To the reader

The Service Manual is intended to be a practical reference source to be used in workshop. The repair instructions in the manual are based on methods which have been worked out in practice during normal workshop conditions and which are based on the use of special tools from the manufacturer when stated in the instructions. The manual also contains descriptions of the design and function of the components.

Detailed maintenance instructions can be found in Operator’s Manual.

The Service Manual will be continually updated with new revised pages which should be inserted in the manual. Alterations and additions will first appear as service bulletins.

Only genuine Valtra spare parts should be used to ensure the best possible function of the machine. Certain operations should be carried out with the aid of special tools designed by Valtra.

10. General information

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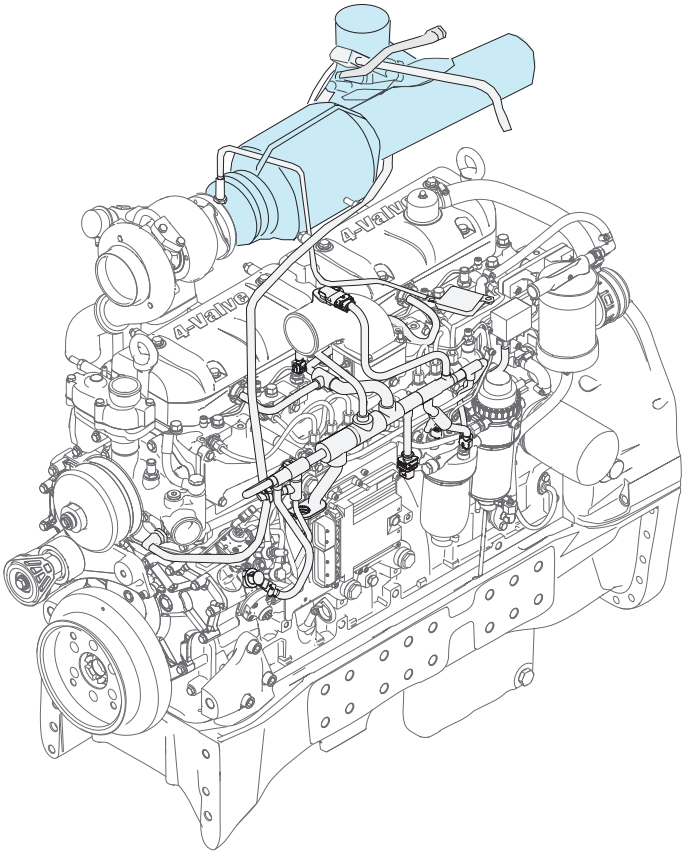
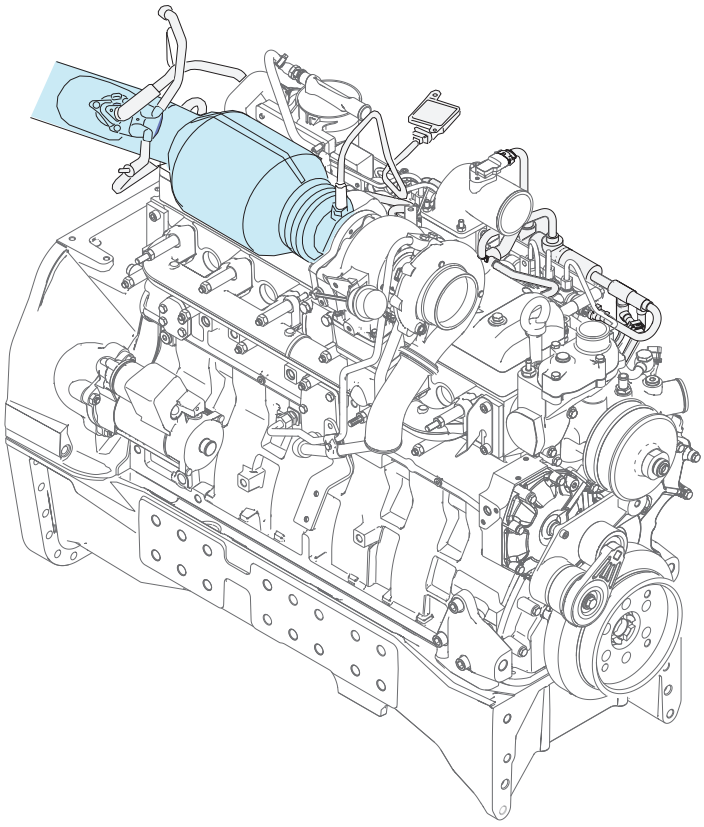
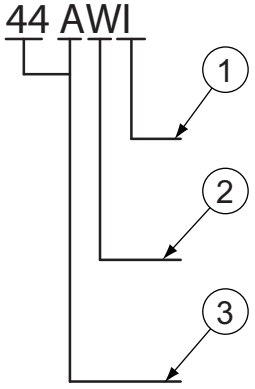




Model	T133 H	T153 H	T173 H	T193 H
Designation	66 AWI		74 AWI	
Type	Four-stroke diesel engine with common rail direct injection			
Turbocharged and intercooling	Yes			
Number of cylinders	6			
Transport boost [1)]	Yes	Yes	Yes	Yes
Sigma Power [2)]	No	No	No	Yes
Max. output, kW/(hp)/rpm (ISO 14396)				
Normal	104/(141)/2 000	114/(155)/2 000	132/(180)/2 000	140/(190)/2 000
Boost	116/(158)/2 000	125/(170)/2 000	140/(190)/2 000	155/(210)/2 000
Max. torque, Nm/rpm (ISO 14396)				
Normal	580/1 500	640/1 500	660/1 500	680/1 500
Boost	630/1 500	680/1 500	730/1 500	800/1 500
Max. no load speed, rpm	2360			
Low idling speed, rpm				
Normal	850			
Parking brake is on	650			

1) Higher transport boost power area when the main gear is H2 or higherThe driving speed depends on the tyres used. For example with tyres 480/80R42, the transport boost is available for speeds over 17 km/h.
2) Sigma Power area, the largest output/torque area, when the power transferred through the power take-off is large enough. The Sigma Power indicator light Σ is lit on the instrument panel.

Engine designation



1. Equipped with intercooler
   I = Air to air
2. Turbocharged engine
   W = by-pass turbo
   T = standard turbo
3. Basic type
   44 = cylinder displacement (dl)
   A = aftertreatment system

Lubrication system specifications

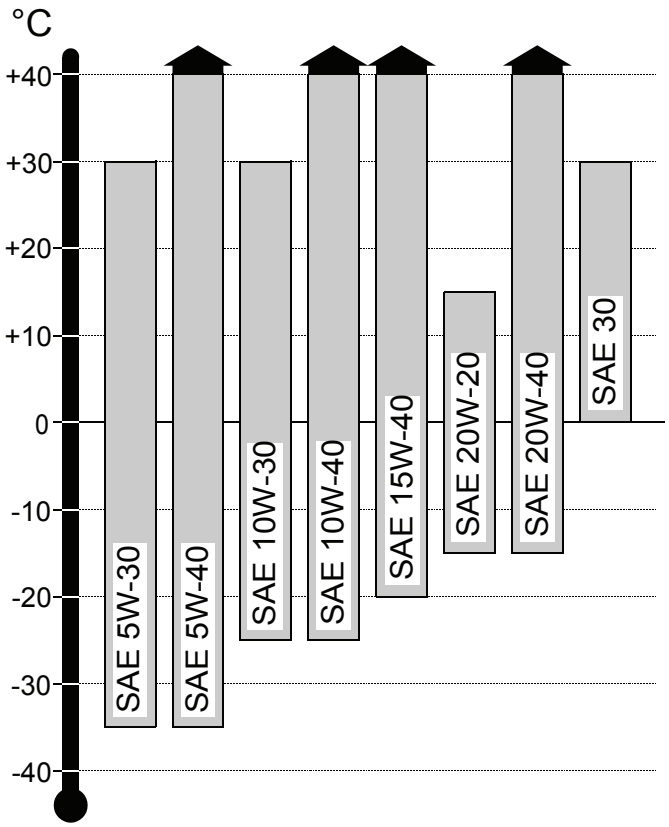
Oil pump	
Type	Gear pump, strainer on the suction side and replaceable filter on the pressure side
Oil pressure at idling speed (min)	100 kPa (1 bar)
Oil pressure at normal working speed	250-400 kPa (2.5-4 bar)

Oil filter	
Type	Disposable type filter element

Oil type	
Valtra grade	Valtra Engine CR-4
SAE grade	10W-40: -25°C...+40°C
API grade	CJ-4
ACEA grade	E9

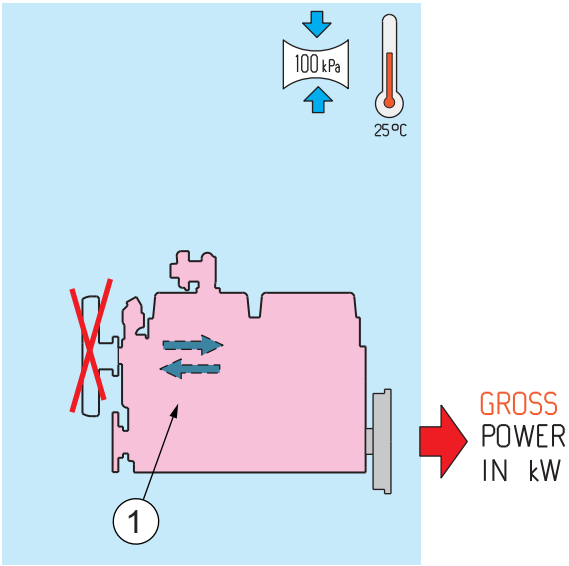
Oil volume	
When changing with filter	19 litres

Viscosity grade should be selected depending on the temperature outside.



Engine output standards

ISO 14396
97/68/EC
(Valtra 2003→)



1. External coolant supply

Gross power standard (in kW) without a fan.

Method of testing:

- testing temperature 25°C
- testing pressure 100 kPa
- no engine ancillaries fitted
    - if water pump drive requires a fan belt, alternator or other ancillaries, these are present but not under load
- coolant supplied externally

97/98/EC

This is an emission standard, in which the power measurement according to the standard ISO 14396 has been added. This is why the power measurement is similar to the above mentioned standard.

Technical data

Cylinder block

Guide pin holes	13.250-13.320 mm
Main bearing housing diameter	91.000-91.025 mm
Main bearing housing diameter	96.000-96.025 mm
Cylinder liner upper end location diameter	124.514-124.554 mm
Cylinder liner lower end location diameter	123.000-123.040 mm
Inside diameter of camshaft bushing no. 1 (fitted)	50.040-50.060 mm
Inside diameter of camshaft bushings, others (fitted)	50.010-50.070 mm
Bearing bushing bore diameter in block (bearing bushing no. 1)	55.620-55.650 mm
Cylinder block height	428.170-428.430 mm

Cylinder liners

Protrusion of cylinder liner above cylinder block top face	0.030–0.080 mm
Max. permissible height difference between liners (under same head)	0.02 mm
Cylinder liner flange height, standard	9.03–9.05 mm
Cylinder liner flange height, 1st oversize	9.08–9.10 mm
Cylinder liner flange height, 2nd oversize	9.13–9.15 mm
Cylinder liner flange height, 3rd oversize	9.23–9.25 mm
Cylinder liner flange outer diameter	131.700–131.800 mm

Cylinder liner guide outer diameter at upper end of liner	124.475–124.500 mm
Cylinder liner guide outer diameter at upper end of liner	124.975–125.000 mm
Cylinder liner guide outer diameter at lower end of liner	122.961–122.986 mm
Cylinder liner guide outer diameter at lower end of liner	120.966–120.991 mm
Liner bore	108.010–108.32 mm
Liner bore	111.000–111.022 mm

Cylinder head

Cylinder head height	109.900-110.000 mm
Cylinder head height after repair grinding (minimum)	109.500 mm
Length of cylinder head bolts	145 ± 0.08 mm (max. 147 mm)
Cylinder studs length (overall length)	186 + 1 mm (max. 188.5 mm)
Valve guide inside diameter	8.000-8.015 mm
Valve guide outside diameter	16.028-16.039 mm
Valve guide bore diameter in cylinder head	16.000-16.018 mm
Valve guide position top above cylinder head surface	13 mm
Depth of inlet valve head face below cylinder head surface	0.65-0.85 mm (max. 2.20 mm)
Depth of exhaust valve head face below cylinder head surface	0.45-0.65 mm (max. 2.20 mm)
Inlet valve seat angle	35°+20'
Exhaust valve seat angle	45°+20'
Inlet valve seat width	2.2 mm
Exhaust valve seat width	2.0 mm
Exhaust valve seat ring diameter	36.060-36.122 mm
Exhaust valve seat rings recess diameter	36.000-36.025 mm
Exhaust valve seat ring diameter	36.260-36.322 mm
Exhaust valve seat ring recess diameter	36.200-36.225 mm
Inlet valve seat ring diameter	41.070–41.132 mm
Inlet valve seat ring recess diameter	41.000–41.025 mm

Inlet valve seat ring diameter	41.270–41.332 mm
Inlet valve seat ring recess diameter	41.200–41.225 mm

Valves and rockers

With a valve clearance of 1.0 mm:	
- inlet valve opens	2° ± 2° B.T.D.C
- inlet valve closes	18° ± 2° A.B.D.C
- exhaust valve opens	36° ± 2° B.B.D.C
- exhaust valve closes	2° ± 2° A.T.D.C
Inlet valve clearance, hot and cold	0.35 mm
Exhaust valve clearance, hot and cold	0.35 mm
Inlet valve face angle	35°-20'
Exhaust valve face angle	45°-20'
Inlet valve head outside diameter	39 mm
Exhaust valve head outside diameter	35mm
Max. inlet valve movement with a valve clearance of 0.35 mm:	9.5 mm
Max. exhaust valve movement with a valve clearance of 0.35 mm:	9.0 mm
Inlet valve stem diameter	7.960-7.975 mm
Exhaust valve stem diameter	7.925-7.940 mm
Inlet valve stem clearance	0.025-0.055 mm
- Reject limit	0.30 mm
Exhaust valve stem clearance	0.060-0.090 mm
- Reject limit	0.35 mm
Depth of inlet valve head face below cylinder head surface	0.65-0.85 mm (max. 2.20 mm)
Depth of exhaust valve head face below cylinder head surface	0.45-0.65 mm (max. 2.20 mm)
Valve spring free length	75.1 mm
Spring pressure when spring compressed to a length of 48.6 mm	300 ± 10 N
Spring pressure when spring compressed to a length of 37.4 mm	420 ± 15N
Rocker arm shaft diameter	24.970-24.990 mm
Rocker arm bore diameter	25.000-25.021 mm
Rocker arm spring free length	88 mm
Spring pressure when spring compressed to a length of 66 mm	75-95 N

Tappets and push rods

Tappet outside diameter	29.939–29.960 mm
Tappet bore diameter in cylinder block	30.000–30.043 mm
Max. permissible push rod deflection (when free)	0.4 mm

Camshaft

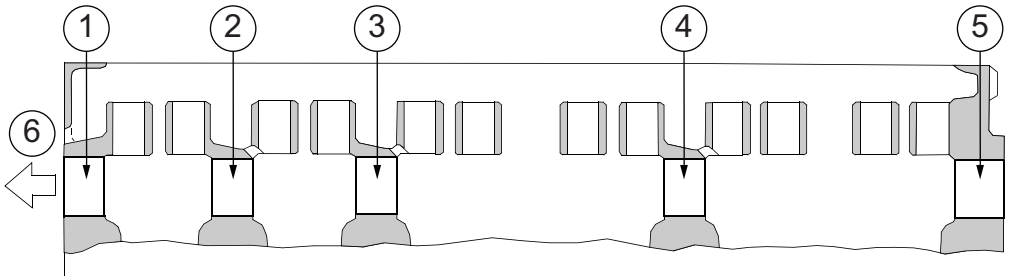
Camshaft bearing journal no. 1 diameter	49.875-49.900 mm
Camshaft bearing journal nos 2-4 diameter	49.865-49.890 mm
Camshaft bearing journal no. 5 diameter	49.885-49.910 mm
Camshaft clearance in bearing bush no. 1	0.140-0.185 mm
Camshaft clearance in bearing bush nos. 2-4	0.110-0.160 mm
Camshaft end play	0.7-1.2 mm
Inlet valve cam height (distance between back of cam and tip of cam)	43.180-43.680 mm
Exhaust valve cam height (distance between back of cam and tip of cam)	41.700-42.200 mm
Inlet valve cam lift	6.18 mm
Exhaust valve cam lift	7.70 mm
Cam width	19.70-20.30 mm

Camshaft max. permissible deflection (total indicator reading)	0.03 mm

Oversize camshaft bushings

If the camshaft bushing location (front bearing) is damaged, a bushing with outer diameter of 0.4 mm oversize can be fitted. Bushings are available also for camshaft bearings that do not normally have bushings.

The installing places are the same as with the standard bushings. Observe the position of the oil holes. Bushings do not require reaming after fitting.



1. Bushing location
2. Bushing location
3. Bushing location
4. Bushing location
5. Bushing location
6. Tractor front

Numbering begins from the front end of the engine.

Camshaft bushing location	Hole diameter for the bushing
1.	56.02–56.05 mm
2.	55.62–55.65 mm
3.	55.42–55.45 mm
4.	55.62–55.65 mm
5.	55.84–55.87 mm

Crankshaft

Crankpin diameter:	
- standard	67.981-68.000 mm
- 1st undersize 0.25 mm	67.731-67.750 mm
- 2nd undersize 0.50 mm	67.481-67.500 mm
- 3rd undersize 1.00 mm	66.981-67.000 mm
- 4th undersize 1.50 mm	66.481-66.500 mm
Crankpin length	40.000-40.160 mm
Main bearing journal diameter:	
- standard	89.985-90.020 mm
- 1st undersize 0.25 mm	89.735-89.770 mm
- 2nd undersize 0.50 mm	89.485-89.520 mm
- 3rd undersize 1.00 mm	88.985-89.020 mm
- 4th undersize 1.50 mm	88.485-88.520 mm
Main bearing housing diameter (in cylinder block)	96.000-96.025 mm
Main bearing shell thickness:	
- standard	2.955-2.965 mm
- 1st undersize 0.25 mm	3.080-3.090 mm
- 2nd undersize 0.50 mm	3.205-3.215 mm

- 3rd undersize 1.00 mm	3.455-3.465 mm
- 4th undersize 1.50 mm	3.705-3.715 mm
- main bearing (outer ⌀ 1.0 mm oversize and inner ⌀ 0.5 mm undersize)	3.705-3.715 mm
Main bearing clearance	0.050-0.127 mm
Thrust bearing journal length (journal nearest to flywheel):	
- standard (2 standard thrust plates)	45.000-45.080 mm
- 1st oversize (one standard and one 0.1 mm overthick thrust plate)	45.100-45.180 mm
- 2nd oversize (one standard and one 0.2 mm overthick thrust plate)	45.200-45.280 mm
- 3rd oversize (one 0.1 mm and one 0.2 mm overthick thrust plate)	45.300-45.380 mm
- 4th oversize (two 0.2 mm overthick thrust plates)	45.400-45.480 mm
Other crankshaft journals cannot be ground longer.	
Crankshaft end float	0.100-0.380 mm
Max. permissible ovality and other deformity of crankpins or journals	0.03 mm
Crankshaft unbalance	1.0 Ncm max.
Number of teeth on trigger wheel	60-2

Flywheel

Interference fit between ring gear and flywheel	0.425–0.600 mm
Before fitting the ring gear, heat up to a temperature of	150–200°C
Flywheel unbalance	1 Ncm max.
Max. permissible axial wobble of flywheel clutch face, measured at inner edge of clutch face on diameter 200	0.06:⌀200

Timing gears

Tooth backlash	0.05–0.25 mm
Max. permissible side wobble of gears	0.05 mm
Idle gear (slide bearing, 50.7 mm length shaft)	
- Idler gear shaft, diameter	55.151–55.170 mm
- Inner diameter of idler gear bushing (fitted)	55.200–55.230 mm
Inner diameter of idler gear hole	60.000–60.030 mm

Timing marks	
On crankshaft gear	2 dots on tooth
On idler gear against crankshaft gear mark	1 dot on tooth
On idler gear against camshaft gear mark	1 dot on tooth
On idler gear against high pressure pump mark	2 dots on notch
On high pressure pump gear	1 dot on notch
On camshaft gear	1 dot on notch

NOTE: The timing marks on the gears are in alignment when the first cylinder piston is at its top dead centre (TDC) between compression and power strokes.

Connecting rod

Big-end bearing shell thickness:	
- standard	1.835-1.842 mm
- 1st st undersize 0.25 mm	1.960-1.967 mm
- 2nd undersize 0.50 mm	2.085-2.092 mm
- 3rd undersize 1.00 mm	2.335-2.342 mm
- 4th undersize 1.50 mm	2.585-2.592 mm
Big-end bearing clearance	0.046-0.098 mm

End float (side clearance) at big-end on crankshaft	0.200-0.410 mm
Piston pin bushing location perpendicular to longitudinal axis of connecting rod to be within	0.15:100
Piston pin bushing location and big-end bearing location to be parallel to within	0.05:100
Max. permissible weight difference between connecting rods in the same engine	20 g
Weight marking	a letter at lower end

Inside diameter of piston pin bush (with bush pressed into connecting rod)	40.025-40.040 mm
Outside diameter of piston pin bush (standard)	44.080-44.120 mm
Outside diameter of piston pin bush (oversize)	44.580-44.620 mm
Interference fit: connecting rod small-end bushing-connecting rod:	0.057-0.120 mm
Connecting rod small-end bore	44.000-44.025 mm
Connecting rod small-end bore (oversize bushing)	44.500-44.525 mm
Connecting rod big-end bore	71.730-71.749 mm

Piston, rings and pin

Piston diameter (17 mm from lower edge)	107.883-107.897 mm
Piston diameter (19 mm from lower edge)	107.893-107.907 mm
Pin bore in piston	40.003-40.009 mm
Piston pin diameter	39.991-40.000 mm
Width of ring grooves:	
- 1st groove	wedge-shaped ring
- 2nd groove	2.520-2.540 mm
- 3rd groove	4.040-4.060 mm
Side clearance of piston rings in their grooves:	
- 1st ring	wedge-shaped ring
- 2nd ring	0.03-0.062 mm
- 3rd ring	0.05-0.082 mm
- Reject limit	0.15 mm
Piston ring height (in direction of cylinder):	
- 1st ring	wedge-shaped ring
- 2nd ring	2.478-2.490 mm
- 3rd ring	3.975-3.990 mm
Piston ring gap (with piston fitted in cylinder):	
- 1st ring	0.40-0.55 mm
- 2nd ring	0.60-0.80 mm
- 3rd ring	0.30-0.60 mm
- Reject limit 1st and 3rd ring	1.0 mm
- Reject limit 2nd ring	1.5 mm
Max. permissible weight difference between pistons in same engine	25 g

Lubricating oil system

Oil pressure at normal running temperature:	
- at idling speed (min.)	1.0 bar
- at running speed	2.5–5.0 bar
Oil pressure regulating valve:	
Free length of oil pressure valve spring (identification = yellow dot)	49.3–50.8 mm
Assembly length / load of oil pressure valve spring	28.5 mm / 127 N
Oil filter by-pass valve opens at a pressure difference of	2 ± 0.5 bar

Oil pump

Backlash between gears when crankshaft lies firmly against the lower side of the main bearings:	
- crankshaft gear-lubricating oil pump gear	0.05-0.25 mm
- between the pump gears	0.16-0.26 mm
Diameter of drive shaft at bearings for body and cover	17.966-17.984 mm
Diameter of drive shaft bearing hole on body and cover	18.000-18.018 mm
Inner diameter of bearing for gear wheel which rotates on fixed shaft	18.000-18.018 mm
Diameter of fixed shaft at gear wheel	17.966-17.984 mm
Fixed shaft in pump body, diameter	20.035-20.048 mm
Protrusion of fixed shaft end below pump body face	0.5 mm
Cover gasket thickness	0.06-0.08 mm
Gear wheels outer diameter	55.824-55.870 mm
Housing diameter	56.000-56.120 mm
Gears thickness	32.000-32.027 mm
Gears end play	0.03-0.11 mm
Housing depth	32.000-32.043 mm

Turbocharger

Type	S200G
Maximum axial clearance	0.10 mm
Maximum radial clearance (compressor end)	0.88 mm
Compressor wheel locking nut tightening torque	13.6 Nm
Compressor housing screws tightening torque	13.6 Nm
Turbine housing screws tightening torque	21.0 Nm

Tightening torques

Object	Nm
Cylinder head bolts and nuts	80 Nm + 90° + 90°
Cylinder head studs to cylinder block	30
Main bearing screws	200
Connecting rod screws	40 Nm + 80 Nm + 90°
Crankshaft nut	1000
Crankshaft pulley screws	30
Crankshaft pulley screws	80
Flywheel housing screws:	
-M12	150
-M10	80
Flywheel screws	150
Idler gear screws (with ball bearing)	
-M14	180
-M8	32
Small idler gear:	
-M8 screws (shaft, 2 pcs)	45
-M8 screws (thrust ring)	32
Camshaft gear nut	200
Rocker arm shaft bracket screw and nuts	45
Valve cover and frame screws	25
Piston cooling valve	30
Oil pump retaining screws	50
Oil sump drain plug M18	80
Oil cooler connecting piece	60
Coolant pump pulley nut	120
Belt tightener screw	48
Exhaust manifold screws	50

Always use the torque values listed in the following table when specific torque values are not available.

Thread	Strength class 8.8	Strength class 10.9
M8	25 Nm	35 Nm
M10	50 Nm	75 Nm

Use a washer with the aluminium parts.

Engine construction

Cylinder block

The cylinder block is the main body of the engine, to which other engine parts are attached.

Wet and replaceable cylinder liners are supported at the middle, which reduces vibrations and directs coolant circulation mainly to the upper part of the liners.

The seal between the lower part of the cylinder liner and the cylinder block is achieved by three O-rings which are fitted in grooves in the liner.

The camshaft is located in the cylinder block.

The engine has separate bearing sleeves in all camshaft bearing locations. The drilling for the camshaft rear end is covered with a plug.

There are spaces on both sides of the rear main bearing for guide bearing shims (the crankshaft thrust bearings).

Flywheel housing

The flywheel housing is fitted at the rear end of the cylinder block.

The seal for the crankshaft rear end is placed in a bore in the housing. The starter motor fixing point is fitted in the flywheel housing.

The lower face of the flywheel housing functions as a sealing surface for the oil sump gasket. This means that the lower face of the cylinder block must be level with the flywheel housing. When fitting the flywheel housing, its position is determined by tension pins.

The flywheel housing is delivered according to the requirements set by the engine model. Different flywheel housings can be mounted on all engine types.

Valve mechanism

The valve mechanism is operated by the camshaft which is located in the cylinder block.

The drive is transferred with the help of tappets and push rods. The camshaft gear wheel is fitted with a nut and guided with a key. Each bearing is lubricated by the force feed lubrication system through drilled oilways in the cylinder block.

Two valve engine cylinder head

The engine has two cylinder heads which are interchangeable with each other and with the 33 engine cylinder head. Each cylinder has its own inlet and exhaust ports located on either side of the head. A cool inlet valve is fitted between hot exhaust valves to balance the thermal load.

Cylinder head bolts are high tensile bolts, which are tightened up to yield limit using the angle tightening method. Due to the large stretch, the tightening forces are kept constant during the whole lifetime and retightening is unnecessary.

The injector locations are machined directly into the cylinder head. The inlet and exhaust valve guides are identical and can be interchanged. Exhaust valves are fitted with separate valve seat rings. The engines with high output are also equipped with separate inlet valve seats.

Crank mechanism

The crankshaft is forged from chrome alloy special steel and is induction hardened at the bearing and sealing surfaces. This makes it possible to grind bearings four times without a new heat treatment. Gear wheels are located at the front end of the crankshaft. They are a press fit, and drive the idler wheel and oil pump. In addition, the front end of the crankshaft has splines for the hub of the V-belt pulley.

The hub is fastened to the crankshaft with a cone joint. An oil deflector ring is fitted between the hub and gear wheel.

The crankshaft is supported on the cylinder block by main bearings, which are placed on both sides of each cylinder. There is therefore one main bearing more than there are cylinders. The crankshaft thrust washers are placed in both sides of the rearmost main bearing.

A flywheel, on which there is a press-fit starter ring gear, is fitted at the rear end of the crankshaft. The forged connecting rod has an I-cross-section. The bearing location at the bottom end of the connecting rod is fracture-split, and the bearing cup is secured by two special elongated screws. The upper part has a wedge-shaped bearing location, in which the piston pin bearing bushing is fitted with a press fit.

The piston is made of a eutectic aluminium alloy. In the upper face of the piston there is a combustion chamber. The shape of the chamber is intended to maximise the mixture of air and fuel. The upper ring location is formed in a cast iron ring which is cast in the piston. In addition, the piston is graphite-coated to ensure correct running-in.

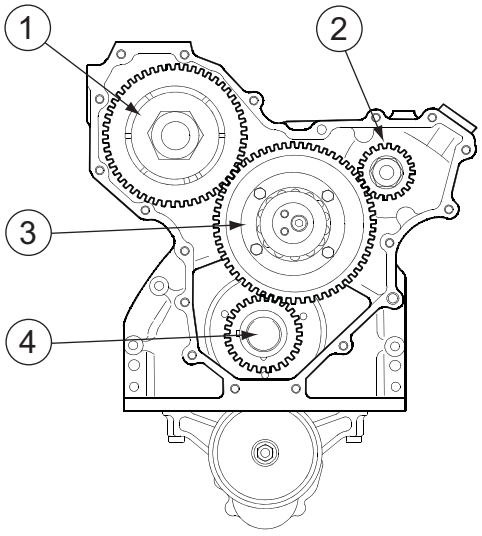
The piston has three rings. The upper molybdenum-coated ring has a wedge-shaped cross-section. On some slightly supercharged engines the upper ring is right-angled. The middle ring is tapered and it fits into its groove. The taper takes up the clearance. The oil control ring is spring-loaded and it has a twostage, chromed scraping edge.

Timing gears

The timing gear drives the camshaft, high-pressure pump and oil pump. The timing gear train consists of hardened, helically cut gear wheels. The gear of the high-pressure pump is spur-geared and it is driven by a double idler gear. The gears are encased by the timing gear casing which is fitted to the front of the engine.

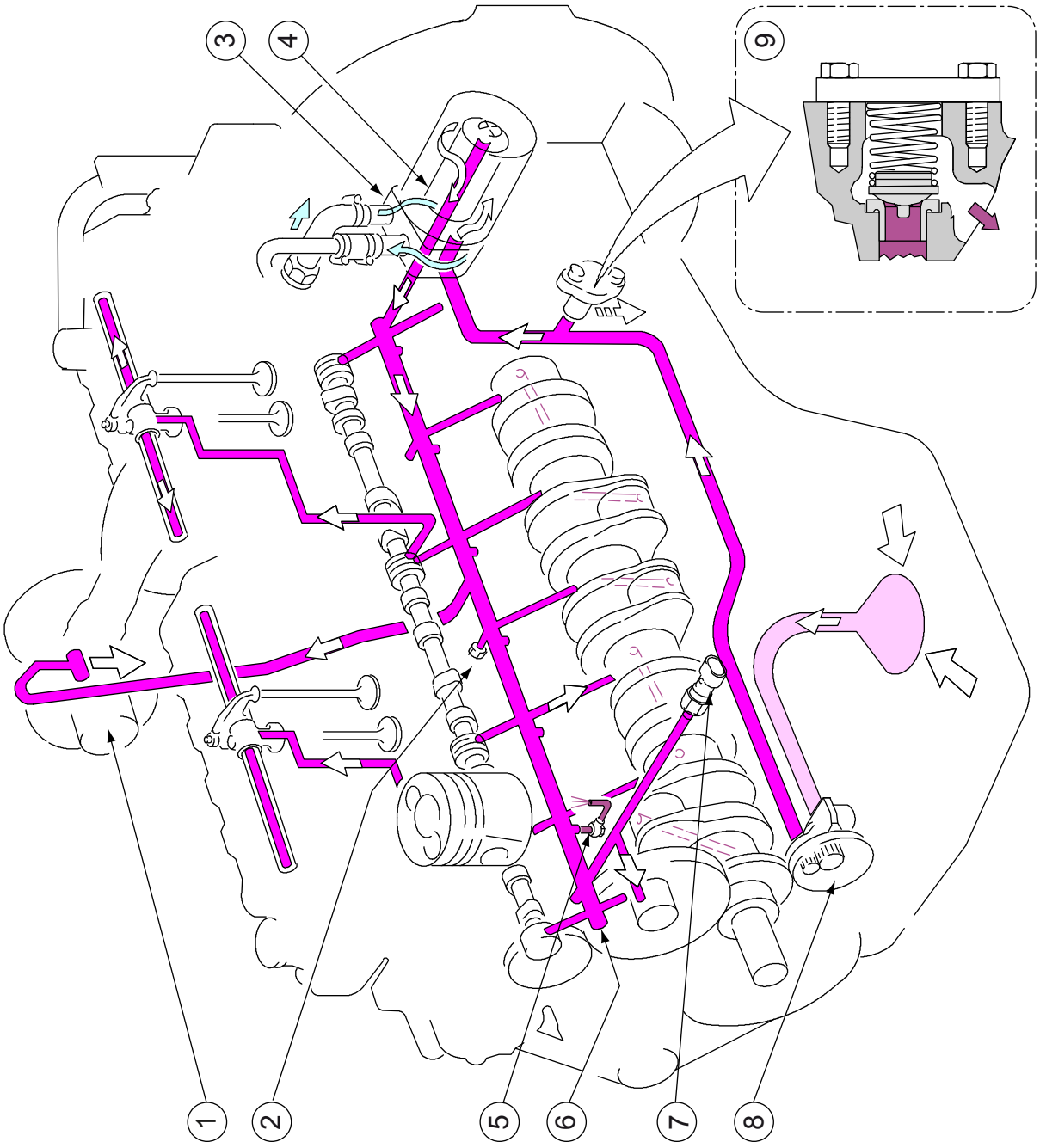
If the engine is equipped with a hydraulic pump, it is driven via a gear or a separate drive unit. The idler gear is supported with a ball bearing on the shaft on the front face of the cylinder block.

Timing gear parts:



1. Camshaft gear
2. High-pressure pump gear
3. Idler gear
4. Crankshaft gear

Lubricating system



1. Turbocharger
2. Plug
3. Oil cooler
4. Oil filter
5. Piston cooling nozzle
6. Main oil gallery
7. Oil pressure sensor (B6M)
8. Oil pump
9. Oil pressure regulating valve

The engine has a pressure lubricating system in which the oil pump (gear pump) is attached to the lower face of the cylinder block. The oil is sucked up by the pump through a suction strainer. After the pump, the oil is led through an oilway to the oil pressure regulating valve and via the oil cooler to the oil filter. After the filter, the oil is led through the

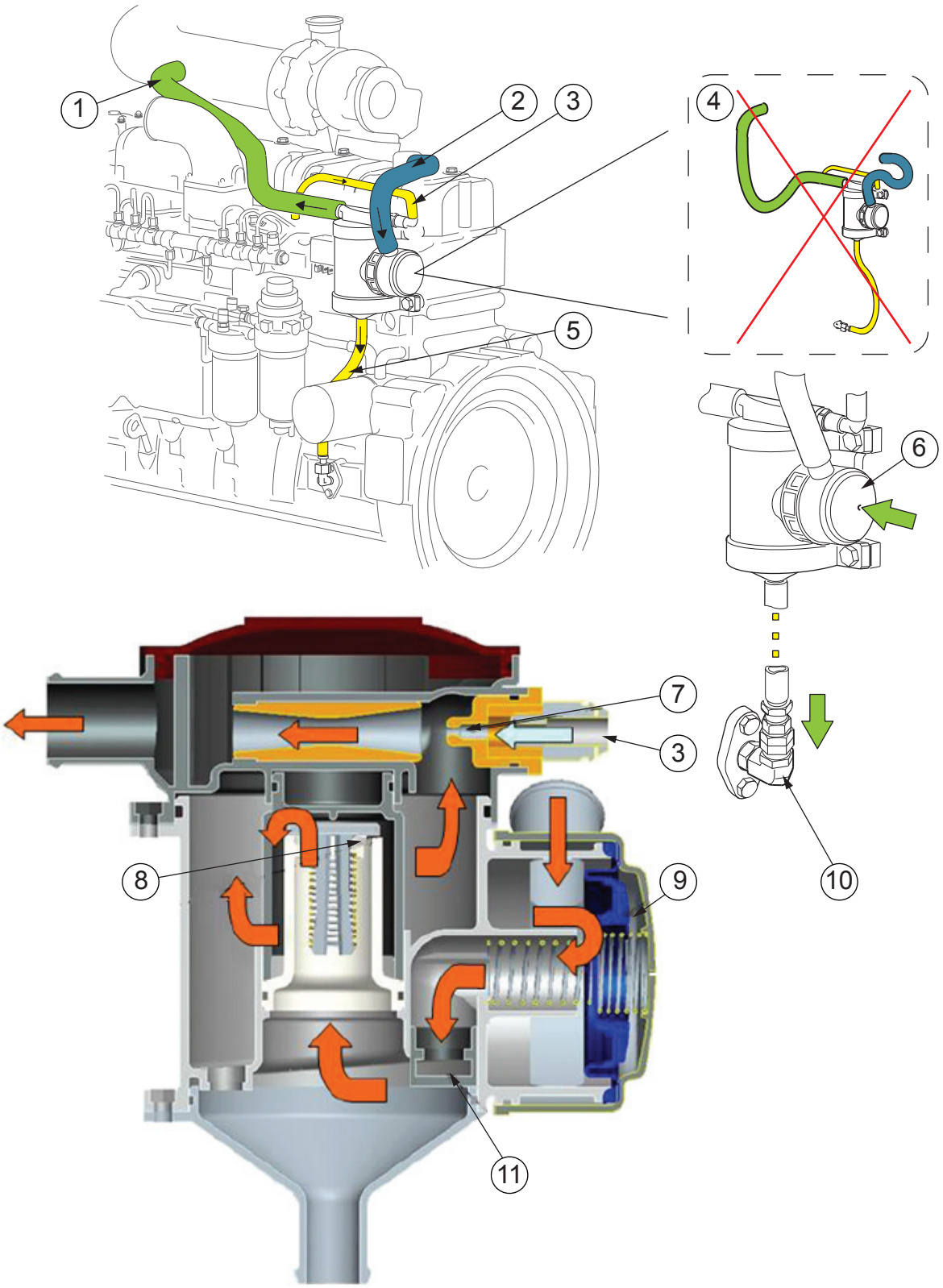
main oil gallery from which oilways branch out. The oil is led through the oilways in the main bearings and through the crankshaft to the big end bearings.

The oil is further directed from the main gallery to accessory equipment, turbocharger and, if applicable, to a compressor. In addition, the camshaft bearing points and the valve mechanism get their lubrication oil via the main oil gallery. The undersides of the pistons of the engines with high output are always cooled by the oil spray when the oil pressure is more than 3 bar.

The oil pressure regulating valve is located under the oil filter on the left side of the engine. The regulating valve keeps the oil pressure constant, independent of the engine speed. At working speed, the oil pressure is 2.5 to 5 bar depending on the temperature and the quality of the lubricating oil. At idling speed, the pressure is 1.0 bar minimum.

The oil filter is of main flow type. It has a replaceable cartridge mounted on the left side of the engine. At the bottom of the oil filter cartridge there is a bypass valve for cold start or clogging of the filter.

Closed crankcase ventilation

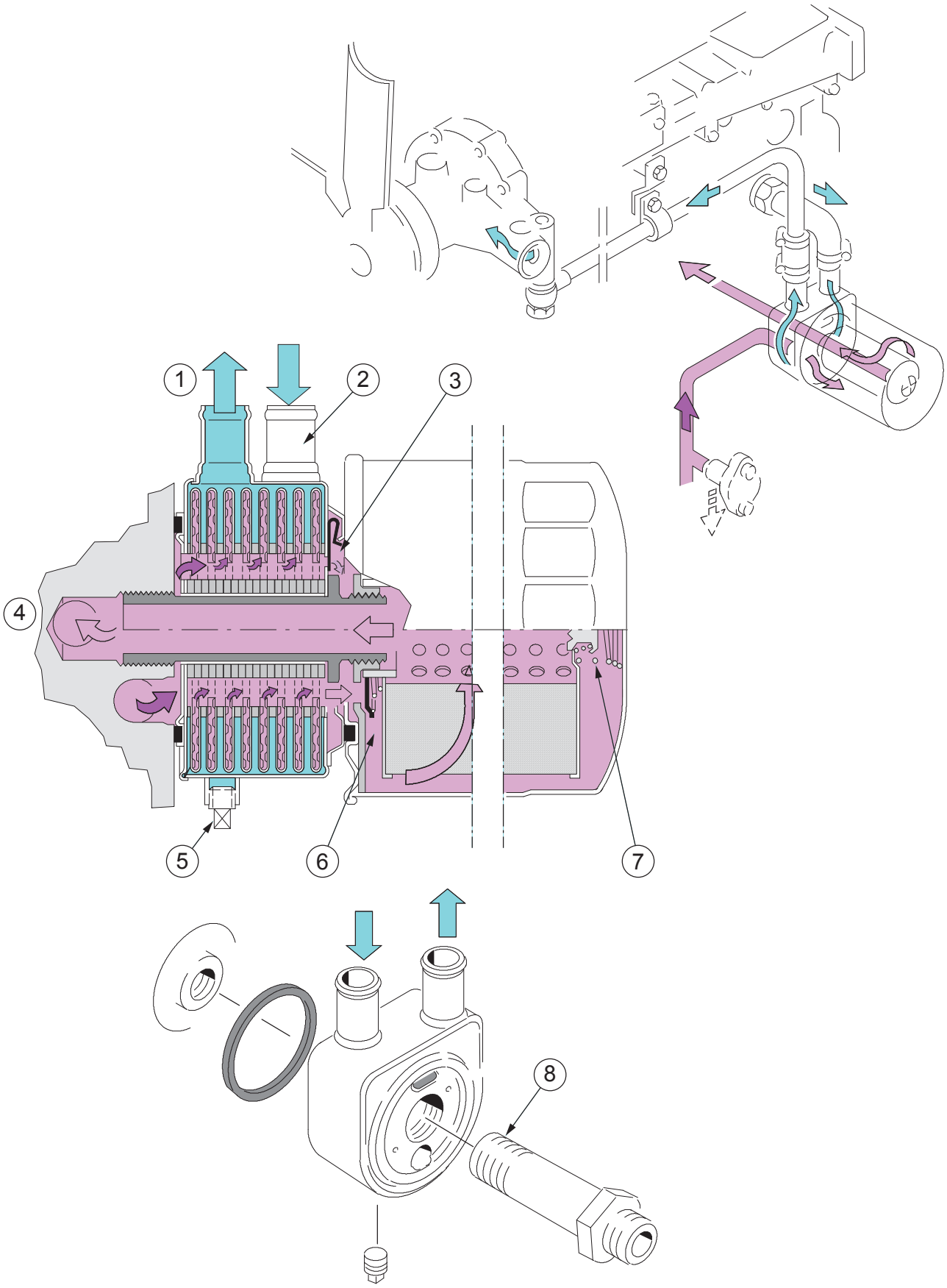


1. Hose (from cover to engine air intake)
2. Hose (from valve mechanism to cover)
3. Hose, boost air (from the inlet manifold to cover)
4. Assembling (hoses straight when mounting)
5. Return hose (from engine lower part to crankcase)

6. Ventilation hole
7. Jet nozzle and jet pump
8. Variable impact separator
9. Pressure regulator
10. Connector (with an anti-suction check valve)
11. Pre-separator

In the closed crankcase ventilation system, oil is separated from the breathing air with the help of boost pressure. The pressure regulator located on the filter side equalizes pressure in the crankcase so that it corresponds to the outside pressure. This is done by regulating the amount of incoming breathing air. The separated oil is returned to the crankcase and so protects the environment from contamination.

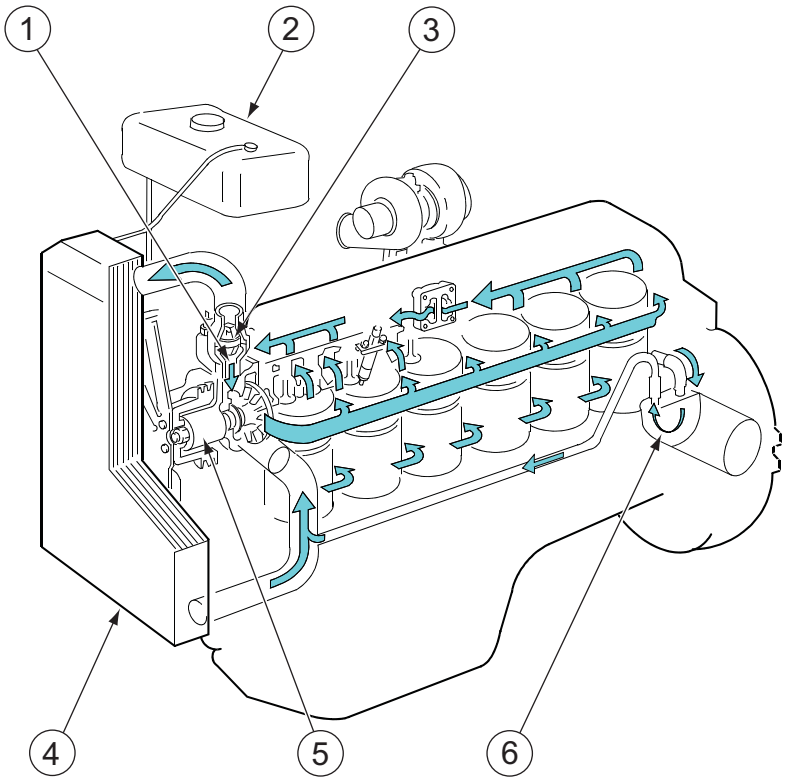
Oil cooler



1. Cooling water out
2. Cooling water in
3. By-pass valve for the cooler
4. Oil
5. Drain plug for the cooling water
6. Oil filter
7. By-pass valve
8. Connection piece (60 Nm, Loctite 243)

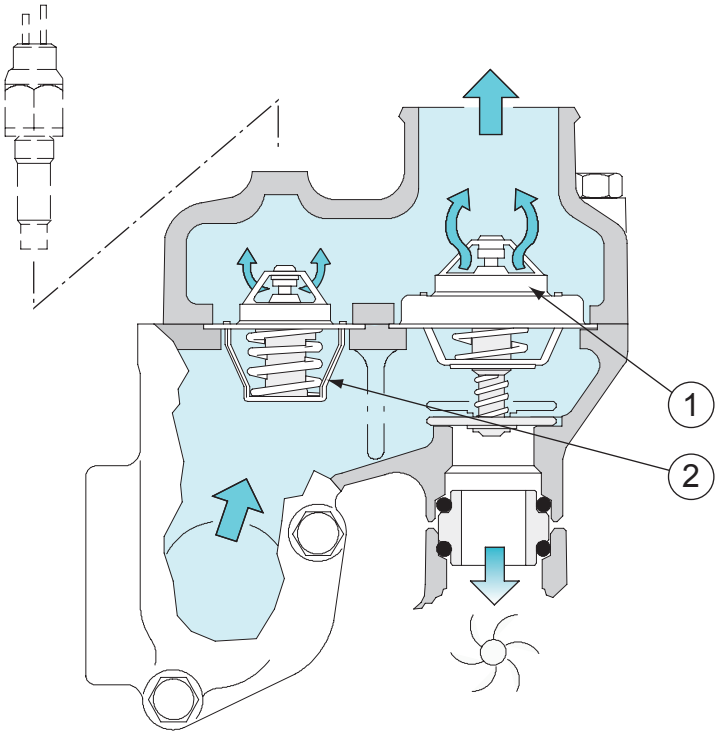
The engine oil cooler is placed between the filter and the cylinder block. The oil circulating in the cooler is cooled with the engine coolant. The oil filter has a valve, which prevents the oil flowing away from the filter when the engine is not running.

Cooling system



1. By-pass pipe
2. Expansion tank
3. Thermostats
4. Radiator
5. Coolant pump
6. Oil cooler

Coolant pump



1. Double-acting thermostat, opening temperature 83°C
2. Single-acting thermostat, opening temperature 79°C

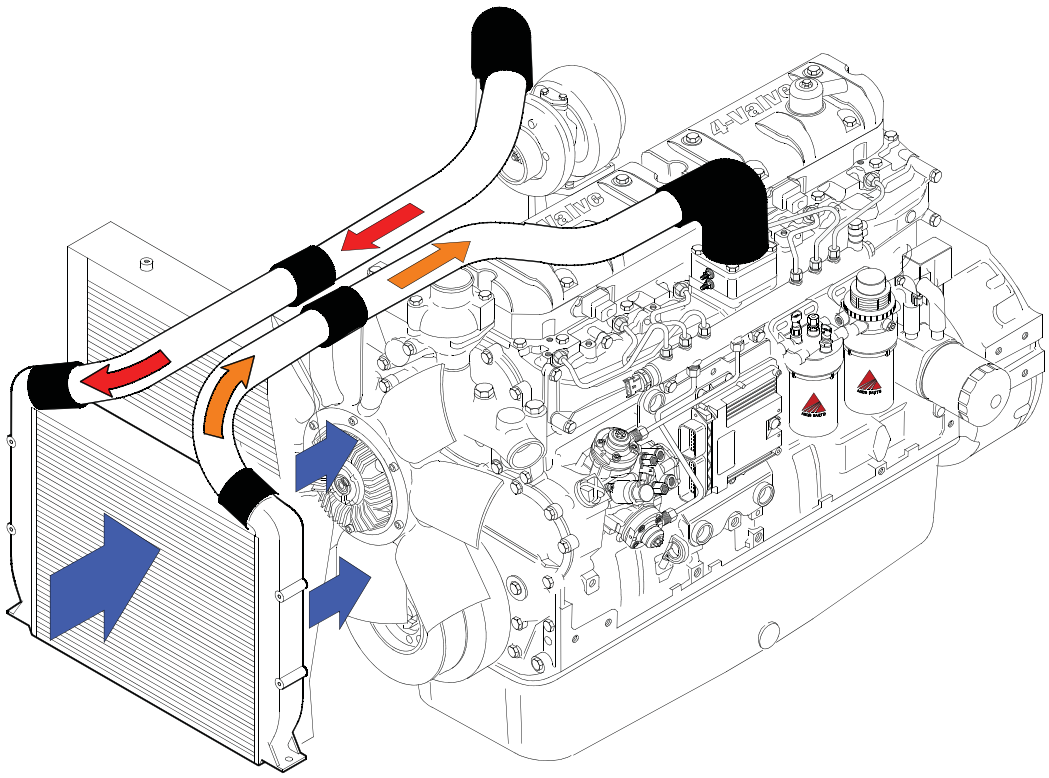
The coolant pump is attached to the front face of the cylinder block and the thermostat housing is mounted above it.

One of the two thermostats steers the bypass of coolant liquid.This arrangement ensures a steady warming-up of the engine under all conditions. The thermostats differ in types and opening temperatures.

When the coolant temperature is below the thermostat opening temperature, the coolant circulates through the bypass hole into the coolant pump. The smaller, single-acting thermostat opens at 79°C, letting one part of the coolant into the radiator.

Following the load increase, the other thermostat opens at 83°C. This is a double-acting type which closes the bypass hole when it opens and directs the coolant into the radiator. These engine models do not have any separate winter-type thermostats.

Inlet and exhaust system



The filter system for the engine inlet air consists of a cyclone type pre-cleaner and a paper filter, which acts as the main filter. The incoming air is made to rotate in the cyclone pre-cleaner. This causes most of the impurities to settle out and collect in the cyclone pre-cleaner dust collector. The filter is made of corrugated paper and has one or two replaceable filter elements. The corrugated paper is surrounded by a metal support.

The impurities in the air collect at the larger filter element, which can be cleaned when necessary. The inner safety filter prevents impurities form entering the engine if the main filter element breaks, or is fitted incorrectly.

A mechanical or electrical service indicator can be mounted on the filter housing or on the inlet pipe to show when the filter cartridge is clogged. The inlet system also includes the hoses between the air cleaner and the turbocharger and between the turbocharger and the intake manifold.

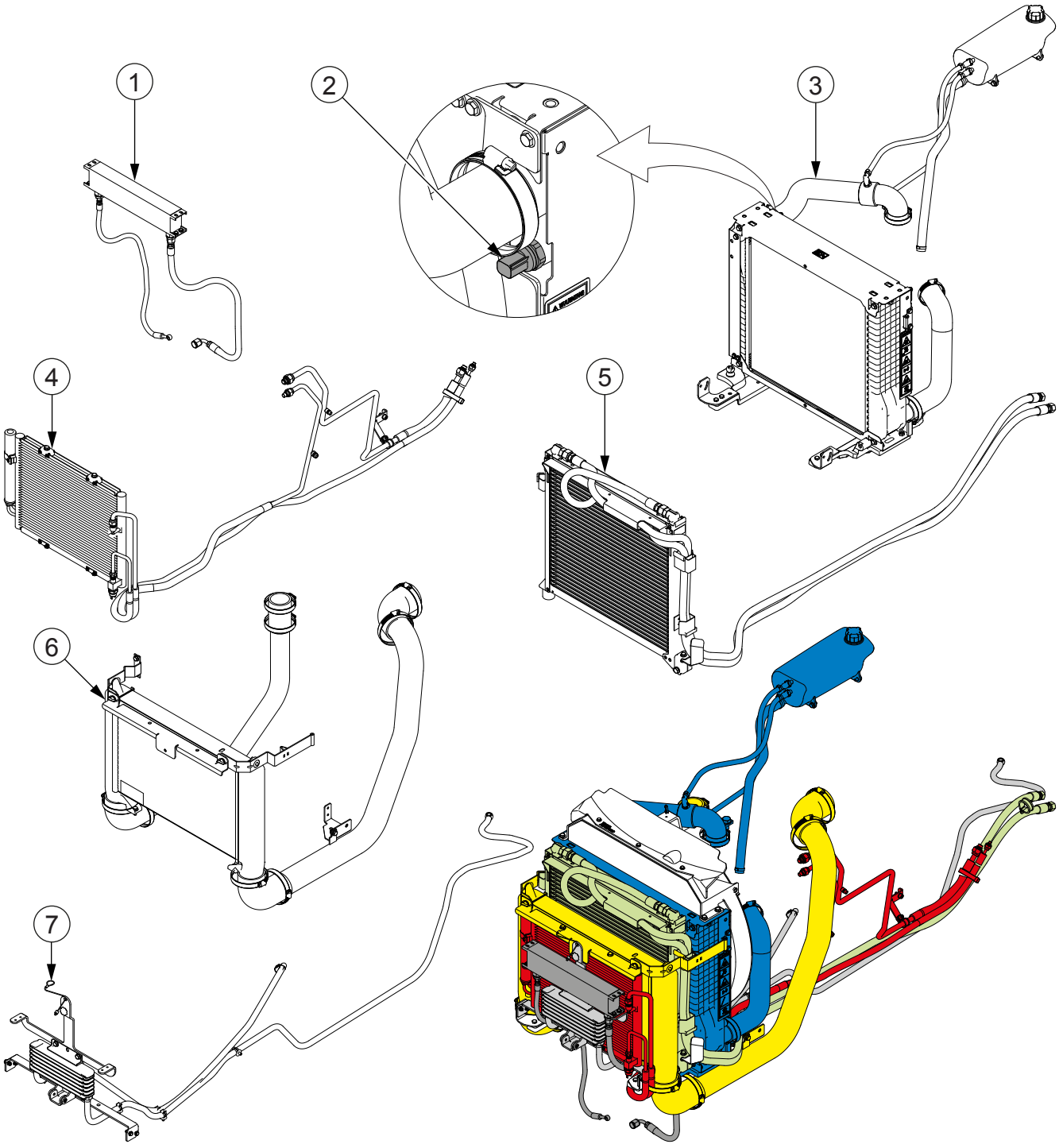
The exhaust manifold is attached to the cylinder head with high tensile bolts without a separate gasket. Retightening of the manifold bolts is unnecessary.

The turbocharger is a turbo-compressor driven by exhaust gas. The turbocharger is lubricated and cooled by the engine lubrication system. The AWI engine is equipped with a by-pass turbocharger in which excessive air pressure is adjusted by a by-pass channel. The boost pressure is adjusted correctly by the manufacturer, and must not be changed.

The compressed air is cooled on an air-to-air basis. The air coming from the turbocharger has a temperature of about 150°C and is cooled by the cooling engine air. The intercooler cell is ideally installed in front of the radiator or side-by-side with the radiator. The cooling of the compressed air stabilises the combustion, irrespective of the temperature, and minimises the thermal and mechanical load of the engine, thus lowering nitric oxides (NOx) and particles (PT).

An engine fitted with a turbocharger is more sensitive to disturbances and impurities in the inlet and exhaust systems than a naturally aspirated engine. The whole inlet and exhaust system should therefore be checked thoroughly for any repair need.

Coolers



1. Front power take-off (PTO) oil cooler (extra equipment)
2. Coolant pressure sensor (B3M)
3. Engine cooler
4. Air conditioning condenser (extra equipment)
5. Transmission oil cooler
6. Intercooler
7. Fuel cooler

Coolant pressure sensor

- If the pressure exceeds 0.7 bar, the alarm limit is 108°C and stop limit 115°C.
- If the pressure goes under 0.5 bar, the alarm limit is the normal (as without sensor) 106°C and stop limit 113°C.

The alarm limit information comes from the engine control unit (as a fault code). At the stop limit the engine control unit stops the engine.

Air cleaner

The air cleaner consists of the main air filter and safety air filter.

Keeping the air cleaner in good condition is essential for engine performance and service life. A defective air cleaner allows impurities to pass through, which in time damages the turbocharger and the engine. A blocked air cleaner reduces the engine output and also causes oil leakage through the sealing ring on the turbocharger shaft.

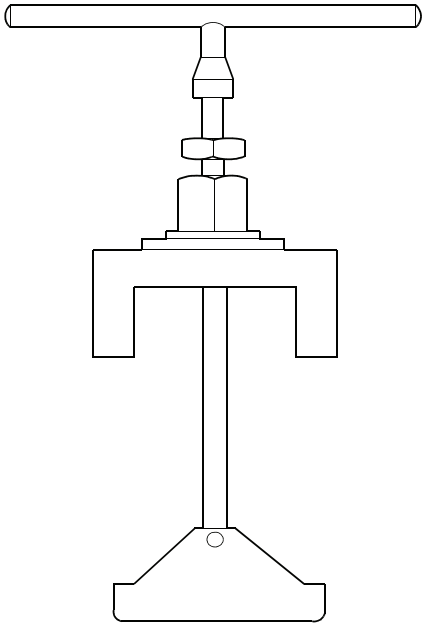
NOTE: Do not remove the safety filter unnecessarily for checking or cleaning.

NOTE: Do not clean the safety filter. Always change the safety filter according to the maintenance schedule.

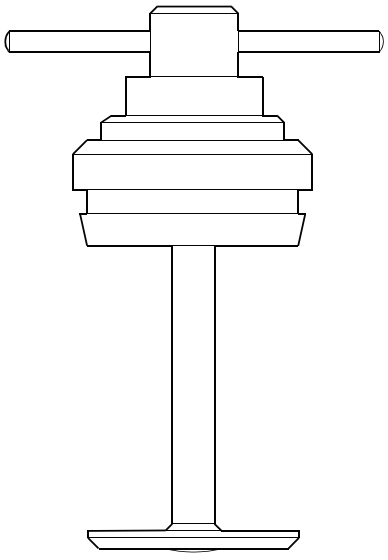
Cylinder block tools

Special tools

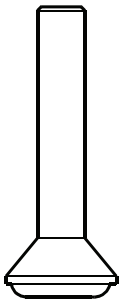
905173100	Puller for cylinder liner



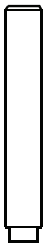
910165600	Milling cutter for cylinder liner seat
904587600	Spare cutting blade for milling cutter



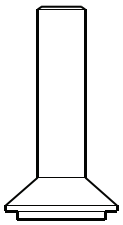
905246620	Drift for 40 mm cup plug



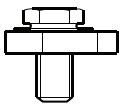
905246650	Drift for 16 mm cup plug



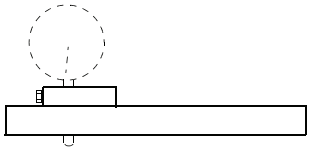
902587400	Drift for fitting camshaft cup plug



910166300	Press tool for cylinder liner



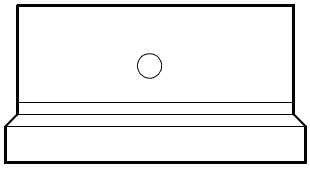
902579200	Holder for dial gauge



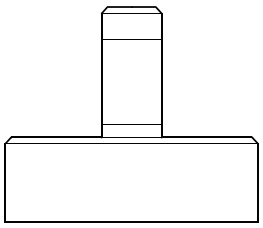
Timing gears and flywheel housing tools

Special tools

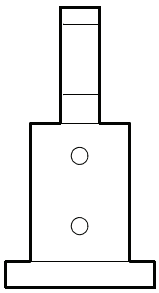
905246400	Centring tool for flywheel housing



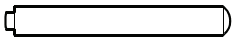
905246300	Drift for fitting rear crankshaft seal



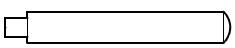
910394600	Drift for fitting front crankshaft seal



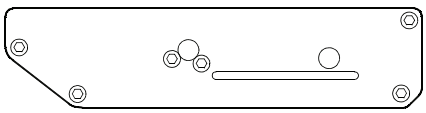
902598800	Drift for tension pins in timing gear housing



902598700	Drift for tension pins in timing gear- and flywheel housing



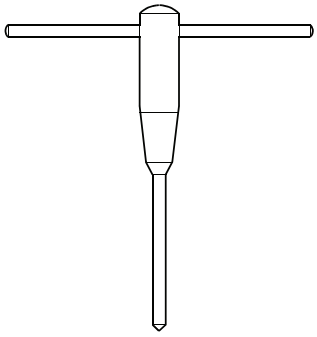
920130270	Centring tool for idler gear, narrow timing gear housing



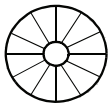
Cylinder head and valve mechanism tools

Special tools

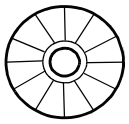
910166100	T-handle for valve seat milling cutter



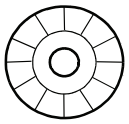
910171100	Milling cutter for facing exhaust valve seat



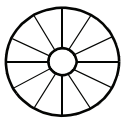
910165502	Milling cutter for exhaust valve seat



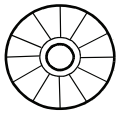
910165503	Inner milling cutter for exhaust valve seat



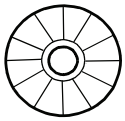
910175800	Milling cutter for facing inlet valve seat



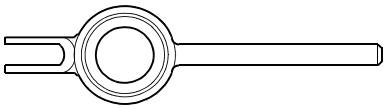
910165505	Milling cutter for inlet valve seat



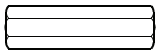
910165506	Inner milling cutter for inlet valve seat



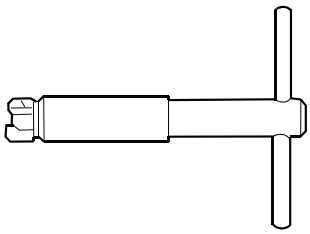
910166200	Lever for compressing valve spring



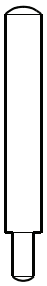
905247200	Counter nut for lever for compressing valve spring



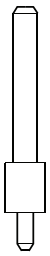
912085400	Milling tool for injector seat, 4V engines



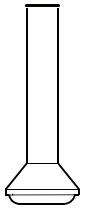
912085300	Drift for removing valve guide 4V engines



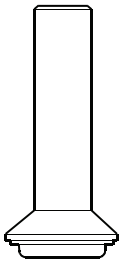
912085000	Drift for fitting valve guide, 4V engines



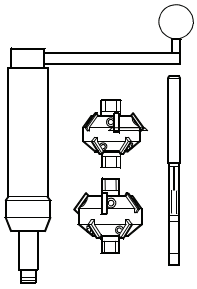
905246660	Drift for 36 mm cup plug



910394800	Drift for 45 mm cup plug



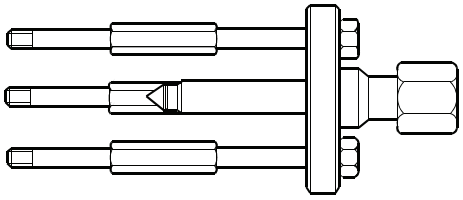
837062635	Milling cutter kit for valve seat, 4V engines



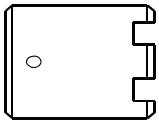
Crank mechanism tools

Special tools

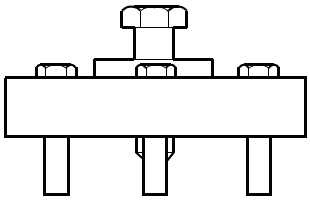
905248800	Puller for crankshaft gears



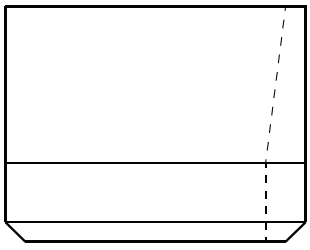
902455800	Spanner for crankshaft nut



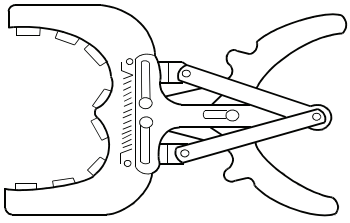
910453300	Puller for crankshaft hub



902001100	Conical sleeve for fitting pistons



905246900	Piston ring pliers



910394700	Drift for fitting crankshaft gears