Cylinder block, measurement

Measuring the cylinder bore

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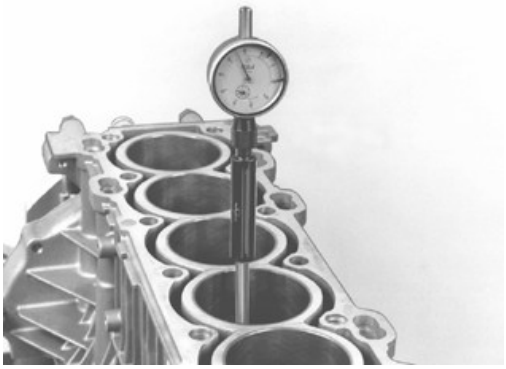
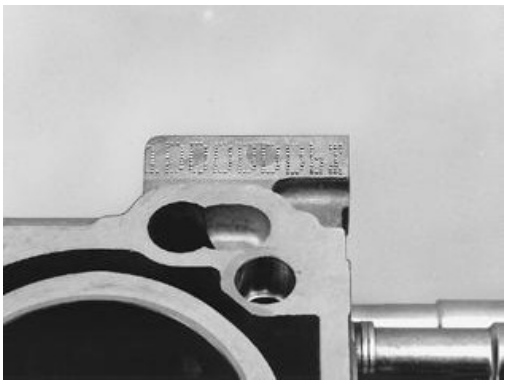
First clean the cylinder bores and check them visually.
Measure the cylinder bores. Use a bore gauge (50–100–mm), a micrometer and a micrometer stand.
Set the micrometer to maximum cylinder bore diameter tolerance using the marking on the cylinder block.
Calibrate the bore gauge in the micrometer.

Checking for wear



Take measurements for the greatest amount of wear across the engine, just before the upper limit position.
Take measurements for the lowest amount of wear along the length of the engine, at the lower limit position.

Classification marking



Each cylinder is stamped with a classification letter (C, D or E) at the rear edge of the cylinder block.
Cylinder bore diameter: See Specifications, mechanical

Measuring crankshaft assembly

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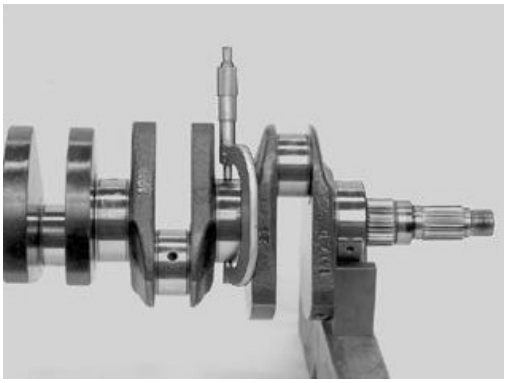
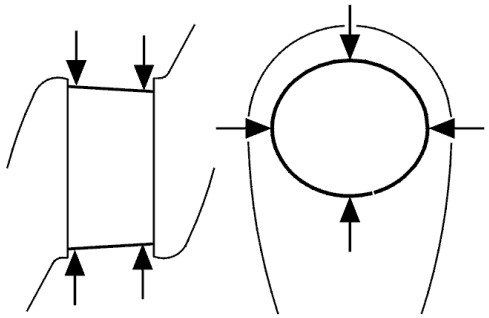
However, the essential information in the illustrations is always correct.

Measuring the crankshaft

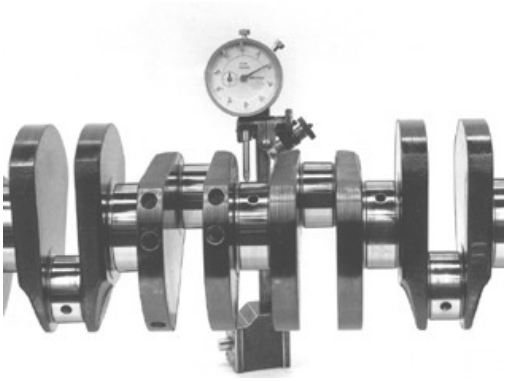


Use a micrometer.
Measure bearing journal out-of-round and taper.
Measure at a number of points laterally and longitudinally.



For the correct values for connecting rod bearing and main bearing journals see Specifications, mechanical .

Check crankshaft out-of-true



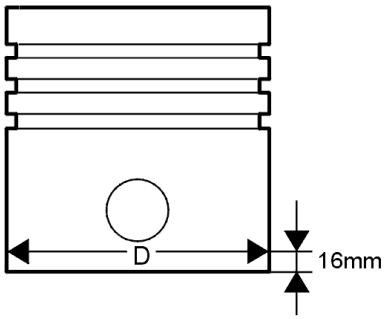
Use a dial indicator and magnetic holder.
Position the crankshaft with the two outer main bearings in the V block.
Turn the crankshaft and measure radial runout on other main bearing journals.
For the correct values, see Specifications, mechanical .

Removing the piston rings

Use piston ring pliers.
Remove coke deposits. Scrape piston ring grooves clean with a groove cleaner or a broken and filed piston ring.
Check for damage, wear and cracks.

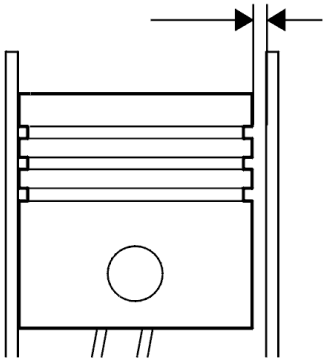
Checking piston ring axial clearance

Use new piston rings.
For the correct values, see Specifications, mechanical .



Checking piston diameter

Use a micrometer and vernier caliper.
For the correct values, see Specifications, mechanical .



Calculating piston running clearance

For the correct values, see Specifications, mechanical .

Disassembling connecting rods / pistons

Check first that the piston and connecting rod are marked.
Piston marking: Scrape the piston pin clean. If the markings are unclear mark the piston with the cylinder number and an arrow pointing to the front of the engine. Use a marker pen.
Connecting rod marking Se Crank mechanism, assembling .
Carefully push out the lock-ring using a groove-cut chisel. Press out the piston pin with your

thumb. Clean and check connecting rods, caps and screws for damage, signs of wear or cracks.

Check the piston pin alignment with the pistons

The piston pin must not be loose. It should be possible to push it through the hole using thumb pressure.
If the play is too great replace the piston.

Check the piston pin alignment with the connecting rods

The piston pin should slide through the hole with light thumb pressure.
If the play is too great measure the piston pin. Use a micrometer.
For the correct piston pin diameter see Specifications, mechanical .

Checking the bearing recess in the connecting rod big end

Visually check the bearing shells.
If in doubt measure out-of-round. Use a bore gauge.
For the correct bearing recess see Specifications, mechanical .

Checking the connecting rod in a connecting rod aligner

Check for out-of-true and twisting.

Caution! Check that the aligner fork is unburred and round at the handle.
Remove and apply the expander at the big end

between each alignment operation.

Measuring and reconditioning the cylinder head

Special tools: 998 6052 , 999 5219 , 999 5222 , 999 5379 , 999 5748 , 999 5764

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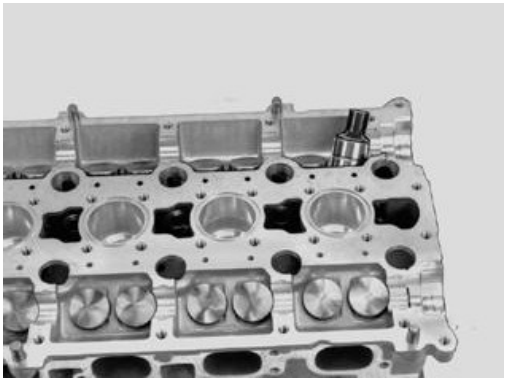
Removing tappets from the cylinder head

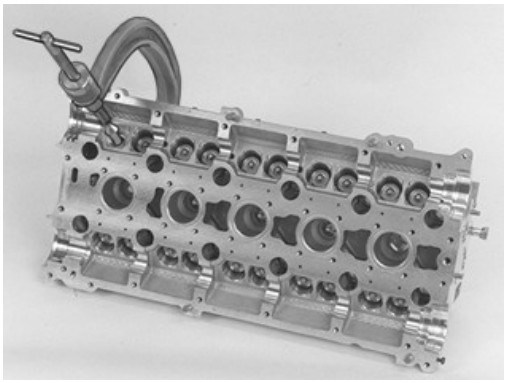


Use a magnet or suction cup to remove the tappets.
Check for wear on the tappets. Measure if necessary.

Note! Tappets must be stored upside down to prevent draining. Place the tappets in order. They must not be mixed up.
Store tappets in an oil filled container when storing for long periods.

Tappets, dimensions: See Specifications, mechanical .
Clearance, top of tappets: See Specifications, mechanical .

Removing valves



Use valve spring compressor 998 6052 with attachment claw 999 5748 .

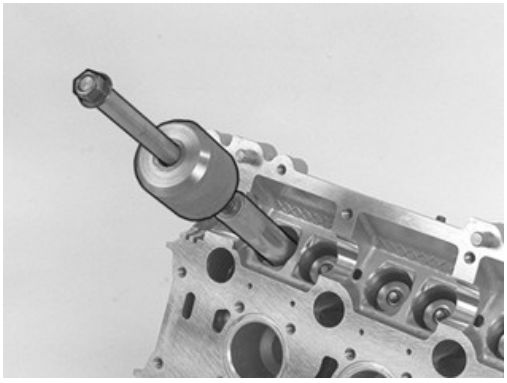
Remove
- the valve locks
- the upper valve collars
- the valve springs
- the valves.

Note! Keep track of the position of the moving parts.

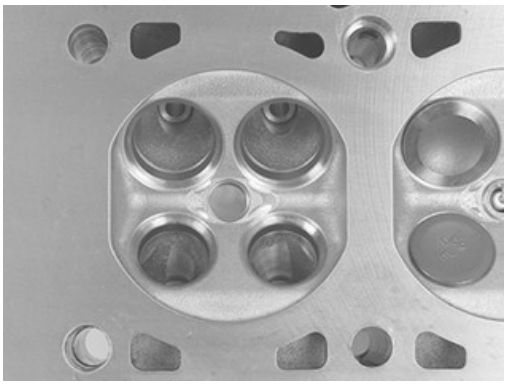
Removing valve stem seals

Use tool 999 5219 .
Remove the valve stem seals and the lower valve collars.

Clean the cylinder head:
- the gasket faces
- the combustion chambers
- the inlet and exhaust ports
- the valve seats



- the valve seats.

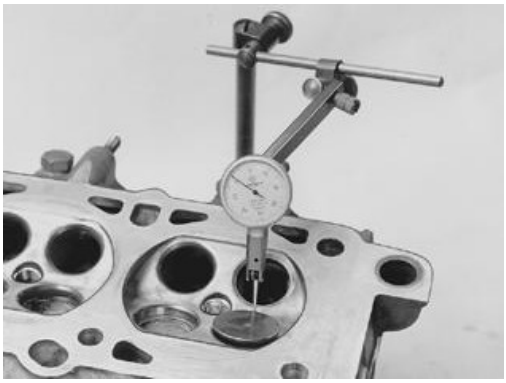


Checking the cylinder head

Clean the spark plug threads (tap M14 x 1.25).
Clean the valves, valve springs and collars.
Visually check for damage.
Regrind the seats if unsure about cracks. See Specifications, mechanical .

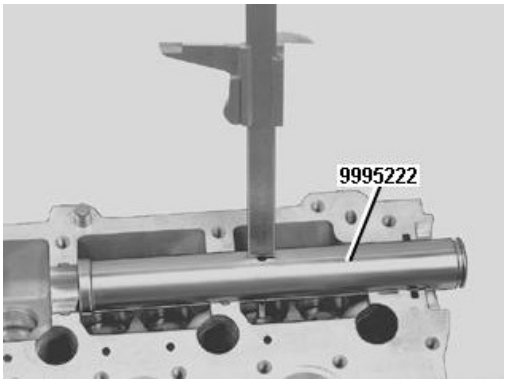
Checking the cylinder head for distortion

Measure cylinder head distortion Use a steel ruler and feeler gauge. See Specifications, mechanical .



Checking for wear in the valve guides

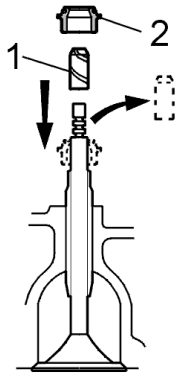
Measure the wear in the valve guides. Use a dial indicator and magnetic holder. Lift the valve approximately 2–3 mm from the seat when carrying out the check.
Clearance between the valve and valve guide: See Specifications, mechanical .



Checking the vertical position of the valve stem

Use camshaft adjustment tool 999 5222 .
Position the camshaft adjustment tool in the camshaft bearing recesses.
Measure the height of the valve stem using a feeler gauge through the hole in the camshaft adjustment tool. See Specifications, mechanical .

Note! The valve stems must be at the correct height for the hydraulic tappets to operate correctly.



Installing valve stem seals

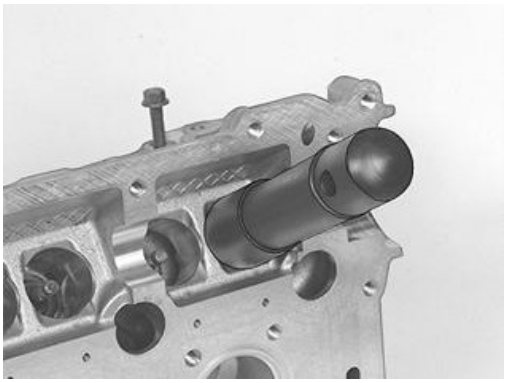
Lubricate the valve stems and the upper ends of the valve guides.

Install
- the lower valve spring collars
- the valves in their positions.

Install the protective sleeve (included in the gasket kit) on the valve stem.

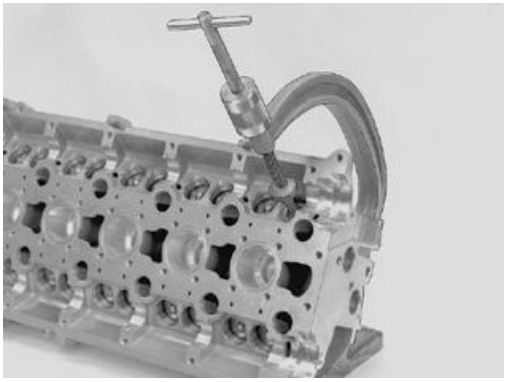
Note! The protective sleeve must be installed on the valve stem when the valve stem seal is installed.

Lubricate the protective sleeve (1) and install it on the valve stem.



Lubricate the valve stem seal (2).
Press down the seal past the protective sleeve with your finger.
Press the seal down. Use tool 999 5764 . Press down by hand until the tool stops against the lower valve spring washer.
Remove the tool. Pull off the protective socket.

Installing valve springs



Install the valve spring. Install the valve spring washer.
Compress the valve spring so that the three valve lock tracks are visible. Use valve spring compressor 998 6052 with attachment claw 999 5748 .

Note! Do not compress more than is absolutely necessary. The valve stem seal may be damaged.

Install the valve locks.
Check that valve locks are in the correct position when the spring is not loaded.
Repeat the procedure with the remaining valves.

Threads, reconditioning

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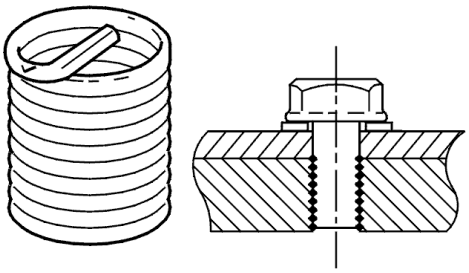
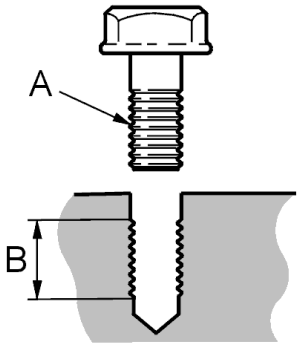
and / or models, some variation may occur. However, the essential information in the illustrations is always correct.

Thread inserts, general



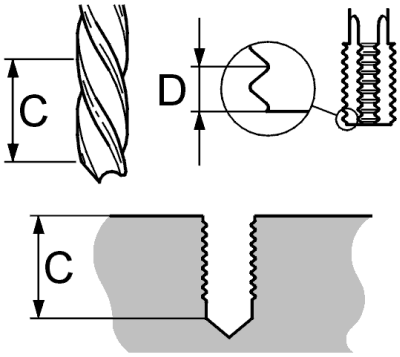
Damaged threads can in most cases be reconditioned using HELICOIL thread inserts. Thread inserts are available in a variety of sizes, pitches and lengths. A correctly reconditioned thread will generally increase the strength of a joint.

Designation of thread insert



Measure the old threads and thread length in the hole.
A: Thread.
B: Thread length.

Drilling and tapping new thread in the hole



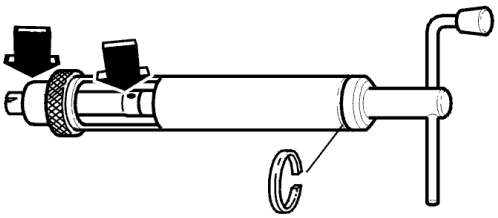
Drill out the old threads using the correct diameter drill bit. Blow the hole clean.
Tap the new thread using the correct tap.

Note! The thread taps referred to in the text are specially made for use with HELI-COIL.

Use methylated spirit or similar to lubricate the threading operation in aluminium. Thread longer threads in stages, backing out the tap and blowing the tap and the hole clean in between.
Thread the hole to the proper depth (or through if it is to be threaded throughout).
C: drill depth.
D: cutting phase.

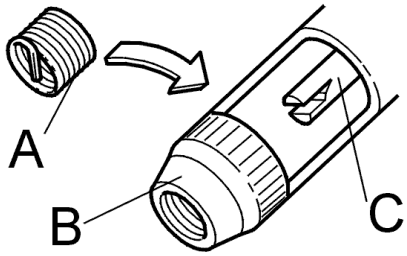
Tools required for installation

The installation tool (illustrated) is used for threads M6 - M14. During some operations the



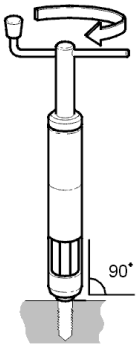
tool must be disassembled by removing the locking ring, for example with countersunk threads.
For threads M16 and larger the specific tool for each thread size must be used The guide and mandrel are included.

Installing the thread insert in the installation tool



Locate the thread insert with the tang facing down in the tool.
Turn the spindle until the tang engages in the recess.
Screw the thread insert into the guide, do not apply pressure, until the first turn of the thread insert is flush with the guide opening.
A: Tang.
B: Guide.
C: Mandrel.

Installation of thread insert



Hold the installation tool straight above and centred over the hole. Screw in the insert without applying pressure on the spindle handle. Screw in until the end of the insert reaches at least half a thread revolution into the thread.
The insert must not touch the bottom of the hole or stick out of the other side if it is a through hole.
Break off the tang with the proper tang breaker. For M14 threads and coarser, use a pair of flat-nosed pliers or similar and break downwards.

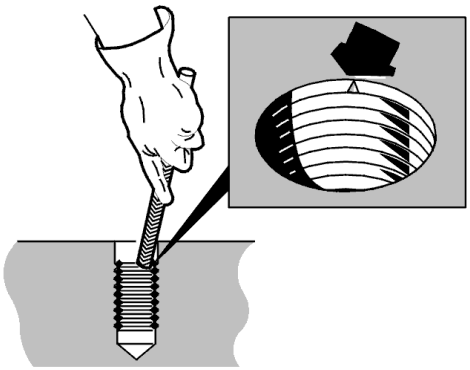
Extraction of damaged thread insert

Alternative 1

File a notch in the thread insert, about a quarter turn in from the end. Do not file through the insert.

Note! Take care not to damage the thread in the bore.

Use a triangular scraper or similar to extract the insert by rotating it.



Alternative 2

Carefully expose the end of the thread insert.
Use flat-nose pliers to pull the thread insert out.
Clean out the threads in the hole using the thread tap and blow clean.
Install a new thread insert.

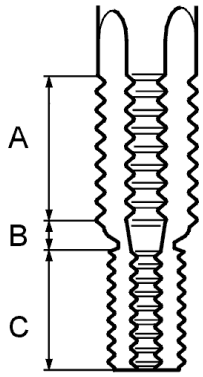
Reconditioning sparkplug threads

Note! Reconditioning of sparkplug threads must be carried out with the cylinder head removed.

Tapping thread in sparkplug hole

Use combination tap 998 5823-5 and thread repair inserts for spark plug thread M14x1,25.

Note! Do not drill out sparkplug threads.

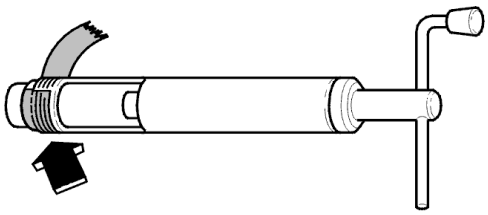


Combined tap

A: Tap.
B: Reamer.
C: Steering.

Installation of thread insert

There are times when the cap nut cannot be used because of space restrictions. On these occasions the guide should be taped into place.



Note! For thread inserts for the spark plug threads that are finer than usual it is important not to apply pressure on the tang when threading (both in the guide and the material).

Twist the thread insert down and check that the upper thread is at least a half thread down into the thread and that none of the insert protrudes into the combustion chamber.
If the insert has been screwed in too far it must be turned until it is all the way through. If it is not deformed it can be inserted again.
Break off the tang with a pair of flat nose pliers.
Check the thread. Install a sparkplug.

Thread table

Values in mm		
Thread dimension	Drill - diameter	Examples of areas of use
M6x1	6.3	Oil pump
M7x1	7.3	Sump to cylinder block, Intermediate section to cylinder block, Water pump to cylinder block
M8x1.25	8.4	Studs at the exhaust ports
M10x1.5	10.5	Intermediate section to cylinder block, Gearbox to engine
M12x1.5	12.5	
M14x1.25		Spark plugs
M14x1.5	14.2	Oil pressure switch. Oil pressure outlet engine / turbocharger unit.
M18x1.5	18.5	Oil drain plug in the sump.

Threads which must not be reconditioned

Coolant outlet for the drain nipple, heat exchanger / oil cooler.
Plug hole for crankshaft setting.
Screw holes for cylinder head screws.

Sealing micro-enclosed screws

Note! Micro-enclosed screws are used where the seal requirements are high. Loose screws are replaced or sealed with new sealing compound. Sealant “HYDRAULIC THREADSEAL” has P/N 11 61 056-5 and sealing must be carried out according to the instructions on the packet.
The screws to be sealed with "HYDRAULIC THREAD SEAL" and their positions are shown below.
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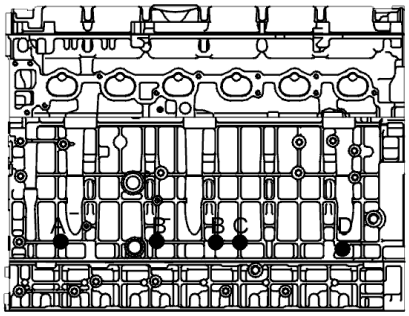
Sealant

“Hydraulic thread sealant”

- P/N 11 61 056-5
- Use a brush and/or the packet spout to apply the sealant to the screw.
- Avoid skin contact with the sealant.

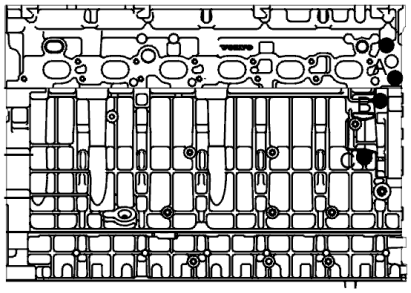


Engine intake side

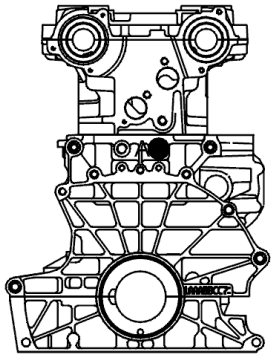
Location	Designation	Number	P/N
A	Auxiliary equipment bracket screw	1	946671-5
B	Air conditioning (A/C) stay screw (for cars with air conditioning (A/C))	1	965180-3
B	Intake manifold stay screw (cars without AC)	1	946173-2
C	Starter motor mounting screw	1	946173-2
D	Engine mounting screw	1	946470-2

Engine exhaust side

Location	Designation	Number	P/N
A	Coolant manifold screw (M7 X 20) with	2	975880-6

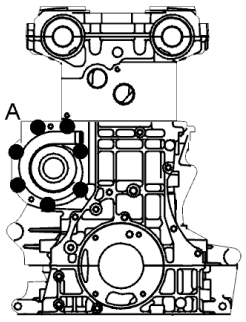


	flange height 7mm including gasket		
A	Coolant manifold screw (M7 X 25) with flange height 9mm including gasket	2	979090-8
B	Plug water pump housing	1	968144-6
C	Drain cock	1	9135268-2



Rear of engine

Location	Designation	Number	P/N
A	Nipple	1	976040-6



Engine front

Location	Designation	Number	P/N
A	Coolant pump screw	7	977744-2