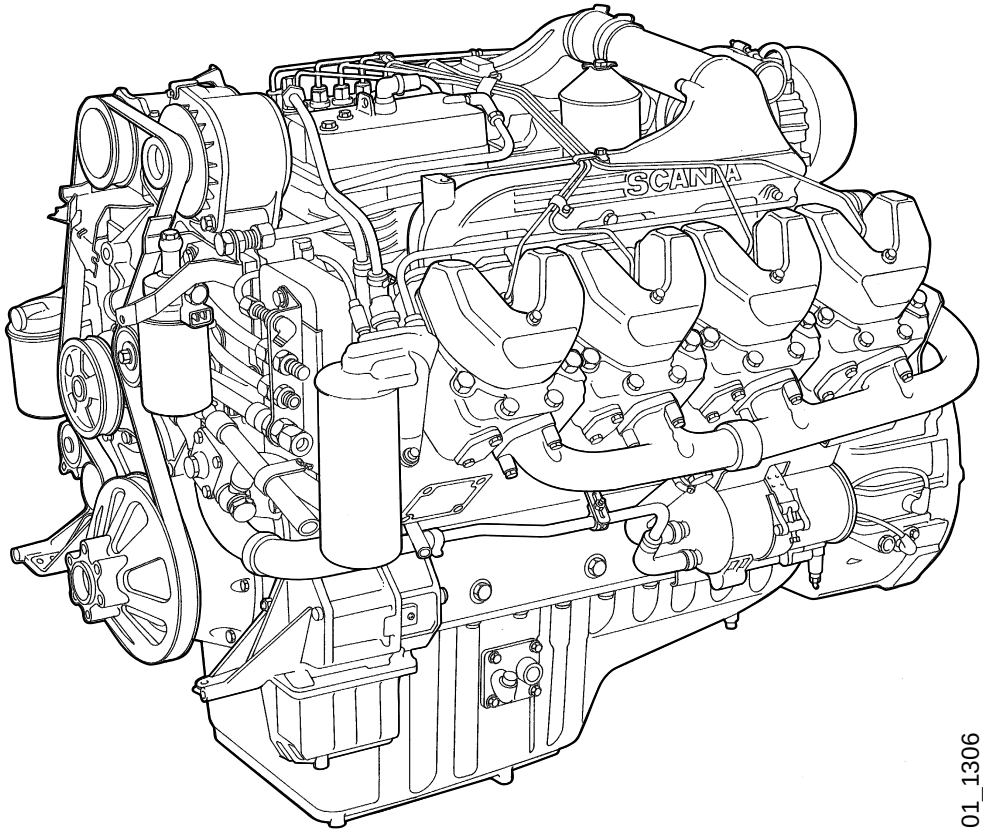
SCANIA

01:04-02

Issue 1.4 **en**

14 litre engine

Work description



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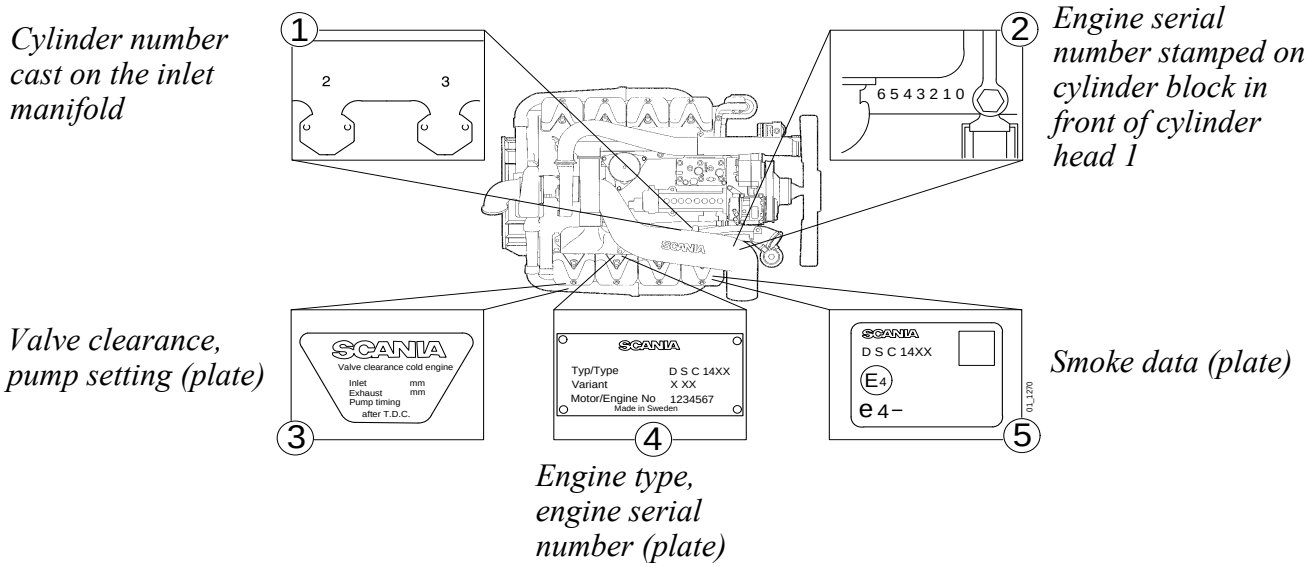


Cylinder number cast on the inlet manifold

Engine serial number stamped on cylinder block in front of cylinder head 1

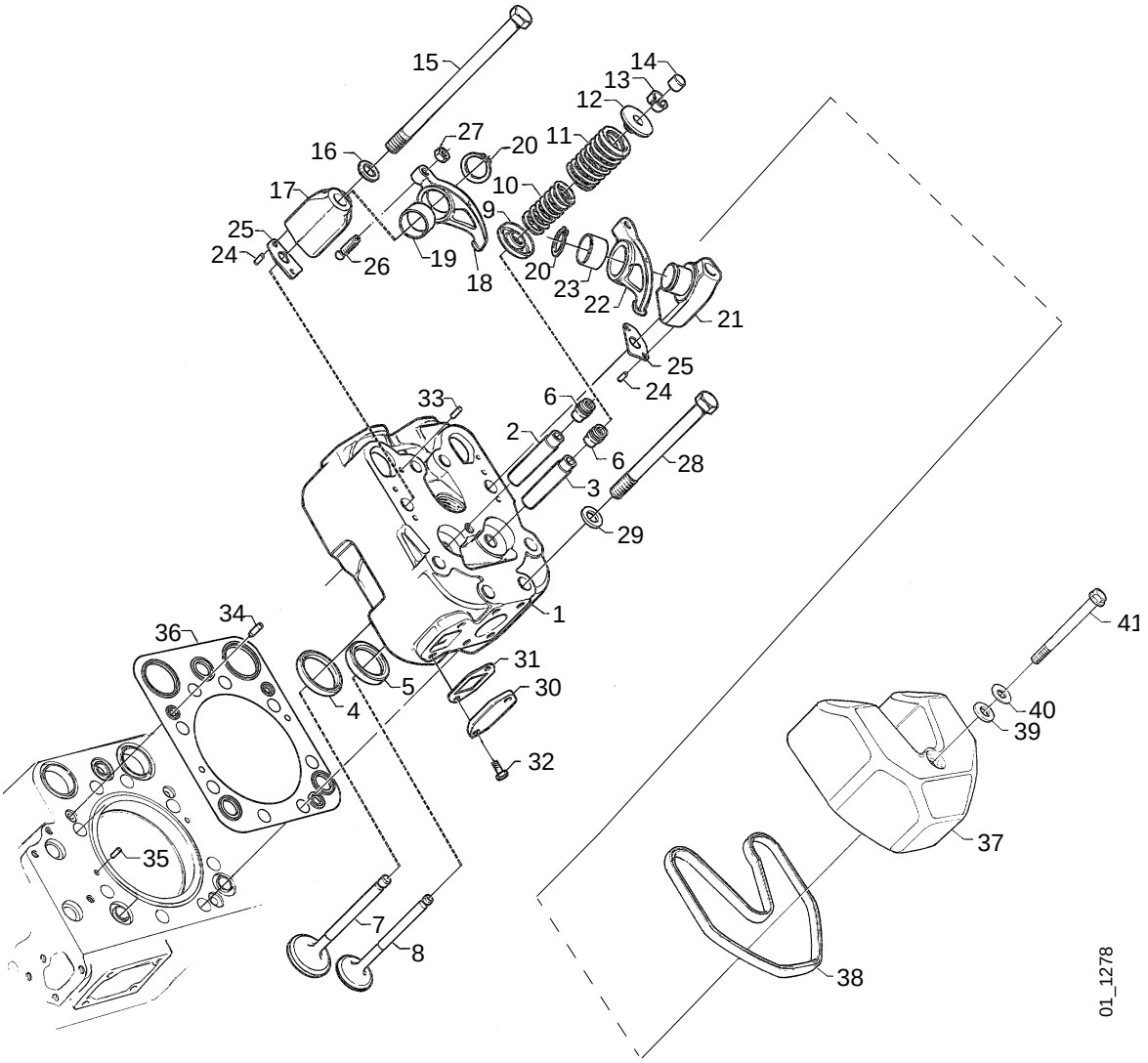
Valve clearance, pump setting (plate)

Smoke data (plate)

Engine type, engine serial number (plate)

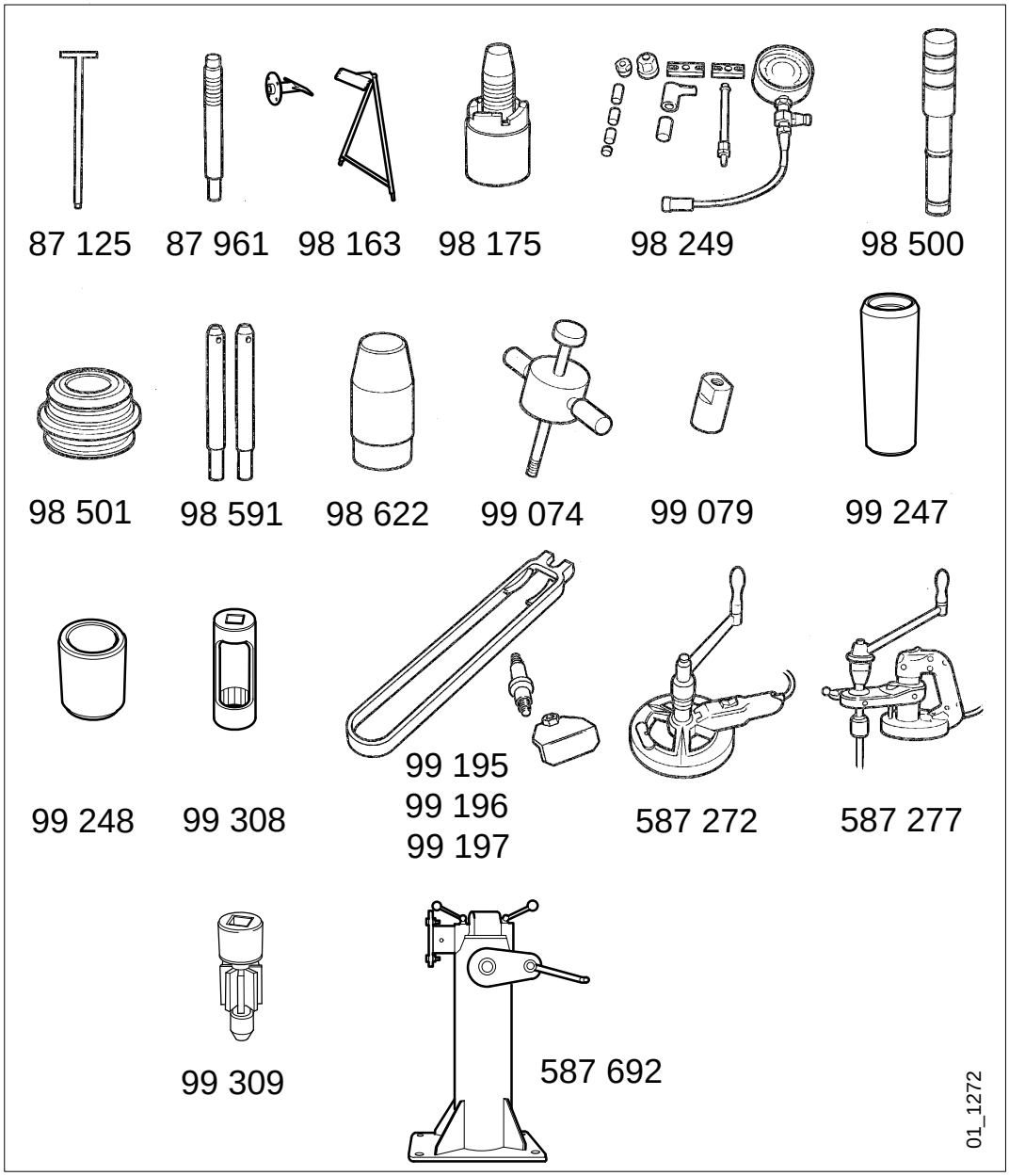
Contents

Cylinder head



1 Cylinder head
2 Valve guide
3 Valve guide
4 Valve seat insert
5 Valve seat insert
6 Valve stem seal
7 Intake valve
8 Exhaust valve
9 Valve spring collar
10 Valve spring
11 Valve spring
12 Valve spring collar
13 Split collet
14 Valve stem cap
15 Screw
16 Washer
17 Bearing bracket
18 Rocker arm
19 Bearing bush
20 Circlip
21 Bearing bracket
22 Rocker arm
23 Bearing bush
24 Spiral pin
25 Gasket
26 Adjusting screw
27 Nut
28 Screw
29 Washer
30 Cover
31 Gasket
32 Flange screw
33 Pin
34 Pin
35 Pin
36 Cylinder head gasket
37 Rocker cover
38 Rocker cover gasket
39 Sealing washer
40 Washer
41 Flange screw

Special tools



87 125	*Extractor*
87 961	*Mandrel*
98 163	*Fixture*
98 175	*Cleaning tool*
98 249	*Compression tester*
98 500	*Shank*
98 501	*Drift*
98 591	*Guide pins*
98 622	*Press drift*
99 074	*Impact drift*
99 079	*Extractor for injectors*
99 247	*Assembly drift*
99 248	*Press drift*
99 195 *99 196* *99 197*	*Valve spring compressor*
99 308	*Sleeve for injectors*
99 309	*Tool for rotating the flywheel*
587 272	*Cylinder liner cutter with grooving tool*
587 277	*Valve seat cutter*
587 692	*Universal stand*

Valve clearance

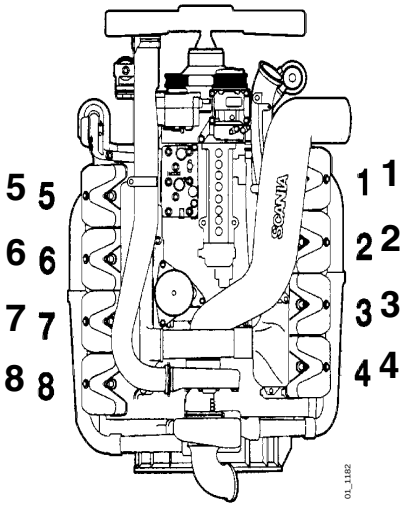
Checks and adjustments

Check the valve clearance. The clearance for intake valves should be 0.45 mm and the clearance for exhaust valves should be 0.80 mm when the engine is cold.

The following alternative methods of adjustment can be used:

A. Adjust both valves on each cylinder starting with cylinder 1 at TDC after the compression stroke. Rotate the crankshaft 1/4 of a turn at a time and adjust the valves in the injection sequence:

1-5-4-2-6-3-7-8



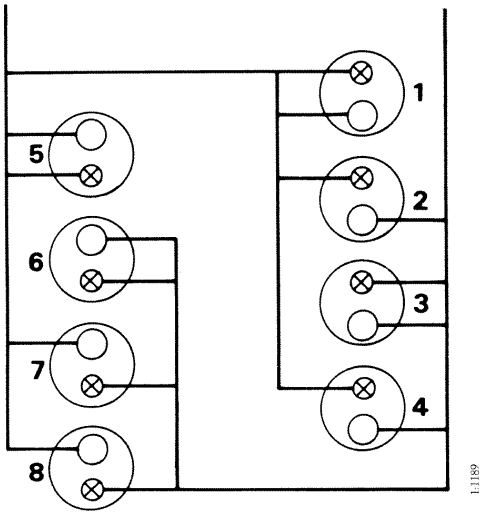
Cylinder numbering

B.Rotate the crankshaft in the direction of rotation until the piston in cylinder 1 is at 20° after TDC in the combustion stroke. There is a mark^ at this angle.

Adjust the following valves:

Right-hand side:
cyl. 1 Exhaust and intake
cyl. 2 Exhaust
cyl. 4 Exhaust

Left-hand side:
cyl. 5 Intake and exhaust
cyl. 7 Intake
cyl. 8 Intake



O *Intake valve*

Ä *Exhaust valve*

Rotate the crankshaft exactly one revolution in the direction of rotation, when the piston in cylinder 1 will be 20° after TDC in the induction stroke, and adjust the following valves:

Right-hand side
cyl. 2 Intake
cyl. 3 Exhaust and intake
cyl. 4 Intake

Left-hand side:
cyl. 6 Intake and exhaust
cyl. 7 Exhaust
cyl. 8 Exhaust

Compression

Measuring

The compression tester is used to quickly and simply check wear and damage to primarily the cylinder head valves, but also to cylinder liners and piston rings.

The results are only intended for comparison between the cylinders. Lower compression in one or more of the cylinders is a sign of abnormal wear or damage.

The compression tester can be used on many engine types by using various accessories.

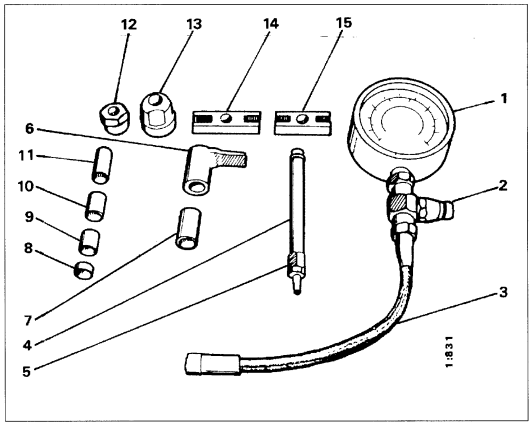
1 Shut off the fuel supply by removing fuse No. 20 for fuel shut off in the central electrical unit.

2 Clean around the injectors. Disconnect the pressure pipes and fuel leak-off pipes for all injectors.

Important! Fit protective caps on the delivery valve holders in the injection pump and on the injectors to protect them from dirt.

3 Unscrew and remove the injectors and copper washers.

4 Turn the engine with the starter motor a couple of times to remove any loose soot in the cylinders.



1 Manometer
2 Reset valve
3 Flexible metal hose
4 Gauge rod
5 End sleeve, diameter 21 mm
6 Spacing sleeve with support lug
7 Spacing sleeve with shoulder
8 Spacing sleeve, length 6 mm
9 Spacing sleeve, length 19 mm
10 Spacing sleeve, length 25 mm
11 Spacing sleeve, length 38 mm
12 Cap nut
13 Threaded socket nut
14 Large yoke
15 Small yoke

Compression tester 98 249

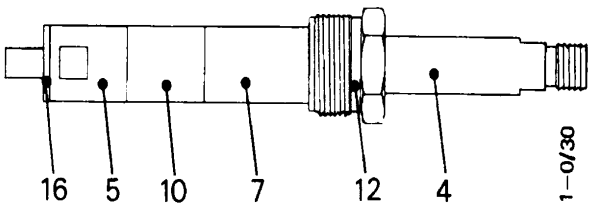
5 Connect the compression tester to the injector hole for one cylinder. Use copper washer **16** between the compression tester and the bottom of the injector hole

6 Turn the engine with the starter motor and read off the manometer. Note the reading.

7 Reset the manometer by pressing reset button **2**.

8 Move the compression tester to the next cylinder and continue according to steps 7-9.

9 Evaluate the readings and assess what further measures need to be taken on the engine.



4 Gauge rod
5 End sleeve, diameter 21 mm
7 Spacing sleeve with shoulder
10 Spacing sleeve, L = 25 mm
12 Cap nut (use socket 99 308 for tightening)
16 Copper washer

Combination for 14 engines

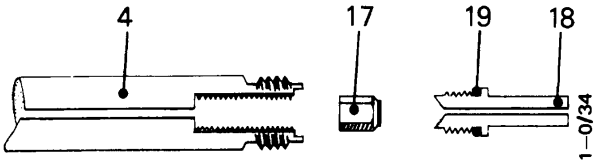
Cleaning

Gauge rod **4** has a check valve which, in the case of leakage, should be cleaned as follows:

1 Unscrew the valve seat **18**.

2 Remove any soot from valve **17** and valve seat **18**. Do not scratch the sealing surfaces. Use compressed air to clean gauge rod **4** internally.

3 Reassemble the parts. Ensure that O-ring **19** is not damaged. Screw valve seat **18** into place properly so that it forms a seal with gauge rod **4**.



4 Gauge rod
17 Valve
18 Valve seat
19 O-ring

Cleaning

Removal

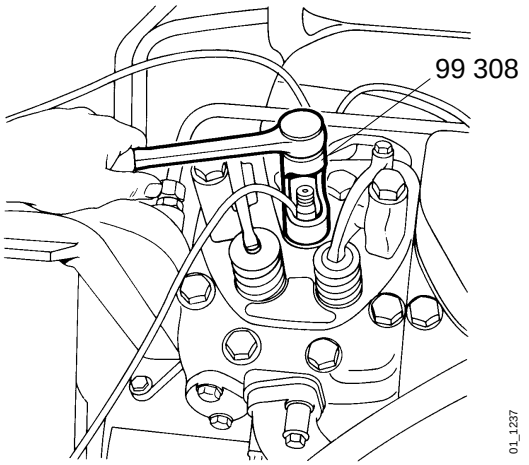
1 Detach the charge air cooler pipe and air hose to the compressor. (On the right-hand side detach the turbocharger intake as well)

2 Remove jet pipes. Fit protective caps on the injector and injection pump.

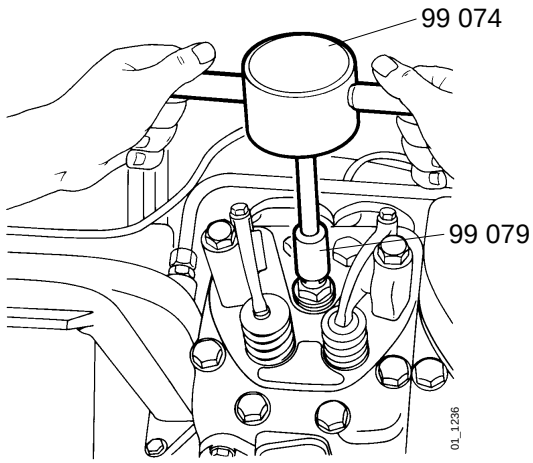
3 Detach the water pipe, intake manifold and exhaust pipe.

4 Remove the leak-off pipe and valve cover.

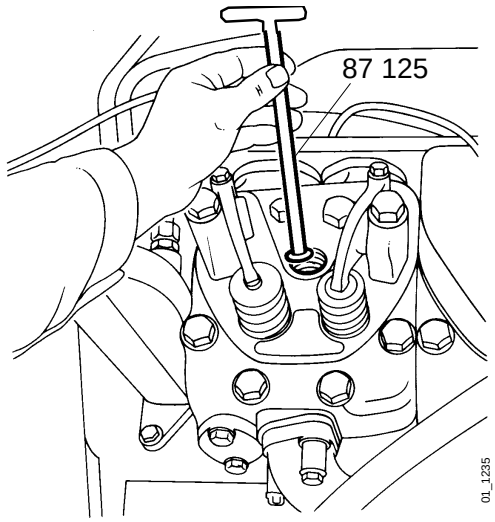
5 Remove the injectors using socket 99 308. Unscrew the injector with the needle movement sensor carefully, so that the cable does not break.



6 Extract the injectors using tools 99 074 and 99 079.



7 Remove the sealing washer for the injector



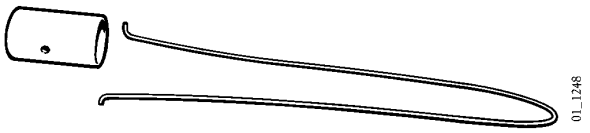
8 Detach and remove the rocker arms.

9 Lift up the push rods carefully so that the valve tappet is not pulled up with them.

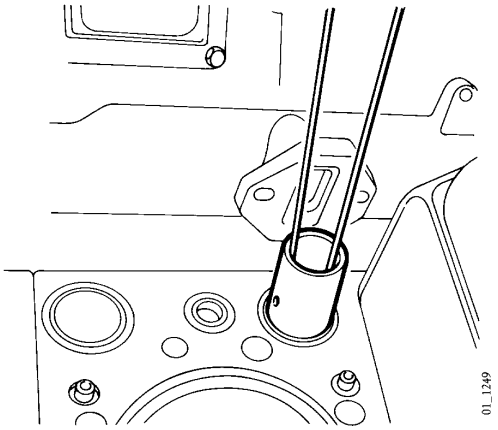
12 Remove the remaining cylinder head bolts and lift off the cylinder head. Position the cylinder head so that the sealing surface is not damaged.

10 Remove the cylinder head gasket.

11 Remove the valve tappets if the engine is later to be turned in the universal stand. Bend a welding rod as illustrated. Hook the rod in the valve tappets and lift it up. Place the valve tappets in sequential order in a stand.



Use a bent welding rod to remove and fit valve tappets



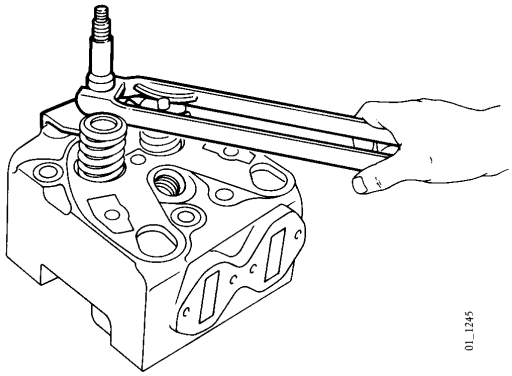
Remove the valve tappets

Note: All parts must be refitted in the same positions.

Dismantling

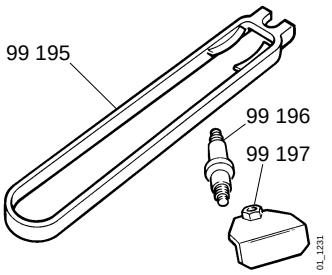
1 Remove the valve stem caps.

2 Remove split collets, valve spring collars, springs and valves. Use tools 99 195, 99 196 and 99 197 to compress the valve spring so that the split collets can be removed.



Remove the split collets

3 Place the valves in a stand so that they can be refitted in the same cylinder head. Mark the cylinder heads if more than one is being removed at the same time.



Split collet removal tool

Checking, replacing and machining

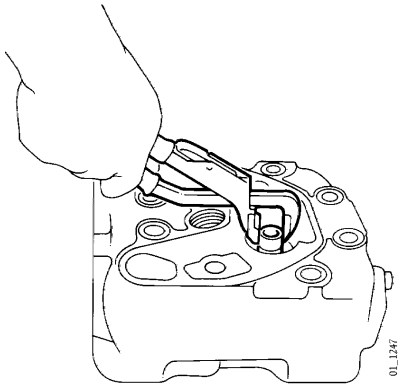
Valve stem seal

Renewal

1 Remove the valve stem seal.

2 Fit a new seal using tool 99 247.

Note: Do not hit the seal too hard or the valve guide will end up out of position.



Remove the valve stem seal

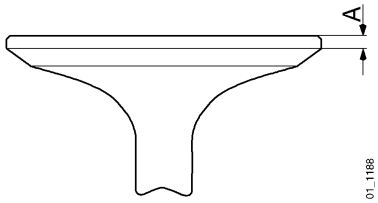
Valves

Checking and machining

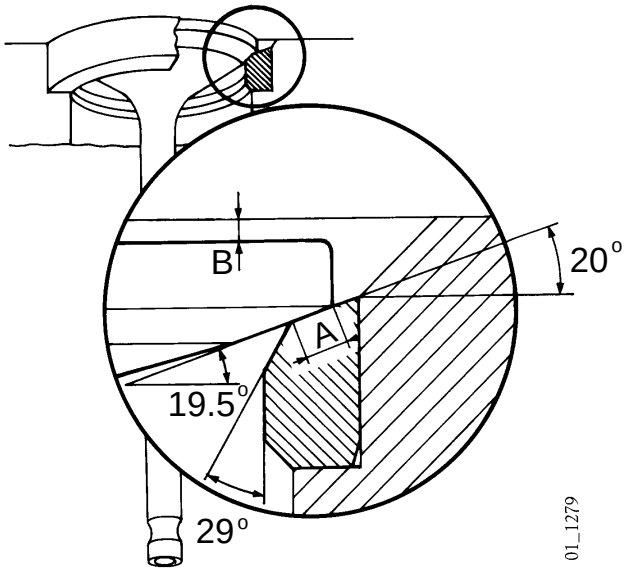
Check dimension A on all valves.

Grind the valves in a valve grinding machine. Intake 19.5° and exhaust 44.5°.

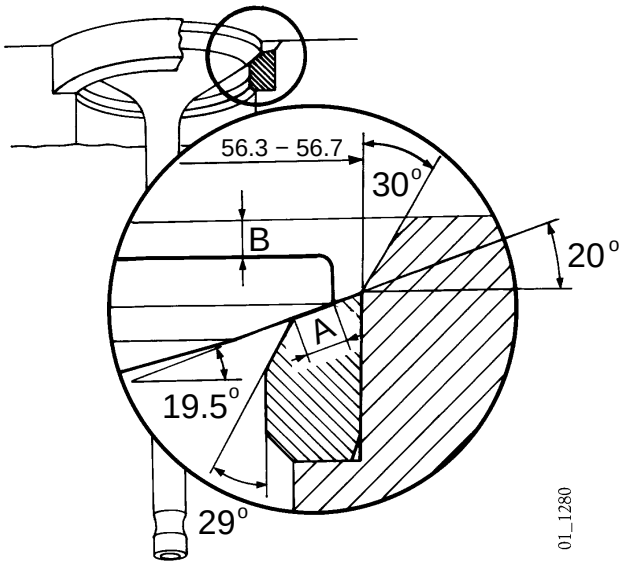
Refer to *Specifications*.



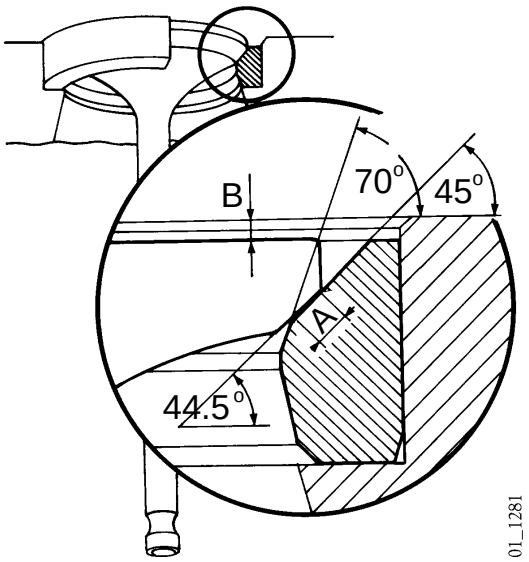
Minimum dimension A for ground valve
Intake 3.0 mm
Exhaust 1.7 mm



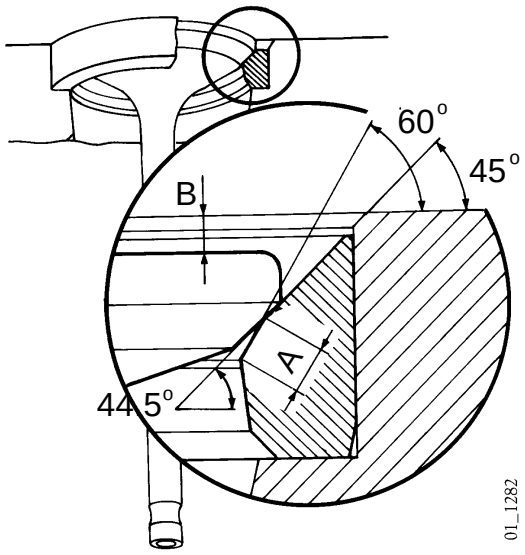
New intake valve and new valve seat insert



New intake valve and valve seat insert machined to the maximum extent

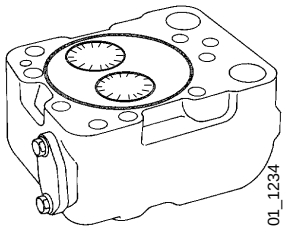


New exhaust valve and new valve seat insert



New exhaust valve and valve seat insert machined to the maximum extent. The surfaces at the arrows are in line

Valve seats

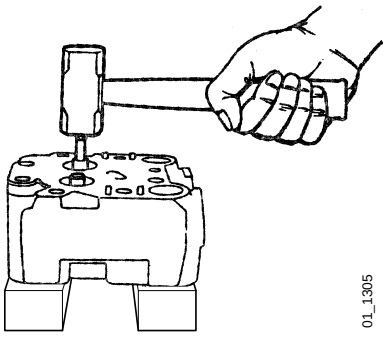


Valve welded

Renewal

1 Remove the valve seat inserts. Use a discarded valve that has been ground so that the diameter of the disc is slightly smaller than the inside diameter of the seat.

2 Fit the valve and weld around it with an electric welder. Cool with water. Turn over the cylinder head and knock the valve stem so that the valve and seat insert fall out. Wear eye protection!



WARNING!

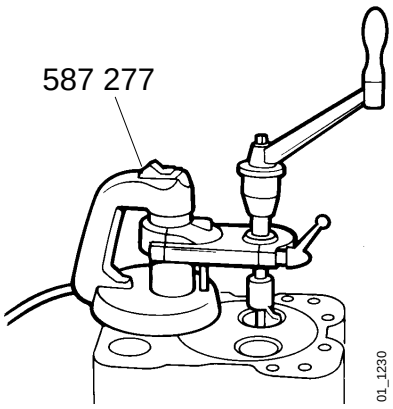
Always turn the cylinder head with the underside face down while knocking out the valve seat insert. Otherwise, there is a risk that loose shivers of metal can cause personal injury.

3 Press in new valve seat inserts. Use drift 98 501 and shank 98 500. Cool the drift and valve seat to approximately -80°C in dry ice or with liquid air. Pressing must be carried out rapidly.

WARNING!

Be careful when handling the cold parts and cooling agents above. Risk of frost injuries.

Oversize valve seat inserts can be fitted if the valve seat insert position has been damaged. The position must then be machined using tool 587 277.



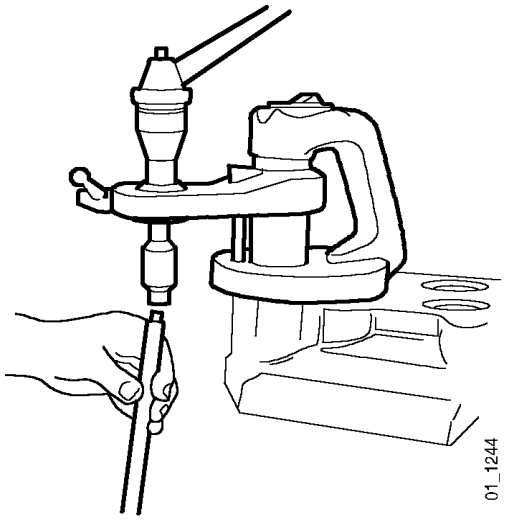
Machine the valve seat insert positions

Machining

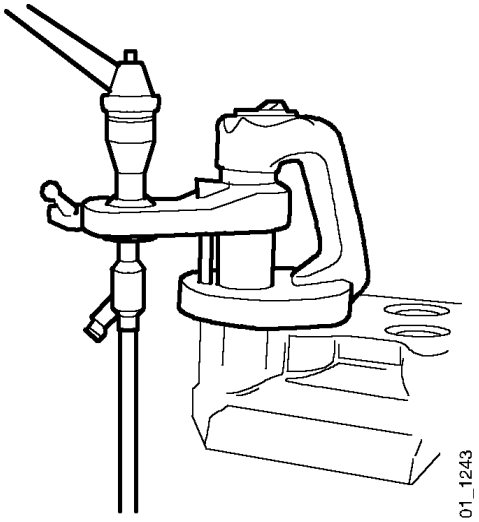
Machining measurements and oversize valve seat inserts, refer to *Specifications*.

1 Make sure the contact surface and magnetic stand are level and clean. Clean the valve bushes.

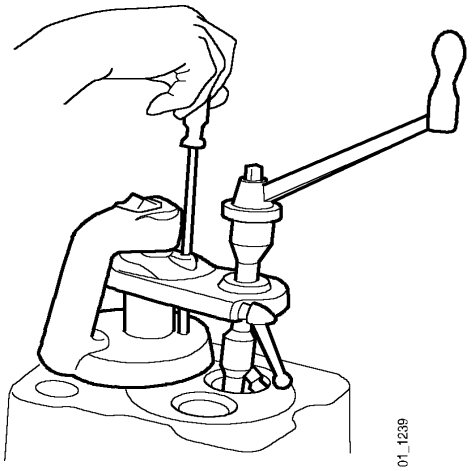
2 Select the largest spindle that moves easily in the valve guide.
Insert the guide spindle and turn the feed screw to its uppermost position.



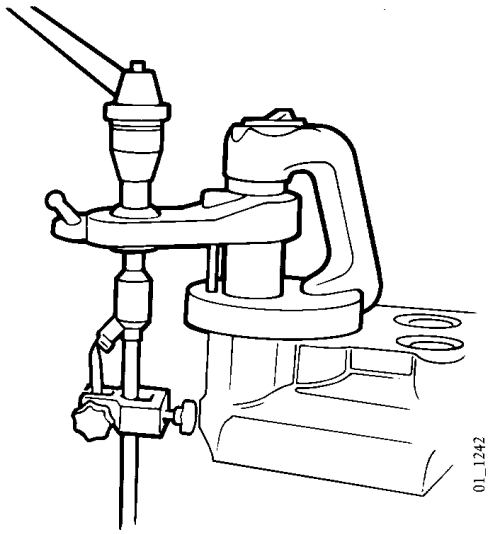
3 Select the cutter and fit it



4 Release the quick-action lock and move the pivot plate to the upper position with the adjusting screw.

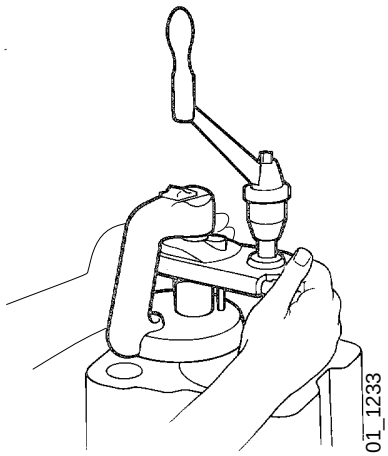


5 Set up the dial on the cutter adjuster using a valve.



6 Adjust the cutter.

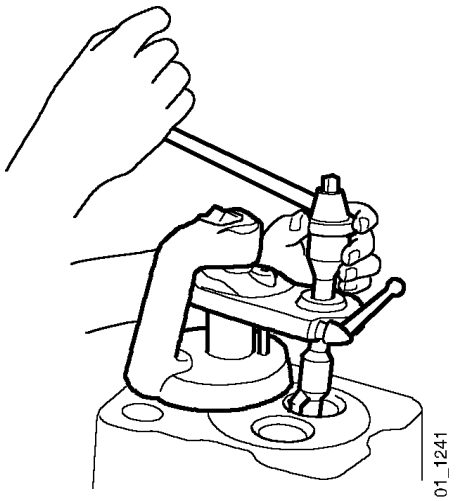
7 Turn off the magnet (position 2). Insert the guide spindle into the valve bush. Adjust the pivot plate so that the distance between the cutter and the valve seat is approx. 1 mm. Centre the tool precisely.



8 Turn on the magnet (position 1).

9 Lock the quick-action lock. Make sure the crank can be turned easily. If not, redo the centring.

10 Machine the valve seat by cranking clockwise while turning the feed screw. Never turn anticlockwise, as this could damage the cutter. Lubricate with cutting oil while machining.



11 When the surface of the valve seat has been machined, reduce the cutting pressure by turning 2-3 revolutions without any feed. Continue turning while backing the feed screw. The valve seat cutter is now ready for the next valve seat.

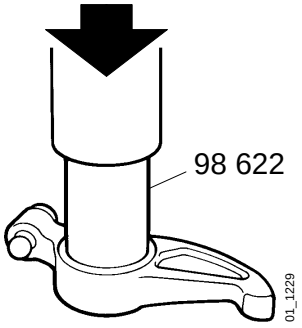
Rocker arms

Renewing the bush

1 Remove the retaining ring.

2 Remove the rocker arm from the bearing bracket.

3 Press the bush out of the rocker arm using drift 98 622.



Rocker arm using drift 98 622

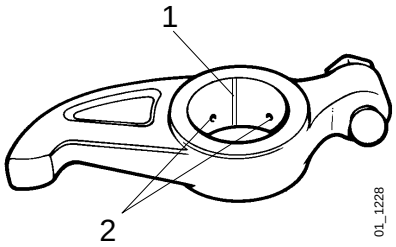
4 If wear is moderate, the rocker arm pressure surface against the valve stem cap can be adjusted in a grinding machine.

5 Turn the slot in the bush so it faces upwards Press the bush into the rocker arm using drift 98 622.

6 Drill both oil holes in the bush to the same diameter as the oil holes in the rocker arm.

7 After that the bush must be finely machined.
Refer to *Specifications*.

8 Lubricate the bush using engine oil before fitting the rocker arm to the bearing bracket.

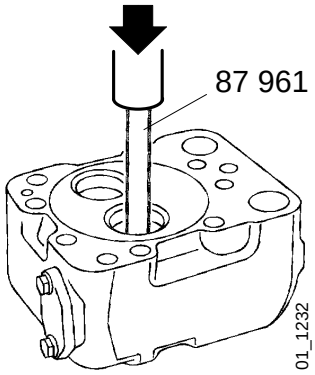


1 Slot in the bush
2 Lubricating hole
Rocker arm with bush

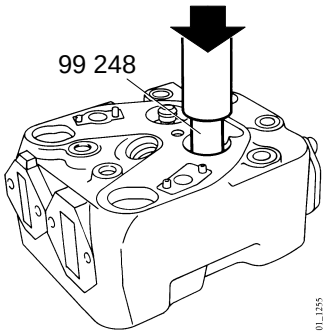
Valve guides

Renewal

1 Press out the valve guides using drift 87 961.



2 Press in the new valve guides using drift 99 248. Press down the guide as far as possible using the drift, i.e. until it makes contact with the spring seat in the cylinder head.

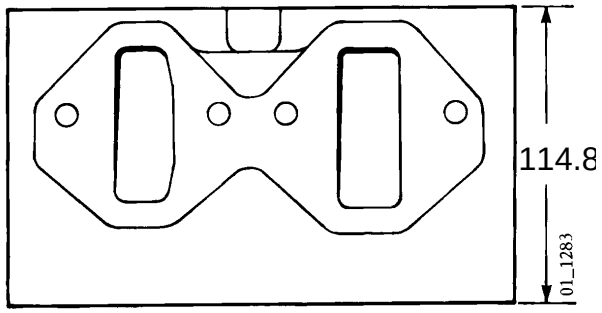


Note: The valve guides for the intake and exhaust valves have different part numbers. The intake valve guide is longer than that of the exhaust valve.

Cylinder head

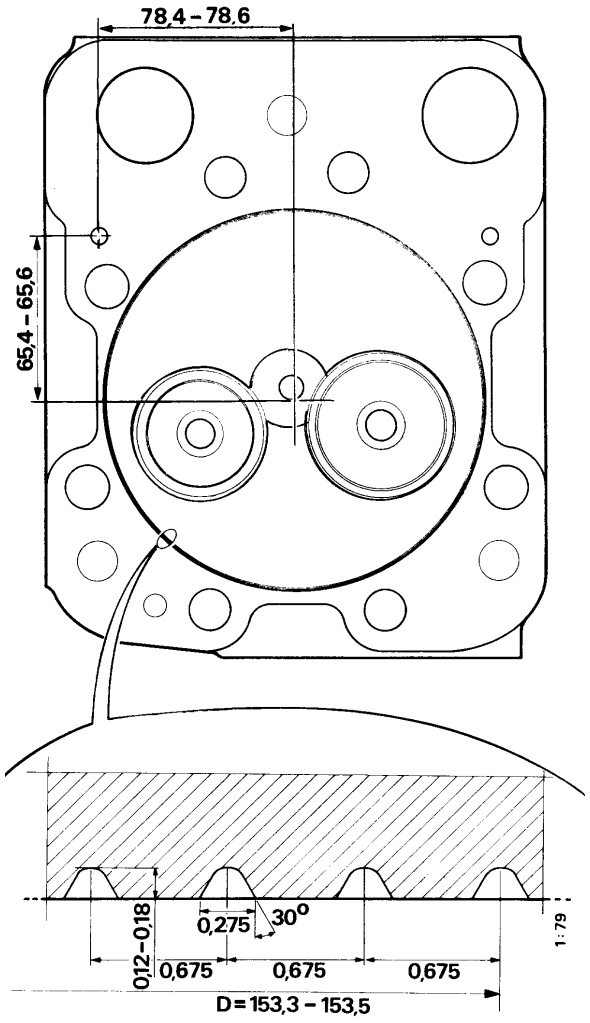
Checking and machining the cylinder block sealing surface.

Check the cylinder head for cracks and other defects. Inspect the mating surface with the cylinder block using a surface plate. If the sealing surface must be machined, the height of the cylinder head after machining must not be below 114.8 mm.



The minimum height of the cylinder head after spot-facing.

After spot-facing, new sealing grooves must be milled for the gasket. Use tool 587 272. The position and dimensions of the grooves are contained in the figure.



Sealing groove in the cylinder head

Assembly

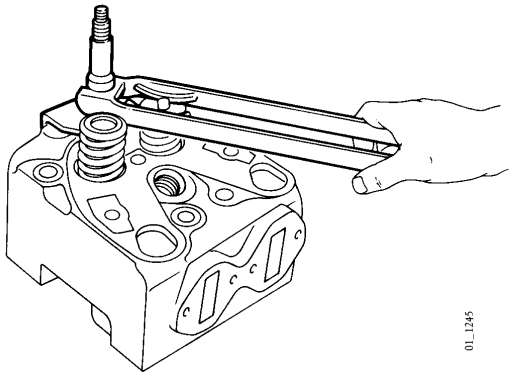
1 Lubricate all parts well before assembly.

2 Insert the valve stem into the guide.

3 Fit the lower guide washer, the two valve springs and the upper guide washer.

4 Compress the springs using tools 99 195, 99 196 and 99 197 and fit the split collets.

5 Fit the valve stem caps.



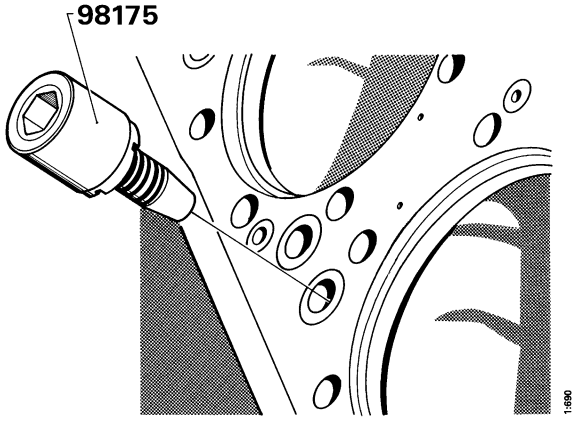
Fit the split collets

Fitting

1 Clean the grooves for the sealing rings in the cylinder block using tool 98 175. Check the liner height, refer to *Pistons and cylinder liners*.

2 Lubricate and fit the valve tappets.

3 Fit a new gasket.



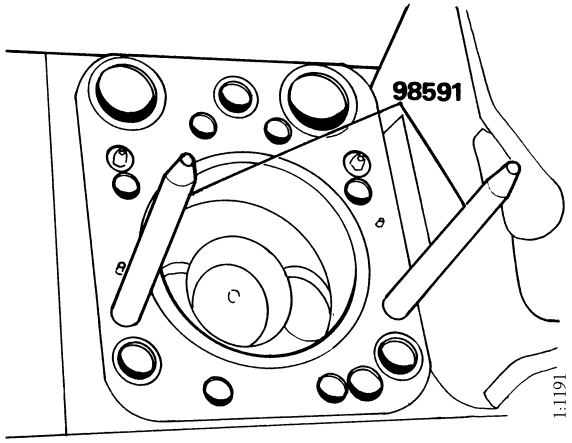
Cleaning the seal grooves for the water ducts.

4 Fit two guide pins 98 591.

5 Fit the cylinder head.

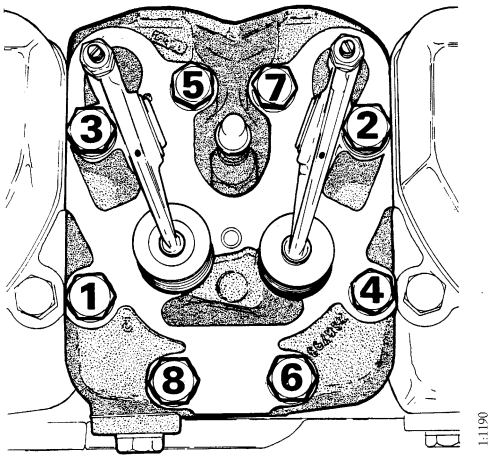
6 Lubricate and fit the push rods.

7 Check that the bearing bracket guide pins fitted. Fit the bearing bracket with new gaskets and new polyseal washers under the bolt.



Guide pins for fitting the cylinder head. The gasket for the cylinder head is fitted.

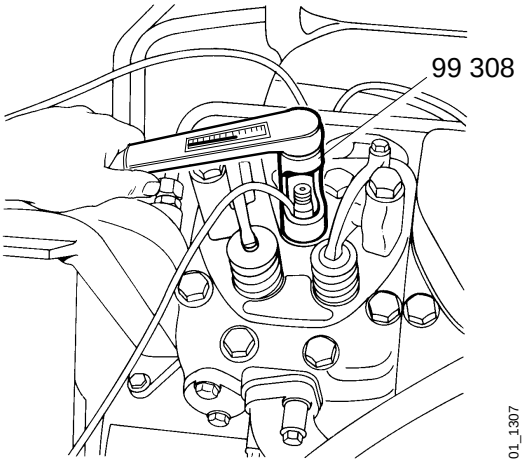
8 Lubricate the thread and under the heads of the cylinder head bolts. Tighten the bolts in the following three stages in the order given in the figure:



Tightening sequence for cylinder head bolts

- Tighten all bolts to 110 Nm
- Tighten all bolts to 165 Nm
- Finally, tighten all bolts to 220 Nm + 90°

9 Fit the injector with a new sealing washer. The injector must be tightened to 70 Nm.



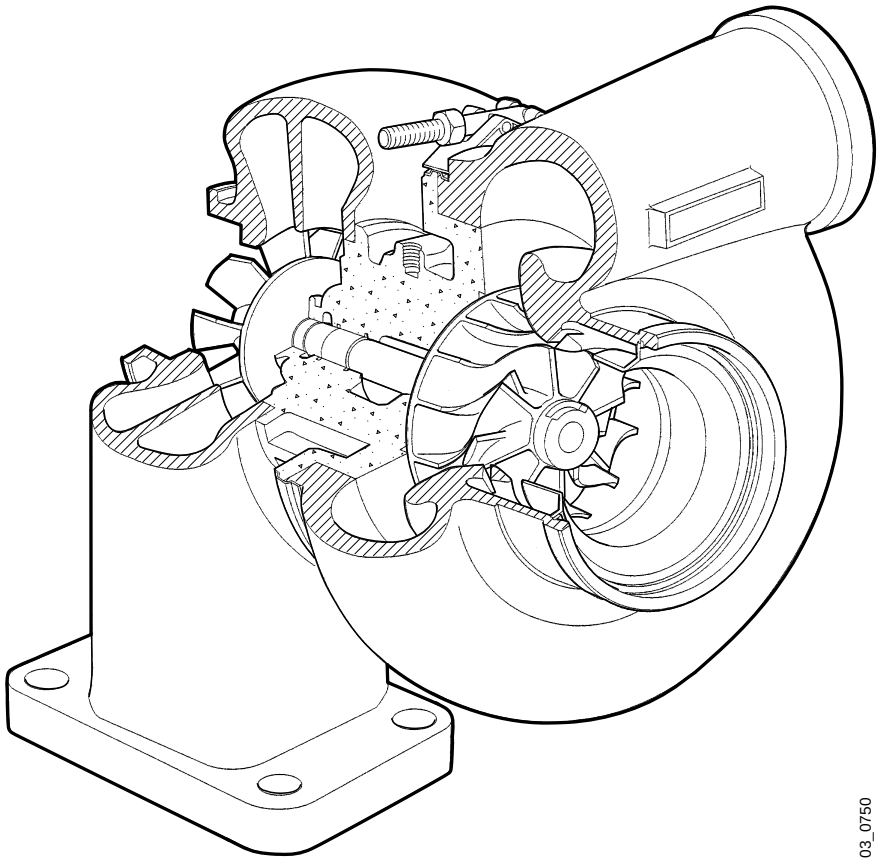
Tighten the injectors

10 Fit the pressure pipe, leak-off pipe, water pipe, intake manifold and exhaust pipe with new gaskets and seals.

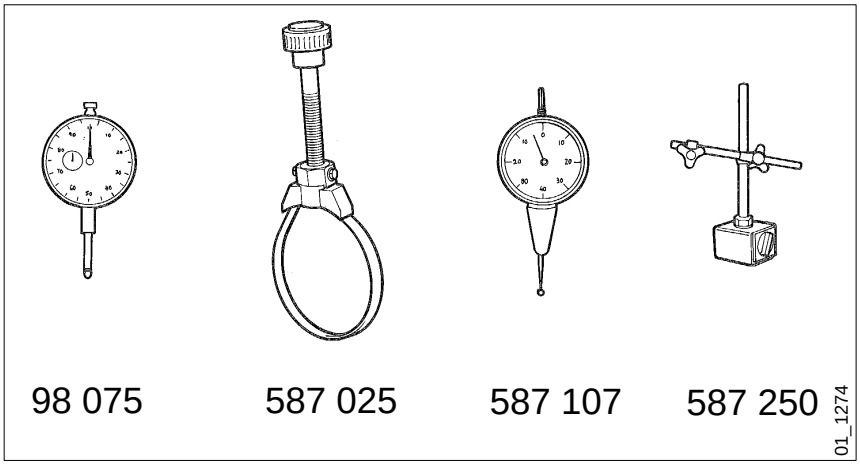
11 If the exhaust pipe has been removed and disassembled, lubricate its joints using lubricant 561 205 during assembly.

12 Check valve clearance according to *Valve clearance, checking and adjusting* on page 5.

Turbocharger



Special tools



98 075 Dial gauge
587 025 Filter wrench
587 107 Rocker indicator
587 250 Indicator stand

General

IMPORTANT!
Observe strict cleanliness at all times when working on the turbocharger. The oil inlet and outlet connections must never be left unprotected. Foreign bodies in the bearing housing will soon lead to total breakdown.

Oil leaks

A blocked air filter will cause excessive vacuum in the intake pipe. If this happens, the excessive vacuum may draw oil mist from the bearing housing via the compressor into the engine.

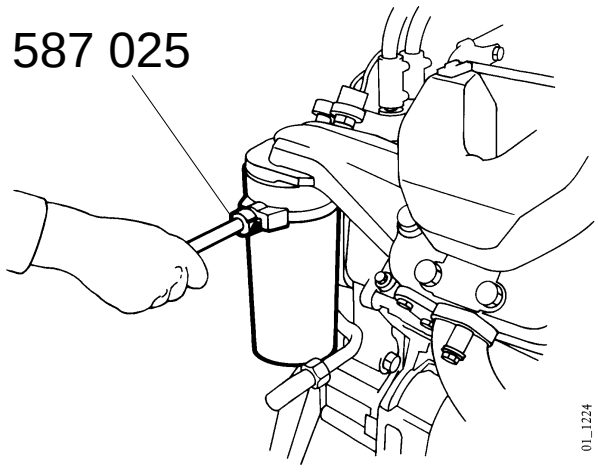
If the sealing ring on the turbine side is worn, the exhaust gases will be blue when idling.

If the oil drain tube from the turbocharger is damaged, the pressure of the lubricating oil pressure may cause oil to leak out through the seals.

Oil filter

The turbocharger rotates at high speed, sometimes above 100,000 rpm.

It is vital that the lubrication functions properly. For this reason, change the oil filter and clean the lubricating oil cleaner in accordance with our instructions. Use filter wrench 587 025 to remove the filter.



Removing the oil filter

If the centrifugal cleaner is not cleaned, the oil filter will quickly block up and the flow resistance in the filter will increase. If this happens, a valve in the filter retainer opens and lets the oil pass the filter without being filtered. Unfiltered oil is then passed to the turbo compressor, resulting in excessive wear of the bearings.

The valve is designed to fit original Scania filters, and only these filters should be used.

Foreign bodies

Foreign bodies in the turbine or compressor, e.g. a grain of sand or metal shavings, will ruin the vanes. This will lead to imbalance and bearing wear. The power output of the engine decreases, and if the engine is still running the reduced air supply may cause overheating and engine damage. This type of overheating does not show on the coolant temperature gauge.

Note: Never attempt to straighten a damaged vane. It is then often broken during operation causing the turbo to break down completely, which also can damage the engine.

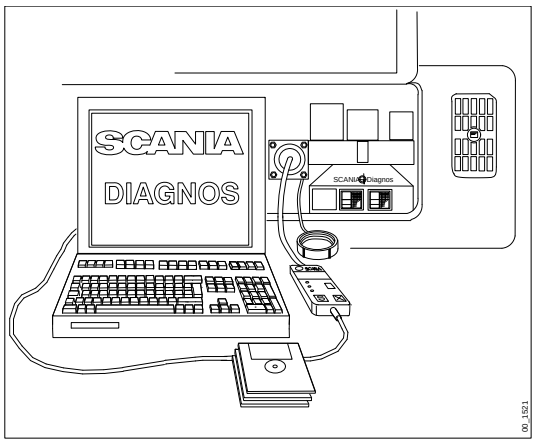
Air and exhaust leaks

Even a minute leakage in the pipe between the air filter and the turbo compressor will cause deposits of dirt on the compressor wheel. The charging pressure will decrease, resulting in increased exhaust temperature and smoke. In addition, it will lead to excessive wear of the engine.

Exhaust leaks between the cylinder head and the turbocharger also cause a low charging pressure.

Measuring the charging pressure

Measure the charging pressure using Scania Diagnos 2.



Tools for Scania Diagnos

Cleaning the compressor wheel

Low charging pressure could, for example, be caused by a dirty compressor wheel. Remove the compressor cover. Clean the compressor impeller with white spirit and a brush. Fit the compressor cover and measure the charging pressure again.

Note: The compressor wheel must not be removed from the shaft. Imbalance may occur when it is refitted.

Measuring radial and axial clearance

Measuring radial and axial clearance often does not give a good indication of the remaining service life of the turbocharger.

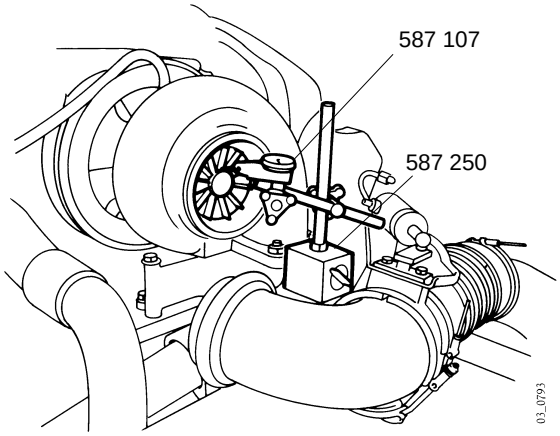
When the turbocharger seems to be functioning poorly or noisily, measuring the charging pressure or radial and axial clearance can indicate whether the turbocharger is defective.

Radial clearance

Take readings on both the turbine and compressor wheels.

1 Remove the exhaust pipe and induction pipe.

2 Place the tip of the dial gauge against the turbine / compressor wheel.



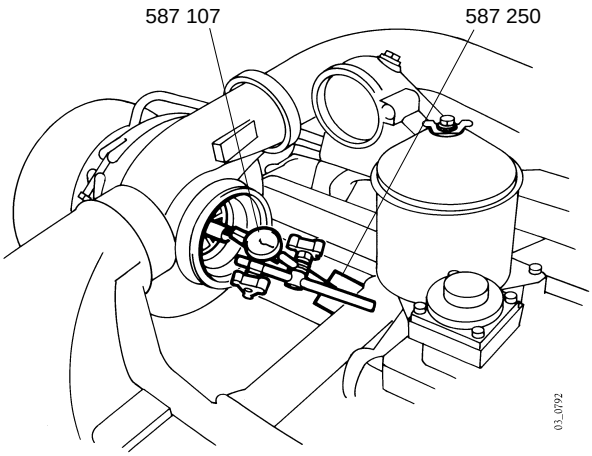
Measuring turbine wheel radial clearance.

3 Pull up both ends of the shaft. Take a reading.

4 Press down both ends of the shaft. Take a reading. The difference between the two readings is the radial clearance.

5 Repeat the test three times on each side

6 If any of the wheels makes contact with the housing despite the radial clearance being within tolerances, the turbocharger must be renewed.



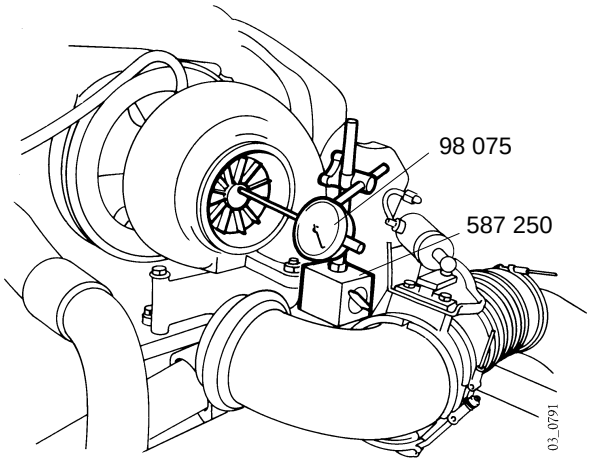
Measuring compressor wheel radial clearance

Axial clearance

1 Place the tip of the dial gauge against the end of the shaft.

2 Press the shaft forwards and backwards and read the dial at the end positions. The difference between the readings is the axial clearance.

3 Repeat the test three times.



Measuring the axial clearance

Wear limits for Holset:

Radial clearance .....0.198-0.564 mm
Axial clearance
(after running in) .....0.025-0.106 mm

If the turbocharger does not work

1 Ensure that there are no leaks or loose particles in the line between the air cleaner and the turbocharger.

2 Check that there are no loose particles in the exhaust or intake manifolds. Renew the charge air cooler.

3 Make sure all valves are intact.

4 Check the oil return pipe from the turbocharger for blockage or deformation.

5 Check the oil pressure pipe to the turbocharger for any blockage, deformation and leakage under pressure.

6 Check the condition and part number of the oil filter.

Renewal of turbocharger

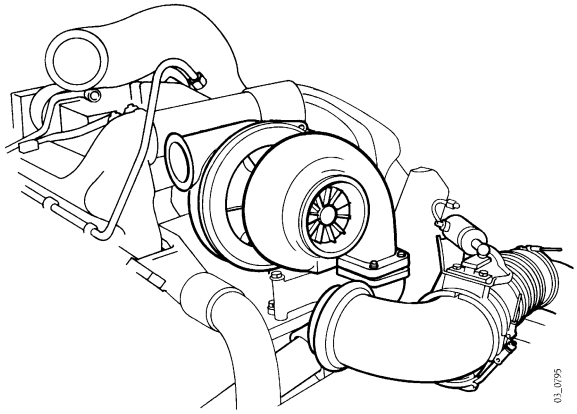
Note! When renewing the turbocharger, all gaskets and the oil filter must be changed and the centrifugal cleaner must be cleaned.

Removal

1 Undo the exhaust pipe, induction pipe and charge air cooler pipe from the turbocharger.

2 Detach the oil inlet and return lines.

3 Undo the bolts in the turbocharger base and remove the turbocharger.



Remove the exhaust pipe, induction pipe and charge air cooler pipe

Fitting

1 Check the connecting flange on the exhaust manifold for any remains of the old gasket.

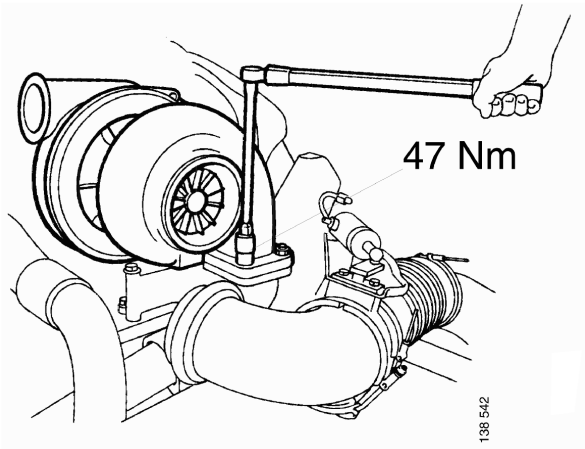
2 Fit a new gaskets and bolt the new turbocharger into place. Lubricate the exhaust manifold screws with high-temperature resistant lubricant, part No. 561 205. Tighten to 47 Nm.

3 Connect the oil inlet and return lines.

4 Connect the charge air pipe, induction pipe and exhaust pipe.

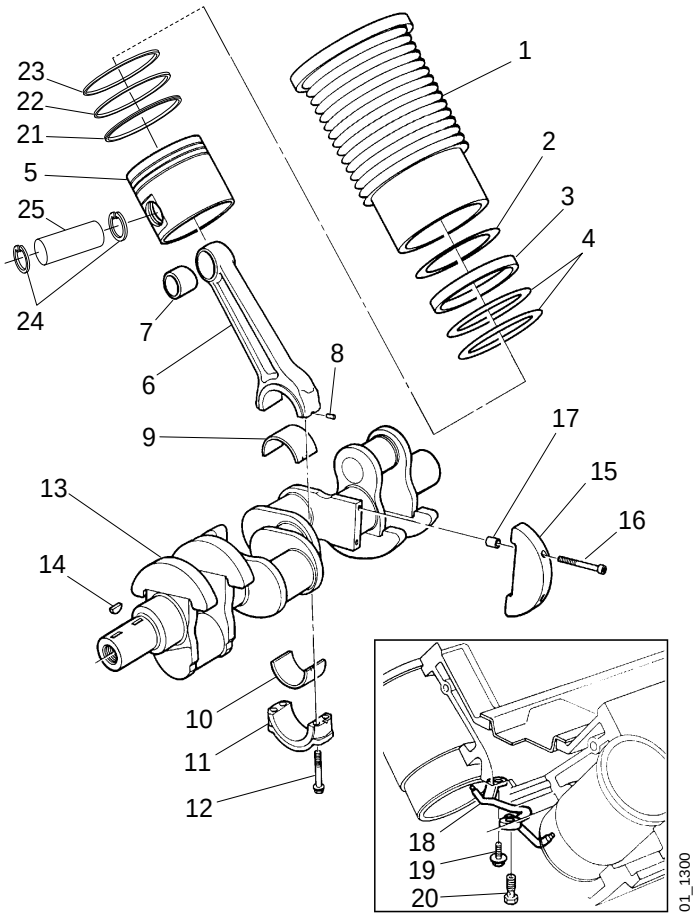
5 Remove fuse 20 for the fuel valve (fuel shut-off) and turn the engine over with the starter motor for at least 30 seconds so that lubricating oil reaches the turbocharger.

6 Start the engine and check for leaks.



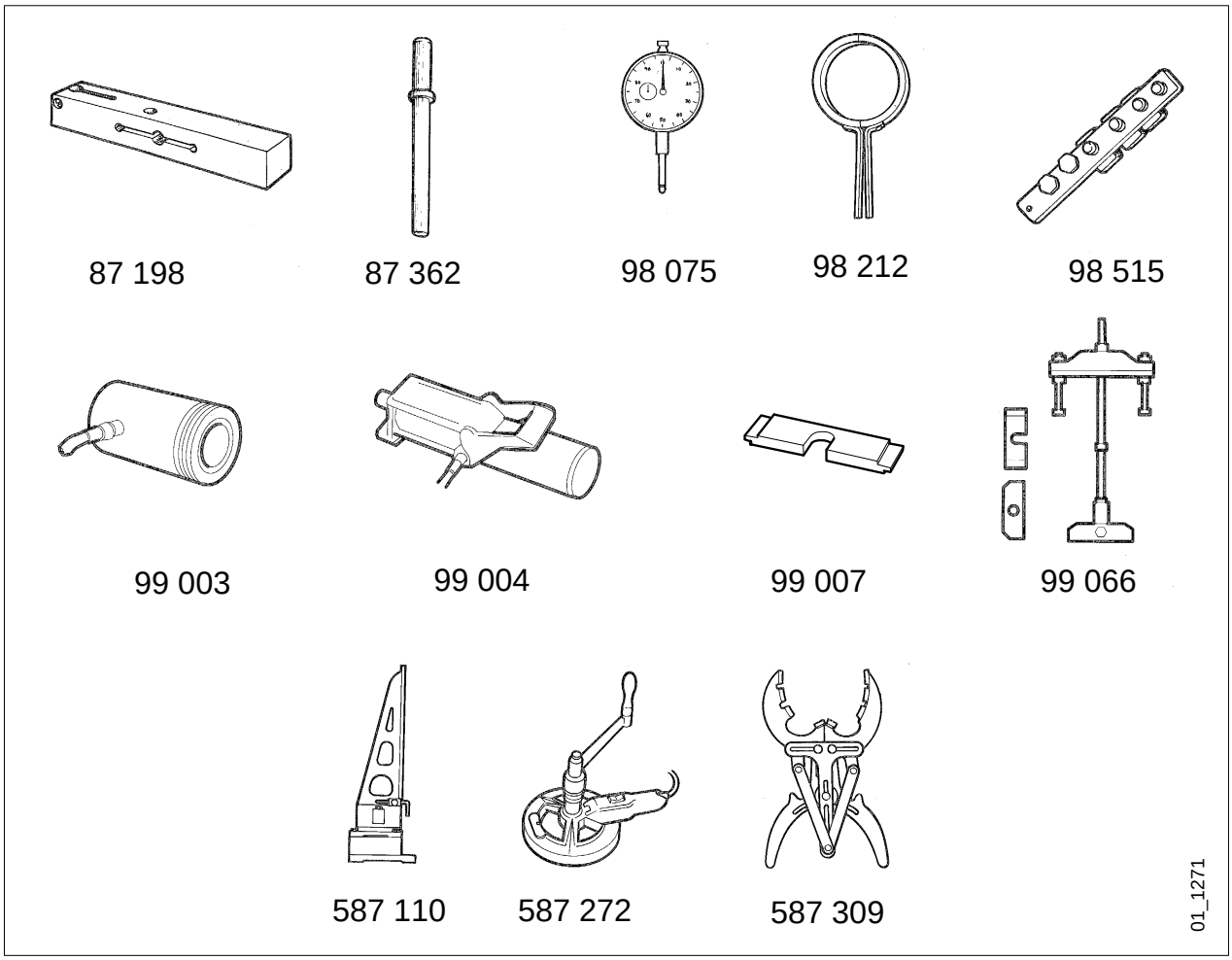
Bolt the turbocharger into place

Piston and cylinder liner



1 Cylinder liner
2 Shim
3 Sealing ring
4 O-ring
5 Piston
6 Connecting rod
7 Bearing bush
8 Pin
9 Bearing shell
10 Bearing shell
11 Bearing cap
12 Flange screw
13 Crankshaft
14 Key
15 Counterweight
16 Counterweight bolt
17 Guide sleeve
18 Piston cooling nozzle
19 Flange screw
20 Banjo screw
21 Oil scraper ring
22 Compression ring
23 Compression ring
24 Circlip
25 Gudgeon pin

Special tools



87 198	*Rule for dial gauge*
87 362	*Drift*
98 075	*Dial gauge*
98 212	*Piston ring compressor*
98 515	*Press tool*
99 003	*Hydraulic hole cylinder*
99 004	*Compressed air driven hydraulic pump*
99 007	*Support plate*
99 066	*Puller for cylinder liner*
587 110	*Test apparatus for connecting rods*
587 272	*Cylinder liner cutter*
587 309	*Piston ring expander*

Removing and dismantling pistons and connecting rods

1 Remove the cylinder head and oil sump.

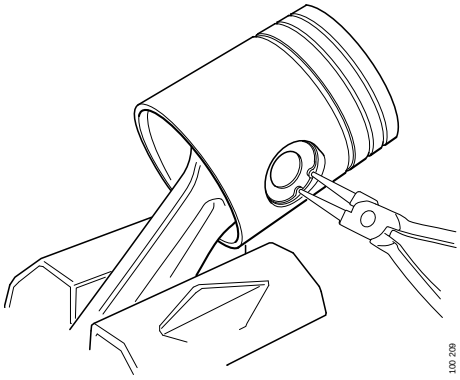
2 Remove the piston cooling nozzle in the cylinder block.

Important! The piston cooling nozzle must not be damaged. The oil jet must hit the piston precisely. If it does not, the piston will become too warm, resulting in engine breakdown. Damaged nozzles must not be re-aligned; renew them instead.

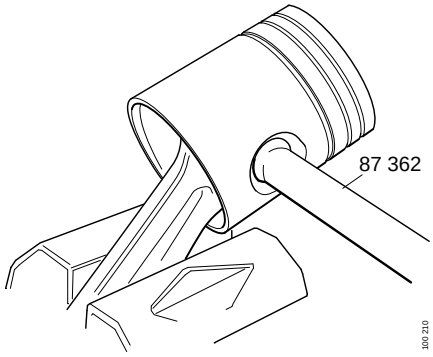
3 Remove the bearing cap and bearing shells. Protect the oil way in the crankcase using adhesive tape, applied with the sticky side out.

4 Lift out the piston and connecting rod.

5 Place the connecting rod in a vice with soft jaws. Remove the gudgeon pin retaining rings.

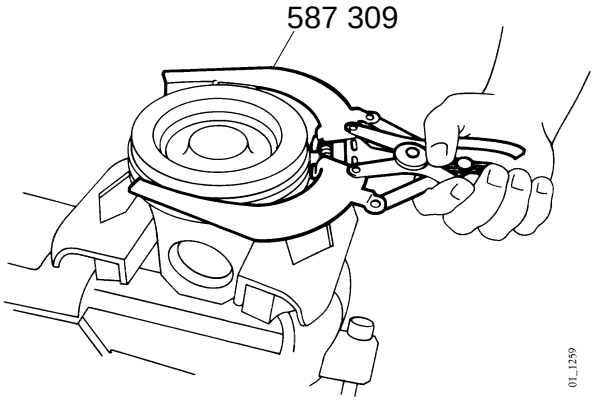


6 Push out the gudgeon pin using drift 87 362.



7 Remove the piston rings using tool 587 309. Take care not to scratch the surface of the piston skirt with the piston rings.

When cleaning graphited pistons in a machine, the graphiting may disappear. This does not matter after they have been in use for a while. New pistons, however, should be washed with care in e.g. white spirit.



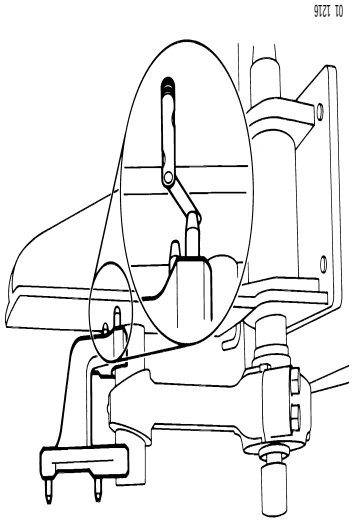
Note: Always check the connecting rod in a cylinder that has seized, been water filled or has a broken valve. Bent connecting rods must not be straightened.

Checking the connecting rod

Check the connecting rods using tool 587 110. Proceed as follows:

1 When the gudgeon pin bush has been checked, insert the bearing cap as marked and tighten the bolts to full torque.

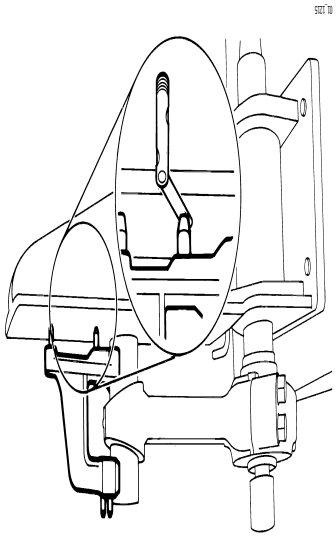
2 Mount the connecting rod in the tool using the expander and place the gudgeon pin in its bush. Then place the indicator studs on the gudgeon pin.



Checking whether the connecting rod is twisted

Check whether the connecting rod is twisted with the indicator studs horizontal.

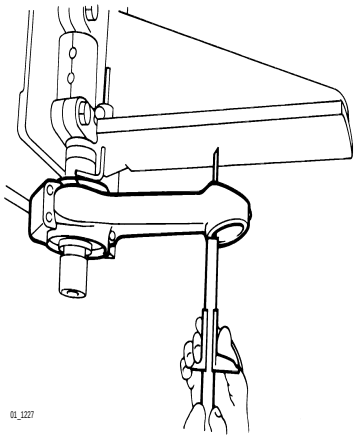
Check whether the connecting rod is bent with the indicator studs vertical.



Checking whether the connecting rod is bent

The distance between the indicator studs on the tool illustrated here is 75 mm. The distance between one of the indicator studs and the measuring surface must be max. 0.1 mm when measured using this tool. Check with a feeler gauge.

Check also whether the connecting rod is bent in an S-shape. This is done by measuring the distance between the outside of the connecting rod bush and the level surface of the tool. Turn the connecting rod around and measure the corresponding distance. The difference should be 2.45-3.50 mm (asymmetrical).



Checking whether the connecting rod is bent in an S-shape

Weight class combinations of connecting rods

There are three different connecting rod weight classes. The different weight classes are marked on the connecting rod cap with the letters A for light, B for medium and C for heavy connecting rod.

To obtain a low level of vibrations, the weight of two connecting rods on the same crank pin must be kept within certain limits.

The combinations permitted are as follows:

A+B, A+C, B+B and B+C

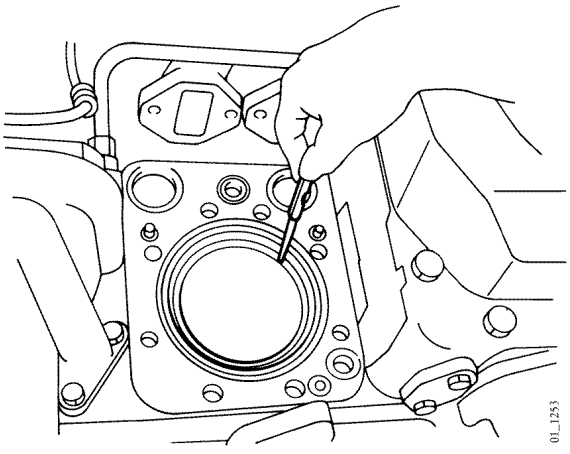
Combinations A+A and C+C can occur in production.

Only weight class B is available as a spare part.

Assembling pistons and connecting rods

1 Clean the piston and its rings thoroughly without scratching the sides of the ring grooves. The oil holes in the piston should be cleaned using a suitable drill.

2 Make sure the piston ring gaps do not exceed the permitted limit.
Place the piston rings inside the cylinder liner and measure the gap with a feeler gauge. Refer to *Specifications* for the permitted gap.

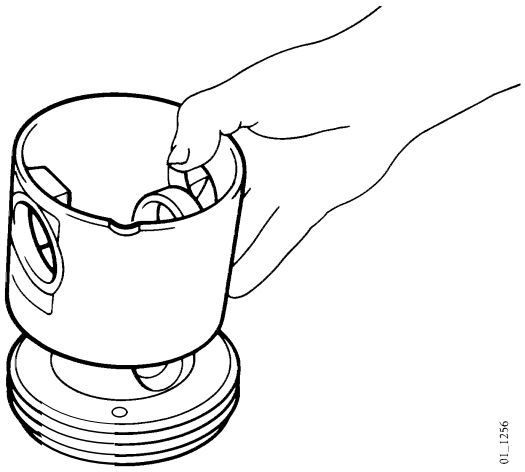


Measuring the piston ring gap

3 Fit the piston rings using tool 587 309. The oil scraper ring has an expander. Pistons rings marked with TOP must be turned with TOP face up.

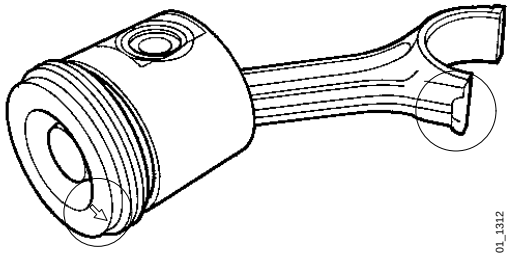
4 Lubricate all bushes and the gudgeon pin before assembly.

5 Turn the skirt so that the recess for the piston cooling nozzle is pointing in the same direction as the arrow on the piston top (in line with the large oval oil hole).



6 Fit the piston skirt to the piston crown and fit one of the gudgeon pin retaining rings. Fit the piston onto the connecting rod.

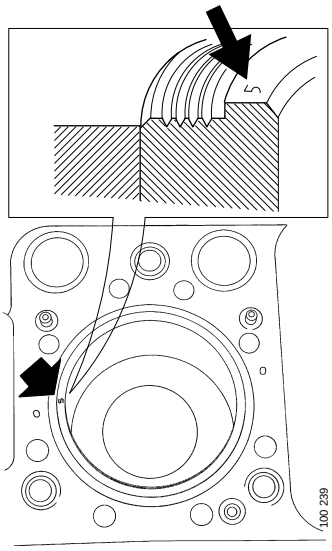
7 The shortest part of the connecting rod's big end and the piston arrow must be facing the same direction.



8 Insert the gudgeon pin using tool 87 362 and fit the second gudgeon pin retaining ring.

Removing the cylinder liners

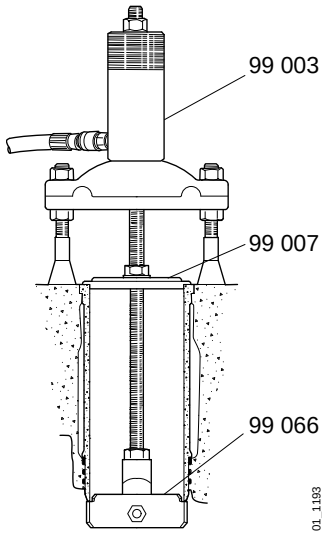
1 Mark the liners with the numbers 1-8. The mark is necessary so that the liners can be refitted in the same place and position as previously.



Mark on cylinder liner

2 Withdraw the cylinder liner using puller 99 066 and support plate 99 007.

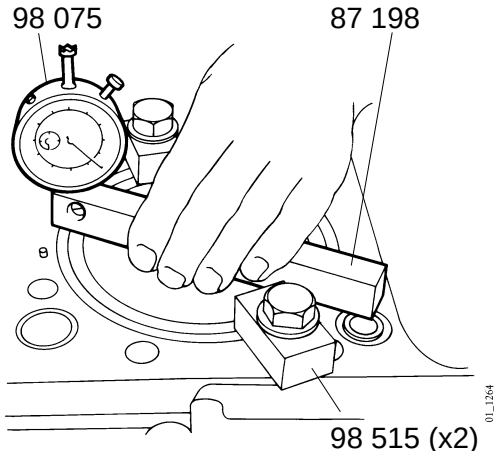
3 Remove the sealing rings in the cylinder block.



Cylinder liner puller with hydraulic hole cylinder

Measuring the cylinder liner height

Fit the cylinder liner without sealing rings and push it down using two tension lugs 98 515. Torque tighten the screws to 60 Nm.



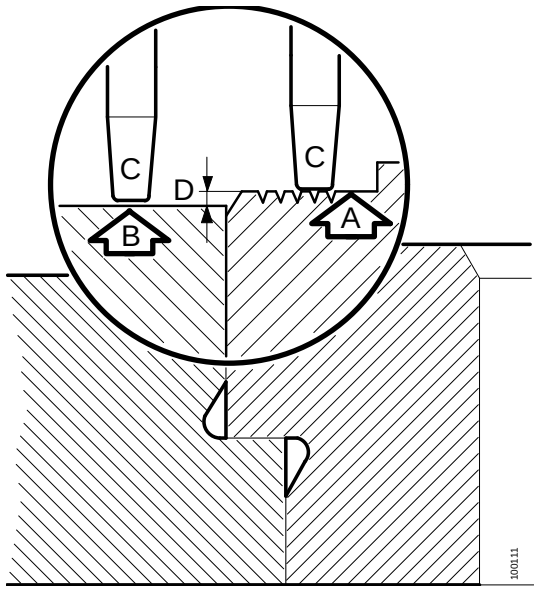
Measuring the cylinder liner height

Place frame gauge 87 198 with dial gauge 98 075 on the liner and zero the dial gauge to the liner (A). Slide the tip of the dial gauge over to the cylinder block (B) and measure the height of the liner (A-B) as illustrated. Measure each liner at two diametrically opposite points.

The cylinder liner must be slightly above the face of the cylinder block.

The difference between the two measurements on the same liner must not exceed 0.02 mm.

The height of the cylinder liner D (=A-B) above the block should be 0.08-0.12 mm



A Measured surface on the cylinder liner
B Measured surface on the cylinder block
C Tip of the dial gauge
D Height of the cylinder liner D = A-B

Adjusting the cylinder liner height

Check and, if necessary, adjust the entire cylinder line at the same time.

The contact surface of the liner in the block must be clean and free from defects. Tape over (sticky side out) the oil way holes in the crankshaft. Place a rag in the cylinder liner to catch swarf.

If the surface is damaged it is necessary to machine it using tool 587 272. After the contact surface of the liner in the block has been machined, fit a shim in order to get the liner height right.

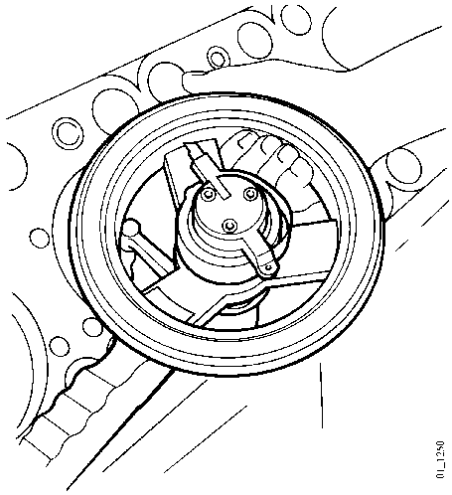
Try to machine the liner as little as possible so that the thinnest possible shim can be used. Shims are available in the following thicknesses: 0.20; 0.25; 0.30; 0.40; 0.50 and 0.75 mm.

Deburr if necessary, and measure the thickness of the shims using a micrometer. Use only one shim, i.e. a thick one rather than several thinner ones.

Try to adjust the liner height close to the upper limit value of 0.12 mm.

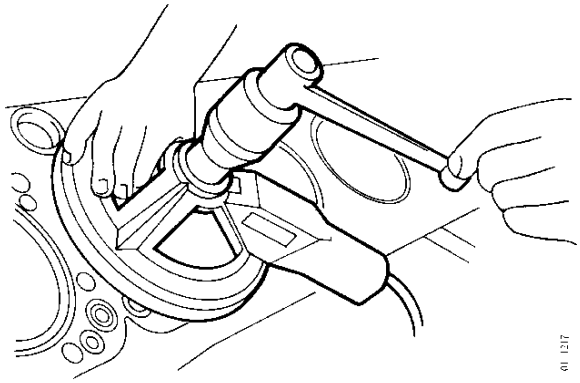
Machining the cylinder liner height

1 Calculate the difference between the thickness of the shim and the measurement by which the cylinder liner must be raised. The difference is the thickness of the layer that must be milled off.



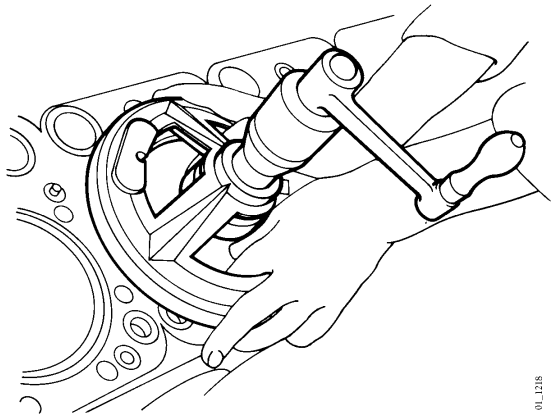
Example for calculating the necessary milling depth:

Desired height	0.12 mm
Measured cylinder liner	0.07 mm
Raising the cylinder liner, 0.12-0.07 =	0.05 mm
Nearest thickness of the shim	0.20 mm
Material to be removed = 0.20-0.05 =	0.15 mm

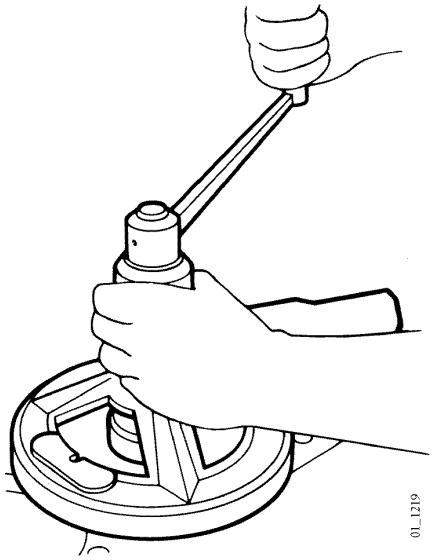


2 Clean the contact surfaces between the tool and the cylinder block face. Set the cutter in the cutter head by lifting the quick feed ring.

3 Centre the tool using the centring roller. Connect the magnet (position 1)

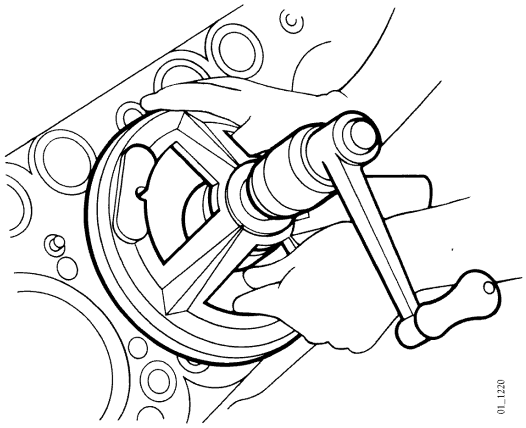


4 Lift the quick feed ring and move the cutter forward so that its carbide tip is over the face of the liner seat without being in contact with the outer edge.

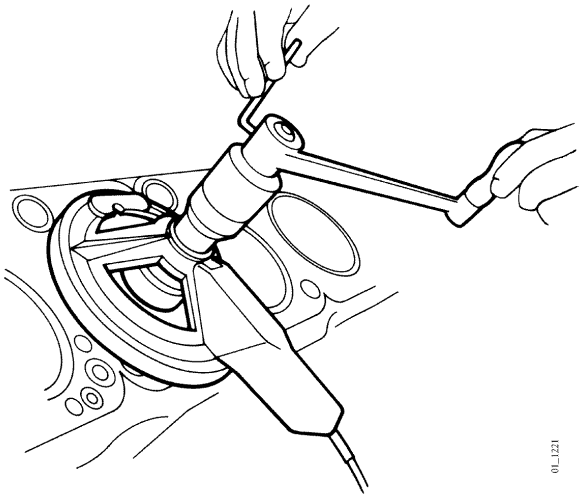


5 Wind round and at the same time turn the vertical feed screw clockwise until the cutter just touches the liner seat.

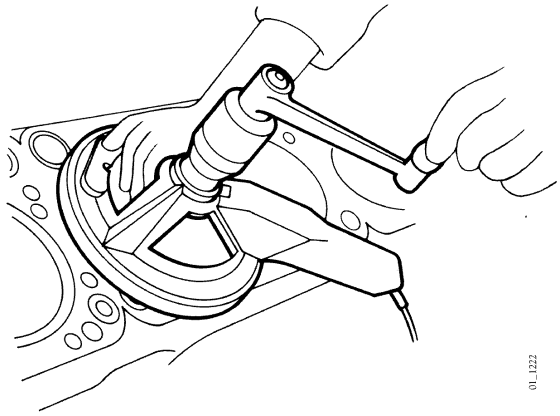
6 Lift the quick feed ring and move the cutter back so that its tip is just within the liner seat plane.



7 Set the vertical feed screw to the desired depth. See step 1.

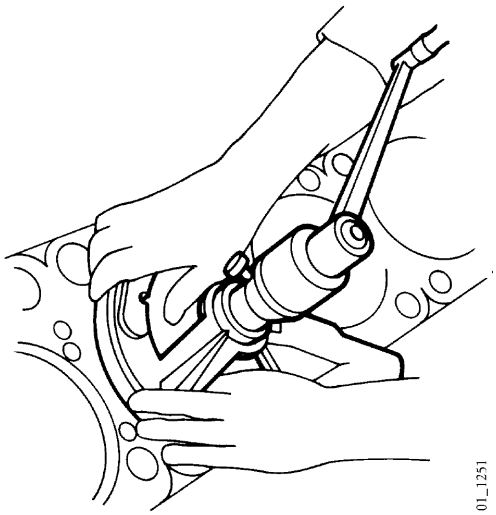


8 Wind clockwise with an even movement. At the same time hold in the horizontal feed screw with your other hand. This will feed the cutter out horizontally by 0.13 mm per turn. Turn more cautiously as the cutter approaches the outer edge of the liner seat and let the horizontal feed screw slip in your fingers. Release the ring completely when the cutter reaches the outer edge, so that the cutter is no longer being fed out. Do not move the vertical feed screw during milling.



9 Move the cutter back towards the centre so that neither it nor the cylinder block are damaged when the tool is positioned over the next liner seat.

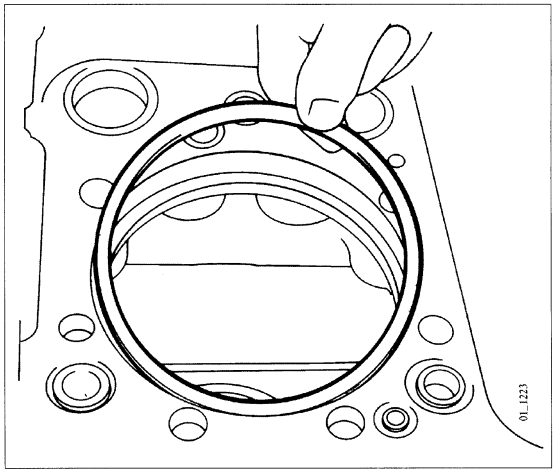
Lift out the tool and position it over the next liner seat.



10 Measure the thickness of the shim using the micrometer with the tool.

11 Fit the shim and cylinder liner.

12 Press down the cylinder liner using the tension lugs and follow the instructions to check the cylinder liner height.



Shim for liner height

Fitting the cylinder liners

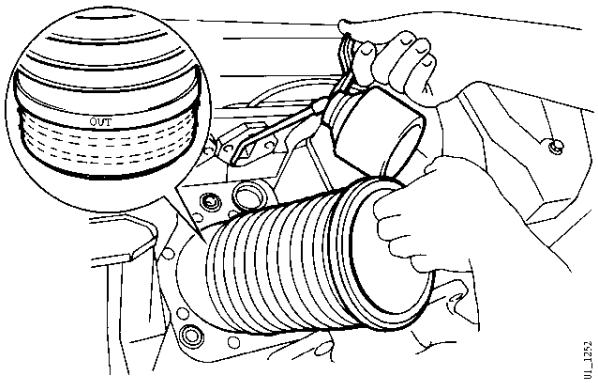
1 Make sure the interior of the cylinder block is clean.

2 Carefully check the cylinder liners, both new and old, for cracks which might have arisen during transport or careless handling. Tap the liner carefully with a metal object. It should give a clear metallic ring if it is intact. If it sounds cracked, renew it.

3 Lubricate the two sealing rings to be fitted in the cylinder block with glycerine, part no. 584 084. Fit them in the cylinder block.

Note: The upper seal, fitted on the cylinder liner with the text "out" facing outwards, cannot withstand oil and must **not** be lubricated.

Lubricate the lower guide surface on the cylinder liner.



Lubricate the lower section of the cylinder liner prior to fitting

4 Turn the liner with the stamped cylinder number facing in the same direction as it was before it was removed, and carefully tap it down with a rubber mallet.

5 Check and adjust the cylinder liner height as described in *Measuring the cylinder liner height* and *Adjusting the cylinder liner height*.

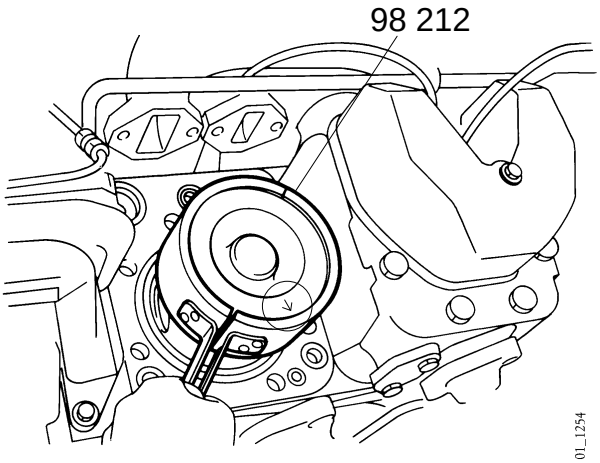
Fitting the piston and connecting rod

1 Lubricate the piston, piston rings, cylinder liner and piston ring compressor with engine oil.

2 Remove the protection on the connecting rod journal and lubricate it.

3 Turn the piston rings so that the ring gaps are evenly distributed round the piston.

4 Carefully insert the connecting rod and piston so that the arrow on the piston points towards the exhaust manifold. Clamp the piston ring compressor 98 212 and push the piston into the cylinder.



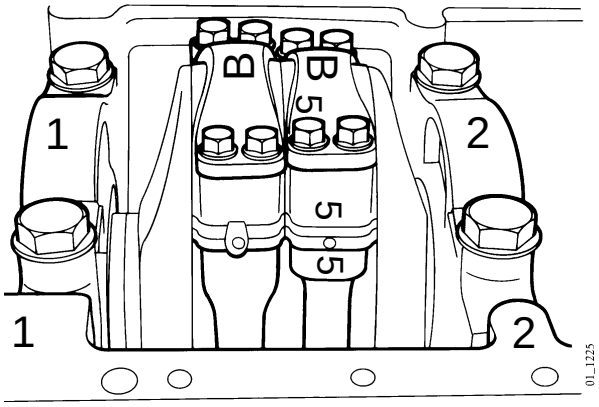
5 Fit the connecting rod bearing shells into the caps and lubricate the bearing surface. Fit the caps. Lubricate the screws, fit them and torque tighten to 20 Nm + 90°.

6 Fit the piston cooling nozzle.

Important! The piston cooling nozzle must not be damaged. The oil jet must hit the piston precisely. If it does not, the piston will become too warm, resulting in engine breakdown. Damaged nozzles must not be re-aligned; renew them instead.

7 Fit the oil sump.

8 Fit the cylinder head. Tighten the cylinder head bolts as described in the section *Cylinder head*.

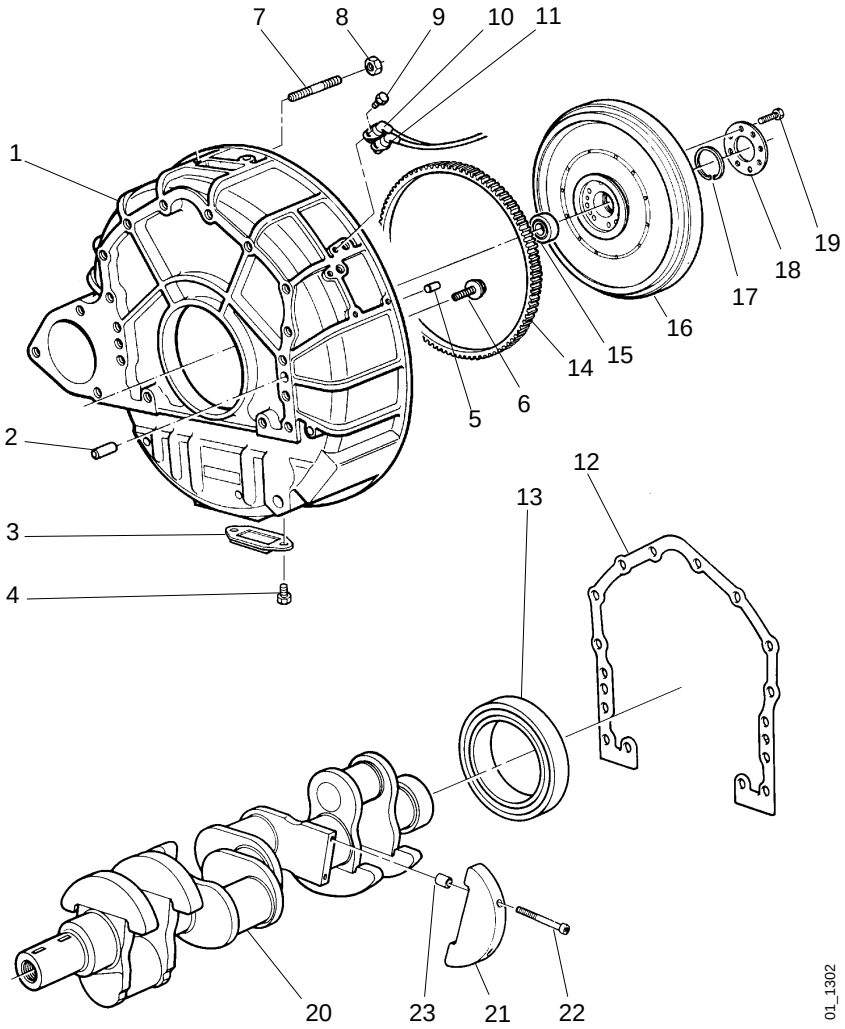


1 and 2 *Numbering of the main bearings on the cap and block.*

5 *Piston and connecting rod numbering*

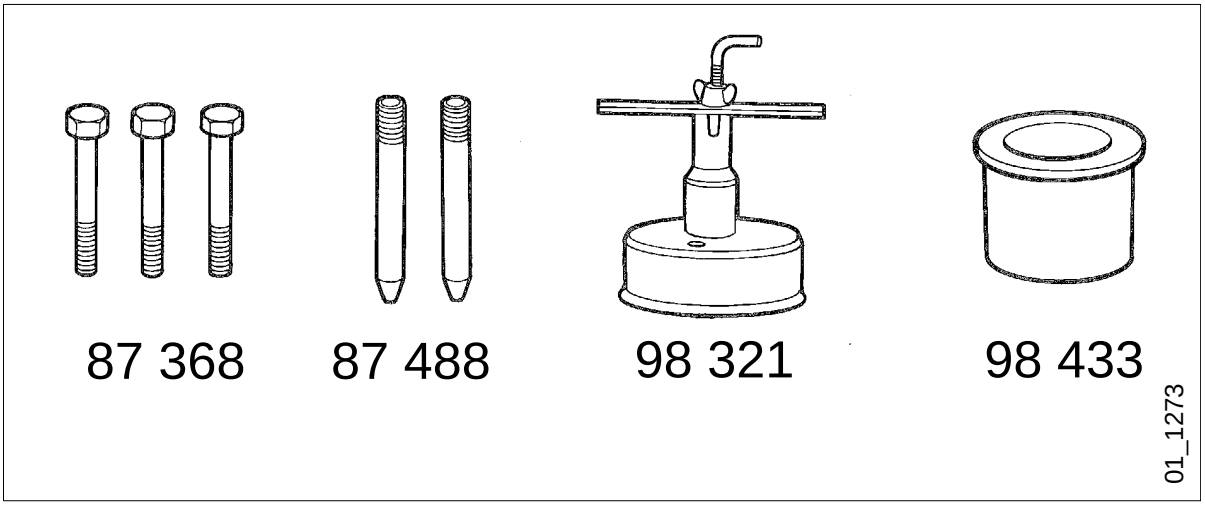
B *The weight class of factory fitted connecting rods is marked A, B and C.*

Flywheel and flywheel housing



1 Flywheel housing
2 Pin
3 Cover
4 Screw
5 Pin
6 Flange screw
7 Stud
8 Nut
9 Screw
10 Rotational speed sensor
11 Rotational speed sensor
12 Gasket
13 Shaft seal
14 External ring gear
15 Ball bearing
16 Flywheel
17 Circlip
18 Lock washer
19 Screw
20 Crankshaft
21 Counterweight
22 Counterweight bolt
23 Guide sleeve

Special tools



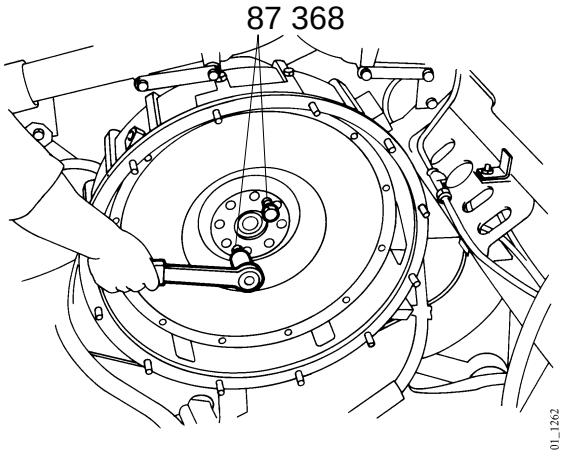
87 368	*Puller screws*	*98 321*	*Assembly tool*
87 488	*Guide pins*	*98 433*	*Drift*

Removing the flywheel

1 Remove the two engine speed sensors in the flywheel housing.

2 Remove the bolts and the ball bearing lock washer.

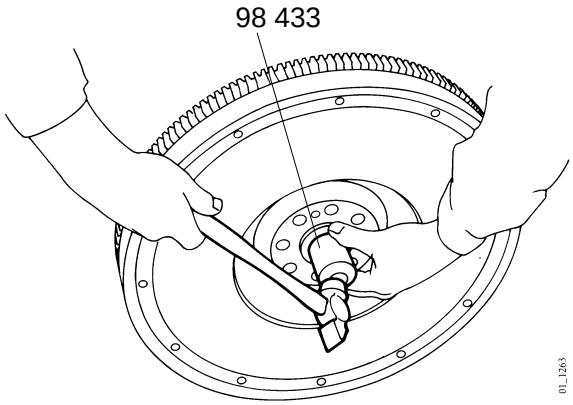
3 Pull off the flywheel from the crankshaft using puller screws 87 368.



Renewing support bearing

1 Tap the support bearing out of the flywheel using a drift.

2 Fit a new support bearing using drift 98 433.



Renewing the external ring gear

Renew the flywheel external ring gear if the gear teeth have become so worn that the starter motor pinion will not engage.

1 Grind a groove as deep as possible in the external ring gear and crack it open with a chisel. Remove the external ring gear from the flywheel.

2 Clean the contact surfaces on the flywheel with a wire brush.

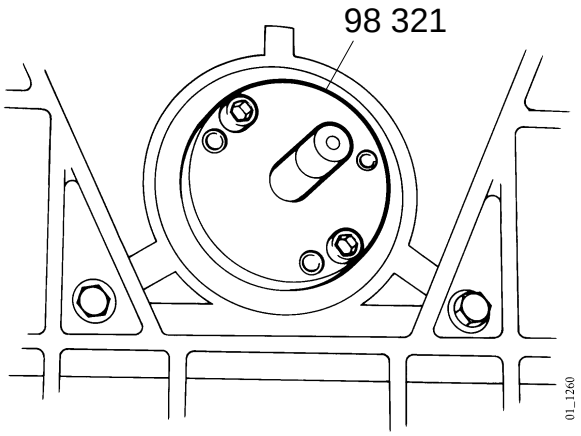
3 Heat the new external ring gear evenly around its circumference to 100-150°C.

4 Place the heated external ring gear on the flywheel so that the bevelled side is facing the starter motor. Ensure that the external ring gear is properly in contact with the flywheel. If necessary, tap down the external ring gear using a plastic hammer.

5 The external ring gear must not be cooled down rapidly but be left to cool in the open air.

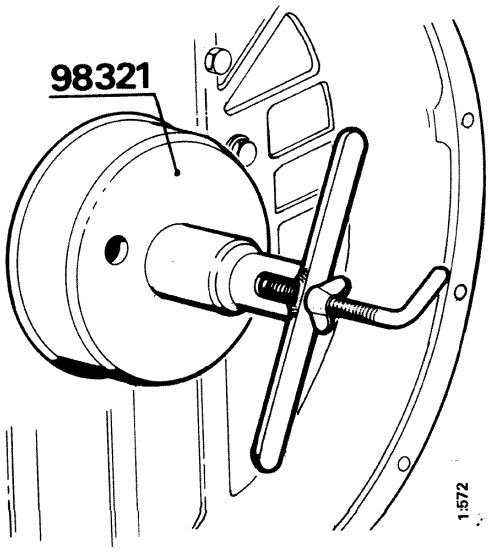
Renewing the crankshaft seal

1 Fit the inner part of assembly tool 98 321 onto the driver.



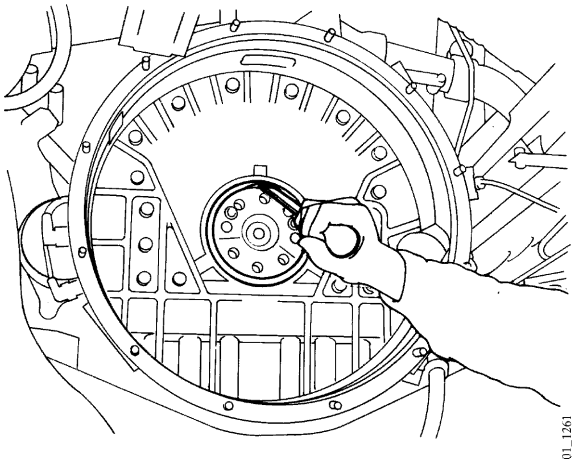
Fit the inner part of the assembly tool

2 Fit the outer part of the assembly tool and screw it in so that it is in contact with the sealing ring. Screw in the adjustment screw to the inner part and lock the wing nut.



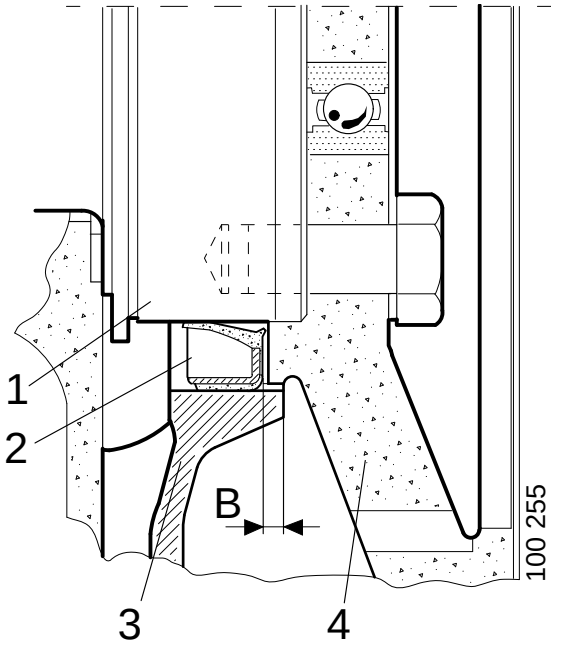
Fit the outer part of the assembly tool

3 Remove the assembly tool and remove the sealing ring using a screwdriver. Take care not to damage the end of the crankshaft and flywheel housing.



Note: The crankshaft seal must be fitted dry and must not be lubricated. The sleeve in the seal must not be removed until just before the crankshaft seal is to be fitted on the engine.

4 Fit the inner part of assembly tool 98 321 again. Push the sealing ring onto the shaft. Fit the outer part of the assembly tool. Screw in the outer part until the adjustment screw is in contact with the inner part.



B = Distance between sealing ring and edge of flywheel housing. B = 7 mm

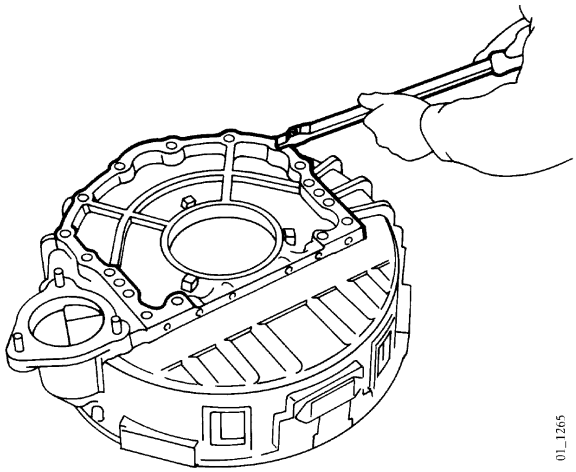
1 Crankshaft
2 Sealing ring
3 Flywheel housing
4 Flywheel

Removal and fitting of the flywheel housing

Renewing the gasket behind the flywheel housing

1 Remove the starter motor.

2 Remove the 16 bolts holding the flywheel housing. Remove the flywheel housing.

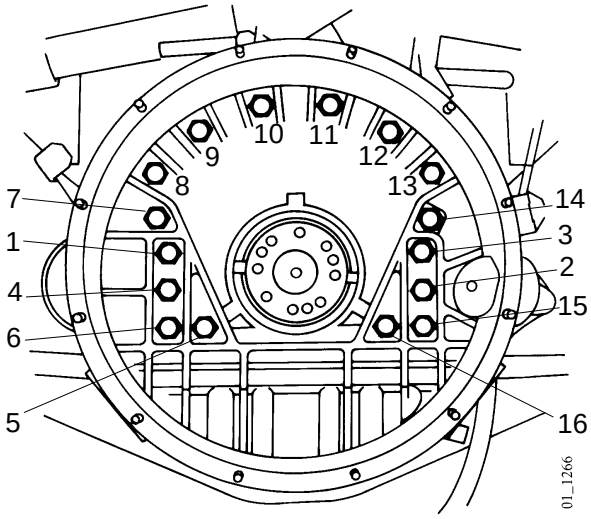


3 Clean the mating surfaces o the flywheel housing and engine.

4 Fit a new gasket and fit the flywheel housing. Tighten the bolts to 90 Nm in order as illustrated.

5 Fit a new crankshaft seal. Always renew the sealing ring when the flywheel housing has been removed.

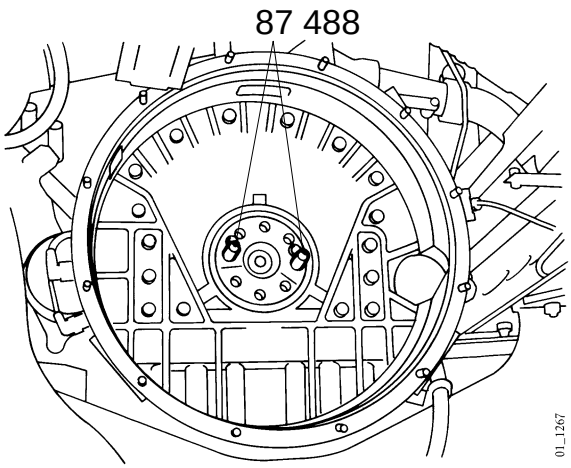
6 Fit the starter motor.



Tightening sequence for flywheel housing bolts

Fitting the flywheel

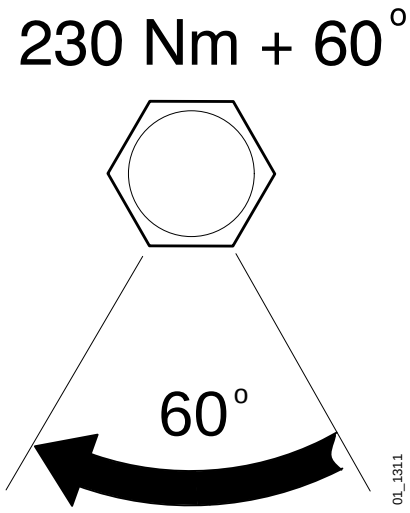
1 Fit two 87 488 guide pins to the flywheel housing.



2 Fit the flywheel on the crankshaft.

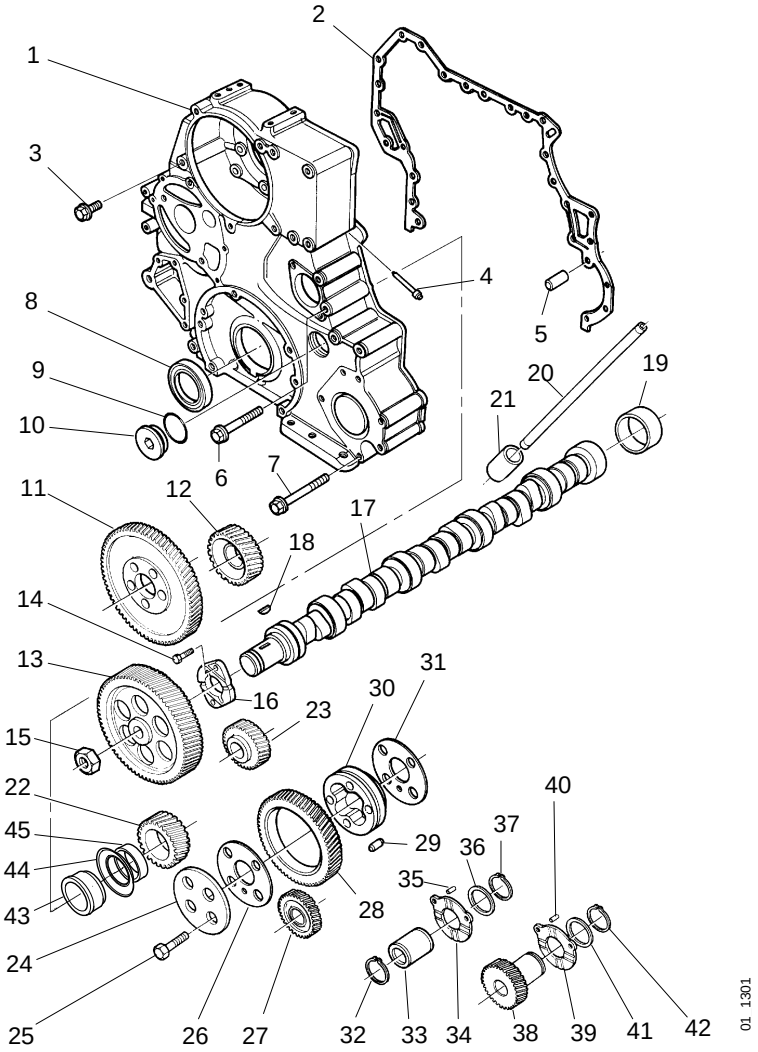
IMPORTANT! Always use new screws.

3 Fit the washer for the ball bearing and tighten the bolts to 230 Nm. And then a further 60° (one flat)



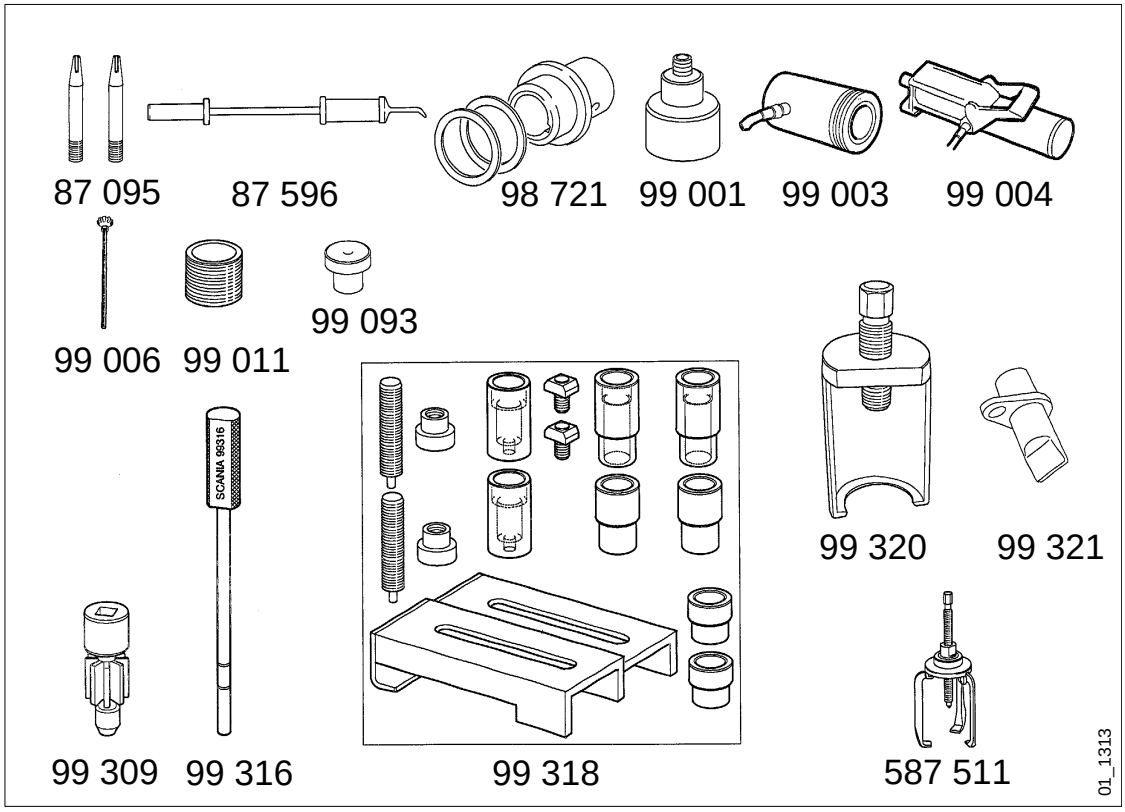
4 Fit the two engine speed sensors.

Timing gears



1 Timing gear casing
2 Gasket
3 Flange screw
4 Rivet plug
5 Pin
6 Flange screw
7 Flange screw
8 Shaft seal
9 Gasket
10 Screw plug
11 Injection pump gear
12 Compressor gear
13 Camshaft gear
14 Flange screw
15 Nut
16 Guide flange
17 Camshaft
18 Key
19 Camshaft bearing
20 Pushrod
21 Valve tappet
22 Crankshaft seal
23 Hydraulic pump gear
24 Washer
25 Screw
26 Bearing washer
27 Oil pump gear
28 Intermediate gear
29 Spiral pin
30 Shaft journal
31 Bearing washer
32 Circlip
33 Bearing bush
34 Thrust bearing
35 Pin
36 Washer
37 Circlip
38 Power take-off drive gear
39 Thrust bearing
40 Pin
41 Washer
42 Circlip
43 Hub
44 Oil deflector
45 Spacing ring

Special tools

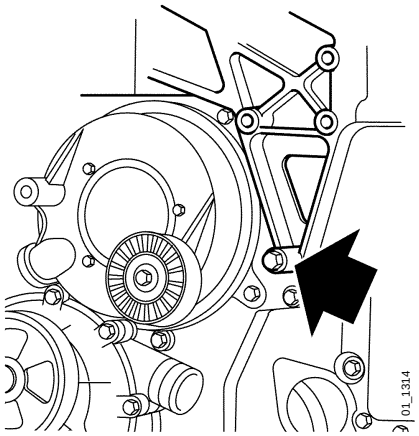


Special tools, timing gears

87 095	*Guide pins*
87 596	*Slide hammer*
98 721	*Assembly tool*
99 001	*Threaded adapter*
99 003	*Hydraulic hole cylinder*
99 004	*Hydraulic pump*
99 006	*Spindle threaded up to the neck*
99 011	*Threaded bushing*
99 093	*Support drift*
99 309	*Tool for turning the flywheel*
99 316	*Lock pin*
*99 318**	*Engine support (*or 2 377 964)*
99 320	*Puller*
99 321	*Locking tool for the flywheel*
587 511	*Puller*

Lower compressor bolt

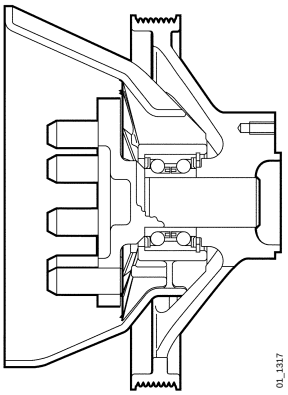
The compressor is attached to the timing gear casing with three bolts. The upper two are studs and the lower is a bolt that goes through the timing gear casing and is secured from in front. It is screwed into a threaded socket nut on the alternator bracket.



Fan drive

The fan drive, consisting of a housing, bearing and pulley, is one unit and must be renewed as a complete unit.

When fitting a new fan drive lubricate the studs in the fan drive housing with grease or oil.



Crankshaft seal

Removal

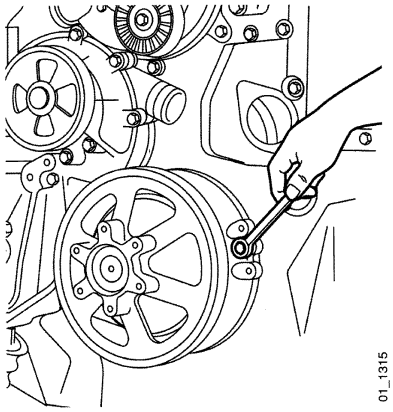
1 Remove the radiator, refer to *Cooling system, work description*.

2 Tilt the cab. Follow the cab tilting instructions. See Group 18.

3 Remove the fan ring and the fan. Keep the fan upright.

4 Disconnect the cooling loop for the compressor and fan belt.

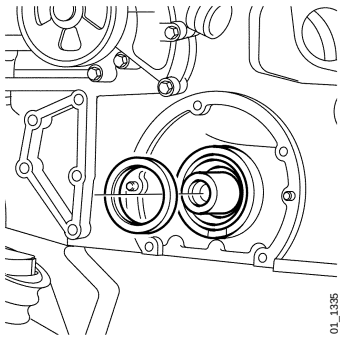
5 Detach the fan drive housing with the pulley and pull it off using 2 fully threaded M10x60 bolts.



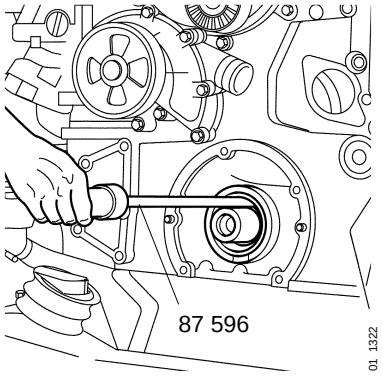
6 Lock the flywheel using tool 99 321 in one of the holes for engine speed sensors in the flywheel housing.

7 Remove the fan drive hub.

8 Remove the O-ring and the cone behind the hub.



9 Remove the sealing ring with slide hammer 87 596. Protect the end of the crankshaft from scratching.



Fitting

1 Wipe clean the sealing ring seat in the housing.

Note: The crankshaft seal must be fitted dry and must not be lubricated. The sleeve in the seal must not be removed until just before the crankshaft seal is to be fitted on the engine.

2 Use assembly tool 98 721 to press in the sealing ring. Tap in the tool using a copper mallet.

3 Fit the cone and O-ring.

4 Fit the fan drive hub and tighten the screw to 1,000 Nm.

5 Lubricate the pins with grease or oil and fit the fan drive housing with the pulley.

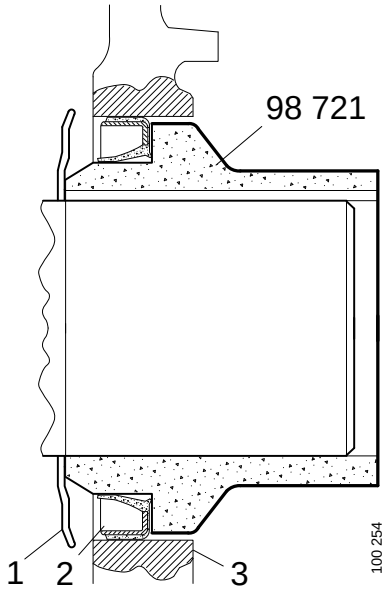
6 Remove tool 99 321 from the flywheel housing.

7 Fit the fan belt and cooling coil for the compressor.

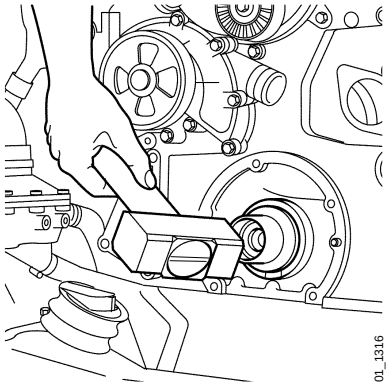
8 Fit the fan and fan ring.

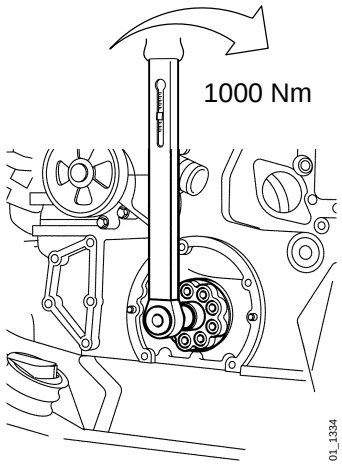
9 Tilt the cab back.

10 Fit the radiator, refer to *Cooling system, work description*.



1 Oil deflector
2 Sealing ring
3 Timing gear casing





Timing gear casing

Removal

1 Remove the radiator, refer to *Cooling system, work description*.

2 Tilt the cab. Follow the cab tilting instructions. See Group 18.

3 Remove the fan ring and the fan. Keep the fan upright.

4 Disconnect the cooling loop for the compressor and fan belt.

5 Detach the fan drive housing with the pulley and pull it off using 2 fully threaded M10x60 bolts.

6 Turn the engine to the firing position and lock the flywheel using tool 99 321 in the flywheel housing.

7 Remove the fan drive hub.

8 Remove the O-ring and the cone behind the hub.

9 Remove the sealing ring with slide hammer 87 596. Protect the end of the crankshaft from scratching.

10 Remove the belt tensioner.

11 Detach the power steering pump and move it aside.

12 Remove the water pipe between the water pump and cylinder block along with the hose elbow to the cylinder block.

13 Remove the turbocharger induction pipe and EDC junction box bracket.

Note: Plug the turbocharger induction pipe hole to prevent the ingress of dirt.

14 Detach the crankcase ventilation pipe and disconnect the water pipe on the right-hand side of the engine.

15 Disconnect the battery negative cable, remove the alternator and move it aside.

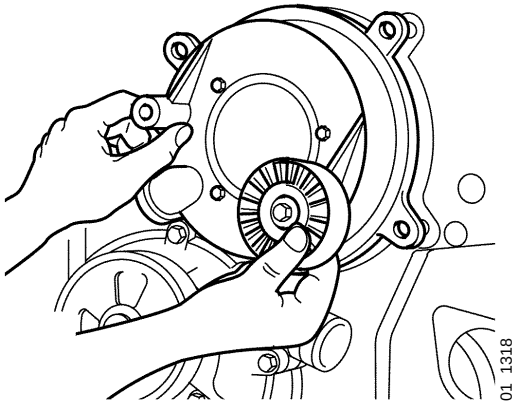
16 Detach the A/C compressor and fuel filter with cabling.

17 Detach and pull the compressor backwards.

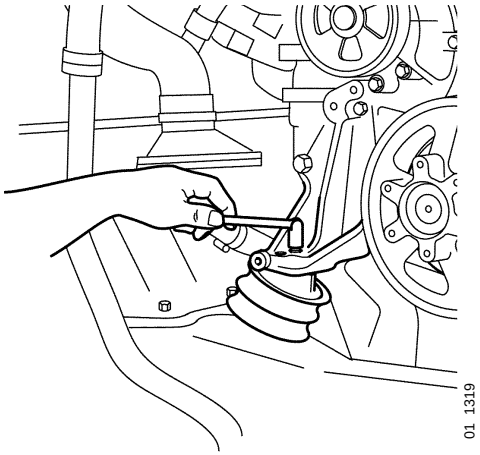
18 Remove the crankcase ventilation cover.

19 Check that the engine is in the firing position and is locked with tool 99 321. Remove the injection pump drive, detach the injection pump and push it backwards.

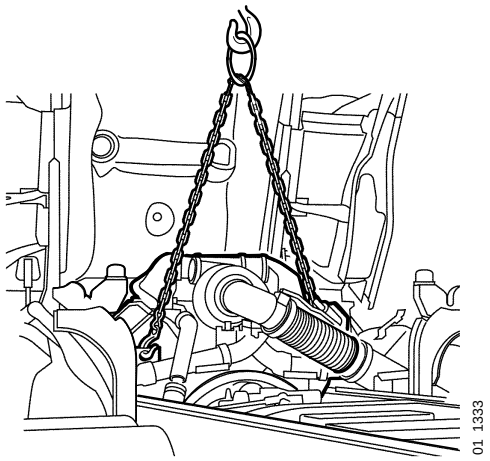
20 Remove the oil sump.



21 Undo the engine bracket bolts to the engine cushions.

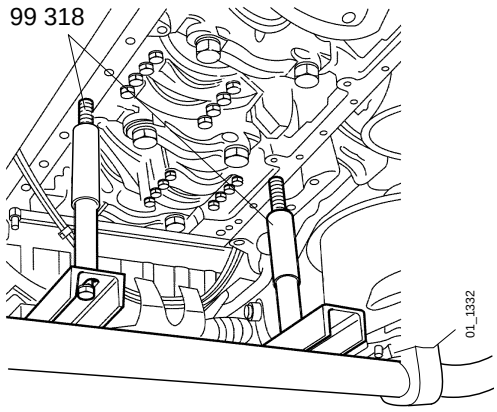


22 Lift the engine using an overhead hoist in the flywheel housing lifting eyes so that the engine brackets are approx. 10 mm above the engine insulators.



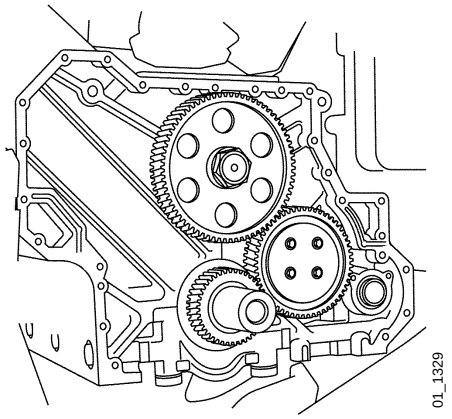
23 Support the engine on stands against the front axle beam using tool 99 318 which guides two oil sump holes in the cylinder block. Take the load off the overhead hoist.

Note: The engine is now supported on the front axle beam. One must now not alter the distance between the front axle beam and frame, e.g. by raising the air suspension. There is a risk that the engine will fall.



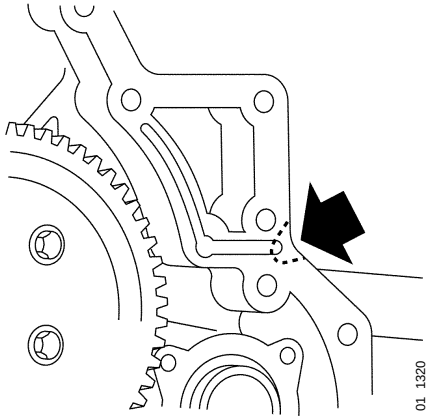
24 Remove the engine brackets from the timing gear casing.

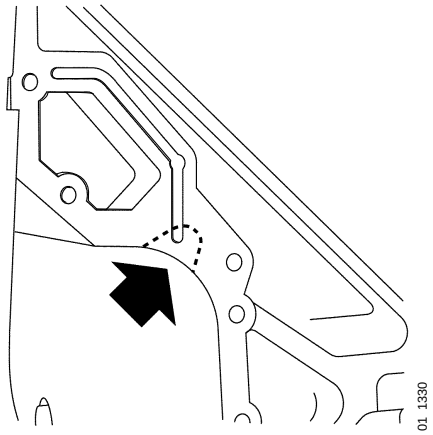
25 Remove the timing gear casing.



Fitting

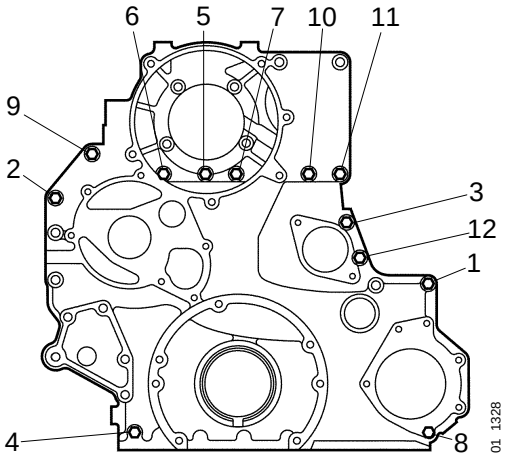
1 The timing gear casing gasket has slots for both water ducts. Ensure that the cylinder block is well cleaned where the slots open out.





2 Fit guide pins 87 095 and fit a new gasket.

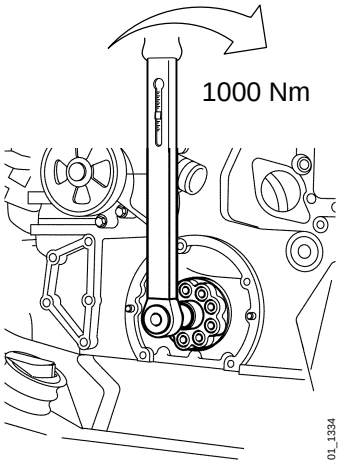
3 Fit the timing gear casing. Tighten the bolts to 39 Nm in the order illustrated in the illustration.



4 Fit a new crankshaft seal. Refer to crankshaft seal, fitting, steps 1-2.

5 Fit the cone and O-ring behind the fan drive hub.

6 Fit the fan drive hub and tighten to 1,000 Nm.



7 Lubricate the pins with grease or oil and fit the fan drive housing with the pulley.

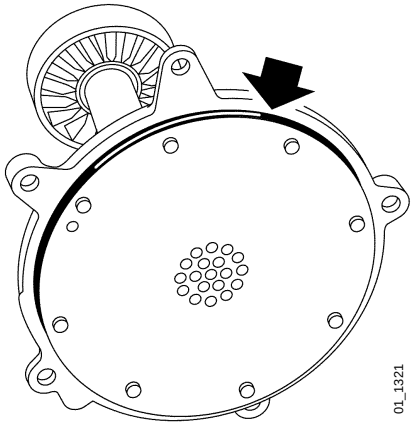
8 Fit the injection pump. Ensure that the O-ring is not damaged or comes out of its groove.
Torque tighten the four bolts in the timing gear casing to 39 Nm. Then tighten the two bolts in the V to 39 Nm.

Note: It is important to tighten the bolts in the timing gear casing first.

9 Fit the injection pump gear. Check that the engine is in the firing position and fit tool 99 316. Torque tighten the screws to 20 Nm, crosswise.

Important! Remove the tool

Torque tighten the screws to 80 Nm, crosswise. Finally tighten to 105 Nm, crosswise.

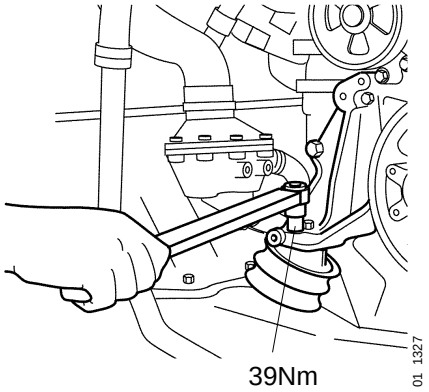


10 Remove tool 99 321 from the flywheel housing.

11 Fit the crankcase ventilation cover. Ensure that the O-ring is not damaged.

12 Fit the engine brackets o the timing gear casing. Torque tighten to 59 Nm.

13 Lift up the engine using an overhead hoist in the flywheel housing lifting eyes and remove tool 99 318.



14 Lower the engine slightly so that the bolts in the engine brackets can be positioned in the engine cushions.

15 Lower the engine completely and tighten the bolts to 39 Nm.

16 Fit the oil sump with a new gasket.

17 Fit the compressor and alternator bracket.

18 Fit the fuel filter with cabling.

19 Fit the alternator and the A/C compressor.

20 Connect the negative cable to the battery and fit the battery cover.

21 Fit the crankcase ventilation pipe and the water pipe on the right-hand side of the engine.

22 Fit the EDC junction box bracket.

23 Fit the turbocharger induction pipe.

24 Fit the water pipe between the water pump and cylinder block along with the hose elbow to the cylinder block.

25 Fit the power steering pump. Take care not to damage the O-ring.

26 Fit the belt tensioner.

27 Fit the fan belt and cooling coil for the compressor.

28 Fit the fan and fan ring. The fan must be tightened to 30 Nm.

29 Tilt the cab back.

30 Fit the radiator, refer to *Cooling system, work description.*

Intermediate gear

Removal

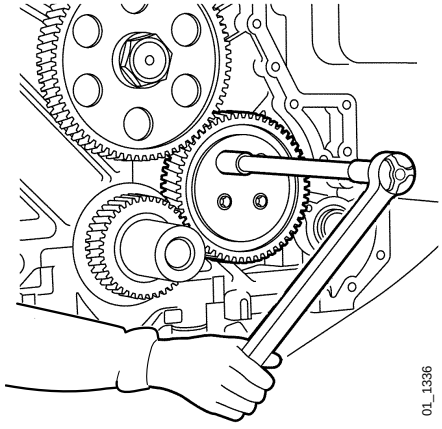
1 Remove the timing gear casing. Refer to *Timing gear casing removing*.

2 Remove the spacer and oil collector on the end of the end of the crankshaft. Remove the oil pump.

3 Turn the crankshaft so that the marking on the camshaft and crankshaft gear is towards the centre of the intermediate gear. Use tool 99 309 and a locking bar at the flywheel starter gear.

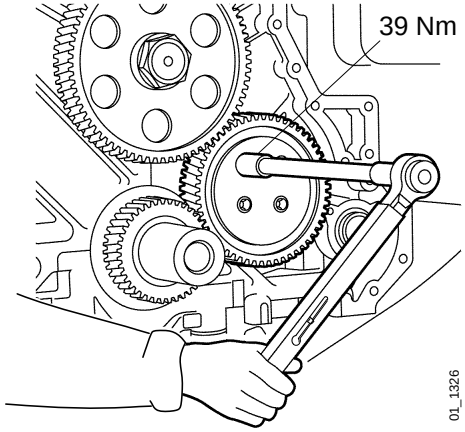
4 Lock the engine using tool 99 321 in the flywheel housing.

5 Remove the intermediate gear.



Remove the intermediate gear

IMPORTANT! After removing the intermediate gear, neither the camshaft nor the crankshaft must be rotated. Pistons and valves can collide and be damaged.



Tighten the bolts

Fitting

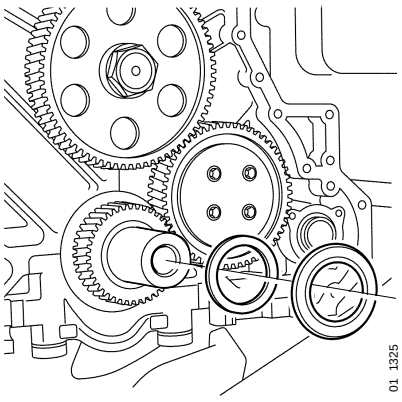
1 Lubricate the bearing surfaces and fit the intermediate gear so that all markings are in the correct positions.

2 Fit the washer and torque tighten the bolts to 39 Nm.

3 Fit the oil pump.

4 Fit the spacer and oil collector onto the end of the crankshaft.

5 Fit the timing gear casing. Refer to *Timing gear casing, fitting.*



Fit the spacer and oil collector on the crankshaft.

Camshaft gear

Removal

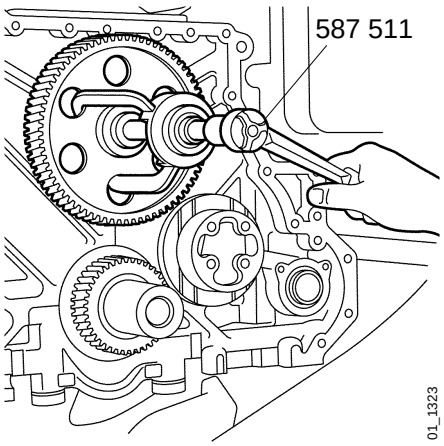
1 Remove the timing gear casing. Refer to *Timing gear casing, removing*.

2 Remove the spacer and oil collector on the end of the end of the crankshaft. Remove the oil pump.

3 Turn the crankshaft so that the marking on the camshaft and crankshaft gear is towards the centre of the intermediate gear. Use tool 99 309 and a ratchet handle on the flywheel starter gear ring

4 Lock the engine using tool 99 321 in the flywheel housing. Remove the intermediate gear.

5 Remove the camshaft gear using puller 587 511.



IMPORTANT! After removing the intermediate gear, neither the camshaft nor the crankshaft must be rotated. Pistons and valves can collide and be damaged.

Fitting

1 Lubricate the end of the camshaft with engine oil.

2 Heat the gear to 100°C and fit it onto the shaft with the marking outwards. Ensure that it points towards the centre of the intermediate gear bearing.

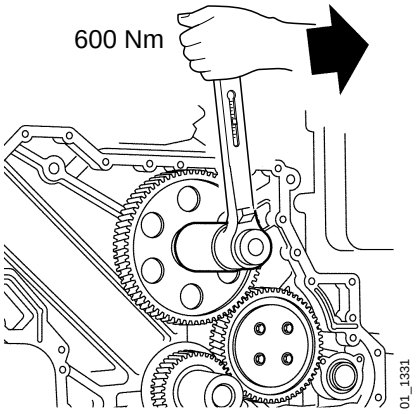
3 Check that the gear has cooled. Torque tighten the camshaft nut to 600 Nm.

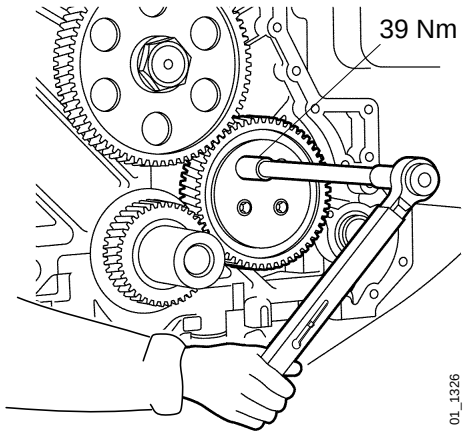
4 Fit the intermediate gear, refer to *Intermediate gear, fitting steps 1-2*.

5 Fit the oil pump.

6 Fit the spacer and oil collector onto the end of the crankshaft.

7 Fit the timing gear casing. Refer to *Timing gear casing, fitting*.





Tighten the bolts on the intermediate gear

Crankshaft gear

Removal

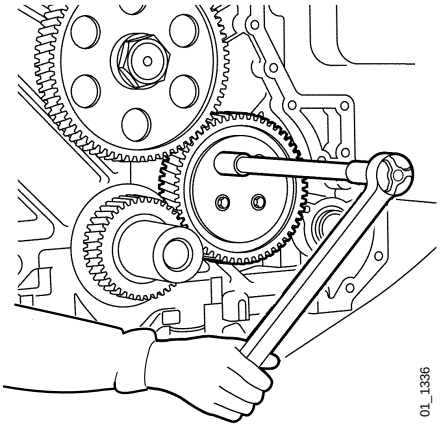
1 Remove the timing gear casing. Refer to *Timing gear casing, removing.*

2 Remove the spacer and oil collector on the end of the end of the crankshaft. Remove the oil pump.

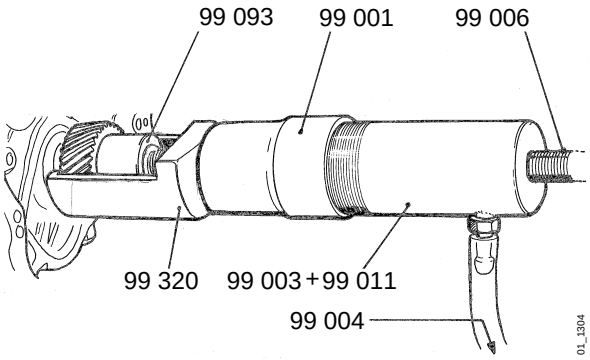
3 Turn the crankshaft so that the marking on the camshaft and crankshaft gear is towards the centre of the intermediate gear. Use tool 99 309 and a ratchet handle on the flywheel starter gear ring

4 Lock the engine using tool 99 321 in the flywheel housing. Remove the intermediate gear.

5 Pull off the crankshaft gear using puller 99 320 and support drift 99 093.



IMPORTANT! After removing the intermediate gear, neither the camshaft nor the crankshaft must be rotated. Pistons and valves can collide and be damaged.



Fitting

1 Lubricate the end of the crankshaft with engine oil.

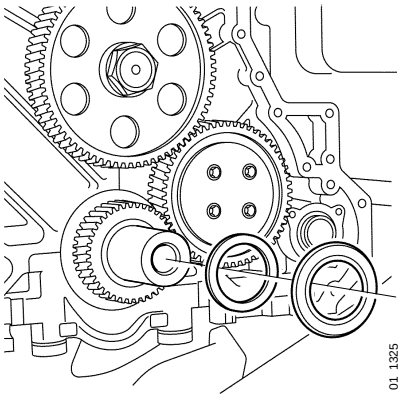
2 Heat the gear to 100°C and fit it onto the shaft with the marking outwards. Ensure that it points towards the centre of the intermediate gear bearing.

3 Fit the intermediate gear , refer to *Intermediate gear, fitting steps 1-2.*

4 Fit the oil pump.

5 Fit the spacer and oil collector onto the end of the crankshaft.

6 Fit the timing gear casing. Refer to *Timing gear casing, fitting.*



Fit the spacer and oil collector on the crankshaft.

Camshaft

Removal

The timing gear casing, oil pump and V space cover plate have already been removed.

1 Remove rocker arms, pushrods and valve tappets.

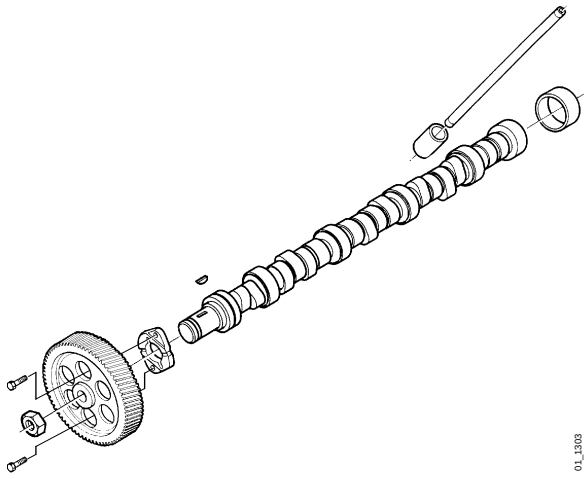
2 Turn the crankshaft until the O marked tooth on the crankshaft and camshaft gear points towards the centre of the intermediate gear. In this position the camshaft guide flange bolts are accessible through the holes in the camshaft gear.

3 Lock the engine using tool 99 321 in the flywheel housing.

4 Undo the camshaft gear nut. The camshaft gear can now be pulled off the camshaft, but can also remain in place when the camshaft is removed.

5 Remove the intermediate gear and the guide flange bolts.

6 Pull the camshaft out forwards. Take care not to damage the cams and bearings.



Fitting

1 Lubricate and insert the camshaft. Take care not to damage the cams and bearings.

2 Fit the guide flange screws.

3 Fit the intermediate gear, refer to *Intermediate gear, fitting steps 1-2*.

4 Ensure that the markings on the camshaft gear point towards the centre of the intermediate gear.

5 Tighten the camshaft gear nut.

6 Lubricate the valve tappets, pushrods and rocker arms using engine oil and fit them.

Camshaft bearing

The wear on the camshaft and camshaft bearings is insignificant and rarely need attention. However, when carrying out an engine overhaul, check that the bearing surfaces and cams are not abnormally worn.

Fit new bearings so that the lubricating holes are opposite the oilways in the block.

Crankshaft

Removal

1 Remove the cylinder head, pushrods and valve tappets.

2 Remove the flywheel and flywheel housing.

3 Remove the fan, fan hub, oil sump, timing gear casing and intermediate gear.

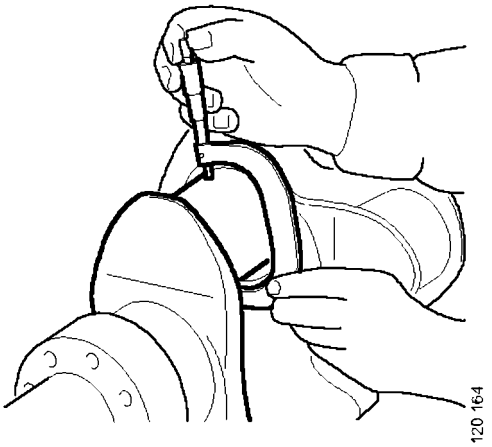
4 Remove the oil pump and all pistons and connecting rods.

5 Remove all main bearing caps and carefully lift out the crankshaft using a lifting strap for example, which will not damage the shaft journals.

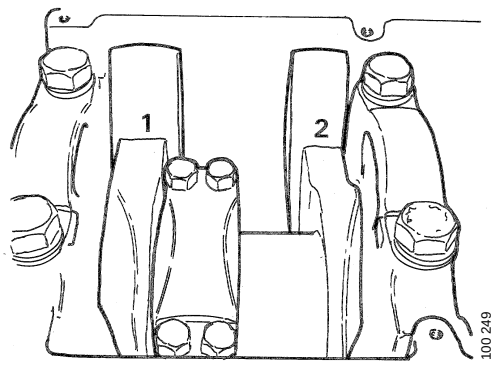
6 Remove all main bearing shells and guide washers by the 5th main bearing.

Checking and grinding

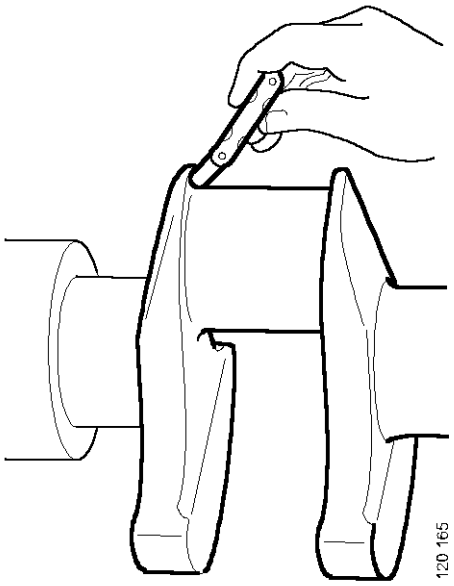
1 Measure the diameter on the crankshaft bearing journals using a micrometer as illustrated. Measure at several points around the bearing journal. If any of these diameters is lower than the minimum indicated limit, regrinding of the crankshaft should be considered. Oil pressure should also be checked, as it is affected by such factors as wear in the main bearings and connecting rod bearings.



2 The balancing weights must be removes prior to grinding. Mark the position of the weights in the crankshaft according to the illustration so that they can be refitted in the same positions. Undo the bolts and remove the weights.



3 When regrinding, keep to the specified minimum dimensions. Suitable bearings are available for these sizes. It is important that the fillet radius of the bearing journals is correct. Check the fillet radius using a template as illustrated.



4 After grinding the bearing journals, round off and polish the oil hole openings on the bearing surfaces.

Fitting

1 Fit the balancing weights with new bolts as marked.

IMPORTANT! Always fit new bolts of the same type previously fitted to the counterweights.

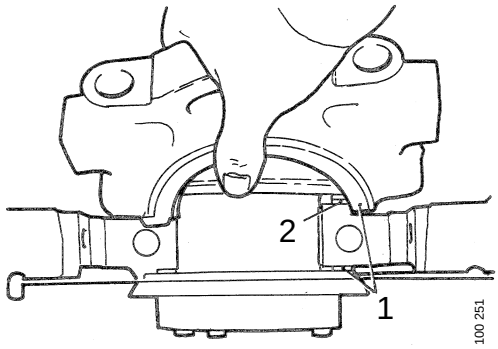
2 Lubricate the bolt threads with molybdenum disulphide grease.

3 Torque tighten the screws to 50 Nm+90°.

4 Take special care to clean all oilways in the crankshaft, bearing journals and bearing and cap contact surfaces.

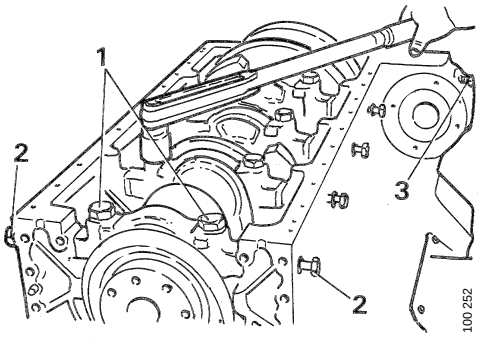
5 Check that the dimensions of the bearings and guide washers are correct. Fit the bearing shells in the block and caps. Generously lubricate the bearings and bearing journals.

6 Lift in the crankshaft carefully. Fit the guide washers and fit the caps as marked.



1 Rear guide washers
2 Front guide washers
Rear main bearing with guide washers

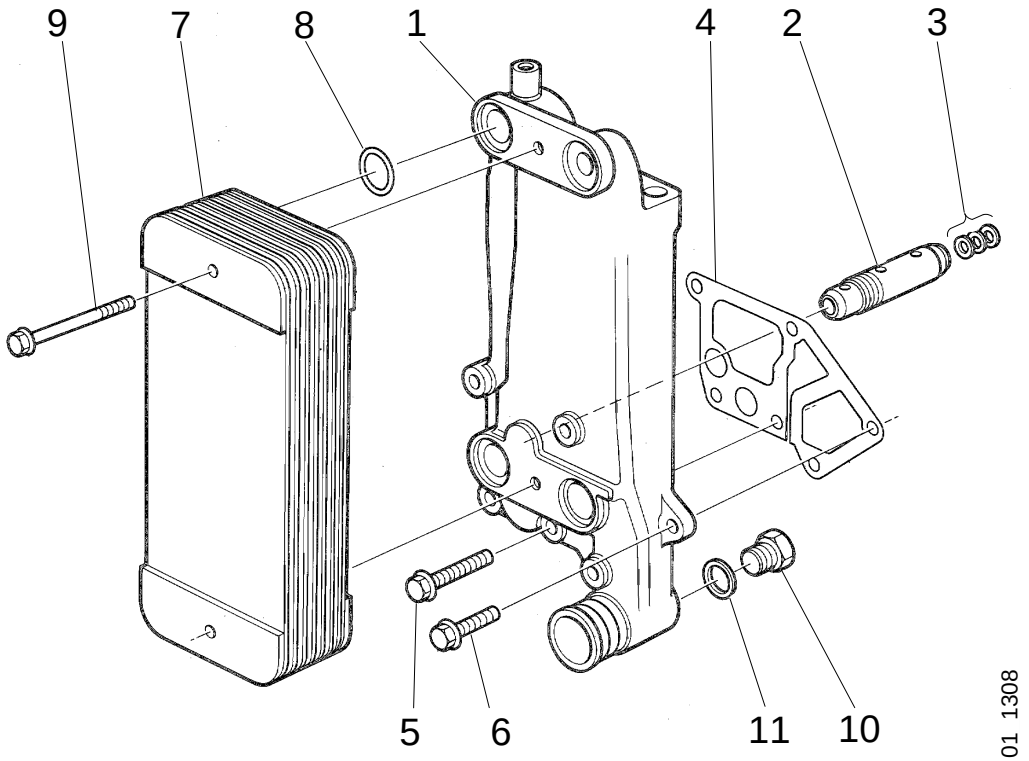
7 Lubricate the bolt threads and first tighten the vertical cap bolts to 120 Nm + 60°. Then tighten the horizontal bolts on the sides of the cylinder block to 140 Nm + 60°. Make sure the crankshaft can be turned easily.



1 Vertical bolts
2 Horizontal bolts
3 The left horizontal bolt for the first main bearing is longer than the other bolts

Lubrication system

Oil cooler



1 Intermediate piece
2 Valve sleeve
3 Washer
4 Gasket
5 Flange screw
6 Flange screw
7 Oil cooler
8 O-ring
9 Flange screw
10 Screw plug
11 Sealing ring

Setting the lubrication pressure

Note: If the oil pressure is low, establish the cause before adjusting. If the engine is very worn, too great a bearing play can contribute to a lowering of the oil pressure. A worn oil pump or leak in an oil line may also be the cause. When checking the oil pump the suction pipe should also be checked for leaks.

Set the specified oil pressure with the engine at operating temperature, and at the specified engine speed. **Note that the oil pressure at idling and low engine speeds are not affected by this adjustment**.

The engine should not be run when the lubrication pressure is either too low or too high.

Adjust with washers in the pressure-reducing valve behind the oil cooler. Each washer gives an increase in pressure of 0.10-0.15 bar, a maximum of 8 washers can be used.

Removal

1 Drain the engine cooling system. Refer to booklet *02:01-01, Cooling system, Work description*.

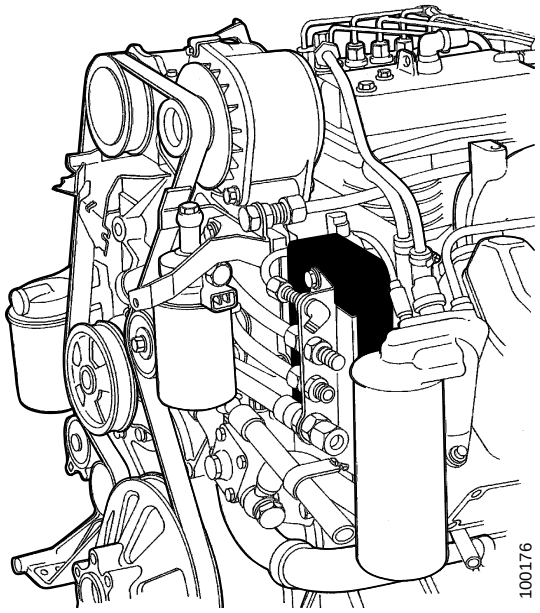
2 Screw the oil filter out of the oil filter housing.

3 Disconnect the oil pressure sensor and warning lamp cables.

4 Detach the fuel filter bracket from the alternator bracket.

5 Remove the oil cooler bolts and remove the oil cooler from the intermediate piece.

6 Undo the hose clamps on the upper water pipes on the intermediate piece and push up the hoses.

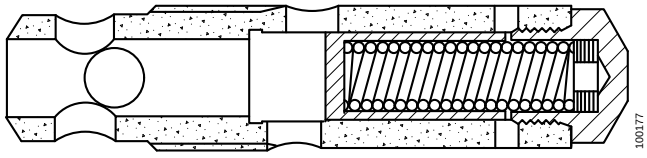


7 Disconnect the water hoses at the lower edge of the intermediate piece.

8 Detach the compressor cooling coil clamp.

9 Remove the intermediate piece.

10 Remove the pressure-reducing valve from the intermediate piece and insert a shim (max. 8 off).



Fitting

11 Fit the pressure-reducing valve in the intermediate piece.

12 Fit the intermediate piece onto the engine.

13 Fit the compressor cooling coil clamp.

14 Fit the water hoses in the lower edge of the intermediate piece.

15 Fit the hoses onto the upper water pipes on the intermediate piece.

16 Fit the oil cooler.

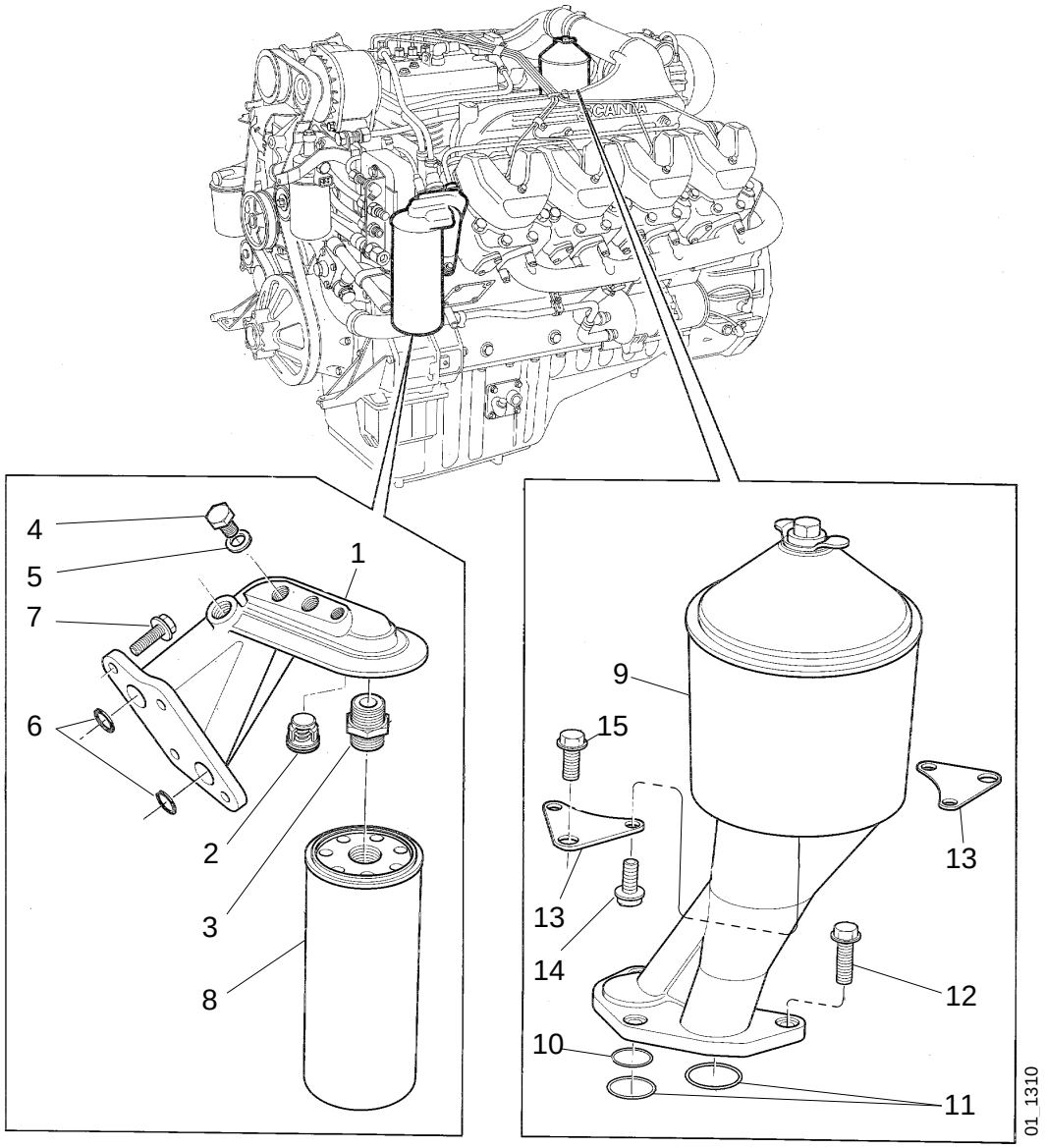
17 Fit the fuel filter bracket in the alternator bracket.

18 Clamp the cables for the oil pressure sensor and oil warning lamp.

19 Screw the oil filter into the oil filter housing.

20 Fill the engine cooling system. Refer to booklet *02:01-01, Cooling system, Work description*.

Oil cleaner



1 Filter bracket
2 Overflow valve
3 Union
4 Screw plug
5 Sealing ring
6 O-ring
7 Flange screw
8 Oil filter
9 Oil cleaner
10 O-ring
11 O-ring
12 Flange screw
13 Attachment plate
14 Flange screw
15 Flange screw

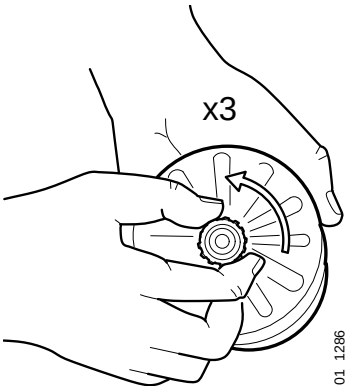
Dismantling and assembly

There should be a certain amount of deposited dirt in the rotor cover during routine cleaning of the oil cleaner. If not, this indicates that the rotor is not spinning. The cause must be established immediately.

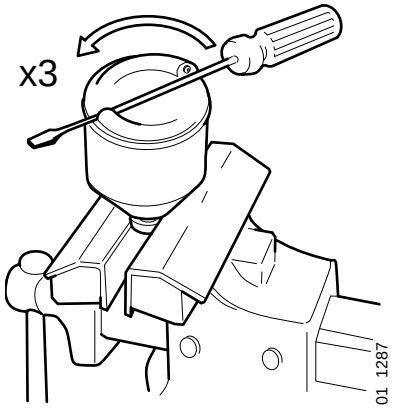
If the dirt deposit exceeds 20 mm at the recommended intervals, the rotor cover should be cleaned more often.

1 Undo the nut holding the outer cover and remove the nut.

2 Lift out the rotor. Wipe off the outside. Undo the rotor nut and unscrew it about three turns to protect the bearing.



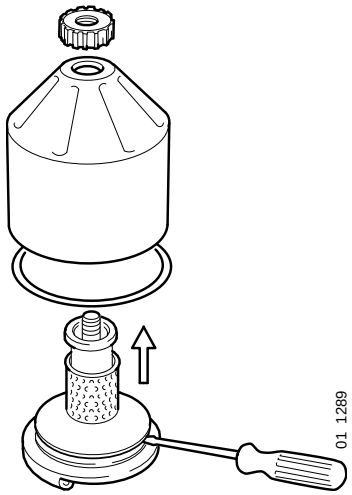
3 If the rotor nut is difficult to get loose, turn the rotor upside down and secure the rotor nut in a vice. Turn the rotor counterclockwise three turns by hand or if this does not help, place a screwdriver between the outlet holes.



IMPORTANT! The rotor must not be put in a vice. Never strike the rotor cover. This may cause damage resulting in imbalance.

1 Grasp the rotor cover and tap the rotor nut lightly with your hand or a plastic mallet so that the rotor cover comes loose from the rotor. Never strike the rotor directly as this may damage its bearings.

2 Remove the rotor nut and cover from the rotor.



3 Remove the strainer located on the rotor. If the strainer is stuck, prise carefully with a knife at the bottom between the rotor and the strainer.

4 Scrape away the deposits inside the cover with a knife.

5 Wash the parts.

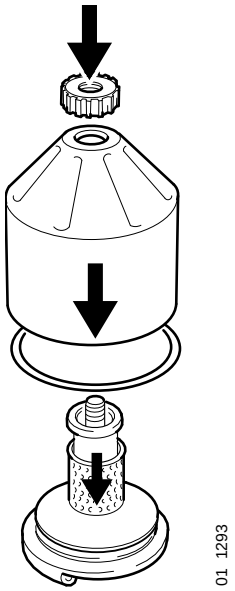
6 Inspect the two nozzles on the rotor. Make sure they are not blocked or damaged. Renew any damaged nozzles.

7 Check that the bearings are undamaged.

8 Position the O-ring in the cover. Renew the O-ring if it is at all damaged.

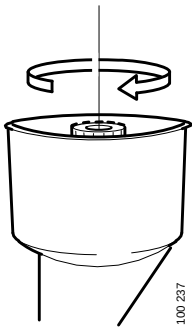
1 Assemble the parts and tighten the rotor nut by hand.

2 Check that the shaft is not loose. If it is, it should be locked using locking compound 561 200. Clean thoroughly first with a suitable solvent. Tighten the rotor shaft using socket wrench 98 421. Tightening torque 41 Nm.



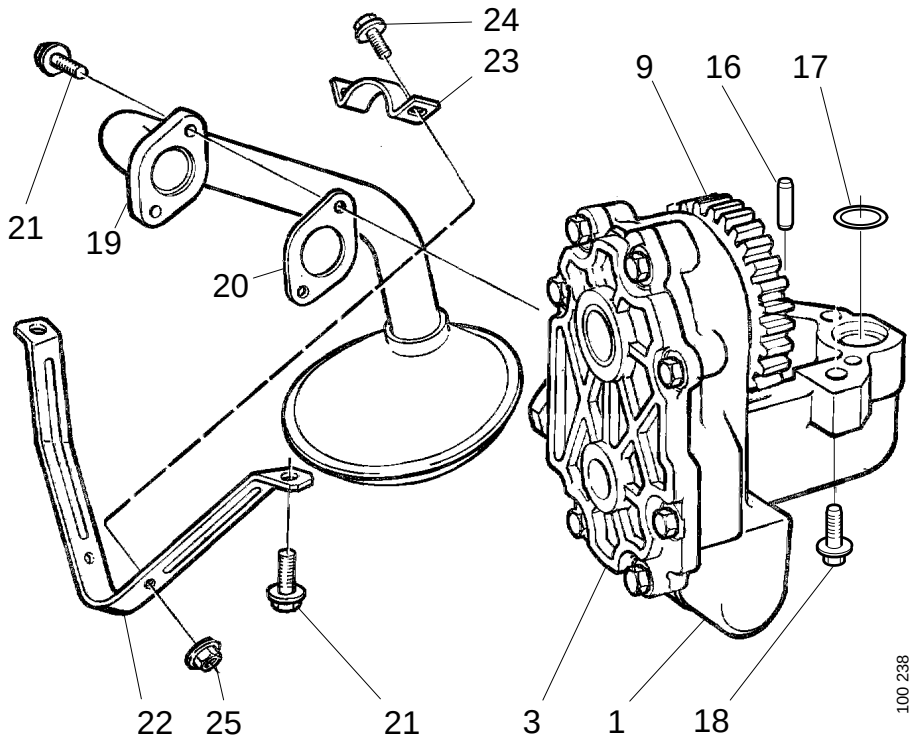
3 Refit the rotor and spin it by hand to make sure it rotates easily.

4 Inspect the O-ring on the cleaner housing cover and fit it. Torque tighten the lock nut to 10 Nm.



Oil pump

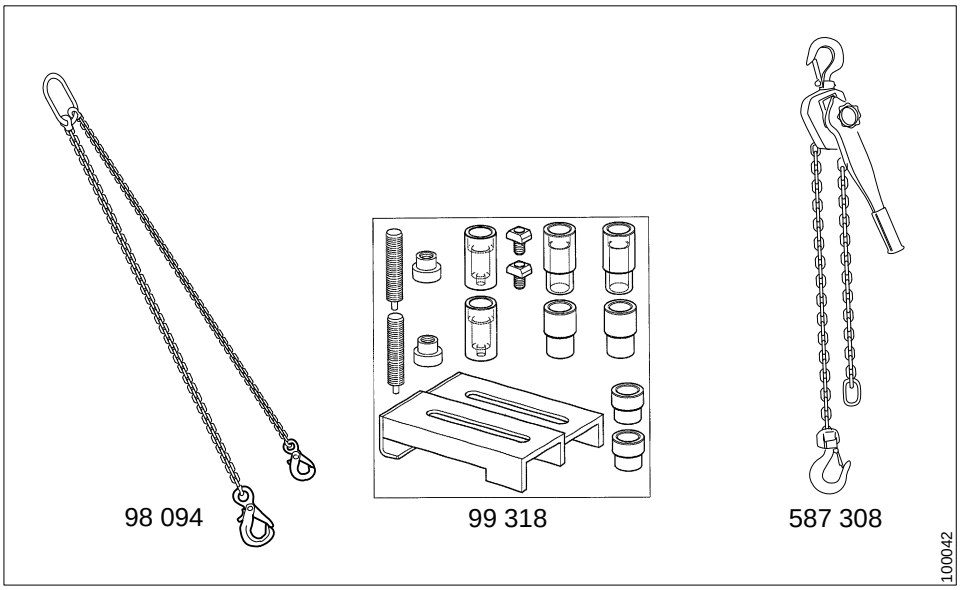
In the case of leakage or fault in the oil pump, it should not be reconditioned but should be renewed as a unit.



1 Oil pump housing
2 Guide sleeve
3 Oil pump cover
4 Screw
5 Screw
6 Spring washer
7 Pump gear
8 Pump gear
9 Oil pump gear
10 Valve sleeve
11 Valve piston
12 Pin
13 Compression spring
14 Screw plug
15 Spacer
16 Pin
17 O-ring
18 Flange screw
19 Suction pipe
20 Gasket
21 Flange screw
22 Support
23 Clamp
24 Flange screw
25 Flange nut

Engine change

Special tools



98 094 *Lifting chain*
*99 318** *Engine support (*or 2 377 964)*
587 308 *Lever block*

Removal

1 Remove the battery cover and disconnect the negative cable.

2 Remove the protecting cover for the central electric unit under the front grille panel and remove connectors 13 and 14. Also disconnect the positive and negative cables.

3 Remove the clamps to release cables 13 and 14.

4 Tilt the cab according to instructions, refer to Group 18.

5 Remove the gearbox, refer to group 5.

6 Pull through the detached cable harnesses and place it on the engine.

IMPORTANT! The lifting eyes on the engine are not dimensioned to lift the whole vehicle and must therefore not be used for this purpose.
All three lifting eyes must be used when lifting the engine.

Right-hand side:

1 Remove the starter motor cables and the ribbed exhaust hose.

2 Remove the air pipe for the exhaust brake and the hose between the air filter and the engine. Cover the air filter.

3 Remove the water hose between the engine and the distribution pipe and the water hose between the thermostat housing and the radiator.

4 Remove the fan belt.

5 Remove the A/C compressor and angle it forward.

6 Remove the two hoses to the charge air cooler.

Left-hand side:

1 Remove the fuel pipes.

2 Remove the air hose between the compressor and air dryer.

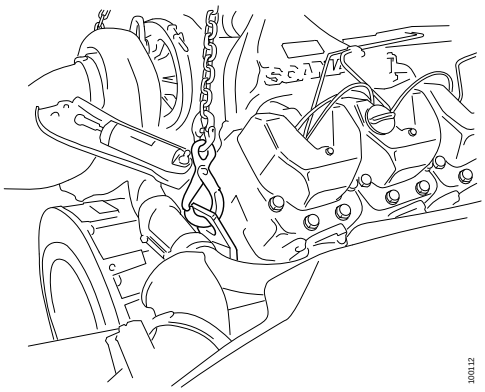
3 Remove the air hose between the cooling loop and air dryer.

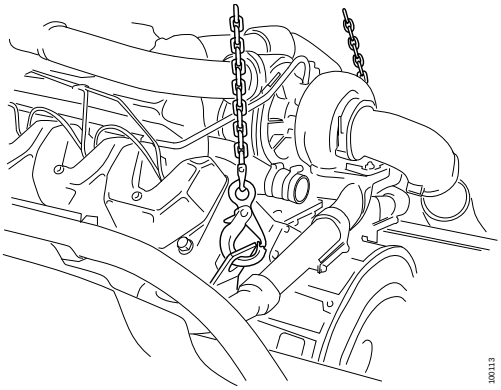
4 Disconnect the ground braid and remove the positive cable to the starter motor.

5 Detach the power steering pump and move it aside.

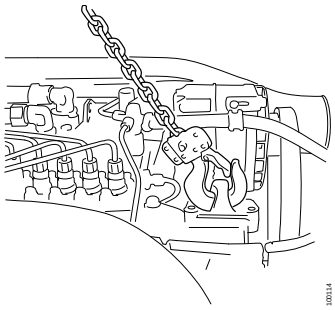
6 Remove the oil filler hose and the oil dipstick.

7 Secure the lifting chain 98 094 in the rear lifting eyes.

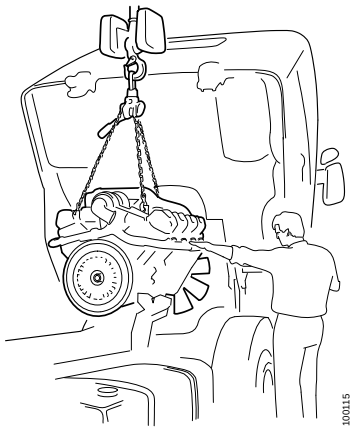




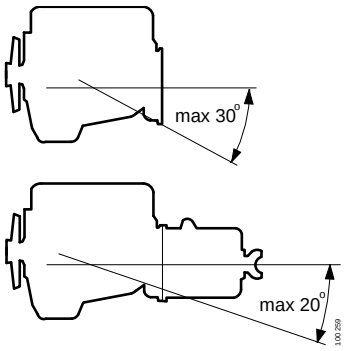
8 Secure ratchet lever hoist 587 308 in the front lifting eye.



9 Remove the screws in the engine brackets and lift out the engine.



IMPORTANT! The lifting eyes are designed to cope with a maximum inclination angle of 30°, when lifting an engine with the gearbox removed. (For engines without the gearbox removed, the maximum angle is 20°)



Fitting

1 Lift the engine so that the engine brackets are approx. 10 mm over the engine cushions.

2 Position the screws and lower the engine so that it rests on the engine insulators and engine supports 99 318 or 2 377 964. Torque tighten the screws to 47 Nm.

Left-hand side:

1 Fit the oil filler hose and oil dipstick.

2 Fit the power steering pump.

3 Fit the ground braid.

4 Fit the air hose between the cooling loop and air dryer.

5 Fit the air hose between the compressor and air dryer.

6 Fit the fuel lines.

Right-hand side:

1 Fit the two hoses to the charge air cooler.

2 Fit the A/C compressor.

3 Fit the fan belt.

4 Fit the water hose between the engine and the distribution pipe and the water hose between the thermostat housing and the radiator.

5 Fit the air pipe for the exhaust brake and the hose between the air filter and the engine.

6 Fit the starter motor cables and the ribbed exhaust hose.

7 Secure cables 13 and 14 with a clamp and route them to the front of the vehicle.

8 Fit the gearbox, refer to group 5.

9 Tilt the cab back to the driving position.

10 Connect the positive and negative cables and connect cables 13 and 14. Secure all cables with clamps.

11 Refit the plastic covers over the central electric unit.

12 Connect the negative battery cable. Fit the battery cover.

Specifications

General information

Arrangement of cylinders ..... V engine
Number of cylinders 8
Cylinder diameter ..... 127 mm
Piston stroke ..... 140 mm
Cubic capacity ..... 14.2 dm^3
Number of main bearings 5
Firing sequence 1-5-4-2-6-3-7-8
Injection ..... Direct
Principle of operation 4-stroke
Cooling ..... Liquid
Approx. weight, including alternator ..... 1,230 kg

Compression ratio
Power
Engine speed
Torque
Oil volume
Oil grade

} See the Operator's Manual or Service Card for that particular engine

Locking compound, lubricants, sealing compound

Activator T for faster hardening of locking compound 561 200 ..... 561 045
Locking compound 561 200
Lubricant for exhaust pipe bolts and joints 561 205
Sealing compound for cylinder liner 584 106
Thread sealant 561 019

Cylinder head

Cylinder head min. height after machining, page 17 ..... 114.8 mm

Distance "B" between the cylinder head face and valve disc, page 11
With new parts min. ..... 0.72 mm
With machined parts max. ..... 1.80 mm

Intake valve

Clearance (cold engine) ..... 0.45 mm
Head angle ..... 19.4°-19.6°
Min. dimension A for ground valve, page 10 ..... 3.0 mm

Exhaust valve

Clearance (cold engine) ..... 0.80 mm
Head angle ..... 44.4°-44.6°
Min. dimension A for ground valve, page 10 ..... 1.7 mm

Intake valve seat

Seat angle ..... 20.0°-20.5°
Width of contact surface A, page 11 ..... 2.3-2.8 mm
Valve seat insert, outer diameter ..... 56.0 mm
Seat for valve seat insert, diameter ..... 55.934-55.953 mm
Seat for valve seat insert, depth ..... 11.25-11.35 mm

Oversize valve seat insert:
Outer diameter ..... 56.2 mm
Seat for valve seat insert, diameter ..... 56.134-56.153 mm
Cooling temperature when fitting valve seat insert ..... approx. -80°C

Exhaust valve seat

Seat angle ..... 44.0°-46.0°
Width of contact surface A, page 11 ..... 1.9-2.6 mm
Valve seat insert, outer diameter ..... 52.0 mm
Seat for valve seat insert, diameter ..... 51.914-51.933 mm
Seat for valve seat insert, depth ..... 11.25-1.35 mm

Oversize valve seat insert:
Outer diameter ..... 52.2 mm
Seat for valve seat insert, diameter ..... 52.114-52.133 mm
Cooling temperature when fitting valve seat insert ..... approx. -80°C

Valve guides

Height above valve spring washer plane ..... 19.00-19.45 mm

Rocker arm mechanism

Rocker arm bush, inner diameter (pressed in and machined) ..... 30.007-30.028 mm
Surface quality ..... 0.8 Ra
Drill the lubricating holes (2 holes) to the same diameter as in the rocker arm.

Tightening torques

Cylinder head screws:
- First tightening ..... 110 Nm
- Second tightening ..... 165 Nm
- Third tightening ..... 220 Nm+90°

Nut for injector ..... 70 Nm
Nut for adjusting screw on rocker arm ..... 40 Nm
Rocker cover screw ..... 16 Nm
Exhaust manifold screws ..... 59 Nm

Turbocharger

Wear limits

Shaft radial clearance ..... 0.198-0.564 mm
Shaft axial clearance (after running in) ..... 0.025-0.106 mm

Tightening torques

Screws, turbocharger - exhaust pipe ..... 47 Nm
V-clamps, exhaust and intake ..... 6-10 Nm

Piston and cylinder liner

Cylinder liner

Shims for cylinder liner, thickness ..... 0.20; 0.25; 0.30; 0.40; 0.50; 0.75 mm

Height of cylinder liner above cylinder block ..... 0.08-0.12 mm

The maximum permitted height difference on the same liner between readings at two diametrically opposed points in the transverse direction of the engine ..... 0.02 mm

Pistons

Fitted with the arrow on the piston top towards the outside of the engine.

Piston rings	DSC14 15	DSC14 13
Number of compression rings	2 off	2 off
Gap: 1st ring	0.50-0.75 mm	0.35-0.60 mm
2nd ring	0.45-0.65 mm	0.45-0.65 mm
Maximum clearance in groove, 2nd ring	0.25 mm	0.25 mm

Rings marked "TOP" should be turned with the marking up.

Number of oil scraper rings	1 off	1 off
Gap	0.4-0.65 mm	0.4-0.65 mm
Maximum clearance in groove	0.25 mm	0.25 mm

Connecting rods

Connecting rod and bearing cap marked 1 to 8.
Fitted with marking in.

Weight classes ..... A, B and C
Only weight class B is available as a spare part.

Tightening torques

Tensioning lug bolts when pressing down the cylinder liner	60 Nm
Oil sump screws	47 Nm
Connecting rod bolts	20 Nm+90°

Flywheel and flywheel housing

Flywheel

Maximum machining allowance for disc pressure surface: Refer to group 4 *Clutch*

External ring gear

Heated to 100-150°C before fitting.

Flywheel housing

Sealing ring in the flywheel housing: Dimension B, page 46 ..... 7 mm

Tightening torques

Flywheel screws ..... 230 Nm+60°

Flywheel housing screws ..... 90 Nm

Timing gears

Camshaft gear

Heated to 100°C before fitting.
Backlash against the intermediate gear ..... 0.05-0.15 mm

Injection pump gear

Backlash against the intermediate gear ..... 0.05-0.14 mm

Intermediate gear

Max. axial clearance ..... 0.24 mm

Bush for power take-off gear

Diameter ..... 45.009-45.034 mm

Camshaft

Axial clearance ..... 0.15-0.30 mm

Crankshaft

Main bearing race	Diameter:	
	Standard	101.598-101.620 mm
	Undersized 1	101.348-101.370 mm
	Undersized 2	101.098-101.120 mm
	Undersized 3	100.848-100.870 mm
	Undersized 4	100.598-100.620 mm
	Undersized 5	100.348-100.370 mm
	Undersized 6	100.098-100.120 mm
	Fillet radius	4.8-5.2 mm
	Surface quality	0.25 Ra
	Max. width	51.28 mm
	Radial clearance	0.054-0.116 mm
Connecting rod races	Diameter	
	Standard	89.978-90.000 mm
	Undersized 1	89.728-89.750 mm
	Undersized 2	89.478-89.500 mm
	Undersized 3	89.228-89.250 mm
	Undersized 4	88.978-89.000 mm
	Undersized 5	88.728-88.750 mm
	Undersized 6	88.478-88.500 mm
	Fillet radius	4.8-5.2 mm
	Surface quality	0.25 Ra
	Max. width	94.35 mm
	Radial clearance	0.050-0.112 mm
Thrust bearing	Thickness:	
	Standard	3.378-3.429 mm
	Oversized 1	3.454-3.505 mm
	Oversized 2	3.505-3.556 mm
	Oversized 3	3.632-3.683 mm
	Oversized 4	3.886-3.937 mm
	Oversized 5	4.267-4.318 mm
	Axial clearance	0.18-0.37 mm

Tightening torques

Nut for camshaft gear ..... 600 Nm
Nut for compressor gear ..... 200 Nm
Screws for intermediate gear shaft journal ..... 39 Nm
Connecting rod bolts ..... 20 Nm + 90°
Main bearing bolts
- Vertical ..... 120 Nm + 60°
- Horizontal ..... 140 Nm + 60°

Flywheel screws ..... 230 Nm + 60°
Fan coupling hub(crankshaft bolt) ..... 1,000 Nm
Bolts for crankshaft counterweights ..... 50 Nm + 90°
Fan ..... 30 Nm

Lubrication system

Oil pump

Radial clearance: pump gear - pump housing ..... 0.115-0.239 mm
Axial clearance: pump gear - pump housing cover (without gasket) ..... 0.058-0.094 mm

Oil pressure valve (Note: not safety valve)

Oil pressure:
With the engine warm running at 2,000 rpm ..... 4.5-6 bar
With the engine warm running at 800 rpm ..... 1.5 bar

Free spring length ..... 70.85 mm

Oil cleaner

Permitted thickness of deposits on wall of cover ..... 20 mm

Oil filter

Only use original Scania filters.

Tightening torques

Oil pump:

Oil pump cover screws ..... 20 Nm
Screws oil pump - cylinder block ..... 59 Nm
Valve sleeve ..... 30 Nm

Oil cleaner:

Lock nut for oil cleaner housing cover ..... 10 Nm
Nut for rotor cover ..... Tightened by hand
Rotor shaft ..... 34 Nm

Oil nozzle for piston cooling:

Banjo screw ..... 23 Nm
M8 screw ..... 20 Nm

Special tools

Number	Designation	Shown on page	Tool board
87 095	Guide pins	54	D4
87 125	Extractor	8	D1
87 198	dial gauge ruler	33, 34	D2
87 362	Drift	29, 32	D3
87 368	Puller bolt	42	D3
87 488	Guide pins	46	R2
87 596	Slide hammer	49, 51	D2
87 961	Drift	16	D1
98 075	Dial gauge	25, 33, 34	D2
98 094	Lifting chain	66, 67	
98 163	Fixture	-	MV
98 175	Cleaning tool	18	D2
98 212	Piston ring compressor	39	D3
98 249	Compression tester	6	MV
98 321	Assembly tool	43, 44	D2
98 433	Drift	42	D3
98 500	Shank	12	D1
98 501	Drift	12	D1
98 515	Press tool	33	D2
98 591	Guide pins	18	D1
98 622	Press drift	15	D1
98 721	Assembly tool	50	D2
99 001	Adapter	59	AD3
99 003	Hydraulic hole cylinder	33, 59	H1
99 004	Compressed air driven hydraulic pump	59	H1
99 006	Spindle threaded up to the neck	59	H1
99 007	Support plate	33	AM1
99 011	Threaded bush	59	H1
99 066	Puller for cylinder liner	33	D2
99 074	Impact drift	8	D1
99 079	Extractor for injectors	8	D1
99 093	Drift	59	D3
99 195 99 196 99 197	Valve spring compressor	10, 18	D1
99 247	Assembly drift	10	D1
99 248	Press drift	16	D1
99 308	Sleeve for injectors	8, 19	-
99 309	Tool for turning the flywheel	5, 57, 58, 59	-
99 316	Lock pin	55	-
99 318	Engine support	53, 55	-
2 377 964	Completing kit	53, 55	-
99 320	Puller	59	-
99 321	Locking tool for the flywheel	49, 51, 57, 58, 59	-

Number	Designation	Shown on page	Tool board
587 025	Filter tongs	21	M1
587 107	Rocker indicator	24	
587 110	Test apparatus for connecting rods	30	
587 250	Indicator stand	24, 25	M1
587 272	Cylinder liner cutter with grooving tool	17, 34	
587 277	Valve seat cutter	12	
587 308	Lever block	66	
587 309	Piston ring expander	29	D3
587 511	Puller	58	XA3
587 692	Universal stand	-	