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1. ENGINE GENERAL

1.1 GENERAL

The terms **"COLD ENGINE"** and **"WARM ENGINE"** are defined as follows:

COLD ENGINE
A cold engine is an engine which, having reached operating temperature, has been allowed to cool down for at least **six hours**.

WARM ENGINE
A warm engine is an engine which, having reached operating temperature, has not been at a standstill for more than **thirty minutes**.

Direction of rotation of the engine
The direction of rotation of the engine is clockwise, as seen from the timing gear end.

First cylinder of the engine
The first cylinder of the engine is the cylinder at the timing gear end.

Left-hand and right-hand side of the engine
The left-hand side of the engine is the side where the fuel pump is mounted.

The right-hand side of the engine is the side where the air compressor is mounted.

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2. XF ENGINE

2.1 GENERAL

Types	XF 280 M XF 315 M XF 355 M
Version	Euro 2 (M), water-cooled, four-stroke diesel engine with direct fuel injection, 4 valves per cylinder and turbo-intercooling.
Number of cylinders	6
Bore x stroke	130 x 158 mm
Swept volume	12.58 l
Compression ratio	16.0 : 1
Firing order	1-5-3-6-2-4
Weight	approx. 1,049 kg

ENGINE TYPE	P (kW) at rpm	M (Nm) at rpm
XF 280 M	280 at 2000	1750 at 1100 - 1500
XF 315 M	315 at 2000	1900 at 1050 - 1500
XF 355 M	355 at 2000	2050 at 1000 - 1500

ENGINE TYPE	IDLING SPEED rpm	MAX. NO LOAD SPEED rpm
XF 280 M	525 - 575	approx. 2300
XF 315 M	525 - 575	approx. 2300
XF 355 M	525 - 575	approx. 2300

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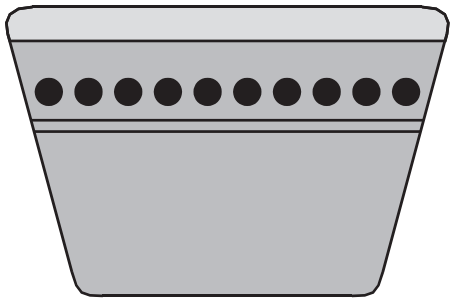
V-BELT TENSION

Belt tension, "AVX" raw-edge[1] V-belts in Newtons (N)		
	Multiple-V-belt	Single-V-belt
	New V-belt[2]	
Setting tension	1200	600
Test tension	≥ 800	≥ 400
	Worn V-belt[3]	
Minimum tension	500	250
Adjusting tension	700	350

(1) Raw-edge V-belts can be recognised by the absence of textile fabric in the rubber, with the exception of the top of the belt edge, on the edges and the insides of the belt (polished belt edges). Version: either toothed or non-toothed.

(2) After fitting the new V-belt, set the pre-tension to the "setting tension" and after a trial run check whether the pre-tension complies with the "test tension". If the tension reading is lower than the "test tension" specified in the table, set the V-belt to the minimum "test tension".

(3) If the V-belt tension is lower than the "minimum tension", set the belt to the "adjusting tension".



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Cylinder liner	
Height above cylinder block	0.02 - 0.10 mm
Cylinder head	
Minimum height after overhaul	119.50 mm
Test pressure using air (max. pressure)	1.5 bar
Valve clearance	
Valve clearance (cold/hot)	
inlet	0.50 mm
exhaust	0.50 mm
Valve opening	
Valve opening at 1 mm valve clearance	0.3 - 0.7 mm
Axial play	
Crankshaft axial play	0.06 - 0.32 mm
Camshaft axial play	0.10 - 0.55 mm
Idler gear axial play	0.05 - 0.25 mm
Gear backlash	
Idler gear - crankshaft gear	0.02 - 0.21 mm
Idler gear - fuel-pump gear	0.02 - 0.22 mm
Idler gear - camshaft gear	0.02 - 0.21 mm
Camshaft gear - compressor gear	0.02 - 0.22 mm
Fuel pump gear - steering pump gear	0.02 - 0.19 mm
Oil pump idler gear - oil pump gear	0.02 - 0.20 mm
Crankshaft gear - oil pump idler gear	0.02 - 0.20 mm
Number of teeth, timing gears	
Crankshaft gear	35
Idler gear	54
Fuel pump gear	70
Camshaft gear	70
Air compressor gear	27
Fan drive housing gear	29
Steering pump gear	18
Lubricating oil pump idler gear	34
Fan drive	
Heat gear wheel for max. 30 min.	245°C
Compression pressure	
Differences in compression pressure	15%
Flywheel/starter ring gear	
Axial variation, measured at a radial distance of 210 mm	0.10 mm
Starter ring gear warm up	max. 185°C

2.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Starter motor	
Attachment nuts	73 Nm(1)
Alternator	
Alternator bracket attachment bolts	55 Nm
Alternator attachment bolts	50 Nm
Pulley attachment nut, version 55A	70 Nm
Pulley attachment nut, version 95A	70 Nm
Air compressor	
M12 attachment bolts for compressor	110 Nm
M8 attachment bolts for bracket	30 Nm
M10 attachment bolts for bracket	60 Nm
Compressor gear flange bolt	120 Nm
M14 cylinder head threaded coupling	40 Nm
M26 cylinder head threaded coupling	90 Nm
Delivery pipe reducer valve	75 Nm
Suction and pressure line unions	90 Nm
Air-conditioning compressor	
M12 attachment bolts for compressor bracket	110 Nm
M10 attachment bolts for compressor	60 Nm(1)
Exhaust manifold	
Fit gasket with steel side towards manifold	
Sleeved attachment bolts	65 Nm
Heat shield attachment bolts	30 Nm(1)

Inlet manifold	
Attachment bolts	60 Nm
Glow plug attachment nut	55 Nm
Air inlet hose clamps	12 Nm
Turbocharger	
Heat shield attachment bolts	30 Nm(1)
Turbine housing clamp plate attachment nut	15 Nm
Attachment nuts, exhaust manifold flange/turbocharger	60 Nm(2)
Elbow on turbocharger	40 Nm
Oil supply pipe banjo bolt	90 Nm

(1) Secure with Loctite 243
(2) Apply Copaslip to secure

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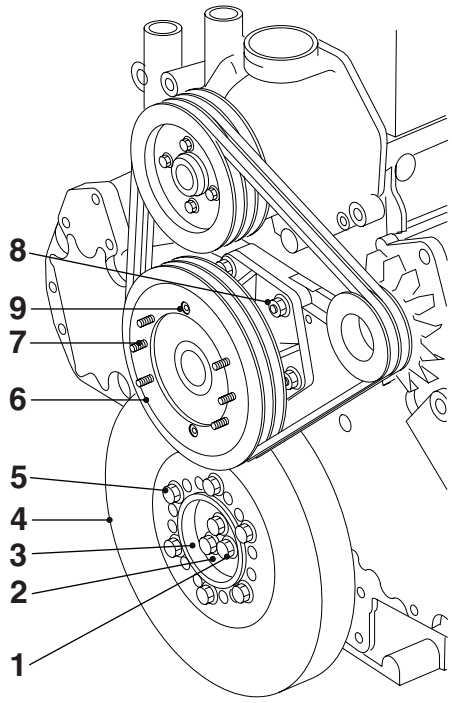
Vibration damper and fan drive



Vibration damper hub attachment bolts (1) in 4 phases:	
1st phase, all attachment bolts	100 Nm(1)
2nd phase, all attachment bolts	100 Nm(1)
3rd phase, all attachment bolts	100 Nm(1)
4th phase, all attachment bolts	100 Nm(1)
Attachment bolts, vibration damper (5)	110 Nm
Attachment nuts, fan drive (8)	60 Nm
Attachment bolts, fan pulley (9)	30 Nm(2)
Attachment nuts, fan clutch (7)	25 Nm(2)

(1) Tighten the attachment bolts evenly
(2) Secure with Loctite 243

Cylinder head attachment bolts
Cylinder head bolts must only be used **once** . So the cylinder head bolts should always be replaced. The new cylinder head bolts have a red/brown sealant on the thread.

Note:
- Because of the sealant used on the cylinder head bolts, their untightening torque may be very high!
- All M16 and M12 threaded holes must be carefully cleaned with a screw tap before the bolts are fitted.
- Once the bolts have been tightened to the specified torque, the angular displacement of the M16 bolts must **immediately** be started.
- The sealant cannot be applied later.

Tightening cylinder head attachment bolts

Note:
Apply a drop of oil underneath the bolt heads (on their abutting surface). Sealant also reduces the frictional resistance, which means that **no** oil must be applied to the thread.

1st phase

Tighten M16 in the order indicated	50 Nm(1)

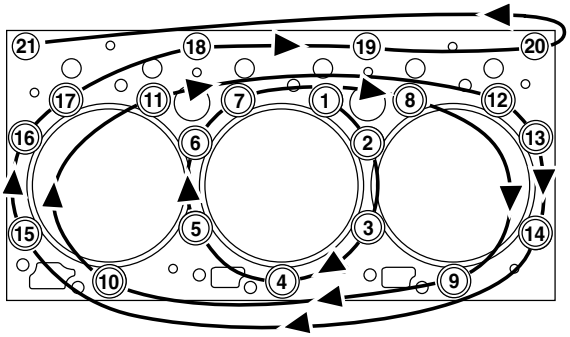
2nd phase

Tighten M16 in the order indicated	150 Nm
Tighten M12 in the order indicated	94 Nm(1)

3rd phase

M16 in the order indicated in two steps of	60° angular displacement

(1) Apply a drop of oil to bolts M16 and M12 on the abutting surface of the bolt heads.



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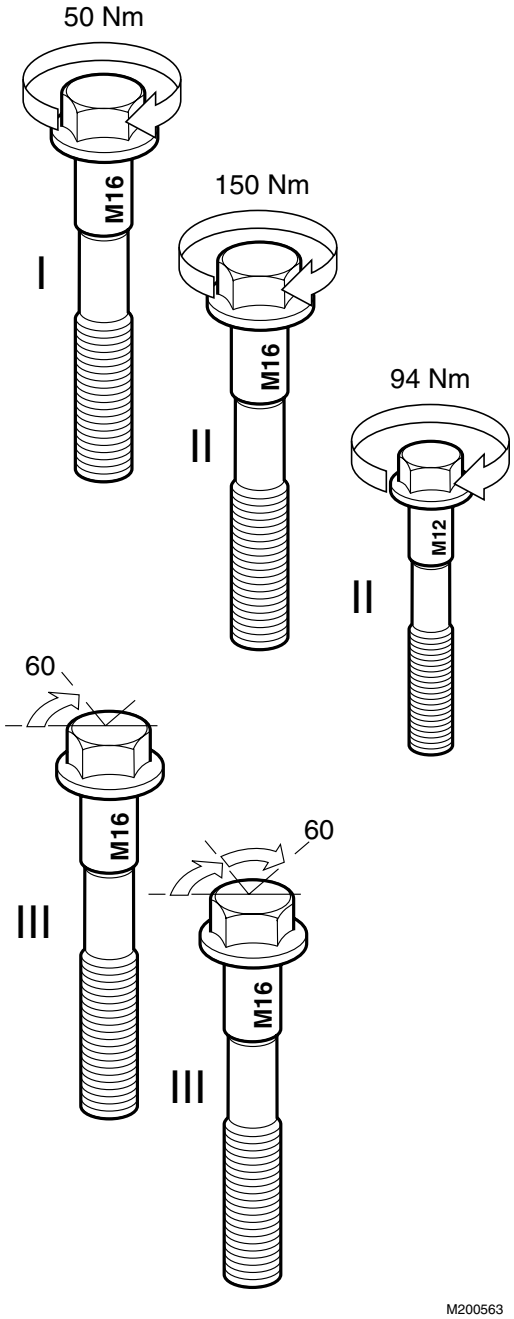

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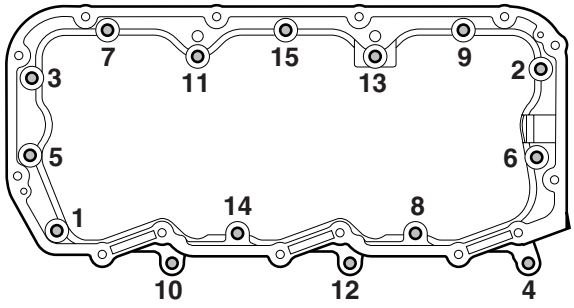
Timing gear

Camshaft locking plate attachment bolts	30 Nm(1)
Attachment bolts, fuel pump drive shaft locking plate	30 Nm(1)
Timing case attachment bolts	30 Nm(1)
Timing cover attachment bolts:	
M10 attachment bolts	60 Nm
M8 attachment bolts	25 Nm
Timing cover protection plate attachment bolt	15 Nm
Camshaft gear attachment bolt	425 Nm(1)
Idler gear attachment bolt	170 Nm
Attachment bolt, fuel pump gear wheel	260 Nm(1)
Attachment bolt, silencer	30 Nm
Steering pump gear attachment nut	80 Nm(1)
Steering pump intake pipe banjo bolt	90 Nm
Steering pump delivery pipe banjo bolt	40 Nm
Compressor gear attachment nut	120 Nm

(1) Secure with Loctite 243

Flywheel housing	
Attachment bolts	110 Nm(1)
Sealant to be used when fitting flywheel housing	Loctite 510
Flywheel	
Attachment bolts	
Without PTO	260 Nm(1) + 90° angular displacement
Without PTO spanner size 21 mm	260 Nm + 90° angular displacement
With PTO	260 Nm + 150° angular displacement
Engine mountings on timing gear end	
Cylinder block bracket attachment bolts	92 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	225 Nm + 60° angular displacement
Engine mountings on flywheel end	
Flywheel housing engine bracket attachment bolts	260 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	225 Nm + 60° angular displacement
Engine hanger brackets	
Attachment bolts	110 Nm
Valve gear	
Valve cover attachment bolts	25 Nm
Rocker setting bolt lock nut	40 Nm
Bridge piece setting bolt lock nut	40 Nm
Lubricating oil strip/rocker seat attachment bolts	110 Nm
DEB set screw nut	25 Nm
Solenoid valve	20 Nm
Wiring harness attachment bolt	9 Nm
Valve sleeve attachment bolts	30 Nm
Tighten the valve sleeve bolts in the sequence shown.	



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(1) Secure with Loctite 243

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3. XF ENGINE COOLING SYSTEM

3.1 GENERAL

Thermostat

Thermostat opening temperatures:	
- thermostat opens at	± 83°C
- thermostat opened at least 12 mm at	± 95°C
Thermostat seat	Loctite 638

Water pump

Maximum radial play	0.16 - 0.20 mm

Expansion tank pressure cap

Pressure relief valve opening pressure	± 0.75 bar
Underpressure valve opening pressure	± 0.1 bar

Pressure testing the cooling system

Test pressure	0.5 - 0.7 bar

3.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Water pump	
M8 attachment bolts	30 Nm
Threaded coupling	35 Nm
Coolant pipe	
Attachment bolts	54 Nm
Coolant pipe threaded coupling	90 Nm
Coolant pipe plug	30 Nm
Thermostat housing	
Attachment bolts	30 Nm
Plug	35 Nm
Radiator	
Attachment nuts	70 Nm

3.3 FILLING CAPACITIES

Cooling system capacity	approx. 50 litres
Cooling system capacity with ZF-intarder	approx. 60 litres

4. XF ENGINE LUBRICATION SYSTEM

4.1 GENERAL

Oil pressure	
Oil pressure at engine idling speed	1 bar (warm engine)
Oil pressure at full-load engine speed	3,5 - 4.5 bar
Oil filter	
Type	disposable filter
Quantity	1
Installation in the oil circuit	full flow
Opening pressure of bypass valve at a pressure difference of	2,5 ± 0.3 bar
Oil cooler	
Opening pressure of bypass valve at a pressure difference of	2 bar
Oil section test pressure	6 bar

4.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Fuel filter	
Attachment bolts, fuel filter/water pipe connection	40 Nm
Fuel pump filter head banjo bolt	40 Nm
Lubricating oil strip/rocker seats	
Attachment bolts	110 Nm
Oil sump	
Clamp attachment bolts	25 Nm
Oil drain plug	60 Nm
Oil pump	
Attachment bolts for oil pump housing sections	30 Nm
Attachment bolts connecting oil pump to main bearing cap	60 Nm(1)
Delivery pipe attachment bolts	30 Nm(1)
Idler gear central bolt	60 Nm(1)
Strainer	
Bracket attachment bolts	30 Nm(1)
Lubricating oil filter	
Lubricating oil filter housing attachment bolts	50 Nm(2)
Oil filter	45 Nm
Coupling in lubricating oil filter head	60 Nm(3)
Bypass pressure regulator	
Plug	80 Nm

Oil cooler

Attachment bolts connecting oil cooler to cylinder block	50 Nm
Coolant supply pipe union	90 Nm
Plug, adjustable banjo connection	90 Nm
Banjo bolt, adjustable banjo connection	90 Nm

Centrifugal oil filter

Central bolt	20 Nm
Oil discharge pipe union	50 Nm

Dip stick

Threaded coupling	60 Nm

(1) Secure with Loctite 243
(2) Secure with Loctite 572
(3) Secure with Loctite 2701

Oil sprayer

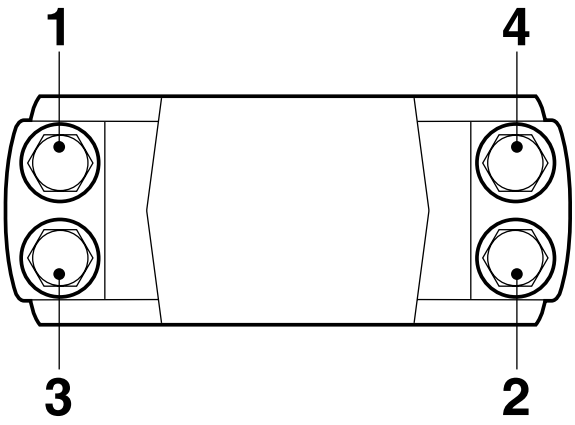
Banjo bolt M14 for oil sprayer with locking plate	30 Nm
M10 banjo bolt for oil sprayer	30 Nm

Main bearing caps

Main bearing cap attachment bolts	150 Nm + 120° angular displacement(1)

Big-end bearing caps

Attachment bolts, big-end bearing caps	
1st phase, sequence 1-2-3-4	35 Nm
2nd phase, sequence 4-3-2-1	45 Nm
3rd phase, sequence 1-2-3-4	60° angular displacement(2)



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(1) Apply a drop of oil to thread and contact surface.

(2) Connecting rod bolts are to be used once and tightened as instructed.
When fitting the connecting rod in the engine, apply a drop of oil to the threads and contact surfaces of the connecting rod bolts.

4.3 FILLING CAPACITIES

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Lubrication system

Total capacity, including oil cooler and oil filter	approx. 32 litres
Oil sump capacity, maximum level	approx. 25 litres
Oil sump capacity, minimum level	approx. 17 litres

5. XE ENGINE

5.1 GENERAL

Types	XE 280 C XE 315 C/C2 XE 355 C XE 390 C
Version	Euro 3 (C), (C2 = 4 öko), water-cooled, four-stroke diesel engine with direct fuel injection, 4-valves per cylinder and turbo-intercooling.
Number of cylinders	6
Bore x stroke	130 x 158 mm
Swept volume	12.58 l
Compression ratio	16.0 : 1
Firing order	1-5-3-6-2-4
Weight	approx. 1,080 kg

ENGINE TYPE	P (kW) at rpm	M (Nm) at rpm
XE 280 C	280 at 2000	1750 at 1000 - 1500
XE 315 C/C2	315 at 2000	1900 at 1100 - 1500
XE 355 C	355 at 2000	2100 at 1100 - 1500
XE 390 C	390 at 1900	2350 at 1100 - 1500

ENGINE TYPE	IDLING SPEED	MAX. NO LOAD SPEED
XE 280 C	525 - 575	approx. 2300
XE 315 C/C2	525 - 575	approx. 2300
XE 355 C	525 - 575	approx. 2300
XE 390 C	525 - 575	approx. 2300

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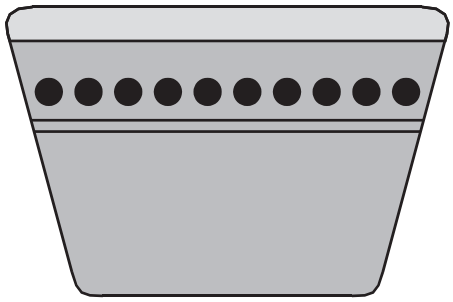
V-BELT TENSION

Belt tension, "AVX" raw-edge[1] V-belts in Newtons (N)		
	Multiple-V-belt	Single-V-belt
	New V-belt[2]	
Setting tension	1200	600
Test tension	≥ 800	≥ 400
	Worn V-belt[3]	
Minimum tension	500	250
Adjusting tension	700	350

(1) Raw-edge V-belts can be recognised by the absence of textile fabric in the rubber, with the exception of the top of the belt edge, on the edges and the insides of the belt (polished belt edges). Version: either toothed or non-toothed.

(2) After fitting the new V-belt, set the pre-tension to the "setting tension" and after a trial run check whether the pre-tension complies with the "test tension". If the tension reading is lower than the "test tension" specified in the table, set the V-belt to the minimum test tension.

(3) If the V-belt tension is lower than the "minimum tension", set the belt to the "adjusting tension".



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Cylinder liner

Height above cylinder block	0.02 - 0.10 mm

Cylinder head

Minimum height after overhaul	119.50 mm
Test pressure using air (hot)	1.5 bar

Valve clearance

Valve clearance (cold/hot)	
inlet	0.50 mm
exhaust	0.50 mm

Valve opening

Valve opening at 1 mm valve clearance	0.3 - 0.7 mm

Axial play	
Crankshaft axial play	0.06 - 0.32 mm
Camshaft axial play	0.10 - 0.55 mm
Idler gear axial play	0.05 - 0.25 mm
Gear backlash	
Idler gear - crankshaft gear	0.02 - 0.21 mm
Idler gear pump housing camshaft gear	0.02 - 0.22 mm
Idler gear - camshaft gear	0.02 - 0.21 mm
Camshaft gear - compressor gear	0.02 - 0.22 mm
Pump housing camshaft gear - steering pump gear	0.02 - 0.19 mm
Oil pump idler gear - oil pump gear	0.02 - 0.20 mm
Crankshaft gear - oil pump idler gear	0.02 - 0.20 mm
Number of teeth, timing gears	
Crankshaft gear	35
Idler gear	54
Pump housing camshaft gear	70
Camshaft gear	70
Air compressor gear	27
Fan drive housing gear	29
Steering pump gear	18
Lubricating oil pump idler gear	34
Fan drive	
Heat gear wheel for max. 30 min.	245°C
Compression pressure	
Differences in compression pressure	max. 15%
Flywheel/starter ring gear	
Axial variation, measured at a radial distance of 210 mm	0.10 mm
Starter ring gear warm up	max. 185°C

5.2 TIGHTENING TORQUES

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The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Starter motor	
Attachment nuts	73 Nm(1)
Alternator	
Alternator bracket attachment bolts	55 Nm
Alternator attachment bolts	50 Nm
Pulley attachment nut, version 55A	70 Nm
Pulley attachment nut, version 95A	70 Nm
Air compressor	
M12 attachment bolts	110 Nm
M8 attachment bolts for bracket	30 Nm
M10 attachment bolts for bracket	60 Nm
Compressor gear flanged nut	120 Nm
M14 cylinder head threaded coupling	40 Nm
M26 cylinder head threaded coupling	90 Nm
Delivery pipe reducer valve	75 Nm
Suction and pressure line unions	90 Nm
Air-conditioning compressor	
M12 attachment bolts for compressor bracket	110 Nm
M10 attachment bolts for compressor	60 Nm(1)
Exhaust manifold	
Fit gasket with steel side towards manifold	
Sleeved attachment bolts	65 Nm
Heat shield attachment bolts	30 Nm(1)

Inlet manifold	
Attachment bolts	60 Nm
Glow plug attachment nut	55 Nm
Air inlet hose clamps	12 Nm
Turbocharger	
Heat shield attachment bolts	30 Nm(1)
Turbine housing clamp plate attachment nut	15 Nm
Attachment nuts	
Exhaust manifold flange/turbocharger	60 Nm(2)
Elbow on turbocharger	40 Nm
Oil supply pipe banjo bolt	90 Nm

(1) Apply Loctite 243 to secure
(2) Apply Copaslip to secure

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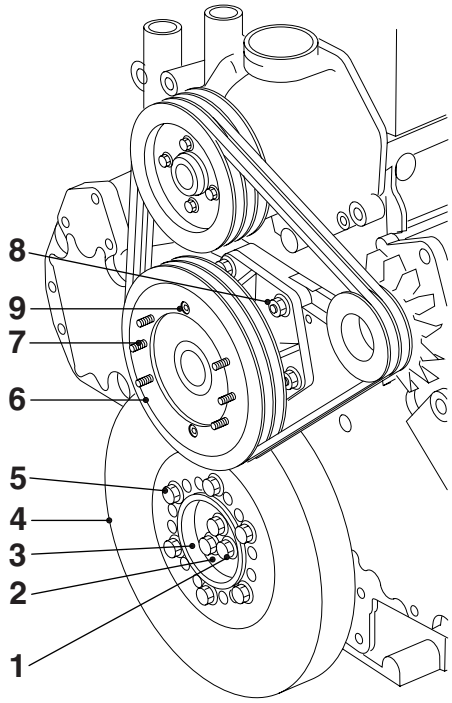
Vibration damper and fan drive



Vibration damper hub attachment bolts (1) in 4 phases:	
1st phase, all attachment bolts	100 Nm(1)
2nd phase, all attachment bolts	100 Nm(1)
3rd phase, all attachment bolts	100 Nm(1)
4th phase, all attachment bolts	100 Nm(1)
Attachment bolts, vibration damper (5)	110 Nm
Attachment nuts, fan drive (8)	60 Nm
Attachment bolts, fan pulley (9)	30 Nm(2)
Attachment nuts, fan clutch (7)	25 Nm(2)

(1) Tighten the attachment bolts evenly
(2) Secure with Loctite 243

Cylinder head attachment bolts
Cylinder head bolts must only be used **once**. So the cylinder head bolts should always be replaced. The new cylinder head bolts have a red/brown sealant on the thread.

Note:
- Because of the sealant used on the cylinder head bolts, their untightening torque may be very high!
- All M16 and M12 threaded holes must be carefully cleaned with a screw tap before the bolts are fitted.
- Once the bolts have been tightened to the specified torque, the angular displacement of the M16 bolts must **immediately** be started.
- The sealant cannot be applied later.

Tightening cylinder head attachment bolts

Note:
Apply a drop of oil underneath the bolt heads (on their abutting surface). Sealant also reduces the frictional resistance, which means that **no** oil must be applied to the thread.

1st phase

Tighten M16 in the order indicated	50 Nm(1)

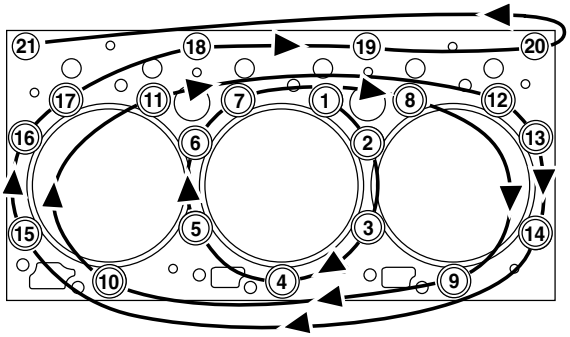
2nd phase

Tighten M16 in the order indicated	150 Nm
Tighten M12 in the order indicated	94 Nm(1)

3rd phase

M16 in the order indicated in two stages of	60° angular displacement

(1) Apply a drop of oil to bolts M16 and M12 on the abutting surface of the bolt heads.



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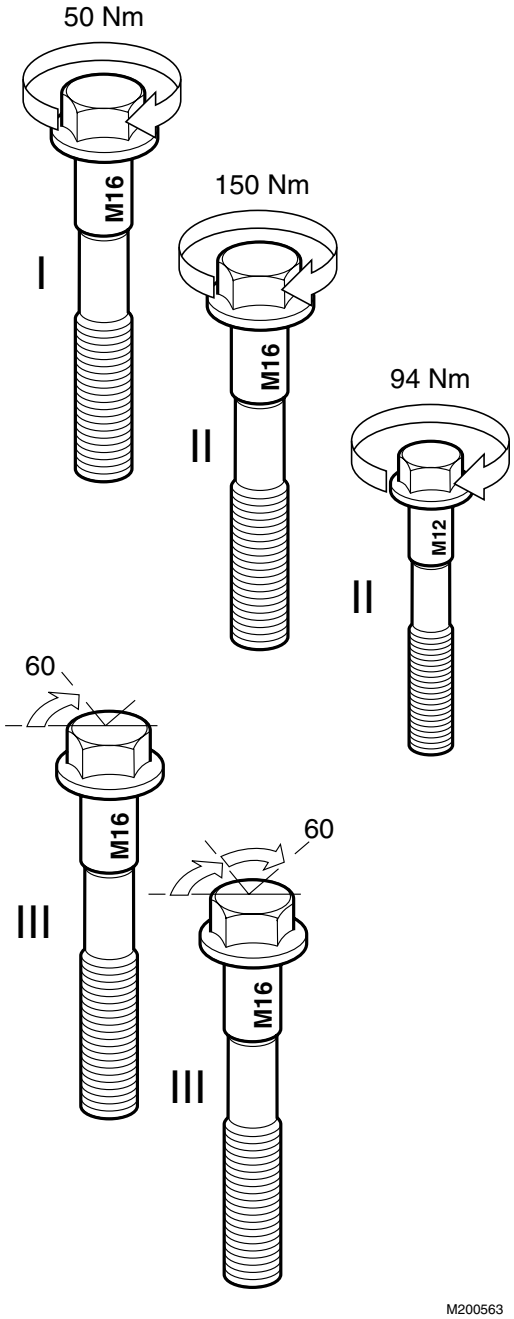

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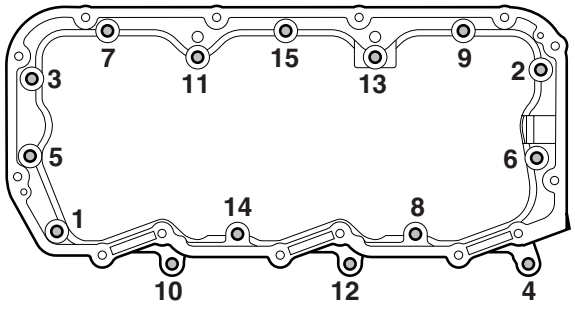
Timing gear

Camshaft locking plate attachment bolts	30 Nm(1)
Pump housing camshaft locking plate attachment bolts	30 Nm(1)
Timing case attachment bolts	25 Nm
Timing cover attachment bolts:	
M10 attachment bolts	60 Nm
M8 attachment bolts	25 Nm
Timing cover protection plate attachment bolt	15 Nm
Camshaft gear attachment bolt	425 Nm(1)
Idler gear attachment bolt	170 Nm
Pump housing camshaft gear attachment bolt	260 Nm(1)
Compressor gear attachment nut	120 Nm
Steering pump gear attachment nut	80 Nm(1)
Suction pipe banjo bolt	90 Nm
Delivery pipe banjo bolt	40 Nm

(1) Apply Loctite 243 to secure

0

Flywheel housing	
Attachment bolts	110 Nm(1)
Sealant to be used when fitting flywheel housing	Loctite 510
Flywheel	
Attachment bolts	
Without PTO	260 Nm + 90° angular displacement
With PTO	260 Nm + 150° angular displacement
Engine mountings on timing gear end	
Cylinder block bracket attachment bolts	92 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	225 Nm + 60° angular displacement
Engine mountings on flywheel end	
Flywheel housing engine bracket attachment bolts	260 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	225 Nm + 60° angular displacement
Engine hanger brackets	
Attachment bolts	110 Nm
Valve gear	
Valve cover attachment bolts	25 Nm
Rocker setting bolt lock nut	40 Nm
Bridge piece setting bolt lock nut	40 Nm
Lubricating oil strip/rocker seat attachment bolts	110 Nm
DEB set screw nut	25 Nm
Solenoid valve	20 Nm
Wiring harness attachment bolt	9 Nm
Valve sleeve attachment bolts	30 Nm
Tighten the valve sleeve bolts in the sequence shown.	



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(1) Apply Loctite 243 to secure

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6. XE ENGINE COOLING SYSTEM

6.1 GENERAL

Thermostat

Thermostat opening temperatures:	
- thermostat opens at	± 83°C
- thermostat opened at least 12 mm at	± 95°C
Thermostat seat	Loctite 638

Water pump

Maximum radial play	0.16 - 0.20 mm

Expansion tank pressure cap

Pressure relief valve opening pressure	0.75 - 0.9 bar
Underpressure valve opening pressure	0.1 bar

Pressure testing the cooling system

Test pressure	0.5 - 0.7 bar

0

6.2 TIGHTENING TORQUES

The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Water pump	
M8 attachment bolts	30 Nm
Threaded coupling	35 Nm
Coolant pipe	
Attachment bolts	54 Nm
Coolant pipe threaded coupling	90 Nm
Plug	35 Nm
Thermostat housing	
Attachment bolts	30 Nm
Plug	35 Nm
Radiator	
Attachment nuts	70 Nm

6.3 FILLING CAPACITIES

Cooling system capacity	approx. 50 litres
Cooling system capacity with ZF-intarder	approx. 60 litres

7. XE ENGINE LUBRICATION SYSTEM

7.1 GENERAL

Oil pressure	
Oil pressure at engine idling speed	1 bar (warm engine)
Oil pressure at full-load engine speed	3.5 - 4.5 bar
Oil filter	
Type	disposable filter
Quantity	1
Installation in the oil circuit	full flow
Opening pressure of bypass valve at a pressure difference of	2.5 ± 0.3 bar
Oil cooler	
Opening pressure of bypass valve at a pressure difference of	2 bar
Oil section test pressure	6 bar

7.2 TIGHTENING TORQUES

0

The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques. The other threaded connections which are not stated must therefore be tightened to the tightening torque stated in the overview of standard tightening torques.
When attachment bolts and nuts are to be replaced, it is important that they are of exactly the same length and property class as the ones removed unless stated otherwise.

Fuel filter	
Attachment bolts, fuel filter/water pipe connection	40 Nm
Lubricating oil strip/rocker seats	
Attachment bolts	110 Nm
Oil sump	
Clamp attachment bolts	25 Nm
Oil drain plug	60 Nm
Oil pump	
Attachment bolts for oil pump housing sections	30 Nm
Attachment bolts connecting oil pump to main bearing cap	60 Nm(1)
Oil delivery pipe attachment bolts	30 Nm(1)
Idler gear central bolt	60 Nm(1)
Strainer	
Bracket attachment bolts	30 Nm(1)
Lubricating oil filter	
Lubricating oil filter housing attachment bolts	50 Nm(2)
Oil filter	45 Nm
Coupling in lubricating oil filter head	60 Nm(3)
Bypass pressure regulator	
Plug	80 Nm

Oil cooler

Attachment bolts connecting oil cooler to cylinder block	50 Nm
Coolant supply pipe union	90 Nm
Plug, adjustable banjo connection	90 Nm
Banjo bolt, adjustable banjo connection	90 Nm

Centrifugal oil filter

Central bolt	20 Nm
Oil discharge pipe union	50 Nm

Dip stick

Threaded coupling	60 Nm

(1) Apply Loctite 243 to secure
(2) Apply Loctite 572 to secure
(3) Apply Loctite 2701 to secure

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Oil sprayer

Oil sprayer banjo bolt	30 Nm

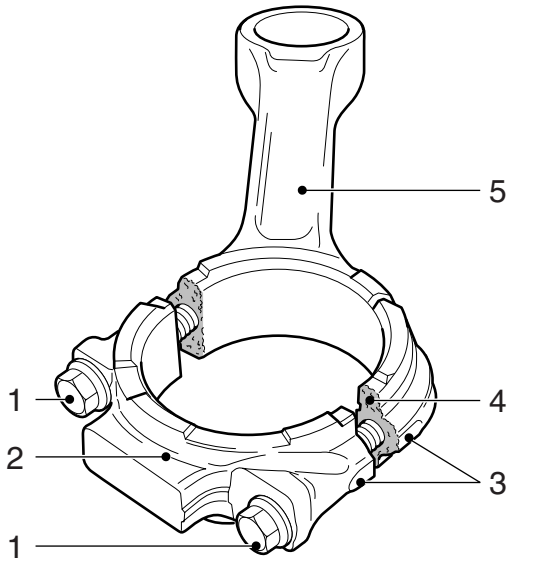
Main bearing caps

Main bearing cap attachment bolts	150 Nm + 120° angular displacement(1)

Big-end bearing caps

Attachment bolts (1) for **cracked** big-end bearing caps

1st phase, order	100 Nm
2nd phase, order	175 ± 15 Nm
3rd phase, order	60° angular displacement(2)



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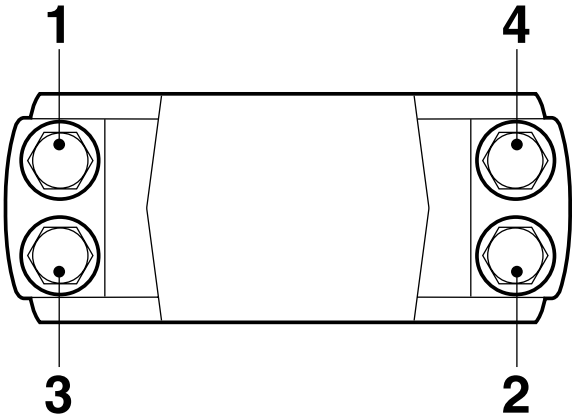
Attachment bolts, big-end bearing caps

1st phase, sequence 1-2-3-4	35 Nm
2nd phase, sequence 4-3-2-1	45 Nm
3rd phase, sequence 1-2-3-4	60° angular displacement(2)



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Attachment bolts, big-end bearing caps **XE390C**

1st phase, sequence 1-2-3-4	50 Nm
2nd phase, sequence 4-3-2-1	80 Nm
3rd phase, sequence 1-2-3-4	60° angular displacement(2)

(1) Apply a drop of oil to thread and contact surface.
(2) Connecting rod bolts are to be used once and tightened as instructed. When fitting the connecting rod in the engine, apply a drop of oil to the threads and contact surfaces of the connecting rod bolts.

7.3 FILLING CAPACITIES

Lubrication system

Total capacity, including oil cooler and oil filter	approx. 32 litres
Oil sump capacity, maximum level	approx. 25 litres
Oil sump capacity, minimum level	approx. 17 litres

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1. TRACTIVE PROBLEMS

1.1 INTRODUCTION

There may be several reasons for improper vehicle performance.

Some of these may be mechanical, others are particularly also of a psychological nature.

It is therefore important to properly identify the problem.

Try to get as much information as possible from the customer or driver.

- When does the vehicle not perform properly?
- In what road or weather conditions?
- How is the vehicle loaded?
- Is the vehicle not being compared with a vehicle with completely different specifications, for instance engine power?
- Is the vehicle being driven in the correct engine speed range?

If the answers are unsatisfactory, ask the customer or driver for facts.

- Tachograph cards of trips
- Reliable consumption figures of trips

Following proper identification of the complaint, vehicle performance can be tested by an acceleration test.

If the vehicle fails to pass the acceleration test, a boost pressure curve may be plotted as an aid to identify the cause.

Note:
Checking the boost pressure will in general only make sense after the vehicle has covered at least 20,000 km.

The test sheets are available through the DAF organisation.

For plotting a boost pressure curve, see Group 4 of the workshop manual.

1.2 ACCELERATION TEST
(engine model with conventional fuel system)

The acceleration test is required to acquire an effective understanding of the fuel consumption and tractive force of a vehicle. When carrying out the test the legal regulations should be observed and maximum security be ensured.

Compared with other diagnostic tools, this test is a fast and cheap way of checking whether the vehicle meets DAF's requirements and, therefore, whether or not the complaint is justified.

During the acceleration test the time required to accelerate the loaded vehicle from starting speed to final speed is measured. (Weight of entire combination at least 75% of the train weight, GCW).

To eliminate weather influences and road conditions, this test must be done in both driving directions. The average acceleration time is obtained by averaging both measured times.

The maximum acceleration time, the speeds between which the time is to be measured and the gear to be engaged for the various vehicle configurations is calculated using the DAF "Topec" route simulation computer program.

For this purpose, "Topec" needs the following and other vehicle data:
- vehicle type
- height of the entire vehicle combination
- weight of entire vehicle combination (at least 75% of the train weight)
- aerodynamic influences, e.g. roof spoilers, fenders, etc.
- engine type
- gearbox type and reduction
- rear axle type and axle reduction
- tyre size
- cab type.

Before starting the acceleration test

- Check the tyre pressure of the entire vehicle combination. Also check the tyres for a deviating wear pattern.
- Examine the complete condition of the trailer or semi-trailer.
- Check the entire vehicle combination for adverse aerodynamic influences, for instance loose tarpaulins, wrongly adjusted spoilers and fenders.
- Check the vehicle and trailer or semi-trailer for excessive road drag. Be aware of dragging brakes.
- Check the tachograph. The speed signal should be present.
- Check that the correct k-factor is set on the tachograph.
- Check that the fuel pump of the engine has been provided with the original seal.
- Check that the throttle control is able to reach the maximum stop of the fuel pump.

Acceleration test

1. Use the “Acceleration test form” in the workshop manual.
2. Check the activities as set out under “Before starting the acceleration test”.
3. Choose a test route where the difference between the measured times in both directions does not exceed 15%. If the difference in time exceeds 15%, find another test route.
4. Establish the starting and end points on the selected test route, to ensure that exactly the same route can be taken in both directions. Do the entire test at least twice and take the average time.

5. Run the drive train at operating temperature (drive for at least 15 minutes with a loaded vehicle).

Note:
When switched on, the air compressor and fan consume 10 to 15 kW engine power on average. During the test try to avoid that both consumers are or have been switched on.

6. Before the starting point on the test route, engage the gear specified by Topec and make sure the vehicle speed is at least 3 km/h below the starting speed.

7. **Fully** depress the accelerator pedal and (using a stopwatch) measure the time needed to accelerate the vehicle from starting speed to end speed.

Result of first acceleration test
If the acceleration time is not achieved, first carry out the following work.

- Check the injection timing. Adjust or optimise, if necessary.
- Check the fuel system for the presence of air.
- Replace/clean the air filter element.
- Check the setting of the wastegate on the turbocharger (if present).
- Check the engine brake butterfly valve for smooth operation.
- Check the inlet air cooler exterior for dirt deposits.
- Clean the water separator (if fitted).
- Replace the fuel filter.
- Replace/clean the fuel prefilter (if present).

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- Check the suction pipe of the tank for clogging by large pieces of foreign matter.
- Check the fuel tank for contamination. Clean the tank with a steam cleaner, if necessary.
- Check the air inlet system for any leaks.
- Check the exhaust system for any leaks.
- Check the exhaust system for blockages by measuring the exhaust back pressure.
- Check the turbocharger wheels on the compressor and turbine side for damage and for deposits of salt or any other contaminants.
- Check the banjo bolt strainer in the fuel lift pump for dirt (if fitted).
- Check the valve and DEB play.
- Check the injection lines for damage.
- Check the fuel pump gallery pressure.
- Check the discharge pump pressure.
- Check whether the right type of components have been fitted. Fuel pump, turbocharger, injectors, etc.
- Check the opening pressure of the injectors.
- Clean the nozzle openings using calibrated injector needles (DAF no. 1329371).

Repeat the acceleration test. If necessary, plot a boost pressure curve.

Result of second acceleration test
If the specified acceleration time is not achieved, carry out the following work.

- Remove the fuel pump from the engine.
- Check the fuel pump setting on a fuel pump test bench.
- Repeat the acceleration test.

1.3 ACCELERATION TEST
(engine model with UPEC fuel system)

The acceleration test is required to acquire an effective understanding of the fuel consumption and tractive force of a vehicle. When carrying out the test the legal regulations should be observed and maximum security be ensured.

Compared with other diagnostic tools, this test is a fast and cheap way of checking whether the vehicle meets DAF's requirements and, therefore, whether or not the complaint is justified.

During the acceleration test the time required to accelerate the loaded vehicle from starting speed to final speed is measured. (Weight of entire combination at least 75% of the train weight, GCW).

To eliminate weather influences and road conditions, this test must be done in both driving directions. The average acceleration time is obtained by averaging both measured times.

The maximum acceleration time, the speeds between which the time is to be measured and the gear to be engaged for the various vehicle configurations is calculated using the DAF "Topec" route simulation computer program.

For this purpose, "Topec" needs the following and other vehicle data:
- vehicle type
- height of the entire vehicle combination
- weight of entire vehicle combination (at least 75% of the train weight)
- aerodynamic influences, e.g. roof spoilers, fenders, etc.
- engine type
- gearbox type and reduction
- rear axle type and axle reduction
- tyre size
- cab type.

Before starting the acceleration test

- Check the tyre pressure of the entire vehicle combination. Also check the tyres for a deviating wear pattern.
- Examine the complete condition of the trailer or semi-trailer.
- Check the entire vehicle combination for adverse aerodynamic influences, for instance loose tarpaulins, wrongly adjusted spoilers and fenders.
- Check the vehicle and trailer or semi-trailer for excessive road drag. Be aware of dragging brakes.
- Check the tachograph. The speed signal should be present.
- Check that the correct k-factor is set on the tachograph.
- Using DAVIE, check whether the pedal can be depressed 100% with the gas pedal position sensor.

Acceleration test

1. Use the “Acceleration test form” in the workshop manual.
2. Check the activities as set out under “Before starting the acceleration test”.
3. Choose a test route where the difference between the measured times in both directions does not exceed 15%. If the difference in time exceeds 15%, find another test route.
4. Establish the starting and end points on the selected test route, to ensure that exactly the same route can be taken in both directions. Do the entire test at least twice and take the average time.

5. Run the drive train at operating temperature (drive for at least 15 minutes with a loaded vehicle).

Note:
When switched on, the air compressor and fan consume 10 to 15 kW engine power on average. During the test try to avoid that both consumers are or have been switched on.

6. Connect DAVIE and follow the instructions in DAVIE.

7. Fully depress the brake pedal during the acceleration test.

Result of first acceleration test
If the acceleration time is not achieved, first carry out the following work.

- Check the fuel system for the presence of air.
- Replace/clean the air filter element.
- Check the setting of the wastegate on the turbocharger (if present).
- Check the engine brake butterfly valve for smooth operation.
- Check the inlet air cooler exterior for dirt deposits.
- Clean the water separator (if fitted).
- Clean the fuel coarse filter.
- Check whether the hand pump on the fuel coarse filter is tightened.
- Replace the fuel fine filter.
- Check the suction pipe of the tank for clogging by large pieces of foreign matter.

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- Check the fuel tank for contamination. Clean the tank with a steam cleaner, if necessary.
- Check the air inlet system for any leaks.
- Check the exhaust system for any leaks.
- Check the exhaust system for blockages by measuring the exhaust back pressure.
- Check the turbocharger wheels on the compressor and turbine side for damage and for deposits of salt or any other contaminants.
- Check the valve and DEB play.
- Check the injection lines for damage.
- Check the gallery pressure.
- Check the fuel lift pump output.
- Check the reducing valve.
- Check whether the right type of components has been fitted. Turbocharger, injectors etc.
- Check the opening pressure of the injectors.
- Clean the nozzle openings using calibrated injector needles (DAF no. 1329371).

Repeat the acceleration test. If necessary, plot a boost pressure curve.

1.4 ACCELERATION TEST FORM

General data:

Client's name : .....

Type/vehicle number plate : .....

Type of trailer/semi-trailer : .....

Owner of trailer/semi-trailer : Client/Dealer/Third parties .....

Date : .....

Weather conditions : .....

Route : .....

Vehicle data:

Engine type : .....

Gearbox type : .....

Rear axle type : .....

Vehicle combination height : .....

Total weight of vehicle combination : .....

Aerodynamic influences : .....

TOPEC data:

Gear to be selected : .....

Maximum acceleration time : ..... seconds

Starting speed : ..... km/hour

End speed : ..... km/hour

Acceleration test result:

Measured acceleration time : ..... seconds

End result of acceleration test : .....

1.5 ACCELERATION TEST USING DAVIE

The acceleration test can also be carried out using DAVIE. Collect all the required information and, having started DAVIE, access the engine management system installed on the vehicle (E-gas, ASL-G or UPEC) and carefully follow the instructions in DAVIE in order to carry out the test correctly.

Following each test, the test results should always be stored on a disk.

The acceleration test in DAVIE should only be started when the vehicle is at a complete standstill. Because the communication between the accelerator pedal sensor and the unit is interrupted briefly during starting of DAVIE, this could lead to very dangerous situations in a vehicle which is not at a complete standstill.

Never switch to the direct test or fault-finding test when driving the vehicle.

2. XF ENGINE

2.1 FAULT-FINDING TABLE

FAULT: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	**Remedy**
Air in the fuel system.	Bleed the fuel system.
Insufficient discharge pressure of the discharge pump.	Check the discharge pump pressure.
Contaminated banjo bolt strainer in the discharge pump.	Check the strainer for contamination.
Water in the fuel system.	Check the water separator.
Fuel filter silted up.	Replace the fuel filter.
Incorrect or contaminated injectors installed.	Check whether the correct injectors have been installed. Clean contaminated injectors and set them.
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.
Compression pressure too low.	Check the compression pressure.

FAULT: ENGINE STARTS AND STOPS	
Possible cause	**Remedy**
Air in the fuel system.	Bleed the fuel system.
Insufficient discharge pressure of the discharge pump.	Check the discharge pump pressure.
Fuel filter silted up.	Replace the fuel filter.
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.

FAULT: ENGINE WILL NOT RUN IDLE	
Possible cause	**Remedy**
Air in the fuel system.	Bleed the fuel system.
Incorrect or contaminated injectors installed.	Check whether the correct injectors have been installed. Clean contaminated injectors and set them.
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.
Injection pipes torn or broken.	Check the injection lines. Replace if necessary.

1

FAULT: ENGINE DELIVERS LESS THAN MAXIMUM POWER	
Possible cause	**Remedy**
Fuel filter silted up.	Replace the fuel filter.
Incorrect or contaminated injectors installed.	Check whether the correct injectors have been installed. Clean contaminated injectors and set them.
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.
Fuel tank ventilation opening clogged blocked.	Check/clean the vent opening.
Air cleaner element blocked.	Clean or replace the air-filter element.
Blocked air inlet from turbocharger to inlet manifold.	Check air inlet. Clean if necessary.
Air leak in the pressure part of the inlet system.	Check the inlet unit for any leaks.
Compressor side of turbocharger contaminated.	Clean compressor side with a non-corrosive cleaning agent or a soft brush Check the inlet side for carbon deposits or other contamination.
Exhaust manifold, exhaust silencer, exhaust pipe blocked.	Check the exhaust unit. Clean if necessary.
Gas leak between exhaust manifold and cylinder head.	Check the fixing bolts and gaskets.
Gas leak between exhaust manifold and turbocharger.	Check the fixing bolts and gaskets.
Incorrect wastegate setting or defective wastegate.	Check the wastegate or wastegate setting.
Damaged turbocharger.	Replace the turbocharger and identify the cause.
Incorrect valve clearance setting.	Check valve clearance. Adjust if necessary.
Incorrect DEB setting.	Check the DEB play. Adjust if necessary.
DEB continues to operate.	Check the DEB function.
Compression pressure too low.	Check the compression pressure.

FAULT: ENGINE PRODUCES EXTREME SMOKE LEVELS	
Possible cause	**Remedy**
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.
Incorrect or contaminated injectors installed.	Check whether the correct injectors have been installed. Clean contaminated injectors and set them.
Fuel filter silted up.	Replace the fuel filter.
Blocked air cleaner.	Check the air-filter element. Blow-clean or replace, if necessary.
Air leak between inlet manifold and cylinder head.	Check for leaks. Replace the gaskets, if necessary.
Gas leak between exhaust manifold and turbocharger.	Check the fixing bolts and gaskets.
Gas leak between exhaust manifold and cylinder head.	Check the fixing bolts and gaskets.
Cooling system failure.	Check the cooling system.
Lubrication system failure.	Check the lubricating-oil system.
Compression pressure too low.	Check the compression pressure.

1

FAULT: ENGINE PRODUCES EXCESSIVE NOISE	
Possible cause	**Remedy**
Broken valve springs.	Check valve springs. Replace if necessary.
Excess clearance between piston and cylinder wall.	Check the piston clearance in the cylinder.
Run-out main and/or connecting-rod bearings.	Check the main and connecting-rod bearings.
Fuel system failure.	Check the fuel system.
Inlet system failure.	Check the inlet system.
Exhaust system failure.	Check the exhaust system.
Air compressor, fan drive, air-conditioning compressor.	Check whether the air compressor, fan drive, air-conditioning compressor or other engine attachments may be the cause of the noise.
Lubrication system failure.	Check the lubricating-oil system.
Incorrect V-belt tension or V-belt misalignment.	Check the V-belt tension or the V-belt alignment.
Excessive radial play of water pump.	Check radial play of water pump.
Fan damaged or fan touching the radiator.	Check fan and radiator.
Damaged or loose engine brackets.	Check the engine brackets.
Excessive valve clearance.	Readjust the valve clearance.
Damaged valve train and/or push rods, cam followers, rocker shafts or rocker arms.	Check the drive train, etc. for damage.
Damaged vibration damper.	Check the vibration damper for damage.
Damaged pistons and/or cylinder linings.	Check the pistons and cylinder linings.
Timing gear wheels.	Check the timing gear wheels for play and/or damage.
Loose or broken flywheel or coupling bolts.	Check the flywheel/coupling.

3. COOLING SYSTEM XF ENGINE

3.1 FAULT-FINDING TABLE

FAULT: ENGINE TEMPERATURE INCREASES	
Possible cause	**Remedy**
Incorrect injection timing or incorrect fuel pump setting.	Check the injection timing and/or fuel pump setting.
Incorrect injectors installed.	Check whether the correct injectors have been installed.
Inlet system failure.	Check the inlet system.
Lubrication system failure.	Check the lubricating-oil system.
Incorrect V-belt tension.	Check the V-belt tension or replace the V-belt.
Insufficient coolant.	Check the coolant level. Top up if necessary.
Coolant pipe torn or blocked.	Check the coolant pipes.
Contaminated radiator/cooling system.	Check the radiator. Clean if necessary.
Incorrect or malfunctioning pressure cap.	Check the pressure cap.
Thermostat opens insufficiently or not at all.	Check the thermostat and its operation.
Contaminated coolant filter.	Check the coolant filter. If necessary, replace and clean the cooling system.
Defective water pump.	Check the water-pump shaft, bearings and impeller. Replace water pump, if necessary.
Defective viscous fan.	Check operation of viscous fan.

1

FAULT: EXTERNAL COOLANT LEAKAGE	
Possible cause	**Remedy**
Defective coolant pipes.	Check the coolant pipes.
Defective coolant pipes.	Check coolant pipes.
Leaking radiator.	Check the radiator. Pressure-test if necessary.
Leaking water pump.	Check the water pump. If necessary, measure the bearing play.
Defective oil cooler.	Check the oil cooler. Pressure-test if necessary.
Defective pressure cap.	Check the pressure cap. Pressure-test if necessary.
Leaking heater.	Check heater pipes.
Leaking connection between coupling and water pipe.	Check connection between water pipe and coupling for damage. Replace the O-rings.

FAULT: INTERNAL COOLANT LEAKAGE	
Possible cause	**Remedy**
Defective cylinder head gasket.	Check the cylinder head gasket.
Cracked cylinder heads or cylinder block.	Check the cylinder heads and engine block for internal cracks. Pressure-test if necessary.
Leaking injector bushes.	Check cylinder heads. Pressure-test if necessary.
Defective compressor cylinder head gasket.	Replace compressor cylinder head gasket.
Defective oil cooler.	Check whether there is coolant in the lubricating oil system.
Defective freeze plugs in tappet area (cylinder block) or at the top of the cylinder heads.	Replace freeze plug(s).

4. LUBRICATING OIL SYSTEM XF ENGINE

4.1 FAULT-FINDING TABLE

FAULT: ENGINE OIL PRESSURE TOO LOW	
Possible cause	**Remedy**
Engine oil level too low.	Top up engine oil to maximum level.
External oil leakage.	Visually check engine for leakage. Repair if necessary.
Defective oil-pressure switch.	Check the switch. Replace if necessary.
Oil fails to meet the required specifications.	Renew the engine oil and the oil filter.
Oil temperature is too high.	Check the oil cooler.
Oil mixed with coolant or fuel.	Renew the engine oil and the oil filter.
Oil feed-through pipe or oil suction pipe loose or broken.	Check the oil pipes. Repair if necessary.
Oil-pressure control valve fails to operate.	Check the oil pressure control valve.
Inadequate functioning of oil pump.	Check the oil pump.
Run-out main or connecting-rod bearings.	Check the main or connecting-rod bearings.
Loose oil nozzle of piston cooler.	Check the oil nozzle. Replace if necessary.
Defective internal oil pressure pipes or sealing.	Check the oil pressure pipes and seals.
Contamination between oil-pressure control valve and seat.	Check/clean the oil pressure control valve.
Contaminated oil filter.	Renew the oil filter.

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FAULT: ENGINE USES TOO MUCH OIL	
Possible cause	**Remedy**
Inlet system failure.	Check the inlet system.
Exhaust system failure.	Check the exhaust system.
Leaking oil cooler.	Check whether there is lubricating oil in the engine cooling system.
Oil temperature is too high.	Check whether the correct oil cooler has been installed
Blow-by is too high.	Check the compression pressure and carry out a cylinder leak test. Check the condition of the piston rings and cylinder linings.
Worn piston rings and/or cylinder linings.	Replace the piston rings and/or cylinder linings. Check the air inlet system. Check the oil specifications.
Damaged or missing injector O-ring.	Check the injector seal.

5. XE ENGINE

5.1 FAULT-FINDING TABLE FOR ENGINE FUNCTIONS

FAULT: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fuel filter blocked.	Replace the fuel filter and clean the system.
Fault in electrical components/wiring of: - connectors - pump unit - electronic unit - crankshaft position sensor and camshaft position sensor	Check the electrical system.
Communication with DAVIE interrupted when the engine is tested with DAVIE.	Remove the earth cable from the battery and fit it again.
Incorrect pump housing camshaft timing, camshaft position sensor signal not present at correct moment.	Check timing/signal from camshaft position sensor.
No fuel supply, or fuel lift pump defective, no output.	Check: - fuel level - pipes for clogging and leakage - fuel lift pump
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.

1

FAULT: ENGINE STALLS AND PICKS UP AFTER RESTARTING	
Possible cause	**Remedy**
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Poor contacts, contact resistance in connectors.	Check the connector joints.
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.

FAULT: ENGINE DOES NOT PICK UP PROPERLY	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fuel filter blocked.	Replace the fuel filter and clean the system.
Fault in electrical components/wiring of: - connectors - pump unit - electronic unit - crankshaft position sensor and camshaft position sensor - sensor for engine coolant temperature	Check the electrical system.
Battery voltage too low.	Charge the batteries.
Connection points on pump units changed.	Install the correct connection points on the correct pump unit.
Mechanical defect or clogging of pump units.	Replace the pump units.
Injectors defective.	Check the injectors.
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.

FAULT: ENGINE RUNS AT (INCREASED) IDLING SPEED AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	**Remedy**
Accelerator pedal sensor, mechanical defect.	Check: - mechanical connection sensor/accelerator pedal - accelerator pedal sensor
Fuel quantity adjusted by ABS/ASR.	
Engine brake input signal available.	Check the electrical system of the engine brake.

FAULT: ENGINE RUNS AT INCREASED IDLING SPEED (1000 RPM) AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - connectors - pump unit - electronic unit - crankshaft position sensor and camshaft position sensor - sensor for engine coolant temperature	Check the electrical system.

FAULT: ENGINE RUNS AT INCREASED IDLING SPEED (1000 RPM) AND RESPONDS TO ACCELERATOR PEDAL	
Possible cause	**Remedy**
Fault in electrical components/wiring of accelerator pedal sensor.	Check the electrical system.

FAULT: MAXIMUM ENGINE SPEED IS 1000 RPM	
Possible cause	**Remedy**
Fault in electrical components/wiring of accelerator pedal sensor.	Check the electrical system.

1

FAULT: DIESEL KNOCK DURING ACCELERATION	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fault in electrical components/wiring of sensor for engine coolant temperature.	Check the electrical system.
Injector defective.	Check the injectors.
Crankshaft position sensor defective.	Check the crankshaft position sensor.

FAULT: ENGINE RUNS IRREGULARLY	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fuel filter blocked.	Replace the fuel filter.
Connection points on pump units changed.	Install the correct connection points on the correct pump unit.
Mechanical defect or clogging of pump units.	Replace the pump units.
Injector defective.	Check the injectors.
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.
Fault in electrical components/wiring of: - connectors - pump unit	Check the electrical system.

FAULT: REDUCED POWER AT ALL SPEEDS	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Fuel filter blocked.	Replace the fuel filter.
Accelerator pedal sensor, mechanical defect.	Check: - mechanical connection sensor/accelerator pedal - accelerator pedal sensor
Fault in electrical components/wiring of: - accelerator pedal sensor - sensor for engine coolant temperature - boost pressure sensor - fuel temperature sensor - contacts - contact resistance in connector joints	Check the electrical system.
Air filter clogged.	Replace or clean the air filter.
Turbocharger defective/incorrect waste-gate control.	Check wastegate or wastegate control.
Electro-pneumatic boost pressure valve mechanically defective.	Check electro-pneumatic boost pressure valve.
Air leaks in inlet system.	Pressure-test the inlet system.
Mechanical defect or clogging of pump units.	Replace the pump units.
Injector defective.	Check the injectors.
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.

1

FAULT: REDUCED POWER ABOVE A PARTICULAR SPEED	
Possible cause	**Remedy**
Fuel filter partially blocked.	Replace the fuel filter.
Air filter partially clogged.	Replace or clean the air filter.
Electro-pneumatic boost pressure valve mechanically defective.	Check electro-pneumatic boost pressure valve.
Fault in electrical components/wiring of sensor for electro-pneumatic boost pressure valve.	Check the electrical system.
Air leaks in inlet system.	Pressure-test the inlet system.
Pressure-relief valve on pump housing does not shut off.	Check the pressure-relief valve.
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.

FAULT: WHITE/BLUE SMOKE DEVELOPMENT	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fuel filter blocked.	Replace the fuel filter and clean the system.
Fault in electrical components/wiring of: - crankshaft position sensor - sensor for engine coolant temperature	Check the electrical system.
Mechanical defect or clogging of pump units.	Replace the pump units.
Injector defective.	Check the injectors.
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.

FAULT: BLACK SMOKE DEVELOPMENT	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - crankshaft position sensor - air inlet temperature sensor - fuel temperature sensor - boost pressure sensor	Check the electrical system.
Injector defective.	Check the injectors.

FAULT: FUEL CONSUMPTION TOO HIGH	
Possible cause	**Remedy**
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Fuel filter blocked.	Replace the fuel filter and clean the system.
Fault in electrical components/wiring of: - sensor for engine coolant temperature - boost pressure sensor - fuel temperature sensor	Check the electrical system.
Air leaks in inlet system.	Pressure-test the inlet system.
Mechanical defect or clogging of pump units.	Replace the pump units.
Injector defective.	Check the injectors.
Leaks in fuel system.	Check for leaks.

1

FAULT: REDUCED MAXIMUM SPEED	
Possible cause	**Remedy**
Air in the fuel system.	Check the fuel system for drawing in air: - through suction pipe - through sealing ring of fuel lift pump
Fuel filter blocked.	Replace the fuel filter and clean the system.
Crankshaft position sensor, signal fault.	Check: - crankshaft position sensor - wiring
Fault in electrical components/wiring of sensor for - accelerator pedal sensor - engine coolant temperature sensor	Check the electrical system.
Turbocharger defective.	Check the turbocharger.
Mechanical defect or clogging of pump units.	Replace the pump units.
Fuel quantity adjusted by ABS/ASR.	
Fuel lift pump output too low.	Check the fuel lift pump and replace, if necessary.

5.2 FAULT-FINDING TABLE FOR VEHICLE FUNCTIONS

FAULT: VEHICLE SPEED CONTROL IS NOT FUNCTIONING	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - wiring harness - combination switch - speed signal - proximity switch	Check the electrical system.
There is/are switch-off condition(s) for vehicle speed control.	Check for presence of switch-off condition(s).

FAULT: ENGINE SPEED CONTROL IS NOT FUNCTIONING	
Possible cause	**Remedy**
There is/are switch-off condition(s) for engine speed control.	Check for presence of switch-off condition(s).
Fault in electrical components/wiring of: - wiring harness - combination switch - speed signal	Check the electrical system.

FAULT: DEFECTIVE PRE-GLOWING AND AFTER-GLOWING FUNCTIONS	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - wiring harness - preglowing control light - glow filaments - glow-filament relay	Check the electrical system.
There is/are switch-off condition(s) for the pre-glowing and after-glowing functions.	Check for presence of switch-off condition(s).

1

FAULT: INCORRECT SPEED DISPLAY ON REV COUNTER	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - wiring harness - crankshaft position sensor - electronic unit, UPEC	Check the electrical system.

FAULT: ENGINE CANNOT BE TURNED OFF WITH CONTACT KEY	
Possible cause	**Remedy**
Fault in electrical components/wiring of wiring harness. Supply voltage to UPEC electronic unit is not switched off. Supply voltage after contact at the UPEC electronic unit is not switched off by ignition lock.	Check the electrical system.

FAULT: WARNING LAMP DOES NOT LIGHT UP OR IS NOT EXTINGUISHED	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - wiring harness - electronic unit, UPEC	Check the electrical system.

FAULT: COMMUNICATION WITH DAVIE IMPOSSIBLE	
Possible cause	**Remedy**
Fault in electrical components/wiring of: - wiring harness - diagnosis connector Supply voltage after contact at the UPEC electronic unit is not switched off by ignition lock. No supply voltage on the UPEC electronic unit. UPEC electronic unit defective.	Check the electrical system.

6. COOLING SYSTEM XE ENGINE

6.1 FAULT-FINDING TABLE

FAULT: ENGINE TEMPERATURE INCREASES	
Possible cause	**Remedy**
Incorrect injectors installed.	Check whether the correct injectors have been installed.
Inlet system failure.	Check the inlet system.
Lubrication system failure.	Check the lubricating-oil system.
Incorrect V-belt tension.	Check the V-belt tension or replace the V-belt.
Insufficient coolant.	Check the coolant level. Top up if necessary.
Coolant pipe torn or blocked.	Check the coolant pipes.
Intercooler, cooling system radiator contaminated.	Check/clean the intercooler, the cooling system radiator.
Wastegate setting is too high.	Check wastegate setting.
Air hose from turbocharger housing to wastegate diaphragm leaking or not connected.	Check air hose. Replace if necessary.
Incorrect or malfunctioning pressure cap.	Check the pressure cap.
Thermostat opens insufficiently or not at all.	Check the thermostat and its operation.
Contaminated coolant filter.	Check the coolant filter. If necessary, replace and clean the cooling system.
Defective water pump.	Check the water-pump shaft, bearings and impeller. Replace the water pump, if necessary.
Defective viscous fan.	Check operation of viscous fan.
Poor fuel quality.	Drain fuel, rinse the fuel system, replace the fuel filters and fill the fuel tank with fuel.
Sensor for engine coolant temperature, signal fault/short-circuit/interruption.	Check: - engine coolant temperature sensor - wiring

1

FAULT: EXTERNAL COOLANT LEAKAGE	
Possible cause	**Remedy**
Defective coolant pipes.	Check the coolant pipes.
Defective coolant pipes.	Check coolant pipes.
Leaking radiator.	Check the radiator. Pressure-test if necessary.
Leaking water pump.	Check the water pump. If necessary, measure bearing play.
Defective oil cooler.	Check the oil cooler. Pressure-test if necessary.
Defective pressure cap.	Check the pressure cap. Pressure-test if necessary.
Leaking heater.	Check heater pipes.
Leaking connection between coupling and water pipe.	Check the connection between water pipe and coupling for damage. Replace the O-rings.

FAULT: INTERNAL COOLANT LEAKAGE	
Possible cause	**Remedy**
Defective cylinder head gasket.	Check the cylinder head gasket.
Cracked cylinder heads or cylinder block.	Check the cylinder heads and engine block for internal cracks. Pressure-test if necessary.
Leaking injector bushes.	Check cylinder heads. Pressure-test if necessary.
Defective compressor cylinder head gasket.	Replace compressor cylinder head gasket.
Defective oil cooler.	Check whether there is coolant in the lubricating oil system.
Defective freeze plugs in tappet area (cylinder block) or at the top of the cylinder heads.	Replace the freeze plug(s).

7. LUBRICATING OIL SYSTEM XE ENGINE

7.1 FAULT-FINDING TABLE

FAULT: ENGINE OIL PRESSURE TOO LOW	
Possible cause	**Remedy**
Engine oil level too low.	Top up engine oil to maximum level.
External oil leakage.	Visually check engine for leakage. Repair if necessary.
Defective oil-pressure switch.	Check the switch. Replace if necessary.
Oil fails to meet the required specifications.	Renew the engine oil and the oil filter.
Oil temperature is too high.	Check the oil cooler.
Oil mixed with coolant or fuel.	Renew the engine oil and the oil filter.
Oil feed-through pipe or oil suction pipe loose or broken.	Check the oil pipes. Repair if necessary.
Oil-pressure control valve fails to operate.	Check the oil pressure control valve.
Inadequate functioning of oil pump.	Check the oil pump.
Run-out main or connecting-rod bearings.	Check the main or connecting-rod bearings.
Loose oil nozzle of piston cooler.	Check the oil nozzle. Replace if necessary.
Defective internal oil pressure pipes or sealing.	Check the oil pressure pipes and seals.
Contamination between oil-pressure control valve and seat.	Check/clean the oil pressure control valve.
Contaminated oil filter.	Replace the oil filter.

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FAULT: ENGINE USES TOO MUCH OIL	
Possible cause	**Remedy**
Inlet system failure.	Check the inlet system.
Exhaust system failure.	Check the exhaust system.
Leaking oil cooler.	Check whether there is lubricating oil in the engine cooling system.
Oil temperature is too high.	Check whether the correct oil cooler has been installed.
Blow-by is too high.	Check the compression pressure and carry out a cylinder leak test. Check the condition of the piston rings and cylinder linings.
Worn piston rings and/or cylinder linings.	Replace the piston rings and/or cylinder linings. Check the air inlet system. Check the oil specifications.
Damaged or missing injector O-ring.	Check the injector seal.

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2

1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

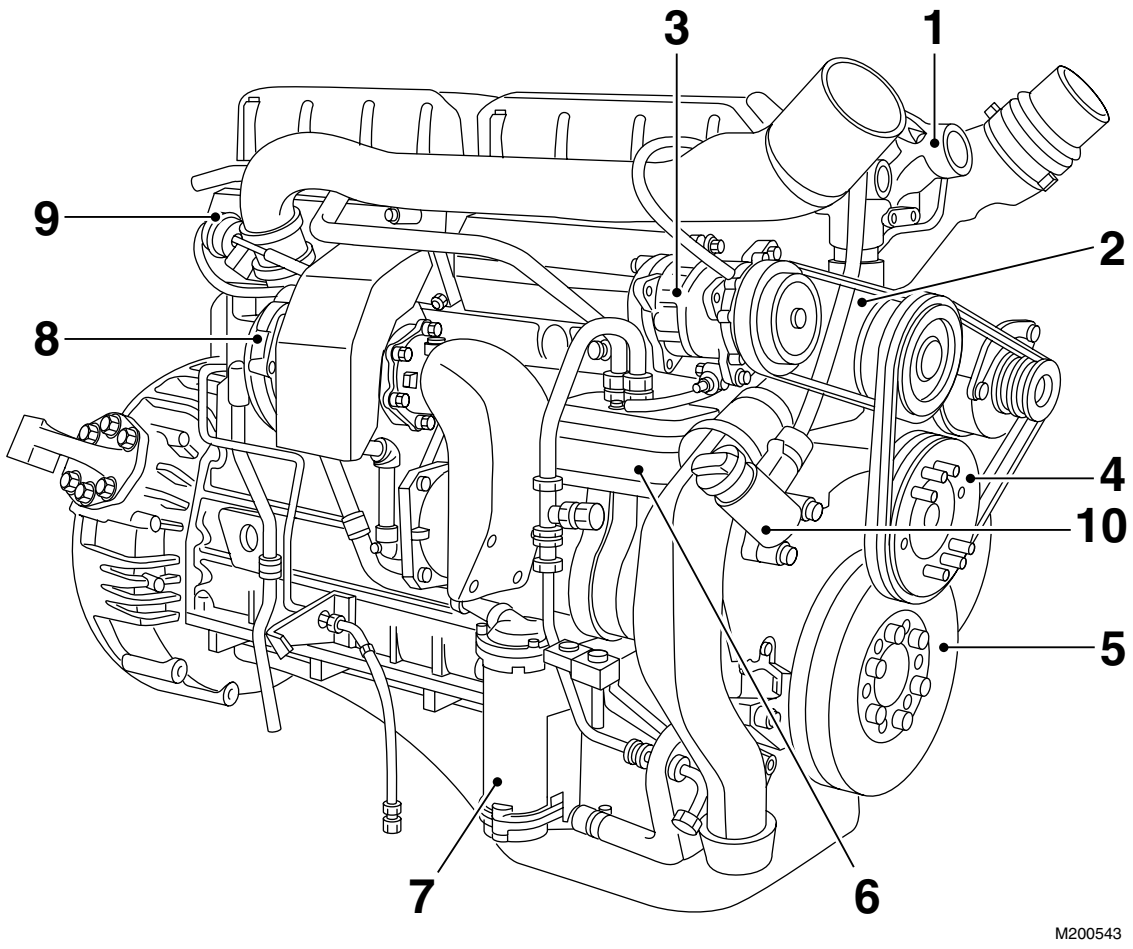
Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel fuel.
So avoid inhaling and direct contact.

Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

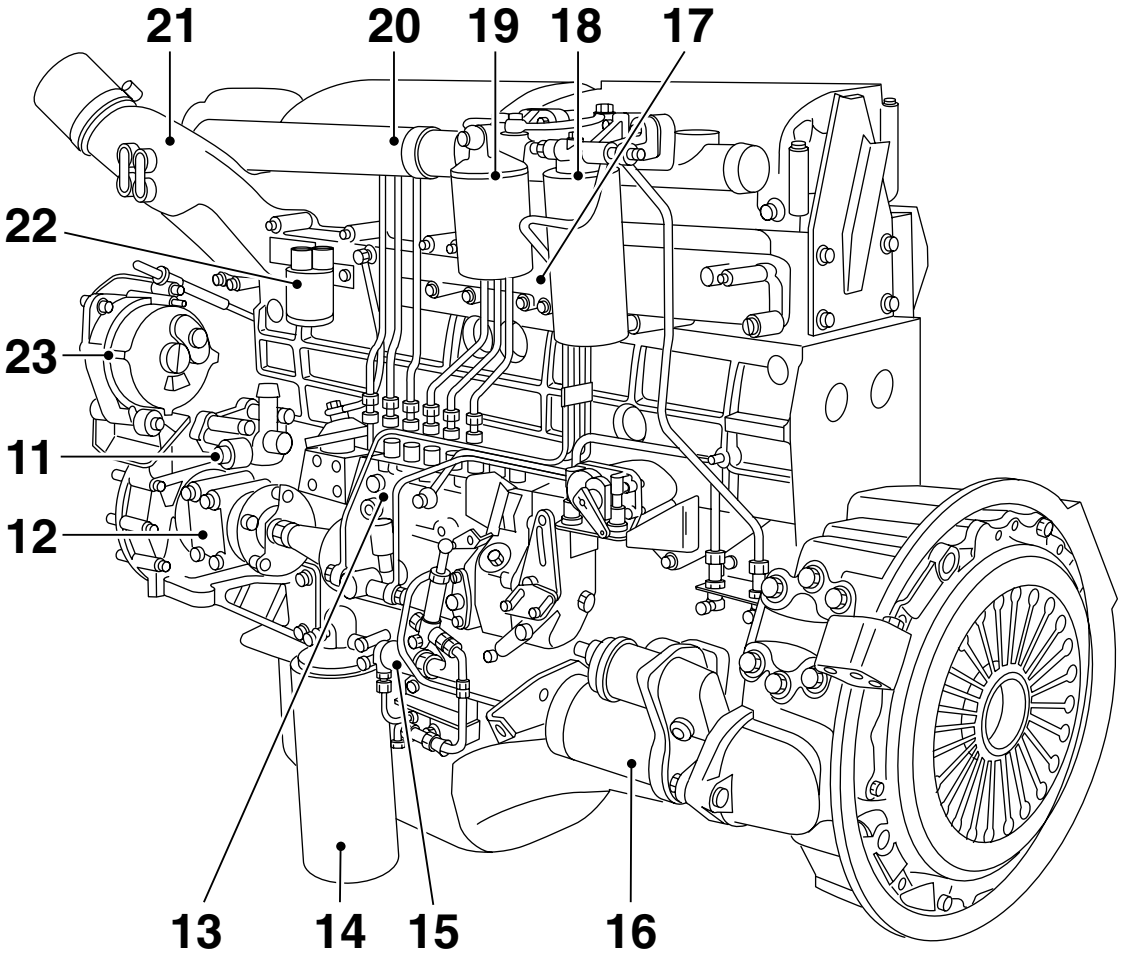
It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

2. GENERAL

2.1 LOCATION OF COMPONENTS

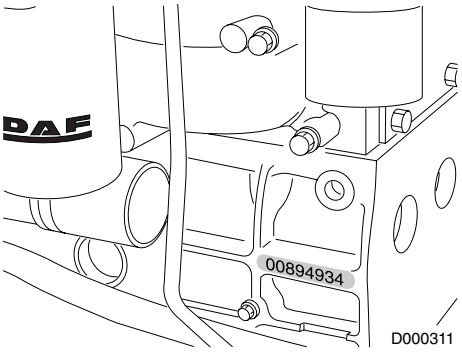


Legend
1. Thermostat housing
2. Water pump
3. Air-conditioning compressor
4. Fan drive
5. Vibration damper
6. Air compressor
7. Oil cooler
8. Turbocharger
9. Wastegate diaphragm
10. Oil-filling pipe



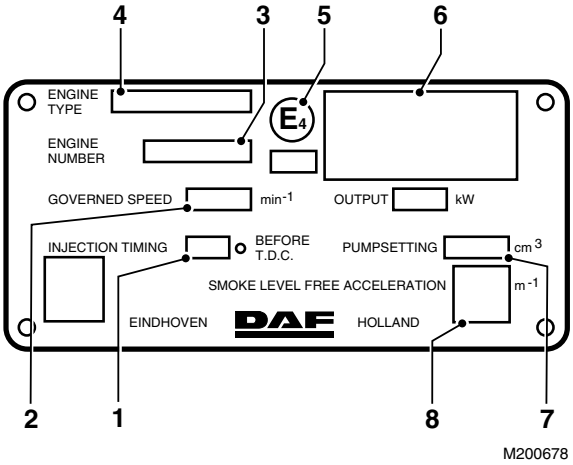
Legend
11. Steering pump
12. Fuel pump drive housing
13. Fuel pump
14. Oil filter
15. Engine brake valve
16. Starting motor
17. Engine information-code plate
18. Fuel filter
19. Coolant filter
20. Coolant pipe
21. Inlet manifold
22. Glow-filament relay
23. Alternator

Engine number
The engine number is marked on the engine block at the rear left.

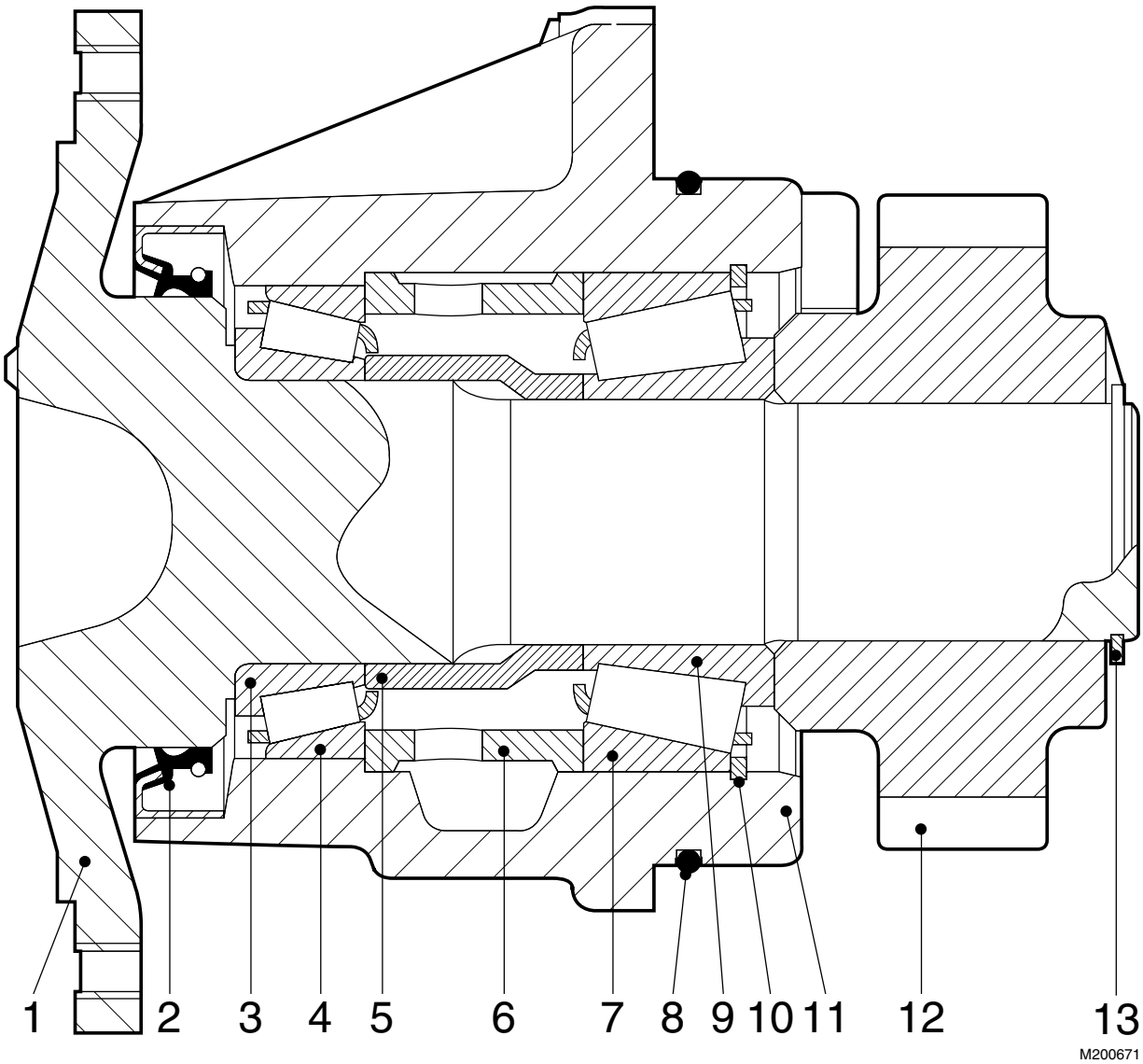


XF Engine information-code plate
Fitted to the inlet manifold

1. Injection timing
2. Maximum governed engine speed
3. Engine number
4. Engine type
5. Indication of country of origin
6. Certificate number
7. Fuel pump setting (output)
8. Smoke level at maximum engine speed, without load

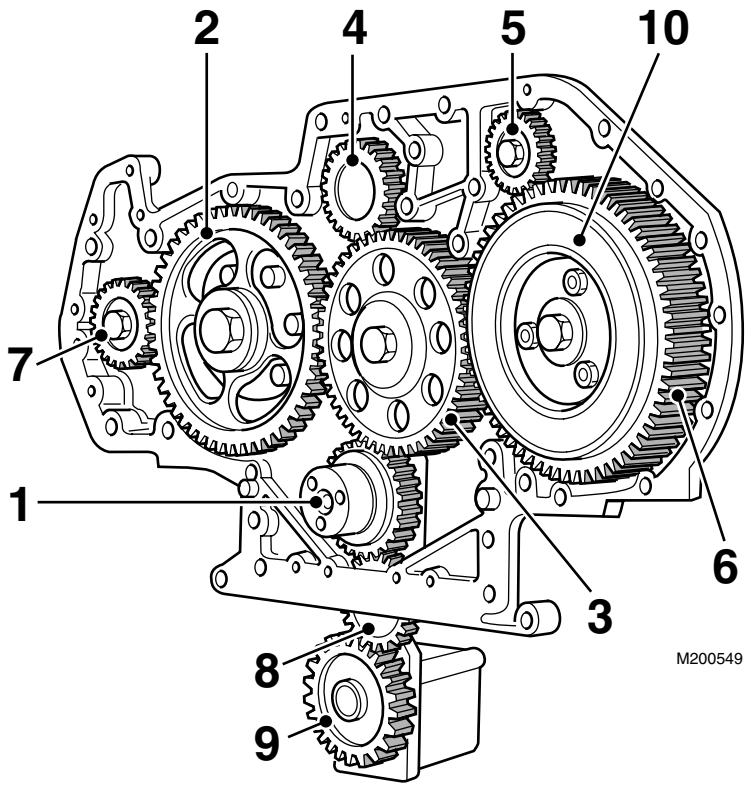


2.2 OVERVIEW DRAWING OF FAN DRIVE



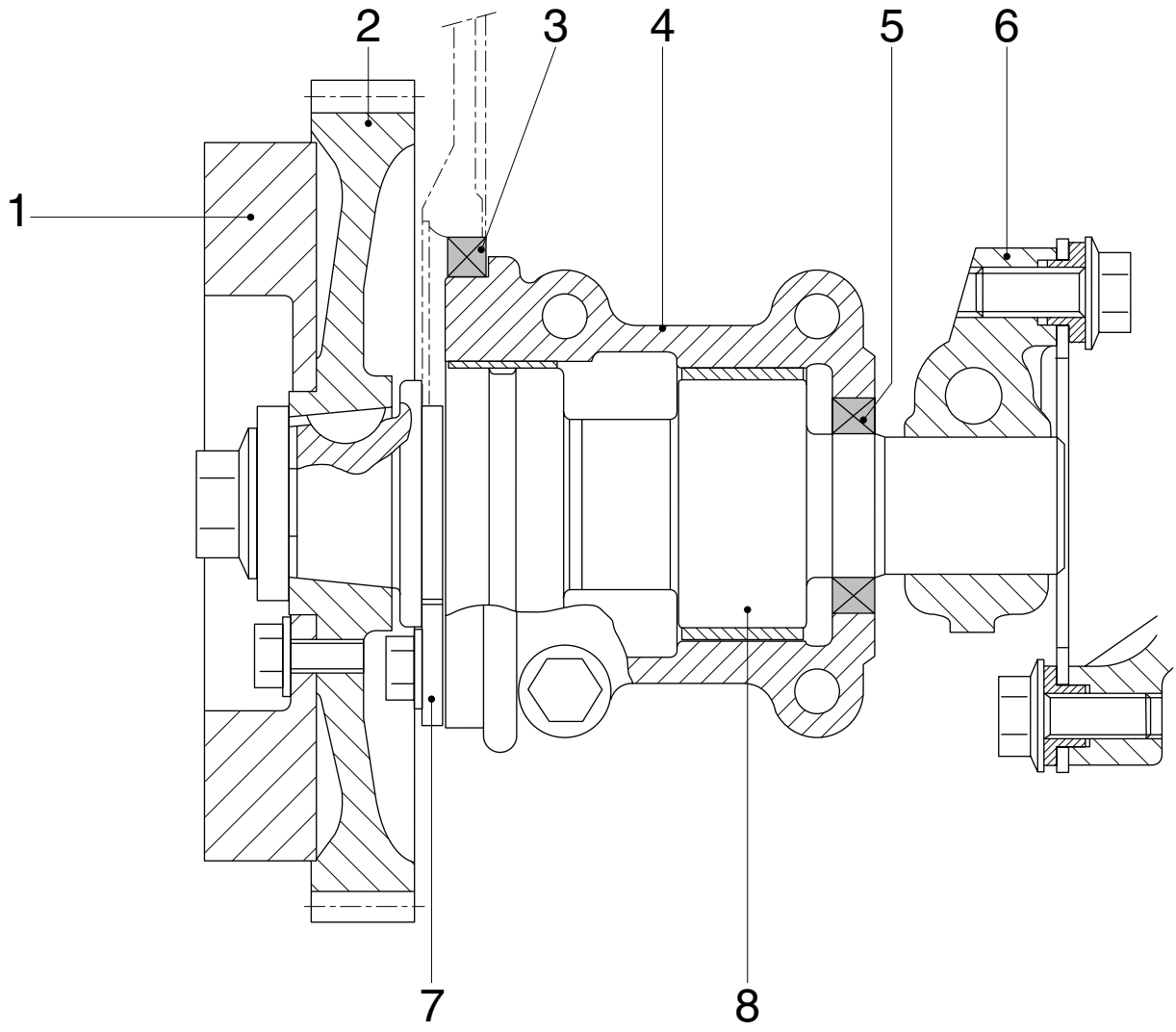
Legend
1. Fan clutch shaft
2. Oil sealing ring
3. Bearing
4. Bearing ring
5. Spacer sleeve
6. Intermediate ring
7. Bearing ring
8. O-ring
9. Bearing
10. Retaining ring
11. Bearing housing
12. Gearwheel
13. Retaining ring

2.3 OVERVIEW DRAWING OF TIMING GEAR



Legend
1. Crankshaft
2. Camshaft
3. Intermediate gear wheel
4. Fan drive
5. Steering pump
6. Fuel-pump drive gear wheel
7. Air compressor
8. Intermediate gear wheel of oil pump
9. Oil pump
10. Silencer

2.4 OVERVIEW DRAWING FUEL PUMP DRIVE



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Legend
1. Silencer
2. Fuel-pump drive gear wheel
3. Timing gear sealing ring
4. Bearing housing
5. Fuel-pump drive sealing ring
6. Clamping piece
7. Axial retainer plate
8. Drive shaft

3. INSPECTION AND ADJUSTMENT

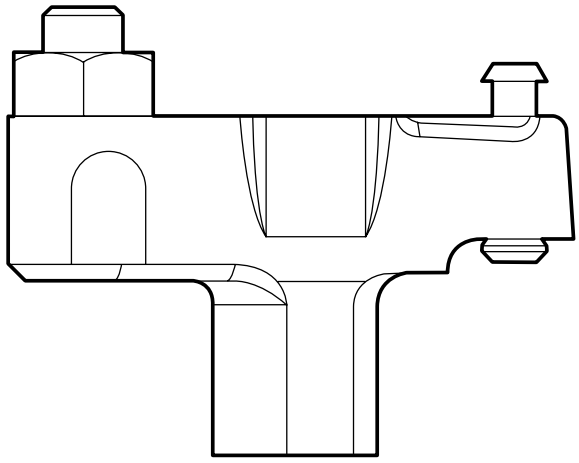
3.1 CHECKING AND ADJUSTING THE VALVE MECHANISM BRIDGES

Loosening and torqueing the lock nuts (B) of the bridges may cause severe engine damage if the bridge is fitted on the valves.

1. Remove the valve covers, see chapter “Removal and installation”.
2. Place the fuel pump in the stop position. Lock the fuel pump in this position.
3. Remove the DEB or the lubricating-oil strip (depending on model).
4. Remove the entire rocker bracket. Mark the position to allow reinstallation in the same position.

Note:
In engines equipped with a DEB, the bridges of the inlet and exhaust valves are not the same. In engines without a DEB, the bridges of the inlet and exhaust valves are the same.

Exhaust bridge with DEB



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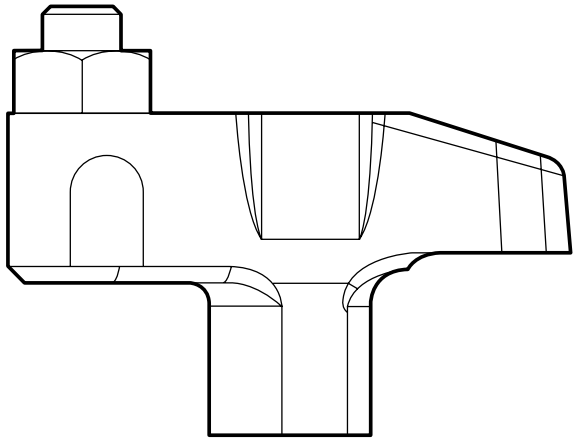
Exhaust bridge without DEB



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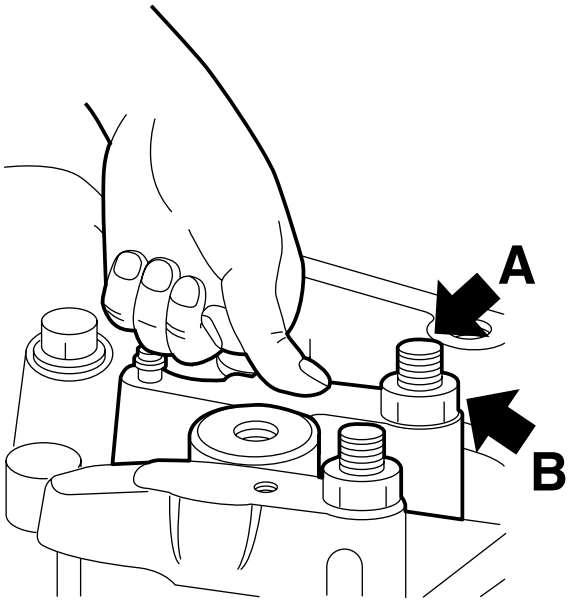
5. Remove the bridge from the valves and place it in a vice.
6. Slacken lock nut (B).
7. Reposition the bridge in the engine over the valves.
8. Firmly press on the bridge centre (above the guiding pin) with your thumb.
9. Hand-tighten adjusting screw (A) until the bridge starts to move (adjusting screw (A) now touches the valve).
10. Turn adjusting screw (A) through another 90° and carefully remove the bridge from the valves.
11. Place the bridge in a vice and tighten lock nut (B) to the specified torque without turning adjusting screw (A), see main group “Technical data”.
12. Reposition the bridge over the valves.
13. Install the rocker bracket.
14. Install the DEB or the lubricating-oil strip (depending on model). Install the lubricating-oil strip in such a way that the mark “cyl. 1/4” is located on cylinder 1 or cylinder 4 respectively.
15. Adjust the valve clearance and, if fitted, the DEB clearance.
16. Fit the valve covers, see chapter “Removal and installation”.



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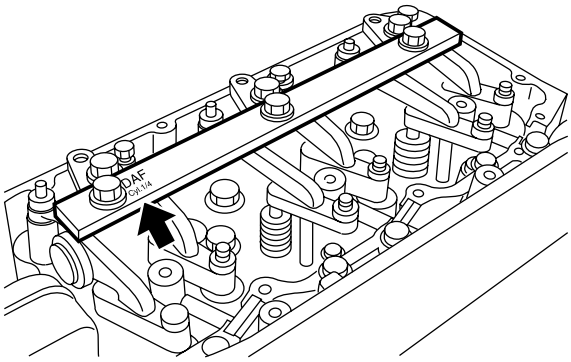

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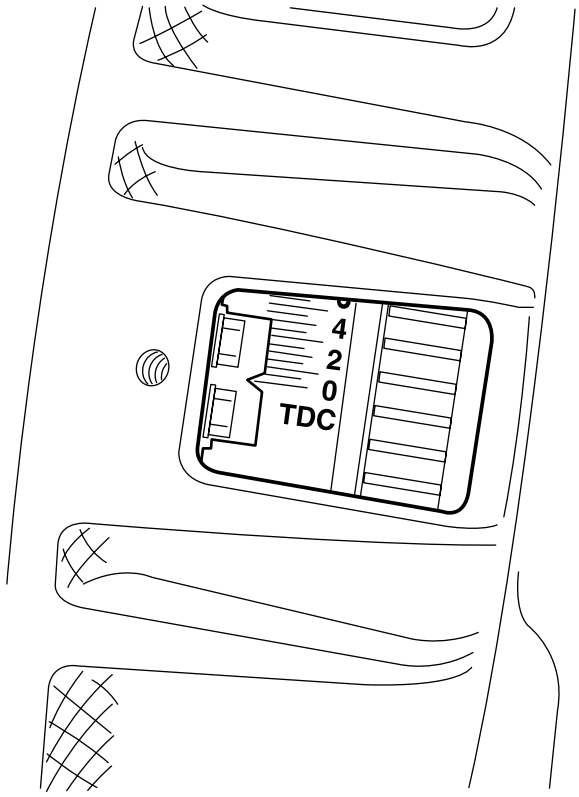
3.2 INSPECTION AND ADJUSTMENT, VALVE CLEARANCE

1. Remove the valve cover, see “Removal and installation”.
2. Place the fuel pump in the stop position. Lock the fuel pump in this position.
3. Use the special tool (DAF no. 1310477) to turn the crankshaft clockwise, as seen from the timing gear end (this is the engine’s normal direction of rotation), until the valves of cylinder 1 are in overlap position. The pistons of cylinders 1 and 6 are now in the top dead centre.

   Note:
   “Overlap” is the moment at which the inlet valve starts opening and the exhaust valve is completing the closing.



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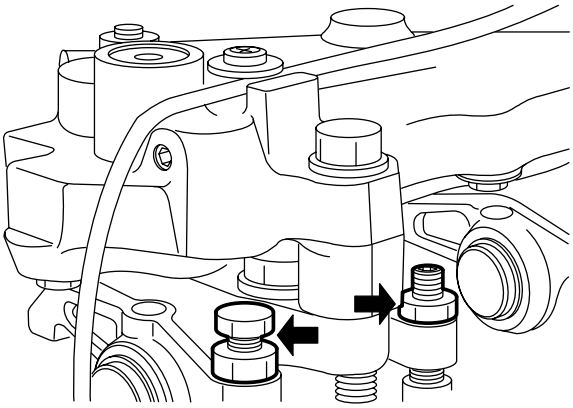
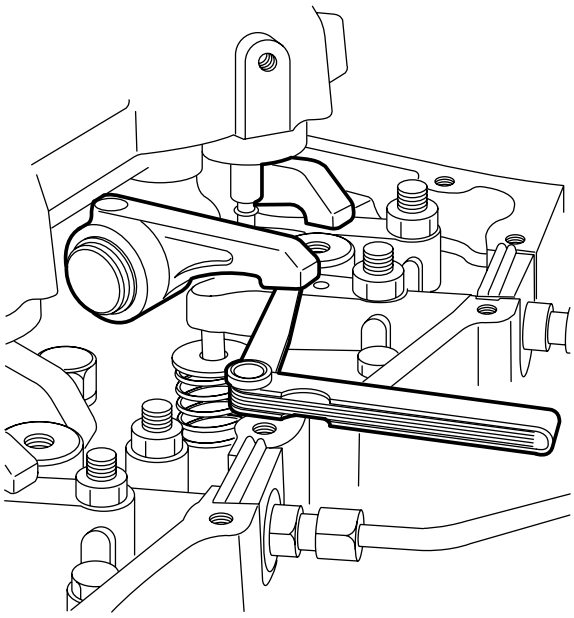
If the engine has been fitted with a DEB, loosen the lock nut by means of a flat ring spanner. This is necessary so as to prevent damage to the DEB spring plate.

4. Check/correct the valve clearance of cylinder 6. The correct valve clearance is adjusted by loosening the lock nut and turning the adjusting bolt in the correct direction, see main group “Technical data” for the correct valve clearance.


M200539

5. By cranking the crankshaft always $^1/_3$ stroke, using the special tool (DAF no. 1310477), the valves can be adjusted according to the injection sequence 1-5-3-6-2-4.

Cylinder with valves in overlap position	Adjust valves of cylinder
1	6
5	2
3	4
6	1
2	5
4	3


M200540

6. If the engine has been fitted with a DEB, the DEB clearance must be checked following the valve-clearance adjustment.

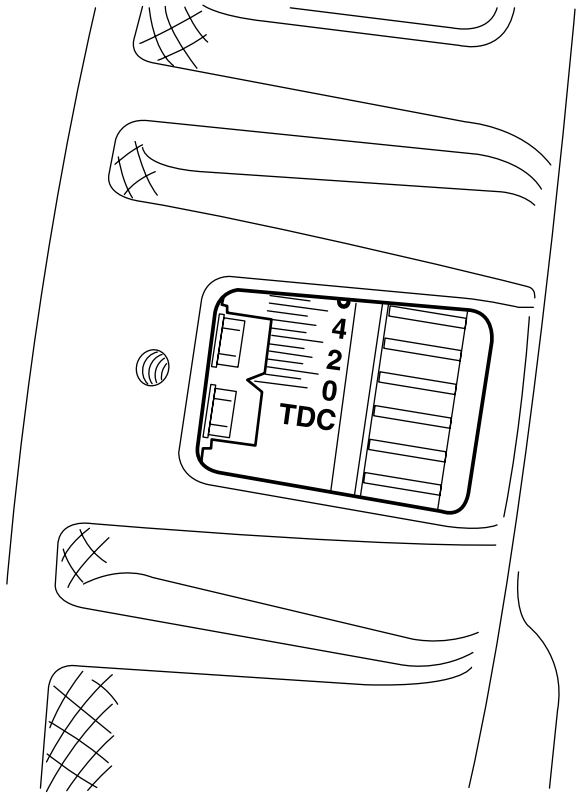
7. Fit the valve covers, see chapter “Removal and installation”.

3.3 CHECKING AND ADJUSTING THE TIMING GEAR

Checking the timing gear

1. Remove the valve cover from cylinders 1-2-3, see chapter “Removal and installation”.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).

   Note:
   It is important that the bridges of the valve mechanism are properly adjusted.
3. Set the inlet valve clearance of the first cylinder to 1 mm.



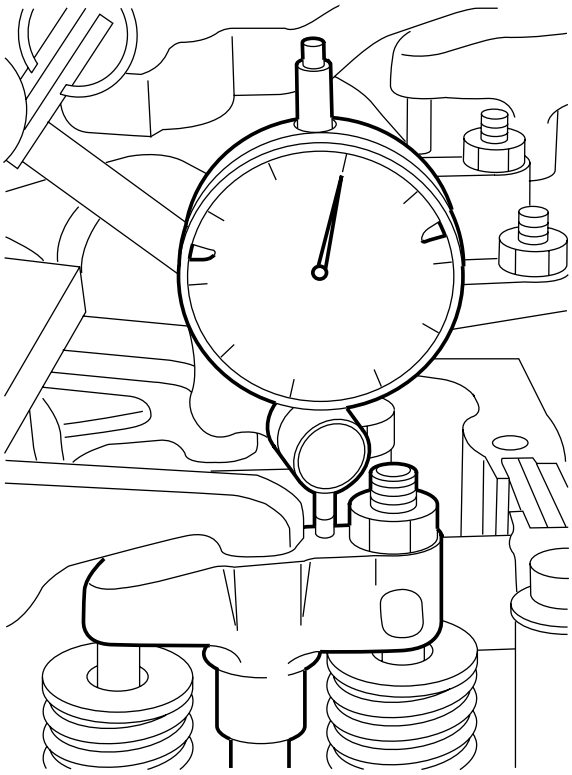
M200574

4. Position the dial gauge on the inlet valve bridge of the first cylinder, in such a way that it measures in an exact vertical position on the bridge and is capable of registering an upward and downward measuring value of 5 mm.
5. Use the special tool (DAF no. 1310477) to turn the crankshaft further in the direction of rotation until the pistons of cylinders 1 and 6 have returned to the top dead centre (TDC).
6. Read the dial gauge and compare the measured value, see main group “Technical data”.

Example

Pre-tension dial gauge	5.00 mm
Measured tension	4.65 mm
Valve opening	0.35 mm

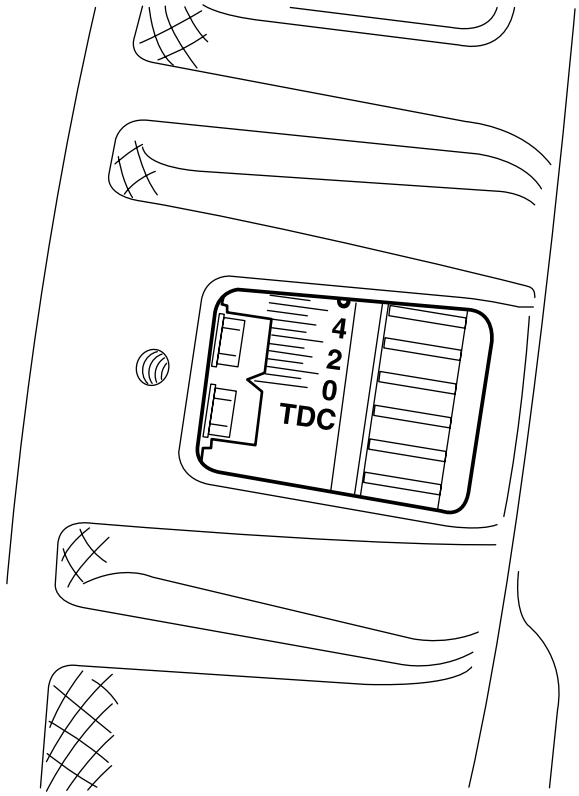
Note:
If the valve opening matches that in the technical data, it may be assumed that the timing gear is properly set.



M200551

Adjustment, timing gear

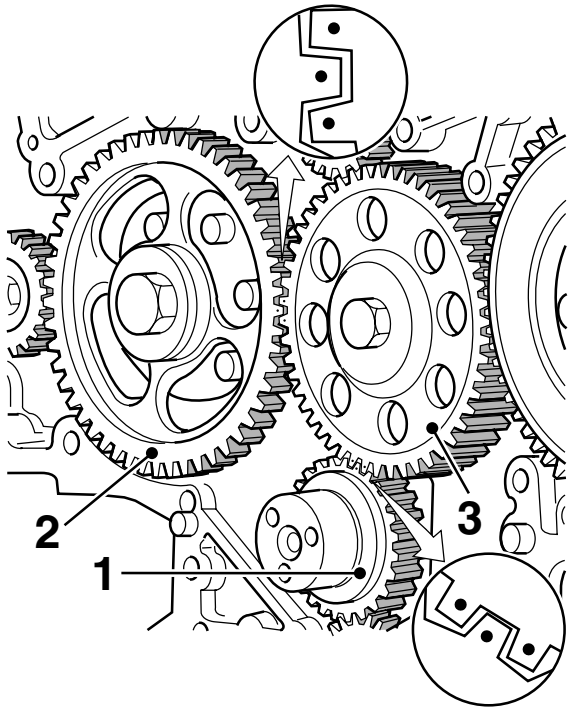
1. Remove the valve cover from cylinders 1-2-3, see chapter “Removal and installation”.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
3. Remove the timing-gear cover, see chapter “Removal and installation”.



M200574

Note:
When the crankshaft (1) or the camshaft (2) of an engine without intermediate gear wheel (3) is rotated separately, the engine’s pistons may touch the valves.

4. Remove the intermediate gear wheel (3), see “Removal and installation”.
5. Rotate the camshaft gear wheel (2) in such a position that the intermediate gear wheel (3) can be installed in accordance with the marks.
6. Install the intermediate gear wheel and tighten the attachment bolt to the specified torque, see main group “Technical data”.
7. Fit the timing-gear cover, see chapter “Removal and installation”.
8. Fit the valve cover, see “Removal and installation”.



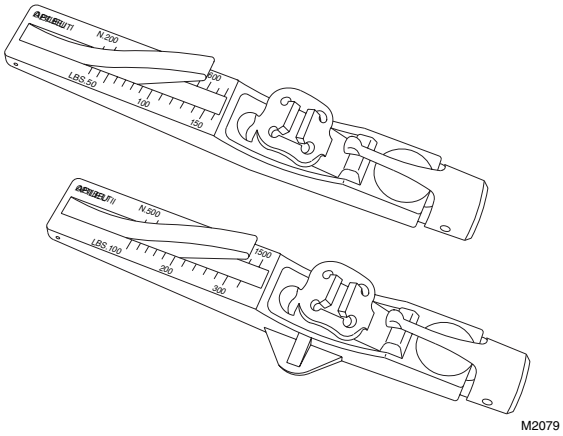
M200602

3.4 INSPECTION AND ADJUSTMENT, V-BELT TENSION

Inspection, V-belt tension
Check the V-belt by means of a belt-tension gauge. The advantage of this method is a higher measuring accuracy of the pre-tension, so that the service life of the V-belt, among other things, can be prolonged.

There are two versions: belt tension “Krikit I”, to be used with the single belt version (DAF no. 1240442), belt tension “Krikit II” to be used with the twin belt version (DAF no. 1240443).

The difference between belt-tension gauge “Krikit I” and belt-tension gauge “Krikit II” is that the latter has a larger belt support area.



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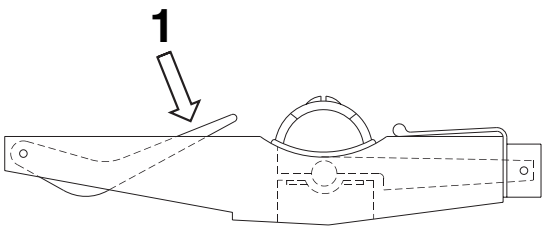
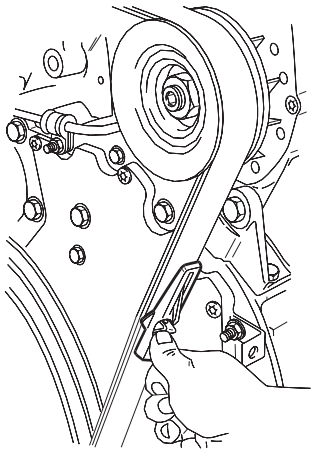
Measuring with the “KRIKIT” belt-tension gauge
1. Set the gauge to zero by depressing the measuring arm (1).

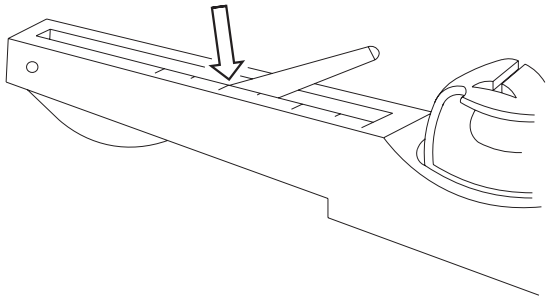


M2061

2. Place the belt-tension gauge on the V-belt, halfway between the alternator and the crankshaft pulley.
3. Slowly depress the V-belt by means of the belt-tension gauge until a click is heard. Then remove the belt-tension gauge carefully. Take care that the gauge bar does not move.


M2091

4. Take the reading as indicated by the position of the measuring arm in relation to the scale. Compare this pressure reading with the recommended pre-tension, see main group “Technical data”.

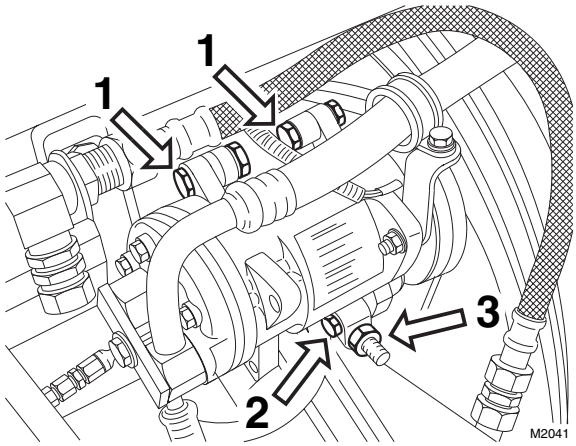


M2062

2

Adjustment, V-belt tension of the air-conditioning compressor

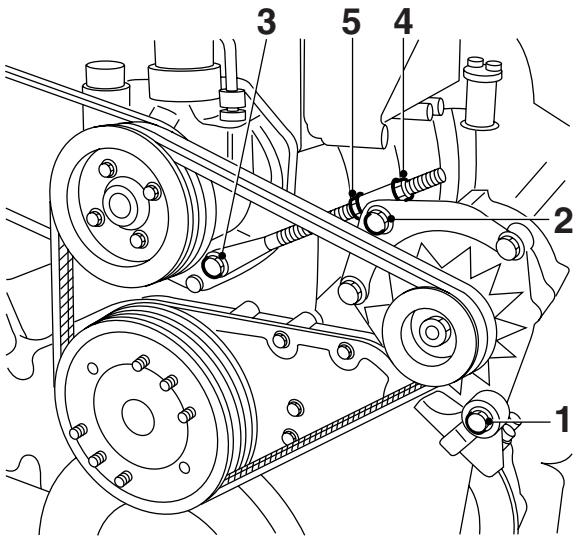
1. Slacken the upper fixing bolt (1) on the compressor.
2. Slacken the lower fixing bolt (2) on the compressor.
3. Slacken the fixing bolt from the threaded spindle which is attached to the cooling-water pump.
4. Shift the compressor using the lock nuts (3) until the correct V-belt tension is achieved, see main group “Technical data”.



M2041

Adjustment, V-belt tension of the water pump and alternator

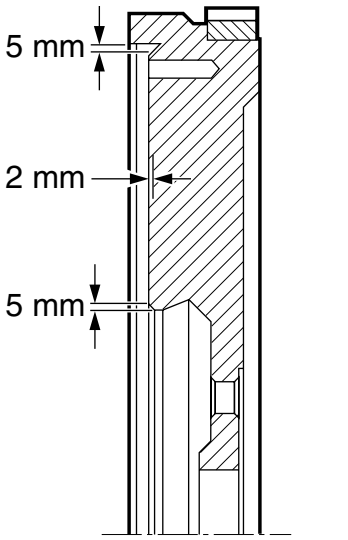
1. Slacken the lower fixing bolt (1) of the alternator.
2. Slacken the upper fixing bolt (2) of the alternator.
3. Slacken the fixing bolt (3) from the threaded spindle which is attached to the water pump.
4. Turn the lock nuts (4) and (5) on the threaded spindle so that the correct V-belt tension is achieved, see main group “Technical data”.



M200550

3.5 CHECKING THE FLYWHEEL

1. If the flywheel shows marks on the contact surface with the clutch plate, the flywheel may be ground down, on condition that the cracks are not within 5 mm of the inner rim.
2. The flywheel has an indicator groove for inspection purposes.
3. Grinding down is allowed until the indicator groove has just disappeared. This means that a **maximum of 2 mm** may be ground down.



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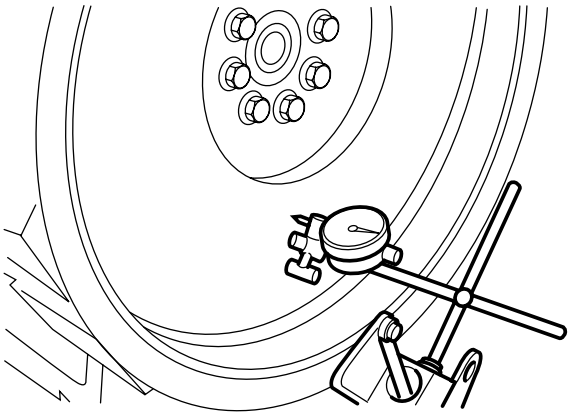
Inspection, flywheel swing

1. Clean the flywheel.
2. Place a metal strip on the edge of the flywheel housing to install a dial gauge.
3. Place the dial gauge on the metal strip.
4. Place the dial gauge of the stylus at the specified distance, see main group “Technical data”.
5. Set the dial gauge to “0”.
6. Place the fuel pump in the stop position and lock it in this position.
7. Use the special tool (DAF no. 1310477) to crank the engine through 360°, and measure the maximum clock reading. Compare this reading with the technical data, see main group “Technical data”.


M200230

3.6 INSPECTION, ENGINE COMPRESSION PRESSURE

Be careful when working on an engine at operating temperature.

When the engine is run without the valve covers, hot lubricating oil may escape from the engine. Make sure you are adequately protected.

A compression measurement serves to rapidly check the valve seals, the valve gasket seal and the seal between the cylinder lining and the piston rings.
The measuring results may only be used for comparing the various cylinders.

1. Run the engine to operating temperature.
2. Place the fuel pump in the stop position. Lock the fuel pump in this position.
3. Remove the valve covers, see chapter “Removal and installation”.
4. Remove the injectors.
5. Turn the engine a number of times using the starting motor, so that any carbon or dirt particles in the cylinder are removed.
6. Install the dummy-injector (DAF no. 1329306), compression gauge (DAF no. 1329301) and adapter (DAF no. 0694972).
7. Carry out the measurement by rotating the engine using the starter motor, until the gauge reading no longer rises. For the mutual allowable differential pressures, see main group “Technical data”.
8. Remove the dummy injector and install the injectors.
9. Fit the valve covers, see chapter “Removal and installation”.

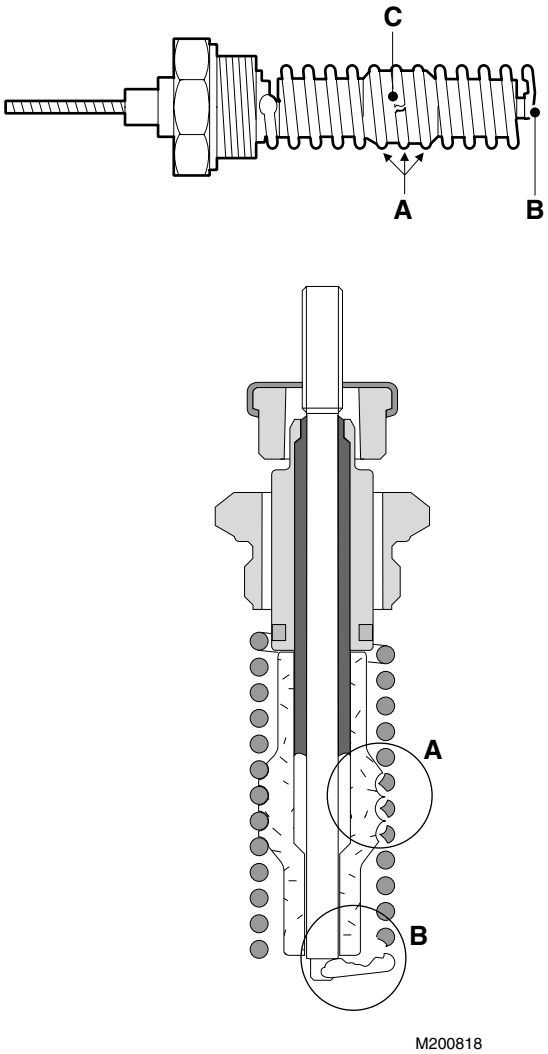
3.7 INSPECTION, CYLINDER HEAD

1. Check the sealing plugs of the cylinder head for leaks. If necessary, pressure-test the cylinder head.
2. Check the cylinder head for damage on the sealing face, and possible cracks. If necessary, have the cylinder head levelled, see main group “Technical data”.

3.8 INSPECTION, GLOW FILAMENTS

Note:
To avoid engine damage it is important that the glow filaments should be checked periodically.

1. Check the glow filaments for the following points:
   - windings that have worn thin due to abrasion (A);
   - filament end broken or worn thin due to continuous knocking of a loose insulator (see B);
   - broken plug windings (C).
2. Replace all glow filaments if one or more of the above-mentioned situations occurs.



4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENGINE

Suspend the engine carefully from the hoist, using approved lifting gear.

Various fluids will be released when pipes are removed. Collect these fluids. Take care of your personal protection and any fire hazards.

Note:
Because of the large number of vehicle specifications, it is not feasible to exactly specify the engine removal and installation procedures for every vehicle.
This description only includes the main points requiring attention.

- Disconnect the earth lead from the battery pole.
- Avoid opening of fluid systems as much as possible. If possible, remove and put aside the engine components.
- When removing the engine, ensure that no parts or dirt fall into the engine, radiator or other components. Therefore, plug all openings.
- Electrical wiring harnesses are easily damaged. If damaged, they may cause faults. Make sure these wiring harnesses are stress-free and have been installed away from moving parts.
- Tighten all fixing bolts to the correct tightening torque.
- Do not allow the engine to rest on the oil sump. Because the oil sump is made of sheet material, it will be severely damaged by the engine's own weight.

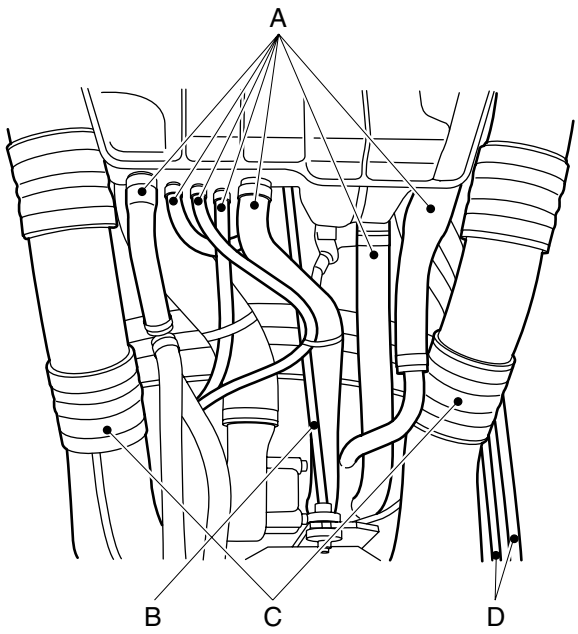
4.2 REMOVAL AND INSTALLATION, ENGINE MOUNTING

Suspend the engine carefully from the hoist, using approved lifting gear.

Various fluids will be released when pipes are removed. Collect these fluids. Take care of your personal protection and any fire hazards.

Removing the engine mounting

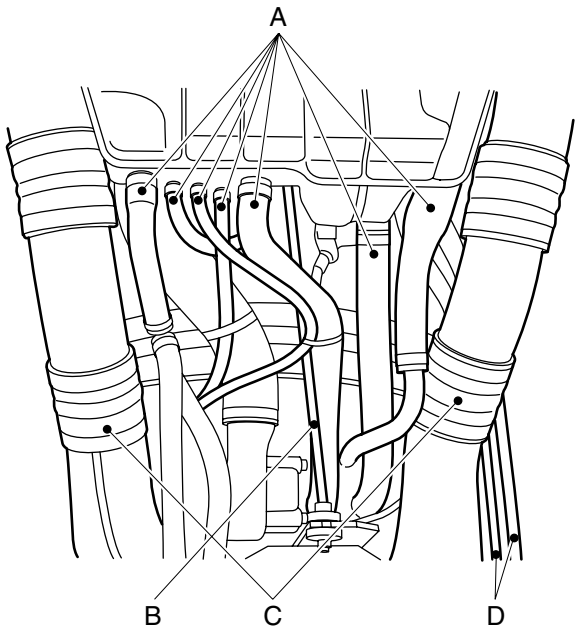
1. Disconnect the earth lead from the battery pole.
2. Drain the coolant.
3. Remove the coolant hoses (A) between the engine, the radiator and the header tank.
4. Remove the reaction rod (B) between the engine and the radiator.
5. Remove the air inlet hoses (C) between the engine and the intercooler. Plug the openings.
6. Remove the air-conditioning compressor, if present, so that it can be put aside with the pipes (D) attached.
7. Remove the fixing nuts of the viscous fan clutch and place the viscous fan clutch and the fan in the wind tunnel.
8. Disconnect the earth strip on the flywheel housing.
9. Properly suspend the engine in the hoist.
10. Remove the central engine mount fixing bolts at the front and/or back of the engine.
11. Lift the engine up as much as is necessary.
12. Remove the engine mounting.



M201019

Installing the engine mounting

1. Tighten the engine mounting fixing bolts to the specified torque, see main group “Technical data”.
2. Install the viscous fan clutch and the fan. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the reaction rod (B) between the engine and the radiator.
4. Install the air inlet hoses (C) between the engine and the intercooler.
5. Install the coolant hoses (A) between the engine, the radiator and the header tank.
6. If fitted, install the air-conditioning compressor.
7. Install the earth strip from the chassis to the flywheel housing.
8. Reconnect the earth lead to the battery.
9. Fill the cooling system.



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4.3 REMOVAL AND INSTALLATION, VALVE COVER

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removal of the valve cover

1. Clean the area around the valve cover.
2. Remove the fixing bolts from the valve cover.
3. Remove the valve cover and the valve cover gasket.

Installation of the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Install the valve cover, using a new valve cover gasket.
3. Install the attachment bolts of the valve cover and tighten them to the specified tightening torque, see main group “Technical data”.

4.4 REMOVAL AND INSTALLATION, VALVE MECHANISM

Removing the valve mechanism

1. Remove the valve covers.
2. Place the fuel pump in the stop position and lock it in this position.
3. Remove the DEB or the lubricating-oil strip (depending on model).

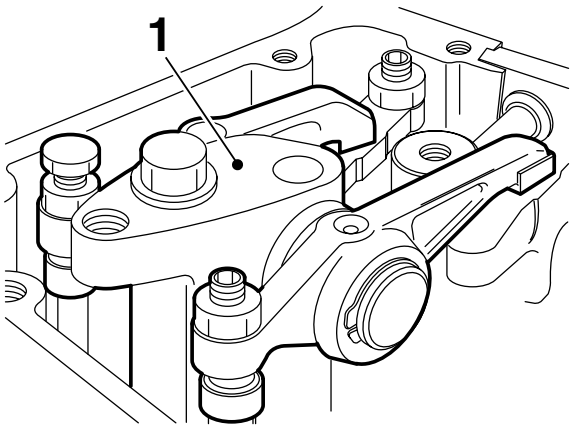
Note:
Place numbers on the rocker brackets (1) and the bridges (2-3-4), to allow reinstallation in the same position.

4. Remove the rocker brackets (1).
5. Remove the bridges (2-3-4).

Installing the valve mechanism
Note:
In engines equipped with a DEB, the bridges (2-3-4) of the inlet and exhaust valves are not the same.
In engines without a DEB, the bridges (2-3-4) of the inlet and exhaust valves are the same.

1. Install the bridges (2-3-4) on the valves.
2. Adjust the bridges (2-3-4), see chapter “Checking and adjusting”.
3. Tighten the rocker brackets (1) by hand.

   Note:
   Depending on the engine position, some rocker brackets will have to be positioned against the pressure of the valve springs. The rocker bracket will resist this spring pressure and can therefore not be positioned correctly.
   By cranking the crankshaft always $^1/_3$ stroke using the special tool (DAF no. 1310477), the rocker brackets can be tightened according to the injection sequence 1-5-3-6-2-4.



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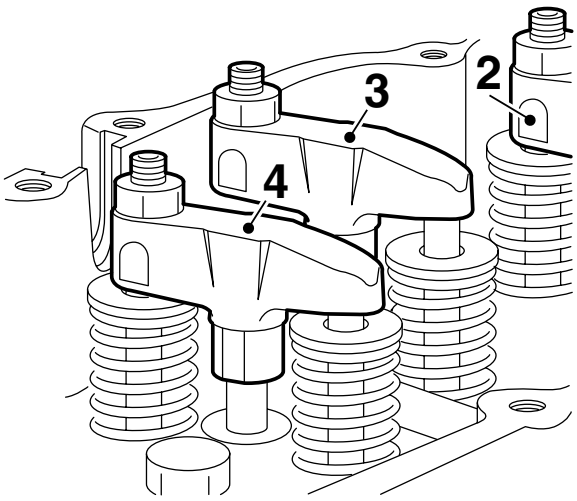

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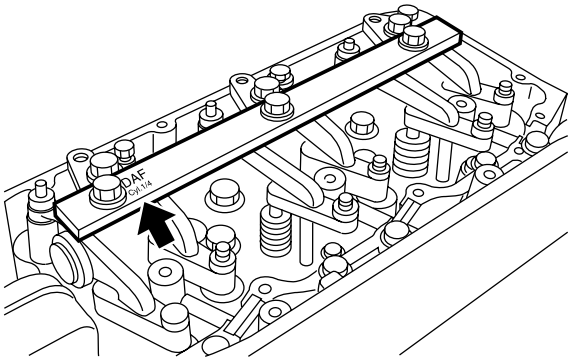
4. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Install the DEB or the lubricating-oil strip (depending on model). Install the lubricating-oil strip in such a way that the mark “cyl. 1/4” is located on cylinder 1 or cylinder 4 respectively. For the tightening torques of the fixing bolts, see main group “Technical data”.
6. Adjust the valve clearance and, if present, the DEB clearance, see chapter “Inspection and adjustment”.
7. Fit the valve covers.



M200548

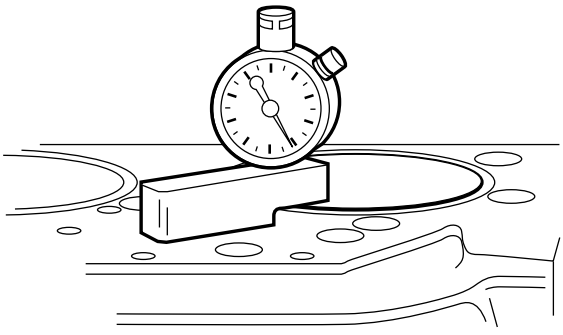
4.5 REMOVAL AND INSTALLATION, CYLINDER HEAD

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removing the cylinder head

1. Disconnect the earth lead from the battery pole.
2. Drain the coolant.
3. Disconnect all electrical wiring around the engine which is relevant for the removal of the cylinder heads.
4. Remove the inlet air hoses between the engine and the intercooler.
5. Remove the inlet pipe from the intercooler to the turbocharger.
6. Remove the compressor pipe from the air inlet pipe to the compressor.
7. Remove the reaction rod between the engine and the radiator.
8. Slacken the air-conditioning compressor tensioning device, if present.
9. Remove the fixing bolts of the air-conditioning compressor attachment bracket, if present.
10. Remove the heat shields from the exhaust manifold.
11. Remove the fixing bolts from the exhaust manifold and move the manifold and the turbocharger a little away from the cylinder heads.
12. Remove the hoses of the auxiliary heating, if present.

13. Remove the coolant filter, if present.
14. Remove the fuel leak-off pipe between the fuel filter and the fuel leak-off pipe on the inlet manifold.
15. Remove the entire fuel filter from the coolant pipe.
16. Remove both sets of injection lines.
17. Remove the water hoses between the thermostat housing and the radiator.
18. Remove the coolant pipe together with the thermostat housing.
19. Remove the fixing bolts of the inlet manifold and take it completely off the cylinder heads.
20. Remove the valve covers.
21. Remove the injectors.
22. Remove the valve mechanism.
23. Remove the push rods.
24. Remove the valve sleeve.
25. Remove the cylinder head bolts.
26. Remove the cylinder head from the cylinder block.
27. Remove any remaining gasket pieces from the cylinder head and the cylinder block.
28. Check the cylinder block sealing faces.
29. Check the threaded holes in the cylinder block for damage and cracking.
30. Use the special tool (DAF no. 0694795) to check that the height which the cylinder liner protrudes above the cylinder block is within the tolerance limits, see main group “Technical data”.
31. Check the cylinder head, see chapter “Inspection and adjustment”.



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Installing the cylinder head

1. Clean the threaded holes in the cylinder block, using a screw tap.
2. Insert both guiding pins (DAF no. 0694912) into the threaded holes of the cylinder block.
3. Place the new gasket(s) on the cylinder block, making sure that the letters **TOP** are visible. The cylinder head gasket must **not be retorqued**.
4. Place the cylinder head(s) on the cylinder block and hand-tighten a number of cylinder head bolts.

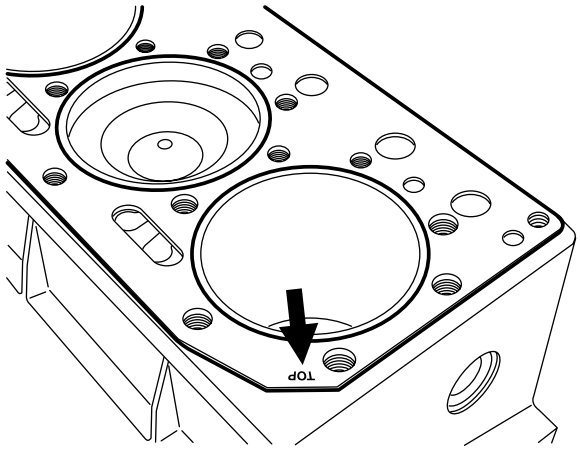
   Note:
   To prevent the inlet and outlet manifolds from being installed with tension, the inlet and exhaust manifolds must be installed before the cylinder head bolts are tightened.
5. Install the inlet and exhaust manifolds with new gaskets and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.

   Note:
   The M16 cylinder head bolts may be used a maximum of three times. After tightening the bolts, mark the bolt heads with a centre punch, to indicate how often they have been used.

   New bolts should not be marked on the first fitting.

   Bolts marked with 2 centre points must not be reused and must be replaced by new ones.

   When fitting used bolts, clean the thread and check for damage.



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6. Fit the M16 and M12 bolts, after having applied a drop of oil to the bearing face of the bolt head and locking compound to the thread, see main group “Technical data”.
7. Remove the two guiding pins, and replace them with the two remaining cylinder head bolts.
8. Tighten the cylinder head bolts to the specified tightening torque and in the sequence shown, see main group “Technical data”.
9. Install the valve sleeve. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
10. Fit the push rods.
11. Install the injectors.
12. Install the valve mechanism.
13. Install the coolant pipe and the thermostat housing with new gaskets.
14. Install the water hoses between the radiator and the thermostat housing.
15. Fit the injection lines.
16. Fit the thermostat housing to the coolant pipe.
17. Install the fuel leak-off pipe between the fuel filter and the inlet manifold.
18. Install the coolant filter, if present, on the coolant pipe.
19. Install the hoses of the auxiliary heating, if present.

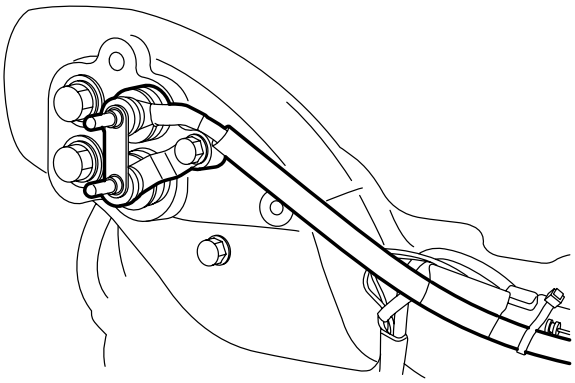
20. Install the heat shields of the exhaust manifold and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
21. Install the air-conditioning bracket, if present.
22. Adjust the V-belt tension of the air-conditioning compressor, see chapter “Checking and adjusting”.
23. Install the reaction rod between the engine and the radiator.
24. Install the compressor pipe from the air inlet pipe to the compressor.
25. Install the inlet pipe between the turbocharger and the intercooler.
26. Install the inlet air hoses between the engine and the intercooler and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
27. Connect the electric wiring.
28. Reconnect the earth lead to the battery.
29. Fill the cooling system.

4.6 REMOVAL AND INSTALLATION OF GLOW FILAMENTS

Note:
If the vehicle has been fitted with two glow filaments upon ex-works delivery, you must not add two glow filaments yourself. The feeder cable between starting motor, glow relay and glow filaments on these vehicles is inadequate for four glow filaments.

Removing the glow filaments

1. Disconnect the earth lead from the battery pole.
2. Remove the electric wiring and connection strip from the glow filaments.
3. Remove the glow filaments.
4. Check the glow filaments for damage, see chapter “Inspection and adjustment”.



M200689

Installing the glow filaments

1. Tighten the glow filaments to the specified tightening torque, see main group “Technical data”.
2. Connect the wiring and the connection strip. Make sure that the insulators are installed in the correct place.
3. Clean the contact surface of the glow filament earth cable to ensure that it is properly earthed on the inlet manifold.
4. Fit the earth lead to the battery pole.

4.7 REMOVAL AND INSTALLATION, INLET MANIFOLD

Removal, inlet manifold

1. Disconnect the earth lead from the battery pole.
2. Remove the wiring from the glow filaments and the temperature sensor.
3. Remove the coolant filter element, if present.
4. Remove the fuel leak-off pipe of the inlet manifold.
5. Remove the fuel filter element.
6. Remove the injection lines.
7. Disconnect the boost pressure pipe on the inlet manifold.
8. Remove the air inlet pipe between the intercooler and the inlet manifold.
9. Remove the attachment bolts from the inlet manifold and remove the manifold.

Installation, inlet manifold

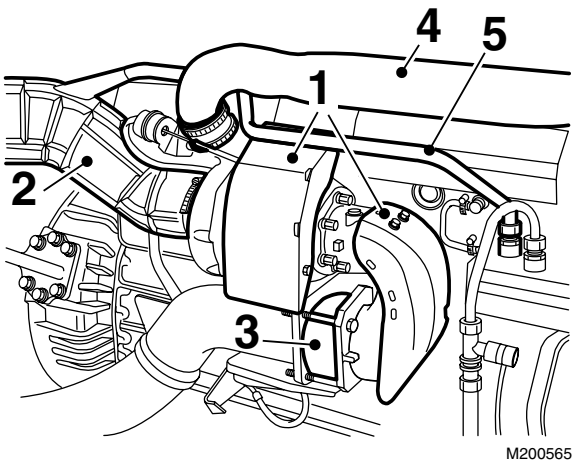
1. Carefully clean the sealing faces of the inlet manifold and the cylinder head.
2. Install the inlet manifold with new gaskets and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
3. Fit the fuel leak-off pipe to the inlet manifold.
4. Install the inlet air hose between the intercooler and the inlet manifold and tighten the fixing bolt to the specified tightening torque, see main group “Technical data”.
5. Fit the boost pressure pipe.

6. Fit the injection lines.
7. Install the fuel filter element.
8. Install the coolant filter element, if present.
9. Install the electric wiring of the glow filaments and the temperature sensor.
10. Reconnect the earth lead to the battery pole.

4.8 REMOVAL AND INSTALLATION, EXHAUST MANIFOLD

Removing the exhaust manifold

1. Remove the heat shields (1) from the turbocharger.
2. Remove the air inlet hose (2).
3. Remove the butterfly valve (3).
4. Remove the inlet air pipe (4) between the turbocharger and the intercooler.
5. Remove the compressor pipe (5).
6. Remove the heat shields from the exhaust manifold.
7. Remove the turbocharger oil supply and discharge pipes.
8. Remove the fixing bolts from the exhaust manifold and remove the manifold.



M200565

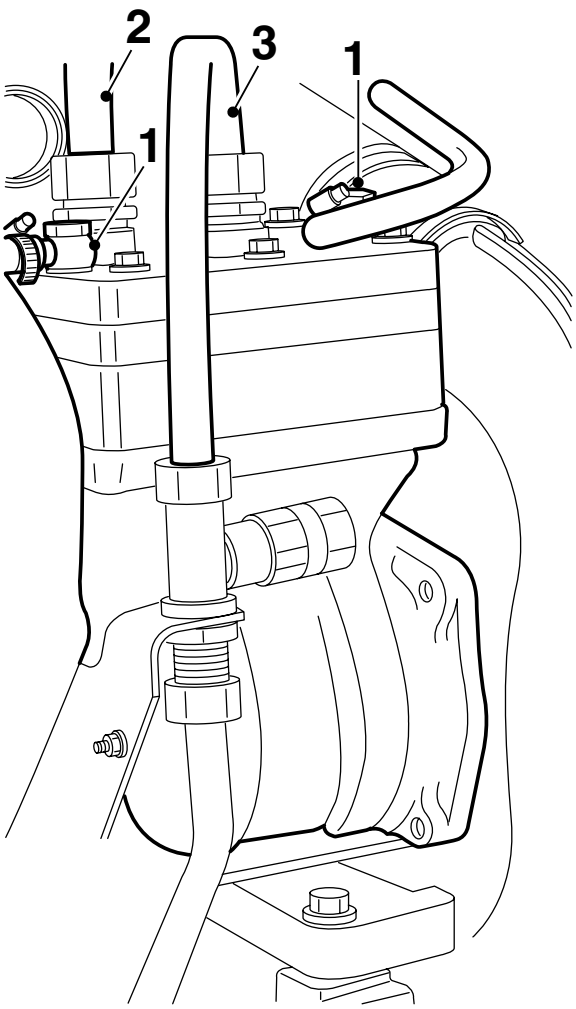
Installing the exhaust manifold

1. Install the exhaust manifold with new gaskets. Tighten the fixing bolts with the spacer sleeves to the specified torque, see main group “Technical data”.
2. Install the heat shields of the exhaust manifold. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the oil discharge pipe for the turbocharger.
4. Spray clean engine oil into the oil supply of the turbocharger, and install the oil supply pipe.
5. Install the turbocharger pipe (5).
6. Install the inlet air pipe (4) between the turbocharger and the intercooler.
7. Install the butterfly valve (3).
8. Install the air inlet pipe (2).
9. Install the turbocharger heat shields (1). Tighten the fixing bolts to the specified torque. See main group “Technical data”.
10. Start the engine and check all connections for leaks.

4.9 REMOVAL AND INSTALLATION, AIR COMPRESSOR

Removal, air compressor

1. Partially drain the coolant.
2. Remove the coolant connections (1).
3. Remove the air pipes (2) and (3).
4. Disconnect the lubricating-oil pipe.
5. Disconnect the service pipe from the air dryer.
6. Remove the mounting bracket at the back of the compressor.
7. Remove the fixing bolts from the timing-gear cover.
8. Remove the compressor from the timing-gear case. Remove the O-ring from the compressor housing.



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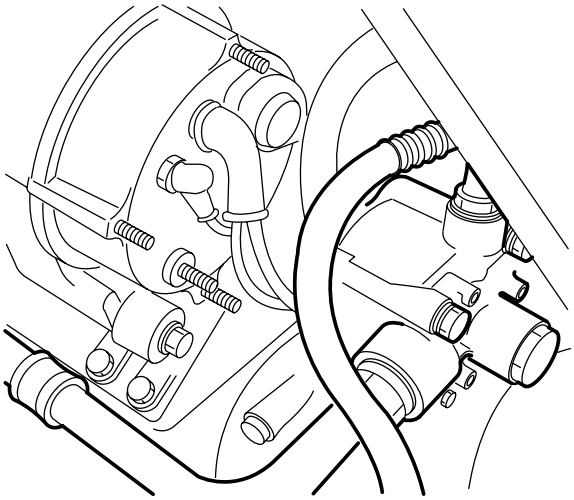
Installation, air compressor

1. Fit a new O-ring to the compressor housing and install the compressor on the timing-gear case.
2. Install the fixing bolts of the air compressor and tighten them to the specified tightening torque, see main group “Technical data”.
3. Install the mounting bracket at the back of the compressor. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
4. Fit the service pipe.
5. Install the lubricating-oil pipe.
6. Install the air pipes (2) and (3).
7. Install the coolant pipes (1).
8. Fill the cooling system.

4.10 REMOVAL AND INSTALLATION, STEERING PUMP

Removal, steering pump

1. Clean the steering pump and the surrounding area.
2. Remove the suction and delivery pipes from the steering pump. Collect the oil flowing out of the system.
3. Immediately plug the openings in the pump and pipes to prevent dirt entering the system.
4. Remove the two fixing bolts in the timing-gear cover and take the pump from the timing-gear case.
5. Check the gear wheel for wear or damage.
6. Remove the O-ring.


M200567

Installation of the steering pump

1. Fit a new O-ring.
2. Fit the steering pump. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the suction and delivery pipes of the steering pump. Fit the banjo bolts. Tighten the banjo bolts to the specified torque, see main group “Technical data”.
4. Fill the oil tank with the specified oil.
5. Bleed the steering system.
6. Check the pipes for leaks.

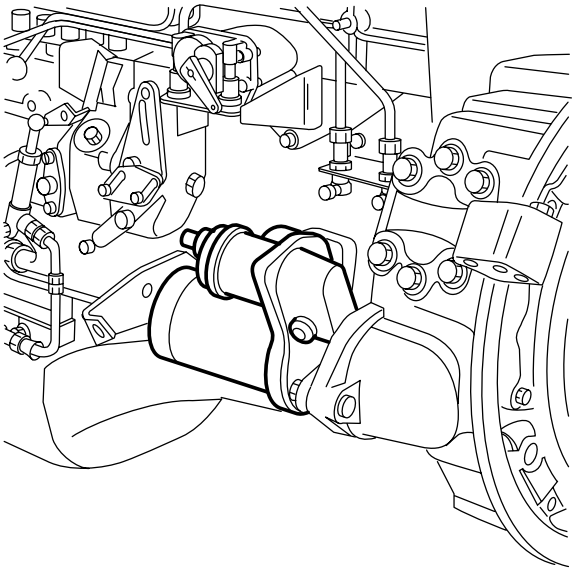
4.11 REMOVAL AND INSTALLATION, STARTING MOTOR

Removing the starting motor

1. Remove both battery leads from the battery poles.
2. Remove the electrical connections from the starting motor.
3. Remove the fixing nuts and the starting motor.
4. Check the toothed pinion for damage.

Installing the starting motor

1. Clean the contact surfaces of the starting motor and the flywheel housing.
2. Install the starting motor in the flywheel housing and tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
3. Install the electrical connections of the starting motor.
4. Reconnect both leads to the battery terminals.



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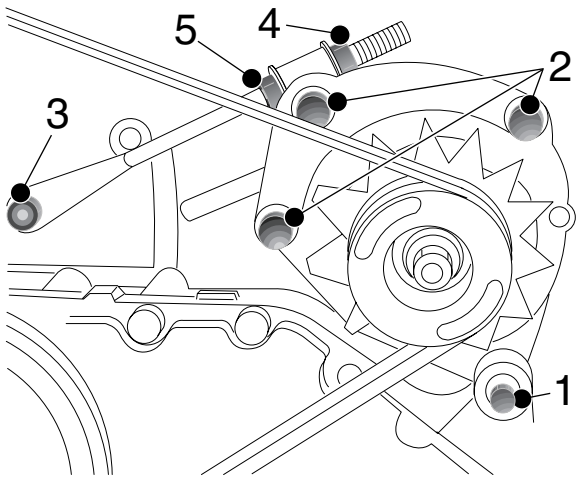
4.12 REMOVAL AND INSTALLATION, ALTERNATOR

Removing the alternator

1. Remove both battery leads from the battery poles.
2. Remove the electrical connections from the alternator.
3. Slacken the fixing bolt (3) from the threaded spindle which is attached to the cooling water pump.
4. Slacken the lock nut (5).
5. Remove the upper fixing bolts (2) of the alternator.
6. Remove the lower fixing bolt (1) of the alternator.
7. Remove the alternator.



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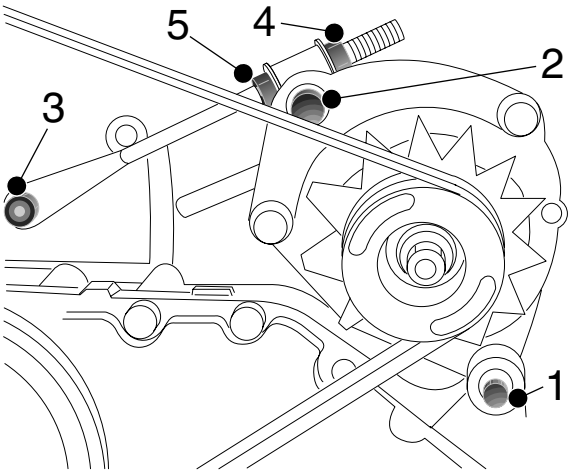
Installing the alternator

1. Fit the alternator on its bracket.
2. Fit the attachment bolt (1) of the alternator.
3. Install the upper fixing bolts (2) of the alternator.
4. Install the V-belts and check the V-belt tension, see the chapter “Checking and adjusting”.
5. Install the electrical connections of the alternator.
6. Reconnect both leads to the battery terminals.

4.13 REMOVAL AND INSTALLATION, V-BELTS

Removal, water pump and alternator V-belt

1. Slacken the attachment bolts (1) and (2) of the alternator.
2. Slacken the attachment bolt (3) from the threaded spindle which is attached to the water pump.
3. Turn the lock nuts (4) and (5) on the threaded spindle so that the alternator can be tilted towards the engine block and the V-belt can be removed from the pulley.



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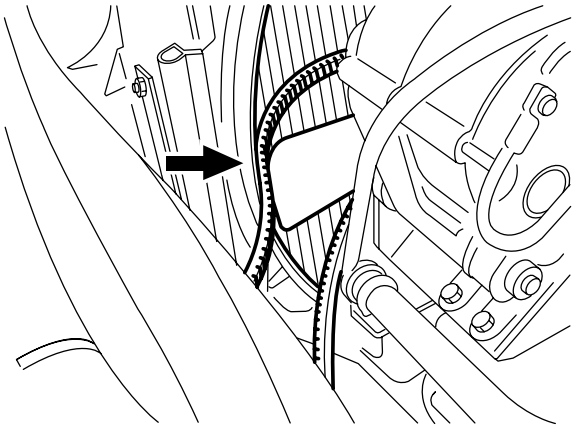
4. Remove the V-belt through the opening at the guide ring (see arrow in drawing). Hang the V-belt over a fan blade. Rotate the fan blade by blade, hanging the V-belt over them. Repeat this for the entire fan, after which the belt can be removed.

   Note:
   With versions where the fan ring is mounted on the engine block, the fan or the fan ring is to be disconnected prior to removal of the V-belt, depending on the accessibility of the attachment bolts.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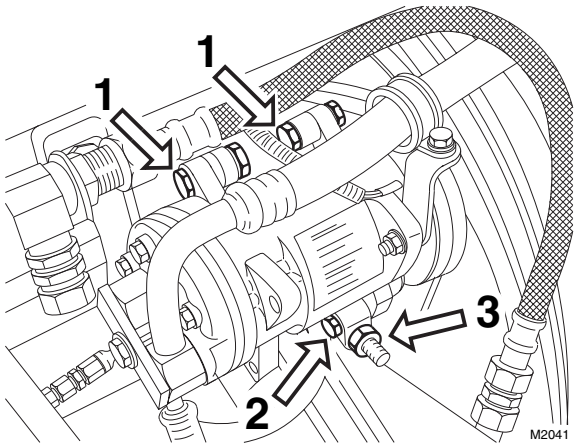
Installation, water pump and alternator V-belt

1. Inspect the pulleys for damage, rust and grease deposits.
2. Install the V-belt through the opening at the guide ring (see arrow in drawing) and adjust the V-belt tension, see the chapter “Checking and adjusting”.
3. Install the fan if it has been removed.

Removal, compressor and air-conditioning V-belt

1. Slacken the upper attachment bolt (1) on the compressor.
2. Slacken the lower fixing bolt (2) on the compressor.
3. Slacken the fixing bolt from the threaded spindle which is attached to the cooling-water pump.
4. Turn the lock nuts (3) on the threaded spindle so that the alternator can be tilted towards the engine block and the V-belt can be removed from the pulley.



Installation, compressor and air-conditioning V-belt

1. Inspect the pulleys for damage, rust and grease deposits.
2. Install the compressor and air-conditioning V-belt and adjust the V-belt tension, see the chapter “Checking and adjusting”.

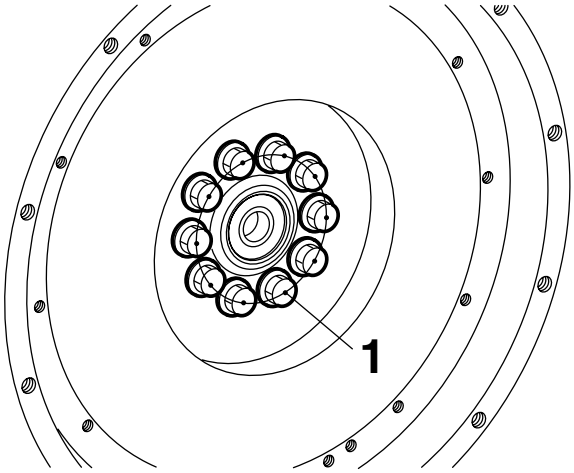
4.14 REMOVAL AND INSTALLATION, FLYWHEEL

Removing the flywheel

1. Remove the gearbox.
2. Remove the clutch release assembly and the clutch plate.
3. Remove the fixing bolts (1) from the flywheel.
4. Use two threaded bolts to remove the flywheel from the dowel pin.
5. Remove the flywheel.

Installing the flywheel

1. Clean the flywheel housing.
2. Clean the crankshaft flange, the dowel pin and the fixing bolts. Remove the locking compound from the threaded holes.
3. Clean the back of the flywheel and install the flywheel.
4. Fit the fixing bolts. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Install the clutch plate and the clutch release assembly.
6. Install the gearbox.



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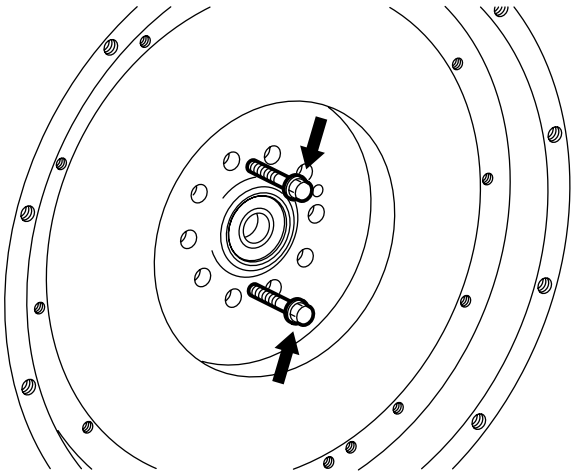
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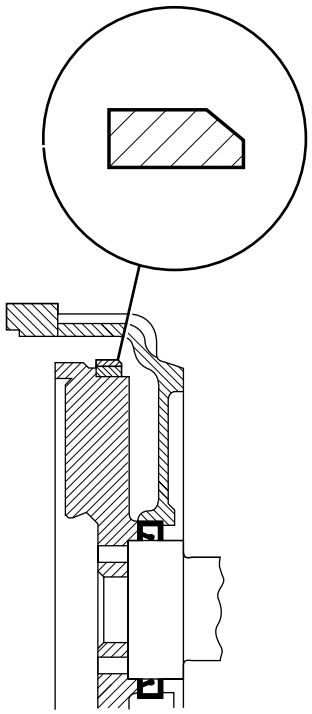
4.15 REMOVAL AND INSTALLATION, STARTER RING

Removing the starter ring

1. Remove the flywheel.
2. Remove the starter ring by tapping it off the flywheel using a blunt chisel. If this is not possible, cut it between two teeth, using a sharp chisel.

Installing the starter ring

1. Clean the flywheel and the starter ring. Ensure that the contact areas are degreased.
2. Heat the new starter ring evenly in an oven, see main group “Technical data”.
3. Tap the starter ring onto the flywheel so that the bevelled sides of the teeth point towards the starting motor. Ensure a good contact between starter ring and flywheel, all round.
4. Install the flywheel.



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4.16 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING SEALING RING

Removing the flywheel housing sealing ring

Note:
Each new oil sealing ring is supplied with a plastic mounting ring, which can only be used **once**.

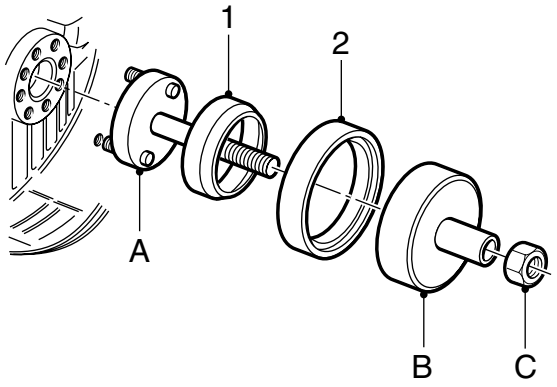
2

1. Remove the flywheel.
2. Drill two small holes into the sealing ring and pull, using the special tools (DAF no. 0484899 and DAF no. 0694928), the sealing ring from the flywheel housing.

Installing the flywheel housing sealing ring

1. Thoroughly clean sealing ring recess and check for damage. Even the slightest damage can cause a leak.
2. Clean the crankshaft flange.

   Note:
   If a filler ring was fitted in the oil sealing ring recess, re-install this filler ring.
3. Install the base plate (A) of special tool (DAF no. 0535598) on the crankshaft flange.
4. Then place the new **dry** oil sealing ring (the felt ring may not become greasy) over the supplied plastic mounting ring (1).
5. Install the supplied plastic mounting ring (1) and the oil sealing ring on the crankshaft flange.
6. Place the thrust washer (B) over the spindle and gradually tighten the nut (C) until you feel a clear resistance.
7. Disassemble the thrust washer (B) and remove the plastic mounting ring (1).
8. Place the thrust washer (B) over the spindle and gradually tighten the nut (C) until the sealing ring is properly positioned.
9. Remove the special tool.
10. Install the flywheel.



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4.17 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING

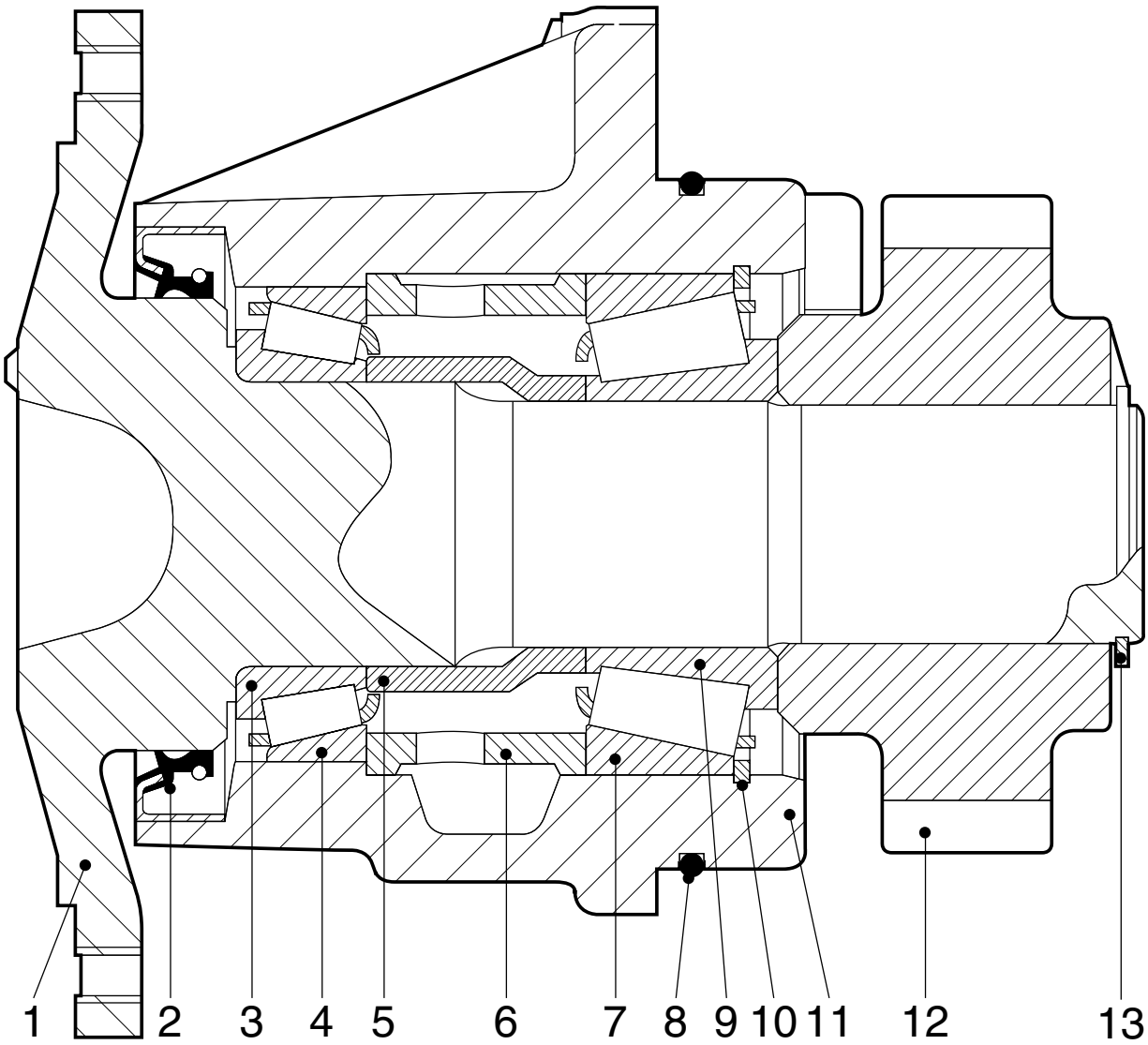
Removing the flywheel housing

1. Remove the flywheel.
2. Disconnect the earth cable from the flywheel housing.
3. Remove the starting motor.
4. Properly suspend the engine in the hoist.
5. Remove the two oil sump fixing bolts on the flywheel housing.
6. Slacken the other oil sump fixing bolts until the oil sump is free from the flywheel housing.
7. Remove the central engine mount fixing bolts at the back of the engine.
8. Remove the fixing bolts from the flywheel housing.
9. Remove the flywheel housing.

Installing the flywheel housing

1. Remove the oil sealing ring from the flywheel housing, by carefully tapping or forcing it from the housing.
2. Remove any traces of old gaskets from the contact areas.
3. Check the sealing faces for damage.
4. Check the flywheel housing for cracks.
5. Apply a locking compound to the sealing face of the cylinder block, see main group “Technical data”. Apply the locking compound with a roller or brush, across the entire sealing face.
6. Install the flywheel housing and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
7. Install the central engine mount fixing bolts at the back of the engine. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
8. Install the oil sealing ring.
9. Install the flywheel.
10. Install the starting motor.
11. Clean the contact surface of the earth cable, and connect it to the flywheel housing.
12. Install the oil sump fixing bolts. Tighten all fixing bolts to the specified torque, see main group “Technical data”.

4.18 REMOVAL AND INSTALLATION, FAN DRIVE



Removing the fan drive

1. Remove the fixing nuts from the viscous fan. Place the viscous fan clutch and the fan in the wind tunnel.
2. Remove the water pump, alternator and fan-drive V-belts.
3. Remove the fixing nuts from the fan drive.
4. Remove the fan drive.

Installing the fan drive

1. Install a new O-ring (8), lightly greased, in the groove of the bearing housing (11).
2. Apply engine oil to the bearings in the bearing housing.
3. Install the fan drive in the timing-gear case. Tighten the fixing nuts crosswise to the specified tightening torque, see main group “Technical data”.
4. Install the water pump, alternator and fan-drive V-belts. Adjust the V-belts, see chapter “Checking and adjusting”.
5. Install the viscous fan clutch and the fan.

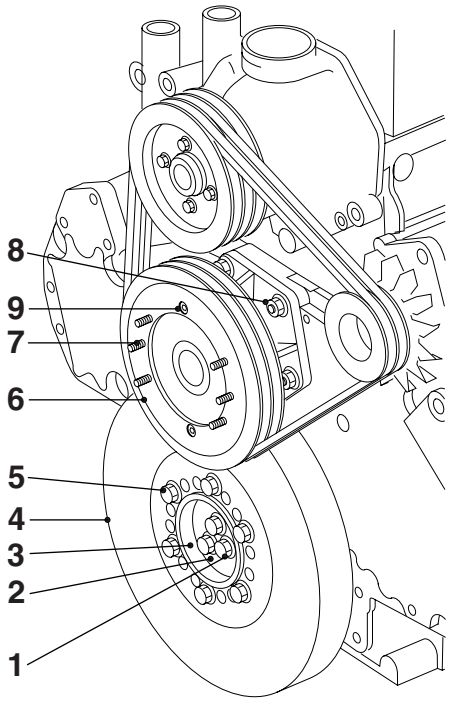
4.19 REMOVAL AND INSTALLATION, VIBRATION DAMPER

Removing the vibration damper

1. Remove the fixing nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
2. Remove the water pump and alternator V-belts.
3. Remove the fan pulley fixing bolts (9).
4. Remove the fan pulley (6).
5. Remove the fixing bolts (5) of the vibration damper.
6. Remove the vibration damper (4).

Installing the vibration damper

1. Check the vibration damper for external damage and silicone liquid leaks. In the event of damage or leaks, the vibration damper should be replaced.
2. Install the vibration damper (4) and tighten the fixing bolts (5) to the specified tightening torque, see main group “Technical data”.
3. Install the fan pulley (6) onto the fan drive.
4. Install the V-belts and check the V-belt tension, see the chapter “Checking and adjusting”.
5. Install the viscous fan clutch and the fan.



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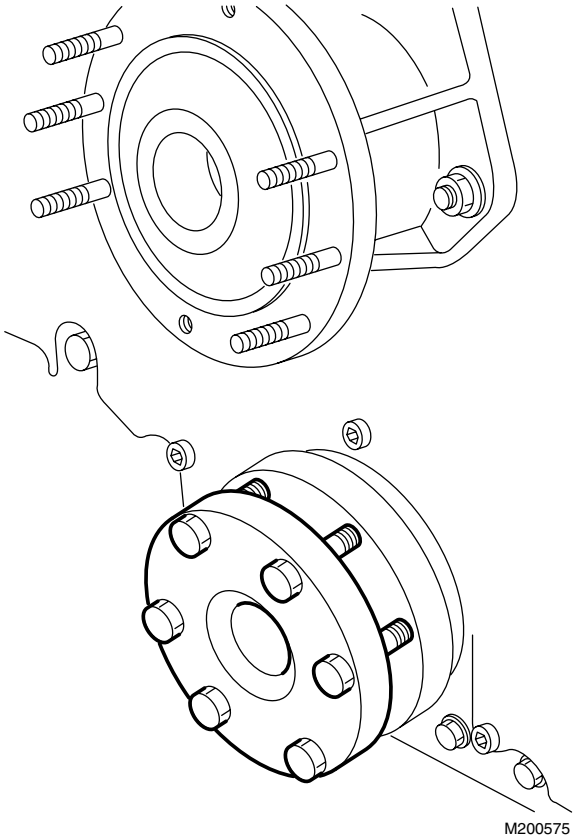
4.20 REMOVAL AND INSTALLATION, VIBRATION-DAMPER HUB

Removing the vibration damper hub

1. Remove the vibration damper.
2. Remove the fixing bolts from the vibration damper hub, and remove the thrust piece.
3. Use the special tool (DAF no. 1310422) to remove the vibration damper hub.

Installing the vibration damper hub

1. Install the vibration damper hub onto the crankshaft.
2. Install the thrust piece and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
3. Install the vibration damper.



4.21 REMOVAL AND INSTALLATION, TIMING-GEAR COVER SEALING RING

Removing the timing-gear cover sealing ring

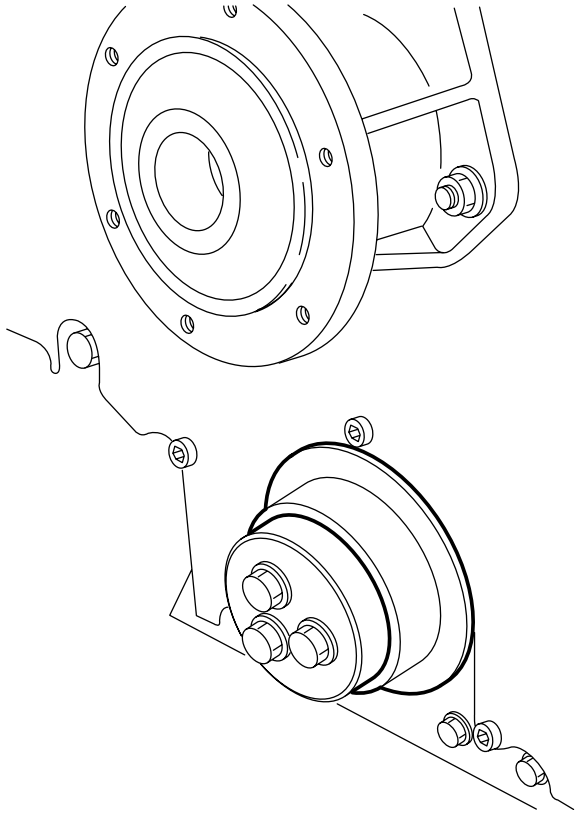
1. Remove the vibration damper hub.
2. Remove the timing-gear cover sealing ring by drilling two small holes into the sealing ring and pull, using the special tools (DAF no. 0484899 and DAF no. 0694928) to pull the sealing ring from the timing-gear cover.

Installing the timing-gear cover sealing ring

1. Clean and check the sealing ring recess in the timing-gear cover. Even minimal damage can lead to a leak.

   Note:
   If a filler ring was fitted in the oil sealing ring recess, re-install this filler ring.

2. Use the special tool (DAF no. 1310424) to fit a **dry** new sealing ring and install the thrust piece in the recess of the timing-gear cover.
3. Remove the special tool.
4. Install the vibration damper hub.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4.22 REMOVAL AND INSTALLATION, TIMING-GEAR COVER

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removing the timing-gear cover

1. Remove the vibration damper hub.
2. Remove the oil filler pipe.
3. Mark the positions of the various fixing bolts and studs.
4. Remove the fixing bolts and studs from the timing-gear cover.
5. Remove the timing-gear cover.
6. Remove any remains of the gasket. Clean and check the sealing faces, dowel pins and locating holes.
7. Remove the oil sealing ring from the timing-gear cover.

Installing the timing-gear cover

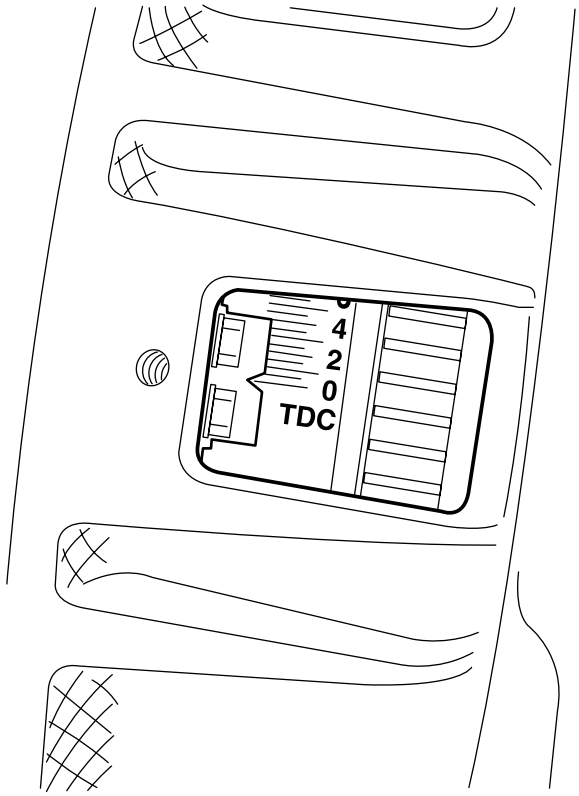
1. Use three studs to position the gasket. Install the new gasket.
2. Install the timing-gear cover.
3. Install the fixing bolts and the studs. Tighten the fixing bolts and studs to the specified torque, see main group “Technical data”.
4. Remove the three studs used to position the gasket and replace them by the remaining fixing bolts.
5. Install the oil filler pipe, fitted with a new O-ring.
6. Install the timing-gear cover sealing ring.
7. Install the vibration damper hub.

4.23 REMOVAL AND INSTALLATION, TIMING GEAR WHEELS

Removing the timing gear

1. Remove the valve covers.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
3. Remove the timing-gear cover.

   Note:
   It is possible that the marks of the intermediate gear wheel are **not** exactly opposite the camshaft and crankshaft gear wheel.



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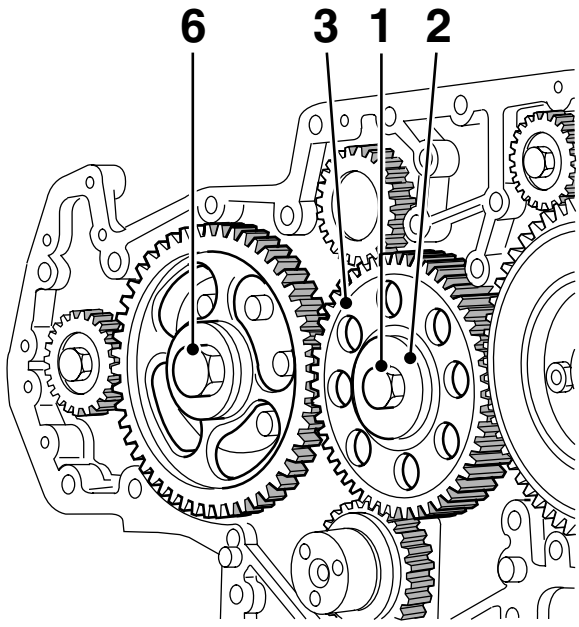
Removing the intermediate gear wheel

1. Remove the fixing bolt (1) with the axial thrust washer (2).
2. Remove the intermediate gear wheel (3).

Removing the camshaft gear wheel

1. Remove the fixing bolt (6) of the camshaft gear wheel.
2. Remove the intermediate gear wheel.
3. Remove the camshaft gear wheel using a commercially available puller.



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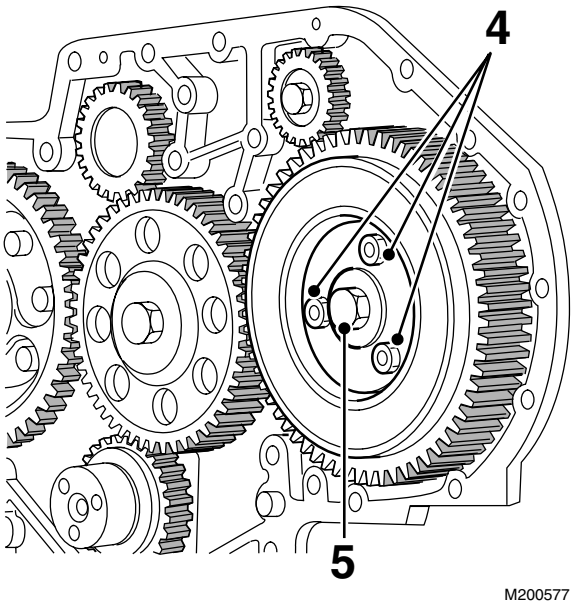
Removing the fuel-pump drive gear wheel

1. Turn the engine speed sensor a number of revolutions out of the timing-gear case to prevent the sensor from being damaged when the gear wheel is removed.
2. Remove the fixing bolts (4) from the silencer and remove the silencer.
3. Remove the fixing bolt (5) from the fuel pump drive gear wheel.
4. Remove the intermediate gear wheel.
5. Remove the gear wheel using a commercially available puller.



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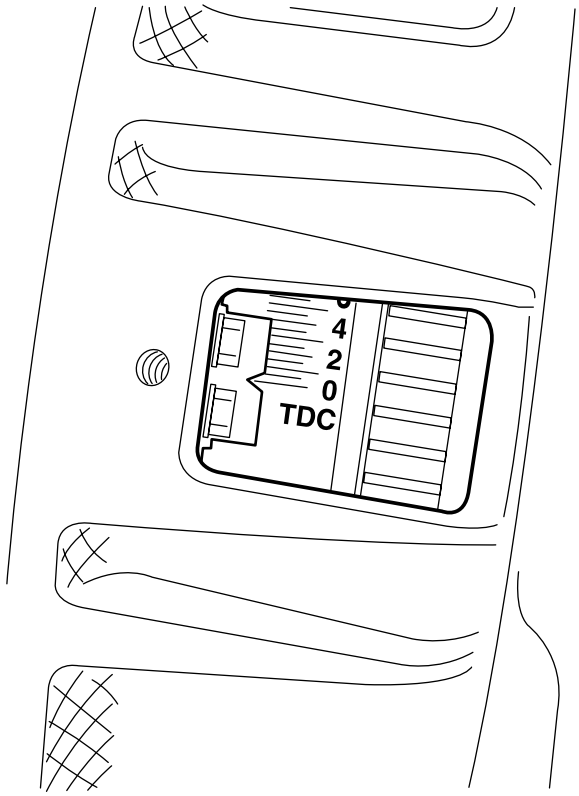
Installing the timing gear wheels

1. Remove the valve covers.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).



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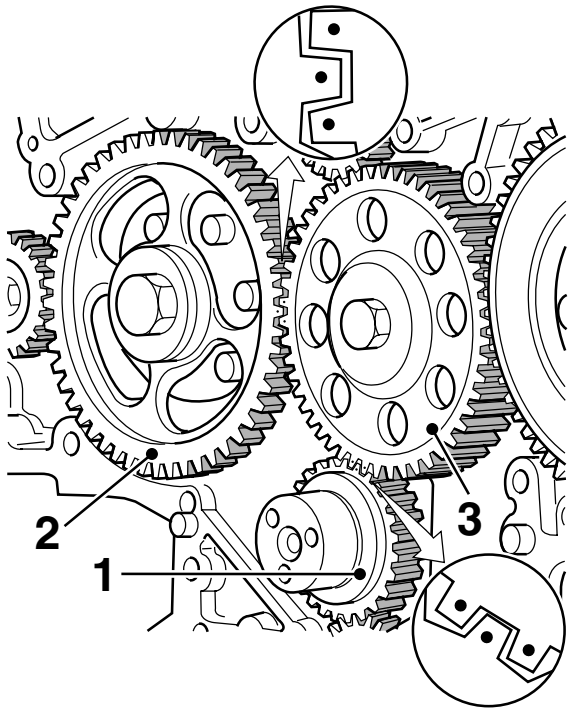
Installing the intermediate gear wheel

Note:
Before installing the intermediate gear wheel, ensure that you can access the clamp bolt used to set the injection time.

1. Install the intermediate gear wheel (3) in such a position that the marks of the camshaft gear wheel (2), crankshaft gear wheel (1) and intermediate gear wheel (3) are in line.



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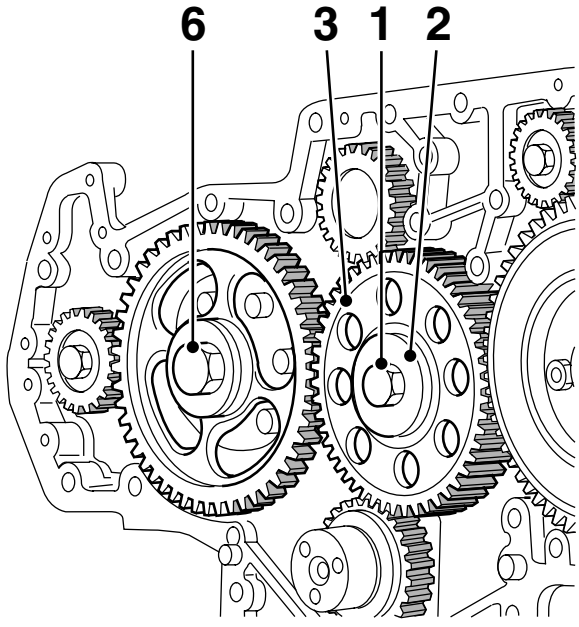
2. Install the fixing bolt (1) with the axial thrust washer (2) from the intermediate gear wheel (3). Tighten the fixing bolt (1) to the specified tightening torque, see main group “Technical data”.
3. Check whether the gear wheels have some play.

Installing the camshaft gear wheel
1. Install the gear wheel onto the camshaft.
2. Install the intermediate gear wheel (3).
3. Install the camshaft gear wheel fixing bolt. Tighten the fixing bolt (1) to the specified tightening torque, see main group “Technical data”.
4. Check whether the gear wheels have some play.



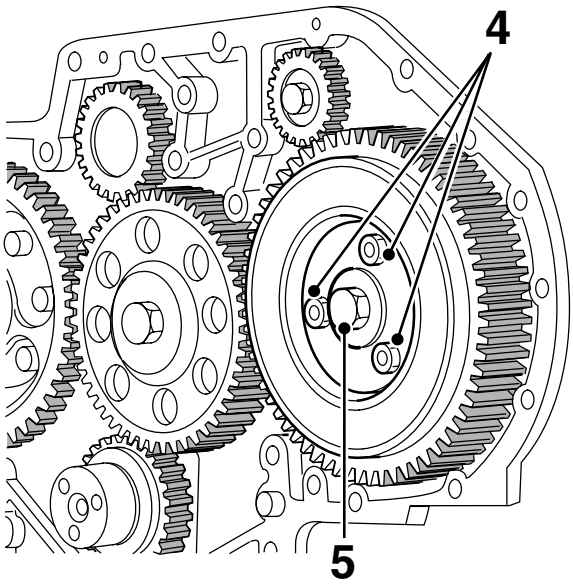
M200578

Installing the fuel-pump drive gear wheel

Note:
Before installing the intermediate gear wheel, ensure that you can access the clamp bolt used to set the injection time.

1. Install the gear wheel onto the shaft end.
2. Install the intermediate gear wheel.
3. Install the fuel pump drive gear wheel fixing bolt (5). Tighten the attachment bolts (4) to the specified torque, see main group “Technical data”.
4. Install the silencer.
5. Install the fixing bolts (4) of the silencer. Tighten the fixing bolt to the specified torque, see main group “Technical data”.
6. Check whether the gear wheels have some play.
7. Turn the engine speed sensor in the timing-gear case, adjust the distance between the sensor and the gear wheel, see main group “Technical data”.

Installing the timing gear
1. Install the timing-gear cover.
2. Fit the valve covers.
3. Check the injection timing.



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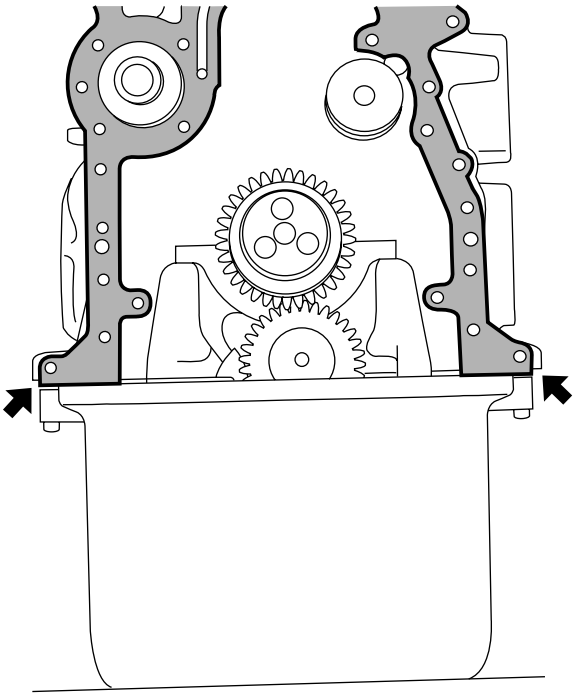
4.24 REMOVAL AND INSTALLATION, TIMING-GEAR CASE

Removing the timing-gear case

1. Remove the timing gear wheels.
2. Remove the air compressor.
3. Remove the steering pump.
4. Remove the fixing bolts and the lock plate of the cam shaft.
5. Slacken the oil sump fixing bolts until the oil sump is free from the timing-gear case.
6. Remove the fixing bolts from the timing-gear case to the engine block, and remove the timing-gear case.

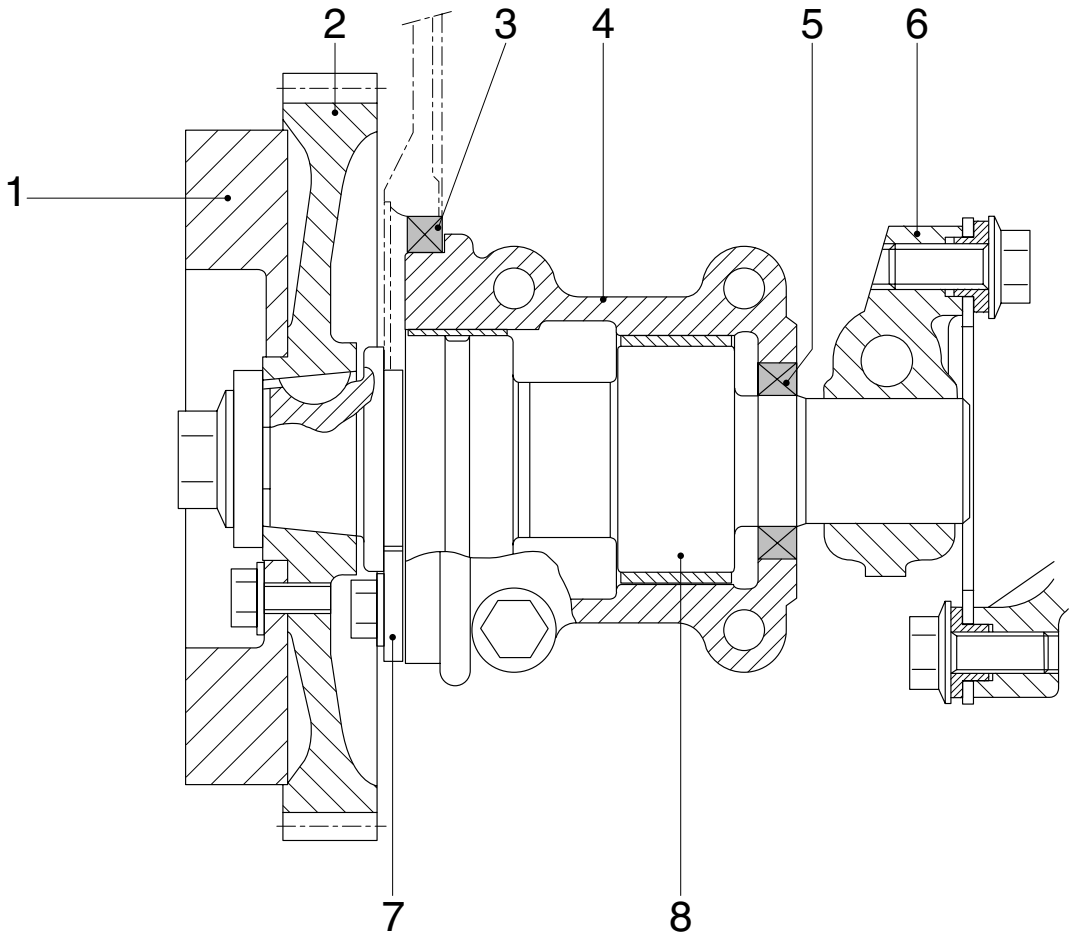


M200579

Installing the timing-gear case

1. Remove any remains of the gasket. Clean and check the sealing faces, dowel pins and locating holes.
2. To position the gasket, insert three studs, and install the new gasket.
3. Then first remove any excess gasket material between the engine block and the oil sump.
4. Install a new O-ring on the air compressor.
5. Install the timing-gear case.
6. Install the fixing bolts for the timing-gear case. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
7. Tighten the oil sump fixing bolts to the specified tightening torque, see main group “Technical data”.
8. Remove the fixing bolts and the lock plate of the cam shaft. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
9. Install the timing gear wheels.
10. Install the air compressor.
11. Fit the steering pump.

4.25 REMOVAL AND INSTALLATION, TIMING GEAR SEALING RING



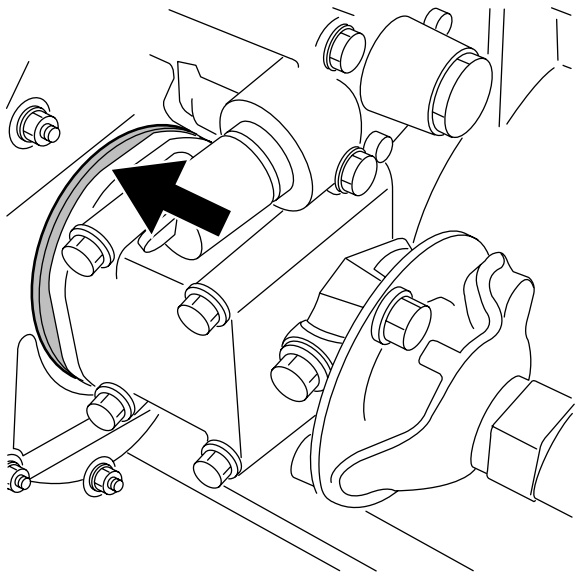
M200582

Removing the timing-gear case sealing ring

1. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
2. Remove the fuel pump drive gear wheel (2).
3. Remove the sealing ring (3) by tapping it from the timing-gear case in the driving direction.

Installing the timing-gear case sealing ring

1. Install a dry new timing-gear case sealing ring (3) using special tool (DAF no. 1329318).
2. Install the fuel pump drive gear wheel (2).



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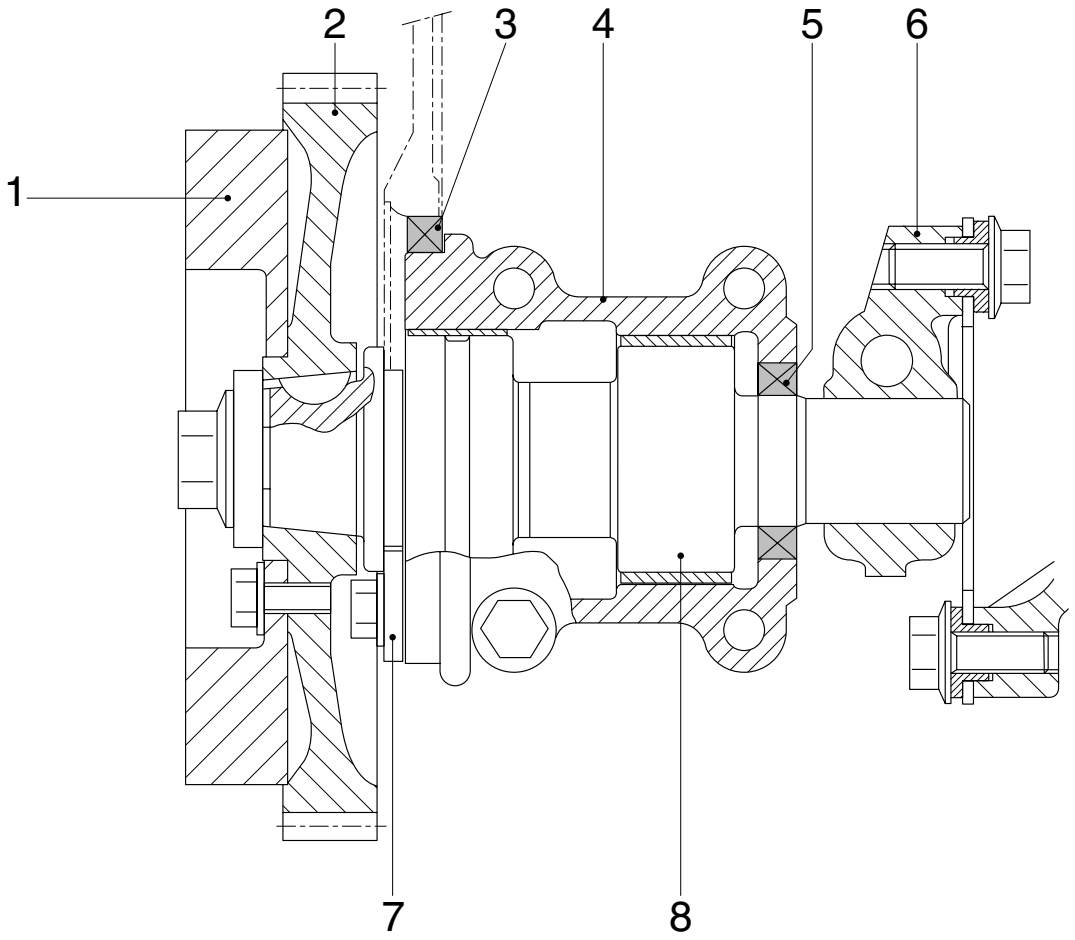
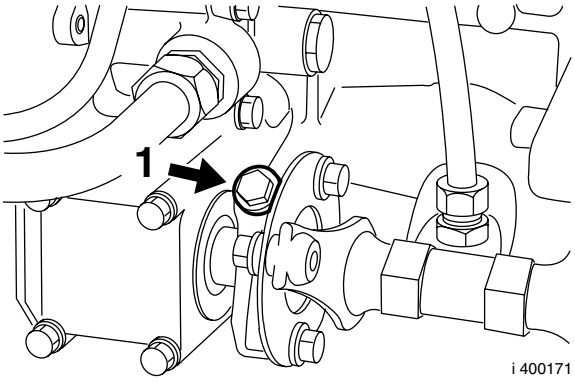
4.26 REMOVAL AND INSTALLATION, FUEL-PUMP DRIVE HOUSING



Removing the fuel pump drive housing

1. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
2. Remove the fuel pump drive gear wheel (2).

3. Remove the clamping bolt (1).



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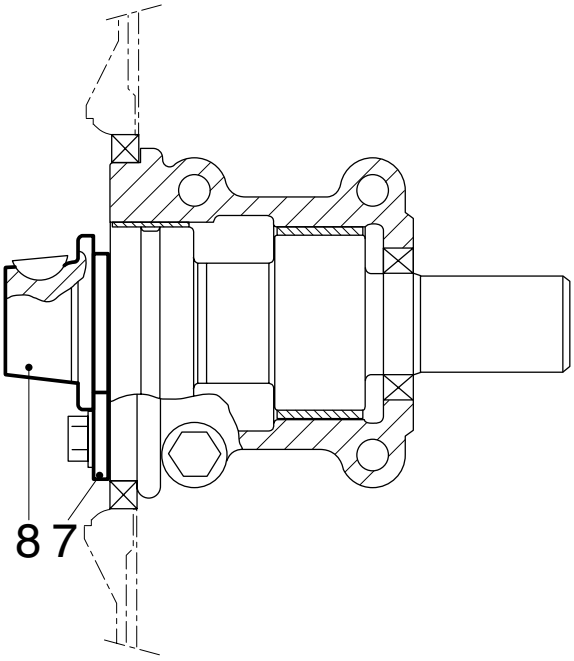
4. Remove the axial retainer plate (7) from the drive shaft.
5. Remove the drive shaft (8) from the drive housing.



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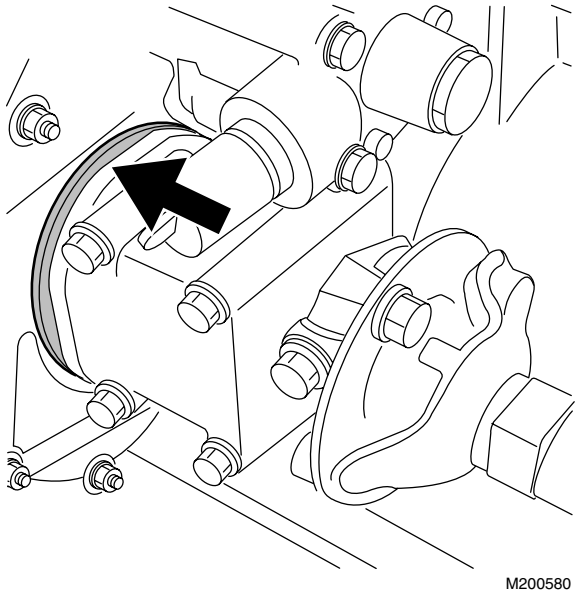
6. Remove the sealing ring by tapping it from the timing-gear case in the driving direction.
7. Remove the fixing bolts of the fuel pump drive housing.
8. Remove the fuel-pump drive housing from the engine block.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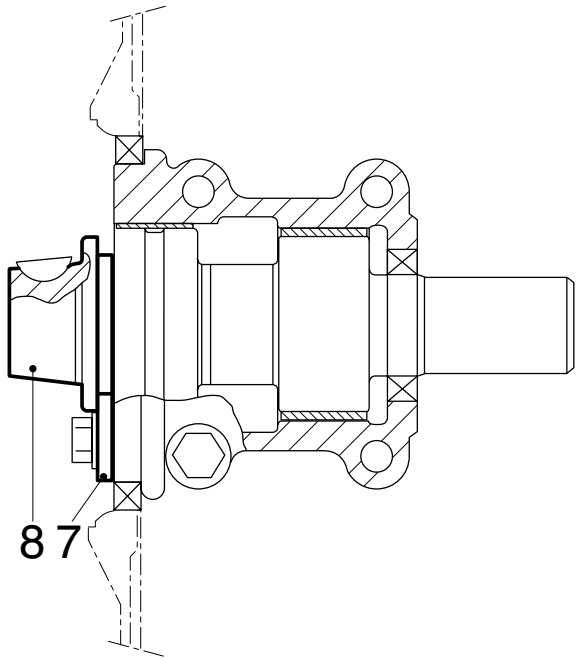
Installing the fuel pump drive housing

1. Install the fuel-pump drive housing with a new O-ring for lubrication. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
2. Install the drive shaft (8) in the fuel-pump drive housing.
3. Install the axial retainer plate (7) and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
4. Install a dry new timing-gear case sealing ring (3) using special tool (DAF no. 1329318).
5. Install the fuel pump drive gear wheel.
6. Set the injection timing.



M200581

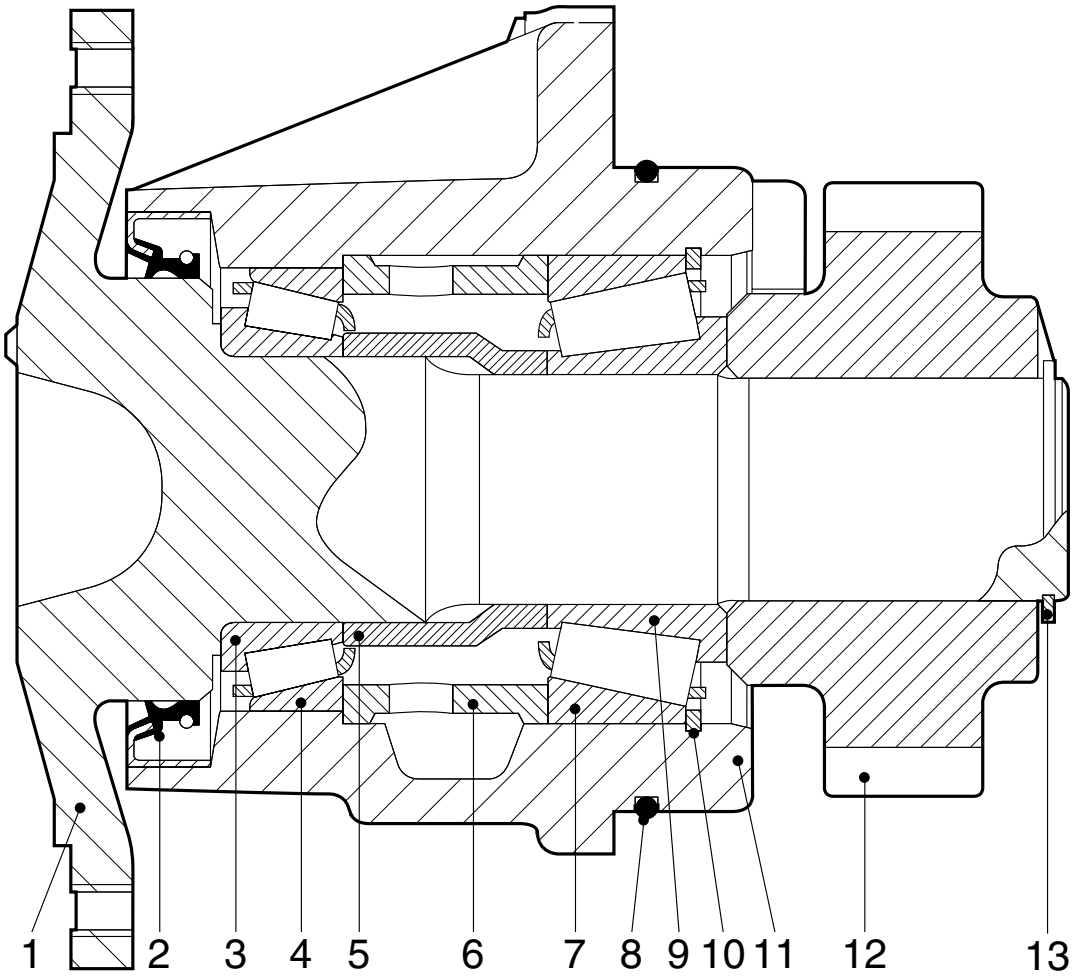
5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY OF THE FAN DRIVE

The fan drive should be disassembled and assembled in a very accurate fashion. Inaccurate assembly of the fan drive may produce strange noises in the engine or severe engine damage.

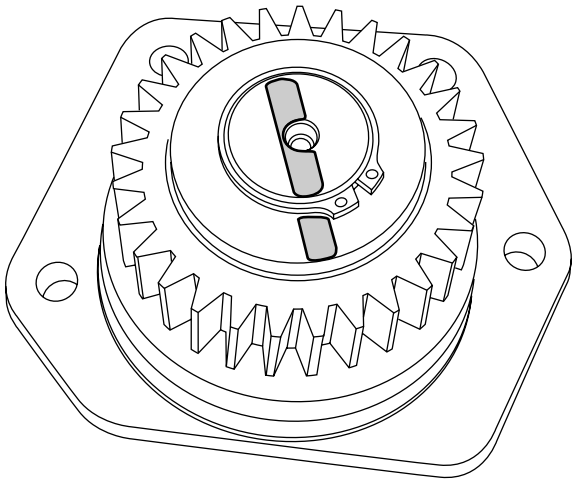
2

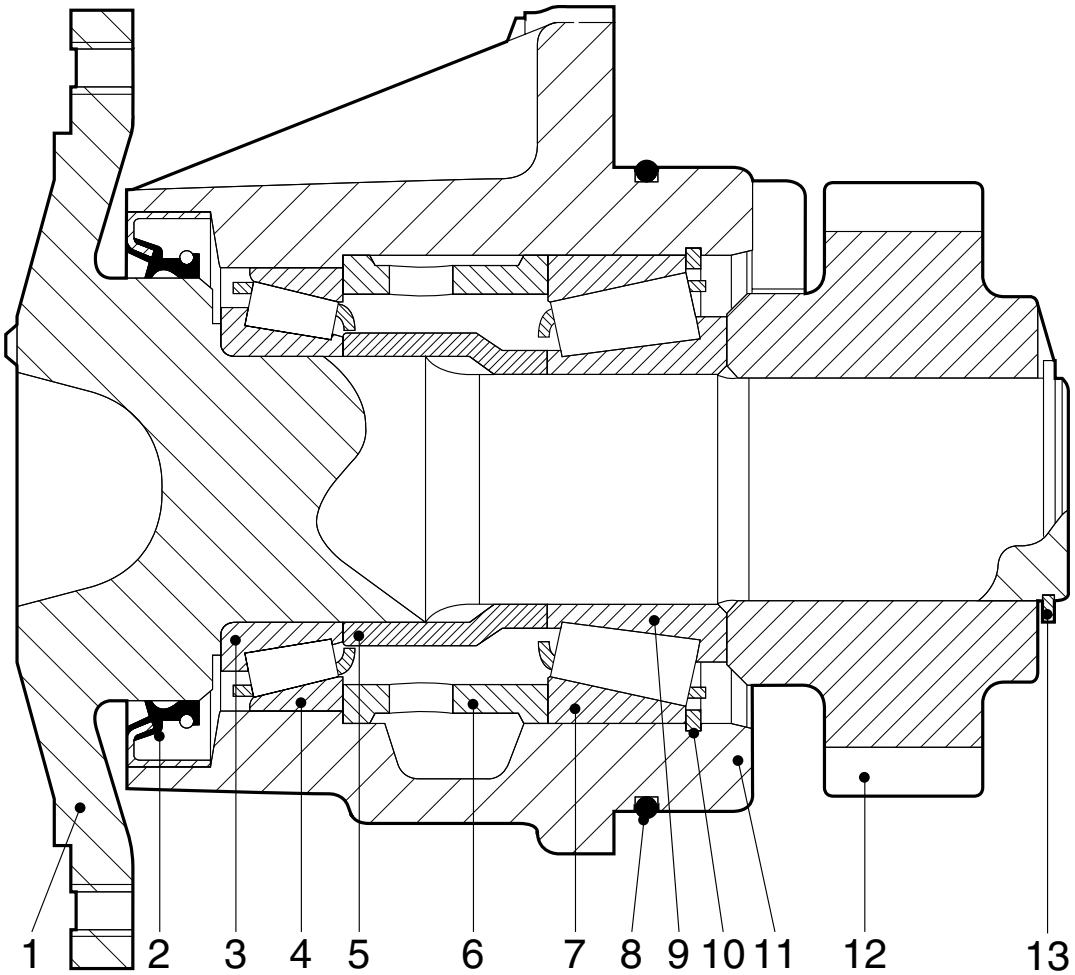
Disassembling the fan drive



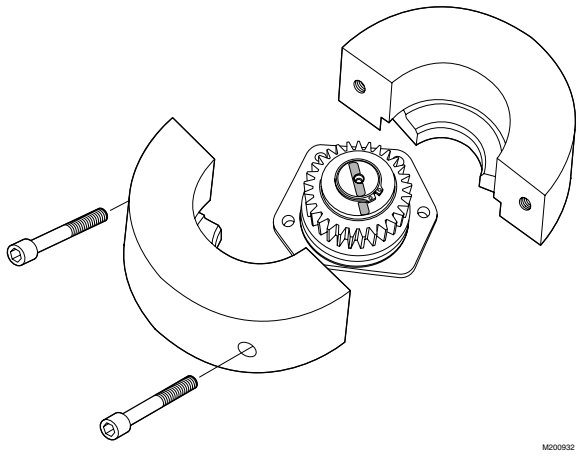
1. Remove the circlip (13) on the gear wheel (12) side.

   Note:
   A mark may have been provided on the rear side of the shaft during initial assembly. This mark is used to check whether the gear wheel (12) has turned relative to the shaft. If so, the shaft and/or the gear wheel (12) is/are rejected.



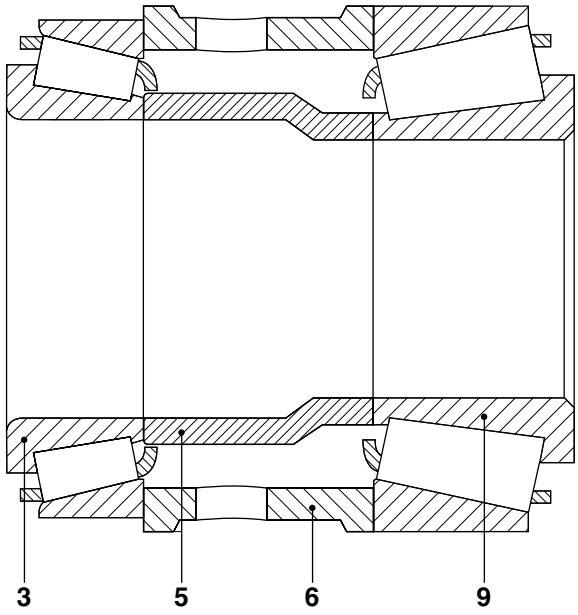


2. Fit the special tool (DAF no. 1329445) under the gear wheel (12) and press the shaft out of the gear wheel (12).
3. Support the bearing housing (11) and press the shaft until the bearing (9) is released from the shaft.
4. Remove the shaft from the bearing housing (11) and remove the spacer sleeve (5).
5. Remove the bearing (3) from the shaft.
6. Remove the oil sealing ring (2) from the bearing housing (11).
7. Remove the circlip (10) from the bearing housing (11).
8. Support the bearing housing (11) and press the bearing rings (4) and (7), with intermediate ring (6), jointly out of the bearing housing (11).



Assembling the fan drive

Note:
The bearings (3) and (9), with spacer sleeve (5) and intermediate ring (6), go together and **must be replaced as a set**. This is necessary to obtain a proper bearing play.
The parts must be free of dirt and grease.



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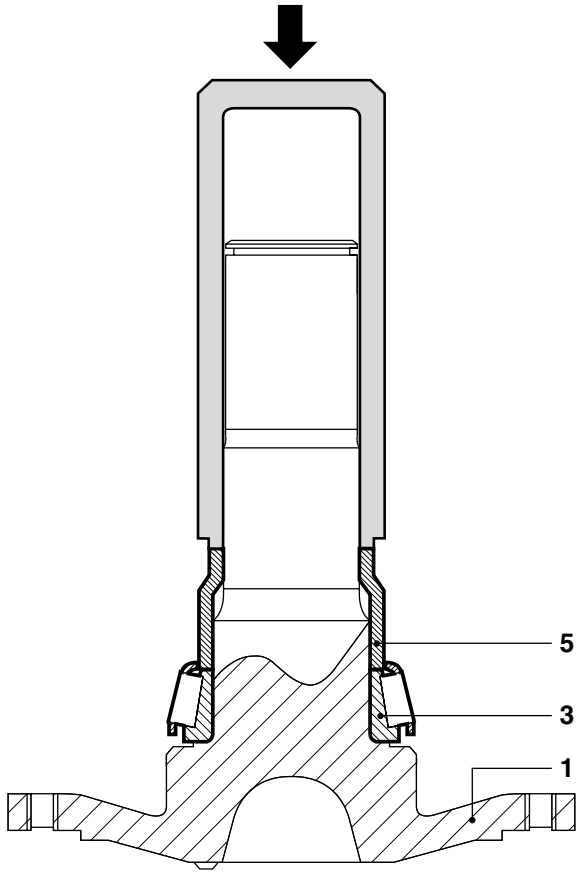
1. Use the special tool (DAF no. 1329386) to press the bearing (3) with the spacer (5) over the shaft (1).



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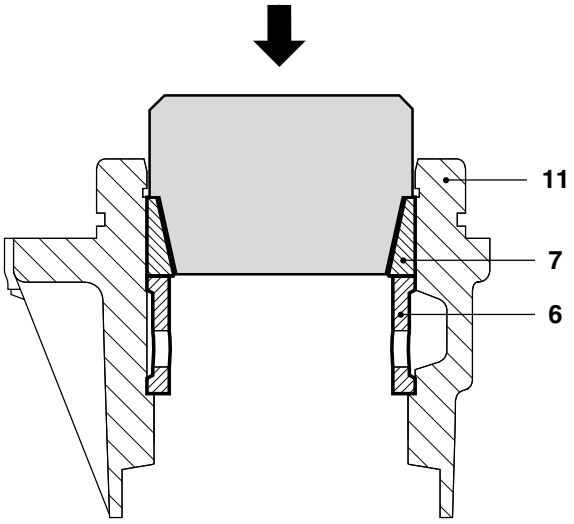
Note:
The holes in the intermediate ring should be on the oil sealing ring side.

2. Install the intermediate ring (6) in the bearing housing (11).
3. Use the special tool (DAF no. 1329383) to press the bearing ring (7) into the bearing housing (11) until it abuts on the intermediate ring (6).



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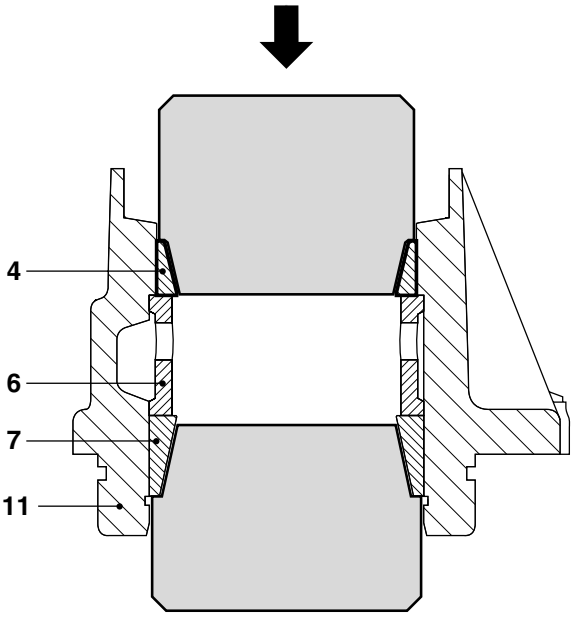
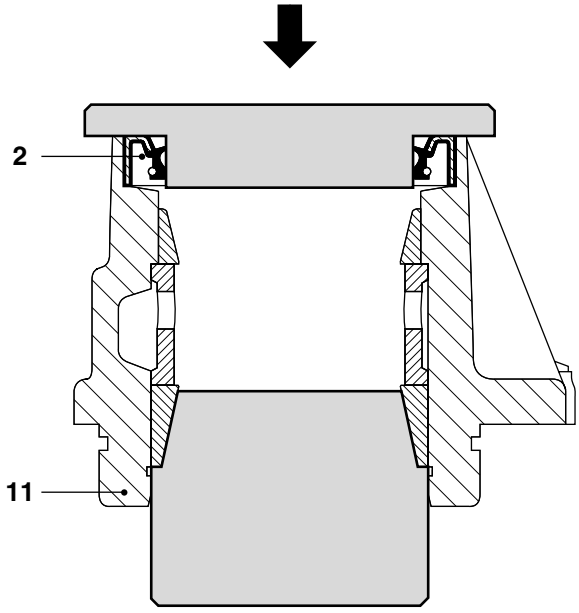
4. Turn the bearing housing (11) and support the bearing ring (7), using the special tool (DAF no. 1329383).
5. Use the special tool (DAF no. 1329384) to press the bearing ring (4) into the bearing housing (11) until it abuts on the intermediate ring (6).



M200682

6. Use the special tool (DAF no. 1329385) to press the oil sealing ring (2) into the bearing housing (11) until it is level with the front of the bearing housing (11).



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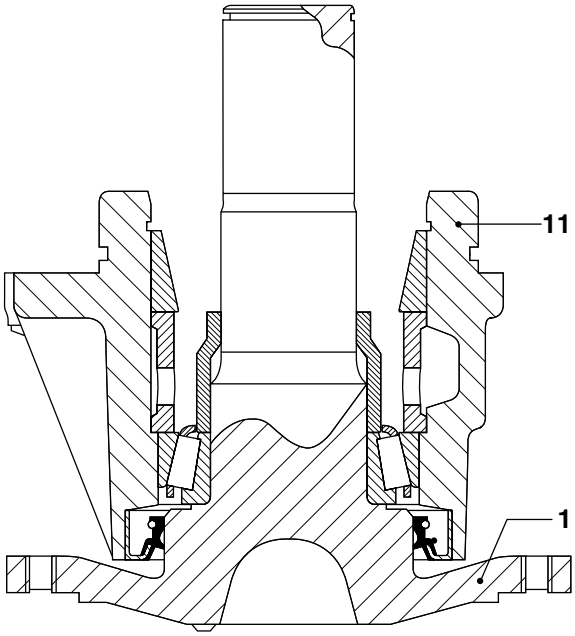
7. Lightly oil the bearing face of the oil sealing ring on the shaft (1) and carefully install the shaft (1) in the bearing housing (11).



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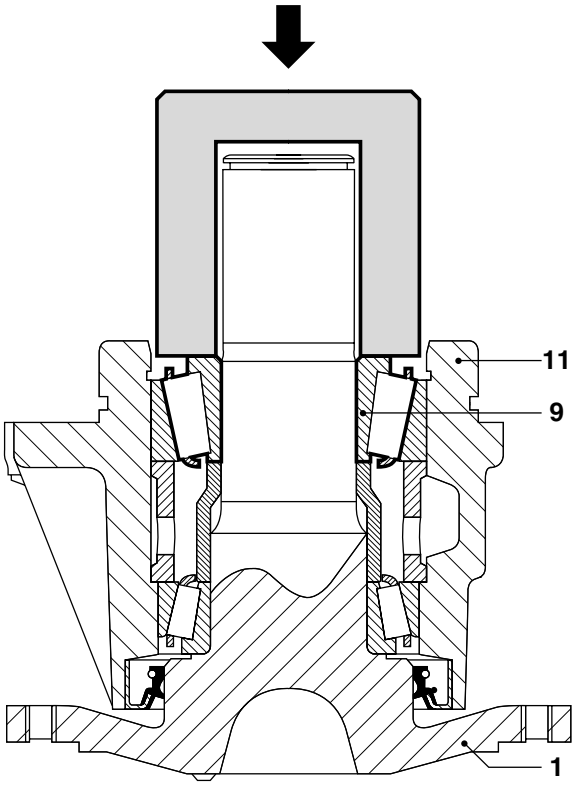
Note:
When forcing on the bearing (9), rotate the bearing housing (11) at least 5 times, allowing the bearings to settle.

8. Using **a low pressing force** and the special tool (DAF no. 1329382) press the bearing (9) onto the shaft (1) until it abuts.



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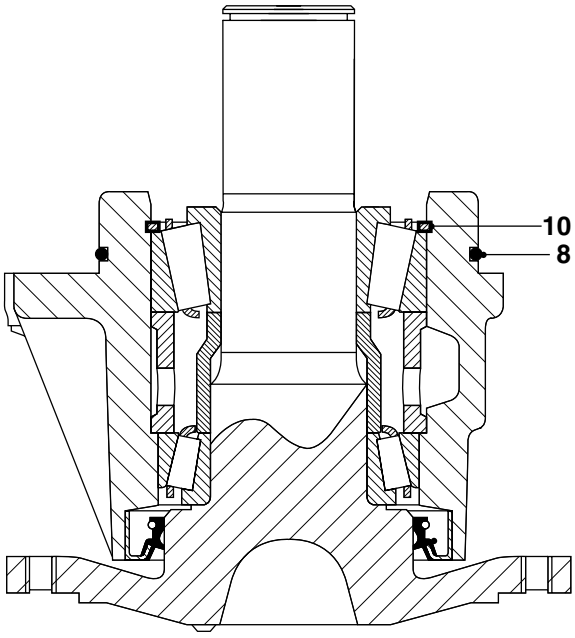
9. Install the circlip (10) in the bearing housing (11). Install a new O-ring (8).



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10. Remove any grease and oil from the shaft (1) and gear wheel (12) local to the contact areas.

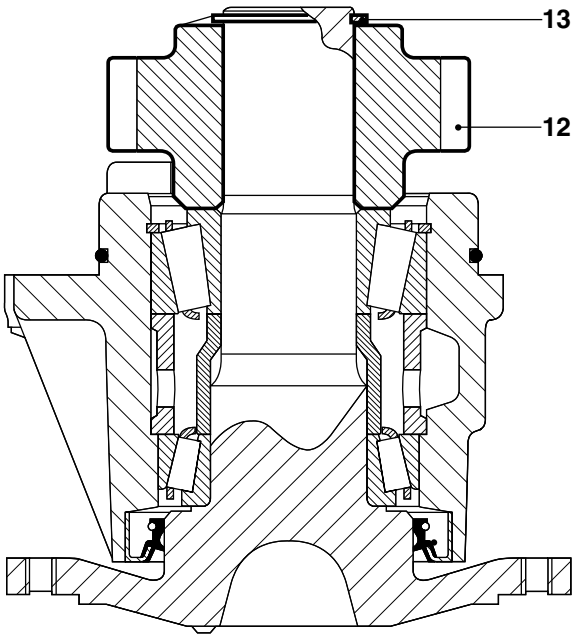
    Note:
    The gear wheel (12) must not under any circumstances be exposed to the specified maximum temperature for more than 30 minutes. This may have a negative impact on the mechanical properties of the gear wheel (12).

11. Heat the gear wheel (12) evenly to the specified temperature in the shortest possible time (on a hot plate using thermal pins), see main group “Technical data”.

12. Install the gear wheel (12) onto the shaft (1). Do **not** use a **press**.

13. Fit the circlip (13).

14. Make a marking across shaft (1) and gear wheel (12). This is necessary to check during inspection or repair whether the gear wheel (12) has turned relative to the shaft (1).



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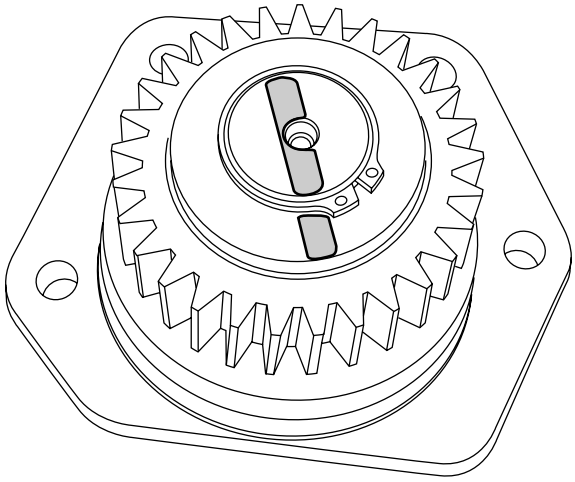
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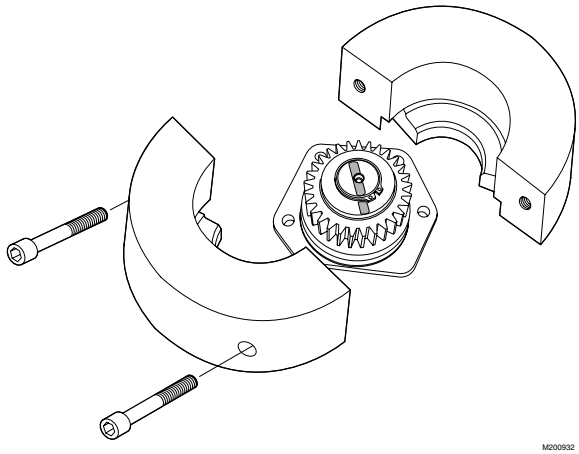
Inspect
Fit the special tool (DAF no. 1329445) under the gear wheel (12) and press the shaft with a force of 100 kN. If the shaft is pressed from the gear wheel, the shaft and/or the gear wheel is/are rejected.

15. Apply a little engine oil in the bearing housing (11) and check the shaft (1) for even rotation.



6. CLEANING

6.1 CLEANING THE ENGINE

Note:
It is advisable to clean the engine with a high-pressure cleaner before starting maintenance or service operations. A clean engine makes your work easier, and enables you to notice any defects at an early stage.

Before cleaning the engine, check for any leaks.

If the engine is cleaned with a high-pressure cleaner, the latter must be used with care. It is also important to observe the following points:

- When cleaning the universal joint on the steering box, the spider seals may be forced open by the high-pressure jet of water, so that the grease behind them is flushed away. As a result, the spider may get stuck, so that the steering mechanism will jam.
- A bleed screw is fitted to the power steering fluid reservoir of the steering system. Water may enter the tank through this valve, causing damage to the steering mechanism.
- Make sure that when cleaning the radiator/intercooler element the zigzag-tube core is not damaged.
- Do not direct the high-pressure cleaner jet too long at the condenser of the air-conditioning system. As a result of the high temperature, the pressure in the system will become excessive, causing damage to the system.

- Ensure that no water can enter the gearbox via the breathers.
- Make sure that no water can enter via the reservoir bleed screws of the clutch.
- The engine compartment can be cleaned with a high-pressure cleaner. Never direct the jet of water to electrical components.
- Do not aim the jet of water directly at electrical connections such as connectors, cable plugs of the vehicle lighting system, etc.
- Ensure that no water can enter the air inlet system via the air intake or its flexible seals.

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3

1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel fuel.
So avoid inhaling and direct contact.

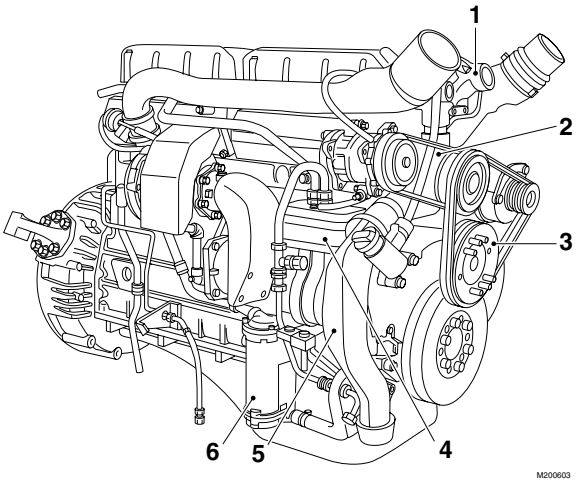
Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

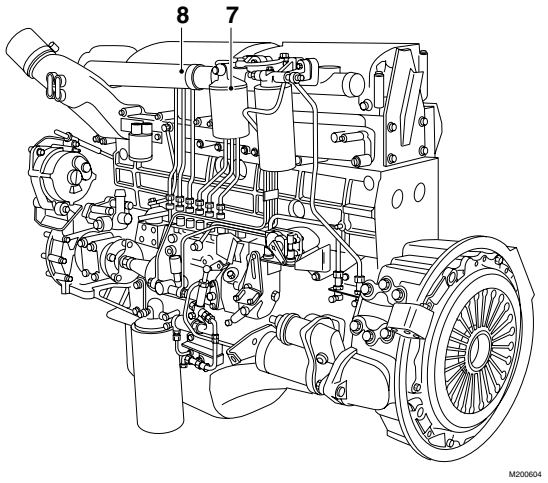
It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

3

2. GENERAL

2.1 LOCATION OF COMPONENTS





1. Thermostat housing
2. Water pump
3. Fan drive
4. Water-cooled air compressor
5. Water pipe
6. Oil cooler
7. Coolant filter
8. Coolant pipe

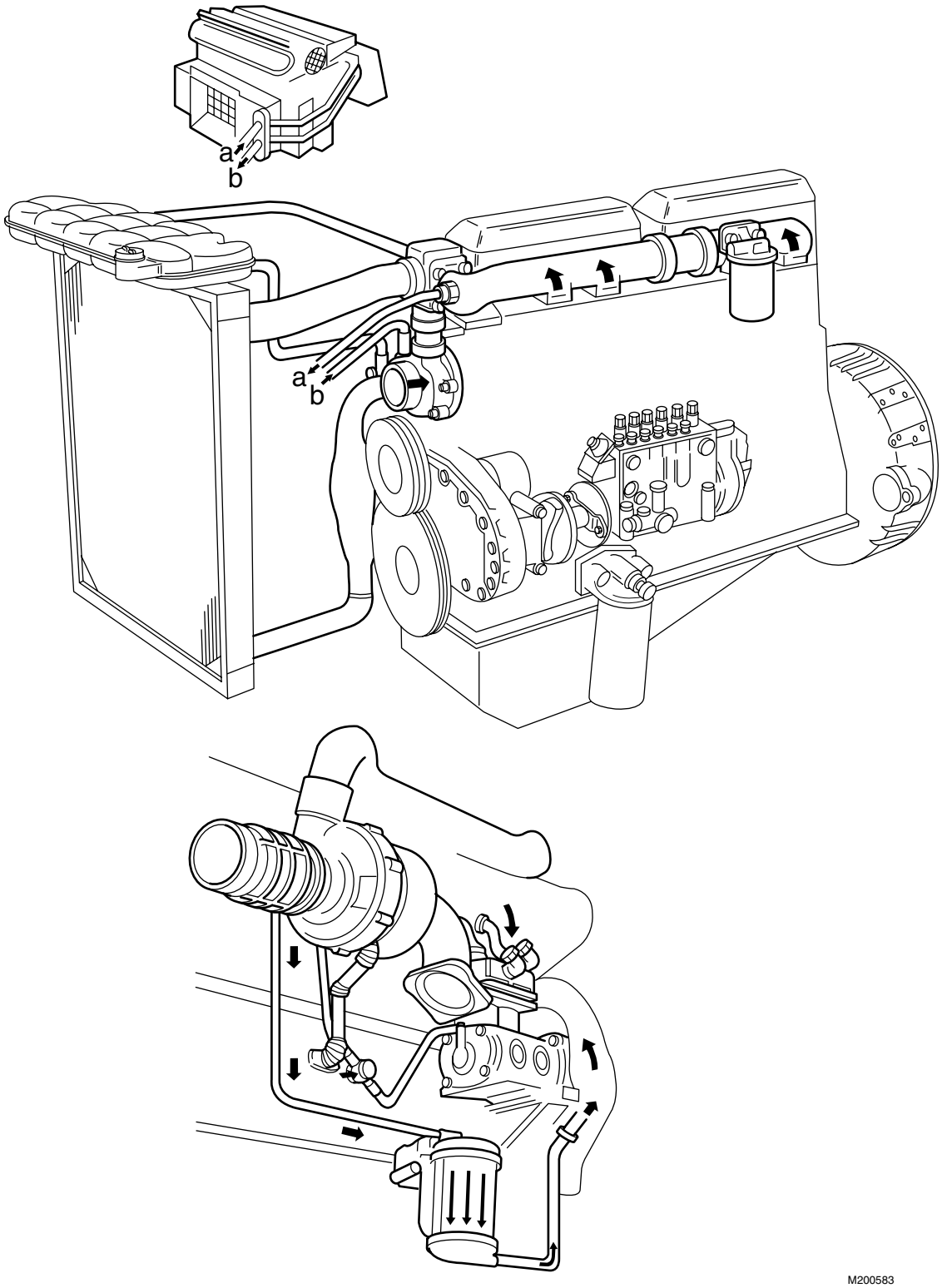
2.2 DESCRIPTION OF THE COOLING SYSTEM

The cooling system consists of a water pump, a radiator, a header tank, an oil cooler, an air compressor, a thermostat housing with one thermostat, a coolant filter and pipes.

At the highest point in the cooling system, a bleed pipe has been installed.
Through this pipe, any air in the cooling system is discharged to the header tank, rendering the cooling system auto-bleeding.

The water pump is located immediately below the thermostat housing. The thermostat housing is mounted on the coolant collection pipe.
From the delivery side of the water pump, the coolant is directed to the cylinder block via an opening at the back of the water pump.
The coolant flows through the cylinder block, along the cylinder linings, and up towards the cylinder heads.
The coolant leaves cylinder heads through the coolant collector pipe to the thermostat housing.

Depending on the coolant temperature, the thermostat distributes the coolant flow to the radiator or directly back to the coolant pump.
The coolant transported to the radiator enters the radiator at the top, and leaves the radiator at the bottom.
From the bottom of the radiator, the coolant is returned to the water pump, via the return pipe.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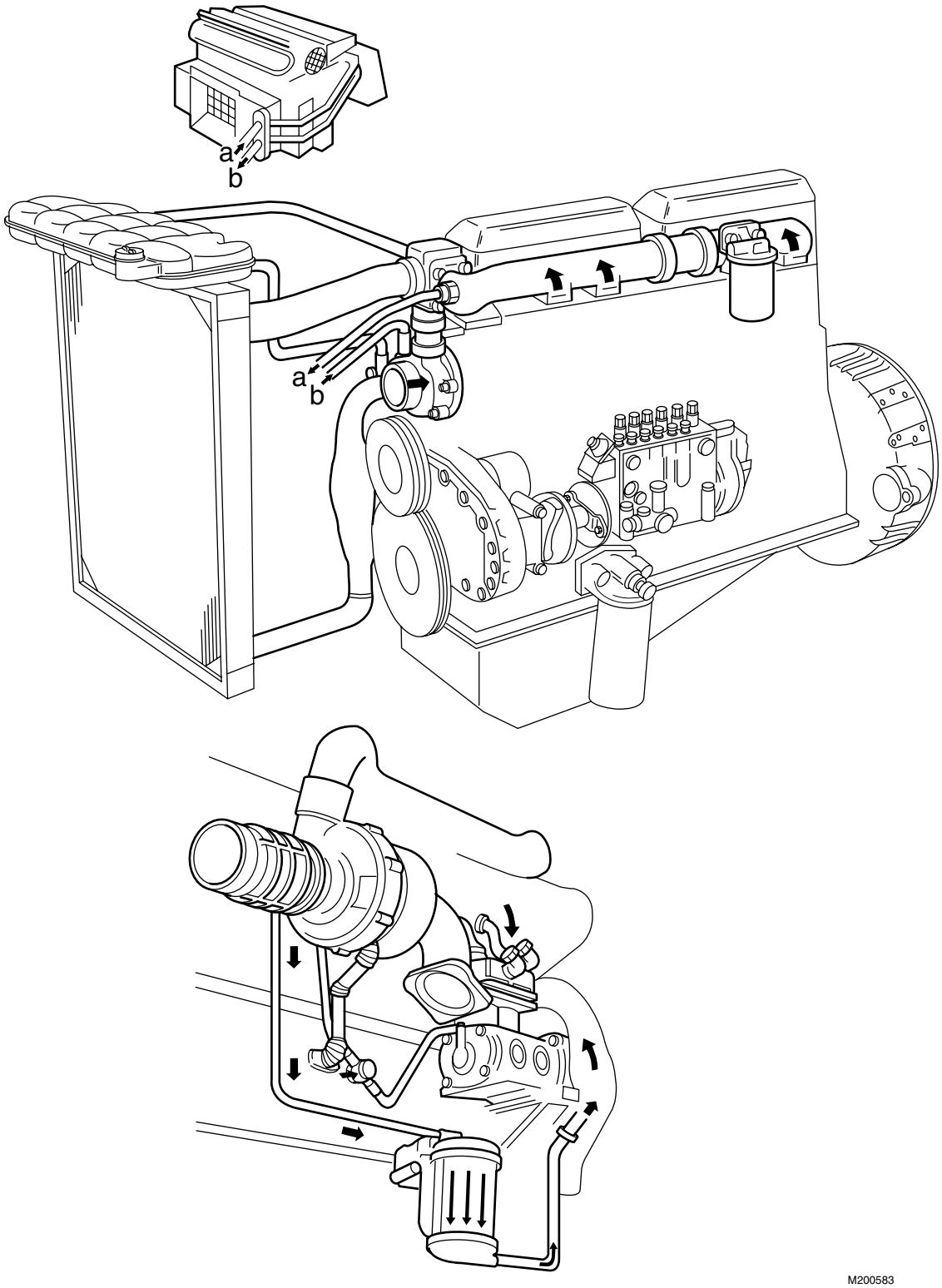
The connection pipe to the header tank is also connected to the return pipe from the radiator. If the coolant heats up, the coolant flows to the header tank. If the coolant cools down, the coolant flows back from the header tank.

From the engine block, some of the coolant flows through the oil cooler. From the oil cooler, the coolant is returned to the water pump through a pipe, via the coolant return pipe. The oil cooler is not only intended to cool the lubricating oil, but also to heat the lubricating oil in a “cold” engine.

3

From the cylinder block, some of the coolant flows through the air compressor.
From the air compressor, the coolant is returned via a pipe to the water pump.

The pipe which takes the coolant to the heater for the cab heating is connected to the top of the thermostat housing. From the heater, the coolant is returned via a pipe to the water pump.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3

3. DESCRIPTION OF COMPONENTS

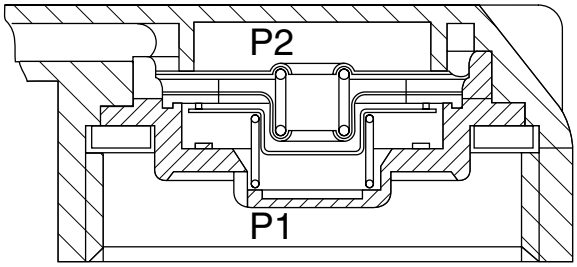
3.1 DESCRIPTION OF COOLING SYSTEM PRESSURE CAP

The pressure cap on the header tank is attached to the header tank via a screw thread. To fill the cooling system, remove this pressure cap or the filler cap at the front of the header tank.

The pressure cap has two valves. Normally, both valves are closed.

Overpressure in the cooling system
If the pressure (P1) in the cooling system rises to 0.7 bar, however, the overpressure valve opens.
The overpressure in the cooling system makes it possible to allow a higher temperature in the cooling system, without the coolant boiling.

Underpressure in the cooling system
If the pressure (P1) in the cooling system drops to approximately 0.1 bar below the outside air pressure (P2), the underpressure valve opens.



M200445

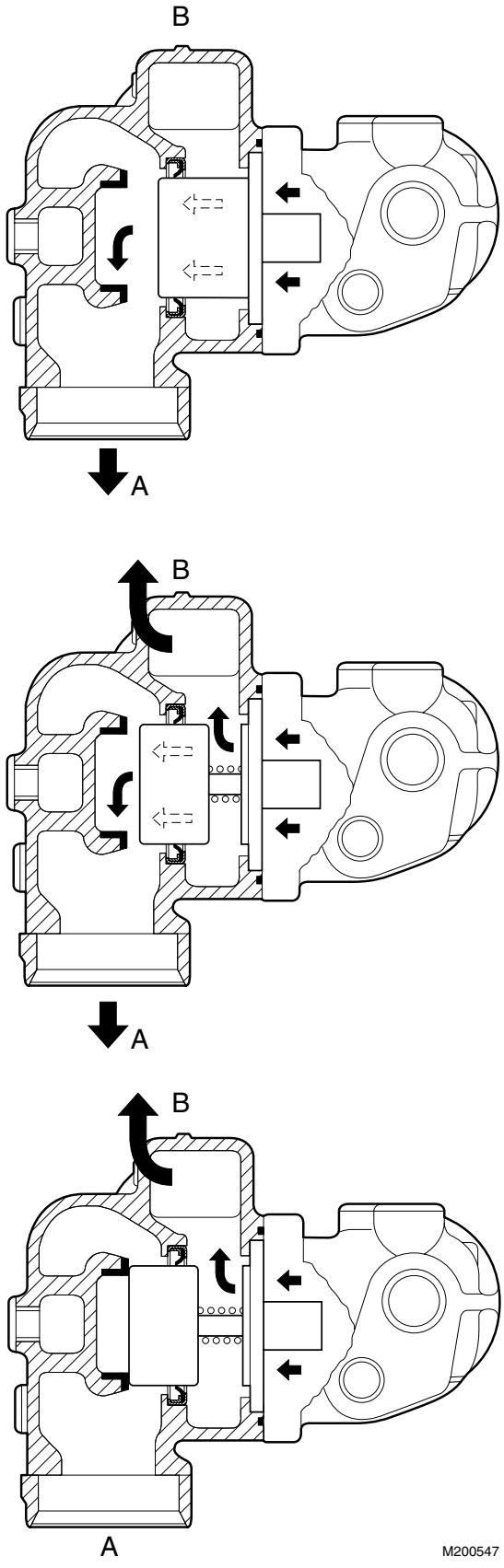
3.2 DESCRIPTION OF THE THERMOSTAT

Operation of the thermostat
The coolant enters the thermostat housing directly from the coolant collector pipe at the back and flows through the thermostat. Depending on the temperature of the coolant and the related position of the thermostat, there are 3 possibilities:

Thermostat closed
The coolant has not yet reached the opening temperature of the thermostat.
Supply channel (B) to the radiator is completely closed.
The coolant passes via a by-pass channel (A) directly to the water pump and the pump once again passes the coolant to the cylinder block.

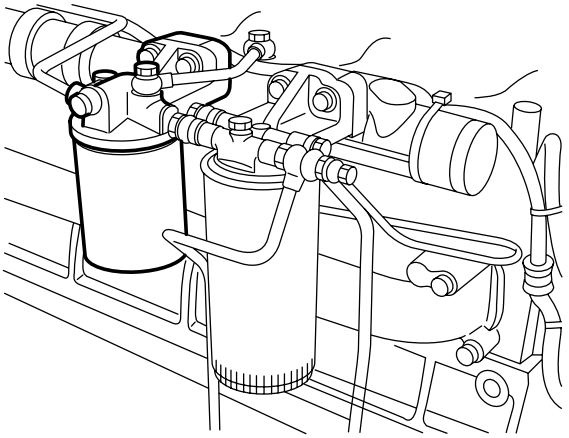
Thermostat starts opening
The coolant has reached the opening temperature of the thermostat.
The supply channel (B) to the radiator is opened and the by-pass channel (A) is partially closed.
At this time, coolant will flow both through the supply channel (B) to the radiator and through the by-pass channel (A) to the water pump.

Thermostat fully opened
The temperature of the coolant has become even higher, the supply channel (B) to the radiator is fully opened and the by-pass channel (A) is fully closed.
The entire coolant circulation now flows via the supply channel (B) to the radiator where it is cooled before flowing back to the water pump.
In the event of excessive coolant temperatures, it is **not permitted** to remove the thermostat as an emergency solution.
If the thermostat is removed from the engine, uncooled coolant will flow to the water pump via the by-pass channel (A). As a consequence, the coolant temperature will continue to rise.



3.3 DESCRIPTION OF COOLANT FILTER

The task of the coolant filter is to filter the coolant to prevent cavitation. The coolant filter also adds additives to the coolant.



M200546

3

4. INSPECTION AND ADJUSTMENT

4.1 PRESSURE-TESTING THE COOLING SYSTEM

When the coolant is hot, there is an overpressure in the cooling system. Carefully remove the filler cap to release the overpressure.

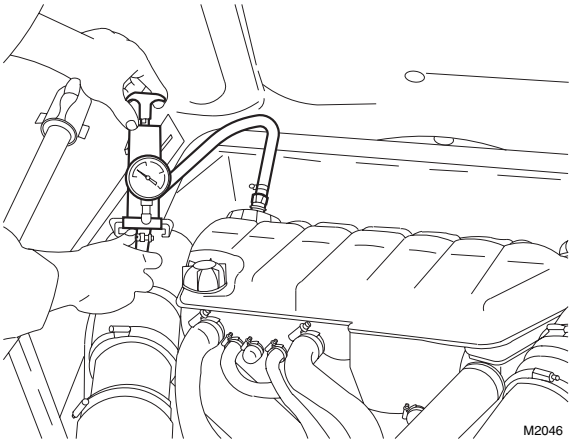
Coolant is a noxious fluid. Avoid skin contact to prevent poisoning.

In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

The cooling system can be checked for leaks by means of a pressure-test pump. When this is done with a warm engine, it is easier to spot any cracks.

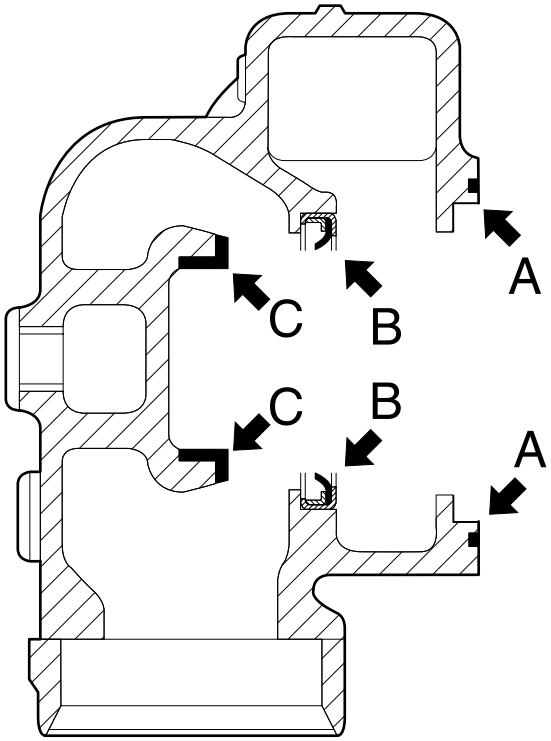
1. Fill the cooling system to the specified level.
2. Raise the engine temperature. This need not be the operating temperature.
3. Remove the filler cap from the header tank.
4. Install the pressure-test pump.
5. **Note:**
   By installing the pressure-test pump on the filler opening of the header tank, you also test the pressure cap.

   Test the system at the specified pressure, see main group “Technical data”.
6. Check the cooling system for any leaks.



4.2 INSPECTION, THERMOSTAT

1. Remove the thermostat, see chapter “Removal and installation”.
2. Inspect the sealing surfaces (A) of the thermostat housing for damage.
3. Inspect the lubricating ring (B) for damage.
4. Inspect the thermostat seat (C) for damage.
5. Inspect whether the thermostat is fully closed.



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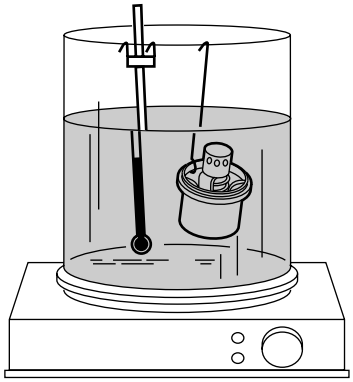
6. Place the thermostat in a container filled with clean water.
7. Place a thermometer in the container, and heat the water. Check at which temperature the thermostat opens and whether the thermostat opens fully, see main group “Technical data”.


M200513

4.3 CHECKING THE VISCOUS FAN CLUTCH

Do not run the engine in an enclosed or unventilated area.

Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

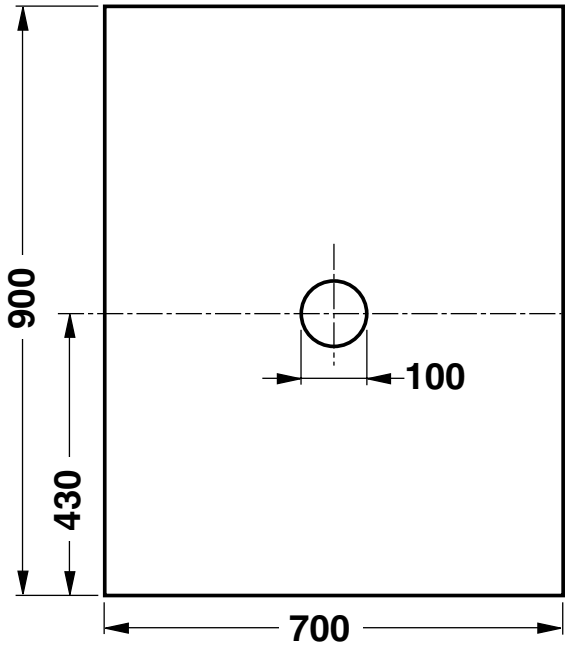
Testing with a cold engine
During this test, the slip in the viscous fan clutch is measured, when the clutch is not operational. This test must be carried out with a “cold” engine (coolant temperature approximately 50°C).

1. Check the coolant level, and as necessary top up with coolant.
2. Start the engine and run it at idling speed for at least 5 minutes.
3. Then use a digital revolution counter to measure the fan speed at a number of engine speeds (from idling to maximum engine speed).
   During this test procedure, the speed of the fan should be approx. 600 to 1100 rpm.

Testing with a warm engine
This test checks whether the contact operates at an operating temperature of 85 - 95°C.

1. Check the coolant level, and as necessary top up with coolant. Be careful when topping up the coolant, if the engine is warm.
2. Remove the front engine encapsulation.

3. Take a sheet of cardboard, perforated with a 100 mm hole, as shown in the diagram opposite, and place it in front of the radiator, so that the hole is in front of the viscous clutch.
4. Check that the gearbox is in neutral position.
5. Bring the cooling system to operating temperature.
6. Have the fan drive flange run at a speed of 1000 rpm.
   Then use an optical revolution counter to determine the difference in speed of the fan in relation to the drive flange. The speeds will differ if there is any slip in the viscous coupling. With the clutch fully engaged, slip should not exceed 10%. If it is more than 10%, the viscous fan clutch must be replaced.



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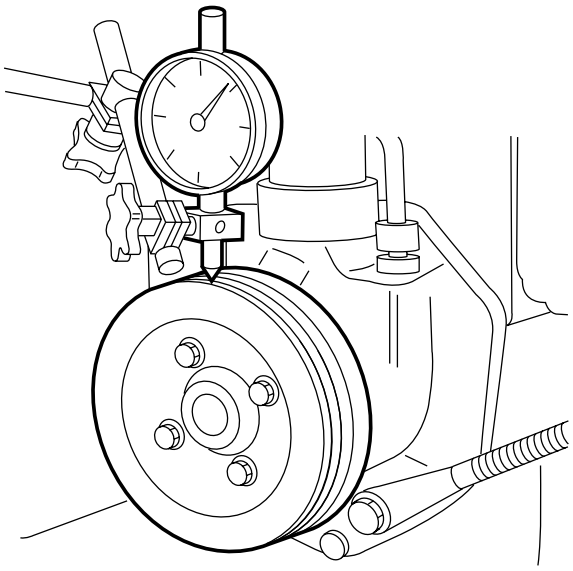
4.4 CHECKING RADIAL PLAY OF WATER PUMP

1. Remove the V-belts from the water pump pulley.
2. Connect a dial gauge as shown in the drawing.
3. Force the water pump pulley downwards, and set the dial gauge to zero.
4. Pull the water pump pulley upwards, and read off the dial gauge.
5. Compare the pressure reading with the technical data, see main group “Technical data”. If the level shown is greater than that in the technical data, the water pump must be replaced.

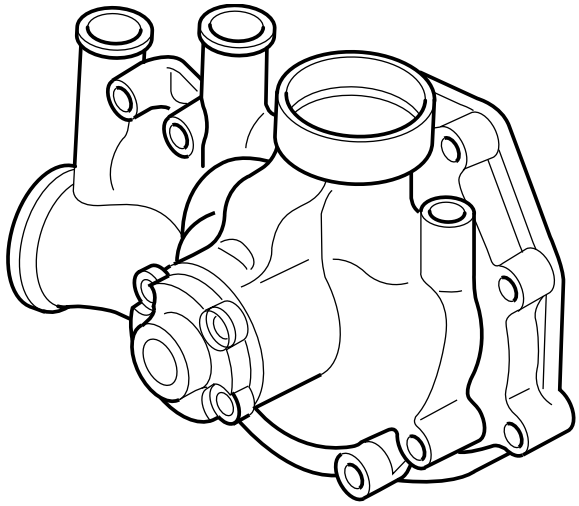

M200595

5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, WATER PUMP

Removal, water pump

1. Remove the front engine encapsulation.
2. Drain the coolant, see chapter “Draining and filling”.
3. Remove the reaction rod between the engine and the radiator.
4. Remove the bolts from the guide ring brackets, and remove the guide ring.
5. Remove the fixing nuts of the viscous fan clutch on the fan pulley and place the viscous fan clutch and the fan as far forward as possible in the wind tunnel.
6. Remove the water pump, alternator and air-conditioning compressor V-belts.
7. Remove the fixing bolts from the thermostat housing on the water pipe and remove the thermostat housing with the connection piece.
8. Remove all water pipes connected to the water pump.
9. Remove the pipe from the water pump to the coolant filter.
10. Remove the fixing bolts holding the spindles of the alternator and air-conditioning compressor.
11. Remove the fixing bolts from the water pump.
12. Remove the water pump.



M200596

Installation, water pump

1. Thoroughly clean and check the sealing surfaces of the water pump, the thermostat housing, and the engine block.
2. Fit the water pump with a new gasket. Fit the fixing bolts. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the connection piece with new O-rings onto the water pump.
4. Fit the thermostat housing with new O-rings onto the coolant pipe.
5. Install the pipe from the water pump to the coolant filter.
6. Fit all water pipes connected to the water pump.
7. Install the alternator and air-conditioning compressor V-belts.
8. Install the viscous fan clutch and the fan.
9. Install the guide ring brackets and the guide ring.
10. Install the reaction rod between the engine and the radiator.
11. Fill the cooling system, see chapter “Draining and filling”.
12. Install the front engine encapsulation.

5.2 REMOVAL AND INSTALLATION, COOLANT FILTER

When the coolant is hot, there is an overpressure in the cooling system. Carefully remove the filler cap to release the overpressure.

Coolant is a noxious fluid. Avoid skin contact to prevent poisoning.

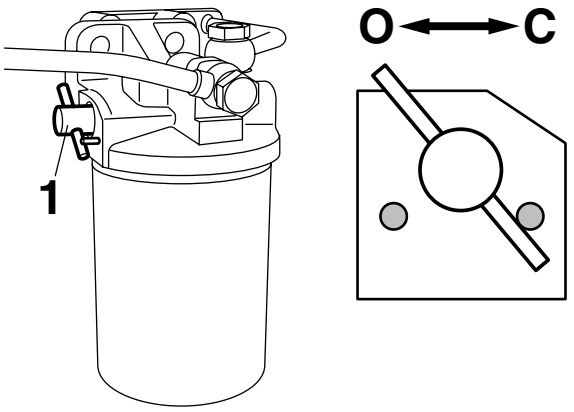
In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

Removal of the coolant filter

1. Place a tray beneath the filter to capture any escaping coolant.
2. Remove the filler cap from the header tank.
3. Switch the shut-off valve (1) clockwise to the “C” position.
4. Remove the coolant filter by turning it counter-clockwise.

Installation of the coolant filter

1. Clean the sealing face of the coolant filter.
2. Apply a small amount of coolant to the sealing ring of the coolant filter element.
3. Fit the coolant filter until the sealing ring abuts. Then tighten the filter by hand $^{1}/_{2}$ to $^{3}/_{4}$ of a turn.
4. Switch shut-off valve (1) counter-clockwise to the “O” position.
5. Put the filler cap back on the header tank.
6. Run the engine and check that the coolant filter has sealed correctly.
7. Then check the coolant fluid level.



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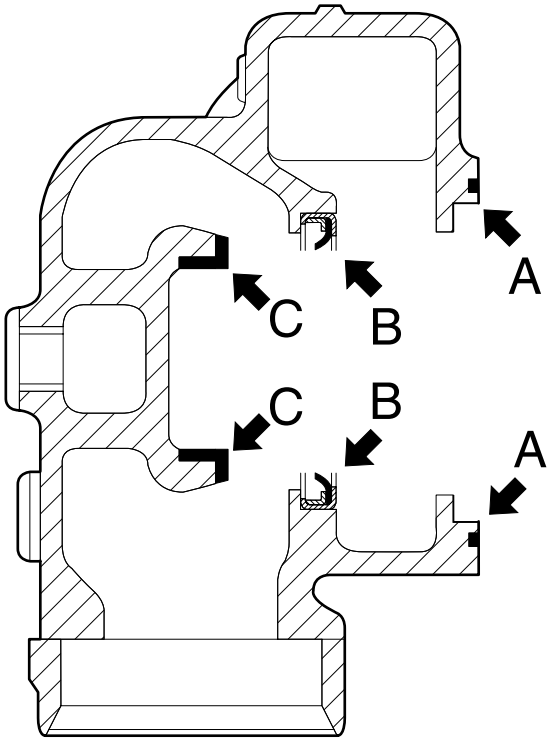
5.3 REMOVAL AND INSTALLATION, THERMOSTAT

Removal, thermostat
1. Drain the coolant, see chapter “Draining and filling”.
2. Remove the water pipe between the thermostat housing and the radiator.
3. Remove the fixing bolts from the thermostat housing.
4. Remove the thermostat housing and the connection piece from the water pump.
5. Remove the O-ring (A) from the thermostat housing.
6. Remove the thermostat.

Removal, thermostat sealing ring
1. Remove the sealing ring (B) in the thermostat housing using a commercially available internal puller.

Removal, thermostat seat
1. Remove the thermostat seat (C) at the bottom of the thermostat housing using a commercially available internal puller.

Installation, thermostat seat
1. Install the thermostat seat (C), provided with a locking compound, into the thermostat housing, see main group “Technical data”, using the special tool (DAF no. 1310456).



M200594

Installation, thermostat sealing ring

1. Install the thermostat sealing ring (B) in the thermostat housing, using the special tool (DAF no. 1310456).

Installation, thermostat

1. Fit the thermostat in the thermostat housing.
2. Fit the O-ring (A) in the thermostat housing.
3. Fit new O-rings to the connection piece from the thermostat housing to the water pump and subsequently fit the connection piece in the thermostat housing.
4. Fit the thermostat housing onto the coolant pipe.
5. Fit the fixing bolts of the thermostat housing. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
6. Fit the water pipe between the thermostat housing and the radiator.
7. Fill the cooling system, see chapter “Draining and filling”.

5.4 REMOVAL AND INSTALLATION, VISCOUS FAN CLUTCH

Removing the viscous fan clutch

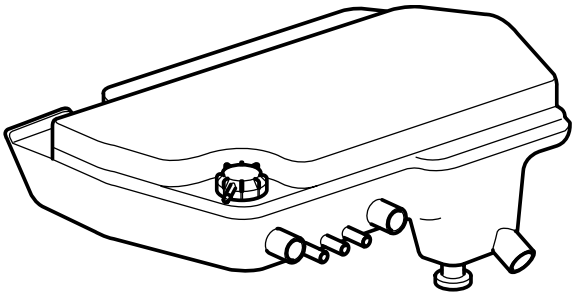
1. Remove the front engine encapsulation.
2. Remove the water pump and alternator V-belts.
3. Remove the air inlet pipe between the intercooler and the inlet manifold on the alternator side.
4. Remove the fixing bolts from the guide ring brackets, and remove the guide ring.
5. Remove the fixing nuts from the viscous fan clutch on the drive flange. Temporarily place the viscous fan clutch and the fan in the wind tunnel.

   Note:
   The viscous fan clutch must **always** be stored **vertically**.
6. Remove the fixing nuts of the fan and remove the viscous fan clutch.

Installing the viscous fan clutch

1. Place the new viscous fan clutch in the fan. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
2. Install the guide ring and the fixing bolts of the guide ring brackets.
3. Install the viscous fan clutch and the fan on the drive flange. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
4. Install the air inlet hose. Tighten the fixing bolt to the specified torque, see main group “Technical data”.
5. Install the water pump and alternator V-belts.
6. Install the front engine encapsulation.

5.5 REMOVAL AND INSTALLATION, HEADER TANK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Removing the header tank
1. Remove the front engine encapsulation.
2. Drain the coolant until the header tank is empty, see chapter “Draining and filling”.
3. Remove all water hoses between the header tank and the engine.
4. Slacken the circlips at the front of the header tank.
5. Lift the front of the header tank a little.
6. Slacken the circlips at the back of the header tank.
7. Remove the header tank.

Installing the header tank
1. Install the header tank, pushing it into the circlips at the back first.
2. Install all water hoses between the header tank and the engine.
3. Install the front engine encapsulation.
4. Fill the cooling system, see chapter “Draining and filling”.
5. Run the engine and check that all connections are sealed properly.

5.6 REMOVAL AND INSTALLATION, RADIATOR

Note:
The removal and installation procedure of the radiator allows for the presence of an air-conditioning unit.
If such a unit is not present, the sections concerned can be skipped.

Removing the radiator

1. Disconnect the earth lead from the battery pole.
2. Drain the coolant, see chapter “Draining and filling”.
3. Remove the front engine encapsulation.
4. Remove the engine encapsulation under the cab.
5. Remove the bolts from the guide ring brackets, and remove the guide ring.
6. Remove the guide strip at the front of the intercooler.
7. Remove the oil dip stick holder of the intercooler and put it aside.
8. Remove the header tank.
9. Remove the water hoses to the radiator.
10. Remove the fixing bolts from the air-conditioning condenser and pull the condenser forwards.
11. Disconnect the other air-conditioning pipes from the intercooler.
12. Remove the wire mesh underneath the intercooler.
13. Remove the air-conditioning dryer underneath the intercooler.
14. Remove the left-hand connector pipe from the inlet manifold to the intercooler.

15. Remove the right-hand connector pipe from the inlet pipe to the intercooler.
16. Remove the air-conditioning compressor unit and move it, together with the hoses, to the front of the intercooler.
17. Remove the fixing bolts from the intercooler.
18. Move the intercooler a little to the right to remove the fixing bolt of the oil filler pipe.
19. Remove the oil filler pipe.
20. Remove the reaction rod from the radiator to the engine lifting eye.
21. Remove the fixing nuts from the radiator brackets. Remove the entire radiator, intercooler, and wind tunnel from the chassis.
22. Remove the intercooler from the radiator.

Installing the radiator

1. Install the entire radiator, intercooler, and wind tunnel in the chassis. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
2. Slide the oil filler pipe onto the radiator and install the fixing bolt.
3. Place the intercooler in its position and hand-tighten with two fixing bolts.
4. Install the reaction rod from the radiator to the engine lifting eye.
5. Install the air-conditioning compressor and its pipes over the radiator.
6. Install the air-conditioning compressor unit on the engine bracket.

7. Install the guide ring brackets and the guide ring.
8. Install the air-conditioning dryer underneath the intercooler.
9. Install the wire mesh underneath the intercooler.
10. Install the air-conditioning condenser.
11. Install the guide strip at the front of the intercooler. Tighten the fixing bolts of the intercooler.
12. Insert the oil dip stick holder.
13. Install the air inlet hoses between manifolds and intercooler.
14. Install the expansion reservoir.
15. Install the engine encapsulation under the cab.
16. Install the front engine encapsulation.
17. Fit the earth lead to the battery pole.
18. Fill the cooling system, see chapter “Draining and filling”.
19. Run the engine and check that all connections are sealed properly.

6. DRAINING AND FILLING

6.1 DRAINING AND FILLING/BLEEDING, COOLING SYSTEM

In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

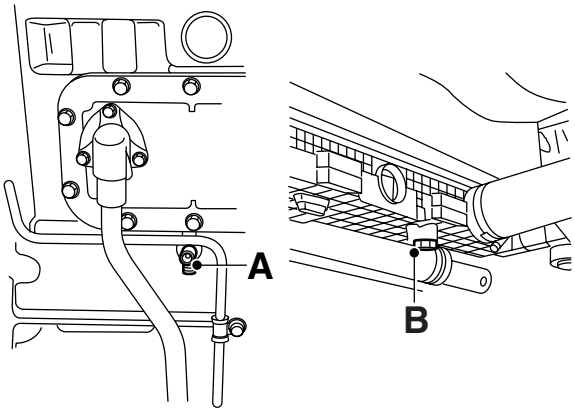
Coolant is a toxic substance and must be handled with care. Protect the skin and eyes.

Coolant is harmful to the environment; after use, it should be processed as industrial chemical waste.

When the coolant is hot, there is an overpressure in the cooling system. When removing the filler cap, allow the overpressure to escape, by first loosening the filler cap, one turn.

Draining the cooling system

1. Turn the heater control knob to the "warmest" temperature setting. As a result, the heater cock will be fully opened.
2. Remove the cooling system filler cap.
3. Collect the coolant. To do so, place suitable containers beneath the drain points.
4. Drain the cooling system at the engine block via drain tap (A) and the radiator via drain plug (B).
5. Flush out the cooling system.
6. Close drain tap (A) and install drain plug (B).



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Filling/de-aerating, cooling system

1. Turn the heater temperature control knob in the cab to the “warmest” setting.
2. Fill the cooling system with the specified coolant.
3. Run the engine for several minutes.
4. The cooling system is self-venting. Ensure that the air bleed pipe from the thermostat housing to the header tank is not kinked or pinched off.
5. Check the coolant level, and as necessary top up with coolant.

If the vehicle is equipped with a water/air auxiliary heating.

1. Run the engine at idling speed.
2. Switch on the auxiliary heating, using the rocker switch on the dashboard.
3. Turn the heater temperature control knob in the cab to the “warmest” setting.
4. Switch on the heater fan.
5. Set the rocker switch on the thermostat in the cab to position 1.

   Note:
   Combustion will start after approximately one minute.
6. Allow the auxiliary heating to operate for approximately 15 minutes.

7. CLEANING

7.1 CLEANING, COOLING SYSTEM

Use a cleaning agent approved by DAF to remove any internal oil contamination. Consult the TRP catalogue to this end.

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4

4

1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel fuel.
So avoid inhaling and direct contact.

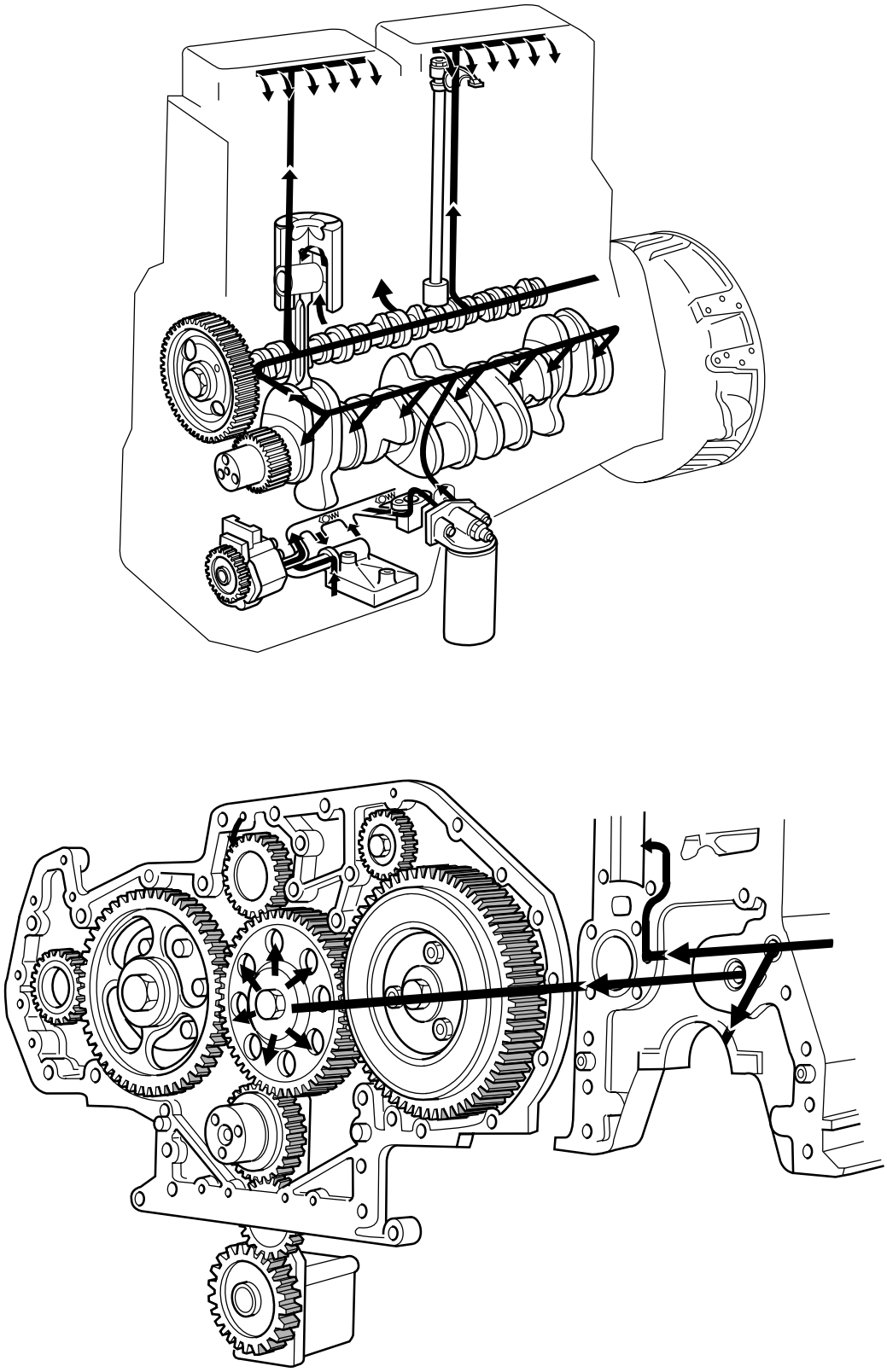
Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

4

2. GENERAL

2.1 LUBRICATING OIL SYSTEM DESCRIPTION



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General
The lubricating oil pump is directly driven from the crankshaft, via an intermediate gear wheel. The lubricating oil pump draws the oil from the oil sump, and pumps it via the oil cooler and the lubricating-oil filter to the main oil channel in the cylinder block. From the main oil channel, the lubricating oil is further distributed to the various components requiring lubrication.

Oil cooler
The oil cooler is connected to the cooling system. The oil cooler warms up the lubricating oil in a “cold” engine and cools it in a “warm” engine.
Parallel to the oil cooler, a short-circuit valve has been fitted. If the oil cooler is blocked, the short-circuit valve will open when a certain pressure has built up. In this case, uncooled engine oil enters the lubricating system.

A centrifugal lubricating oil filter may be installed in parallel to the lubricating oil system. In this case, lubricating oil will flow from the oil cooler to the centrifugal filter. The lubricating oil is additionally filtered in the centrifugal filter. This is done in view of vehicles that have longer maintenance intervals.

Pressure limiting valve
A pressure limiting valve is installed in the lubricating system after the oil cooler. When the pressure set for the pressure limiting valve has been reached; the valve opens and allows excess, cooled lubricating oil to flow to the oil sump.

Oil filter
The oil is cleaned in the disposable oil filter. A pressure-relief valve fitted in this filter, opens if the pressure in the filter becomes too high as a result of contamination or cold oil. The oil then passes through the filter unfiltered.

Main oil channel
From the main oil channel, lubricating oil is supplied to the crankshaft main bearings and through an oil channel in the crankshaft also to the connecting rod bearings. From the main oil channel, lubricating oil is pumped through the first camshaft bearing into the hollow camshaft. From the oil channel in the camshaft, lubricating oil is supplied to the other camshaft bearings.

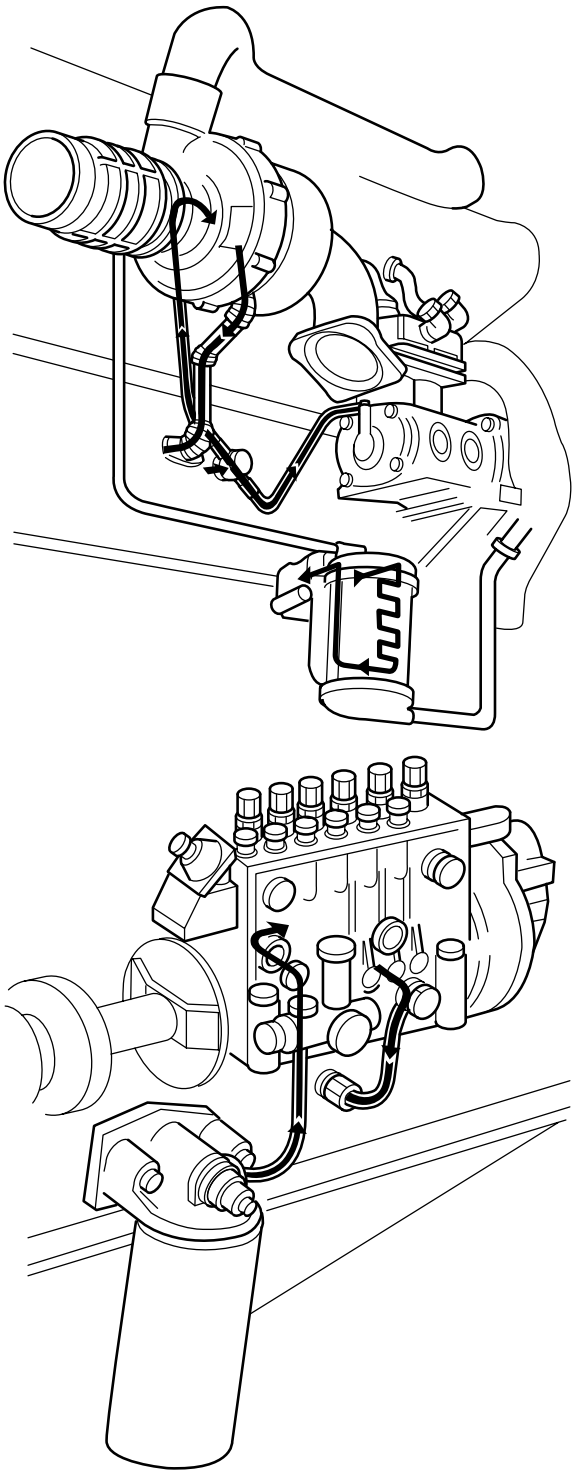
Cylinder head
From the second and fifth camshaft bearings, an oil channel passes through the cylinder heads to the second and fifth rocker seats.
Depending on the model, the other rocker shafts, rockers, and bridges receive lubrication from the DEB or a lubricating-oil strip.

Timing gear
From the oil channel in the first crankshaft main bearing, an oil channel leads to the hollow hub of the intermediate gear wheel. The oil passes through the hollow hub onto the intermediate gear wheel. The other gear wheels receive lubricating oil from the intermediate gear wheel. The fan drive is lubricated through a bore hole in the cylinder block and an oil channel in the timing-gear case.

Piston and gudgeon pin
The pistons and the upper connection-rod bearings are lubricated by means of oil nozzles linked to the main oil channel. In addition to lubricating, this oil has an important cooling function.
A bore hole has been created at the top of the connection rod, through which the oil that the nozzles spray against the bottom of the piston may reach the upper connecting rod bearing.

Turbocharger and air compressor
An oil channel from the camshaft bearing connects the oil pipes to the turbocharger and air compressor.
The oil discharge pipe from the turbocharger is connected to a channel in the cylinder block, from where the oil returns to the oil sump.
The oil returning from the air compressor flows from the front of the air compressor back to the timing gear and from there to the oil sump.

Fuel pump
The fuel pump obtains its lubricating oil from the oil filter and discharges it through a channel in the cylinder block, from where it flows back into the oil sump.



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3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION, LUBRICATING OIL CONSUMPTION

Note:
An oil consumption test is only useful after the engine has been run in (approx. 20,000 km).

1. First carefully check the engine for leaks. Clean the engine before starting the test.
2. Run the engine to operating temperature.
3. Place the vehicle on a horizontal surface.
4. Remove the oil drain plug and drain the oil for 15 minutes. Collect the oil in a clean container.
5. Measure the exact amount of oil drained.
6. Refill the oil sump with the drained engine oil. If necessary, top up the amount of oil to the specified level.
7. Before starting the test, write down the exact amount of engine oil (**A**) in the oil sump. Write down the mileage (**C**) of the vehicle.
8. Drive between 500 and 1000 km under similar conditions as those in which the vehicle is normally used.
9. Immediately after the test run, place the vehicle on a level surface and write down its mileage (**D**).
10. Remove the oil drain plug and drain the oil for 15 minutes. Collect the oil in a clean container.
11. Measure the exact amount of oil drained (**B**).

12. Return the oil to the oil sump. If necessary, top up the amount of oil to the specified level.

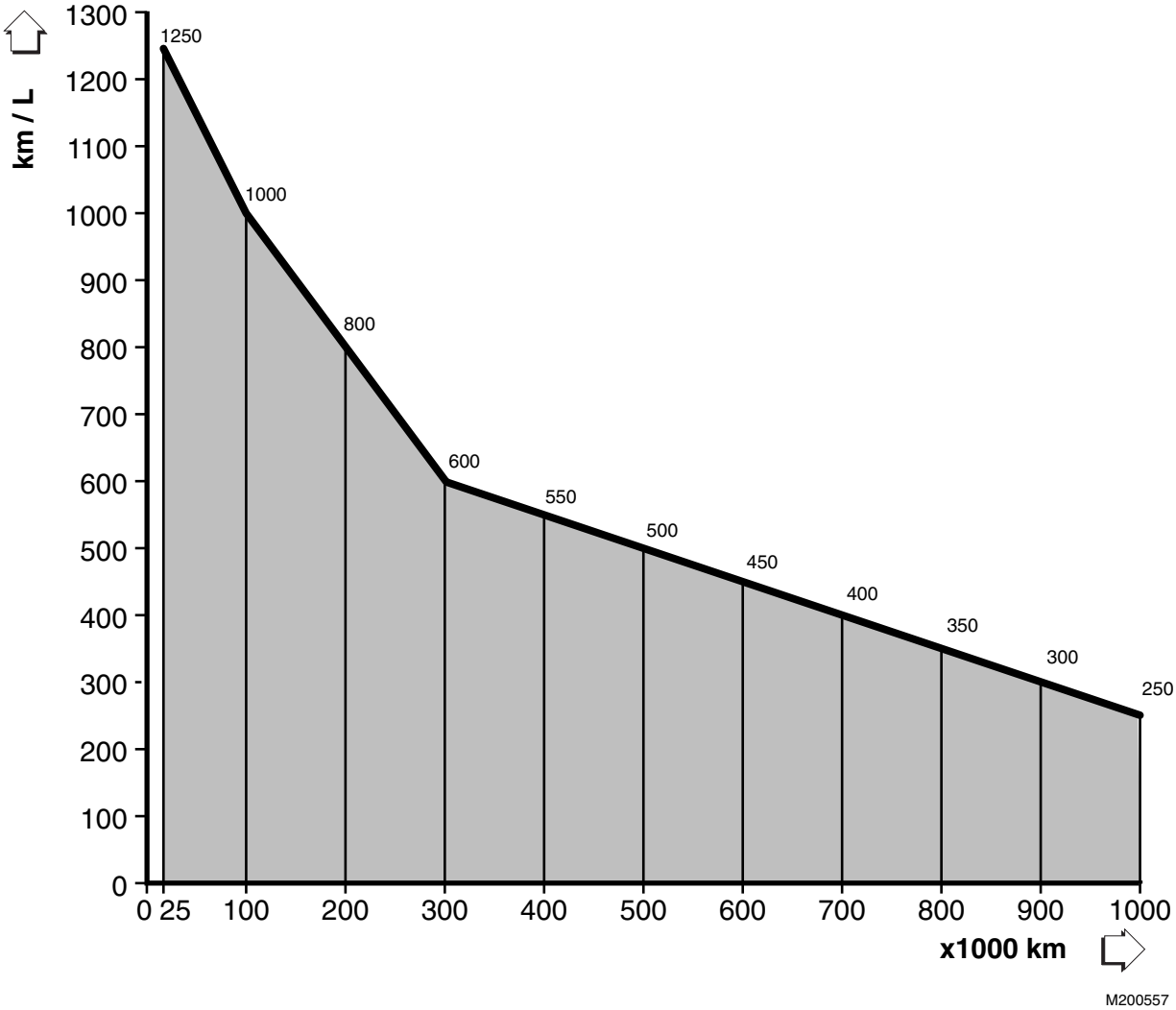
13. Calculate the oil consumption using the following formula.

$$\textbf{Oil consumption} = \frac{\textbf{D - C}}{\textbf{A - B}} = \textbf{km/l}$$

In the graph the oil consumption in km/l is marked out on the left and the total number of kilometres covered by the engine at the bottom.

If the oil consumption and the number of kilometres covered intersect in the shaded section, corrective measures may be considered.

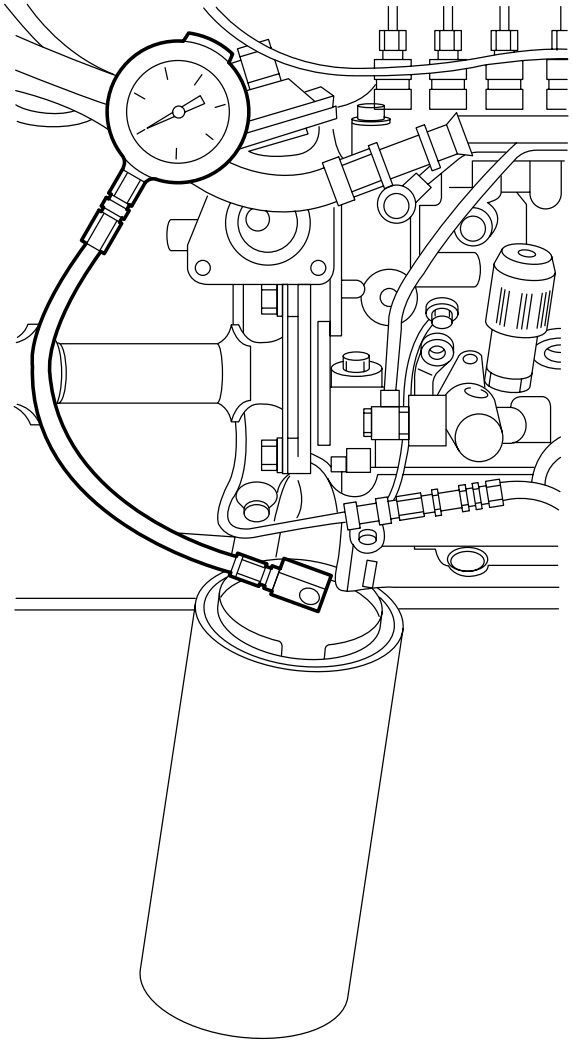
Bear in mind, however, that the oil consumption is very much dependent upon the operating conditions.



3.2 INSPECTION, LUBRICATING OIL PRESSURE

1. Run the engine to operating temperature.
2. Remove the lubricating oil pressure sensor. This sensor is mounted on the oil-filter housing.
3. In the lubricating-oil pressure sensor connection, install an oil pressure gauge, special tool (DAF no. 0535551).
4. Start the engine and measure the lubricating oil pressure at maximum engine speed, and at idling speed.
   Compare the pressure reading with the technical data. See main group “Technical data”.

   Note:
   The oil pressure control valve, mounted in the oil sump, cannot be adjusted.
5. Stop the engine and remove the oil pressure gauge. Fit the oil pressure sensor with a new lubricating ring.



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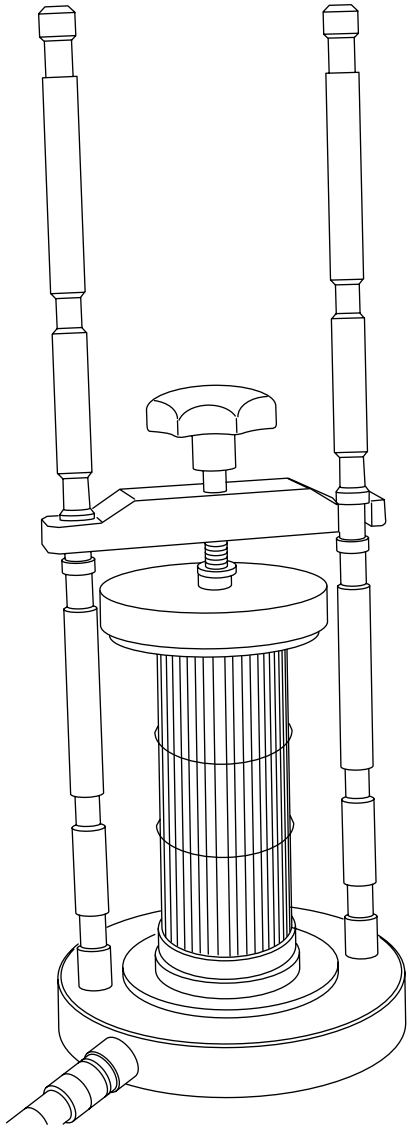
3.3 PRESSURE-TESTING THE OIL COOLER

1. Remove the oil cooler, see chapter “Removal and installation”.
2. Disassemble the oil cooler, see chapter “Disassembly and assembly”.
3. Place the cooling element in special tools (DAF no. 1329307 and DAF no. 0694889).
4. Apply up to 3 bar of pressurised air to the special tool.
5. Submerge the cooling element in warm water (approx. 50°C) and check for leaks.

   Note:
   If the cooling element leaks, it must be replaced.
6. Assemble the oil cooler, see chapter “Disassembly and assembly”.
7. Install the oil cooler, see chapter “Removal and installation”.



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4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, LUBRICATING OIL FILTER HOUSING

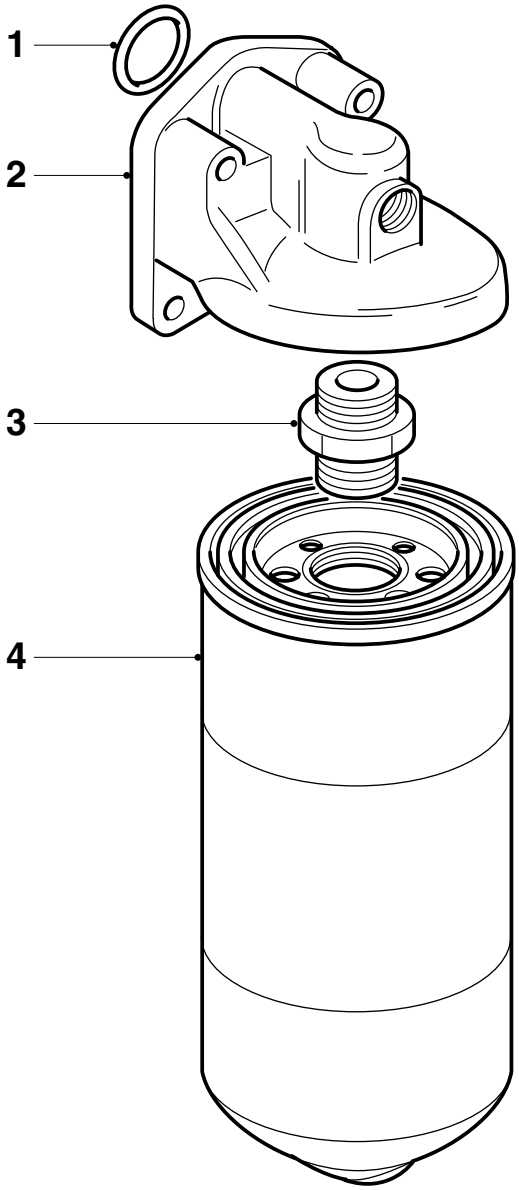
To prevent skin injury, avoid unnecessary contact with the drained oil.

Removal, lubricating oil filter housing

1. Clean the filter housing and the surrounding area.
2. Remove the electrical connections from the lubricating oil pressure sensor.
3. Remove the filter element. Collect any oil flowing out of the system.
4. Remove the fixing bolts from the filter housing and remove the filter housing (2).
5. Remove the O-rings (1).

Installation, lubricating oil filter housing

1. Replace the O-rings (1) at the rear of the filter housing (2).
2. Install the filter housing (2). Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Check the coupling piece (3), see main group “Technical data”.
4. Lightly grease the sealing ring of the filter element.
5. Install the filter element filled with clean lubricating oil. Tighten the filter element to the specified torque. See main group “Technical data”.
6. Install the electrical connections of the lubricating oil pressure sensor.
7. Run the engine for a short time, and check whether the oil filter is correctly sealed.
8. Check the oil level.



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4.2 REMOVAL AND INSTALLATION, OIL COOLER

Removing the oil cooler

1. Drain the coolant, see chapter “Draining and filling”.
2. Remove the coolant connections.
3. Remove the compressor pipe.
4. Remove the oil delivery pipe, if installed, to the centrifugal filter.
5. Remove the fixing bolts and the oil cooler. Collect the lubricating oil flowing out of the system.
6. Remove the O-rings on the oil cooler.

4

Installing the oil cooler

1. Clean the contact surfaces between the oil cooler and the engine block. Install new O-rings on the oil cooler housing.
2. Install the oil cooler onto the engine block. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the coolant connections.
4. Install the compressor pipe.
5. Install the oil delivery pipe, if present, to the centrifugal filter.
6. Fill the cooling system.
7. Run the engine briefly, and check that the oil cooler does not leak.
8. Check the oil level.
9. Check the coolant level.

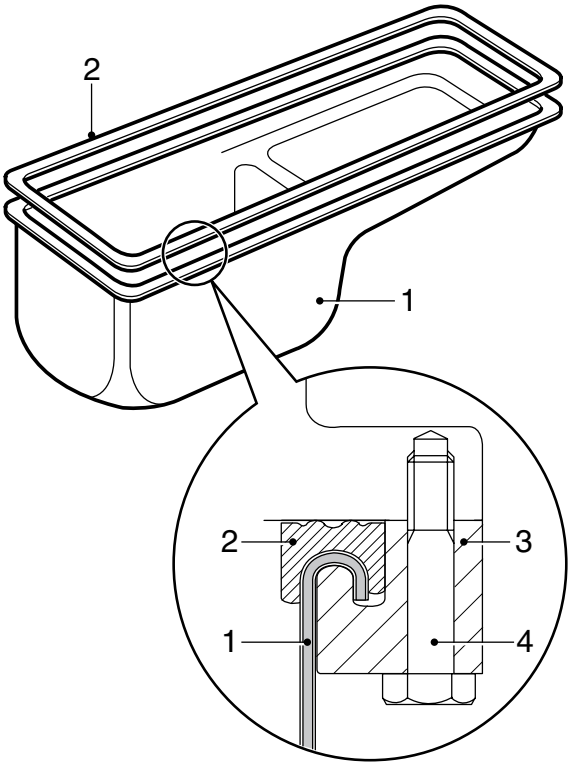
4.3 REMOVAL AND INSTALLATION, OIL SUMP

Removal, oil sump

1. Remove the soundproofing under the engine.
2. Drain the engine oil, see chapter “Draining and filling”.
3. Support the oil sump (1).
4. Remove the attachment bolts (4) and locking brackets (3) all around.
5. Remove the oil sump together with the sealing rubber (2).

Installation, oil sump

1. Clean the sealing surfaces of the oil sump and the engine block.
2. Check the oil sump sealing rubber (2). Damaged sealing rubbers (2) must be replaced.
3. First install the sealing rubber on the front and rear sides of the oil sump. As a next step, the sealing rubber may be fitted to the long sides of the oil sump.
4. Fit the oil sump (1) with the sealing rubber (2) in a straight position.
5. Install the attachment bolts (4) and locking brackets (3). Tighten the fixing bolts crosswise to the specified tightening torque, see main group “Technical data”.
6. Fill the engine with the specified quantity of lubricating oil.
7. Run the engine for a short time, and check whether the oil sump is correctly sealed. Check the oil level.
8. Install the soundproofing under the engine.



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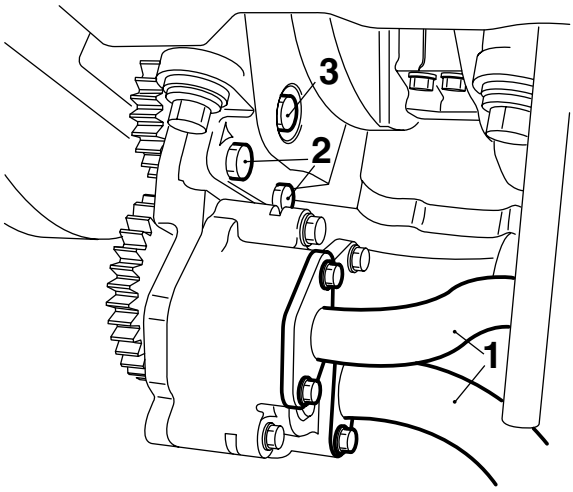
4.4 REMOVAL AND INSTALLATION, LUBRICATING OIL PUMP

Removal, lubricating oil pump

1. Remove the oil sump.
2. Remove the oil strainer.
3. Remove the oil suction and delivery pipes (1) from the lubricating oil pump.
4. Remove the fixing bolts (2) from the lubricating oil pump at the main bearing cap.
5. Remove the fixing bolt (3).
6. Remove the lubricating oil pump from the main bearing cap.



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Installation, lubricating oil pump

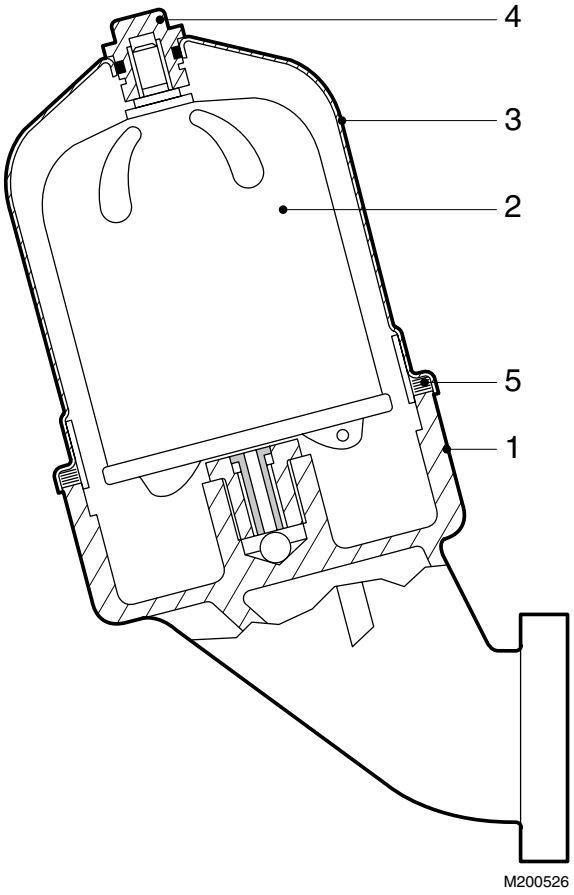
1. Check that the lubricating oil pump operates smoothly and is not getting stuck anywhere.
2. Install the lubricating oil pump with the intermediate gear wheel on the main bearing cap. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the oil suction and delivery pipes (1) with new O-rings.
4. Install the oil strainer.
5. Install the oil sump.

4.5 REMOVAL AND INSTALLATION, CENTRIFUGAL OIL FILTER

To prevent skin injury, avoid unnecessary contact with the drained oil.

Removal and installation, centrifugal oil filter
1. Clean the housing (3).
2. Slacken the central bolt (4).
3. Remove the housing (3) simultaneously with the central bolt (4) and the rotor (2).
4. Remove the rotor (2) from the central bolt (4).
5. Replace the rotor (2).

Installation, centrifugal oil filter rotor
1. Clean the housing (3).
2. Check the central bolt (4) for damage.
3. Replace the sealing ring (5).
4. Fit the new rotor into the housing.
5. Lightly oil the sealing ring (5) and install it in the housing (3).
6. Tighten the central bolt (4) to the specified tightening torque, see main group “Technical data”.
7. Start the engine and check for leaks. Check the oil level.



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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, LUBRICATING OIL PUMP

Disassembly, lubricating oil pump

1. Remove the intermediate gear wheel with the hub from the front plate.
2. Remove the fixing bolts around the halves of the lubricating oil pump housing.
3. Remove the rear half of the lubricating oil pump housing.
4. Remove the gear wheels from the lubricating oil pump housing.

Assembly, lubricating oil pump

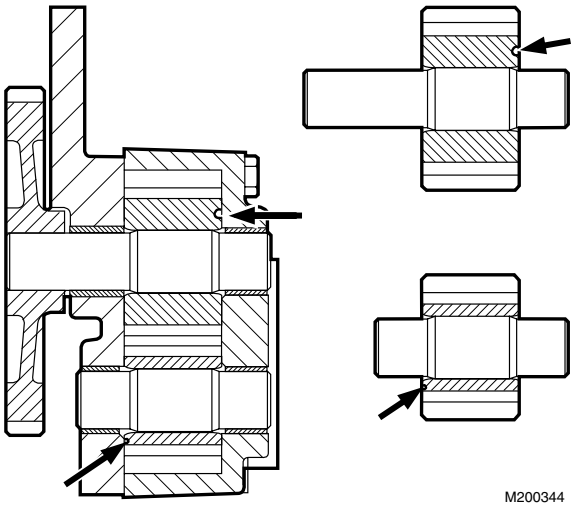
1. Clean the gear wheels and check for damage.

   Note:
   Gear wheels must be replaced as a set.

2. **Note:**
   The gear wheels are marked. The gear wheels with the marks must be installed as shown.

   Install the gear wheels in the lubricating oil pump housing.

3. Install the rear half of the lubricating oil pump housing.
4. Install the fixing bolts around the halves of the lubricating oil pump housing. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Check that the lubricating oil pump operates smoothly and is not getting stuck anywhere.
6. Install the intermediate gear wheel with the hub on the front plate. Tighten the fixing bolt to the specified torque, see main group “Technical data”.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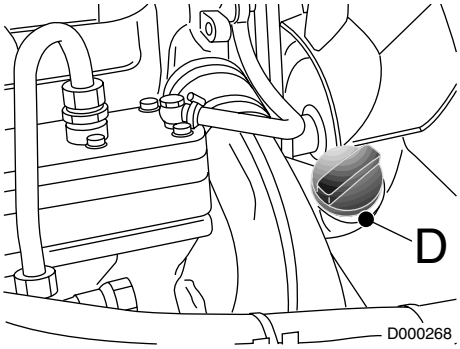
6. DRAINING AND FILLING

6.1 DRAINING AND FILLING, ENGINE OIL

To prevent skin injury, avoid unnecessary contact with the drained oil.

1. Place the vehicle on a flat and level surface.
2. Drain the oil using the drain plug in the oil sump.
3. Replace the drain-plug sealing ring and tighten the drain plug to the specified tightening torque. See main group “Technical ata”.
4. Fill the engine through oil-filler pipe (D) with the specified engine-oil quantity, see main group “Technical data”.



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5

1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel fuel.
So avoid inhaling and direct contact.

Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

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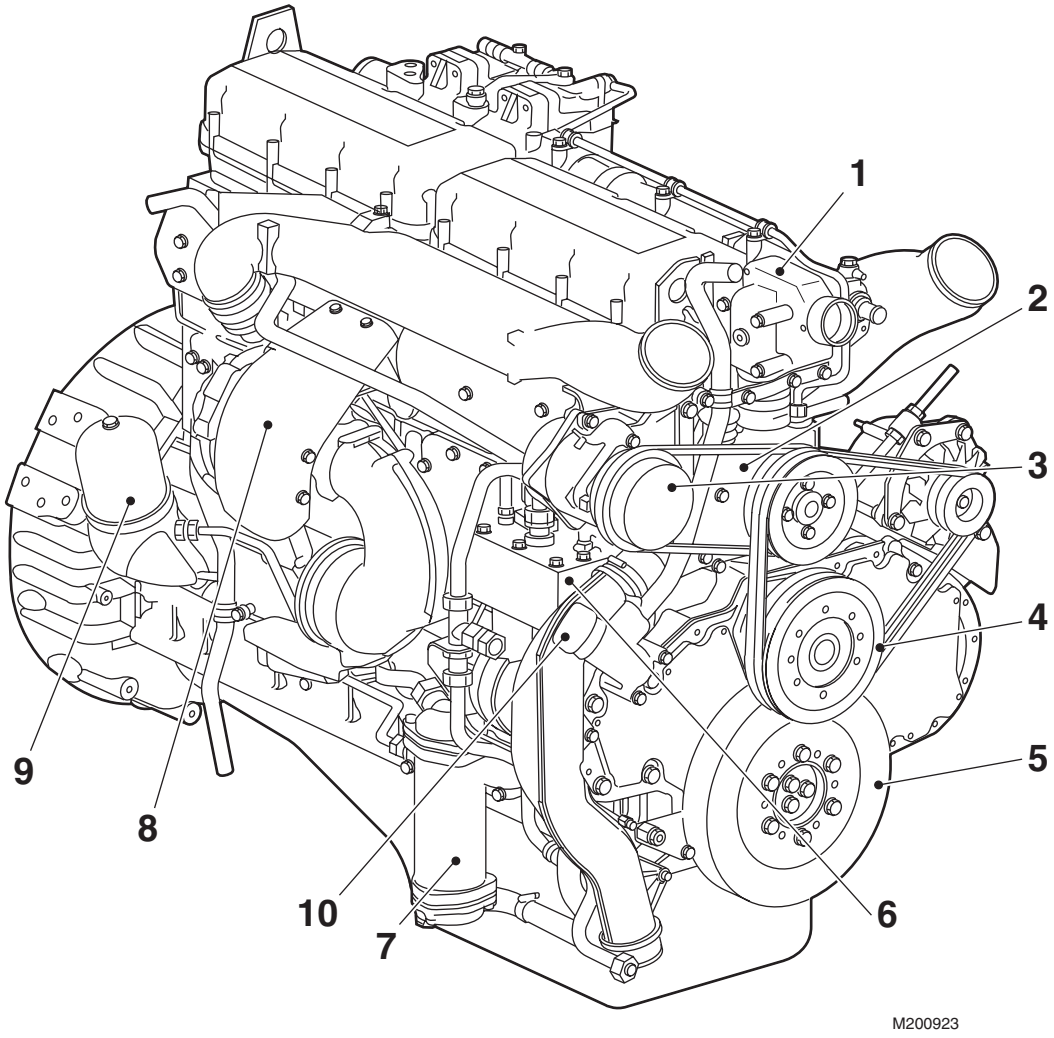
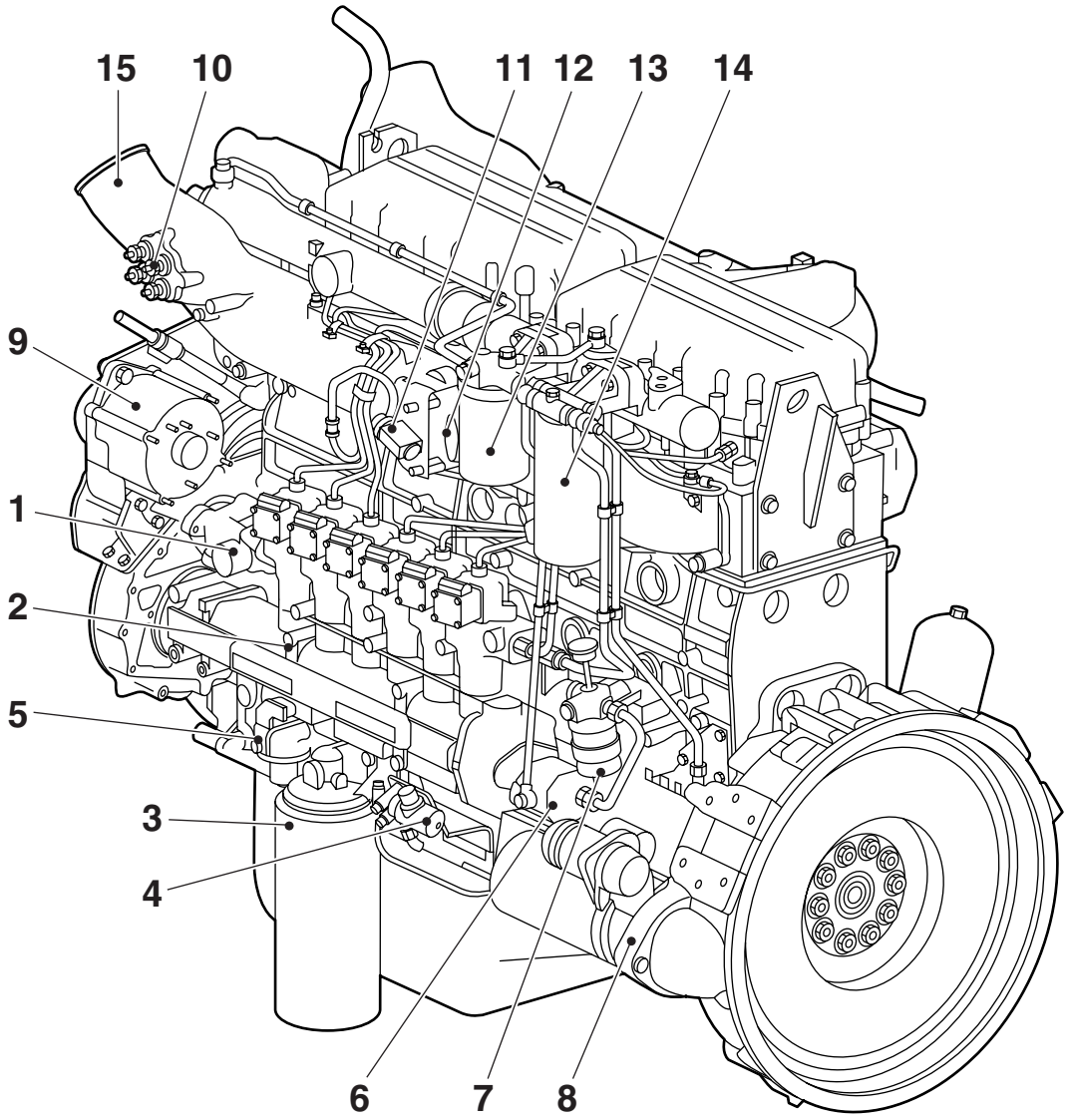
2. GENERAL

2.1 LOCATION OF COMPONENTS



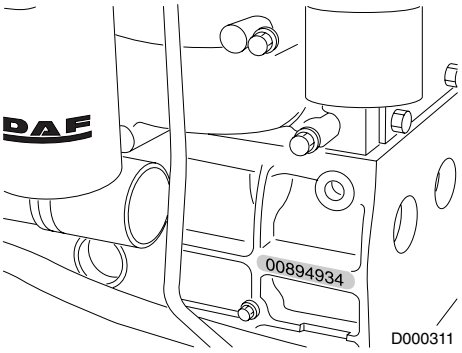
Legend
1. Thermostat housing
2. Water pump
3. Air-conditioning compressor
4. Fan drive
5. Vibration damper
6. Air compressor
7. Oil cooler
8. Turbocharger
9. Centrifugal filter
10. Oil-filling pipe



Legend
1. Steering pump
2. Pump housing
3. Oil filter
4. Engine brake valve
5. Pressure-reducing valve
6. Fuel lift pump
7. Hand pump
8. Starting motor
9. Alternator
10. Glow filaments
11. Electro-pneumatic boost pressure valve
12. Engine information-code plate
13. Coolant filter
14. Fuel filter
15. Inlet manifold

2.2 IDENTIFICATION

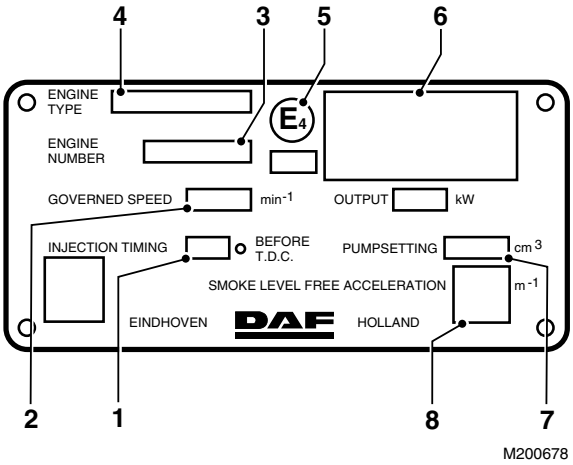
Engine number
The engine number is marked on the engine block at the rear left.



XE Engine information-code plate
Fitted to the inlet manifold

1. Injection timing*
2. Maximum governed engine speed
3. Engine number
4. Engine type
5. Indication of country of origin
6. Certificate number*
7. Pump setting*
8. Smoke level at maximum engine speed, without load

* Not filled out in case of XE engines



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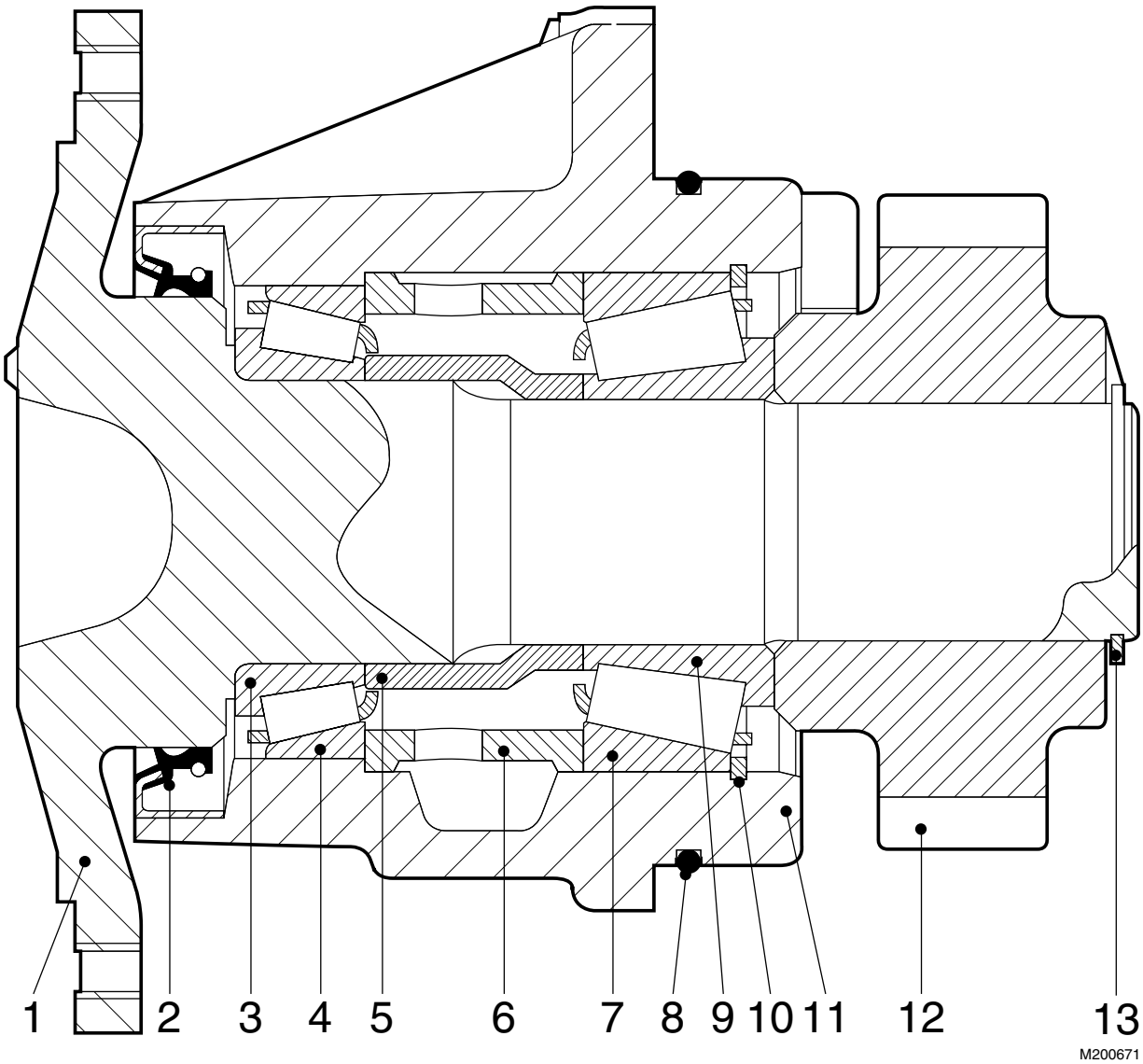
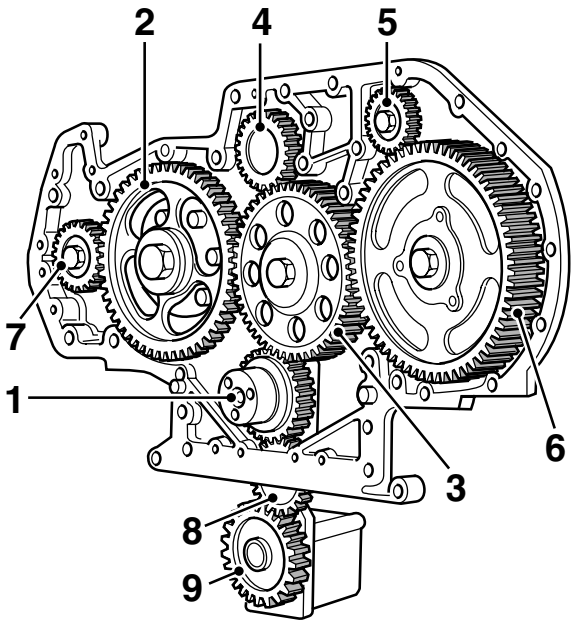
2.3 OVERVIEW DRAWING OF FAN DRIVE



Legend
1. Fan drive shaft
2. Oil sealing ring
3. Bearing
4. Bearing ring
5. Spacer sleeve
6. Intermediate ring
7. Bearing ring
8. O-ring
9. Bearing
10. Retaining ring
11. Bearing housing
12. Gearwheel
13. Retaining ring

2.4 OVERVIEW DRAWING OF TIMING GEAR

Legend
1. Crankshaft gear wheel
2. Camshaft gear wheel
3. Intermediate gear wheel
4. Fan drive
5. Steering pump gear wheel
6. Pump housing camshaft gear wheel
7. Air compressor gear wheel
8. Intermediate gear wheel of oil pump
9. Oil pump



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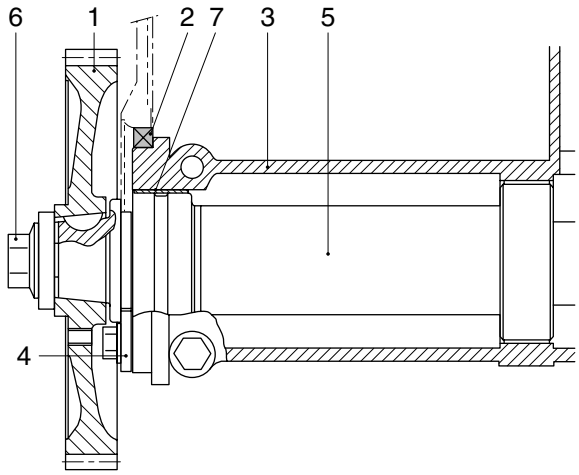
2.5 OVERVIEW DRAWING OF PUMP HOUSING CAMSHAFT DRIVE

Legend
1. Pump housing camshaft gear wheel
2. Timing gear sealing ring
3. Pump housing
4. Axial retainer plate
5. Pump housing camshaft
6. Camshaft gear wheel fixing bolt
7. Bearing bush camshaft



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3. INSPECTION AND ADJUSTMENT

3.1 CHECKING AND ADJUSTING THE VALVE MECHANISM BRIDGES

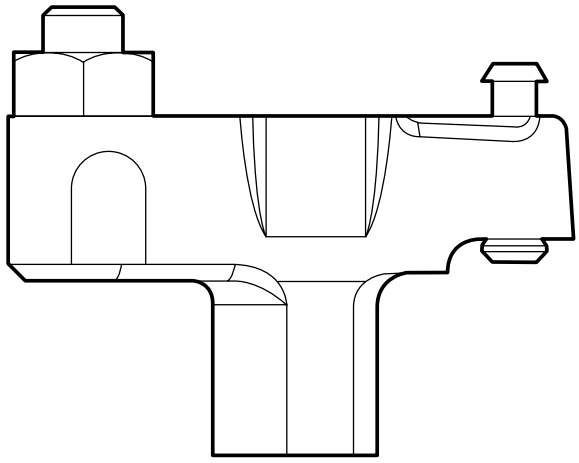
Loosening and torqueing the lock nuts (B) of the bridges may cause severe engine damage if the bridge is fitted on the valves.

1. Remove the valve covers, see chapter “Removal and installation”.
2. Remove the DEB or the lubricating-oil strip (depending on model).
3. Remove the entire rocker bracket. Mark the position to allow reinstallation in the same position.

Note:
In engines equipped with a DEB, the bridges of the inlet and exhaust valves are not the same. In engines without a DEB, the bridges of the inlet and exhaust valves are the same.

5

Exhaust bridge with DEB



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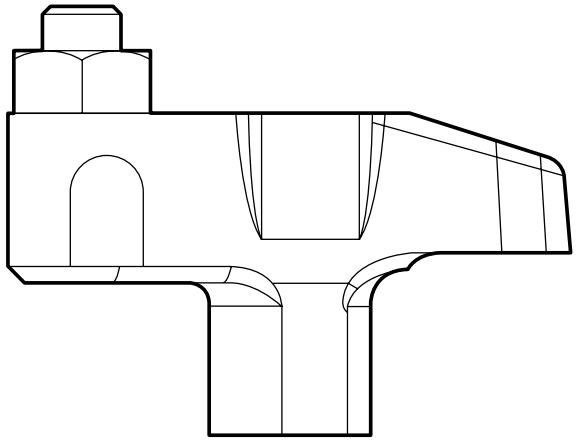
Exhaust bridge without DEB



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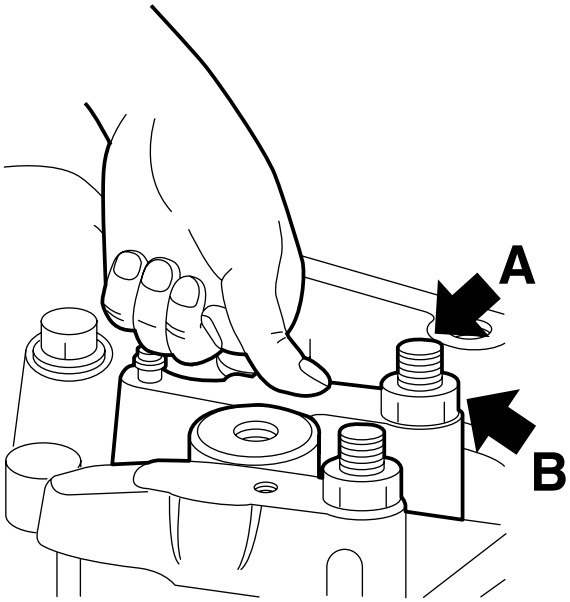
4. Remove the bridge from the valves and place it in a vice.
5. Slacken lock nut (B).
6. Reposition the bridge in the engine over the valves.
7. Firmly press on the bridge centre (above the guiding pin) with your thumb.
8. Hand-tighten adjusting screw (A) until the bridge starts to move (adjusting screw (A) now touches the valve).
9. Turn adjusting screw (A) through another 90° and carefully remove the bridge from the valves.
10. Place the bridge in a vice and tighten lock nut (B) to the specified torque without turning adjusting screw (A), see main group “Technical data”.
11. Reposition the bridge over the valves.
12. Install the rocker bracket.
13. Install the DEB or the lubricating-oil strip (depending on model). Install the lubricating-oil strip in such a way that the mark “cyl. 1/4” is located on cylinder 1 or cylinder 4 respectively.
14. Adjust the valve clearance and, if fitted, the DEB clearance.
15. Fit the valve covers, see chapter “Removal and installation”.



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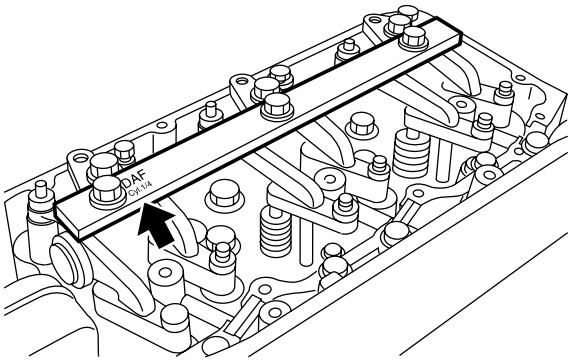
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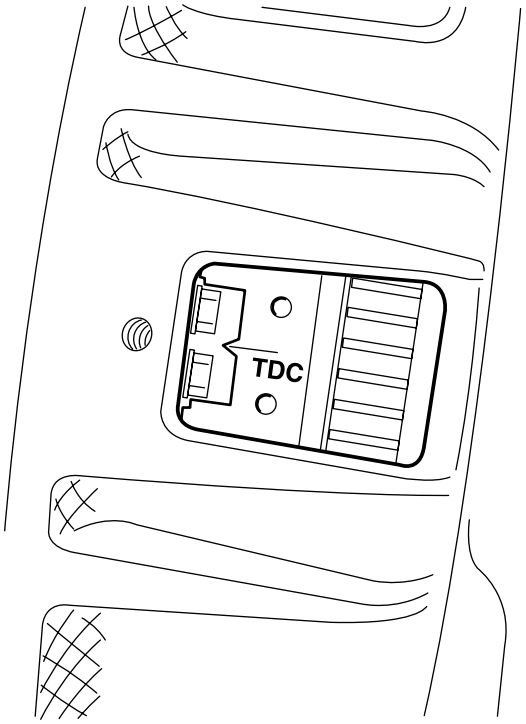
3.2 INSPECTION AND ADJUSTMENT, VALVE CLEARANCE

1. Remove the valve cover, see “Removal and installation”.
2. Use the special tool (DAF no. 1310477) to turn the crankshaft clockwise, as seen from the timing gear end (this is the engine’s normal direction of rotation), until the valves of cylinder 1 are in rocking position. The pistons of cylinders 1 and 6 are now in the top dead centre.

Note:
“Overlap” is the moment at which the inlet valve starts opening and the exhaust valve is completing the closing.



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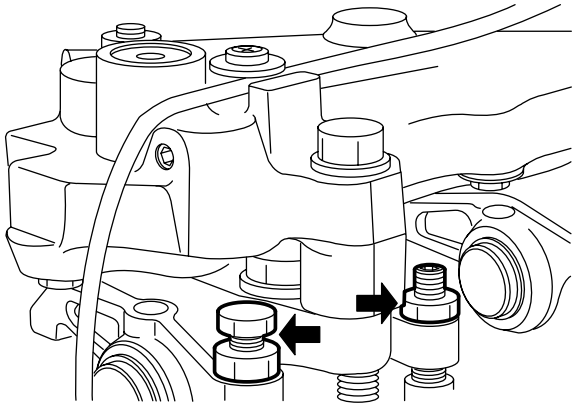
If the engine has been fitted with a DEB, loosen the lock nut by means of a flat ring spanner. This is necessary so as to prevent damage to the DEB spring plate.

3. Check/correct the valve clearance of cylinder 6. The correct valve clearance is adjusted by loosening the lock nut and turning the adjusting bolt in the correct direction, see main group “Technical data” for the correct valve clearance.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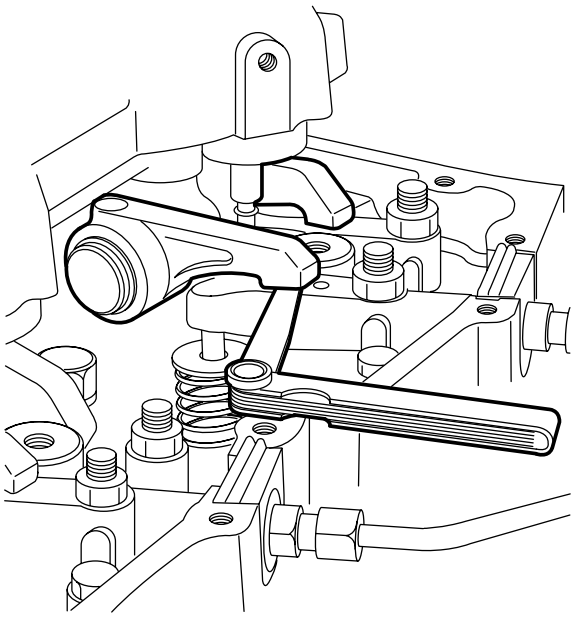
4. By cranking the crankshaft always $^1/_3$ stroke, using the special tool (DAF no. 1310477), the valves can be adjusted according to the injection sequence 1-5-3-6-2-4.

Cylinder with valves in overlap position	Adjust valves of cylinder
1	6
5	2
3	4
6	1
2	5
4	3


M200540

5. If the engine has been fitted with a DEB, the DEB clearance must be checked following the valve-clearance adjustment.

6. Fit the valve cover, see “Removal and installation”.

3.3 CHECKING AND ADJUSTING THE TIMING GEAR

Checking the timing gear

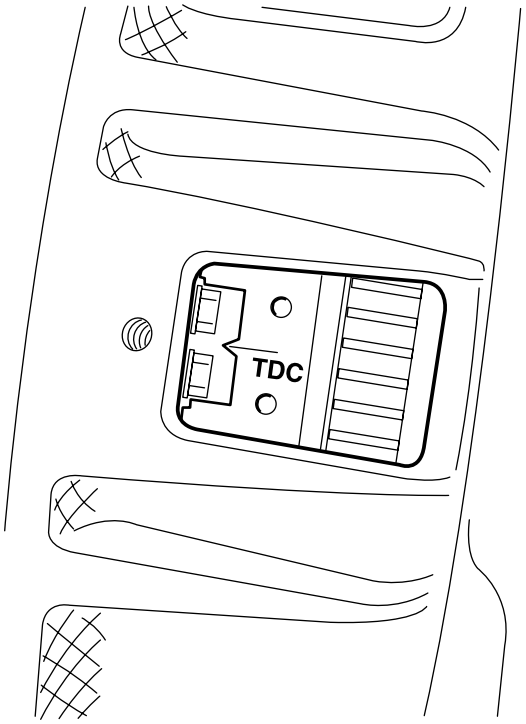
1. Remove the valve cover from cylinders 1-2-3, see chapter “Removal and installation”.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).

   Note:
   It is important that the bridges of the valve mechanism are properly adjusted.
3. Set the inlet valve clearance of the first cylinder to 1 mm.
4. Position the dial gauge on the inlet valve bridge of the first cylinder, in such a way that it measures in an exact vertical position on the bridge and is capable of registering an upward and downward measuring value of 5 mm.
5. Use the special tool (DAF no. 1310477) to turn the crankshaft further in the direction of rotation until the pistons of cylinders 1 and 6 have returned to the top dead centre (TDC).
6. Read the dial gauge and compare the measured value, see main group “Technical data”.

   Example

Pre-tension dial gauge	5.00 mm
Measured tension	4.65 mm
Valve opening	0.35 mm

   Note:
   If the valve opening matches that in the technical data, it may be assumed that the timing gear is properly set.



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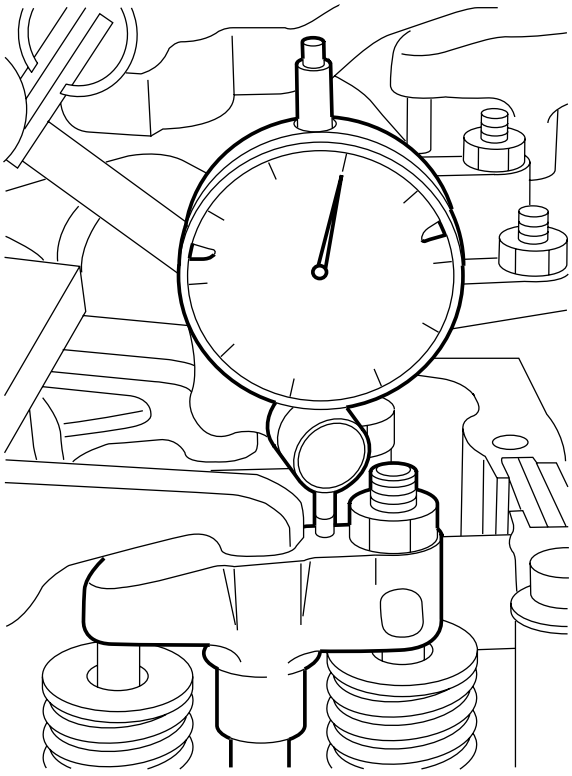
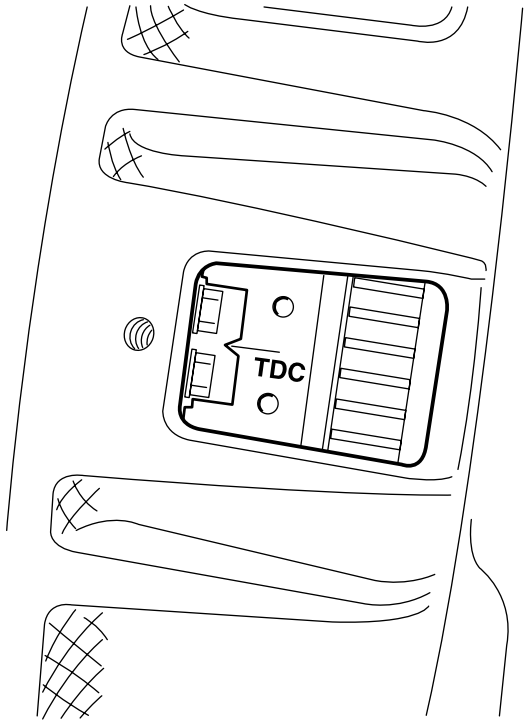

M200551

Adjustment, timing gear

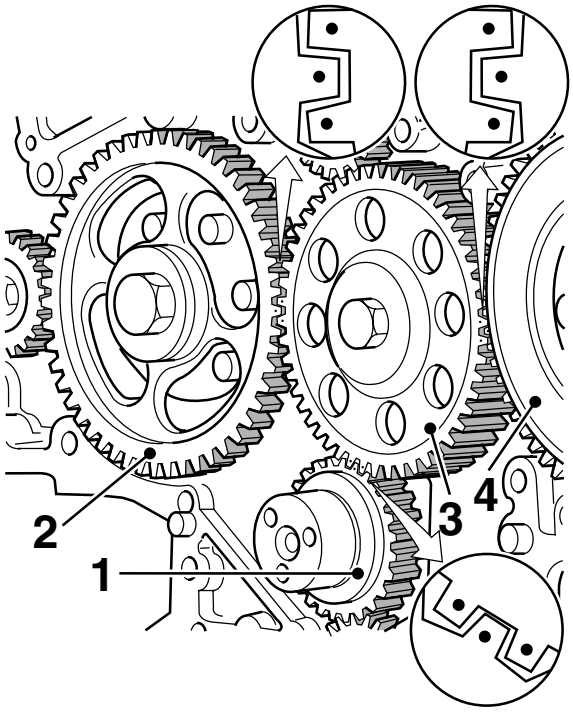
1. Remove the valve cover from cylinders 1-2-3, see chapter “Removal and installation”.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
3. Remove the timing-gear cover, see chapter “Removal and installation”.



M200724

Note:
When the crankshaft (1) or the camshaft (2) of an engine without intermediate gear wheel (3) is rotated separately, the engine’s pistons may touch the valves.

4. Remove the intermediate gear wheel (3), see “Removal and installation”.
5. Rotate the camshaft gear wheel (2) in such a position that the intermediate gear wheel (3) can be installed in accordance with the marks.
6. Install the intermediate gear wheel and tighten the attachment bolt to the specified torque, see main group “Technical data”.
7. Fit the timing-gear cover, see chapter “Removal and installation”.
8. Fit the valve cover, see “Removal and installation”.



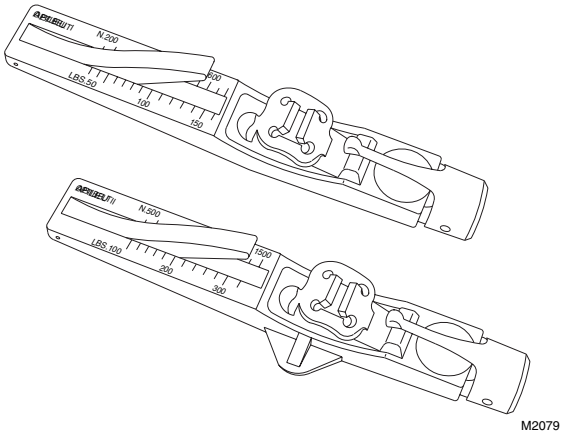
M200726

3.4 INSPECTION AND ADJUSTMENT, V-BELT TENSION

Check the V-belt by means of a belt-tension gauge. The advantage of this method is a higher measuring accuracy of the pre-tension, so that the service life of the V-belt, among other things, can be prolonged.

There are two versions: belt tension “Krikit I”, to be used with the single belt version (DAF no. 1240442), belt tension “Krikit II” to be used with the twin belt version (DAF no. 1240443).

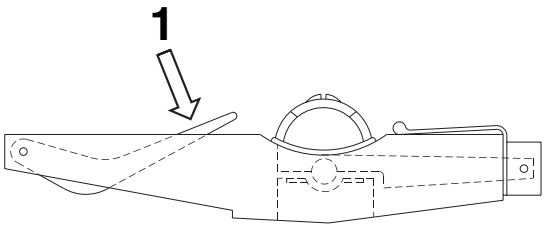
The difference between belt-tension gauge “Krikit I” and belt-tension gauge “Krikit II” is that the latter has a larger belt support area.



M2079

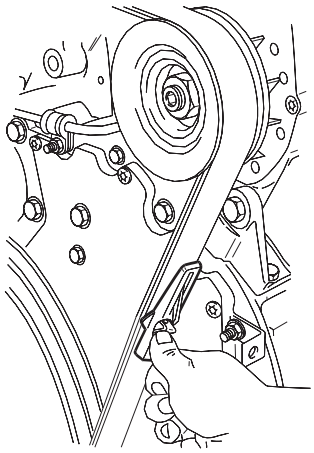
Measuring with the “KRIKIT” belt-tension gauge

1. Set the gauge to zero by depressing the measuring arm (1).

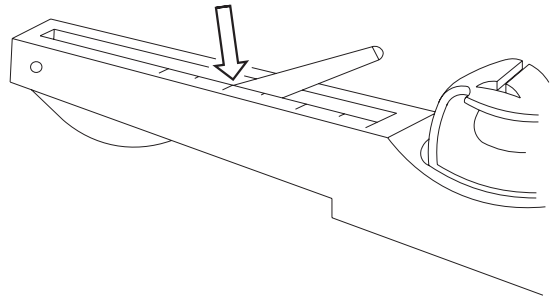


M2061

2. Place the belt-tension gauge on the V-belt, halfway between the alternator and the crankshaft pulley.
3. Slowly depress the V-belt by means of the belt-tension gauge until a click is heard. Then remove the belt-tension gauge carefully. Take care that the gauge bar does not move.


M2091

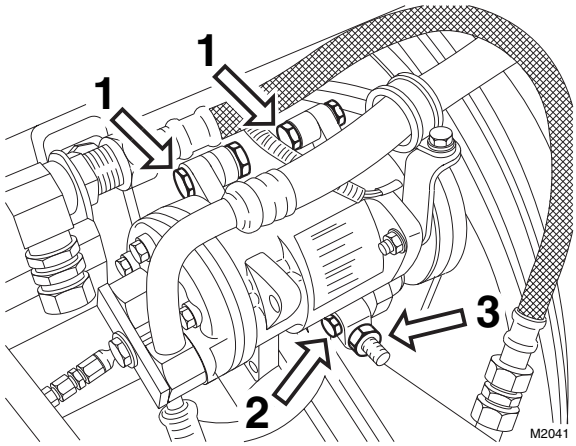
4. Take the reading as indicated by the position of the measuring arm in relation to the scale. Compare this pressure reading with the recommended pre-tension, see main group “Technical data”.



M2062

Adjustment, V-belt tension of the air-conditioning compressor

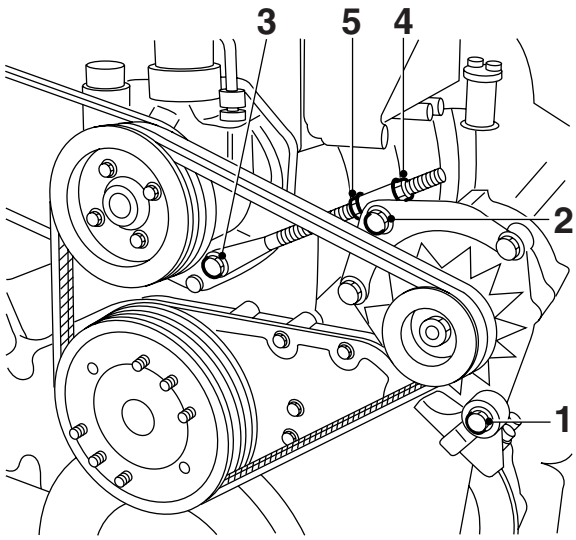
1. Slacken the upper fixing bolt (1) on the compressor.
2. Slacken the lower fixing bolt (2) on the compressor.
3. Slacken the fixing bolt from the threaded spindle which is attached to the cooling-water pump.
4. Shift the compressor using the lock nuts (3) until the correct V-belt tension is achieved, see main group “Technical data”.



M2041

Adjustment, V-belt tension of the water pump and alternator

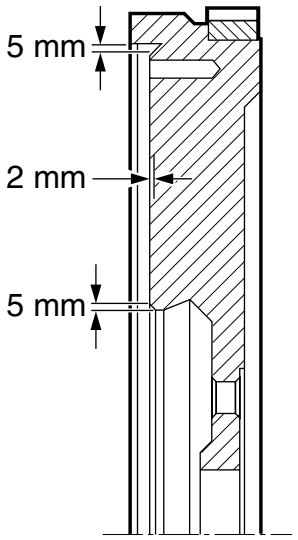
1. Slacken the lower fixing bolt (1) of the alternator.
2. Slacken the upper fixing bolt (2) of the alternator.
3. Slacken the fixing bolt (3) from the threaded spindle which is attached to the water pump.
4. Turn the lock nuts (4) and (5) on the threaded spindle so that the correct V-belt tension is achieved, see main group “Technical data”.



M200550

3.5 CHECKING THE FLYWHEEL

1. If the flywheel shows marks on the contact surface with the clutch plate, the flywheel may be ground down, on condition that the cracks are not within 5 mm of the inner rim.
2. The flywheel has an indicator groove for inspection purposes.
3. Grinding down is allowed until the indicator groove has just disappeared. This means that a **maximum of 2 mm** may be ground down.



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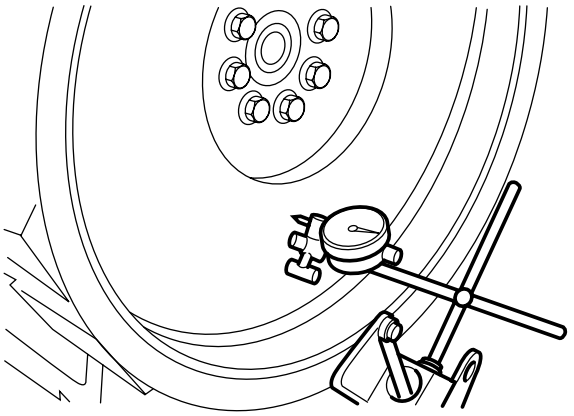
Inspection, flywheel swing

1. Clean the flywheel.
2. Place a metal strip on the edge of the flywheel housing to install a dial gauge.
3. Place the dial gauge on the metal strip.
4. Place the dial gauge of the stylus at the specified distance, see main group “Technical data”.
5. Set the dial gauge to “0”.
6. Use the special tool (DAF no. 1310477) to crank the engine through 360°, and measure the maximum clock reading. Compare this reading with the technical data, see main group “Technical data”.


M200230

3.6 INSPECTION, ENGINE COMPRESSION PRESSURE

Be careful when working on an engine at operating temperature.

When the engine is run without the valve covers, hot lubricating oil may escape from the engine. Make sure you are adequately protected.

A compression measurement serves to rapidly check the valve seals, the valve gasket seal and the seal between the cylinder lining and the piston rings.
The measuring results may only be used for comparing the various cylinders.

1. Run the engine to operating temperature.
2. Remove the fuse or relay, to prevent the pump units from being activated.
3. Remove the valve covers, see chapter “Removal and installation”.
4. Remove the injectors.
5. Turn the engine a number of times using the starting motor, so that any carbon or dirt particles in the cylinder are removed.
6. Install the dummy-injector (DAF no. 1329306), compression gauge (DAF no. 1329301) and adapter (DAF no. 0694972).
7. Carry out the measurement by rotating the engine using the starter motor, until the gauge reading no longer rises. For the mutual allowable differential pressures, see main group “Technical data”.
8. Remove the dummy injector and install the injectors.
9. Fit the valve covers, see chapter “Removal and installation”.
10. Reinstall the fuse or relay.

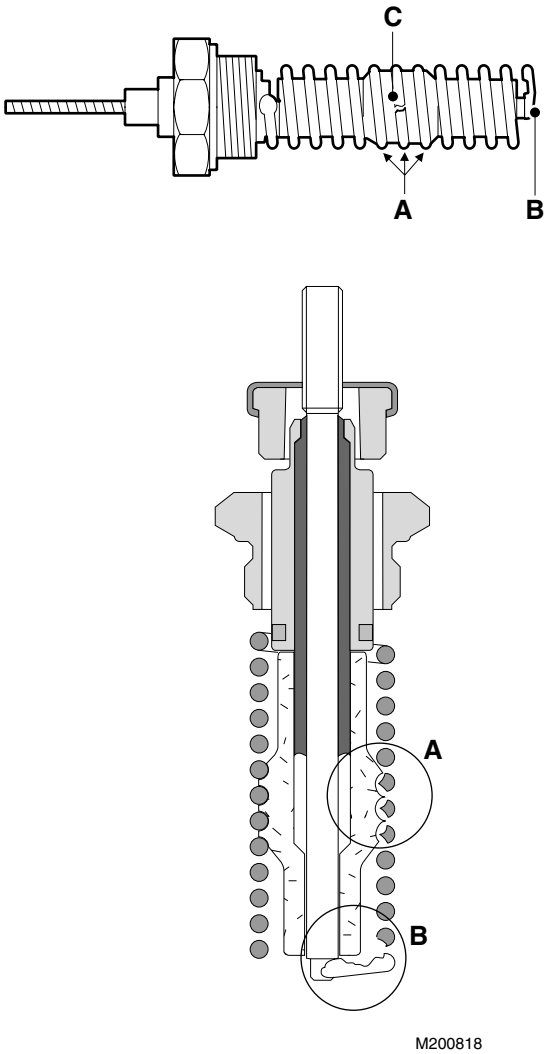
3.7 INSPECTION, CYLINDER HEAD

1. Check the sealing plugs of the cylinder head for leaks. If necessary, pressure-test the cylinder head.
2. Check the cylinder head for damage on the sealing face, and possible cracks. If necessary, have the cylinder head levelled, see main group “Technical data”.

3.8 INSPECTION GLOW FILAMENTS

Note:
To avoid engine damage it is important that the glow filaments should be checked periodically.

1. Check the glow filaments for the following points:
   - windings that have worn thin due to abrasion (A);
   - filament end broken or worn thin due to continuous knocking of a loose insulator (see B);
   - broken plug windings (C).
2. Replace all glow filaments if one or more of the above-mentioned situations occurs.



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4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENGINE

Suspend the engine carefully from the hoist, using approved lifting gear.
Various fluids will be released when pipes are removed. Collect these fluids. Take care of your personal protection and any fire hazards.

Note:
Because of the large number of vehicle specifications, it is not feasible to exactly specify the engine removal and installation procedures for every vehicle.
This description only includes the main points requiring attention.

- Disconnect the earth lead from the battery pole.
- Avoid opening of fluid systems as much as possible. If possible, remove and put aside the engine components.
- When removing the engine, ensure that no parts or dirt fall into the engine, radiator or other components. Therefore, plug all openings.
- Electrical wiring harnesses are easily damaged. If damaged, they may cause faults. Make sure these wiring harnesses are stress-free and have been installed away from moving parts.
- Tighten all fixing bolts to the correct tightening torque.
- Do not allow the engine to rest on the oil sump. Because the oil sump is made of sheet material, it will be severely damaged by the engine's own weight.

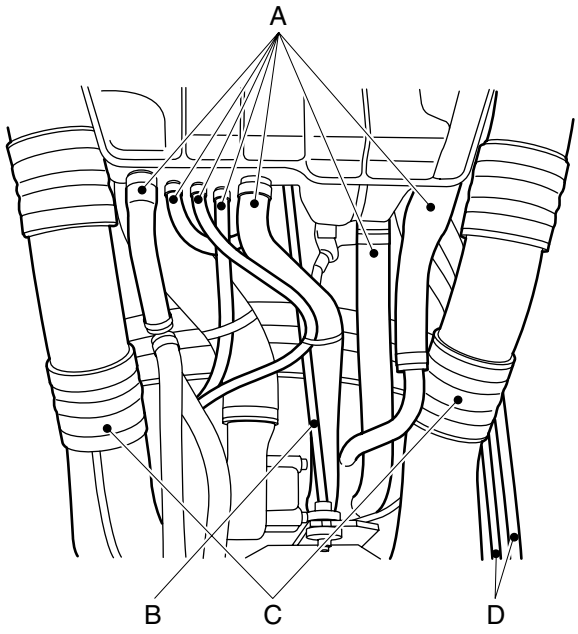
4.2 REMOVAL AND INSTALLATION, ENGINE MOUNTING

Suspend the engine carefully from the hoist, using approved lifting gear.

Various fluids will be released when pipes are removed. Collect these fluids. Take care of your personal protection and any fire hazards.

Removing the engine mounting

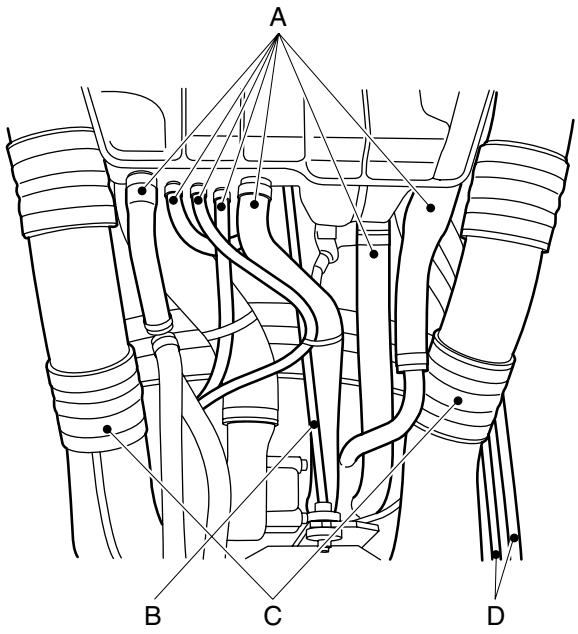
1. Disconnect the earth lead from the battery pole.
2. Drain the coolant.
3. Remove the coolant hoses (A) between the engine, the radiator and the header tank.
4. Remove the reaction rod (B) between the engine and the radiator.
5. Remove the air inlet hoses (C) between the engine and the intercooler. Plug the openings.
6. Remove the air-conditioning compressor, if present, so that it can be put aside with the pipes (D) attached.
7. Remove the fixing nuts of the viscous fan clutch and place the viscous fan clutch and the fan in the wind tunnel.
8. Disconnect the earth strip on the flywheel housing.
9. Properly suspend the engine in the hoist.
10. Remove the central engine mount fixing bolts at the front and/or back of the engine.
11. Lift the engine up as much as is necessary.
12. Remove the engine mounting.



M201019

Installing the engine mounting

1. Tighten the engine mounting fixing bolts to the specified torque, see main group “Technical data”.
2. Install the viscous fan clutch and the fan. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the reaction rod (B) between the engine and the radiator.
4. Install the air inlet hoses (C) between the engine and the intercooler.
5. Install the coolant hoses (A) between the engine, the radiator and the header tank.
6. If fitted, install the air-conditioning compressor.
7. Install the earth strip from the chassis to the flywheel housing.
8. Reconnect the earth lead to the battery.
9. Fill the cooling system.



M201019

4.3 REMOVAL AND INSTALLATION, VALVE COVER

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removal of the valve cover

1. Clean the area around the valve cover.
2. Remove the fixing bolts from the valve cover.
3. Remove the valve cover and the valve cover gasket.

Installation of the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Install the valve cover, using a new valve cover gasket.
3. Install the attachment bolts of the valve cover and tighten them to the specified tightening torque, see main group “Technical data”.

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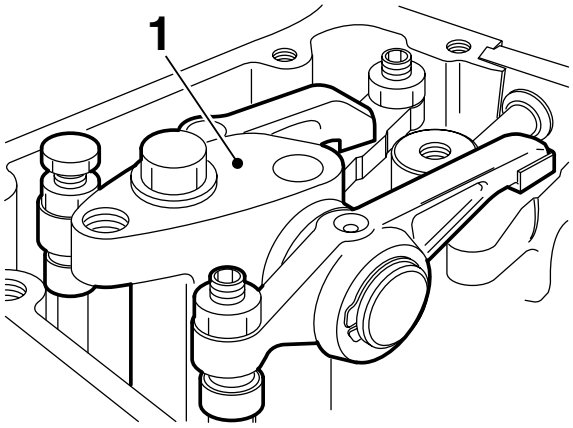
4.4 REMOVAL AND INSTALLATION, VALVE MECHANISM

Removing the valve mechanism

1. Remove the valve covers.
2. Remove the DEB or the lubricating-oil strip (depending on model).

   Note:
   Place numbers on the rocker brackets (a) and the bridges (2-3-4), to allow reinstallation in the same position.
3. Remove the rocker brackets (1).
4. Remove the bridges (2-3-4).



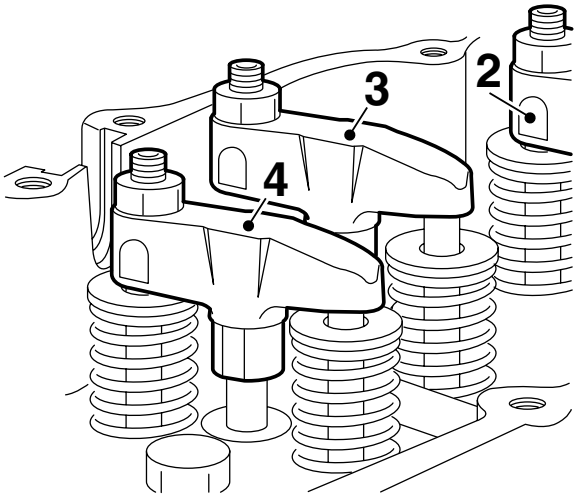
M200559

Installing the valve mechanism

Note:
In engines equipped with a DEB, the bridges (2-3-4) of the inlet and exhaust valves are not the same.
In engines without a DEB, the bridges (2-3-4) of the inlet and exhaust valves are the same.

1. Install the bridges (2-3-4) on the valves.
2. Adjust the bridges (2-3-4), see chapter “Checking and adjusting”.
3. Tighten the rocker brackets (1) by hand.

   Note:
   Depending on the engine position, some rocker brackets (1) will have to be positioned against the pressure of the valve springs.
   The rocker bracket will resist this spring pressure and can therefore not be positioned correctly. By cranking the crankshaft always $^1/_3$ stroke using the special tool (DAF no. 1310477), the rocker brackets (1) can be tightened according to the injection sequence 1-5-3-6-2-4.



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4. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Install the DEB or the lubricating-oil strip (depending on model). Install the lubricating-oil strip in such a way that the mark “cyl. 1/4” is located on cylinder 1 or cylinder 4 respectively. For the tightening torques of the fixing bolts, see main group “Technical data”.
6. Adjust the valve clearance and, if present, the DEB clearance, see chapter “Inspection and adjustment”.
7. Fit the valve covers.

4.5 REMOVAL AND INSTALLATION, CYLINDER HEAD

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removing the cylinder head

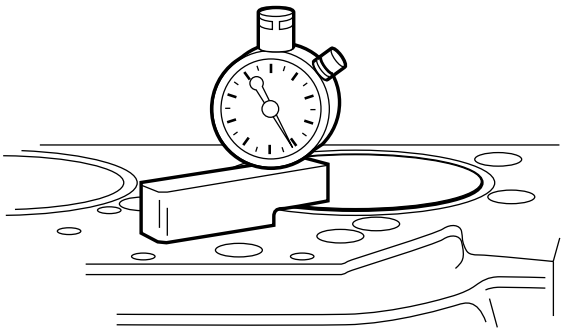
1. Disconnect the earth lead from the battery pole.
2. Drain the coolant.
3. Disconnect all electrical wiring around the engine which is relevant for the removal of the cylinder heads.
4. Remove the inlet air hoses between the engine and the intercooler.
5. Remove the inlet pipe from the intercooler to the turbocharger.
6. Remove the compressor pipe from the air inlet pipe to the compressor.
7. Remove the reaction rod between the engine and the radiator.
8. Slacken the air-conditioning compressor tensioning device, if present.
9. Remove the fixing bolts of the air-conditioning compressor attachment bracket, if present.
10. Remove the heat shields from the exhaust manifold.
11. Remove the fixing bolts from the exhaust manifold and move the manifold and the turbocharger a little away from the cylinder heads.
12. Remove the hoses of the auxiliary heating, if applicable.

13. Remove the coolant filter, if present.
14. Remove the fuel leak-off pipe between the fuel filter and the fuel leak-off pipe on the inlet manifold.
15. Remove the entire fuel filter from the coolant pipe.
16. Remove both sets of injection lines.
17. Remove the water hoses between the thermostat housing and the radiator.
18. Remove the coolant pipe together with the thermostat housing.
19. Remove the fixing bolts of the inlet manifold and take it completely off the cylinder heads.
20. Remove the valve covers.
21. Remove the injectors.
22. Remove the valve mechanism.
23. Remove the push rods.
24. Remove the valve sleeve.
25. Remove the cylinder head bolts.
26. Remove the cylinder head from the cylinder block.
27. Remove any remaining gasket pieces from the cylinder head and the cylinder block.
28. Check the cylinder block sealing faces.

29. Check the threaded holes in the cylinder block for damage and cracking.

30. Use the special tool to check that the height which the cylinder liner protrudes above the cylinder block is within the tolerance limits, see main group “Technical data”.

31. Check the cylinder head, see chapter “Inspection and adjustment”.



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Installing the cylinder head

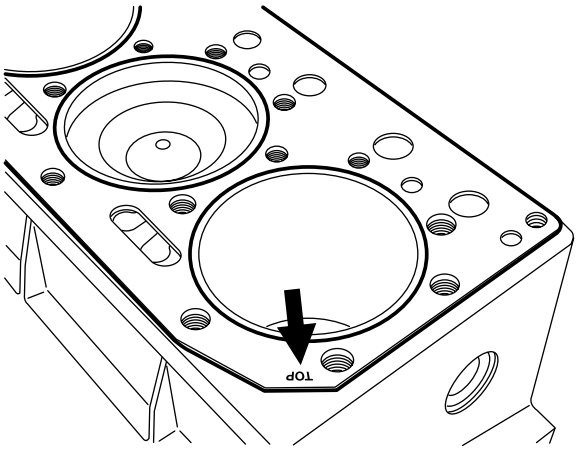
1. Clean the threaded holes in the cylinder block, using a screw tap.

2. Insert both guiding pins (DAF no. 0694912) into the threaded holes of the cylinder block.

3. Place the new gasket(s) on the cylinder block, making sure that the letters **TOP** are visible. The cylinder head gasket must **not be retorqued**.

4. Place the cylinder head(s) on the cylinder block and hand-tighten a number of cylinder head bolts.

   Note:
   To prevent the inlet and outlet manifolds from being installed with tension, the inlet and exhaust manifolds must be installed before the cylinder head bolts are tightened.



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5. Install the inlet and exhaust manifolds with new gaskets and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.

   Note:
   The M16 cylinder head bolts may be used a maximum of three times. After tightening the bolts, mark the bolt heads with a centre punch, to indicate how often they have been used.

   New bolts should not be marked on the first fitting.

   Bolts marked with 2 centre points must not be reused and must be replaced by new ones.

   When fitting used bolts, clean the thread and check for damage.

6. Fit the M16 and M12 bolts, after having applied a drop of oil to the bearing face of the bolt head and locking compound to the thread, see main group “Technical data”.

7. Remove the two guiding pins, and replace them with the two remaining cylinder head bolts.

8. Tighten the cylinder head bolts to the specified tightening torque and in the sequence shown, see main group “Technical data”.

9. Install the valve sleeve. Tighten the fixing bolts to the specified torque. See main group “Technical data”.

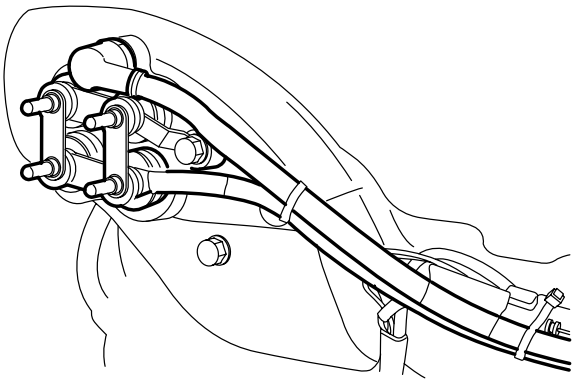
10. Fit the push rods.

11. Install the injectors.
12. Install the valve mechanism.
13. Install the coolant pipe and the thermostat housing with new gaskets.
14. Install the water hoses between the radiator and the thermostat housing.
15. Fit the injection lines.
16. Fit the thermostat housing to the coolant pipe.
17. Install the fuel leak-off pipe between the fuel filter and the inlet manifold.
18. Install the coolant filter, if present, on the coolant pipe.
19. Install the hoses of the auxiliary heating, if present.
20. Install the heat shields of the exhaust manifold and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
21. Install the air-conditioning bracket, if present.
22. Adjust the V-belt tension of the air-conditioning compressor, see chapter “Checking and adjusting”.
23. Install the reaction rod between the engine and the radiator.
24. Install the compressor pipe from the air inlet pipe to the compressor.
25. Install the inlet pipe between the intercooler and the turbocharger.
26. Install the air inlet hoses between the engine and the intercooler.
27. Connect the electric wiring.
28. Reconnect the earth lead to the battery.
29. Fill the cooling system.

4.6 REMOVAL AND INSTALLATION OF GLOW FILAMENTS

Removing the glow filaments

1. Disconnect the earth lead from the battery pole.
2. Remove the electric wiring and connection strip from the glow filaments.
3. Remove the glow filaments.
4. Check the glow filaments for damage, see chapter “Inspection and adjustment”.



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Installing the glow filaments

1. Tighten the glow filaments to the specified tightening torque, see main group “Technical data”.
2. Connect the wiring and the connection strip. Make sure that the insulators are installed in the correct place.
3. Clean the contact surface of the glow filament earth cable to ensure that it is properly earthed on the inlet manifold.
4. Fit the earth lead to the battery pole.

5

4.7 REMOVAL AND INSTALLATION, INLET MANIFOLD

Removal, inlet manifold

1. Disconnect the earth lead from the battery pole.
2. Mark the connectors and remove the electric wiring from the inlet manifold.
3. Remove the coolant filter element, if present.
4. Remove the fuel leak-off pipe of the inlet manifold.
5. Remove the fuel filter element.
6. Remove the injection lines per set.
7. Remove the air inlet pipe between the intercooler and the inlet manifold.
8. Remove the attachment bolts from the inlet manifold and remove the manifold.

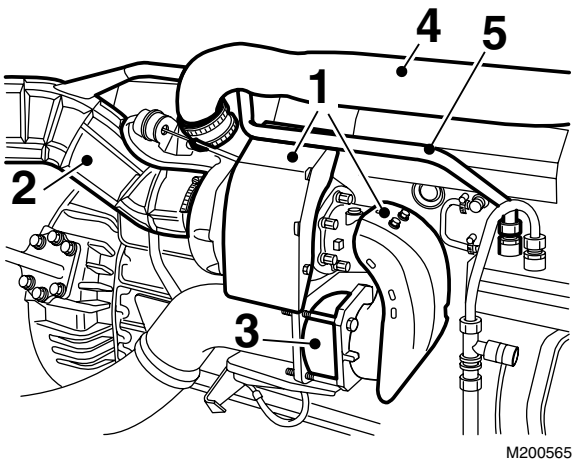
Installation, inlet manifold

1. Carefully clean the sealing faces of the inlet manifold and the cylinder head.
2. Install the inlet manifold with new gaskets, Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the air inlet hose between the intercooler and the inlet manifold.
4. Fit the fuel leak-off pipe to the inlet manifold.
5. Fit the injection lines per set.
6. Install the fuel filter element.
7. Install the coolant filter element, if present.
8. Connect the electric wiring to the inlet manifold and to the water pipe.
9. Reconnect the earth lead to the battery pole.

4.8 REMOVAL AND INSTALLATION, EXHAUST MANIFOLD

Removing the exhaust manifold

1. Remove the heat shields (1) from the turbocharger.
2. Remove the air inlet hose (2).
3. Remove the butterfly valve (3).
4. Remove the inlet air pipe (4) between the turbocharger and the intercooler.
5. Remove the compressor pipe (5).
6. Remove the heat shields from the exhaust manifold.
7. Remove the turbocharger oil supply and discharge pipes.
8. Remove the fixing bolts from the exhaust manifold and remove the manifold.



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Installing the exhaust manifold

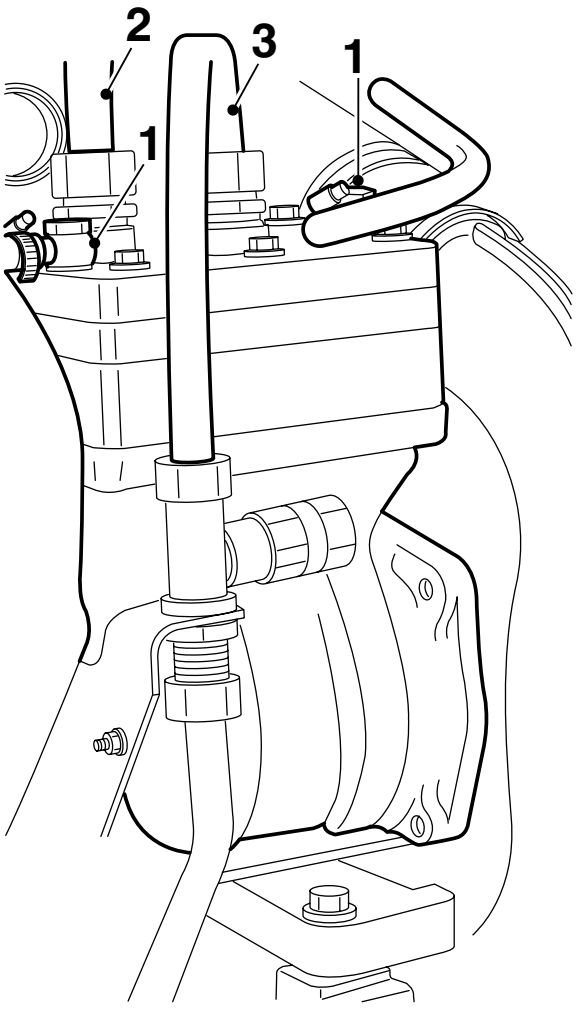
1. Install the exhaust manifold with new gaskets. Tighten the fixing bolts with the spacer sleeves to the specified torque, see main group “Technical data”.
2. Install the heat shields of the exhaust manifold and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
3. Install the oil discharge pipe for the turbocharger.
4. Spray clean engine oil into the oil supply of the turbocharger, and install the oil supply pipe.
5. Install the turbocharger pipe (5).
6. Install the inlet air pipe (4) between the turbocharger and the intercooler.
7. Install the butterfly valve (3).

8. Install the turbocharger heat shields (1). Tighten the fixing bolts to the specified torque. See main group “Technical data”.
9. Install the air inlet pipe (2). Tighten the fixing bolts to the specified torque. See main group “Technical data”.
10. Start the engine and check all connections for leaks.

4.9 REMOVAL AND INSTALLATION, AIR COMPRESSOR

Removal, air compressor

1. Partially drain the coolant.
2. Remove the coolant connections (1).
3. Remove the air pipes (2) and (3).
4. Disconnect the lubricating-oil pipe.
5. Disconnect the service pipe from the air dryer.
6. Remove the mounting bracket at the back of the compressor.
7. Remove the fixing bolts from the timing-gear cover.
8. Remove the compressor from the timing-gear case. Remove the O-ring from the compressor housing.



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Installation, air compressor

1. Fit a new O ring to the compressor housing and install the compressor on the timing-gear case.
2. Fit the fixing bolts of the air compressor. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the mounting bracket at the back of the compressor. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
4. Fit the service pipe.
5. Install the lubricating-oil pipe.
6. Install the air pipes (2) and (3).
7. Install the coolant pipes (1).
8. Fill the cooling system.

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4.10 REMOVAL AND INSTALLATION, STEERING PUMP

Removal, steering pump

1. Clean the steering pump and the surrounding area.
2. Remove the suction and delivery pipes from the steering pump. Collect the oil flowing out of the system.
3. Immediately plug the openings in the pump and pipes to prevent dirt entering the system.
4. Remove the two fixing bolts in the timing-gear cover and take the pump from the timing-gear case.
5. Check the gear wheel for wear or damage.
6. Remove the O-ring.

Installation of the steering pump

1. Fit a new O-ring.
2. Fit the steering pump. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the suction and delivery pipes of the steering pump. Fit the banjo bolts. Tighten the banjo bolts to the specified torque, see main group “Technical data”.
4. Fill the oil tank with the specified oil.
5. Bleed the steering system.
6. Check the pipes for leaks.

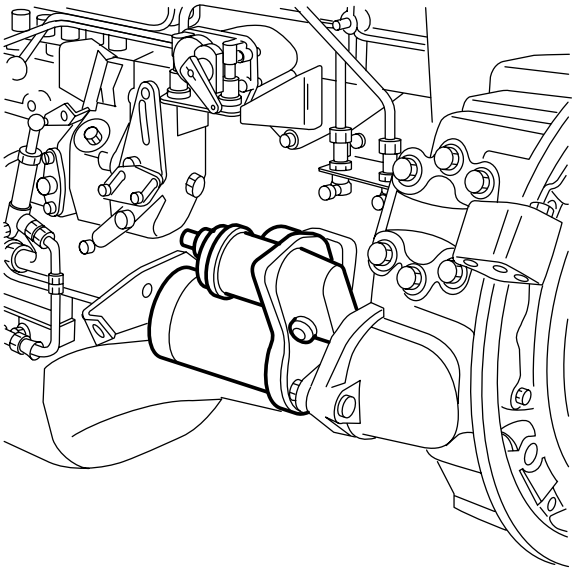
4.11 REMOVAL AND INSTALLATION, STARTING MOTOR

Removing the starting motor

1. Remove both battery leads from the battery poles.
2. Remove the electrical connections from the starting motor.
3. Remove the fixing nuts and the starting motor.
4. Check the toothed pinion for damage.

Installing the starting motor

1. Clean the contact surfaces of the starting motor and the flywheel housing.
2. Install the starting motor in the flywheel housing and tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
3. Install the electrical connections of the starting motor.
4. Reconnect both leads to the battery terminals.



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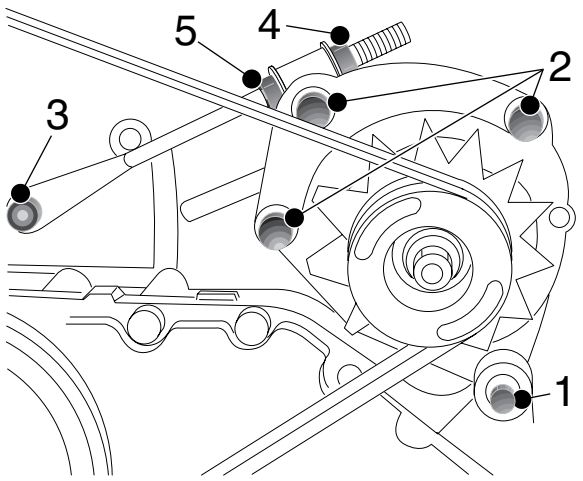
4.12 REMOVAL AND INSTALLATION, ALTERNATOR

Removing the alternator

1. Remove both battery leads from the battery poles.
2. Remove the electrical connections from the alternator.
3. Slacken the fixing bolt (3) from the threaded spindle which is attached to the cooling water pump.
4. Slacken the lock nut (5).
5. Remove the upper fixing bolts (2) of the alternator.
6. Remove the lower fixing bolt (1) of the alternator.
7. Remove the alternator.



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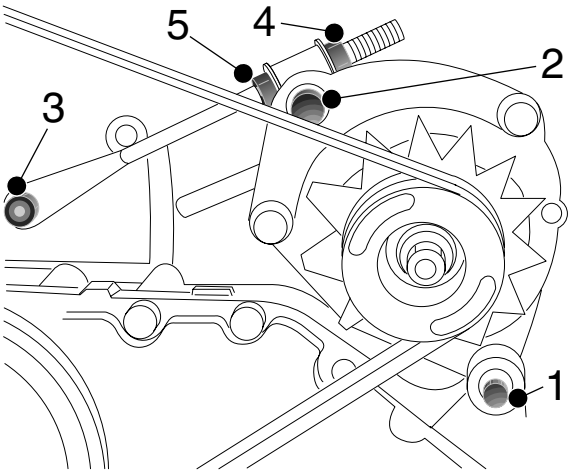
Installing the alternator

1. Fit the alternator on its bracket.
2. Install the lower fixing bolt (1) of the alternator.
3. Install the upper fixing bolts (2) of the alternator.
4. Install the V-belts and check the V-belt tension, see the chapter “Checking and adjusting”.
5. Install the electrical connections of the alternator.
6. Reconnect both leads to the battery terminals.

4.13 REMOVAL AND INSTALLATION, V-BELTS

Removal, water pump and alternator V-belt

1. Slacken the lower fixing bolt (1) of the alternator.
2. Slacken the upper fixing bolt (2) of the alternator.
3. Slacken the fixing bolt (3) from the threaded spindle which is attached to the water pump.
4. Turn the lock nuts (4) and (5) on the threaded spindle so that the alternator can be tilted towards the engine block and the V-belt can be removed from the pulley.
5. Remove the V-belt through the opening at the guide ring (see arrow in drawing). Hang the V-belt over a fan blade. Rotate the fan blade by blade, hanging the V-belt over them. Repeat this for the entire fan, after which the belt can be removed.



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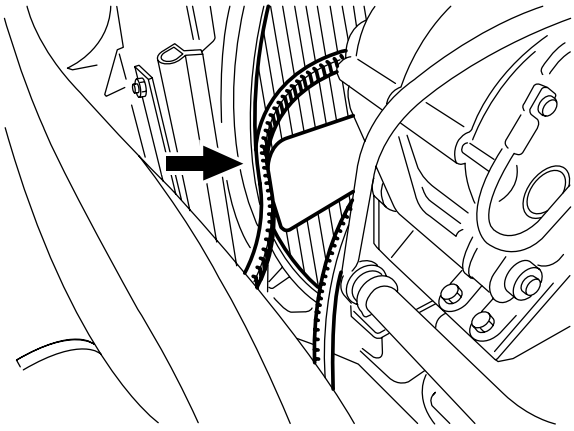
Note:
With versions where the fan ring is mounted on the engine block, the fan or the fan ring is to be disconnected prior to removal of the V-belt, depending on the accessibility of the attachment bolts.

Installation, water pump and alternator V-belt

1. Inspect the pulleys for damage, rust and grease deposits.
2. Install the V-belt through the opening at the guide ring (see arrow in drawing) and adjust the V-belt tension, see the chapter “Checking and adjusting”.
3. Install the fan if it has been removed.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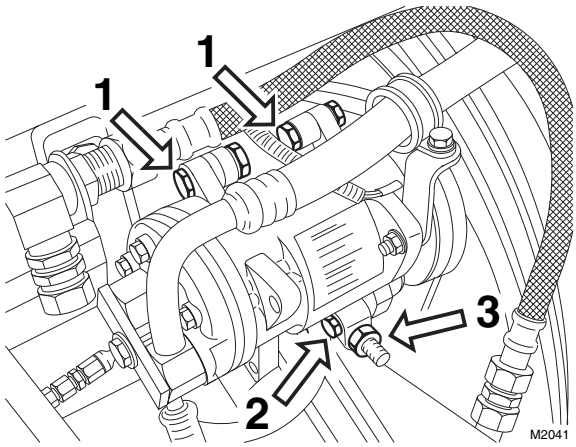
Removal, compressor and air-conditioning V-belt

1. Slacken the upper fixing bolt (1) on the compressor.
2. Slacken the lower fixing bolt (2) on the compressor.
3. Slacken the fixing bolt from the threaded spindle which is attached to the cooling-water pump.
4. Turn the lock nuts (3) on the threaded spindle so that the alternator can be tilted towards the engine block and the V-belt can be removed from the pulley.



Installation, compressor and air-conditioning V-belt

1. Inspect the pulleys for damage, rust and grease deposits.
2. Install the compressor and air-conditioning V-belt and adjust the V-belt tension, see the chapter “Checking and adjusting”.

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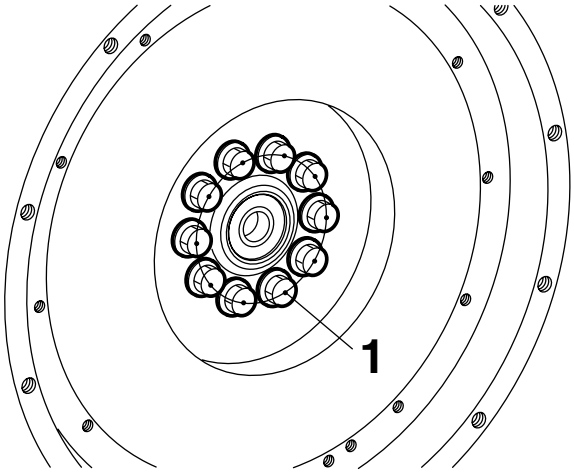
4.14 REMOVAL AND INSTALLATION, FLYWHEEL

Removing the flywheel

1. Remove the gearbox.
2. Remove the clutch release assembly and the clutch plate.
3. Remove the fixing bolts (1) from the flywheel.



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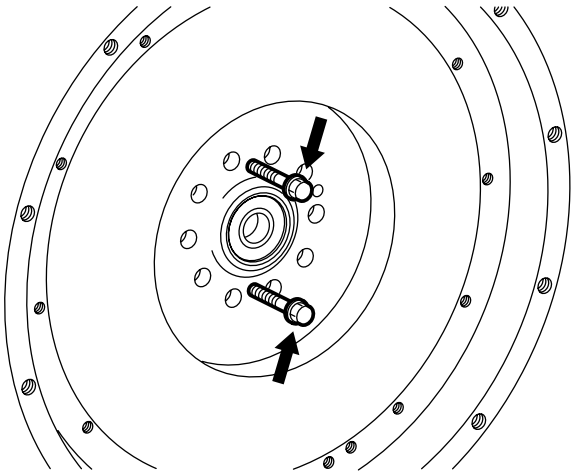
4. Use two threaded bolts to remove the flywheel from the dowel pin.
5. Remove the flywheel.

Installing the flywheel

1. Clean the flywheel housing.
2. Clean the crankshaft flange, the dowel pin and the fixing bolts. Remove the locking compound from the threaded holes.
3. Clean the back of the flywheel and install the flywheel.
4. Fit the fixing bolts. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Install the clutch plate and the clutch release assembly.
6. Install the gearbox.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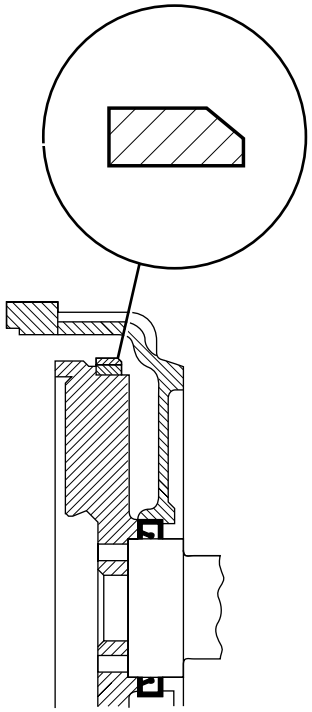
4.15 REMOVAL AND INSTALLATION, STARTER RING

Removing the starter ring

1. Remove the flywheel.
2. Remove the starter ring by tapping it off the flywheel using a blunt chisel. If this is not possible, cut it between two teeth, using a sharp chisel.

Installing the starter ring

1. Clean the flywheel and the starter ring. Ensure that the contact areas are degreased.
2. Heat the new starter ring evenly in an oven, see main group “Technical data”.
3. Tap the starter ring onto the flywheel so that the bevelled sides of the teeth point towards the starting motor. Ensure a good contact between starter ring and flywheel, all round.
4. Install the flywheel.



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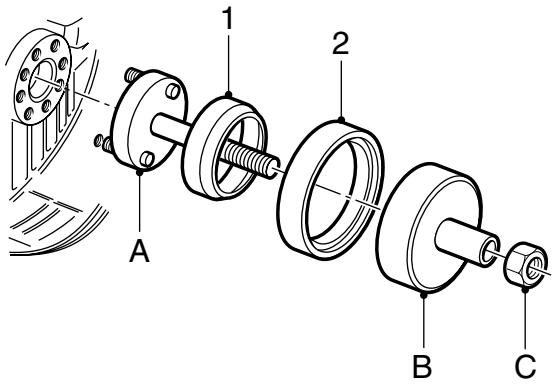
4.16 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING SEALING RING

Note:
Each new oil sealing ring is supplied with a plastic mounting ring, which can only be used **once**.

Removing the flywheel housing sealing ring
1. Remove the flywheel.
2. Drill two small holes into the oil seal and, using the special tool (DAF no. 0484899 and DAF no. 0694928), pull the oil seal out of the flywheel housing.

Installing the flywheel housing sealing ring
1. Thoroughly clean sealing ring recess and check for damage. Even the slightest damage can cause a leak.
2. Clean the crankshaft flange.

   Note:
   If a filler ring was fitted in the oil sealing ring recess, re-install this filler ring.
3. Install the base plate (A) of special tool (DAF no. 0535598) on the crankshaft flange.
4. Then place the new **dry** oil sealing ring (the felt ring may not become greasy) over the supplied plastic mounting ring (1).
5. Install the supplied plastic mounting ring (1) and the oil sealing ring on the crankshaft flange.
6. Place the thrust washer (B) over the spindle and gradually tighten the nut (C) until you feel a clear resistance.
7. Disassemble the thrust washer (B) and remove the plastic mounting ring (1).
8. Place the thrust washer (B) over the spindle and gradually tighten the nut (C) until the sealing ring is properly positioned.
9. Remove the special tool.
10. Install the flywheel.



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4.17 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING

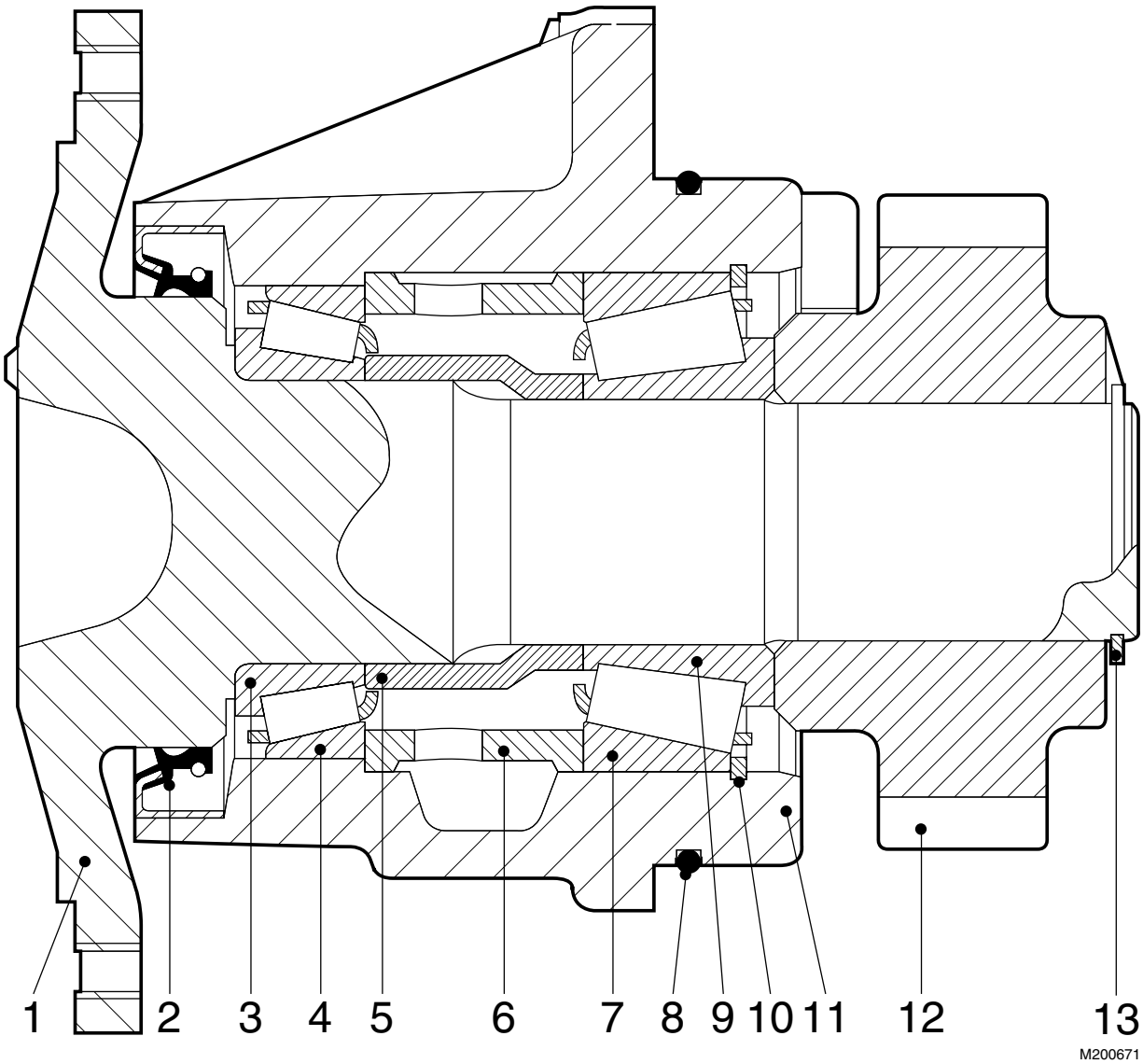
Removing the flywheel housing

1. Remove the flywheel.
2. Disconnect the earth cable from the flywheel housing.
3. Remove the starting motor.
4. Remove the crankshaft position sensor.
5. Properly suspend the engine in the hoist.
6. Remove the two oil sump fixing bolts on the flywheel housing.
7. Slacken the other oil sump fixing bolts until the oil sump is free from the flywheel housing.
8. Remove the central engine mount fixing bolts at the back of the engine.
9. Remove the fixing bolts from the flywheel housing.
10. Remove the flywheel housing.

Installing the flywheel housing

1. Remove the oil sealing ring from the flywheel housing, by carefully tapping or forcing it from the housing.
2. Remove any traces of old gaskets from the contact areas.
3. Check the sealing faces for damage.
4. Check the flywheel housing for cracks.
5. Apply a locking compound to the sealing face of the cylinder block, see main group “Technical data”. Apply the locking compound with a roller or brush, across the entire sealing face.
6. Install the flywheel housing and tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
7. Install the central engine mount fixing bolts at the back of the engine. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
8. Install the oil sealing ring.
9. Install the flywheel.
10. Install the starting motor.
11. Install the crankshaft position sensor.
12. Clean the contact surface of the earth cable, and connect it to the flywheel housing.
13. Install the oil sump fixing bolts. Tighten all fixing bolts to the specified torque, see main group “Technical data”.

4.18 REMOVAL AND INSTALLATION, FAN DRIVE



Removing the fan drive

1. Remove the fixing nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
2. Remove the water pump, alternator and fan-drive V-belts.
3. Remove the fixing nuts from the fan drive.
4. Remove the fan drive.

Installing the fan drive

1. Install a new O-ring (8), lightly greased, in the groove of the bearing housing (11).
2. Apply engine oil to the bearings in the bearing housing.
3. Install the fan drive in the timing-gear case. Tighten the fixing nuts crosswise to the specified tightening torque, see main group “Technical data”.
4. Install the water pump, alternator and fan-drive V-belts. Adjust the V-belts, see chapter “Checking and adjusting”.
5. Install the viscous fan clutch and the fan.

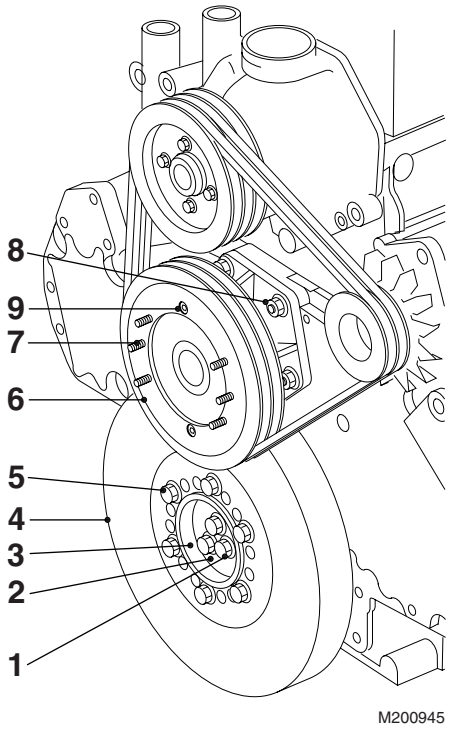
4.19 REMOVAL AND INSTALLATION, VIBRATION DAMPER

Removing the vibration damper

1. Remove the fixing nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
2. Remove the water pump, alternator and fan-drive V-belts.
3. Remove the fan pulley fixing bolts (9).
4. Remove the fan pulley (6).
5. Remove the fixing bolts (5) of the vibration damper.
6. Remove the vibration damper (4).

Installing the vibration damper

1. Check the vibration damper for external damage and silicone liquid leaks. In the event of damage or leaks, the vibration damper should be replaced.
2. Fit the vibration damper (4). Tighten the attachment bolts (5) to the specified torque, see main group “Technical data”.
3. Install the fan pulley (6) on the fan drive and tighten the fixing bolts (9) to the specified tightening torque, see main group “Technical data”.
4. Install the V-belts and check the V-belt tension, see the chapter “Checking and adjusting”.
5. Install the viscous fan clutch and the fan.



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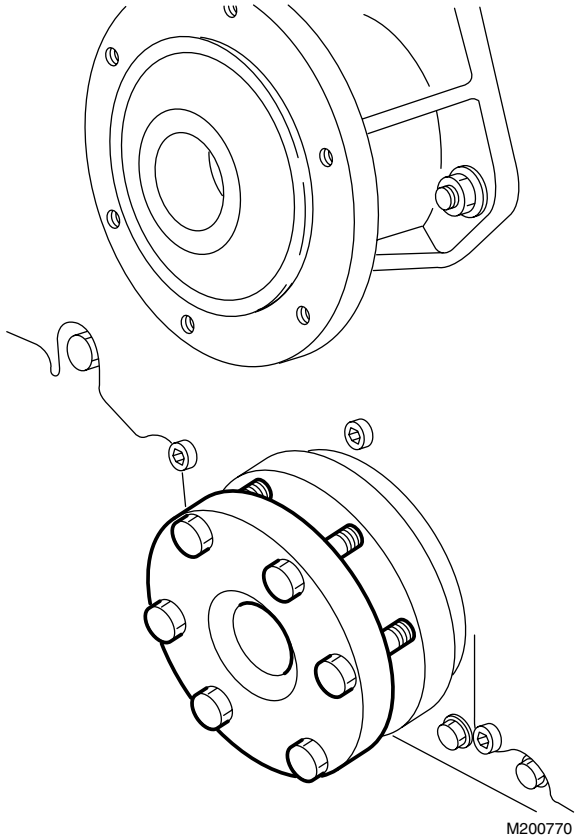
4.20 REMOVAL AND INSTALLATION, VIBRATION-DAMPER HUB

Removing the vibration damper hub

1. Remove the vibration damper.
2. Remove the fixing bolts from the vibration damper hub, and remove the thrust piece.
3. Remove the vibration damper hub using the special tool (DAF no. 1310422).

Installing the vibration damper hub

1. Install the vibration damper hub onto the crankshaft.
2. Install the thrust piece. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the vibration damper.



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4.21 REMOVAL AND INSTALLATION, TIMING-GEAR COVER SEALING RING

Removing the timing-gear cover sealing ring

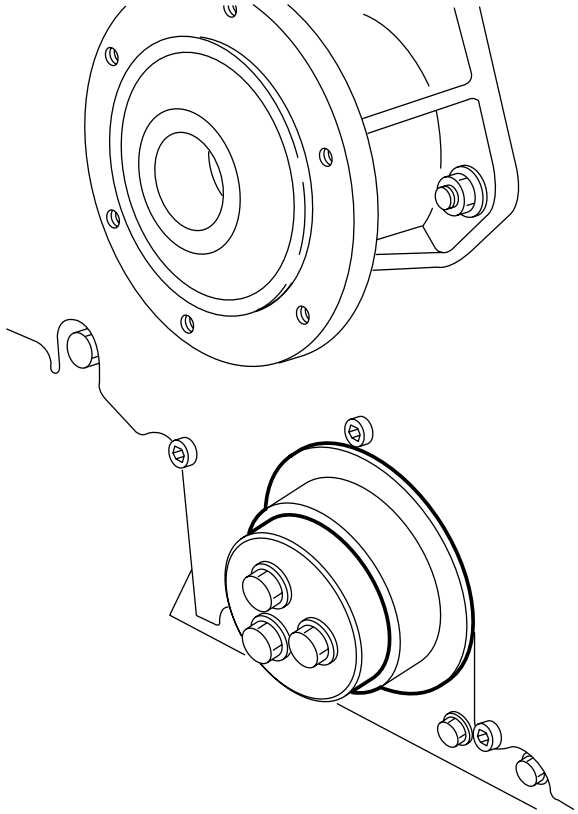
1. Remove the vibration damper hub.
2. Remove the timing-gear cover sealing ring by drilling two holes in the sealing ring and using special tools (DAF no. 0484899 and DAF no. 0694928) to pull the sealing ring from the timing-gear cover.

Installing the timing-gear cover sealing ring

1. Clean and check the sealing ring recess in the timing-gear cover. Even minimal damage can lead to a leak.

   Note:
   If a filler ring was fitted in the oil sealing ring recess, re-install this filler ring.

2. Use the special tool (DAF no. 1310424) to fit a **dry** new sealing ring and install the thrust piece in the recess of the timing-gear cover.
3. Remove the special tool.
4. Install the vibration damper hub.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4.22 REMOVAL AND INSTALLATION, TIMING-GEAR COVER

When the engine or parts thereof are opened, dirt may enter. This may result in serious damage to the engine. You should therefore clean the engine before opening it.

Removing the timing-gear cover

1. Remove the vibration damper hub.
2. Remove the oil filler pipe.
3. Mark the positions of the various fixing bolts and studs.
4. Remove the fixing bolts and studs from the timing-gear cover.
5. Remove the timing-gear cover.
6. Remove any remains of the gasket. Clean and check the sealing faces, dowel pins and locating holes.
7. Remove the oil sealing ring from the timing-gear cover.

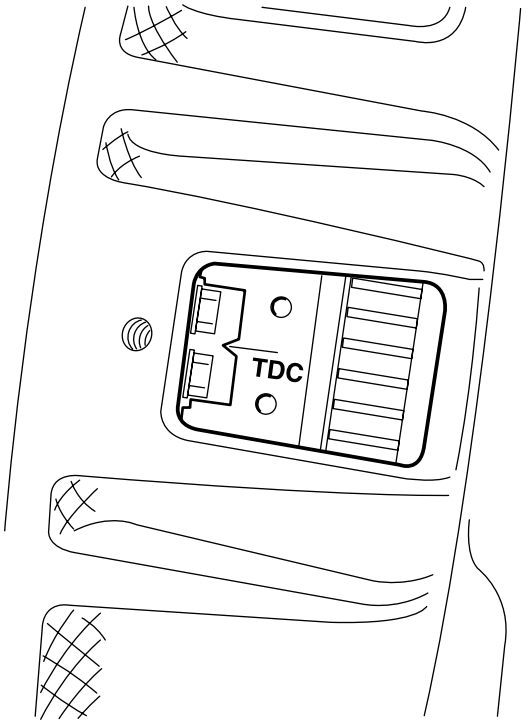
Installing the timing-gear cover

1. Use three studs to position the gasket. Install the new gasket.
2. Install the timing-gear cover.
3. Install the fixing bolts and the studs. Tighten the fixing bolts and studs to the specified torque, see main group “Technical data”.
4. Remove the three studs used to position the gasket and replace them by the remaining fixing bolts.
5. Install the oil filler pipe, fitted with a new O-ring.
6. Install the timing-gear cover sealing ring.
7. Install the vibration damper hub.

4.23 REMOVAL AND INSTALLATION, TIMING GEAR WHEELS

Removing the timing gear
1. Remove the valve covers.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
3. Remove the timing-gear cover.

   Note:
   It is possible that the marks of the intermediate gear wheel are **not** exactly opposite the camshaft and crankshaft gear wheel.



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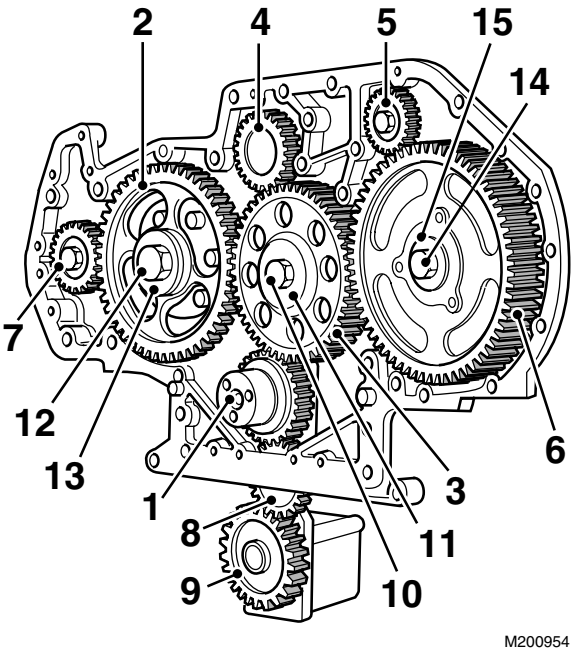
Removing the intermediate gear wheel
1. Remove the fixing bolt (10) with the axial thrust washer (11).
2. Remove the intermediate gear wheel (3).

Removing the camshaft gear wheel
1. Remove the fixing bolt (12) of the camshaft gear wheel (2).
2. Remove the intermediate gear wheel.
3. Remove the camshaft gear wheel using a commercially available puller.

Removing the pump housing camshaft gear wheel
1. Remove the fixing bolt (14) of the pump housing camshaft gear wheel (6).
2. Remove the intermediate gear wheel.
3. Remove the gear wheel using a commercially available puller.



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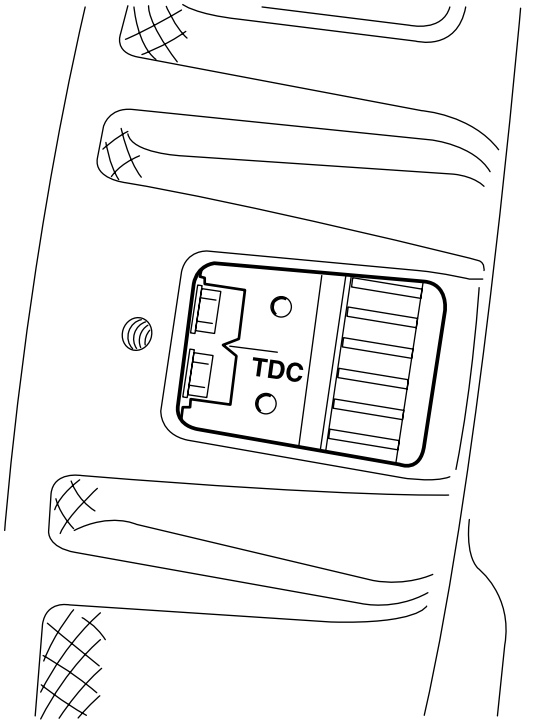
Installing the timing gear wheels

1. Remove the valve covers.
2. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).



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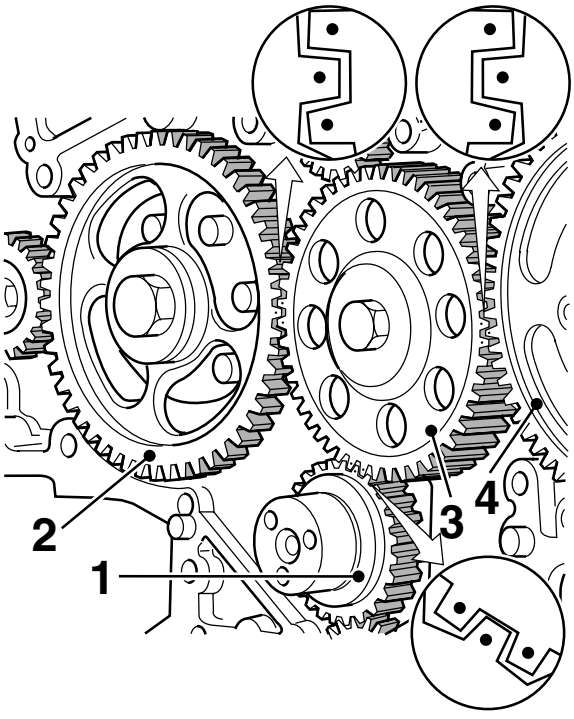
Installing the intermediate gear wheel

1. Install the intermediate gear wheel (3) in such a position that the marks of the camshaft gear wheel (2), crankshaft gear wheel (1) and intermediate gear wheel (3) are in line.



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2. Install the fixing bolt (10) with the axial thrust washer (11) from the intermediate gear wheel (3). Tighten the fixing bolt to the specified torque, see main group “Technical data”.

3. Check whether the gear wheels have some play.

Installing the camshaft gear wheel

1. Install the gear wheel (2) onto the camshaft.

2. Install the intermediate gear wheel (3).

3. Install the fixing bolt (12) with thrust washer (13) of the camshaft gear wheel (2). Tighten the fixing bolt (12) to the specified tightening torque, see main group “Technical data”.

4. Check whether the gear wheels have some play.

Installing the pump housing camshaft gear wheel

1. Fit the pump housing camshaft gear wheel (6) onto the axle end.

2. Install the intermediate gear wheel.

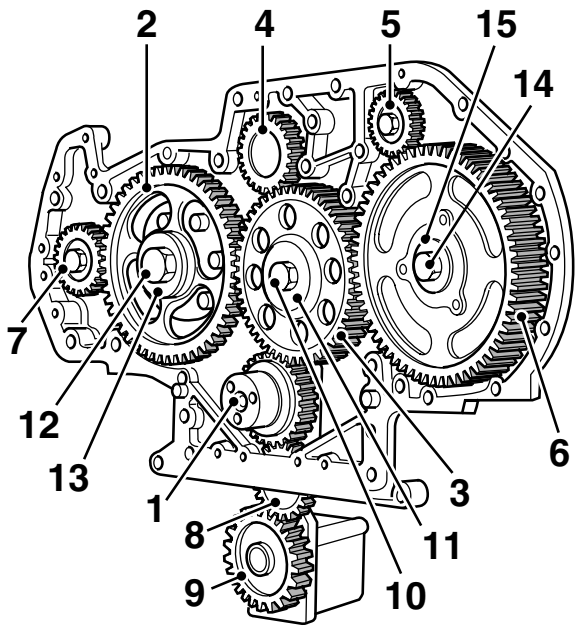
3. Install the fixing bolt (14) of the pump housing camshaft gear wheel (6). Tighten the fixing bolt to the specified torque, see main group “Technical data”.

4. Check whether the gear wheels have some play.

Installing the timing gear

1. Install the timing-gear cover.

2. Fit the valve covers.



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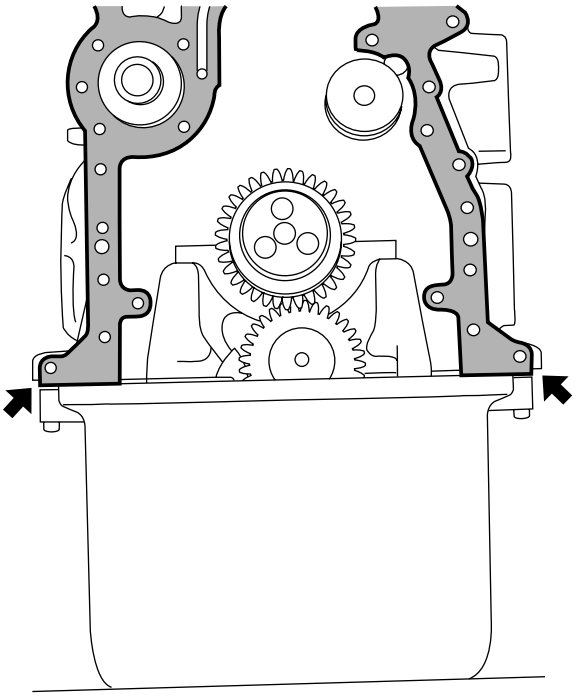
4.24 REMOVAL AND INSTALLATION, TIMING-GEAR CASE

Removing the timing-gear case

1. Remove the timing gear wheels.
2. Remove the air compressor.
3. Remove the steering pump.
4. Remove the fixing bolts and the lock plate of the cam shaft.
5. Slacken the oil sump fixing bolts until the oil sump is free from the timing-gear case.
6. Remove the fixing bolts from the timing-gear case to the engine block, and remove the timing-gear case.



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Installing the timing-gear case

1. Remove any remains of the gasket. Clean and check the sealing faces, dowel pins and locating holes.
2. To position the gasket, insert three studs, and install the new gasket.
3. Then first remove any excess gasket material between the engine block and the oil sump.
4. Install a new O-ring on the air compressor.
5. Install the timing-gear case.
6. Install the fixing bolts for the timing-gear case. Tighten the fixing bolts to the specified tightening torque, see main group “Technical data”.
7. Tighten the oil sump fixing bolts to the specified tightening torque, see main group “Technical data”.
8. Remove the fixing bolts and the lock plate of the cam shaft. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
9. Install the timing gear wheels.
10. Install the air compressor.
11. Fit the steering pump.

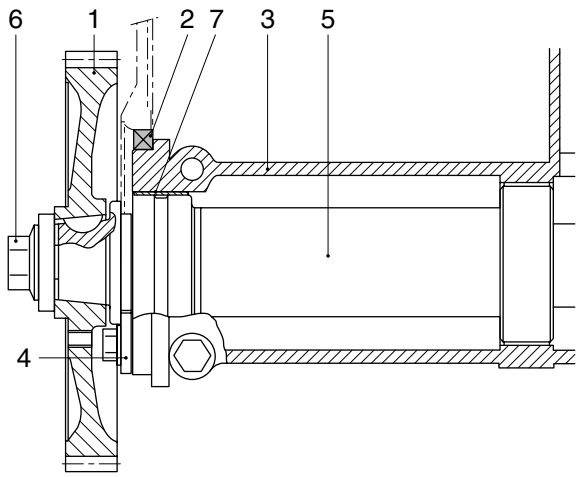
4.25 REMOVAL AND INSTALLATION, TIMING GEAR SEALING RING

Removing the timing-gear case sealing ring

1. Position cylinder 1 in the top dead centre (TDC on the flywheel, cylinder 6 in rocking position).
2. Remove the pump housing camshaft gear wheel (1).
3. Remove the sealing ring (2) by tapping it from the timing-gear case in the driving direction.

Installing the timing-gear case sealing ring

1. Install a **dry** new timing-gear case sealing ring (2) using special tool (DAF no. 1329318).
2. Install the pump housing camshaft gear wheel (1).



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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY OF THE FAN DRIVE

The fan drive should be disassembled and assembled in a very accurate fashion. Inaccurate assembly of the fan drive may produce strange noises in the engine or severe engine damage.

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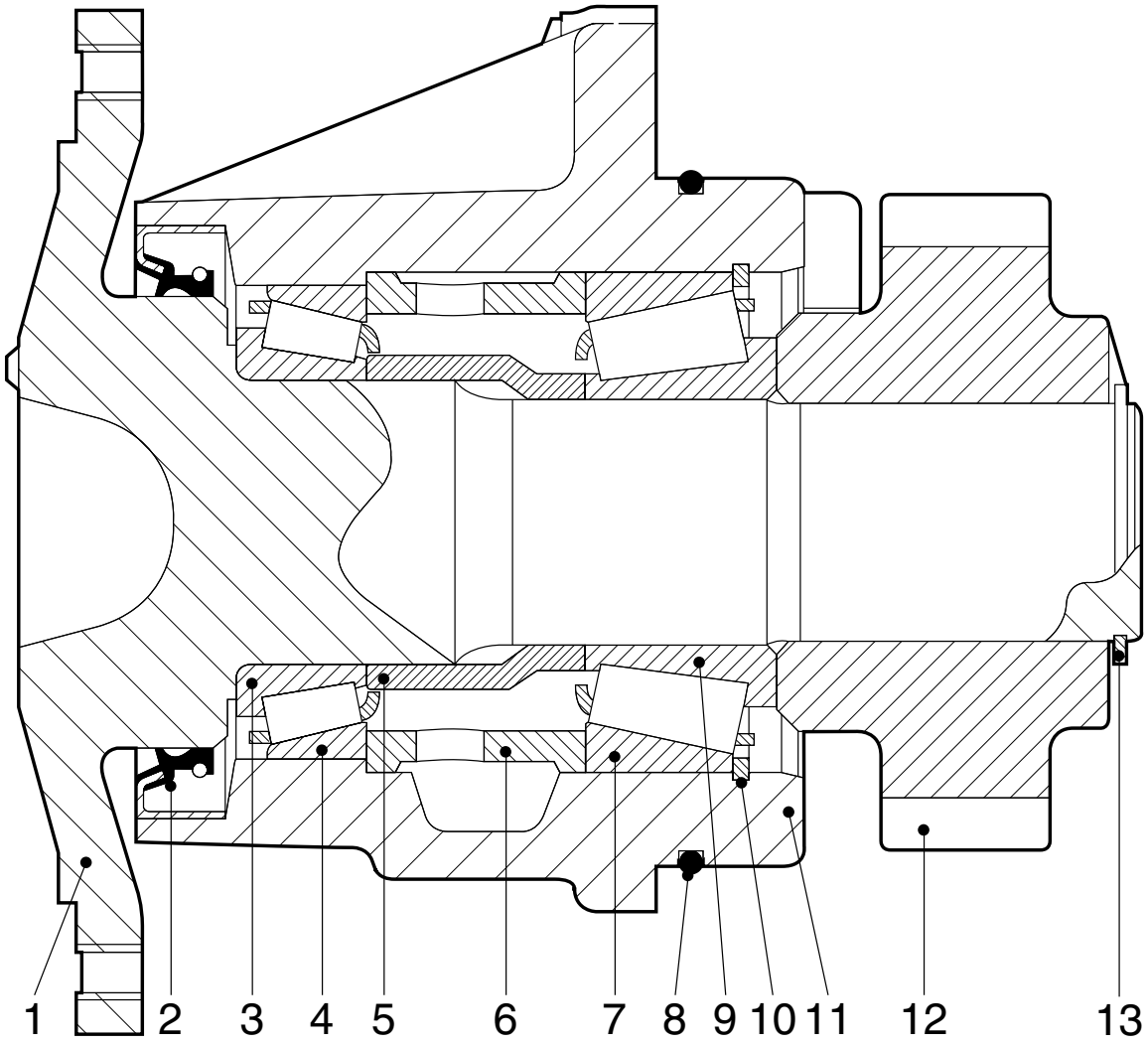
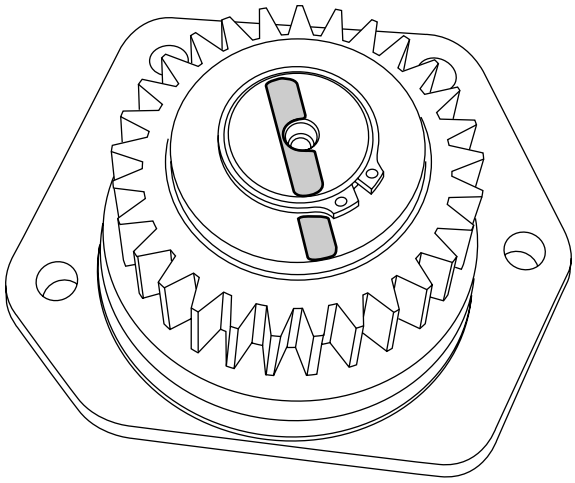


M200671

Disassembling the fan drive

1. Remove the circlip (13) on the gear wheel (12) side.

   Note:
   A mark may have been provided on the rear side of the shaft during initial assembly. This mark is used to check whether the gear wheel (12) has turned relative to the shaft. If so, the shaft and/or the gear wheel (12) is/are rejected.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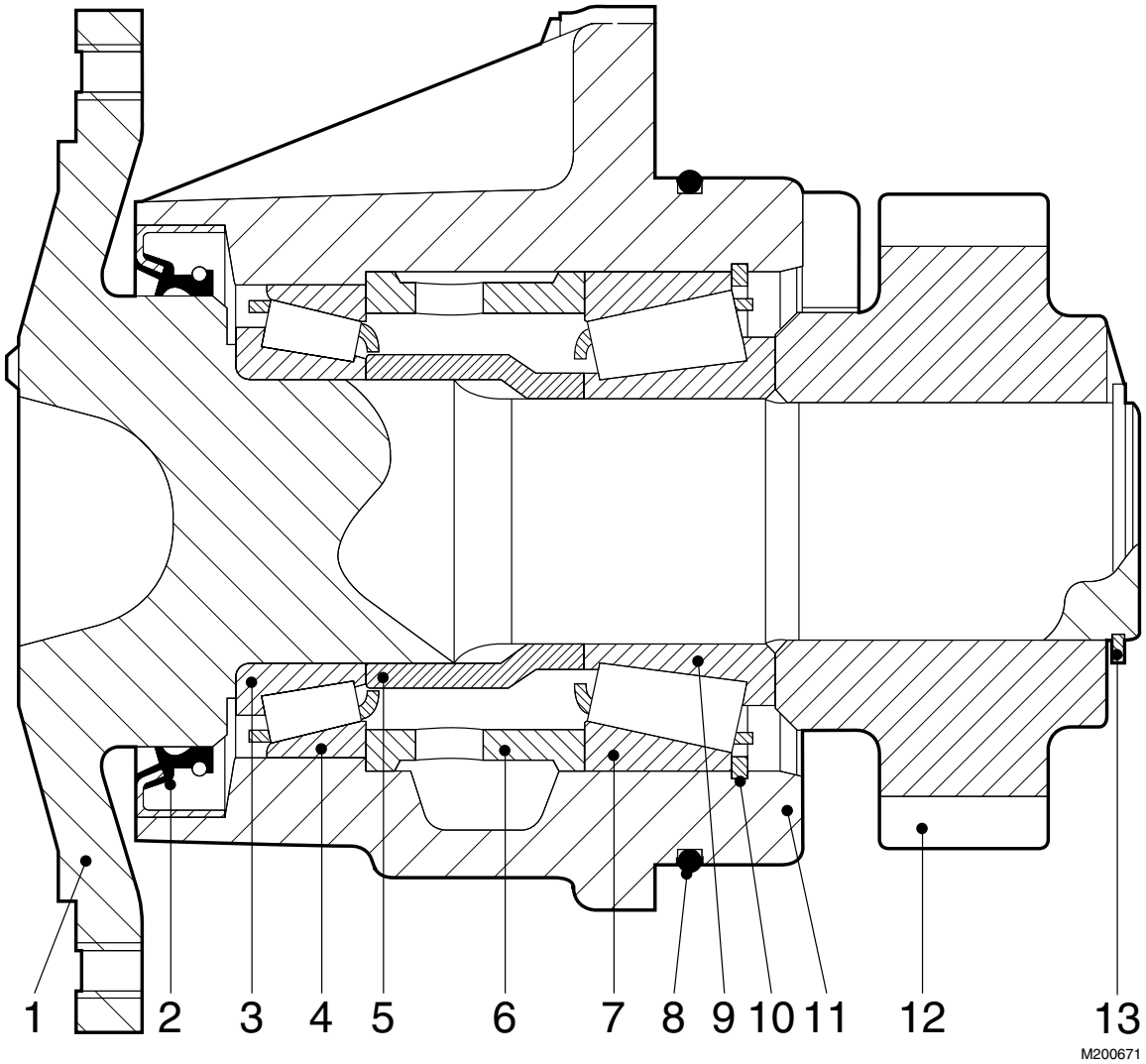
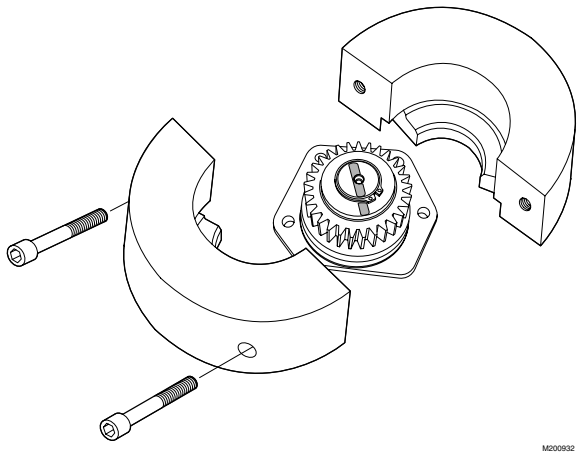
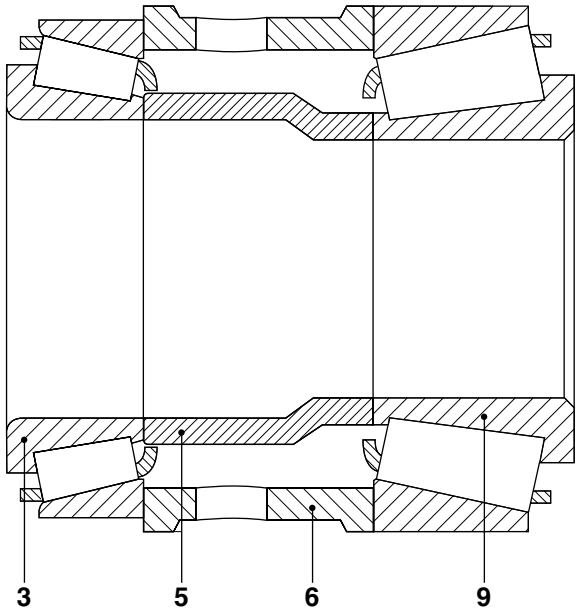


2. Fit the special tool (DAF no.1329445) under the gear wheel (12) and press the shaft out of the gear wheel (12).
3. Support the bearing housing (11) and press the shaft until the bearing (9) is released from the shaft.
4. Remove the shaft from the bearing housing (11) and remove the spacer sleeve (5).
5. Remove the bearing (3) from the shaft.
6. Remove the oil sealing ring (2) from the bearing housing (11).
7. Remove the circlip (10) from the bearing housing (11).
8. Support the bearing housing (11) and press the bearing rings (4) and (7), with intermediate ring (6), jointly out of the bearing housing (11).



Assembling the fan drive

Note:
The bearings (3) and (9), with spacer sleeve (5) and intermediate ring (6), go together and **must be replaced as a set**. This is necessary to obtain a proper bearing play.
The parts must be free of dirt and grease.



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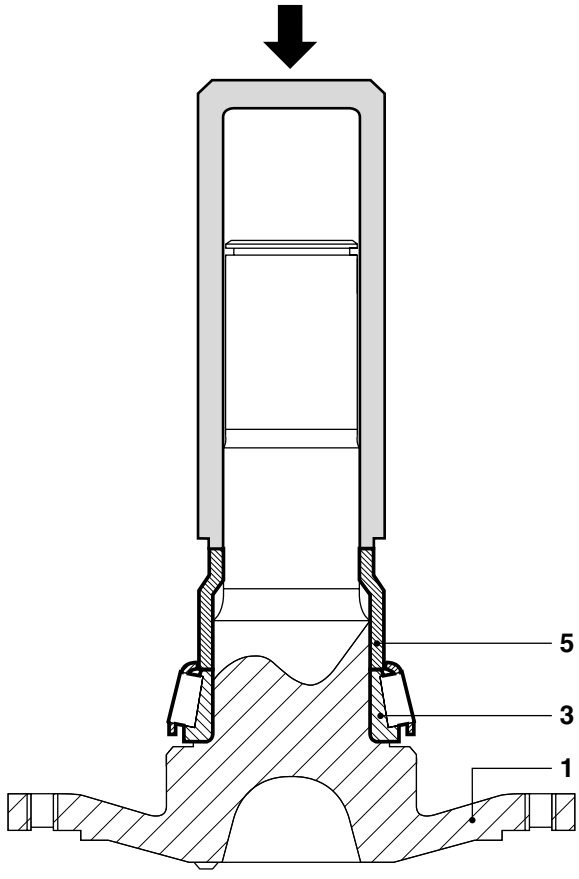
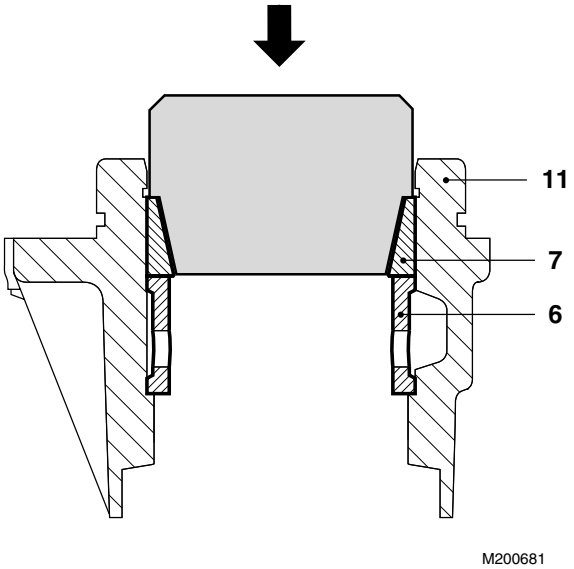
1. Using the special tool (DAF no. 1329386), press the bearing (3) with spacer (5) over the shaft (1).



M200680

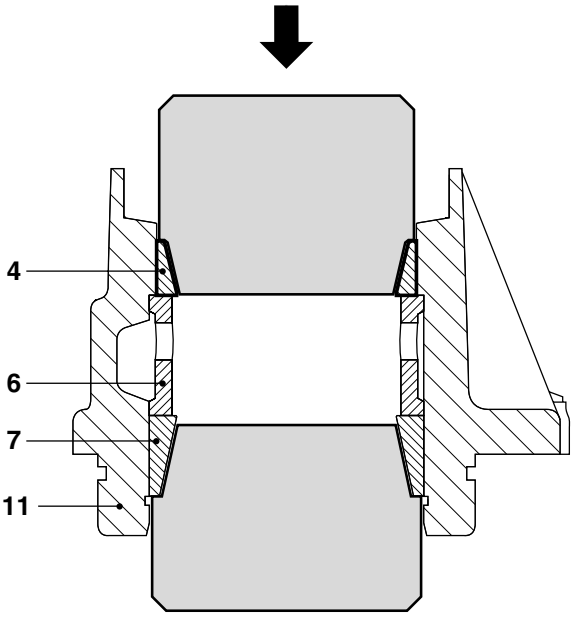
Note:
The holes in the intermediate ring should be on the oil sealing ring side.

2. Install the intermediate ring (6) in the bearing housing (11).
3. Use the special tool (DAF no. 1329383) to press the bearing ring (7) into the bearing housing (11) until it abuts on the intermediate ring (6).



M200681

4. Turn the bearing housing (11) and support the bearing ring (7), using the special tool (DAF no. 1329383).
5. Use the special tool (DAF no. 1329384) to press the bearing ring (4) into the bearing housing (11) until it abuts on the intermediate ring (6).



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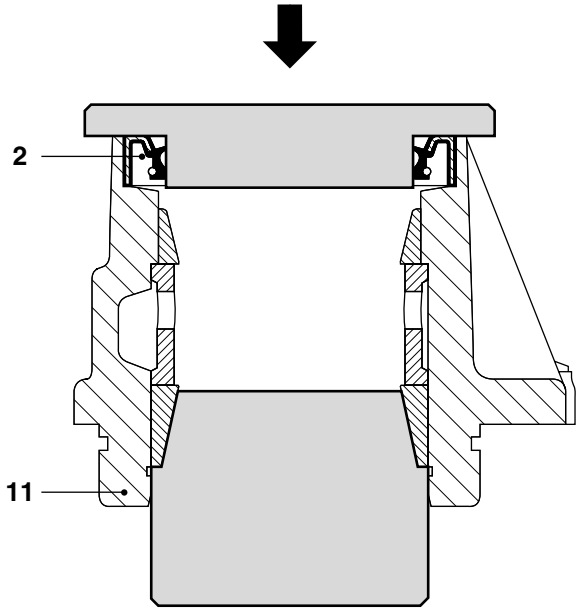
6. Use the special tool (DAF no. 1329385)) to press the oil sealing ring (2) into the bearing housing (11) until it is level with the front of the bearing housing (11).



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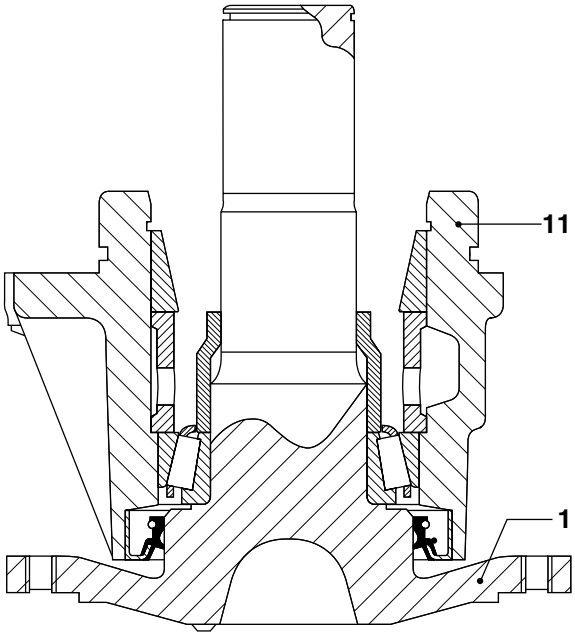
7. Lightly oil the bearing face of the oil sealing ring on the shaft (1) and carefully install the shaft (1) in the bearing housing (11).



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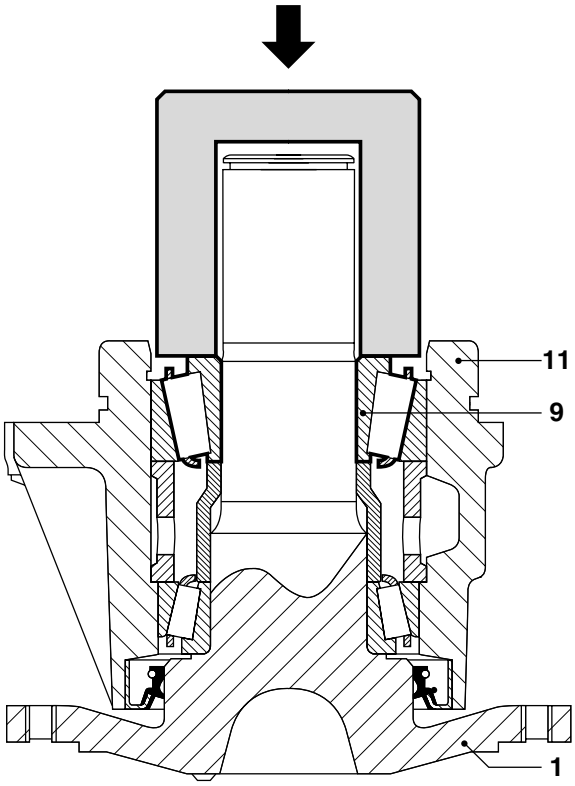
Note:
When forcing on the bearing (9), rotate the bearing housing (11) at least 5 times, allowing the bearings to settle.

8. Using **a low pressing force** and the special tool (DAF no. 1329382) press the bearing (9) onto the shaft (1) until it abuts.



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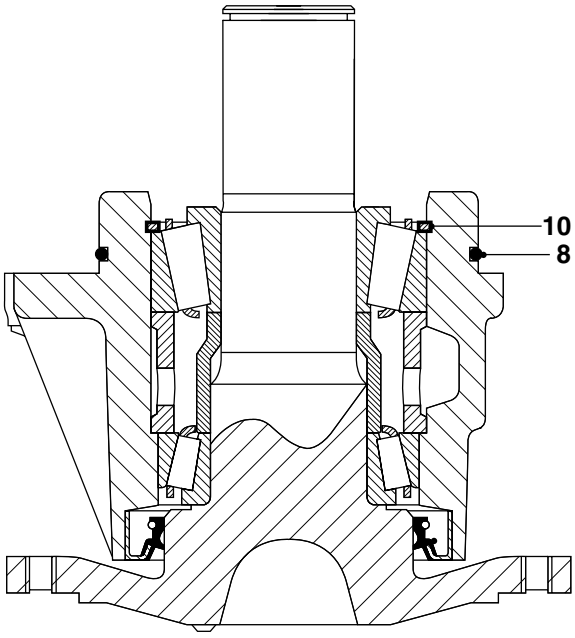
9. Install the circlip (10) in the bearing housing (11). Install a new O-ring (8).



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10. Remove any grease and oil from the shaft (1) and gear wheel (12) local to the contact areas.

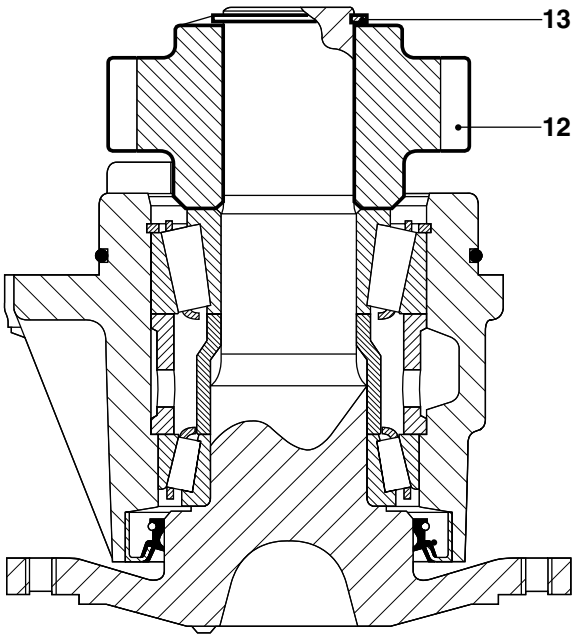
    Note:
    The gear wheel (12) must not under any circumstances be exposed to the specified maximum temperature for more than 30 minutes. This may have a negative impact on the mechanical properties of the gear wheel (12).

11. Heat the gear wheel (12) evenly to the specified temperature in the shortest possible time (on a hot plate using thermal pins), see main group “Technical data”.

12. Install the gear wheel (12) onto the shaft (1). Do **not** use a **press**.

13. Fit the circlip (13).

14. Make a marking across shaft (1) and gear wheel (12). This is necessary to check during inspection or repair whether the gear wheel (12) has turned relative to the shaft (1).



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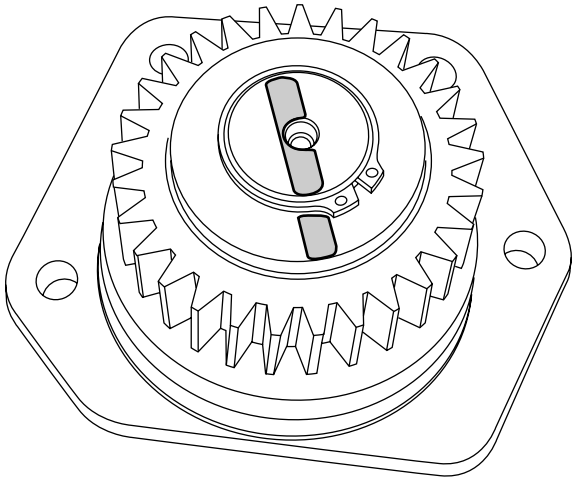
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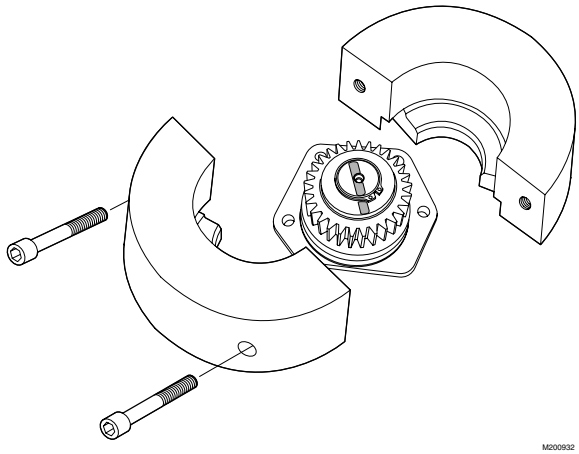
Inspect
Fit the special tool (DAF no.1329445) under the gear wheel (12) and press the shaft with a force of 100 kN. If the shaft is pressed from the gear wheel, the shaft and/or the gear wheel is/are rejected.

15. Apply a little engine oil in the bearing housing (11) and check the shaft (1) for even rotation.



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6. CLEANING

6.1 CLEANING THE ENGINE

Note:
It is advisable to clean the engine with a high-pressure cleaner before starting maintenance or service operations.
A clean engine makes your work easier, and enables you to notice any defects at an early stage.

Before cleaning the engine, check for any leaks.

If the engine is cleaned with a high-pressure cleaner, the latter must be used with care. It is also important to observe the following points:

- When cleaning the universal joint on the steering box, the spider seals may be forced open by the high-pressure jet of water, so that the grease behind them is flushed away. As a result, the spider may get stuck, so that the steering mechanism will jam.
- A bleed screw is fitted to the power steering fluid reservoir of the steering system. Water may enter the tank through this valve, causing damage to the steering mechanism.
- Make sure that when cleaning the radiator/intercooler element the zigzag-tube core is not damaged.
- Do not direct the high-pressure cleaner jet too long at the condenser of the air-conditioning system. As a result of the high temperature, the pressure in the system will become excessive, causing damage to the system.

- Ensure that no water can enter the gearbox via the breathers.
- Make sure that no water can enter via the reservoir bleed screws of the clutch.
- The engine compartment can be cleaned with a high-pressure cleaner. Never direct the jet of water to electrical components.
- Do not point the high-pressure cleaning jet directly at the pump units when cleaning UPEC engines using a high-pressure cleaner. Water could enter the protective hoods through the vent holes. The water could cause faults to the electrical connections of the pump units.
- Do not aim the jet of water directly at electrical connections such as connectors, cable plugs of the vehicle lighting system, etc.
- Ensure that no water can enter the air inlet system via the air intake or its flexible seals.

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1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel fuel.
So avoid inhaling and direct contact.

Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

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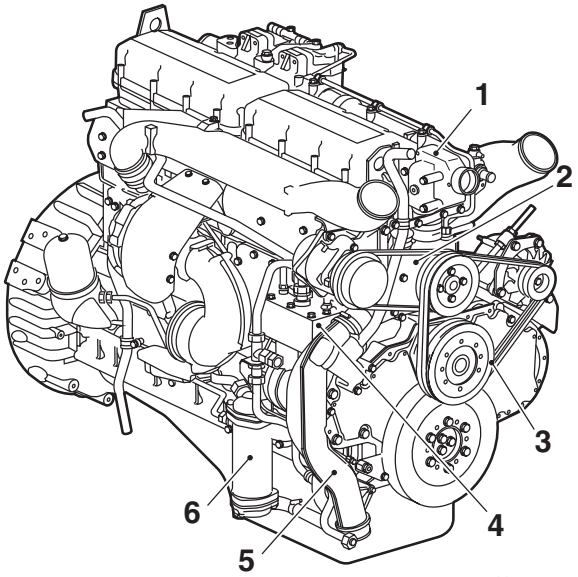
2. GENERAL

2.1 LOCATION OF COMPONENTS



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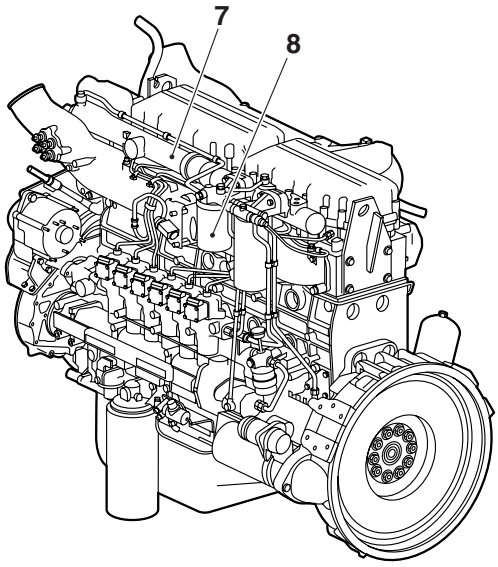

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1. Thermostat housing
2. Water pump
3. Fan drive
4. Water-cooled air compressor
5. Water pipe
6. Oil cooler
7. Coolant pipe
8. Coolant filter

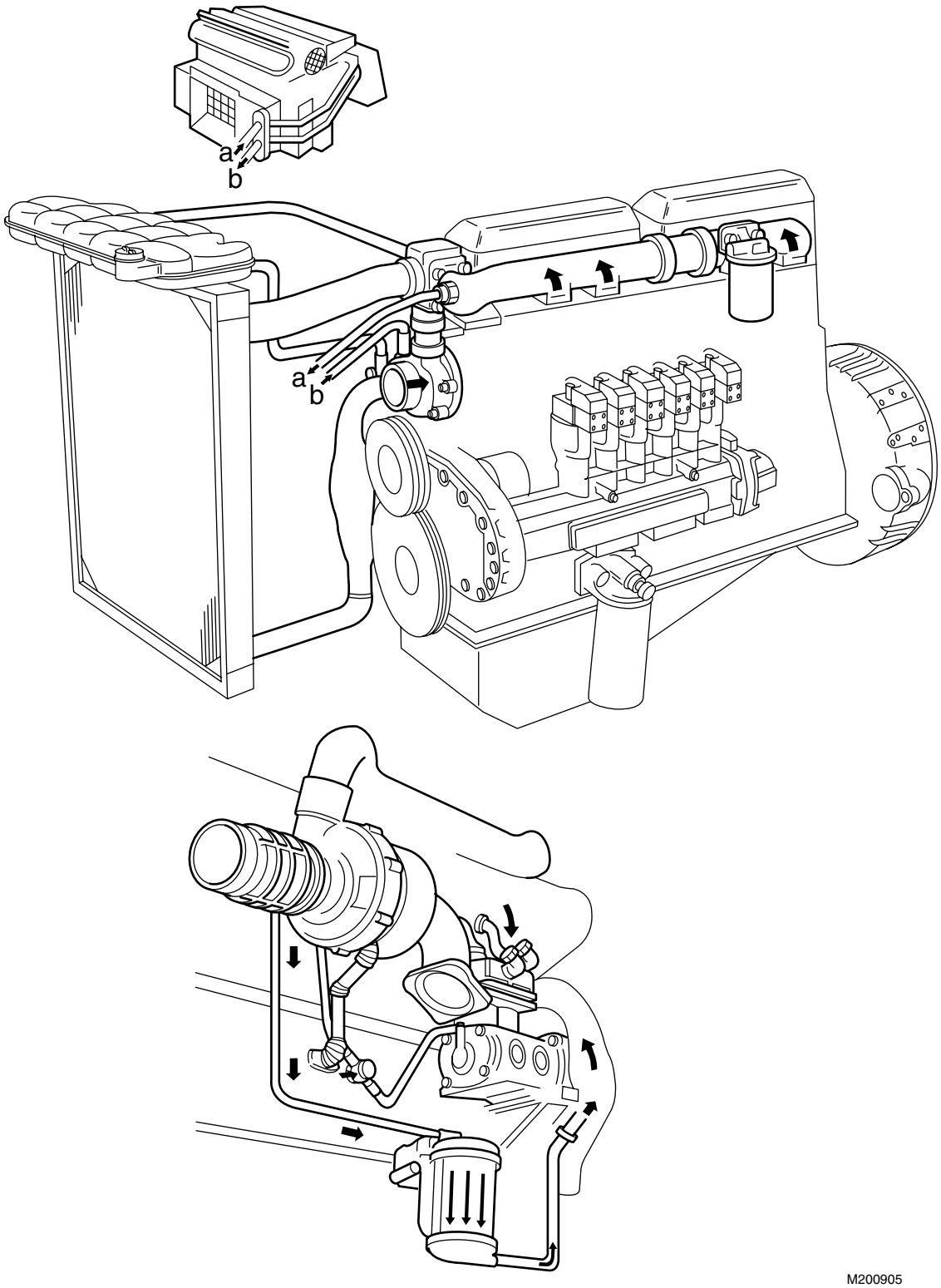
2.2 DESCRIPTION OF THE COOLING SYSTEM

The cooling system consists of a water pump, a radiator, a header tank, an oil cooler, an air compressor, a thermostat housing with one thermostat, a coolant filter and pipes.

At the highest point in the cooling system, a bleed pipe has been installed.

Through this pipe, any air in the cooling system is discharged to the header tank, rendering the cooling system auto-bleeding.

The water pump is located immediately below the thermostat housing. The thermostat housing is mounted on the coolant collection pipe.
From the delivery side of the water pump, the coolant is directed to the cylinder block via an opening at the back of the water pump. The coolant flows through the cylinder block, along the cylinder linings, and up towards the cylinder heads. The coolant leaves cylinder heads through the coolant collector pipe to the thermostat housing.
Depending on the coolant temperature, the thermostat distributes the coolant flow to the radiator or directly back to the coolant pump.
The coolant transported to the radiator enters the radiator at the top, and leaves the radiator at the bottom. From the bottom of the radiator, the coolant is returned to the water pump, via the return pipe.



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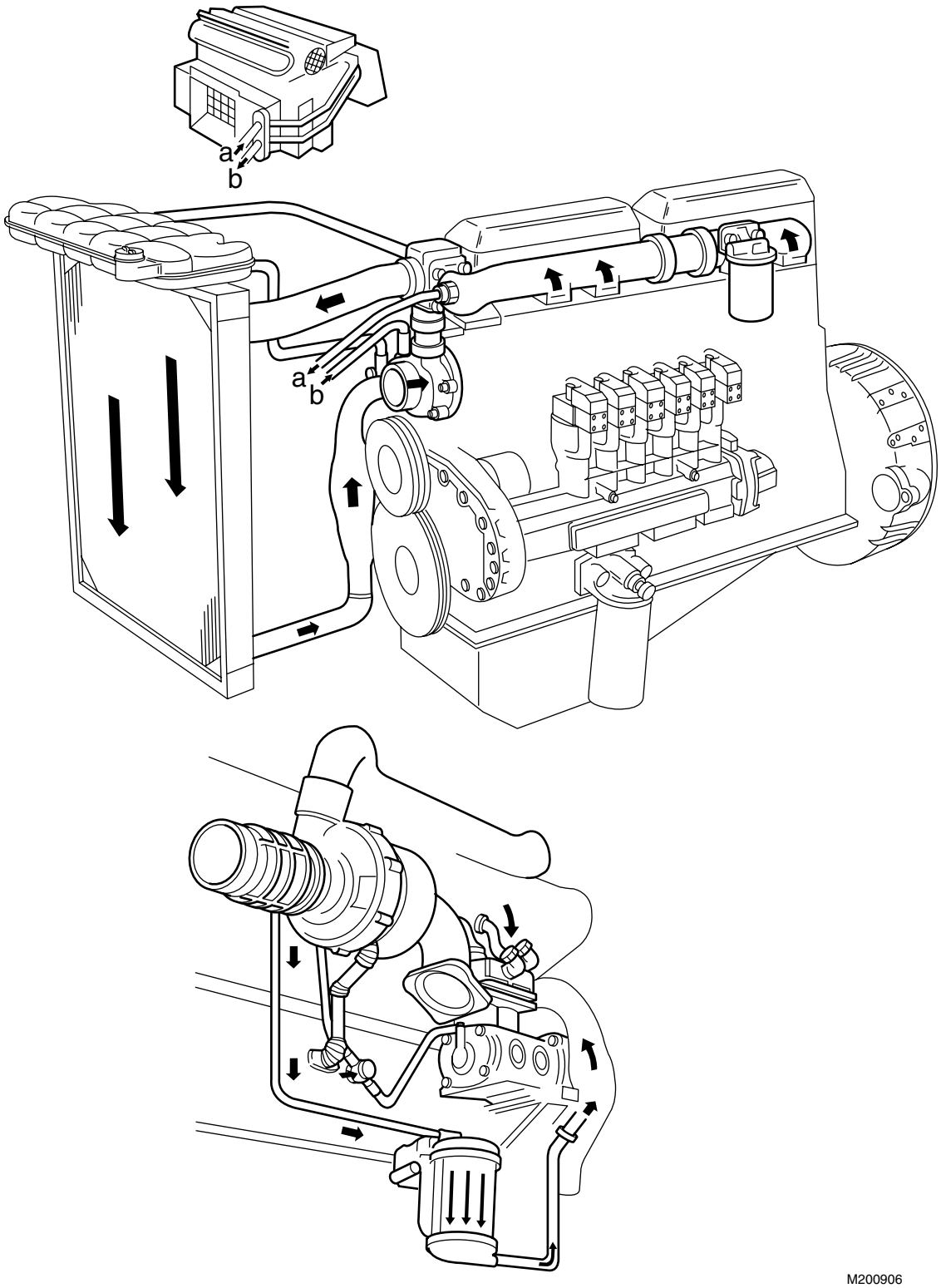
The connection pipe to the header tank is also connected to the return pipe from the radiator. If the coolant heats up, the coolant flows to the header tank. If the coolant cools down, the coolant flows back from the header tank.

From the engine block, some of the coolant flows through the oil cooler. From the oil cooler, the coolant is returned to the water pump through a pipe, via the coolant return pipe. The oil cooler is not only intended to cool the lubricating oil, but also to heat the lubricating oil in a “cold” engine.

From the cylinder block, some of the coolant flows through the air compressor.

From the air compressor, the coolant is returned via a pipe to the water pump.

The pipe which takes the coolant to the heater for the cab heating is connected to the top of the thermostat housing. From the heater, the coolant is returned via a pipe to the water pump.



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3. DESCRIPTION OF COMPONENTS

3.1 DESCRIPTION OF COOLING SYSTEM PRESSURE CAP

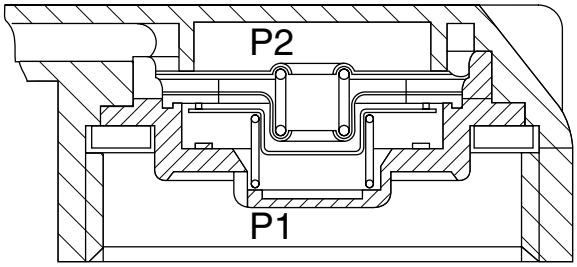
The pressure cap on the header tank is attached to the header tank via a screw thread. To fill the cooling system, remove this pressure cap or the filler cap at the front of the header tank.

The pressure cap has two valves. Normally, both valves are closed.

Overpressure in the cooling system
If the pressure (P1) in the cooling system rises to 0.7 bar, however, the overpressure valve opens.

The overpressure in the cooling system makes it possible to allow a higher temperature in the cooling system, without the coolant boiling.

Underpressure in the cooling system
If the pressure (P1) in the cooling system drops to approximately 0.1 bar below the outside air pressure (P2), the underpressure valve opens.



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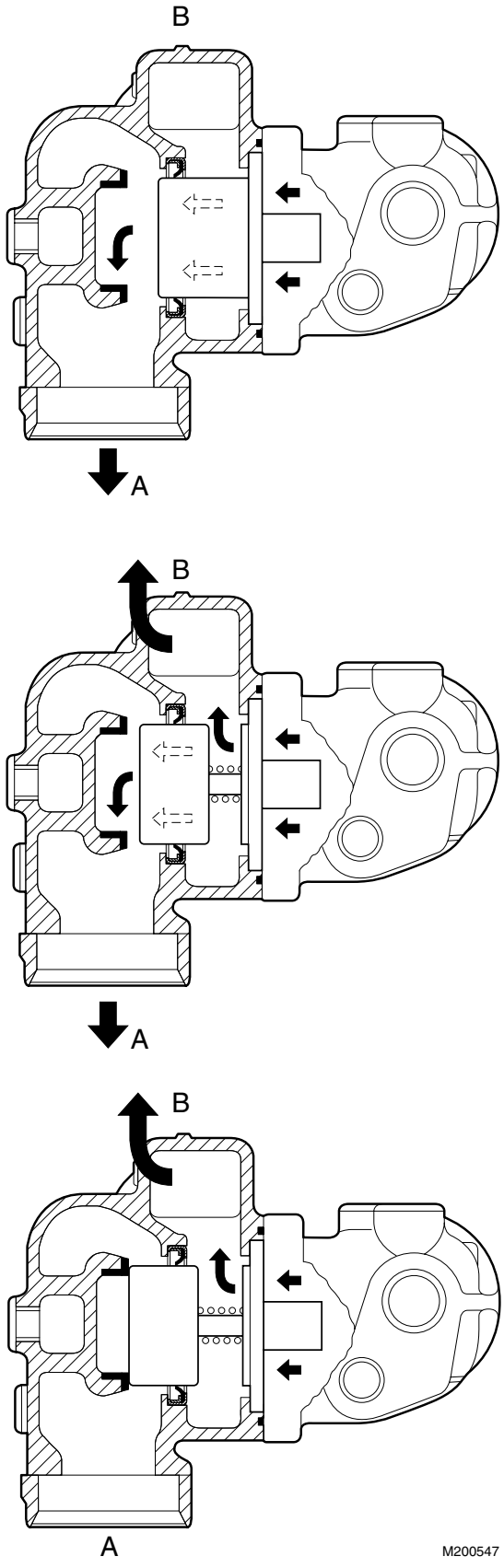
3.2 DESCRIPTION OF THE THERMOSTAT

Operation of the thermostat
The coolant enters the thermostat housing directly from the coolant collector pipe at the back and flows through the thermostat. Depending on the temperature of the coolant and the related position of the thermostat, there are 3 possibilities:

Thermostat closed
The coolant has not yet reached the opening temperature of the thermostat.
Supply channel (B) to the radiator is completely closed.
The coolant passes via a by-pass channel (A) directly to the water pump and the pump once again passes the coolant to the cylinder block.

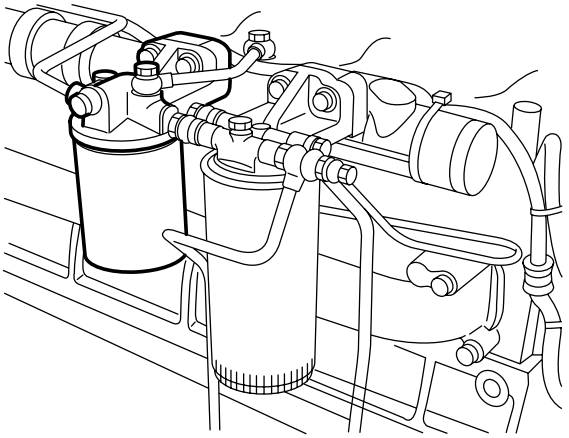
Thermostat starts opening
The coolant has reached the opening temperature of the thermostat.
The supply channel (B) to the radiator is opened and the by-pass channel (A) is partially closed.
At this time, coolant will flow both through the supply channel (B) to the radiator and through the by-pass channel (A) to the water pump.

Thermostat fully opened
The temperature of the coolant has become even higher, the supply channel (B) to the radiator is fully opened and the by-pass channel (A) is fully closed.
The entire coolant circulation now flows via the supply channel (B) to the radiator where it is cooled before flowing back to the water pump.
In the event of excessive coolant temperatures, it is **not permitted** to remove the thermostat as an emergency solution.
If the thermostat is removed from the engine, uncooled coolant will flow to the water pump via the by-pass channel (A). As a consequence, the coolant temperature will continue to rise.



3.3 DESCRIPTION OF COOLANT FILTER

The task of the coolant filter is to filter the coolant to prevent cavitation. The coolant filter also adds additives to the coolant.



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4. INSPECTION AND ADJUSTMENT

4.1 PRESSURE-TESTING THE COOLING SYSTEM

When the coolant is hot, there is an overpressure in the cooling system. Carefully remove the filler cap to release the overpressure.

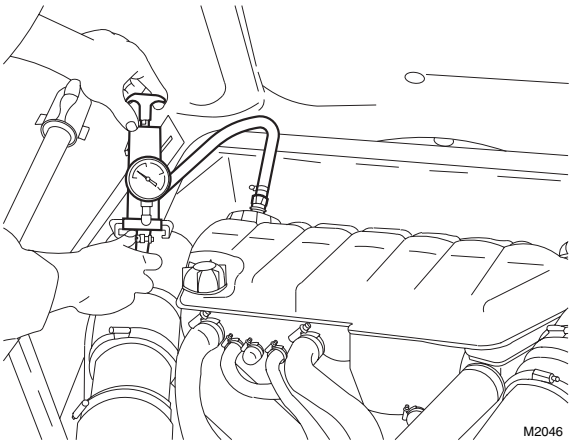
Coolant is a noxious fluid. Avoid skin contact to prevent poisoning.

In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

The cooling system can be checked for leaks by means of a pressure-test pump.
When this is done with a warm engine, it is easier to spot any cracks.

1. Fill the cooling system to the specified level.
2. Raise the engine temperature. This need not be the operating temperature.
3. Remove the filler cap from the header tank.
4. Install the pressure-test pump.
5. **Note:**
   By installing the pressure-test pump on the filler opening of the header tank, you also test the pressure cap.

   Test the system at the specified pressure, see main group “Technical data”.
6. Check the cooling system for any leaks.



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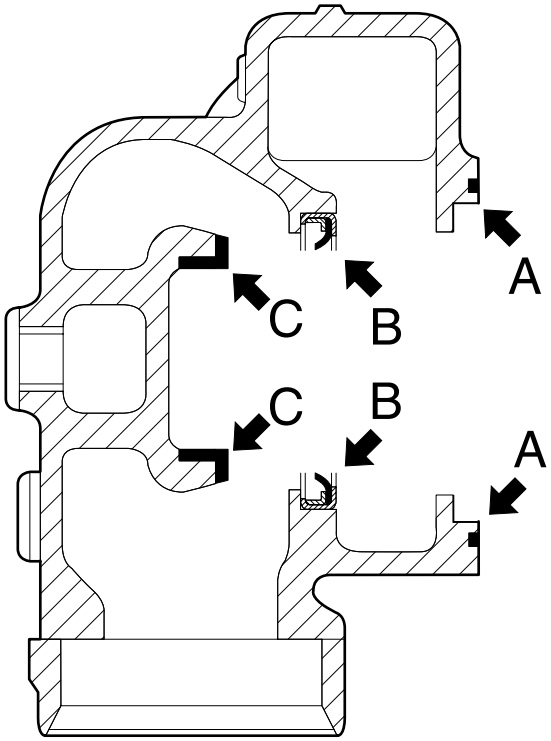
4.2 INSPECTION, THERMOSTAT

1. Remove the thermostat, see chapter “Removal and installation”.
2. Inspect the sealing surfaces (A) of the thermostat housing for damage.
3. Inspect the lubricating ring (B) for damage.
4. Inspect the thermostat seat (C) for damage.
5. Inspect whether the thermostat is fully closed.



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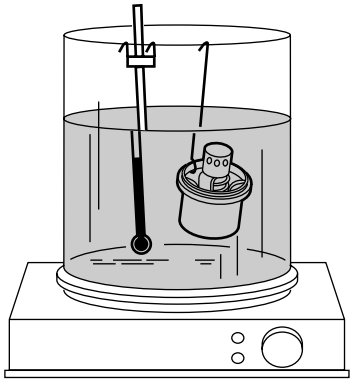
6. Place the thermostat in a container filled with clean water.
7. Place a thermometer in the container, and heat the water. Check at which temperature the thermostat opens and whether the thermostat opens fully, see main group “Technical data”.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4.3 CHECKING THE VISCOUS FAN CLUTCH

Do not run the engine in an enclosed or unventilated area.

Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

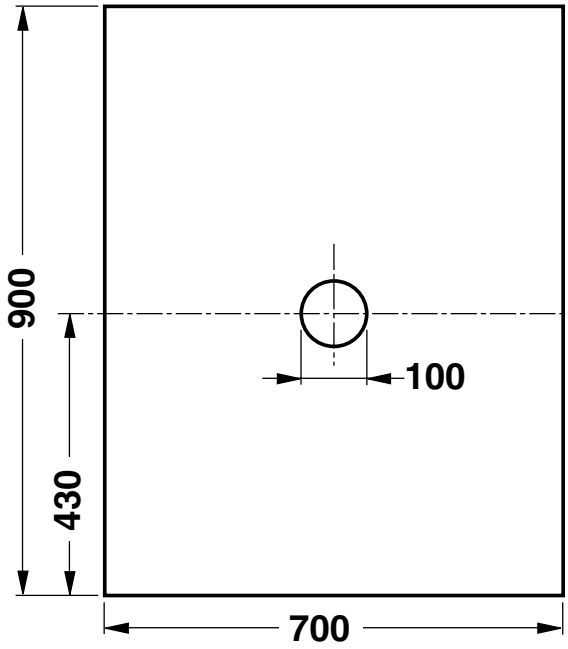
Testing with a cold engine
During this test, the slip in the viscous fan clutch is measured, when the clutch is not operational. This test must be carried out with a “cold” engine (coolant temperature approximately 50°C).

1. Check the coolant level, and as necessary top up with coolant.
2. Start the engine and run it at idling speed for at least 5 minutes.
3. Then use a digital revolution counter to measure the fan speed at a number of engine speeds (from idling to maximum engine speed).
   During this test procedure, the speed of the fan should be approx. 600 to 1100 rpm.

Testing with a warm engine
This test checks whether the contact operates at an operating temperature of 85 - 95°C.

1. Check the coolant level, and as necessary top up with coolant. Be careful when topping up the coolant, if the engine is warm.
2. Remove the front engine encapsulation.

3. Take a sheet of cardboard, perforated with a 100 mm hole, as shown in the diagram opposite, and place it in front of the radiator, so that the hole is in front of the viscous clutch.
4. Check that the gearbox is in neutral position.
5. Bring the cooling system to operating temperature.
6. Have the fan drive flange run at a speed of 1000 rpm.
   Then use an optical revolution counter to determine the difference in speed of the fan in relation to the drive flange. The speeds will differ if there is any slip in the viscous coupling. With the clutch fully engaged, slip should not exceed 10%. If it is more than 10%, the viscous fan clutch must be replaced.



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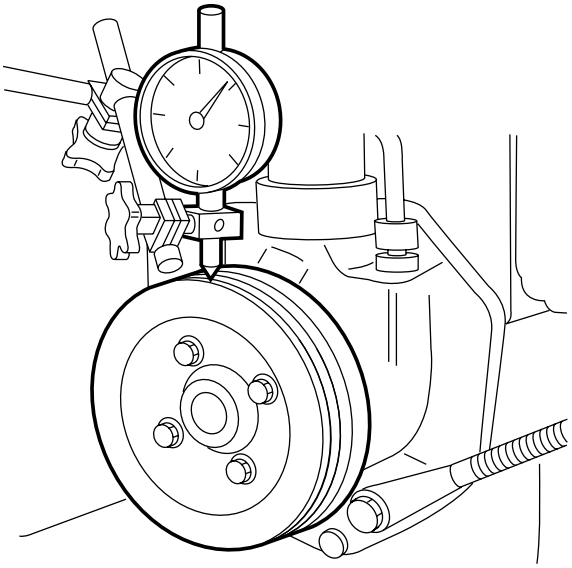
4.4 CHECKING RADIAL PLAY OF WATER PUMP

1. Remove the V-belts from the water pump pulley.
2. Connect a dial gauge as shown in the drawing.
3. Force the water pump pulley downwards, and set the dial gauge to zero.
4. Pull the water pump pulley upwards, and read off the dial gauge.
5. Compare the pressure reading with the technical data, see main group “Technical data”. If the level shown is greater than that in the technical data, the water pump must be replaced.



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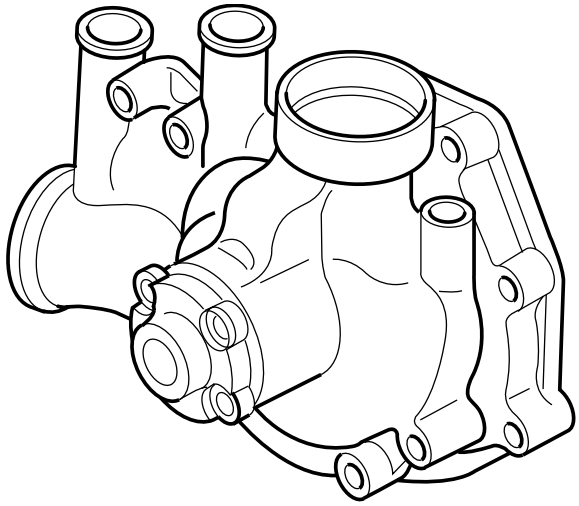
5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, WATER PUMP

Removal, water pump

1. Remove the front engine encapsulation.
2. Drain the coolant, see chapter “Draining and filling”.
3. Remove the reaction rod between the engine and the radiator.
4. Remove the bolts from the guide ring brackets, and remove the guide ring.
5. Remove the fixing nuts of the viscous fan clutch on the fan pulley and place the viscous fan clutch and the fan as far forward as possible in the wind tunnel.
6. Remove the water pump, alternator and air-conditioning compressor V-belts.
7. Remove the fixing bolts from the thermostat housing on the water pipe and remove the thermostat housing with the connection piece.
8. Remove all water pipes connected to the water pump.
9. Remove the pipe from the water pump to the coolant filter.
10. Remove the fixing bolts holding the spindles of the alternator and air-conditioning compressor.
11. Remove the fixing bolts from the water pump.
12. Remove the water pump.



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Installation, water pump

1. Thoroughly clean and check the sealing surfaces of the water pump, the thermostat housing, and the engine block.
2. Fit the water pump with a new gasket. Fit the fixing bolts. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the connection piece with new O-rings onto the water pump.
4. Install the thermostat housing, fitted with a new O-ring, against the coolant pipe.
5. Install the pipe from the water pump to the coolant filter.
6. Fit all water pipes connected to the water pump.
7. Install the alternator and air-conditioning compressor V-belts.
8. Install the viscous fan clutch and the fan.
9. Install the guide ring brackets and the guide ring.
10. Install the reaction rod between the engine and the radiator.
11. Fill the cooling system, see chapter “Draining and filling”.
12. Install the front engine encapsulation.

5.2 REMOVAL AND INSTALLATION, COOLANT FILTER

When the coolant is hot, there is an overpressure in the cooling system. Carefully remove the filler cap to release the overpressure.

Coolant is a noxious fluid. Avoid skin contact to prevent poisoning.

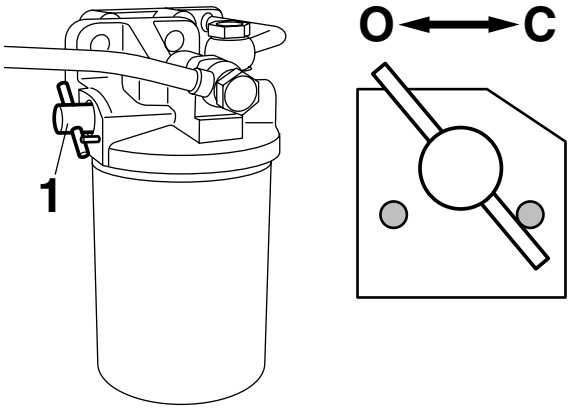
In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

Removal of the coolant filter

1. Place a tray beneath the filter to capture any escaping coolant.
2. Remove the filler cap from the header tank.
3. Switch the shut-off valve (1) clockwise to the “C” position.
4. Remove the coolant filter by turning it counter-clockwise.

Installation of the coolant filter

1. Clean the sealing face of the coolant filter.
2. Apply a small amount of coolant to the sealing ring of the coolant filter element.
3. Fit the coolant filter until the sealing ring abuts. Then tighten the filter by hand $^{1}/_{2}$ to $^{3}/_{4}$ of a turn.
4. Switch shut-off valve (1) counter-clockwise to the “O” position.
5. Put the filler cap back on the header tank.
6. Run the engine and check that the coolant filter has sealed correctly.
7. Then check the coolant fluid level.



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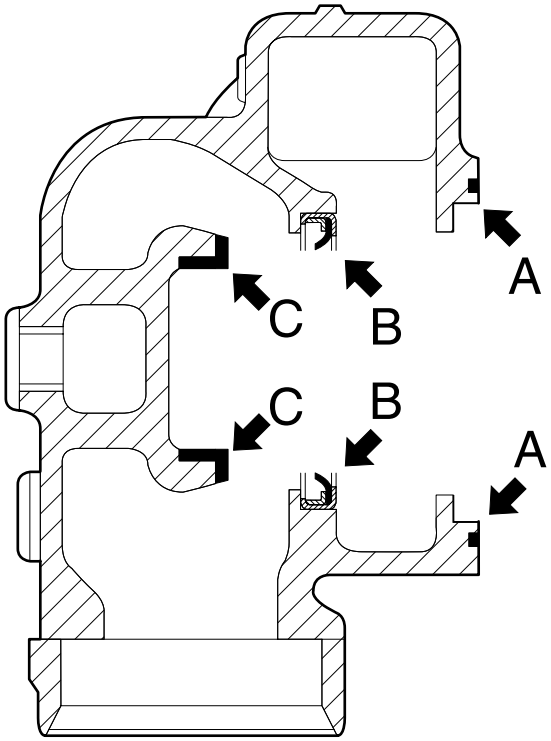
5.3 REMOVAL AND INSTALLATION, THERMOSTAT

Removal, thermostat
1. Drain the coolant, see chapter “Draining and filling”.
2. Remove the water pipe between the thermostat housing and the radiator.
3. Remove the fixing bolts from the thermostat housing.
4. Remove the thermostat housing and the connection piece from the water pump.
5. Remove the O-ring (A) from the thermostat housing.
6. Remove the thermostat.

Removal, thermostat sealing ring
1. Remove the sealing ring (B) in the thermostat housing using a commercially available internal puller.

Removal, thermostat seat
1. Remove the thermostat seat (C) at the bottom of the thermostat housing using a commercially available internal puller.



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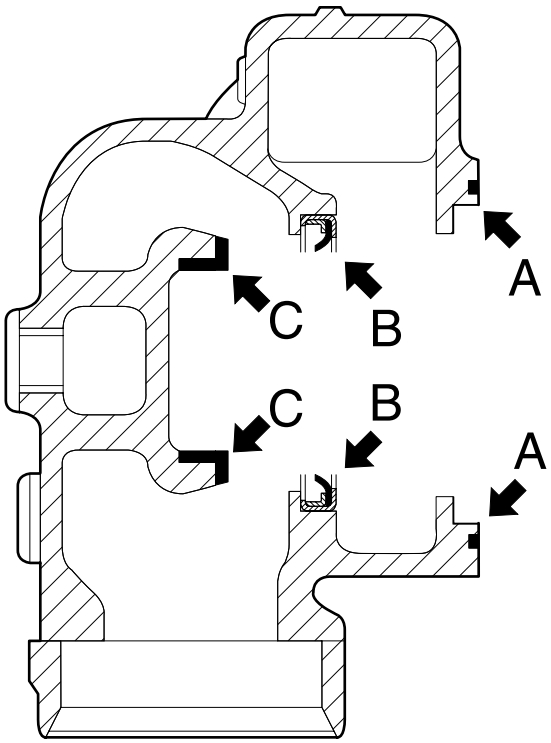
Installation, thermostat seat
1. Install the thermostat seat (C), provided with a locking compound, into the thermostat housing, see main group “Technical data”, using the special tool (DAF no. 1310456).

Installation, thermostat sealing ring
1. Install the thermostat sealing ring (B) in the thermostat housing, using the special tool (DAF no. 1310456).

Installation, thermostat
1. Fit the thermostat in the thermostat housing.
2. Fit the O-ring (A) in the thermostat housing.
3. Fit new O-rings to the connection piece from the thermostat housing to the water pump and subsequently fit the connection piece in the thermostat housing.
4. Fit the thermostat housing onto the coolant pipe.
5. Fit the fixing bolts of the thermostat housing. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
6. Fit the water pipe between the thermostat housing and the radiator.
7. Fill the cooling system, see chapter “Draining and filling”.



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5.4 REMOVAL AND INSTALLATION, VISCOUS FAN CLUTCH

Removing the viscous fan clutch

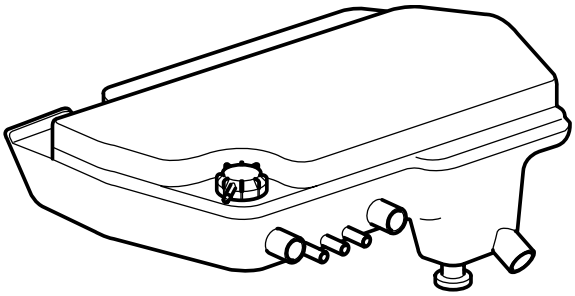
1. Remove the front engine encapsulation.
2. Remove the water pump and alternator V-belts.
3. Remove the air inlet pipe between the intercooler and the inlet manifold on the alternator side.
4. Remove the fixing bolts from the guide ring brackets, and remove the guide ring.
5. Remove the fixing nuts from the viscous fan clutch on the drive flange. Temporarily place the viscous fan clutch and the fan in the wind tunnel.

   Note:
   The viscous fan clutch must **always** be stored **vertically**.
6. Remove the fixing nuts of the fan and remove the viscous fan clutch.

Installing the viscous fan clutch

1. Place the new viscous fan clutch in the fan. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
2. Install the guide ring and the fixing bolts of the guide ring brackets.
3. Install the viscous fan clutch and the fan on the drive flange. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
4. Install the air inlet hose. Tighten the fixing bolt to the specified torque, see main group “Technical data”.
5. Install the water pump and alternator V-belts.
6. Install the front engine encapsulation.

5.5 REMOVAL AND INSTALLATION, HEADER TANK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Removing the header tank

1. Remove the front engine encapsulation.
2. Drain the coolant until the header tank is empty, see chapter “Draining and filling”.
3. Remove all water hoses between the header tank and the engine.
4. Slacken the circlips at the front of the header tank.
5. Lift the front of the header tank a little.
6. Slacken the circlips at the back of the header tank.
7. Remove the header tank.

Installing the header tank

1. Install the header tank, pushing it into the circlips at the back first.
2. Install all water hoses between the header tank and the engine.
3. Install the front engine encapsulation.
4. Fill the cooling system, see chapter “Draining and filling”.
5. Run the engine and check that all connections are sealed properly.

5.6 REMOVAL AND INSTALLATION, RADIATOR

Note:
The removal and installation procedure of the radiator allows for the presence of an air-conditioning unit. If such a unit is not present, the sections concerned can be skipped.

Removing the radiator

1. Disconnect the earth lead from the battery pole.
2. Drain the coolant, see chapter “Draining and filling”.
3. Remove the front engine encapsulation.
4. Remove the engine encapsulation under the cab.
5. Remove the bolts from the guide ring brackets, and remove the guide ring.
6. Remove the guide strip at the front of the intercooler.
7. Remove the oil dip stick holder of the intercooler and put it aside.
8. Remove the header tank.
9. Remove the water hoses to the radiator.
10. Remove the fixing bolts from the air-conditioning condenser and pull the condenser forwards.
11. Disconnect the other air-conditioning pipes from the intercooler.
12. Remove the wire mesh underneath the intercooler.
13. Remove the air-conditioning dryer underneath the intercooler.
14. Remove the left-hand connector pipe from the inlet manifold to the intercooler.
15. Remove the right-hand connector pipe from the inlet pipe to the intercooler.

16. Remove the air-conditioning compressor unit and move it, together with the hoses, to the front of the intercooler.
17. Remove the fixing bolts from the intercooler.
18. Move the intercooler a little to the right to remove the fixing bolt of the oil filler pipe.
19. Remove the oil filler pipe.
20. Remove the reaction rod from the radiator to the engine lifting eye.
21. Remove the fixing nuts from the radiator brackets. Remove the entire radiator, intercooler, and wind tunnel from the chassis.
22. Remove the intercooler from the radiator.

Installing the radiator

1. Install the entire radiator, intercooler, and wind tunnel in the chassis. Tighten the fixing nuts to the specified tightening torque, see main group “Technical data”.
2. Slide the oil filler pipe onto the radiator and install the fixing bolt.
3. Place the intercooler in its position and hand-tighten with two fixing bolts.
4. Install the reaction rod from the radiator to the engine lifting eye.
5. Install the air-conditioning compressor and its pipes over the radiator.
6. Install the air-conditioning compressor unit on the engine bracket.
7. Install the guide ring brackets and the guide ring.
8. Install the air-conditioning dryer underneath the intercooler.

9. Install the wire mesh underneath the intercooler.
10. Install the air-conditioning condenser.
11. Install the guide strip at the front of the intercooler. Tighten the fixing bolts of the intercooler.
12. Insert the oil dip stick holder.
13. Install the air inlet hoses between manifolds and intercooler.
14. Install the expansion reservoir.
15. Install the engine encapsulation under the cab.
16. Install the front engine encapsulation.
17. Fit the earth lead to the battery pole.
18. Fill the cooling system, see chapter “Draining and filling”.
19. Run the engine and check that all connections are sealed properly.

6. DRAINING AND FILLING

6.1 DRAINING AND FILLING/BLEEDING, COOLING SYSTEM

In order to avoid damaging the engine block, do not top up the warm engine with cold coolant.

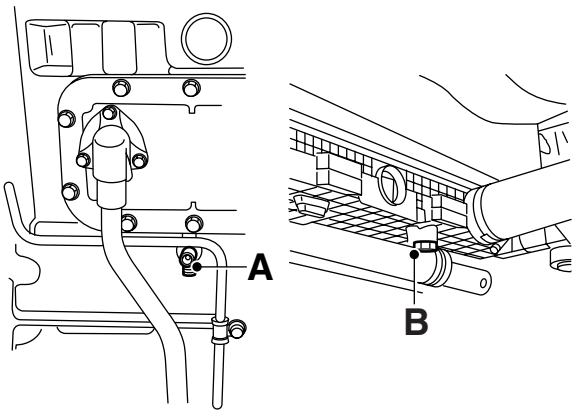
Coolant is a toxic substance and must be handled with care. Protect the skin and eyes.

Coolant is harmful to the environment; after use, it should be processed as industrial chemical waste.

When the coolant is hot, there is an overpressure in the cooling system. When removing the filler cap, allow the overpressure to escape, by first loosening the filler cap, one turn.

Draining the cooling system

1. Turn the heater control knob to the "warmest" temperature setting. As a result, the heater cock will be fully opened.
2. Remove the cooling system filler cap.
3. Collect the coolant. To do so, place suitable containers beneath the drain points.
4. Drain the cooling system at the engine block via drain tap (A) and the radiator via drain plug (B).
5. Flush out the cooling system.
6. Close drain tap (A) and install drain plug (B).



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Filling/de-aerating, cooling system

Note:
The cooling system is self-venting.

1. Turn the heater temperature control knob in the cab to the “warmest” setting.
2. Fill the cooling system with the specified coolant.
3. Run the engine for several minutes.
4. Ensure that the air bleed pipe from the thermostat housing to the header tank is not kinked or pinched off.
5. Check the coolant level, and as necessary top up with coolant.

If the vehicle is equipped with a water/air auxiliary heating.

1. Run the engine at idling speed.
2. Switch on the auxiliary heating, using the rocker switch on the dashboard.
3. Turn the heater temperature control knob in the cab to the “warmest” setting.
4. Switch on the heater fan.
5. Set the rocker switch on the thermostat in the cab to position 1.

   Note:
   Combustion will start after approximately one minute.
6. Allow the auxiliary heating to operate for approximately 15 minutes.

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7

1. SAFETY INSTRUCTIONS

Do not run the engine in an enclosed or unventilated area.
Make sure exhaust fumes are properly extracted.

Maintain a safe distance from rotating and/or moving components.

Various sorts of oil and other lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and diesel lubricating oil. So avoid inhaling and direct contact.

Exhaust gases contain carbon monoxide. Carbon monoxide is a deadly, colourless and odourless gas, which, when inhaled, deprives the body of oxygen, leading to asphyxiation. Serious carbon monoxide poisoning may result in brain damage or death.

It is recommended to always disconnect the battery's earth connection during repair or maintenance activities for which the power supply is not required.

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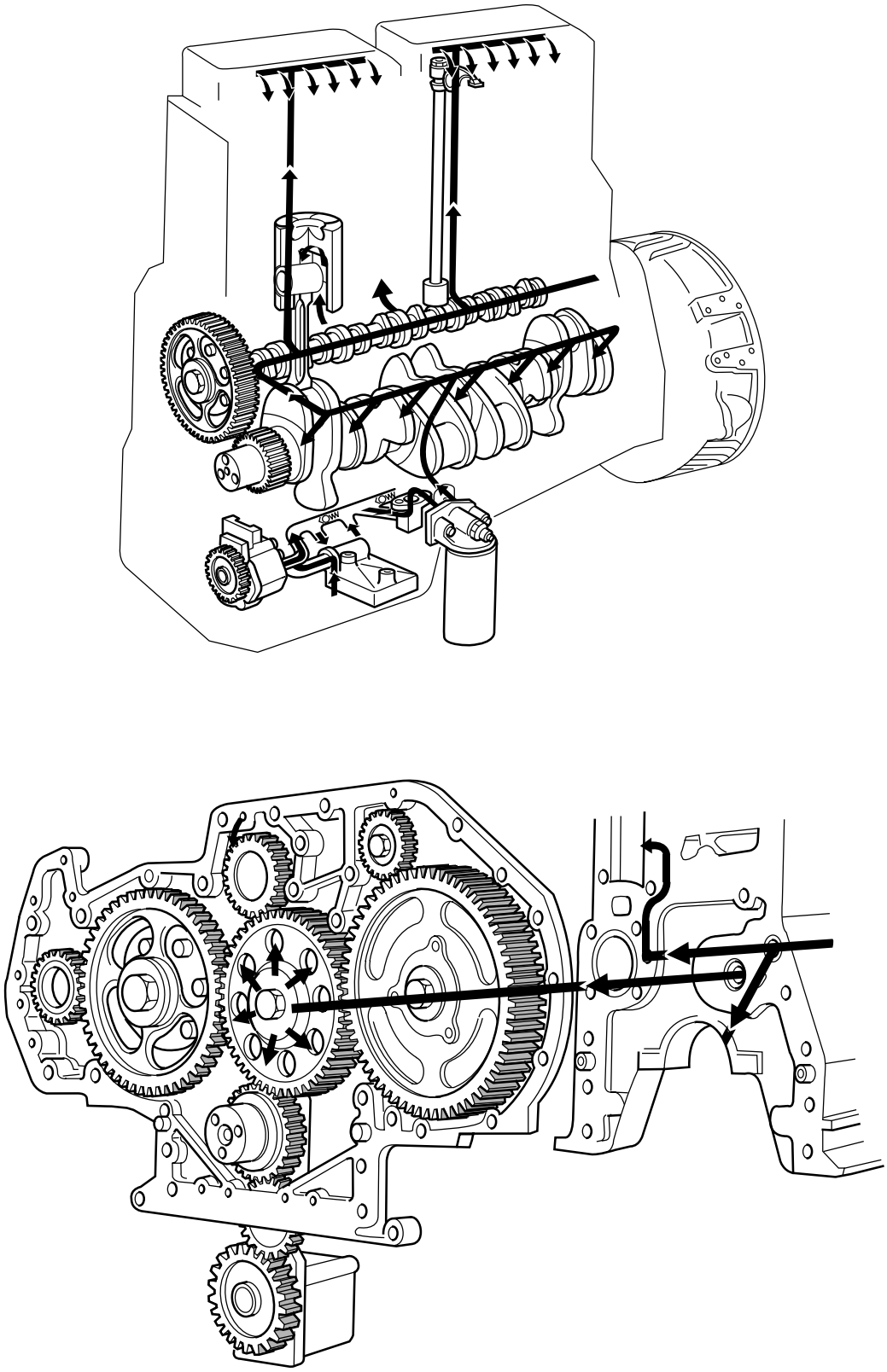
2. GENERAL

2.1 LUBRICATING OIL SYSTEM DESCRIPTION



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General
The lubricating oil pump is directly driven from the crankshaft, via an intermediate gear wheel. The lubricating oil pump draws the lubricating oil from the oil sump, and pumps it via the oil cooler and the lubricating oil filter to the main lubricating oil channel in the cylinder block. From the main lubricating oil channel, the lubricating oil is further distributed to the various components requiring lubrication.

Oil cooler
The oil cooler is connected to the cooling system. The oil cooler warms up the lubricating oil in a “cold” engine and cools it in a “warm” engine.
Parallel to the oil cooler, a short-circuit valve has been fitted. If the oil cooler is blocked, the short-circuit valve will open when a certain pressure has built up. In this situation, uncooled lubricating oil flows into the lubricating system.
A centrifugal lubricating oil filter may be installed in parallel to the lubricating oil system. In this case, lubricating oil will flow from the oil cooler to the centrifugal filter. The lubricating oil is additionally filtered in the centrifugal filter. This is done in view of vehicles that have longer maintenance intervals.

Pressure limiting valve
A pressure limiting valve is installed in the lubricating system after the oil cooler. When the pressure set for the pressure limiting valve has been reached; the valve opens and allows excess, cooled lubricating oil to flow to the oil sump.

Lubricating oil filter
The lubricating oil is cleaned in the disposable lubricating oil filter. A pressure-relief valve fitted in this filter, opens if the pressure in the filter becomes too high as a result of contamination or cold lubricating oil. In that case, the lubricating oil passes through the filter unfiltered.

Main lubricating oil channel
From the main lubricating oil channel, lubricating oil is supplied to the crankshaft main bearings and through a lubricating oil channel in the crankshaft also to the connecting rod bearings. From the lubricating oil channel, lubricating oil is pumped into the hollow camshaft via the first camshaft bearing.

From the lubricating oil channel in the camshaft, lubricating oil is supplied to the other camshaft bearings.

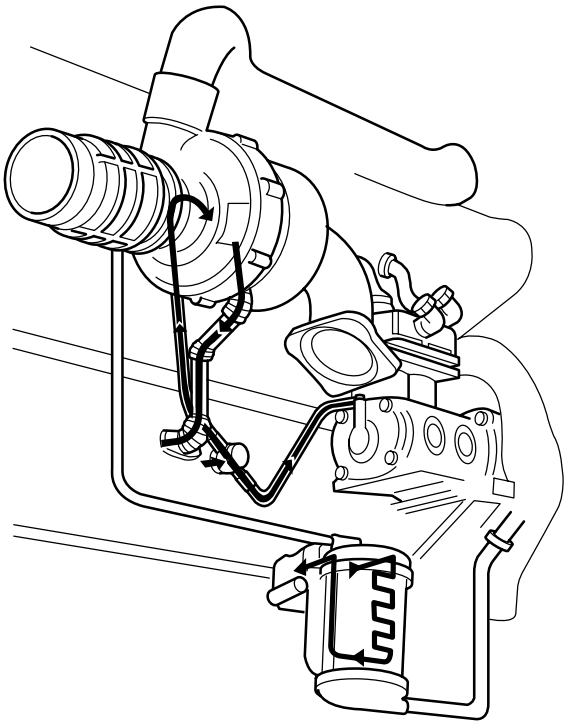
Cylinder head
From the second and fifth camshaft bearings, a lubricating oil channel passes through the cylinder heads to the second and fifth rocker seats.
Depending on the model, the other rocker shafts, rockers, and bridges receive lubrication from the DEB or a lubricating-oil strip.

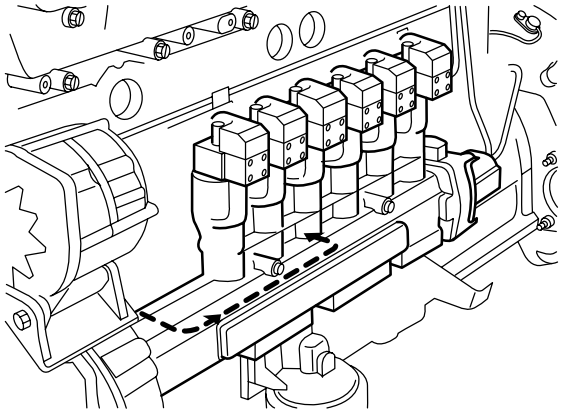
Timing gear
From the lubricating oil channel in the first crankshaft main bearing, a lubricating oil channel leads to the hollow hub of the intermediate gear wheel. From the hollow hub the lubricating oil is supplied to the intermediate gear wheel. The other gear wheels receive lubricating oil from the intermediate gear wheel. The fan drive is lubricated through a bore hole in the cylinder block and a lubricating oil channel in the timing-gear case.

Piston and gudgeon pin
The pistons and the upper connection-rod bearings are lubricated by means of lubricating oil nozzles linked to the main lubricating oil channel. In addition to lubricating, this oil has an important cooling function. For this purpose, the pistons of the XE390C have been equipped with additional lubricating oil channels to obtain better cooling.
A bore hole provided at the top of the connection rod supplies the lubricating oil that the lubricating oil nozzles spray against the bottom of the piston to lubricate the upper connecting rod bearing.

Turbocharger and air compressor
A lubricating oil channel from the camshaft bearing connects the lubricating oil pipes to the turbocharger and air compressor.
The lubricating oil discharge pipe from the turbocharger is connected to a channel in the cylinder block, from where the lubricating oil returns to the oil sump.
The lubricating oil returning from the air compressor flows from the front of the air compressor back to the timing gear and from there to the oil sump.

Pump housing
The pump housing obtains lubricating oil from the cylinder block and discharges it through a channel in the cylinder block, from where the lubricating oil returns to the oil sump. The pump units are supplied with lubricating oil via a channel in the pump housing.





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3. INSPECTION AND ADJUSTMENT

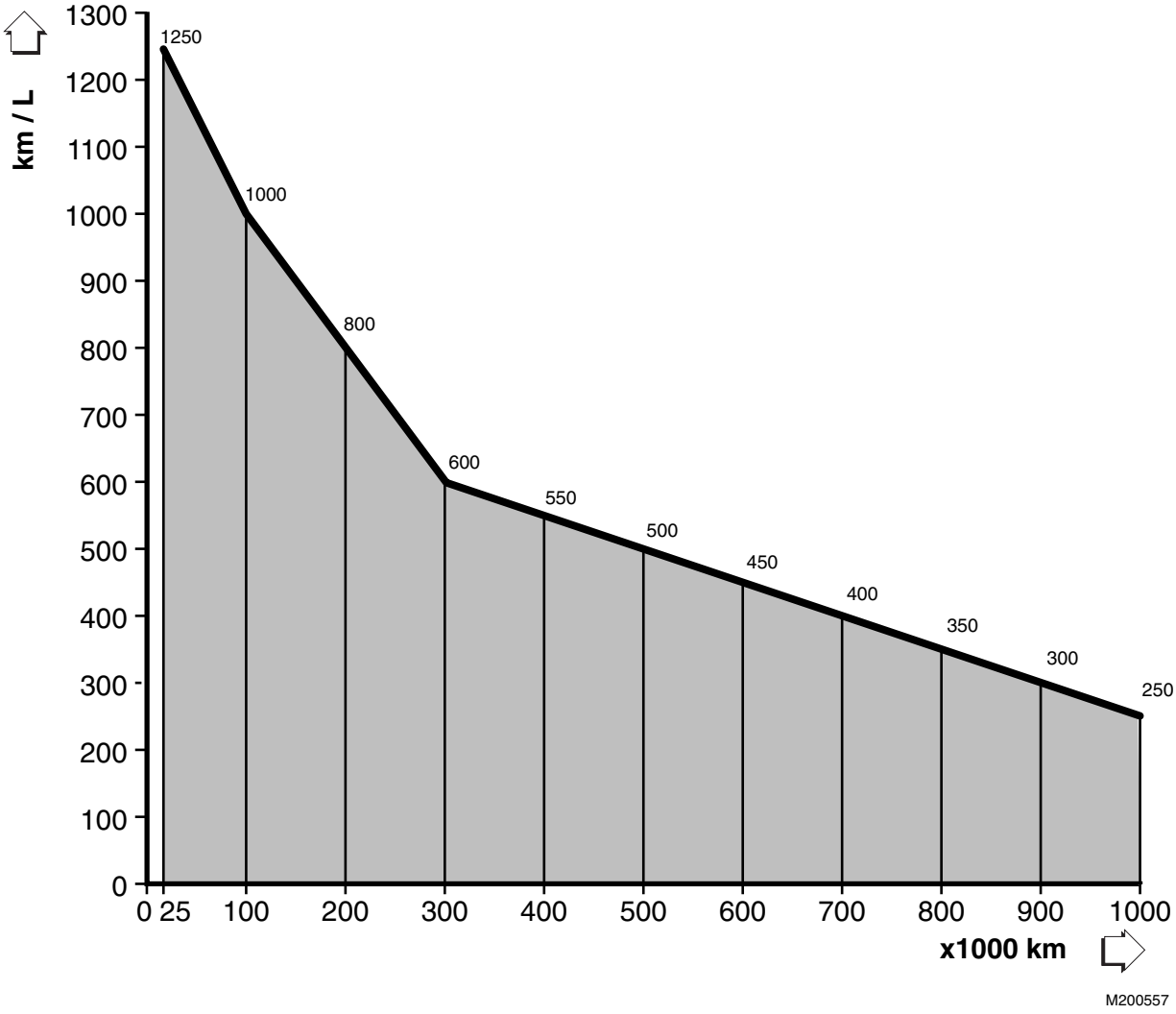
3.1 INSPECTION, LUBRICATING OIL CONSUMPTION

Note:
A lubricating oil consumption test is only useful after the engine has been run in (approx. 20,000 km).

1. First carefully check the engine for any lubricating oil leaks. Clean the engine before starting the test.
2. Run the engine to operating temperature.
3. Place the vehicle on a horizontal surface.
4. Remove the lubricating oil drain plug and drain the lubricating oil for 15 minutes. Collect the lubricating oil in a clean container.
5. Measure the exact amount of lubricating oil drained.
6. Refill the oil sump with the drained lubricating oil. Top up the lubricating oil amount to the specified quantity of lubricating oil.
7. Before starting the test, write down the exact amount of lubricating oil (**A**) in the oil sump. Write down the mileage (**C**) of the vehicle.
8. Drive between 500 and 1000 km under similar conditions as those in which the vehicle is normally used.
9. Immediately after the test run, place the vehicle on a level surface and write down its mileage (**D**).
10. Remove the lubricating oil drain plug and drain the lubricating oil for 15 minutes. Collect the lubricating oil in a clean container.

11. Measure the exact amount of lubricating oil drained (**B**).
12. Return the lubricating oil to the oil sump. Top up the lubricating oil amount to the specified quantity of lubricating oil.
13. Calculate the lubricating oil consumption using the following formula.

$$\textbf{Lubricating oil consumption} = \frac{\textbf{D - C}}{\textbf{A - B}} = \textbf{km/l}$$



In the graph the lubricating oil consumption in km/l is marked out on the left and the total number of kilometres covered by the engine at the bottom.

If the lubricating oil consumption and the number of kilometres covered intersect in the shaded section, corrective measures may be considered.

Bear in mind, however, that the lubricating oil consumption is very much dependent upon the operating conditions.

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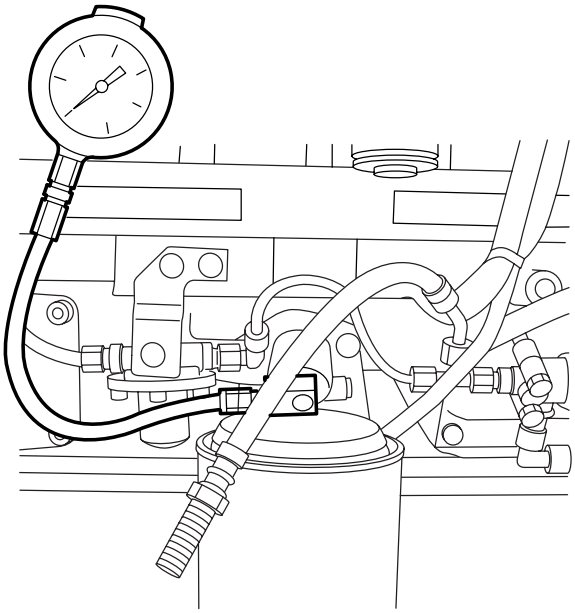
3.2 INSPECTION, LUBRICATING OIL PRESSURE

1. Run the engine to operating temperature.
2. Remove the lubricating oil pressure sensor. This sensor is mounted on the lubricating oil filter housing.
3. In the lubricating-oil pressure sensor connection, install a lubricating oil pressure gauge, special tool (DAF no. 0535551).
4. Start the engine and measure the lubricating oil pressure at maximum engine speed, and at idling speed.
   Compare the pressure reading with the technical data. See main group “Technical data”.

   Note:
   The oil pressure control valve, mounted in the oil sump, cannot be adjusted.
5. Stop the engine and remove the lubricating oil pressure gauge. Fit the oil pressure sensor with a new lubricating ring.



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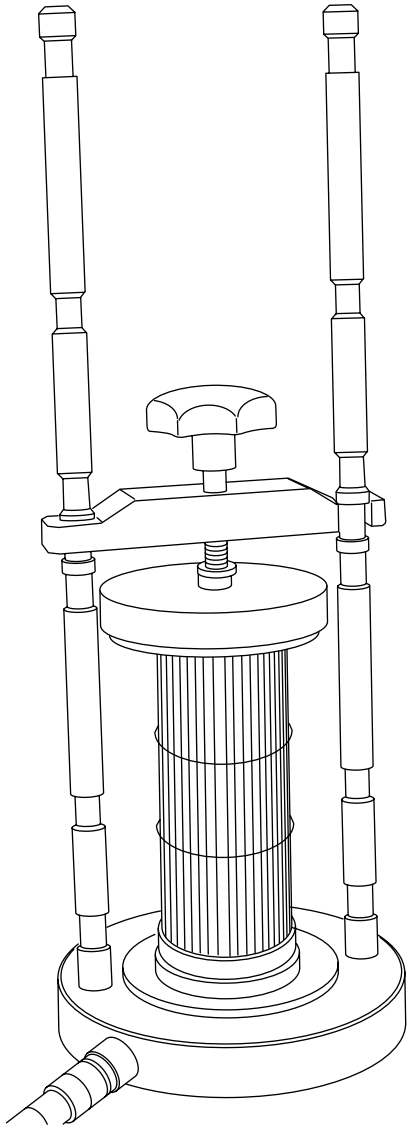
3.3 PRESSURE-TESTING THE OIL COOLER

1. Remove the oil cooler, see chapter “Removal and installation”.
2. Disassemble the oil cooler, see chapter “Disassembly and assembly”.
3. Place the cooling element in special tools (DAF no. 1329307 and DAF no. 0694889).
4. Apply up to 3 bar of pressurised air to the special tool.
5. Submerge the cooling element in warm water (approx. 50°C) and check for leaks.

   Note:
   If the cooling element leaks, it must be replaced.
6. Assemble the oil cooler, see chapter “Disassembly and assembly”.
7. Install the oil cooler, see chapter “Removal and installation”.



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4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, LUBRICATING OIL FILTER HOUSING

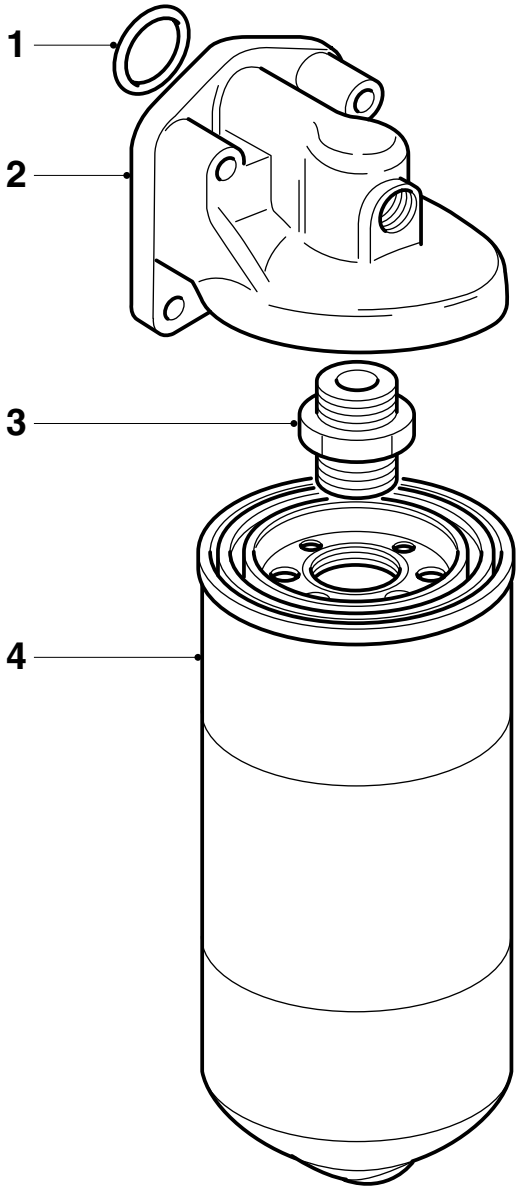
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

Removal, lubricating oil filter housing

1. Clean the filter housing and the surrounding area.
2. Remove the electrical connections from the lubricating oil pressure sensor.
3. Remove the filter element. Collect any lubricating oil flowing out of the system.
4. Remove the fixing bolts from the filter housing and remove the filter housing (2).
5. Remove the O-rings (1).

Installation, lubricating oil filter housing

1. Replace the O-rings (1) at the rear of the filter housing (2).
2. Install the filter housing (2). Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Check the coupling piece (3), see main group “Technical data”.
4. Lightly grease the sealing ring of the filter element.
5. Install the filter element filled with clean lubricating oil. Tighten the filter element to the specified torque. See main group “Technical data”.
6. Install the electrical connections of the lubricating oil pressure sensor.
7. Run the engine for a short time, and check whether the lubricating oil filter is correctly sealed.
8. Check the lubricating oil level.



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4.2 REMOVAL AND INSTALLATION, OIL COOLER

Removing the oil cooler

1. Drain the coolant, see chapter “Draining and filling”.
2. Remove the coolant connections.
3. Remove the compressor pipe.
4. Remove the lubricating oil delivery pipe, if installed, to the centrifugal filter.
5. Remove the fixing bolts and the oil cooler. Collect the lubricating oil flowing out of the system.
6. Remove the O-rings on the oil cooler.

Installing the oil cooler

1. Clean the contact surfaces between the oil cooler and the engine block. Install new O-rings on the oil cooler housing.
2. Install the oil cooler onto the engine block. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the coolant connections.
4. Install the compressor pipe.
5. Install the lubricating oil delivery pipe, if installed, to the centrifugal filter.
6. Fill the cooling system.
7. Run the engine briefly, and check that the oil cooler does not leak.
8. Check the lubricating oil level.
9. Check the coolant level.

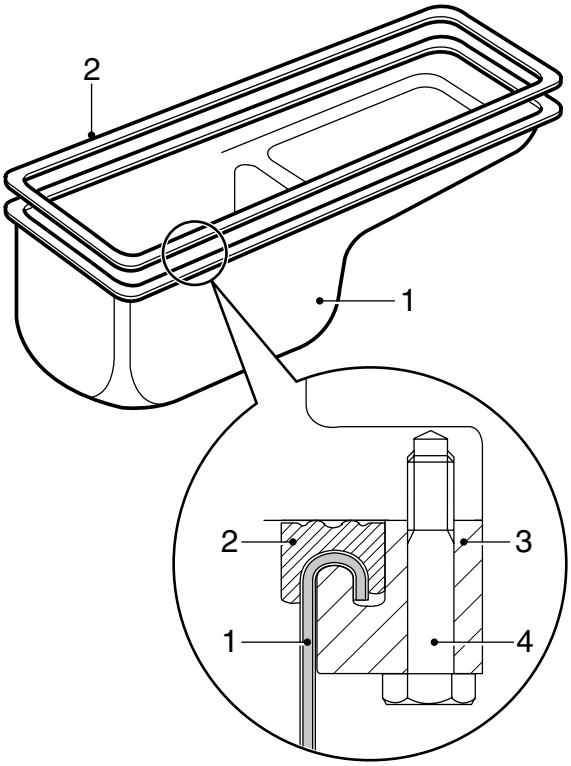
4.3 REMOVAL AND INSTALLATION, OIL SUMP

Removal, oil sump

1. Remove the soundproofing under the engine.
2. Drain the lubricating oil, see chapter “Draining and filling”.
3. Support the oil sump (1).
4. Remove the attachment bolts (4) and locking brackets (3) all around.
5. Remove the oil sump together with the sealing rubber (2).

Installation, oil sump

1. Clean the sealing surfaces of the oil sump and the engine block.
2. Check the oil sump sealing rubber (2). Damaged sealing rubbers (2) must be replaced.
3. First install the sealing rubber on the front and rear sides of the oil sump. As a next step, the sealing rubber may be fitted to the long sides of the oil sump.
4. Fit the oil sump (1) with the sealing rubber (2) in a straight position.
5. Install the attachment bolts (4) and locking brackets (3). Tighten the fixing bolts crosswise to the specified tightening torque, see main group “Technical data”.
6. Fill the engine with the specified quantity of lubricating oil.
7. Run the engine for a short time, and check whether the oil sump is correctly sealed. Subsequently check the lubricating oil level.
8. Install the soundproofing under the engine.



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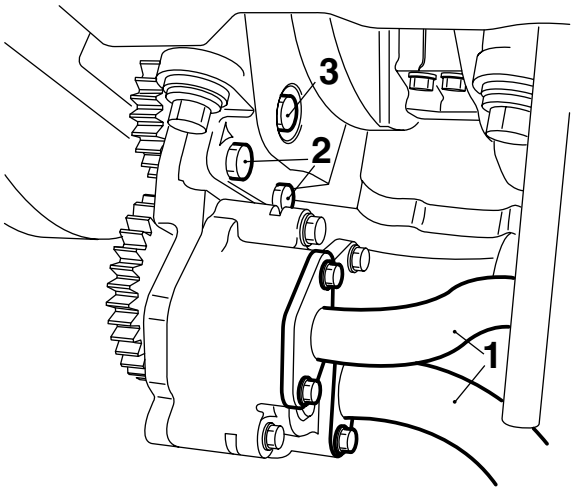
4.4 REMOVAL AND INSTALLATION, LUBRICATING OIL PUMP

Removal, lubricating oil pump

1. Remove the oil sump.
2. Remove the lubricating oil strainer.
3. Remove the lubricating oil supply and discharge pipes (1) from the lubricating oil pump.
4. Remove the fixing bolts (2) from the lubricating oil pump at the main bearing cap.
5. Remove the fixing bolt (3).
6. Remove the lubricating oil pump from the main bearing cap.



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Installation, lubricating oil pump

1. Check that the lubricating oil pump operates smoothly and is not getting stuck anywhere.
2. Install the lubricating oil pump with the intermediate gear wheel on the main bearing cap. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
3. Install the lubricating oil supply and discharge pipes (1) fitted with new O-rings.
4. Install the lubricating oil strainer.
5. Install the oil sump.

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4.5 REMOVAL AND INSTALLATION, CENTRIFUGAL LUBRICATING OIL FILTER

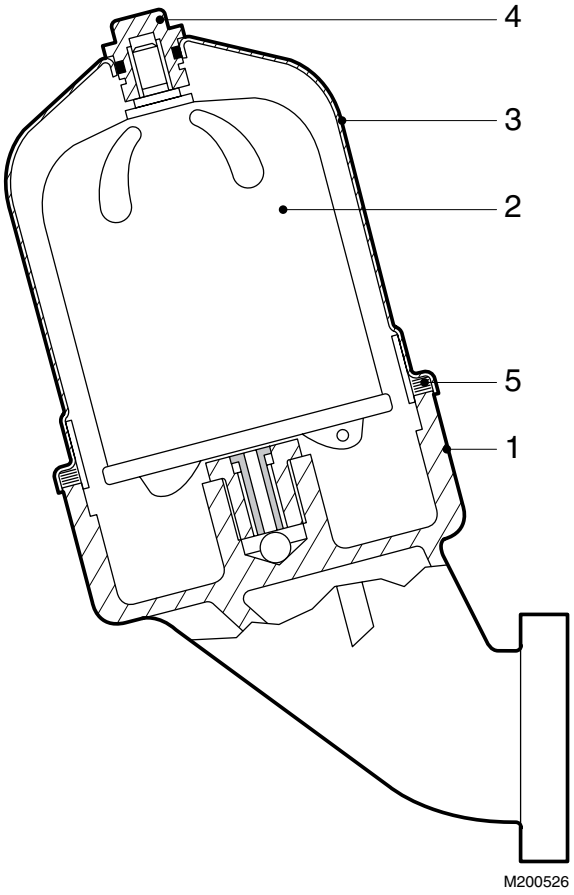
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

Removal, centrifugal lubricating oil filter rotor

1. Clean the housing (3).
2. Slacken the central bolt (4).
3. Remove the housing (3) simultaneously with the central bolt (4) and the rotor (2).
4. Remove the rotor (2) from the central bolt (4).
5. Replace the rotor (2).

Installation, centrifugal lubricating oil filter rotor

1. Clean the housing (3).
2. Check the central bolt (4) for damage.
3. Replace the sealing ring (5).
4. Fit the new rotor into the housing.
5. Lightly oil the sealing ring (5) using lubricating oil and install the housing (3).
6. Tighten the central bolt (4) to the specified tightening torque, see main group “Technical data”.
7. Start the engine and check for leaks. Check the lubricating oil level.



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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, LUBRICATING OIL PUMP

Disassembly, lubricating oil pump

1. Remove the intermediate gear wheel with the hub from the front plate.
2. Remove the fixing bolts around the halves of the lubricating oil pump housing.
3. Remove the rear half of the lubricating oil pump housing.
4. Remove the gear wheels from the lubricating oil pump housing.

Assembly, lubricating oil pump

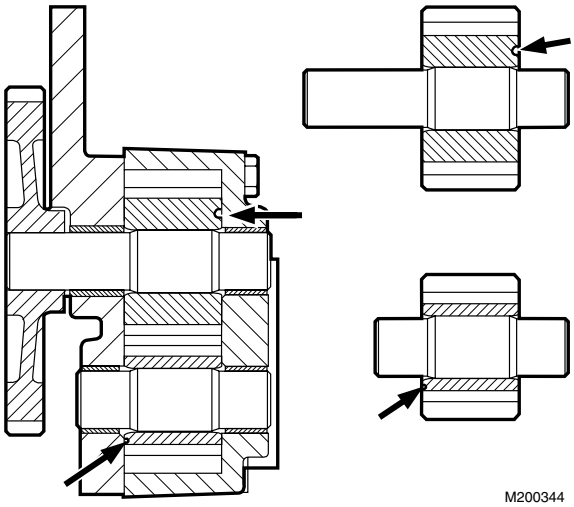
1. Clean the gear wheels and check for damage.

   Note:
   Gear wheels must be replaced as a set.

2. **Note:**
   The gear wheels are marked. The gear wheels with the marks must be installed as shown.

   Install the gear wheels in the lubricating oil pump housing.

3. Install the rear half of the lubricating oil pump housing.
4. Install the fixing bolts around the halves of the lubricating oil pump housing. Tighten the fixing bolts to the specified torque. See main group “Technical data”.
5. Check that the lubricating oil pump operates smoothly and is not getting stuck anywhere.
6. Install the intermediate gear wheel with the hub on the front plate.



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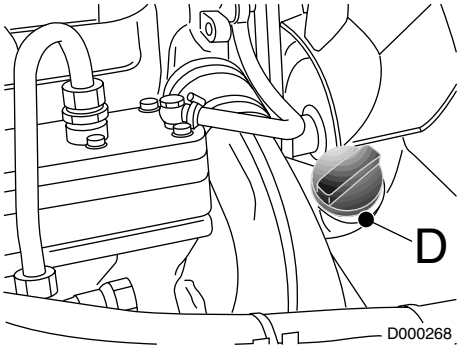
6. DRAINING AND FILLING

6.1 DRAINING AND FILLING, LUBRICATING OIL

To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

1. Place the vehicle on a flat and level surface.
2. Drain the lubricating oil using the drain plug in the oil sump.
3. Replace the drain-plug sealing ring and tighten the drain plug to the specified tightening torque. See main group “Technical data”.
4. Fill the engine through the lubricating oil-filler pipe (D) with the specified lubricating-oil quantity, see main group “Technical data”.



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