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1. CE ENGINE

1.1 GENERAL

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 been allowed to cool down for not more than thirty minutes .
Direction of rotation of the engine	The direction of rotation of the engine is clockwise, as seen from the vibration damper end.
First cylinder of the engine	The first cylinder of the engine is the cylinder at the vibration damper end of the engine.
Left-hand and right-hand side of the engine	The left-hand side of the engine is the side where the air compressor and electronic unit are mounted. The right-hand side of the engine is the side where the turbocharger and oil filter are mounted.

Engine types

Coding	CE 136 C CE 162 C CE 184 C
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General specifications

Environmental standard	Euro 3 (C)
Number of cylinders	6 cylinders in line
Valves	4 per cylinder
Bore x stroke	102 x 120 mm
Cubic capacity	5.9 litres
Compression ratio	17,3:1
Fuel injection	direct
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Cooling	fluid
Weight	approx. 498 kg

ENGINE TYPE	P (kW) at rpm	M (Nm) at rpm
CE 136 C	136 at 2500	700 at 1200 - 1600
CE 162 C	162 at 2500	820 at 1250 - 1600
CE 184 C	184 at 2500	950 at 1200 - 1600

Exhaust manifold

Maximum flatness deviation	0.20 mm
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Cylinder block

Flatness deviation in the longitudinal direction	max. 0.076 mm
Flatness deviation in the lateral direction	max. 0.051 mm

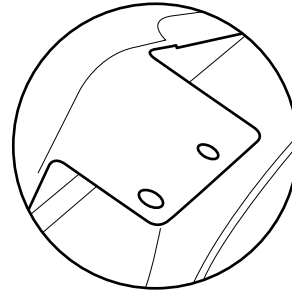
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Cylinder head

Rough value	0.4 - 1.6 mm
Flatness deviation in the longitudinal direction	max. 0.305 mm
Flatness deviation in the lateral direction	max. 0.076 mm
Test pressure using air	max. 2.75 bar
Water pressure temperature	approx. 60°C

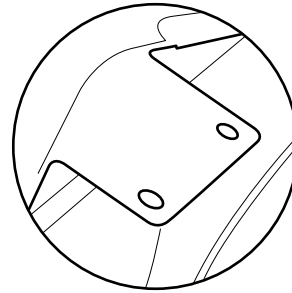
Cylinder head gasket

Thickness: 1.15 mm



M201231

Thickness: 1.25 mm



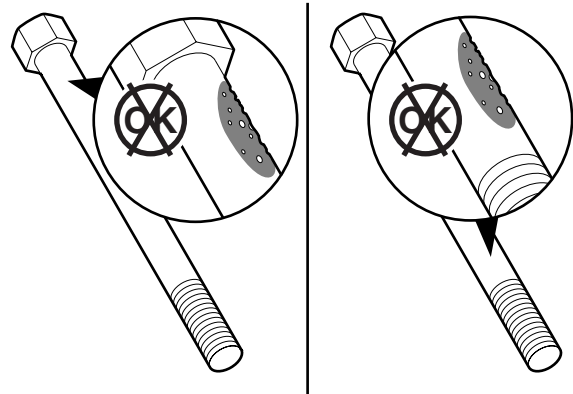
M201232

Type cylinder head gasket to be used:

Average piston projection	Thickness of cylinder head gasket
< 0.301 mm	1.15 mm
≥ 0.301 mm	1.25 mm

Cylinder head bolts

Maximum dimensions of visible corrosion or pitting	1 cm ²
Maximum depth of pitting	0.12 mm

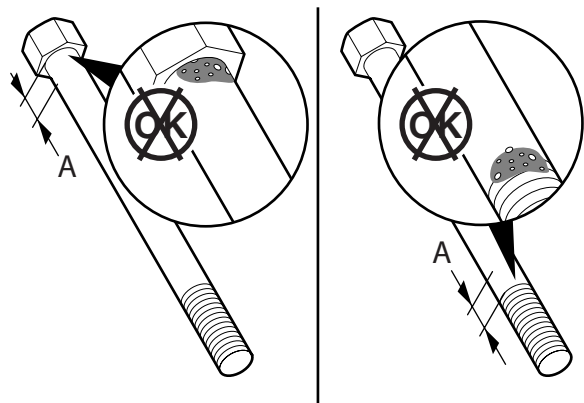


M201249



Length of the area under the bolt head and area above the start of the screw thread where corrosion and pitting may not occur (A)

3.2 mm



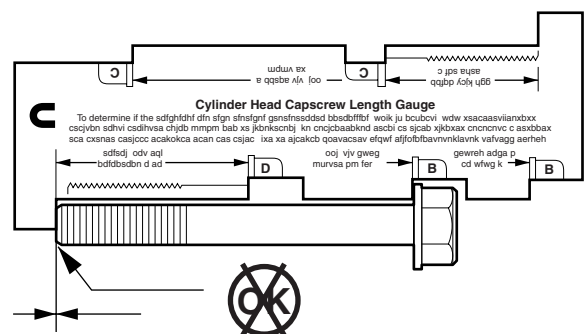
M201250

Maximum free length of the short cylinder head bolt (nominal 130 mm)

132.1 mm

Maximum free length of the long cylinder head bolt (nominal 150 mm)

152.1 mm



M201252

Valve clearance

Inspection dimension, cold valve clearance

Inlet 0.15 - 0.40 mm
 Exhaust 0.40 - 0.75 mm

Setting dimension, cold valve clearance

Inlet 0.25 mm
 Exhaust 0.50 mm

Gear backlash

Crankshaft gear - camshaft gear 0.076 - 0.28 mm
 Oil pump gear - idler gear 0.250 - 0.30 mm

Axial play

Crankshaft axial play 0.267 ± 0.165 mm
 Camshaft axial play 0.230 ± 0.130 mm

Oil sump pressure

New engine 60 - 80 l/min.
 Worn engine 180 l/min.

0

Oil sump pressure conversion table	
Inches (water)	Litres per minute (l/min.)
1	50
2	84
3	103
4	119
5	133
6	145
7	155
8	164
9	172
10	180
11	187
12	193
13	200
14	206
15	211
16	217
17	222
18	226
19	229
20	232

Flywheel/starter ring gear

Axial variation, measured on the outer diameter
 Starter ring gear warm up (max. 20 min.)

0.127 mm
 max. 127°C

Vibration damper

Difference in thickness at 4 places must not
 exceed:

6.35 mm

1.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Starter motor

Attachment bolts 43 Nm

Automatic tensioner

Attachment bolts 43 Nm

Alternator

Alternator bracket attachment bolts 30 Nm

Alternator attachment bolts 60 Nm

Pulley attachment nut 80 Nm

Air compressor

Compressor attachment nuts 60 Nm

Attachment of pipes 39 Nm

Air-conditioning compressor

Compressor support attachment bolts 30 Nm

Compressor attachment bolts 60 Nm

Valve gear

Rocker setting bolt lock nut 24 Nm

Valve sleeve attachment bolts 24 Nm

Valve cover attachment bolts 10 Nm

Rocker seat attachment bolts 36 Nm

Injector wiring 1 Nm

Inlet manifold

Inlet manifold attachment bolts 24 Nm

Fit inlet manifold using sealant Loctite Ultra Grey

Fuel rail attachment bolts 24 Nm

Glow element attachment bolts 14 Nm

Air inlet hose clamps 7 Nm

Exhaust manifold

Attachment bolts 43 Nm ⁽¹⁾

Heat shields 60 Nm

(1) Tighten crosswise from inside to outside.

0

Cylinder head

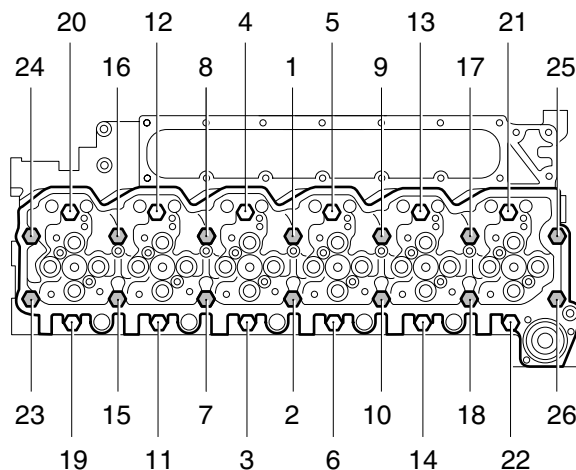
Note:

Apply a drop of engine oil to the thread and under the abutting surface of the attachment bolt heads.

Stage 1

All attachment bolts 35 Nm ⁽¹⁾

(1) Tighten the bolts in the order indicated

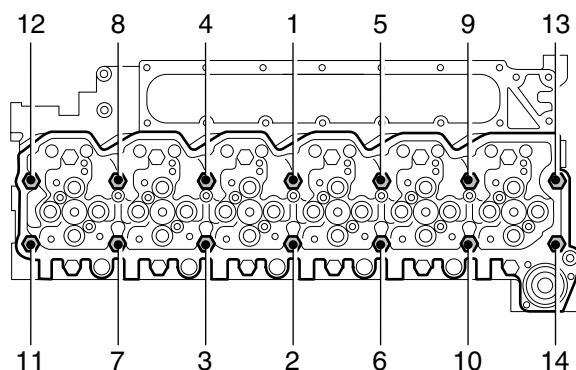


M201143

Stage 2

Only attachment bolts with a length of 150 mm 55 Nm ⁽¹⁾

(1) Tighten the bolts in the order indicated

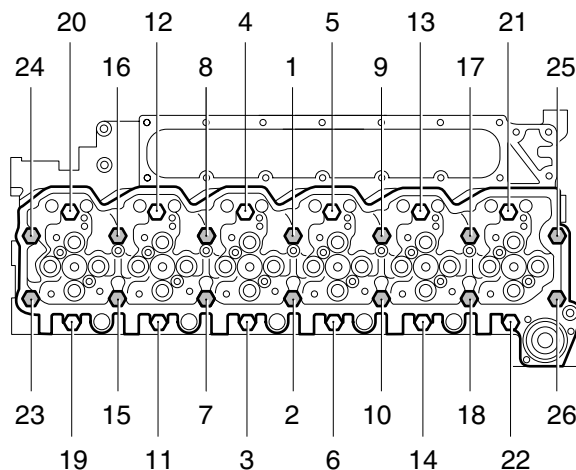


M201202

Stage 3

All attachment bolts 2 steps each with a 90° angular displacement ⁽¹⁾

(1) Tighten the bolts in the order indicated



M201143

Vibration damper

Attachment bolts

50 Nm + 90° angular displacement

Timing gear

Camshaft locking plate attachment bolts

24 Nm

M8 attachment bolts for timing gear case

24 Nm

M10 attachment bolts for timing gear case

47 Nm

M12 attachment bolts for timing gear case

50 Nm

Fit timing gear case using sealant

Loctite Ultra Grey

Attachment bolts, camshaft gear

36 Nm

Attachment bolts, cap, front of engine

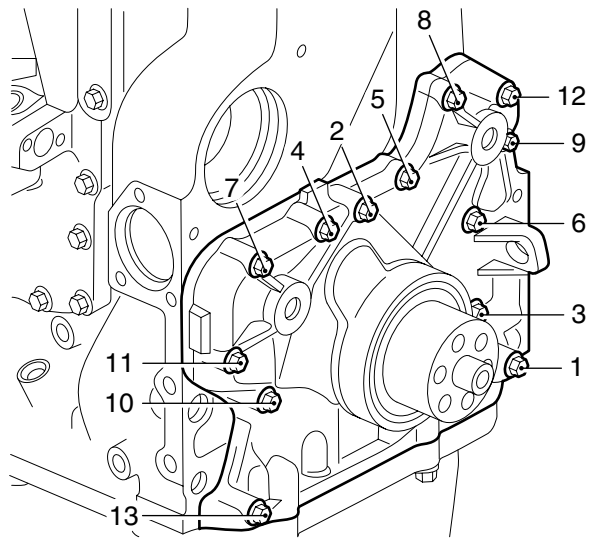
Attachment bolts,
cap, front of
engine ⁽¹⁾

24 Nm

Fit cap at engine
front using sealant

Loctite Ultra Grey

(1) Tighten the attachment bolts in the order indicated



M201144

Flywheel

Attachment bolts

30 Nm + 60° angular displacement

Flywheel housing

M10 attachment
bolts ⁽¹⁾

49 Nm

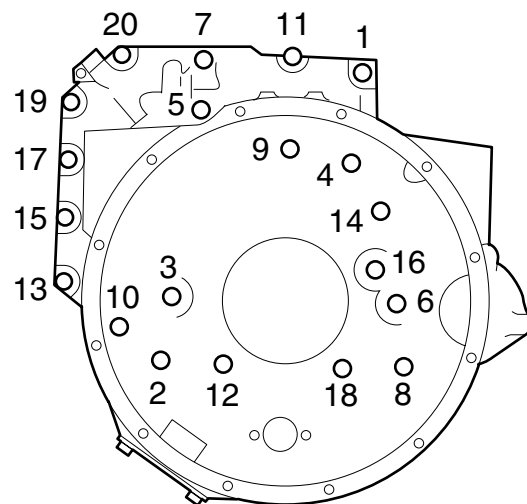
M12 attachment
bolts ⁽¹⁾

85 Nm

Fit flywheel housing
using sealant

Loctite 5205

(1) Tighten the attachment bolts in the order indicated



M201080

Engine mounts, front

Engine bracket attachment bolts/nuts

110 Nm

CE engine

CF65/75/85 series**0****Engine mounts, rear**

Bolts attaching engine bracket to chassis

110 Nm + 90° angular displacement

Bolts attaching engine bracket to engine

110 Nm + 60° angular displacement

Bolts attaching support to engine bracket

170 Nm + 90° angular displacement

Engine hanger brackets

Attachment bolts

113 Nm

2. CE-ENGINE COOLING SYSTEM

2.1 GENERAL

Thermostat

Thermostat opening temperatures:

Thermostat opens at

approx. 81°C

Thermostat fully open at

approx. 94°C

Full thermostat opening

14.3 mm

Header tank pressure cap

Pressure relief valve opening pressure

1 - 1.2 bar

Underpressure valve opening pressure

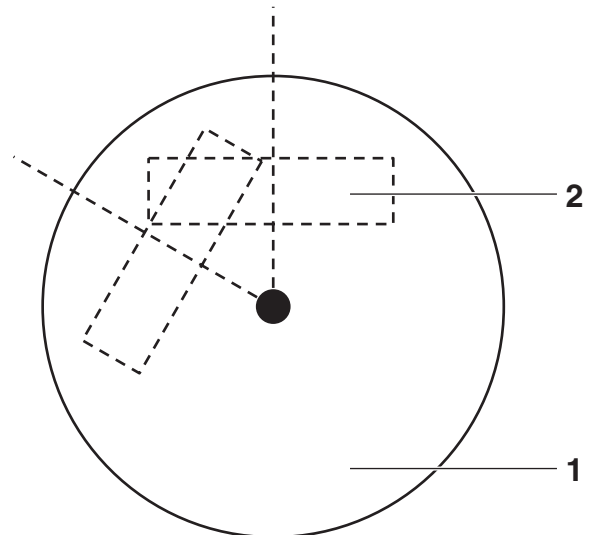
0.1 - 0.02 bar

Closed pressure cap position

Brand name (2) legible horizontally or 60° before this position.

Closed pressure cap position

Brand name (2) legible horizontally or 60° before this position.



M201272

Pressure-testing the cooling system

Test pressure

0.5 - 0.7 bar

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2.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Coolant pump

Attachment bolts 24 Nm

Thermostat housing

Attachment bolts 10 Nm

Radiator

Attachment nuts 60 Nm

2.3 FILLING CAPACITIES

Cooling system capacity

approx. 26 litres

3. CE-ENGINE LUBRICATION SYSTEM

3.1 GENERAL

Oil pressure

Lubricating oil pressure at engine idling speed	min. 0.69 bar
Lubricating oil pressure at full-load engine speed	min. 2.07 bar
Bypass pressure regulator opening pressure	3.52 bar

Oil filter

Type	disposable filter
Number	1
Installation in the oil circuit	full flow

Oil cooler

Oil section test pressure	4.5 - 5.0 bar
Opening pressure of bypass valve at a pressure difference of	3.45 bar

Lubricating oil pump

Maximum clearance, inner rotor - outer rotor	0.178 mm
Maximum clearance, outer rotor - lubricating oil pump housing	0.381 mm
Maximum flatness of inner/outer rotor versus straight edge	0.127 mm
Backlash (disassembled)	0.25 - 0.30 mm
Idle gear backlash (assembled)	0.15 - 0.25 mm
Oil pump gear backlash (assembled)	0.30 - 0.50 mm

Oil consumption

Maximum permissible engine oil consumption	0.5% of the average fuel consumption
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Example:

Average measured fuel consumption: 25 litres / 100 km = 250 litres / 1000 km

Maximum permissible engine oil consumption:
 $0.5\% \times 250 = 1.25$ litres / 1000 km

- Engine oil consumption of 1.25 litres / 1000 km is permissible
- Engine oil consumption > 1.25 litres / 1000 km; check the engine using the diagnostics table. See "Diagnostics".

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3.2 TIGHTENING TORQUES

The tightening torques specified in this section are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Oil filter

Attachment bolts to connect filter head to engine block

24 Nm

Oil sump

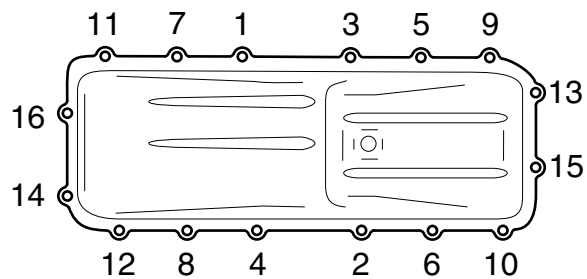
Oil sump attachment bolts

24 Nm ⁽¹⁾

Oil drain plug

60 Nm

(1) Tighten the attachment bolts in the order indicated



M201079

Strainer

Suction tube attachment bolts

24 Nm

Bypass pressure regulator

Plug

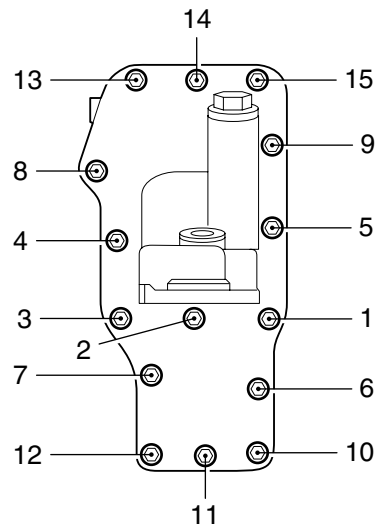
80 Nm

Oil cooler

Attachment bolts
connecting oil cooler
to cylinder block

24 Nm ⁽¹⁾

(1) Tighten the attachment bolts in the order indicated



M201145

Oil pump

Attachment bolts

24 Nm

Turbocharger oil supply pipe

Union on filter head

28 Nm

Union on turbocharger

28 Nm

Bypass pressure regulator

Plug

80 Nm

Oil nozzle

Banjo bolt

15 Nm

Main bearing caps

Main bearing cap attachment bolts

1st phase

60 Nm

2nd phase

80 Nm

3rd phase

90° angular displacement

Big-end bearing caps

Attachment bolts, big-end bearing caps

60 Nm + 60° angular displacement

3.3 FILLING CAPACITIES**Lubrication system**

Total capacity, including oil cooler and oil filter	19.5 litres
Oil sump capacity, maximum level	17.5 litres
Oil sump capacity, minimum level	15.4 litres

4. PE ENGINE

4.1 GENERAL

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 been allowed to cool down for not 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.

Engine types

Coding	PE 183 C1 PE 228 C PE 265 C
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General specifications

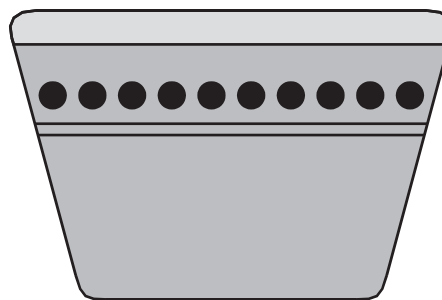
Environmental standard	Euro 3 (C)
Number of cylinders	6 cylinders in line
Valves	4 per cylinder
Bore x stroke	118 x 140 mm
Total cubic capacity	9,20 l
Compression ratio	17,4 : 1
Fuel injection	direct
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Cooling	fluid
Weight	approx. 860 kg

V-belt tension

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

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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 inside of the belt (polished belt edge). Version: either a toothed or a non-toothed belt.
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 test tension reading is lower than the value 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 "correction tension".



M2121

Cylinder liner

Height above cylinder block 0.02 - 0.10 mm

Cylinder head

Minimum height after overhaul 119.5 mm

Cylinder head test pressure

Test pressure using air (hot) 1.5 bar

Valve clearance

Valve clearance (cold/hot)

inlet 0.45 mm
 exhaust 0.45 mm

Valve opening

Valve opening at 1 mm valve clearance 0.45 ± 0.2 mm

Axial play

Crankshaft axial play 0.05 - 0.35 mm
 Camshaft axial play 0.10 - 0.55 mm
 Idler gear axial play 0.03 - 0.25 mm

Gear backlash

Idler gear - crankshaft gear 0.02 - 0.20 mm
 Idler gear - fuel pump gear 0.02 - 0.22 mm
 Idler gear - camshaft gear 0.02 - 0.22 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 31
 Idler gear 52
 Fuel pump gear 62
 Camshaft gear 62
 Air compressor gear 27
 Steering pump gear 18
 Oil pump idler gear 28

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



4.2 TIGHTENING TORQUES

Starter motor

Attachment nuts 73 Nm ⁽¹⁾

Alternator

Alternator bracket attachment bolts 30 Nm

Alternator attachment bolts 60 Nm

Pulley attachment nut 80 Nm

Electrical connection to alternator 12 Nm

Air compressor

Compressor gear flange bolt 120 Nm

M12 attachment bolts 110 Nm

M8 attachment bolts for bracket 30 Nm

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

M10 attachment bolts 60 Nm

M10 attachment studs 60 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

Fan

Attachment nuts 25 Nm ⁽¹⁾

Fan pulley attachment bolts 30 Nm ⁽¹⁾

(1) Use Loctite 243 to secure

(2) Fasten with Copaslip

Vibration damper

Vibration damper hub attachment bolts in 4 phases:

1 st phase, all attachment bolts	50 Nm ⁽¹⁾
2 nd phase, all attachment bolts	70 Nm ⁽¹⁾
3 rd phase, all attachment bolts	100 Nm ⁽¹⁾
4 th phase, all attachment bolts	60° angular displacement ⁽¹⁾
Vibration damper attachment bolts	110 Nm ⁽²⁾

(1) Tighten the attachment bolts evenly

(2) Use Loctite 243 to secure

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Cylinder head attachment bolts

Cylinder bolts must only be used **once**. So the cylinder bolts must always be replaced. The thread of the new cylinder head bolts is provided with a red/brown sealant.

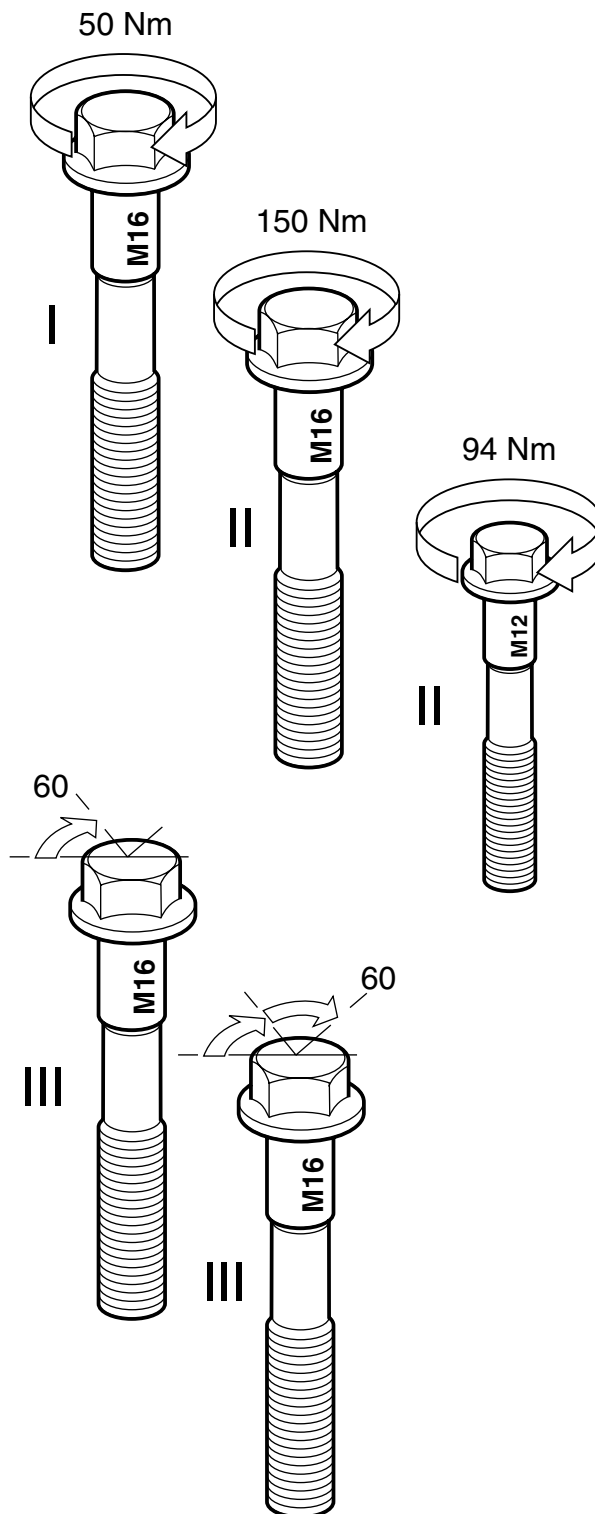
Note:

- Due to the sealant used on the cylinder head bolts, the untightening torque of the cylinder head bolts can be substantial!
- All M16 and M12 threaded holes must be carefully cleaned using a screw tap prior to the mounting of the bolts.
- After tightening of the bolts with the appropriate tightening torque, the angular displacement of the M16 bolts must **immediately** be started.
- The sealant cannot be applied later.

Tightening cylinder head attachment bolts

Note:

Underneath the bolt head, apply a drop of oil on the bearing surface of the bolt heads. Sealants also reduce the frictional resistance, which means that you must **not** apply any oil to the thread.



M200563

1st phase

- M16 in the indicated order

50 Nm ⁽¹⁾

2nd phase

- M16 in the indicated order

150 Nm

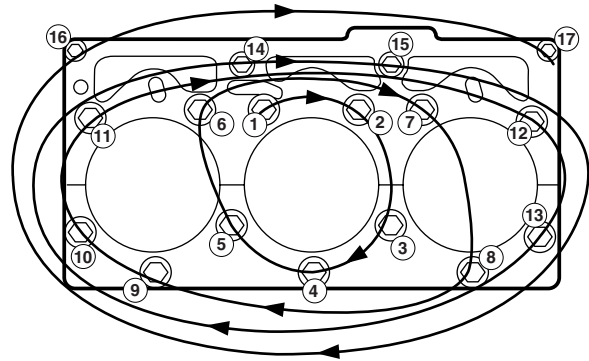
- M12 in the indicated order

94 Nm ⁽¹⁾

3rd phase

- M16 in the indicated order in two stages of

60° angular displacement



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

M200734

Timing gear

Pump housing drive unit attachment bolts	60 Nm
Attachment bolts, pump housing drive shaft locking plate	30 Nm ⁽¹⁾
Locking plate attachment bolts	30 Nm ⁽¹⁾
Crankshaft hub attachment bolts in 4 phases:	
1 st phase, all attachment bolts	100 Nm ⁽²⁾
2 nd phase, all attachment bolts	100 Nm ⁽²⁾
3 rd phase, all attachment bolts	100 Nm ⁽²⁾
4 th phase, all attachment bolts	100 Nm ⁽²⁾
Viscous fan clutch attachment nuts	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	8.5 Nm
Camshaft gear attachment bolt	425 Nm
Idler gear attachment bolt	170 Nm
Pump housing camshaft gear attachment bolt	260 Nm ⁽¹⁾
Steering pump gear attachment nut	80 Nm ⁽¹⁾
Suction pipe banjo bolt	90 Nm
Delivery pipe banjo bolt	40 Nm

(1) Use Loctite 243 to secure

(2) Apply a drop of oil to the attachment bolts and tighten evenly.

Flywheel housing

Attachment bolts:	110 Nm
Sealant to be used when fitting flywheel housing	Loctite 510

Flywheel

Attachment bolts:	
without PTO	170 Nm ⁽¹⁾ + 90° angle tightening
with PTO	170 Nm + 150° angle tightening

(1) Use Loctite 243 to secure

0

Engine mountings at timing gear end

Cylinder block bracket attachment bolts	92 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	170 Nm

Engine mountings at flywheel end

Flywheel housing engine bracket attachment bolts	260 Nm
Chassis engine bracket attachment bolts	73 Nm
Vibration damper engine bracket attachment bolts	226 Nm + 60° angle tightening

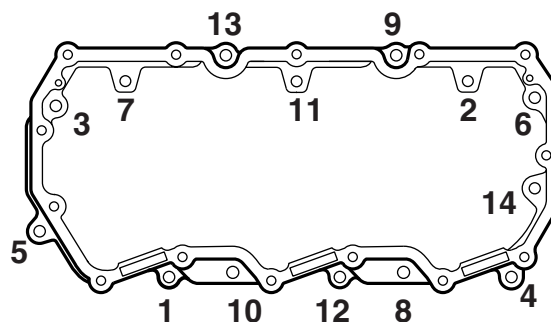
Engine hanger brackets

M12 attachment bolts	110 Nm
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Valve gear

Valve cover attachment bolts	25 Nm
M10 setting bolt lock nut for rocker	40 Nm
Bridge piece setting bolt lock nut	40 Nm
Lubricating oil strip/rocker seat attachment bolts	60 Nm
Valve sleeve attachment bolts	30 Nm

Tighten the valve sleeve attachment bolts in the sequence shown.



M200959

5. PE-ENGINE COOLING SYSTEM

5.1 GENERAL

Thermostat

Thermostat opening temperature standard:

- thermostat opens at	approx. 87°C
- thermostat open at least 12 mm at	approx. 99°C
with intarder and/or automatic transmission:	
- thermostat opens at	approx. 83°C
- thermostat open at least 12 mm at	approx. 95°C
Thermostat seat	Loctite 638

Coolant pump

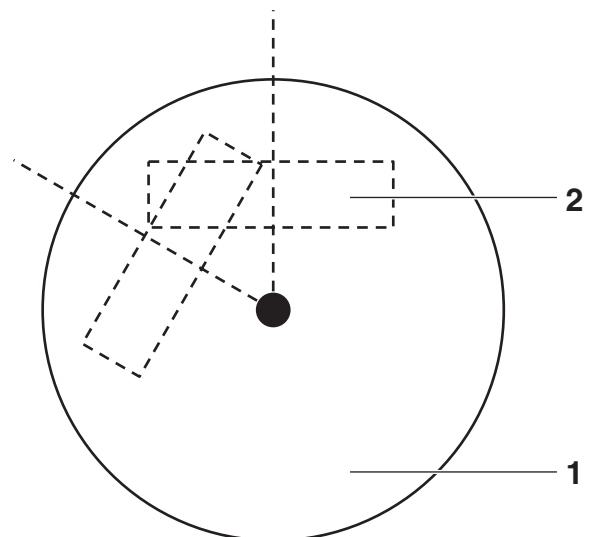
Radial play 0.16 - 0.20 mm

Header tank pressure cap

Pressure relief valve opening pressure 1 - 1.2 bar
 Underpressure valve opening pressure 0.1 - 0.02 bar
 Closed pressure cap position Brand name (2) legible horizontally or 60° before this position.

Closed pressure cap position

Brand name (2) legible horizontally or 60° before this position.



M201272

Pressure testing the cooling system

Test pressure 0.7 - 0.9 bar

Viscous fan clutch

Permissible slip at maximum speed control ≤10%

0

5.2 TIGHTENING TORQUES

The tightening torques recorded in this paragraph are different from the standard tightening torques recorded in the overview of the standard tightening torques. The other threaded connections which are not recorded must therefore be tightened to the torque recorded in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

Coolant pump

M8 attachment bolts 30 Nm

Coolant pipe on cylinder head

Attachment bolts 54 Nm

Coolant pipe threaded coupling 90 Nm

Coolant pipe plug 35 Nm

Thermostat housing on coolant pipe

Attachment bolts 30 Nm

Radiator

Attachment nuts 60 Nm

Oil cooler

Coolant drain plug 16 Nm

5.3 FILLING CAPACITIES

Cooling system

Cooling system capacity, standard vehicle approx. 38 litres

Cooling system capacity of vehicle with ZF
intarder approx. 50 litres

Cooling system capacity of vehicle with automatic
gearbox approx. 50 litres

6. PE-ENGINE LUBRICATION SYSTEM

6.1 GENERAL

Oil pressure

Oil pressure at engine idling speed	1 bar (warm engine)
Oil pressure at full-load engine speed	3.35 - 4.35 bar

Oil filter

Type	filter element
Number	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

Coolant test pressure	2.5 bar
-----------------------	---------

Oil consumption

Maximum admissible engine oil consumption	0.3% of the average fuel consumption
---	--------------------------------------

Example:

Average measured fuel consumption: 30 litres / 100 km = 300 litres / 1000 km

Maximum admissible engine oil consumption:

$0.3\% \times 300 = 0.9$ litres / 1000 km

- Engine oil consumption = 0.9 litres / 1000 km is permitted

- Engine oil consumption > 0.9 litres / 1000 km; check the engine using the diagnostics table. See "Diagnosis".

6.2 TIGHTENING TORQUES

The tightening torques specified in this paragraph are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

Lubricating oil strip/rocker seats

Attachment bolts: 60 Nm

Oil pan

Clamp attachment bolts 25 Nm
 Oil drain plug 60 Nm
 Oil level sensor 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⁾
 Filter element screw cap 45 Nm

Bypass pressure regulator

Plug 80 Nm

Oil cooler

Attachment bolts connecting oil cooler to cylinder block 50 Nm

(1) Use Loctite 243 to secure
 (2) Use Loctite 572 to secure

Oil nozzles

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

Main bearing capsMain bearing cap attachment bolts ⁽¹⁾

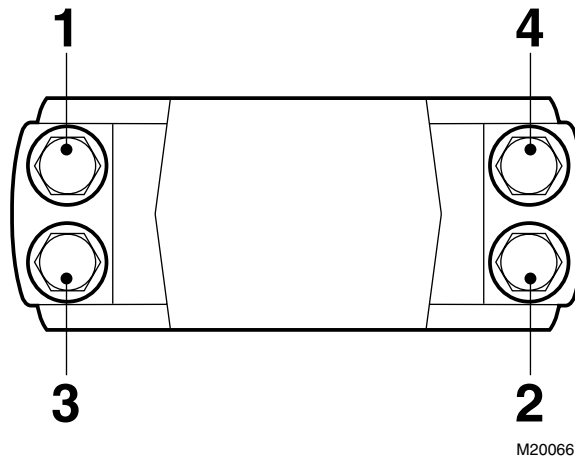
1 st phase	50 Nm
2 nd phase	150 Nm
3 rd phase	120° angular displacement

Big-end bearing capsAttachment bolts, big-end bearing caps ⁽²⁾

1 st phase, sequence 1-2-3-4	25 Nm
2 nd phase, sequence 4-3-2-1	35 Nm
3 rd phase, sequence 1-2-3-4	60° angular displacement

(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 on the thread and bearing face of the connecting rod bolts.



M200661

6.3 FILLING CAPACITIES**Lubrication system**

Total capacity, including oil cooler and oil filter	approx. 29 litres
Oil sump capacity, maximum level	approx. 24 litres
Oil pan capacity, minimum level	approx. 16 litres

7. XE ENGINE

7.1 GENERAL

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 been allowed to cool down for not 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.

Engine types

Coding	XE 250 C 1 XE 280 C 1 XE 280 C 3 XE 315 C 1 XE 315 C 3 XE 355 C 1
--------	--

General specifications

Environmental standard	Euro 3 (C)
Number of cylinders	6
Valves	4 per cylinder
Bore x stroke	130 x 158 mm
Total cubic capacity	12.6 l
Compression ratio	17,4 : 1
Fuel injection	direct
Injection sequence	1-5-3-6-2-4
Air inlet system	Turbocharger intercooling
Cooling	fluid
Weight	approx. 1,080 kg

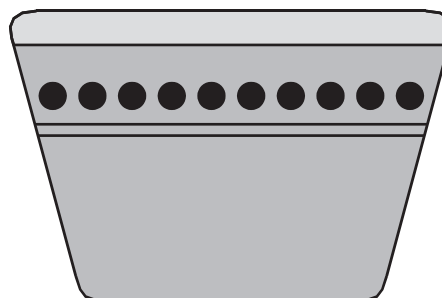
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V-belt tension

V-belt tension, "AVX" raw edge ⁽¹⁾(N) Application example: air-conditioning compressor drive	
New V-belt ⁽²⁾	
Setting tension	600
Test tension	≥ 400
Run-in V-belt ⁽³⁾	
Minimum tension	250
Correction tension	350

V-belt tension, "XPB" raw edge ⁽¹⁾(N) Application example: steering pump drive on FAX vehicle	
New V-belt ⁽²⁾	
Setting tension	1250
Test tension	≥ 950
Run-in V-belt ⁽³⁾	
Minimum tension	750
Correction tension	950

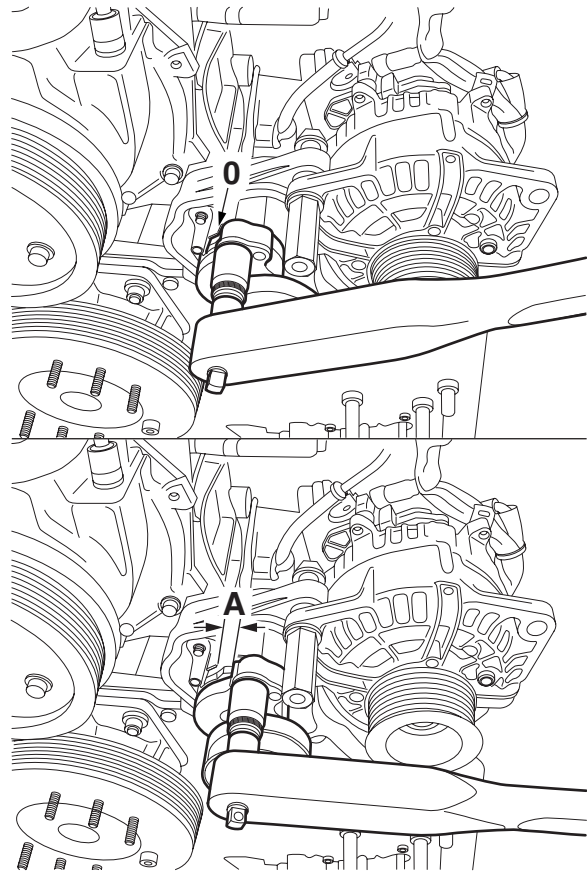
- (1) Raw-edge V-belts can be recognised by the absence of textile fabric in the rubber, with the exception of the top of the belt edge, on the edges and the inside of the belt (polished belt edge). Version: either a toothed or a non-toothed belt.
- (2) After fitting the new V-belt, set the pre-tension to the "setting tension" and after a trial run inspect whether the pre-tension complies with the "test tension". If the test tension reading is lower than the value 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".



M2121

Automatic poly-V-belt tensioner

Torsional moment
from rest position (0)
to 17 mm torsion (A) 19 - 37 Nm



M201274

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

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

0

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 wheel	70
Camshaft gear	70
Air compressor gear	27
Fan drive housing gear	29
Steering pump gear	18
Lubricating oil pump idler gear	34

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

7.2 TIGHTENING TORQUES

The tightening torques specified in this paragraph are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

Starter motor

Attachment nuts	73 Nm ⁽¹⁾
Electrical connection to starter motor	28 Nm

Alternator

Alternator attachment bolts	60 Nm
Pulley attachment nut	80 Nm
Electrical connection to alternator (M8)	15 Nm

Air compressor

M12 attachment bolts	110 Nm
M8 attachment bolts for bracket	30 Nm
M10 attachment bolts for bracket	60 Nm
Compressor gear flange bolt	120 Nm
M14 threaded coupling for cylinder head	40 Nm
M26 threaded coupling for cylinder head	90 Nm
Cylinder head service line banjo bolt	25 Nm
Pressure line safety valve	75 Nm
Suction and pressure line unions	90 Nm
Oil supply banjo bolt	25 Nm

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:	46 Nm
Air inlet hose clamps	12 Nm
Electrical connection to glow plug	8.5 Nm
Attachment bolts, boost pressure/charge temperature sensor	4 Nm
Hose clamps	12 Nm

0

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) Use Loctite 243 to secure
 (2) Fasten with Copaslip

Glow plug relay

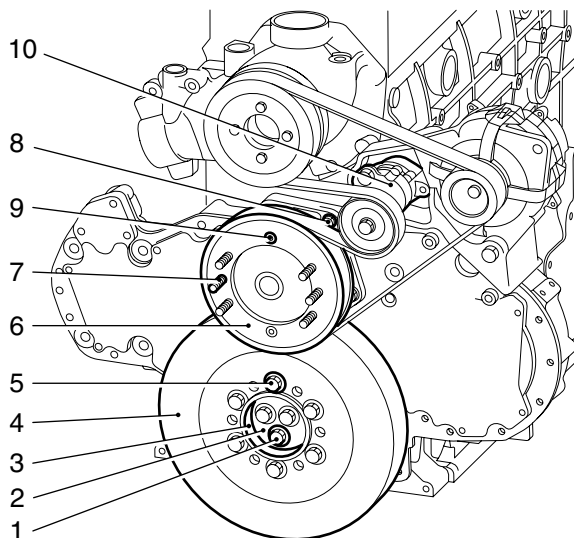
Glow plug relay cap	2 Nm
Electrical connections to glow plug relay:	
M5	3.5 Nm
M8	8 Nm

Main fuse

Fuse holder (M6)	4.5 Nm
Fuse (M8)	18 Nm

Vibration damper and fan drive

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



M201153

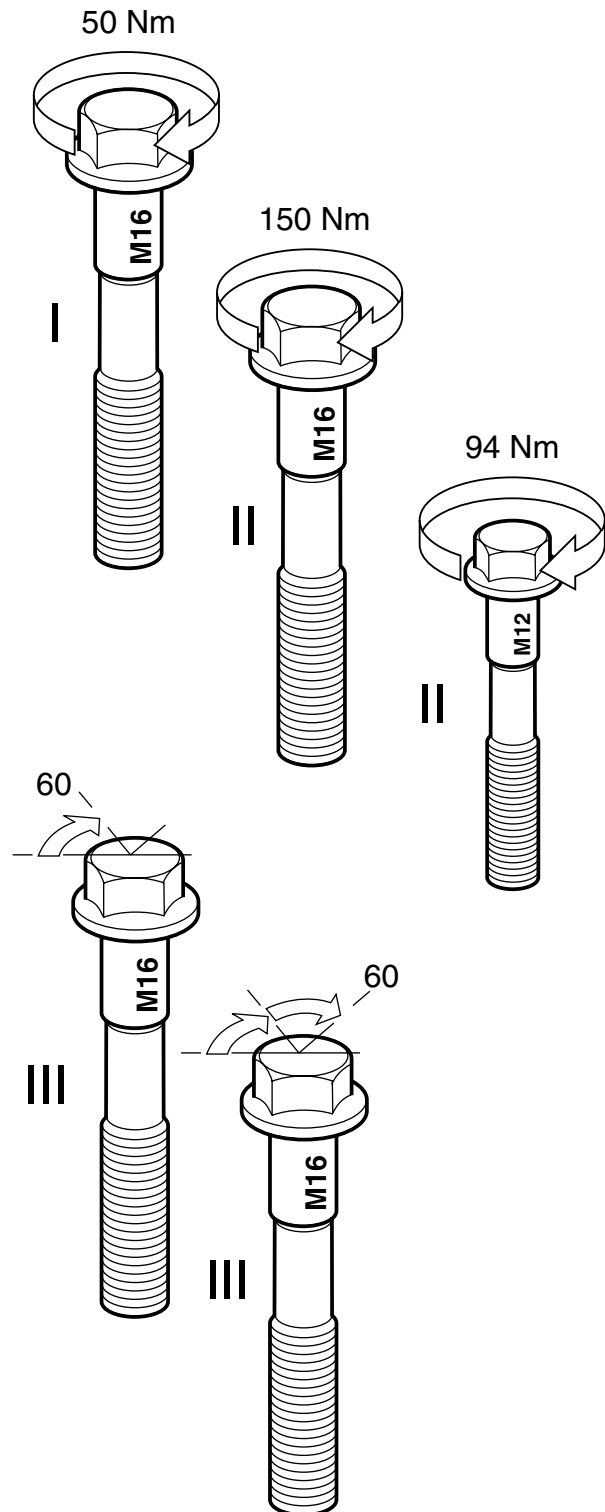
(1) Tighten the attachment bolts evenly
 (2) Use Loctite 243 to secure

Cylinder head attachment bolts

Cylinder head bolts must only be used **once**. So the cylinder head bolts must always be replaced. The thread of the new cylinder head bolts is provided with a red/brown sealant.

Note:

- Due to the sealant used on the cylinder head bolts, the untightening torque of the cylinder head bolts can be substantial!
- All M16 and M12 threaded holes must be carefully cleaned using a screw tap prior to the mounting of the bolts.
- After tightening of the bolts with the appropriate tightening torque, the angular displacement of the M16 bolts must **immediately** be started.
- The sealant cannot be applied later.



M200563

0

Tightening cylinder head attachment bolts

Note:

Underneath the bolt head, apply a drop of oil on the bearing surface of the bolt heads. Sealants also reduce the frictional resistance, which means that you must **not** apply any oil to the thread.

1st phase

- M16 in the indicated order 50 Nm ⁽¹⁾

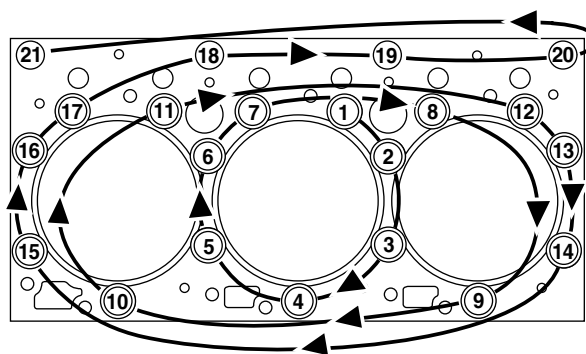
2nd phase

- M16 in the indicated order 150 Nm

- M12 in the indicated order 94 Nm ⁽¹⁾

3rd phase

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



M200562

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

Timing gear

Pump housing drive unit attachment bolts	60 Nm
Attachment bolts, pump housing drive shaft locking plate	30 Nm ⁽¹⁾
Locking plate attachment bolts	30 Nm ⁽¹⁾
Crankshaft hub attachment bolts in 4 phases:	
1 st phase, all attachment bolts	100 Nm ⁽²⁾
2 nd phase, all attachment bolts	100 Nm ⁽²⁾
3 rd phase, all attachment bolts	100 Nm ⁽²⁾
4 th phase, all attachment bolts	100 Nm ⁽²⁾
Viscous fan clutch attachment nuts	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	8.5 Nm
Camshaft gear attachment bolt	425 Nm
Idler gear attachment bolt	170 Nm
Pump housing camshaft gear attachment bolt	260 Nm ⁽¹⁾
Steering pump gear attachment nut	80 Nm ⁽¹⁾
Suction pipe banjo bolt	90 Nm
Delivery pipe banjo bolt	40 Nm

(1) Use Loctite 243 to secure
 (2) Apply a drop of oil to the attachment bolts and tighten evenly.

Flywheel housing

Attachment bolts	110 Nm ⁽¹⁾
Sealant to be used when fitting flywheel housing	Loctite 510
Attachment bolt, crankshaft sensor	8 Nm

(1) Use Loctite 243 to secure

Flywheel

Attachment bolts:	
- standard	260 Nm + 60° angle tightening
- with engine PTO	260 Nm + 120° angle tightening

Engine mountings at timing gear end

Cylinder block bracket attachment bolts	110 Nm
Chassis engine bracket attachment bolts	110 Nm
Vibration damper engine bracket attachment bolts	170 Nm

Engine mountings at flywheel end

Flywheel housing engine bracket attachment bolts	260 Nm
Chassis engine bracket attachment bolts	110 Nm
Vibration damper engine bracket attachment bolts	260 Nm + 90° angle tightening

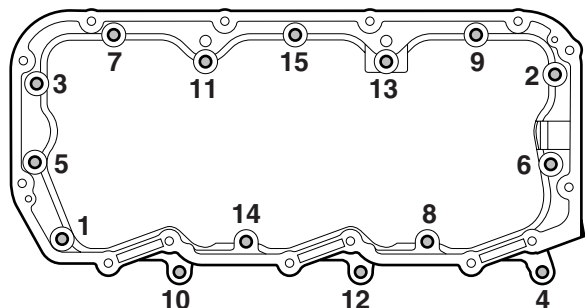
Engine hanger brackets

Attachment bolts:	110 Nm
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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 attachment bolts in the sequence shown



M200942

8. XE-ENGINE COOLING SYSTEM

8.1 GENERAL

Thermostat

Thermostat opening temperatures:
standard

- thermostat opens at	approx. 87°C
- thermostat open at least 12 mm at	approx. 99°C
with intarder and/or tropical cooling:	
- thermostat opens at	approx. 83°C
- thermostat open at least 12 mm at	approx. 95°C

Thermostat seat Loctite 638

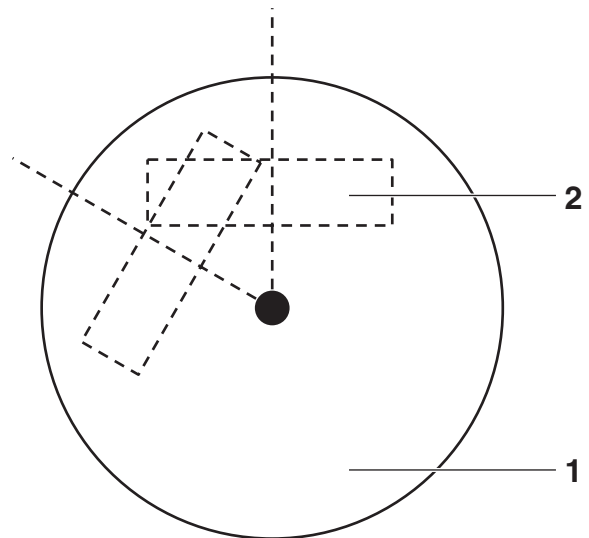
Coolant pump

Maximum radial play 0.16 - 0.20 mm

Header tank pressure cap

Pressure relief valve opening pressure	1 - 1.2 bar
Underpressure valve opening pressure	0.1 - 0.02 bar
Closed pressure cap position	Brand name (2) legible horizontally or 60° before this position.

Closed pressure cap position	Brand name (2) legible horizontally or 60° before this position.
------------------------------	--



M201272

Pressure testing the cooling system

Test pressure 0.7 - 0.9 bar

Viscous fan clutch

Permissible slip at maximum speed control	≤10%
Fan drive (i) transmission	1,207

0

8.2 TIGHTENING TORQUES

The tightening torques specified in this paragraph are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

Coolant pump

M8 attachment bolts	30 Nm
M14 threaded coupling	35 Nm
M26	90 Nm

Coolant pipe

Attachment bolts	60 Nm
Coolant pipe threaded coupling	90 Nm
Coolant pipe plug	35 Nm
Engine coolant temperature sensor	20 Nm

Thermostat housing

Attachment bolts	30 Nm
Plug	35 Nm

Radiator

Attachment nuts	70 Nm
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Coolant hoses

Hose clamps	7 Nm
-------------	------

8.3 FILLING CAPACITIES

Cooling system capacity	approx. 47 litres
Cooling system capacity of vehicle with ZF intarder	approx. 57 litres

9. XE-ENGINE LUBRICATION SYSTEM

9.1 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	filter element
Number	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

Coolant test pressure maximum	2.5 bar
-------------------------------	---------

Oil consumption

Maximum admissible engine oil consumption	0.3% of the average fuel consumption
---	--------------------------------------

Example:

Average measured fuel consumption: 30 litres / 100 km = 300 litres / 1000 km

Maximum admissible engine oil consumption:

$0.3\% \times 300 = 0.9$ litres / 1000 km

- Engine oil consumption = 0.9 litres / 1000 km is permitted

- Engine oil consumption > 0.9 litres / 1000 km; check the engine using the diagnostics table. See "Diagnosis".

9.2 TIGHTENING TORQUES

The tightening torques specified in this paragraph are different from the standard tightening torques cited in the overview of the standard tightening torques. The other threaded connections not specified must therefore be tightened to the torque cited in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important - unless stated otherwise - that these bolts and nuts are of exactly the same length and property class as those removed.

Lubricating oil strip/rocker seats

Attachment bolts 110 Nm

Oil pan

Clamp attachment bolts 25 Nm
 Oil drain plug 60 Nm
 Oil level sensor 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⁾
 Filter element screw cap 40 Nm

(1) Use Loctite 243 to secure
 (2) Use Loctite 572 to secure

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 nozzle

Oil nozzle banjo bolt

30 Nm

Main bearing caps

Main bearing cap attachment bolts ⁽¹⁾

150 Nm + 120° angle tightening

Big-end bearing caps

Attachment bolts (1),
cracked big-end
bearing caps ⁽²⁾

1st phase

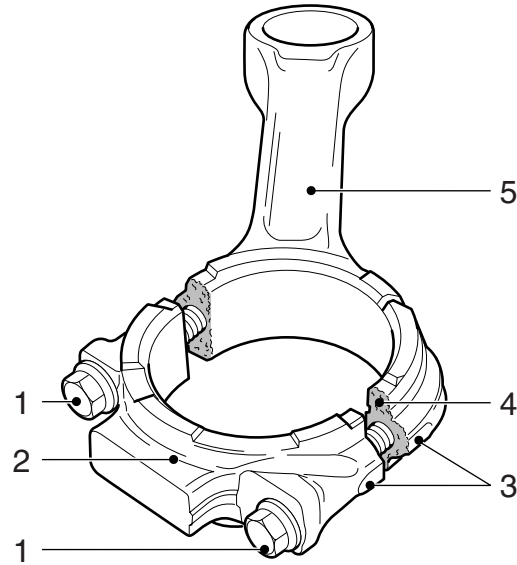
100 Nm

2nd phase

175 Nm ± 15 Nm

3rd phase

60° angular
displacement



M2 01 285

Attachment bolts,
big-end bearing
caps ⁽²⁾

1st phase, sequence

1-2-3-4

35 Nm

2nd phase, sequence

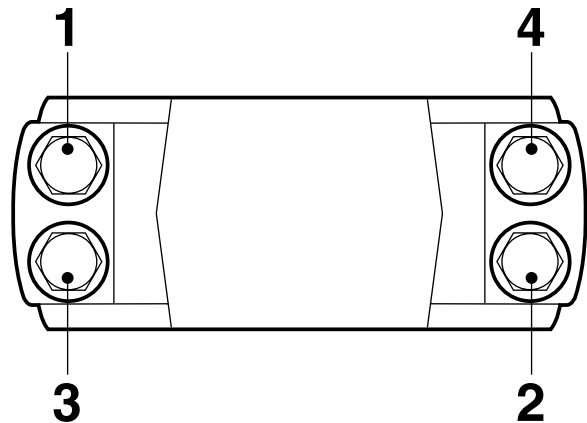
4-3-2-1

45 Nm

3rd phase, sequence

1-2-3-4

60° angular
displacement



M200661

- (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.

9.3 FILLING CAPACITIES**Lubrication system**

Total capacity, including oil cooler and oil filter	approx. 35 litres
Oil sump capacity, maximum level	approx. 30 litres
Oil pan capacity, minimum level	approx. 22 litres

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1. TRACTIVE PROBLEMS

1.1 INTRODUCTION

There may be many reasons why a vehicle's performance is below standard.

Some of these may be mechanical, but some may be psychological in nature. It is therefore important to identify the problem properly.

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

- When does the vehicle not perform properly?
- What are the road or weather conditions when this occurs?
- What are the vehicle's loading conditions?
- 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 correct 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 identifying the cause.

Note:

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

1.2 ACCELERATION TEST

1. Use the "Acceleration test form", which is included in the Workshop Manual.
2. Do the checks set out under "Before starting the acceleration test".
3. Establish 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 these two consumers being switched on.

6. Connect DAVIE and follow the instructions given.
7. Fully depress the accelerator 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 or clean the air filter element.
- Check the setting of the wastegate on the turbocharger (if present).
- Check the exhaust brake butterfly valve for correct operation.
- Check the charge cooler exterior for dirt deposits.
- Clean the water separator (if present).
- Check that the primer pump is attached.
- Replace the fuel fine filter.
- Check the suction pipe of the tank for clogging by coarse dirt.
- Check the fuel tank for fouling. Clean with a steam cleaner, if necessary.
- Check the air intake 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 impellers on the compressor and turbine sides for damage and for deposits of salt or any other contaminants.
- Check both the valve clearance and the DEB clearance (if present).
- Check the injector pipes for damage.
- Check the fuel gallery/rail pressure.
- Check the fuel lift pump output.
- Check whether the right type of components has been fitted. This includes turbocharger, injectors, etc.
- Check the opening pressure of the injectors (if possible).

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

1.3 ACCELERATION TEST FORM**General data**

Customer's name: _____
 Chassis number: _____ Registration number: _____

Test conditions

Weather conditions: dry / rain / wet road / drizzle

Wind force: none / average / strong Outside temperature: _____ °C

Vehicle data

Vehicle type: _____ Trailer type: _____ Superstructure: _____

Total combination weight: _____ kg Total vehicle height: _____ m

Cab type: day / sleeper / space / superspace

Aerodynamics: roof spoiler / fenders / front spoiler / skirts / sun visor / _____

Engine type: _____ | Gearbox type: _____ | Transmission: _____

Rear axle type: _____ Transmission: _____

Tyre size: front: _____ rear: _____

Tyre make: _____ Energy: _____

Space between cab and superstructure/trailer: _____ m

TOPEC data

Starting speed: _____ km/h End speed: _____ km/h
 Gear selection: _____ Acceleration time: _____ sec.

Measured time of outward 1: _____ sec.
 journey:

2: _____ sec.

3: _____ sec.

Average time of outward journey: _____ sec.

Average time: _____ sec.

Measured time of return 1: _____ sec.
 journey:

2: _____ sec.

3: _____ sec.

Average return time: _____ sec.

1.4 ACCELERATION TEST USING DAVIE-XD

The acceleration test can also be carried out using DAVIE-XD. Collect the necessary data and, after starting DAVIE-XD, go to the engine management system and carefully follow the instructions in DAVIE-XD for carrying out the test correctly.

The test results should be saved to diskette after each test.



The acceleration test in DAVIE-XD should only be started when the vehicle is stationary. As the communication between the accelerator pedal sensor and the unit will be broken for a short time when DAVIE is started up, this can lead to dangerous situations when the vehicle is being driven.

When driving, never start a "direct test" or "guide diagnosis".

2. CE ENGINE, GENERAL

2.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

2.2 FAULT-FINDING TABLE, ENGINE FUNCTIONS

1

SYMPTOM: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
While carrying out an engine test with DAVIE, communication with DAVIE was interrupted	Remove the battery earth lead and then refit it
No fuel supply/fuel lift pump defective; no delivery	Check: <ul style="list-style-type: none"> - the fuel level - the pipes for blockage and leaks - the fuel lift pump

SYMPTOM: ENGINE STALLS AND RUNS AGAIN AFTER RE-STARTING	
Possible cause	Remedy
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal

SYMPTOM: ENGINE STARTS POORLY	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Battery voltage too low	Charge the batteries
Mechanical defect or clogging in injector	Replace the injector
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary
Internal leakage between the fuel supply pipe and the injector	Check the fuel supply pipe/injector connections for internal leaks.

SYMPTOM: ENGINE RUNS AT (INCREASED) IDLING SPEED AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	Remedy
Mechanical defect of accelerator pedal sensor	Check: <ul style="list-style-type: none"> - the mechanical connection between the sensor and the accelerator pedal - the accelerator pedal sensor
Fuel quantity adjustment by ABS/ASR	
Engine brake input signal present	Check the electrical system of the engine brake

SYMPTOM: DIESEL KNOCK DURING ACCELERATION	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fault in electrical components/wiring of the engine coolant temperature sensor	Check the electrical system
Injector defective	Check the injectors.
Crankshaft position sensor defective	Check the crankshaft position sensor

SYMPTOM: IRREGULAR RUNNING OF ENGINE	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter
Connection points on injectors mixed up	Connect the correct connection points to the correct injector
Mechanical defect or clogging in injectors	Replace the injectors
Injector defective	Check the injectors.
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary
Pressure relief valve on common rail does not shut off	Check the pressure relief valve

1

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel filter clogged	Replace the fuel filter
Mechanical defect of accelerator pedal sensor	Check: - the mechanical connection between the sensor and the accelerator pedal - the accelerator pedal sensor
Fault in electrical components/wiring of: - contacts - contact resistors in connector connections	Check the electrical system
Air filter clogged.	Replace or clean the air filter.
Turbocharger defective/wastegate control incorrect.	Check the turbocharger/wastegate control.
Air leak in inlet system.	Pressure-test the inlet system.
Mechanical defect or clogging in injectors	Replace the injectors
Injector defective	Check the injectors.
Pressure relief valve on pump housing does not shut off	Check the pressure relief valve
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	Remedy
Fuel filter partially clogged	Replace the fuel filter
Air filter partially clogged.	Replace or clean the air filter.
Air leak 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 delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: WHITE/BLUE SMOKE IS EMITTED	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Mechanical defect or clogging in injectors	Replace the injectors

SYMPTOM: WHITE/BLUE SMOKE IS EMITTED	
Possible cause	Remedy
Injector defective	Check the injectors.
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: BLACK SMOKE IS EMITTED	
Possible cause	Remedy
Injector defective	Check the injectors.

SYMPTOM: FUEL CONSUMPTION TOO HIGH	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel filter clogged	Replace the fuel filter and clean the system
Air leak in inlet system.	Pressure-test the inlet system.
Mechanical defect or clogging in injectors	Replace the injectors
Leak in fuel system	Check for leaks

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	Remedy
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Turbocharger defective.	Check turbocharger.
Mechanical defect or clogging in injectors	Replace the injectors
Fuel quantity adjustment by ABS/ASR	
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary

2.3 FAULT-FINDING TABLE, VEHICLE FUNCTIONS

1

SYMPTOM: VEHICLE SPEED CONTROL DOES NOT WORK	
Possible cause	Remedy
Fault in electrical components/wiring of: - combi-switch - proximity switch	Check the electrical system
Condition(s) for disengaging vehicle speed control present	Check for presence of condition(s) for disengaging

SYMPTOM: ENGINE SPEED CONTROL DOES NOT WORK	
Possible cause	Remedy
Condition(s) for disengaging engine speed control are present	Check for presence of condition(s) for disengaging
Fault in electrical components/wiring of: wiring harness - combi-switch	Check the electrical system

SYMPTOM: PRE-GLOWING AND AFTER-GLOWING FUNCTION DOES NOT WORK	
Possible cause	Remedy
Fault in electrical components/wiring of: - wiring harness - warning lamp, pre-glowing - glow plugs - glow plug relay	Check the electrical system
Condition(s) for disengaging pre-glowing and after-glowing function present	Check for presence of condition(s) for disengaging

SYMPTOM: ENGINE CANNOT BE SWITCHED OFF WITH IGNITION KEY	
Possible cause	Remedy
Power supply to electronic unit not cut off. Power supply to electronic unit after contact not cut off with contact switch	Check the electrical system

SYMPTOM: FAULT INDICATOR LAMP DOES NOT GO ON OR OFF	
Possible cause	Remedy
Fault in electrical components/wiring of: - wiring harness - Electronic unit	Check the electrical system

SYMPTOM: NO COMMUNICATION POSSIBLE WITH DAVIE	
Possible cause	Remedy
Fault in electrical components/wiring of: - wiring harness - diagnostic connector Power supply to electronic unit after contact not cut off with contact switch No supply voltage to the electronic unit Electronic unit defective	Check the electrical system

3. CE-ENGINE COOLING SYSTEM

3.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

3.2 FAULT-FINDING TABLE

1

SYMPTOM: 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 lubrication system
Incorrect poly-V-belt tension	Check the poly-V-belt tensioner or replace the poly-V-belt
Insufficient coolant	Check the coolant level. Top up if necessary
Coolant hose torn or clogged	Check coolant hoses
Air cooler and cooling system radiator fouled	Check/clean the air cooler and cooling system radiator
Wastegate setting is too high.	Check the wastegate setting
Air hose from the turbocharger housing to the wastegate diaphragm leaks or is not connected.	Check the 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
Coolant filter fouled	Check the coolant filter Replace, if necessary, and clean the cooling system
Coolant pump defective	Check the coolant pump shaft, bearings and impeller. Replace the coolant pump, if necessary
Viscous fan defective	Check operation of the viscous fan
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel

SYMPTOM: EXTERNAL COOLANT LEAKAGE	
Possible cause	Remedy
Coolant hoses defective	Check coolant hoses
Coolant pipes defective	Check coolant pipes
Radiator leaking	Check the radiator Pressure-test if necessary
Coolant pump leaking	Check coolant 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
Heater leaking	Check the heater hoses
Leaking connection between coupling and water pipe	Check connection between water pipe and coupling for damage. Replace the O-rings

SYMPTOM: 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 cylinder block for internal cracks. Pressure-test if necessary
Leaking injector sleeves	Check the 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 lubrication system
Defective freeze plugs in tappet area (cylinder block) or at the top of the cylinder heads	Replace freeze plug(s)

4. CE-ENGINE LUBRICATION SYSTEM

4.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

4.2 FAULT-FINDING TABLE

1

SYMPTOM: ENGINE OIL PRESSURE TOO LOW	
Possible cause	Remedy
Engine oil level too low	Top up engine oil to maximum level
External oil leaks	Visually check the engine for leaks. Repair if necessary
Oil pressure switch defective	Check the switch Replace if necessary
Oil does not meet the required specifications	Change the engine oil and the oil filter
Oil temperature is too high	Check the oil cooler
Oil mixed with coolant or fuel	Change the engine oil and the oil filter
Oil passage pipe or oil suction pipe loose or broken	Check 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
Main or big-end bearings worn out	Check main or big-end bearings
Piston cooler oil nozzle has come loose	Check oil nozzle. Replace if necessary
Defective internal oil pressure pipes or seals	Check the oil pressure pipes and seals
Fouling between oil pressure control valve and seat	Check/clean the oil pressure control valve
Oil filter fouled	Replace the oil filter

SYMPTOM: ENGINE CONSUMES TOO MUCH OIL	
Possible cause	Remedy
Inlet system failure	Check the inlet system
Exhaust system failure	Check the exhaust system
Oil cooler leaks	Check whether there is lubricating oil in the engine cooling system
Oil temperature is too high	Check that the correct oil cooler has been installed
Excessive blow-by	Check the compression pressure and carry out a cylinder leak test Check the condition of the piston rings and cylinder liners
Worn piston rings and/or cylinder liners	Replace the piston rings and/or cylinder liners Check the air inlet system Check the oil specifications
Injector O-ring damaged or not present	Check the injector seal

5. PE/XE ENGINE, GENERAL

5.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

5.2 FAULT-FINDING TABLE, ENGINE FUNCTIONS

1

SYMPTOM: ENGINE CAN BE STARTED, BUT DOES NOT RUN	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter(s) blocked	Replace the fuel filter and clean the system
No fuel supply/fuel lift pump defective; no delivery	Check: <ul style="list-style-type: none"> - the fuel level - the pipes for blockage and leaks - the fuel lift pump
Pressure relief valve on pump housing does not shut off	Check the pressure relief valve

SYMPTOM: ENGINE STALLS AND RUNS AGAIN AFTER RE-STARTING	
Possible cause	Remedy
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Pressure relief valve on pump housing does not shut off	Check the pressure relief valve

SYMPTOM: ENGINE STARTS POORLY	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Mechanical defect or clogging in 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 delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: ENGINE RUNS AT (INCREASED) IDLING SPEED AND DOES NOT RESPOND TO ACCELERATOR PEDAL	
Possible cause	Remedy
Mechanical defect of accelerator pedal sensor	Check: <ul style="list-style-type: none"> - the mechanical connection between the sensor and the accelerator pedal - the accelerator pedal sensor
Fuel quantity adjustment by ABS/ASR	
Engine brake input signal present	Check the electrical system of the engine brake

SYMPTOM: DIESEL KNOCK DURING ACCELERATION	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Injector defective	Check the injectors

SYMPTOM: IRREGULAR RUNNING OF ENGINE	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: <ul style="list-style-type: none"> - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Fuel lift pump delivery 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

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel filter clogged	Replace the fuel filter
Mechanical defect of accelerator pedal sensor	Check: <ul style="list-style-type: none"> - the mechanical connection between the sensor and the accelerator pedal - the accelerator pedal sensor
Air filter clogged	Replace or clean the air filter

1

SYMPTOM: REDUCED POWER AT ALL ENGINE SPEEDS	
Possible cause	Remedy
Turbocharger defective/wastegate control incorrect	Check the turbocharger/wastegate control
Air leak in inlet system	Pressure-test the inlet system
Mechanical defect or clogging in 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 delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: REDUCED POWER ABOVE A CERTAIN ENGINE SPEED	
Possible cause	Remedy
Fuel filter partially clogged	Replace the fuel filter
Air filter partially clogged	Replace or clean the air filter
Air leak 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 delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: WHITE/BLUE SMOKE IS EMITTED	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary

SYMPTOM: BLACK SMOKE IS EMITTED	
Possible cause	Remedy
Injector defective	Check the injectors

SYMPTOM: ENGINE CONSUMES TOO MUCH FUEL	
Possible cause	Remedy
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel filter clogged	Replace the fuel filter and clean the system
Air leak in inlet system	Pressure-test the inlet system
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Check the injectors
Leak in fuel system	Check for leaks

SYMPTOM: REDUCED MAXIMUM ENGINE SPEED	
Possible cause	Remedy
Air in fuel system	Check for drawing in of air: - via the suction pipe - via the fuel lift pump seal
Fuel filter clogged	Replace the fuel filter and clean the system
Turbocharger defective	Check turbocharger
Mechanical defect or clogging in pump units	Replace the pump units
Fuel quantity adjustment by ABS/ASR	
Fuel lift pump delivery too low	Check the fuel lift pump and replace if necessary

5.3 FAULT-FINDING TABLE, VEHICLE FUNCTIONS

1

SYMPTOM: CRUISE CONTROL DOES NOT WORK	
Possible cause	Remedy
Steering column switch, mechanically defective/ interruption	Check the steering column switch in all positions
Condition(s) for disengaging cruise control present	Check for presence of condition(s) for disengaging
The function has not been parametrised in the unit	Adjust identity card

SYMPTOM: ENGINE SPEED CONTROL DOES NOT WORK	
Possible cause	Remedy
Condition(s) for disengaging engine speed control are present	Check for presence of condition(s) for disengaging
Steering column switch, mechanically defective/ interruption	Check the steering column switch in all positions
The customer parameter settings have not been met	Check the customer parameter settings using DAVIE

SYMPTOM: ENGINE CANNOT BE SWITCHED OFF WITH IGNITION KEY	
Possible cause	Remedy
Fault in electrical components and/or wiring Power supply to UPEC electronic unit not cut off. Power supply to UPEC electronic unit after contact not cut off with ignition switch	Check the electrical system

SYMPTOM: FAULT INDICATOR LAMP DOES NOT GO ON OR DOES NOT GO OFF	
Possible cause	Remedy
Fault in electrical components and/or wiring of: - UPEC electronic unit	Check the electrical system

SYMPTOM: NO COMMUNICATION POSSIBLE WITH DAVIE	
Possible cause	Remedy
Fault in electrical components and/or wiring of: - diagnostic connector Power supply to UPEC electronic unit after contact not cut off with ignition switch No power supply to the UPEC electronic unit UPEC electronic unit defective	Check the electrical system

6. PE/XE-ENGINE COOLING SYSTEM

6.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

6.2 FAULT-FINDING TABLE

1

SYMPTOM: 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 lubrication system
Incorrect poly-V-belt tension	Check the poly-V-belt tension or replace the poly-V-belt or poly-V-belt tensioner
Insufficient coolant	Check the coolant level Top up if necessary
Coolant hose torn or clogged	Check coolant hoses
Air cooler and cooling system radiator fouled	Check/clean the air cooler and cooling system radiator
Wastegate setting is too high	Check the wastegate setting
Air hose from turbocharger housing to wastegate diaphragm leaks or is not connected	Check the 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
Coolant filter fouled	Check the coolant filter Replace, if necessary, and clean the cooling system
Coolant pump defective	Check the coolant pump shaft, bearings and impeller. Replace the coolant pump, if necessary
Viscous fan defective	Check operation of the viscous fan
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel

SYMPTOM: EXTERNAL COOLANT LEAKAGE	
Possible cause	Remedy
Coolant hoses defective	Check the coolant hoses
Coolant pipes defective	Check the coolant pipes
Radiator leaking	Check the radiator Pressure-test if necessary
Coolant pump leaking	Check coolant 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
Heater leaking	Check the heater hoses
Leaking connection between coupling and water pipe	Check connection between water pipe and coupling for damage. Replace the O-rings

SYMPTOM: 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 cylinder block for internal cracks. Pressure-test if necessary
Leaking injector sleeves	Check the cylinder heads Pressure-test if necessary
Defective compressor cylinder head gasket	Replace the compressor cylinder head gasket
Defective oil cooler	Check whether there is coolant in the lubrication system
Defective freeze plugs in tappet area (cylinder block) or at the top of the cylinder heads	Replace the freeze plug(s)

1

7. XE/PE-ENGINE LUBRICATION SYSTEM

7.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

7.2 FAULT-FINDING TABLE

1

SYMPTOM: ENGINE OIL PRESSURE TOO LOW	
Possible cause	Remedy
Engine oil level too low	Top up engine oil to maximum level
External oil leaks	Visually check the engine for leaks. Repair if necessary
Oil pressure switch defective	Check the switch Replace if necessary
Oil does not meet the required specifications	Change the engine oil and the oil filter
Oil temperature is too high	Check the oil cooler
Oil mixed with coolant or fuel	Change the engine oil and the oil filter
Oil passage pipe or oil suction pipe loose or broken	Check 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
Main or big-end bearings worn out	Check main or big-end bearings
Piston cooler oil nozzle has come loose	Check oil nozzle. Replace if necessary
Defective internal oil pressure pipes or seals	Check the oil pressure pipes and seals
Fouling between oil pressure control valve and seat	Check/clean the oil pressure control valve
Oil filter fouled	Replace the oil filter

SYMPTOM: ENGINE CONSUMES TOO MUCH OIL	
Possible cause	Remedy
Inlet system failure	Check the inlet system
Exhaust system failure	Check the exhaust system
Oil cooler leaks	Check whether there is lubricating oil in the engine cooling system
Oil temperature is too high	Check that the correct oil cooler has been installed
Oil sump pressure too high	Check the compression pressure and carry out a cylinder leak test Check the condition of the piston rings and cylinder liners
Worn piston rings and/or cylinder liners	Replace the piston rings and/or cylinder liners Check the air inlet system Check the oil specifications
Injector O-ring damaged or not present	Check the injector seal
Damaged/worn valve guide	Inspect valve guide Replace the valve guide
Damaged/worn valve stem seal	Inspect the condition and mounting of the valve stem seal Replace the valve stem seal

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

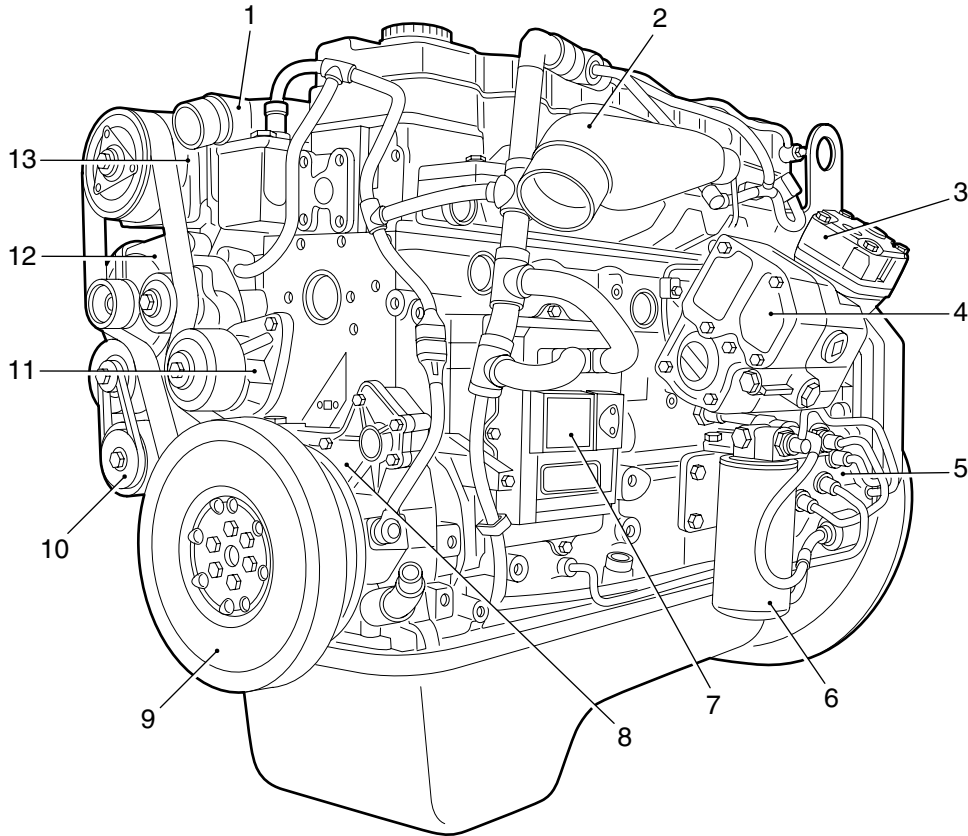
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

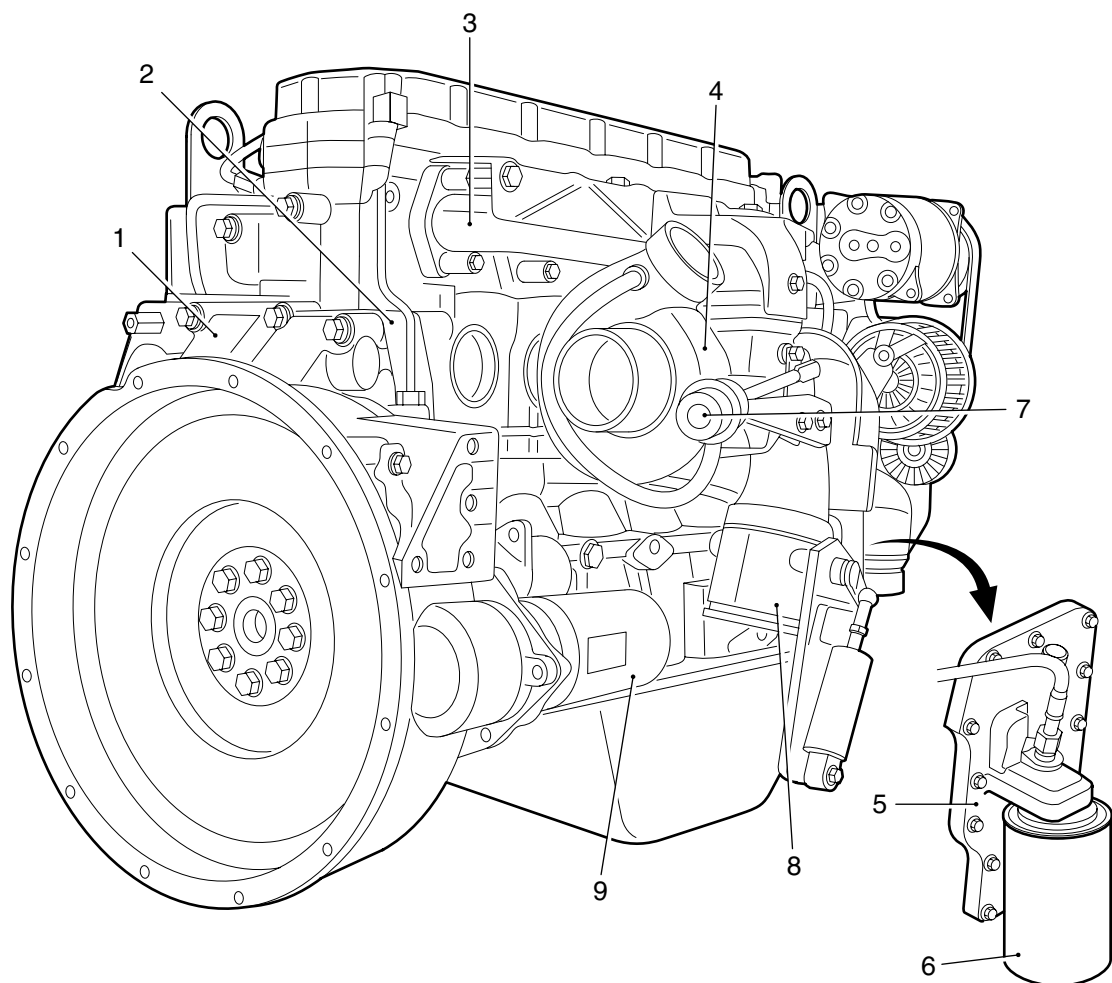
2. GENERAL

2.1 LOCATION OF COMPONENTS



1. Thermostat housing
2. Inlet manifold
3. Air compressor
4. Steering pump with reservoir
5. High-pressure pump
6. Fuel filter
7. ECS-DC3 electronic unit
8. Front engine panel
9. Vibration damper
10. Automatic tensioner
11. Coolant pump
12. Alternator
13. Air-conditioning compressor

M201141



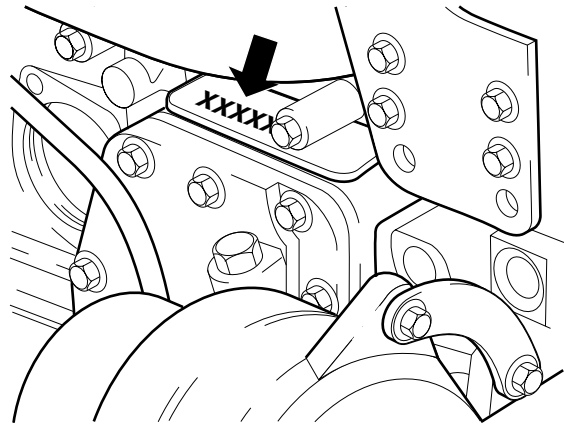
M201140

- 1. Flywheel housing
- 2. Timing gear case
- 3. Exhaust manifold
- 4. Turbocharger
- 5. Oil cooler
- 6. Oil filter
- 7. Wastegate diaphragm
- 8. Exhaust brake
- 9. Starter motor

2.2 IDENTIFICATION

Engine number

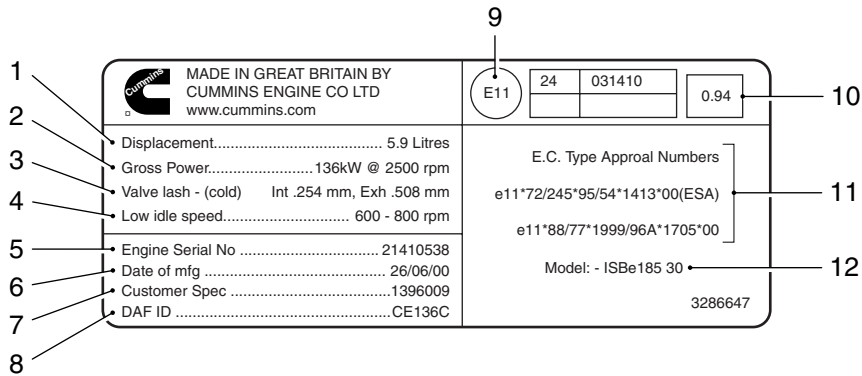
The engine number is stamped front right in the cylinder block, at the top of the lubricating oil cooler housing.



M2 01 138

Engine identification plate

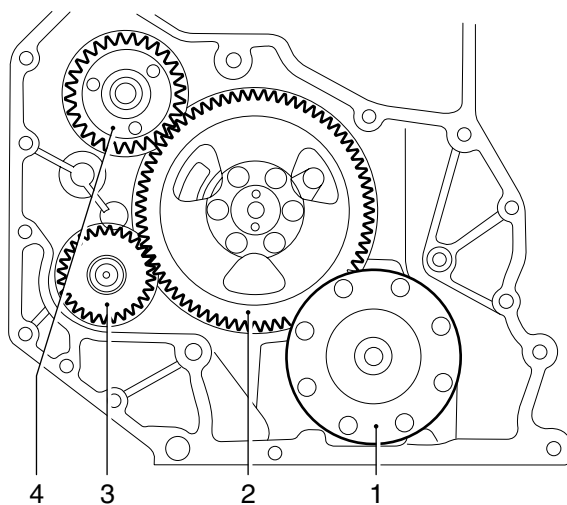
The engine identification plate is located at the top of the flywheel housing or on the valve cover, depending on the production date.



M201135

1. Cubic capacity
2. Engine output
3. Valve clearance
4. Idle engine speed
5. Engine number
6. Production date
7. Client specification
8. DAF type designation
9. Indication of country of origin
10. K-factor
11. Type approval numbers
12. Cummins type designation

2.3 OVERVIEW DRAWING, TIMING GEAR



M201125

1. Crankshaft
2. Camshaft
3. High-pressure pump
4. Compressor

3. INSPECTION AND ADJUSTMENT

3.1 CHECKING AND ADJUSTING THE CE ENGINE VALVE CLEARANCE

Note:

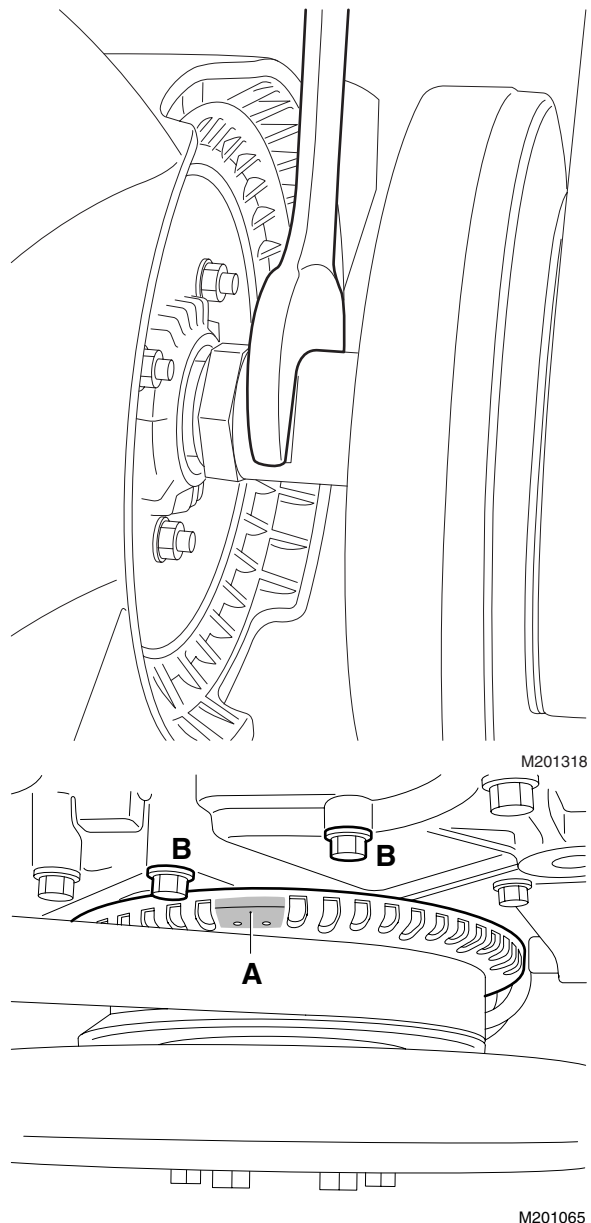
Inspection and adjustment of valve clearance must only be carried out when the engine is cold.

1. Remove the valve cover: see chapter "Removal and installation".
2. Use an open-end spanner on the fan shaft to turn the crankshaft clockwise, as seen from the vibration damper end (this is the engine's normal direction of rotation), until the mark (A) is between the bolts (B) and the valves of cylinder 1 are in overlap position.

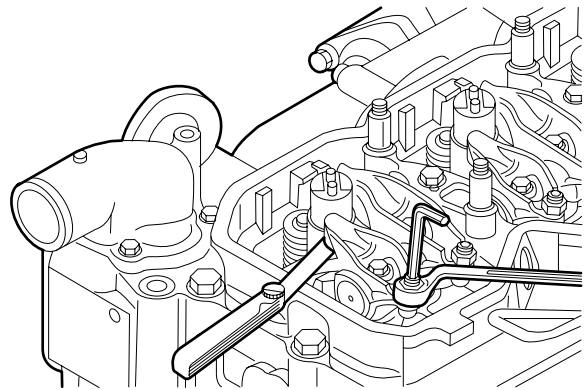
Note:

"Overlap" is the moment at which the inlet valves start opening and the exhaust valves stop closing.

The inlet valves are operated by the short rockers and the exhaust valves by the long rockers.



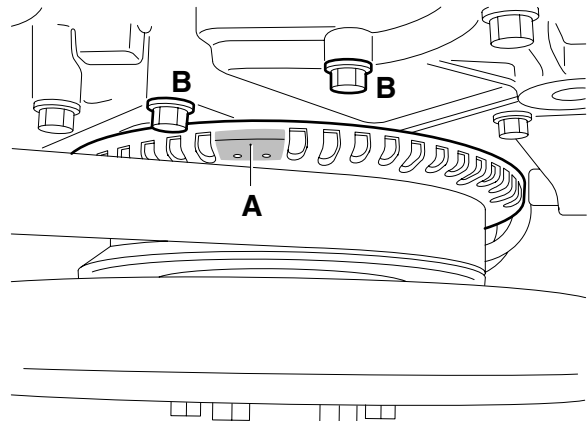
3. Check/correct the valve clearance of the specified inlet and exhaust valves. Set the correct valve clearance by loosening the locknut and rotating the adjusting screw in the correct direction; see "Technical data" for the correct valve clearance.



M201064

Cylinder	Inlet valve	Exhaust valve
1		
2		X
3	X	
4		X
5	X	
6	X	X

4. Using an open-end spanner on the fan shaft, turn the crankshaft one rotation further so that the mark (A) is once again between the bolts (B) and the valves of cylinder 6 overlap.
5. Check/correct the valve clearance of the specified inlet and exhaust valves. Set the correct valve clearance by loosening the locknut and rotating the adjusting screw in the correct direction; see "Technical data" for the correct valve clearance.



M201065

Cylinder	Inlet valve	Exhaust valve
1	X	X
2	X	
3		X
4	X	
5		X
6		

6. Fit the valve cover. See "Removal and installation".

3.2 INSPECTION AND ADJUSTMENT, TIMING GEAR

Note:

The engine is fitted with gears on either side. The gears at the vibration damper end only drive the oil pump. These gears have no marks and may be fitted in any position.

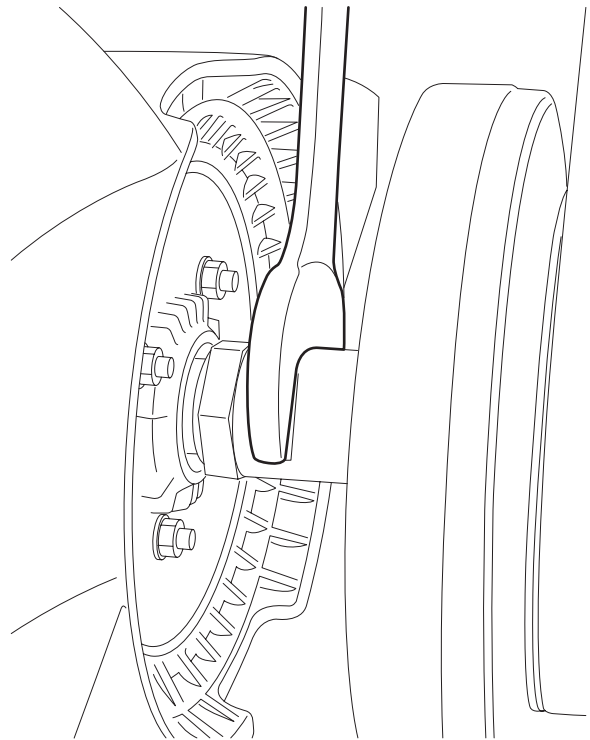
The timing gear wheels on the flywheel side drive the camshaft, air compressor and fuel pump. Only the camshaft gear and the crankshaft gear have marks which must be aligned. The other gears may be fitted randomly.

1. Remove the engine encapsulation panels.
2. Remove the gearbox.
3. Remove the flywheel. See "Removal and installation".
4. Remove the flywheel housing. See "Removal and installation".

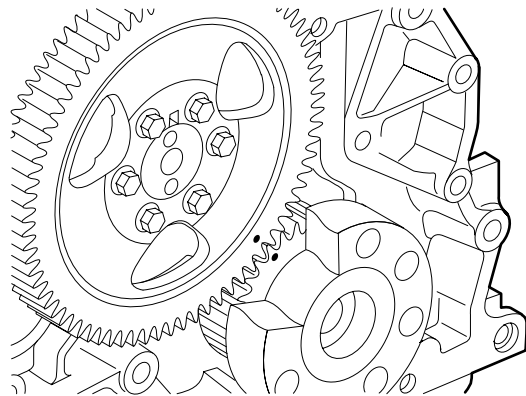
Note:

When the engine crankshaft or camshaft is turned separately, the pistons and valves may touch each other.

5. Use an open-end spanner on the fan shaft to crank the engine clockwise, as seen from the vibration damper end, until the marks in the crankshaft gear and camshaft gear match. The crankshaft gear has a punched hole in the tooth which has to fall into the tooth depth of the camshaft gear marked with a punched hole.
6. Check that the marked tooth falls exactly into the marked depth. If not, remove and refit the camshaft gear. See "Removal and installation".
7. Fit the flywheel housing. See "Removal and installation".
8. Fit the flywheel. See "Removal and installation".
9. Fit the gearbox.
10. Fit the engine encapsulation panels.



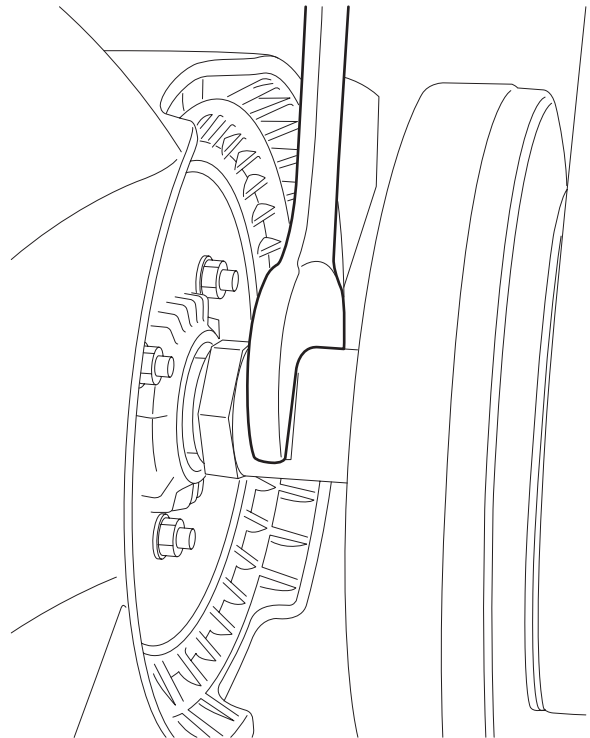
M201318



M201146

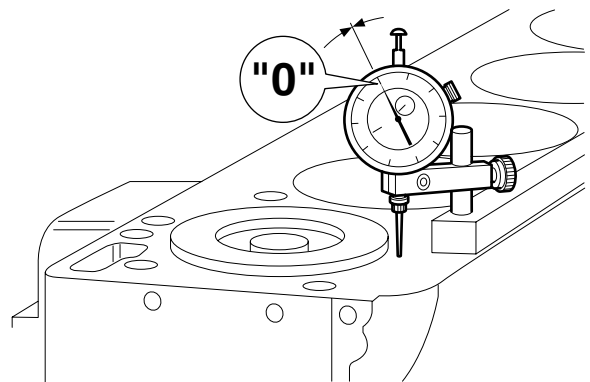
3.3 CHECKING PISTON PROJECTION

1. Use an open-end spanner on the fan shaft to turn the crankshaft, so that the piston of cylinder 1 is in the top dead centre (TDC).
2. Clean the upper surface of the cylinder block and the pistons.



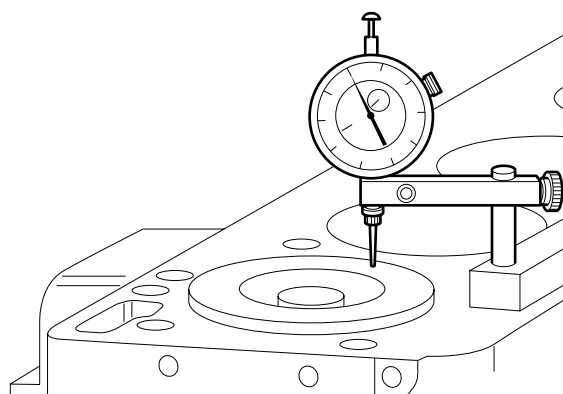
M201318

3. Place a dial gauge on the upper surface of the cylinder block next to cylinder 1 and set the gauge to zero.



M201233

4. Pull up the stylus of the dial gauge and move the stylus to the first piston above the gudgeon pin, but not the anodised part of the piston.
5. Use an open-end spanner on the fan shaft to turn the crankshaft anti-clockwise and clockwise, at the same time reading the dial gauge to find the highest position of the piston. Make a note of this reading.
6. Repeat this measurement for the other pistons.
7. Calculate the average value of the piston projection above the cylinders.

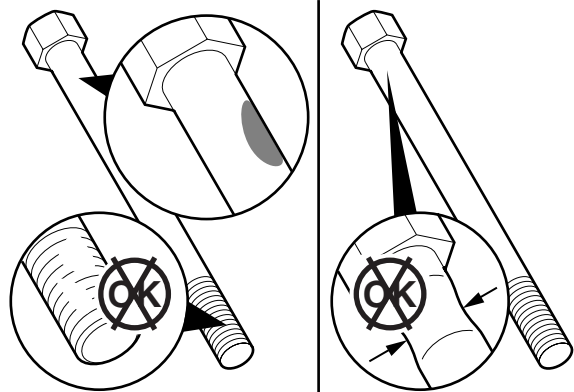


M201234

3.4 CHECKING CYLINDER HEAD BOLTS

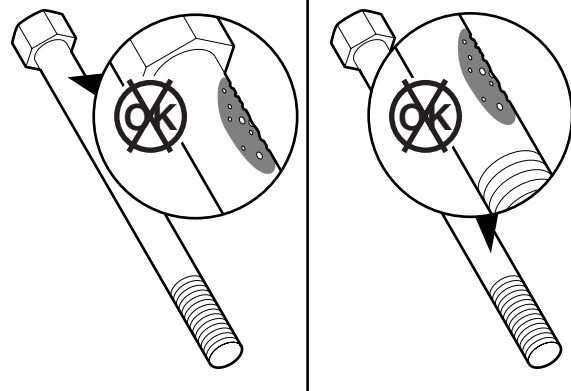
Cylinder head bolts can be re-used provided they satisfy a number of conditions. If a cylinder head bolt does not meet one or more of these conditions, new cylinder head bolts must be used.

1. Check cylinder head bolts for damaged screw threads, corroded surfaces and thinning as a result of overstretching.



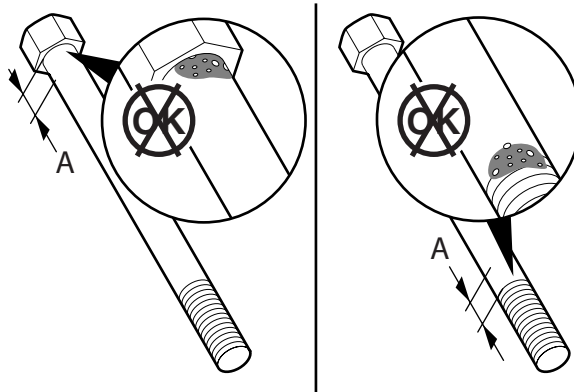
M201248

2. Check the dimensions of visible pitting on the cylinder head bolt, see "Technical data".



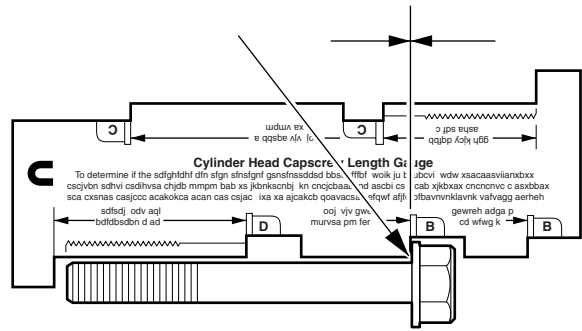
M201249

3. Check the cylinder head bolt for visible corrosion or pitting immediately under the bolt head and directly above the start of the screw thread, see "Technical data".

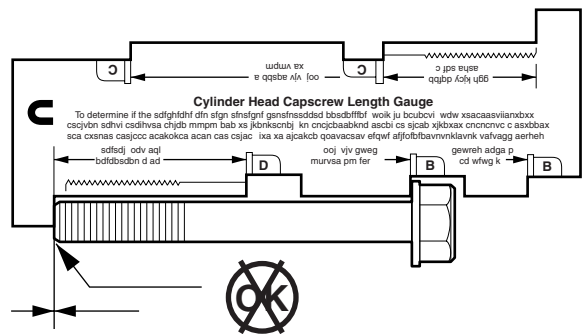


M201250

4. Check the free length of the cylinder head bolt. Use the special tool (DAF no. 1329477) for this purpose. Place the bolt head against the abutting surface.



5. The end of the bolt must not touch the gauge.

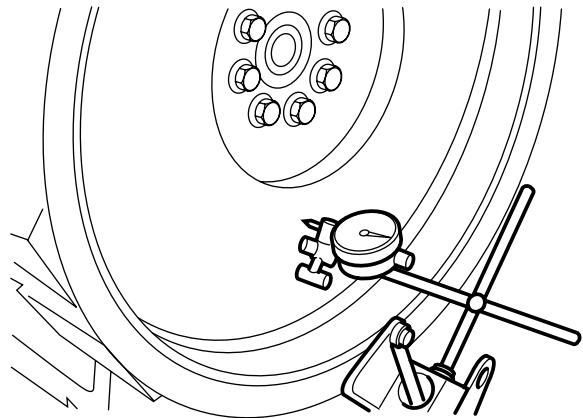


3.5 INSPECTION, FLYWHEEL

If cracks are visible on the flywheel, on the contact surface of the clutch plate, it must be replaced.

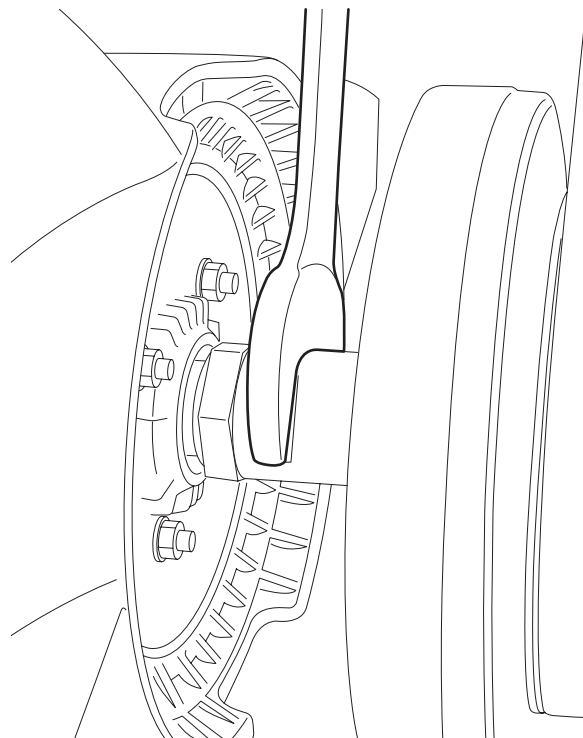
Checking flywheel run-out

1. Clean the flywheel.
2. Place a metal strip on the edge of the flywheel housing to fit a dial gauge.
3. Place the dial gauge on the metal strip.
4. Place the stylus of the dial gauge as close as possible to the outer edge of the flywheel.
5. Set the dial gauge to "0".



M200230

6. Use an open-end spanner on the fan shaft to crank the engine through 360°, and measure the maximum dial gauge reading. Compare the reading with the technical data. See "Technical data".



M201318

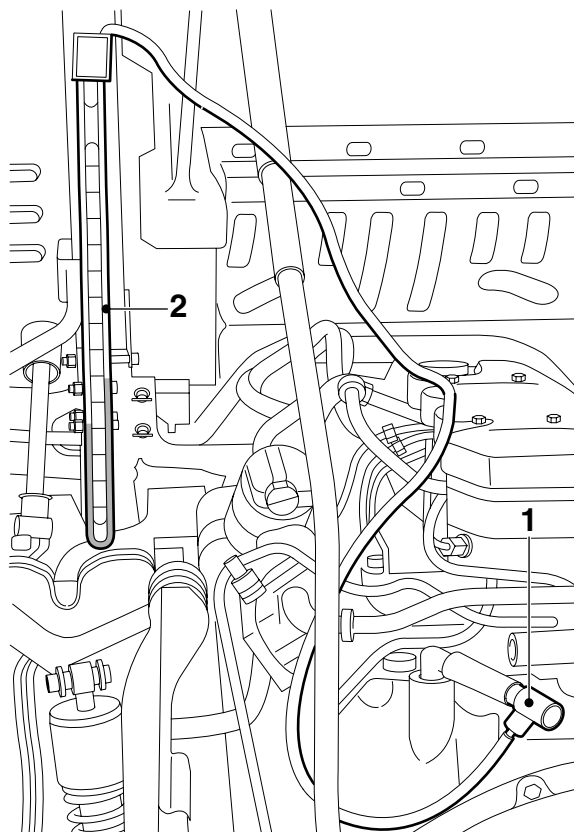
3.6 INSPECTION, ENGINE OIL SUMP PRESSURE



Be careful when working on an engine at operating temperature.

The oil sump pressure is measured to quickly check the cylinder seals. The readings obtained are an indication of the leakage from all cylinders.

1. Bring the engine up to operating temperature.
2. Turn off the engine and fit the special tool (DAF no. 1240080) (1) to the crankcase breather hose.
3. Fit the special tool with a water pressure gauge (DAF no. 1240081) (2) using a hose and start the engine.
4. Using the water pressure gauge, measure the oil sump pressure at idling speed and compare the measured reading with the technical data. See "Technical data".



M201316

3.7 INSPECTION, VIBRATION DAMPER

Note:

The viscous vibration damper is filled with a silicone liquid, which may expand after a long time.

1. Remove the paint at four places on either side of the vibration damper.
2. Measure the thickness at these four places at a distance of 80.65 mm from the outer edge. Compare the reading with the technical data. See "Technical data".

3.8 INSPECTION, CYLINDER HEAD

1. Check the sealing plugs of the cylinder head for leaks. If necessary, pressure-test the cylinder head.
2. Inspect the cylinder head for damage to the sealing surface and any cracks.
3. Using a straight edge and a feeler gauge, check the cylinder head for smoothness.

Note:

The cylinder head must be replaced if it does not meet the specified value

3.9 INSPECTION, CYLINDER BLOCK

1. Inspect the cylinder block for damage to the sealing surface and any cracks.
2. Check the cylinder block for smoothness using a straight edge and feeler gauge. See "Technical data".

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENGINE



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

Various fluids will be released when fluid pipes are removed.

Collect these fluids. Personal safety and the risk of fire should always be considered.

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 most important points requiring attention.

- Disconnect the earth lead from the battery terminal.
- Avoid opening fluid systems as much as possible. If possible, remove and set 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 that are freed.
- Wiring harnesses are vulnerable. If damaged, they may cause failures. Make sure these wiring harnesses are stress-free and clear of moving parts.
- Fit all attachment bolts and tighten them to the correct torque.
- The engine should not be allowed to rest on the oil sump. Because the oil sump is made of sheet material, it will be severely damaged by the engine's weight.

4.2 REMOVAL AND INSTALLATION, ENGINE MOUNTS



Suspend the engine carefully from the hoist, using approved lifting gear. Various fluids will be released when fluid pipes are removed. Collect these fluids. Personal safety and the risk of fire should always be considered.

2

Removing the engine mounts

1. Disconnect the earth lead from the battery terminal.
2. Drain the coolant.
3. Remove the hoses between the engine and the radiator.
4. Remove the attachment bolts from the radiator torque rod bracket on the engine side.
5. Remove the air inlet hoses between the engine and the air cooler. Plug the openings.
6. Detach the air-conditioning pipes, if present, at the top of the radiator.
7. Detach the heater hose bracket at the top of the radiator.
8. Remove the oil supply pipe from the engine.
9. Remove the lower connector from electronic unit ECS-DC3.
10. Remove the attachment bolts of the viscous fan clutch on the drive flange and place the viscous fan clutch with the fan in the wind tunnel.
11. Firmly suspend the engine in the hoist.
12. Remove the engine mount attachment bolts at the front and rear of the engine.
13. Hoist the engine very carefully as far as necessary and support it properly.
14. Remove the engine mounts.

Installing the engine mounts

1. Tighten the engine mounting attachment bolts to the specified torque. See "Technical data".
2. Fit the viscous fan clutch with the fan. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the connector of electronic unit ECS-DC3.
4. Fit the oil supply pipe.
5. Fit the heater hose bracket at the top of the radiator.
6. Fit the bracket for the air-conditioning pipes at the top of the radiator.
7. Fit the torque rod bracket between the engine and the radiator.
8. Fit the air inlet hoses between the engine and the air cooler.
9. Fit the coolant hoses between the engine, radiator and the header tank.
10. Fit the torque rod between the radiator and the engine.
11. Fill the cooling system. See "Draining and filling".
12. Connect the battery earth lead.

4.3 REMOVAL AND INSTALLATION, VALVE COVER



When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

2

Removing the valve cover

1. Clean the area around the valve cover.
2. Remove the banjo bolt and the attachment of the plastic crankcase breather tube.
3. Remove the valve cover attachment nuts.
4. Remove the valve cover.

Installing the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Check the valve cover gasket. If it is not damaged it may be re-used.
3. Fit the valve cover gasket to the valve cover.
4. Fit the valve cover.
5. Fit the attachment nuts of the valve cover and tighten them to the specified torque. See "Technical data".
6. Fit the plastic crankcase breather tube and the banjo bolt to the valve cover.

4.4 REMOVAL AND INSTALLATION, VALVE SLEEVE



When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the valve sleeve

1. Remove the valve cover.
2. Detach the feed-through connectors from the injectors.
3. Remove the injector wiring from the injectors.
4. Remove the attachment bolts from the valve sleeve.
5. Remove the valve sleeve with the gasket.

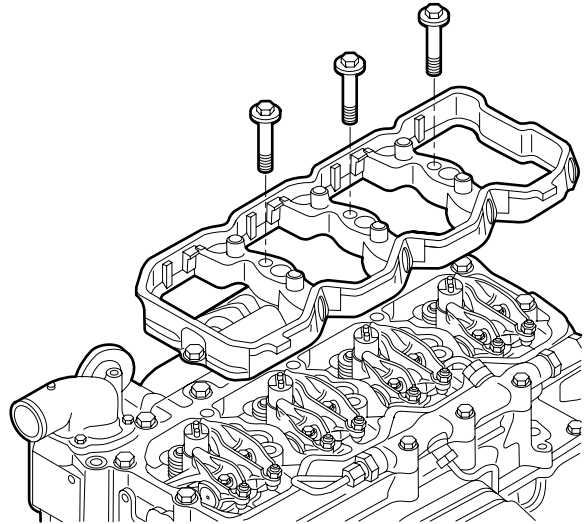
Installing the valve sleeve

1. Clean the sealing surface of the cylinder head and valve sleeve.
2. Check the valve sleeve gasket. If it is undamaged, it may be re-used. Fit the valve sleeve gasket to the valve sleeve.
3. Fit the valve sleeve.
4. Tighten the valve sleeve attachment bolts to the specified torque. See "Technical data".



Tightening the injector wiring to a higher torque than specified may cause damage to the injector.

5. Fit the injector wiring on the injectors and tighten it to the specified torque. See "Technical data".
6. Fit the feed-through connectors of the injectors.
7. Fit the valve cover.



M201082

4.5 REMOVAL AND INSTALLATION, VALVE GEAR

Removing the valve gear

1. Remove the valve cover.
2. Loosen the lock nuts on the valve stem bolts and unscrew the bolts until they abut.
3. Remove the rocker seat attachment bolts.

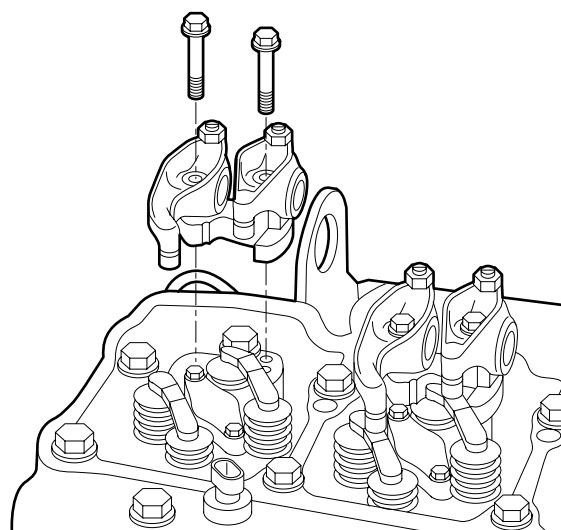
Note:

Number the rocker seats so that they can be refitted in their original position.

4. Remove the rocker seats with the rockers.
5. Remove the bridges.

Installing the valve gear

1. Check that the push rods are in the correct position in the valve tappets and apply a drop of engine oil to the push rod cavity.
2. Fit the bridges on the valves.
3. Fit the push rods in their original position.
4. Hand-tighten the rocker seats and rockers in their original position.
5. Tighten the attachment bolts to the specified torque. See "Technical data".
6. Adjust the valve clearance. See "Inspection and adjustment".
7. Fit the valve cover.

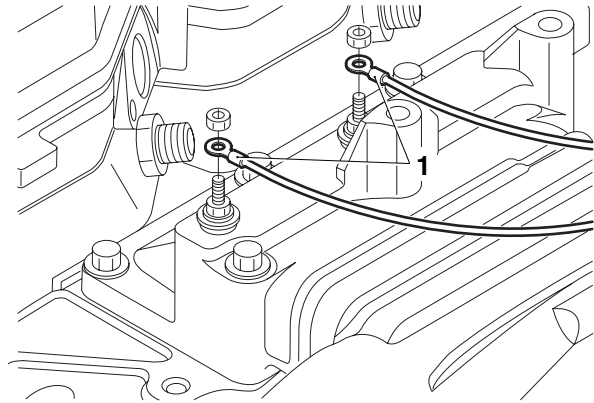


M201081

4.6 REMOVAL AND INSTALLATION, INLET MANIFOLD

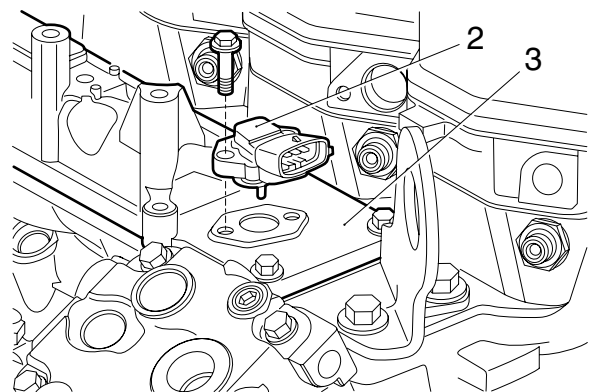
Removing the inlet manifold

1. Remove the pipe from the inlet manifold coming from the air cooler.
2. Detach the electric wiring from the glow elements (1) (if fitted) using the connectors.
3. Remove the fuel rail.



i400521

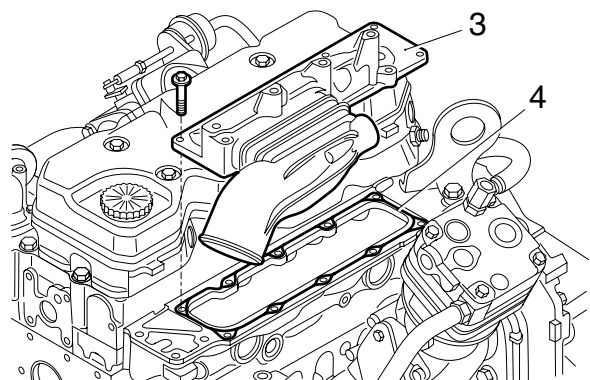
4. Remove the inlet air boost pressure sensor/temperature sensor (2) from the inlet manifold.
5. Remove the inlet manifold (3).
6. Cover the open inlet duct from the cylinder head to prevent the ingress of foreign matter.



i400522

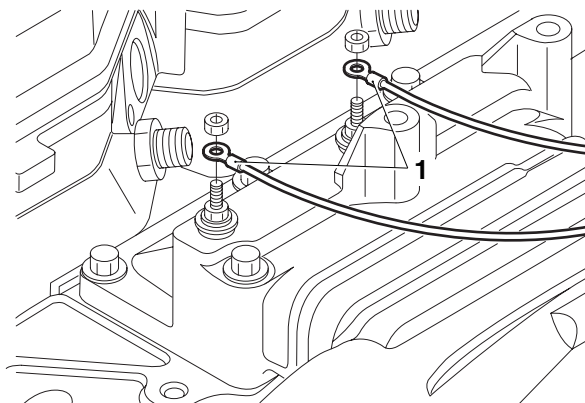
Installing the inlet manifold

1. Thoroughly clean the sealing surfaces of the inlet manifold and the cylinder head. Do not let any particles fall into the open inlet duct in the cylinder head.
2. Apply a bead (4) of sealant to the sealing surfaces from the cylinder head to the inlet manifold (3). See "Technical data".
3. Fit the inlet manifold straight away.
4. Fit the inlet air boost pressure sensor/temperature sensor on the inlet manifold.
5. Fit the fuel rail.



i400523

6. Connect the electric wiring to the glow elements (if fitted) using the connectors (1).
7. Fit the pipe to the inlet manifold coming from the air cooler.

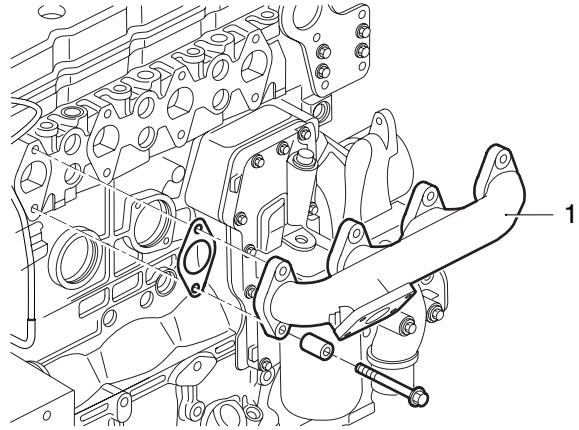


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4.7 REMOVAL AND INSTALLATION, EXHAUST MANIFOLD

Removing the exhaust manifold

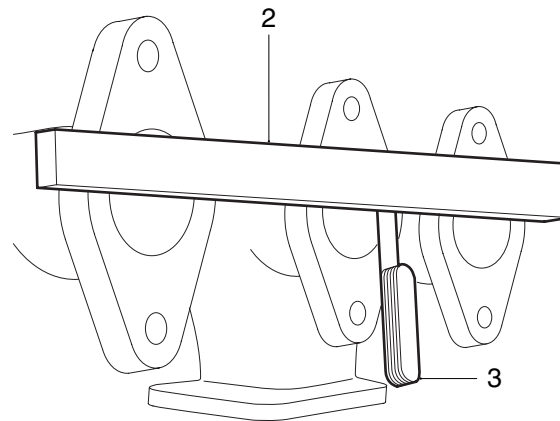
1. Remove the turbocharger.
2. Remove the exhaust manifold (1) and gaskets.



i400524

Installing the exhaust manifold

1. Check the contact surface of the exhaust manifold for smoothness with a steel ruler (2) and feeler gauge (3). Compare the readings with the values referred to in "Technical data".
2. Fit new gaskets.
3. Fit the exhaust manifold. Tighten the bolts, from the middle outwards alternately. For the specified torque, see "Technical data".
4. Fit the turbocharger.
5. Start the engine and check for leakage.



i400525

4.8 REMOVAL AND INSTALLATION, CYLINDER HEAD



When components are removed from any part of the engine, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before it is opened. Plug all openings that are freed.

2

Removing the cylinder head

1. Drain the coolant.
2. Disconnect all electrical wiring around the engine which is required for removing the cylinder head.
3. Disconnect the air inlet pipe from the air cooler on the turbocharger side.
4. Remove the poly-V-belt.
5. Remove the heat shields from the exhaust manifold.
6. If fitted, remove the attachment bolts of the air-conditioning compressor.
7. Remove the attachment bolts from the alternator/air-conditioning compressor bracket and remove the attachment bracket.
8. Remove the attachment bolts from the exhaust manifold and move the manifold and the turbocharger a little away from the cylinder head.
9. Remove the other coolant hoses that are attached to the cylinder head.



When removing components from the fuel system, dirt can enter. This may result in serious damage. Therefore, clean the area around the fuel system before opening it. Detached pipes must be plugged immediately.

10. Detach the injector pipes on the injector side.
11. Detach the supply pipe between the high-pressure pump and fuel rail on the fuel rail side.
12. Detach the fuel return pipe from the fuel rail and from the cylinder head.
13. Unscrew the attachment bolts from the fuel rail and remove it.

14. Unscrew the attachment bolts from the inlet manifold and remove it.

Note:

To avoid dirt entering the inlet opening, it must be taped up.

15. Remove the valve cover.
16. Remove the valve sleeve.
17. Remove the valve gear.
18. Remove the push rods. Mark the push rods so that they can be refitted in their original position.
19. Remove the fuel supply pipes.
20. Remove the injectors.
21. Remove the attachment bolts from the cylinder head in the reverse order to that followed for tightening. See "Technical data".
22. Remove the cylinder head from the cylinder block. Keep the gasket to enable the correct new head gasket to be selected.
23. Remove any gasket remnants from the cylinder head and the cylinder block.
24. Check the cylinder block. See "Inspection and adjustment".
25. Check the threaded holes in the cylinder block for damage and cracking.
26. Check the cylinder head. See "Inspection and adjustment".

Installing the cylinder head

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

Note:

Cylinder head gaskets are available in two thicknesses. The thickness of the cylinder head gasket can be identified by the position of the holes in the projecting cylinder head gasket lip under the exhaust manifold on cylinder 2. See "Technical data" for the cylinder head gasket thicknesses.

2. Position the new cylinder head gasket. If the type of cylinder head gasket is known, use a gasket of the same type as the one used.

Note:

If it is not known what type of cylinder head gasket is used or if the main components of the driving gear have been changed, the type of gasket required must be determined afresh.

To do this, measure the average piston projection. See "Inspection and adjustment". Select the correct type of cylinder head gasket using the information in "Technical data" and use it.

3. Check that all lubricating and coolant ducts are free.
4. Position the cylinder head carefully on the cylinder block and ensure that the cylinder head fits well over the dowel pins.
5. Check the cylinder head bolts. See "Inspection and adjustment". Use new cylinder head bolts if one bolt does not meet one or more conditions.
6. Apply engine oil to the thread and to the underside of the bolt head.
7. Position the cylinder head bolts and hand-tighten them.

Note:

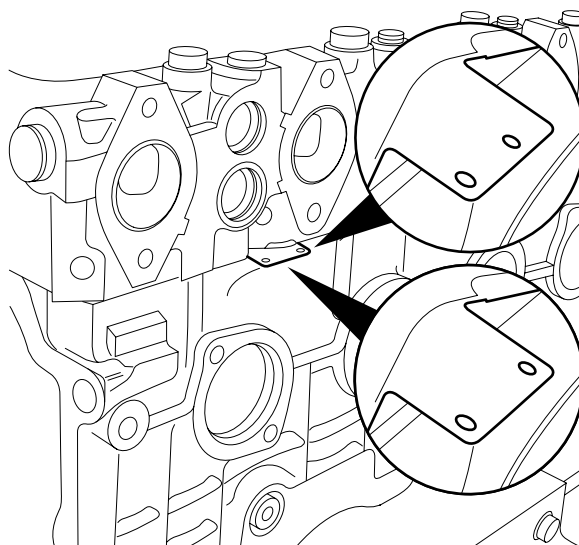
The short cylinder head bolts must be fitted in the outer rows.

8. Tighten the cylinder head bolts to the specified torque and in the sequence shown. See "Technical data"
9. Fit the exhaust manifold with new gaskets and tighten the attachment bolts to the specified torque. See "Technical data".
10. Fit the injectors.

Note:

Ensure that the injector is fitted correctly, bearing in mind the supply opening.

11. Fit the fuel supply pipes.
12. Fit the push rods in their original position and apply a drop of engine oil to the head of the push rod.
13. Fit the valve gear.



M201230

14. Fit the valve sleeve.
15. Tighten the injector wiring to the specified torque. See "Technical data".
16. Fit the valve cover.
17. Remove any gasket remnants from the inlet manifold and the cylinder head.

Note:

Ensure that the air inlet is free of gasket remnants.

18. Apply sealant to the inlet manifold and fit it. See "Technical data".
19. Fit the fuel rail.
20. Fit the injector pipes.
21. Fit the supply pipe between the high-pressure pump and fuel rail.
22. Fit the fuel return pipe on the fuel rail and cylinder head.
23. Connect the various coolant hoses.
24. Fit the brackets of the alternator and the air-conditioning compressor.
25. If present, fit the air-conditioning compressor.
26. Fit the poly-V-belt.
27. Fit the heat shields.
28. Connect the electrical wiring.

4.9 REMOVAL AND INSTALLATION, AIR COMPRESSOR**Removing the air compressor**

1. Partially drain the coolant.
2. Remove the steering pump.
3. Remove the coolant pipes.
4. Remove the air pipes.
5. Remove the attachment bolts from the air compressor and remove it.
6. Remove the O-ring from the compressor housing.

Installing the air compressor

1. Fit the compressor with a new O-ring and tighten the attachment bolts to the specified torque. See "Technical data".
2. Fit the air pipes.
3. Fit the coolant pipes.
4. Fit the steering pump.
5. Fill the cooling system.

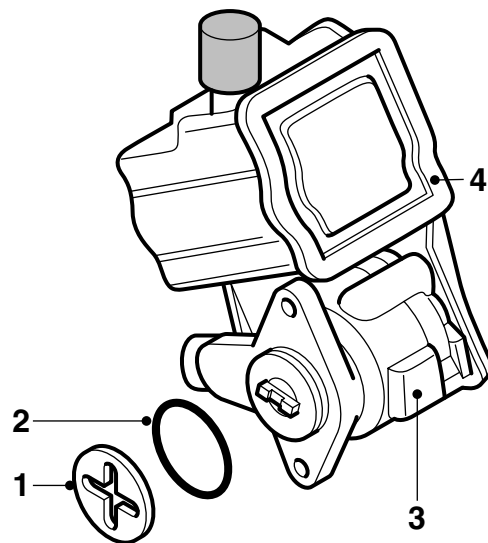
4.10 REMOVAL AND INSTALLATION, STEERING PUMP

Note:

When replacing a worn steering pump, you are advised to fully drain the steering oil and replace the steering oil reservoir and integrated filter. In extreme situations, the steering pump may have been worn to such an extent that metal pump parts have entered the steering box. Check the steering box for internal wear using the test-equipment case.

Removing the steering pump

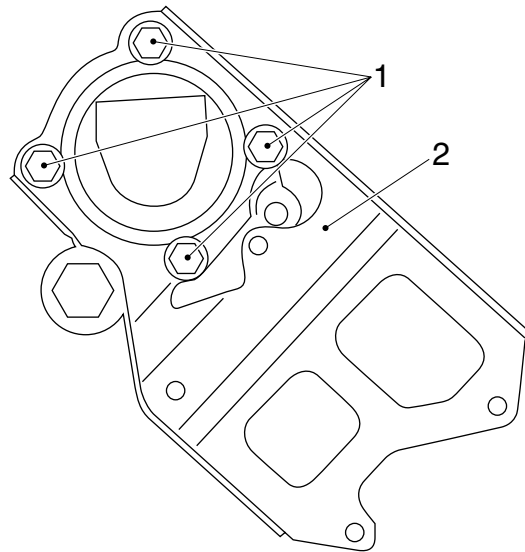
1. Clean the pipe connections.
2. Place a receptacle beneath the steering pump.
3. Remove the pipes from the steering pump and plug the pipe and pump openings. The steering-oil filter is fitted in the return pipe, which means that should any dirt enter, it will immediately also enter the steering gear.
4. Remove the attachment bolts and remove the steering pump (3) and the driver (1) from the compressor.
5. Remove the reservoir (4) from the pump (3).



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Installing the steering pump

1. If necessary, fit the bracket (2) on top of the new pump. Do not remove the cover from the pump to do this. Tighten the attachment bolts (1) evenly to the specified torque. See "Technical data".



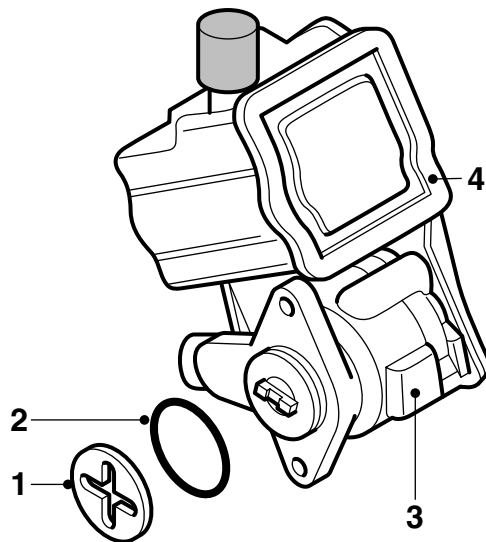
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2. Check the driver (1) for wear.
3. If necessary, connect the pipe couplings to the steering pump to be fitted. Tighten the couplings to the specified torques. See "Technical data".



If the specified tightening torques are exceeded, the aluminium pump housing may be damaged.

4. Fit a new O-ring (2) to the steering pump and grease it lightly.
5. Crank the engine until the compressor driver half is horizontal.
6. Grease the driver (1) lightly and fit it to the compressor driver half.
7. Fit the reservoir (4) to the pump.
8. Fit the pump (3). Tighten the attachment bolts evenly to the specified torque. See "Technical data".
9. Fit the pipes.
10. Fill and bleed the steering gear hydraulic system.
11. Take a test drive and check the pump and pipe connections for leaks.



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4.11 REMOVAL AND INSTALLATION, STARTER MOTOR

Removing the starter motor

1. Remove both battery leads from the battery terminals.
2. Remove the electrical connections from the starter motor.
3. Remove the attachment nuts from the starter motor and remove the starter motor.
4. Check the starter pinion for damage.

Installing the starter motor

1. Clean the contact surfaces of the starter motor and the flywheel housing.
2. Install the starter motor in the flywheel housing and tighten the attachment nuts to the specified torque. See "Technical data".
3. Fit the electrical connections of the starter motor.
4. Reconnect both leads to the battery terminals.

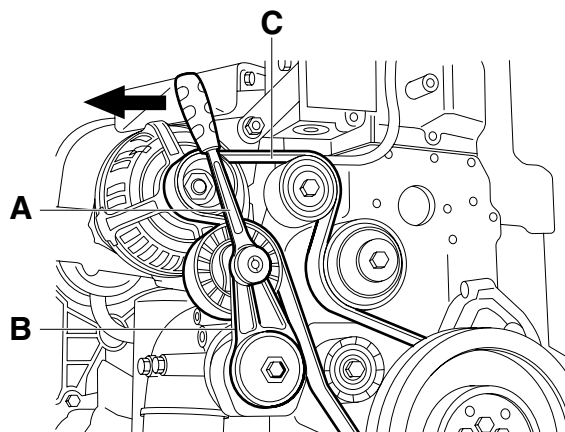
4.12 REMOVAL AND INSTALLATION, POLY-V-BELT

Removing the poly-V-belt

1. Remove the battery terminal clamp from the negative terminal of the starter battery and break the contact.
2. Put a ratchet with a $\frac{3}{8}$ " socket (A) in the arm (B) of the belt tensioner and release the belt so that it can be removed from the belt pulleys. Carefully let the belt tensioner expand to the stop.
3. Remove the poly-V-belt (C), lifting it over the fan.

Installing the poly-V-belt

1. Inspect the belt pulleys for damage, rust and grease deposits. Clean or replace the belt pulleys if necessary.
2. Pull the poly-V-belt over the fan.
3. Place a ratchet with a $\frac{3}{8}$ " socket in the arm of the belt tensioner and push the belt against the spring pressure so that it can be placed on all belt pulleys. Carefully let the belt tensioner spring back until the belt is tensioned.



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4.13 REMOVAL AND INSTALLATION, ALTERNATOR

Removing the alternator

1. Remove both battery leads from the battery terminals.
2. Remove the alternator electrical connections.
3. Remove the poly-V-belt.
4. Remove the attachment bolts from the alternator and remove the alternator.

Installing the alternator

1. Fit the alternator and tighten the attachment bolts to the specified torque. See "Technical data".
2. Fit the poly-V-belt.
3. Fit the electrical connections of the alternator.
4. Reconnect both leads to the battery terminals.

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 attachment bolts from the flywheel.
4. To guide the flywheel during removal, fit two threaded ends - each approx. 90 mm - to the now-empty bolt holes.
5. Place two bolts in the circumference of the flywheel and carefully pull the flywheel free.

Installing the flywheel

1. Clean the flywheel housing.
2. Clean the crankshaft flange and attachment bolts.
3. Clean the rear of the flywheel and inspect it. See "Inspection and adjustment".
4. Fit the flywheel.
5. Apply a drop of engine oil to the attachment bolts and install them. Tighten the attachment bolts in a crosswise sequence to the specified torque. See "Technical data".
6. Fit the clutch plate and the clutch release assembly.
7. Fit the gearbox.

4.15 REMOVAL AND INSTALLATION, STARTER RING GEAR

Removing the starter ring gear

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

Installing the starter ring gear

1. Clean the flywheel and the starter ring gear. Ensure that the contact areas are free of grease.
2. Heat the new starter ring gear evenly in an oven. See "Technical data".
3. Tap the starter ring gear onto the flywheel so that the bevelled sides of the teeth point towards the starter motor. Ensure that the starter ring gear is properly fitted to the flywheel.
4. Fit the flywheel.

4.16 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING SEAL

Removing the flywheel housing seal

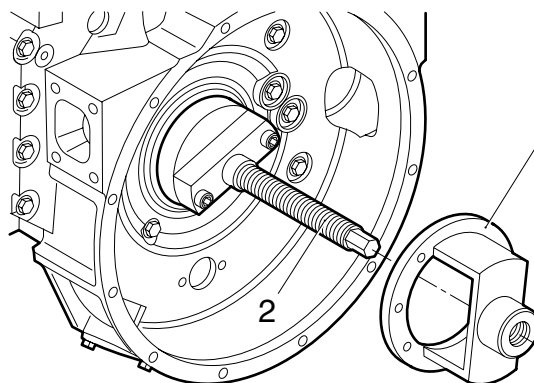
1. Remove the gearbox.
2. Remove the clutch release assembly and the clutch plate.
3. Remove the flywheel.
4. Fit the threaded spindle (2) of the special tool (DAF no. 1329475) on the crankshaft flange.

5. Screw the push/pull piece (1) onto the spindle up to the flywheel housing.

Note:

Mark the drill at a length of 22 mm using a piece of tape.

6. Drill a hole through the base plate to the tape marking and fit a screw in the seal to keep the base plate in its place.
7. Drill the other five holes and fit screws.
8. Turn the threaded spindle (2) clockwise until the seal has been removed.

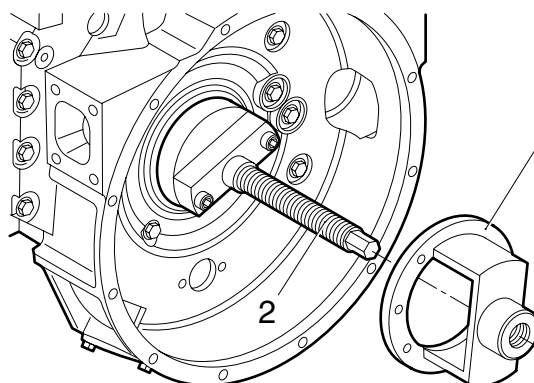


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Installing the flywheel housing seal

1. Clean and inspect the seal chamber. Even minimal damage may cause a leak.
2. Fit the threaded spindle (2) of the special tool (DAF no. 1329475) on the crankshaft flange.
3. Put a new seal over the crankshaft.
4. Screw the push/pull piece (1) onto the threaded spindle (2) up to the seal.
5. Turn the threaded spindle (2) anti-clockwise until the push/pull piece (1) is level with the flywheel housing. The seal has been properly fitted once it is level with the flywheel housing.

6. Remove the special tool.
7. Fit the flywheel.
8. Fit the clutch plate and the clutch release assembly.
9. Fit the gearbox.



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4.17 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING

Removing the flywheel housing

1. Remove the starter motor.
2. Remove the flywheel.
3. Remove the flywheel housing seal.
4. Firmly suspend the engine in the hoist.
5. Remove the engine brackets.
6. Detach the crankcase breather on the flywheel housing so that the attachment bolt can be accessed.
7. Remove the flywheel housing attachment bolts.
8. Remove the flywheel housing.

Installing the flywheel housing

1. Remove any gasket remnants from the contact areas.
2. Check the sealing surfaces for damage.
3. Check the flywheel housing for cracks.
4. Apply a sealant to the sealing face of the cylinder block. See "Technical data". Apply the sealant with a roller or brush evenly over the entire sealing face.
5. Install the flywheel housing and tighten the attachment bolts in the correct sequence to the specified torque. See "Technical data".
6. Fit the engine brackets.
7. Fit the flywheel housing seal.
8. Fit the flywheel.
9. Fit the starter motor.

4.18 REMOVAL AND INSTALLATION, VIBRATION DAMPER**Removing the vibration damper**

1. Remove the attachment bolts of the fan and place the fan in the wind tunnel.
2. Remove the poly-V-belt.
3. Remove the attachment bolts from the vibration damper and remove it.

Installing the vibration damper

1. Check the vibration damper. See "Inspection and adjustment".
2. Fit the vibration damper and tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the poly-V-belt.
4. Fit the fan.

4.19 REMOVAL AND INSTALLATION, CRANKSHAFT SENSOR RING

Removing the crankshaft sensor ring

1. Remove the attachment bolts from the viscous fan clutch and place the fan in the wind tunnel.
2. Remove the poly-V-belt.
3. Remove the attachment bolts from the vibration damper.
4. Remove the vibration damper and the crankshaft sensor ring.

Installing the crankshaft sensor ring

1. Fit the crankshaft sensor ring with vibration damper and tighten the attachment bolts to the specified torque. See "Technical data".

Note:

There is only one way of fitting the crankshaft sensor ring. For this purpose, a pin has been fitted which fits into a bore in the crankshaft sensor ring.

2. Fit the poly-V-belt.
3. Fit the fan and tighten the attachment bolts to the specified torque. See "Technical data".

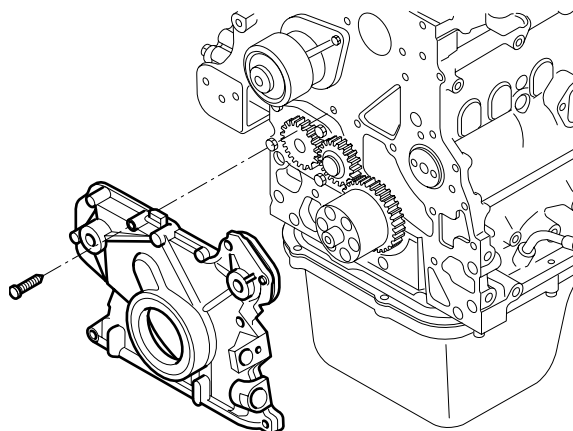
4.20 REMOVAL AND INSTALLATION, FRONT ENGINE PANEL

Removing the front engine panel

1. Remove the poly-V-belt.
2. Remove the attachment bolts from the vibration damper and remove it, along with the crankshaft pulley.
3. Remove the front crankshaft seal.
4. Remove the attachment bolts from the front engine panel and remove it.

Installing the front engine panel

1. Remove any gasket remnants from the contact areas.
2. Check the sealing surfaces for damage.
3. Check the engine panel for cracks.
4. Apply a sealant to the sealing face of the cylinder block. See "Technical data". Apply the sealant with a roller or brush evenly over the entire sealing face.
5. Fit the engine panel and tighten the attachment bolts to the specified torque. See "Technical data".
6. Fit the front crankshaft seal.
7. Fit the crankshaft pulley and the vibration damper. Tighten the attachment bolts to the specified torque. See "Technical data".
8. Fit the poly-V-belt.

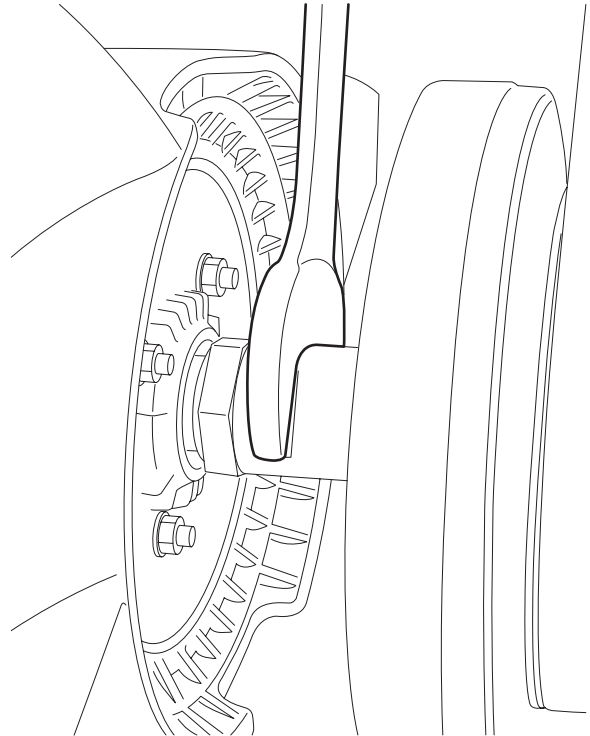


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4.21 REMOVAL AND INSTALLATION, CAMSHAFT GEAR

Removing the camshaft gear

1. Remove the flywheel housing.
2. Use an open-end spanner on the fan shaft to crank the engine until the marks in the crankshaft gear and camshaft gear match. The crankshaft gear has a punched hole in the tooth which has to fall into the tooth depth of the camshaft gear marked with a punched hole.
3. Remove the air compressor.



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4. Remove the attachment bolts from the camshaft gear and remove it.

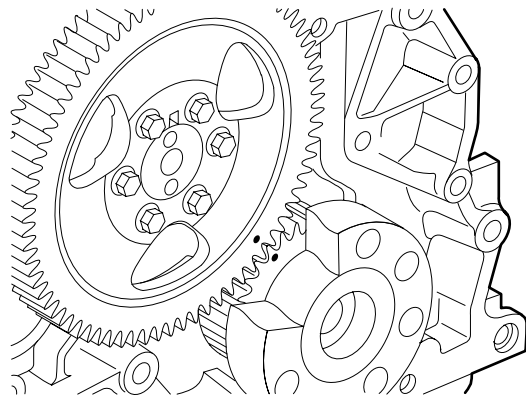
Installing the camshaft gear

1. Fit the camshaft gear making sure that the timing gear is properly set. See "Inspection and adjustment".

Note:

There is only one way of fitting the camshaft gear. For this purpose, a recess has been made which falls over a pin on the camshaft.

2. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the air compressor.
4. Fit the flywheel housing.

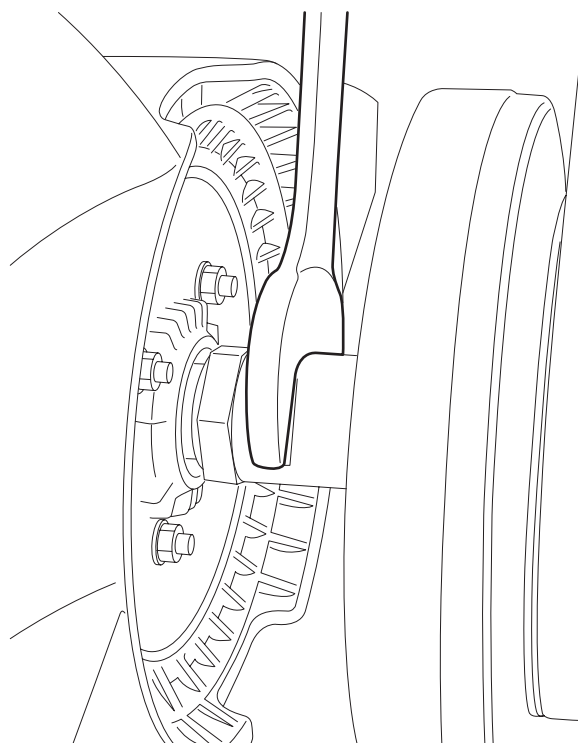


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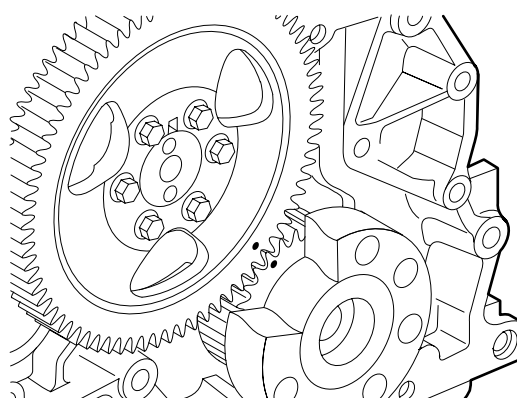
4.22 REMOVAL AND INSTALLATION, TIMING GEAR CASE

Removing the timing gear case

1. Remove the flywheel housing.
2. Remove the steering pump.
3. Remove the air compressor.
4. Remove the high-pressure pump.
5. Use an open-end spanner on the fan shaft to crank the engine until the marks in the crankshaft gear and camshaft gear match. The crankshaft gear has a punched hole in the tooth which has to fall into the tooth depth of the camshaft gear marked with a punched hole.
6. Remove the camshaft gear.
7. Loosen the oil sump bolts and remove the oil sump bolts fitted in the timing gear case.

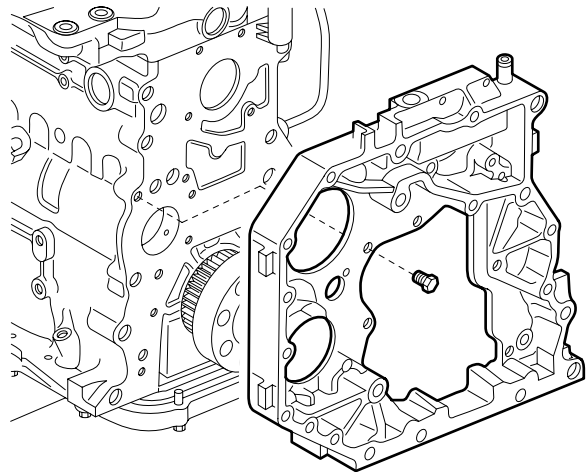


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8. Remove the attachment bolts from the timing gear case and remove it.



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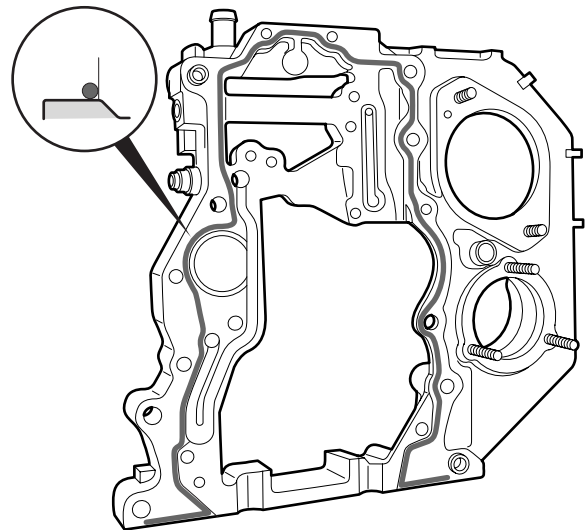
Installing the timing gear case

1. Apply a sealant to the sealing surface of the cylinder block. See "Technical data". Apply the sealant in accordance with the pattern and at the indicated location. The bead has to be 1.5 to 2.0 mm thick. Fit the timing gear case with liquid gasket and tighten the attachment bolts to the specified torque. See "Technical data".

Note:

If too much sealant is used, or if the sealant is applied in a wrong place, this may cause obstruction of an oil duct or oil sump ventilating duct. This could result in serious damage.

2. Fit the oil sump attachment bolts and tighten them to the specified torque. See "Technical data".
3. Fit the camshaft gear.
4. Fit the high-pressure pump.
5. Fit the air compressor.
6. Fit the steering pump.
7. Fit the flywheel housing.



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4.23 REMOVAL AND INSTALLATION, FRONT CRANKSHAFT SEAL

Removing the front crankshaft seal

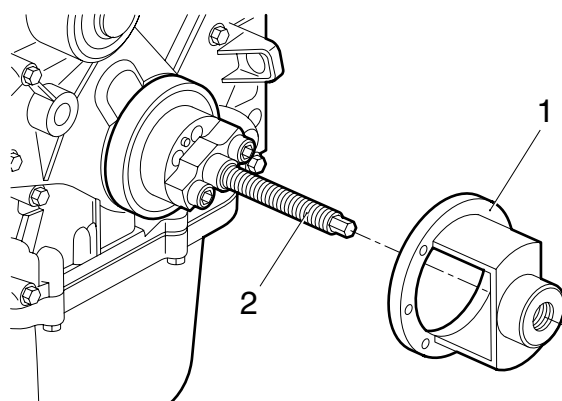
1. Remove the attachment bolts from the fan and place it in the wind tunnel.
2. Remove the poly-V-belt.
3. Remove the attachment bolts from the vibration damper and remove it, along with the crankshaft pulley.
4. Fit the threaded spindle (2) of the special tool (DAF no. 1329474) on the crankshaft flange.

5. Screw the push/pull piece (1) onto the spindle up to the engine top panel.

Note:

Mark the drill at a length of 18 mm using a piece of tape.

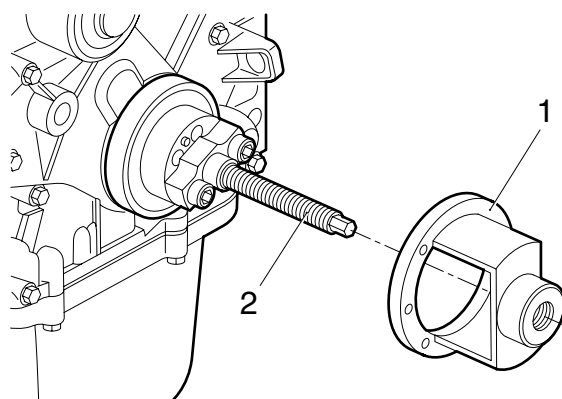
6. Drill a hole through the base plate to the tape marking and fit a screw in the seal to keep the base plate in its place.
7. Drill the other five holes and fit screws.
8. Turn the threaded spindle (2) clockwise until the seal has been removed.



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Installing the front crankshaft seal

1. Clean and inspect the seal chamber. Even minimal damage may cause a leak.
2. Fit the threaded spindle (2) of the special tool (DAF no. 1329474) on the crankshaft flange.
3. Put a new seal over the crankshaft.
4. Screw the push/pull piece (1) onto the threaded spindle (2) up to the seal.
5. Turn the threaded spindle (2) anti-clockwise until the push/pull piece (1) is level with the panel. The seal has been properly fitted once it is level with the engine top panel.
6. Remove the special tool.
7. Inspect the vibration damper.
8. Fit the crankshaft pulley and the vibration damper and tighten the attachment bolts to the specified torque. See "Technical data".
9. Fit the poly-V-belt.
10. Fit the fan.



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5. CLEANING

5.1 CLEANING THE ENGINE

Note:

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

Before cleaning the engine, check for any leaks.

If the engine is cleaned with a high-pressure cleaner, the high-pressure cleaner 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.
- There is an air bleed vent on the power steering fluid reservoir of the steering gear. Water may enter the reservoir through this air bleed vent, causing damage to the steering gear.
- When cleaning the radiator/air cooler element, be careful not to damage the fins.
- Do not direct the high-pressure cleaner jet too long at the air-conditioning system condenser. As a result of the high temperature, the pressure in the system will become excessive, which may cause damage to the system.
- Ensure that no water can enter the gearbox via the air bleed vents.
- Make sure that no water can enter via the clutch reservoir bleed vents.
- The engine compartment can be cleaned with a high-pressure cleaner. Never direct the jet of water towards electrical components.
- When cleaning UPEC engines with a high-pressure cleaner, do not aim the jet directly at the pump units. Water could penetrate into the protective covers via the bleed holes. This could result in failures in the electrical connections of the pump units.
- Do not direct the jet of water at electrical connections such as connectors or lead-throughs of the vehicle lighting system.
- Ensure that no water can enter the air intake system via the air intake or its flexible seals.

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

Various oils and 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 clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

2.1 SYSTEM DESCRIPTION, 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 and pipes.

The water pump is located below the thermostat in the engine block.

The thermostat housing is part of the cylinder head.

From the delivery side of the water pump, the coolant is directed to the oil cooler via an opening at the back of the water pump. Afterwards the coolant flows to the cylinder block.

The coolant flows through the cylinder block, along the cylinder liners, and up to the cylinder heads.

The coolant leaves the cylinder heads through the thermostat housing.

Depending on the coolant temperature, the thermostat distributes the coolant flow to the radiator or back to the water 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.

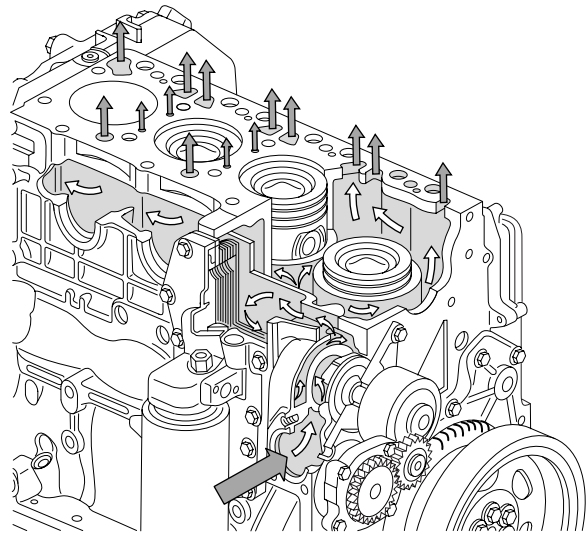
The connection pipe to the header tank is also connected to the return pipe from the radiator. When the coolant heats up, it flows to the header tank. When the coolant cools down, it will flow back from the header tank.

The oil cooler is not only intended to cool the lubricating oil, but also to heat the lubricating oil in a "cold" engine.

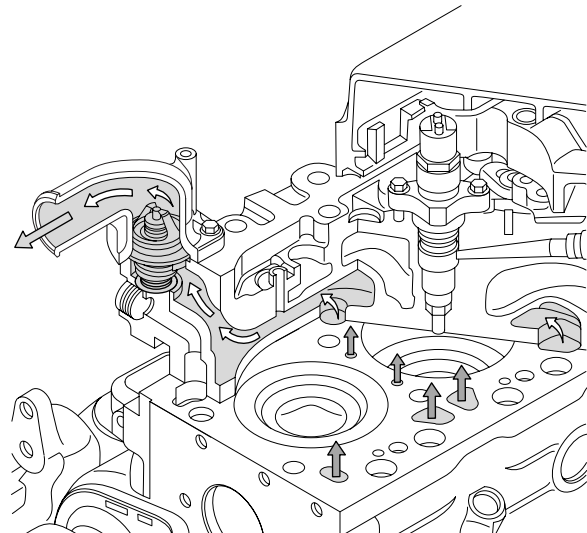
From the cylinder block, some of the coolant flows through the air compressor.

From the air compressor, the coolant is returned to the engine block via a pipe.

The pipe which takes the coolant to the cab heater is connected to the cylinder head. From the heater, the coolant is returned to the water pump via a pipe.



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3. DESCRIPTION OF COMPONENTS

3.1 PRESSURE CAP

The pressure cap is fitted to the header tank by means of a threaded connection.

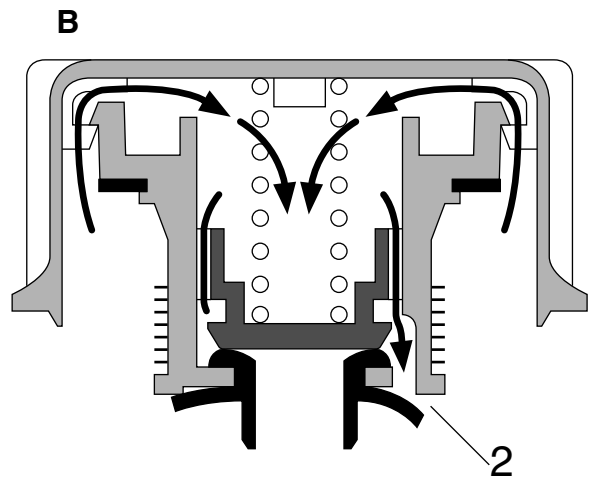
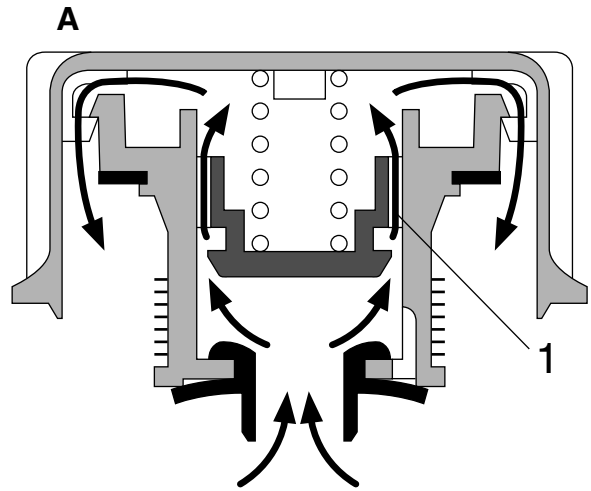
The pressure cap has two valves: a pressure relief valve (1) and a vacuum relief valve (2).

Overpressure

As a result of the rising coolant temperature, the pressure in the cooling system will increase. If the pressure in the cooling system becomes too high, the pressure relief valve (1) will open against the pressure of the spring.

Underpressure

If the coolant temperature drops, the pressure in the cooling system will decrease. If the pressure in the cooling system becomes too low, the vacuum relief valve (2) will be opened.



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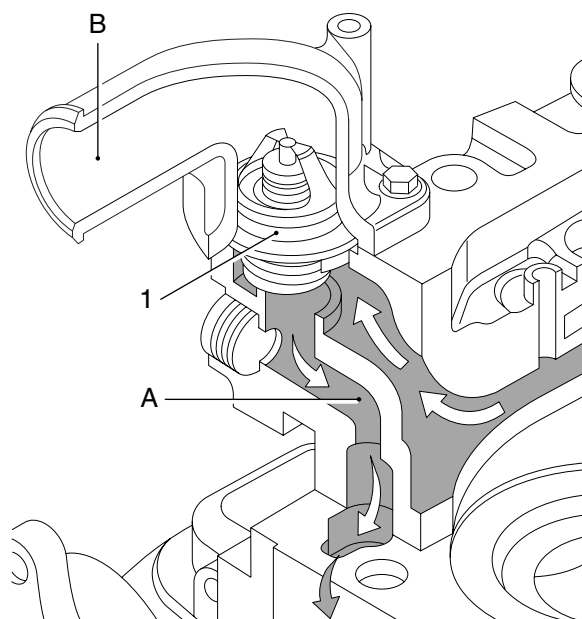
3.2 THERMOSTAT

Operation, thermostat

Coming from the cylinder head, the coolant passes through the thermostat. Depending on the coolant temperature and the corresponding position of the thermostat, there are three possibilities:

Thermostat closed

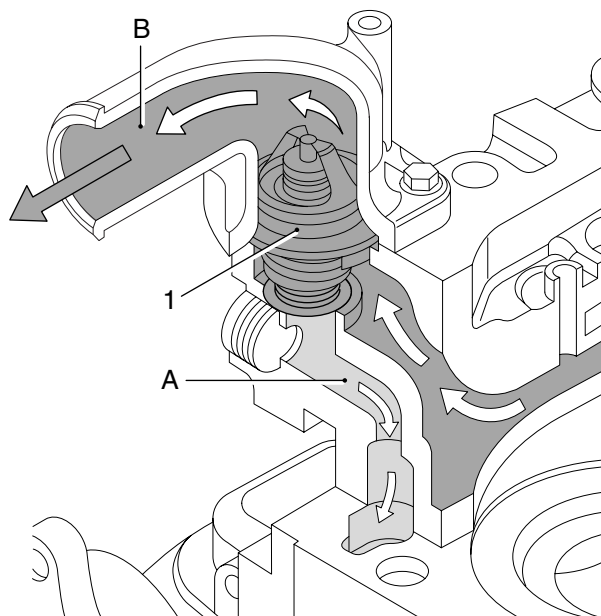
The coolant has not yet reached the opening temperature of the thermostat (1). The supply channel (B) to the radiator is completely closed. The coolant flows directly to the water pump through a bypass (A) and the water pump returns the coolant to the cylinder block.



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Thermostat starts opening

The coolant has reached the opening temperature of the thermostat (1). The supply channel (B) to the radiator is opened and the bypass (A) is partially closed. Now coolant will flow both through the supply channel (B) to the radiator and directly to the water pump through the bypass channel (A).



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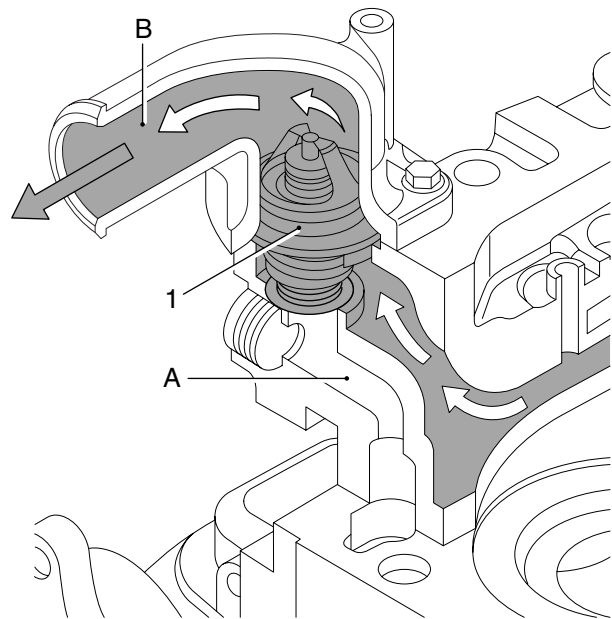
Thermostat fully opened

The temperature of the coolant has further increased. The supply channel (B) to the radiator is fully opened and the bypass 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, removing the thermostat as an emergency solution is **not permitted**.

If the thermostat is removed from the engine, uncooled coolant will flow to the water pump through the bypass (A). As a result, the coolant temperature will continue to rise.



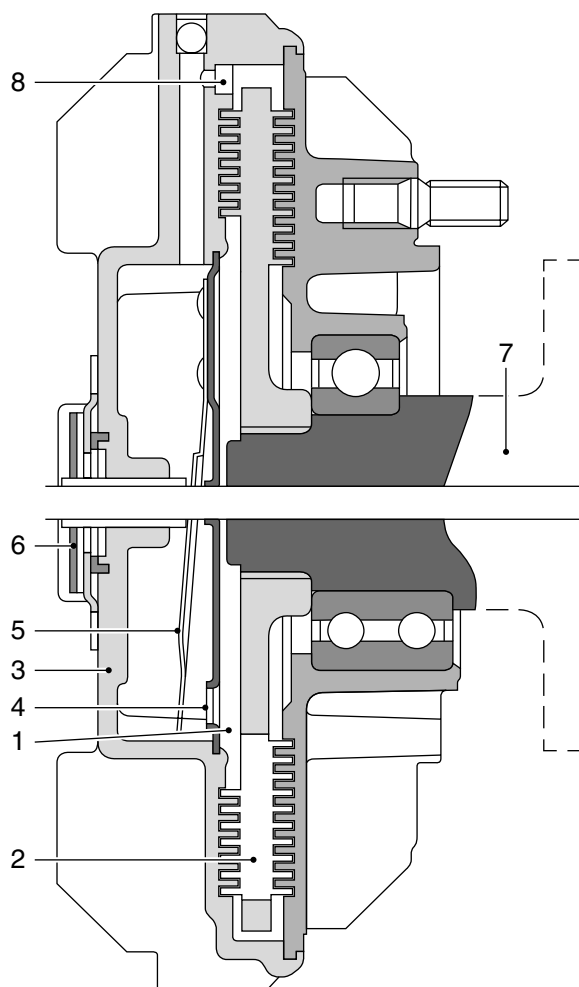
3.3 VISCOUS FAN CLUTCH

The fan is connected to the engine by means of a viscous fan clutch. If, under certain circumstances, the heat is not sufficiently dissipated by the air flow passing through the radiator, the fan will have to draw in extra cooling air through the radiator. In a viscous fan clutch, the drive torque is transmitted by a silicone fluid.

The fan clutch is divided into two chambers. In the working area (1) is the rotor (2), which is connected to the drive flange (7). The supply chamber (3) rotates freely round the drive flange (7) and is connected to the fan. There is silicone fluid in the supply chamber (3). The opening (4) in the supply chamber (3) is closed by a valve (5). The valve (5) is operated by a bimetallic strip (6).

If the opening (4) in the supply chamber (3) is closed by the valve (5), no silicone fluid can enter the working area (1). The silicone fluid still present in the working area (1) will flow back to the supply chamber (3) through the bores (8). As only very little fluid will be left in the working area (1), there will be a great difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan.

When the air temperature increases, the bimetallic strip (6) will bend and the valve (5) will partially release the opening (4) in the supply chamber (3). Through this opening, a limited amount of silicone fluid can enter the working area (1) and flow past the rotor (2). This will cause friction, so that the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan will decrease.



M201039

2

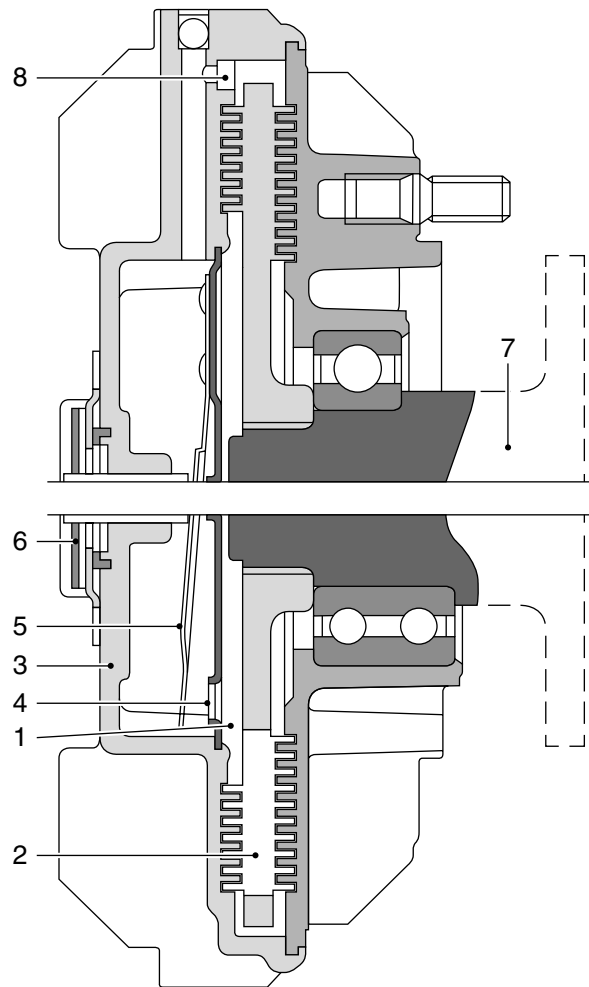
CF65/75/85 series

CE-ENGINE COOLING SYSTEM

Description of components

As the air temperature rises, the bimetallic strip (6) will continue to bend and the opening (4) in the supply chamber (3) will be fully released.

The further the opening (4) in the supply chamber (3) is released, the more silicone fluid will flow into the working area (1) and past the rotor (2). As a result of the increase in friction, the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) will further decrease.



M201039

4. INSPECTION AND ADJUSTMENT

4.1 PRESSURE TESTING

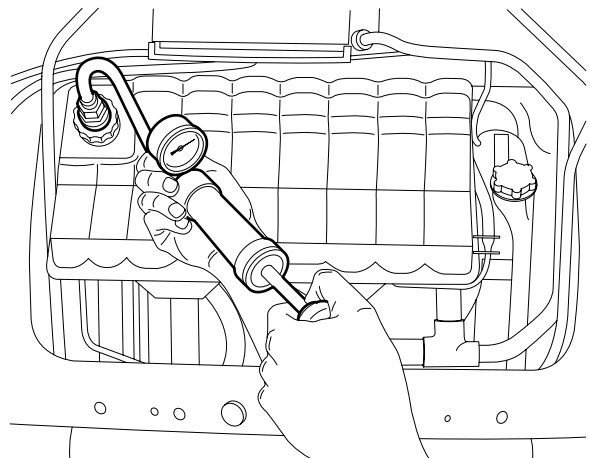


When the coolant is hot, there is overpressure in the cooling system. Carefully remove the filler cap to release the overpressure. Coolant is a toxic fluid. Contact with the skin should therefore be avoided. To avoid damaging the cylinder block; do not top up a warm engine with cold coolant.

If this is done when the engine is warm, any cracks can be spotted more quickly.

The cooling system can be checked for leaks with a pressure-test pump.

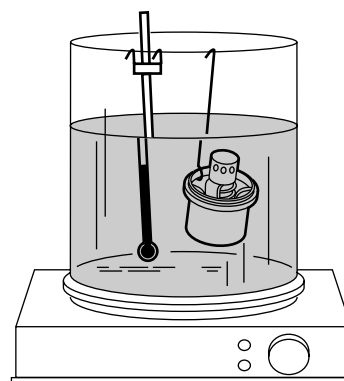
1. Open the grille.
2. Remove the filler cap.
3. Fill the cooling system to the correct level.
4. Raise the engine temperature. This need not be the operating temperature.
5. Fit a pressure-test pump. Pressure-test the system at the specified pressure. See "Technical data".
6. Check for leakage.



M201192

4.2 INSPECTION, THERMOSTAT

1. Remove the thermostat. See "Removal and installation".
2. Inspect the sealing surfaces of the thermostat housing for damage.
3. Check the thermostat seat for damage.
4. Check whether the thermostat is fully closed.
5. Place the thermostat in a container filled with clean water.
6. Place a thermometer in the container and heat the water. Check at which temperature the thermostat opens and whether it opens fully. See "Technical data".



M200513

4.3 INSPECTION, VISCOUS FAN CLUTCH



Do not run the engine in an enclosed or unventilated area. Make sure exhaust fumes are properly extracted. Remain at a safe distance from rotating and/or moving components.

During this test, the slip in the viscous fan clutch is measured while the clutch is not operating. This test must be carried out when the engine is "cold" (coolant temperature approximately 50°C).

Testing with a cold engine

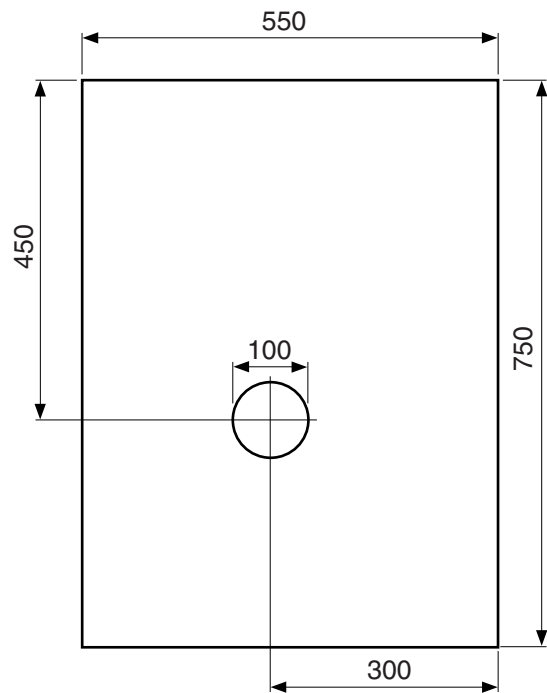
1. Check the coolant level, and top up as necessary.
2. Start the engine and run it at idling speed for at least 5 minutes.
Then use an optical rev counter to measure the fan speed at different engine speeds (from idling to maximum engine speed).
During this test procedure, the speed of the fan should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

This test checks whether the bimetallic strip starts opening the valve at an operating temperature of 85 - 95°C.

Testing with a warm engine

1. Check the coolant level, and top up as necessary. Be careful when topping up the coolant of a warm engine.

2. Take a sheet of cardboard with a 100 mm hole, as shown in the drawing opposite, and place it in front of the radiator, with the hole in front of the viscous clutch.
3. Check that the gearbox is in neutral.
4. Bring the cooling system to operating temperature.
5. Allow the fan drive flange to run at a speed of 1000 rpm. Then use an optical rev counter to determine the difference between the rotating speeds of the fan and the drive flange. The speeds will differ as a result of slip in the viscous clutch. When the clutch is fully engaged, the slip must not exceed 10%. If it is more, the viscous fan clutch must be replaced.



M201166

5. REMOVAL AND INSTALLATION

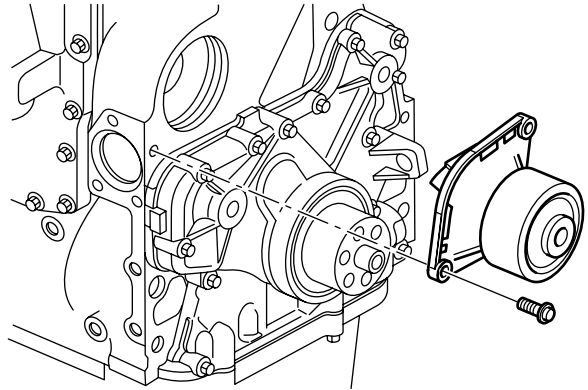
5.1 REMOVAL AND INSTALLATION, COOLANT PUMP

Removal, coolant pump

1. Drain the coolant. See "Draining and filling".
2. Remove the poly-V-belt.
3. Remove the attachment bolts from the coolant pump and remove it.

Installation, coolant pump

1. Thoroughly clean the sealing surfaces of the coolant pump and the cylinder block.
2. Check the O-ring. If the O-ring is not damaged, it may be re-used.
3. Fit the coolant pump and tighten the attachment bolts to the specified torque. See "Technical data".
4. Fit the poly-V-belt.
5. Fill the cooling system. See "Draining and filling".



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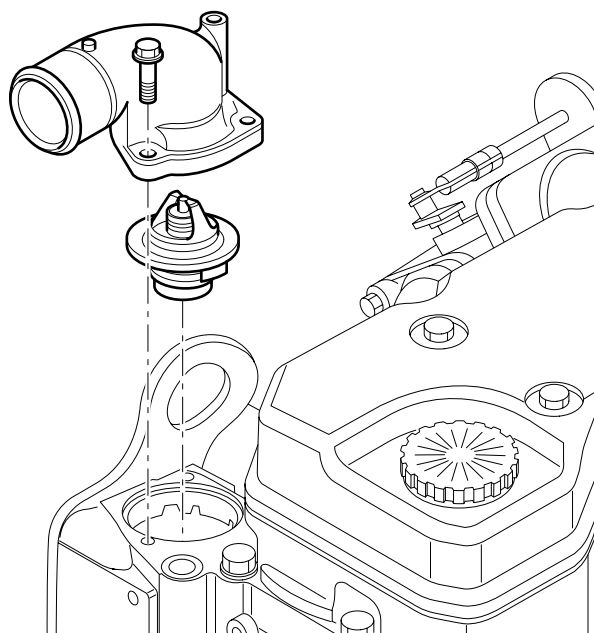
5.2 REMOVAL AND INSTALLATION, THERMOSTAT

Removing the thermostat

1. Drain the coolant. See "Draining and filling".
2. Remove the water hose between the thermostat housing and the radiator.
3. Remove the thermostat housing attachment bolts.
4. Remove the thermostat housing.
5. Remove the thermostat.

Installing the thermostat

1. Fit the thermostat in the thermostat housing.
2. Fit the thermostat housing onto the cylinder head.
3. Fit the thermostat housing attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
4. Fit the water hose between the thermostat housing and the radiator.
5. Fill the cooling system. See "Draining and filling".

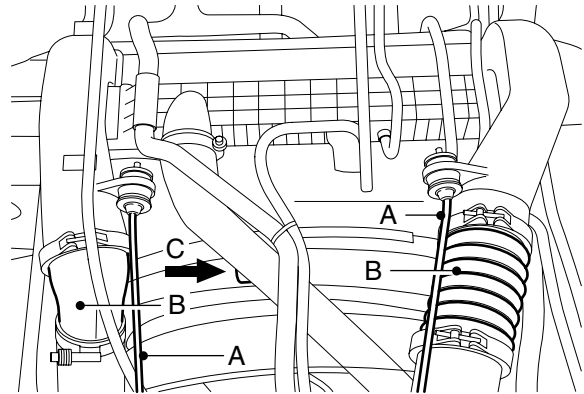


M201156

5.3 REMOVAL AND INSTALLATION, VISCOUS FAN CLUTCH

Removing the viscous fan clutch

1. Drain some of the coolant. See "Draining and filling".
2. Remove the upper radiator hose.
3. Remove the air inlet hose between the air cooler and the inlet manifold (B).
4. Remove the heater hose.
5. Remove the torque rods (A).
6. Remove the locking screws from the wind tunnel collar (C) and turn the latter inwards.
7. Remove the attachment nuts from the fan.
8. Remove the bolts attaching the viscous fan clutch to the drive flange. Remove the viscous fan clutch with the fan from the wind tunnel.



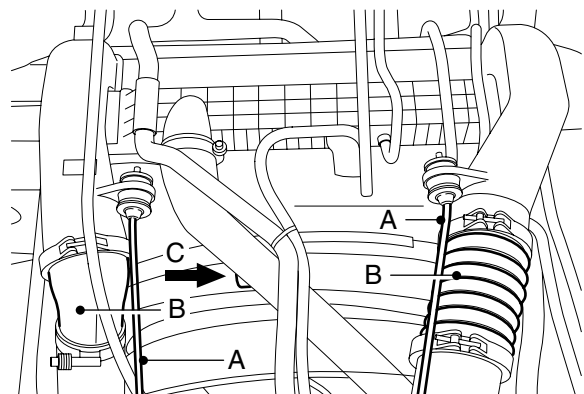
M201193

Note:

The viscous fan clutch must **always** be stored **vertically**.

Installing the viscous fan clutch

1. Place the new viscous fan clutch in the fan. Position it in the wind tunnel and fit the viscous fan clutch with the fan onto the drive flange.
2. Tighten the attachment nuts of the fan.
3. Turn the wind tunnel collar (C) back and fit the locking screws.
4. Fit the torque rods (A).
5. Fit the heater hose.
6. Fit the air inlet hose between the air cooler and the inlet manifold (B).
7. Fit the upper radiator hose.
8. Fill the cooling system. See "Draining and filling".
9. Run the engine and check that all connections are sealed properly.



M201193

5.4 REMOVAL AND INSTALLATION, RADIATOR UNIT

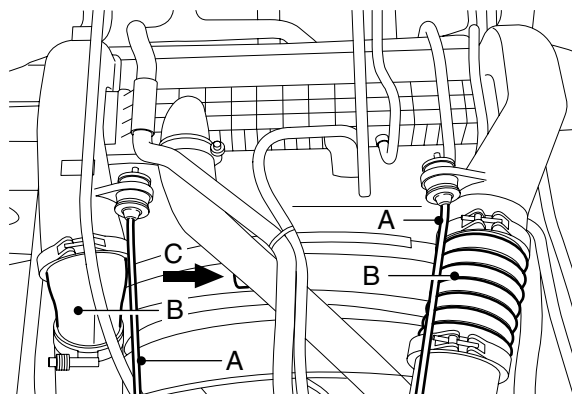
Note:

The removal and installation procedure for the radiator unit 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 unit

1. Drain the coolant.
2. Disconnect the torque rods (A).
3. Remove the air inlet hoses (B) between the engine and the air cooler.
4. Remove the locking screws from the wind tunnel collar (C) and turn the latter inwards.
5. Disconnect the air-conditioning condenser (if fitted) including accessories from the radiator unit.
6. Disconnect the air-conditioning compressor from the engine and carefully put the complete air-conditioning system to one side.
7. Disconnect the rubber hoses from the radiator unit.
8. Disconnect the oil filler pipe from the radiator unit.
9. Disconnect the radiator unit and remove the assembly with the air cooler.



M201193

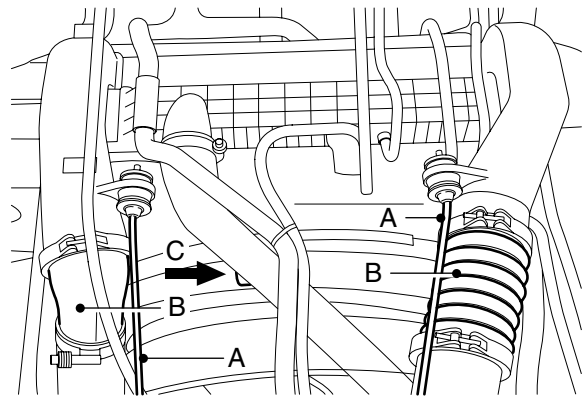
Installing the radiator unit

1. Fit the radiator in the chassis. Tighten the attachment nuts to the specified tightening torque. See "Technical data".
2. Fit the oil filler pipe to the radiator unit.
3. Fit all rubber hoses to the radiator unit.
4. Fit the air-conditioning compressor to the engine.
5. Fit the air-conditioning condenser (if present) including accessories to the radiator unit.

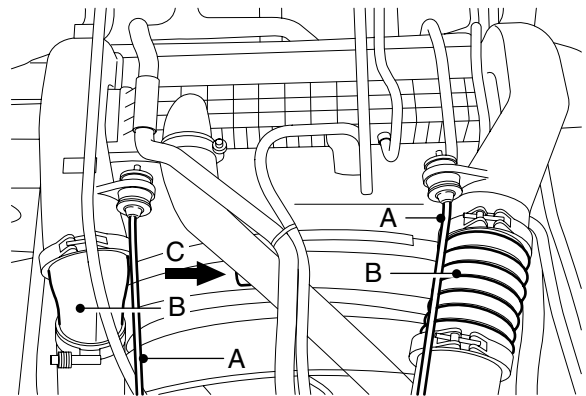
6. Fit the wind tunnel collar (C) and turn it outwards and fit the locking screws.
7. Fit the air inlet hoses (B) between the engine and the air cooler.
8. Fit the torque rods (A).
9. Fill the cooling system.

Installing the radiator

1. Fit the radiator in the chassis. Tighten the attachment nuts to the specified tightening torque. See "Technical data".
2. Fit the air cooler to the radiator.
3. Fit the guide ring in the vehicle.
4. Fit the wind tunnel (C).
5. Install the fan clutch and the fan.
6. Fit the guide ring.
7. Fit the oil filler hose.
8. Suspend the condenser at the bottom to the brackets and fit the retainer clips.
9. Fit the bracket of the heater hose to the radiator.
10. Fit the water hoses to the radiator.
11. Install the air inlet hoses (B) of the air cooler.
12. Fit the bracket of the air-conditioning pipes on the radiator.
13. Fit the front engine encapsulation on the left-hand side.
14. Fit the earth lead to the battery terminal.
15. Fill the cooling system. See "Draining and filling".
16. Run the engine and check that all connections are sealed properly.



M201193



M201193

6. DRAINING AND FILLING

6.1 DRAINING AND FILLING COOLANT



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

Coolant is a toxic fluid and must be handled with care.

Protect 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 overpressure in the cooling system.

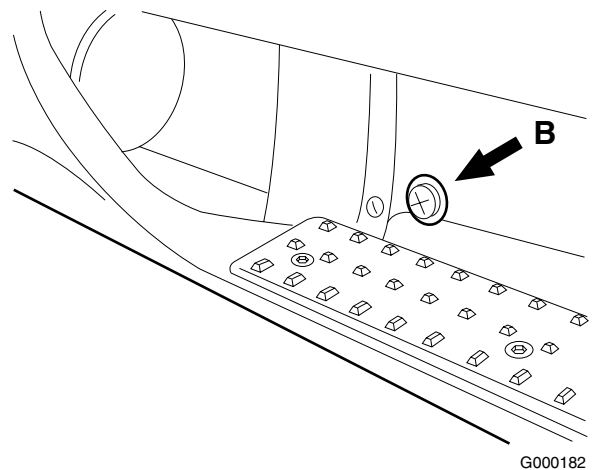
When removing the filler cap, allow the overpressure to escape by first loosening the filler cap one turn.

Draining the cooling system

1. Turn the heater control knob to the maximum "hot" temperature setting.
2. Remove the cooling system filler cap.
3. Collect the coolant. To do this, place a suitable container under the drain point.
4. Drain the cooling system at the radiator via drain plug B.
5. Flush the cooling system.
6. Fit drain plug B.

Filling/venting the cooling system

1. Turn the heater temperature control knob in the cab to the maximum "hot" setting.
2. Fill the cooling system with the specified coolant up to the fill opening of the expansion tank.
3. Start the engine and continue to top up the cooling system.
4. The cooling system is auto-venting. Venting will be audible during topping up. Continue topping up until venting is no longer audible.
5. Close the cooling system and allow the engine to warm up until the thermostat has opened.
6. Stop the engine and check the coolant level on the transparent rear side of the expansion tank; add more coolant if necessary.



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If the vehicle is fitted with water cab heater

1. Run the engine at idling speed.
2. Switch on the cab heater using the rocker switch on the dashboard.
3. Turn the heater temperature control knob in the cab to the maximum "hot" 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 cab heater to operate for approximately 15 minutes.
7. Check the coolant level again; top up with coolant if necessary.

7. CLEANING

7.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER



Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.

This tool can be made in your own workshop. It cannot be ordered from DAF.

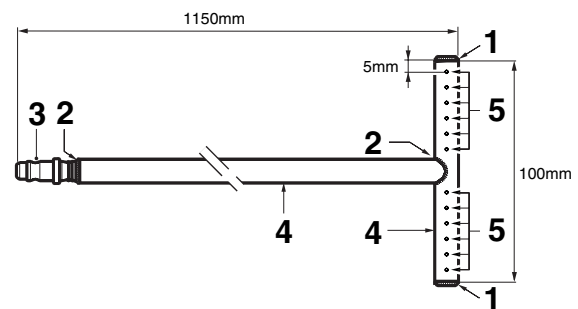
Key to drawing:

1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, \varnothing 10 mm
5. 6 x \varnothing 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side.

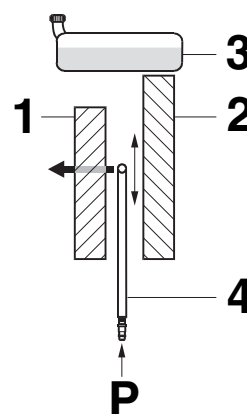
Note:

Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

1. From below, insert the radiator cleaner (4) between the air cooler (1) and radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.

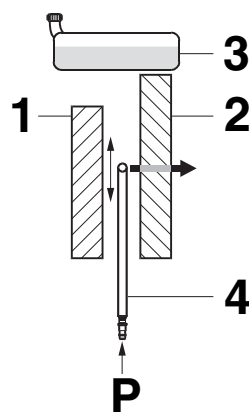


M2108



M2109

3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).
4. Fit the wire mesh.
5. Install the lower grille.



M2110

7.2 CLEANING THE COOLING SYSTEM

Use a cleaning agent approved by DAF to remove internal oil pollution. Refer to the TRP catalogue.

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

Various oils and 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 clutch fluid. So avoid inhaling and direct contact.

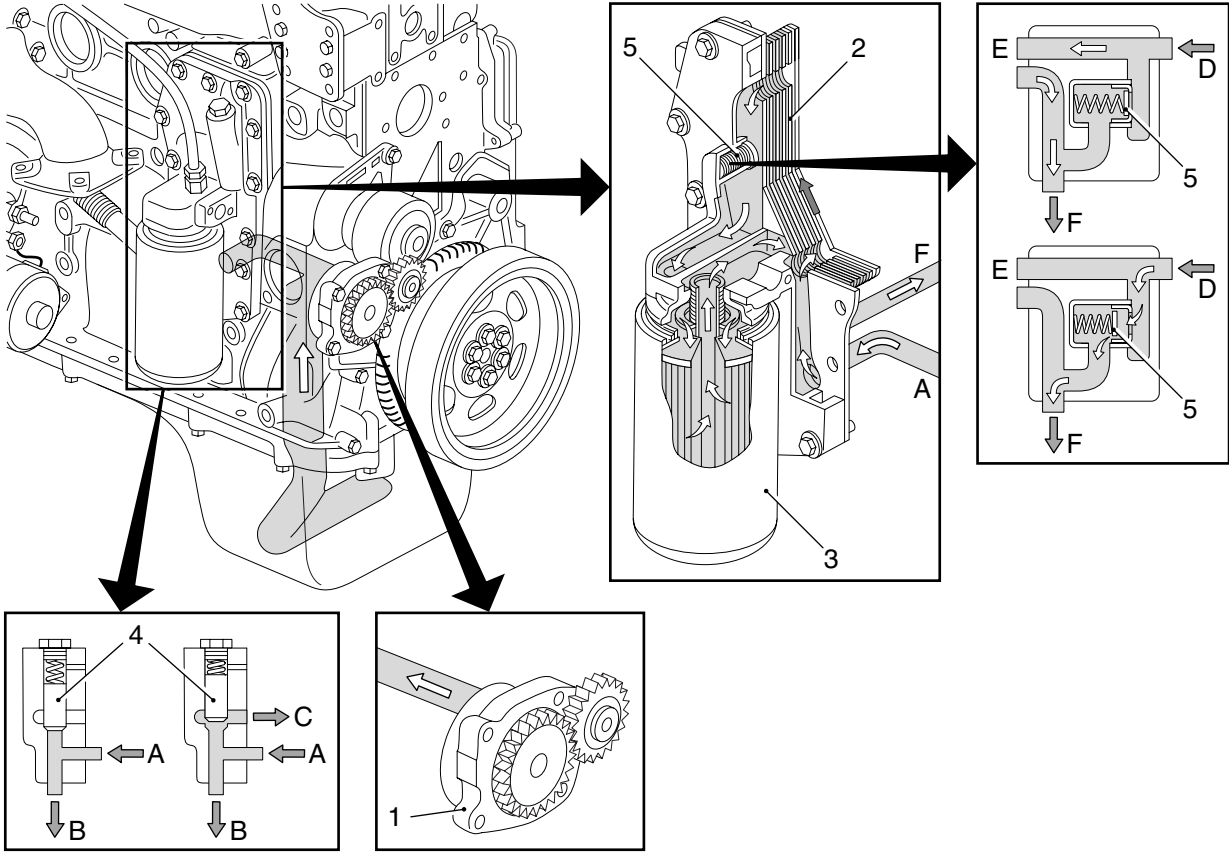
Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

4

2. GENERAL

2.1 SYSTEM DESCRIPTION, LUBRICATION SYSTEM



- A From oil pump
- B To oil cooler
- C To lubricating oil pump
- D From oil cooler
- E To oil filter
- F To main oil channel

General

The lubricating oil pump (1) is directly driven by the crankshaft via an idler gear. The lubricating oil pump draws the oil from the oil sump, and pumps it via the oil cooler (2) and the lubricating oil filter (3) 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 (2) 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.

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Pressure limiting valve

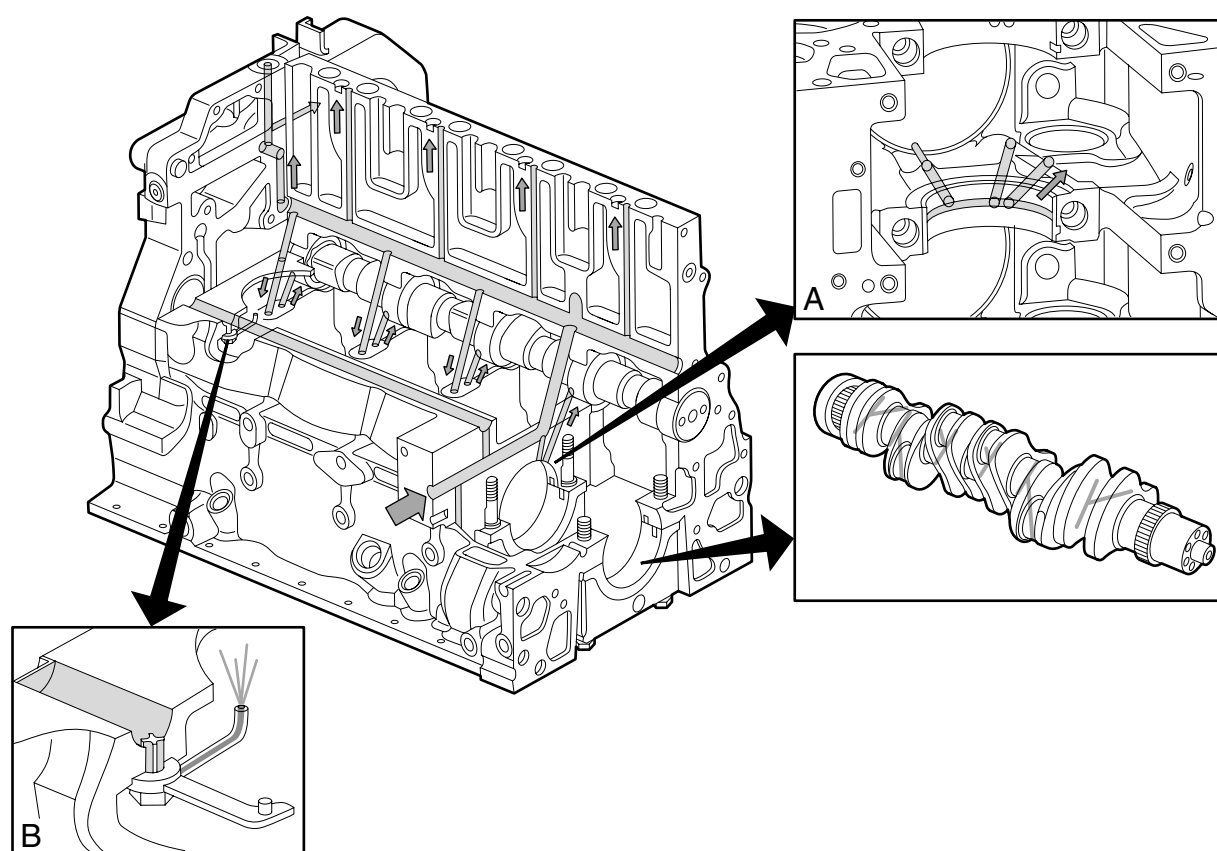
A pressure limiting valve (4) is fitted in the oil cooler housing.

When the pressure set for the pressure limiting valve has been reached, the valve opens and allows the excess lubricating oil to be discharged to the supply side of the lubricating oil pump.

Oil filter

The oil is cleaned in the disposable oil filter (3). A pressure relief valve (5) fitted in the oil cooler housing 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.

4



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Main oil channel

From the main oil channel, lubricating oil is supplied to the crankshaft main bearings (A) and via an oil channel in the crankshaft also to the big-end bearings.

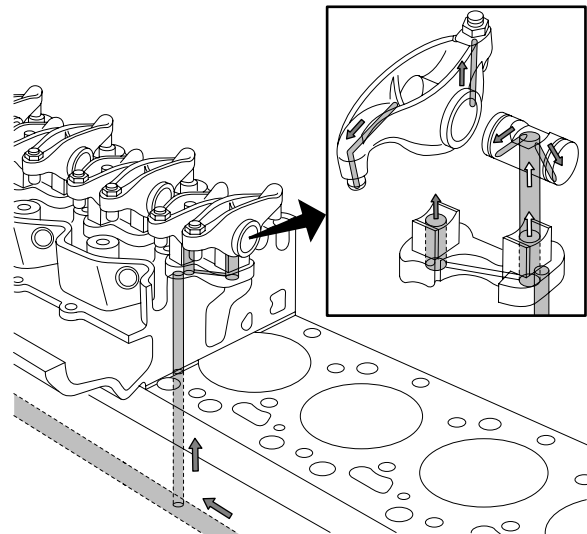
From the main oil channel, lubricating oil is pumped to the camshaft.

Cylinder head

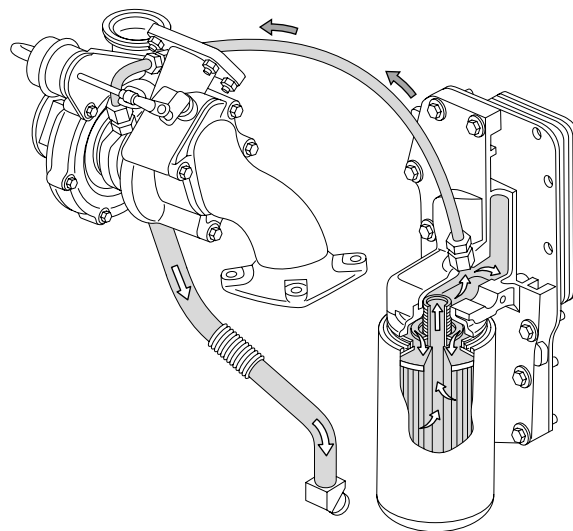
From the main oil channel, vertical oil channels pass through the cylinder block to the cylinder head. This bore is continued in the cylinder head to supply lubricating oil to the rockers.

Piston and gudgeon pin

The pistons are lubricated by oil nozzles (B). In addition to its lubricating function, the lubricating oil has an important cooling function. A hole has been drilled at the top of the connecting rod, through which the oil that the oil nozzles spray against the piston head may reach the upper big-end bearing.



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Turbocharger

The turbocharger is lubricated via an oil pipe from the oil filter.

The oil discharge pipe from the turbocharger is connected to 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 to the timing gear, and from there to the oil sump.

Air compressor

The air compressor is supplied with oil from an oil channel in the timing gear case connected to the main oil channel.

The oil returning from the air compressor flows from the front of the air compressor to the timing gear case, and from there to the oil sump.

3. INSPECTION AND ADJUSTMENT

3.1 CHECKING ENGINE OIL CONSUMPTION

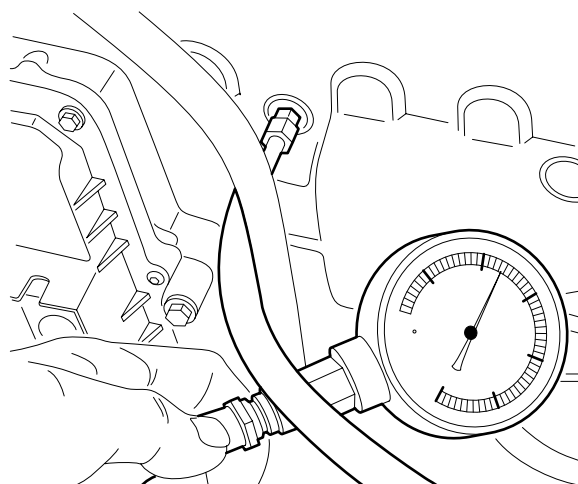
Engine oil consumption relates to the engine oil used during combustion in the engine. Since engine oil consumption is affected by driving style and the use to which the vehicle is put, it is also related to average fuel consumption. See "Technical data" for the maximum permissible engine oil consumption.

Test conditions

1. An engine oil consumption test is only meaningful after the engine has been run in (approx. 25,000 km).
2. Check the engine carefully for engine oil leakage before carrying out an engine oil consumption test. First repair any leaks.
3. Check the average fuel consumption and engine oil consumption as accurately as possible.
4. Only check the engine oil level when the engine is at operating temperature and only when the engine has been turned off for five minutes.
5. Make sure the vehicle is horizontal before checking the engine oil level.

3.2 INSPECTION, LUBRICATING OIL PRESSURE

1. Bring the engine up to operating temperature.
2. Remove the plug from the main oil channel. It is located on the left, in the centre of the engine block.
3. Connect the special tool (DAF no. 0535551) to the oil pressure gauge connection.
4. Start the engine and measure the lubricating oil pressure at idling speed and at full-load engine speed. Compare the pressure readings with the technical data. See "Technical data".
5. Stop the engine and remove the oil pressure gauge. Fit the plug with a new sealing ring.



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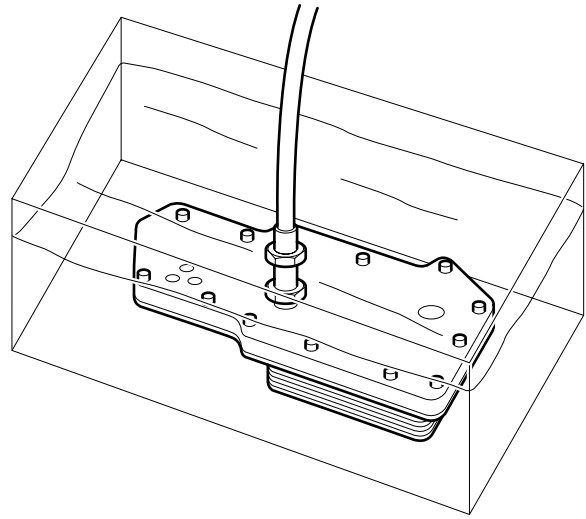
3.3 PRESSURE TESTING THE OIL COOLER

1. Remove the oil cooler. See "Removal and installation".
2. Fit the special tool (DAF no. 1329478).
3. Apply up to 5 bar of pressurised air to the special tool.
4. Immerse the oil cooler in warm water (approx. 50°C) and check the cooling element for leaks.

Note:

The oil cooler should be replaced if it is leaking.

5. Remove the special tool.
6. Fit the oil cooler. See "Removal and Installation".



M201154

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, LUBRICATING OIL FILTER



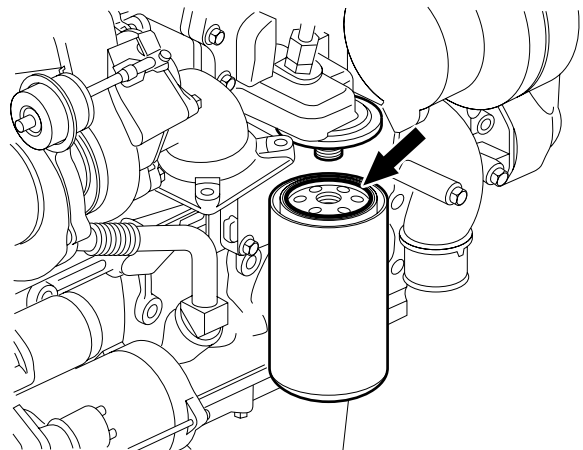
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil. Be careful when changing the oil. Hot oil may cause serious injuries.

Removing the oil filter

1. Clean the location and the area surrounding the filter element if extremely fouled.
2. Remove the filter element by turning it anti-clockwise. Collect any oil that is flowing out.
3. Remove the O-ring if it has not been removed already.

Installing the oil filter

1. Lightly oil the filter element sealing ring.
2. Fill the filter element with clean oil. Use the specified oil.
3. Fit the filter until the seal abuts, and tighten it by hand another $\frac{3}{4}$ to a full turn.
4. Run the engine for a short time and check whether the oil filter is correctly sealed.
5. Check the oil level and correct if necessary. Use the specified oil.



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4.2 REMOVAL AND INSTALLATION, OIL COOLER**Removing the oil cooler**

1. Drain the coolant. See "Draining and filling".
2. Remove the lubricating oil filter.
3. Remove the turbocharger oil supply pipe.
4. Remove the attachment bolts from the oil cooler and remove it.

Installing the oil cooler

1. Fit the oil cooler with new gaskets and tighten the attachment bolts to the specified torque and in the specified sequence. See "Technical data".
2. Tighten the oil supply pipe to the specified torque. See "Technical data".
3. Fit the lubricating oil filter.
4. Fill the cooling system.
5. Run the engine briefly, and check that the oil cooler does not leak.
6. Check the lubricating oil level.
7. Check the coolant level.

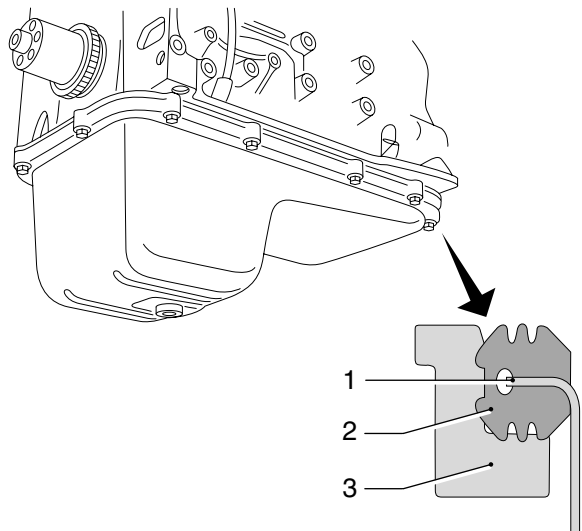
4.3 REMOVAL AND INSTALLATION, OIL SUMP

Removing the oil sump

1. Remove the under-engine noise encapsulation.
2. Drain the engine oil. See "Draining and filling".
3. Support the oil sump.
4. Remove the attachment bolts all around.
5. Remove the oil sump (1) with sealing rubber (2) and flange (3).

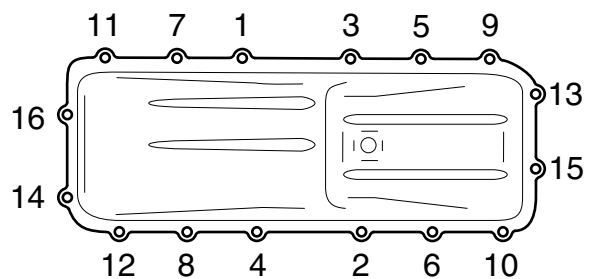
Installing the oil sump

1. Thoroughly clean the sealing surfaces of the oil sump and the cylinder block.
2. Check the oil sump sealing rubber (2). Damaged sealing rubbers must be replaced.
3. Fit the oil sump (1) with sealing rubber (2) and flange (3) upright.



M201139

4. Install the attachment bolts in the specified sequence and tighten them to the specified torque. See "Technical data".
5. Fill the engine with the correct amount of lubricating oil. See "Draining and Filling".
6. Run the engine briefly, and check that the oil sump does not leak. Then check the oil level.
7. Fit the under-engine noise encapsulation.



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4.4 REMOVAL AND INSTALLATION, LUBRICATING OIL PUMP

Removing the lubricating oil pump

1. Remove the fan.
2. Remove the poly-V-belt.
3. Remove the vibration damper and the crankshaft pulley.
4. Remove the front crankshaft seal.
5. Remove the front engine panel.
6. Remove the attachment bolts from the lubricating oil pump crosswise and remove it.

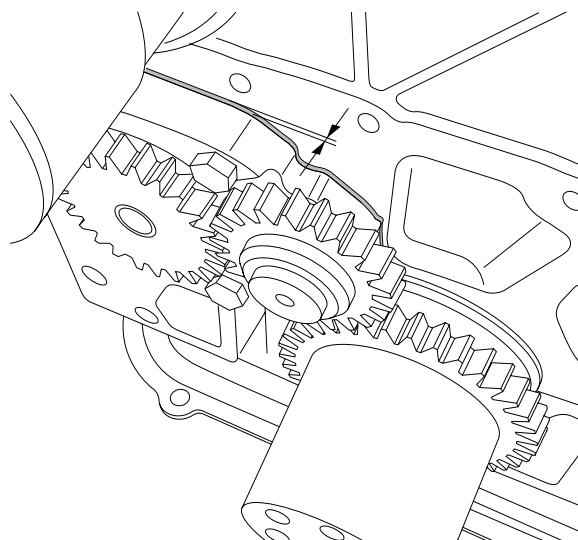
Installing the lubricating oil pump

1. Check the lubricating oil pump.
2. Fill the lubricating oil pump with engine oil and position the lubricating oil pump in the cylinder block.
3. Fit the attachment bolts and tighten them crosswise to the specified torque. See "Technical data".

Note:

The rear plate of the lubricating oil pump is at the back of the bore; if the lubricating oil pump is fitted correctly, the flange will not touch the cylinder block.

4. Fit the front engine panel.
5. Fit the front crankshaft seal.
6. Fit the crankshaft pulley and the vibration damper.
7. Fit the poly-V-belt.
8. Fit the fan.



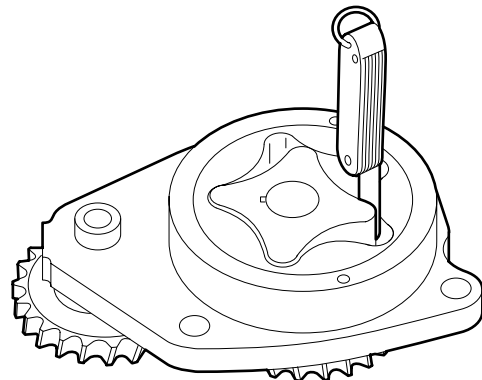
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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, LUBRICATING OIL PUMP

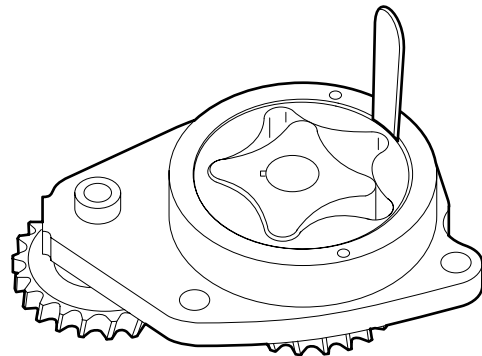
Disassembling the lubricating oil pump

1. Check the lubricating oil pump gears for damage and excessive wear.
2. Remove the rear plate from the lubricating oil pump.
3. Check the play between the inner and outer rotors using a feeler gauge. See "Technical data".



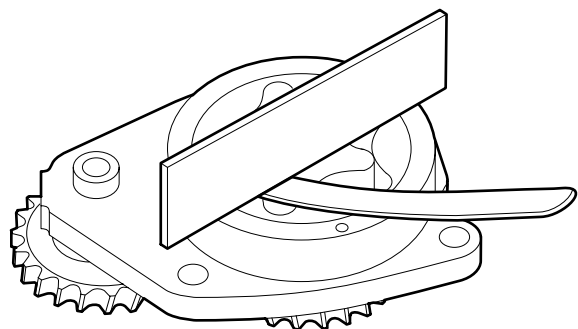
M201077

4. Check the play between the outer rotor and the lubricating oil pump housing using a feeler gauge. See "Technical data".



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5. Using a feeler gauge and a straight edge check the play between the inner and outer rotors in relation to the straight edge. See "technical data".
6. Check the gear backlash. See "Technical data".
7. Mark the top of the outer rotor and remove the outer rotor.
8. Check the inner rotor and outer rotor for damage and excessive wear.



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Assembling the lubricating oil pump

1. Fit the outer rotor with the marked side upwards.
2. Fit the rear plate.

6. DRAINING AND FILLING

6.1 DRAINING AND FILLING THE ENGINE OIL



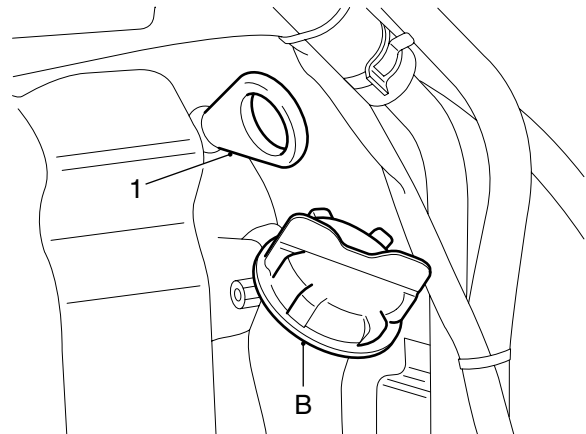
To prevent skin injury, avoid unnecessary contact with the drained oil.

Draining the engine oil

1. Ensure that the vehicle is standing on a flat and level surface.
2. Drain the engine oil at operating temperature using the drain plug in the oil sump.
3. Replace the drain plug sealing ring and tighten the drain plug to the specified torque; see "Technical data".

Filling the engine oil

1. Fill the engine through the oil filler pipe (B) with the specified quantity of engine oil; see "Technical data".
2. Check the engine oil level; see "Inspection and adjustment".



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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

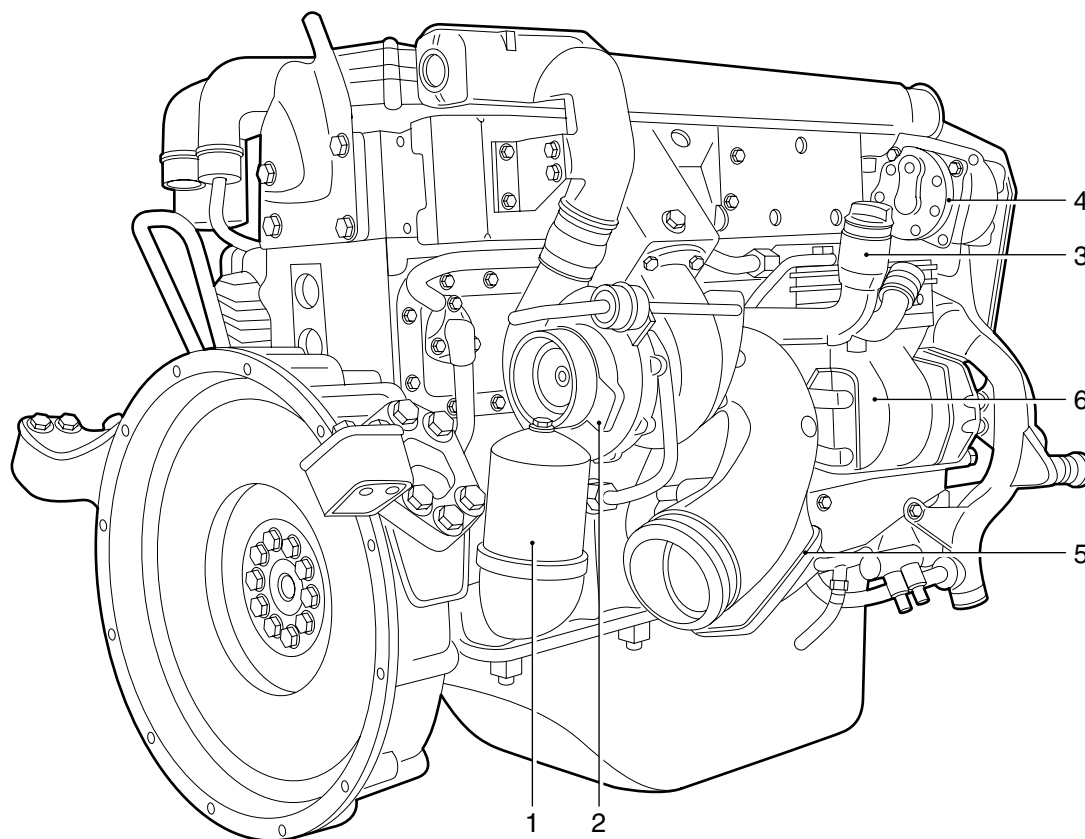
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

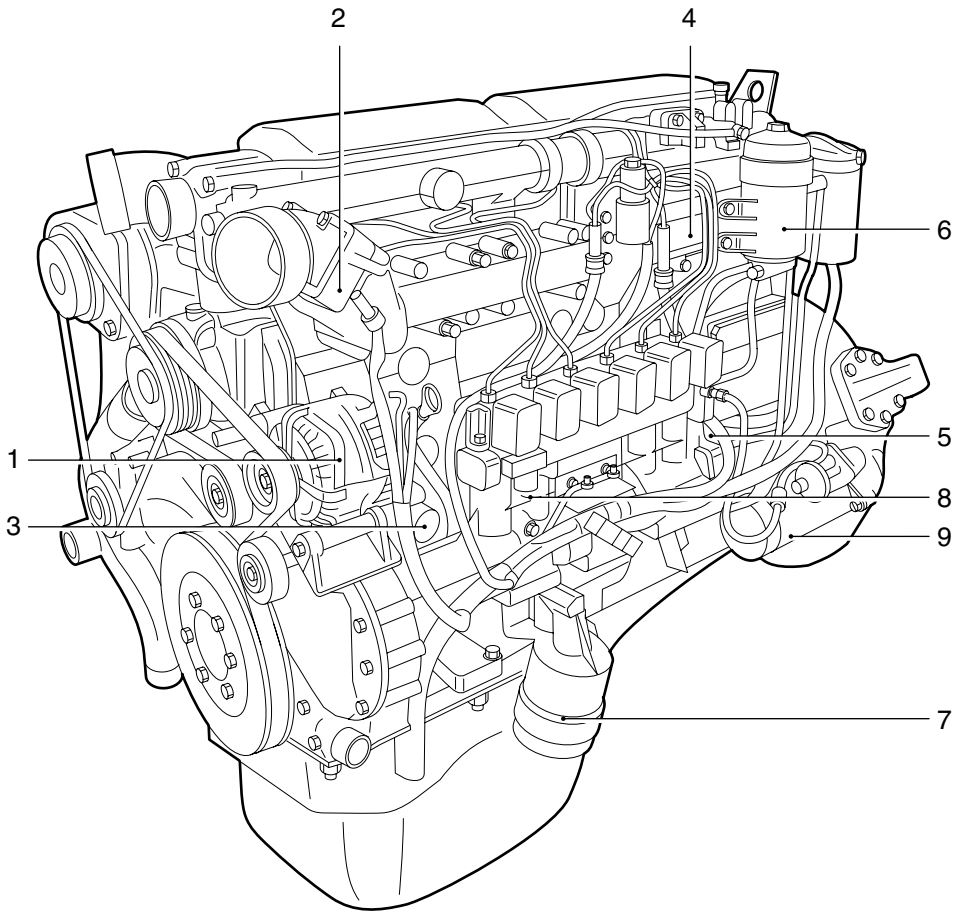
2.1 LOCATION OF COMPONENTS



Legend

1. Centrifugal oil filter
2. Turbocharger
3. Oil filler pipe
4. Air-conditioning compressor
5. Oil cooler
6. Air compressor

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5

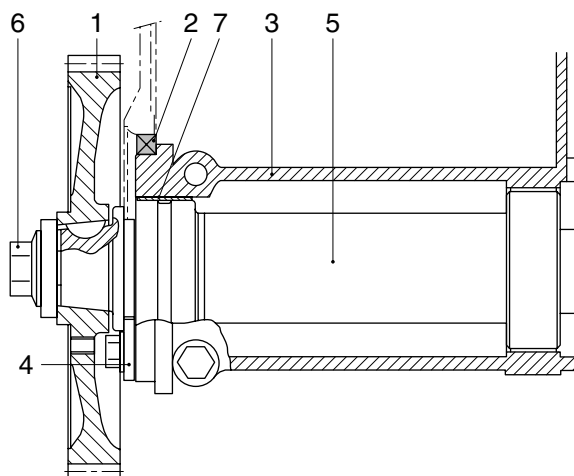
Legend

- 1. Alternator
- 2. Glow plug
- 3. Steering pump
- 4. Engine identification plate
- 5. Fuel lift pump/primer pump
- 6. Fuel filter
- 7. Oil filter
- 8. UPEC pump housing
- 9. Starter motor

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2.4 OVERVIEW DRAWING, PUMP HOUSING CAMSHAFT DRIVE

1. Pump housing camshaft gear
2. Timing case oil seal
3. Pump housing
4. Locking plate
5. Pump housing camshaft
6. Camshaft gear attachment bolt
7. Camshaft bearing bush



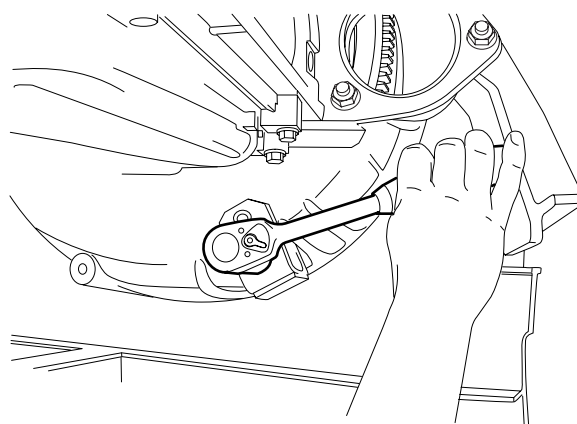
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5

2.5 CRANKING THE ENGINE

Cranking on the flywheel housing

1. Place the special tool (DAF no. 1310477) on the opening at the bottom of the flywheel housing such that the pinion engages the starter ring gear.
2. Turn the crankshaft clockwise as seen from the timing gear end (this corresponds to the direction of rotation of the engine).



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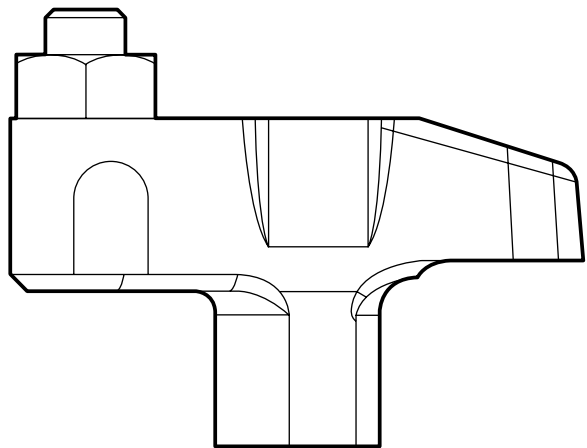
3. INSPECTION AND ADJUSTMENT

3.1 INSPECTION AND ADJUSTMENT, VALVE GEAR BRIDGES



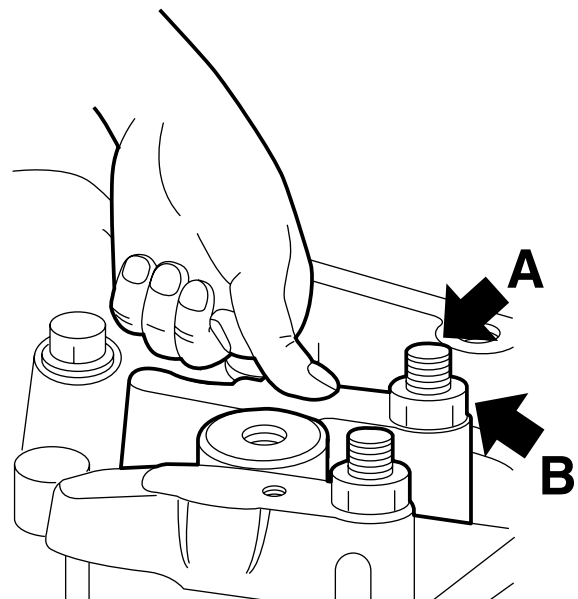
Loosening and tightening the lock nuts (B) of the bridges may cause severe engine damage if the bridge is fitted over the valves.

1. Remove the valve covers. See "Removal and installation".
2. Undo the adjusting nuts of the valve rockers in such a manner that there is no longer tension on the rockers.
3. Remove the lubricating oil strip.
4. Remove the entire rocker seat. Mark the position to enable reinstallation in the same position.
5. Remove the bridge from the valves and place it in a vice.
6. Slacken the lock nut (B).



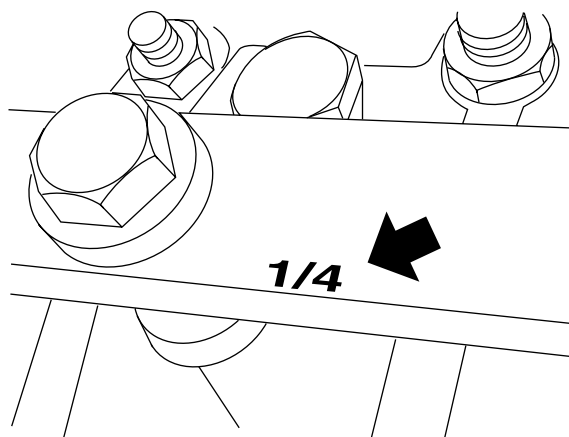
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7. Reposition the bridge in the same position in the engine over the valves.
8. Firmly press on the bridge centre (above the guide pin) with your thumb.
9. Hand-tighten the adjusting screw (A) until the bridge starts to move. The adjusting screw (A) 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 the lock nut (B) to the specified torque without turning the adjusting screw (A). See "Technical data".
12. Reposition the bridge over the valves.



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13. Fit the rocker seat.
14. Fit the lubricating oil strip in such a way that the mark "cyl. 1/4" is at the position of cylinder 1 and cylinder 4 respectively.
15. Adjust the valve clearance.
16. Fit the valve covers. See "Removal and installation".



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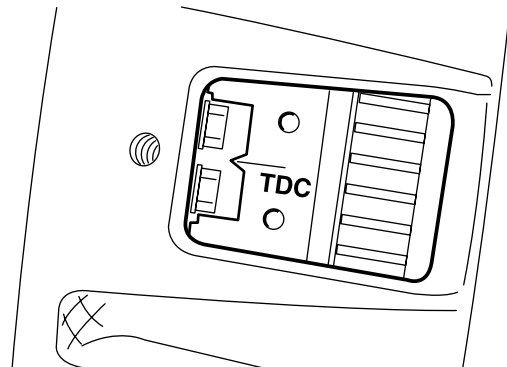
3.2 INSPECTION AND ADJUSTMENT, VALVE CLEARANCE

1. Remove the valve covers, see chapter "Removal and installation".
2. Use the special tool (DAF no. 1310477) to turn the crankshaft clockwise, as seen from the timing gear end (this corresponds with the engine's direction of rotation), until the valves of cylinder 1 are in overlap position. The pistons of cylinders 1 and 6 are now at top dead centre.

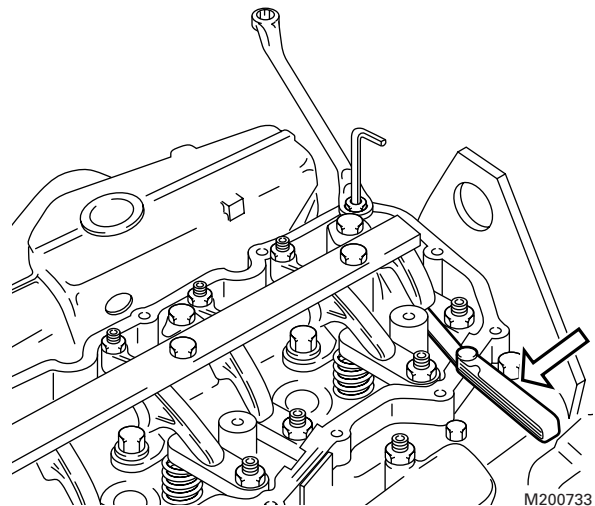
Note:

"Overlap" is the moment at which the inlet valve starts opening and the exhaust valve finishes closing.

3. Check/correct the valve clearance of cylinder 6. Set the correct valve clearance by loosening the lock nut and turning the adjusting screw in the correct direction. See main group "Technical data" for the correct valve clearance.



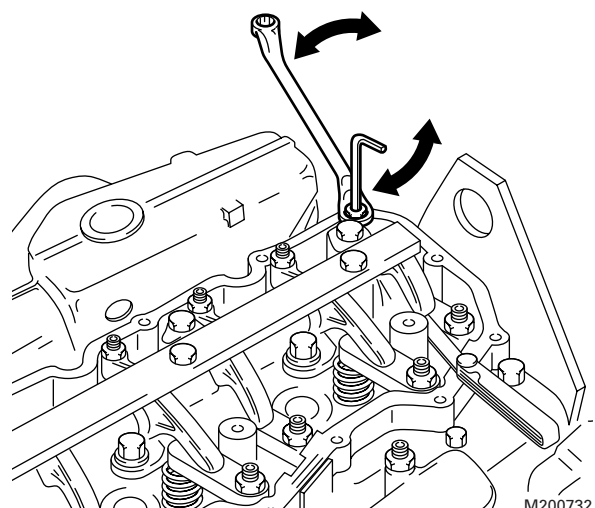
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M200733

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

Valves in overlap position of cylinder	Adjusting valves of cylinder
1	6
5	2
3	4
6	1
2	5
4	3



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5. Fit the valve covers, see chapter "Removal and installation".

3.3 INSPECTION AND ADJUSTMENT, TIMING GEAR

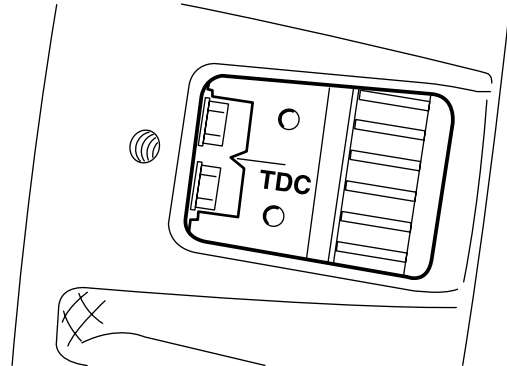
Checking the timing gear

1. Remove the valve cover from cylinders 1-2-3. See "Removal and Installation".
2. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
3. Remove the timing gear cover. See "Removal and installation".

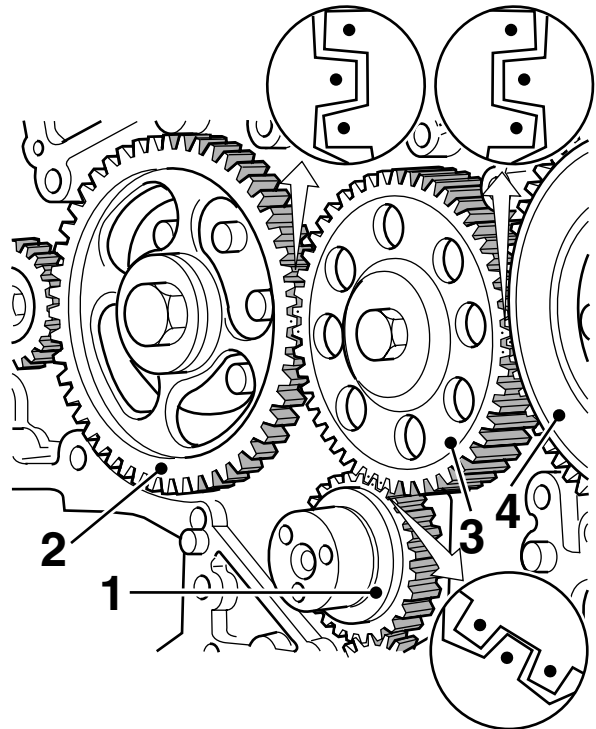
Note:

When the crankshaft (1) or the camshaft (2) of an engine is rotated separately without an idler gear (3), the engine's pistons may touch the valves.

4. Remove the idler gear (3). See "Removal and installation".
5. Now put the idler gear (3) back in such a way that the marks on it line up with the marks on the camshaft gear (2), the crankshaft gear (1) and the pump housing gear (4).
6. If the marks are not in line, the timing gear must be adjusted.
7. Tighten all attachment bolts that have been removed to the specified torque. See "Technical data".



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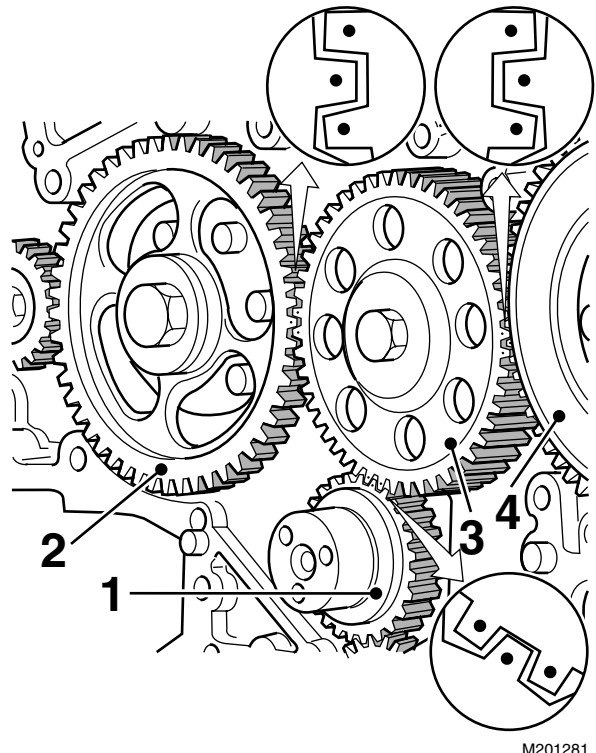
Adjusting the timing gear

1. Remove the valve cover from cylinders 1-2-3. See "Removal and Installation".
2. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
3. Remove the timing gear cover. See "Removal and installation".

Note:

When the crankshaft (1) or the camshaft (2) of an engine is rotated separately without an idler gear (3), the engine's pistons may touch the valves.

4. Remove the idler gear (3). See "Removal and installation".
5. Rotate the camshaft gear (2) to such a position that the idler gear (3) can be installed in accordance with the marks.
6. Fit the idler gear and tighten the attachment bolt to the specified torque. See "Technical data".
7. Fit the timing cover. See "Removal and installation".
8. Fit the valve cover. See "Removal and installation".

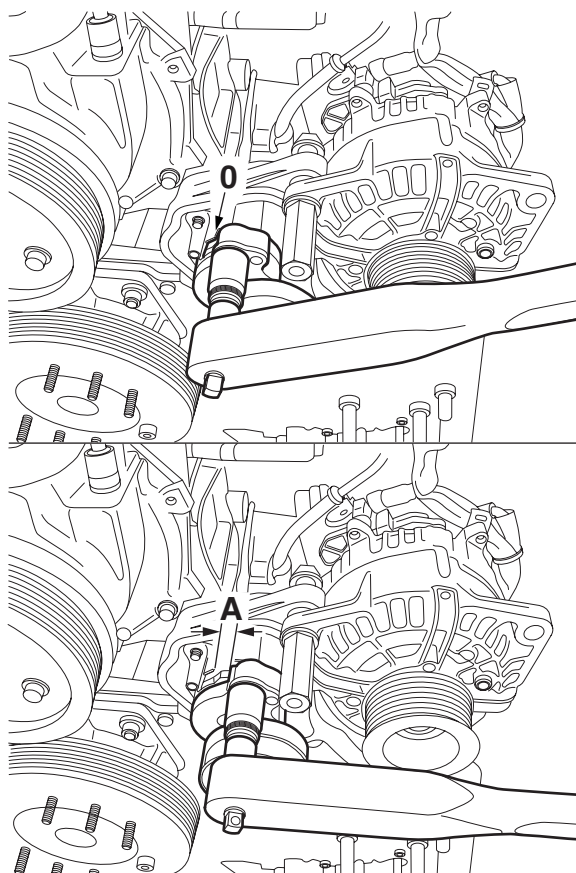


M201281

3.4 INSPECTION OF AUTOMATIC POLY-V-BELT TENSIONER

Inspection of automatic poly-V-belt tensioner

1. Remove the poly-V-belt and switch off the automatic tensioner (0). See "Removal and installation".
2. Place a torque wrench on the hexagonal head of the automatic tensioner.
3. At the specified torsional distance (A) the torsional moment must have a certain value. See "Technical data".
The automatic tensioner must be replaced if the measured value is not the same as the reference value.
4. Fit the poly-V-belt. See "Removal and installation".

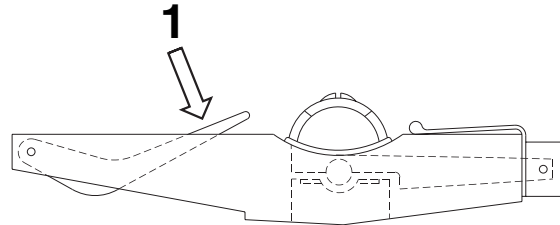


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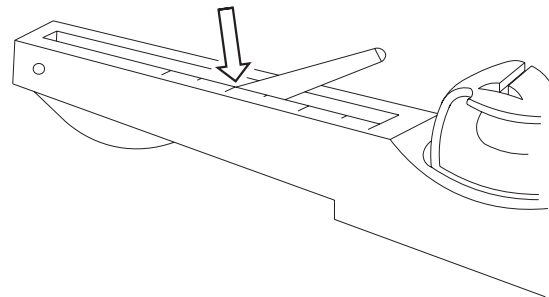
3.5 INSPECTION AND ADJUSTMENT, V-BELT TENSION

Inspecting the V-belt tension

1. Check the V-belt tension of the air conditioning-compressor drive with the Krikit I, special tool (DAF no. 1240442).
2. Set the gauge to zero by depressing the measuring arm (1).
3. Place the belt tension gauge on the V-belt, halfway between the two pulleys.
4. 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 not to let the measuring arm move.
5. Take the reading as indicated by the position of the measuring arm in relation to the scale. Compare this reading with the recommended pre-tension, see main group "Technical data".



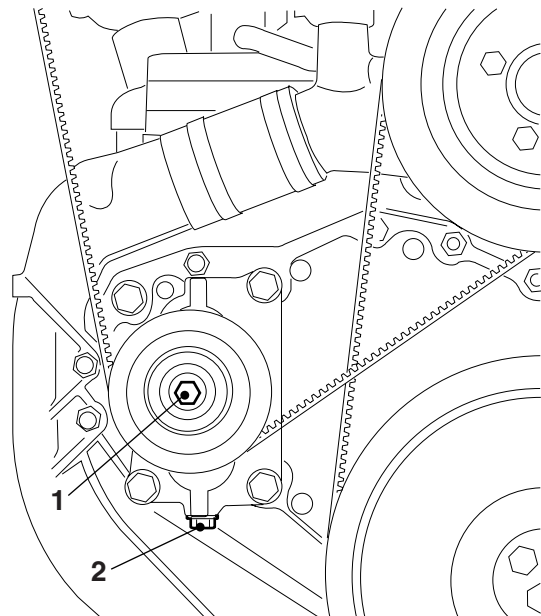
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Adjusting the V-belt tension of air conditioning compressor drive

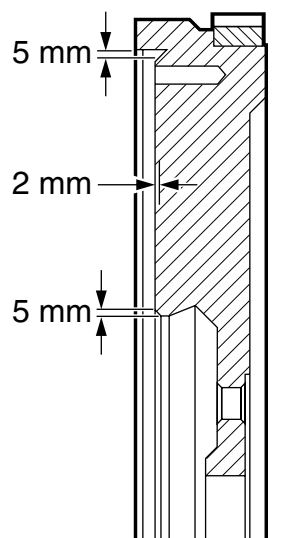
1. Slacken the central bolt (1) of the tensioning roller.
2. Turn the adjusting screw (2) until the V-belt tension is correct. See "Technical data".
3. Tighten the central bolt (1).



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3.6 INSPECTION, FLYWHEEL

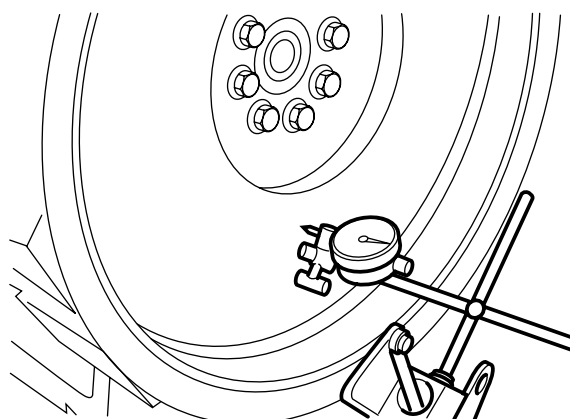
1. If the flywheel shows cracks on the abutting surface with the clutch plate, the flywheel may be ground down, provided that the cracks are not within 5 mm of the inner rim.
2. The flywheel has an indicator groove for inspection purposes.
3. Grinding down is allowed until the indicator groove is no longer visible. This means that a maximum of 2 mm may be ground down.



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Checking flywheel run-out

1. Clean the flywheel.
2. Place a metal strip on the edge of the flywheel housing to fit a dial gauge.
3. Place the dial gauge on the metal strip.
4. Place the stylus of the dial gauge at the specified distance. See "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 dial gauge reading. Compare this reading with the technical data. See "Technical data".



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3.7 INSPECTION, CYLINDER HEAD

1. Check the sealing plugs of the cylinder head for leaks. If necessary, pressure-test the cylinder head.
2. Inspect the cylinder head for damage to the sealing surface and any cracks. If necessary, have the cylinder head levelled. See "Technical data".

3.8 INSPECTION, ENGINE COMPRESSION PRESSURE



Be careful when working on an engine at operating temperature. Hot lubricating oil may escape from the engine when it is run without the valve covers. Make sure you are adequately protected.

A compression measurement is a quick check of the sealing of the valves and the head gasket, and of the sealing between the cylinder liner and the piston rings.

The results of the measurements can only be used to compare the cylinders with each other.

1. Bring the engine up to operating temperature.
2. Remove the engine management system supply fuse or supply relay, so that the pump units cannot be activated.
3. Remove the valve covers. See "Removal and installation".
4. Remove the injectors.
5. Turn the engine a number of times using the starter motor, so that any carbon or dirt particles in the cylinder are removed.
6. Fit 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 pressure differences permitted between individual cylinders see "Technical data".
8. Remove the dummy injector and fit the injectors.
9. Fit the valve covers. See "Removal and installation".
10. Fit the fuse or relay.

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENGINE



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

Various fluids will be released when fluid pipes are removed.

Collect these fluids. Personal safety and the risk of fire should always be considered.

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 most important points requiring attention.

- Disconnect the earth lead from the battery terminal.
- Avoid opening fluid systems as much as possible. If possible, remove and set 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 that are freed.
- Wiring harnesses are vulnerable. If damaged, they may cause failures. Make sure these wiring harnesses are stress-free and clear of moving parts.
- Fit all attachment bolts and tighten them to the correct torque.
- The engine should not be allowed to rest on the oil sump. Because the oil sump is made of sheet material, it will be severely damaged by the engine's weight.

4.2 REMOVAL AND INSTALLATION, ENGINE MOUNTS

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

Note:

If the engine is lifted slightly it is not necessary to disconnect coolant hoses, air inlet hoses and torque rods between the engine and the radiator.

Removing the engine mounts

1. Disconnect the earth lead from the battery terminal.
2. Suspend the engine securely in the hoist.
3. Remove the central engine mount fixing bolts at the front and/or rear of the engine.
4. Remove the engine mounts.

Installing the engine mounts

1. Fit the engine mounts.
2. Tighten the engine mount attachment bolts to the specified torque. See "Technical data".
3. Connect the battery earth lead.

4.3 REMOVAL AND INSTALLATION, VALVE COVER



When the engine or parts thereof are opened, dirt may penetrate. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the valve cover

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

Installing the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Fit the valve cover using a new valve cover gasket.
3. Fit the attachment bolts of the valve cover and tighten them to the specified torque. See the main group "Technical data".

4.4 REMOVAL AND INSTALLATION, VALVE GEAR

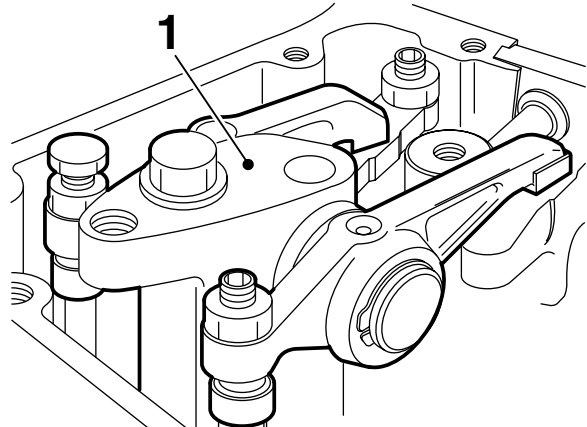
Removing the valve gear

1. Remove the valve covers.
2. Remove the lubricating oil strip.

Note:

Number the rocker seats (1) and the bridges (2-3-4) to allow reinstallation in the same position.

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



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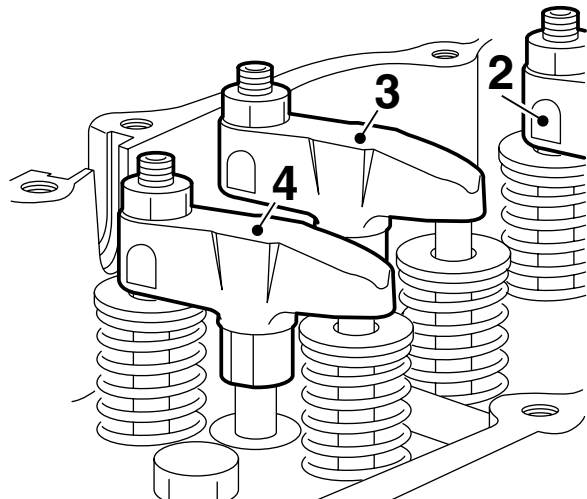
Installing the valve gear

1. Fit the bridges (2-3-4) on the valves.
2. Set the bridges (2-3-4). See "Inspection and adjustment".
3. Hand-tighten the rocker seats (1).

Note:

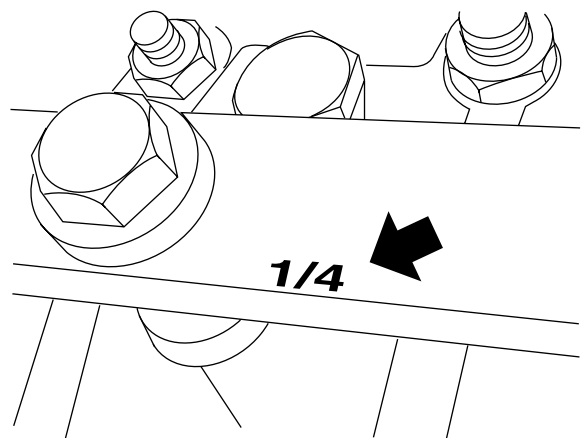
Depending on the engine position, some rocker seats (1) have to be positioned against the pressure of the valve springs. The rocker seat will resist this spring pressure and cannot therefore be positioned correctly.

By cranking the crankshaft always $\frac{1}{3}$ stroke, using the special tool (DAF no. 1310477), the rocker seats (1) can be tightened according to the injection sequence 1-5-3-6-2-4.



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4. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Fit the lubricating oil strip in such a way that the mark "cyl. 1/4" is at the position of cylinder 1 and cylinder 4 respectively. For the tightening torques of the attachment bolts, see "Technical data".
6. Adjust the valve clearance. See "Inspection and adjustment".
7. Fit the valve covers.



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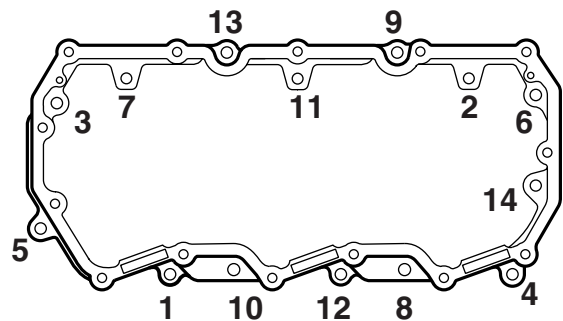
4.5 REMOVAL AND INSTALLATION, VALVE SLEEVE

Removing the valve sleeve

1. Remove the injection pipes in sets.
2. Remove the valve covers.
3. Remove the injectors.
4. Remove the valve gear.
5. Remove the push rods.
6. Remove the valve sleeve and gasket.

Installing the valve sleeve

1. Fit the valve sleeve with a new gasket and tighten the attachment bolts to the specified torque and in the correct sequence. See "Technical data".
2. Fit the push rods
3. Fit the injectors.
4. Fit the valve gear.
5. Fit the valve covers.
6. Fit the injector pipes in sets.



M200959

4.6 REMOVAL AND INSTALLATION, INLET MANIFOLD**Removing the inlet manifold**

1. Disconnect the electrical wiring on the inlet manifold.
2. Remove the fuel leak-off pipe between the fuel filter and inlet manifold.
3. Remove the coolant filter, if applicable.
4. Remove the entire fuel filter from the inlet manifold.
5. Disconnect the injector pipes.
6. Remove the attachment bolts from the inlet manifold and remove it.

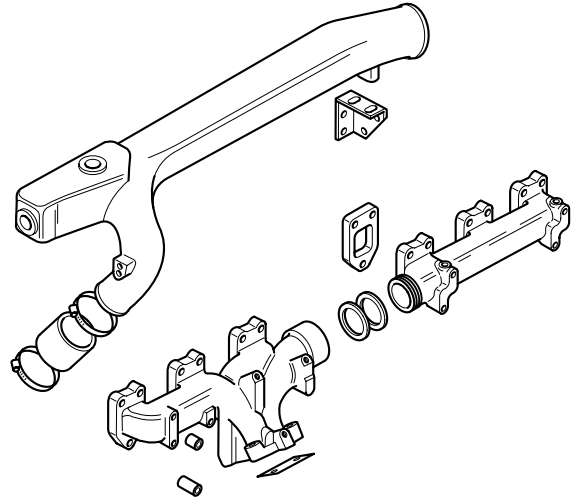
Installing the inlet manifold

1. Carefully clean the sealing surfaces of the inlet manifold and the cylinder head.
2. Fit new gaskets to the inlet manifold and fit the manifold. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the fuel leak-off pipe between the fuel filter and the inlet manifold.
4. Fit the injector pipes.
5. Fit the complete fuel filter.
6. Fit the coolant filter.
7. Connect the electrical wiring.

4.7 REMOVAL AND INSTALLATION, EXHAUST MANIFOLD

Removing the exhaust manifold

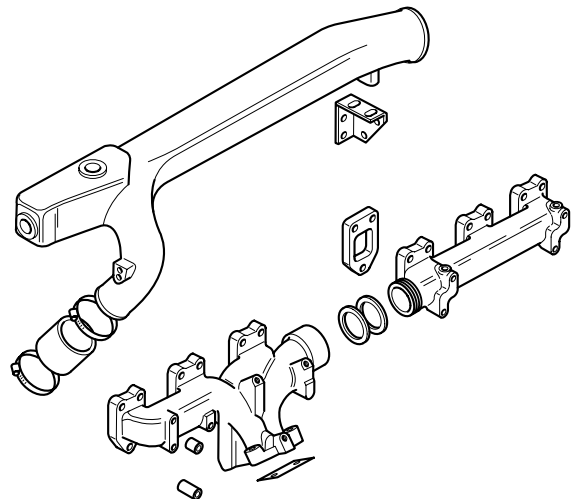
1. Remove the intake air pipe between the turbocharger and the air cooler.
2. Remove the compressor pipe.
3. Remove the turbocharger heat shields.
4. Remove the air inlet hose.
5. Remove the exhaust brake.
6. Remove the heat shields from the exhaust manifold.
7. Remove the oil supply and oil discharge pipes from the turbocharger.
8. Remove the attachment bolts from the exhaust manifold and remove it.



M200964

Installing the exhaust manifold

1. Fit new gaskets to the exhaust manifold and install the manifold. Fit the gasket with the steel side towards the manifold. Tighten the attachment bolts with the spacer sleeves to the specified torque. See "Technical data".
2. Fit the heat shields of the exhaust manifold and tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the oil discharge pipe for the turbocharger.
4. Spray clean engine oil into the oil supply of the turbocharger and fit the oil supply pipe.
5. Fit the compressor pipe.
6. Fit the inlet air pipe between the turbocharger and the air cooler.
7. Fit the exhaust brake.
8. Fit the air inlet hose.
9. Fit the heat shields for the turbocharger. Tighten the attachment bolts to the specified torque. See "Technical data".



M200964

4.8 REMOVAL AND INSTALLATION, CYLINDER HEAD



When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the cylinder heads

1. Disconnect any wiring around the engine which is relevant for the removal of the cylinder heads.
2. Disconnect the inlet pipe from the turbocharger to the air cooler.
3. Disconnect the compressor pipe from the air intake pipe to the compressor.
4. Slacken the tensioner of the air-conditioning compressor, if fitted.
5. Remove the attachment bolts of the air-conditioning compressor mounting bracket, if fitted.
6. Remove the heat shields from the exhaust manifold.
7. Remove the attachment bolts from the exhaust manifold and remove the manifold and the turbocharger from the cylinder heads.
8. Remove the coolant filter, if fitted.
9. Disconnect the fuel leak-off pipe between the fuel filter and the fuel leak-off pipe on the inlet manifold.
10. Disconnect the fuel filter assembly from the coolant pipe.
11. Disconnect both sets of injector pipes.
12. Remove the coolant pipe together with the thermostat housing.
13. Remove the inlet manifold attachment bolts and remove the entire manifold from the cylinder heads.
14. Remove the valve covers.
15. To remove the injectors and the clamping pieces, **only** use the special tool (DAF no. 1329412).

16. Remove the valve gear.
17. Remove the push rods.
18. Remove the valve sleeve.

Note:

Due to the sealant used on the cylinder head bolts, the untightening torque of the cylinder head bolts can be substantial!

19. Remove the cylinder head bolts in the **reverse** order to that shown.
20. Remove the cylinder heads from the cylinder block.
21. Remove any remnants of gasket from the cylinder heads and the cylinder block.
22. Check the sealing surfaces of the cylinder block.
23. Check the threaded holes in the cylinder block for damage and cracking.
24. Using the special tool (DAF no. 0694795), check that the amount the cylinder liner protrudes above the cylinder block is within tolerance. See "Technical data".
25. Check the cylinder head. See "Inspection and adjustment".

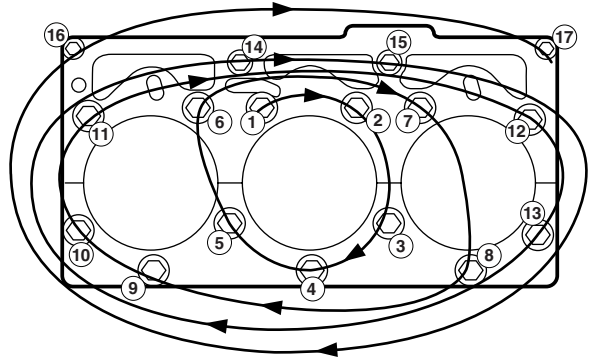
Installing the cylinder heads

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

Note:

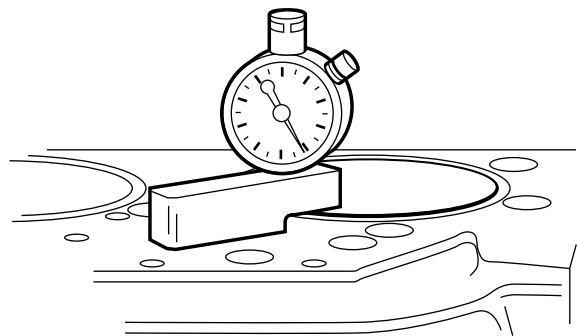
Threaded holes not properly cleaned may lead to too low a pre-tension of the cylinder head bolts, causing leakage.

2. Clean and degrease the sealing surfaces of the cylinder heads and the cylinder block.
3. Insert both guide pins (DAF no. 0694912) into the threaded holes of the cylinder block.



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4. Place the new gasket(s) on the cylinder block, making sure that the letters **TOP** (1) are visible. The cylinder head gasket must **not be retightened**.

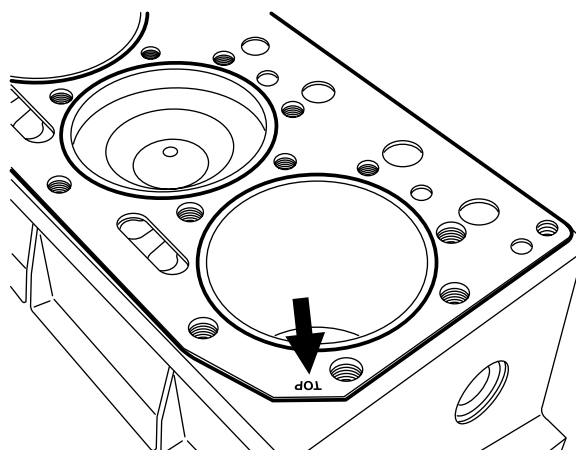
Note:

Always replace the cylinder head bolts. See "Technical data".

5. Place the cylinder head(s) on the cylinder block and hand-tighten a few new cylinder head bolts.

Note:

To prevent the inlet and exhaust manifolds from being installed under tension, they must be installed before the cylinder head bolts are tightened.



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6. Fit the inlet and exhaust manifolds with new gaskets and tighten the attachment bolts to the specified torque. See "Technical data".
7. Fit the remaining M16 and M12 bolts and apply a drop of oil to the bearing surface of the bolt heads.
8. Remove the two guide pins and replace them with the two remaining cylinder head bolts.
9. Tighten the cylinder head bolts to the specified torque and in the correct sequence. See "Technical data".
10. Fit the valve sleeve.
11. Fit the push rods
12. Fit the valve gear.
13. Fit the injectors.
14. Fit the valve covers.
15. Fit the coolant pipe, fit new gaskets to the thermostat housing and install the thermostat housing.
16. Fit the injector pipes in sets.
17. Fit the fuel filter onto the coolant pipe.
18. Fit the fuel leak-off pipe between the fuel filter and the inlet manifold.

19. If applicable, fit the coolant filter to the coolant pipe.
20. Fit the heat shields of the exhaust manifold and tighten the attachment bolts to the specified torque. See "Technical data".
21. If applicable, fit the air-conditioning bracket.
22. Adjust the V-belt tension of the air-conditioning compressor.
23. Connect the compressor pipe from the charge pipe to the compressor.
24. Connect the inlet pipe between the turbocharger and air cooler.

4.9 REMOVAL AND INSTALLATION, AIR COMPRESSOR

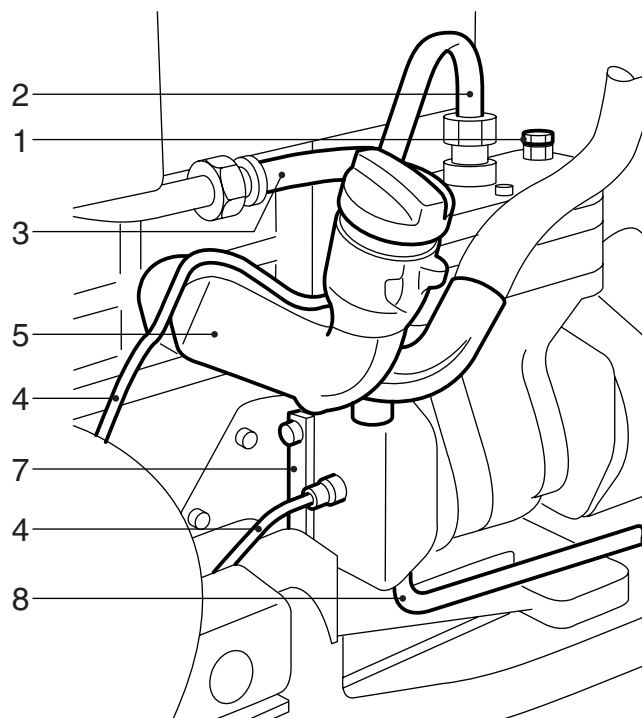
Removing the air compressor

1. Drain the coolant.
2. Remove the oil filler pipe (5).
3. Disconnect the service pipe from the air dryer (8).
4. Remove the coolant connections (1).
5. Disconnect the air pipes (2 and 3).
6. Disconnect the lubricating oil pipe (4).
7. Remove the mounting bracket at the back of the compressor (7).
8. Remove the attachment bolts from the timing cover.

Note:

If the vehicle is equipped with air-conditioning, the air-conditioning compressor V-belt must be disconnected to enable removal of the tensioner.

9. Remove the compressor from the timing case. Remove the O-ring from the compressor housing.



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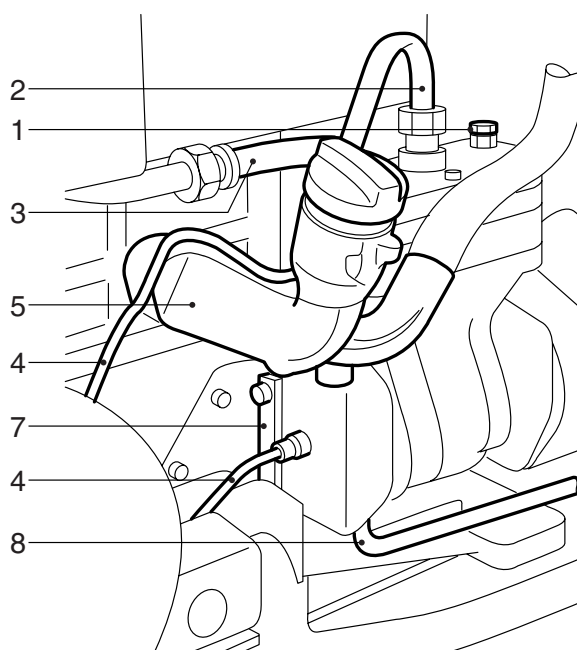
Installing the air compressor

1. Fit a new O-ring to the compressor housing and fit the compressor to the timing case.
2. Fit the air compressor attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".

Note:

If the vehicle is equipped with air-conditioning, the tensioner of the air-conditioning compressor must be fitted and the V-belt tension adjusted.

3. Fit the mounting bracket (7) at the back of the compressor. Tighten the attachment bolts to the specified torque. See "Technical data".
4. Fit the service pipe (8).
5. Fit the lubricating oil pipe.
6. Fit the air pipes (2 and 3).
7. Fit the coolant pipes (1).
8. Fill the cooling system.



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4.10 REMOVAL AND INSTALLATION, STEERING PUMP**Removing the steering pump**

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

Installing the steering pump

1. Fit a new O-ring.
2. Fit the steering pump and tighten the attachment bolts to the specified torque. See "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 "Technical data".
4. Fill the oil reservoir with the specified oil. See "Fluids and lubricants" specifications manual.
5. Bleed the steering system.
6. Check the pipes for leaks.

4.11 REMOVAL AND INSTALLATION, STARTER MOTOR

Removing the starter motor

1. Disconnect the earth lead from the battery terminal.
2. Disconnect the contacts of the starter motor.
3. Remove the noise insulation cover if fitted.
4. Remove the starter motor. Check the starter pinion for damage.

Installing the starter motor

1. Clean the contact surfaces of the starter motor and the flywheel housing.
2. Fit the starter motor and tighten the attachment nuts to the specified torque. See "Technical data".
3. Connect the starter motor.
4. Check the operation of the starter motor.
5. Fit the noise insulation cover.
6. Fit the earth cable.

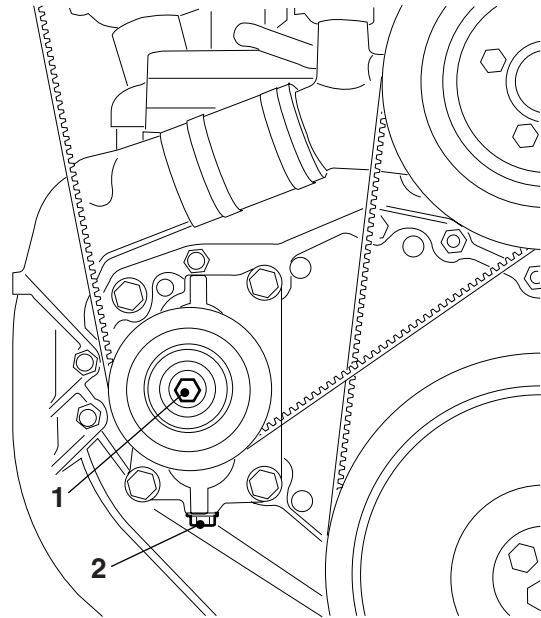
4.12 REMOVAL AND INSTALLATION, AIR-CONDITIONING COMPRESSOR V-BELT

Removing the air-conditioning compressor V-belt

1. Slacken the central bolt (1) of the tensioner.
2. Unscrew the adjusting bolt (2) until the V-belt can be removed from the pulley.

Fitting the air-conditioning compressor V-belt

1. Inspect the pulley discs for damage, rust and greasy deposits.
2. Fit the new air-conditioning compressor V-belt and adjust the V-belt tension. See "Inspection and adjustment".

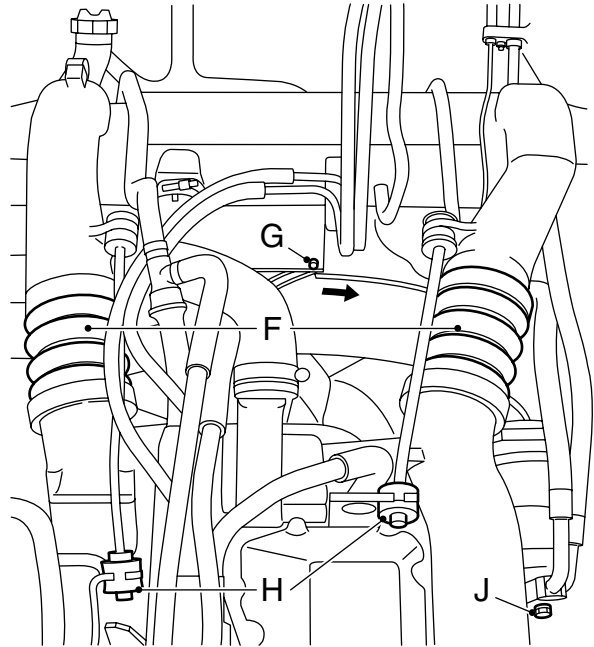


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4.13 REMOVAL AND INSTALLATION, POLY-V-BELT

Removing the poly-V-belt

1. Remove the locking screw from the wind tunnel collar (G) and turn the latter towards the radiator.
2. If fitted, remove the air-conditioning compressor V-belt.

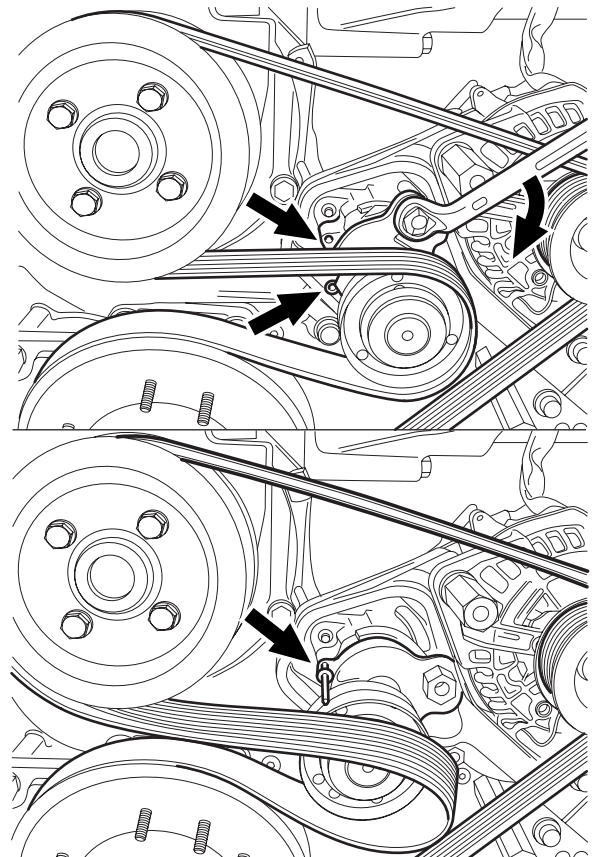


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3. Move the tensioner against the spring force and lock it with a 4 to 5 mm thick pin (bore).
4. Take the poly-V-belt off over the fan.
5. Inspect the automatic tensioner. See "Inspection and adjustment".

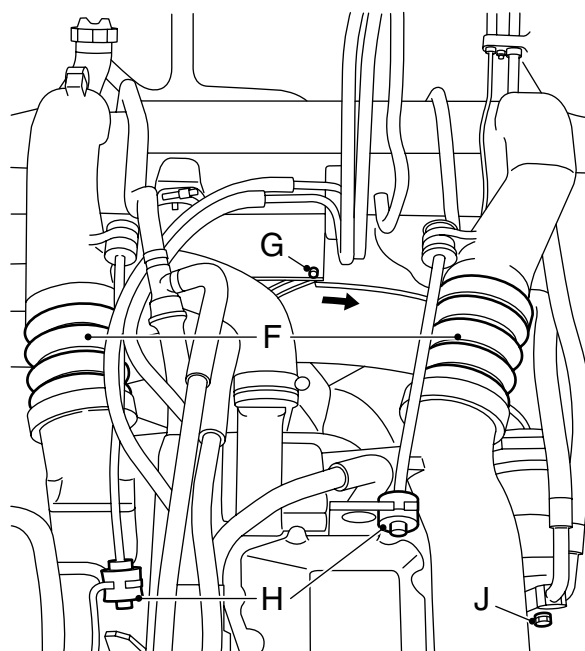
Installing the poly-V-belt

1. Inspect the belt pulleys for damage, rust and grease deposits.
2. Pull the poly-V-belt over the fan.
3. Move the tensioner against the spring tension so that the locking pin can be removed. Tension the tensioner against the belt.
4. Fit the new air-conditioning compressor V-belt and adjust the V-belt tension. See "Inspection and adjustment".



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- 5. Turn the wind tunnel collar towards the engine and fit the locking screw.



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4.14 REMOVAL AND INSTALLATION, ALTERNATOR

Removing the alternator

1. Disconnect the earth lead from the battery terminal.
2. Disconnect the electrical connections from the alternator.
3. Move the tensioner against the force of the spring and lock the tensioner. Remove the poly-V-belt from the alternator pulley.
4. Remove the attachment bolts from the alternator and remove it.
5. Dismount the alternator pulley and discard it if the alternator is to be replaced.

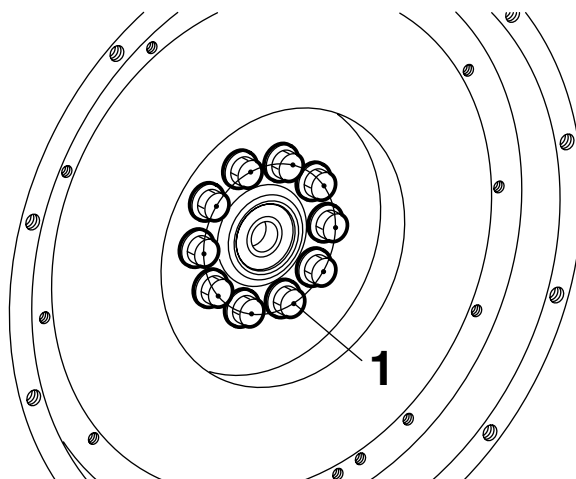
Installing the alternator

1. Fit the alternator pulley (if removed) and tighten the nut to the specified torque. See "Technical data".
2. Fit the alternator.
3. Fit the alternator attachment bolts.
4. Place the poly-V-belt over the alternator pulley. Move the tensioner against the force of the spring and remove the tensioner lock.
5. Fit the electrical connections of the alternator.
6. Fit the earth cable.

4.15 REMOVAL AND INSTALLATION, FLYWHEEL

Removing the flywheel

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

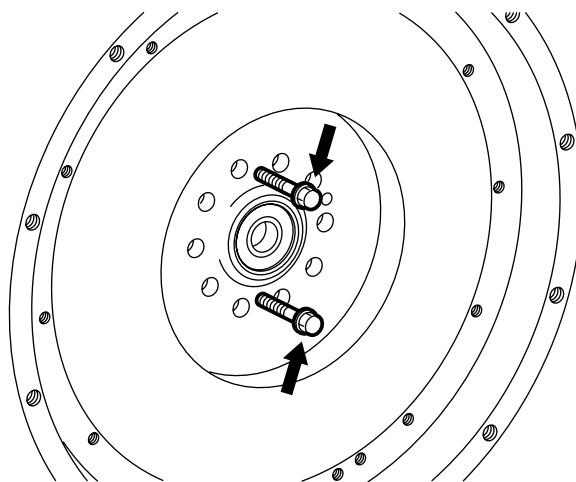


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4. Use two bolts to remove the flywheel from the dowel pin.
5. Remove the flywheel.

Installing the flywheel

1. Clean the flywheel housing.
2. Clean the crankshaft flange, the dowel pin and the attachment bolts. Remove the locking compound from the threaded holes.
3. Clean the back of the flywheel and fit it.
4. Fit the attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Fit the clutch plate and the clutch release assembly.
6. Fit the gearbox.



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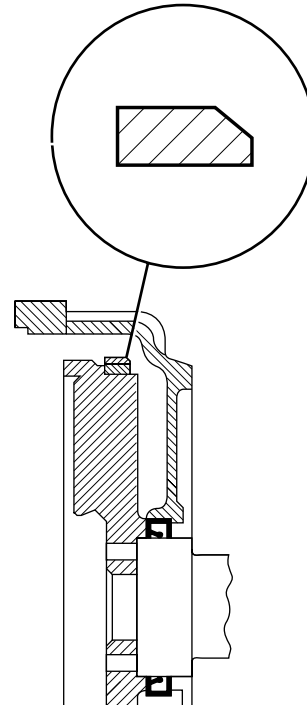
4.16 REMOVAL AND INSTALLATION, STARTER RING GEAR

Removing the starter ring gear

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

Installing the starter ring gear

1. Clean the flywheel and the starter ring gear. Ensure that the contact areas are free of grease.
2. Heat the new starter ring gear evenly in an oven. See "Technical data".
3. Tap the starter ring gear onto the flywheel so that the bevelled sides of the teeth point towards the starter motor. Ensure that the starter ring gear is properly fitted to the flywheel.
4. Fit the flywheel.



M2 00 035

4.17 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING SEAL

Note:

Each new seal is supplied with a plastic mounting ring, which can only be used **once**.

Removing the flywheel housing seal

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

Installing the flywheel housing seal

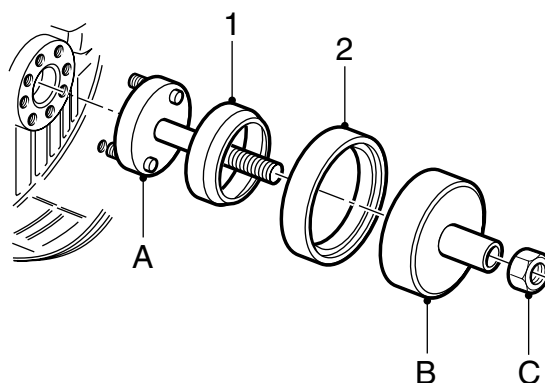
1. Thoroughly clean the oil seal recess and inspect for damage. Even the slightest damage can cause a leak.

2. Clean the crankshaft flange.

Note:

If a shim was fitted in the seal recess, it must be re-fitted.

3. Fit the plastic mounting ring (1), with the oil seal **dry**, to the crankshaft flange.
4. Press the oil seal as far as possible into the recess by hand and then carefully remove the plastic mounting ring (1).
5. Fit the base plate (A) of the special tool (DAF no. 1329402) on the crankshaft flange.
6. Place the thrust washer (B) over the base plate (A) and gradually tighten the nut (C) until the resistance increases.
7. Remove the nut (C) and thrust washer (B).
8. Make sure that the entire oil seal is positioned evenly in the chamber. If not, fit the thrust washer (B) again and tighten the oil seal a little further with the nut (C).
9. Remove the base plate (A).
10. Fit the flywheel and tighten the bolts to the specified torque. See "Technical data".



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4.18 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING

Removing the flywheel housing

1. Remove the flywheel.
2. Disconnect the earth lead from the flywheel housing.
3. Remove the starter motor.
4. Remove the crankshaft position sensor.
5. Suspend the engine securely in the hoist.
6. Remove the two bolts attaching the oil sump to the flywheel housing.
7. Slacken the other oil sump attachment bolts until the oil sump is free from the flywheel housing.
8. Remove the central engine mounting attachment bolts at the rear of the engine.
9. Remove the flywheel housing attachment bolts.
10. Remove the flywheel housing.

Installing the flywheel housing

1. Remove the oil seal from the flywheel housing by carefully tapping or pushing it out of the housing.
2. Remove any gasket remnants from the contact areas.
3. Check the sealing surfaces for damage.
4. Check the flywheel housing for cracks.
5. Apply a locking compound to the sealing surface of the cylinder block. See "Technical data". Spread the sealing compound with a roller or brush across the entire sealing surface.

6. Fit the flywheel housing. Tighten the attachment bolts to the specified torque. See "Technical data".
7. Fit the central engine mounting attachment bolts at the rear of the engine. Tighten the attachment bolts to the specified torque. See "Technical data".
8. Fit the oil seal.
9. Fit the flywheel.
10. Fit the starter motor.
11. Fit the crankshaft position sensor.
12. Clean the contact surface of the earth lead and connect it to the flywheel housing.
13. Fit the oil sump attachment bolts. Tighten all attachment bolts to the specified torque. See "Technical data".

4.19 REMOVAL AND INSTALLATION, VIBRATION DAMPER

Removing the vibration damper

1. Remove the poly-V-belt.
2. Remove the attachment nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
3. Remove the attachment bolts from the vibration damper.

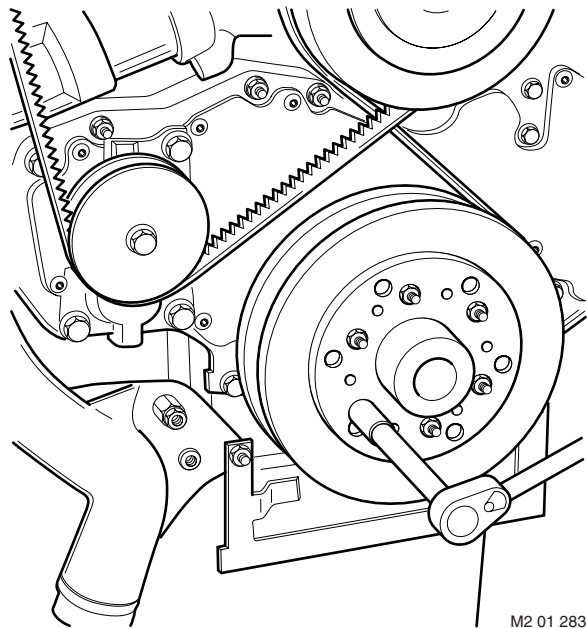
Note:

Using the special tool (DAF no. 1453155), the vibration damper can be removed in one movement along with the vibration damper hub. In that case, remove the 3 bolts and thrust washer from the vibration damper hub and fit the special tool (DAF no. 1453155) with the protruding part facing the engine.

4. Fit the special tool (DAF no. 1453155) with the protruding part facing the radiator; use the 6 attachment nuts of the fan hub.
5. Push the vibration damper off the hub by tightening the nuts evenly.

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. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the poly-V-belt.
4. Fit the viscous fan clutch with the fan.



M2 01 283

4.20 REMOVAL AND INSTALLATION, VIBRATION DAMPER HUB

Removing the vibration damper hub

1. Remove the vibration damper.
2. Remove the attachment bolts from the vibration damper hub and remove the thrust washer.

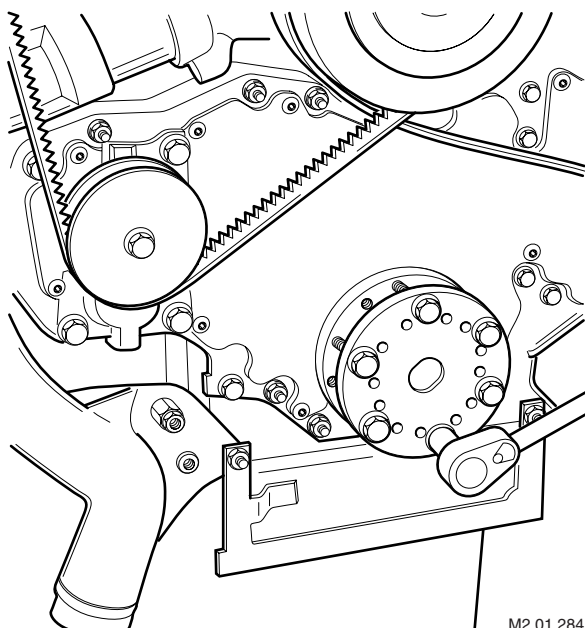


In most cases the vibration damper hub will suddenly break off from the crankshaft during removal. Avoid personal injury and damage to the hub.

3. Remove the vibration damper hub using the special tool (DAF no. 1453155).

Installing the vibration damper hub

1. Fit the vibration damper hub onto the crankshaft.
2. Fit the thrust piece. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Install the vibration damper. Fit the thrust piece. Tighten the attachment bolts to the specified torque. See "Technical data".



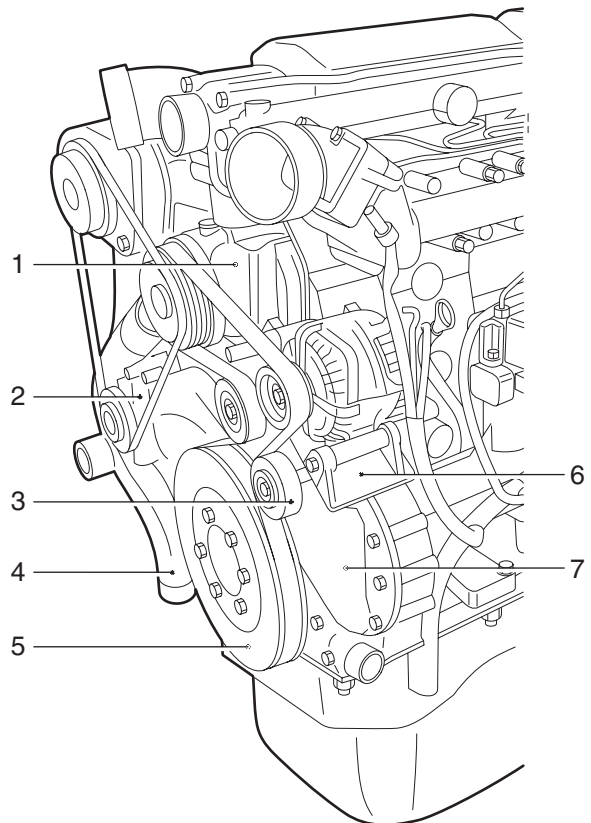
4.21 REMOVAL AND INSTALLATION, TIMING COVER



When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the timing cover

1. Drain the coolant.
2. Remove the air conditioning compressor V-belt and the tensioner (2), if fitted.
3. Remove the poly-V-belt.
4. Remove the electrical connections of the alternator and remove the alternator bracket (6) and alternator.
5. Remove the guide roller (3).
6. Remove the pulley (1) from the coolant pump.
7. Remove the vibration damper (5).
8. Remove the vibration damper hub using the special tool (DAF no. 1329472).
9. Loosen the coolant pipe (4) until it does not impede removal of the timing cover.
10. Mark the position of the various attachment bolts and studs.
11. Remove the attachment bolts from the timing cover (7) and remove the cover.
12. Remove any remnants of gasket. Clean and inspect the sealing surfaces, dowels and locating holes.
13. Remove the oil seal from the timing cover.



M2 01 282

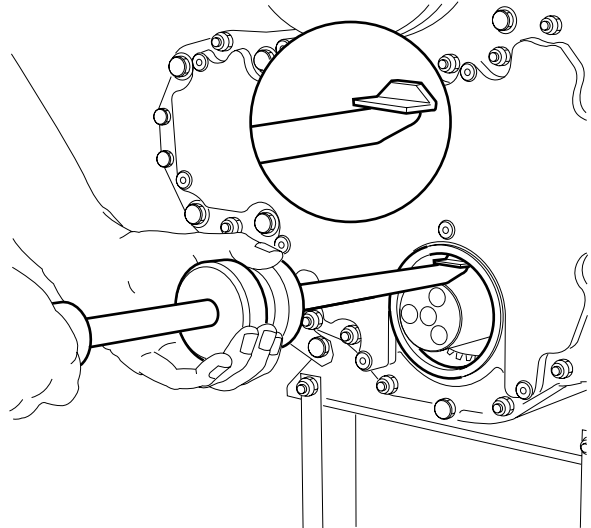
Installing the timing cover

1. Use three studs to position the gasket. Fit the new gasket.
2. Fit the timing cover (7).
3. Install the attachment bolts and tighten them to the specified torque. See "Technical data".
4. Remove the three studs used to position the gasket and replace them with the remaining attachment bolts.
5. Fit new O-rings to the coolant pipe (4) and fit it.
6. Fit the timing cover seal.
7. Fit the vibration damper hub.
8. Fit the vibration damper (5).
9. Fit the coolant pump pulley.
10. Fit the poly-V-belt.
11. Fit the tensioner (2) and the air conditioning compressor V-belt.
12. Fit the alternator bracket (6) and alternator and connect the electrical wiring to the alternator.

4.22 REMOVAL AND INSTALLATION, TIMING COVER SEAL

Removing the timing cover seal

1. Remove the poly-V-belt.
2. Remove the vibration damper.
3. Remove the vibration damper hub.
4. Remove the timing cover seal by using the special tool (DAF no. 1329458) to pull the seal out of the cover.



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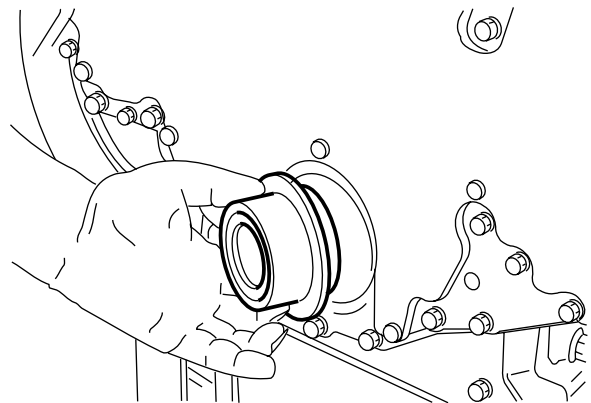
Installing the timing cover seal

1. Clean and check the seal recess in the timing cover. Even minimal damage may cause a leak.

Note:

If a shim was fitted in the seal recess, it must be re-fitted.

2. Use the special tool (DAF no. 1329446) to install the **dry** sealing ring and the thrust piece in the recess of the timing cover.
3. Remove the special tool.
4. Fit the vibration damper hub.
5. Install the vibration damper.
6. Fit the poly-V-belt.



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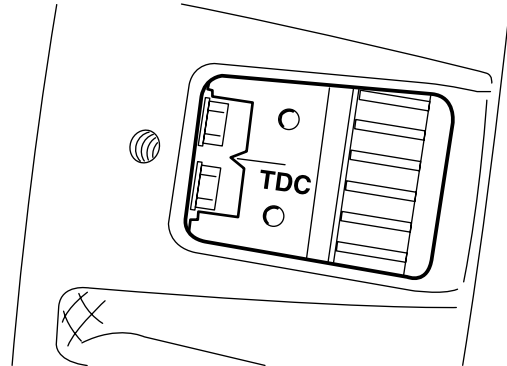
4.23 REMOVAL AND INSTALLATION, TIMING GEARS

Removing the timing gear

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

Note:

It is possible that the marks on the idler gear are **not** exactly opposite the camshaft and crankshaft gear wheel.



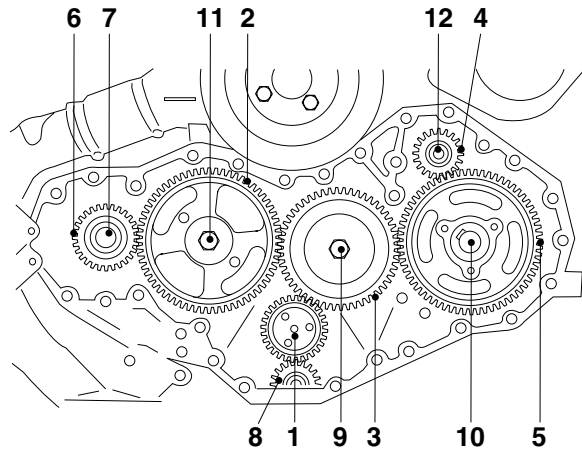
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Removing the idler gear

1. Remove the attachment bolt (9) and the axial thrust washer.
2. Remove the idler gear (3).

Removing the pump housing camshaft gear

1. Remove the attachment bolt (10) of the pump housing camshaft gear (5).
2. Remove the attachment bolt (9) and the axial thrust washer from the idler gear (3).
3. Remove the idler gear.
4. Remove the pump housing camshaft gear using a commercially available puller.



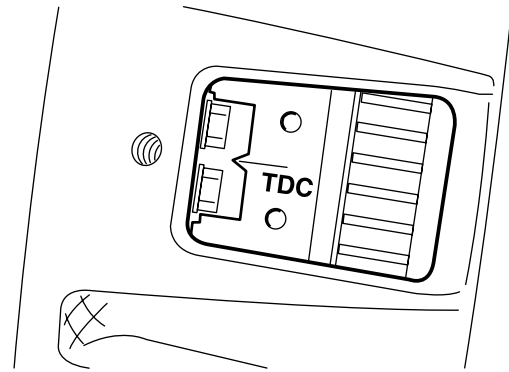
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Removing the camshaft gear

1. Remove the attachment bolt (11) of the camshaft gear (2).
2. Remove the attachment bolt (9) and the axial thrust washer from the idler gear (3).
3. Remove the idler gear.
4. Remove the camshaft gear using a commercially available puller.

Installing the timing gears

1. Check whether cylinder 1 is at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).

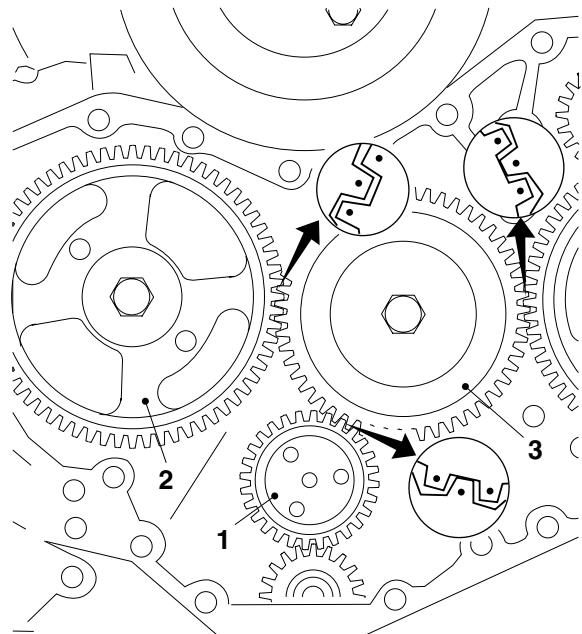


M201185

Note:

When the crankshaft (1) or the camshaft (2) of an engine without an idler gear (3) is rotated separately, the engine's pistons may touch the valves.

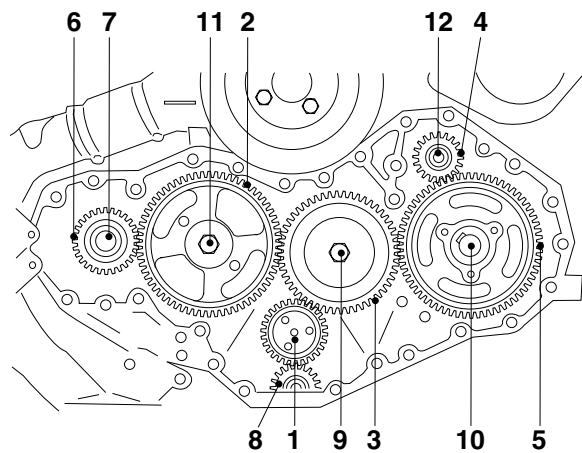
2. When fitting the gears, make sure that the marks are correctly positioned.



M200884

Installing the camshaft gear

1. Fit the camshaft gear (2) onto the camshaft.
2. Fit the camshaft gear wheel attachment bolt (11). Tighten the attachment bolt to the specified torque. See "Technical data".
3. Install the idler gear (3).
4. Fit the attachment bolt and axial thrust washer (9) of the idler gear and tighten the attachment bolt to the specified torque. See "Technical data".
5. Check that the backlash specified for the gears is not exceeded. See "Technical data".



M201171

Installing the pump housing camshaft gear

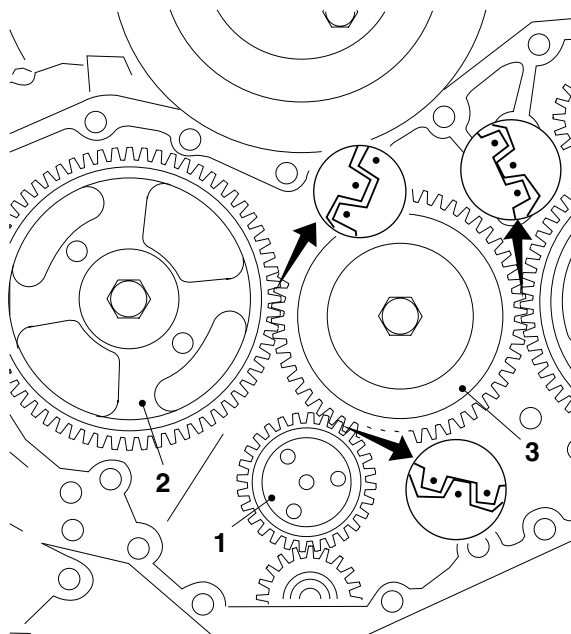
1. Fit the pump housing camshaft gear (5) to the shaft journal.
2. Fit the pump housing camshaft gear attachment bolt (10). Tighten the attachment bolt to the specified torque. See "Technical data".
3. Install the idler gear (3).
4. Fit the attachment bolt and axial thrust washer (9) of the idler gear and tighten the attachment bolt to the specified torque. See "Technical data".
5. Check that the backlash specified for the gears is not exceeded. See "Technical data".

Installing the idler gear

1. Fit the idler gear (3) so that the mark on the idler gear (3) is opposite the marks on the camshaft gear (2) and the crankshaft gear (1).
2. Fit the attachment bolt and axial thrust plate of the idler gear. Tighten the attachment bolt to the specified torque. See "Technical data".
3. Check that the backlash specified for the gears is not exceeded, see "Technical data".

Installing the timing gear

1. Fit the timing cover.
2. Fit the valve covers.

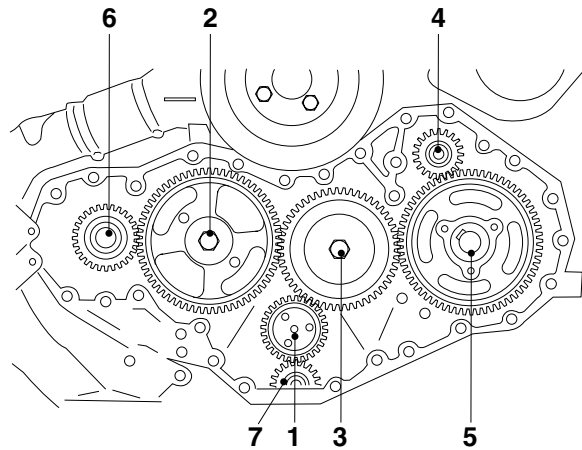


M200884

4.24 REMOVAL AND INSTALLATION, TIMING CASE

Removing the timing case

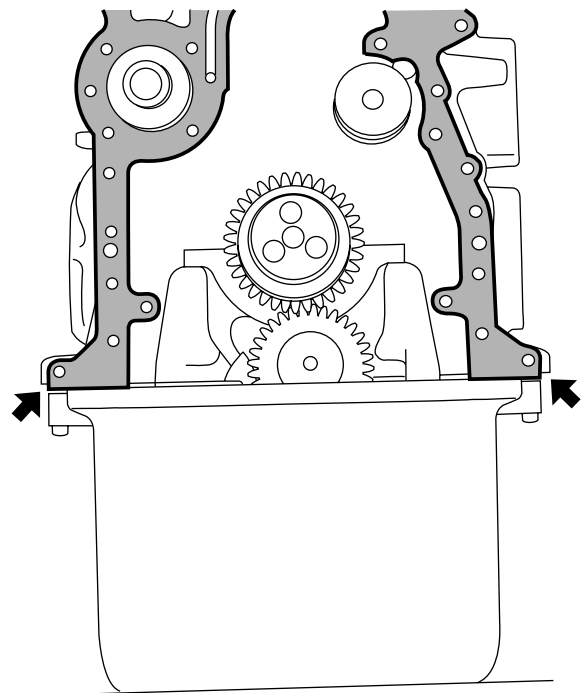
1. Remove the timing cover.
2. Remove the timing gears.
3. Remove the air compressor.
4. Remove the steering pump.
5. Remove the camshaft attachment bolts and locking plate.



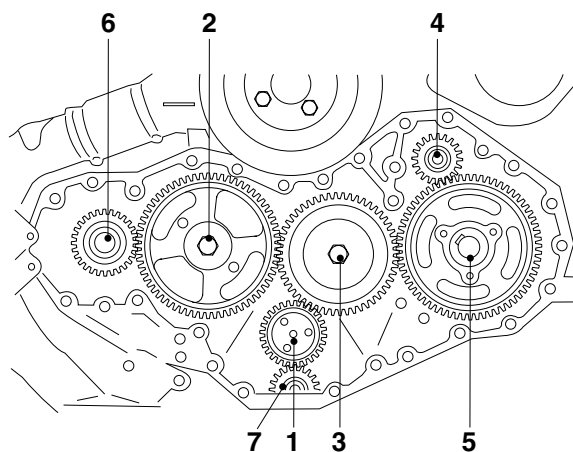
6. Loosen the oil sump attachment bolts until the oil sump is free from the timing case.
7. Remove the bolts attaching the timing case to the cylinder block, and remove the timing case.

Installing the timing case

1. Remove any remnants of gasket. Clean and inspect the sealing surfaces, dowels and locating holes.
2. To position the gasket, insert three studs and fit the new gasket.
3. Then remove any gasket remains between the cylinder block and oil sump.
4. Fit the timing case.
5. Fit the timing case attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
6. Tighten the oil sump attachment bolts to the specified torque. See "Technical data".
7. Fit the camshaft locking plate and attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".



8. Fit the timing gears.
9. Fit a new O-ring to the air compressor and install the compressor.
10. Fit the steering pump.
11. Fit the timing cover.

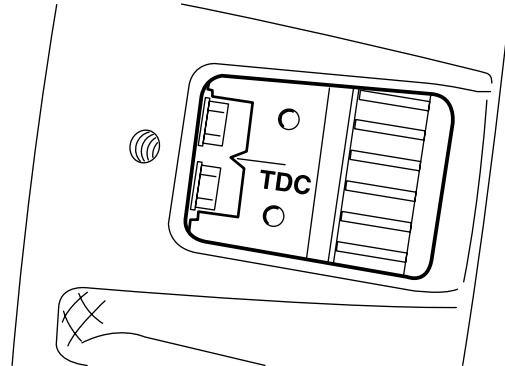


M200744

4.25 REMOVAL AND INSTALLATION, TIMING CASE OIL SEAL

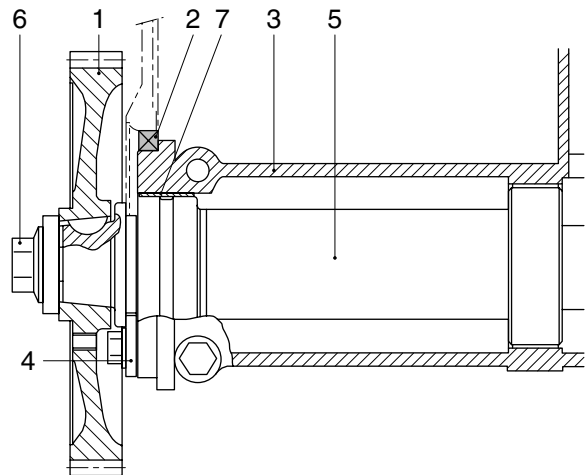
Removing the timing case oil seal

1. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
2. Remove the idler gear.



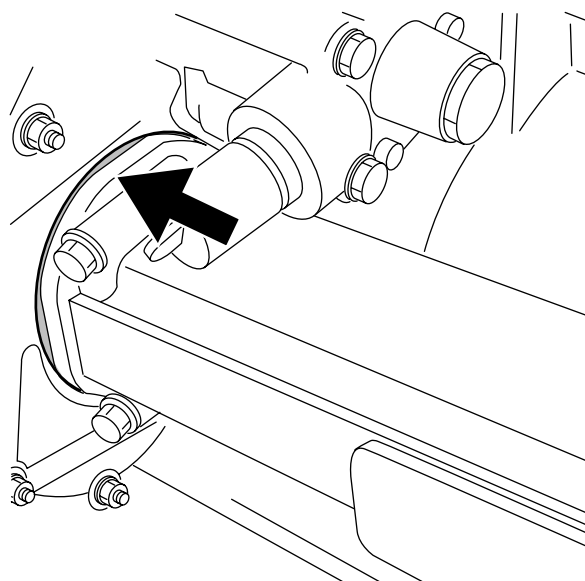
M201185

3. Remove the pump housing camshaft gear (1).



M200887

4. Remove the oil seal (2) by tapping it from the timing case in the driving direction.



M200728

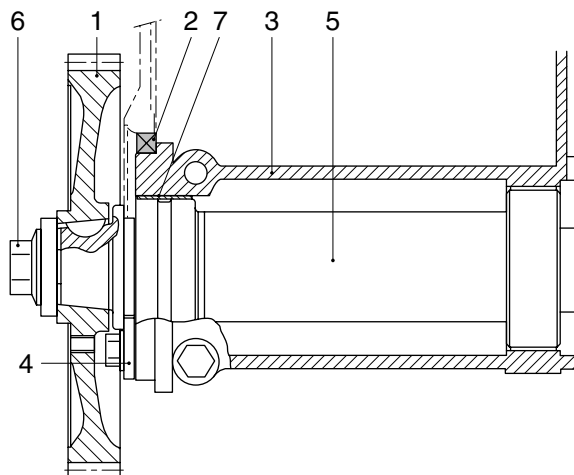
Installing the timing case oil seal

1. Fit a **dry** new timing case oil seal (2) using the special tool (DAF no. 1329318).
2. Fit the pump housing camshaft gear (1).
3. Fit the idler gear.

Note:

Remember the marks.

4. Fit the timing cover.



M200887

5. CLEANING

5.1 CLEANING THE ENGINE

Note:

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

Before cleaning the engine, check for any leaks.

If the engine is cleaned with a high-pressure cleaner, the high-pressure cleaner 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.
- There is an air bleed vent on the power steering fluid reservoir of the steering gear. Water may enter the reservoir through this air bleed vent, causing damage to the steering gear.
- When cleaning the radiator/air cooler element, be careful not to damage the fins.
- Do not direct the high-pressure cleaner jet too long at the air-conditioning system condenser. As a result of the high temperature, the pressure in the system will become excessive, which may cause damage to the system.
- Ensure that no water can enter the gearbox via the air bleed vents.
- Make sure that no water can enter via the clutch reservoir bleed vents.
- The engine compartment can be cleaned with a high-pressure cleaner. Never direct the jet of water towards electrical components.
- When cleaning UPEC engines with a high-pressure cleaner, do not aim the jet directly at the pump units. Water could penetrate into the protective covers via the bleed holes. This could result in failures in the electrical connections of the pump units.
- Do not direct the jet of water at electrical connections such as connectors or lead-throughs of the vehicle lighting system.
- Ensure that no water can enter the air intake system via the air intake or its flexible seals.

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

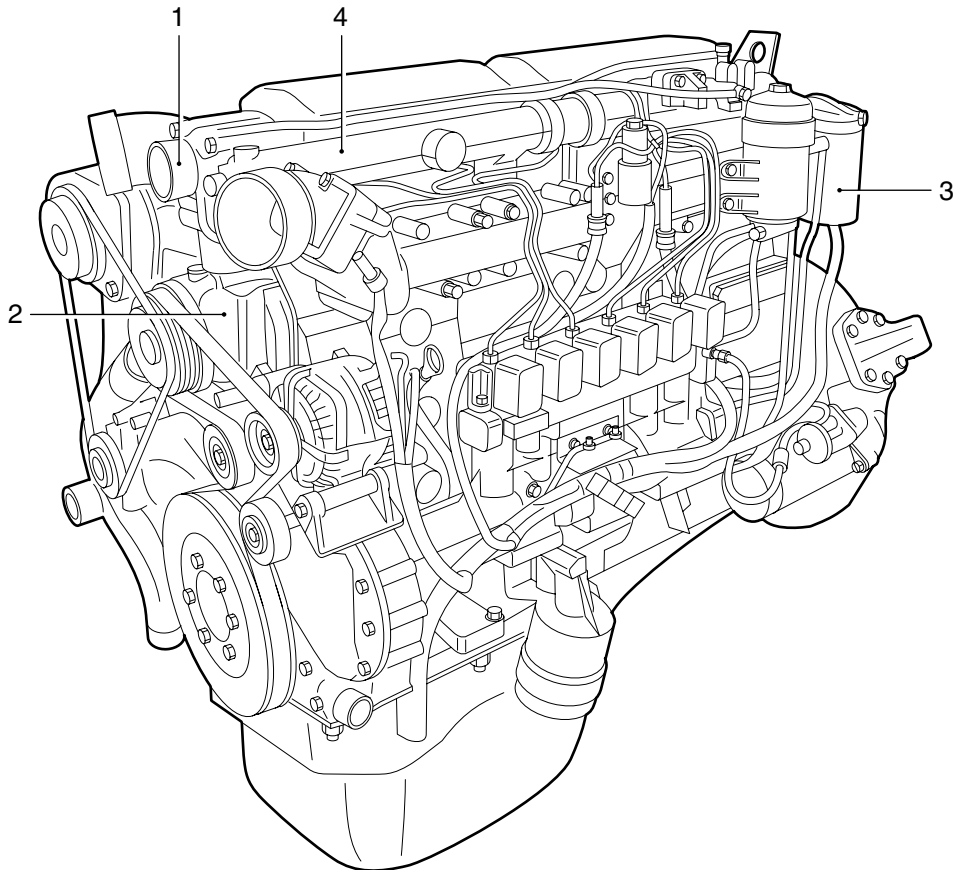
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

2.1 LOCATION OF COMPONENTS

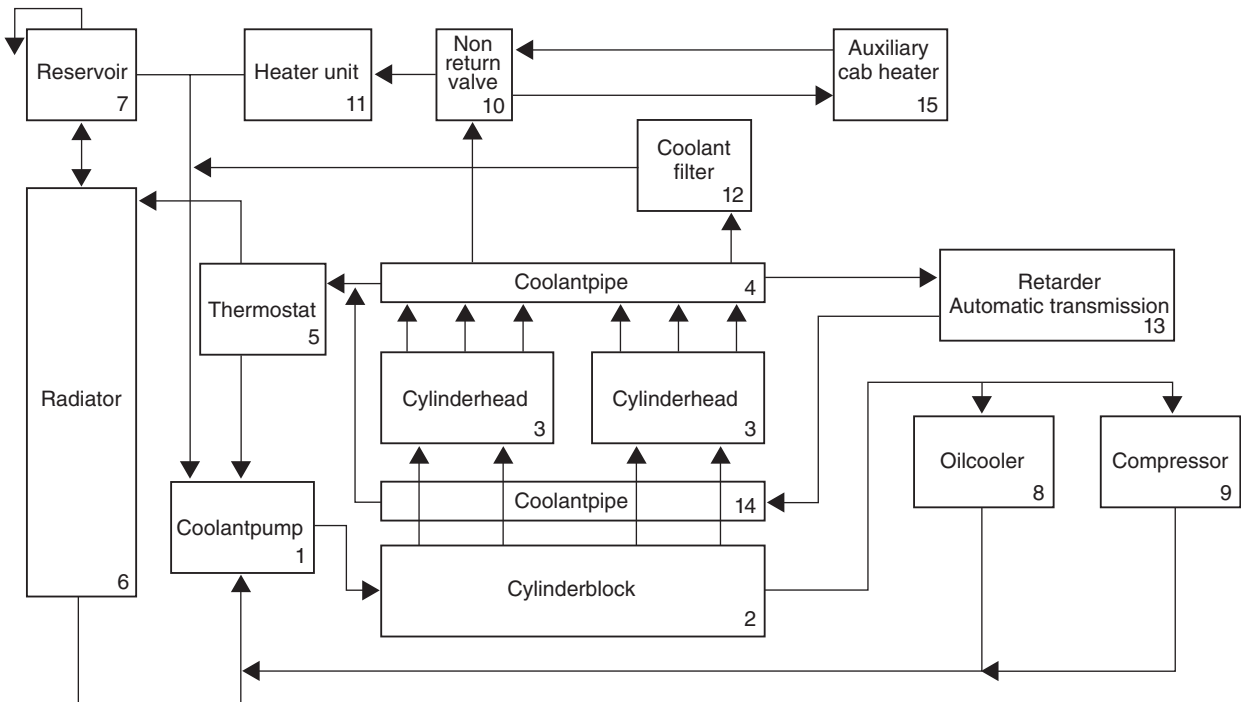


Legend

1. Thermostat housing
2. Coolant pump
3. Coolant filter
4. Coolant pipe

M201118

2.2 SYSTEM DESCRIPTION, COOLING SYSTEM



M201279

From the delivery side of the water pump (1), the coolant is directed to the cylinder block (2) via an opening at the back of the coolant pump. The coolant flows through the cylinder block up to the cylinder heads (3).

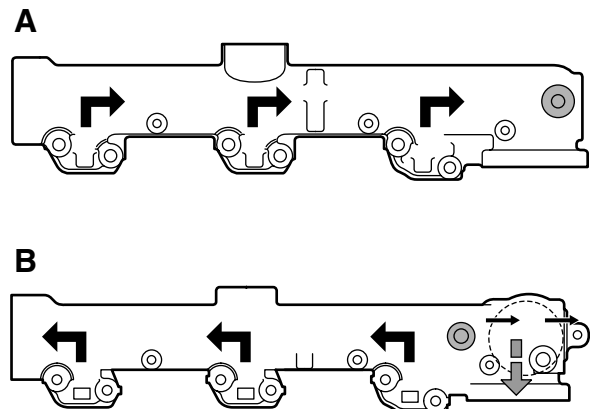
The coolant leaves the cylinder heads through the coolant collector pipe (4) (A), which takes it to the thermostat housing (5).

If an interarder (13) or automatic gearbox (13) is fitted, the coolant leaving the cylinder heads flows via the coolant collector pipe (4) (B) to the interarder or the automatic gearbox.

From the interarder or automatic gearbox, the coolant then flows via the coolant collector pipe (B) to the thermostat housing (5).

Depending on the coolant temperature, the thermostat distributes the coolant flow to the radiator (6) or back to the coolant pump (1). 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 coolant pump, via the coolant return pipe.



M201038

6

The header tank (7) has four connections. On the top of the radiator, there is a bleed pipe which is linked to connection 3 of the header tank.

Connections 1 and 2 of the header tank are linked to the coolant collector pipe by bleed pipes. If no interarder or automatic gearbox is fitted, one of the connections will be sealed.

Connection 4 enables siphoning of the coolant between the header tank and the engine when the coolant temperature increases.

Connection 4 is linked together with the heater return pipe to the coolant return pipe leading to the coolant pump.

From the cylinder block, some of the coolant flows through the oil cooler (8). From the oil cooler, the coolant returns to the coolant pump through a pipe via the coolant return pipe.

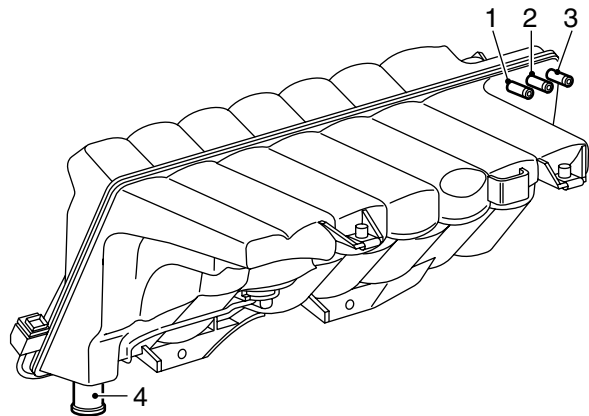
From the cylinder block, some of the coolant flows through the air compressor (9). From the air compressor, the coolant returns to the coolant pump via a pipe.

From the coolant collector pipe, a pipe runs to the cab heater (11). The heater return pipe is linked together with the header tank pipe to the coolant return pipe leading to the coolant pump.

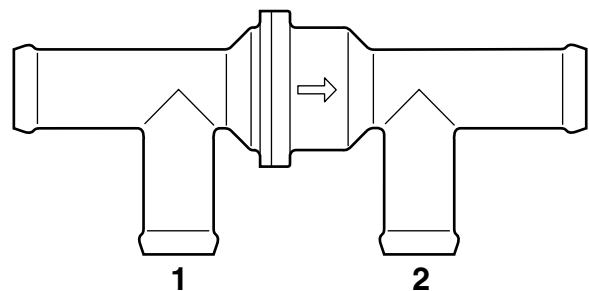
If a cab heater (15) is fitted, a non-return valve (10) is fitted in the heater supply pipe. It has two connections. Connection (1) is for the cab heater supply pipe. Connection (2) is for the cab heater discharge pipe.

Note:

Fit the non-return valve with the arrow pointing in the flow direction of the coolant.



M201034



M201035

3. DESCRIPTION OF COMPONENTS

3.1 PRESSURE CAP

The pressure cap is fitted to the header tank by means of a threaded connection.

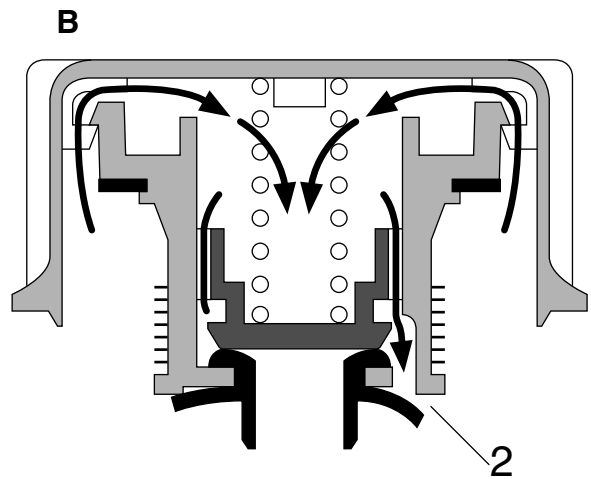
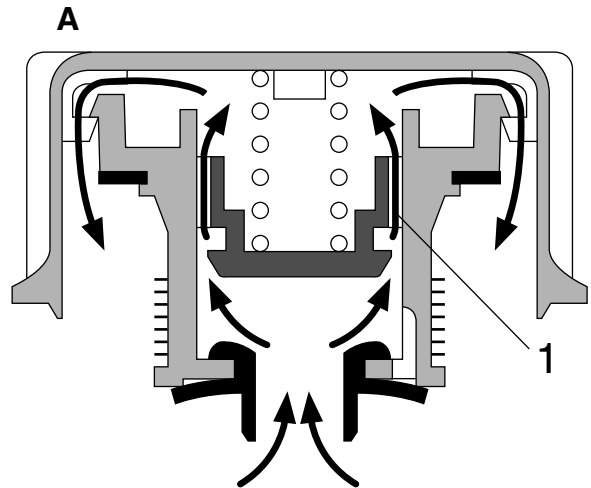
The pressure cap has two valves: a pressure relief valve (1) and a vacuum relief valve (2).

Overpressure

As a result of the rising coolant temperature, the pressure in the cooling system will increase. If the pressure in the cooling system becomes too high, the pressure relief valve (1) will open against the pressure of the spring.

Underpressure

If the coolant temperature drops, the pressure in the cooling system will decrease. If the pressure in the cooling system becomes too low, the vacuum relief valve (2) will be opened.



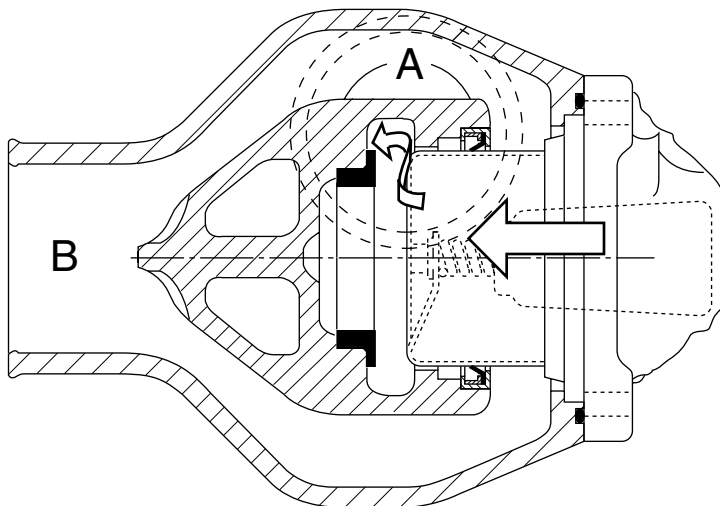
M201036

3.2 DESCRIPTION OF THERMOSTAT

Operation, thermostat

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

Thermostat closed

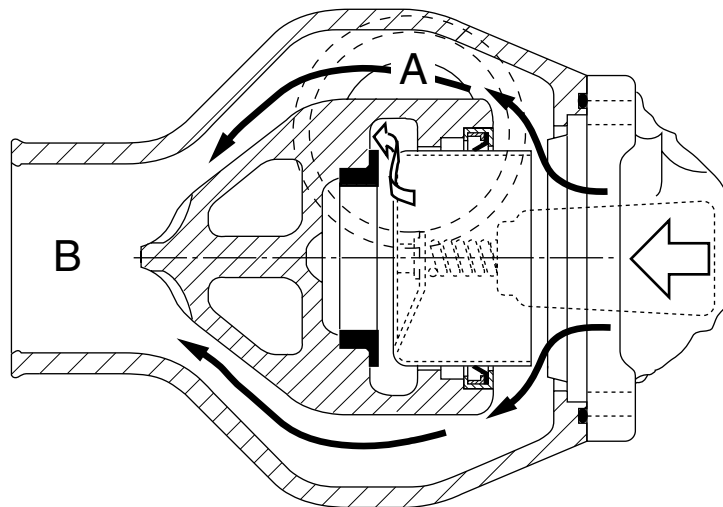


M200739

The coolant has not yet reached the thermostat opening temperature.

The supply channel (B) to the radiator is completely closed.

The coolant flows directly to the coolant pump through a bypass (A) and the coolant pump returns the coolant to the cylinder block.

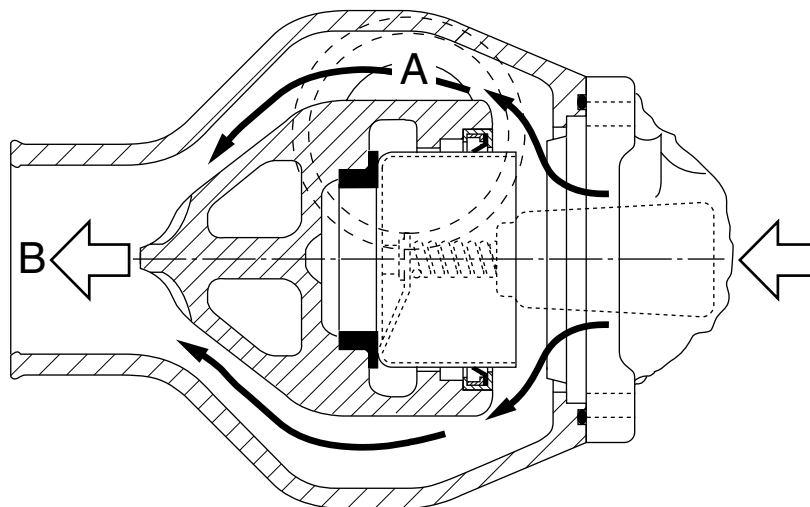
Thermostat starts opening

M200740

The coolant has reached the thermostat opening temperature.

The supply channel (B) to the radiator is opened and the bypass (A) is partially closed.

Now coolant will flow both through the supply channel (B) to the radiator and through the bypass (A) directly to the coolant pump.

Thermostat fully opened

M200741

The temperature of the coolant has further increased. The supply channel (B) to the radiator is fully opened and the bypass 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 coolant pump. In the event of excessive coolant temperatures, removing the thermostat as an emergency solution is **not permitted**.

If the thermostat is removed from the engine, uncooled coolant will flow to the coolant pump through the bypass (A). As a result, the coolant temperature will continue to rise.

3.3 COOLANT FILTER

The task of the coolant filter is to filter the coolant to prevent cavitation. The coolant filter is necessary when the cooling system is filled with low-quality coolant.

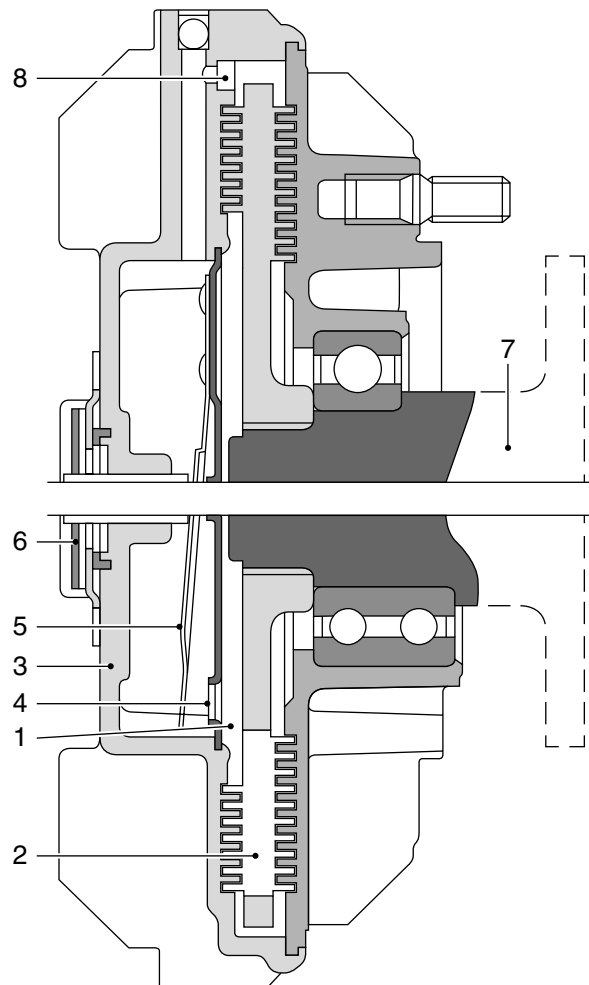
3.4 VISCOUS FAN CLUTCH

The fan is connected to the engine by means of a viscous fan clutch. If, under certain circumstances, the heat is not sufficiently dissipated by the air flow passing through the radiator, the fan will have to draw in extra cooling air through the radiator. In a viscous fan clutch, the drive torque is transmitted by a silicone fluid.

The fan clutch is divided into two chambers. In the working area (1) is the rotor (2), which is connected to the drive flange (7). The supply chamber (3) rotates freely round the drive flange (7) and is connected to the fan. There is silicone fluid in the supply chamber (3). The opening (4) in the supply chamber (3) is closed by a valve (5). The valve (5) is operated by a bimetallic strip (6).

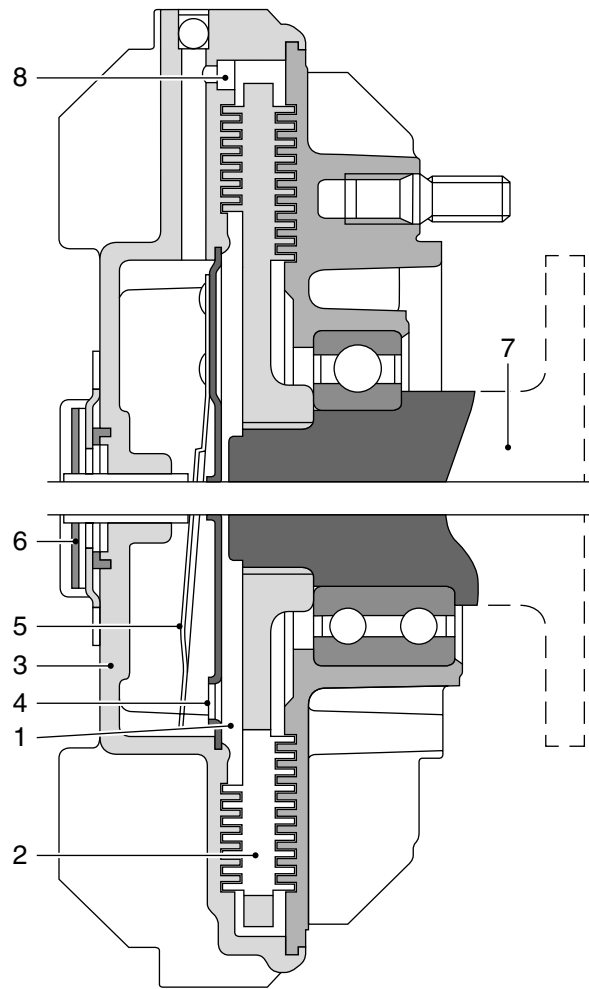
If the opening (4) in the supply chamber (3) is closed by the valve (5), no silicone fluid can enter the working area (1). The silicone fluid still present in the working area (1) will flow back to the supply chamber (3) through the bores (8). As only very little fluid will be left in the working area (1), there will be a great difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan.

When the air temperature increases, the bimetallic strip (6) will bend and the valve (5) will partially release the opening (4) in the supply chamber (3). Through this opening, a limited amount of silicone fluid can enter the working area (1) and flow past the rotor (2). This will cause friction, so that the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan will decrease.



M201039

As the air temperature rises, the bimetallic strip (6) will continue to bend and the opening (4) in the supply chamber (3) will be fully released. The further the opening (4) in the supply chamber (3) is released, the more silicone fluid will flow into the working area (1) and past the rotor (2). As a result of the increase in friction, the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) will further decrease.



4. INSPECTION AND ADJUSTMENT

4.1 PRESSURE TESTING

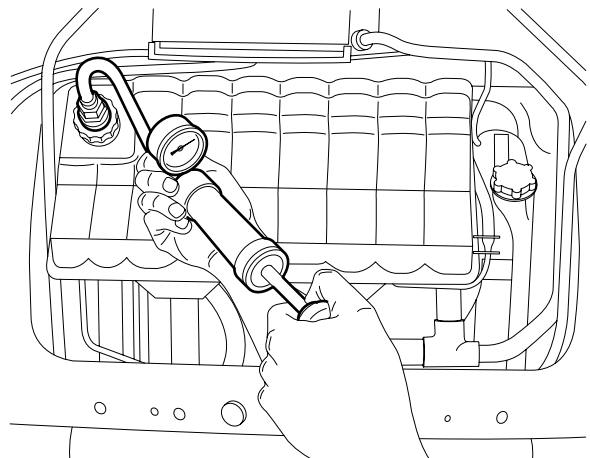


When the coolant is hot, there is overpressure in the cooling system. Carefully remove the filler cap to release the overpressure. Coolant is a toxic fluid. Contact with the skin should therefore be avoided. To avoid damaging the cylinder block; do not top up a warm engine with cold coolant.

If this is done when the engine is warm, any cracks can be spotted more quickly.

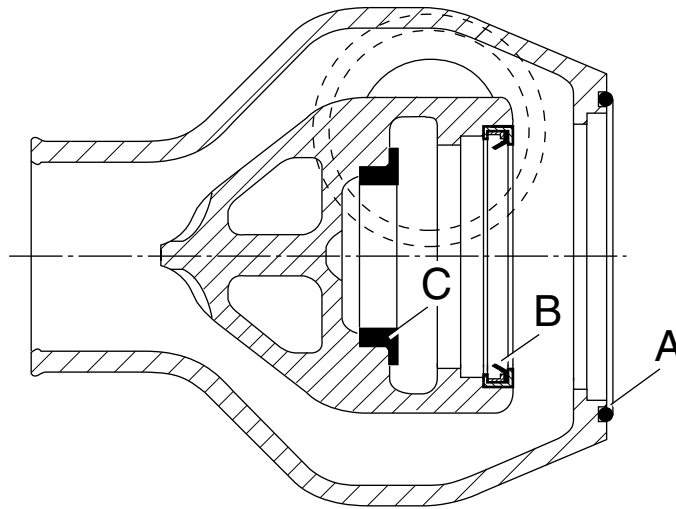
The cooling system can be checked for leaks with a pressure-test pump.

1. Open the grille.
2. Remove the filler cap.
3. Fill the cooling system to the correct level.
4. Raise the engine temperature. This need not be the operating temperature.
5. Fit a pressure-test pump. Pressure-test the system at the specified pressure. See "Technical data".
6. Check for leakage.



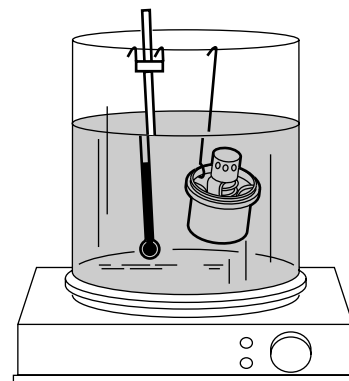
M201192

4.2 INSPECTION, THERMOSTAT



M200742

1. Remove the thermostat. See "Removal and installation".
2. Inspect the sealing surfaces (A) of the thermostat housing for damage.
3. Inspect the oil seal (B) for damage.
4. Inspect the thermostat seat (C) for damage.
5. Check whether the thermostat is fully closed.
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 it opens fully. See "Technical data".



M200513

4.3 INSPECTION, VISCOUS FAN CLUTCH



Do not run the engine in an enclosed or unventilated area. Make sure exhaust fumes are properly extracted. Remain at a safe distance from rotating and/or moving components.

During this test, the slip in the viscous fan clutch is measured while the clutch is not operating. This test must be carried out when the engine is "cold" (coolant temperature approximately 50°C).

Testing with a cold engine

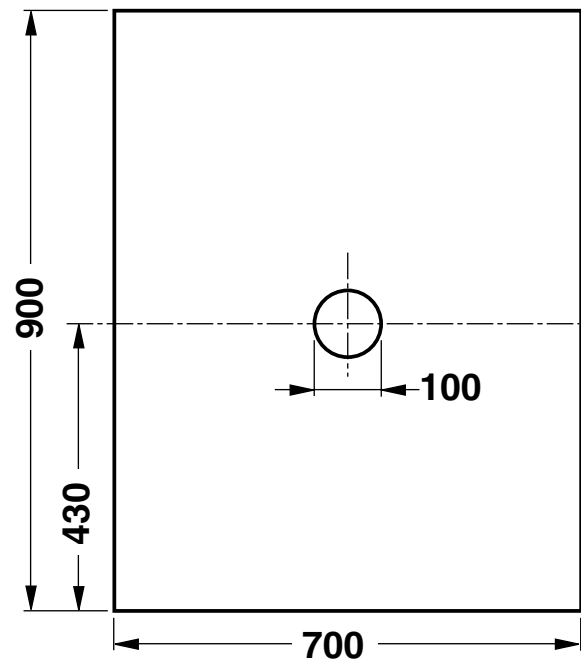
1. Check the coolant level, and top up as necessary.
2. Start the engine and run it at idling speed for at least 5 minutes.
3. Then use a digital rev counter to measure the fan speed at a number of engine speeds (from idling to maximum engine speed). During this test procedure, the speed of the fan should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

This test checks whether the bimetallic strip starts opening the valve at an operating temperature of 85 - 95°C.

Testing with a warm engine

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

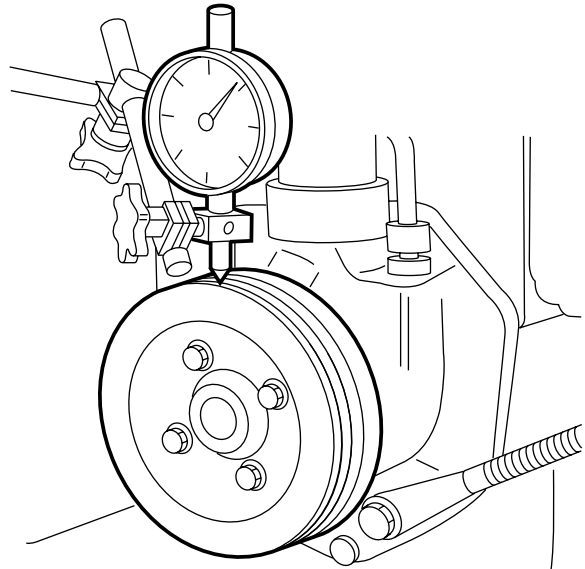
3. Take a sheet of cardboard with a 100 mm hole, as shown in the drawing opposite, and place it in front of the radiator, with the hole in front of the viscous clutch.
4. Check that the gearbox is in neutral.
5. Bring the cooling system to operating temperature.
6. Allow the fan drive flange to run at a speed of 1000 rpm.
7. Then use an optical rev counter to determine the difference between the rotating speeds of the fan and the drive flange. The speeds will differ as a result of slip in the viscous clutch. For the permissible slip, see "Technical data". If the slip measured is greater than that permitted, the viscous fan clutch must be replaced.



M200440

4.4 INSPECTION, COOLANT PUMP RADIAL PLAY

1. Remove the poly-V-belt from the coolant pump pulley.
2. Fit a dial gauge as shown in the illustration.
3. Force the coolant pump pulley downwards and set the dial gauge to zero.
4. Pull the coolant pump pulley upwards and read the dial gauge.
5. Compare the reading with the technical data. See "Technical data". If it is more than the maximum radial play specified in the technical data, the coolant pump must be replaced.



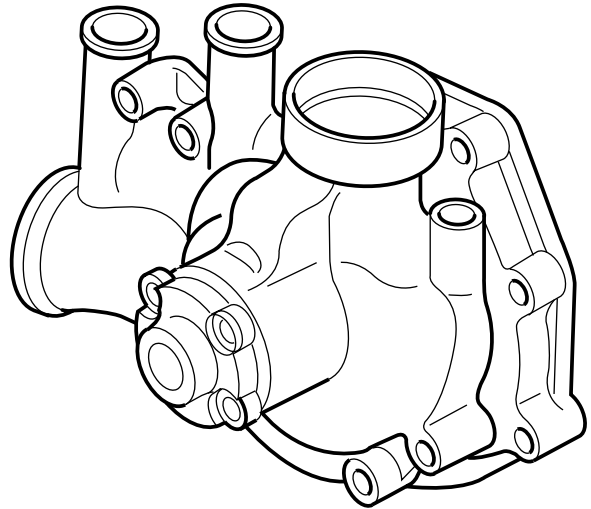
M200595

5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, COOLANT PUMP

Removal, coolant pump

1. Drain the coolant. See "Draining and filling".
2. Remove the V-belt from the air conditioning compressor and the poly-V-belt from the alternator.
3. Remove the pulley from the coolant pump.
4. Remove the attachment bolts from the thermostat housing on the coolant pipe and remove the thermostat housing and connection piece.
5. Disconnect all coolant hoses connected to the coolant pump.
6. Disconnect the pipe from the coolant pump to the coolant filter.
7. Remove the attachment bolts from the coolant pump.
8. Remove the coolant pump.



M200596

Installation, coolant pump

1. Thoroughly clean and check the sealing surfaces of the coolant pump, the thermostat housing and the cylinder block.
2. Install the coolant pump, using a new gasket. Fit the attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Install the connection piece with new O-rings onto the coolant pump.
4. Fit new O-rings to the thermostat housing and fit it to the coolant pipe.
5. Connect the pipe from the coolant pump to the coolant filter.
6. Fit all coolant hoses connected to the coolant pump.
7. Fit the poly-V-belt.
8. Install the V-belt and check the V-belt tension. See "Inspection and adjustment".
9. Fill the cooling system. See "Draining and filling".

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.

Do not remove the filler cap when the engine is running.

Coolant is a toxic fluid. Contact with the skin should therefore be avoided.

In the event of contact with the skin: remove the liquid with paper or a cloth, wash with soap and water. If irritation persists, consult a doctor.

If swallowed: DO NOT induce vomiting. Rinse mouth, drink two glasses of water and consult a doctor.

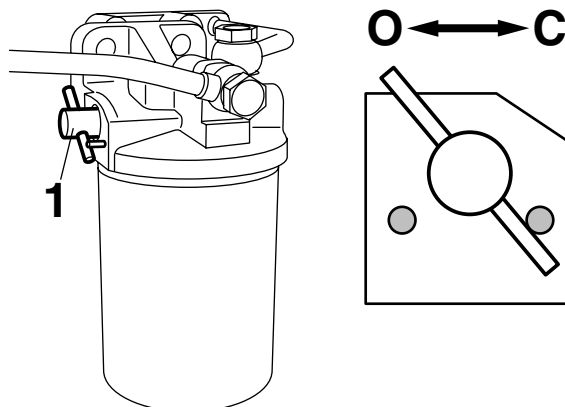
In the event of inhalation: get fresh air and rest.

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

6

Removing the coolant filter

1. Place a tray beneath the coolant filter to collect any escaping coolant.
2. Remove the filler cap from the expansion tank.
3. Turn the shut-off valve (1) clockwise to the "C" position.
4. Remove the coolant filter by turning it counter-clockwise.



Installing the coolant filter

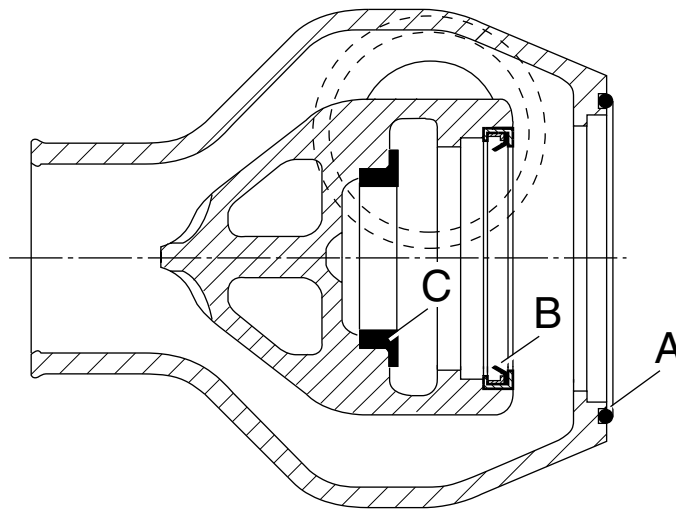
1. Clean the sealing face of the coolant filter.
2. Apply a small amount of coolant to the sealing ring of the coolant filter.
3. Fit the coolant filter so that the sealing ring makes contact. Then tighten the filter by hand 1/2 to 3/4 of a turn.
4. Turn shut-off valve (1) anti-clockwise to the "O" position.
5. Fit the filler cap on the expansion tank.
6. Run the engine and check that the coolant filter seals correctly.
7. Check the coolant level.

M200372

5.3 REMOVAL AND INSTALLATION, THERMOSTAT

Removing the thermostat

1. Drain the coolant. See "Draining and filling".
2. Remove the hose between the thermostat housing and the radiator.
3. Remove the thermostat housing attachment bolts.
4. Remove the thermostat housing and the connecting piece from the coolant pump.



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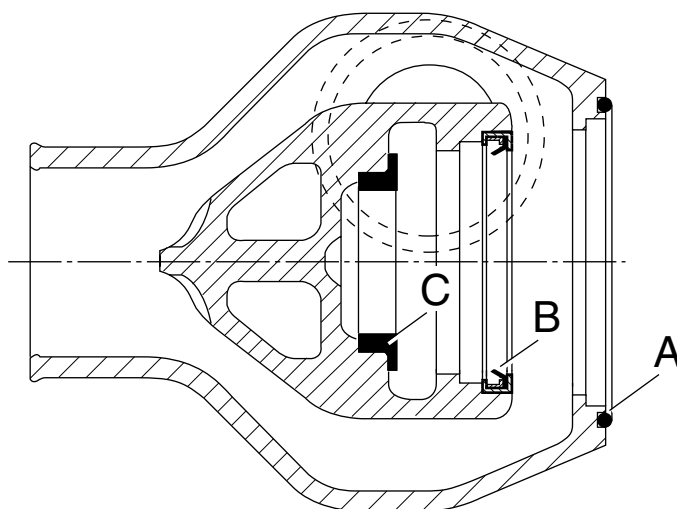
5. Remove the O-ring (A) from the thermostat housing.
6. Remove the thermostat.

Removing the thermostat oil seal

1. Remove the oil seal (B) from the thermostat housing, using a commercially available internal puller.

Removing the thermostat seat

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

Installing the thermostat seat

M200742

1. Apply locking compound to the thermostat seat (C) and fit it in the thermostat housing using the special tool (DAF no. 1310456). See "Technical data".

6

Installing the thermostat oil seal

1. Fit the thermostat seal (B) in the thermostat housing using the special tool (DAF no. 1310456).

Installing the 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 coolant pump, and fit the connection piece in the thermostat housing.
4. Fit the thermostat housing onto the coolant pipe.
5. Fit the thermostat housing attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
6. Fit the hose between the thermostat housing and the radiator.
7. Fill the cooling system. See "Draining and filling".

5.4 REMOVAL AND INSTALLATION, VISCOUS FAN CLUTCH

Removing the viscous fan clutch

1. Remove the front engine encapsulation.
2. Loosen the wind tunnel collar by removing the retaining screw (G) and turn the wind tunnel collar towards the radiator.
3. Remove the fan from the viscous fan clutch and place it temporarily in the wind tunnel.

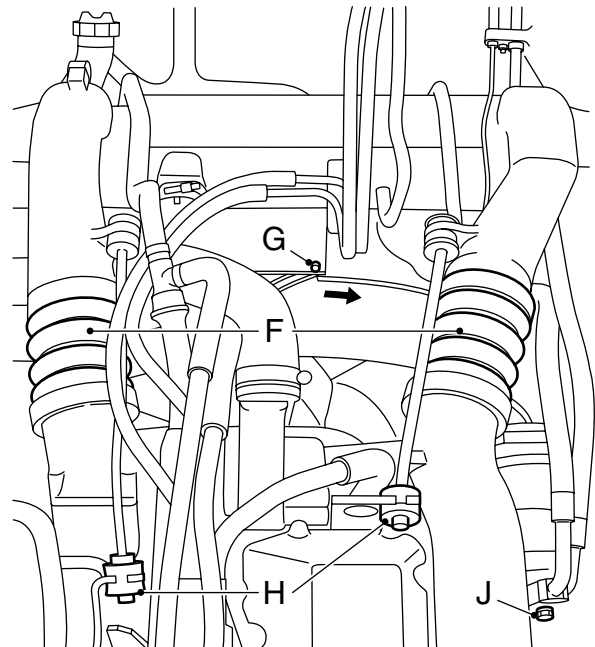
Note:

The viscous fan must **always** be stored **vertically**.

4. Remove the viscous fan clutch from the drive flange.

Installing the viscous fan clutch

1. Install the viscous fan clutch on the drive flange and tighten the attachment bolts to the specified torque. See "Technical data".
2. Fit the fan to the viscous fan clutch. Tighten the attachment nuts to the specified tightening torque. See "Technical data".
3. Turn the wind tunnel collar towards the engine and check whether it is installed properly all round in its lock. Fit the locking screw (G).
4. Fit the front engine encapsulation.

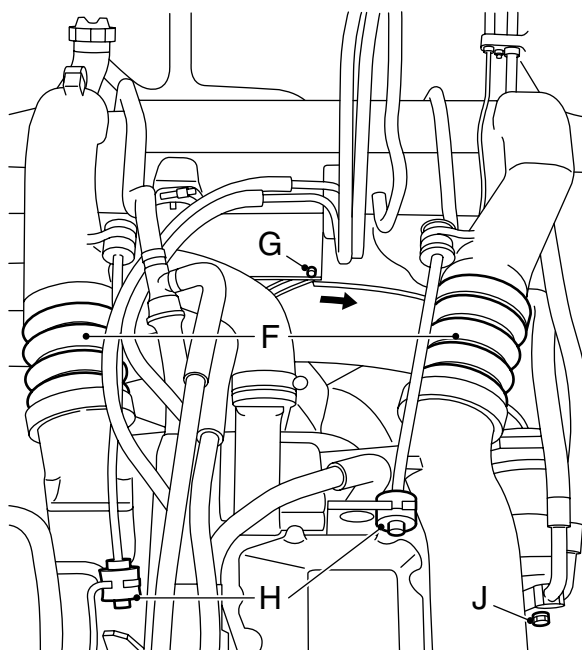


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5.5 REMOVAL AND INSTALLATION, RADIATOR UNIT

Removing the radiator unit

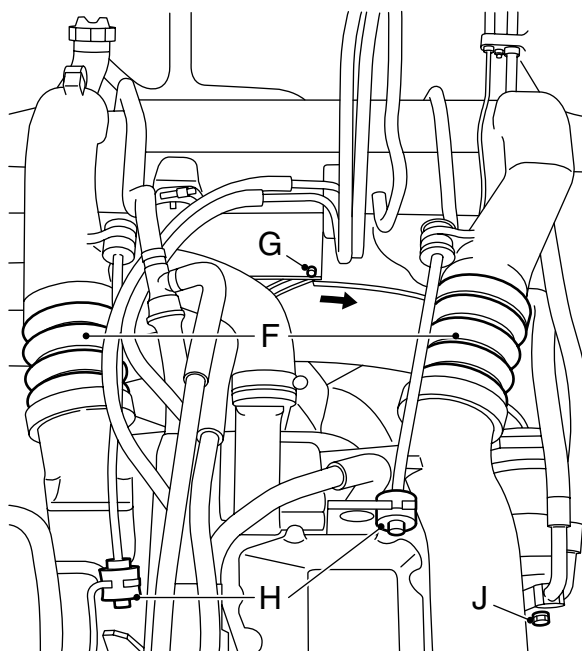
1. Drain the coolant.
2. Disconnect the torque rods (H).
3. Remove the air inlet hoses (F) between the engine and the air cooler.
4. Remove the locking screws from the wind tunnel collar (G) and turn the latter inwards.
5. Disconnect the air-conditioning condenser (if fitted) including accessories from the radiator unit.
6. Disconnect the air-conditioning compressor from the engine and carefully put the complete air-conditioning system to one side.
7. Disconnect the rubber hoses from the radiator unit.
8. Disconnect the oil filler pipe from the radiator unit.
9. Disconnect the radiator unit and remove the assembly with the air cooler.



M201032

Installing the radiator unit

1. Fit the radiator unit together with the air cooler.
2. Fit the oil filler pipe to the radiator unit.
3. Fit all rubber hoses to the radiator unit.
4. Fit the air-conditioning condenser (if present) including accessories to the radiator unit.
5. Fit the air-conditioning compressor to the engine.
6. Turn the wind tunnel collar (G) outwards and fit the locking screws.
7. Remove the air inlet hoses (F) between the engine and the air cooler.
8. Fit the torque rods (H).
9. Fill the cooling system.



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6. DRAINING AND FILLING

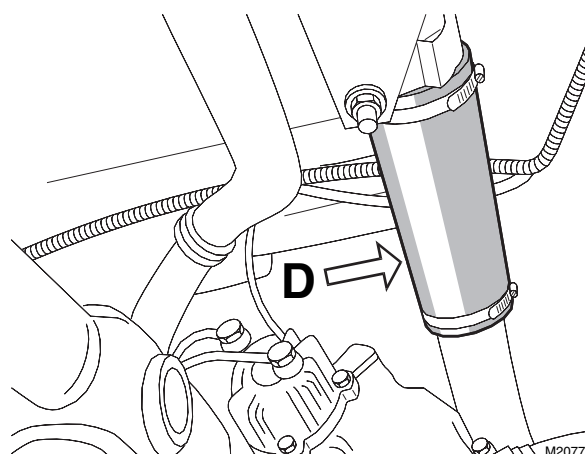
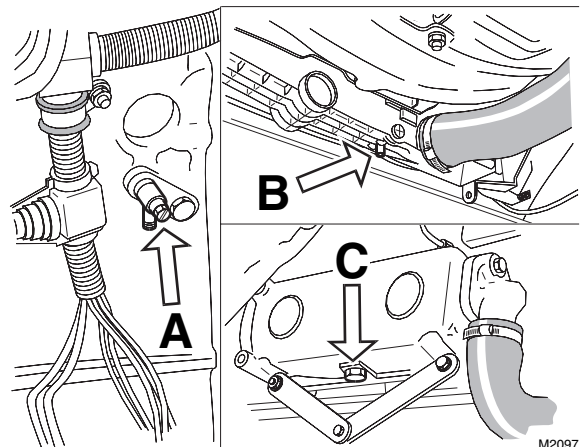
6.1 DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM



In order to avoid damaging the cylinder block, do not top up a warm engine with cold coolant. Coolant is a toxic fluid and must be handled with care. Protect 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 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 valve will be fully opened.
2. Remove the cooling system filler cap.
3. Collect the coolant. Position suitable containers under the drain points.
4. Drain the cooling system via the drain tap (A) on the side of the cylinder block and via drain plug B underneath the radiator and plug C on the lower side of the oil cooler.
5. If an integrated retarder has been fitted remove the coolant hose (D) from the oil cooler and drain the remaining coolant.
6. Flush the cooling system.
7. Close the engine drain tap (A) and install the drain plugs (B and C) on the lower side of the radiator and on the oil cooler.



Filling and bleeding cooling system

1. Turn the heater temperature control knob in the cab to the "warmest" setting.
2. With the cab in the driving position, fill the cooling system with the specified coolant up to the edge of the filler opening.
3. Run the engine for several minutes.

Note:

The cooling system is auto-bleeding.

4. Ensure that the air bleed pipe from the thermostat housing to the header tank is not twisted or pinched.
5. Check the coolant level, and top up with coolant if necessary.

If the vehicle is equipped with a water/air cab heater.

1. Run the engine at idling speed.
2. Switch on the cab heater 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 cab heater to operate for approximately 15 minutes.

7. CLEANING

7.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER



Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.

This tool can be made in your own workshop. It cannot be ordered from DAF.

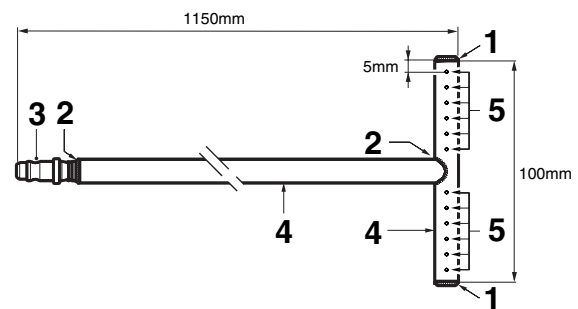
Key to drawing:

1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, \varnothing 10 mm
5. 6 x \varnothing 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side.

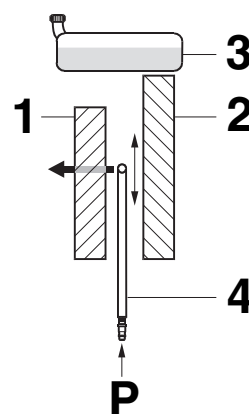
Note:

Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

1. From below, insert the radiator cleaner (4) between the air cooler (1) and radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.

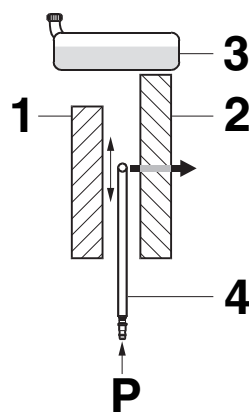


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3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).
4. Fit the wire mesh.
5. Install the lower grille.



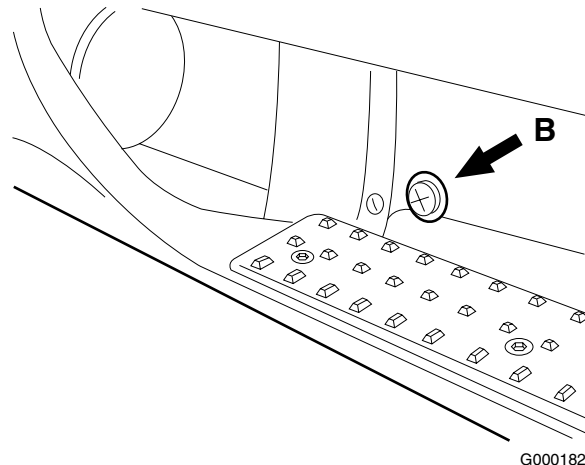
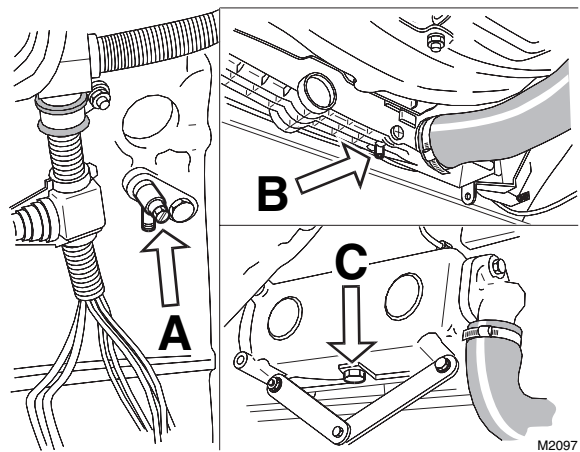
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7.2 FLUSHING COOLING SYSTEM



In order to avoid damaging the cylinder block, do not top up a warm engine with cold coolant. Coolant is a toxic fluid and must be handled with care. Protect 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 overpressure in the cooling system. When removing the filler cap, allow the overpressure to escape by first loosening the filler cap one turn.

1. Drain the cooling system at the cylinder block via the drain tap (A), the radiator via drain plug B and the oil cooler via plug C. If an integrated retarder is fitted, remove the coolant drain plug of the heat exchanger.
2. Flush the cooling system.
3. Close the drain cock (A) and fit drain plug B and, if applicable, the coolant drain plug of the heat exchanger of the integrated retarder.
4. Fill the cooling system.
5. Check the coolant level.



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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

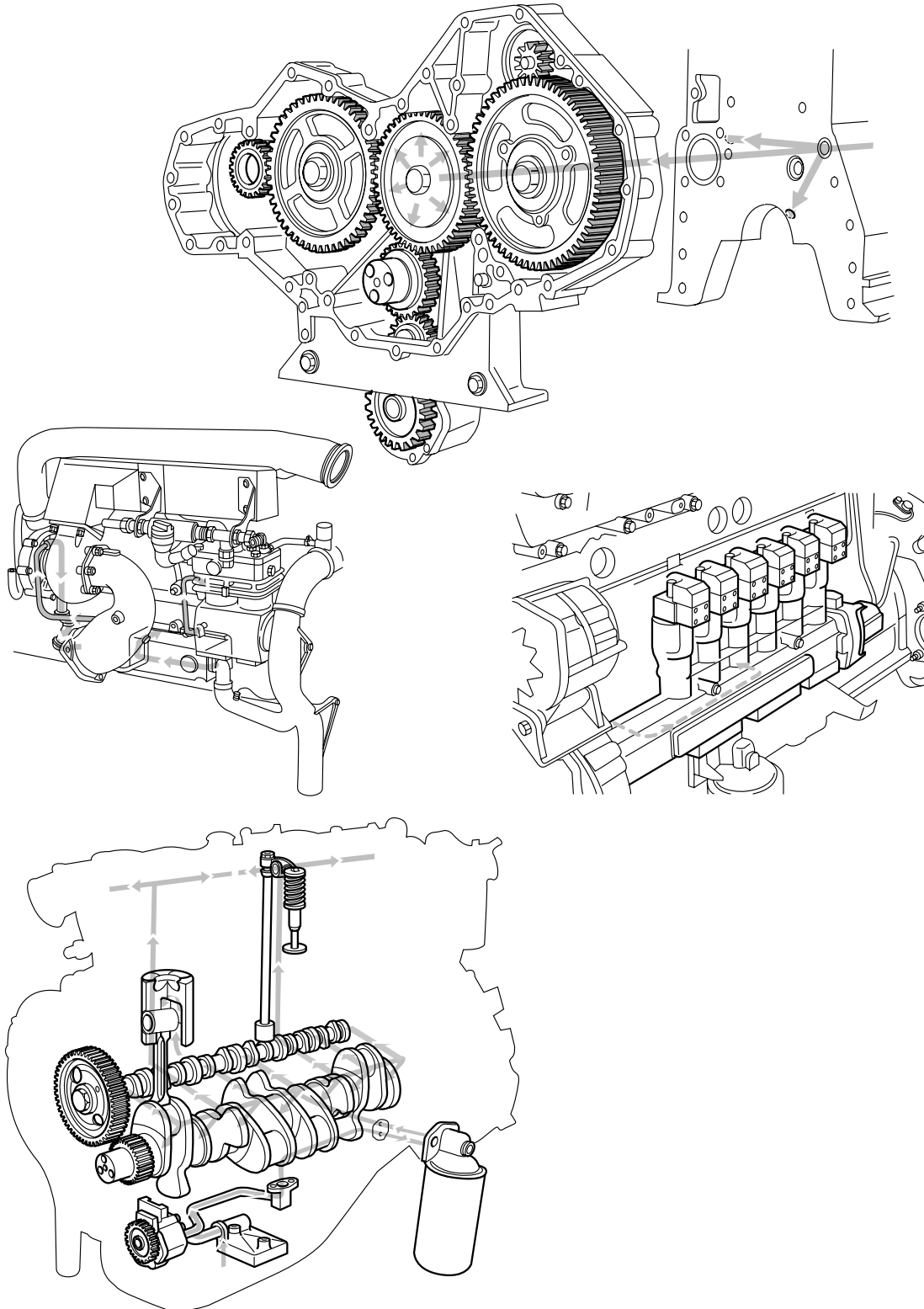
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

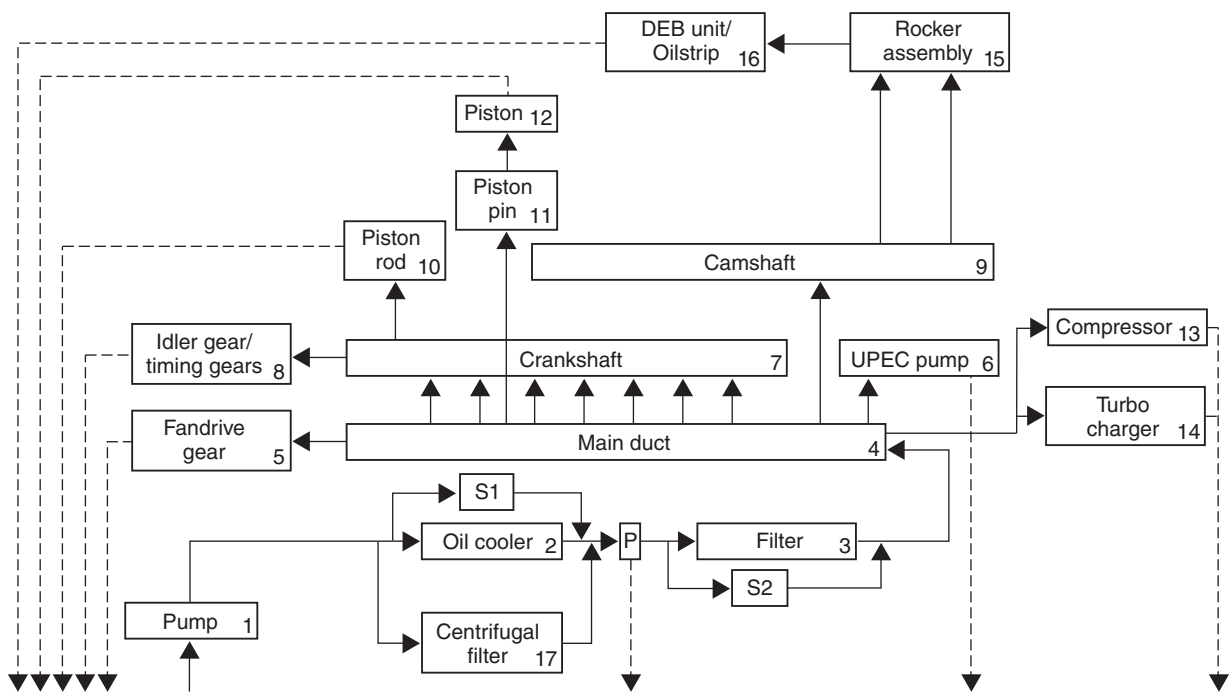
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

2.1 SYSTEM DESCRIPTION, LUBRICATION SYSTEM



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General

The oil pump (1) is directly driven by the crankshaft via an intermediate gear wheel. The oil pump (1) draws the lubricating oil from the oil sump, and pumps it via the oil cooler (2) and the oil filter (3) to the main oil channel (4) in the cylinder block. From the main oil channel, the lubricating oil is further distributed to the various components requiring lubrication.

Oil cooler

The lubricating oil cooler (2) is connected to the cooling system. It warms up the lubricating oil in a "cold" engine and cools it in a "warm" engine. Parallel to the lubricating oil cooler, a bypass valve (S1) has been installed. If the lubricating oil cooler is blocked, or in the event of extremely low temperatures, the bypass valve will open at a pressure difference of about 2 bar. In this situation, uncooled lubricating oil will enter the lubrication system.

Centrifugal filter

A centrifugal filter (17) may be included parallel to the lubrication system. In this case, lubricating oil will flow from the oil cooler to the centrifugal filter. In the centrifugal filter, the lubricating oil undergoes extra filtering.

7

Pressure limiting valve

A pressure-limiting valve (P) is installed in the lubricating system after the lubricating oil cooler. When the pressure set for the pressure limiting valve has been reached, the valve opens and any excess cooled lubricating oil will be discharged to the sump.

Oil filter

The oil is cleaned in the oil filter cartridge. A pressure-relief valve (S2), fitted in this filter, opens if the pressure in the filter becomes too high as a result of fouling or cold lubricating oil. The lubricating oil then passes through the filter unfiltered.

Main lubricating oil channel

From the main lubricating oil channel (4) lubricating oil is supplied to the crankshaft main bearings (7) and via an oil channel in the crankshaft to the big-end bearings (10). From the main lubricating oil channel, lubricating oil is pumped through the first camshaft bearing (9) into the bored camshaft. 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 runs through the cylinder heads to the second and fifth rocker seats (15). The other rocker shafts are provided with lubricant by lubricating-oil strips (16) that run along the rocker seats.

Timing gear

A lubricating oil channel leads from the lubricating oil duct via the first crankshaft main bearing (7) to the bored hub of the idler gear (8). From the bored hub, the lubricating oil reaches the idler gear. From the idler gear, the lubricating oil is supplied to the other gears. The PE engine has **no** fan drive (5).

Piston and gudgeon pin

The pistons (12) and the upper big-end bearings (11) are lubricated by means of lubricating oil nozzles connected to the main oil channel (4). In addition to its lubricating function, the lubricating oil has an important cooling function.

A bore at the top of the connecting rod ensures that the lubricating oil sprayed against the piston head by the lubricating oil nozzles can reach the upper big-end bearing.

Turbocharger and air compressor

A lubricating oil channel running from a camshaft bearing is connected to the lubricating oil pipes leading to the turbocharger (14) and air compressor (13).

The lubricating 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 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 (6) obtains lubricating oil from the cylinder block and discharges it through a channel in the cylinder block, from where it returns to the oil sump. The pump units are supplied with lubricating oil via a channel in the pump housing.

3. INSPECTION AND ADJUSTMENT

3.1 CHECKING ENGINE OIL CONSUMPTION

Engine oil consumption relates to the engine oil used during combustion in the engine. Since engine oil consumption is affected by driving style and the use to which the vehicle is put, it is also related to average fuel consumption. See "Technical data" for the maximum permissible engine oil consumption.

Test conditions

1. An engine oil consumption test is only meaningful after the engine has been run in (approx. 25,000 km).
2. Check the engine carefully for engine oil leakage before carrying out an engine oil consumption test. First repair any leaks.
3. Check the average fuel consumption and engine oil consumption as accurately as possible.
4. Only check the engine oil level when the engine is at operating temperature and only when the engine has been turned off for five minutes.
5. Make sure the vehicle is horizontal before checking the engine oil level.

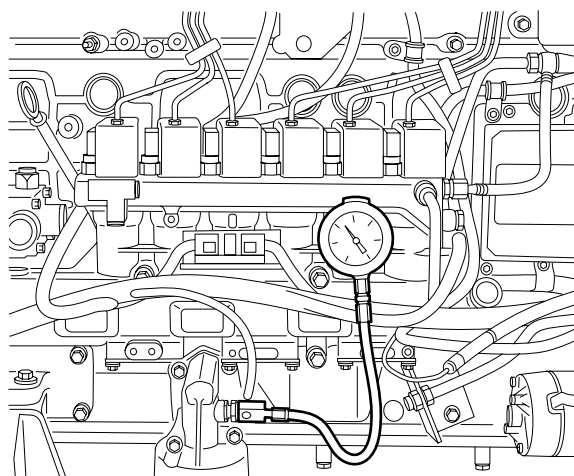
3.2 INSPECTION, LUBRICATING OIL PRESSURE

1. Bring the engine up to operating temperature.
2. Remove the lubricating oil pressure sensor. This sensor is mounted on the oil filter housing.
3. In the oil pressure sensor connection, fit a lubricating oil pressure gauge and the special tool (DAF no. 0535551).
4. Start the engine and measure the lubricating oil pressure at idling speed and at full-load engine speed. Compare the pressure readings with the technical data. See "Technical data".

Note:

The pressure limiting valve mounted in the oil sump cannot be adjusted.

5. Switch off the engine and remove the lubricating oil pressure gauge. Fit a new sealing ring to the oil pressure sensor and fit the sensor.



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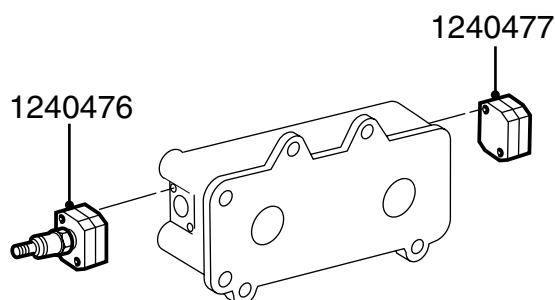
3.3 PRESSURE TESTING THE LUBRICATING OIL COOLER

1. Remove the lubricating oil cooler. See "Removal and installation".
2. Place the special tools (DAF no. 1240476) and (DAF no. 1240477) on the lubricating oil cooler.
3. Apply up to 2.5 bar of pressurised air to the special tool.
4. Immerse the lubricating oil cooler in hot water (approx. 50°C) and check the lubricating oil cooler for leaks.

Note:

The lubricating oil cooler should be replaced if it is leaking.

5. Fit the lubricating oil cooler. See "Removal and Installation".



M200185

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, OIL FILTER ELEMENT



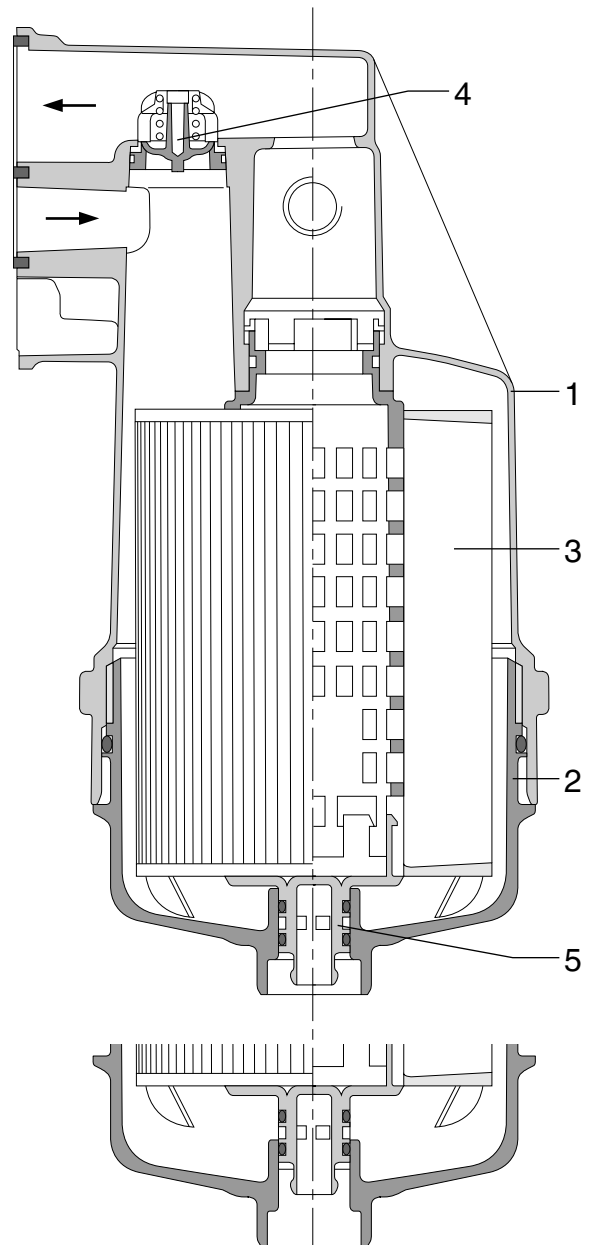
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.
Discard the oil filter element.

Removing the oil filter element

1. Unscrew the cap (2) a few turns and drain the filter housing. Collect the oil.
2. Remove the cap (2) with the oil filter element (3) from the filter housing (1) and then remove the element from the cap.

Fitting oil filter element

1. Fit a new O-ring to the cap (2).
2. Fit the oil filter element with the cap in the filter housing and tighten the cap to the specified torque. See "Technical data".



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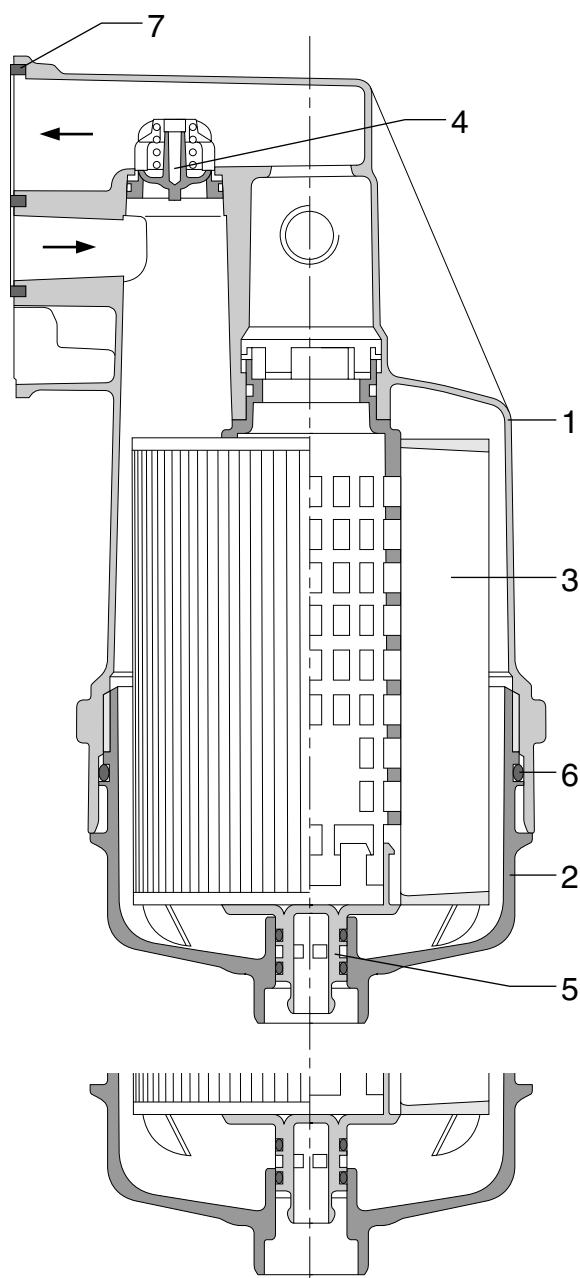
4.2 REMOVAL AND INSTALLATION, OIL-FILTER HOUSING

Removing the oil-filter housing

1. Drain the oil from the filter housing by loosening the cap (2) a few turns.
2. Disconnect the electrical connections from the lubricating oil pressure sensor.
3. Remove the oil-filter housing (1).

Installing the oil-filter housing

1. Replace the O-rings (7) on the rear of the filter housing (1).
2. Fit the filter housing (1) and tighten the attachment bolts to the specified torque. See "Technical data".
3. Hand-tighten the cap (2) and then tighten to the specified torque. See "Technical data".
4. Run the engine for a short time and check for oil leaks.
5. Check the lubricating oil level.

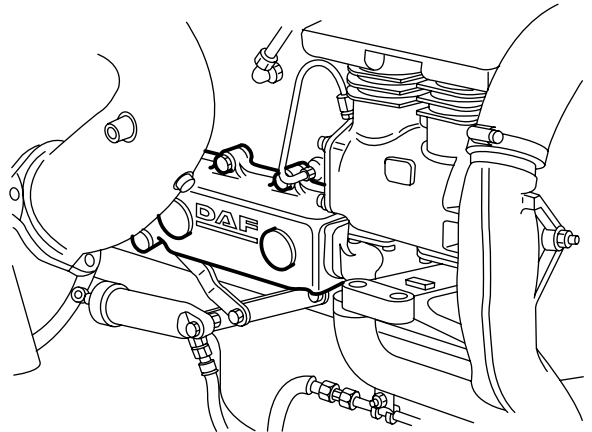


M201170

4.3 REMOVAL AND INSTALLATION, OIL COOLER

Removing the oil cooler

1. Drain the coolant. See "PE engine cooling system".
2. Remove the heat shield from the exhaust elbow.
3. Remove the exhaust elbow and exhaust brake operating cylinder.
4. Remove the plug on the underside of the oil cooler and drain the coolant.
5. Remove the coolant hoses from the oil cooler.
6. Remove the oil cooler. Collect the escaping lubricating oil.
7. Remove any remnants of gasket.



W267003

Installing the oil cooler

1. Thoroughly clean the contact surfaces between the oil cooler and the cylinder block, and replace the gaskets.
2. Fit the oil cooler.
3. Connect the coolant hoses to the oil cooler.
4. Fit the exhaust elbow and exhaust brake operating cylinder.
5. Fit the heat shield of the exhaust bend.
6. Fill the cooling system.
7. Run the engine briefly, and check that the lubricating oil cooler does not leak.
8. Check the lubricating oil level.
9. Check the coolant level.

4.4 REMOVAL AND INSTALLATION, OIL SUMP

Removing the oil sump

1. Remove the oil sealing plug.
2. Drain the oil. See "Draining and filling".
3. Remove the oil level sensor.

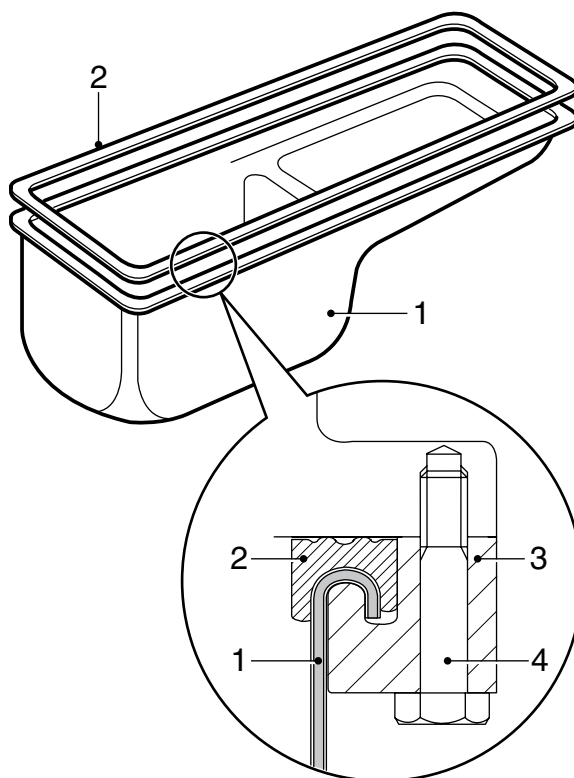
Note:

If the oil level sensor is not removed, the sensor could easily break while removing the oil sump.

4. Support the oil sump (1). Remove the attachment bolts (4) and locking brackets (3) all around.
5. Remove the oil sump and its sealing rubber (2).

Installing the oil sump

1. Thoroughly clean the sealing surfaces of the oil sump and the cylinder block.
2. Check the oil sump sealing rubber (2). A damaged sealing rubber (2) must be replaced.
3. First attach the sealing rubber to the front and rear sides of the oil sump. Then, attach it to the long sides of the oil sump.
4. Fit the oil sump (1) with the sealing rubber (2) upright.
5. Fit the attachment bolts (4) and locking brackets (3). Tighten the attachment bolts crosswise to the specified torque. See "Technical data".
6. Fit the oil level sensor.
7. Fill the engine with the specified quantity of lubricating oil.
8. Run the engine.
9. Check for oil leakage.
10. Check the oil level.
11. If applicable, fit the under-engine noise encapsulation.



M200601

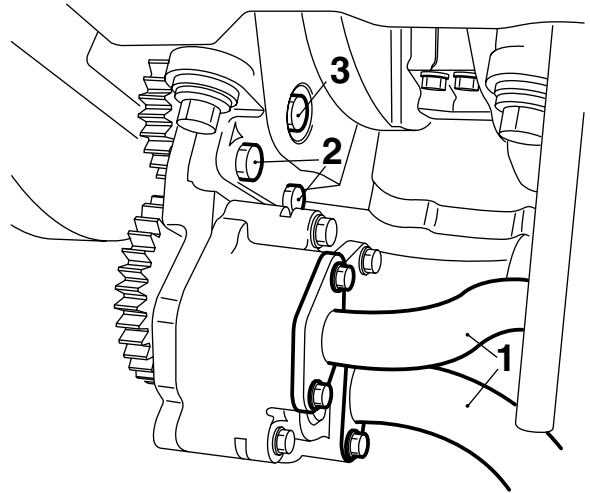
4.5 REMOVAL AND INSTALLATION, OIL PUMP

Removing the oil pump

1. Remove the oil sump.
2. Remove the suction pipe and delivery pipe (1).
3. Remove the bolts (2) attaching the oil pump to the main bearing cap.
4. Remove the attachment bolt (3) and take the oil pump off the main bearing cap.

Installing the oil pump

1. Check that the oil pump rotates smoothly and has no heavy point.
2. Fit the oil pump and tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit new O-rings to the suction and delivery pipes (1).
4. Fit the oil strainer.
5. Fit the oil sump.
6. Top up oil. See "Draining and filling"
7. Check for oil leakage.
8. Check the oil level.



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4.6 REMOVAL AND INSTALLATION, CENTRIFUGAL OIL FILTER ELEMENT



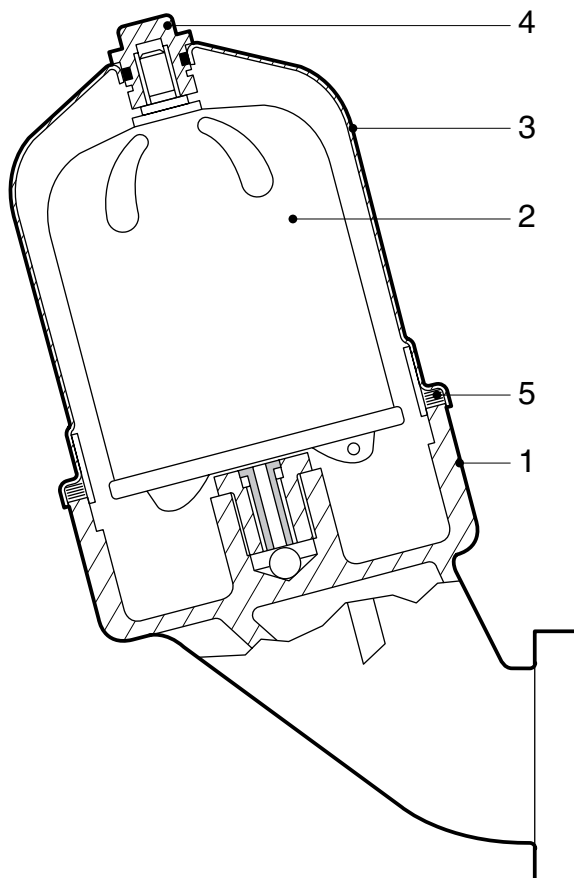
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

Removing centrifugal oil filter element

1. Remove the noise encapsulation on the right-hand side.
2. Clean the cap (3) and surrounding area and unscrew the central bolt (4).
3. Remove the centrifugal oil filter element (2).

Fitting the centrifugal oil filter element

1. Clean the interior of the cap (3) and fit the centrifugal oil filter element (2).
2. Check the central bolt (4) for damage.
3. Replace the sealing ring (5) and lightly lubricate the sealing ring with lubricating oil.
4. Fit the cap (3) and tighten the central bolt (4) to the specified torque. See "Technical data".
5. Start the engine and check for leakage.
6. Check the lubricating oil level.



M200526

5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, OIL PUMP

Disassembling the oil pump

1. Remove the idler gear and hub from the front plate.
2. Remove all attachment bolts from the two sections of the oil-pump housing.
3. Remove the rear section of the oil pump housing.
4. Remove the gear wheels from the oil pump housing.

Assembling the oil pump

1. Clean the gears and check them for damage.

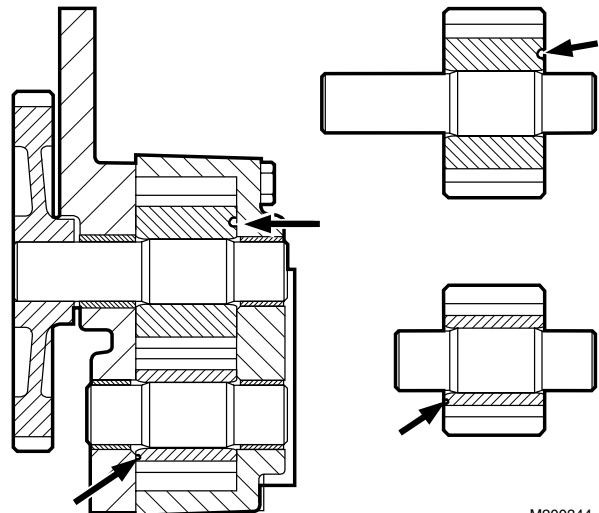
Note:

Gears must be replaced as a set.

Note:

The gears are marked. The gears with the marks must be fitted as shown in the drawings.

2. Fit the gear wheels in the oil pump housing.
3. Fit the rear section of the oil pump housing.
4. Fit the attachment bolts of the oil pump sections. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Check that the oil pump operates smoothly and has no heavy point.
6. Fit the idler gear and hub to the front plate. Tighten the bolt to the specified torque. See "Technical data".



M200344

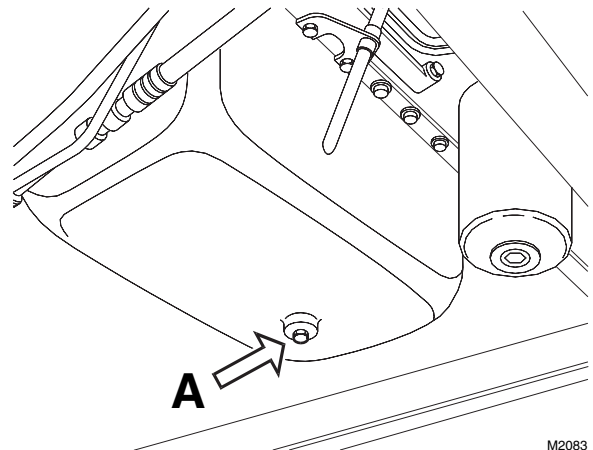
6. DRAINING AND FILLING

6.1 DRAINING AND FILLING LUBRICATING OIL

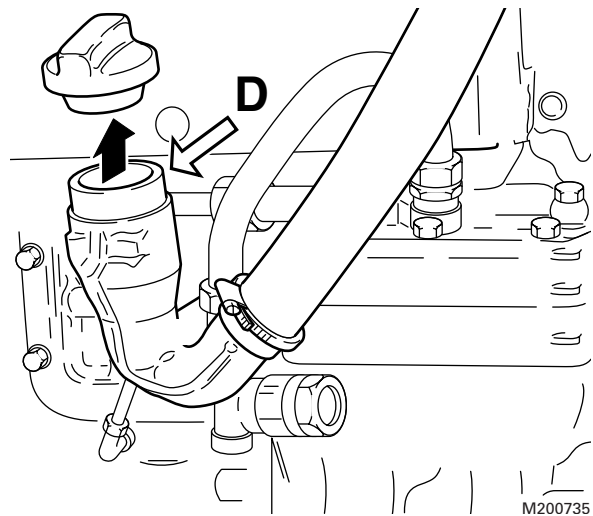


To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

1. Place the vehicle on a level and horizontal 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 torque. See "Technical data".
4. Fill the engine through the lubricating oil filler pipe (D) with the specified quantity of lubricating oil. See "Technical data".



M2083



M200735

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

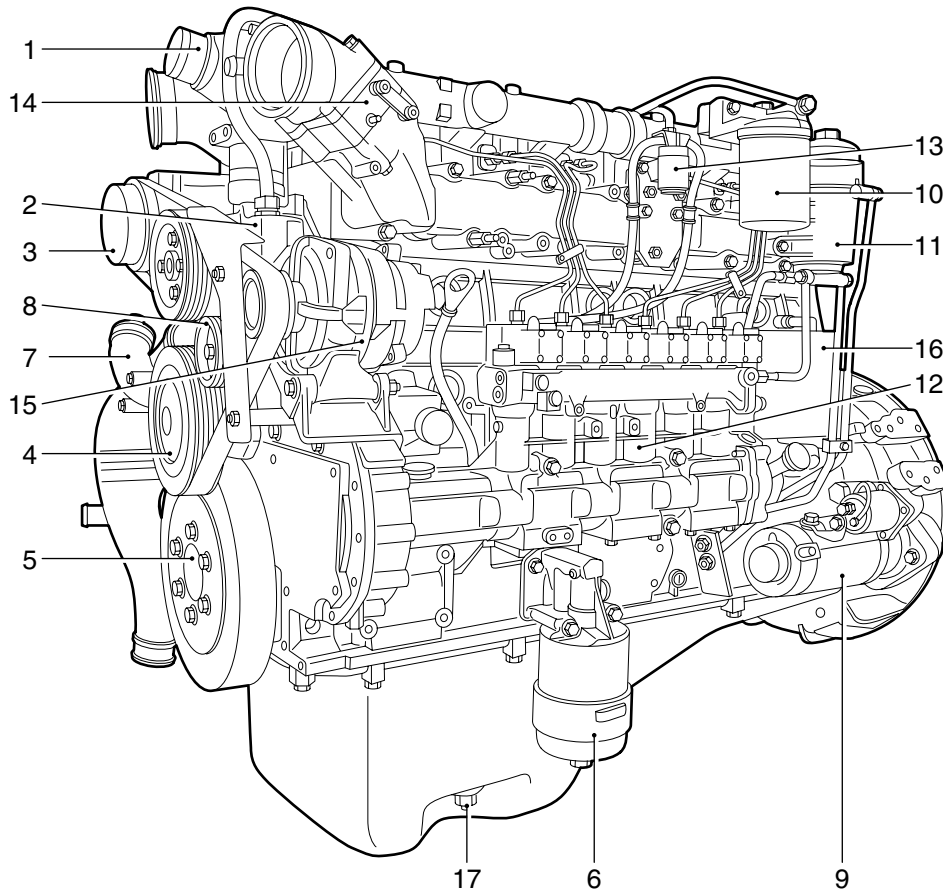
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

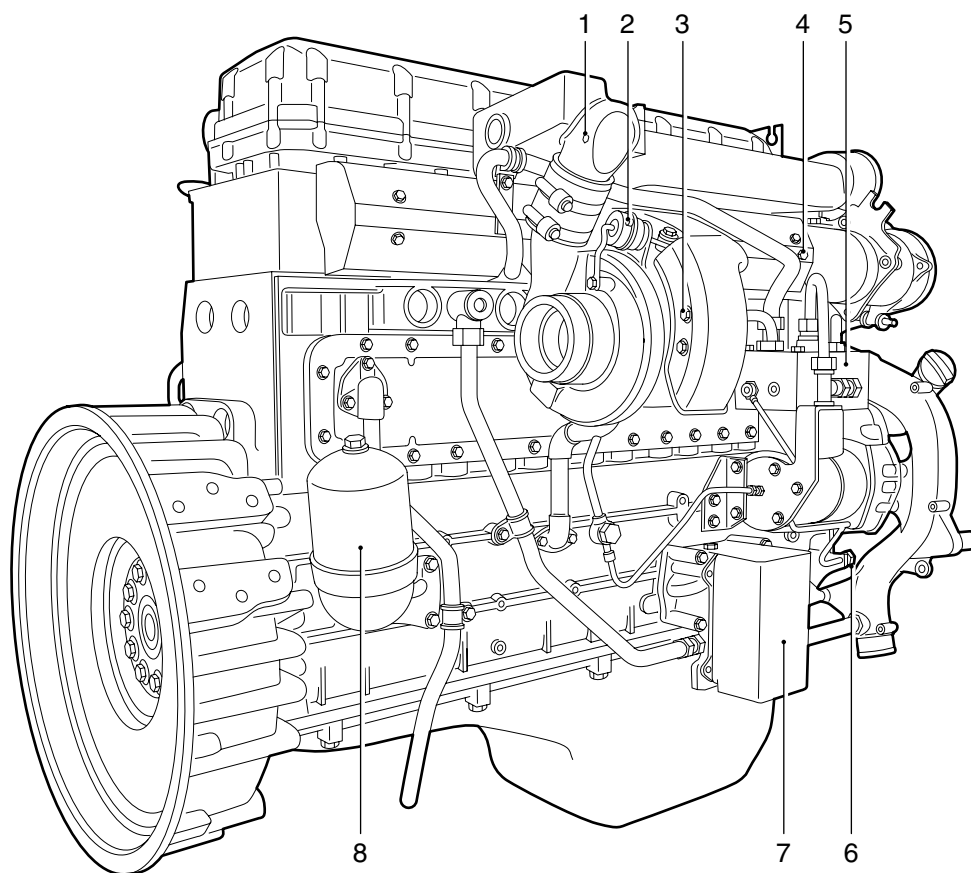
2.1 LOCATION OF COMPONENTS



M201130

Legend

1. Thermostat housing
2. Coolant pump
3. Air-conditioning compressor
4. Fan drive
5. Vibration damper
6. Oil filter
7. Oil filler pipe
8. Poly-V-belt tensioner
9. Starter motor
10. Coolant filter
11. Fuel filter
12. UPEC pump housing
13. Glow plug relay
14. Glow plug
15. Alternator
16. UPEC electronic unit
17. Oil level sensor



M201129

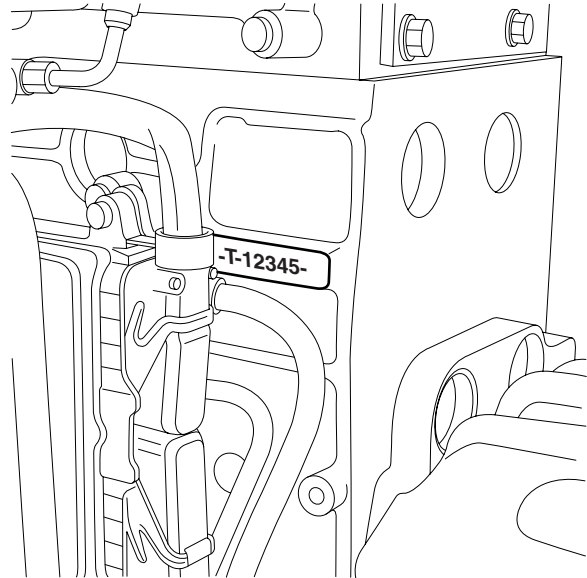
Legend

- 1. Air intake pipe
- 2. Wastegate diaphragm
- 3. Turbocharger
- 4. Exhaust manifold
- 5. Air compressor
- 6. Exhaust brake valve
- 7. Oil cooler
- 8. Centrifugal oil filter

2.2 IDENTIFICATION

Engine number

The engine number is stamped on the cylinder block at the rear left

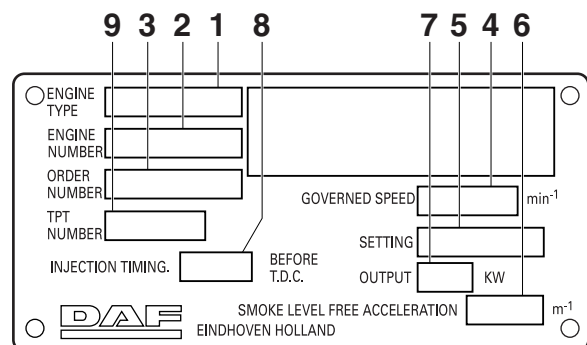


M201087

XE engine identification plate
Fitted to the inlet manifold

1. Engine type
2. Engine number
3. Order number⁽²⁾
4. Maximum governed engine speed
5. Number (for type approval)
6. Smoke level at maximum no-load engine speed
7. Engine output
8. Injection timing⁽¹⁾
9. Transport number⁽²⁾

- (1) Not filled in for XE engines
(2) For production

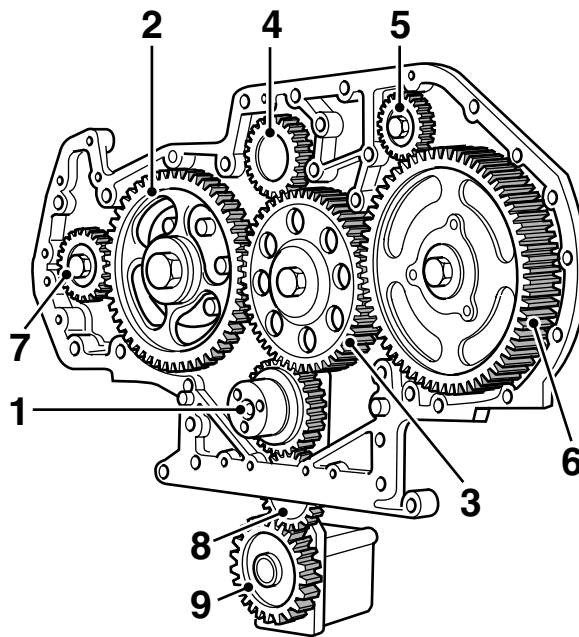


M201088

2.3 OVERVIEW DRAWING, TIMING GEAR

Legend

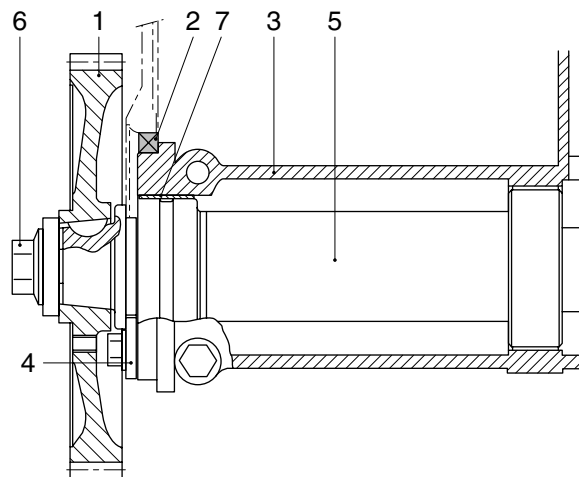
- 1. Crankshaft gear
- 2. Camshaft gear
- 3. Idler gear
- 4. Fan drive
- 5. Steering pump gear
- 6. Pump housing camshaft gear
- 7. Air compressor gear
- 8. Oil pump idler gear
- 9. Oil pump



M200886

2.4 OVERVIEW DRAWING, PUMP HOUSING CAMSHAFT DRIVE

- 1. Pump housing camshaft gear
- 2. Timing case oil seal
- 3. Pump housing
- 4. Locking plate
- 5. Pump housing camshaft
- 6. Camshaft gear attachment bolt
- 7. Camshaft bearing bush



M200887

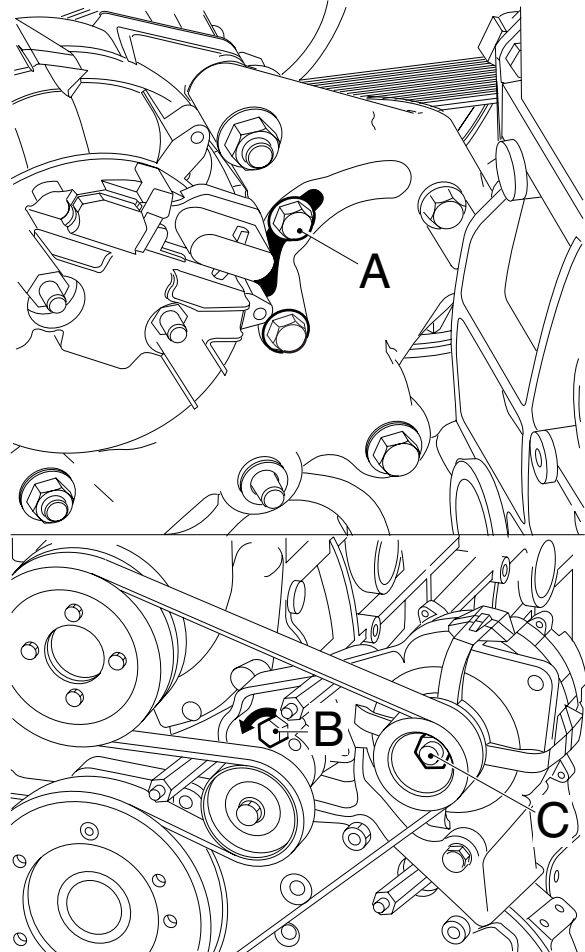
2.5 CRANKING THE ENGINE

Crank using the automatic poly-V-belt tensioner

1. Put an M8 x 90 bolt (A) into the rear of the automatic tensioner via the opening at the rear of the alternator bracket.
2. Screw the bolt in until the automatic tensioner locks.
3. Place a spanner on the nut (C) on the alternator and turn the engine clockwise.

Note:

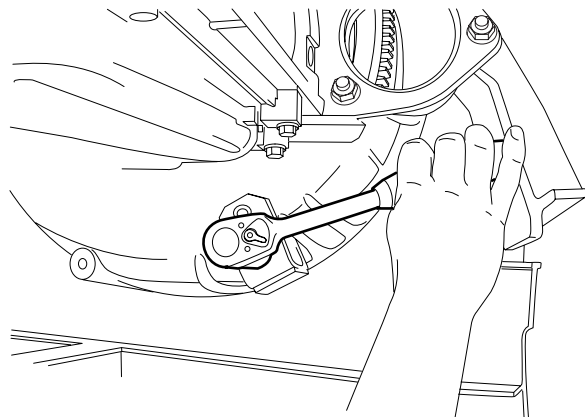
Turning the nut anti-clockwise may cause the alternator nut to work loose.
If the tensioner slips while cranking, it can be pre-tensioned a little by turning the automatic tensioner anti-clockwise (B) whilst securing the bolt (A).



M201273

Cranking using the flywheel

1. Place the special tool (DAF no. 1310477) on the opening at the bottom of the flywheel housing such that the pinion engages the starter ring gear.
2. Turn the crankshaft clockwise as seen from the timing gear end (this corresponds to the direction of rotation of the engine).



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3. INSPECTION AND ADJUSTMENT

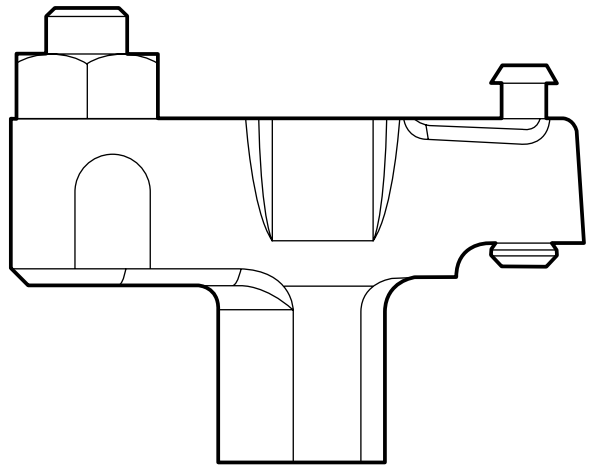
3.1 INSPECTION AND ADJUSTMENT, VALVE GEAR BRIDGES

1. Remove the valve covers. See "Removal and installation".
2. Remove the DEB or the lubricating oil strip (depending on version).
3. Remove the entire rocker seat. Mark the position to enable reinstallation in the same position.

Note:

In engines with a DEB, the bridges of the inlet and exhaust valves are different.

Exhaust bridge with DEB

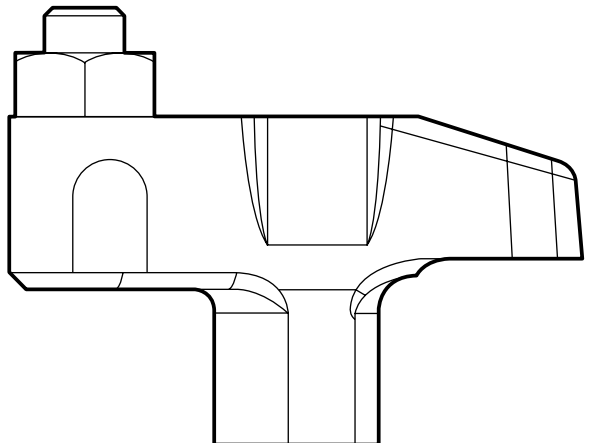


i 400162

Note:

In engines without a DEB, the bridges of the inlet and exhaust valves are the same.

Exhaust bridge without DEB



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- Remove the bridge from the valves and place it in a vice.

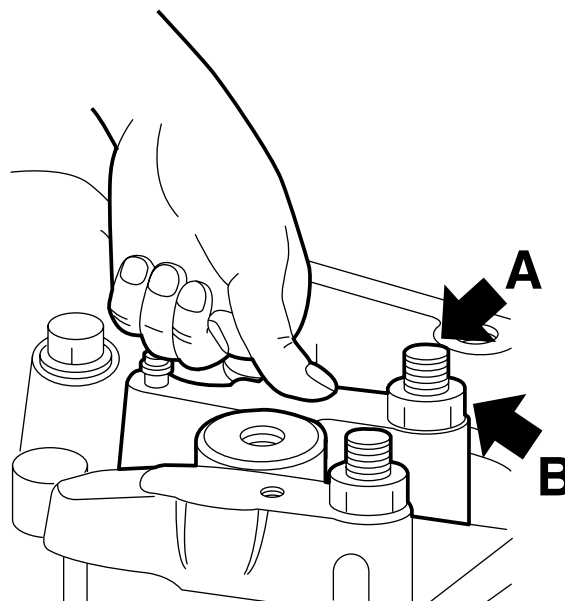


Loosening and tightening the lock nuts (B) of the bridges may cause severe damage to the valve guides if the bridge is fitted over the valves.

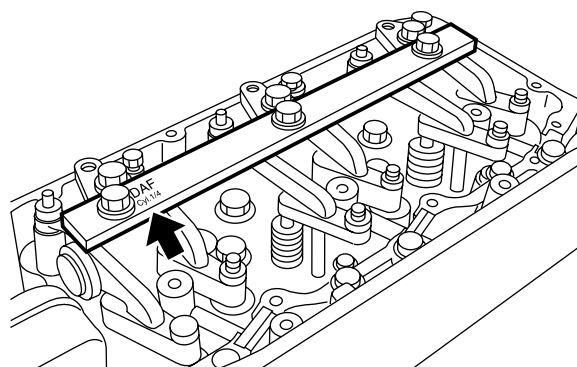
- Slacken the lock nut (B).
- Reposition the bridge in the same position in the engine over the valves.
- Firmly press on the bridge centre (above the guide pin) with your thumb and hand-tighten the adjusting screw (A) until the bridge starts to move (the adjusting screw (A) now touches the valve).
- Turn the adjusting screw (A) through another 90° and carefully remove the bridge from the valves.
- Place the bridge in a vice and tighten the lock nut (B) to the specified torque without turning the adjusting screw (A). See "Technical data".

Note:

Loosening and tightening the lock nuts (B) of the bridges may cause severe damage to the valve guides if the bridge is fitted over the valves.



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M200548

- Reposition the bridge over the valves.
- Fit the rocker seat.
- Fit the DEB or the lubricating oil strip (depending on version). Fit the lubricating oil strip in such a way that the mark "cyl. 1/4" is located on cylinder 1 or cylinder 4.
- Set the valve clearance and, if applicable, the DEB clearance (see "Technical data").
- Fit the valve covers. See "Removal and installation".

3.2 REMOVAL AND INSTALLATION, VALVE COVER



When the engine or parts thereof are opened, dirt may penetrate. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the valve cover

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

Installing the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Fit the valve cover using a new valve cover gasket.
3. Fit the attachment bolts of the valve cover and tighten them to the specified torque. See the main group "Technical data".

3.3 INSPECTION AND ADJUSTMENT, TIMING GEAR

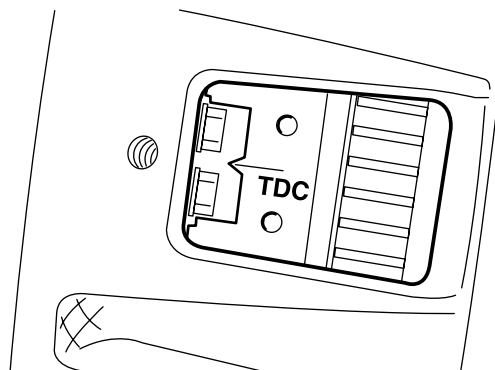
Checking the timing gear

1. Remove the valve cover from cylinders 1-2-3. See "Removal and Installation".
2. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
3. Remove the timing gear cover. See "Removal and installation".

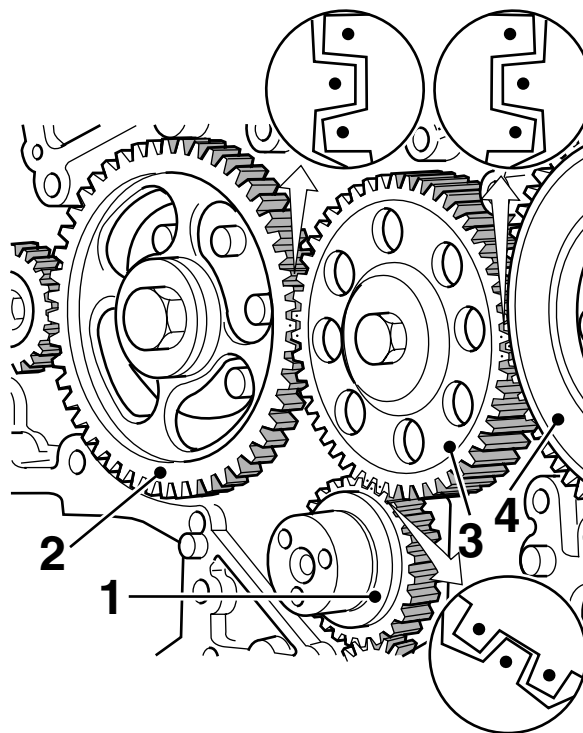
Note:

When the crankshaft (1) or the camshaft (2) of an engine is rotated separately without an idler gear (3), the engine's pistons may touch the valves.

4. Remove the idler gear (3). See "Removal and installation".
5. Now put the idler gear (3) back in such a way that the marks on it line up with the marks on the camshaft gear (2), the crankshaft gear (1) and the pump housing gear (4).
6. If the marks are not in line, the timing gear must be adjusted.
7. Tighten all attachment bolts that have been removed to the specified torque. See "Technical data".



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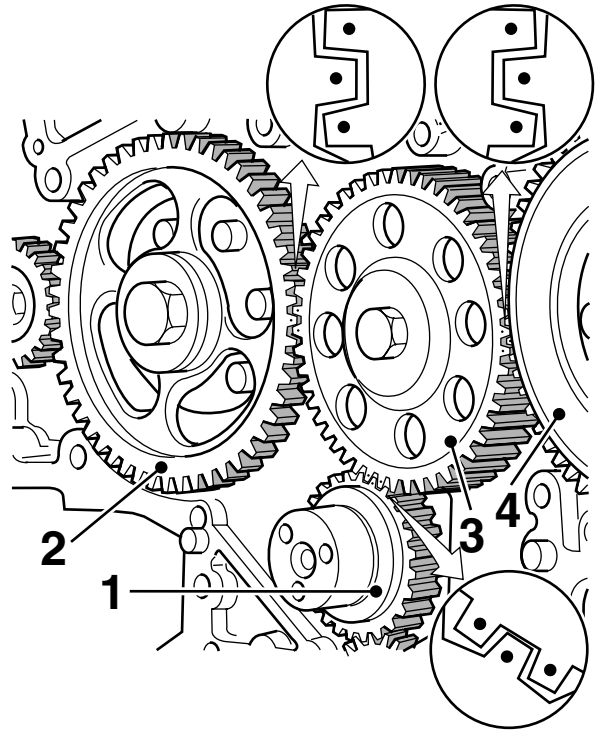
Adjusting the timing gear

1. Remove the valve cover from cylinders 1-2-3. See "Removal and Installation".
2. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
3. Remove the timing gear cover. See "Removal and installation".

Note:

When the crankshaft (1) or the camshaft (2) of an engine is rotated separately without an idler gear (3), the engine's pistons may touch the valves.

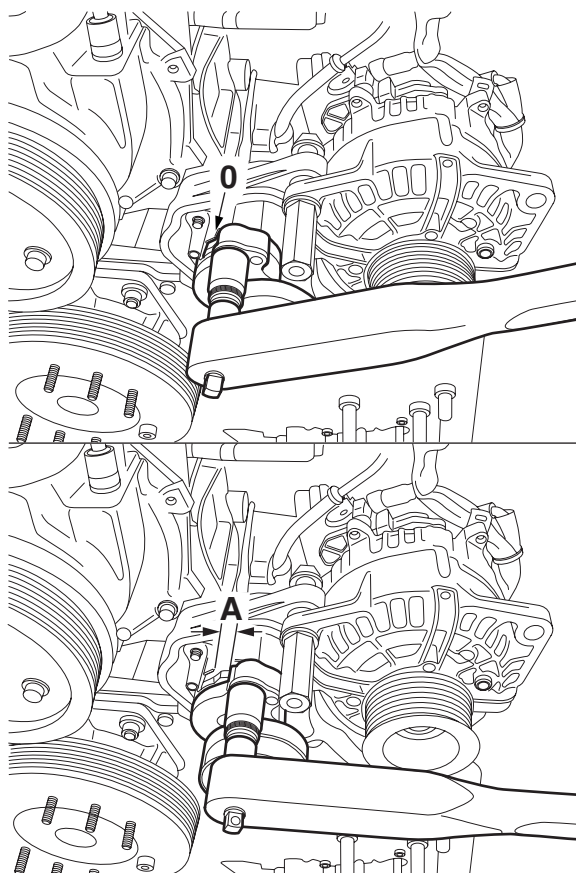
4. Remove the idler gear (3). See "Removal and installation".
5. Rotate the camshaft gear (2) to such a position that the idler gear (3) can be installed in accordance with the marks.
6. Fit the idler gear and tighten the attachment bolt to the specified torque. See "Technical data".
7. Fit the timing cover. See "Removal and installation".
8. Fit the valve cover. See "Removal and installation".



M201281

3.4 INSPECTION OF AUTOMATIC POLY-V-BELT TENSIONER**Inspection of automatic poly-V-belt tensioner**

1. Remove the poly-V-belt and switch off the automatic tensioner (0). See "Removal and installation".
2. Place a torque wrench on the hexagonal head of the automatic tensioner.
3. At the specified torsional distance (A) the torsional moment must have a certain value. See "Technical data".
The automatic tensioner must be replaced if the measured value is not the same as the check value.
4. Fit the poly-V-belt. See "Removal and installation".

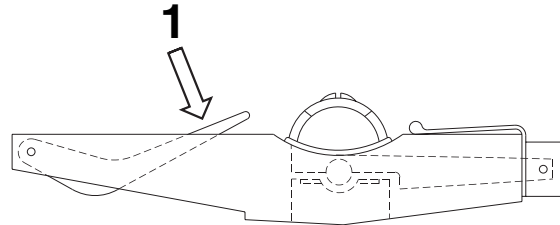


M201274

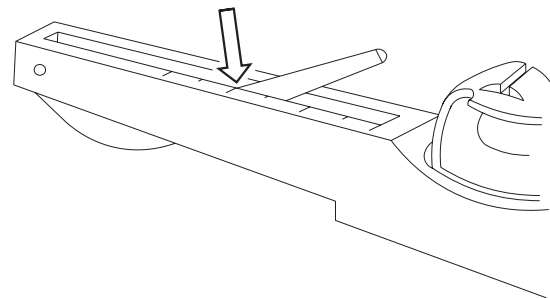
3.5 INSPECTION AND ADJUSTMENT, V-BELT TENSION

Inspecting the V-belt tension

1. Check the V-belt tension of the air conditioning compressor drive using the Kriket I, special tool (DAF no. 1240442). Check the V-belt tension of the FAX model steering pump drive using the Kriket II, special tool (DAF no. 1240443).
2. Set the gauge to zero by depressing the measuring arm (1).
3. Place the belt tension gauge on the V-belt, halfway between the two pulleys.
4. 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 not to let the measuring arm move.
5. Take the reading as indicated by the position of the measuring arm in relation to the scale. Compare this reading with the recommended pre-tension, see "Technical data".



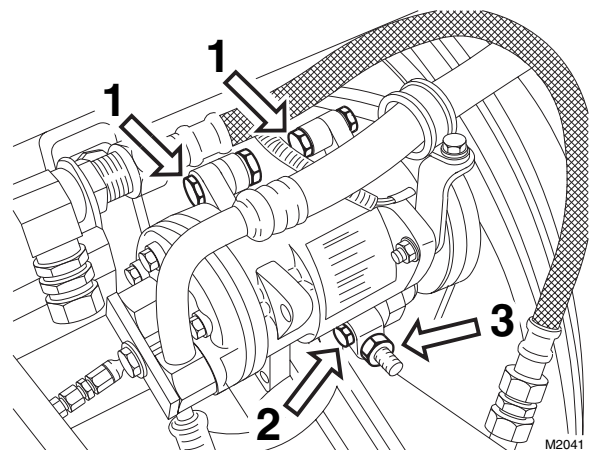
M2061



M2062

Adjust V-belt tension of air conditioning compressor drive

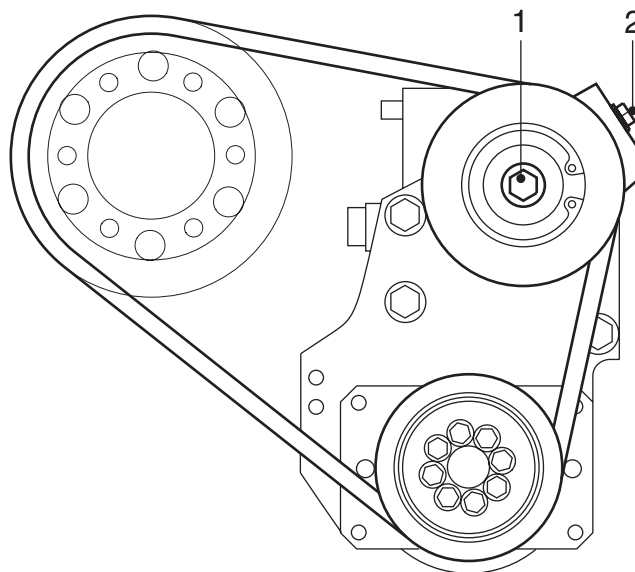
1. Slacken the upper attachment bolt (1) of the compressor.
2. Slacken the lower attachment bolt (2) of the compressor.
3. Loosen the attachment bolt from the threaded spindle which is attached to the coolant pump.
4. Shift the compressor using the lock nuts (3) until the correct V-belt tension is achieved, see "Technical data".



M2041

Adjusting V-belt tension of FAX model steering pump

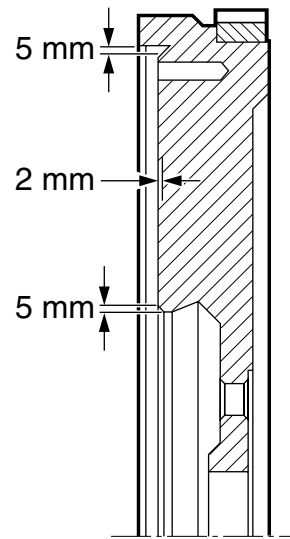
1. Slacken the central bolt (1) of the tension roller.
2. Turn the adjusting bolt (2) until the V-belt tension is correct, see "Technical data".
3. Tighten the central bolt (1) to the specified tightening torque, see "Technical data".



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3.6 INSPECTION, FLYWHEEL

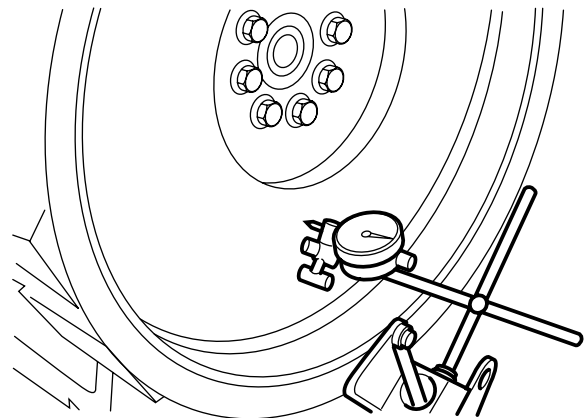
1. If the flywheel shows cracks on the abutting surface with the clutch plate, the flywheel may be ground down, provided that the cracks are not within 5 mm of the inner rim.
2. The flywheel has an indicator groove for inspection purposes.
3. Grinding down is allowed until the indicator groove is no longer visible. This means that a maximum of 2 mm may be ground down.



M2 00 033

Checking flywheel run-out

1. Clean the flywheel.
2. Place a metal strip on the edge of the flywheel housing to fit a dial gauge.
3. Place the dial gauge on the metal strip.
4. Place the stylus of the dial gauge at the specified distance. See "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 dial gauge reading. Compare this reading with the technical data. See "Technical data".



M200230

3.7 INSPECTION, CYLINDER HEAD

1. Check the sealing plugs of the cylinder head for leaks. If necessary, pressure-test the cylinder head.
2. Inspect the cylinder head for damage to the sealing surface and any cracks. If necessary, have the cylinder head levelled. See "Technical data".

3.8 INSPECTION, ENGINE COMPRESSION PRESSURE



Be careful when working on an engine at operating temperature. Hot lubricating oil may escape from the engine when it is run without the valve covers. Make sure you are adequately protected.

A compression measurement is a quick check of the sealing of the valves and the head gasket, and of the sealing between the cylinder liner and the piston rings.

The results of the measurements can only be used to compare the cylinders with each other.

1. Bring the engine up to operating temperature.
2. Remove the engine management system supply fuse or supply relay, so that the pump units cannot be activated.
3. Remove the valve covers. See "Removal and installation".
4. Remove the injectors.
5. Turn the engine a number of times using the starter motor, so that any carbon or dirt particles in the cylinder are removed.
6. Fit 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 pressure differences permitted between individual cylinders see "Technical data".
8. Remove the dummy injector and fit the injectors.
9. Fit the valve covers. See "Removal and installation".
10. Fit the fuse or relay.

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, ENGINE



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

Various fluids will be released when fluid pipes are removed.

Collect these fluids. Personal safety and the risk of fire should always be considered.

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 most important points requiring attention.

- Disconnect the earth lead from the battery terminal.
- Avoid opening fluid systems as much as possible. If possible, remove and set 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 that are freed.
- Wiring harnesses are vulnerable. If damaged, they may cause failures. Make sure these wiring harnesses are stress-free and clear of moving parts.
- Fit all attachment bolts and tighten them to the correct torque.
- The engine should not be allowed to rest on the oil sump. Because the oil sump is made of sheet material, it will be severely damaged by the engine's weight.

4.2 REMOVAL AND INSTALLATION, ENGINE MOUNTS

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

Note:

If the engine is lifted slightly it is not necessary to disconnect coolant hoses, air inlet hoses and torque rods between the engine and the radiator.

Removing the engine mounts

1. Disconnect the earth lead from the battery terminal.
2. Suspend the engine securely in the hoist.
3. Remove the central engine mount fixing bolts at the front and/or rear of the engine.
4. Remove the engine mounts.

Installing the engine mounts

1. Fit the engine mounts.
2. Tighten the engine mount attachment bolts to the specified torque. See "Technical data".
3. Connect the battery earth lead.

4.3 REMOVAL AND INSTALLATION, VALVE COVER



When the engine or parts thereof are opened, dirt may penetrate. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the valve cover

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

Installing the valve cover

1. Clean the sealing surface of the valve sleeve and the valve cover.
2. Fit the valve cover using a new valve cover gasket.
3. Fit the attachment bolts of the valve cover and tighten them to the specified torque. See the main group "Technical data".

4.4 REMOVAL AND INSTALLATION, VALVE GEAR

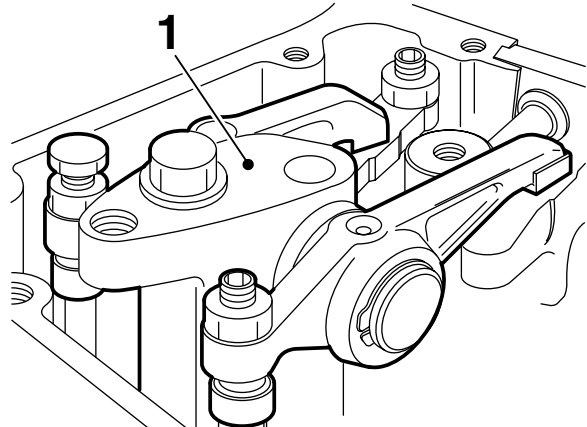
Removing the valve gear

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

Note:

Number the rocker seats (1) and the bridges (2-3-4) to allow reinstallation in the same position.

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



M200559

Installing the valve gear

Note:

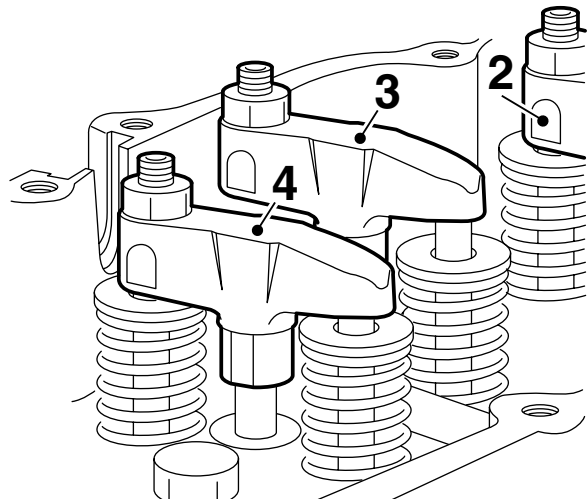
In engines with a DEB, the bridges of the inlet and exhaust valves are different.
In engines without a DEB, the bridges of the inlet and exhaust valves are the same.

1. Fit the bridges (2-3-4) on the valves.
2. Set the bridges (2-3-4). See "Inspection and adjustment".
3. Hand-tighten the rocker seats (1).

Note:

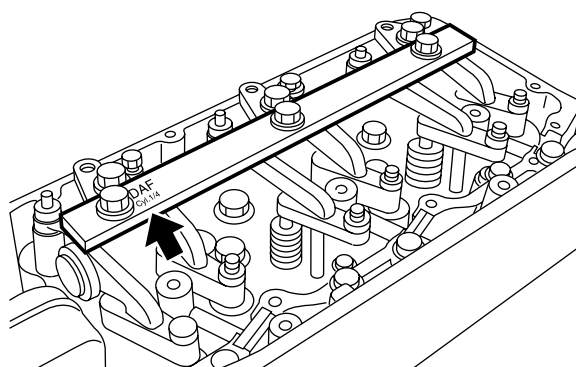
Depending on the engine position, some rocker seats will have to be positioned against the pressure of the valve springs. The rocker seat will resist this spring pressure and cannot therefore be positioned correctly. By cranking the crankshaft $\frac{1}{3}$ turn each time using the special tool (DAF No. 1310477), the rocker seats can be tightened in the injection sequence 1-5-3-6-2-4.

4. Tighten the attachment bolts to the specified torque. See "Technical data".



M200560

5. Fit the DEB or the lubricating oil strip (depending on version). Fit the lubricating oil strip in such a way that the mark "cyl. 1/4" is located on cylinder 1 or cylinder 4. For the tightening torques of the attachment bolts, see "Technical data".
6. Set the valve clearance and, if applicable, the DEB clearance. See "Inspection and adjustment".
7. Fit the valve covers.



M200548

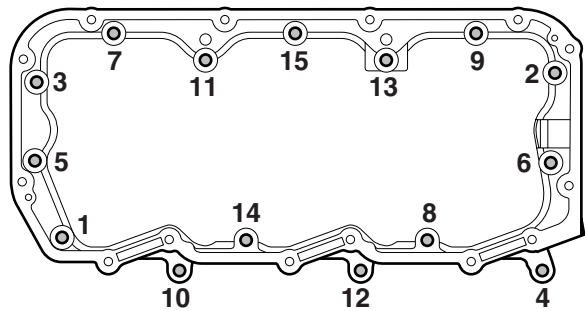
4.5 REMOVAL AND INSTALLATION, VALVE SLEEVE

Removing the valve sleeve

1. Remove the injection pipes in sets.
2. Remove the valve covers.
3. If necessary, disconnect the electrical connection of the DEB.
4. If necessary, remove the cable harness from the DEB or the plug from the valve sleeve.
5. If fitted, remove the DEB.
6. Remove the injectors.
7. Remove the valve gear.
8. Remove the push rods.
9. Remove the valve sleeve and gasket.

Installing the valve sleeve

1. Fit the valve sleeve with a new gasket and tighten the attachment bolts to the specified torque and in the correct sequence. See "Technical data".
2. Fit the push rods
3. Fit the injectors.
4. Fit the valve gear.
5. If necessary, fit the DEB.
6. If necessary, fit the DEB cable harness or the plug in the valve sleeve.
7. If fitted, connect the electrical connections of the DEB.
8. Fit the valve covers.
9. Fit the injector pipes in sets.



M200942

4.6 REMOVAL AND INSTALLATION, INLET MANIFOLD

Removing the inlet manifold

1. Disconnect the electrical wiring on the inlet manifold.
2. Remove the fuel leak-off pipe between the fuel filter and inlet manifold.
3. Remove the coolant filter, if applicable.
4. Remove the entire fuel filter from the inlet manifold.
5. Disconnect the injector pipes.
6. Remove the attachment bolts from the inlet manifold and remove it.

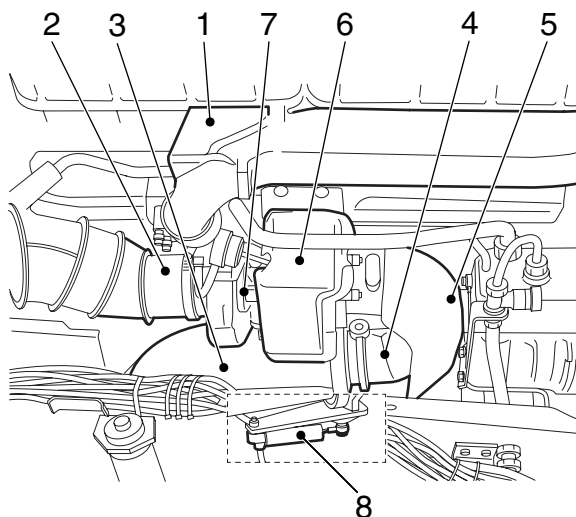
Installing the inlet manifold

1. Carefully clean the sealing surfaces of the inlet manifold and the cylinder head.
2. Fit new gaskets to the inlet manifold and fit the manifold. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the fuel leak-off pipe between the fuel filter and the inlet manifold.
4. Fit the injector pipes.
5. Fit the complete fuel filter.
6. Fit the coolant filter.
7. Connect the electrical wiring.

4.7 REMOVAL AND INSTALLATION, EXHAUST MANIFOLD

Removing the exhaust manifold

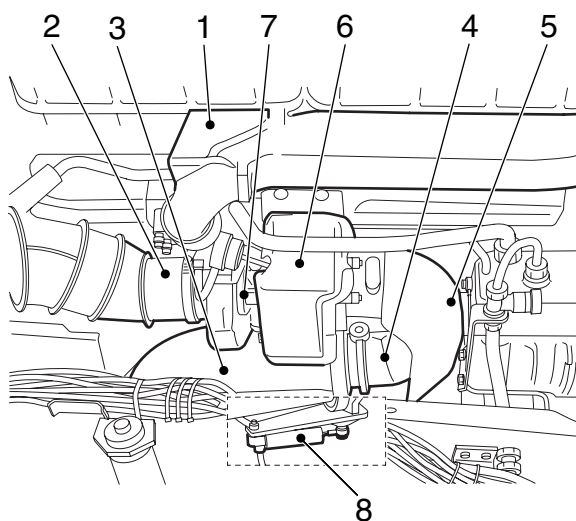
1. Take the exhaust brake cylinder (8) off the butterfly valve (4).
2. Remove the clamping strip from the exhaust brake (4).
3. Remove the air inlet hose (2).
4. Remove the inlet air pipe (1) between the turbocharger and the intercooler.
5. Remove the compressor pipe.
6. Remove the heat shields from the exhaust manifold.
7. Remove the oil supply and oil discharge pipes from the turbocharger.
8. Remove the attachment bolts from the exhaust manifold and remove the manifold along with the turbocharger.



i400671

Installing the exhaust manifold

1. Fit new gaskets to the exhaust manifold and install the manifold. Tighten the attachment bolts with the spacer sleeves to the specified torque. See "Technical data".
2. Install the heat shields of the exhaust manifold. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the heat shields for the oil discharge pipe.
4. Spray clean engine oil into the oil supply of the turbocharger and fit the oil supply pipe.
5. Fit the compressor pipe.
6. Fit the inlet air pipe (1) between the turbocharger and the intercooler.
7. Connect the air inlet hose (2).
8. Fasten the clamping strip of the exhaust brake (4).
9. Fit the exhaust brake cylinder (8) onto the butterfly valve (4).
10. Start the engine and check all connections for leaks.



i400671

4.8 REMOVAL AND INSTALLATION, CYLINDER HEADS



When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the cylinder heads

1. Disconnect any wiring around the engine which is relevant for the removal of the cylinder heads.
2. Disconnect the inlet pipe from the turbocharger to the air cooler.
3. Disconnect the compressor pipe from the air intake pipe to the compressor.
4. Slacken the tensioner of the air-conditioning compressor, if fitted.
5. Remove the attachment bolts of the air-conditioning compressor mounting bracket, if fitted.
6. Remove the heat shields from the exhaust manifold.
7. Remove the attachment bolts from the exhaust manifold and remove the manifold and the turbocharger from the cylinder heads.
8. Remove the coolant filter, if fitted.
9. Disconnect the fuel leak-off pipe between the fuel filter and the fuel leak-off pipe on the inlet manifold.
10. Disconnect the fuel filter assembly from the coolant pipe.
11. Disconnect both sets of injector pipes.
12. Remove the coolant pipe together with the thermostat housing.
13. Remove the inlet manifold attachment bolts and remove the entire manifold from the cylinder heads.
14. Remove the valve covers.
15. If fitted, remove the DEB.

- 16. To remove the injectors and the clamping pieces, **only** use the special tools (DAF no. 1329412) and (DAF no. 0694928).
- 17. Remove the valve gear.
- 18. Remove the push rods.

Note:

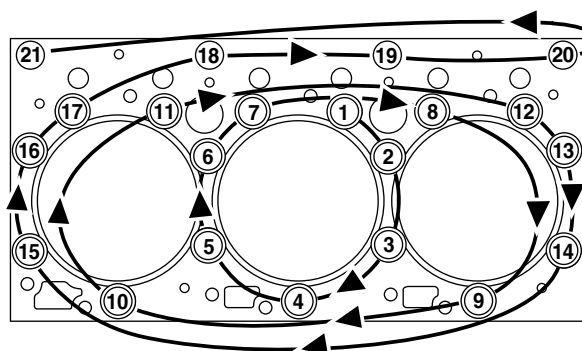
Make sure that any solid push rods (yellow marking and diameter 12 mm) are fitted back on the **inlet side** only. These solid push rods may be replaced by hollow ones (diameter 14 mm).

- 19. Remove the valve sleeve.

Note:

Due to the sealant used on the cylinder head bolts, the untightening torque of the cylinder head bolts can be substantial!

- 20. Remove the cylinder head bolts in the **reverse** order to that shown.
- 21. Remove the cylinder heads from the cylinder block.

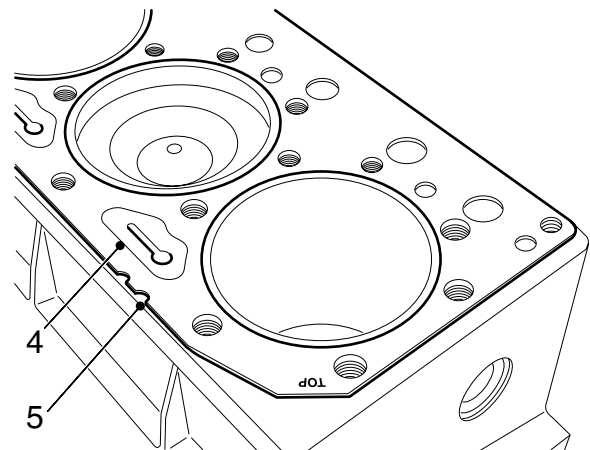
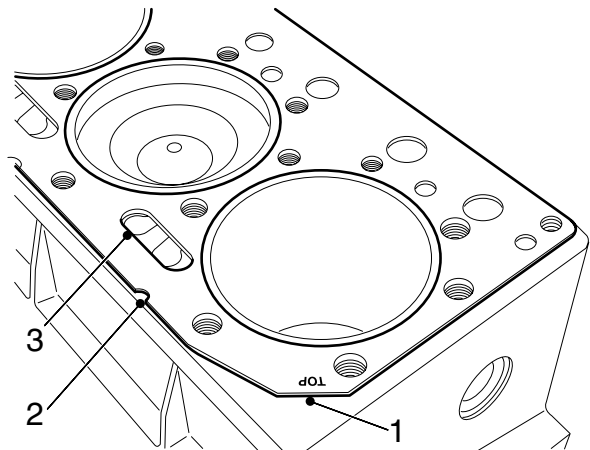


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Note:

Note the markings (2, 5) on the cylinder head gasket to be replaced and use the same gasket when fitting. The cylinder head gaskets can also be recognised from the coolant holes (3, 4).

22. Remove any remnants of gasket from the cylinder heads and the cylinder block.
23. Check the sealing surfaces of the cylinder block.
24. Check the threaded holes in the cylinder block for damage and cracking.



M201278

25. Using the special tool (DAF no. 0694795), check that the amount the cylinder liner protrudes above the cylinder block is within tolerance. See "Technical data".
26. Check the cylinder head. See "Inspection and adjustment".

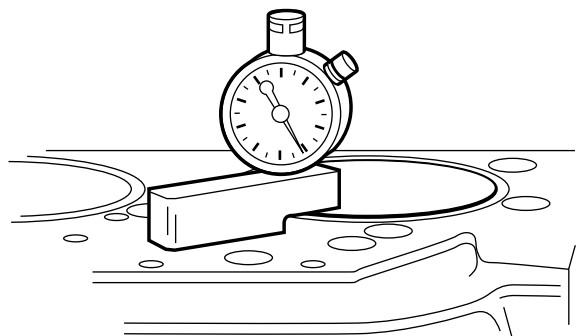
Installing the cylinder heads

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

Note:

Threaded holes not properly cleaned may lead to too low a pre-tension of the cylinder head bolts, causing leakage.

2. Clean and degrease the sealing surfaces of the cylinder heads and the cylinder block.
3. Insert both guide pins (DAF no. 0694912) into the threaded holes of the cylinder block.



M2 00 100

- Place the new gasket(s) on the cylinder block, making sure that the letters **TOP** (1) are visible. The cylinder head gasket **must not be retightened**.

Note:

Always replace the cylinder head bolts. See "Technical data".

- Place the cylinder head(s) on the cylinder block and hand-tighten a few new cylinder head bolts.

Note:

To prevent the inlet and exhaust manifolds from being installed under tension, they must be installed before the cylinder head bolts are tightened.

- Fit the inlet and exhaust manifolds with new gaskets and tighten the attachment bolts to the specified torque. See "Technical data".

- Fit the remaining bolts (M16 and M12) and apply a drop of oil to the bearing surface of the bolt heads.

- Remove the two guide pins and replace them with the two remaining cylinder head bolts.

- Tighten the cylinder head bolts to the specified torque and in the correct sequence. See "Technical data".

- Fit the valve sleeve.

- Fit the push rods

Note:

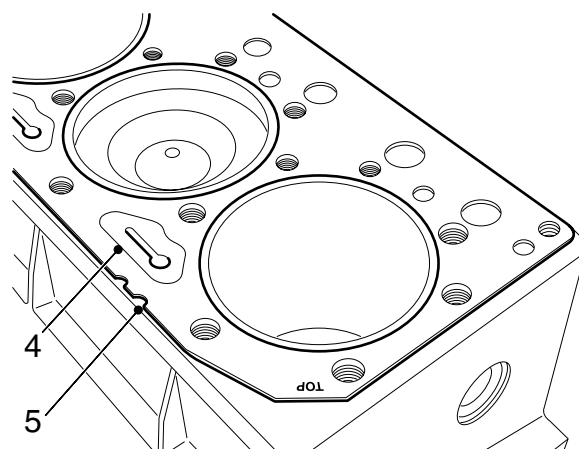
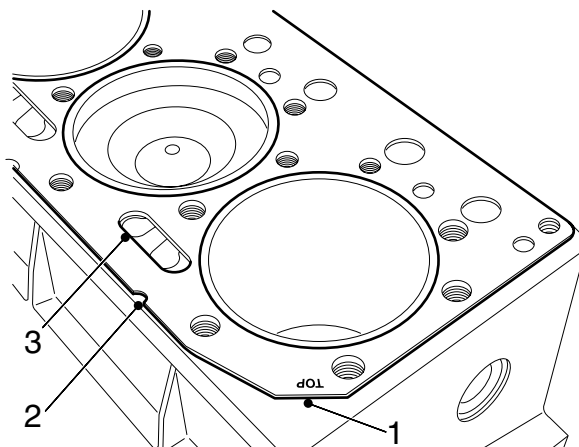
Make sure that any solid push rods (yellow marking and diameter 12 mm) are fitted back on the **inlet side** only. These solid push rods may be replaced by hollow ones (diameter 14 mm).

- Fit the valve gear.

- Fit the injectors.

- If necessary, fit the DEB.

- Fit the valve covers.



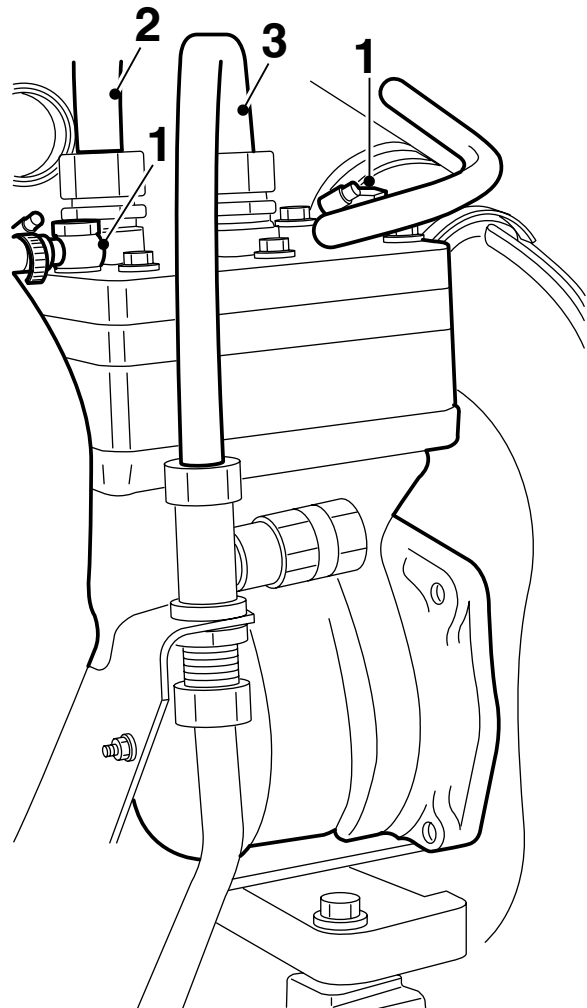
M201278

16. Fit the coolant pipe, fit new gaskets to the thermostat housing and install it.
17. Fit the injector pipes in sets.
18. Fit the fuel filter onto the coolant pipe.
19. Fit the fuel leak-off pipe between the fuel filter and the inlet manifold.
20. If applicable, fit the coolant filter to the coolant pipe.
21. Fit the heat shields of the exhaust manifold and tighten the attachment bolts to the specified torque. See "Technical data".
22. If applicable, fit the air-conditioning bracket.
23. Adjust the V-belt tension of the air-conditioning compressor.
24. Connect the compressor pipe from the charge pipe to the compressor.
25. Connect the inlet pipe between the turbocharger and the air cooler.

4.9 REMOVAL AND INSTALLATION, AIR COMPRESSOR

Removing the air compressor

1. Partially drain the coolant.
2. Remove the coolant connections (1).
3. Disconnect 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 rear of the compressor.
7. Remove the attachment bolts from the timing cover.
8. Remove the compressor from the timing case. Remove the O-ring from the compressor housing.



R600246

Installing the air compressor

1. Fit a new O-ring to the compressor housing and fit the compressor to the timing case.
2. Fit the air compressor attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the mounting bracket at the rear of the compressor. Tighten the attachment bolts to the specified torque. See "Technical data".
4. Fit the service pipe.
5. Fit the lubricating oil pipe.
6. Fit the air pipes (2 and 3).
7. Fit the coolant pipes (1).
8. Fill the cooling system with the specified coolant. See "Fluids and lubricants" specifications manual.

4.10 REMOVAL AND INSTALLATION, STEERING PUMP

Removing the steering pump

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

Installing the steering pump

1. Fit a new O-ring.
2. Fit the steering pump and tighten the attachment bolts to the specified torque. See "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 "Technical data".
4. Fill the oil reservoir with the specified oil. See "Fluids and lubricants" specifications manual.
5. Bleed the steering system.
6. Check the pipes for leaks.

4.11 REMOVAL AND INSTALLATION, STARTER MOTOR**Removing the starter motor**

1. Disconnect the earth lead from the battery terminal.
2. Disconnect the contacts of the starter motor.
3. Remove the noise insulation cover if fitted.
4. Remove the starter motor. Check the starter pinion for damage.

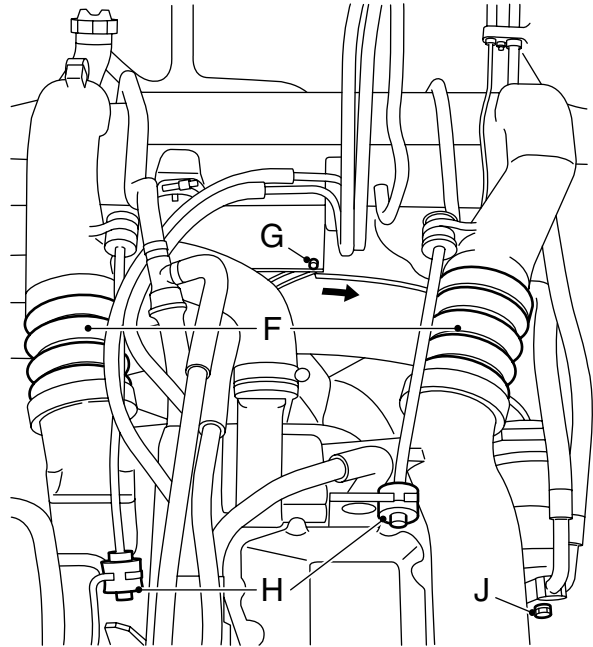
Installing the starter motor

1. Clean the contact surfaces of the starter motor and the flywheel housing.
2. Fit the starter motor and tighten the attachment nuts to the specified torque. See "Technical data".
3. Connect the starter motor.
4. Check the operation of the starter motor.
5. Fit the noise insulation cover.
6. Fit the earth cable.

4.12 REMOVAL AND INSTALLATION, POLY-V-BELT

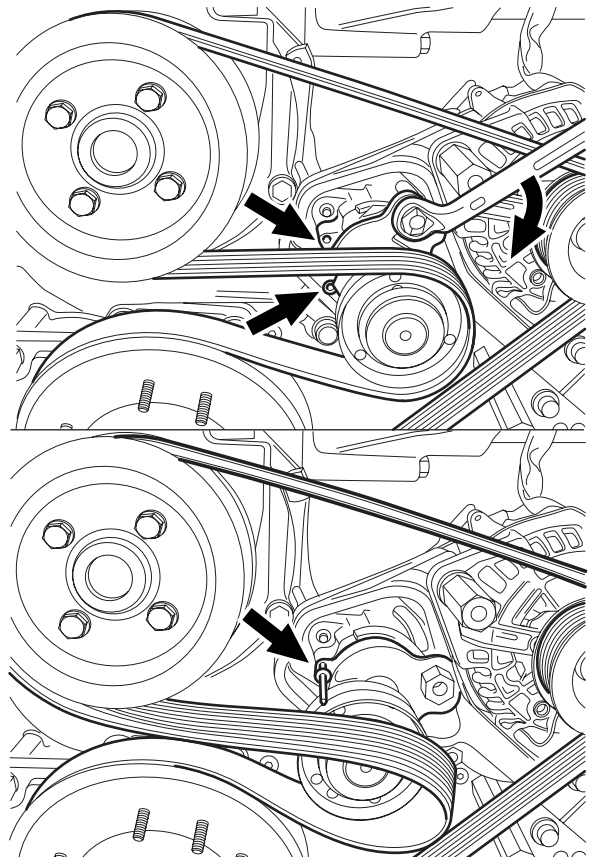
Removing the poly-V-belt

1. Remove the locking screw from the wind tunnel collar (G) and turn the latter towards the radiator.



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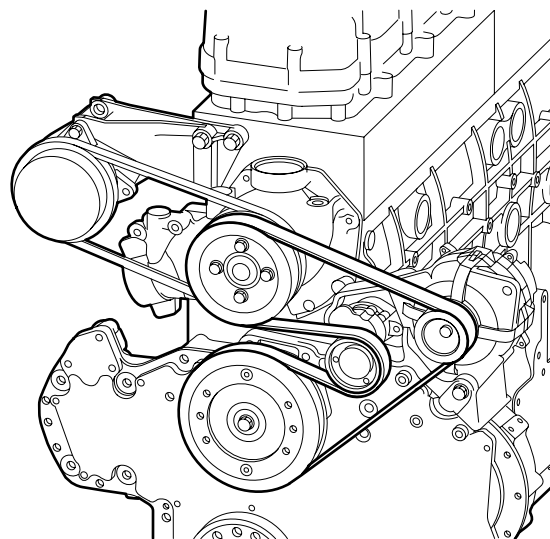
2. Move the tensioner against the spring force and lock it with a 4 to 5 mm thick pin (bore).
3. Loosen the connector of the electric fan clutch, if fitted, and remove the wiring from the bracket.
4. Take the poly-V-belt off over the fan.
5. Inspect the automatic tensioner. See "Inspection and adjustment".



M201275

Installing the poly-V-belt

1. Inspect the belt pulleys for damage, rust and grease deposits.
2. Pull the poly-V-belt over the fan.
3. Pull the poly-V-belt over the coolant pump, fan drive and alternator pulleys and push it between the pulleys in the direction of the tensioner.
4. Move the tensioner against the spring tension and fit the poly-V-belt.
5. If applicable, fit the electric fan clutch connector and connect the wiring ensuring that it is clear of moving parts.
6. Install the wind tunnel collar and fit the locking screw (G).

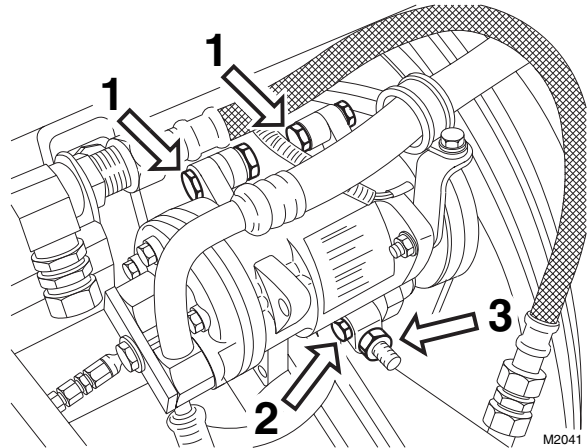


M201066

4.13 REMOVAL AND INSTALLATION, AIR-CONDITIONING COMPRESSOR V-BELT

Removing the air-conditioning compressor V-belt

1. Remove the poly-V-belt from the coolant pump.
2. Slacken the upper attachment bolt (1) of the compressor.
3. Slacken the lower attachment bolt (2) of the compressor.
4. Slacken the attachment bolt of the threaded spindle which is fitted to the coolant water pump.
5. Turn the lock nuts (3) on the threaded spindle so that the compressor tilts towards the cylinder block and the V-belt can be removed.



Fitting the air-conditioning compressor V-belt

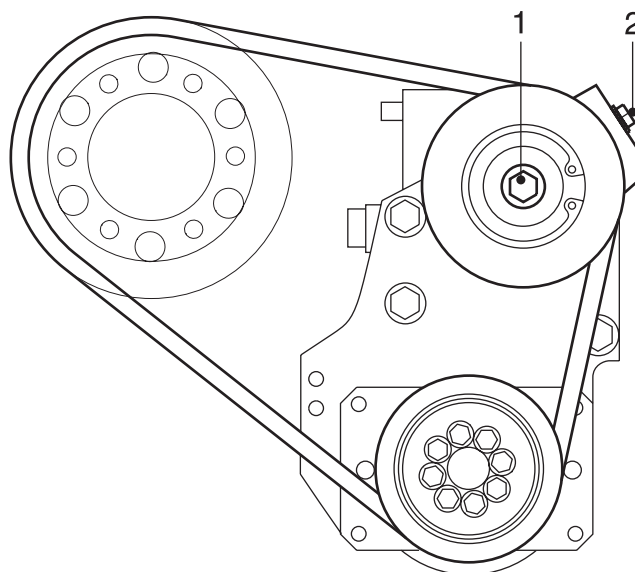
1. Inspect the pulleys for damage, rust and greasy deposits.
2. Fit the new air-conditioning compressor V-belt and adjust the V-belt tension. See "Inspection and adjustment".
3. Install the poly-V-belt on the coolant pump.

4.14 REMOVAL AND INSTALLATION, FAX MODEL STEERING PUMP V-BELT**Removing V-belt of FAX model steering pump**

1. Unscrew the central tensioner (1) bolt.
2. Unscrew the adjusting bolt (2) until the V-belt can be removed.

Fitting V-belt of FAX model steering pump

1. Inspect the pulley discs for damage, rust and greasy deposits.
2. Fit the new steering pump V-belt and adjust the V-belt tension. See "Inspection and adjustment".
3. Tighten the central bolt (1).



G0 00 270

4.15 REMOVAL AND INSTALLATION, ALTERNATOR

Removing the alternator

1. Disconnect the earth lead from the battery terminal.
2. Disconnect the electrical connections from the alternator.
3. Move the tensioner against the force of the spring and lock the tensioner. Remove the poly-V-belt from the alternator pulley.
4. Remove the attachment bolts from the alternator and remove it.
5. Dismount the alternator pulley and discard it if the alternator is to be replaced.

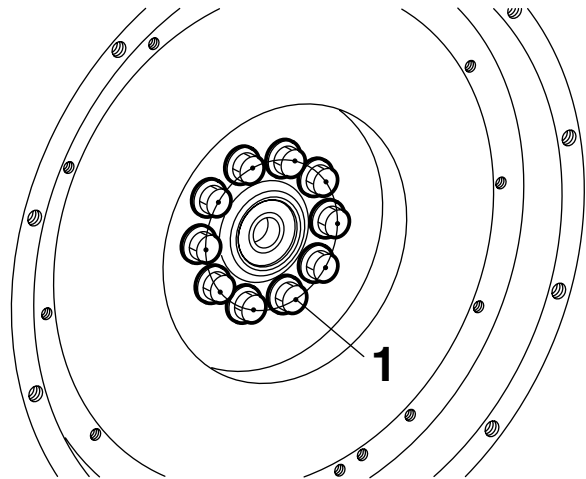
Installing the alternator

1. Fit the alternator pulley (if removed) and tighten the nut to the specified torque. See "Technical data".
2. Fit the alternator.
3. Fit the alternator attachment bolts.
4. Place the poly-V-belt over the alternator pulley. Move the tensioner against the force of the spring and remove the tensioner lock.
5. Fit the electrical connections of the alternator.
6. Fit the earth cable.

4.16 REMOVAL AND INSTALLATION, FLYWHEEL

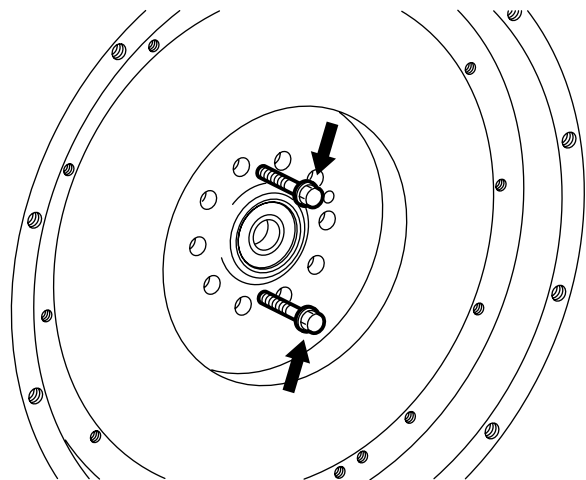
Removing the flywheel

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



M200569

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



M200570

Installing the flywheel

1. Clean the flywheel housing.
2. Clean the crankshaft flange, the dowel pin and the attachment bolts. Remove the locking compound from the threaded holes.
3. Clean the back of the flywheel and fit it.
4. Fit the attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Fit the clutch plate and the clutch release assembly.
6. Fit the gearbox.

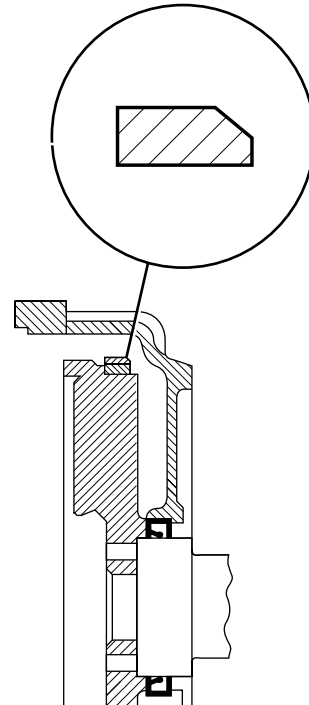
4.17 REMOVAL AND INSTALLATION, STARTER RING GEAR

Removing the starter ring gear

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

Installing the starter ring gear

1. Clean the flywheel and the starter ring gear. Ensure that the contact areas are free of grease.
2. Heat the new starter ring gear evenly in an oven. See "Technical data".
3. Tap the starter ring gear onto the flywheel so that the bevelled sides of the teeth point towards the starter motor. Ensure that the starter ring gear is properly fitted to the flywheel.
4. Fit the flywheel.



M2 00 035

4.18 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING SEAL

Note:

A new oil seal is fitted on a plastic mounting ring. The oil seal must not be removed from the mounting ring until the oil seal ring has been pressed into the flywheel housing by hand.

Removing the flywheel housing seal

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

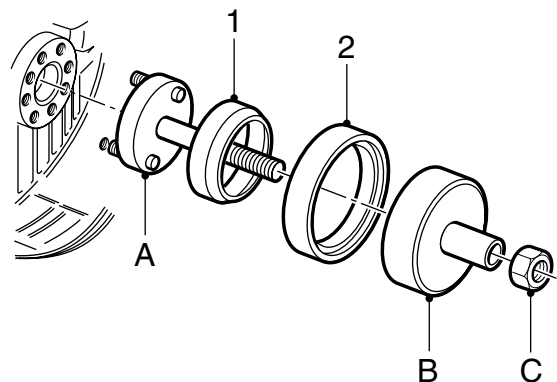
Installing the flywheel housing seal

1. Thoroughly clean the oil seal recess and inspect for damage. Even the slightest damage can cause a leak.
2. Clean the crankshaft flange.

Note:

If a shim was fitted in the seal recess, it must be re-fitted.

3. Fit the plastic mounting ring (1), with the oil seal **dry**, to the crankshaft flange.
4. Press the oil seal (2) as far as possible into the recess by hand and then carefully remove the plastic mounting ring (1).
5. Fit the base plate (A) of the special tool (DAF no. 0535598) on the crankshaft flange.
6. Place the thrust washer (B) over the base plate (A) and gradually tighten the nut (C) until the resistance increases.
7. Remove the nut (C) and thrust washer (B).
8. Make sure that the entire oil seal is positioned evenly in the recess. If not, fit the thrust washer (B) again and tighten the oil seal a little further with the nut (C).
9. Remove the base plate (A).
10. Fit the flywheel and tighten the bolts to the specified torque. See "Technical data".



M2 00 036

4.19 REMOVAL AND INSTALLATION, FLYWHEEL HOUSING

Removing the flywheel housing

1. Remove the flywheel.
2. Disconnect the earth lead from the flywheel housing.
3. Remove the starter motor.
4. Remove the crankshaft position sensor.
5. Suspend the engine securely in the hoist.
6. Remove the two bolts attaching the oil sump to the flywheel housing.
7. Slacken the other oil sump attachment bolts until the oil sump is free from the flywheel housing.
8. Remove the central engine mounting attachment bolts at the rear of the engine.
9. Remove the flywheel housing attachment bolts.
10. Remove the flywheel housing.

Installing the flywheel housing

1. Remove the oil seal from the flywheel housing by carefully tapping or pushing it out of the housing.
2. Remove any gasket remnants from the contact areas.
3. Check the sealing surfaces for damage.
4. Check the flywheel housing for cracks.
5. Apply a locking compound to the sealing surface of the cylinder block. See "Technical data". Spread the sealing compound with a roller or brush across the entire sealing surface.
6. Fit the flywheel housing. Tighten the attachment bolts to the specified torque. See "Technical data".

7. Fit the central engine mounting attachment bolts at the rear of the engine. Tighten the attachment bolts to the specified torque. See "Technical data".
8. Fit the oil seal.
9. Fit the flywheel.
10. Fit the starter motor.
11. Fit the crankshaft position sensor.
12. Clean the contact surface of the earth lead and connect it to the flywheel housing.
13. Fit the oil sump attachment bolts. Tighten all attachment bolts to the specified torque. See "Technical data".

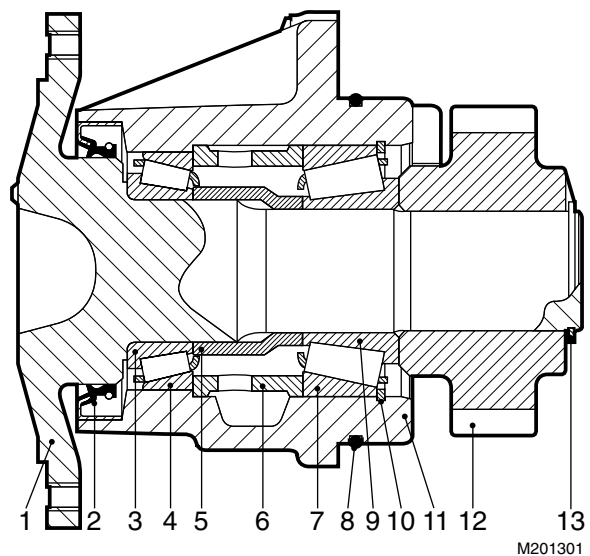
4.20 REMOVAL AND INSTALLATION, FAN DRIVE

Removing the fan drive

1. Remove the attachment nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
2. Remove the poly-V-belt.
3. Remove the fan drive attachment nuts.
4. Remove the fan drive.

Installing the fan drive

1. Fit a new lightly greased O-ring (8) in the groove of the bearing housing (11).
2. Apply engine oil to the bearings in the bearing housing.
3. Fit the fan drive in the timing case. Tighten the attachment nuts crosswise to the specified torque. See "Technical data".
4. Fit the poly-V-belt. Fit the viscous fan clutch with the fan.

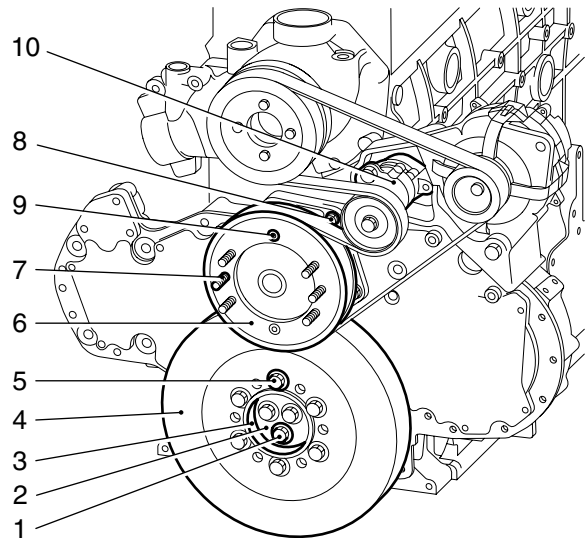


4.21 REMOVAL AND INSTALLATION, VIBRATION DAMPER**Removing the vibration damper**

1. Remove the poly-V-belt.
2. Remove the attachment nuts from the viscous fan clutch. Place the viscous fan clutch and the fan in the wind tunnel.
3. Remove the attachment bolts (9) of the fan pulley (6) and remove it.
4. Remove the attachment nuts (8) of the fan drive and remove it.
5. Remove the attachment bolts (5) of the vibration damper (4) and remove it.

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 "Technical data".
3. Fit the fan drive and tighten the attachment nuts (8) to the specified torque. See "Technical data".
4. Fit the fan pulley (6). Tighten the attachment bolts (9) to the specified torque. See "Technical data".
5. Fit the poly-V-belt.
6. Fit the viscous fan clutch with the fan.



M201153

4.22 REMOVAL AND INSTALLATION, VIBRATION DAMPER HUB

Removing the vibration damper hub

1. Remove the vibration damper.
2. Remove the attachment bolts from the vibration damper hub and remove the thrust piece.

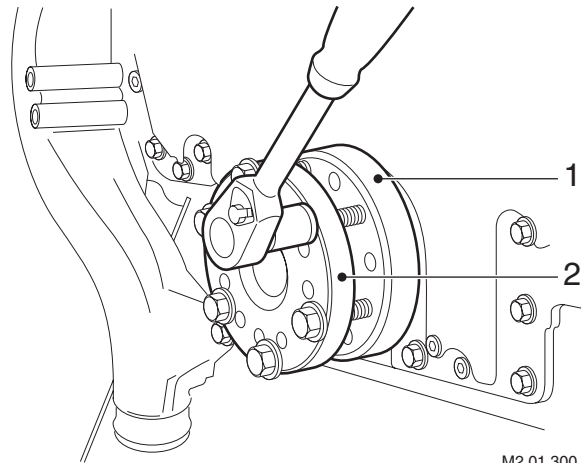


In most cases the vibration damper hub will suddenly break off from the crankshaft during removal. Avoid personal injury and damage to the hub.

3. Remove the vibration damper hub (1) using the special tool (2) (DAF no. 1453155).

Installing the vibration damper hub

1. Fit the vibration damper hub (1) onto the crankshaft.
2. Fit the thrust piece. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Install the vibration damper. Fit the thrust piece. Tighten the attachment bolts to the specified torque. See "Technical data".



M2 01 300

4.23 REMOVAL AND INSTALLATION, TIMING COVER

When the engine or parts thereof are opened, dirt may enter. This may cause serious damage to the engine. Therefore, the engine should be cleaned thoroughly before any parts are opened.

Removing the timing cover

1. Drain the coolant. See "XE engine cooling system".
2. Remove the poly-V-belt.
3. Remove the electrical connections of the alternator and remove the alternator bracket and alternator.
4. Remove the fan drive.
5. Remove the vibration damper.
6. Remove the vibration damper hub using the special tool (DAF no. 1310422).
7. Remove the coolant pipe.
8. Remove the oil filler pipe.
9. Mark the positions of the various attachment bolts and studs.
10. Remove the attachment bolts and studs from the timing cover.
11. Remove the timing cover.
12. Remove any remnants of gasket. Clean and inspect the sealing surfaces, dowels and locating holes.
13. Remove the oil seal from the timing cover.

Installing the timing cover

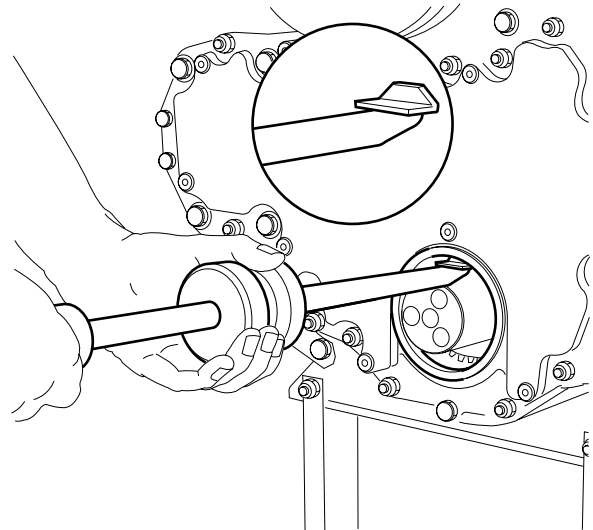
1. Use three studs to position the gasket. Fit the new gasket.
2. Fit the timing cover.
3. Fit the attachment bolts and the studs. Tighten the attachment bolts and studs to the specified torque. See "Technical data".

4. Remove the three studs used to position the gasket and replace them with the remaining attachment bolts.
5. Fit new O-rings to the coolant pipe and fit it.
6. Fit a new O-ring to the oil filler pipe and install the oil filler pipe.
7. Fit the timing cover seal.
8. Fit the vibration damper hub.
9. Install the vibration damper.
10. Fit the fan drive.
11. Fit the alternator bracket and alternator and connect the electrical wiring to the alternator.
12. Fit the poly-V-belt.
13. Fill the cooling system. See "XE engine cooling system".

4.24 REMOVAL AND INSTALLATION, TIMING COVER SEAL

Removing the timing cover seal

1. Remove the poly-V-belt.
2. Remove the vibration damper.
3. Remove the vibration damper hub.
4. Remove the timing cover seal by using the special tool (DAF no. 1329458) to pull the seal out of the cover.



M200971

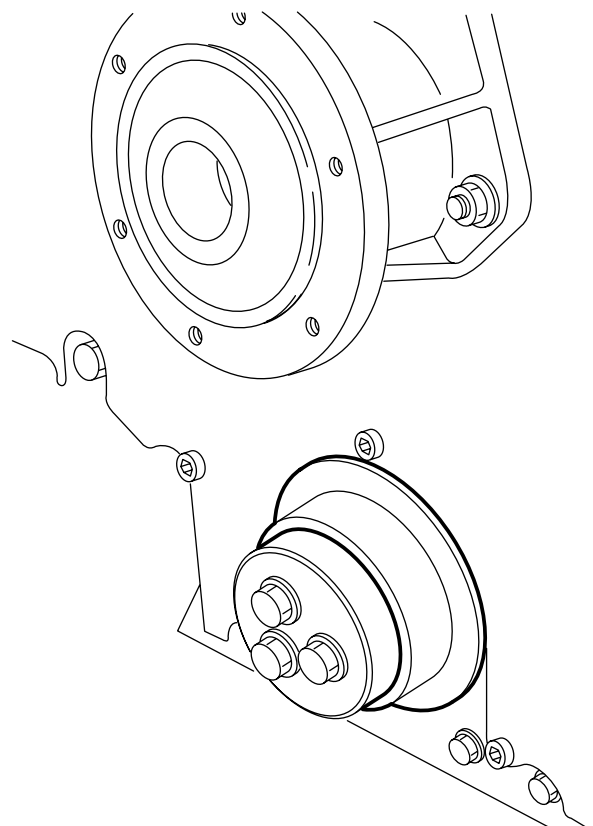
Installing the timing cover seal

1. Clean and check the seal recess in the timing cover. Even minimal damage may cause a leak.

Note:

If a shim was fitted in the seal recess, it must be re-fitted.

2. Use the special tool (DAF no. 1310424) and the thrust piece in the recess of the timing cover to install the **dry** seal.
3. Remove the special tool.
4. Fit the vibration damper hub.
5. Install the vibration damper.
6. Fit the poly-V-belt.



M200771

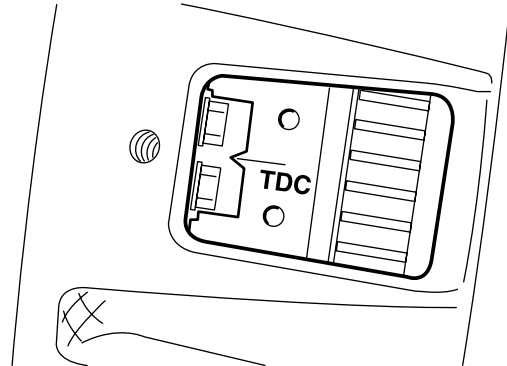
4.25 REMOVAL AND INSTALLATION, TIMING GEAR WHEELS

Removing the timing gear

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

Note:

It is possible that the marks on the idler gear are **not** exactly opposite the camshaft and crankshaft gear wheels.



M201185

Removing the idler gear

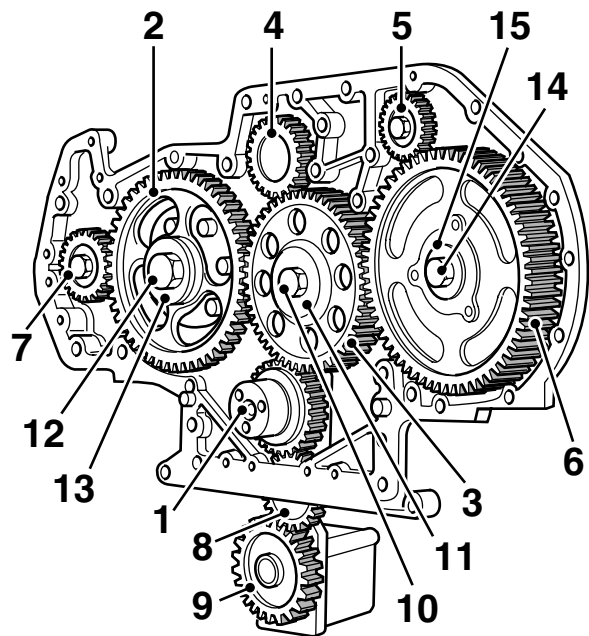
1. Remove the attachment bolt (10) and the axial thrust washer (11).
2. Remove the idler gear (3).

Removing the camshaft gear

1. Remove the attachment bolt (12) of the camshaft gear (2).
2. Remove the idler gear.
3. Remove the camshaft gear using a commercially available puller.

Removing the pump housing camshaft gear

1. Remove the attachment bolt (14) from the pump housing camshaft gear wheel (6).
2. Remove the idler gear.
3. Remove the gear wheel, using a commercially available puller.



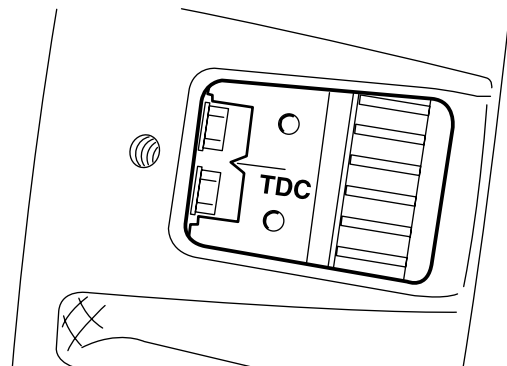
M200954

Installing the timing gears

1. Check whether cylinder 1 is at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).

Note:

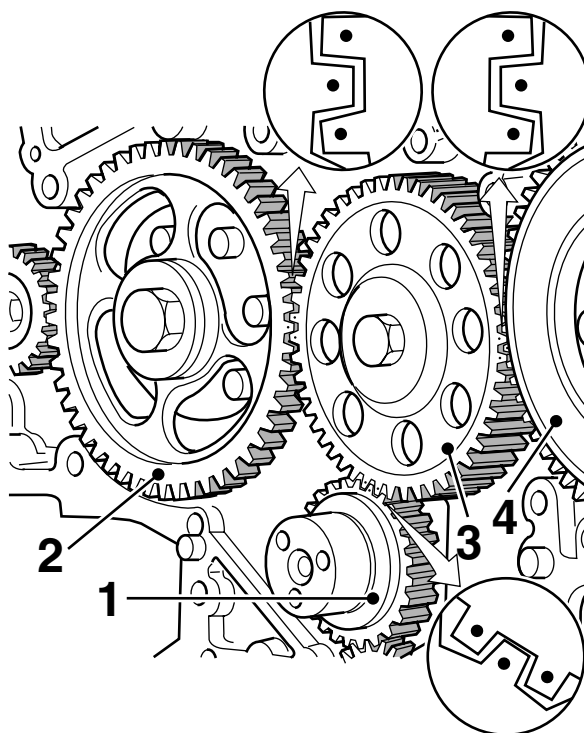
When the crankshaft (1) or the camshaft (2) of an engine without an idler gear (3) is rotated separately, the engine's pistons may touch the valves.



M201185

Installing the idler gear

1. Fit the idler gear (3) so that the mark on the idler gear (3) is opposite the marks on the camshaft gear (2) and the crankshaft gear (1).
2. Fit the attachment bolt (10) and the axial thrust washer (11) of the idler gear (3). Tighten the attachment bolt to the specified torque. See "Technical data".
3. Check that the backlash specified for the gears is not exceeded. See "Technical data".



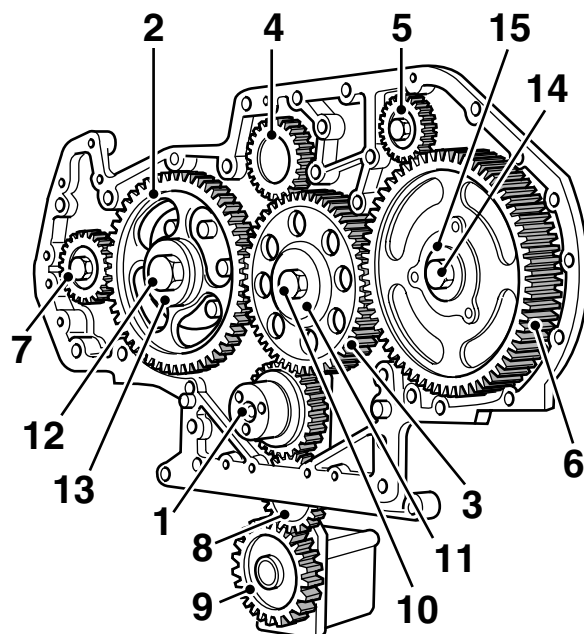
M201281

Installing the camshaft gear

1. Fit the gear wheel (2) onto the camshaft.
2. Install the idler gear (3).
3. Fit the attachment bolt (12) and the thrust washer (13) of the camshaft gear wheel (2). Tighten the attachment bolt (12) to the specified torque. See "Technical data".
4. Check that the backlash specified for the gears is not exceeded. See "Technical data".

Installing the pump housing camshaft gear wheel

1. Fit the pump housing camshaft gear (6) to the shaft journal.
2. Fit the idler gear.
3. Fit the attachment bolt (14) of the pump housing camshaft gear wheel (6). Tighten the attachment bolt to the specified torque. See "Technical data".
4. Check that the backlash specified for the gears is not exceeded. See "Technical data".



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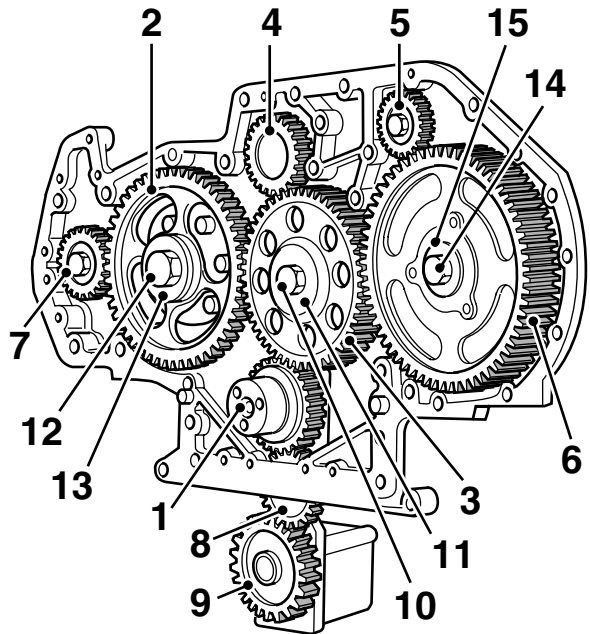
Installing the timing gear

1. Fit the timing cover.
2. Fit the valve covers.

4.26 REMOVAL AND INSTALLATION, TIMING CASE

Removing the timing case

1. Remove the timing gears.
2. Remove the air compressor.
3. Remove the steering pump.
4. Remove the camshaft attachment bolts and locking plate.

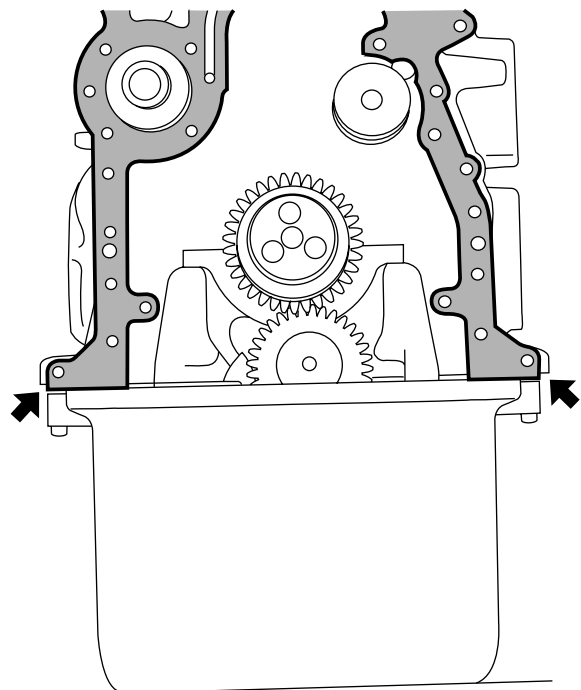


M200954

5. Loosen the oil sump attachment bolts until the oil sump is free from the timing case.
6. Remove the bolts attaching the timing case to the cylinder block, and remove the timing case.

Installing the timing case

1. Remove any remnants of gasket. Clean and inspect the sealing surfaces, dowels and locating holes.
2. To position the gasket, insert three studs and fit the new gasket.
3. Then remove any gasket remnants between the cylinder block and the oil sump.
4. Fit the timing case. Tighten the attachment bolts to the specified torque. See "Technical data".



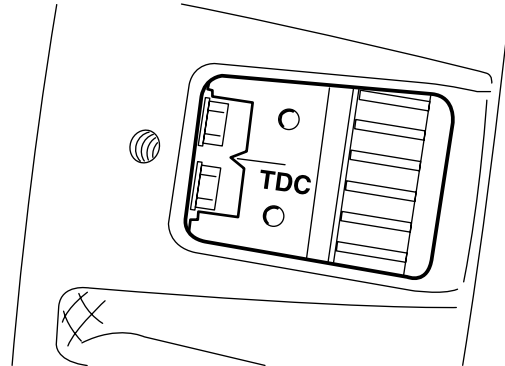
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5. Tighten the oil sump attachment bolts to the specified torque. See "Technical data".
6. Fit the camshaft locking plate and attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
7. Fit the timing gears.
8. Fit a new O-ring to the air compressor and fit the air compressor.
9. Fit the steering pump.

4.27 REMOVAL AND INSTALLATION, TIMING CASE OIL SEAL

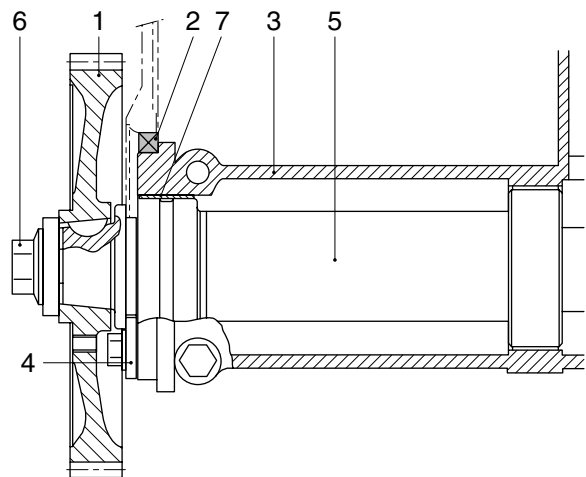
Removing the timing case oil seal

1. Position cylinder 1 at top dead centre (TDC on the flywheel, cylinder 6 in overlap position).
2. Remove the idler gear.



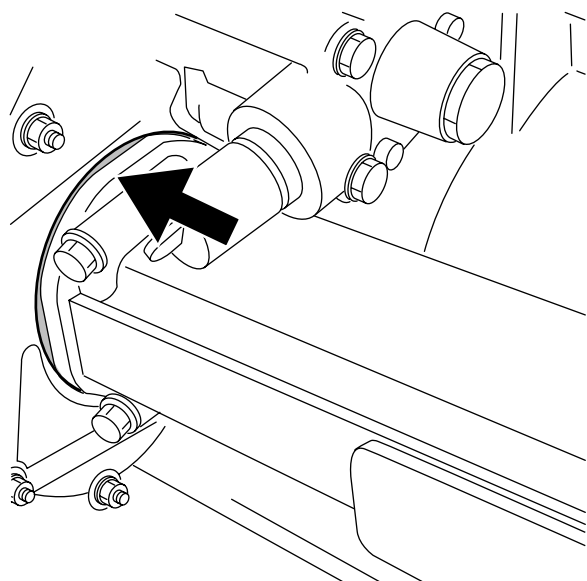
M201185

3. Remove the pump housing camshaft gear (1).



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4. Remove the oil seal (2) by tapping it from the timing case in the driving direction.



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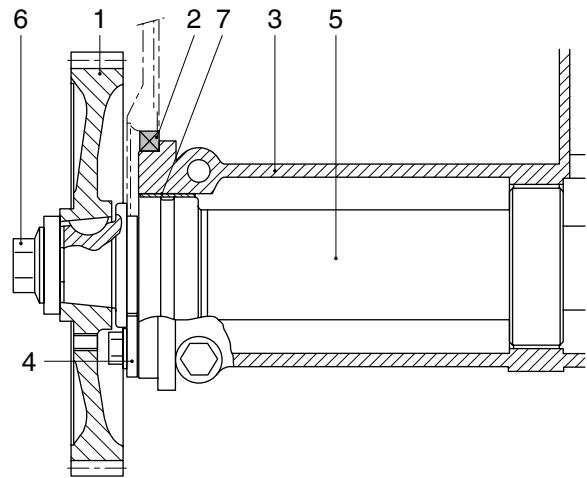
Installing the timing case oil seal

1. Fit a **dry** new timing case oil seal (2) using the special tool (DAF no. 1329318).
2. Fit the pump housing camshaft gear (1).
3. Fit the idler gear.

Note:

Remember the marks.

4. Fit the timing cover.



M200887

5. CLEANING

5.1 CLEANING THE ENGINE

Note:

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

Before cleaning the engine, check for any leaks.

If the engine is cleaned with a high-pressure cleaner, the high-pressure cleaner 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.
- There is an air bleed vent on the power steering fluid reservoir of the steering gear. Water may enter the reservoir through this air bleed vent, causing damage to the steering gear.
- When cleaning the radiator/air cooler element, be careful not to damage the fins.
- Do not direct the high-pressure cleaner jet too long at the air-conditioning system condenser. As a result of the high temperature, the pressure in the system will become excessive, which may cause damage to the system.
- Ensure that no water can enter the gearbox via the air bleed vents.
- Make sure that no water can enter via the clutch reservoir bleed vents.
- The engine compartment can be cleaned with a high-pressure cleaner. Never direct the jet of water towards electrical components.
- When cleaning UPEC engines with a high-pressure cleaner, do not aim the jet directly at the pump units. Water could penetrate into the protective covers via the bleed holes. This could result in failures in the electrical connections of the pump units.
- Do not direct the jet of water at electrical connections such as connectors or lead-throughs of the vehicle lighting system.
- Ensure that no water can enter the air intake system via the air intake or its flexible seals.

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1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure. Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

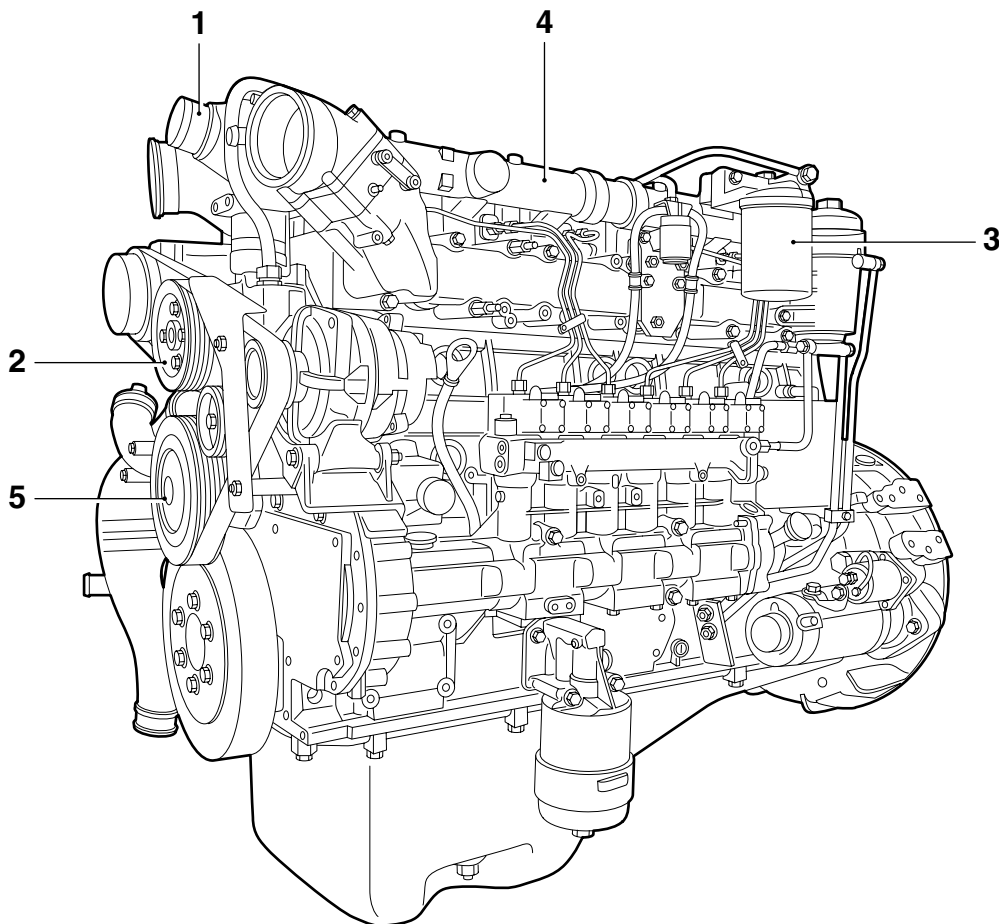
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

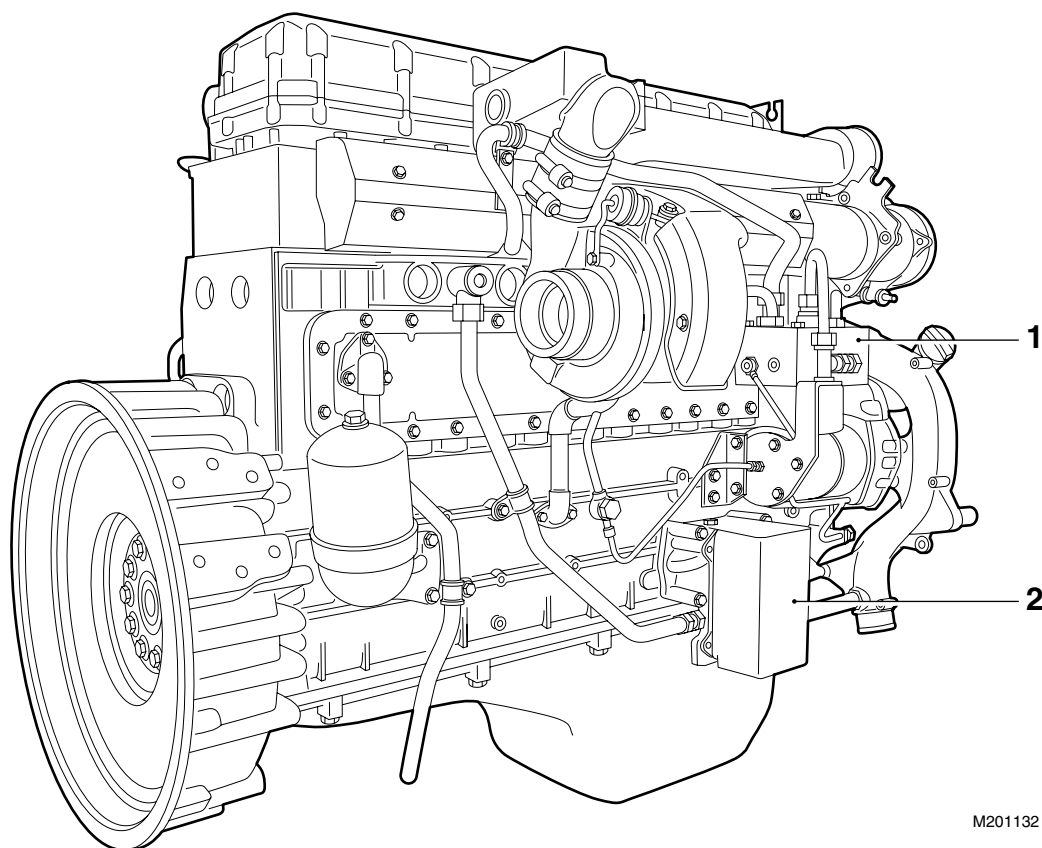
2.1 LOCATION OF COMPONENTS



1. Thermostat housing
2. Coolant pump
3. Coolant filter

4. Coolant pipe
5. Fan drive

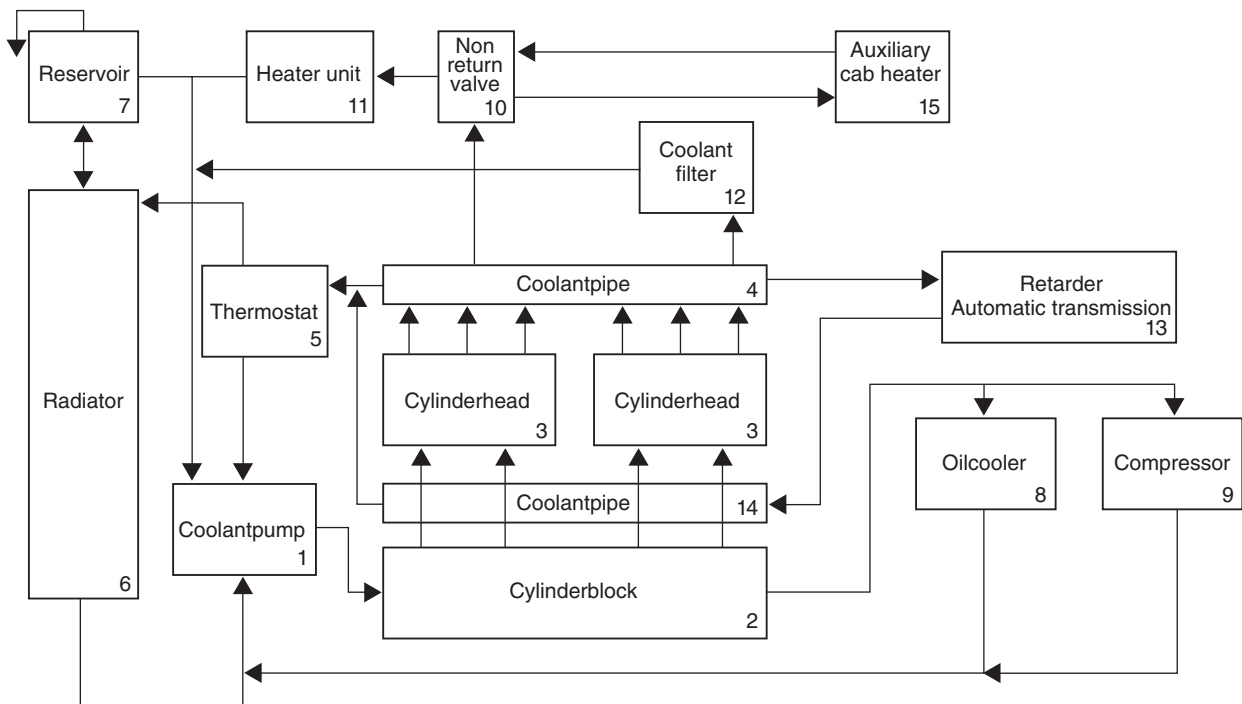
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M201132

- 1. Water-cooled compressor
- 2. Oil cooler

2.2 SYSTEM DESCRIPTION, COOLING SYSTEM



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From the delivery side of the water pump (1), the coolant is directed to the cylinder block (2) via an opening at the back of the coolant pump. The coolant flows through the cylinder block up to the cylinder heads (3).

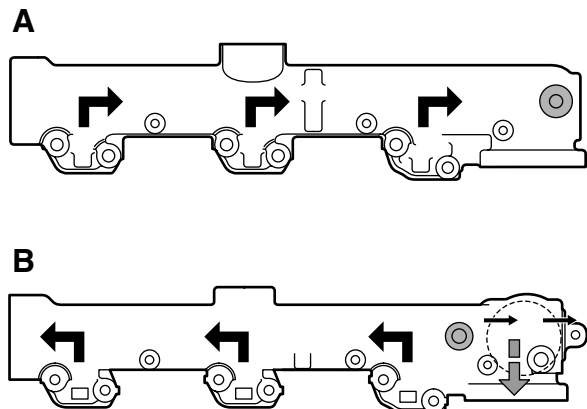
The coolant leaves the cylinder heads through the coolant collector pipe (4) (A), which takes it to the thermostat housing (5).

If an interarder (13) or automatic gearbox (13) is fitted, the coolant leaving the cylinder heads flows via the coolant collector pipe (4) (B) to the interarder or the automatic gearbox.

From the interarder or automatic gearbox, the coolant then flows via the coolant collector pipe (B) to the thermostat housing (5).

Depending on the coolant temperature, the thermostat distributes the coolant flow to the radiator (6) or back to the coolant pump (1). 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 coolant pump, via the coolant return pipe.



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The header tank (7) has four connections. On the top of the radiator, there is a bleed pipe which is linked to connection 3 of the header tank.

Connections 1 and 2 of the header tank are linked to the coolant collector pipe by bleed pipes. If no interarder or automatic gearbox is fitted, one of the connections will be sealed.

Connection 4 enables siphoning of the coolant between the header tank and the engine when the coolant temperature increases.

Connection 4 is linked together with the heater return pipe to the coolant return pipe leading to the coolant pump.

From the cylinder block, some of the coolant flows through the oil cooler (8). From the oil cooler, the coolant returns to the coolant pump through a pipe via the coolant return pipe.

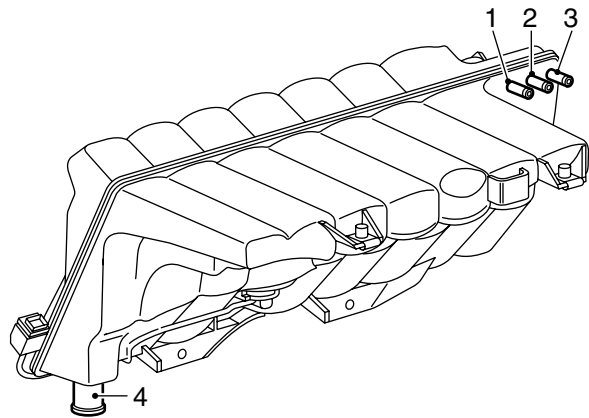
From the cylinder block, some of the coolant flows through the air compressor (9). From the air compressor, the coolant returns to the coolant pump via a pipe.

From the coolant collector pipe, a pipe runs to the cab heater (11). The heater return pipe is linked together with the header tank pipe to the coolant return pipe leading to the coolant pump.

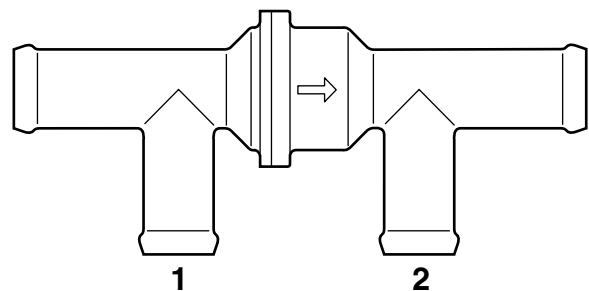
If a cab heater (15) is fitted, a non-return valve (10) is fitted in the heater supply pipe. It has two connections. Connection (1) is for the cab heater supply pipe. Connection (2) is for the cab heater discharge pipe.

Note:

Fit the non-return valve with the arrow pointing in the flow direction of the coolant.



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3. DESCRIPTION OF COMPONENTS

3.1 PRESSURE CAP

The pressure cap is fitted to the header tank by means of a threaded connection.

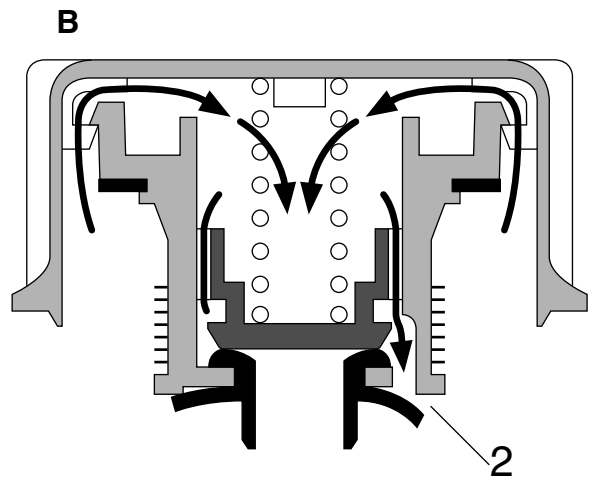
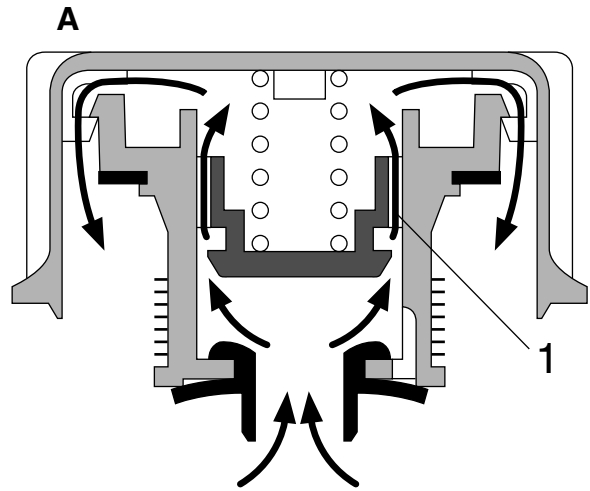
The pressure cap has two valves: a pressure relief valve (1) and a vacuum relief valve (2).

Overpressure

As a result of the rising coolant temperature, the pressure in the cooling system will increase. If the pressure in the cooling system becomes too high, the pressure relief valve (1) will open against the pressure of the spring.

Underpressure

If the coolant temperature drops, the pressure in the cooling system will decrease. If the pressure in the cooling system becomes too low, the vacuum relief valve (2) will be opened.



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3.2 THERMOSTAT

The coolant enters the thermostat housing from the coolant collector pipe at the back and then flows through the thermostat. Depending on the coolant temperature and the corresponding position of the thermostat, there are three possibilities:

Thermostat closed

The coolant has not yet reached the thermostat opening temperature.

The supply channel (B) to the radiator is completely closed.

The coolant flows directly to the coolant pump through a bypass (A) and the coolant pump returns the coolant to the cylinder block.

Thermostat starts opening

The coolant has reached the thermostat opening temperature.

The supply channel (B) to the radiator is opened and the bypass (A) is partially closed.

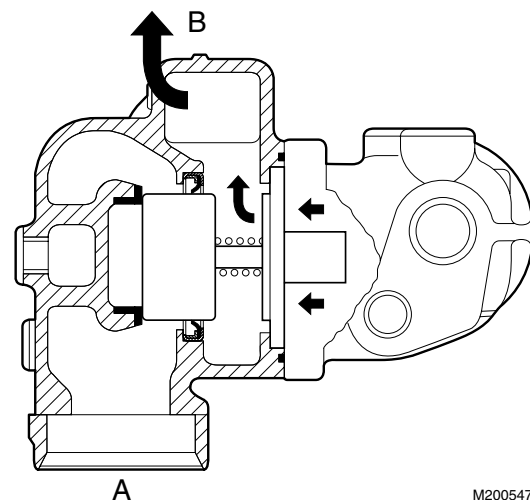
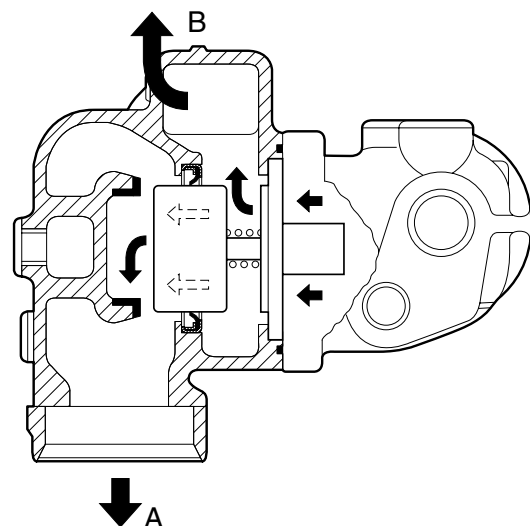
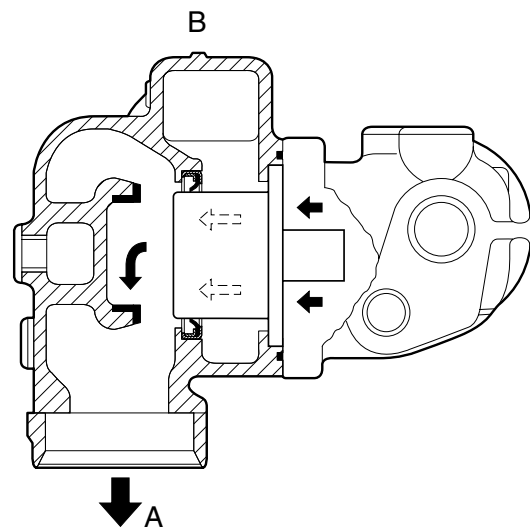
Now coolant will flow both through the supply channel (B) to the radiator and through the bypass (A) directly to the coolant pump.

Thermostat fully opened

The temperature of the coolant has further increased. The supply channel (B) to the radiator is fully opened and the bypass (A) is fully closed. All the coolant now flows through the supply channel (B) to the radiator, where it is cooled before flowing back to the coolant pump.

In the event of excessive coolant temperatures, removing the thermostat as an emergency solution is **not permitted**.

If the thermostat is removed from the engine, uncooled coolant will flow to the coolant pump through the bypass (A). As a result, the coolant temperature will continue to rise.



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9

3.3 COOLANT FILTER

The task of the coolant filter is to filter the coolant to prevent cavitation. The coolant filter is necessary when the cooling system is filled with low-quality coolant.

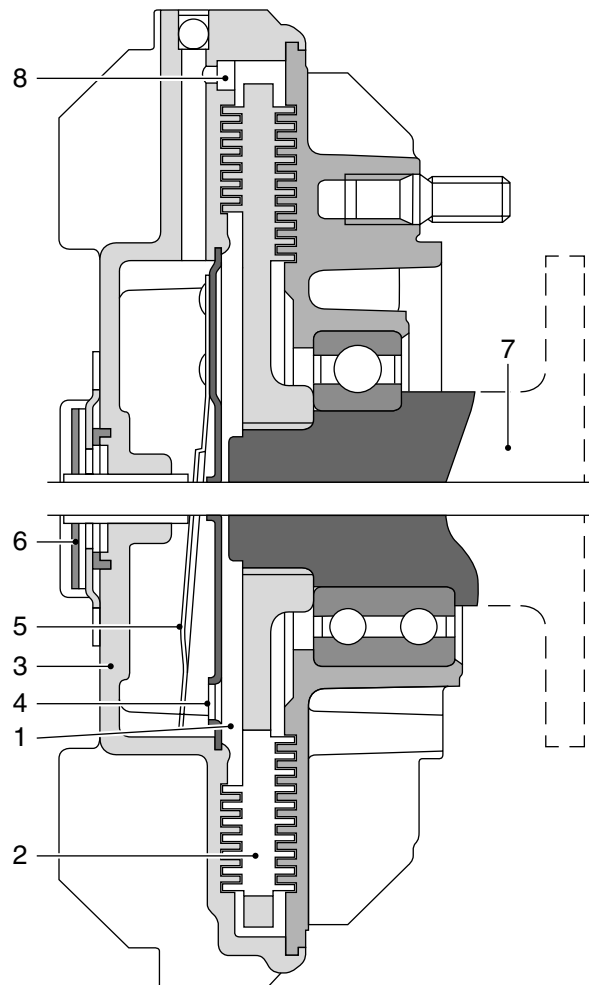
3.4 VISCOUS FAN CLUTCH

The fan is connected to the engine by means of a viscous fan clutch. If, under certain circumstances, the heat is not sufficiently dissipated by the air flow passing through the radiator, the fan will have to draw in extra cooling air through the radiator. In a viscous fan clutch, the drive torque is transmitted by a silicone fluid.

The fan clutch is divided into two chambers. In the working area (1) is the rotor (2), which is connected to the drive flange (7). The supply chamber (3) rotates freely round the drive flange (7) and is connected to the fan. There is silicone fluid in the supply chamber (3). The opening (4) in the supply chamber (3) is closed by a valve (5). The valve (5) is operated by a bimetallic strip (6).

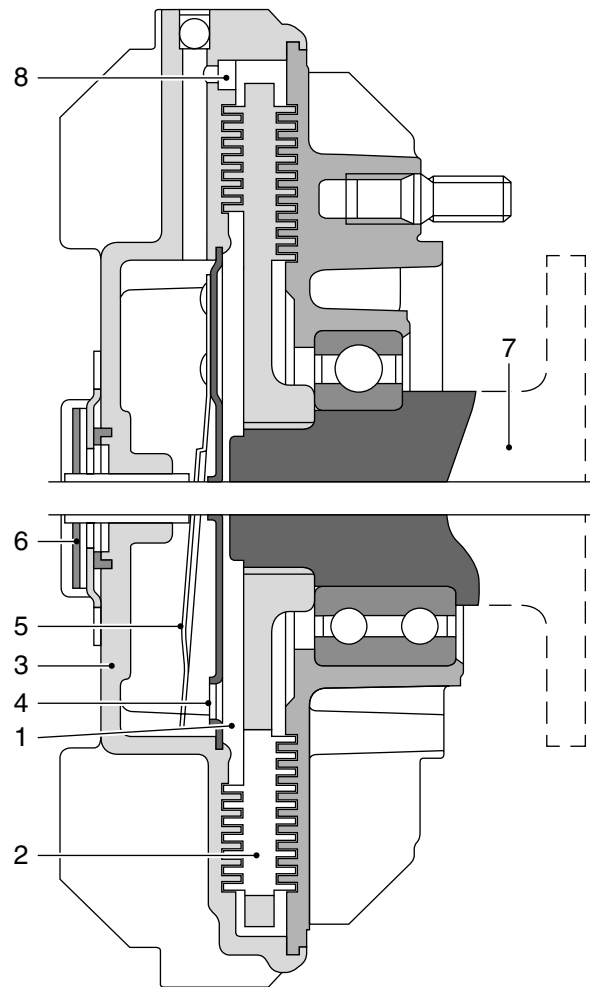
If the opening (4) in the supply chamber (3) is closed by the valve (5), no silicone fluid can enter the working area (1). The silicone fluid still present in the working area (1) will flow back to the supply chamber (3) through the bores (8). As only very little fluid will be left in the working area (1), there will be a great difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan.

When the air temperature increases, the bimetallic strip (6) will bend and the valve (5) will partially release the opening (4) in the supply chamber (3). Through this opening, a limited amount of silicone fluid can enter the working area (1) and flow past the rotor (2). This will cause friction, so that the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) with the fan will decrease.



M201039

As the air temperature rises, the bimetallic strip (6) will continue to bend and the opening (4) in the supply chamber (3) will be fully released. The further the opening (4) in the supply chamber (3) is released, the more silicone fluid will flow into the working area (1) and past the rotor (2). As a result of the increase in friction, the difference in rotating speed (slip) between the drive flange (7) and the supply chamber (3) will further decrease.



M201039

3.5 ELECTRONICALLY CONTROLLED VISCOUS FAN CLUTCH

For accurate fan speed control, an electronically controlled viscous fan clutch is used.

The electronically controlled viscous fan clutch checks and controls the fan speed to ensure that the flow of cooling air through the cooling system is sufficient to keep the coolant temperature and/or inlet air temperature within certain limits.

The fan clutch is activated by a PWM signal (duty cycle). Activation depends on several variables:

- the coolant temperature
- the inlet air temperature
- the vehicle speed
- the engine speed
- interarder engaged/disengaged
- the heat production of the fan clutch (slip heat protection)

In the event of failure of the control system of the fan clutch, the fan will be fully engaged.

The speed of the fan is sensed by an inductive sensor.

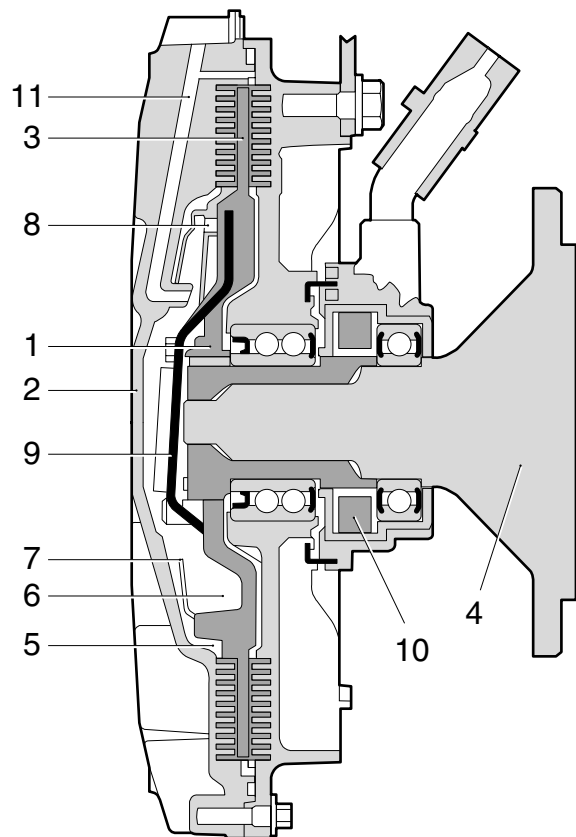
Construction

The fan clutch is divided into two parts, a primary part (1) and a secondary part (2).

The primary part (1) consists of the rotor (3), which is fixed to the drive shaft (4). It also includes the supply chamber (6) for the silicone fluid.

The secondary part (2) includes the working area (5). The fan is fitted to the secondary part (2) and rotates freely round the drive shaft (4).

The supply chamber (6) is enclosed by a raised ring (7) and part of the rotor (3). The supply chamber (6) has an opening (8) to the working area (5), which is closed by a valve (9).



M201063

The coil (10) fitted to the drive shaft (4) with bearings generates a magnetic field. Depending on the variables mentioned earlier, the PWM signal to the coil (10) will be adapted. This will cause changes in the magnetic field and the valve (9) will be attracted either more or less frequently.

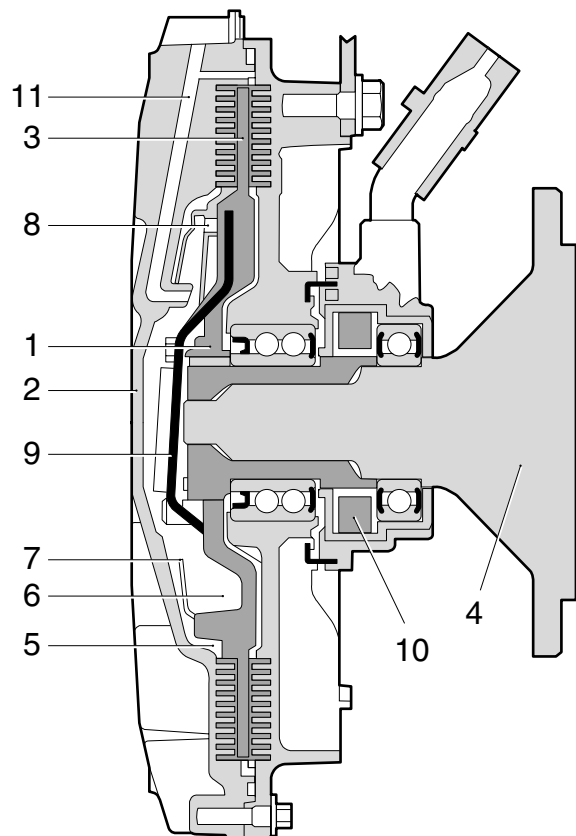
In static condition all silicone fluid will flow out of the supply chamber (6), while in dynamic condition the silicone fluid will remain in the supply chamber (6) as a result of the centrifugal force.

When the engine is being started, the fan will always run for a short time, because the silicone fluid that has settled at the bottom will be forced outwards by the centrifugal force. Some of the silicone fluid will first flow into the working area (5). The silicone fluid causes friction between the rotor (3) and the working area (5). As a result, the difference in rotating speed (slip) between the working area (5) and the rotor (3) will decrease. The fan will be more and more engaged.

The silicone fluid will flow through the return bores (11) of the working area (5), back to the supply chamber (6).

If the valve (9) releases the opening (8) with a certain frequency, a certain quantity of silicone fluid will flow from the supply chamber (6) to the working area (5). The quantity of silicone fluid flowing through the working area, determines the difference in rotating speed (slip) between the working area (5) and the rotor (3).

If the valve (9) releases the opening (8) with a higher frequency, the quantity of silicone fluid flowing through the working area (5) will increase. The friction between the working area (5) and the rotor (3) will increase and the difference in rotating speed (slip) between the working area (5) and the rotor (3) will decrease.



M201063

4. INSPECTION AND ADJUSTMENT

4.1 PRESSURE TESTING

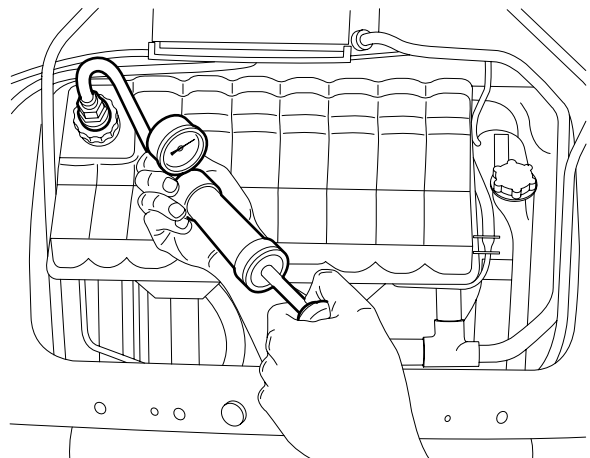


When the coolant is hot, there is overpressure in the cooling system. Carefully remove the filler cap to release the overpressure. Coolant is a toxic fluid. Contact with the skin should therefore be avoided. To avoid damaging the cylinder block; do not top up a warm engine with cold coolant.

If this is done when the engine is warm, any cracks can be spotted more quickly.

The cooling system can be checked for leaks with a pressure-test pump.

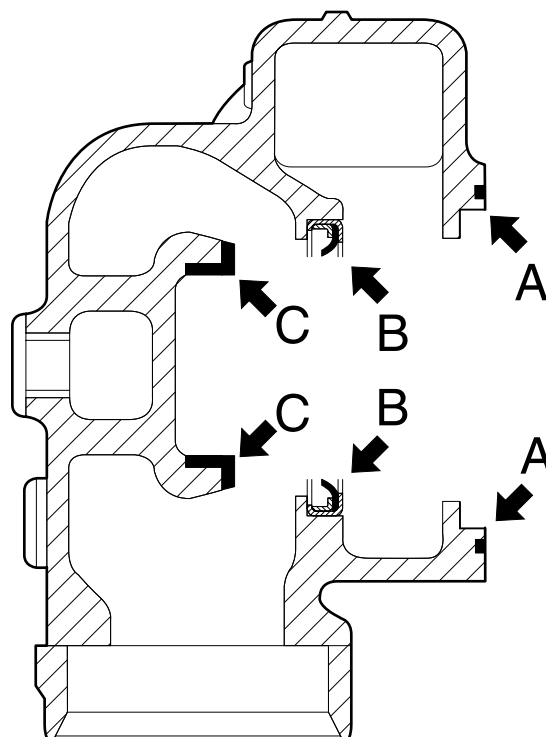
1. Open the grille.
2. Remove the filler cap.
3. Fill the cooling system to the correct level.
4. Raise the engine temperature. This need not be the operating temperature.
5. Fit a pressure-test pump. Pressure-test the system at the specified pressure. See "Technical data".
6. Check for leakage.



M201192

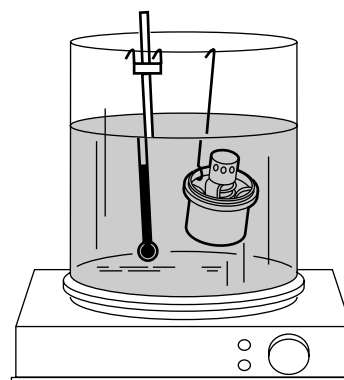
4.2 INSPECTION, THERMOSTAT

1. Remove the thermostat. See "Removal and installation".
2. Inspect the sealing surfaces (A) of the thermostat housing for damage.
3. Inspect the oil seal (B) for damage.
4. Inspect the thermostat seat (C) for damage.
5. Check whether the thermostat is fully closed.



M200594

6. Place the thermostat in a container filled with clean water.
7. Place a thermometer in the container and heat the water. Check at what temperature the thermostat starts opening and whether it fully opens. See "Technical data".



M200513

4.3 INSPECTION, VISCOUS FAN CLUTCH



Do not run the engine in an enclosed or unventilated area. Make sure exhaust fumes are properly extracted. Remain at a safe distance from rotating and/or moving components.

Normal version:

During this test, the slip in the viscous fan clutch is measured while the clutch is not operating. This test must be carried out when the engine is "cold" (coolant temperature approximately 50°C).

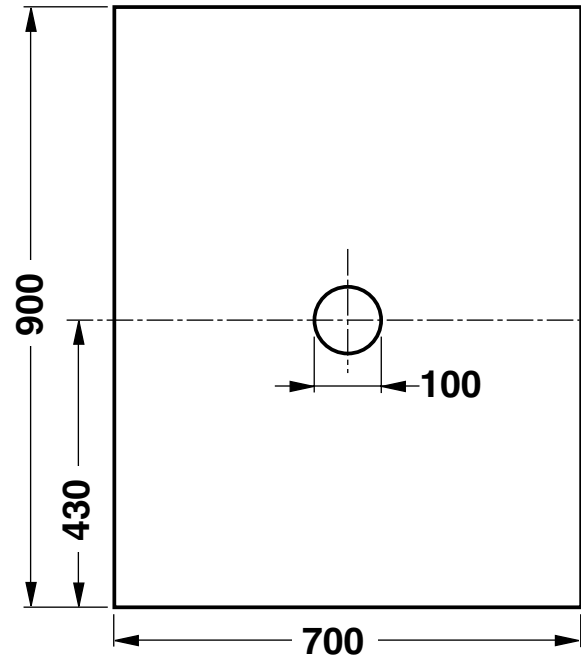
Testing with a cold engine

1. Check the steering oil level and top up as necessary.
2. Start the engine and run it at idling speed for at least 5 minutes.
3. Then use a digital rev 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.

This test checks whether the bimetallic strip starts opening the valve at an operating temperature of 85 - 95°C.

Testing with a warm engine

1. Check the steering oil level and top up as necessary. Be careful when topping up the coolant of a warm engine.
2. Take a sheet of cardboard with a 100 mm hole, as shown in the drawing opposite, and place it in front of the radiator, with the hole in front of the viscous clutch.
3. Check that the gearbox is in neutral.
4. Bring the cooling system to operating temperature.
5. Allow the fan drive flange to run at a speed of 1000 rpm. Then use an optical rev counter to determine the difference between the rotating speeds of the fan and the drive flange. The speeds will differ as a result of slip in the viscous clutch. For the permissible slip, see "Technical data". If the slip measured is greater than that permitted, the viscous fan clutch must be replaced.



M200440

Version with electronic control:

1. When the engine is not running, disconnect the connector of the electrically controlled viscous fan clutch.
2. Run the engine at 1000 rpm. Then measure the difference between the rotating speeds of the fan and the drive flange, using an optical rev counter. After about 30 sec. the fan will run at maximum speed. The speeds will differ as a result of slip in the viscous clutch. For the permissible slip, see "Technical data". If the slip measured is greater than that permitted, the viscous fan clutch must be replaced.

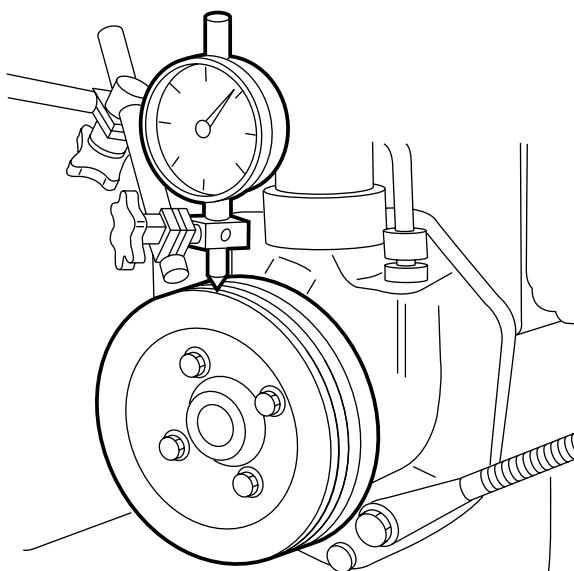
Note:

The electrically controlled viscous fan clutch can also be diagnosed using DAVIE-XD in the UPEC program.

$$100 - (n_{fan} \times 100) / (n_{engine} \times i_{(fan\ drive)}) = slip$$

4.4 INSPECTION, COOLANT PUMP RADIAL PLAY

1. Remove the poly-V-belt from the coolant pump pulley.
2. Fit a dial gauge as shown in the illustration.
3. Force the coolant pump pulley downwards and set the dial gauge to zero.
4. Pull the coolant pump pulley upwards and read the dial gauge.
5. Compare the reading with the technical data. See "Technical data". If it is more than the maximum radial play specified in the technical data, the coolant pump must be replaced.



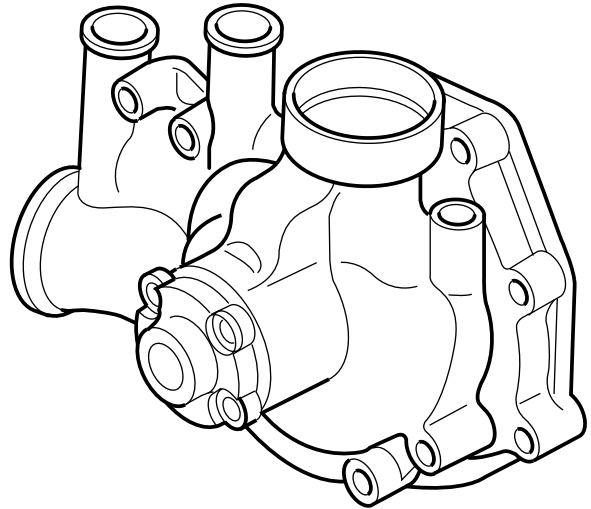
M200595

5. REMOVAL AND INSTALLATION

5.1 REMOVAL AND INSTALLATION, COOLANT PUMP

Removal, coolant pump

1. Remove the front engine encapsulation.
2. Drain the coolant. See "Draining and filling".
3. Remove the torque rod between the engine and the radiator.
4. Remove the bolts from the guide ring brackets, and remove the guide ring.
5. Remove the attachment nuts of the viscous fan clutch on the fan pulley and place the viscous fan clutch and fan as far forward as possible in the wind tunnel.
6. Remove the poly-V-belt from the alternator and the V-belt from the air-conditioning compressor.
7. Remove the attachment bolts from the thermostat housing on the coolant pipe and remove the thermostat housing and connection piece.
8. Disconnect all coolant hoses connected to the coolant pump.
9. Disconnect the pipe from the coolant pump to the coolant filter.
10. Remove the attachment bolts from the coolant pump.
11. Remove the coolant pump.



M200596

Installation, coolant pump

1. Thoroughly clean and check the sealing surfaces of the coolant pump, the thermostat housing and the cylinder block.
2. Install the coolant pump, using a new gasket. Fit the attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
3. Install the connection piece with new O-rings onto the coolant pump.
4. Fit a new O-ring to the thermostat housing and fit it to the coolant pipe.
5. Connect the pipe from the coolant pump to the coolant filter.

6. Fit all coolant hoses connected to the coolant pump.
7. Fit the V-belts from the alternator and the air-conditioning compressor.
8. Fit the viscous fan clutch with the fan.
9. Fit the guide ring brackets and the guide ring.
10. Fit the torque rod between the radiator and the engine.
11. Fill the cooling system. See "Draining and filling".
12. Fit 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.

Do not remove the filler cap when the engine is running.

Coolant is a toxic fluid. Contact with the skin should therefore be avoided.

In the event of contact with the skin: remove the liquid with paper or a cloth, wash with soap and water. If irritation persists, consult a doctor.

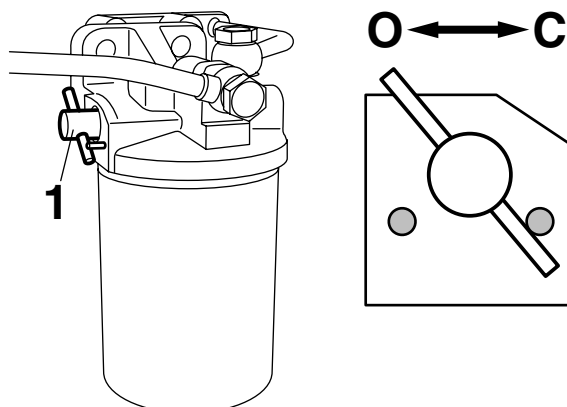
If swallowed: DO NOT induce vomiting. Rinse mouth, drink two glasses of water and consult a doctor.

In the event of inhalation: get fresh air and rest.

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

Removing the coolant filter

1. Place a tray beneath the coolant filter to collect any escaping coolant.
2. Remove the filler cap from the expansion tank.
3. Turn the shut-off valve (1) clockwise to the "C" position.
4. Remove the coolant filter by turning it counter-clockwise.



M200372

Installing 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.
3. Fit the coolant filter so that the sealing ring makes contact. Then tighten the filter by hand $\frac{1}{2}$ to $\frac{3}{4}$ of a turn.
4. Turn shut-off valve (1) anti-clockwise to the "O" position.
5. Fit the filler cap on the expansion tank.
6. Run the engine and check that the coolant filter seals correctly.
7. Check the coolant level.

5.3 REMOVAL AND INSTALLATION, THERMOSTAT

Removing the thermostat

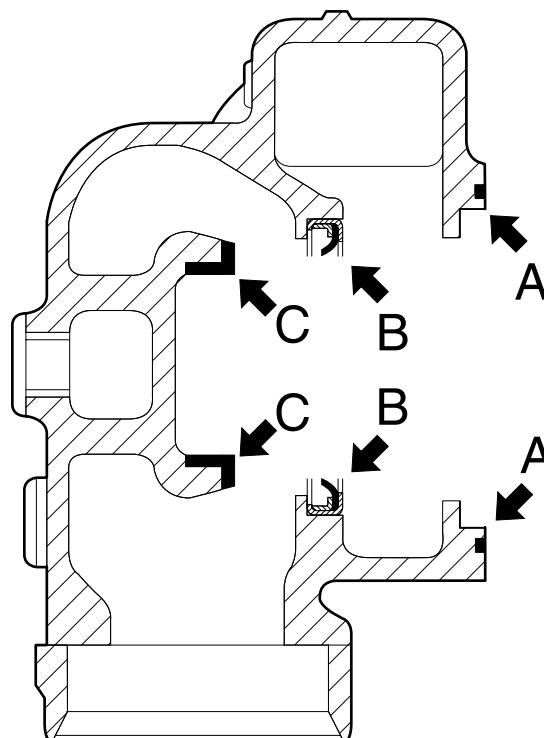
1. Partially drain the radiator. See "Draining and filling".
2. Remove the filler cap.
3. Disconnect the hose.
4. Remove the thermostat housing attachment bolts. Remove the thermostat housing and the connecting piece from the coolant pump and the O-ring (A) from the thermostat housing.

Removing the thermostat oil seal

1. Remove the oil seal (B) from the thermostat housing, using a commercially available internal puller.

Removing the thermostat seat

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



M200594

Installing the thermostat seat

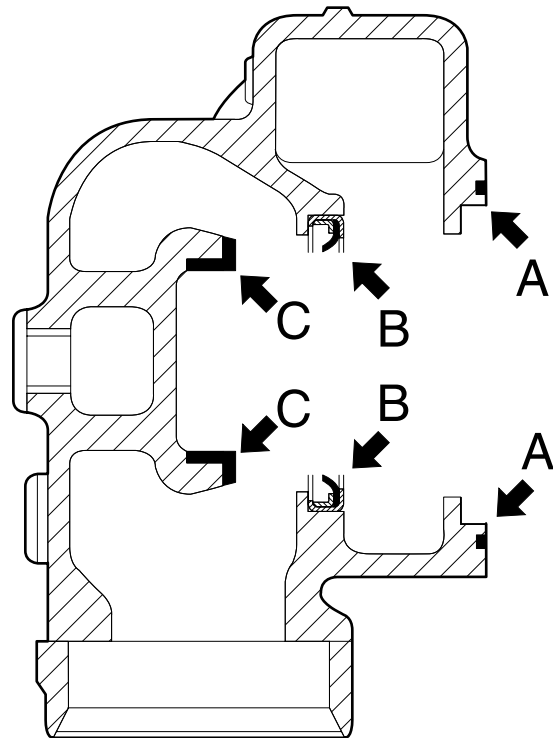
1. Apply locking compound to the thermostat seat (C) and fit it in the thermostat housing using the special tool (DAF no. 1310456). See "Technical data".

Installing the thermostat oil seal

1. Fit the thermostat seal (B) in the thermostat housing using the special tool (DAF no. 1310456).

Installing the thermostat

1. Connect the coolant pipe.
2. Fit the O-ring (A) in the thermostat housing. Fit new O-rings to the connection piece from the thermostat housing to the coolant pump, and fit the connection piece in the thermostat housing.
3. Fit the thermostat housing attachment bolts. Tighten the attachment bolts to the specified torque. See "Technical data".
4. Connect the hose.
5. Top up with coolant. See "Draining and filling".
6. Check for leakage.



M200594

5.4 REMOVAL AND INSTALLATION, VISCOUS FAN CLUTCH

Removing the viscous fan clutch

1. Remove the front engine encapsulation.
2. Loosen the wind tunnel collar by removing the retaining screw (G) and turn the wind tunnel collar towards the radiator.
3. Remove the fan from the viscous fan clutch and place it temporarily in the wind tunnel.

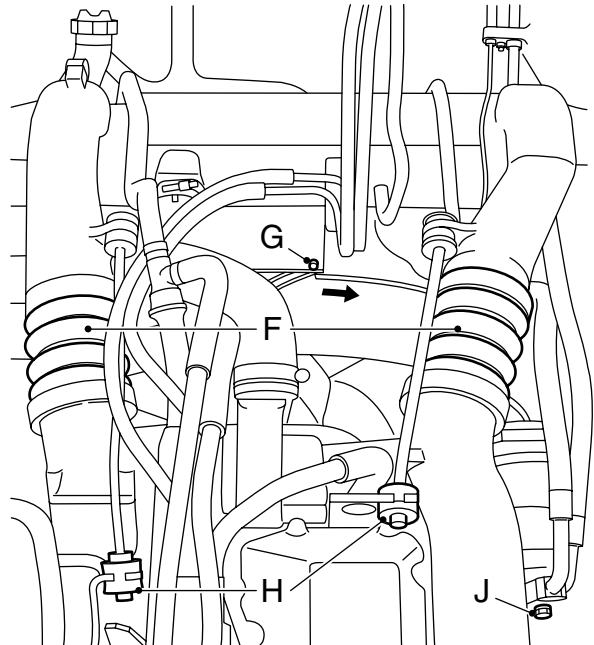
Note:

The viscous fan must **always** be stored **vertically**.

4. Remove the viscous fan clutch from the drive flange.

Installing the viscous fan clutch

1. Install the viscous fan clutch on the drive flange and tighten the attachment bolts to the specified torque. See "Technical data".
2. Fit the fan to the viscous fan clutch. Tighten the attachment nuts to the specified tightening torque. See "Technical data".
3. Turn the wind tunnel collar towards the engine and check whether it is installed properly all round in its lock. Fit the locking screw (G).
4. Fit the front engine encapsulation.

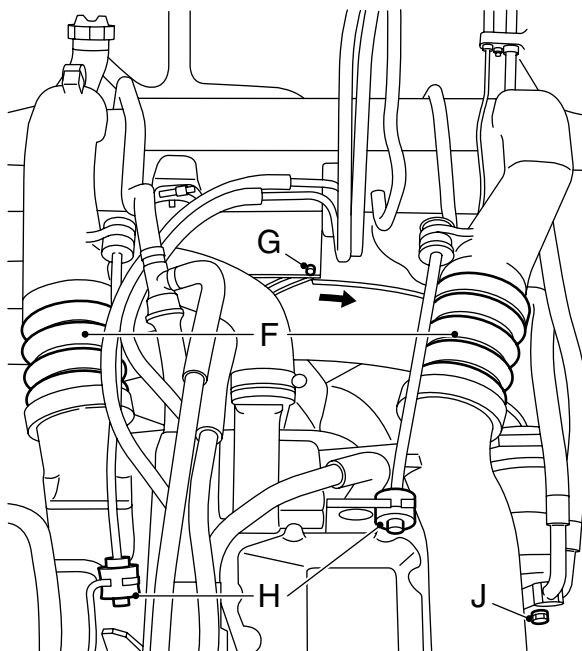


M201032

5.5 REMOVAL AND INSTALLATION, RADIATOR UNIT

Removing the radiator unit

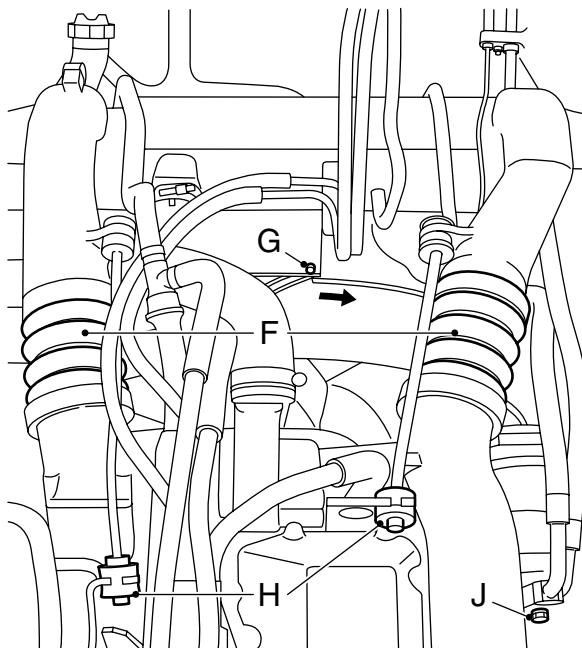
1. Drain the coolant.
2. Disconnect the torque rods (H).
3. Remove the air inlet hoses (F) between the engine and the air cooler.
4. Remove the locking screws from the wind tunnel collar (G) and turn the latter inwards.
5. Disconnect the air-conditioning condenser (if fitted) including accessories from the radiator unit.
6. Disconnect the air-conditioning compressor from the engine and carefully put the complete air-conditioning system to one side.
7. Disconnect the rubber hoses from the radiator unit.
8. Disconnect the oil filler pipe from the radiator unit.
9. Disconnect the radiator unit and remove the assembly with the air cooler.



M201032

Installing the radiator unit

1. Fit the radiator unit together with the air cooler.
2. Fit the oil filler pipe to the radiator unit.
3. Fit all rubber hoses to the radiator unit.
4. Fit the air-conditioning condenser (if present) including accessories to the radiator unit.
5. Fit the air-conditioning compressor to the engine.
6. Turn the wind tunnel collar (G) outwards and fit the locking screws.
7. Remove the air inlet hoses (F) between the engine and the air cooler.
8. Fit the torque rods (H).
9. Fill the cooling system.



M201032

6. DRAINING AND FILLING

6.1 DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM



In order to avoid damaging the cylinder block, do not top up a warm engine with cold coolant. Coolant is a toxic fluid and must be handled with care. Protect 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 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

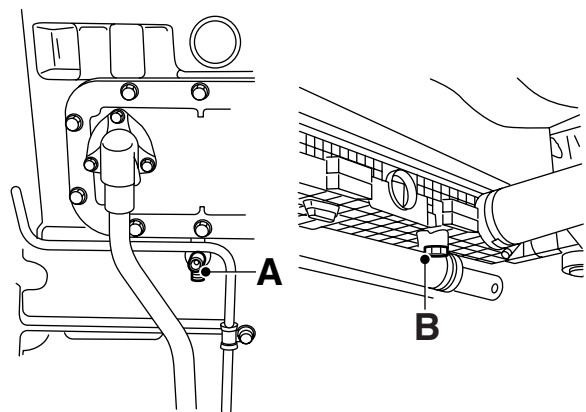
1. Turn the heater control knob to the "warmest" temperature setting. As a result, the heater valve will be fully opened.
2. Remove the cooling system filler cap.
3. Collect the coolant. Position suitable containers under the drain points.
4. Drain the cooling system at the cylinder block via the drain cock (A) and the radiator via the drain plug (B).
5. Flush the cooling system.
6. Close the drain tap (A) and fit the drain plug (B).

Note:

The cooling system is auto-bleeding.

Filling and bleeding 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. Ensure that the air bleed pipe from the thermostat housing to the header tank is not twisted or pinched.
5. Check the coolant level, and top up with coolant if necessary.



M200556

If the vehicle is equipped with a water/air cab heater:

1. Run the engine at idling speed.
2. Switch on the cab heater, 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 cab heater to operate for approximately 15 minutes.

7. CLEANING

7.1 CLEANING THE EXTERIOR OF RADIATOR/AIR COOLER



Inhalation of dust may have serious consequences for your health. Take the necessary precautions, such as wearing goggles and a face mask.

Cleaning wire mesh

1. Remove the lower grille.
2. Remove the wire mesh.
3. Clean the wire mesh.

Cleaning, radiator/air cooler

With the aid of a simple tool, the radiator and the air cooler can be blow-cleaned.

This tool can be made in your own workshop. It cannot be ordered from DAF.

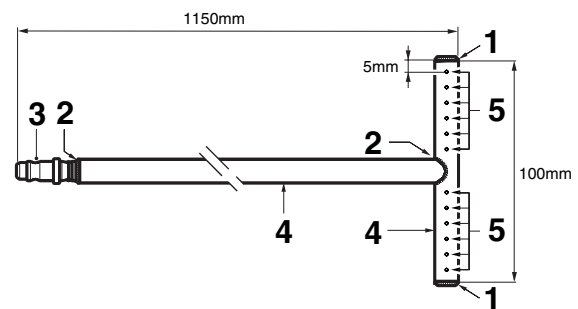
Key to drawing:

1. Solder up
2. Solder
3. Quick-release coupling for air hose
4. Steel pipe, \varnothing 10 mm
5. 6 x \varnothing 1.5 mm between holes, with a centre-to-centre distance between the holes of 7 mm, drilled on one side.

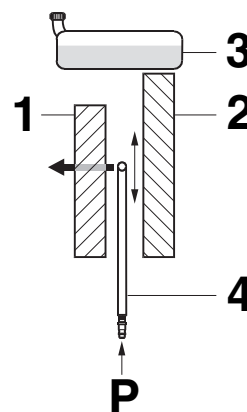
Note:

Make sure that the air cooler and radiator element are not damaged when positioning the radiator cleaner.

1. From below, insert the radiator cleaner (4) between the air cooler (1) and radiator (2), with the air holes facing the air cooler (1).
2. Apply air pressure to the radiator cleaner (4) and continue blow-cleaning the air cooler (1) until no more dirt comes out.



M2108

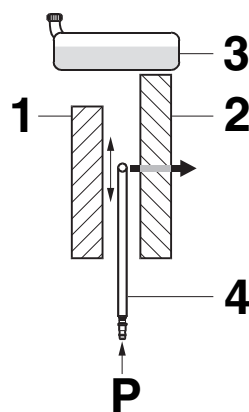


M2109

Cleaning

CF65/75/85 series

3. Turn the radiator cleaner over, turning the holes towards the radiator (2), and blow-clean the radiator (2).
4. Fit the wire mesh.
5. Install the lower grille.



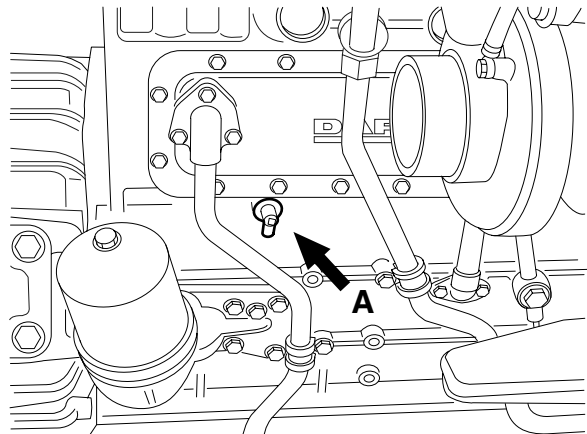
M2110

7.2 DRAINING COOLING SYSTEM

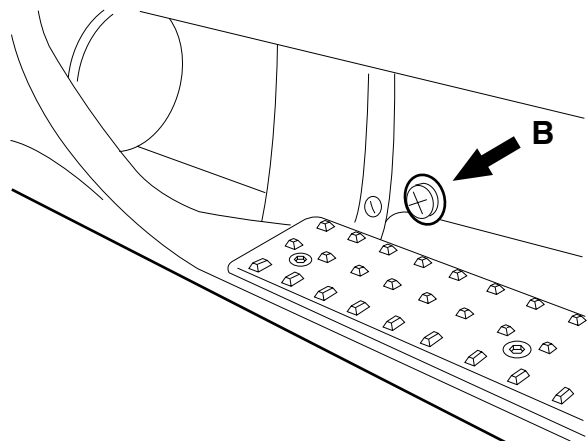


In order to avoid damaging the cylinder block, do not top up a warm engine with cold coolant. Coolant is a toxic fluid and must be handled with care. Protect skin and eyes. Coolant is harmful to the environment; after use, it should be processed as industrial chemical waste. When the coolant is hot, there is overpressure in the cooling system. When removing the filler cap, allow the overpressure to escape by first loosening the filler cap one turn.

1. Drain the cooling system at the cylinder block via the drain cock (A) and the radiator via the drain plug (B). If an integrated retarder is fitted, remove the coolant drain plug of the heat exchanger.
2. Flush the cooling system.
3. Close the drain cock (A) and fit the drain plug (B) and, if applicable, the coolant drain plug of the heat exchanger of the integrated retarder.
4. Fill the cooling system.
5. Check the coolant level.



G000181



G000182

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6.1 Draining and filling the engine oil	6-1	200324

1. SAFETY INSTRUCTIONS

1.1 SAFETY INSTRUCTIONS

Fuel



Diesel fuel is an extremely flammable liquid, and must not be exposed to naked flames or come into contact with hot surfaces. The diesel fuel fumes remaining in an empty fuel tank form an extremely explosive mixture.

When fuel system components are being removed, some fuel will escape. To keep this spillage to a minimum, unscrew the tank cap to release any overpressure.

Any spilled fuel must be collected, bearing in mind the risk of fire.

Exhaust gases

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



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.

Moving parts

Remain at a safe distance from rotating and/or moving components.

Various fluids

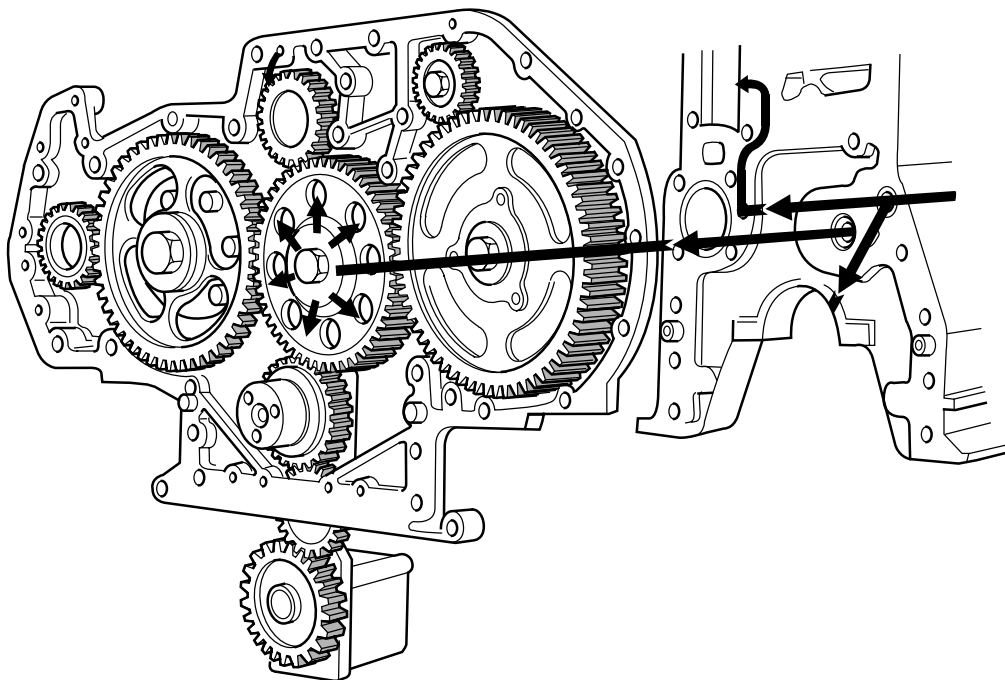
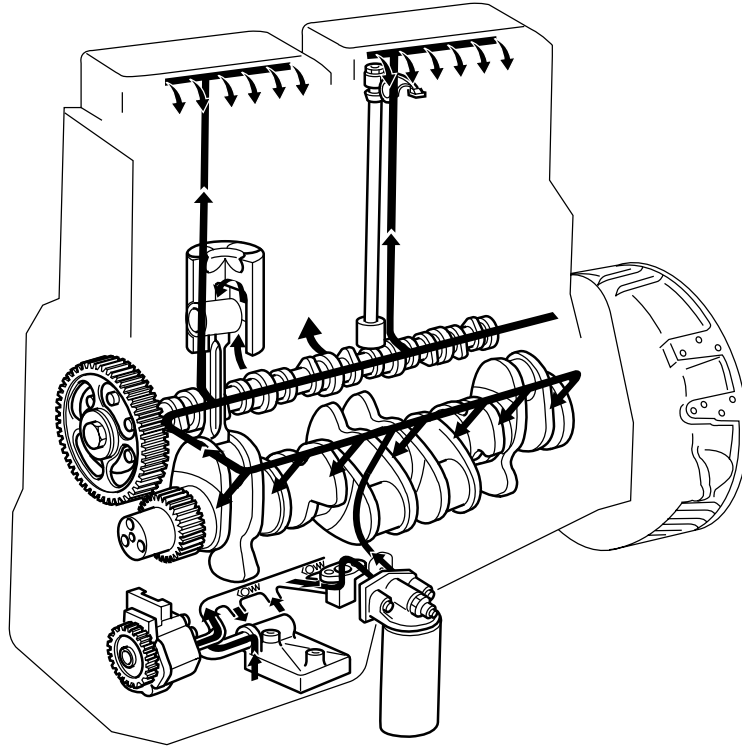
Various oils and lubricants used on the vehicle may constitute a health hazard. This also applies to engine coolant, windscreen washer fluid, refrigerant in air-conditioning systems, battery acid and clutch fluid. So avoid inhaling and direct contact.

Electrical short-circuit

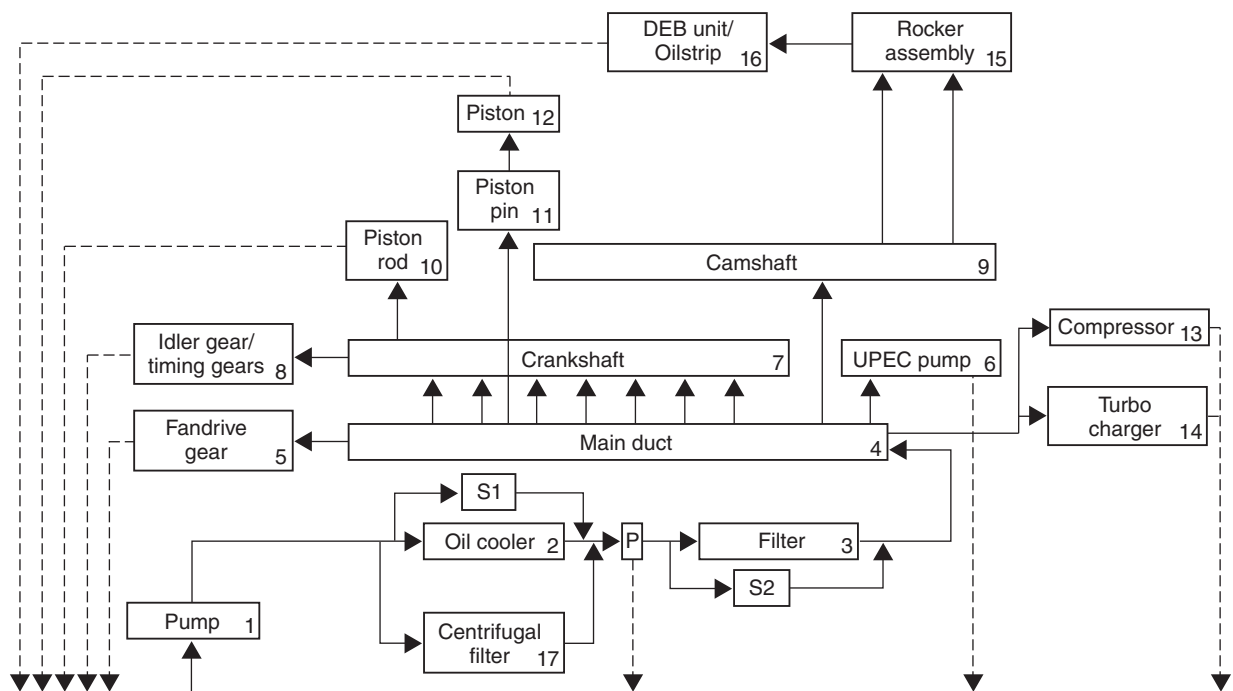
Always disconnect the battery's earth connection during repair or maintenance operations for which the electric power supply is not required.

2. GENERAL

2.1 SYSTEM DESCRIPTION, LUBRICATION SYSTEM



M200907



M201280

General

The oil pump is driven by an idler gear directly from the crankshaft. The oil pump (1) draws the lubricating oil from the oil sump, and pumps it via the oil cooler (2) and the oil filter (3) to the main lubricating oil channel (4) 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 (2) 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 bypass valve (S1) has been installed, which opens at a pressure difference of about 2 bar. If the oil cooler is blocked, or in the event of extremely low temperatures, the bypass valve will open at a pressure difference of about 2 bar. In this situation, uncooled lubricating oil will enter the lubrication system.

Centrifugal filter

A centrifugal filter (17) may be included parallel to the lubrication system. In this case, lubricating oil will flow from the oil cooler to the centrifugal filter. In the centrifugal filter, the lubricating oil undergoes extra filtering.

Pressure limiting valve

A pressure limiting valve (P) is installed in the lubricating system after the lubricating oil cooler. When the pressure set for the pressure limiting valve has been reached, the valve opens and any excess cooled lubricating oil will be discharged to the sump.

Oil filter cartridge

The lubricating oil is cleaned in the oil filter (3). A pressure relief valve (S2), fitted in this filter housing, opens if the pressure in the oil filter becomes too high as a result of fouling or cold lubricating oil. The lubricating oil then passes through the oil filter cartridge unfiltered.

Main lubricating oil channel

From the main lubricating oil channel (4) lubricating oil is supplied to the crankshaft main bearings (7) and via an oil channel in the crankshaft to the big-end bearings (10). From the main lubricating oil channel, lubricating oil is pumped through the first camshaft bearing (9) into the bored camshaft. At the end of the camshaft there is a sealing plug. 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 runs through the cylinder heads to the second and fifth rocker seats (15). Depending on the model, the other rocker shafts, rockers, and bridge pieces are supplied with lubricating oil by the DEB or a lubricating oil strip (16).

Timing gear

From the lubricating oil channel leading to the first crankshaft main bearing (7), another lubricating oil channel goes to the bored hub of the idler gear (8). From the bored hub, the lubricating oil reaches the idler gear. From the idler gear, the lubricating oil is supplied to the other gears. The fan drive (5) is lubricated through a bore in the cylinder block and a lubricating oil channel in the timing case.

Piston and big-end bearings

The pistons (12) and the upper big-end bearings (11) are lubricated by means of lubricating oil nozzles connected to the main lubricating oil channel (4). In addition to its lubricating function, the lubricating oil has an important cooling function. Depending on the engine type, the pistons may be equipped with extra lubricating oil channels to achieve better cooling.

A bore at the top of the connecting rod ensures that the lubricating oil sprayed against the piston head by the lubricating oil nozzles can reach the upper big-end bearing.

Turbocharger and air compressor

A lubricating oil channel running from the main lubricating oil channel is connected to the lubricating oil pipes leading to the turbocharger (14) and air compressor (13).

The lubricating oil discharge pipe from the turbocharger is connected to a channel in the cylinder block, from where the oil returns to the 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 sump.

Pump housing

The pump housing (6) is lubricated from the cylinder block and it discharges the oil through a channel in the cylinder block, from where the lubricating oil returns to the sump. The pump units are supplied with lubricating oil via a channel in the pump housing.

3. INSPECTION AND ADJUSTMENT

3.1 CHECKING ENGINE OIL CONSUMPTION

Engine oil consumption relates to the engine oil used during combustion in the engine. Since engine oil consumption is affected by driving style and the use to which the vehicle is put, it is also related to average fuel consumption. See "Technical data" for the maximum permissible engine oil consumption.

Test conditions

1. An engine oil consumption test is only meaningful after the engine has been run in (approx. 25,000 km).
2. Check the engine carefully for engine oil leakage before carrying out an engine oil consumption test. First repair any leaks.
3. Check the average fuel consumption and engine oil consumption as accurately as possible.
4. Only check the engine oil level when the engine is at operating temperature and only when the engine has been turned off for five minutes.
5. Make sure the vehicle is horizontal before checking the engine oil level.

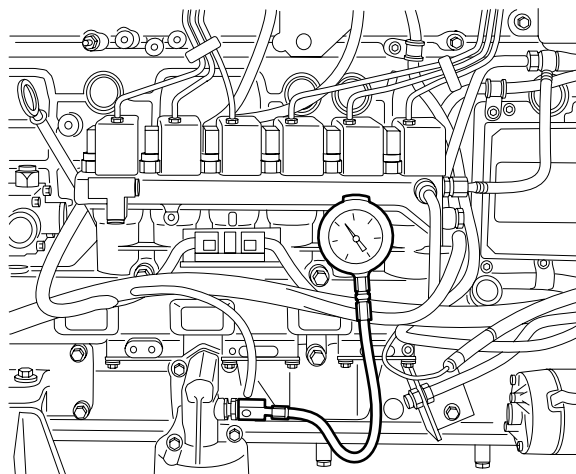
3.2 INSPECTION, LUBRICATING OIL PRESSURE

1. Bring the engine up to operating temperature.
2. Remove the lubricating oil pressure sensor. This sensor is mounted on the oil filter housing.
3. In the oil pressure sensor connection, fit a lubricating oil pressure gauge and the special tool (DAF no. 0535551).
4. Start the engine and measure the lubricating oil pressure at idling speed and at full-load engine speed. Compare the pressure readings with the technical data. See "Technical data".

Note:

The pressure limiting valve mounted in the oil sump cannot be adjusted.

5. Switch off the engine and remove the lubricating oil pressure gauge. Fit a new sealing ring to the oil pressure sensor and fit the sensor.



M201089

3.3 PRESSURE TESTING THE OIL COOLER

1. Remove the oil cooler including the oil cooler bracket from the cylinder block. See "Removal and installation".
2. Remove any protective cover from the oil cooler.
3. Fit a plug in the opening (B) and to the other end (A) connect a nipple with a compressed air connection.
4. Supply compressed air with a pressure of at most 2.5 bar.
5. Immerse the cooling element in warm water (approx. 50°C) and check it for external and internal leakage (air bubbles coming from opening (C)).

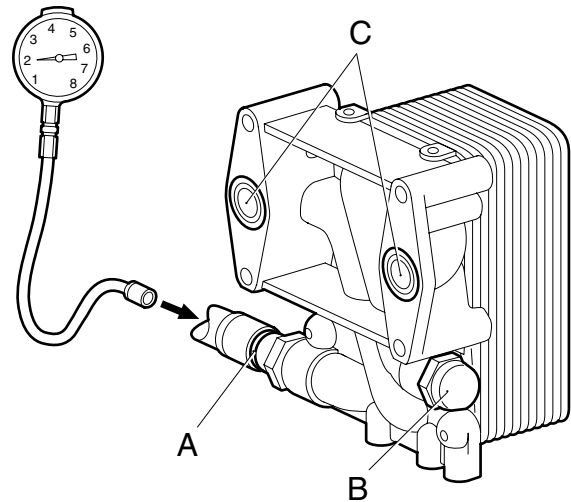
Note:

If the cooling element leaks, it must be replaced.

6. Fit the oil cooler. See "Removal and installation".

Note:

Do not refit the protective cap (if present).



M201092

4. REMOVAL AND INSTALLATION

4.1 REMOVAL AND INSTALLATION, OIL FILTER ELEMENT



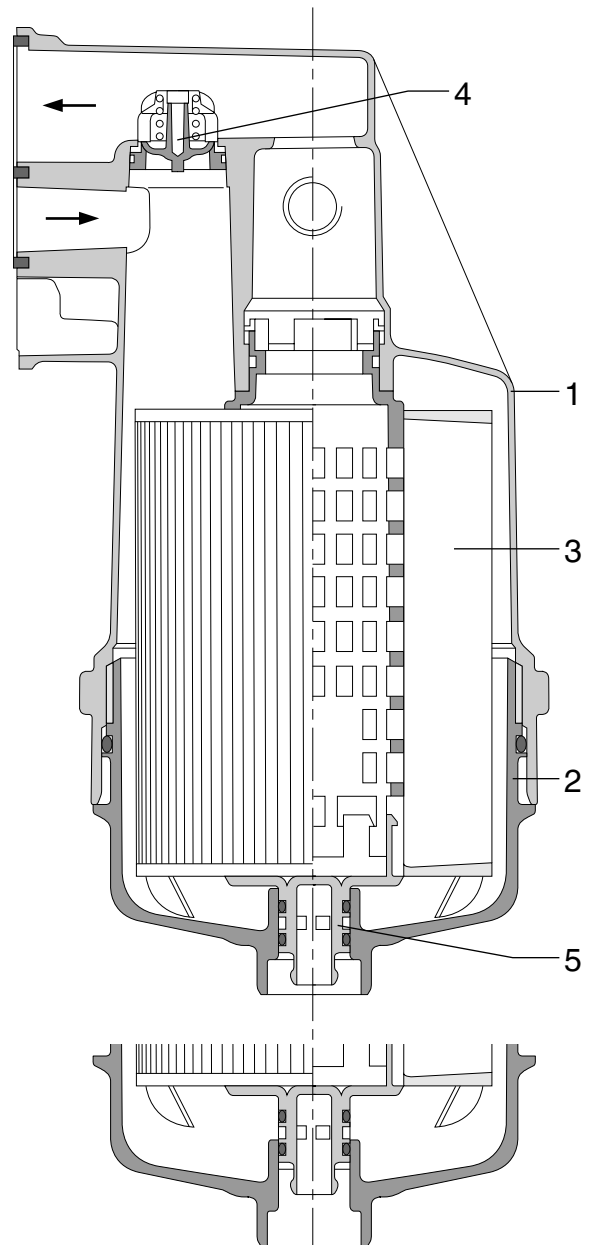
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.
Discard the oil filter element.

Removing the oil filter element

1. Unscrew the cap (2) a few turns and drain the filter housing. Collect the oil.
2. Remove the cap (2) with the oil filter element (3) from the filter housing (1) and then remove the element from the cap.

Fitting oil filter element

1. Fit a new O-ring to the cap (2).
2. Fit the oil filter element with the cap in the filter housing and tighten the cap to the specified torque. See "Technical data".



M201049

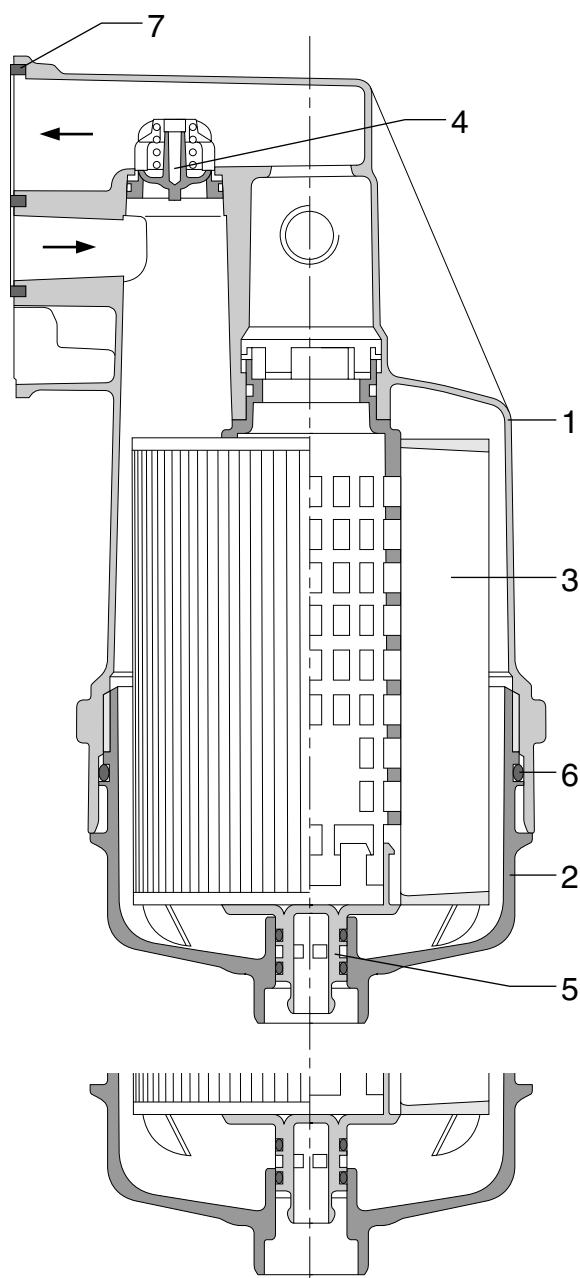
4.2 REMOVAL AND INSTALLATION, OIL-FILTER HOUSING

Removing the oil-filter housing

1. Drain the oil from the filter housing by loosening the cap (2) a few turns.
2. Disconnect the electrical connections from the lubricating oil pressure sensor.
3. Remove the oil-filter housing (1).

Installing the oil-filter housing

1. Replace the O-rings (7) on the rear of the filter housing (1).
2. Fit the filter housing (1) and tighten the attachment bolts to the specified torque. See "Technical data".
3. Hand-tighten the cap (2) and then tighten to the specified torque. See "Technical data".
4. Run the engine for a short time and check for oil leaks.
5. Check the lubricating oil level.



M201170

4.3 REMOVAL AND INSTALLATION, OIL COOLER

Removing the oil cooler

1. Drain the coolant. See "Draining and filling".
2. Disconnect the coolant connections.
3. Disconnect the exhaust brake air supply pipe.
4. Remove the attachment bolts and the oil cooler. Collect the escaping lubricating oil.
5. Remove the O-rings on the oil cooler.

Installing the oil cooler

1. Clean the contact surfaces between the oil cooler and the cylinder block and fit new O-rings onto the oil cooler housing.
2. Fit the oil cooler to the cylinder block and tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit the exhaust brake air supply pipe.
4. Connect the coolant connections.
5. Fill the cooling system.
6. Check the lubricating oil level.
7. Run the engine briefly, and check that the oil cooler does not leak.
8. Check the coolant level.

4.4 REMOVAL AND INSTALLATION, OIL SUMP

Removing the oil sump

1. Remove the oil sealing plug.
2. Drain the oil. See "Draining and filling".
3. Remove the oil level sensor.

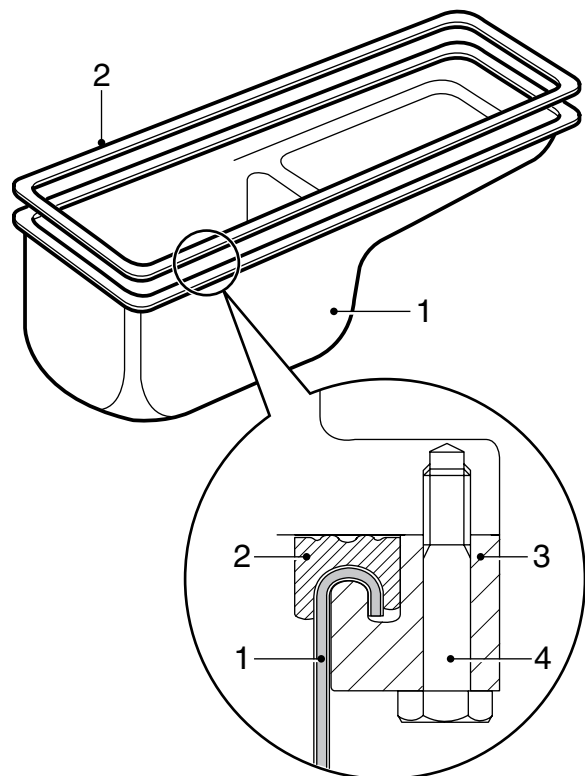
Note:

If the oil level sensor is not removed, the sensor could easily break while removing the oil sump.

4. Support the oil sump (1). Remove the attachment bolts (4) and locking brackets (3) all around.
5. Remove the oil sump and its sealing rubber (2).

Installing the oil sump

1. Thoroughly clean the sealing surfaces of the oil sump and the cylinder block.
2. Check the oil sump sealing rubber (2). A damaged sealing rubber (2) must be replaced.
3. First attach the sealing rubber to the front and rear sides of the oil sump. Then, attach it to the long sides of the oil sump.
4. Fit the oil sump (1) with the sealing rubber (2) upright.
5. Fit the attachment bolts (4) and locking brackets (3). Tighten the attachment bolts crosswise to the specified torque. See "Technical data".
6. Fit the oil level sensor.
7. Fill the engine with the specified quantity of lubricating oil.
8. Run the engine.
9. Check for oil leakage.
10. Check the oil level.
11. If applicable, fit the under-engine noise encapsulation.



M200601

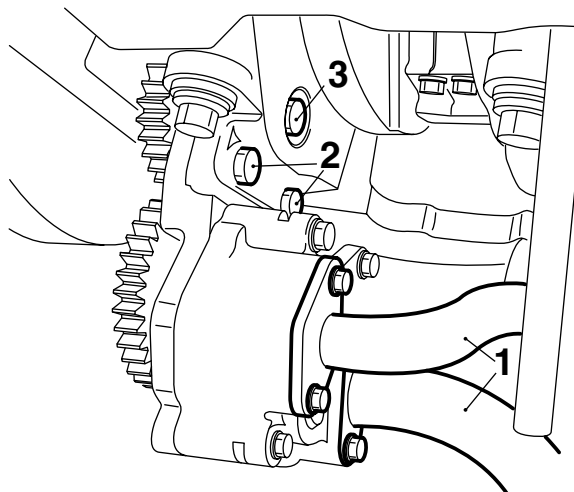
4.5 REMOVAL AND INSTALLATION, OIL PUMP

Removing the oil pump

1. Remove the oil sump.
2. Remove the suction pipe and delivery pipe (1).
3. Remove the bolts (2) attaching the oil pump to the main bearing cap.
4. Remove the attachment bolt (3) and take the oil pump off the main bearing cap.

Installing the oil pump

1. Check that the oil pump rotates smoothly and has no heavy point.
2. Fit the oil pump and tighten the attachment bolts to the specified torque. See "Technical data".
3. Fit new O-rings to the suction and delivery pipes (1).
4. Fit the oil strainer.
5. Fit the oil sump.
6. Top up oil. See "Draining and filling"
7. Check for oil leakage.
8. Check the oil level.



M200600

4.6 REMOVAL AND INSTALLATION, CENTRIFUGAL OIL FILTER ELEMENT



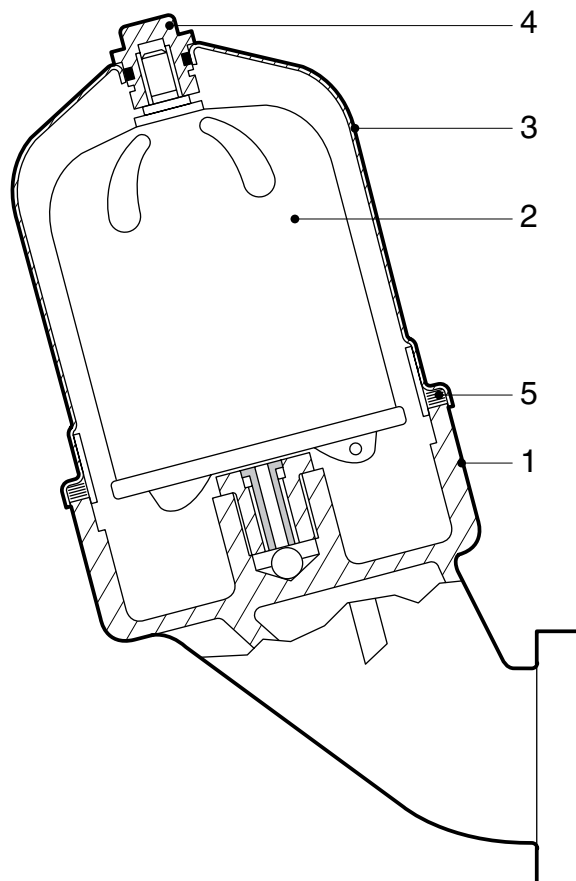
To prevent skin injury, avoid unnecessary contact with the drained lubricating oil.

Removing centrifugal oil filter element

1. Remove the noise encapsulation on the right-hand side.
2. Clean the cap (3) and surrounding area and unscrew the central bolt (4).
3. Remove the centrifugal oil filter element (2).

Fitting the centrifugal oil filter element

1. Clean the interior of the cap (3) and fit the centrifugal oil filter element (2).
2. Check the central bolt (4) for damage.
3. Replace the sealing ring (5) and lightly lubricate the sealing ring with lubricating oil.
4. Fit the cap (3) and tighten the central bolt (4) to the specified torque. See "Technical data".
5. Start the engine and check for leakage.
6. Check the lubricating oil level.



M200526

5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY, OIL PUMP

Disassembling the oil pump

1. Remove the idler gear and hub from the front plate.
2. Remove all attachment bolts from the two sections of the oil-pump housing.
3. Remove the rear section of the oil pump housing.
4. Remove the gear wheels from the oil pump housing.

Assembling the oil pump

1. Clean the gears and check them for damage.

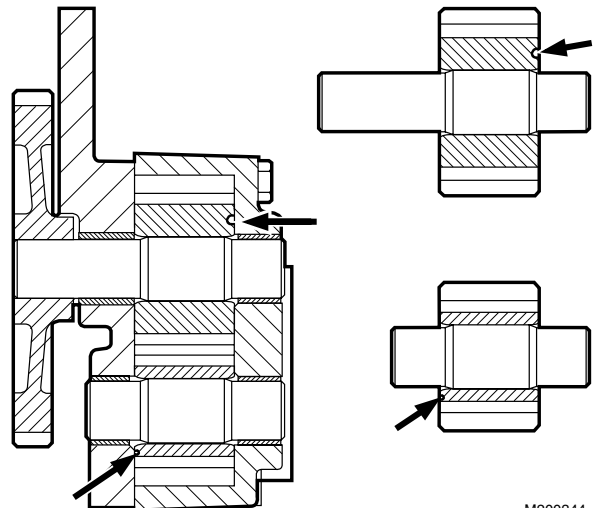
Note:

Gears must be replaced as a set.

Note:

The gears are marked. The gears with the marks must be fitted as shown in the drawings.

2. Fit the gear wheels in the oil pump housing.
3. Fit the rear section of the oil pump housing.
4. Fit the attachment bolts of the oil pump sections. Tighten the attachment bolts to the specified torque. See "Technical data".
5. Check that the oil pump operates smoothly and has no heavy point.
6. Fit the idler gear and hub to the front plate. Tighten the bolt to the specified torque. See "Technical data".



M200344

6. DRAINING AND FILLING

6.1 DRAINING AND FILLING THE ENGINE OIL



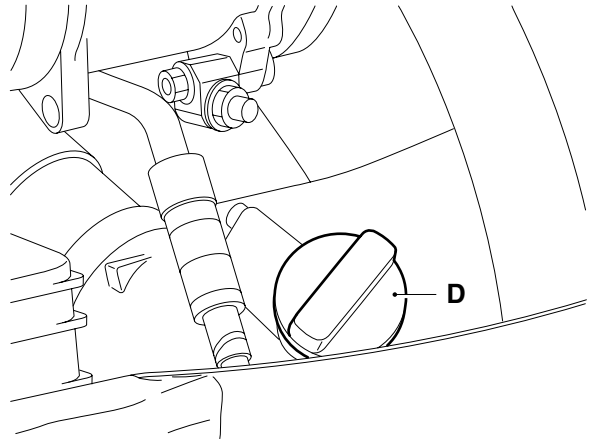
To prevent skin injury, avoid unnecessary contact with the drained oil

Draining the engine oil

1. Ensure that the vehicle is standing on a flat and level surface.
2. Drain the engine oil at operating temperature using the drain plug in the oil sump.
3. Replace the drain plug sealing ring and tighten the drain plug to the specified torque, see "Technical data".

Filling the engine oil

1. Through the oil filler pipe (D), fill the engine with the specified amount of engine oil , see "Technical data".
2. Check the engine oil level, see "Inspection and adjustment".



V300389

