8) **Do not attempt to clean the old PCV valve.**

(9) Return PCV valve back to oil filler tube by placing valve locating tabs (Fig. 19) into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(10) Connect PCV line/hose and connecting rubber hose to PCV valve.

(11) Disconnect rubber hose from fresh air fitting at air cleaner resonator box. Start engine and bring to idle speed. Hold a piece of stiff paper (such as a parts tag) loosely over the opening of the disconnected rubber hose.

(12) The paper should be drawn against the hose opening with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

(13) If vacuum is not present, disconnect each PCV system hose at top of each crankcase breather (Fig. 20). Check for obstructions or restrictions.

(14) If vacuum is still not present, remove each PCV system crankcase breather (Fig. 20) from each cylinder head. Check for obstructions or restrictions. If plugged, replace breather. Tighten breather to 12 N·m (106 in. lbs.) torque. Do not attempt to clean breather.

(15) If vacuum is still not present, disconnect each PCV system hose at each fitting, and at each check valve (Fig. 21). Check for obstructions or restrictions.

DIAGNOSIS AND TESTING - PCV VALVE - 5.9L V-8

(1) With engine idling, remove the PCV valve from cylinder head (valve) cover. If the valve is not plugged, a hissing noise will be heard as air passes through the valve. Also, a strong vacuum should be felt at the valve inlet (Fig. 22).

(2) Return the PCV valve into the valve cover. Remove the fitting and air hose at the opposite valve

PCV VALVE (Continued)

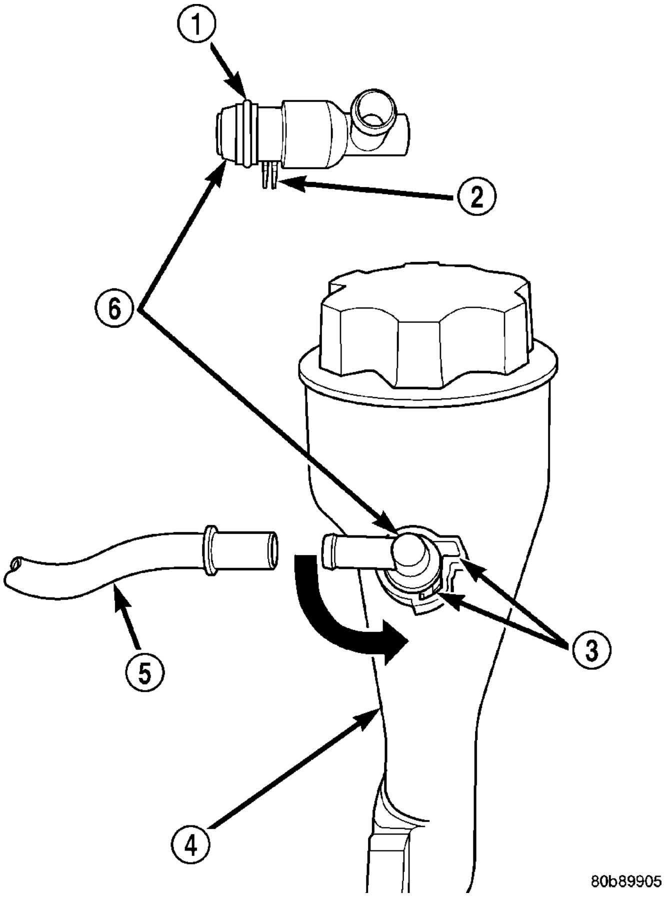

Fig. 19 PCV VALVE - 3.7L V-6 / 4.7L V-8

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

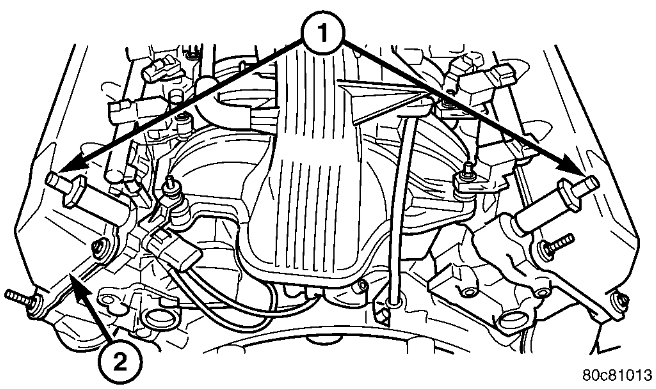

Fig. 20 CRANKCASE BREATHERS (2) - 3.7L V-6 / 4.7L V-8

1 - CRANKCASE BREATHERS (2)
2 - REAR OF ENGINE

cover. Loosely hold a piece of stiff paper, such as a parts tag, over the opening (rubber grommet) at the valve cover (Fig. 23).

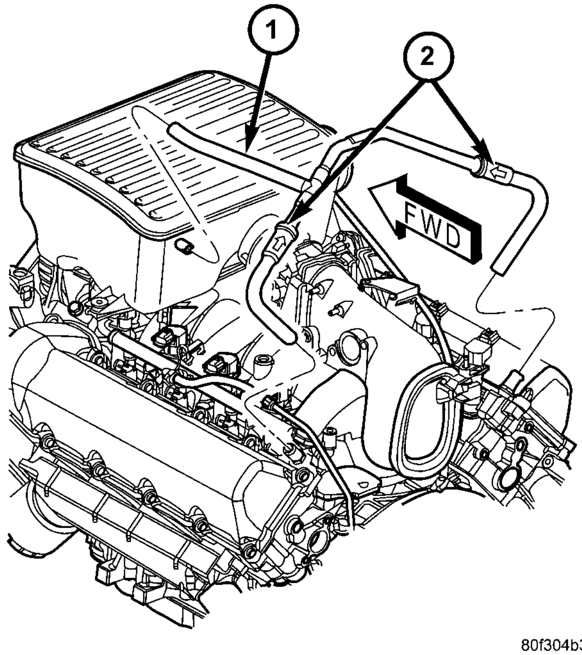

Fig. 21 CHECK VALVES - PCV SYSTEM - 3.7L V-6 / 4.7L V-8

1 - CONNECTING HOSES
2 - CHECK VALVES

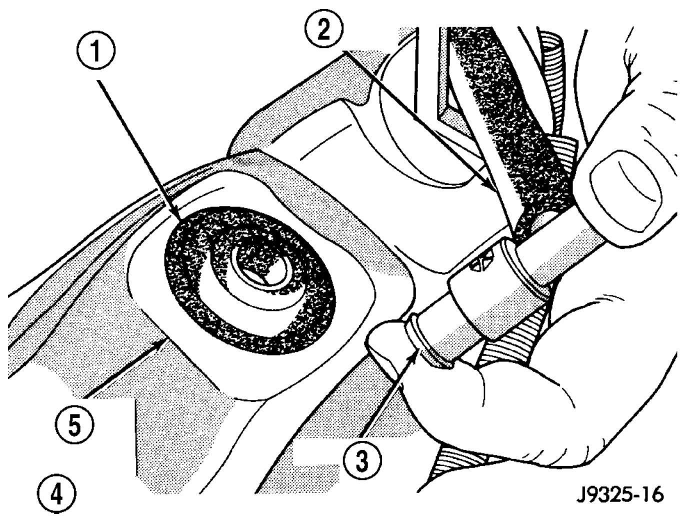

Fig. 22 VACUUM CHECK AT PCV - 5.9L V-8

1 - PCV VALVE GROMMET
2 - PCV HOSE
3 - PCV VALVE
4 - VACUUM MUST BE FELT AGAINST FINGER
5 - ENGINE VALVE COVER

(3) The paper should be drawn against the opening in the valve cover with noticeable force. This will be after allowing approximately one minute for crankcase pressure to reduce.

(4) Turn engine off and remove PCV valve from valve cover. The valve should rattle when shaken (Fig. 24).

PCV VALVE (Continued)

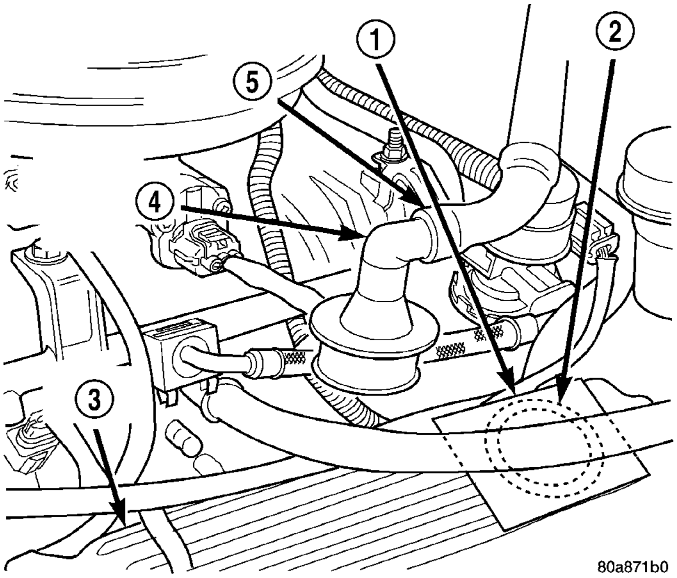

Fig. 23 VACUUM CHECK AT VALVE COVER OPENING - 5.9L V-8

1 - STIFF PAPER PLACED OVER RUBBER GROMMET
2 - RUBBER GROMMET
3 - VALVE COVER
4 - FITTING REMOVED FROM VALVE COVER
5 - AIR TUBE

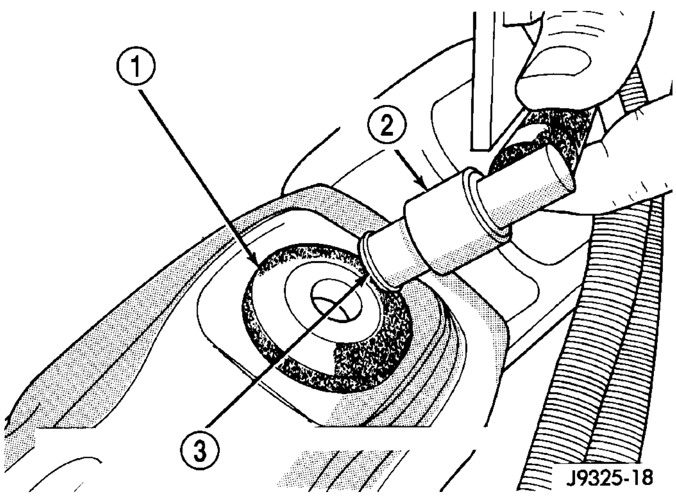

Fig. 24 SHAKE PCV - 5.9L V-8

1 - PCV VALVE GROMMET
2 - PCV VALVE
3 - PCV VALVE MUST RATTLE WHEN SHAKEN

(5) Replace the PCV valve and retest the system if it does not operate as described in the preceding tests. **Do not attempt to clean the old PCV valve.**

(6) If the paper is not held against the opening in valve cover after new valve is installed, the PCV valve hose may be restricted and must be replaced. The passage in the intake manifold must also be checked and cleaned.

(7) To clean the intake manifold fitting, turn a 1/4 inch drill (by hand) through the fitting to dislodge any solid particles. Blow out the fitting with shop air. If necessary, use a smaller drill to avoid removing any metal from the fitting.

REMOVAL

3.7L V-6 / 4.7L V-8

The PCV valve is located on the oil filler tube (Fig. 25). Two locating tabs are located on the side of the valve (Fig. 25). These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

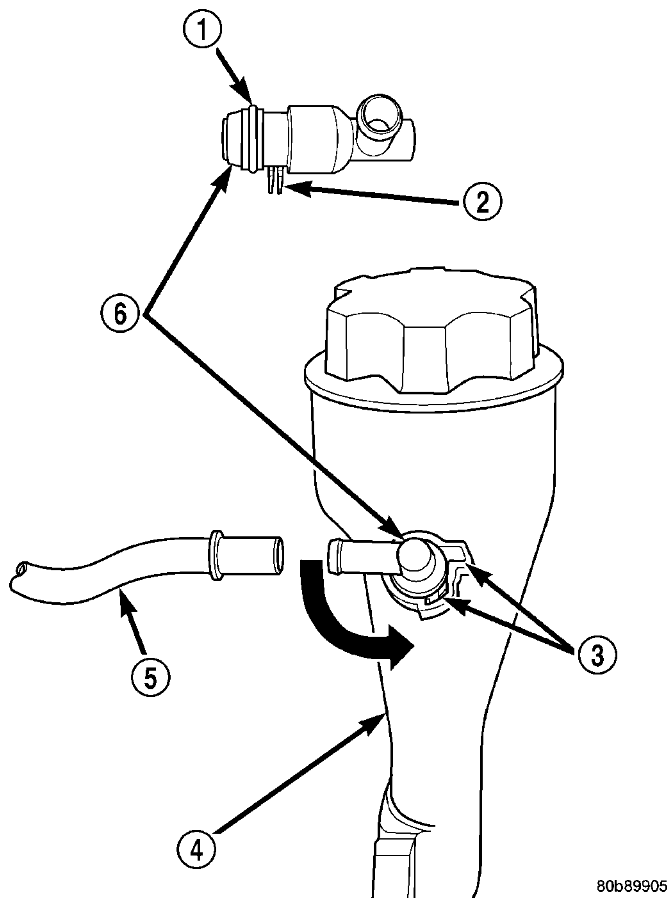

Fig. 25 PCV VALVE/OIL FILLER TUBE LOCATION - 3.7L V-6 / 4.7L V-8

1 - O-RING
2 - LOCATING TABS
3 - CAM LOCK
4 - OIL FILLER TUBE
5 - PCV LINE/HOSE
6 - PCV VALVE

(1) Disconnect PCV line/hose (Fig. 25) by disconnecting rubber hose at PCV valve fitting.

(2) Remove PCV valve at oil filler tube by rotating PCV valve downward (counter-clockwise) until locating tabs have been freed at cam lock (Fig. 25). After tabs have cleared, pull valve straight out from filler tube. **To prevent damage to PCV valve locating**

PCV VALVE (Continued)

tabs, valve must be pointed downward for removal. Do not force valve from oil filler tube.

(3) After valve is removed, check condition of valve o-ring (Fig. 25).

5.7L V-8

The PCV valve is mounted into the top of the intake manifold, located to the right / rear of the throttle body (Fig. 12). The PCV valve is sealed to the intake manifold with 2 o-rings (Fig. 13).

(1) Remove PCV valve by rotating counter-clockwise 90 degrees until locating tabs have been freed. After tabs have cleared, pull valve straight up from intake manifold.

(2) After valve is removed, check condition of 2 valve o-rings.

INSTALLATION

3.7L V6 / 4.7L V-8

The PCV valve is located on the oil filler tube. Two locating tabs are located on the side of the valve. These 2 tabs fit into a cam lock in the oil filler tube. An o-ring seals the valve to the filler tube.

(1) Return PCV valve back to oil filler tube by placing valve locating tabs into cam lock. Press PCV valve in and rotate valve upward. A slight click will be felt when tabs have engaged cam lock. Valve should be pointed towards rear of vehicle.

(2) Connect PCV line/hose and rubber hose to PCV valve.

5.7L V-8

(1) Clean out intake manifold opening.

(2) Check condition of 2 o-rings on PCV valve.

(3) Apply engine oil to 2 o-rings.

(4) Place PCV valve into intake manifold and rotate 90 degrees clockwise for installation.

VACUUM LINES

DESCRIPTION

A vacuum schematic for emission related items can be found on the vehicles VECI label. Refer to Vehicle Emission Control Information (VECI) Label for label location.

VAPOR CANISTER

DESCRIPTION

Two, maintenance free, EVAP canisters are used. Both canisters are mounted into a two-piece support bracket located near the front of the fuel tank (Fig. 26).

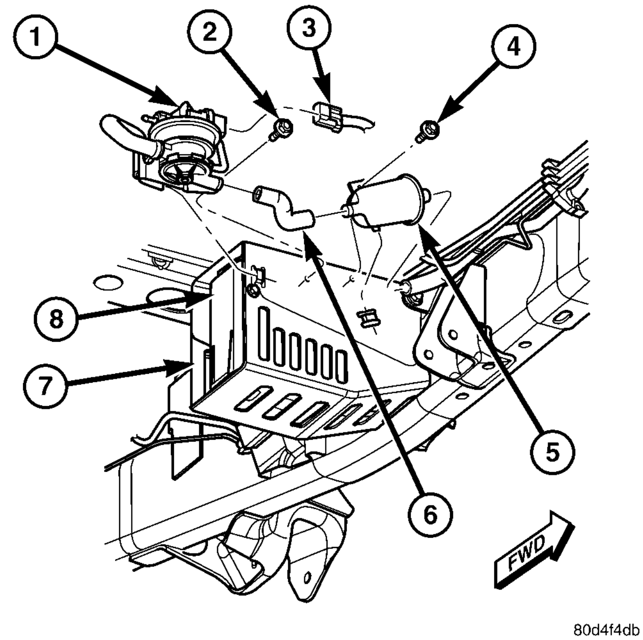

Fig. 26 LOCATION, EVAP CANISTERS

1 - LDP
2 - LDP MOUNTING BOLT
3 - ELEC. CONNEC.
4 - FILTER MOUNTING BOLT
5 - LDP FILTER
6 - CONNECTING HOSE
7 - EVAP CANISTER MOUNTING BRACKET
8 - EVAP CANISTERS (2)

OPERATION

Two, maintenance free, EVAP canisters are used.The EVAP canisters are filled with granules of an activated carbon mixture. Fuel vapors entering the EVAP canisters are absorbed by the charcoal granules.

Fuel tank pressure vents into the EVAP canisters. Fuel vapors are temporarily held in the canisters until they can be drawn into the intake manifold. The duty cycle EVAP canister purge solenoid allows the EVAP canisters to be purged at predetermined times and at certain engine operating conditions.

REMOVAL

Two, maintenance free, EVAP canisters are used. Both canisters are mounted into a two-piece support bracket located near the front of the fuel tank (Fig. 26).

(1) Raise and support vehicle.

(2) Remove fuel tubes/lines at each EVAP canister. Note location of tubes/lines before removal for easier installation.

(3) Remove lower support bracket (Fig. 27).

(4) Remove mounting nuts at top of each canister (Fig. 27).

VAPOR CANISTER (Continued)

(5) Remove each canister from upper support bracket.

The NVLD pump is located in the same area as the leak detection pump. Refer to NVLD Removal / Installation for additional information.

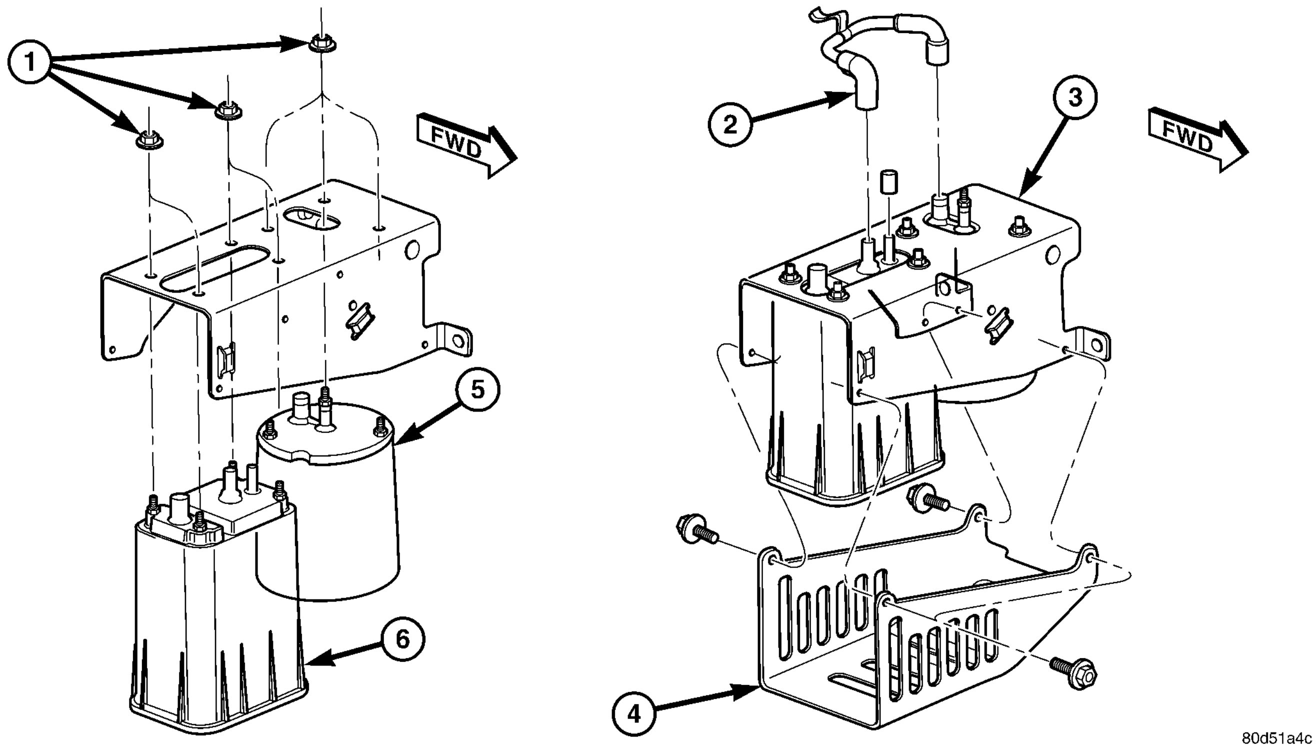

Fig. 27 EVAP CANISTERS - REMOVAL / INSTALLATION

1 - CANISTER MOUNTING NUTS
2 - CONNECTING HOSE
3 - UPPER SUPPORT BRACKET
4 - LOWER SUPPORT BRACKET
5 - OUTER CANISTER
6 - INNER CANISTER

INSTALLATION

(1) Place each canister into upper support bracket and install nuts. Refer to Torque Specifications.

(2) Install lower support bracket. Refer to Torque Specifications.

(3) Carefully install vapor/vacuum lines. **The vapor/vacuum lines and hoses must be firmly connected. Also check the vapor/vacuum lines at the LDP, LDP filter and EVAP canister purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**

NATURAL VAC LEAK DETECTION ASSY

DESCRIPTION

Vehicles equipped with NGC engine control modules use an NVLD pump and system.Vehicles equipped with JTEC engine control modules use an LDP (leak detection pump). Refer to Leak Detection Pump (LDP) for additional information.

OPERATION

Vehicles equipped with NGC engine control modules use an NVLD pump and system.Vehicles equipped with JTEC engine control modules use a leak detection pump. Refer to Leak Detection Pump (LDP) for additional information.

The Natural Vacuum Leak Detection (NVLD) system is the next generation evaporative leak detection system that will first be used on vehicles equipped with the Next Generation Controller (NGC). This new system replaces the leak detection pump as the method of evaporative system leak detection. This is to detect a leak equivalent to a 0.020″ (0.5 mm) hole. This system has the capability to detect holes of this size very dependably.

The basic leak detection theory employed with NVLD is the ″Gas Law″. This is to say that the pressure in a sealed vessel will change if the temperature of the gas in the vessel changes. The vessel will only see this effect if it is indeed sealed. Even small leaks will allow the pressure in the vessel to come to equilibrium with the ambient pressure. In addition to the

NATURAL VAC LEAK DETECTION ASSY (Continued)

detection of very small leaks, this system has the capability of detecting medium as well as large evaporative system leaks.

A vent valve seals the canister vent during engine off conditions. If the vapor system has a leak of less than the failure threshold, the evaporative system will be pulled into a vacuum, either due to the cool down from operating temperature or diurnal ambient temperature cycling. The diurnal effect is considered one of the primary contributors to the leak determination by this diagnostic. When the vacuum in the system exceeds about 1″ H2O (0.25 KPA), a vacuum switch closes. The switch closure sends a signal to the NGC. The NGC, via appropriate logic strategies, utilizes the switch signal, or lack thereof, to make a determination of whether a leak is present.

The NVLD device is designed with a normally open vacuum switch, a normally closed solenoid, and a seal, which is actuated by both the solenoid and a diaphragm. The NVLD is located on the atmospheric vent side of the canister. The NVLD assembly may be mounted on top of the canister outlet, or in-line between the canister and atmospheric vent filter. The normally open vacuum switch will close with about 1″ H2O (0.25 KPA) vacuum in the evaporative system. The diaphragm actuates the switch. This is above the opening point of the fuel inlet check valve in the fill tube so cap off leaks can be detected. Submerged fill systems must have recirculation lines that do not have the in-line normally closed check valve that protects the system from failed nozzle liquid ingestion, in order to detect cap off conditions.

The normally closed valve in the NVLD is intended to maintain the seal on the evaporative system during the engine off condition. If vacuum in the evaporative system exceeds 3″ to 6″ H2O (0.75 to 1.5 KPA), the valve will be pulled off the seat, opening the seal. This will protect the system from excessive vacuum as well as allowing sufficient purge flow in the event that the solenoid was to become inoperative.

The solenoid actuates the valve to unseal the canister vent while the engine is running. It also will be used to close the vent during the medium and large leak tests and during the purge flow check. This solenoid requires initial 1.5 amps of current to pull the valve open but after 100 ms. will be duty cycled down to an average of about 150 mA for the remainder of the drive cycle.

Another feature in the device is a diaphragm that will open the seal in the NVLD with pressure in the evaporative system. The device will ″blow off″ at about 0.5″ H2O (0.12 KPA) pressure to permit the venting of vapors during refueling. An added benefit to this is that it will also allow the tank to ″breathe″ during increasing temperatures, thus limiting the pressure in the tank to this low level. This is beneficial because the induced vacuum during a subsequent declining temperature will achieve the switch closed (pass threshold) sooner than if the tank had to decay from a built up pressure.

The device itself has 3 wires: Switch sense, solenoid driver and ground. It also includes a resistor to protect the switch from a short to battery or a short to ground. The NGC utilizes a high-side driver to energize and duty-cycle the solenoid.

REMOVAL

The NVLD pump and filter are attached to the front of the EVAP canister mounting bracket (Fig. 28). This is located near the front of the fuel tank. The pump and filter are replaced (serviced) as one unit.

(1) Raise and support vehicle.

(2) Carefully remove pump hose clamp and hose at filter.

(3) Carefully remove other vapor/vacuum hose at pump.

(4) Disconnect 3–way electrical connector at pump.

(5) The NVLD pump snaps onto the EVAP canister mounting bracket. Press on release tab (Fig. 29) while sliding pump from bracket.

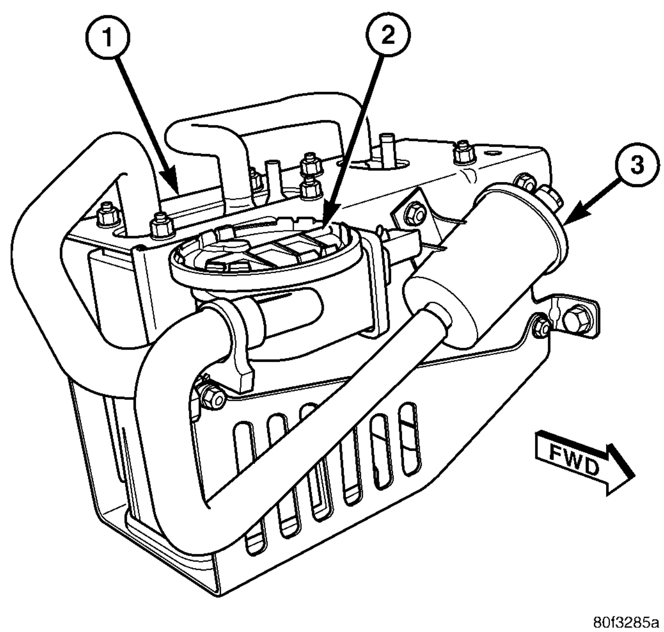

Fig. 28 NVLD PUMP LOCATION

1 - EVAP CANISTER MOUNTING BRACKET
2 - NVLD PUMP
3 - FILTER

INSTALLATION

(1) Install NVLD pump to EVAP canister mounting bracket (snaps on).

NATURAL VAC LEAK DETECTION ASSY (Continued)

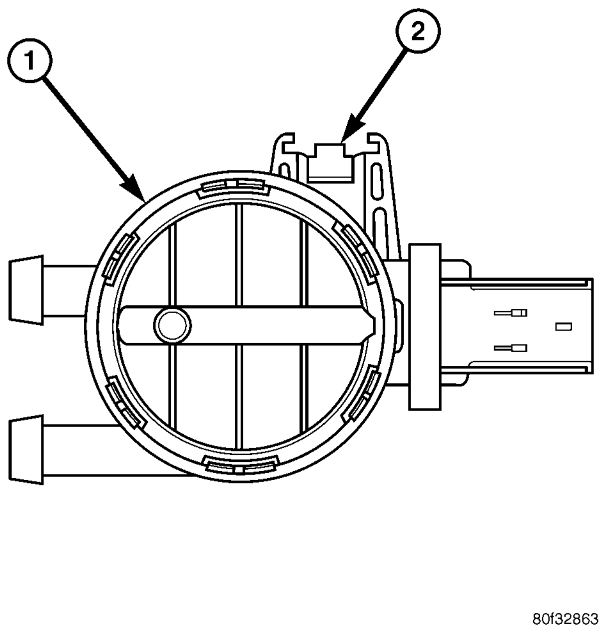

Fig. 29 REMOVE / INSTALL NVLD PUMP

1 - NVLD PUMP
2 - RELEASE TAB

(2) Install NVLD filter and bolt to EVAP canister mounting bracket. Refer to Torque Specifications.

(3) Carefully install vapor/vacuum lines to NVLD pump, and install hose to filter. **The vapor/vacuum lines and hoses must be firmly connected. Check the vapor/vacuum lines at the NVLD pump, filter and EVAP canister purge solenoid for damage or leaks. If a leak is present, a Diagnostic Trouble Code (DTC) may be set.**

(4) Connect 3–way electrical connector to pump.

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What errors(s) have you found?

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In order for us to assist you, please include as much details as possible when reporting an error

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